Illinois Power Generating Company
1500 Eastport Plaza Dr.
Collinsville, IL 62234

June 10, 2025

Illinois Environmental Protection Agency
DWPC – Permits MC #15
Attn: Part 845 Coal Combustion Residual Rule Submittal
2520 W Iles Ave
P.O. Box 19276
Springfield, IL 62794-9276

Re: Coffeen Power Plant Ash Pond No. 2; IEPA ID # W1350150004-02

Dear Mr. LeCrone:

In accordance with 35 I.A.C. § 845.220(c) Illinois Power Generating Company is submitting a corrective action construction permit application for the Coffeen Power Plant Ash Pond No. 2 (IEPA ID # W1350150004-02). One hard copy is provided with this submittal.

The permit application was prepared in accordance with 35 I.A.C. § 845.220 (a) and (c). This submittal includes the completed permit application forms as required by § 845.210.

Sincerely,

Cynthia Vodopivec
SVP, Environmental, Health & Safety

Enclosures

Form CCR 1	Illinois Environmental Protection Agency CCR Surface Impoundment Permit Application Form CCR 1 – General Provisions

Bureau of Water ID Number: W1350150004 **CCR Permit Number:** No Permit Issued **Facility Name:** Coffeen Power Plant	For IEPA Use Only

SECTION 1: FACILITY, OPERATOR, AND OWNER INFORMATION (35 Ill. Adm. Code 845.210(b))

Facility, Operator, and Owner Information

1.1	Facility Name		
	Illinois Power Generating Company - Coffeen Power Plant		
1.2	Illinois EPA CCR Permit Number (if applicable)		
	No Permit Issued		
1.3	Facility Contact Information		
	Name (first and last) Phil Morris	Title Senior Director - Environmental	Phone Number 618-343-7794
	Email address phil.morris@vistracorp.com		
1.4	Facility Mailing Address		
	Street or P.O. box 1500 Eastport Plaza Dr		
	City or town Collinsville	State IL	Zip Code 62234
1.5	Facility Location		
	Street, route number, or other specific identifier 134 CIPS Lane		
	County name Montgomery	County code (if known)	
	City or town Coffeen	State IL	Zip Code 62017
1.6	Name of Owner/Operator		
	Illinois Power Generating Company		

Facility, Operator, and Owner Info				
1.7	Owner/Operator Contact Information			
	Name (first and last) Phil Morris	Title Senior Director - Environmental	Phone Number 618-343-7794	
	Email address phil.morris@vistracorp.com			
1.8	Owner/Operator Mailing Address			
	Street or P.O. box 1500 Eastport Plaza Dr			
	City or town Collinsville	State IL	Zip Code 62234	

SECTION 2: LEGAL DESCRIPTION (35 Ill. Adm. Code 845.210(c))

Legal Description		
2.1	Legal Description of the facility boundary	
	See Attachment A.	

SECTION 3: PUBLICLY ACCESSIBLE INTERNET SITE REQUIREMENTS (35 Ill. Adm. Code 845.810)

Internet Site				
3.1	Web Address(es) to publicly accessible internet site(s) (CCR website)			
	www.luminant.com/illinois-ccr/			
3.2	Is/are the website(s) titled "Illinois CCR Rule Compliance Data and Information"			
	☑	Yes	☐	No

SECTION 4: IMPOUNDMENT IDENTIFICATION

Impoundment Identification			
4.1	List all the impoundment identification numbers for your facility and check the corresponding box to indicate that you have attached a written description for each impoundment.		
	W1350150004-02 (see Attachment A)	☑	Attached written description
		☐	Attached written description
		☐	Attached written description
		☐	Attached written description
		☐	Attached written description
		☐	Attached written description

		☐	Attached written description
		☐	Attached written description
		☐	Attached written description
		☐	Attached written description

SECTION 5: CHECKLIST AND CERTIFICATION STATEMENT

Checklist and Certification Statement

5.1 In Column 1 below, mark the sections of Form 1 that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing.

Column 1		Column 2	
Section 1: Facility, Operator, and Owner Information	✓	w/attachments	☐
Section 2: Legal Description	✓	w/attachments	✓
Section 3: Publicly Accessible Internet Site Requirement	✓	w/attachments	☐
Section 4: Impoundment Identification	✓	w/attachments	✓

5.2 **Certification Statement**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name (print or type first and last name) of Owner/Operator	Official Title
Cynthia Vodopivec	SVP - Environmental
Signature: Cynthia S. Vodopivec	Date Signed: 6/10/25

Form CCR 2CA	Illinois Environmental Protection Agency CCR Surface Impoundment Permit Application Form CCR 2CA – Corrective Action Construction

Bureau of Water ID Number: W1350150004 **CCR Permit Number:** No Permit Issued **Facility Name:** Coffeen Power Plant	For IEPA Use Only

SECTION 1: DESIGN AND CONSTRUCTION PLANS (35 Ill. Adm. Code 845.220)

Design and Construction Plans	1.1	CCR surface impoundment name.
		Ash Pond No. 2
	1.2	Identification number of the CCR surface impoundment (if one has been assigned by the Agency).
		W1350150004-02
	1.3	Describe the boundaries of the CCR surface impoundment (35 Ill. Adm. Code 845.210 (c)).
		See Attachment A
	1.4	State the purpose for which the CCR surface impoundment is being used.
		See Attachment C
	1.5	How long has the CCR surface impoundment been in operation?
		See Attachment C
	1.6	List the types of CCR that have been placed in the CCR surface impoundment.
		See Attachment D
	1.7	List the name of the watershed within which the CCR surface impoundment is located.
		See Attachment F

Design and Construction Plans (Continued)	1.8	What is the size in acres of the watershed within which the CCR surface impoundment is located?	
		See Attachment C	
	1.9	Check the corresponding boxes to indicate that you have attached the following:	
		☑	Drawings satisfying the requirements of 35 Ill. Adm. Code 845.220(a)(1)(F).
		☑	A description of the type, purpose, and location of existing instrumentation.
		☑	Area capacity curves for the CCR Impoundment.
		☑	A description of each spillway and diversion design features and capacities and provide the calculations used in their determination.
		☑	The construction specifications and provisions for surveillance, maintenance, and repair of the CCR surface impoundment.
		☑	A description of the physical and engineering properties of the foundation and abutment materials on which the CCR surface impoundment is constructed.
		☑	A statement of the type, size, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR surface impoundment.
		☑	A statement of the method of site preparation and construction of each zone of the CCR impoundment.
		☑	A statement of the approximate dates of construction of each successive stage of construction of the CCR surface impoundment.
	1.10.1	Is there any record or knowledge of structural instability of the CCR surface impoundment?	
		☑ Yes	☐ No
	1.10.2	If you answered yes to Item 1.10.1, provide detailed explanation of the structural instability.	
		See Attachment C	

SECTION 2: NARRATIVE DESCRIPTION OF THE FACILITY (35 Ill. Adm. Code 845.220)

Narrative Description	2.1	List the types of CCR expected in the CCR surface impoundments.
		See Attachment D

Narrative Description (Cont.)	2.2	Have you attached a chemical analysis of each type of expected CCR?	
		✔	Yes
	2.3	Estimate of the maximum capacity of the surface impoundment in gallons or cubic yards.	
		See Attachment C	
	2.4	Enter the rate at which CCR and non-CCR waste streams currently enter the CCR impoundment in gallons per day and dry tons.	
		See Attachment C GPD	See Attachment C dTn
	2.5	Estimate length of time the CCR surface impoundment will receive CCR and non-CCR waste streams.	
		See Attachment C	
	2.6	Have you attached an on-site transportation plan that includes all existing and planned roads in the facility that will be used during the operation of the CCR surface impoundment?	
		✔	Yes
SECTION 3: MAPS (35 Ill. Adm. Code 845.220)			
Maps	3.1	Check the corresponding boxes to indicate that you have attached the following maps:	
		✔	A site location map on the most recent United Sates Geological Survey (USGS) quadrangle of the area from the 7 ½ minute series (topographic) or on another map whose scale clearly shows the information required in 35 Ill. Adm. Code 845.220(a)(3).
		✔	Site plans maps satisfying the requirements of 35 Ill. Adm. Code 845.220(a)(4).
SECTION 4: ATTACHMENTS			
Attachments	4.1	Check the corresponding boxes to indicate that you have attached the following:	
		✔	A narrative description of the proposed construction of, or modification to, a CCR surface impoundment and any projected changes in the volume or nature of the CCR or non-CCR waste streams.
		✔	Plans and specifications fully describing the design, nature, function, and interrelationship of each individual component of the facility.
		✔	The signature and seal of a qualified professional engineer.
		✔	Certification that the owner or operator of the CCR surface impoundment completed the public notification and public meetings required under 35 Ill. Adm. Code 845.240.
		✔	A summary of the issues raised by the public during the public notification and public meetings.
		✔	A summary of any revisions, determinations, or other considerations made in response to those issues raised by the public during the public notification and public meetings.
		✔	Certification that all contractors, subcontractors, and installers utilized to construct, install, modify, or close a CCR surface impoundment are participants in a training program that is approved by and registered with the U.S. Department of Labor's Employment and Training Administration and that includes instruction in erosion control and environmental remediation.

		☑	Certification that all contractors, subcontractors, and installers utilized to construct, install, modify, or close a CCR surface impoundment are participants in a training program that is approved by and registered with the U.S. Department of Labor's Employment and Training Administration and that includes instruction in the operation of heavy equipment and excavation.
SECTION 5: GROUNDWATER MONITORING PROGRAM			
Groundwater Monitoring	5.1	Indicate that you have attached the following components of a new groundwater monitoring program or any modifications to an existing groundwater monitoring program by checking the corresponding boxes:	
		☑	A hydrogeologic site investigation meeting the requirements of 35 Ill. Adm. Code 845.620, if applicable.
		☑	Design and construction plans of a groundwater monitoring system meeting the requirements of 35 Ill. Adm. Code 845.630.
		☑	A proposed groundwater sampling and analysis program that includes selection of the statistical procedures to be used for evaluating groundwater monitoring data as required by 35 Ill. Adm. Code 845.640 and 845.650.
SECTION 6: CORRECTIVE ACTION (35 Ill. Adm. Code 845.220(c))			
Corrective Action	6.1	Indicate that you have attached a corrective action plan as specified in 35 Ill. Adm. Code 845.670 by checking the box below:	
		☑	Corrective action plan as specified in 35 Ill. Adm. Code 845.670.
		☑	Corrective action groundwater monitoring program, including identification of revisions to the groundwater system for corrective action.
		☑	Any interim measures necessary to reduce the contaminants leaching from the CCR surface impoundment, and/or potential exposures to human or ecological receptors, including an analysis of the factors specified in 35 Ill. Adm. Code 845.680(a)(3).
SECTION 7: GROUNDWATER MODELING (35 Ill. Adm. Code 845.220(c))			
Groundwater Modeling	7.1	Indicate that you have attached the following by checking the corresponding boxes:	
		☑	The results of groundwater contaminant transport modeling and calculations showing how the corrective action will achieve compliance with the applicable groundwater standards.
		☑	All modeling inputs and assumptions.
		☑	Description of the fate and transport of contaminants with the selected corrective action over time.
		☑	Capture zone modeling, if applicable.
		☑	Any necessary licenses and software needed to review and access both the model and the data contained within the models required by 35 Ill. Adm. Code 845.220(c)(2).

Visual Road Map for Corrective Action
Construction Permit Application
Coffeen Power Plant, Ash Pond 2
Coffeen, IL

CONSTRUCTION PERMIT APPLICATION
Coffeen Power Plant - Ash Pond 2

Appendix A
LEGAL DESCRIPTION
§845.210(c)
Legal description of the facility

Appendix B.1
CORRECTIVE ACTION GROUNDWATER MONITORING PLAN
§845.680(a)(1)
Plan that establishes how data will be collected, documented, and evaluated to assess remedy effectiveness

Appendix B.2
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
§845.620
Hydrogeology, groundwater quality data, conceptual site model

Appendix C
HISTORY OF CONSTRUCTION
§845.220(a)(1)
Construction and operational history of the CCR surface impoundment

Appendix D
TYPES OF CCR AND CHEMICAL CONSTITUENTS
§845.220(a)(2)(A)
Types of CCR expected in the CCR surface impoundment, including chemical analysis of each type

Appendix E & F
SITE PLAN MAP & TRANSPORTATION MAP
§845.220(a)(4)
Maps showing the facility and existing CCR surface impoundments, site boundaries, groundwater monitoring wells, access roads and transportation corridors

Appendix G
CORRECTIVE ACTION PLAN
§845.670
Identifies the selected remedy based on the results of the Corrective Measures Assessment

Appendix H
PUBLIC NOTIFICATION
§845.220(a)(9)
Certification that public notification and public meeting have been completed required under *§845.240*

Appendix I
CONTRACTOR CERTIFICATION
415 ILCS 5/22.59(b)(4)
Certification that CCR owner/operator will utilize contractors who are participants in an approved training program

Appendix A
CORRECTIVE ACTION ALTERNATIVE ANALYSIS (CAAA)
§845.670(e)
Evaluation of potential viable corrective actions identified in the Corrective Measures Assessment

Appendix B
DRAWINGS AND MATERIAL SPECIFICATIONS
Permit-level design drawings and specifications

Appendix A
HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
§845.670(f)(4)
Evaluation of potential risks to human and ecological receptors

Appendix B
CAAA SUPPORTING INFORMATION REPORT
§845.670(e)
Information to support preparation of CAAA

Appendix C
CORRECTIVE MEASURES ASSESSMENT
§845.660
Assessment of potential corrective measure technologies to address GWPS exceedances at the CCR surface impoundment

Appendix D
NATURE AND EXTENT REPORT
§845.650(d)(1)
Documents the nature and extent of constituents detected above the GWPS that are attributable to the CCR surface impoundment

Appendix E
GROUNDWATER POLISHING REPORT
§845.220(c)(2)
Presents results of geochemical modeling used to evaluate chemical mechanisms on groundwater polishing under current conditions and after implementation of the corrective measure

Appendix A
FEASIBILITY LEVEL DRAWINGS
Conceptual design drawings showing approximate extents and details of alternatives presented in the CAAA

Appendix B.1
GROUNDWATER MODELING TECHNICAL MEMORANDUM
§845.220(c)(2)
Presents additional groundwater modeling simulations and incorporates data collected since 2022 modeling (Appendix B.2) to support alternatives presented in the CAAA

Appendix B.2
2022 GROUNDWATER MODELING REPORT
§845.220(c)(2)
Presents results of 2022 MODFLOW and MT3DMS groundwater flow and transport models to evaluate potential alternatives

Appendix C
LABOR/MILEAGE ESTIMATES
Detailed material quantity, labor and mileage estimates for alternatives presented in the CAAA

Legend

- New Submittal
- Updated Submittal from Previous Submittal
- Re-submitted from Previous Submittal (No Updates)

Ramboll

Road Map for Corrective Action
Construction Permit Application
Coffeen Power Plant, Ash Pond No. 2
Coffeen, IL

Section	Rule Text	Location of Information Demonstrating Compliance			Version History			Notes
		Document	Section or Appendix	PDF Page No. & Hyperlink	Submitted Previously	Updated Submittal	New Submittal	
Section 845.220 - Construction Permits								
845.220(a)	All construction permit applications must contain the following information and documents.							
845.220(a)(1)	Design and Construction Plans (Construction History)	CPA	Appendix C	927	X			
845.220(a)(2)	Narrative Description of the Facility. The permit application must contain a written description of the facility with supporting documentation describing the procedures and plans that will be used at the facility to comply with the requirements of this Part. The descriptions must include, but are not limited to, the following information:	CPA	Section 2.2	18			X	
845.220(a)(2)(A)	The types of CCR expected in the CCR surface impoundment, including a chemical analysis of each type of expected CCR;	CPA	Section 2.2	18		X		
845.220(a)(2)(B)	An estimate of the maximum capacity of each surface impoundment in gallons or cubic yards;	CPA	Section 2.2	18		X		
845.220(a)(2)(C)	The rate at which CCR and non-CCR waste streams currently enter the CCR surface impoundment in gallons per day and dry tons;	CPA	Section 2.2	18		X		
845.220(a)(2)(D)	The estimated length of time the CCR surface impoundment will receive CCR and non-CCR waste streams; and	CPA	Section 2.2	18		X		
845.220(a)(2)(E)	An on-site transportation plan that includes all existing and planned roads in the facility that will be used during the operation of the CCR surface impoundment.	CPA	Section 2.2	18			X	
845.220(a)(3)	Site Location Map. All permit applications must contain a site location map on the most recent United States Geological Survey (USGS) quadrangle of the area from the 7½ minute series (topographic), or on such other map whose scale clearly shows the following information:							
845.220(a)(3)(A)	The facility boundaries and all adjacent property, extending at least 1000 meters (3280 feet) beyond the boundary of the facility;	CPA	Appendix F	1157		X		
845.220(a)(3)(B)	All surface waters;	CPA	Appendix F	1157		X		
845.220(a)(3)(C)	The prevailing wind direction;	CPA	Appendix F	1157		X		
845.220(a)(3)(D)	The limits of all 100-year floodplains;	CPA	Appendix F	1157		X		
845.220(a)(3)(E)	All natural areas designated as a Dedicated Illinois Nature Preserve under the Illinois Natural Areas Preservation Act [525 ILCS 30];	CPA	Appendix F	1157		X		
845.220(a)(3)(F)	All historic and archaeological sites designated by the National Historic Preservation Act (16 USC 470 et seq.) and the Illinois Historic Sites Advisory Council Act [20 ILCS 3410]; and	CPA	Appendix F	1157		X		
845.220(a)(3)(G)	All areas identified as critical habitat under the Endangered Species Act of 1973 (16 USC 1531 et seq.) and the Illinois Endangered Species Protection Act [520 ILCS 10].	CPA	Appendix F	1157		X		
845.220(a)(4)	Site Plan Map. The application must contain maps, including cross-sectional maps of the site boundaries, showing the location of the facility. The following information must be shown:							
845.220(a)(4)(A)	The entire facility, including any proposed and all existing CCR surface impoundment locations;	CPA	Appendix E	1155		X		
845.220(a)(4)(B)	The boundaries, both above and below ground level, of the facility and all CCR surface impoundments or landfills containing CCR included in the facility;	CPA	Appendix E	1155		X		
845.220(a)(4)(C)	All existing and proposed groundwater monitoring wells; and	CPA	Appendix E	1155		X		
845.220(a)(4)(D)	All main service corridors, transportation routes, and access roads to the facility.	CPA	Appendix E	1155		X		
845.220(a)(5)	A narrative description of the proposed construction of, or modification to, a CCR surface impoundment and any projected changes in the volume or nature of the CCR or non-CCR waste streams.	CPA	Section 2.4	20			X	
845.220(a)(6)	Plans and specifications fully describing the design, nature, function and interrelationship of each individual component of the facility.	CPA	Appendix G	1159			X	
845.220(a)(7)	A new groundwater monitoring program or any modification to an existing groundwater monitoring program that includes but is not limited to the following information:	CPA	Appendix B.1	32			X	
845.220(a)(7)(A)	A hydrogeologic site investigation meeting the requirements of Section 845.620, if applicable;	CPA	Appendix B.2	115	X			
845.220(a)(7)(B)	Design and construction plans of a groundwater monitoring system meeting the requirements of Section 845.630; and	CPA	Section 2.6	22			X	
845.220(a)(7)(C)	A proposed groundwater sampling and analysis program that includes selection of the statistical procedures to be used for evaluating groundwater monitoring data, as required by Sections 845.640 and 845.650.	CPA	Appendix B.1	32			X	
845.220(a)(8)	The signature and seal of a qualified professional engineer	CPA	Section 2.7	23			X	
845.220(a)(9)	Certification that the owner or operator of the CCR surface impoundment completed the public notification and public meetings required under Section 845.240, a summary of the issues raised by the public, a summary of any revisions, determinations, or other considerations made in response to those issues, and a list of interested persons in attendance who would like to be added to the Agency's listserv for the facility.	CPA	Appendix H	2312			X	
845.220(c)	Corrective Action Construction. In addition to the requirements in subsection (a), all construction permit applications that include any corrective action performed under Subpart F must also contain the following information and documents:							
845.220(c)(1)	Corrective action plan (see Section 845.670);	CPA	Appendix G	1159			X	
845.220(c)(2)	Groundwater modeling, including:	CPA	Appendix G	1159			X	
845.220(c)(2)(A)	The results of groundwater contaminant transport modeling and calculations showing how the closure will achieve compliance with the applicable groundwater standards;	CPA	Appendix G	1159			X	
845.220(c)(2)(B)	All modeling inputs and assumptions;	GWTM	Section 2	1340			X	
845.220(c)(2)(C)	Description of the fate and transport of contaminants, with the selected closure over time; and	CPA	Appendix G	1159			X	
845.220(c)(2)(D)	Capture zone modeling, if applicable.	CPA	Appendix G	1159			X	

Road Map for Corrective Action
Construction Permit Application
Coffeen Power Plant, Ash Pond No. 2
Coffeen, IL

Section	Rule Text	Location of Information Demonstrating Compliance			Version History			Notes
		Document	Section or Appendix	PDF Page No. & Hyperlink	Submitted Previously	Updated Submittal	New Submittal	
845.220(c)(3)	Any necessary licenses and software needed to review and access both the models and the data contained within the models required by subsection (c)(2);	CPA	Section 2.9	24			X	
845.220(c)(4)	Corrective action groundwater monitoring program, including identification of revisions to the groundwater monitoring system for corrective action; and	CPA	Section 2.9	24			X	
845.220(c)(5)	Any interim measures necessary to reduce the contaminants leaching from the CCR surface impoundment, and/or potential exposures to human or ecological receptors, including an analysis of the factors specified in Section 845.680(a)(3).	CPA	Section 2.9	24			X	
Section 845.620 - Hydrogeologic Site Characterization								
845.620(a)	The owner or operator of the CCR surface impoundment must design and implement a hydrogeologic site characterization.	CPA	Appendix B.2	115	X			Additional hydrogeologic site characterization information is also provided in the Nature & Extent Report - location depicted on the visual roadmap above.
Section 845.670 - Corrective Action Plan								
845.670(b)	Within one year after completing the assessment of corrective measures as specified in 35 I.A.C. § 845.660, and after completion of the public meeting in 35 I.A.C. § 845.660(d), the owner or operator of the CCR surface impoundment must submit, in a CP application [or modification to the facility's operating permit] to IEPA, a CAP that identifies the selected remedy. This requirement applies in addition to, not in place of, any applicable standards under any other State or federal law.	CPA	Appendix G	1159			X	
845.670(c)	The CAP must meet the following requirements:							
845.670(c)(1)	Be based on the results of the CMA conducted under 35 I.A.C. § 845.660;	CAAA	Appendix C	1553				
845.670(c)(2)	Identify a selected remedy that at a minimum, meets the standards listed in subsection (d);	CAAA	Section 2	1169			X	
845.670(c)(3)	Contain the corrective action alternatives analysis specified in subsection (e); and	CAAA	Section 2	1169			X	
845.670(c)(4)	Contain proposed schedules for implementation, including an analysis of the factors in subsection (f).	CAP	Table 1	1181			X	
845.670(d)	The selected remedy in the CAP must:							
845.670(d)(1)	Be protective of human health and the environment;	CAAA	Section 2.2.1	1221			X	
845.670(d)(2)	Attain the GWPS specified in 35 I.A.C. § 845.600;	GWTM	Section 4	1345			X	
845.670(d)(3)	Control the sources of releases to reduce or eliminate, to the maximum extent feasible, further releases of constituents listed in 35 I.A.C. § 845.600 into the environment;	CAAA	Section 2.2.2	1222			X	
845.670(d)(4)	Remove from the environment as much of the contaminated material that was released from the CCR surface impoundment as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems; and	CAAA	Section 2.5	1239			X	
845.670(d)(5)	Comply with standards for management of wastes as specified in 35 I.A.C. § 845.680(d).	CAAA	Section 2	1213				
845.670(e)	CAAA. In selecting a remedy that meets the standards of subsection (d), the owner or operator of the CCR surface impoundment must consider the following evaluation factors:							
845.670(e)(1)	The long- and short-term effectiveness and protectiveness of each potential remedy, along with the degree of certainty that the remedy will prove successful based on consideration of the following:	CAAA	Section 2.2	1221			X	
845.670(e)(1)(A)	Magnitude of reduction of existing risks;	CAAA	Section 2.2.1	1221			X	
845.670(e)(1)(B)	Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;	CAAA	Section 2.2.3	1223			X	
845.670(e)(1)(C)	The type and degree of long-term management required, including monitoring, operation, and maintenance;	CAAA	Section 2.2.4	1223			X	
845.670(e)(1)(D)	Short-term risks that might be posed to the community or the environment during implementation of a remedy, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal of contaminants;	CAAA	Section 2.2.5	1224			X	
845.670(e)(1)(E)	Time until GWPS in 35 I.A.C. § 845.600 are achieved;	CAAA	Section 2.2.6	1230			X	
845.670(e)(1)(F)	The potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, containment, or changes in groundwater flow;	CAAA	Section 2.2.7	1233			X	
845.670(e)(1)(G)	The long-term reliability of the engineering and institutional controls, including an analysis of any off-site, nearby destabilizing activities; and	CAAA	Section 2.2.8	1233			X	
845.670(e)(1)(H)	Potential need for replacement of the remedy.	CAAA	Section 2.2.9	1234			X	
845.670(e)(2)	The effectiveness of the remedy in controlling the source to reduce further releases based on consideration of each of the following potential factors:	CAAA	Section 2.2.2	1222			X	
845.670(e)(2)(A)	The extent to which containment practices will reduce further releases; and	CAAA	Section 2.2.2	1222			X	
845.670(e)(2)(B)	The extent to which treatment technologies may be used.	CAAA	Section 2.2.2	1222			X	
845.670(e)(3)	The ease or difficulty of implementing each potential remedy based on consideration of the following types of factors:	CAAA	Section 2.3	1235			X	
845.670(e)(3)(A)	Degree of difficulty associated with constructing the technology;	CAAA	Section 2.3.1	1235			X	
845.670(e)(3)(B)	Expected operational reliability of the technologies;	CAAA	Section 2.3.2	1236			X	
845.670(e)(3)(C)	Need to coordinate with and obtain necessary approvals and permits from other agencies;	CAAA	Section 2.3.3	1236			X	
845.670(e)(3)(D)	Availability of necessary equipment and specialists; and	CAAA	Section 2.3.4	1237			X	
845.670(e)(3)(E)	Available capacity and location of needed treatment, storage, and disposal services.	CAAA	Section 2.3.5	1238			X	

Road Map for Corrective Action
Construction Permit Application
Coffeen Power Plant, Ash Pond No. 2
Coffeen, IL

Section	Rule Text	Location of Information Demonstrating Compliance			Version History			Notes
		Document	Section or Appendix	PDF Page No. & Hyperlink	Submitted Previously	Updated Submittal	New Submittal	
845.670(e)(4)	The degree to which community concerns are addressed by each potential remedy.	CAAA	Section 2.4	1239			X	
845.670(f)	The owner or operator must specify, as part of the CAP, a schedule for implementing, of and completing, remedial activities. The schedule must require the completion of remedial activities within a reasonable time, taking into consideration the factors in this subsection (f). The owner or operator of the CCR surface impoundment must consider the following factors in determining the schedule of remedial activities:							
845.670(f)(1)	Extent and nature of contamination, as determined by the characterization required under 35 I.A.C. § 845.650(d);	CAP	Section 3.3	1172			X	
845.670(f)(2)	Reasonable probabilities of remedial technologies achieving compliance with the GWPS established by 35 I.A.C. § 845.600 and other objectives of the remedy;	CAP	Section 3.3	1172			X	
845.670(f)(3)	Availability of treatment or disposal capacity for CCR managed during implementation of the remedy;	CAP	Section 3.3	1172			X	
845.670(f)(4)	Potential risks to human health and the environment from exposure to contamination before completion of the remedy;	CAP	Section 3.3	1172			X	
845.670(f)(5)	Resource value of the aquifer, including:							
845.670(f)(5)(A)	Current and future uses, including potential residential, agricultural, commercial industrial and ecological uses;	CAP	Section 3.3	1172			X	
845.670(f)(5)(B)	Proximity and withdrawal rate of users;	CAP	Section 3.3	1172			X	
845.670(f)(5)(C)	Groundwater quantity and quality;	CAP	Section 3.3	1172			X	
845.670(f)(5)(D)	The potential impact to the subsurface ecosystem, wildlife, other natural resources, crops, vegetation, and physical structures caused by exposure to CCR constituents;	CAP	Section 3.3	1172			X	
845.670(f)(5)(E)	The hydrogeologic characteristic of the facility and surrounding land; and	CAP	Section 3.3	1172			X	
845.670(f)(5)(F)	The availability of alternative water supplies; and	CAP	Section 3.3	1172			X	
845.670(f)(6)	Other relevant factors.	CAP	Section 3.3.1	1177			X	
Section 845.680 Implementation of the Corrective Action Plan								
845.680(a)	Within 90 days after the Agency's approval of the corrective action plan submitted under Section 845.670, the owner or operator must initiate corrective action. Based on the schedule approved by the Agency for implementation and completion of corrective action, the owner or operator must:							
845.680(a)(1)	Establish and implement a corrective action groundwater monitoring program that:							
845.680(a)(1)(A)	At a minimum, meets the requirements of the monitoring program under Section 845.650;	CA GMP	Section 2.1	42			X	
845.680(a)(1)(B)	Documents the effectiveness of the corrective action remedy; and	CA GMP	Section 3	46			X	
845.680(a)(1)(C)	Demonstrates compliance with the groundwater protection standard under subsection (c).	CA GMP	Section 3	46			X	
845.680(a)(2)	Implement the corrective action remedy approved by the Agency under Section 845.670; and	CAP	Section 1.5	1165			X	
845.680(a)(3)	Take any interim measures necessary to reduce the contaminants leaching from the CCR surface impoundment, and/or potential exposures to human or ecological receptors. Interim measures must, to the greatest extent feasible, be consistent with the objectives of, and contribute to the performance of, any remedy that may be required by Section 845.670. The following factors must be considered by an owner or operator in determining whether interim measures are necessary:							
845.680(a)(3)(A)	Time required to develop and implement a final remedy;	CAP	Section 3.4	1177			X	
845.680(a)(3)(B)	Actual or potential exposure of nearby populations or environmental receptors to any of the constituents listed in Section 845.600;	CAP	Section 3.4	1177			X	
845.680(a)(3)(C)	Actual or potential contamination of sensitive ecosystems or current or potential drinking water supplies;	CAP	Section 3.4	1177			X	
845.680(a)(3)(D)	Further degradation of the groundwater that may occur if remedial action is not initiated expeditiously;	CAP	Section 3.4	1177			X	
845.680(a)(3)(E)	Weather conditions that may cause any of the constituents listed in Section 845.600 to migrate or be released;	CAP	Section 3.4	1177			X	
845.680(a)(3)(F)	Potential for exposure to any of the constituents listed in Section 845.600 as a result of an accident or failure of a container or handling system; and	CAP	Section 3.4	1177			X	
845.680(a)(3)(G)	Other situations that may pose threats to human health and the environment.	CAP	Section 3.4	1177			X	

Notes:
CAA = Closure Alternatives Analysis
CAAA = Corrective Action Alternatives Analysis
CAP = corrective action plan
CCR = coal combustion residuals
CMA = Corrective Measures Assessment
CPA = Construction Permit Application
GMP = Groundwater Monitoring Plan
GWPS = groundwater protection standards
GWTM = Groundwater Modeling Technical Memorandum
HCR = Hydrogeologic Site Characterization Report

Intended for
Illinois Power Generating Company
134 Cips Lane
Coffeen, Illinois 62017

Date
June 10, 2025

Project No.
1940110241-001

CONSTRUCTION PERMIT APPLICATION FOR GROUNDWATER CORRECTIVE ACTION

COFFEEN POWER PLANT, ASH POND NO. 2, IEPA ID NO. W1350150004-02

RAMBOLL Bright ideas. Sustainable change.

CONSTRUCTION PERMIT APPLICATION FOR GROUNDWATER CORRECTIVE ACTION COFFEEN POWER PLANT, ASH POND NO. 2, IEPA ID NO. W1350150004-02

Project name	**Coffeen Power Plant Ash Pond No. 2**
Project no.	**1940110241-001**
Recipient	**Illinois Power Generating Company**
Document type	**Construction Permit Application**
Revision	**FINAL**
Date	**June 10, 2025**
Prepared by	**Katlyn Nohr, Sarah Slagle-Garrett**
Checked by	**J. Austin Bond, PE**
Approved by	**Brian G. Hennings, PG**
Description	**Construction Permit Application for 35 I.A.C. § 845**

Ramboll
234 W. Florida Street
Fifth Floor
Milwaukee, WI 53204
USA

T 414-837-3607
F 414-837-3608
https://ramboll.com

CONTENTS

1.	**INTRODUCTION**	**2**
1.1	Legal Description	2
1.2	Previous Assessments	2
2.	**CONSTRUCTION PERMIT**	**4**
2.1	History of Construction	4
2.2	Narrative Description of Facility	4
2.3	Site Maps	5
2.4	Narrative Description of Proposed Construction	6
2.4.1	Proposed Corrective Action Construction	6
2.4.1.1	Site Preparation Activities	6
2.4.1.2	Horizontal Groundwater Extraction Well Installation	7
2.4.1.3	Mechanical, Electrical, and Piping Installation	7
2.4.1.4	Site Restoration	7
2.4.1.5	System Operation and Waste Streams	8
2.5	Plans and Specifications	8
2.6	Groundwater Monitoring Program	8
2.7	Certification	9
2.8	Public Meeting Information	10
2.9	Corrective Action Construction	10
3.	**ADDITIONAL INFORMATION**	**12**
4.	**REFERENCES**	**13**

TABLES (WITHIN TEXT)

Table 1	CCR Surface Impoundments at Coffeen Power Plant

APPENDICES

Appendix A	Legal Description (845.210(c))
Appendix B	Groundwater Information (845.220(a)(7)(A-C) and 845.220(c)(2-5))
Appendix C	History of Construction (845.220(a)(1))
Appendix D	Types of CCR and Chemical Constituents (845.220(a)(2)(A))
Appendix E	Site Plan Map and On-Site Transportation Plan (845.220(a)(4) and 845.220(a)(2)(E))
Appendix F	Site Location Maps (845.220(a)(3))
Appendix G	Corrective Action Plan and Proposed Schedule (845.670), including the Corrective Action Alternatives Analysis (845.670(e))
Appendix H	Public Notification and Public Meeting Certification (845.220(a)(9))
Appendix I	Contractor Training Certification (45 ILCS 5/22.59(b)(4))

1. INTRODUCTION

Illinois Power Generating Company (IPGC) is the owner of the inactive coal-fired Coffeen Power Plant (CPP), also referred to as the Coffeen Power Station (COF), in Coffeen, Montgomery County, Illinois. According to the Illinois Environmental Protection Agency (IEPA), this power plant has four coal combustion residuals (CCR) surface impoundments, as listed in **Table 1** below. This construction permit application is for groundwater corrective action activities at Ash Pond Number 2 (AP2) only. Closure of AP2 was completed in 2020; this included installing a geomembrane final cover system over the CCR unit [1].

Table 1 – CCR Surface Impoundments at Coffeen Power Plant

Impoundment Name	Status	Acronym	IEPA ID Number	Vistra CCR Unit ID	National Inventory of Dams Number
Ash Pond No. 1	Inactive	AP1	W1350150004-01	101	IL50722
Ash Pond No. 2	**Closed**	**AP2**	**W1350150004-02**	**102**	**IL50723**
Gypsum Management Facility Gypsum Stack Pond	Inactive	GMF GSP	W1350150004-03	103	IL50579
Gypsum Management Facility Recycle Pond	Inactive	GMF RP	W1350150004-04	104	IL50578

Note - Bold indicates impoundments included in this Corrective Action Construction Permit Application

This construction permit application for groundwater corrective action activities (application) was developed in accordance with Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845, Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments [2].

1.1 Legal Description

Section 845.210(c): All permit applications must contain a legal description of the facility boundary and a description of the boundaries of all units included in the facility.

A legal description of the facility is provided in **Appendix A**.

1.2 Previous Assessments

Section 845.210(d): Previous Assessments, Investigations Plans, and Programs

AP2 is also regulated by Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257, herein referred to as the Federal CCR Rule [3] and subsequently became regulated by 35 I.A.C. § 845 [2]. Several assessments and plans were completed for AP2 to satisfy the requirements of both the Federal CCR Rule and 35 I.A.C. § 845; some of which are referred to within and attached to this application.

Section 845.210(d)(1): The Agency may approve the use of any hydrogeologic site investigation or characterization, groundwater monitoring well or system, or groundwater monitoring plan, bearing the seal and signature of an Illinois Licensed Professional Geologist or Licensed Professional Engineer, completed before April 21, 2021 to satisfy the requirements of this Part.

A Hydrogeologic Site Characterization Report (HCR) [4] was prepared in January 2017 and included in the closure plan for AP2 [5] that was subsequently approved by IEPA [6]. Applicable

groundwater information is provided in **Appendix B** to meet the requirements of 845.220(a)(7)(A-C), and 845.220(c)(2-5). A Corrective Action Groundwater Monitoring Plan has been developed to support this Construction Permit Application and is provided in **Appendix B.1**. The afore mentioned HCR is provided in **Appendix B.2**.

Section 845.210(d)(2): For existing CCR surface impoundments, the owner or operator of the CCR surface impoundment may use a previously completed location restriction demonstration required by Section 845.300 (Placement Above the Uppermost Aquifer), Section 845.310 (Wetlands), Section 845.320 (Fault Areas), Section 845.330 (Seismic Impact Zones), and Section 845.340 (Unstable Areas) provided that the previously completed assessments meet the applicable requirements of those Sections.

No previous assessments for Placement Above the Uppermost Aquifer, Wetlands, Fault Areas, Seismic Impact Zones, and/or Unstable Areas are included within this construction permit application.

Section 845.210(d)(3): For existing CCR surface impoundments, the owner or operator of the CCR surface impoundment may use a previously completed assessment to serve as the initial assessment required by Section 845.440 (Hazard Potential Classification Assessment), Section 845.450 (Structural Stability Assessment) and Section 845.460 (Safety Factor Assessment) provided that the previously completed assessment: A) Was not completed more than five years ago; and B) Meets the applicable requirements of those Sections.

No previous assessments for the Hazard Potential Classification, Structural Stability, and/or Safety Factors are included within this construction permit application.

Section 845.210(d)(4): For inactive closed CCR surface impoundments, the owner or operator of the CCR surface impoundment may use a post-closure care plan previously approved by the Agency.

A Closure and Post-Closure Care Plan for AP2 [5] was prepared and submitted to the IEPA in January 2017. The Closure and Post-Closure Care Plan was approved by the IEPA in 2018 [6].

2. CONSTRUCTION PERMIT

2.1 History of Construction

Section 845.220(a)(1): Design and Construction Plans (Construction History)

The initial (2016) History of Construction report and subsequent update prepared in 2021 are provided in **Appendix C**.

2.2 Narrative Description of Facility

Section 845.220(a)(2): Narrative Description of the Facility. The permit application must contain a written description of the facility with supporting documentation describing the procedures and plans that will be used at the facility to comply with the requirements of this Part. The descriptions must include, but are not limited to, the following information:

The Facility Narrative Description details are described in the following sections.

Section 845.220(a)(2)(A): The types of CCR expected in the CCR surface impoundment, including a chemical analysis of each type of expected CCR;

The types of CCR expected in AP2 and analysis of the chemical constituents found within the CCR in AP2 is provided in **Appendix D**.

Section 845.220(a)(2)(B): An estimate of the maximum capacity of each surface impoundment in gallons or cubic yards;

AP2 was estimated to contain approximately 2.69 million cubic yards (MCY) of CCR in 2016 in the Closure Plan for Existing CCR Surface Impoundment [7]. AP2 was inactive at this time and no additional CCR was placed into the unit prior to closure initiation in 2019. Closure was completed in 2020 [8]. This volume is not expected to change in the future as AP2 is closed and no longer capable of receiving CCR waste.

Section 845.220(a)(2)(C): The rate at which CCR and non-CCR waste streams currently enter the CCR surface impoundment in gallons per day and dry tons;

There are no waste streams that are currently entering or will enter AP2 in the future as final closure of AP2 has been completed.

Section 845.220(a)(2)(D): The estimated length of time the CCR surface impoundment will receive CCR and non-CCR waste streams; and

There are no CCR or other non-CCR waste streams that are currently entering AP2 or will enter AP2 in the future as final closure of AP2 has been completed.

Section 845.220(a)(2)(E): An on-site transportation plan that includes all existing and planned roads in the facility that will be used during the operation of the CCR surface impoundment.

An On-Site Transportation Plan was developed as required by Section 845.220(a)(2)(E) and is provided for AP2 in **Appendix E** that includes all on-site access roads and the surrounding roadways.

2.3 Site Maps

<u>Section 845.220(a)(3):</u> Site Location Map. All permit applications must contain a site location map on the most recent United States Geological Survey (USGS) quadrangle of the area from the 7½ minute series (topographic), or on another map whose scale clearly shows the following information:

A. The facility boundaries and all adjacent property, extending at least 1000 meters (3280 feet) beyond the boundary of the facility;

B. All surface waters;

C. The prevailing wind direction;

D. The limits of all 100-year floodplains;

E. All-natural areas designated as a Dedicated Illinois Nature Preserve under the Illinois Natural Areas Preservation Act [525 ILCS 30];

F. All historic and archaeological sites designated by the National Historic Preservation Act (16 USC 470 et seq.) and the Illinois Historic Sites Advisory Council Act [20 ILCS 3410]; and

G. All areas identified as critical habitat under the Endangered Species Act of 1973 (16 USC 1531 et seq.) and the Illinois Endangered Species Protection Act [520 ILCS 10].

A Site Location Map for AP2 showing the information required in Section 845.220(a)(3) is provided in **Appendix F**. The Site Location Map consists of the most recent USGS topographic map (2024) which contains the facility and at least 1,000 meters of the surrounding area. Information included on the site location map meets the requirements for a Flood Hazard Map, Topographic Vicinity Map, Designated Nature Map, Designated Historic and Archeological Site Map, and Identified Critical Habitat Map.

The data in the Site Location Map was collected by performing a comprehensive search of the Illinois Department of Natural Resources (IDNR) natural heritage database [9] for natural and protected areas within 1,000 meters of AP2. Within Montgomery County, a total of five sites were identified from the Illinois Natural Areas Inventory (INAI) and two were identified from the Illinois Nature Preserves Commission (INPC). Coffeen Lake is reserved as a State Fish and Wildlife Area and leased to the IDNR for public recreational use. The Coffeen Lake State Fish and Wildlife Area is adjacent to the site to the west. None of the other natural areas or preserves fall within 1,000 meters of AP2.

The IDNR natural heritage database also includes a list of Endangered Species by County [10] and notes that a total of 12 threatened and endangered species are located within Montgomery County, including 8 endangered and 4 threatened species. A review of the U.S. Fish and Wildlife Service (USFWS) Threatened & Endangered Species Active Critical Habitat Report [11] identified no critical habitat for threatened or endangered species within 1,000 meters of AP2.

A search of the IDNR Historic and Architectural Resources Geographic Information System (HARGIS) database [12] for historical sites within the 1,000 meters of the Site located no results.

The 100-year flood plain limits were obtained from the Federal Emergency Management Area (FEMA) Flood Map Service Center [13].

Section 845.220(a)(4): Site Plan Map. The application must contain maps, including cross-sectional maps of the site boundaries, showing the location of the facility. The following information must be shown:

A. The entire facility, including any proposed and all existing CCR surface impoundment locations;

B. The boundaries, both above and below ground level, of the facility and all CCR surface impoundments or landfills containing CCR included in the facility;

C. All existing and proposed groundwater monitoring wells; and

D. All main service corridors, transportation routes, and access roads to the facility.

The Site Plan Map for AP2 showing the information required in Section 845.220(a)(4) is provided in **Appendix E**.

2.4 Narrative Description of Proposed Construction

Section 845.220(a)(5): A narrative description of the proposed construction of, or modification to, a CCR surface impoundment and any projected changes in the volume or nature of the CCR or non-CCR waste streams.

The proposed construction will consist of a horizontal groundwater extraction (GWE) well. This will involve supplementing the IEPA-approved final closure plan [5] and completed source control (*i.e.,* final closure of AP2) with the installation and operation of a new horizontal GWE well as outlined in the Corrective Action Plan for AP2 (see **Appendix G**). The horizontal GWE well, when combined with the completed final closure (described in the Closure and Post Closure Care Plan [5]) will serve as groundwater corrective action for AP2.

The horizontal GWE well is intended to collect CCR-impacted groundwater from beneath the eastern portion of AP2. The horizontal GWE well will reduce to the maximum extent feasible releases and migration of CCR-derived constituents in groundwater until the groundwater protection standards (GWPS) are achieved in monitoring wells. Any liquids collected by the GMS will be transferred to an appropriate location for treatment and discharge in accordance with applicable permits that will be obtained after approval of the Corrective Action Plan.

2.4.1 Proposed Corrective Action Construction

Corrective action construction will involve the construction of multiple elements of a GWE system. This will include, but not be limited to, site preparation activities; installation of a horizontal GWE well; installation of mechanical, electrical, and piping systems to manage extracted liquids; and site restoration. After system installation is complete, system operation and maintenance activities will be performed.

Information associated with each of these construction elements of the horizontal GWE well is described below.

2.4.1.1 Site Preparation Activities

Site preparation will be performed prior to construction of the horizontal GWE well, in order to provide equipment access to the southern embankment of AP2 to allow the well to be installed.

This will include constructing a working platform will be across the discharge flume, in the vicinity of the horizontal GWE well. The working platform will be constructed of compacted, freely draining aggregates, to an elevation that allows equipment to install the horizontal GWE well, will be at least 50 feet in width, and will span the width of the discharge flume.

The discharge flume currently transmits stormwater runoff from the CPP to NPDES Outfall 020, prior to discharge to Coffeen Lake. In order to maintain the functionality of the discharge flume, a culvert or culverts will be installed at the base of the working platform.

2.4.1.2 Horizontal Groundwater Extraction Well Installation

A horizontal GWE well consisting of approximately 1,300 linear feet of piping will be directionally bored in a north-south alignment beneath the eastern portion of AP2, and within the footprint of the existing final cover system. The horizontal well will be single ended, initiating from the southern bank of AP2 at an elevation of approximately 600 feet and will follow the interface between the CCR within AP2 and native foundation soils to the north The horizontal GWE well will include the following characteristics and components:

- The well casing will consist of 4-inch diameter well casing and screen. Slotted sections of the well will be placed to target the removal of CCR-impacted water from areas near the CCR/native foundation interface, while blank casing sections for areas where collection of CCR-impacted water is not required.
- The entry point for the well will be sealed with grout to reduce surface water infiltration into the well and seepage of CCR-impacted groundwater around the outside of the well casing.
- A concrete pad and vault will be constructed at the ground surface at the entry point.

  Drill cuttings and drilling fluids *(e.g.*, spoils) generated during drilling will be placed into dump trucks and hauled to the on-site landfill for disposal.

2.4.1.3 Mechanical, Electrical, and Piping Installation

A mechanical, electrical, and piping system will be installed to support the extraction and conveyance of groundwater from the horizontal GWE well. The system will include the following components:

- A compressor shed consisting of an air compressor to power a submersible pneumatic pump will be installed at or near the entry point for the horizontal GWE well. A shut-off valve, sample port, and flow totalizer to measure the extracted water will be constructed at the extraction well vault pad.
- Underground piping will be used to convey groundwater from the extraction well sump for treatment, as needed, prior to discharge in accordance with applicable permits. This will include the installation of miscellaneous electrical controls to support data collection and system operation.
- An overhead electrical power drop and a buried electrical distribution system will be installed to provide power for the groundwater extraction and water conveyance systems.

2.4.1.4 Site Restoration

After installation of all horizontal GWE system components is complete, site restoration activities will be initiated. This will include establishing vegetation of disturbed areas. The gravel work pad

which will be constructed in the flume, consisting of free-draining gravel backfill and culverts, will be left in place following construction, in order to allow for operational and maintenance access to the horizontal GWE well and associated infrastructure

2.4.1.5 System Operation and Waste Streams

Operation of the horizontal GWE well is expected to result in the generation of approximately 5 gallons per minute (gpm) extracted groundwater for the first 2 years of operation with flow rate decreasing to approximately 2 gpm during long-term operation. However, actual flow rates could vary from this estimate. Extracted groundwater will be totalized and discharged in accordance with applicable permits that will be obtained after approval of this Construction Permit Application.

2.5 Plans and Specifications

Section 845.220(a)(6): Plans and specifications fully describing the design, nature, function and interrelationship of each individual component of the facility.

Permit-level design plans and specifications are included within the Corrective Action Plan for AP2, provided in **Appendix G**. These plans were prepared in accordance with Section 845.670(a)(6) and are consistent with the narrative description provided in **Appendix G**, per Section 845.220(a)(5).

2.6 Groundwater Monitoring Program

Section 845.220(a)(7): A new groundwater monitoring program or any modification to an existing groundwater monitoring program that includes but is not limited to the following information:

A Corrective Action Groundwater Monitoring Plan is included in **Appendix B.1** of this application.

Section 845.220(a)(7)(A): A hydrogeologic site investigation meeting the requirements of Section 845.620, if applicable;

Hydrogeologic site investigations for AP2 are provided in **Appendix B.2**.

Section 845.220(a)(7)(B): Design and construction plans of a groundwater monitoring system meeting the requirements of Section 845.630; and

Design and construction plans of a groundwater monitoring system as required by Section 845.630 are provided in the Operating and Closure and Post Closure Care Plan [14, 5]. The Corrective Action Groundwater Monitoring Plan (**Appendix B.1**) includes content requirements specific to 35 I.A.C. § 845.630 (Groundwater Monitoring System), 35 I.A.C. § 845.640 (Groundwater Sampling and Analysis), 35 I.A.C. § 845.650 (Groundwater Monitoring Program), and 35 I.A.C. § 845.680 (Implementation of the Corrective Action Plan) for AP2.

Section 845.220(a)(7)(C): A proposed groundwater sampling and analysis program that includes selection of the statistical procedures to be used for evaluating groundwater monitoring data (see Sections 845.640 and 845.650).

A groundwater sampling and analysis program that meets the requirements of Section 845.640 and 845.650 is provided in **Appendix B.1.**

2.7 Certification

Section 845.220(a)(8): The signature and seal of a qualified professional engineer

I, J. Austin Bond, being a Registered Professional Engineer in good standing in the State of Illinois, do hereby certify, to the best of my knowledge, information, and belief, that the information contained in this construction permit application has been prepared in accordance with the accepted practice of engineering. The content of this construction permit application is not to be used other than for its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

J. Austin Bond
Printed name

06/10/2025
Signature Date

062-075181 IL 11/30/2025
License No. State Exp. Date

Affix Seal

2.8 Public Meeting Information

Section 845.220(a)(9): Certification that the owner or operator of the CCR surface impoundment completed the public notification and public meetings required under Section 845.240, a summary of issued raised by the public, a summary of any revisions, determinations, or other considerations made in response to those issues, and a list of interested persons in attendance who would like to be added to the Agency's listserv for the facility.

Certification that public notification and public meetings have been completed as required by Section 845.220(a)(9) are provided in **Appendix H**.

2.9 Corrective Action Construction

Section 845.220(c)(1): Corrective action plan (see Section 845.670);

The corrective action plan is provided in **Appendix G**.

Section 845.220(c)(2): Groundwater modeling, including:

A. The results of groundwater contaminant transport modeling and calculations showing how the corrective action will achieve compliance with the applicable groundwater standards;

B. All modeling inputs and assumptions;

C. Description of the fate and transport of contaminants with the selected corrective action over time; and

D. Capture zone modeling, if applicable.

Groundwater modeling as required by Section 845.220(c)(2) is provided within Appendix B.1 of Corrective Action Alternatives Analysis Supporting Information Report, which is included as Appendix B of the Corrective Action Alternatives Analsyis, which is provided as **Appendix G** of this application.

Section 845.220(c)(3): Any necessary licenses and software needed to review and access both the models and the data contained within the models required by subsection (c)(2).

Consistent with previously submitted construction permit applications, electronic copies of the model files are provided within Appendix B.1 of the Corrective Action Alternatives Analysis Supporting Information Report, which is included as Appendix B of the Corrective Action Alternatives Analsyis, which is provided as **Appendix G** of this application. Publicly available software can be used to review and access the models and the data; no additional licenses or software are required.

Section 845.220(c)(4): Corrective action groundwater monitoring program, including identification of revisions to the groundwater monitoring system for corrective action.

The corrective action groundwater monitoring program as required by Section 845.220(c)(4) is provided in **Appendix B.1**. The corrective action groundwater monitoring plan establishes how data will be collected, documented, and evaluated to assess remedy effectiveness for all currently documented and potential future releases from AP2. The presence of exceedances at the waste boundary will continue to be evaluated under the Operating Permit groundwater monitoring program previously submitted to IEPA [14].

Section 845.220(c)(5): *Any interim measures necessary to reduce the contaminants leaching from the CCR surface impoundment, and/or potential exposures to human or ecological receptors, including an analysis of the factors specified in Section 845.680(a)(3).*

No interim measures are necessary or planned ahead of permit approval and completion of the final design. The Corrective Action Plan, provided in **Appendix G**, provides an analysis of the factors specified in Section 845.680(a)(3).

3. ADDITIONAL INFORMATION

Certification that IPGC will utilize contractors, subcontractors, and installers who are participants in an approved training program, in accordance with 415 Illinois Compiled Statutes (ILCS) 5/22.59(b)(4), is provided in **Appendix I**.

4. REFERENCES

[1] Luminant, "Coffeen Power Station; Ash Pond No. 2, Notification of Completion of Closure," 2020.

[2] Illinois Administrative Code, "Title 35, Subtitle G, Chapter I, Subchapter J, Part 845: Standards for The Disposal Of Coal Combustion Residuals In Surface Impoundments," April 21, 2021.

[3] Code of Federal Regulations, "Title 40, Chapter I, Subchapter I, Part 257, Subpart D, Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments," April 17, 2015.

[4] Natural Resource Technology, "Hydrogeologic Site Characterization Report, Ash Pond 2, Coffeen Power Station," Coffeen, IL, January 24, 2017.

[5] AECOM, "Closure and Post-Closure Care Plan for the Coffeen Ash Pond No. 2 at Illinois Power Generating Company Coffeen Power Station," 2017.

[6] Illinois Environmental Protection Agency, "Re: Coffeen Power Station W1350150004 Montgomery County, Illinois," Coffeen, IL, January 30, 2018.

[7] AECOM, "CLOSURE PLAN FOR EXISTING CCR SURFACE IMPOUNDMENT 40 CFR 257.102(b), REV 1," October 17, 2016.

[8] Golder Associates, Inc., "Construction Completion and Construction Quality Assurance Report, Coffeen Power Station Ash Pond #2 Closure," 2021.

[9] Illinois Department of Natural Resources, "IDNR Natural Heritage Database," [Online]. Available: https://www2.illinois.gov/sites/naturalheritage/DataResearch/Pages/Access-Our-Data.aspx. [Accessed 1 May 2025].

[10] Illinois Natural Heritage Database, "Illinois Threatened and Endangered Species by County," April 2023. [Online]. Available: https://naturalheritage.illinois.gov/content/dam/soi/en/web/naturalheritage/documents/EORS%20by%20County%20LastObs%20for%20website%20November2024.pdf. [Accessed 1 May 2025].

[11] U.S. Fish & Wildlife Service, "USFWS Threatened & Endangered Species Active Critical," [Online]. Available: https://ecos.fws.gov/ecp/report/table/critical-habitat.html. [Accessed 1 May 2025].

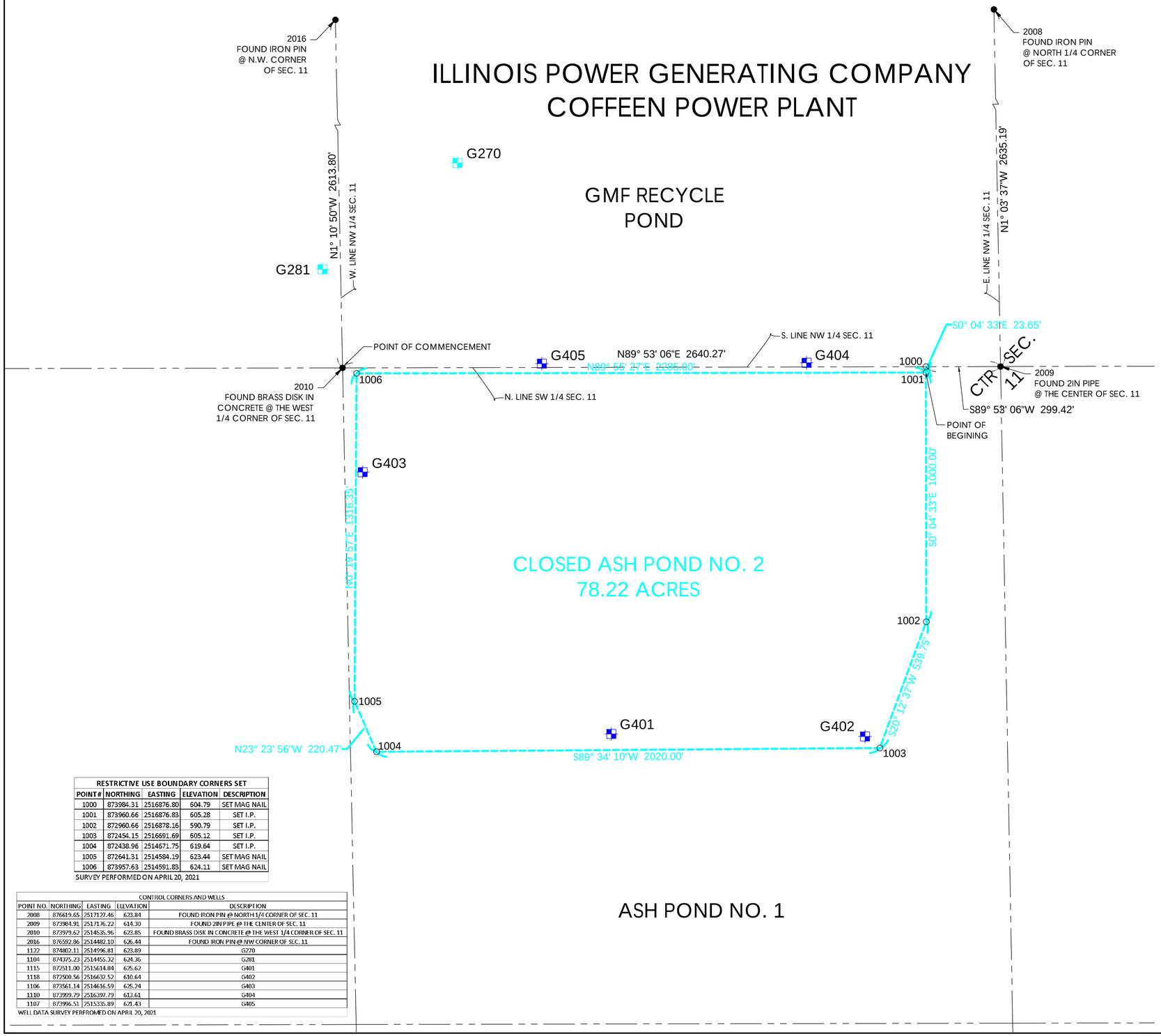
[12] Illinois Department of Natural Resources, "IDNR Historic Preservation Division HARGIS," [Online]. Available: https://www2.illinois.gov/dnrhistoric/Preserve/Pages/HARGIS.aspx. [Accessed 7 February 2025].

[13] Federal Emergency Management Agency, "FEMA Flood Map Service Center: Welcome!," [Online]. Available: https://msc.fema.gov/portal/home. [Accessed 1 May 2025].

[14] Burns & McDonnell Engineering Company, Inc., "Initial Operating Permit, Coffeen Ash Pond No. 2," Coffeen, IL, October 25, 2021.

APPENDIX A
LEGAL DESCRIPTION (845.210(c))

ILLINOIS POWER GENERATING COMPANY
COFFEEN POWER PLANT



RESTRICTIVE USE BOUNDARY CORNERS SET				
POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
1000	873984.31	2516876.80	604.79	SET MAG NAIL
1001	873960.66	2516876.83	605.28	SET I.P.
1002	872960.66	2516878.16	590.79	SET I.P.
1003	872454.15	2516691.69	605.12	SET I.P.
1004	872438.96	2514671.75	619.64	SET I.P.
1005	872641.31	2514584.19	623.44	SET MAG NAIL
1006	873957.63	2514591.83	624.11	SET MAG NAIL

SURVEY PERFORMED ON APRIL 20, 2021

CONTROL CORNERS AND WELLS				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
2008	876619.65	2517127.46	623.84	FOUND IRON PIN @ NORTH 1/4 CORNER OF SEC. 11
2009	873984.91	2517176.22	614.30	FOUND 2IN PIPE @ THE CENTER OF SEC. 11
2010	873979.62	2514535.96	623.85	FOUND BRASS DISK IN CONCRETE @ THE WEST 1/4 CORNER OF SEC. 11
2016	876592.86	2514482.10	626.44	FOUND IRON PIN @ NW CORNER OF SEC. 11
1122	874802.11	2514996.81	623.89	G270
1104	874375.23	2514455.32	624.36	G281
1115	872511.00	2515614.84	625.62	G401
1118	872500.56	2516632.52	610.64	G402
1106	873561.14	2514616.59	625.24	G403
1110	873999.79	2516397.79	613.61	G404
1107	873996.51	2515336.89	621.43	G405

WELL DATA SURVEY PERFROMED ON APRIL 20, 2021

N

0' 200' 400'

LEGEND

- ***SECTION LINE***
- ***RESTRICTED USE BOUNDARY***
- ***FOUND SURVEY MARKER AS NOTED***
- ***SET 5/8" IRON REBAR (UNLESS OTHERWISE NOTED)***
- ***BACKGROUND CCR MONITORING WELL***
- ***DOWNGRADIENT CCR MONITORING WELL***

SURVEY NOTE:
THIS DRAWING AND THE INFORMATION SHOWN HERE ON WAS OBTAINED FROM DATA COLLECTED FROM A FIELD SURVEY MADE BY INGENAE, LLC BETWEEN MARCH 23 THROUGH APRIL 20, 2021. SURVEY COORDINATES, BEARINGS & DISTANCES ARE REFERENCED TO ILLINOIS WEST 1202 STATE PLANE COORDINATE SYSTEM NAD 1983.

Land Description of the Coffeen Power Plant
Closed Ash Pond 2 Restricted Use Area
78.22 Acres

Part of the Southwest Quarter of Section 11, Township 7 North, Range 3 West of the Third Principal Meridian, Montgomery County, Illinois being more particularly described as follows:

Commencing at the Brass Plug in concrete found at the West Quarter Corner of Section 11, from which bears an Iron Pin at the Northwest corner of Section 11 North 1 degree 10 minutes 50 seconds West a distance of 2613.80 feet; thence from said commencement point at the West Quarter Corner of Section 11, North 89 degrees 53 minutes 06 seconds East, along the South line of the Northwest Quarter of Section 11, being the same as the North line of the Southwest Quarter of section 11 a distance of 2640.27 feet to the 2 inch Iron Pipe at the Center of Section 11, from which bears an Iron Pin at the North Quarter Corner of Section 11 North 1 degree 03 minutes 37 seconds West a distance of 2635.19 feet; thence from said 2 inch Iron Pipe at the Center of Section 11 South 89 degrees 53 minutes 06 seconds West back along the North line of the Southwest Quarter of Section 11 a distance of 299.42 feet; thence South 0 degrees 04 minutes 33 seconds East a distance of 23.65 feet to the Point of Beginning of the Tract described herein; thence continuing South 0 degrees 04 minutes 33 seconds East a distance of 1000.00 feet; thence South 20 degrees 12 minutes 37 seconds West a distance of 539.75 feet; thence South 89 degrees 34 minutes 10 seconds West a distance of 2020.00 feet; thence North 23 degrees 23 minutes 56 seconds West a distance of 220.47 feet; thence North 0 degrees 19 minutes 57 seconds East a distance of 1316.35 feet; thence North 89 degrees 55 minutes 27 seconds East a distance of 2285.00 feet to the Point of Beginning and containing 78.22 Acres.

SURVEYOR CERTIFICATE:
THIS IS TO CERTIFY THAT WE, INGENAE, LLC, HAVE AT THE REQUEST OF AND FOR THE EXCLUSIVE USE OF THE OWNERS, PERFORMED A SURVEY OF THE TRACT AS SHOWN HEREON AND THAT THIS IS A TRUE REPRESENTATION OF THAT SURVEY. THIS PLAT AND THE SURVEY FROM WHICH IT IS BASED WERE DONE IN ACCORDANCE WITH THE "MINIMUM STANDARDS OF PRACTICE" FOR LAND SURVEYING IN THE STATE OF ILLINOIS.

INGENAE, LLC
PROFESSIONAL DESIGN FIRM
LICENSE NO. 184.007588-0010

STATE OF ILLINOIS
MICHAEL J. GRAMINSKI
035.002901
PROFESSIONAL LAND SURVEYOR
Sept 22 2021

MICHAEL J. GRAMINSKI, I.P.L.S. NO. 035.002901 ***DATE***
EXPIRES: 11/30/2022

IngenAE
502 Earth City Plaza, Suite 120
Earth City, MO 63045
www.ingenae.com

Submissions / Revisions:	Date:
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	

Project Name & Location:

COFFEEN
POWER PLANT
134 SIPS LANE
COFFEEN, IL
62017

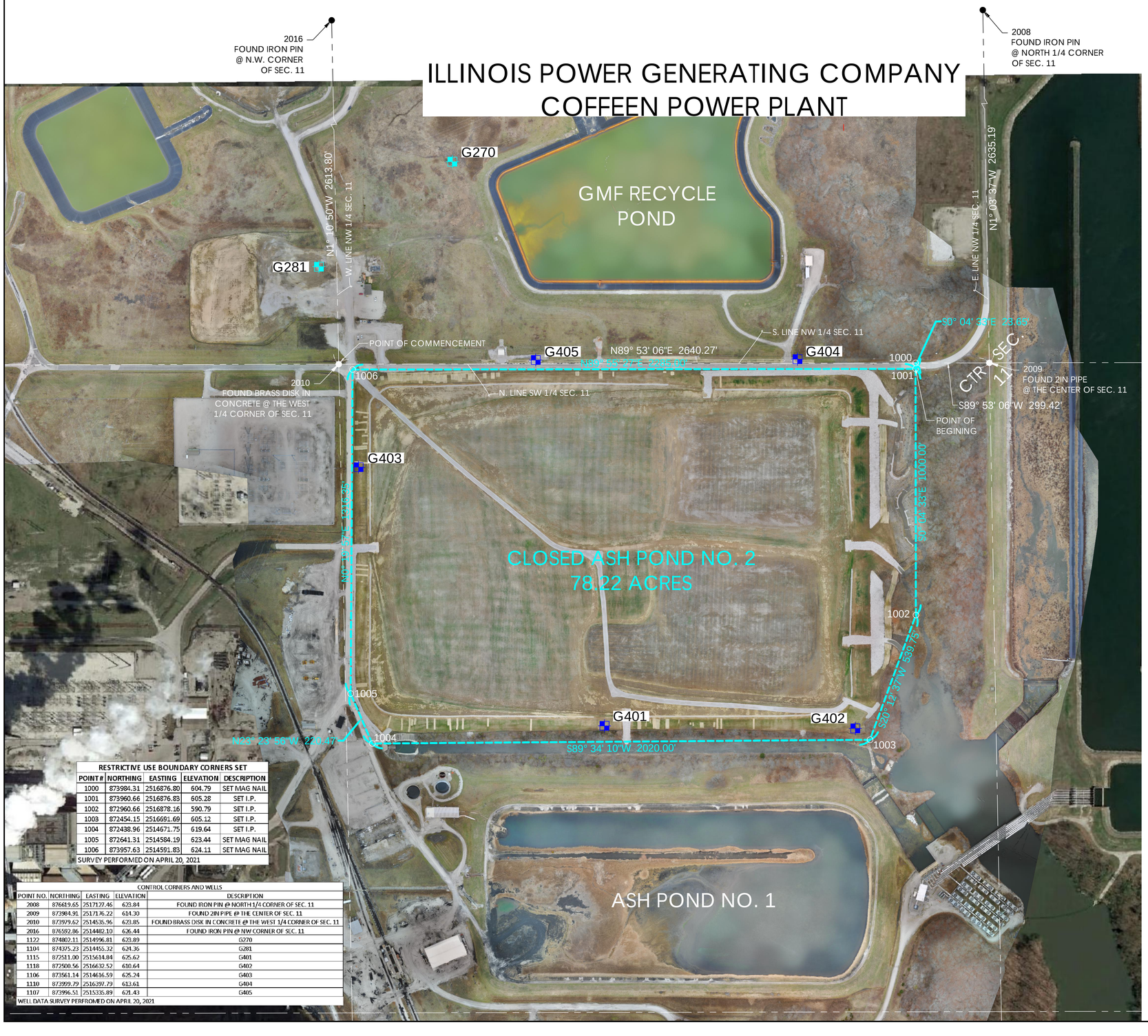
Copyright © 2021
IngenAE, LLC
www.ingenae.com

DO NOT SCALE PLANS
Copying, Printing, Software and other processes required to produce these prints can stretch or shrink the actual paper or layout. Therefore, scaling of this drawing may be inaccurate. Contact IngenAE with any need for additional dimensions or clarifications.

Drawing Name:
CLOSED ASH POND 2
RESTRICTED USE
BOUNDARY EXHIBIT

Date: 9/22/2021	Project No.
Type: SITE	Drawing No.
Drawn By: CB	1
Approved By: MG	
Scale: AS NOTED	

ILLINOIS POWER GENERATING COMPANY
COFFEEN POWER PLANT



RESTRICTIVE USE BOUNDARY CORNERS SET				
POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
1000	873984.31	2516876.80	604.79	SET MAG NAIL
1001	873960.66	2516876.83	605.28	SET I.P.
1002	872960.66	2516878.16	590.79	SET I.P.
1003	872454.15	2516691.69	605.12	SET I.P.
1004	872438.96	2514671.75	619.64	SET I.P.
1005	872641.31	2514584.19	623.44	SET MAG NAIL
1006	873957.63	2514591.83	624.11	SET MAG NAIL

SURVEY PERFORMED ON APRIL 20, 2021

CONTROL CORNERS AND WELLS				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
2008	876619.65	2517127.46	623.84	FOUND IRON PIN @ NORTH 1/4 CORNER OF SEC. 11
2009	873984.91	2517176.22	614.30	FOUND 2IN PIPE @ THE CENTER OF SEC. 11
2010	873979.62	2514535.96	623.85	FOUND BRASS DISK IN CONCRETE @ THE WEST 1/4 CORNER OF SEC. 11
2016	876592.86	2514482.10	626.44	FOUND IRON PIN @ NW CORNER OF SEC. 11
1122	874802.11	2514996.81	623.89	G270
1104	874325.23	2514455.32	624.36	G281
1115	872511.00	2515614.84	625.62	G401
1118	872500.56	2516632.52	610.64	G402
1106	873561.14	2514616.59	625.24	G403
1110	873999.79	2516397.79	613.61	G404
1107	873996.51	2515335.89	621.43	G405

WELL DATA SURVEY PERFROMED ON APRIL 20, 2021

N

0' 200' 400'

LEGEND

- SECTION LINE
- RESTRICTED USE BOUNDARY
- FOUND SURVEY MARKER AS NOTED
- SET 5/8" IRON REBAR (UNLESS OTHERWISE NOTED)
- BACKGROUND CCR MONITORING WELL
- DOWNGRADIENT CCR MONITORING WELL

SURVEY NOTE:
THIS DRAWING AND THE INFORMATION SHOWN HERE ON WAS OBTAINED FROM DATA COLLECTED FROM A FIELD SURVEY MADE BY INGENAE, LLC BETWEEN MARCH 23 THROUGH APRIL 20, 2021. SURVEY COORDINATES, BEARINGS & DISTANCES ARE REFERENCED TO ILLINOIS WEST 1202 STATE PLANE COORDINATE SYSTEM NAD 1983.

IngenAE
502 Earth City Plaza, Suite 120
Earth City, MO 63045
www.ingenae.com

Submissions / Revisions:	Date:
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	

Project Name & Location:

COFFEEN
POWER PLANT
134 SIPS LANE
COFFEEN, IL
62017

Copyright © 2021
IngenAE, LLC
www.ingenae.com

DO NOT SCALE PLANS
Copying, Printing, Software and other processes required to produce these prints can stretch or shrink the actual paper or layout. Therefore, scaling of this drawing may be inaccurate. Contact IngenAE with any need for additional dimensions or clarifications.

Drawing Name:
CLOSED ASH POND 2
RESTRICTED USE
BOUNDARY EXHIBIT

Date: 9/22/2021	Project No.
Type: SITE	Drawing No.
Drawn By: CB	2
Approved By: MG	
Scale: AS NOTED	

APPENDIX B
GROUNDWATER INFORMATION (845.220(a)(7)(A-C), 845.220(c)(2-5))

APPENDIX B.1
CORRECTIVE ACTION GROUNDWATER MONITORING PLAN

Intended for
Illinois Power Generating Company
134 CIPS Lane
Coffeen, IL 62017

Date
June 10, 2025

Project No.
1940110241-001

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN

COFFEEN POWER PLANT, ASH POND NO. 2, IEPA ID NO W1350150004-02

RAMBOLL Bright ideas. Sustainable change.

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN COFFEEN POWER PLANT, ASH POND NO. 2, IEPA ID NO W1350150004-02

Project name	**Coffeen Power Plant Ash Pond No. 2**
Project no.	**1940110241-001**
Recipient	**Illinois Power Generating Company**
Document type	**Corrective Action Groundwater Monitoring Plan**
Revision	**FINAL**
Date	**June 10, 2025**
Prepared by	**Kristen L. Theesfeld**
Checked by	**Austin Bond**
Approved by	**Brian G. Hennings, PG**
Description	**Corrective Action Groundwater Monitoring Plan**

Ramboll
234 W. Florida Street
Fifth Floor
Milwaukee, WI 53204
USA

T 414-837-3607
F 414-837-3608
https://ramboll.com

Brian G. Hennings, PG
Project Officer Hydrogeology

CONTENTS

1.	**Introduction**	**4**
1.1	Overview	4
1.2	Site Location and Background	4
1.3	Conceptual Site Model	5
1.4	Groundwater Quality	6
1.5	Nature and Extent Investigation	7
2.	**Corrective Action Groundwater Monitoring Plan**	**8**
2.1	Corrective Action Groundwater Monitoring Program and Parameters	8
2.1.1	35 I.A.C. § 845 Corrective Action Groundwater Monitoring	8
2.2	Sampling Schedule	8
2.3	Groundwater Sample Collection	9
2.4	Laboratory Analysis	9
2.5	Quality Assurance Program	9
2.6	Groundwater Monitoring Well Maintenance Plan	10
2.7	Statistical Analysis	10
2.8	Data Reporting	10
2.9	Compliance with Applicable Groundwater Protection Standards	10
3.	**Effectiveness of the Corrective Action Remedy**	**12**
3.1	Remedy Progress Evaluation	12
3.1.1	Comparison to Groundwater Protection Standard	13
3.1.2	Agreement with Groundwater Model	13
3.1.3	Trend Analysis	14
3.1.4	Adaptive Management Actions	14
3.1.5	Concluding GWE	15
3.2	Stability Evaluation	16
3.3	Attainment Evaluation and Conclusion of Corrective Action Monitoring	16
4.	**References**	**17**

TABLES (ATTACHED)

Table 1-1 35 I.A.C. § 845 Requirements Checklist
Table 2-1 Summary of Monitoring Well Locations and Purpose
Table 2-2 Monitoring Well Locations and Construction Details
Table 2-3 Sampling and Analysis Summary
Table 3-1 Adaptive Site Management Metrics and Trigger Criteria

FIGURES (ATTACHED)

Figure 1-1 Corrective Action Monitoring Outline
Figure 1-2 Site Location Map
Figure 1-3 Site Map
Figure 1-4 Potentiometric Surface Map, October 28 and 29, 2024
Figure 2-1 Proposed 35 I.A.C. § 845 Corrective Action Monitoring Well Location Map
Figure 3-1 Corrective Action Monitoring Timeline
Figure 3-2 Adaptive Site Management Decision-Making Flow Chart

APPENDICES

Appendix A Boring Logs and Well Construction Forms
Appendix B 35 I.A.C. § 845 Multi-Site Statistical Analysis Plan

ACRONYMS AND ABBREVIATIONS

35 I.A.C.	Title 35 of the Illinois Administrative Code
AP1	Ash Pond No. 1
AP2	Ash Pond No. 2
ASD	Alternative Source Demonstration
CAAA	Corrective Action Alternatives Analysis
CCR	coal combustion residuals
COC	constituent of concern
CPP	Coffeen Power Plant
CSM	conceptual site model
DA	deep aquifer
DCU	deep confining unit
E001	Event 1
GMF GSP	Gypsum Management Facility Gypsum Stack Pond
GMF RP	Gypsum Management Facility Recycle Pond
GMP	Groundwater Monitoring Plan
GWE	Groundwater Extraction
GWPS	groundwater protection standard
HCR	Hydrogeologic Site Characterization Report
ID	identification
IEPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
IPGC	Illinois Power Generating Company
LCU	lower confining unit
LF	Landfill
NID	National Inventory of Dams
No.	Number
Ramboll	Ramboll Americas Engineering Solutions, Inc.
RL	reporting limit
SI	surface impoundment
StAP	Statistical Analysis Plan
TDS	total dissolved solids
UA	uppermost aquifer
UCU	upper confining unit
USEPA	United States Environmental Protection Agency

1. INTRODUCTION

1.1 Overview

In accordance with requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845: Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments, Ramboll Americas Engineering Solutions, Inc. (Ramboll) has prepared this Corrective Action Groundwater Monitoring Plan (GMP) on behalf of Coffeen Power Plant (CPP), operated by Illinois Power Generating Company (IPGC). This GMP will apply specifically to the coal combustion residuals (CCR) Unit referred to as Ash Pond Number (No.) 2 (AP2), CCR identification (ID) No. 102, Illinois Environmental Protection Agency (IEPA) ID No. W1350150004-02, and National Inventory of Dams (NID) No. IL50723. AP2 is a closed CCR surface impoundment (SI) with a surface area of approximately 60 acres and berms 47 feet higher than the surrounding land surface at the CPP. AP2 was originally removed from service and capped in the mid 1980's. This Corrective Action GMP includes content requirements specific to 35 I.A.C. § 845.630 (*Groundwater Monitoring System*), 35 I.A.C. § 845.640 (*Groundwater Sampling and Analysis*), 35 I.A.C. § 845.650 (Groundwater Monitoring Program), and 35 I.A.C. § 845.680 (*Implementation of the Corrective Action Plan*) for AP2 at the CPP.

A checklist in **Table 1-1** provides references to sections, tables, and figures within this document that meet the specific requirements of 35 I.A.C. § 845.630, 35 I.A.C. § 845.640, 35 I.A.C. § 845.650, and 35 I.A.C. § 845.680.

This Corrective Action GMP is included as Appendix B.1 to the Construction Permit Application for CPP AP2. The Corrective Action Plan proposes a horizontal groundwater extraction (GWE) well, combined with source control (*i.e.,* closure of AP2) completed in 2020, as presented in the Final Closure Plan [1] as the remedy for AP2. As described in the Corrective Action Plan, the proposed remedy meets the performance standards of 35 I.A.C. § 845.670(d) and addresses all current and potential future releases from AP2. Likewise, this Corrective Action GMP establishes how data will be collected, documented, and evaluated to assess remedy effectiveness for all currently documented and potential future releases from AP2[1] per the process outlined in **Figure 1-1**.

Adaptive site management strategies are an integral part of corrective action groundwater monitoring. The adaptive site management approach consistent with National Research Council, Interstate Technology & Regulatory Council and United States Environmental Protection Agency (USEPA) methodologies will allow timely incorporation of new site information throughout corrective action to ensure the achievement of the groundwater protection standard (GWPS). The adaptive site management approach expedites progress toward meeting the GWPS while acknowledging uncertainties, such as the persistence of current groundwater flow directions and potential related changes in geochemical conditions. The structured decision-making process proposed in this Corrective Action GMP includes specific metrics used to evaluate remedy progress, criteria which would trigger adaptive management evaluation, and options for those management actions.

1.2 Site Location and Background

The CPP is located in Montgomery County, in central Illinois, within Section 11 Township 7 North and Range 7 East. The CPP is approximately two miles south of the city of Coffeen and about

[1] The presence of exceedances at the waste boundary will continue to be evaluated under the Operating permit GMP previously submitted to IEPA [4].

eight miles southeast of the city of Hillsboro, Illinois (**Figure 1-2**). The CPP operated as a coal-fired power plant with five CCR units present, including AP2, Ash Pond No. 1 (AP1), the Gypsum Management Facility Gypsum Stack Pond (GMF GSP), the Gypsum Management Facility Recycle Pond (GMF RP), and Landfill (LF). Operations began in 1964 and CCR was disposed of in AP1. AP2 was also utilized in the early 1970's and AP1 was reconstructed in 1978. Both of these units were used until the mid-1980's, beginning in 2010 CCR material was placed in the LF and GMF Units. AP2 is located between the two lobes of Coffeen Lake (identified as "Coffeen Lake" and "Unnamed Tributary" on **Figure 1-2**) to the west and east, AP1 to the south, and the GMF RP to the north (**Figure 1-3**). Beyond the lake and other CCR units is agricultural land.

AP2 is a closed (IEPA-approved) SI with a surface area of approximately 60 acres and berms 47 feet higher than the surrounding land surface. AP2 was originally removed from service and capped in the mid-1980s. A clay and soil cap was placed on the surface of the pond with contouring and drainage provided to direct storm water to four engineered revetment down drain structures. Prior to capping, this pond was identified as Outfall 004 in the facility National Pollutant Discharge Elimination System operating permit, IL0000108. Construction of a geomembrane cover system began in July 2019 and was completed on November 17, 2020 in accordance with the Closure and Post Closure Care Plan [1] approved by the IEPA on January 30, 2018.

1.3 Conceptual Site Model

Significant site investigation has been completed at the CPP to characterize the geology, hydrogeology, and groundwater quality. Based on extensive investigation and monitoring, the AP2 has been well characterized as detailed in the Hydrogeologic Site Characterization Report (HCR) [2] included in the Operating Permit Application[2] and in the Nature and Extent Report [3].[3] A conceptual site model (CSM) has been developed and is discussed below.

In addition to the CCR, five hydrostratigraphic units have been identified at AP2 based on stratigraphic relationships, geologic composition, and common hydrogeologic properties. The units, listed from surface downward, are summarized as follows:

- **Upper Confining Unit (UCU):** Consists of the Loess Unit and the upper clayey portion of the Hagarstown Member which has generally lower vertical permeability and generally greater than 60 percent fine. The UCU was encountered across most of the CPP, with the exception of the eastern edges of the SIs near the Unnamed Tributary where the unit was eroded following deposition or locations where it has been excavated for construction.
- **Uppermost Aquifer (UA):** Consists primarily of sand and sandy silts and clays at the base of the Hagarstown Member and, in some locations, the uppermost weathered sandy clay portion of the Vandalia Member. The UA is absent in several locations due to weathering and in others due to excavation during construction of the CCR Unit. The hydraulic characteristics of the Hagarstown Member indicate the UA has a moderate hydraulic conductivity.
- **Lower Confining Unit (LCU):** Is composed of the sandy clay till of the Vandalia Member, the silt of the Mulberry Grove Formation, and the compacted clay till of the Smithboro Member. The LCU underlies the uppermost aquifer and was encountered in all boring

[2] The HCR was previously included as Attachment H of the Coffeen AP2 Operating Permit Application, submitted to IEPA on October 25, 2021.
[3] The Nature and Extent Report was previously submitted to IEPA [3] and is provided as Appendix D of the Corrective Action Alternatives Analysis (CAAA). The CAAA serves as Appendix A to the Corrective Action Plan to which this report is attached.

locations on the CPP. Results from laboratory tests completed for vertical hydraulic conductivity indicate the Vandalia Member has a very low vertical hydraulic conductivity.

- **Deep Aquifer (DA):** Consists primarily of sandy silt and sands of the Yarmouth Soil, which are thin (less than 5 feet) and discontinuous across the CPP.
- **Deep Confining Unit (DCU):** Underlies the DA and is composed of the Banner Formation, of which the thick Lierle Clay is the first encountered unit. No boring penetrated the full thickness of the DCU.

Overall groundwater flow within the UA is divided towards the two lobes of Coffeen Lake. The groundwater divide runs approximately through the center of the CPP, with groundwater east of the divide flowing east to southeast towards the Unnamed Tributary or the eastern lobe of Coffeen Lake and groundwater west of the divide flowing west to southwest towards the western lobe of Coffeen Lake. Groundwater flows east to southeast across AP2 toward the former discharge structure and Unnamed Tributary. Although elevations vary seasonally, the groundwater flow direction in the UA is consistent and likely controlled by the proximity and hydraulic connection to Coffeen Lake. Groundwater elevations and contours for the October 2024 groundwater monitoring event are presented in **Figure 1-4**.

1.4 Groundwater Quality

Groundwater monitoring in accordance with the proposed Operating GMP and sampling methodologies provided in the operating permit application for groundwater compliance at AP2 began in the second quarter of 2023 [4]. The proposed compliance monitoring wells yield groundwater samples that represent the quality of downgradient groundwater at the CCR boundary (as required in 35 I.A.C. § 845.630(a)(2)).

The Event 1 (E001) quarterly groundwater monitoring event was completed on June 8, 2023. In accordance with 35 I.A.C. § 845.610(b)(3)(C) and the statistical analysis plan submitted with the operating permit application (Appendix A of the GMP), constituent concentrations observed at compliance wells were evaluated for compliance with the GWPSs summarized in 35 I.A.C. § 845.600 to determine exceedances[4] of the GWPS. The following GWPS exceedances at compliance groundwater monitoring wells were identified [5]:

- Boron at wells G401, G402, G404, and G405
- Cobalt at well G401
- pH at well G401
- Sulfate at wells G401, G402, G404, G405, G406, and G407
- Total dissolved solids (TDS) at wells G401, G402, G404, G405, and G407

Pursuant to 35 I.A.C. § 845.650(e), an Alternative Source Demonstration (ASD) presented evidence demonstrating that sources other than AP2 were the cause of the cobalt GWPS exceedance at G401 [6]. A second ASD presented evidence demonstrating that sources other

[4] Throughout this document, "exceedance" or "exceedances" is intended to refer only to potential exceedances of proposed applicable background statistics or GWPSs as described in the proposed groundwater monitoring program which was submitted to the IEPA on October 25, 2021 as part of IPGC's operating permit application for the CPP AP2. That operating permit application, including the proposed groundwater monitoring program, remains under review by the IEPA and, therefore, IPGC has not identified any actual exceedances.

than AP2 were the cause of the sulfate and TDS GWPS exceedances at G407 [7]. IEPA did not concur with the ASDs due to alleged data gaps [8].

IPGC submitted written comments and additional information in response to IEPA's request for information and filed petitions asking the Illinois Pollution Control Board (IPCB) to review IEPA's ASD denials. The petitions included a motion for a partial stay of the 35 I.A.C. § 845 requirements as they apply to the exceedances of the cobalt GWPS at G401, and sulfate and TDS GWPSs at G407, at AP2. IEPA had no objection to the requested stays, which were granted by IPCB to IPGC on April 18, 2024.

Subsequent compliance sampling events (following E001) were evaluated for exceedances of the GWPS as described in 35 I.A.C. § 845.600 [9, 10, 11, 12, 13, 14]. Exceedances identified during the subsequent events were consistent with those listed above.

In accordance with 35 I.A.C. § 845.660, a Corrective Measures Assessment was developed to address current and potential future GWPS exceedances originating from AP2, excluding the cobalt, sulfate, and TDS GWPS exceedances addressed in the ASDs, and was submitted to IEPA on June 12, 2024 [15]. The 35 I.A.C. § 845.650 groundwater monitoring requirements will continue to ensure that there will be timely detection of changes in groundwater quality during the stay. The inclusion of the cobalt exceedances at G401, and sulfate and TDS GWPS exceedances at G407 in the Corrective Action Plan process will remain under review pending IPCB's final action on IPGC's appeal of the IEPA ASD denials or until IPCB orders otherwise. The selected remedy will meet the performance standards of 35 I.A.C. § 845.670(d) and once implemented and completed, the selected remedy presented in the Corrective Action Plan will attain the GWPSs.

1.5 Nature and Extent Investigation

A limited investigation was conducted in 2021 to further assess the nature, degree, and extent of boron, pH, sulfate, and TDS groundwater impacts downgradient of AP2 in accordance with 35 I.A.C. § 845.650. Borings were advanced adjacent to the following locations later in 2021 to further delineate the extent of boron, pH, sulfate, and TDS above the GWPS:

- G270, G401, and G1001

Soil lithology was logged continuously from borings completed at the above locations, and soil samples were collected from each boring for laboratory analysis from within the screened interval of each well and from the soil just above the screened interval. Soil samples were analyzed for total metals by 7-step sequential extraction procedure, bulk mineralogy by x-ray diffraction, bulk elemental composition by x-ray fluorescence, total organic carbon and loss on ignition, and cation exchange capacity.

Additionally, six surface water samples were collected later in 2021 to characterize the water quality in Coffeen Lake and supplement previous samples collected in 2016 [16]. Surface water samples were analyzed for 35 I.A.C. § 845.600 parameters (total and dissolved), ferrous and ferric iron, major ions, and monitored natural attenuation parameters. An evaluation of the data is provided in the Nature and Extent Report.[5]

[5] The Nature and Extent Report was previously submitted to IEPA [3] and is provided as Appendix D of the CAAA. The CAAA serves as Appendix A to the Corrective Action Plan to which this report is attached.

2. CORRECTIVE ACTION GROUNDWATER MONITORING PLAN

This Corrective Action GMP is being provided to propose a groundwater monitoring program specific to AP2 that will comply with 35 I.A.C. § 845.680. The Corrective Action GMP will monitor and evaluate groundwater quality specifically to document the effectiveness of the corrective action remedy. The groundwater monitoring program will include sampling and analysis procedures that are consistent and that provide an accurate representation of groundwater quality.

2.1 Corrective Action Groundwater Monitoring Program and Parameters

2.1.1 35 I.A.C. § 845 Corrective Action Groundwater Monitoring

The proposed 35 I.A.C. § 845 corrective action monitoring well network will consist of six wells to document the effectiveness of the corrective action remedy and ultimately demonstrate compliance with GWPSs (**Figure 2-1**). The wells included in the corrective action monitoring well network include select compliance monitoring wells from the Operating GMP network (*e.g.*, those with previously reported exceedances of the GWPS) (**Section 1.4**)

As appropriate to meet the corrective action monitoring objectives and evaluate the effectiveness of the corrective action remedy (as described in **Section 3**), the corrective action monitoring program involves assigning each well to a monitoring category or purpose (**Table 2-1**). These monitoring categories include:

- **Inside Plume**: monitoring wells installed at the CCR boundary with GWPS exceedances.
- **Plume Definition**: wells located along the lateral or vertical boundary of the plume.

A summary of the well locations and associated purpose as it relates to the above category is presented in **Table 2-1** and **Figure 2-1**. Monitoring well depths and construction details are listed in **Table 2-2**, and boring logs and monitoring well construction forms are provided in **Appendix A**. Groundwater samples will be collected and analyzed for the laboratory and field parameters in **Table 2-3**. Laboratory parameters include major ions for evaluating groundwater chemistry and constituents of concern (COCs) (*i.e.*, reported exceedances in accordance with the Operating GMP) the Corrective Action is intended to address. Sampling to evaluate corrective action effectiveness will begin the quarter after the corrective action remedy is implemented and commissioned.

2.2 Sampling Schedule

All wells in the 35 I.A.C. § 845 corrective action GMP network, as presented in **Table 2-1**, will be sampled quarterly to provide a complete picture of corrective action effectiveness. Groundwater elevations will be determined at the time of sample collection from each well. Sampling will end in accordance with 35 I.A.C. § 845.680(c), when compliance with the GWPS has been demonstrated "at all points within the plume of contamination that lies beyond the waste boundary […] for a period of three consecutive years" (details in **Section 3.3**).

Consistent with 35 I.A.C. § 845.650(b)(4), quarterly sampling may be reduced to a semiannual frequency with IEPA approval after completion of five years of monitoring. A request for reduced sampling frequency will include a demonstration that corrective action monitoring effectiveness will not be compromised; sufficient data has been collected to evaluate ongoing remedy

effectiveness; and existing data show trends consistent with anticipated remedy performance (details in **Section 3.1**).

2.3 Groundwater Sample Collection

Groundwater sampling procedures have been developed and the collection of groundwater samples is being implemented to meet the requirements of 35 I.A.C. § 845.640. In addition to groundwater well samples, quality assurance samples will be collected as described in **Section 2.5** (**Table 2-3**). Groundwater samples will be collected and analyzed in accordance with the Multi-Site Sampling and Analysis Plan [17].

2.4 Laboratory Analysis

Laboratory analysis will be performed consistent with the requirements of 35 I.A.C. § 845.640(j) by a state-certified laboratory using methods approved by IEPA and USEPA. Laboratory methods may be modified based on laboratory equipment availability or procedures, but the Reporting Limit (RL) for all parameters analyzed, regardless of method, will be lower than the applicable groundwater quality standard [18]. Concentrations lower than the RL will be reported as less than the RL.

2.5 Quality Assurance Program

Consistent with the requirements of 35 I.A.C. § 845.640(a)(5), the sampling and analysis program includes procedures and techniques for quality assurance/quality control (QA/QC). Additional quality assurance samples to be collected will include the following:

- Field duplicates will be collected at a frequency of one per group of ten or fewer investigative water samples.
- One equipment blank sample will be collected and analyzed for each day of sampling. If dedicated sampling equipment is used, then equipment blank samples will not be collected.
- The duplicate and equipment blank quality assurance samples will be supplemented by the laboratory QA/QC program, which typically includes:
  - Regular generation of instrument calibration curves to assure instrument reliability
  - Laboratory control samples and/or quality control check standards that have been spiked, and analyses to monitor the performance of the analytical method
  - Matrix spike/matrix spike duplicate analyses to determine percent recoveries and relative percent differences for each of the parameters detected
  - Analysis of replicate samples to check the precision of the instrumentation and/or methodology employed for all analytical methods
  - Analysis of method blanks to assure that the system is free of contamination

Water quality meters used to measure pH and turbidity will be calibrated according to manufacturer’s specifications. At a minimum, it is recommended that calibration of pH occur daily prior to sampling and checked for accuracy at the end of each day. Unusual or suspect pH measurements during sampling events will be flagged, evaluated, and additional calibration may be performed throughout the sampling events. Turbidity meters will be checked daily, prior to and following sampling. Unusual measurements or erratic meter performance will be flagged and evaluated for overall effects on the data prior to reporting.

2.6 Groundwater Monitoring Well Maintenance Plan

Consistent with the requirements of 35 I.A.C. § 845.630(e)(2), maintenance will be performed according to the Multi-Site Sampling and Analysis Plan [17] as needed to assure that the monitoring wells provide representative groundwater samples. Monitoring wells will be inspected during each groundwater sampling event; inspections will consist of the following:

- Visual inspection, clearing of vegetation, replacement of markers, and painting of protective casings as needed to assure that monitoring wells are clearly marked and accessible
- Visual inspection and repair or replacement of well aprons as needed to assure that they are intact, drain water away from the well, and have not heaved
- Visual inspection and repair or replacement of protective casings as needed to assure that they are undamaged, and that locks are present and functional
- Checks to assure that well caps are intact and vented, unless in flood-prone areas, in which case caps will not be vented
- Routine measurement of monitoring well depths to determine the degree of siltation within the wells. Wells will be redeveloped as needed to remove siltation from the screened interval if it impedes flow of water into the well
- Checks to assure that wells are clear of internal obstructions, and flow freely

If wells are damaged or become otherwise inoperable, they will be replaced by wells screened at the same elevation and as close to the original well as possible (ideally within 10 feet) and notification will be provided to IEPA. If a replacement well cannot be installed within approximately 10 feet of the original well location, notification will be sent to IEPA and a monitoring well will be installed as close as possible to the original monitoring well and given a new well identification number. Any well replacement activities will also be documented in the Annual Groundwater Monitoring and Corrective Action Report.

2.7 Statistical Analysis

A Multi-Site Statistical Analysis Plan (StAP) (**Appendix B**) has been developed to summarize the statistical procedures that will be used to evaluate the groundwater results.

2.8 Data Reporting

Groundwater monitoring and analysis completed in accordance with 35 I.A.C. § 845 under an approved monitoring program will be reported to IEPA annually by January 31 as required by I.A.C. § 845.550, for data collected the preceding year. The Annual Groundwater Monitoring and Corrective Action Report will include the status of the groundwater monitoring and Corrective Action Plan for AP2 in addition to other requirements detailed in 35 I.A.C. § 845.610(e).

2.9 Compliance with Applicable Groundwater Protection Standards

As provided in 35 I.A.C. § 845.680(c)(2), corrective action is considered complete when compliance with the GWPS has been achieved by demonstrating that concentration of constituents listed in 35 I.A.C. § 845.600 have not exceeded the GWPSs for a period of three consecutive years, using the statistical procedures and performance standards in 35 I.A.C. § 845.640(f) and (g).

Attainment of GWPSs and conclusion of corrective action monitoring is discussed below in **Section 3.3**.

If a new exceedance is determined during monitoring under the Operating GMP, the Corrective Action groundwater monitoring program will be evaluated for monitoring of additional locations and/or constituents using the adaptive site management methods presented herein.

3. EFFECTIVENESS OF THE CORRECTIVE ACTION REMEDY

The methods for evaluating the effectiveness of the corrective action remedy described in this section are based on the following guidance documents:

- "Methods for Evaluating the Attainment of Cleanup Standards Volume 2: Ground Water," USEPA, Office of Policy, Planning, and Evaluation, 1992. [19]
- "Groundwater Remedy Completion Strategy: Moving Forward with the End in Mind," USEPA, Office of Solid Waste and Emergency Response, 2014. [20]
- "Adaptive Site Management – A Framework for Implementing Adaptive Management at Contaminated Sediment Superfund Sites," USEPA, Office of Superfund Remediation and Technology Innovation, 2022. [21]
- "Environmental Cleanup Best Management Practices: Effective Use of the Project Life Cycle Conceptual Site Model," USEPA, Office of Solid Waste and Emergency Response, 2011. [22]

Evaluation of corrective action remedy effectiveness will occur in three phases (**Figure 3-1**): remedy progress evaluation, stability evaluation, and attainment evaluation [19].

1. Remedy progress evaluation occurs after implementation of corrective actions to assess if the remedy is functioning as anticipated.
2. The stability evaluation, which assesses if a new post-treatment steady state in the groundwater has been reached.
3. Attainment evaluation occurs after a new steady state has been achieved and assesses if COC concentrations are below the GWPS.

COCs are parameters with exceedances of the GWPS to be addressed by the Corrective Action Plan. Corrective action monitoring at COF AP2 includes the following COC parameters:

- Boron, pH, sulfate, and TDS

The effectiveness of the remedy at each phase is evaluated using performance metrics designed to assess the goals of that phase. Performance metrics answer questions designed to evaluate multiple aspects of remedy effectiveness with the ultimate goal of holistically guiding management decisions [20]. These metrics may be evaluated using qualitative (subject to expert judgement) or quantitative (numerical outcomes) methods.

This section details the goals and performance metrics of each phase of remedy evaluation. Within each phase, the well groups described in **Section 2.1** have distinct applicable metrics and/or potential management actions consistent with the role of that well group within the corrective action monitoring framework. The remedy evaluation metrics documented here are specific to wells within the Corrective Action monitoring program.

3.1 Remedy Progress Evaluation

The goal of remedy process evaluation is to determine if a groundwater remedy is on track to achieve cleanup standards within the proposed time frame and to inform adaptive management decisions if performance metrics are not achieved. Evaluation of remedy progress includes evaluating the response of COCs in individual monitoring wells and in the plume as a whole. Remedy progress is evaluated using performance metrics as described below. **Table 3-1** details

the questions used to assess remedy progress and metrics which would trigger additional evaluation of adaptive site management options. **Figure 3-2** presents an outline of the decision-making process regarding adaptive management actions (the first step of which is assessing remedy progress per **Table 3-1**).

Documentation of remedy progress metrics will be provided in the Annual Groundwater Monitoring and Corrective Action Report (**Section 2.8**) beginning after the second year of data collection: a minimum of eight data points is required to complete meaningful statistical analysis required for evaluation of the remedy progress metrics, which will be available after two years of quarterly sampling. Per USEPA guidance [20], a thorough review of corrective action progress and remedy effectiveness will be conducted every five years. A Five-Year Annual Groundwater Monitoring and Corrective Action Report will evaluate the comprehensive data set and, if triggered by the results of the remedy progress evaluation metrics (**Table 3-1**), evaluate whether adaptive management actions are needed (**Figure 3-2**). The five-year time frame allows adaptive management decisions to be based on robust data sufficient to complete meaningful statistical analysis while remaining responsive to changing site conditions [20]. The remedy progress evaluation metrics and triggers for additional evaluation are described below.

3.1.1 Comparison to Groundwater Protection Standard

The Inside Plume wells in this monitoring plan were defined based on exceedances of the GWPS. The question posed to evaluate whether exceedances of the GWPS occur, and associated method of evaluation is (**Table 3-1**):

- Are COC concentrations greater than the GWPS? – Compare data points or summary statistics to site-specific GWPS values.

COC concentrations below the GWPS in Inside Plume wells may indicate that remedial actions are approaching completion and that moving to the next phase of remedy effectiveness evaluation may be warranted (see **Section 3.2**). Persistence of COC concentrations above the GWPS in Plume Definition wells may indicate that the plume is no longer properly delineated. Therefore, the trigger criterion for further evaluation is a central tendency measure of the last eight data points exceeding the GWPS.

3.1.2 Agreement with Groundwater Model

A groundwater flow and transport model[6] was used to compare the anticipated time to reach the GWPS for the different corrective actions considered at AP2.

The question posed to evaluate agreement of corrective action remedy progress with the groundwater model results is provided in **Table 3-1** and summarized below:

- Are concentrations of COCs at individual wells consistent with modeling expectations? – Evaluate if the observed results track with the predicted results in general direction and magnitude using expert professional judgement.

Only Inside Plume and Plume Definition wells included in the flow and transport model are evaluated according to this metric. Trigger criteria for additional adaptive site management evaluation include monitoring results failing to follow the general magnitude and direction of

[6] The Groundwater Modeling Technical Memorandum is included as an attachment to the Corrective Action Alternative Analysis Supporting Information Report (CAAA-SIR) presented as part of the Corrective Action Plan.

groundwater model results at one or more locations. It is acceptable to conclude that no further adaptive site management evaluation is triggered if future observations do not precisely match modeled results on an individual well basis if the direction of remedy progress is adequate.

3.1.3 Trend Analysis

Evaluation of COC trends in wells both within and outside of the plume is a major component of remedy progress evaluations [19, 20]. Decreasing COC concentrations within the groundwater plume provides critical support for remedy effectiveness evaluations. Changing concentrations in wells defining the plume may indicate unanticipated plume migration or a need for better plume definition. Both short-term and long-term trends are important to evaluate remedy performance [19]. All trend analyses are performed in accordance with the Multi-Site StAP (**Appendix B**) and the USEPA Unified Guidance for groundwater statistics [23].

The questions posed to evaluate if COC concentrations are decreasing in Inside Plume wells and the associated methods for evaluation are provided in **Table 3-1** and summarized as follows:

- Are the average plume COC concentrations decreasing? – Evaluate trend based on quarterly average of COC concentrations of Inside Plume wells, both for the last eight sampling events and since corrective action was initiated.

The questions posed to evaluate if COC concentrations are changing in Inside Plume wells and Plume Definition wells and the associated methods for evaluation are provided in **Table 3-1** and summarized below:

- Are concentrations of COCs at individual wells changing? – Evaluate trend of COC concentrations, both for the last eight sampling events and since corrective action was initiated.

The goal of the corrective action is to reduce COC concentrations in the groundwater. Therefore, trigger criteria have been established for the one type of corrective action monitoring wells as follows:

- Inside Plume well triggers for adaptive site management evaluation are based on no decreasing trend in COC concentrations (short-term or long-term).
- Plume Definition well triggers are based on increasing COC concentrations, which may indicate improper delineation of the plume. Therefore, the trigger criterion for adaptive site management evaluation at Plume Definition wells is increasing short- or long-term trend.

3.1.4 Adaptive Management Actions

The goal of adaptive management actions is to understand why performance metrics are not met and, if the remedy is found to be unsuccessful in meeting remediation goals, drive supplemental corrective actions or, in extreme cases, re-evaluation of remedy selection. This section describes in greater detail the steps in the flow chart presented in **Figure 3-2** (adapted from Figure 2 in [20]).

As the remedy progress evaluation metrics are evaluated annually, failure to meet the metrics (as described in **Table 3-1**) leads to further action. If the data available at the time of the Five-Year Review are anticipated to be inadequate for determining the need for adaptive site management actions, additional data may be collected before the Five-Year Review including collecting samples from additional wells or measuring additional parameters.

If the remedy progress is not found to be adequate during the Five-Year Review, the most critical question is whether or not the remedy is likely to achieve the GWPS in a reasonable time frame. This may be evaluated using methods such as regression analysis or analysis of groundwater flow. If the remedy progress is not judged to be adequate but the remedy is likely to achieve the GWPS in a reasonable time frame, the CSM or the groundwater model may require updating to reflect evolving field conditions[7]. Additional data collected may also suggest ways to optimize the monitoring network or performance metrics [20].

If the remedy does not appear likely to achieve the GWPS in a reasonable time frame, it may be due to changing hydrogeochemical dynamics within the plume or an additional source of COCs not accounted for in the CSM. If available data suggests either occurrence, the Five-Year Review will describe additional activities planned to investigate if the existing remedy is still a viable option for attaining the GWPS. If the remedy is still viable, an update to the CSM and groundwater model is likely required [20, 22] and will be conducted after additional investigation is completed.

If the remedy does not appear likely to achieve the GWPS in a reasonable time frame, there is no alternative source of COCs not accounted for in the CSM, and the plume is appropriately delineated; or if the investigation into the hydrogeochemical changes or alternative source of COCs determines that the remedial action is no longer solely viable as a corrective action, an evaluation of additional remedial actions will be initiated.

If the remedy progress evaluation metrics indicate that concentrations across the monitoring network are below the GWPS (and the GWE system has ceased operation; see **Section 3.1.5**), the remedy progress phase may be considered complete, and the monitoring program may move to the Stability Evaluation phase (see **Section 3.2**).

3.1.5 Concluding GWE

Groundwater modeling used to support design of the horizontal GWE well (Appendix B of the CAAA-SIR) estimates that the GWPS will be met for all wells within the current monitoring wells within 14 years after the implementation of corrective action. This estimate will be corroborated according to the remedy progress valuation metric for COC concentrations (**Section 3.1.1**) at wells upgradient of the GWE system. The GWE system is intended to drain water from beneath AP2, reducing hydraulic head beneath AP2, which would accelerate achieving GWPS. Additional considerations such as trends in COC concentrations, analysis of groundwater flow, or seasonal variability may also influence the decision of whether to consider ceasing operation of the GWE system.

A period of equilibration and rebound is typical when discontinuing GWE operations and caution should be used when interpreting short-term changes in COC concentrations [19]. Groundwater modeling suggests that GWE operation may need to continue for an additional 25 years after GWPS have been met to prevent concentrations from rebounding above the GWPS (Appendix B of the CAAA-SIR). The groundwater flow and transport model may be revised as necessary in the future to reevaluate the potential for rebound to occur as a component of adaptive management.

[7] As stated in Section 1.4.1 of the Corrective Action Plan, "Estimated times to reach GWPS will be periodically reviewed and updated based on observed corrective action performance via an adaptive site management strategy."

A "slack period" of one year (or more, based on modeling results, if applicable) will be allowed to elapse after conclusion of GWE operations before stability and GWPS attainment are evaluated.

3.2 Stability Evaluation

Evaluation of groundwater stability reflects the idea that implementation of a remedy will, by necessity, cause changes to the physical and chemical environment of the groundwater. In order to evaluate ultimate effectiveness of the remedy, it is critical to evaluate if a new stable equilibrium has been reached after final closure has been implemented. Stability is achieved when groundwater elevations are stable (accounting for seasonal variability), average COC concentrations are stable across all wells, and COC concentrations are stable at each well.

Trends in groundwater elevation and COC concentrations at each plume well will be evaluated using the most recent eight data points (*i.e.*, two years of data when sampling quarterly) according to methods presented in the Multi-Site StAP (**Appendix B**). This metric is met for a plume well when there is no statistically significant trend in groundwater elevation or COC concentrations.

Plume COC concentrations will be evaluated for trend using the most recent eight data points, with the average concentration across plume wells per sampling event considered as one data point, according to methods presented in the Multi-Site StAP (**Appendix B**). This metric is met when there is no statistically significant trend in average COC concentrations.

3.3 Attainment Evaluation and Conclusion of Corrective Action Monitoring

The ultimate goal of groundwater corrective action is to attain compliance with the GWPS for each COC in Inside Plume wells. After stability has been achieved per the metrics discussed in **Section 3.2**, attainment evaluation will begin. Per 35 I.A.C. § 845.680(c), corrective action is considered complete when compliance with the GWPS has been demonstrated "at all points within the plume of contamination that lies beyond the waste boundary […] for a period of three consecutive years". Attainment of the GWPS will be evaluated in accordance with the Multi-Site StAP (**Appendix B**). Corrective action monitoring is considered complete for the site when COCs in the corrective action monitoring well network do not exceed the GWPS for three years.

4. REFERENCES

[1] AECOM, "Closure and Post-Closure Care Plan for the Coffeen Ash Pond No. 2 at Illinois Power Generating Company Coffeen Power Station," 2017.

[2] Natural Resource Technology, Inc., Hydrogeologic Site Characterization Report, Ash Pond 2, Coffeen Power Station, Coffeen, Illinois, January 24, 2017.

[3] Ramboll Americas Engineering Solutions, Inc., Nature and Extent Report, Coffeen Power Plant, Ash Pond No. 2 , IEPA ID No. W1350150004-02, June 12, 2024.

[4] Ramboll Americas Engineering Solutions, Inc., Addendum to the Groundwater Monitoring Plan, Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois, Illinois Power Generating Company, October 25, 2021.

[5] Ramboll Americas Engineering Solutions, Inc., 35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances, Quarter 2, 2023: Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois, October 16, 2023.

[6] Geosyntec Consultants, Inc., Alternative Source Demonstration. Coffeen Power Plant Ash Pond No. 2 (Unit ID #102), IEPA ID: W1350150004-02, 35 I.A.C. 845.650, December 15, 2023.

[7] Geosyntec Consultants, Inc., "Alternative Source Demonstation - G407 Sulfate and Total Dissolved Solids. Coffeen Power Plant Ash Pond No. 2 (Unit #102), IEPA ID: W1350150004-02, 35 I.A.C. 845.650," December 15, 2023.

[8] Illinois Environmental Protection Agency, "Letter from Darin E. LeCrone, P.E. (IEPA) to Dianna Tickner (Electric Energy, Inc.): Re: Coffeen Power Plant Ash Pond No. 2; W1350150004-02 Alternative Source Demonstration Submittal," January 11, 2024.

[9] Ramboll Americas Engineering Solutions, Inc., 35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances Quarter 3, 2023: Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois, January 20, 2024.

[10] Ramboll Americas Engineering Solutions, Inc., 35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances Quarter 4, 2023: Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois, March 10, 2024.

[11] Ramboll Americas Engineering Solutions, Inc., 35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances Quarter 1, 2024: Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois, June 7, 2024.

[12] Ramboll Americas Engineering Solutions, Inc., 35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances Quarter 2, 2024: Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois, August 16, 2024.

[13] Ramboll Americas Engineering Solutions, Inc., 35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances Quarter 3, 2024: Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois, November 12, 2024.

[14] Ramboll Americas Engineering Solutions, Inc., "35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances Quarter 4, 2024: Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois," February 17, 2025.

[15] Ramboll Americas Engineering Solutions, Inc., 35 I.A.C. § 845 Corrective Measures Assessment, Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois, IEPA ID: W1350150004-02, June 12, 2024.

[16] Gradient Corporation, "Human Health and Ecological Risk Assessment. Ash Pond 1, Coffeen Power Plant, Coffeen, Illinois," July 28, 2022.

[17] Ramboll Americas Engineering Solutions, Inc., "Multi-Site Sampling and Analysis Plan," December 28, 2022. [Online]. Available: https://www.luminant.com/documents/ccr/il-ccr/Coffeen/2023/Multi-Site%20Sampling%20Analysis%20Plan-Coffeen-W1350150004%E2%80%9001,02,03,04.pdf.

[18] Ramboll Americas Engineering Solutions, Inc., "Multi-Site Quality Assurance Project Plan," December 28, 2022. [Online]. Available: https://www.luminant.com/documents/ccr/il-ccr/Coffeen/2023/Multi-site%20Quality%20Assurance%20Project%20Plan-Coffeen-W1350150004%E2%80%9001,02,03,04.pdf.

[19] United States Environmental Protection Agency, "Methods for Evaluating the Attainment of Cleanup Standards Volume 2: Ground Water," Office of Policy, Planning, and Evaluation, 1992.

[20] United States Environmental Protection Agency, "Groundwater Remedy Completion Strategy: Moving Forward with the End in Mind," Office of Solid Waste and Emergency Response, 2014.

[21] United States Environmental Protection Agency, "Adaptive Site Management - A Framework for Implementing Adaptive Management at Contaminated Sediment Superfund Sites," Office of Superfund Remediation and Technology Innovation, 2022.

[22] United States Environmental Protection Agency, "Environmental Cleanup Best Management Practices: Effective Use of the Project Life Cycle Conceptual Site Model," Office of Solid Waste and Emergency Response, 2011.

[23] United States Environmental Protection Agency, "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance," Office of Resource Conservation and Recovery, 2009.

TABLES

Table 1-1. 35 I.A.C. § 845 Requirements Checklist

Corrective Action Groundwater Monitoring Plan
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

35 I.A.C. § 845 Reference	35 I.A.C. § 845 Components	Location of Information in Corrective Action GMP
845.630	**Groundwater Monitoring Systems**	
845.630(a)(2)	Potential contaminant pathways must be monitored.	NA
845.630(a) 845.630(b) 845.630(c)	At least two upgradient wells and four downgradient wells (min. 1 and 3, but requires additional documentation)	Section 2.1 Figure 1-4
845.630(a) 845.630(b) 845.630(c)	Downgradient Well Density	Figure 1-4
845.630(a)(2)	Downgradient wells at waste boundary	Figure 1-4
845.640	**Groundwater Sampling and Analysis Requirements**	
845.640(a)	Consistent sampling and analysis procedures	Section 2 Tables 2-3 and 2-4
845.640(b)	Methods are appropriate	Section 2 Tables 2-3 and 2-4
845.640(c)	Groundwater elevations must be measured in each well prior to purging, each time groundwater is sampled.	Section 2.2
845.640 (d)(e)(f)(g)(h)	Establishment of background and application of statistical methods	Section 2.7 Appendix B
845.640(i)	Analyze total recoverable metals	Table 2-3
845.640(j)	Analyze groundwater samples using a certified laboratory	Section 2.4

Table 1-1. 35 I.A.C. § 845 Requirements Checklist
Corrective Action Groundwater Monitoring Plan
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

35 I.A.C. § 845 Reference	35 I.A.C. § 845 Components	Location of Information in Corrective Action GMP
845.650	**Groundwater Monitoring Program**	
845.650(a)	Must include monitoring for all constituents with a groundwater protection standard in Section 845.600(a), calcium, and turbidity	Section 2.1 Table 2-3
845.650(b)(c)	Groundwater Monitoring Frequency	Section 2.2
845.650(d)(e)	Exceedances of the groundwater protection standard	Sections 2.9 and 3.1.1
845.650(b)(2) and (3)	Staff gauge/ piezometer to monitor head in impoundment	NA
NA	Staff gauge/ piezometer to monitor head of neighboring surface water body	Figure 1-4 (SG02 and SG03)
845.680	**Implementation of the Corrective Action Plan**	
845.680(a)(1)(a)	Establish and implement a corrective action groundwater monitoring program that meets requirements of 845.650	Sections 2.1 and 3 Tables 2-1 and 3-1 Figure 2-1
845.680(a)(1)(b)	Document the effectiveness of the corrective action remedy	Section 3
845.680(a)(1)(c)	Demonstrate compliance with the groundwater protection standard under Subsection [845.680] (c)	Sections 2.9 and 3

Table 1-1. 35 I.A.C. § 845 Requirements Checklist

Corrective Action Groundwater Monitoring Plan

Coffeen Power Plant

Ash Pond No. 2

Coffeen, IL

35 I.A.C. § 845 Reference	35 I.A.C. § 845 Components	Location of Information in Corrective Action GMP
845.680(c)(1)	Demonstrate compliance with the groundwater protection standards established by 845.600 has been achieved at all points within the plume of contamination that lies beyond the waste boundary	Section 3.3
845.680(c)(2)	Demonstrate that concentrations of constituents listed in 845.600 have not exceeded the groundwater protection standards for a period of three consecutive years using statistical procedures and performance standards in 845.640(f) and (g)	Sections 3.3 and 3.4

[O: CJC 10/23/2024; U: KLT 02/04/2025, C: CJC 02/24/2025]

Notes:

GMP = Groundwater Monitoring Plan

NA = Not Applicable

Table 2-1. Summary of Monitoring Well Locations and Purpose

Corrective Action Groundwater Monitoring Plan

Coffeen Power Plant

Ash Pond No. 2

Coffeen, IL

Well ID	Monitored Unit	Corrective Action Monitoring Well System	
		Inside Plume	Plume Definition
G401	UA	X	
G402	UA	X	
G404	UA	X	
G405	UA	X	
G406	UA	X	
G1001	LCU		X

[O: KLT 02/03/2025, C: CJC 02/24/2025] /2025, C: CJC 02/24/2025]

Notes:

UA = uppermost aquifer

LCU = lower confining unit

Table 2-2. Monitoring Well Locations and Construction Details
Corrective Action Groundwater Monitoring Plan
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Location	HSU	Date Constructed	Top of PVC Elevation (ft NAVD88)	Measuring Point Elevation (ft NAVD88)	Measuring Point Description	Ground Elevation (ft NAVD88)	Screen Top Depth (ft bgs)	Screen Bottom Depth (ft bgs)	Screen Top Elevation (ft NAVD88)	Screen Bottom Elevation (ft NAVD88)	Well Depth (ft bgs)	Bottom of Boring Elevation (ft NAVD88)	Screen Length (ft)	Screen Diameter (inches)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
G401	UA	9/14/2015	628.6	628.6	Top of Casing	625.6	14.4	18.8	611.2	606.8	22.3	603.3	4.4	2	39.060267	-89.395301
G402	UA	8/27/2010	613.0	613.2	Top of Casing	610.6	10.0	20.0	600.6	590.6	23.0	587.6	10	2	39.060215	-89.391718
G404	UA	5/1/2007	615.5	615.6	Top of Casing	613.5	6.4	11.2	607.1	602.4	13.7	599.8	4.8	2	39.064336	-89.392499
G405	UA	5/1/2007	623.3	623.5	Top of Casing	621.3	9.0	13.8	612.2	607.5	16.5	604.8	4.8	2	39.064352	-89.396239
G406	UA	8/19/2016	626.5	626.7	Top of Casing	623.9	13.6	18.4	610.3	605.5	21.5	602.4	4.8	2	39.060317	-89.398513
G1001	LCU	4/5/2021	597.5	597.7	Top of Casing	594.8	6.0	11.0	588.8	583.8	13.8	581.0	5	4	39.063332	-89.391242

[O: CJC 10/23/2024; U: KLT 02/03/2025, C: CJC 02/24/2025]

Notes:
All elevation data are presented relative to the North American Vertical Datum 1988 (NAVD88), GEOID 12A
-- = data not available
bgs = below ground surface
ft = foot or feet
HSU = Hydrostratigraphic Unit
LCU = lower confining unit
NAVD88 = North American Vertical Datum of 1988
PVC = polyvinyl chloride
UA = uppermost aquifer

Table 2-3. Sampling and Analysis Summary
Corrective Action Groundwater Monitoring Plan
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Parameter	Analytical Method [1]	Number of Samples	Field Duplicates [2]	Field Blanks [3]	Equipment Blanks [3]	MS/MSD [4]	Total	Container Type	Minimum Volume [5]	Preservation (Cool to 6 °C for all samples)	Sample Hold Time from Collection Date
Corrective Action Parameter(s) [6]											
Boron	6020 [7]	6	1	0	0	1	8	plastic	600 mL	HNO_3 to pH<2	6 months
Sulfate	9036 or EPA 300	6	1	0	0	1	8	plastic	50 mL	Cool to 6 °C	28 days
Total Dissolved Solids	SM 2540 C	6	1	0	0	1	8	plastic	200 mL	Cool to 6 °C	7 days
pH	SM 4500-H+ B	6	NA	NA	NA	NA	6	flow-through cell	NA	none	immediately
Inorganic Parameters											
Alkalinity, bicarbonate	SM 2320 B	6	1	0	0	1	8	plastic	500 mL	Cool to 6 °C	14 days
Alkalinity, carbonate	SM 2320 B	6	1	0	0	1	8	plastic	500 mL	Cool to 6 °C	14 days
Calcium	6020 [7]	6	1	0	0	1	8	plastic	600 mL	HNO_3 to pH<2	6 months
Chloride	9251 or EPA 300	6	1	0	0	1	8	plastic	100 mL	Cool to 6 °C	28 days
Fluoride	9214 or EPA 300	6	1	0	0	1	8	plastic	300 mL	Cool to 6 °C	28 days
Magnesium	6020 [7]	6	1	0	0	1	8	plastic	600 mL	HNO_3 to pH<2	6 months
Sodium	6020 [7]	6	1	0	0	1	8	plastic	600 mL	HNO_3 to pH<2	6 months
Potassium	6020 [7]	6	1	0	0	1	8	plastic	600 mL	HNO_3 to pH<2	6 months
Field Parameters											
Dissolved Oxygen [8]	SM 4500-O/405.1	6	NA	NA	NA	NA	6	flow-through cell	NA	none	immediately
Temperature [8]	SM 2550	6	NA	NA	NA	NA	6	flow-through cell	NA	none	immediately
Oxidation/Reduction Potential [8]	SM 2580 B	6	NA	NA	NA	NA	6	flow-through cell	NA	none	immediately
Specific Conductance [8]	SM 2510 B	6	NA	NA	NA	NA	6	flow-through cell	NA	none	immediately
Turbidity [9]	SM 2130 B	6	NA	NA	NA	NA	6	flow-through cell or hand-held turbidity meter	NA	none	immediately

[O: CJC 10/23/2024; U: KLT 02/03/2025; C: CJC 02/24/2025]

Notes:
[1] Analytical method numbers are from SW-846 unless otherwise indicated. Analytical methods may be updated with more recent versions as appropriate.
[2] Field duplicates will be collected at a frequency of one per group of 10 or fewer investigative water samples. Field duplicates will not be collected for radium analysis.
[3] Field blanks will be collected at the discretion of the project manager; Equipment blanks will be collected at a rate of 1 per sampling event if non-dedicated equipment is used.
[4] Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples will be collected at a frequency of one per group of 20 or fewer investigative water samples per CCR unit/multi-unit. Additional volume to be determined by laboratory.
[5] Sample volume is estimated and will be determined by the laboratory.
[6] Determined by reported exceedances under the Operating Groundwater Monitoring Plan
[7] Metals may be analyzed via USEPA methods 6010 or 6020 depending on laboratory instrument availability.
[8] Parameter collected for quality assurance and quality control for field sampling purposes only; not required to be collected or reported under 35 I.A.C. § 845; collection of parameter may be discontinued without notification.
[9] If turbidity exceeds 10 NTU, a duplicate sample filtered through a 0.45 micron filter may be collected for metals analysis in addition to the unfiltered sample. Both samples would be submitted for analysis.
< = less than
°C = degrees Celsius
HNO_3 = nitric acid
mL = milliliter
NA = not applicable
NTU = nephelometric turbidity unit

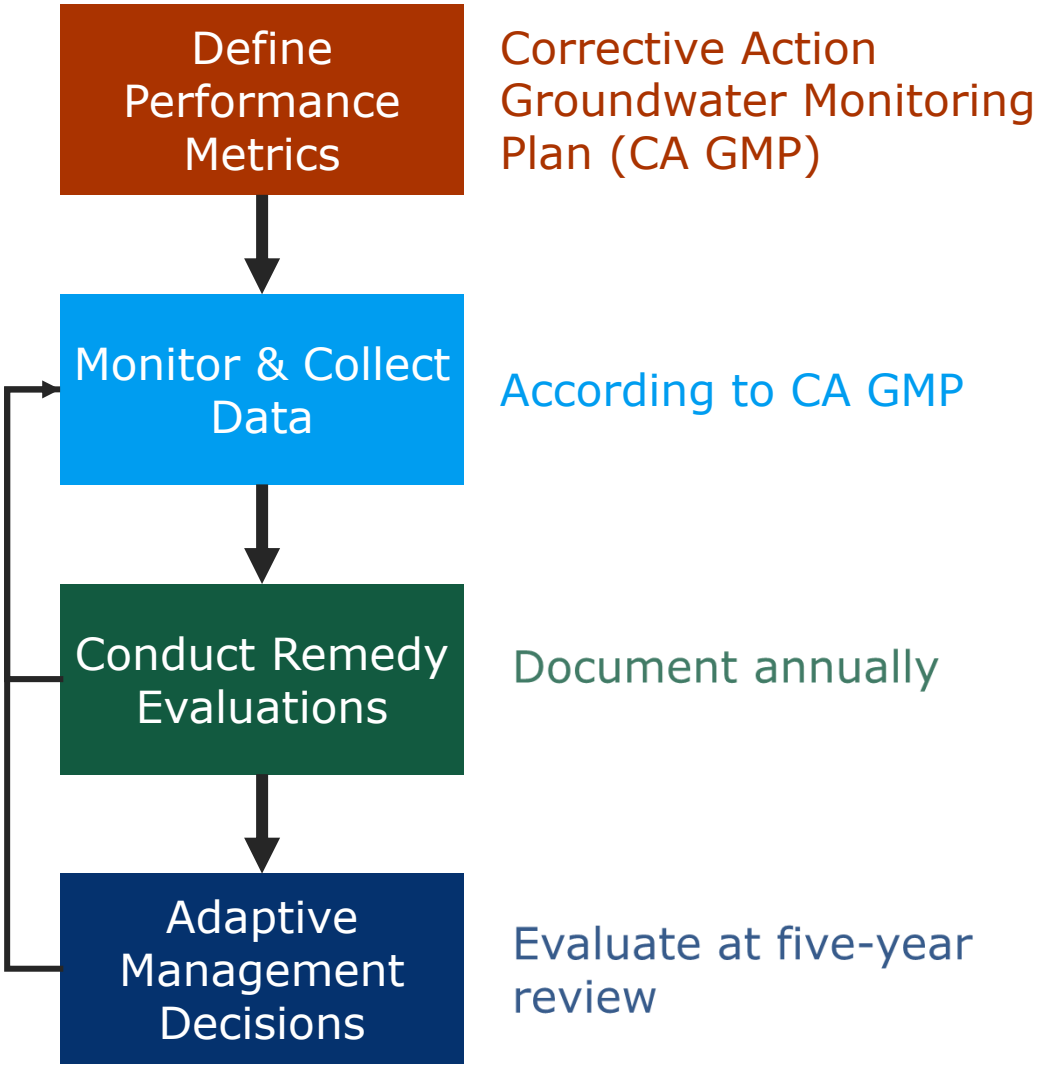
Table 3-1. Adaptive Site Management Metrics and Trigger Criteria
Corrective Action Groundwater Monitoring Plan
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

QUESTION	Are COC concentrations greater than the GWPS?		Are concentrations of COCs at individual wells consistent with modeling expectations? [1]		Are the average COC concentrations decreasing?	Are concentrations of COCs at individual wells changing?	Adaptive Site Management Outcome
EVALUATION [2]	Compare data points or summary statistics to site-specific GWPS		Do the observed results track with the predicted results in general direction and magnitude? (Professional judgement)		Evaluate trend on quarterly average of well concentrations, both for last 8 data points and since corrective action initiated or closure completed	Evaluate trend of COCs at each well, both for last 8 data points and since corrective action initiated	
Inside Plume	Central tendency concentration of last eight data points above the GWPS	**AND**	Results inconsistent with model	**AND MORE THAN ONE OF**	Neither trend decreasing	Neither trend decreasing	**Additional Evaluation Triggered (See Figure 3-2)**
Lateral/Vertical Plume Definition	Central tendency concentration of last eight data points above the GWPS		Results inconsistent with model		--	Either trend increasing	

[O: CJC 10/23/2024; U: KLT 02/03/2025, C: CJC 02/24/2025]

Notes:
1. Only applies to wells included in the flow and transport model
2. To be documented in Annual Monitoring and Corrective Action Reports
-- = No relevant trigger criteria
COC = constituent of concern
GWPS = groundwater protection standard

FIGURES



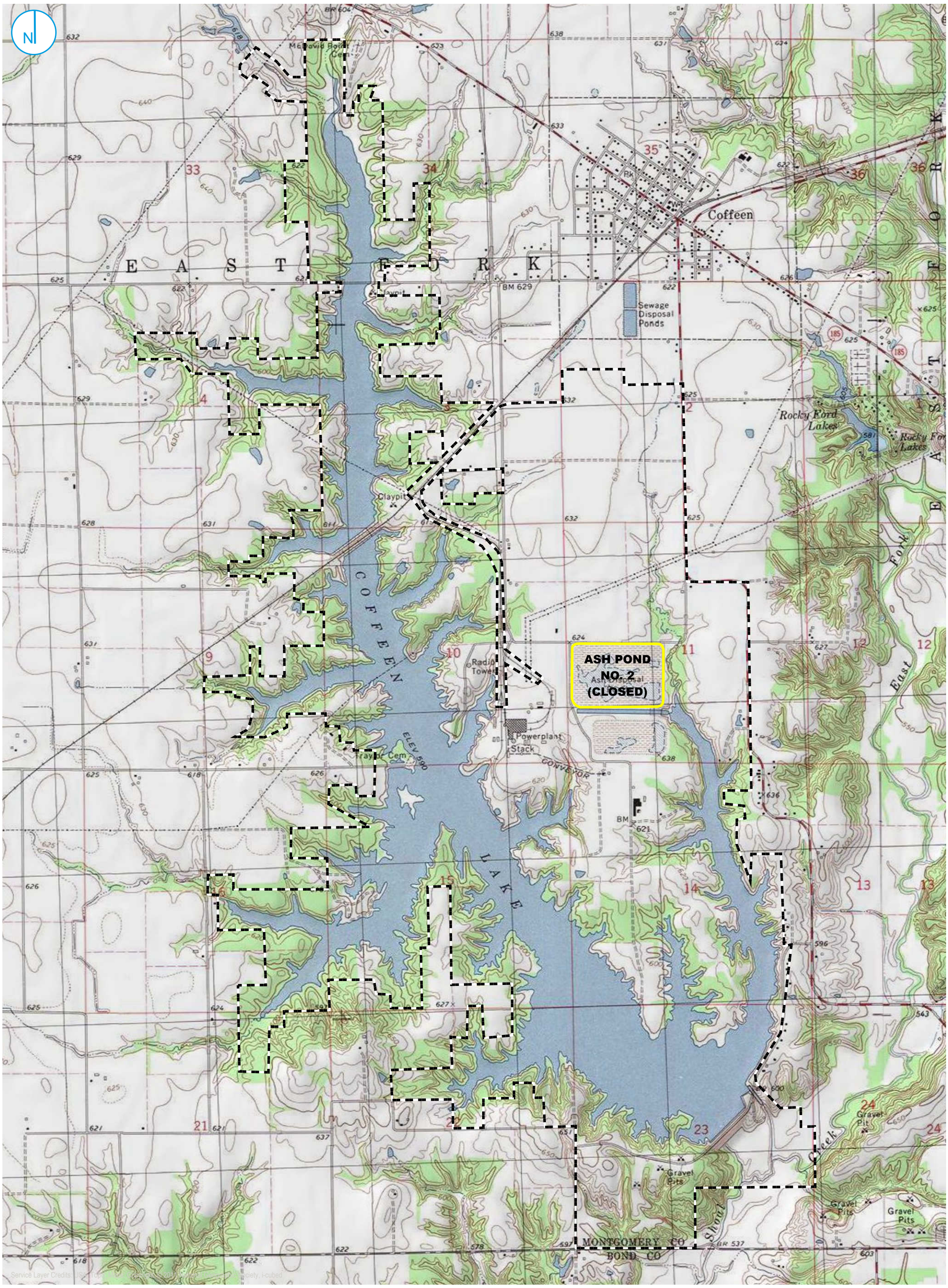
RAMBOLL

DRAFTED BY: AO | 2/4/2025

CORRECTIVE ACTION MONITORING OUTLINE

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN
COFFEEN POWER PLANT
ASH POND NO. 2
COFFEEN, ILLINOIS

Figure 1-1



REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY

0 1,000 2,000 Feet

SITE LOCATION MAP

FIGURE 1-2

CORRECTIVE ACTION
GROUNDWATER MONITORING PLAN
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

0 325 650 Feet

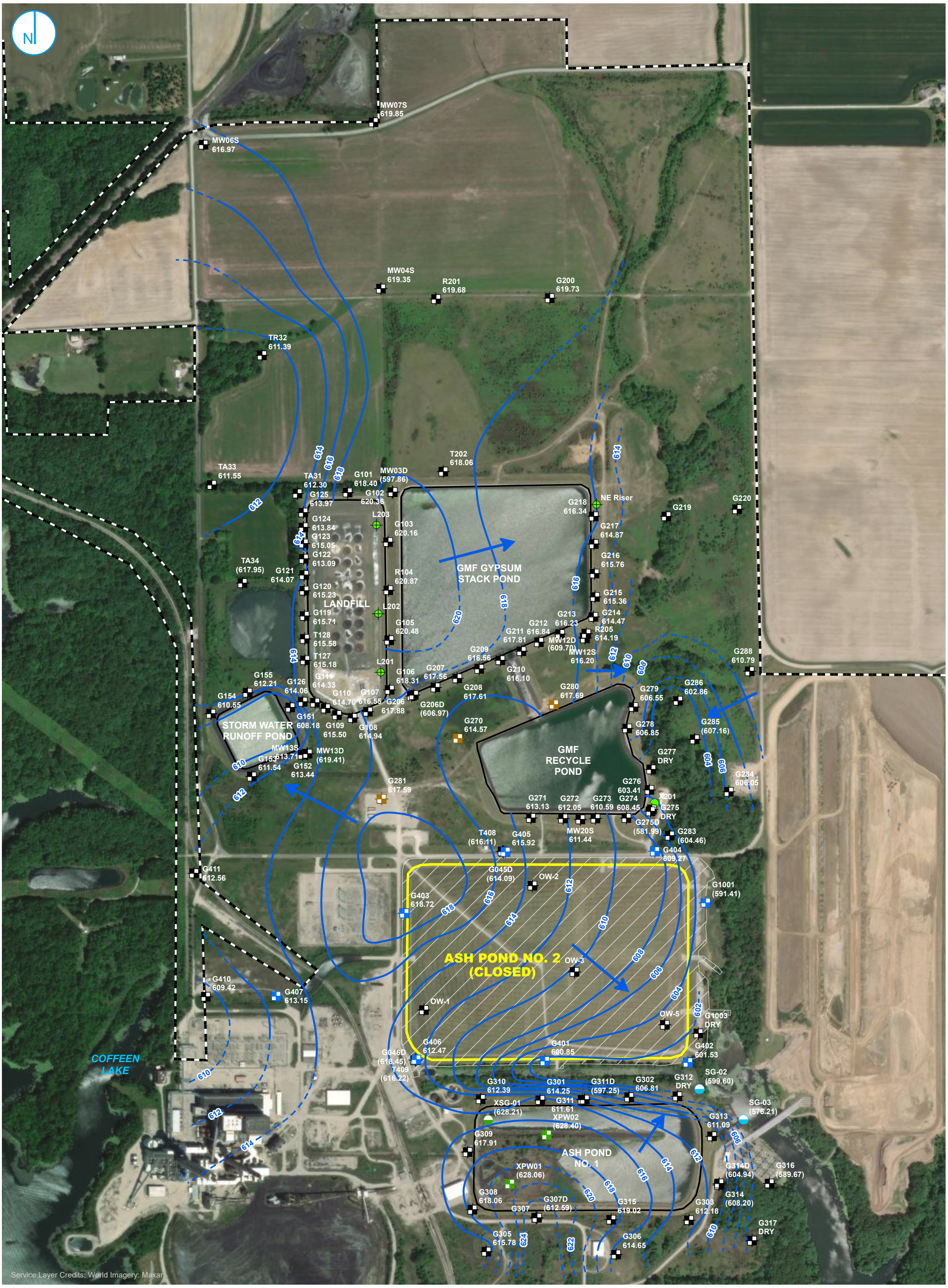
SITE MAP

FIGURE 1-3

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL



- COMPLIANCE MONITORING WELL
- BACKGROUND MONITORING WELL
- MONITORING WELL
- PORE WATER WELL
- LEACHATE WELL
- STAFF GAGE, RIVER
- STAFF GAGE, CCR UNIT
- CCR SOURCE WATER SAMPLE
- GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
- INFERRED GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION
- REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- LIMITS OF FINAL COVER
- PROPERTY BOUNDARY

0 325 650 Feet

NOTES:
1. ELEVATIONS IN PARENTHESES WERE NOT USED FOR CONTOURING.
2. ELEVATION CONTOURS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

POTENTIOMETRIC SURFACE MAP
OCTOBER 28 AND 29, 2024

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 1-4

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL

MONITORING WELL
REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

XXX INSIDE PLUME MONITORING WELL
XXX PLUME DEFINITION MONITORING WELL

0 150 300 Feet

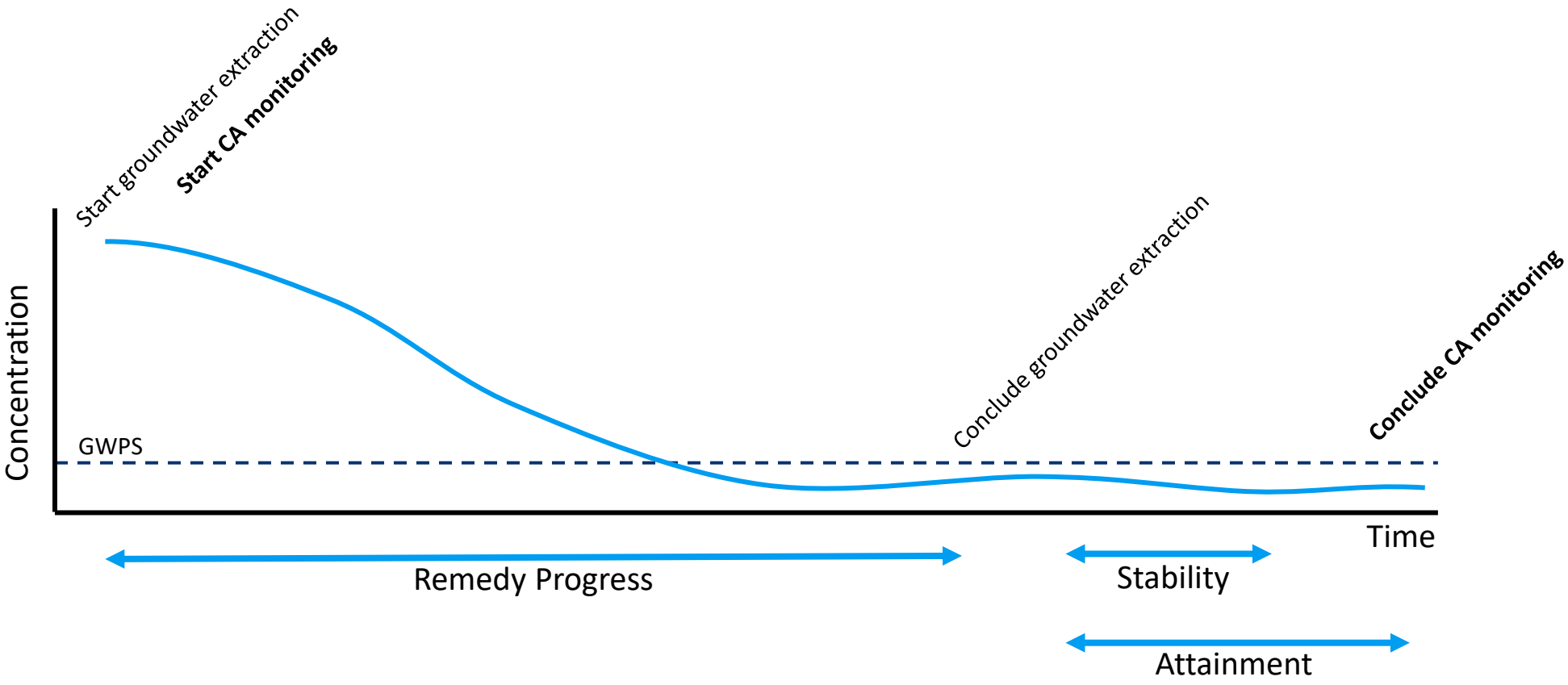
PROPOSED 35 I.A.C. § 845 CORRECTIVE ACTION MONITORING WELL LOCATION MAP

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 2-1

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL



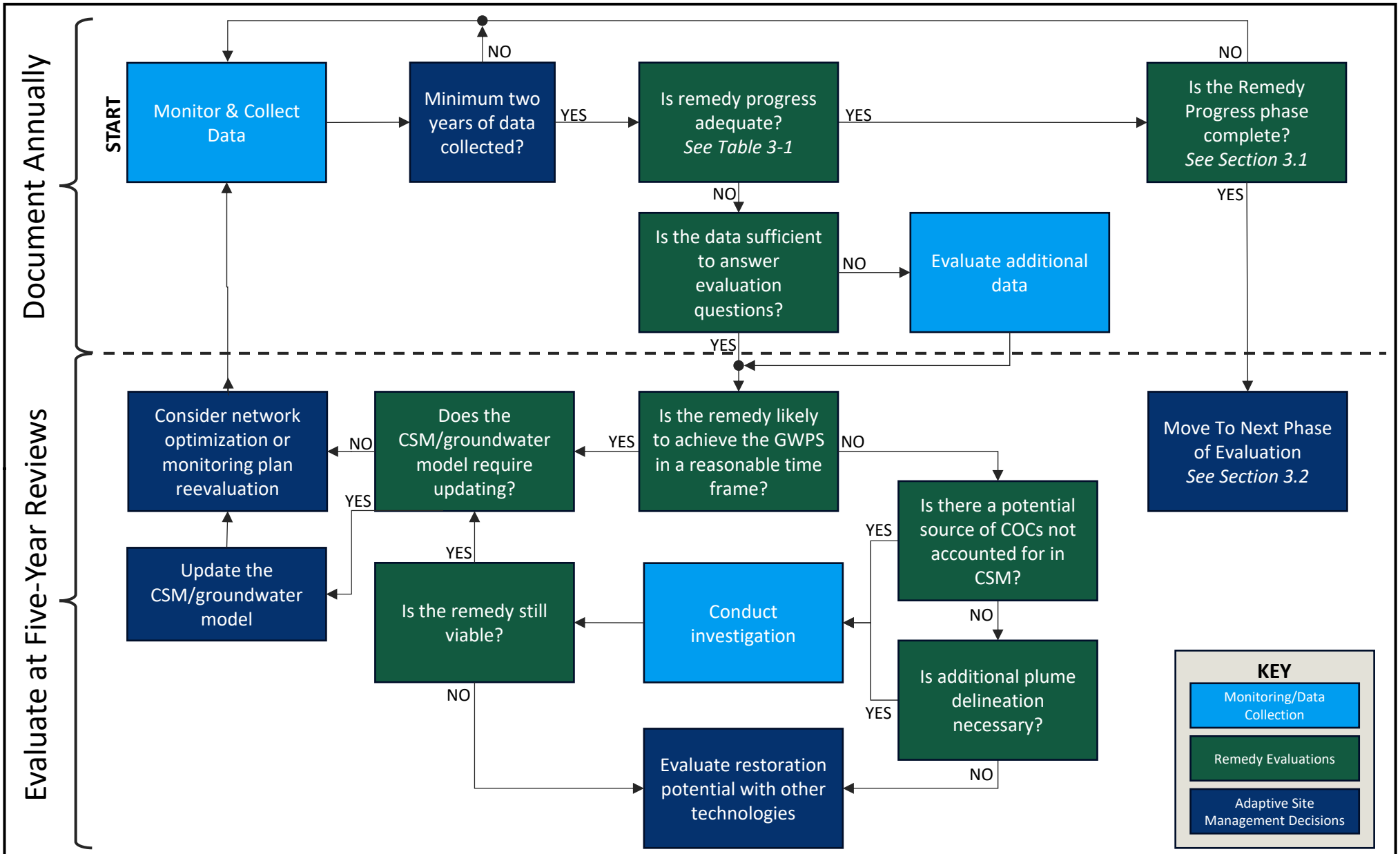
RAMBOLL

DRAFTED BY: AO | 2/25/2025

CORRECTIVE ACTION MONITORING TIMELINE

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN
COFFEEN POWER PLANT
ASH POND NO. 2
COFFEEN, ILLINOIS

Figure 3-1



Adapted from Figure 2 in USEPA (2014) *"Groundwater Remedy Completion Strategy: Moving Forward with the End in Mind,"* Office of Solid Waste and Emergency Response. 9200.2-144. May. https://semspub.epa.gov/work/HQ/100000021.pdf

RAMBOLL

DRAFTED BY: AO | 2/4/2025

ADAPTIVE SITE MANAGEMENT DECISION-MAKING FLOW CHART

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN
COFFEEN POWER PLANT
ASH POND NO. 2
COFFEEN, ILLINOIS

Figure 3-2

APPENDICES

APPENDIX A
BORING LOGS AND WELL CONSTRUCTION FORMS

BORING LOGS

FIELD BORING LOG

CLIENT: Natural Resource Technology, Inc.
Site: Coffeen Energy Center
Location: Coffeen, Illinois
Project: 15E0030
DATES: Start: 9/14/2015
Finish: 9/14/2015
WEATHER: Sunny, hi 60's

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: D-50 Turbo Tracked MST 800ATV
Drilling Method: Hollow Stem Auger (3¼"overdrill / 4¼")
FIELD STAFF: Driller: D. Crump
Helper: D. Groves
Eng/Geo: R. Hasenyager

BOREHOLE ID: G401
Well ID: G401
Surface Elev: 623.03 ft. MSL
Completion: 19.30 ft. BGS
Station: 2,515,614.84N
872,510.57E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	16/24 67%	ss	2-2 3-7 N=5	17		
2A	21/24 88%	ss	8-11 8-9 N=19	17		1.80
2B				25		
3A	23/24 96%	ss	3-4 7-8 N=11	23		2.50
4A	24/24 100%	ss	8-9 12-14 N=21	21		3.30
4B				19		2.80
5A	24/24 100%	ss	2-3 4-5 N=7	21		1.30
6A	24/24 100%	ss	2-4 5-6 N=9	17		2.50
7A	24/24 100%	ss	9-7 8-9 N=15	21		1.40
8A	24/24 100%	ss	2-3 2-4 N=5	17		1.30
8B				19		
9A	20/24 83%	ss	5-4 5-10 N=9	21		
9B				16		
10A	12/16 75%	ss	23-41 50/4"	6		4.50

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark grayish brown (10YR4/2), moist, soft, CLAY with little silt and trace very fine- to fine-grained sand - FILL.	
	Yellowish brown (10YR5/6) moist, medium, CLAY with some silt and trace very fine- to coarse-grained sand - FILL.	622
2	Dark gray (10YR4/1), moist, stiff, SILT with little clay and trace very fine-grained sand.	
	Yellowish brown (10YR5/6), moist, stiff, CLAY with some silt and trace very fine- to fine-grained sand.	620
4	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, medium, CLAY with some silt and trace very fine- to fine-grained sand.	618
6		616
8	Gray (10YR5/1) with 30% yellowish brown (10YR5/8) mottles, moist, stiff, SILT and very fine-grained SAND with trace clay.	
10	Gray (10YR5/1) with 30% yellowish brown (10YR5/6) mottles, moist, medium, CLAY with some silt and trace very fine- to fine-grained sand.	614
12		612
14		610
	Gray (10YR6/1), moist soft, CLAY with very fine- to fine-grained sand and little silt.	608
16	Yellowish brown (10YR5/6), wet, loose, very fine- to fine-grained SAND with trace silt.	
	Yellowish brown (10YR5/6), wet medium, SILT with some very fine-grained sand and little clay.	606
	Yellowish brown (10YR5/6), wet, loose, very fine- to medium-grained SAND with trace silt.	
18	Gray (10YR5/1), moist, very hard, SILT with few clay and little very fine- to very coarse sand.	604

End of boring = 19.3 feet

NOTE(S): G401 installed in borehole.

Surface Elevation: 610.56

Datum msl

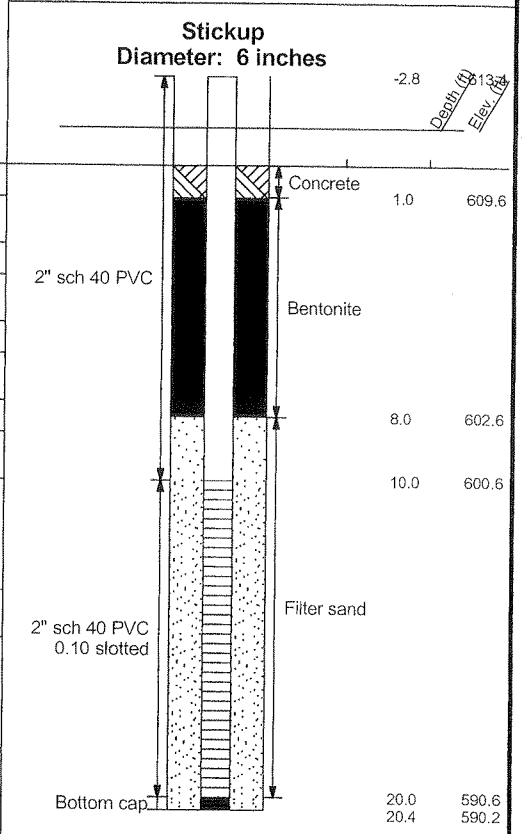
Completion Date: 8/27/10

Northing: 872502.26

Easting: 2516632.59

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium stiff, brown, silty CLAY - CL	6-3-3	SS1
		1-2-4	SS2
5	Medium stiff, gray, silty CLAY, trace sand - CL	1-2-5	SS3
	Hard to stiff, brown to gray, silty CLAY, trace sand seams - CL (TILL)	9-22-28	SS4
10			
15		1-6-12	SS5
20		3-4-9	SS6
	Boring terminated at 20 feet.		
25			
30			
35			

WELL DIAGRAM



GROUNDWATER DATA

ENCOUNTERED AT 7 FEET ∇

DRILLING DATA

___ AUGER 4 1/4" HOLLOW STEM

WASHBORING FROM ___ FEET

MVU DRILLER SWG LOGGER

CME 55TRK DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: DJK	App'vd. by: KBB
Date: 9/10/10	Date: 1-4-11	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Ameren-Coffeen Ash Pond Evaluation

Renamed G402

LOG OF BORING: APW-2

Project No. J017150.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01- COFFEEN.GPJ GTINC 0638301.GPJ 12/13/10

FIELD BORING LOG

HANSON

Formerly MW22S

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Energy Center
Location: Coffeen, Illinois
Project: 15E0030
DATES: Start: 5/1/2007
Finish: 5/1/2007
WEATHER: Partly sunny, warm

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 4¼" Hollow stem auger with split spoon sampler
FIELD STAFF: Driller: A. Rachford
Helper: M. Brown
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB22
Well ID: G404
Surface Elev: 613.10 ft. MSL
Completion: 12.00 ft. BGS
Station: 873,999.77N
2,516,397.85E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 2.07 - 05/10/2007
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % *Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type
1A	19/24 *79%*	ss		26		0.85 B
1B				26		
2A	19/24 *79%*	ss		16		2.47 B
3A	18/24 *75%*	ss		19		2.18 B
3B				18		2.33 B
4A	24/24 *100%*	ss		23		0.58 B
4B				18		
5A	23/24 *96%*	ss		10		
5B				19		
6A	19/24 *79%*	ss		19		
6B				11		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Black (10YR2/1), moist, firm, clayey SILT (TOPSOIL)	612
▼ 2	Gray (10YR5/1) with 35% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with sand and trace gravel	610
4	Gray (10YR6/1) with 20% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and trace gravel	608
6	Yellowish brown (10YR5/8), moist, soft, sandy CLAY with slight trace gravel	
	Yellowish brown (10YR5/8), very moist to wet, very soft, clayey, very fine- to medium-grained SAND with trace gravel	606
8	Yellowish brown (10YR5/4) with 30% yellowish brown (10YR5/8) mottles, moist, hard, clayey SILT with sand and trace gravel	604
10	Yellowish brown (10YR5/6), wet, loose, very fine- to medium-grained SAND with coarse-grained sand and slight trace gravel	602
12	Dark yellowish brown (10YR4/6) with 40% yellowish brown (10YR5/8) mottles, moist, very hard, very silty CLAY with sand and gravel	

End of Boring = 12.0 ft. BGS

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

Formerly MW21S

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Energy Center
Location: Coffeen, Illinois
Project: 15E0030
DATES: Start: 5/1/2007
Finish: 5/1/2007
WEATHER: Partly sunny, warm

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 4¼" Hollow stem auger with split spoon sampler
FIELD STAFF: Driller: A. Rachford
Helper: M. Brown
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB21
Well ID: G405
Surface Elev: 620.90 ft. MSL
Completion: 14.21 ft. BGS
Station: 873,996.79N
2,515,335.70E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 1.28 - 05/10/2007
▼ =
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type
1A	19/24 *79%*	ss		43		0.78 B
1B				26		1.94 B
2A	12/12 *100%*	ss		27		2.52 BSh
3A	24/24 *100%*	ss		24		3.92 BSh
3B				24		2.33 BSh
4A	24/24 *100%*	ss		20		2.33 BSh
5A	24/24 *100%*	ss		24		1.55 BSh
6A	24/24 *100%*	ss		19		
6B				18		
7A	24/24 *100%*	ss		9		7.42 BSh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
▼	Black (10YR2/1), moist, soft, clayey SILT (TOPSOIL)	620
2	Gray (10YR6/1) with 30% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY	618
4	Gray (10YR6/1), moist, firm, silty CLAY slight trace sand	616
6	Gray (10YR5/1), very moist, soft, clayey, very fine- to fine-grained SAND	
	Gray (10YR6/1) with 25% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and trace gravel	614
8	Yellowish brown (10YR5/8) with 40% gray (10YR6/1) mottles, moist, firm, silty CLAY with sand and trace gravel	612
10	Yellowish brown (10YR5/4), wet, loose, very fine- to fine-grained SAND	610
	Dark brown (10YR3/3), very moist, soft, clayey, fine- to very coarse-grained SAND with slight trace gravel	
12	Yellowish brown (10YR5/4), wet, loose, very fine- to fine-grained SAND	
	Dark yellowish brown (10YR4/4), moist, soft, sandy SILT with trace gravel	608
	Yellowish brown (10YR5/4), wet, loose, very fine- to fine-grained SAND	
14	Gray (10YR5/1), moist, very hard, very silty CLAY with sand and gravel	

End of Boring = 14.2 ft. BGS

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/19/2016
Finish: 8/19/2016
WEATHER: Sunny, (mid-70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

BOREHOLE ID: G406
Well ID: G406
Surface Elev: 621.86 ft. MSL
Completion: 18.75 ft. BGS
Station: 872,521.34N
2,514,702.38E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks

Dark brown (10YR3/3), moist, stiff, SILT with few clay and trace organics.

Brown (10YR5/3) with 10% dark brown (10YR3/3) mottles, SILT with some clay and trace small gravel.

Brown (10YR5/3) with 10% dark brown (10YR3/3) mottles, SILT with some clay.

Grayish brown (10YR5/2) with 5% dark yellowish brown (10YR4/6) mottles, moist, stiff, CLAY with few silt and little fine-grained sand.

Very pale brown (10YR7/4) with 25% yellowish brown (10YR5/6) mottles, moist, medium, CLAY with trace silt.

Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with little silt and trace fine- to medium-grained sand.

Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with little silt, little fine- to medium-grained sand and trace small gravel.

Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with few fine- to medium-grained sand, little silt, and trace small gravel.

Gray (10YR6/1) with 25% brownish yellow (10YR6/8) and 5% strong brown (7.5YR4/6) mottles, moist, stiff, CLAY with few fine- to medium-grained sand, little silt, and trace small gravel.

Gray (10YR6/1) with 10% brownish yellow (10YR6/8) and 5% strong brown (7.5YR4/6) mottles, moist, stiff, CLAY with some fine- to medium-grained sand, little silt, and trace small gravel.

Gray (10YR6/1) with 5% brownish yellow (10YR6/6) mottles, wet, loose, fine-grained SAND with some clay.

Gray (10YR6/1) with 5% brownish yellow (10YR6/6) mottles, moist, loose, fine-grained SAND with some clay.

Gray (10YR5/1), dry, hard, SILT with few clay, few fine- to coarse-grained sand and trace small gravel.

Depth (ft. BGS): 2, 4, 6, 8, 10, 12, 14, 16, 18

Elevation (ft. MSL): 620, 618, 616, 614, 612, 610, 608, 606, 604

End of Boring = 18.75 ft. BGS

NOTE(S): G406 installed in boring.
Boring was blind drilled adjacent to G406D.

FIELD BORING LOG

HANSON

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/19/2016
Finish: 8/19/2016
WEATHER: Sunny, (mid-70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

BOREHOLE ID: G406D
Well ID: G46D
Surface Elev: 621.91 ft. MSL
Completion: 52.00 ft. BGS
Station: 872,519.70N
2,514,697.78E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	18/24 75%	ss	4-3 4-6 N=7	11		1.50
1B				15		3.00
2A	12/24 50%	ss	4-6 3-3 N=9	12		2.50
2B				18		2.00
3A	3/24 13%	ss	3-3 4-7 N=7	24		
4A	20/24 83%	ss	2-3 4-5 N=7	21		1.25
5A	19/24 79%	ss	1-3 4-6 N=7	18		1.75
6A	23/24 96%	ss	2-2 4-5 N=6	18		2.50
7A	21/24 88%	ss	1-3 4-5 N=7	16		1.00
8A	23/24 96%	ss	1-2 2-2 N=4	18		0.75
8B				17		0.75
9A	22/24 92%	ss	4-13 27-23 N=40	8		
9B				8		
10A	17/24 71%	ss	13-31 33-42 N=64	7		4.50

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark brown (10YR3/3), moist, stiff, SILT with few clay and trace organics.	
2	Brown (10YR5/3) with 10% dark brown (10YR3/3) mottles, SILT with some clay and trace small gravel.	620
	Brown (10YR5/3) with 10% dark brown (10YR3/3) mottles, SILT with some clay.	
4	Grayish brown (10YR5/2) with 5% dark yellowish brown (10YR4/6) mottles, moist, stiff, CLAY with few silt and little fine-grained sand.	618
	Very pale brown (10YR7/4) with 25% yellowish brown (10YR5/6) mottles, moist, medium, CLAY with trace silt.	
6	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with little silt and trace fine- to medium-grained sand.	616
8	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with little silt, little fine- to medium-grained sand and trace small gravel.	614
10	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with few fine- to medium-grained sand, little silt, and trace small gravel.	612
12	Gray (10YR6/1) with 25% brownish yellow (10YR6/8) and 5% strong brown (7.5YR4/6) mottles, moist, stiff, CLAY with few fine- to medium-grained sand, little silt, and trace small gravel.	610
14	Gray (10YR6/1) with 10% brownish yellow (10YR6/8) and 5% strong brown (7.5YR4/6) mottles, moist, stiff, CLAY with some fine- to medium-grained sand, little silt, and trace small gravel.	608
16	Gray (10YR6/1) with 5% brownish yellow (10YR6/6) mottles, wet, loose, fine-grained SAND with some clay.	606
	Gray (10YR6/1) with 5% brownish yellow (10YR6/6) mottles, moist, loose, fine-grained SAND with some clay.	
18	Gray (10YR5/1), dry, hard, SILT with few clay, few fine- to coarse-grained sand and trace small gravel.	604
20		602

Borehole Detail

NOTE(S): G46D installed in boring.

FIELD BORING LOG

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/19/2016
Finish: 8/19/2016
WEATHER: Sunny, (mid-70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

HANSON

BOREHOLE ID: G406D
Well ID: G46D
Surface Elev: 621.91 ft. MSL
Completion: 52.00 ft. BGS
Station: 872,519.70N
2,514,697.78E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11-1	3/3 100%	SH				
	8/24 33%	DS				
12-1						
13-1						
13-2	24/24 100%	DS				
13-3						
13-4						
14A				19		
14B	21/21 100%	SS	7-30 32-20 N=62	7		
14C				8		4.50
15A	12/24 50%	SS	15-16 10-11 N=26	10		4.50
16A	17/24 71%	SS	2-5 7-11 N=12	16		3.00
17A	17/24 71%	SS	2-5 7-12 N=12	15		2.50
18A	12/24 50%	SS	3-7 12-20 N=19	17		2.50
19A	23/24 96%	SS	4-4 6-9 N=10	25		1.00
20A	22/24 92%	SS	2-2 5-7 N=7	17		1.00
21A	24/24 100%	SS	2-3 4-6 N=7	17		1.00

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
22	Gray (10YR5/1), dry, hard, SILT with few clay, few fine- to coarse-grained sand and trace small gravel. *[Continued from previous page]*	600	
24	Pale brown (10YR6/3), wet, loose, fine-grained SAND.	598	
	Pale brown (10YR6/3), wet, loose, fine-grained SAND and small GRAVEL.		
	Gray (10YR5/1), dry, hard, SILT with some clay, trace fine- to coarse-grained sand and trace small gravel.		
26	Dark gray (10YR4/1), dry, hard, CLAY with some silt, trace fine- to coarse-grained sand and trace small gravel.	596	
28		594	
30	Dark gray (10YR4/1), moist, very stiff, CLAY with few silt, trace fine- to coarse-grained sand and trace small gravel.	592	
32	Dark gray (10YR4/1), moist, very stiff, CLAY with few silt, trace fine- to coarse-grained sand and trace small to large gravel.	590	
	Dark gray (10YR4/1), moist, very stiff, CLAY with few silt, trace fine- to coarse-grained sand and trace small gravel.		
34	Dark gray (10YR4/1) with 5% very dark gray (10YR3/1) and brown (10YR5/3) mottles, moist, very stiff, CLAY with few silt, trace fine- to coarse-grained sand and trace small gravel.	588	
36	Gray (10YR5/1) with 5% very dark gray (10YR3/1) and brown (10YR5/3) mottles, moist, very stiff, CLAY with few silt, trace fine- to coarse-grained sand and trace small gravel.	586	
38	Dark gray (10YR4/1), moist, very stiff, CLAY with few silt, trace fine- to coarse-grained sand and trace small gravel.	584	
40		582	

NOTE(S): G46D installed in boring.

FIELD BORING LOG

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/19/2016
Finish: 8/19/2016
WEATHER: Sunny, (mid-70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

HANSON

BOREHOLE ID: G406D
Well ID: G46D
Surface Elev: 621.91 ft. MSL
Completion: 52.00 ft. BGS
Station: 872,519.70N
2,514,697.78E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
22A	24/24 100%	SS	1-3 5-6 N=8	17		1.50
23-1						
23-2	24/24 100%	SH				
23-3				16		
23-4						
24A	24/24 100%	SS	3-4 6-7 N=10	17		1.50
25A	24/24 100%	SS	2-2 5-7 N=7	18		1.25
26A	24/24 100%	SS	2-5 6-8 N=11	17		1.75
27A	23/24 96%	SS	2-3 9-12 N=12	15		3.50

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
42	Dark gray (10YR4/1), moist, very stiff, CLAY with few silt, trace fine- to coarse-grained sand and trace small gravel. *[Continued from previous page]*	580	
44		578	
46		576	
48		574	
50		572	
52		570	

Borehole Detail

End of Boring = 52.0 ft. BGS

NOTE(S): G46D installed in boring.

Geosyntec consultants engineers | scientists | innovators	**Client:** Dynegy **Project:** GLP8005, Coffeen Power Station **Address:** Coffeen, IL 62017	**WELL LOG** **Well No.** G1001 **Page:** 1 of 2

Drilling Start Date:	**04/05/2021**	Boring Depth (ft):	**32**	Well Depth (ft):	**12**
Drilling End Date:	**04/05/2021**	Boring Diameter (in):	**6**	Well Diameter (in):	**1**
Drilling Company:	**Roberts Drilling**	DTW During Drilling (ft):		Screen Slot (in):	**0.010**
Drilling Method:	**Direct Push**	DTW After Drilling (ft):		Riser Material:	**Sch 40 PVC**
Drilling Equipment:	**Geoprobe**	Top of Casing Elev. (ft)		Screen Material:	**Sch 40 PVC Slotted**
Driller:		Ground Elev. (ft):		Seal Material(s):	**Bentonite Chips**
Logged By:	**A. Toye**	Northing, Easting (NAD83):		Filter Pack:	**Sand**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	WELL COMPLETION	COLLECT: Sample Type	COLLECT: Recovery (in)	COLLECT: Blow Counts	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	MEASURE: Lab Sample	DEPTH (ft)
0				DP	24/48			(0') SILT (ML); very dark grayish brown (2.5Y 3/2), medium soft, moist, trace gravel 2-2.5' bgs.		0
				DP	48/48			(4') CLAY (CL); with trace sand, yellowish brown (10YR 5/6), stiff, moist, trace gravel.		
5										5
									Chem (6-11')	
				DP	48/48			(8') As above: medium stiff, brown (10YR 4/3) with yellowish brown (10YR 5/6) mottling.		
10										10
				DP	48/48			(12') CLAY (CL); dark gray (10YR 4/1), medium stiff, moist.		
15										15
				DP	48/48			(16') As above: dark gray (2.5Y 4/1).		
20										20

NOTES: No groundwater encountered.

Geosyntec consultants engineers | scientists | innovators	**Client:** Dynegy **Project:** GLP8005, Coffeen Power Station **Address:** Coffeen, IL 62017	**WELL LOG** **Well No.** G1001 **Page:** 2 of 2

Drilling Start Date:	**04/05/2021**	Boring Depth (ft):	**32**	Well Depth (ft):	**12**
Drilling End Date:	**04/05/2021**	Boring Diameter (in):	**6**	Well Diameter (in):	**1**
Drilling Company:	**Roberts Drilling**	DTW During Drilling (ft):		Screen Slot (in):	**0.010**
Drilling Method:	**Direct Push**	DTW After Drilling (ft):		Riser Material:	**Sch 40 PVC**
Drilling Equipment:	**Geoprobe**	Top of Casing Elev. (ft)		Screen Material:	**Sch 40 PVC Slotted**
Driller:		Ground Elev. (ft):		Seal Material(s):	**Bentonite Chips**
Logged By:	**A. Toye**	Northing, Easting (NAD83):		Filter Pack:	**Sand**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	WELL COMPLETION	COLLECT: Sample Type	COLLECT: Recovery (in)	COLLECT: Blow Counts	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	MEASURE: Lab Sample	DEPTH (ft)
20				DP	48/48			(20') As above: gravel at 1 ft.		20
				DP	48/48			(24') As above: dry pocket at 2.8 ft.		
25										25
				DP	18/48			(28') As above: trace gravel and silt at 2 ft.		
30										30
								(32') End of Boring.		
35										35

NOTES: No groundwater encountered.

WELL CONSTRUCTION FORMS

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G401

Site Name: Natural Resource Technology, Inc. Coffeen Energy Center Borehole #: G401

State Plane Coordinate: X 872,510.6 Y 2,515,614.8 (or) Latitude: _____ Longitude: _____

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Ramsey Geotechnical Engineering, LLC Driller: D. Crump

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 9/14/2015 Date Finished: 9/14/2015

Report Form Completed By: Suzanna L. Keim Date: 10/7/2015

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite Chips

Installation Method: Gravity

Setting Time: >24 hours

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 minutes

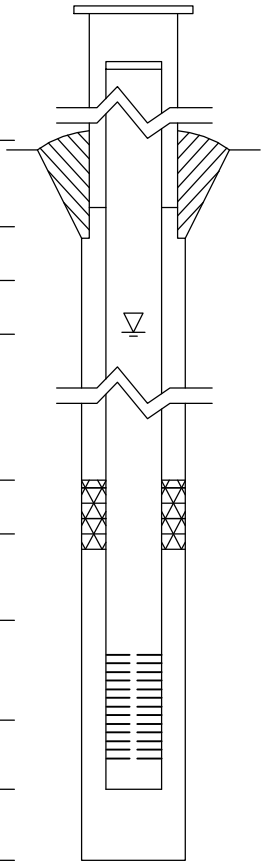
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.84	-2.81	Top of Protective Casing
625.57	-2.54	Top of Riser Pipe
623.03	0.00	Ground Surface
621.33	1.70	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
610.12	12.91	Top of Sand Pack
608.67	14.36	Top of Screen
604.24	18.79	Bottom of Screen
603.74	19.29	Bottom of Well
603.73	19.30	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	16.70
Bottom of Screen to End Cap	(feet)	0.50
Screen Length (1st slot to last slot)	(feet)	4.63
Total Length of Casing	(feet)	21.83
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Surface Elevation: 610.56

Datum msl

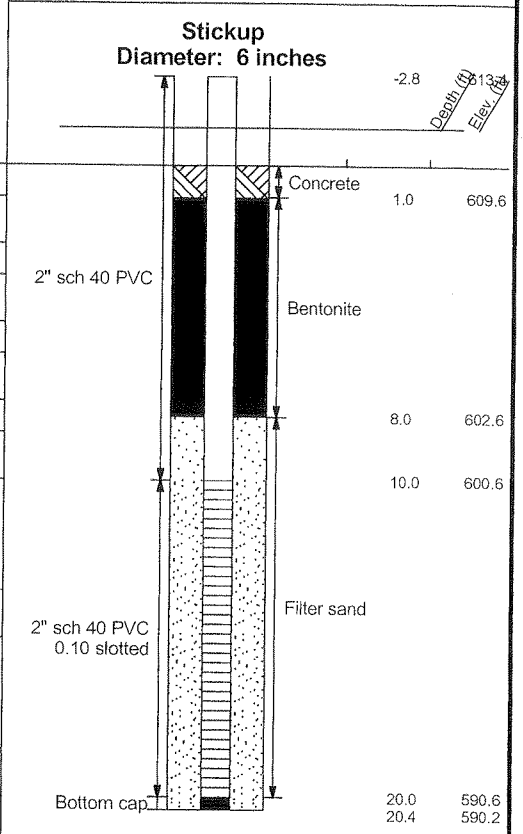
Completion Date: 8/27/10

Northing: 872502.26

Easting: 2516632.59

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium stiff, brown, silty CLAY - CL	6-3-3	SS1
		1-2-4	SS2
5	Medium stiff, gray, silty CLAY, trace sand - CL	1-2-5	SS3
	Hard to stiff, brown to gray, silty CLAY, trace sand seams - CL (TILL)	9-22-28	SS4
10			
15		1-6-12	SS5
20		3-4-9	SS6
	Boring terminated at 20 feet.		
25			
30			
35			

WELL DIAGRAM



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01- COFFEEN.GPJ GTINC 0638301.GPJ 12/13/10

GROUNDWATER DATA

ENCOUNTERED AT 7 FEET ∇

DRILLING DATA

___ AUGER 4 1/4" HOLLOW STEM

WASHBORING FROM ___ FEET

MVU DRILLER SWG LOGGER

CME 55TRK DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: DJK	App'vd. by: KBB
Date: 9/10/10	Date: 1-4-11	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Ameren-Coffeen Ash Pond Evaluation

Renamed G402

LOG OF BORING: APW-2

Project No. J017150.01

Illinois Environmental Protection Agency

Well Completion Report

Formerly MW22S

Site #: _____ County: Montgomery Well #: G404

Site Name: Coffeen Energy Center Borehole #: SB22

State Plane Coordinate: X 2,516,397.9 Y 873,999.8 (or) Latitude: _____ Longitude: _____

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: A. Rachford

Consulting Firm: Hanson Professional Services Inc. Geologist: , LPG #

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 5/1/2007 Date Finished: 5/1/2007

Report Form Completed By: Rhonald W. Hasenyager Date: 5/2/2007

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: gravity

Setting Time: >12 hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: _____

Setting Time: _____

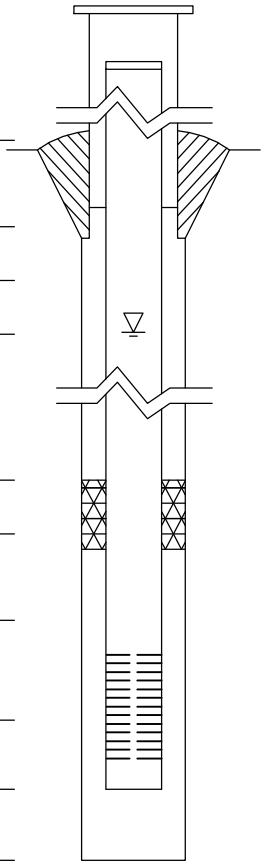
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: Formation sand (if applicable)

Installation Method: slough



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
616.02	-2.92	Top of Protective Casing
615.77	-2.67	Top of Riser Pipe
613.10	0.00	Ground Surface
613.10	0.00	Top of Annular Sealant
611.03	2.07	Static Water Level (After Completion) 5/10/2007
n/a	n/a	Top of Seal
608.05	5.05	Top of Sand Pack
606.68	6.42	Top of Screen
601.93	11.17	Bottom of Screen
601.48	11.62	Bottom of Well
601.10	12.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	9.09
Bottom of Screen to End Cap	(feet)	0.45
Screen Length (1st slot to last slot)	(feet)	4.75
Total Length of Casing	(feet)	14.29
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency

Well Completion Report

Formerly MW21S

Site #: _____ County: Montgomery Well #: G405

Site Name: Coffeen Energy Center Borehole #: SB21

State Plane Coordinate: X 2,515,335.7 Y 873,996.8 (or) Latitude: _____ _____ _____ Longitude: _____ _____ _____

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: A. Rachford

Consulting Firm: Hanson Professional Services Inc. Geologist: , LPG #

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 5/1/2007 Date Finished: 5/1/2007

Report Form Completed By: Rhonald W. Hasenyager Date: 5/2/2007

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: gravity

Setting Time: >12 hours

Type of Bentonite Seal -- Granular Pellet Slurry
(choose one)

Installation Method: _____

Setting Time: _____

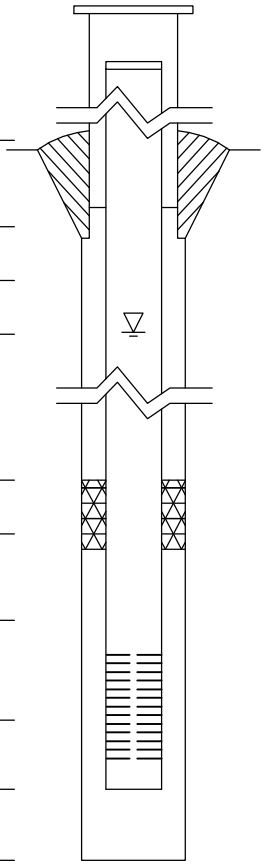
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: _____
(if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
624.04	-3.14	Top of Protective Casing
623.78	-2.88	Top of Riser Pipe
620.90	0.00	Ground Surface
620.90	0.00	Top of Annular Sealant
619.67	1.23	Static Water Level (After Completion) 5/10/2007
n/a	n/a	Top of Seal
613.19	7.71	Top of Sand Pack
611.89	9.01	Top of Screen
607.14	13.76	Bottom of Screen
606.69	14.21	Bottom of Well
606.69	14.21	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	11.89
Bottom of Screen to End Cap	(feet)	0.45
Screen Length (1st slot to last slot)	(feet)	4.75
Total Length of Casing	(feet)	17.09
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G406

Site Name: Coffeen Power Station - Ash Pond 2 Borehole #: G406

State Plane Coordinate: X 2,514,702.4 Y 872,521.3 (or) Latitude: 39° 3' 37.114" Longitude: -89° 23' 54.628"

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Bulldog Drilling, Inc. Driller: J. Dittmaier

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Kristen L. Theesfeld Date Started: 8/19/2016 Date Finished: 8/19/2016

Report Form Completed By: Suzanna L. Keim Date: 8/24/2016

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 30 minutes

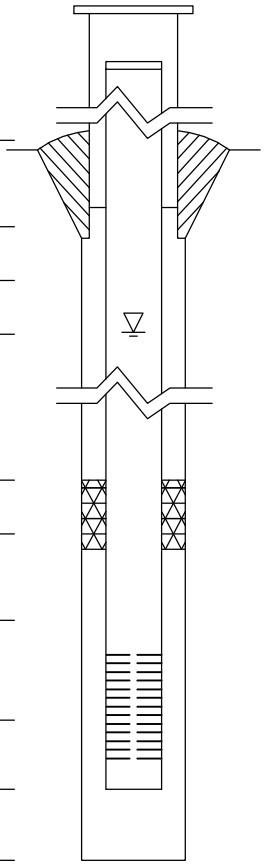
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.70	-3.84	Top of Protective Casing
625.36	-3.50	Top of Riser Pipe
621.86	0.00	Ground Surface
619.86	2.00	Top of Annular Sealant
		Static Water Level (After Completion)
610.74	11.12	Top of Seal
609.65	12.21	Top of Sand Pack
608.30	13.56	Top of Screen
603.49	18.37	Bottom of Screen
603.11	18.75	Bottom of Well
603.11	18.75	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.06
Bottom of Screen to End Cap	(feet)	0.38
Screen Length (1st slot to last slot)	(feet)	4.81
Total Length of Casing	(feet)	22.25
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Geosyntec consultants engineers | scientists | innovators	**Client:** Dynegy **Project:** GLP8005, Coffeen Power Station **Address:** Coffeen, IL 62017	**WELL LOG** **Well No.** G1001 **Page:** 1 of 2

Drilling Start Date:	**04/05/2021**	Boring Depth (ft):	**32**	Well Depth (ft):	**12**
Drilling End Date:	**04/05/2021**	Boring Diameter (in):	**6**	Well Diameter (in):	**1**
Drilling Company:	**Roberts Drilling**	DTW During Drilling (ft):		Screen Slot (in):	**0.010**
Drilling Method:	**Direct Push**	DTW After Drilling (ft):		Riser Material:	**Sch 40 PVC**
Drilling Equipment:	**Geoprobe**	Top of Casing Elev. (ft)		Screen Material:	**Sch 40 PVC Slotted**
Driller:		Ground Elev. (ft):		Seal Material(s):	**Bentonite Chips**
Logged By:	**A. Toye**	Northing, Easting (NAD83):		Filter Pack:	**Sand**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	WELL COMPLETION	COLLECT: Sample Type	COLLECT: Recovery (in)	COLLECT: Blow Counts	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	MEASURE: Lab Sample	DEPTH (ft)
0				DP	24/48			(0') SILT (ML); very dark grayish brown (2.5Y 3/2), medium soft, moist, trace gravel 2-2.5' bgs.		0
				DP	48/48			(4') CLAY (CL); with trace sand, yellowish brown (10YR 5/6), stiff, moist, trace gravel.		
5										5
									Chem (6-11')	
				DP	48/48			(8') As above: medium stiff, brown (10YR 4/3) with yellowish brown (10YR 5/6) mottling.		
10										10
				DP	48/48			(12') CLAY (CL); dark gray (10YR 4/1), medium stiff, moist.		
15										15
				DP	48/48			(16') As above: dark gray (2.5Y 4/1).		
20										20

NOTES: No groundwater encountered.

Geosyntec consultants engineers | scientists | innovators	**Client:** Dynegy **Project:** GLP8005, Coffeen Power Station **Address:** Coffeen, IL 62017	**WELL LOG** **Well No.** G1001 **Page:** 2 of 2

Drilling Start Date:	**04/05/2021**	Boring Depth (ft):	**32**	Well Depth (ft):	**12**
Drilling End Date:	**04/05/2021**	Boring Diameter (in):	**6**	Well Diameter (in):	**1**
Drilling Company:	**Roberts Drilling**	DTW During Drilling (ft):		Screen Slot (in):	**0.010**
Drilling Method:	**Direct Push**	DTW After Drilling (ft):		Riser Material:	**Sch 40 PVC**
Drilling Equipment:	**Geoprobe**	Top of Casing Elev. (ft)		Screen Material:	**Sch 40 PVC Slotted**
Driller:		Ground Elev. (ft):		Seal Material(s):	**Bentonite Chips**
Logged By:	**A. Toye**	Northing, Easting (NAD83):		Filter Pack:	**Sand**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	WELL COMPLETION	COLLECT: Sample Type	COLLECT: Recovery (in)	COLLECT: Blow Counts	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	MEASURE: Lab Sample	DEPTH (ft)
20				DP	48/48			(20') As above: gravel at 1 ft.		20
				DP	48/48			(24') As above: dry pocket at 2.8 ft.		
25										25
				DP	18/48			(28') As above: trace gravel and silt at 2 ft.		
30										30
								(32') End of Boring.		
35										35

NOTES: No groundwater encountered.

APPENDIX B
35 I.A.C. 845 Multi-Site Statistical Analysis Plan

Date
April 1, 2025

Project No.
1940110241

35 I.A.C § 845 MULTI-SITE STATISTICAL ANALYSIS PLAN

RAMBOLL Bright ideas. Sustainable change.

35 I.A.C § 845 MULTI-SITE STATISTICAL ANALYSIS PLAN

Project no.	**1940110241**
Recipient	**Vistra Corp**
Document type	**Statistical Analysis Plan**
Revision	**FINAL**
Date	**April 1, 2025**
Prepared by	**Rachel Banoff and Alison O'Connor**
Checked by	**Eric J. Tlachac, PE**
Approved by	**Brian G. Hennings, PG**

Ramboll
234 W. Florida Street
Fifth Floor
Milwaukee, WI 53204
USA

T 414-837-3607
F 414-837-3608
https://ramboll.com

Rachel A. Banoff
Environmental Engineer

Alison O'Connor
Senior Lead Consultant

Eric J. Tlachac, PE
Senior Managing Engineer

Brian G. Hennings, PG
Senior Managing Hydrogeologist

LICENSED PROFESSIONAL CERTIFICATIONS

This certification is based on the description of the statistical methods selected to evaluate groundwater as presented in the following 35 I.A.C. § 845 Multi-Site Statistical Analysis Plan. The procedures described in the plan will be used to establish background conditions and implement compliance and corrective action monitoring as necessary and required by 35 I.A.C. § 845.640, § 845.650, and § 845.680. The 35 I.A.C. § 845 Multi-Site Statistical Analysis Plan was prepared in accordance with the requirements of 35 I.A.C. § 845.640(f), with reference to the acceptable statistical procedures provided in the United States Environmental Protection Agency (USEPA)'s *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (*Unified Guidance,* USEPA 2009), and is intended to provide a logical process and framework for conducting the statistical analysis of the data obtained during groundwater monitoring. In accordance with 35 I.A.C. § 845.640(f)(1), the statistical method chosen for analysis of background groundwater quality is the tolerance interval procedure for each constituent listed in 35 I.A.C. § 845.600(a)(1) at this CCR unit per 35 I.A.C. § 845.640(f)(1)(C). Groundwater Protection Standards (GWPS) will be established in accordance with 35 I.A.C. § 845.600(a) (greater of the background concentration or numerical limit specified in 35 I.A.C. § 845.600(a)(1)). The GWPS will be compared to the appropriate confidence interval for the observed concentrations for each constituent in each compliance well. Consistent with the *Unified Guidance*, the same general statistical method of confidence interval testing against a fixed GWPS is recommended in compliance and corrective action programs. Confidence intervals provide a flexible and statistically accurate method to test how a parameter estimated from a single sample compares to a fixed numerical limit. Confidence intervals explicitly account for variation and uncertainty in the sample data used to construct them.

Description of the statistical methods chosen for analysis of groundwater monitoring data and application of these methods for determining exceedances of the GWPS identified in 35 I.A.C. § 845.600(a) is provided in this 35 I.A.C. § 845 Multi-Site Statistical Analysis Plan.

35 I.A.C. § 845.640 Statistical Analysis (PE)

I, Eric J. Tlachac, a qualified professional engineer in good standing in the State of Illinois, certify that the statistical methods summarized above and described in this document (35 I.A.C. § 845 Multi-Site Statistical Analysis Plan) are appropriate for evaluating the groundwater monitoring data collected as described in the attached document and are in substantial compliance with 35 I.A.C. § 845.640.

Eric J. Tlachac
Qualified Professional Engineer
062-063091
Illinois
Date: April 1, 2025

35 I.A.C. § 845.640 Statistical Analysis (PG)

I, Brian G. Hennings, a qualified professional geologist in good standing in the State of Illinois, certify that the statistical methods described in this document (35 I.A.C. § 845 Multi-Site Statistical Analysis Plan) are appropriate for evaluating the groundwater monitoring data collected as described in the attached document and are in substantial compliance with 35 I.A.C. § 845.640.

Brian G. Hennings
Professional Geologist
196.001482
Illinois
Date: April 1, 2025

35 I.A.C. § 845.640 Statistical Analysis

I, Rachel A. Banoff, a qualified professional, certify that the statistical methods described in this document (35 I.A.C. § 845 Multi-Site Statistical Analysis Plan), are appropriate for evaluating the groundwater monitoring data collected as described in the attached document and are in substantial compliance with 35 I.A.C. § 845.640.

Rachel A. Banoff, EIT
Project Statistician
Date: April 1, 2025

DOCUMENT REVISION RECORD

Issue No.	Date	Details of Revisions
Revision 0	April 1, 2025	• Original Document

DOCUMENT APPLICABILITY BY FACILITY OWNER

Table A. Document Applicability by Facility Owner

Facility & Owner	Unit ID	Unit Name
Baldwin Power Plant Dynegy Midwest Generation, LLC	601	Bottom Ash Pond
	605	Fly Ash Pond System
Coffeen Power Plant Illinois Power Generating Company	101	Ash Pond No. 1
	102	Ash Pond No. 2
	103	GMF Gypsum Stack Pond
	104	GMF Recycle Pond
Duck Creek Power Plant Illinois Power Resources Generating, LLC	201/202	Ash Pond No. 1 Ash Pond No. 2
	203	GMF Pond
	205	Bottom Ash Basin
Edwards Power Plant Illinois Power Resources Generating, LLC	301	Ash Pond
Hennepin Power Plant Dynegy Midwest Generation, LLC	802	Ash Pond No. 2
	803	East Ash Pond
	804	Old West Ash Pond
	802/805	Ash Pond No. 2 Ash Pond No. 4
Joppa Power Plant Electric Energy, Inc.	401	East Ash Pond
	403	West Ash Pond
Kincaid Power Plant Kincaid Generation, LLC	141	Ash Pond
Newton Power Plant Illinois Power Generating Company	501	Primary Ash Pond
Vermilion Power Plant Dynegy Midwest Generation, LLC	910	North Ash Pond
	911/912	Old East Ash Pond New East Ash Pond

CONTENTS

Licensed Professional Certifications		**1**
1.	**Introduction**	**7**
1.1	Statistical Analysis Objectives	7
1.2	Statistical Analysis Plan Approach	7
2.	**Groundwater Data Evaluation And Statistical Assumptions**	**9**
2.1	Sample Independence	9
2.2	Non-Detect Data Processing	9
2.3	Testing for Normality	9
2.4	Outlier Evaluation and Management	10
2.5	Trend Analysis	10
2.6	Spatial Variation	11
2.7	Temporal Variation	11
2.8	Updating Background	11
3.	**Compliance Monitoring Program**	**12**
3.1	Monitoring Program Outline	12
3.1.1	Establish Background and GWPS	12
3.1.2	Evaluate Background and GWPS Exceedances	12
3.2	Upper Tolerance Limit	13
3.3	Confidence Intervals	15
3.3.1	Confidence Intervals Around Trending Data	15
3.3.2	Parametric Confidence Intervals around a Mean	17
3.3.3	Non-Parametric Confidence Intervals around a Median	18
4.	**Corrective Action Monitoring Program**	**19**
4.1	Remedy Progress Evaluation	19
4.1.1	Central Tendency	19
4.1.2	Trend of Average Concentration in Individual Wells and in a Plume	20
4.2	Stability Evaluation	20
4.3	Attainment Evaluation	20
5.	**References**	**22**

FIGURES (IN TEXT)

Figure 1 Flow chart illustrating the statistical methods used for calculating background under Compliance Monitoring

Figure 2 Flow chart illustrating the statistical methods used for calculating confidence intervals in Compliance Monitoring

ACRONYMS AND ABBREVIATIONS

%	percent
35 I.A.C.	Title 35 of the Illinois Administrative Code
CCR	coal combustion residuals
CI	confidence interval
DQR	Double Quantification Rule
GMP	Groundwater Monitoring Plan
GWPS	groundwater protection standard
IEPA	Illinois Environmental Protection Agency
LCL	lower confidence limit
LTL	lower tolerance limit
MDL	method detection limit
PQL	practical quantitation limit
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RL	reporting limit
SAP	Sampling and Analysis Plan
SI	surface impoundment
UCL	upper confidence limit
Unified Guidance	Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance (USEPA, 2009)
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit

1. INTRODUCTION

In April 2021, the Illinois Environmental Protection Agency (IEPA) issued a final rule for the regulation and management of coal combustion residuals (CCR) in surface impoundments (SIs) under the Standards for the Disposal of CCR in Surface Impoundments: Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845. Facilities regulated under 35 I.A.C. § 845 are required to develop and sample a groundwater monitoring well system to evaluate whether impounded CCR materials are impacting groundwater quality. The groundwater quality evaluation must include certification from a qualified professional engineer that the selected statistical method is appropriate for evaluating groundwater monitoring data for the CCR surface impoundment. The procedures described in the evaluation will be used to establish background conditions and implement Compliance and Corrective Action Monitoring as necessary and required by 35 I.A.C. § 845.640, § 845.650, § 845.680, and § 845.780. This Statistical Analysis Plan was prepared in accordance with the requirements of 35 I.A.C. § 845.640(f), with reference to the acceptable statistical procedures provided in United States Environmental Protection Agency's (USEPA's) Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance (Unified Guidance) (USEPA, 2009).[1]

1.1 Statistical Analysis Objectives

This Multi-Site Statistical Analysis Plan provides a framework for conducting the statistical analyses of groundwater data collected during operation, post-closure care, and corrective action monitoring (if required). This Multi-Site Statistical Analysis Plan does not include procedures for groundwater sample collection and analysis conducted in accordance with the Multi-Site Sampling and Analysis Plan (SAP; Ramboll, 2022) or data quality evaluation conducted in accordance with the Multi-Site Quality Assurance Project Plan (QAPP; Ramboll, 2022).[2]

1.2 Statistical Analysis Plan Approach

The analyses described in this document are intended to support monitoring programs described in detail in the CCR unit-specific Operating Permit Groundwater Monitoring Plans (GMPs), Closure Construction Permit GMPs, and Corrective Action GMPs. When necessary and contingent upon equivalent statistical power, an alternative test consistent with the performance standards in 35 I.A.C. § 845.640(g), not included in this Statistical Analysis Plan, may be chosen due to site-specific data requirements.

35 I.A.C. § 845 outlines three phases of groundwater monitoring:

- Baseline Monitoring in accordance with 35 I.A.C. § 845.650(b)(1)
- Compliance Monitoring in accordance with 35 I.A.C. § 845.650 and 35 I.A.C. § 845.780(b)
- Corrective Action Monitoring in accordance with 35 I.A.C. § 845.680(a)

Each phase of the groundwater monitoring program requires specific statistical procedures to accomplish the intended purpose. During the first phase, background groundwater quality will be established, utilizing upgradient and background wells. Compliance Monitoring, which

[1] Despite being currently archived on USEPA's website, the Unified Guidance remains a valid reference for developing a statistical analysis plan (personal communication with Alison O'Connor, February 11, 2025).

[2] The Multi-Site Sampling and Analysis Plan and Multi-Site Quality Assurance Project plan are living documents which are subject to routine evaluation and updates in accordance with USEPA recommended best practices (USEPA 2020; USEPA 2023).

encompasses data collection and statistical evaluation conducted during unit operation and the post-closure care period, will then evaluate whether exceedances occur for 20 required constituents (per 35 I.A.C. § 845.600(a)(1)) relative to the groundwater protection standard (GWPS) established by 35 I.A.C. § 845.600. Corrective Action Monitoring evaluates remedy progress and completion and will be initiated upon implementation of the Corrective Action GMP.

2. GROUNDWATER DATA EVALUATION AND STATISTICAL ASSUMPTIONS

The following subsections outline the statistical tests and procedures utilized to evaluate data collected for consistency with statistical assumptions and evaluate data distribution. These methods may be used in any phase of groundwater monitoring.

2.1 Sample Independence

Independence of sample results is a major assumption for most statistical analyses. To ensure physical independence of groundwater sampling results, the minimum time between sampling events must be longer than the time required for groundwater to move through the monitoring well. Therefore, the minimum time interval between sampling events is a function of the groundwater velocity and well bore volume (diameter of the well and surrounding filter pack). The sampling schedules for Baseline Monitoring, Compliance Monitoring, and Corrective Action Monitoring are specified in 35 I.A.C. § 845 and may conflict with the statistical assumption of independence of sample results.

2.2 Non-Detect Data Processing

Groundwater sample analysis results below the reporting limit (RL), also referred to as the practical quantitation limit (PQL), will not be used in statistical calculations due to the inherent uncertainty in results that are estimated between the method detection limit (MDL) and RL/PQL, and error assumptions inherent to the statistical calculations. Results below the RL/PQL will be considered non-detect data. For statistical characterization evaluations (*e.g.*, distribution testing, and trend analysis), non-detects were replaced with the half of the RL for the analysis. For statistical test procedures that involve the calculation of a mean and standard deviation (as described in **Section 3**):

- If the frequency of non-detect data are less than or equal to 15 percent (%), half of the RL will be substituted for these data.
- If the non-detect frequency is greater than 15% and less than or equal to 50% and the data are normally or log-normally distributed (**Section 2.3**), the Kaplan-Meier method will be used to estimate the mean and standard deviation adjusted for the presence of left-censored values.
- If the non-detect frequency is greater than 50% or data are not normally or log-normally distributed (**Section 2.3**), a non-parametric test or calculation will be used.

2.3 Testing for Normality

In accordance with 35 I.A.C. § 845.640(g)(1), "the statistical method used to evaluate groundwater monitoring data must be appropriate for the distribution of constituents". The Unified Guidance document recommends the Shapiro-Wilk normality test for sample sizes of 50 or less, and the Shapiro-Francia normality test for sample sizes greater than 50. Log-transformation of datasets to achieve normal distributions is preferred to using non-parametric methods. However, if data normality cannot be achieved through log transformation, a non-parametric method is used.

2.4 Outlier Evaluation and Management

Groundwater analytical data may be screened for the existence of outliers using methods described by the Unified Guidance. Outliers are extreme data points that may represent an anomaly or erroneous data point. To test for outliers, one or more of the following outlier tests will be utilized:

- Dixon's test, for well-constituent pairs with less than 25 samples, assumes normally distributed data.
- Rosner's test, for well-constituent pairs with more than 20 samples, assumes normally distributed data.
- Grubb's test for well-constituent pairs with seven or more samples, assumes normally distributed data.

In addition, time series, box-whisker plots, and probability plots will be used to provide visual tools to identify potential outliers, and evaluation of seasonal, spatial, or temporal variability for both normally and non-normally distributed data.

When necessary, a confirmatory sample will be collected to allow the facility to distinguish between an outlier and a true release from the facility (35 I.A.C. § 845.650(d)). If re-sampling is necessary, this sample will be collected within 60 days following outlier identification. Rigorous data validation and review is preferred to formal outlier testing and exclusion to ensure that all data used in statistical evaluations is representative of field conditions. Quality control/quality assurance data are collected and data verification is completed in accordance with the QAPP. Project staff familiar with the site and historical data will review the data generated each quarter and facilitate additional validation as needed. Data quality control, groundwater geochemistry, and sampling procedures will be evaluated as potential sources of error leading to an outlier result. Exclusion of potential outliers without an identified source of error may be considered only for data that could cause extremely elevated background concentrations.

2.5 Trend Analysis

Statistical analyses confirming the lack of trend are a fundamental step to confirm the assumption that groundwater quality values (*i.e.,* constituent means) are stationary or constant over time. These analyses allow for evaluation of variation in the background and compliance data for each constituent over time. A statistically significant increasing trend in the background data could indicate an existing release from the CCR unit or alternative source, requiring further investigation. In addition, statistically significant trending background data can result in increased standard deviation and, therefore, greater prediction or tolerance limits. Consequently, the increased prediction or tolerance limit will have less statistical power or ability to identify a release from a CCR unit.

A linear regression, coupled with a t-test for slope significance at a 95% confidence level (or 0.05 significance level), may be used on datasets for each constituent with few non-detects and a normally distributed variance of the mean to evaluate time trends. The Theil-Sen trend line, coupled with the Mann-Kendall test for slope significance at a 95% confidence level (or 0.05 significance level), may be used for datasets with frequent non-detects or non-normal variance. Similarly, trend analyses could also be used on compliance data to evaluate a possible release from the CCR unit.

2.6 Spatial Variation

Spatial trends and/or variation between background wells could indicate an existing release from a CCR unit. If the spatial variability is not due to an existing release, intrawell comparisons in compliance wells may be used to account for spatial variability and monitor for a future release. However, the CCR units being monitored have been placed into service prior to the start of groundwater monitoring and it is unknown whether a previous release has occurred. Accordingly, intrawell comparisons in compliance wells cannot be used to determine the occurrence of a future release, and interwell comparisons between compliance wells and background wells will be used.

2.7 Temporal Variation

Time series plots can be used to identify temporal dependence. Potentially significant temporal components of variability can be identified by graphing single constituent data from multiple wells together on a time series plot. With temporal dependence, the time series plot has a pattern of parallel traces, in which the individual wells will tend to rise and fall together across the sequence of sampling dates. Time series plots can be helpful by plotting multiple constituents over time for the same well, or averaging values for each constituent across wells on each sampling event and then plotting the averages over time. In either case, the plots can signify whether the general concentration pattern over time is simultaneously observed for different constituents. If so, it may indicate that a group of constituents is highly correlated in groundwater or that the same artifacts of sampling and/or lab analysis impacted the results of several monitoring parameters.

2.8 Updating Background

Updating the background dataset periodically by adding recent results to an existing background dataset can improve the statistical power and accuracy of the statistical analysis, especially for non-parametric prediction intervals. The Unified Guidance recommends updating statistical limits (background) when at least four to eight new measurements (every 2 to 4 years under a semiannual monitoring program or 1 to 2 years under a quarterly monitoring program) are available for comparison to historical data. Methods discussed in **Section 2.4** and professional judgement will be used to evaluate whether any individual data points appear to drive an anomalously high background level. A t-test for equal means (if normal data distribution) or a Mann-Whitney or Wilcoxon test for equal medians (if non-normal data distribution) will be conducted to verify that the two groups of background sample populations are statistically different prior to updating any background datasets. A 0.05 significance level will be utilized when evaluating the two populations, with the null hypothesis that the two populations have equal means or medians. In addition, time series graphs or other trend evaluation statistics (such as a Mann-Kendall test) will be conducted on the new background dataset to verify the absence of a release or changing groundwater quality. If the tests indicate that there are no statistical differences between the two background populations, the new data will be combined with the existing dataset. If the two populations are found to be different, the data will be reviewed to evaluate the cause of the difference. If the differences appear to be caused by a release (*i.e.,* if the new data are significantly higher, or lower for pH), then the previous background dataset may continue to be used. Furthermore, verified outliers will not be added to an existing background dataset. Spatial variability among background wells will also be assessed when background datasets are updated to determine whether pooling data is appropriate.

3. COMPLIANCE MONITORING PROGRAM

Compliance Monitoring encompasses data collection and statistical evaluation conducted during unit operation (35 I.A.C. § 845.640 and 845.650) and the post-closure care period (35 I.A.C. § 845.780). Compliance Monitoring is designed to evaluate whether concentrations of constituents listed in 35 I.A.C. § 845.600(a)(1) in compliance wells exceed GWPS or background in a statistically significant manner.

3.1 Monitoring Program Outline

3.1.1 Establish Background and GWPS

A site-specific GWPS will be established for constituents listed in 35 I.A.C. § 845.600(a)(1) for each CCR unit. The GWPS will be the concentration specified in 35 I.A.C. § 845.600(a)(1), unless the background concentration is greater. For this exception, background concentrations will be used to define the GWPS. Background concentrations will be calculated using a parametric or non-parametric upper tolerance limit (UTL), depending on the data distribution, consistent with 35 I.A.C. § 845.640(f)(1)(C). The procedure for calculating a UTL is outlined in **Figure 1** and described in **Section 3.2**. If only one background result is detected, that value will be used as the UTL.

3.1.2 Evaluate Background and GWPS Exceedances

Per 35 I.A.C. § 845.610(b)(3), groundwater monitoring data from compliance monitoring wells will be evaluated for statistically significant exceedances over background and the site-specific GWPS. In accordance with recommendation in the Unified Guidance for compliance monitoring, exceedances are evaluated by comparing a confidence interval (CI) to a fixed standard. The null hypothesis of this comparison is that compliance well groundwater concentrations do not exceed the standard unless the statistical test indicates otherwise.

GWPS exceedances will be determined by comparing the lower confidence limit (LCL) of the compliance well concentrations to the GWPS, except for pH where the LCL will be compared to the upper end of the GWPS range, and the upper confidence limit (UCL) compared to the low end of the GWPS range. A GWPS exceedance is determined if the LCL is greater than the GWPS, and, for pH, either the LCL is greater than the upper end of the GWPS range or the UCL is less than the low end of the GWPS range. The method of calculating the CI (outlined in **Figure 2** and described in **Section 3.3**) will be determined by sample size, trends in the data, and data normality. The significance level (alpha) for this calculation will be fixed at 0.01 (99% confidence) as recommended by Unified Guidance. If there are too few data points to calculate an LCL (a minimum of four data points is typically required), the most recent data point will be compared to the GWPS.

In the event that statistical analyses identify an exceedance of the GWPS for one or more parameters, the exceedance parameters and wells of concern may be immediately re-sampled. Compliance Monitoring statistics will be updated using the verification resample. If the Compliance Monitoring statistics using the compliance verification resample data result in an exceedance of the GWPS, the exceedance is confirmed.

Comparison of groundwater monitoring data to background is required by 35 I.A.C. § 845.610(3)(B), but these background "exceedances" do not carry any compliance implications.

Background exceedances will be determined by comparing the LCL of the compliance well concentrations to the background UTL, with the exception of pH where the UCL of the compliance well concentrations will also be compared to the background lower tolerance limit (LTL). A background exceedance is determined if the LCL is greater than the background UTL, or, for pH, either the LCL is greater than the UTL or the UCL is less than the LTL. If there are too few data points to calculate an LCL (a minimum of four data points is required), the most recent data point will be compared to the background UTL (and LTL for pH).

Additionally, an exceedance of either background or GWPS will be identified if the constituent monitored was not detected in all previous samples at a compliance well and the two most recent samples have both detections and exceed the GPWS (or are less than the low end of the GWPS range for pH) or background UTL (or are less than the LTL for pH).

3.2 Upper Tolerance Limit

The method for calculating a UTL depends primarily on the proportion of non-detects and the data distribution (**Figure 1**). A parametric UTL will be used to calculate the GWPS when the background data are normally distributed and have a non-detect frequency of 50% or less. The Unified Guidance recommends 95% confidence level and 95% coverage (95/95 tolerance interval). When the non-detect frequency is 15% or less, half the RL will be substituted for non-detects (simple substitution), and the normal mean and standard deviation will be calculated. The Kaplan-Meier method will be used when the detection frequency is between 15% and 50%. The Kaplan-Meier method assesses the linearity of a censored probability plot to determine whether the background sample can be approximately normalized. If so, then the Kaplan-Meier method will be used to compute estimates of the mean and standard deviation adjusted for the presence of left-censored values. The Kaplan-Meier estimate of the mean and standard deviation will be substituted for the sample mean and standard deviation.

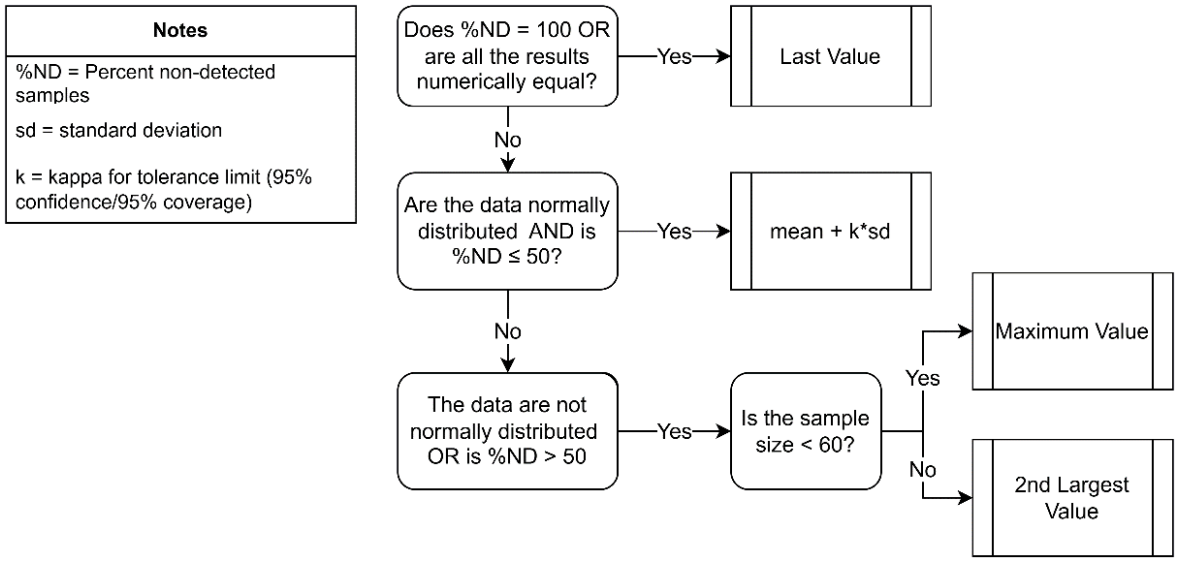


Figure 1. Flow chart illustrating the statistical methods used for calculating background under Compliance Monitoring.

The parametric UTL on a future mean will be calculated from the background dataset as follows:

$$UTL = \overline{x} + \kappa\,(n, \gamma, \alpha - 1) \cdot s$$

$\overline{x}$ = background sample mean

s = background sample standard deviation

$\kappa\,(n, \gamma, \alpha - 1)$ = one-sided normal tolerance factor based on the chosen coverage (γ) and confidence level (α -1) and the size of the background dataset (n). Values may be calculated per Millard (2013) or looked up in Table 17-3 in Appendix D of the Unified Guidance.

If the UTL is constructed on the logarithms of original observations to achieve normality, where $\overline{y}$ and s_y are the log-mean and log-standard deviation, the limit will be exponentiated for back-transformation to the concentration scale as follows:

$$TL = \exp\left[\overline{y} + \kappa\,(n, \gamma, \alpha - 1) \cdot s_y\right]$$

$\overline{y}$ = background sample log-mean

s_y = background sample log-standard deviation

If the background data set is non-parametric or has a non-detect frequency greater than 50%, a non-parametric UTL is used. The maximum concentration is used as the non-parametric UTL for sample sizes less than 60 and the second largest concentration is used as the non-parametric UTL for sample sizes greater than or equal to 60. As described in the Unified Guidance, the advantages include the resulting UTL reflecting actual concentration magnitudes, and the UTL more likely representing a detected concentration (unless all the data were non-detect).

3.3 Confidence Intervals

The method for calculating a CI depends on whether or not there is a trend in the data, the proportion of non-detects, and the data distribution (**Figure 2**). The following sections describe the procedure for calculating the CI in each case.

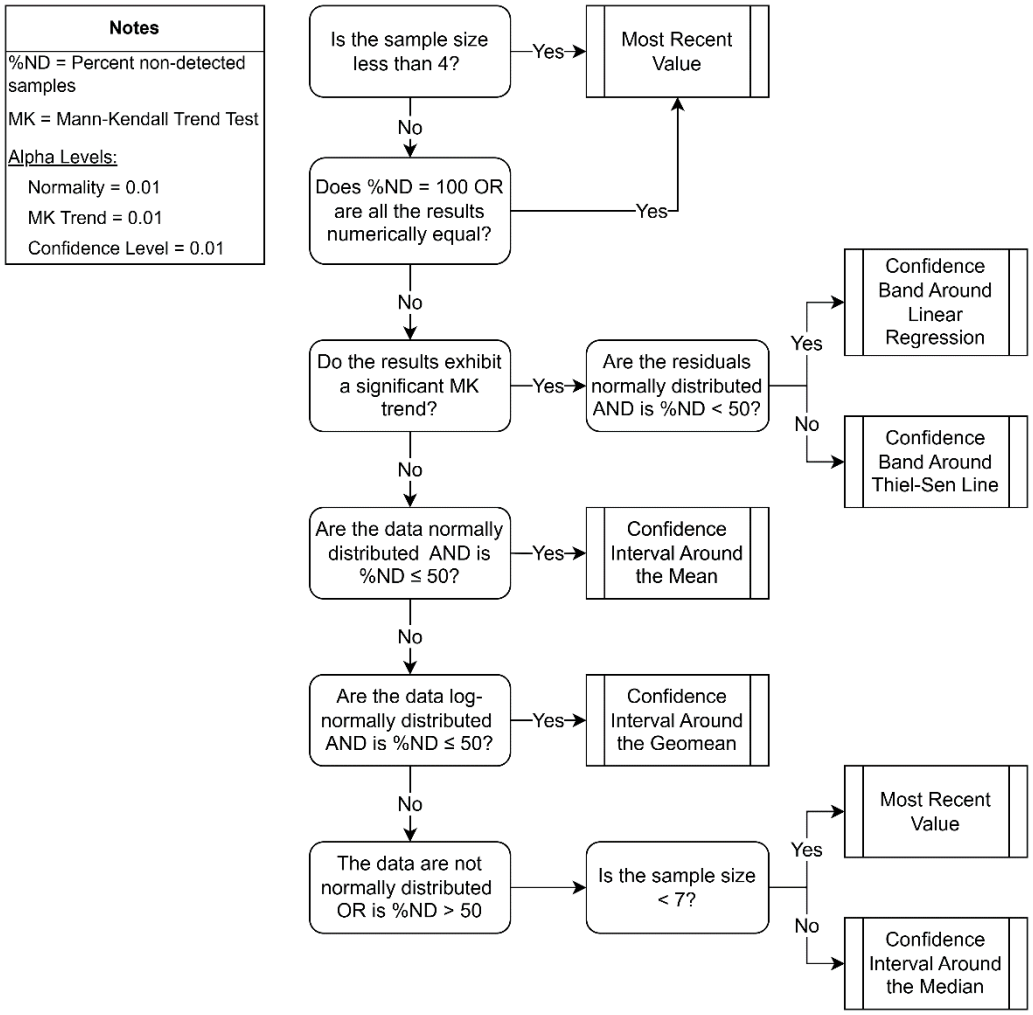


Figure 2. Flow chart illustrating the statistical methods used for calculating confidence intervals in Compliance Monitoring.

3.3.1 Confidence Intervals Around Trending Data

If compliance data exhibit a statistically significant trend based on results from a Mann-Kendall trend test and consists of a sufficient sample size (see below), CIs accounting for trends will be constructed to account for the trend-induced variation. If this is not accounted for, a wider CI will inevitably be calculated for a given confidence level and sample size (*n*). A wider CI will result in less statistical power, or ability to demonstrate an exceedance or return to compliance. When a linear trend line has been estimated, a series of CIs is estimated at each point along the trend. This creates a simultaneous confidence band that follows the trend line. As the underlying population mean increases or decreases, the confidence band also increases to reflect this change at that point in time.

Linear regression will be used when the compliance data set consists of at least eight samples, the frequency of non-detects is below 50%, and residuals around the trend line are normally distributed. The linear regression of concentration against sampling date (time) will be computed as follows:

$$\hat{b} = \sum_{i=1}^{n} (t_i - \bar{t}) \cdot x_i / (n-1) \cdot s_t^2$$

x_i = i^{th} concentration value and

t_i = i^{th} sampling date

$\bar{t}$ = sampling mean date

s_t^2 = variance of the sampling dates

This estimate leads to the following regression equation:

$$\hat{x} = \bar{x} + \hat{b} \cdot (\mathrm{t} - \bar{t})$$

$\bar{x}$ = mean concentration level

$\hat{x}$ = estimated mean concentration at time t

The regression residuals will also be computed at each sampling event to ensure uniformity and lack of significant skewness. Regression residuals will be computed at each sampling event as follows:

$$r_i = x_i - \hat{x}_i$$

The estimated variance around the regression line, or mean squared error, will be computed as follows:

$$s_e^2 = \frac{1}{n-2} \sum_{i=1}^{n} r_i^2$$

The CI around a linear regression trend line given confidence level (1-α) and a point in time (t_0), will be computed as follows:

$$LCL_{1-\alpha} = \hat{x}_0 - \sqrt{2 s_e^2 \cdot F_{1-2\alpha,2,\mathrm{n}-1} \cdot \left[\frac{1}{n} + \frac{(t_0 - \bar{t})^2}{(n-1) \cdot s_t^2}\right]}$$

$$UCL_{1-\alpha} = \hat{x}_0 - \sqrt{2 s_e^2 \cdot F_{1-2\alpha,2,\mathrm{n}-2} \cdot \left[\frac{1}{n} + \frac{(t_0 - \bar{t})^2}{(n-1) \cdot s_t^2}\right]}$$

$\hat{x}_0$ = estimated mean concentration from the regression equation at time t_0

$F_{1-2\alpha,2,\mathrm{n}-2}$ = upper (1-2α)th percentage point from an F-distribution with 2 and (n-2) degrees of freedom

If the compliance data set consists of at least seven samples but has a non-detect frequency greater than 50% or the residuals are not normally distributed, the Thiel-Sen trend line will be used as a non-parametric alternative to linear regression for calculation of the CI. The Thiel-Sen trend line estimates the median concentration over time by combining the median pairwise slope with the median concentration value and the median sample date. To compute the Thiel-Sen line,

the data will first be ordered by sampling event x_1, x_2, x_n. All possible distinct pairs of measurements (x_i, x_j) for $j > i$ will be considered and the simple pairwise slope estimate will be computed for each pair as follows:

$$m_{ij} = (x_j - x_i)/(j - i)$$

With a sample size of n, there will be a total of $N = n(n\text{-}1)/2$ pairwise estimates m_{ij}. If a given observation is a non-detect, half the RL will be substituted. The N pairwise slope estimates (m_{ij}) will be ordered from least to greatest (renamed $m_{(1)}$, $m_{(2)}$,..$m_{(N)}$). The Thiel-Sen estimate of slope (Q) will be calculated as the median value of the list depending on whether N is even or odd as follows:

$$Q = \begin{cases} m_{([N+1]/2)} \; if \; N \; is \; odd \\ (m_{(N/2)} + m_{([N+2]/2)})/2 \; if \; N \; is \; even \end{cases}$$

The sample concentration magnitude will be ordered from least to greatest, $x_{(1)}$, $x_{(2)}$, to $x_{(n)}$ and the median concentration will be calculated as follows:

$$\tilde{x} = \begin{cases} x_{([n+1]/2)} \; if \; n \; is \; odd \\ (x_{(n/2)} + x_{([n+2]/2)})/2 \; if \; n \; is \; even \end{cases}$$

The median sampling date ($\tilde{t}$) with ordered times ($t_{(1)}$, $t_{(2)}$, to $t_{(n)}$) will also be determined in this way. The Thiel-Sen trend line will then be computed for an estimate at any time (t) of the expected median concentration (x) as follows:

$$x = \tilde{x} + Q \cdot (\mathrm{t} - \tilde{t}) = (\tilde{x} - Q \cdot \tilde{t}) + Q \cdot \mathrm{t}$$

To construct a confidence band around the Thiel-Sen line, sample pairs (t_i, x_i) will be formed with a sample date (t_i) and the concentration measurement from that date (x_i). Bootstrap samples (B) will be formed by repeatedly sampling n pairs at random with replacement from the original sample pairs. This will be repeated 500 times. For each bootstrap sample, a Thiel-Sen trend line will be constructed using the equation above. A series of equally spaced t_j values will be identified along the range of sampling dates represented in the original sample, j=1 to m. The Thiel-Sen trend line associated with each bootstrap replicate will be used to compute an estimated concentration ($\hat{x}_j^B$). A CI will be constructed for the lower αth percentile $\hat{x}_j^{[\alpha]}$from the distribution of estimated concentrations at each time point (t_j). For a UCL, compute the upper (1-α)th percentile, $\hat{x}_j^{[1-\alpha]}$ at each t_j; for an LCL, compute the lower αth percentile, $\hat{x}_j^{[\alpha]}$ at each t_j.

3.3.2 Parametric Confidence Intervals around a Mean

If compliance data do not show a trend and are normal or log-normal, one-sided parametric CIs around a sample mean will be constructed for each constituent and well pair. The LCL will be calculated as:

$$LCL_{1-\alpha} = \overline{x} - t_{1-\alpha,n-1} \cdot \frac{s}{\sqrt{n}}$$

The UCL will be calculated as:

$$UCL_{1-\alpha} = \overline{x} + t_{1-\alpha,n-1} \cdot \frac{s}{\sqrt{n}}$$

$\overline{x}$ = compliance sample mean

s = compliance sample standard deviation

n = compliance sample size

$t_{1-\alpha,n-1}$ = obtained from a Student's t-table with (n–1) degrees of freedom at the chosen alpha level (0.01) (Table 16-1 in Appendix D of the Unified Guidance)

If compliance data are distributed lognormally, the LCL will be computed around the lognormal geometric mean as:

$$LCL_{1-\alpha} = \exp\left(\overline{y} - t_{1-\alpha,n-1} \cdot \frac{s_y}{\sqrt{n}}\right)$$

The UCL will be computed around the lognormal geometric mean as:

$$UCL_{1-\alpha} = \exp\left(\overline{y} + t_{1-\alpha,n-1} \cdot \frac{s_y}{\sqrt{n}}\right)$$

$\overline{y}$ = compliance sample log-mean

s_y = compliance sample log-standard deviation

3.3.3 Non-Parametric Confidence Intervals around a Median

Non-parametric confidence intervals around the median will be computed if the compliance data do not show a trend and contain greater than 50% non-detects or are non-normally distributed. The mathematical algorithm used to construct non-parametric CIs is based on the probability p that any randomly-selected measurement in a sample of n concentration measurements will be less than an unknown p x 100th percentile of interest (where P is between 0 and 1). Then the probability that the measurement will exceed the p x 100th percentile is (1–p). The number of sample values falling below the p x 100th percentile out of a set of n should follow a binomial distribution with parameters n and success probability p, where 'success' is defined as the event that a sample measurement is below the p x 100th percentile. The probability that the interval formed by a given pair of order statistics will contain the percentile of interest will then be determined by a cumulative binomial distribution *Bin(x;n,p)*, representing the probability of x or fewer successes occurring in n trials with success probability p. P will be set to 0.50 for an interval around the median. In accordance with the Unified Guidance, a confidence interval around the median will only be calculated if at least seven data points are available.

The sample size n will be ordered from least to greatest. Given p = 0.50, candidate interval endpoints will be chosen by ordered data values with ranks rounded upward to the next higher integers. The ranks of the endpoint will be denoted L^* and U* and are calculated using the following equations (Conover, 1999, p. 144):

$$L^* = np - Z_{1-\alpha}\sqrt{np(1-p)}$$

$$U^* = np + Z_{1-\alpha}\sqrt{np(1-p)}$$

4. CORRECTIVE ACTION MONITORING PROGRAM

Corrective Action Monitoring is performed after a corrective action remedy has been selected and implemented. 35 I.A.C. § 845.680(a)(1) specifies that the corrective action groundwater monitoring program must meet the requirements listed in 35 I.A.C. § 845.650 (*i.e.*, Compliance Monitoring), document the effectiveness of the selected remedy, and demonstrate compliance with the GWPS. Post-Closure Care monitoring as described in **Section 3** will operate concurrently with Corrective Action Monitoring, fulfilling the requirements of 35 I.A.C. § 845.650. This document describes the statistical methods used to document the progress of the selected remedy and demonstrate compliance with the GWPS.

Evaluation of corrective action remedy effectiveness will occur in three phases: remedy progress evaluation, stability evaluation, and attainment evaluation (USEPA, 1992).

1. Remedy progress evaluation occurs after implementation of corrective actions to assess if the remedy is functioning as anticipated.
2. The stability evaluation, which occurs after treatment has been concluded and a re-equilibration period has elapsed, assesses if a new post-treatment steady state in the groundwater has been reached.
3. Attainment evaluation occurs after a new steady state has been achieved and assesses if COC concentrations are below the GWPS.

In accordance with the Unified Guidance, these evaluations only apply to constituents which have previous exceedances of the GWPS. Constituents without previous GWPS exceedances continue to be evaluated according to Compliance Monitoring (per **Section 3**). The Corrective Action GMP for each unit describes the detailed approach to remedy effectiveness evaluation and reporting. Statistical evaluations used in each of these three phases are described below.

4.1 Remedy Progress Evaluation

The goal of remedy progress evaluation is to determine if a groundwater remedy is on track to achieve cleanup standards within the proposed time frame and to inform adaptive management decisions if performance metrics are not achieved. Evaluations of remedy effectiveness include:

- Comparison of the central tendency (*i.e.*, mean or median) of data from corrective action monitoring wells to the GWPS
- Trend analysis of average concentrations in individual wells and in a plume

Unlike Compliance Monitoring, remedy progress evaluation does not result in the determination of exceedances. Instead, the results from these analyses are used to evaluate performance metrics described in the site-specific Corrective Action GMP.

4.1.1 Central Tendency

The two most common central tendency measures of a data set are the sample mean and sample median. The sample mean best represents the central tendency of normally-distributed data; therefore, the mean will be used to represent the tendency if the data are approximately normally distributed and the frequency of non-detects is below 50%. The sample mean is given by the arithmetic average of each value in the sample:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

$\bar{x}$ = sample mean

n = sample count

x_i = i^{th} observation of x

The sample median is the 50th percentile of values in a sample and represents the midpoint of the ordered list of values. Because it is based on rank-order, the sample median is insensitive to data distribution; therefore, the median will be used if the data are not normally distributed or the frequency of non-detects is 50% or greater. The sample median is determined by arranging all values in order and selecting the middle value (or, if an even number of values exists, the mean of the two middle values).

4.1.2 Trend of Average Concentration in Individual Wells and in a Plume

Insight into remedy progress can be gained by evaluating changes in concentration at both the individual well and plume levels.

Trends at the individual well level are evaluated according to **Section 2.5**. To evaluate trends at the plume level, the trend on quarterly average concentrations is evaluated (per **Section 4.1.1**). Quarterly average concentrations in the plume are generated by calculating the mean or median as appropriate based on distribution (**Section 4.1.1**) of concentrations collected during a single sample event. Trend is then evaluated as described in **Section 2.5**. The magnitude of the trend (*i.e.*, slope) may be evaluated according to methods in **Section 3.3.1**.

4.2 Stability Evaluation

In order to evaluate ultimate effectiveness of the remedy, it is critical to evaluate if a new stable equilibrium has been reached after the implementation of corrective action (e.g., completion of source control or conclusion of groundwater extraction). Stability evaluation will be completed using trend analysis as described in **Section 2.5**.

4.3 Attainment Evaluation

Per 35 I.A.C. § 845.680(c), corrective action is considered complete when compliance with the GWPS has been demonstrated "at all points within the plume of contamination that lies beyond the waste boundary […] for a period of three consecutive years". Accordingly, attainment of the GWPS will be evaluated for well-constituent pairs previously determined to exceed the GWPS. This evaluation will include data collected after groundwater conditions have stabilized (**Section 4.2**).

The Unified Guidance recommends comparing a CI to the fixed GWPS to evaluate attainment of corrective action. The null hypothesis of this test is the reverse of that in Compliance Monitoring: corrective action well groundwater concentrations are assumed to exceed the GWPS unless the statistical test indicates otherwise. The CI will be calculated according to methods presented in **Section 3.3**. For pH, the only parameter with an upper and lower background and GWPS, the GWPS will be attained (*i.e.*, the null hypothesis rejected) when the CI falls within the range of the GWPS (*i.e.*, if the LCL of the CI is above the lower limit and the UCL is below the upper limit). For all other parameters, the GWPS will be attained when the UCL is below the GWPS. Once this

statistical evaluation indicates that GWPS has been met for three years (*i.e.*, that the null hypothesis is rejected), corrective action will be concluded.

5. REFERENCES

Conover, W. J., 1999. Practical Nonparametric Statistics (3rd ed.). John Wiley & Sons, Inc.

Illinois Administrative Code, Title 35, Subtitle G, Chapter I, Subchapter J, Part 845: Standards for The Disposal Of Coal Combustion Residuals In Surface Impoundments, effective April 21, 2021.

Millard S. P., 2013. EnvStats: An R Package for Environmental Statistics. Springer. ISBN 978-1-4614-8455-4

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2022. *Multi-Site Sampling and Analysis Plan*. https://www.luminant.com/documents/ccr/il-ccr/Newton/2023/Multi-Site%20Sampling%20Analysis%20Plan-Newton-W0798070001%E2%80%9001.pdf. December 28.

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2022. *Multi-Site Quality Assurance Project Plan.* https://www.luminant.com/documents/ccr/il-ccr/Newton/2023/Multi-site%20Quality%20Assurance%20Project%20Plan-Newton-W0798070001%E2%80%9001.pdf. December 28.

United States Environmental Protection Agency (USEPA), 1992. Methods for Evaluating the Attainment of Cleanup Standards Volume 2: Groundwater. EPA 230-R-92-014. Office of Policy, Planning, and Evaluation. July.

United States Environmental Protection Agency (USEPA), 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance. EPA 530-R-09-007. March.

United States Environmental Protection Agency (USEPA), 2020. EPA QA Field Activities Procedure. IT/IM Directive Procedure. https://www.epa.gov/system/files/documents/2022-09/epa_qa_field_activities_procedure.pdf. June 9.

United States Environmental Protection Agency (USEPA), 2023. Quality Assurance Project Plan Standard. IT/IM Directive Procedure. https://www.epa.gov/system/files/documents/2024-04/quality_assurance_project_plan_standard.pdf. August 21.

APPENDIX B.2
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT

Smarter Solutions

Exceptional Service

Value

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT

Ash Pond 2
Coffeen Power Station
Coffeen, Illinois

January 24, 2017

Natural Resource Technology

Environmental Consultants

NATURAL RESOURCE TECHNOLOGY
ENVIRONMENTAL CONSULTANTS

234 W. FLORIDA STREET, FIFTH FLOOR
MILWAUKEE, WISCONSIN 53204
(P) 414.837.3607
(F) 414.837.3608

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT

ASH POND 2
COFFEEN POWER STATION
COFFEEN, ILLINOIS

Project No. 2380

Prepared For:

Illinois Power Generating Company
Coffeen Power Station
134 Cips Lane
Coffeen, IL 62107

Prepared By:

Natural Resource Technology, Inc.
234 W. Florida Street, Fifth Floor
Milwaukee, Wisconsin 53204

January 24, 2017

Stuart J. Cravens, PG
Principal Hydrogeologist

Nathaniel R. Keller, PG
Hydrogeologist

LICENSED PROFESSIONAL GEOLOGIST
Stuart J. Cravens
196-000108
ILLINOIS

TABLE OF CONTENTS

1 INTRODUCTION 1-1
1.1 Overview 1-1
1.2 Site Location and Background 1-2
1.3 Site History 1-3
2 GEOLOGY AND HYDROGEOLOGY 2-1
2.1 Regional Geology 2-1
2.1.1 Unlithified Deposits 2-1
2.1.2 Bedrock 2-2
2.2 Site Geology 2-2
2.2.1 Ash/Fill 2-2
2.2.2 Roxana Silt / Peoria Silt (Loess Unit) 2-3
2.2.3 Hagarstown Member 2-3
2.2.4 Vandalia Member 2-4
2.2.5 Mulberry Grove Member 2-5
2.2.6 Smithboro Member 2-5
2.2.7 Yarmouth Soil 2-5
2.2.8 Lierle Clay Member 2-6
2.2.9 Bedrock 2-6
2.3 Hydrogeology 2-6
2.3.1 Groundwater Occurrence and Elevations 2-7
2.3.2 Groundwater Flow 2-8
2.3.3 Vertical Groundwater Gradients 2-8
2.3.4 Groundwater Discharge to Coffeen Lake and the Unnamed Creek 2-9
2.4 Conceptual Site Model 2-9
2.5 Potable Water Well Inventory 2-10
3 GROUNDWATER QUALITY 3-1
3.1 Summary of Groundwater Monitoring 3-1
3.2 Groundwater Monitoring Results and Analysis 3-1
3.3 Impacted Groundwater Discharge to Surface Water 3-5
4 CONCLUSIONS 4-1
5 REFERENCES 5-1

FIGURES

Figure 1 Site Location
Figure 2 CCR Management Units
Figure 3 Monitoring Well Location Map
Figure 4 Thickness of Loess / Clay Below Ash Pond 2
Figure 5 Structural Contour Map – Top of Hagarstown Member

Figure 6 Thickness of Hagarstown Member Sand Unit
Figure 7 Structural Contour Map – Top of Vandalia Till
Figure 8 Structural Contour Map – Top of Smithboro Till
Figure 9 Cross-section A-A'
Figure 10 Cross-section B-B'
Figure 11 Cross-section C-C'
Figure 12 Potentiometric Surface Map – May 2016
Figure 13 Potentiometric Surface Map – November 2016
Figure 14 Potential Source Water and Surface Water Sampling Locations

TABLES

Table 1 Summary of Existing Monitoring Well Network
Table 2 Summary of Laboratory Hydraulic Conductivity in Confining Units
Table 3 Summary of Field Hydraulic Conductivity Tests
Table 4 Summary of AECOM Piezometer Construction
Table 5 Groundwater Elevations in Monitoring Wells: 2015 – 2016
Table 6 Groundwater Elevations in Piezometers: 2015 – 2016
Table 7 Ash Pond 2 Leachate Elevations in 2009
Table 8 Summary of Vertical Hydraulic Gradients
Table 9 Statistical Summary of Groundwater Monitoring Parameters and Class I Exceedances: 2015 – 2016
Table 10 Potential Source Water and Surface Water Sampling Results

APPENDICES

Appendix A Boring Logs and Well Construction Details
Appendix A1 Ash Pond 2
Appendix A2 GMF Recycle Pond
Appendix A3 GMF Gypsum Stack Pond
Appendix A4 Landfill
Appendix A5 Southwest Pond
Appendix A6 Ash Pond 1
Appendix A7 Historical Boring Logs
Appendix A8 AECOM Boring Logs and Piezometer Construction Documentation
Appendix B Grain Size Analyses and Hydraulic Conductivity Test Results
Appendix B1 Hydraulic Conductivity Analyses (Wells)
Appendix B2 Hydraulic Conductivity Analyses (Ash Pond Piezometers)
Appendix B3 Laboratory Hydraulic Conductivity Tests
Appendix C Monitoring Well Hydrographs (2015 - 2016)
Appendix D Discharge to Surface Water Calculations
Appendix E Water Well Locations and Records within 2,500-Foot Radius of Coffeen Ash Pond 2
Appendix F Groundwater Quality Data
Appendix G Water Quality Trend Graphs

1 INTRODUCTION

1.1 Overview

This Hydrogeologic Site Characterization Report was prepared by Natural Resource Technology, Inc. (NRT) in support of a Closure Plan for Ash Pond 2 located at the Coffeen Power Station (CPS, Site) which is owned by Illinois Power Generating Company (IPGC). This report and the Closure Plan will apply specifically to this Coal Combustion Residuals (CCR) surface impoundment (Ash Pond 2), and not to any of the other impoundments present on the Site which include the following: Ash Pond 1, Ash Landfill, Gypsum Stack Pond, and Recycle Pond. However, information gathered to evaluate these other CCR units regarding geology, hydrogeology, and groundwater quality is included, where appropriate.

Numerous hydrogeologic investigations have been performed concerning the CCR Units located at the Site. The information presented in this site characterization report includes recent data collected to comply with the Federal CCR Rule (40 CFR Part 257) as well as comprehensive data collection and evaluations from prior hydrogeologic investigation reports (recent to oldest), including, but not limited to, the following:

- ***Corrective Action Plan. Hanson, April 16, 2016.*** A plan to remediate groundwater exceedances around Ash Pond 2 and other units. Proposed plan includes reduction in leachate within Ash Pond 2, enhanced cover system on Ash Pond 2, and a Groundwater Management Zone (GMZ).

- ***Revised 30% Closure Design Package for Coffeen Power Station Ash Pond No. 2. AECOM, April 2016.*** A 30% design package for closure of Ash Pond 2 including the design basis and summary in addition to preliminary construction costs and schedule.

- ***Uppermost Aquifer Considerations. Hanson, April 2016.*** A discussion of the construction of the gyspum pond and relation to the uppermost aquifer in the vicinity of the site.

- ***Addendum to the 30% Design Data Package for Dynegy Coffeen Power Station; GMF Gypsum Stack Pond. AECOM, January 27, 2016.*** A geotechnical program consisting of CPT soundings to obtain information for compliance with requirements of the federal CCR Rule.

- ***30% Design Data Package for Dynegy Coffeen Power Station; Ash Ponds Nos. 1 and 2 CCR Units. AECOM, January 14, 2016.*** A geotechnical program consisting of installation of auger borings, CPT soundings, piezometers and soil testing to obtain information for compliance with requirements of the federal CCR Rule.

- ***G153 Assessment. Hanson, January 15, 2015.*** An investigation and evaluation of elevated concentrations of sulfate and manganese near the Southwest Storm Water Detention Pond (SW Pond).

- ***Phase 1 Hydrogeological Assessment Report, Coffeen Energy Center, Montgomery County, IL. Natural Resource Technology, inc., March 2013.*** An investigation and assessment of the potential for impacts to water quality from unlined impoundments at the Coffeen Power Station. Included a survey to identify wells within 2,500 feet of the Site.

- ***Section_3 Hydrogeologic Report. Hanson, August, 2009,*** A summary of the geology and hydrogeology in the area of the proposed Ash Landfill, Gypsum Stack Pond, and Recycle Pond.

In conjunction with this report, a Groundwater Monitoring Plan and a Groundwater Management Zone Application are being prepared to support the closure of Ash Pond 2. In addition, a groundwater flow and transport model was developed to evaluate the effect of various ash pond closure scenarios on groundwater quality and to predict the fate and transport of CCR leachate components. Modeling has also been conducted to enable estimation of the time required for hydrostatic equilibrium of groundwater to be achieved beneath Ash Pond 2.

1.2 Site Location and Background

Ash Pond 2 is one of five CCR units at the CPS, located approximately 2 miles south of the City of Coffeen in Montgomery County, Illinois (Figure 1). The power plant and the CCR Units are situated on a peninsula between two lobes of Coffeen Lake which was created in 1963 by damming a portion of the East Fork of Shoal Creek (IDNR, 2014). The lake covers approximately 1,100 acres and provides cooling water for the CPS.

Ash Pond 2 is located within Section 11 Township 7 North and Range 7 East. The city of Coffeen is approximately 2 miles north of the CPS and the city of Hillsboro, IL is about 8 miles to the northwest. The CPS is located in an agricultural area. Historically, several coal mines were operated at depth in the vicinity of the site as well as a US Minerals processing facility located to the north. The CPS property is bordered by Coffeen Lake on the west, east, and south, and by agricultural land to the north.

Ash Pond 2 was first investigated in 2010, as requested by the Illinois Environmental Protection Agency(Illinois EPA). Results of the investigation (NRT, 2013) indicated the presence of CCR constituents in groundwater in the vicinity of Ash Pond 1 and 2 as well as exceedances of Class I Groundwater Standards for arsenic, boron, lead, sulfate, manganese, iron,sulfate, total dissolved solids, and pH. Additional wells were installed in 2015 to comply with the Federal CCR Rule (40 CFR Part 257), and define the extent of Class I exceedances associated with Ash Pond 2. Based on the groundwater results of wells installed in 2015, Hanson submitted a Corrective Action Plan (CAP, Hanson, 2016a) to define the proposed remedy. Ash Pond 2 will be closed by leaving CCR in place using an alternative geomembrane cover system, following partial dewatering of the pond. This design will control the potential for slope failure and water infiltration into the closed CCR unit and will allow for drainage of surface water off of the cover system (AECOM, 2016a).

Illinois EPA responded to Dynegy regarding the CAP with a draft letter including comments and Dynegy and Illinois EPA met on July 20, 2016 to discuss the CAP and proposed remedy. Following the discussion, Illinois EPA in a letter dated August 9, 2016 provided the following comments (summarized):

1. Investigation may be required to define the source and extent of exceedances from Ash Pond 2.
2. A vertical component is required for the GMZ.
3. The GMZ contains portions of CCR units not proposed to close, GMZ must be revised to include only areas where CAP for Ash Pond 2 will mitigate impacts.
4. Hydraulic conductivity of foundation layer needs to be evaluated to determine if CAP is appropriate.
5. A groundwater monitoring plan,specific to Ash Pond 2 must be submitted with CAP.
6. Modeling is required to demonstrate corrective action will be successful, and at what point in the future.
7. Evaluate the impacts of the corrective action on Coffeen Lake, with respect to applicable surface water standards.

The Closure Plan, to which this Hydrogeologic Characterization Report, the Groundwater Monitoring Plan, Groundwater Model Report, and Hydrostatic Model Report are attached, provide the information necessary to address these comments and justify the selected corrective action.

1.3 Site History

CPS began operation in 1972 and CCR from the coal fired units was disposed of in Ash Pond 1. Ash Pond 2 was also utilized in the early 1970's and Ash Pond 1 was reconstructed in 1978. Both of these units were used until the mid-1980's. Currently, two coal fired units at Coffeen generate 945 MW of electricity with CCR being handled and filled in Ash Pond 1, the Ash Landfill, the Gypsum Stack Pond, and the Recycle Pond.

Ash Pond 2, which is the sublect of this closure, has a surface area of approximately 60 acres with berms up to 47 feet higher than the surrounding land surface. Ash Pond 2 was removed from service and capped in the mid 1980's. Prior to capping, this pond was identified as Outfall 004 in the facility NPDES operating permit, IL0000108. A 2-foot clay and soil cap was placed on the surface of the pond with contouring and drainage provided to direct storm water to four engineered revetment down drain structures (NRT, 2013).

Other CCR units (not the subject of this Closure Plan) at CPS include the following:

- Ash Pond 1 (active unlined impoundment) covers an area of approximately 23 acres, has berms up to 41 feet above the surrounding land surface, and a volume of 300 acre-feet. It primarily receives bottom ash and low volume wastes from floor drains in the main power block building. Several years ago, air heater wash and boiler chemical cleaning wastes were directed to Ash Pond 1 but this practice was discontinued. This impoundment (also known as

the Bottom Ash/ Recycle Pond) is a reclaimed ash pond that was reconstructed utilizing the existing earthen berms with reinforcement, as provided by Water Pollution Control Permit 1978-EA-389 issued by the Agency on May 26, 1978. The bottom ash is periodically removed for beneficial uses by a third-party contractor.

- A Gypsum Management Facility (GMF), consisting of a 77-acre Gypsum Stack Pond and 17-acre Recycle Pond, receives blowdown from the air emission scrubbers and has been in operation since 2010. Construction of the GMF was in accordance with Water Pollution Control Permit 2008-EA-4661 and features a composite HDPE liner with 3-feet of recompacted soil at 1×10^{-7} cm/s. Both GMF ponds have a groundwater underdrain system. The Gypsum Stack Pond system was actively pumped during construction, but is currently not used. The Recycle Pond underdrain is a passive, gravity drained system.

- Fly ash is managed in a composite lined landfill constructed in 2010. The Ash Landfill has an active groundwater underdrain system that is currently being actively pumped. Additionally, the Ash Landfill leachate collection system is restricted by rule to no more than 1 foot of leachate on the composite liner.

- An Illinois EPA groundwater monitoring program is in effect for the GMF (under Bureau of Water) and Ash Landfill (under Bureau of Land).

- The SW Pond is not a CCR unit; it manages stormwater from around the Ash Landfill. It is managed under NPDES Permit #2011-EB-1289.

2 GEOLOGY AND HYDROGEOLOGY

Since 2010, several site investigations have been completed in the vicinity of the CCR units. The initial site investigation near Ash Pond 2 (Geotechnology, 2010) included the installation of one well near the southeast corner of the unit. Significant investigation has been completed north of the unit prior to permitting of the Ash Landfill, Gypsum Stack Pond, and Recycle Pond. Following promulgation of the Federal CCR Rule (40CFR 257), additional investigation was completed by AECOM (2016a, 2016b)) to obtain geotechnical information and NRT (2013) to install additional wells for groundwater monitoring. The most recent investigation was completed in 2016 by NRT to better define the vertical and horizontal extent of impacts and refine the GMZ proposed in the CAP. The data collected from recent investigations as well as historical work is incorporated in this report to develop an accurate site conceptual model.

2.1 Regional Geology

2.1.1 Unlithified Deposits

Pleistocene deposits of unlithified glacial diamictons, lacustrine/alluvial deposits, and windblown loess overlie Pennsylvanian-age bedrock throughout central Illinois. The most extensive glacial deposits are those from the Illinoian Stage which cover much of the state and are present at the Site. Diamictons deposited by glacial activity during the more recent Wisconsian Stage does not extend into the Coffeen area. Windblown (aeolian) deposits, the Peoria and Roxana Silts, cover the glacial deposits over a majority of the state. These units are fine-grained deposits blown from river valleys by prevailing winds. The Quaternary units are described briefly below (Hensel and Johnson, 1996), and in detail later in this section.

The Illinois State Geologic Survey has mapped loess thickness at the CPS at less than 5 ft. The Peoria Silt is generally classified and described as light yellow-tan to gray, fine sandy silt. The Roxana Silt is predominately silt-sized material, but can be sandier in localized areas and the base of this unit is often colluvium of silt, and sand (Hensel and Johnson, 1996).

Till members of the Glasford Formation include the Smithboro Member, the Mulberry Grove Member, the Vandalia Member, and the Hagarstown Member (oldest to youngest). The Smithboro Member is described as a gray, compact, silty till. The Smithboro is bounded below by the Yarmouth Soil. The Mulberry Grove Member is intermittent at the Site, and is described as a calcareous gray silt and fine sand containing some fossil mollusks. The Vandalia Member is described as a sandy till with thin lenticular bodies of silt, sand, and gravel. It is calcareous, except where weathered, generally gray, and moderately compact. The Hagarstown Member is bounded at the top by the Sangamon Soil. The member consists of gravelly till, poorly sorted gravel, well sorted gravel, and sand (Willman and Frey, 1970).

2.1.2 Bedrock

The site and surrounding areas are underlain by rocks belonging to the Pennsylvanian Bond Formation (Kolata, 2005). Detailed descriptions of the Pennsylvanian strata of Illinois were published by Willman et al. (1975). The Bond Formation includes all strata from the base of the Shoal Creek Limestone Member or the LaSalle Limestone Member to the top of the Millersville Limestone Member or the Livingstone Limestone Member. It is overlain by the Mattoon Formation and underlain by the Modesto Formation. It varies from less than 150 feet thick in eastern Illinois to over 300 feet thick in southeastern Illinois, averaging about 250 feet. The Bond Formation is characterized by a high percentage of limestone and calcareous clays and shales. It is bound by thick limestone members (up to 50 feet), the thickest and purest limestones in the Pennsylvanian System of Illinois. Gray shales constitute the greatest part of the formation, although thick channel sandstones are developed locally.

The elevation of the bedrock surface in the area ranges from 450 to 500 feet above mean sea level (Herzog et al., 1994). The bedrock surface slopes gently towards the west into a minor bedrock valley that runs north-south. Well logs indicate that the lithology of the uppermost bedrock is predominantly shale (Zeizel, 1959).

2.2 Site Geology

Quaternary deposits in the Coffeen area consist mainly of glacial diamictons and outwash deposits that were deposited during Illinoian and Pre-Illinoian glaciations. A hydrogeologic investigation was conducted in 2006 and 2007 by Hanson to characterize the site geology as part of an application for an Initial Facility Report and Operating (Subpart B) Permit, and Hanson issued a Hydrogeologic Report as part of those applications in 2009. The following geologic descriptions are based on the findings of these investigations and supplemented with data near Ash Pond 2 collected from recent investigations performed to meet requirements of the CCR Rule.

Figure 3 and Table 1 display and summarize the monitoring wells present on site, and Appendix A includes boring logs and well construction logs used for this report. Appendix B includes reports for both laboratory and field hydraulic conductivity tests for recent testing completed in 2015 and 2016 in addition to test results from piezometers within the Ash Pond. The major unconsolidated materials present at the site include the following (listed from ground surface down).

2.2.1 Ash/Fill

Ash is present within Ash Pond 2 at thicknesses up to approximately 36 feet as measured in OW-4, but ash is generally only 24 to 29 feet thick as shown in the boring logs for OW1, OW-2, OW-3, and OW-5 (Appendix A). A majority of Ash Pond 2 overlies the Loess/ Silt unit which comprises the Upper Confining Unit (next Subsection). The remaining areas of Ash Pond 2 overlie the Vandalia Till where former

drainage features were present prior to construction and filling (Figure 4). Field hydraulic conductivity tests from piezometers screened within the ash (Appendix B2) resulted in a geometric mean of 1.5 x10^{-3} cm/sec indicating a relatively permeable ash unit.

2.2.2 Roxana Silt / Peoria Silt (Loess Unit)

The Roxana Silt and Peoria Silt are stratigraphically distinct units, but are difficult to differentiate in the area of the Coffeen Power Station. In this report, the combined silts will be called the Loess Unit. The Loess Unit extends from beneath the topsoil, which is derived from the loess, to the the top of the Hagarstown (Beds) Member. Thicknesses range from a minimum of <1.0 ft as observed in G401 and G403 located adjacent to and west/southwest of Ash Pond 2, to a maximum of <6 feet as measured in a boring advanced within the footprint of the landfill prior to construction (MW14S). Actual thickness of the Loess Unit is difficult to evaluate due to the illuviation of the model soil horizon. Around Ash Pond 2, the thickness is presumed to be less than four feet. The loess has been variously classified as silt or clayey silt, with minor amounts of sand. The loess often exhibits mottling, concretions, and some fracturing and may be saturated, dependent on the seasonal variation in groundwater levels.

The Loess Unit is generally considered unsaturated and the upper-most aquifer is recharged by precipitation that percolates through this unit. The laboratory tests from recent geotechnical analysis reported vertical hydraulic conductivity values ranging from 1.3 x 10^{-8} to 5.0 x 10^{-7} cm/sec, with a geometric mean of 1.0 x 10^{-7} cm/sec (Table 2). This unit was likely removed from within the footprint of Ash Pond 2 either through erosion or based on ash pond design grades of 616.5 ft. Construction of the landfill and GMF units required the excavation and removal of this layer.

2.2.3 Hagarstown Member

The Hagarstown Member (consisting of gravelly clay till and sandy materials in contact with the Vandalia, (also referred to as Hagarstown Beds) has been separated into two units for this discussion; the first unit, consisting of the gravelly clay till and the second consisting of sandy material overlying the Vandalia Member. The clay till portion had varying thicknesses ranging from 1.9 feet (G404) to over 12 feet as observed in the borings for G401 and G403, located adjacent to, south and west of the Pond. This unit underlies 95% of the pond and in general the clayey portion is at least 9 feet thick (Figure 4). The thickness of the sandy portion of the Hagarstown is generally less than 3 feet, and near Ash Pond 2 it is generally 1 to 2 feet thick as seen in borings for G401, G404, and G405. The composition of the sandy portion of the Hagarstown unit varies across the site and was classified as gravelly till, poorly sorted gravel, well sorted gravel, sand and silty sand. The elevation of the top of the Hagarstown is mapped in Figure 5 and the general thicknesses are illustrated on Figure 6. As displayed in Figure 5, the elevation of the top of the Hagarstown generally declines as the unit approaches Coffeen Lake or other topographic drainage features.

The elevation of the bottom of the discharge channel south of Ash Pond 2 is approximately 600 ft, based on the Ash Pond design drawing. This implies that the channel intersects and cuts through the Hagarstown along the southern side of the Ash Pond. Along the eastern edge, the creek is at an elevation of ~594 to ~590, indicating that the Hagarstown is also exposed. along the ravine slope.

During construction of the Ash Landfill, the Gypsum Pond, and the Recycle Pond, the Loess Unit and the Hagarstown Beds were excavated to facilitate construction by limiting groundwater flow into excavations. The excavations were backfilled with structural fill and an underdrain system was installed to mitigate inward hydraulic pressure and potential liner uplift damage before the CCR units were filled. The Ash Landfill underdrain system remains active. The Recycle Pond is a gravity drain system, and the Gypsum Pond remains in place, but the system is inactive.

The hydraulic characteristics of the Hagarstown Member indicate the unit has a moderate hydraulic conductivity. The results of single-well field permeability tests have hydraulic conductivity values ranging from 3.1×10^{-5} to 1.6×10^{-3} cm/sec, with a geometric mean of 2.9×10^{-4} cm/sec (Table 3). In several locations (i.e., G402, G403, and G404) this unit is very thin, or was not observed in the boring as shown on the boring logs (Appendix A); however, field hydraulic conductivities are similar to those measured in wells screened across the Hagarstown Beds, indicating that at these locations the upper Vandalia is hydraulically similar to the Hagarstown Beds and is likely connected to and continuous with the Hagarstown. The hydraulic conductivity values measured within wells screened across the Hagarstown Beds are significantly higher than both the overlying Roxana/Peoria Silts and lower Vandalia (Till) Member.

2.2.4 Vandalia Member

The Vandalia (Till) Member is a sandy/silty till with thin, discontinuous lenses of silt, sand, and gravel. The Vandalia Till was encountered in all borings advanced at the site. The Vandalia Till ranged in thickness from 11.7 ft in SB-10 (drilled near MW10S) in the northern portion of the CPS, to 31.0 ft in SB-12 (near MW12S between the Gypsum Stack Pond and the Recycle Pond). Based on Borings G45D and G46D, the Vandalia Till is approximately 7 feet thick in the southeast corner (G46D) to 18 feet thick along the northern edge of the Ash Pond 2 (G45D).The elevation of the top of the Vandalia Till is depicted in Figure 7. Below Ash Pond 2 the elevation ranges from approximately 608.5 to 598 ft. Similar to the observed top elevation of the Hagarstown Beds, the top of the Vandalia unit declines in elevation near Coffeen Lake and topographic drainage features. This unit is relatively thick throughout the site, with an average thickness of of over 15 feet (Hanson 2009).

Results from laboratory tests completed for vertical hydraulic conductivity indicate the Vandalia unit has a very low vertical hydraulic conductivity. The laboratory tests reported hydraulic conductivity values ranging from 6.8×10^{-9} to 4.5×10^{-6} cm/sec, with a geometric mean of 4.9×10^{-8} cm/sec (Table 2). Field

hydraulic conductivity tests completed in temporary piezometers (T408 and T409) indicate horizontal conductivities of 9.0 x 10^{-7} and 3.4 x 10^{-5} cm/sec, respectively (Table 3). The maximum value was measured in a sand seam within the Vandalia Till, but likely is not representative of the diamicton because sand seams are infrequent and discontinuous.

2.2.5 Mulberry Grove Member

The Mulberry Grove (Silt) Member typically consists of a thin, lenticular unit of gray sandy silt (Willman et al., 1975). It represents the interval between the retreat of the glacier that deposited the Smithboro Member and the advance of the glacier that deposited the Vandalia Member. At the site, the Mulberry Grove Member is represented by pockets (generally less than 2 ft thick) of gray sandy silt. This unit was absent in many borings through the central portion of the site from south to north. Where sampled, the Mulberry Grove Member ranged in thickness from 0.5 ft in Borings SB-12 (MW12D) to 4.9 ft in Boring SB-11 (MW11D), both of which are located near the Gypsum Pond (Hanson 2009). The Mulberry Grove Silt was not encountered in the two deep borings, G45D and G46D, advanced near Ash Pond 2.

The laboratory tests reported vertical hydraulic conductivity values of 1.6 x 10^{-6} and 1.9 x 10^{-6} cm/sec, with a geometric mean of 1.7 x 10^{-6} cm/sec. These silts appear to be deposited in depressions found in the surface of the underlying Smithboro Member.

2.2.6 Smithboro Member

The Smithboro (Till) Member is described as a gray, compact, silty, clayey diamicton. The Smithboro Member ranges in thickness from 6.7 ft in Boring SB-05 (near MW05S) to 21.2 ft in Boring SB-02 (near MW02S) located northwest of the landfill. Figure 8 displays the top elevation of the Smithboro Till. As shown on the figure the top of the unit ranges in elevation from 596 to 590 ft below Ash Pond 2. Borings advanced in the vicinity of Ash Pond 2 did not did not penetrate the full thickness of the Smithboro Till.

Laboratory and field conductivity testing indicate the Smithboro Member has a low hydraulic conductivity. Laboratory test reported vertical hydraulic conductivity values ranging from 1.1 x 10^{-9} to 1.0 x 10^{-7} cm/sec with a geometric mean of 1.3 x 10^{-8} cm/sec (Table 2). Horizontal hydraulic conductivities calculated from single well tests performed in wells G45D and G46D were 4.0 x 10^{-8} and 4.9 x 10^{-7} cm/sec, respectively (Table 3).

2.2.7 Yarmouth Soil

The Yarmouth was not encountered in the area of Ash Pond 2 as borings did not extend through the Smithboro. Historical borings in the northern portion of the site which encountered the Yarmouth were summarized previously (Hanson 2009). The Yarmouth Soil is described as the weathered zone on the

Kansan drift, but in some places it consists of accretionary deposits of fine sediment and organic material that accumulated in poorly drained areas on the surface of the Kansan deposits. The Yarmouth Soil was absent in Borings SB-18 and SB-04. Where encountered, the Yarmouth Soil ranged in thickness from 0.8 ft in Boring SB-13 to 5.1 ft in Boring SB-08.

The Yarmouth Soil (considered the deep water-bearing zone) possesses a moderate to moderately low hydraulic conductivity. The single-well permeability tests conducted by Hanson (2009) reported moderate hydraulic conductivity values ranging from 1.3×10^{-4} to 1.7×10^{-3} cm/sec, with a geometric mean of 4.4×10^{-4} cm/sec.

2.2.8 Lierle Clay Member

The Lierle Clay was not encountered in the areas of Ash Pond 2 because borings were terminated in the Smithboro Till. Historical borings in other portions of the CPS which encountered the Lierle were summarized previously (Hanson 2009). The Lierle Clay Member is the upper-most member of the Kansan Stage Banner Formation. It is described as an accretion-gley with clay, silt and some sand. It was encountered by Hanson (2009) in all but a few borings on site (i.e., SB-02 and SB-11), and was the target formation for completion ofsome boreholes. No boring penetrated the full thickness of the Lierle Clay.

The Lierle Clay has a very low hydraulic conductivity. The laboratory tests reported very low vertical hydraulic conductivity values ranging from 3.4×10^{-9} to 1.3×10^{-8} cm/sec, with a geometric mean of 3.6×10^{-9} cm/sec.

2.2.9 Bedrock

The site is underlain by the Pennsylvanian-age Bond Formation, which is characterized by Willman et al., (1975) as having a high percentage of limestone and calcareous clays and shales. Bedrock was not encountered in any borings advanced onsite so site specific information is not available.

2.3 Hydrogeology

One monitoring well was initially installed in 2010 near Ash Pond 2: however, a significant number of wells were installed around the CCR Units prior to and following their construction. In 2015 additional wells and piezometers were installed within and around Ash Pond 2 to meet requirements of the CCR Rule. This discussion focuses on Ash Pond 2 but utilizes historical results from wells at surrounding units, where appropriate, to evaluate the sitewide hydrogeology.

A summary of the current monitoring well networks and construction details is included in Table 1, and recent AECOM piezometers are summarized in Table 4. Since 2006 the hydrogeology of the site has been characterized and described through multiple investigations. This section discusses recently

collected information, focusing on the existing well network and piezometers installed in 2015 and 2016 around Ash Pond 2 as well as appropriate historical data from other units onsite.

2.3.1 Groundwater Occurrence and Elevations

Leachate is present within the ash, and groundwater is present within all geologic units at the CPS; however, the Hagarstown Beds are considered the uppermost aquifer (groundwater monitoring unit or Illinois EPA aquifer) at the site. Hydraulic conductivities of the Hagarstown Beds are generally one to two orders of magnitude higher that the surrounding materials and support the designation of the Hagarstown Beds (and in areas the Upper Vandalia Till) as the Uppermost Aquifer (groundwater monitoring unit). Near Ash Pond 2 (i.e., G402 and G403) the Hagerstown was either very thin or not observed in the boring; however, hydraulic conductivity tests in these wells indicate similar hydraulic conductivities to the Hagarstown Member, indicating that the weathered Upper Vandalia Member is likely part of the Uppermost Aquifer and hydraulicly connected in these areas.

Measured groundwater elevations typically range from about 602 ft near discharge zones along the edges of Coffeen Lake and the Unnamed Creek, to 623 ft in upgradient wells along an approximate center line of the site between the two lobes of the lake (i.e., groundwater divide). Based on the elevation of Coffeen Lake (normal pool elevaton of 590 ft), Unnamed Creek (~590 ft), southern discharge channel (~604 ft) and lowest observed elevation of the Hagarstown Beds (602.6 ft) it is likely that groundwater seeps exist along the shoreline of the lake and slopes near these drainage features. Groundwater elevations are generally consistent and appear to be controlled by discharge as seeps along the shoreline of Coffeen Lake. Geologic cross-sections illustrate the occurrence of the Hagarstown Beds in Figures 9 to 11.

A summary of groundwater elevations from existing wells is included in Table 5 and hydrographs for representative well locations are included in Appendix C. Table 6 summarizes water elevations from piezometers located within and adjacent to Ash Pond 2 and Ash Pond 1. Table 6 also includes elevations from AECOM piezometer (P012) which is screened below the impoundment in the Hagarstown Beds.

Ash leachate is present within Ash Pond 2 and the elevations within the impoundment are significantly above groundwater elevations measured outside the impoundment in the Hagarstown Beds (i.e., observation wells [OW] versus monitoring wells G401 to G405. Within the impoundment, measurements collected from OW-1 through OW-5 indicate the CCR porewater elevation ranges between 635 and 637 (Table 7), while wells outside and below the impoundment range from approximately 604 ft (G402) to 625 ft (P012), indicating the groundwater elevation in the Hagarstown Beds is generally 10 to 15 feet lower than those measured within the impoundment. The leachate appears to be perched above the lower permeability Loess Unit and/or Hagarstown Member gravelly clay till, which locally acts as an aquitard. Leachate head elevations decrease significantly across the impoundment berms and seeps

observed on the berms are likely derived from flow along the ash/aquitard interface. These seeps have been observed adjacent to well locations G404 and G405 along the north impoundment berm and G406 at the southwest corner of Ash Pond 2. The presence of a surface water control channel adjacent to and along the north berm, the ravine to the east, and the southern discharge channel all limit the lateral extent of ash leachate movement.

2.3.2 Groundwater Flow

Potentiometric surface maps prepared from elevation data measured in monitoring wells indicate groundwater elevations can be variable but flow directions are generally consistent. Groundwater generally flows from the center of the site both to the east to the Unnamed Creek, and westward towards Coffeen Lake. Near Ash Pond 1 flow appears to be radial based on mounding created by that unit. In the vicinity of Ash Pond 2 there appears to be a component of radial flow due to water elevations within the ash pond. However, flow within the underlying Hagarstown Beds appears to be east to the Unnamed Creek and south to the discharge flume (water elevation of approximately 604 ft). As shown in Figure 4, ash is in contact with the Hagarstown Member in two areas on the eastern side of the impoundement. Given the elevated heads measured in Ash Pond 2, the predominant flow of water from the ash into the Hagarstown Member likely occurs in these former ravines and migrates within the Hagarstown eastward, beneath the constructed berms, and discharges through seeps into the Unnamed Creek. As previously noted, seeps were also observed along the north and south sides of Ash Pond 2. The horizontal gradient between wells G405 and G404, as measured in May 2016 and November 2016, is 0.007. Representative potentiometric surface maps are shown in Figure 12 and Figure 13.

Construction of the Ash Landfill, Gypsum Stack Pond, and Recycle Pond required removal of the Hagarstown Beds, in effect removing the aquifer beneath the footprint of these units (Hanson 2016b). The groundwater flow dynamics beneath/around the Ash Landfill and GMF Units is affected by several factors, including: removal of the Hagarstown Member from beneath the Units; presence of the construction dewatering systems around the units; and the lateral variability of lithology within the Hagarstown Member. It is uncertain whether these constructed units significantly limit lateral groundwater flow, either by creating no flow zones or by capturing groundwater via their dewatering systems. Potentiometric contours included in Figures 12 and 13 project flow beneath the units.

2.3.3 Vertical Groundwater Gradients

Nested monitoring wells G405D / T408 / G45D and G406 / T409 / G46D were installed in August 2016 to determine the vertical extent of impacts near Ash Pond 2. Based on the water elevations measured in these wells in November 2016, vertical gradients are upward between the Vandalia and Hagarstown Beds and range from 0.009 to 0.42 ft/ft. Between the Vandalia and Smithboro Tills vertical gradients are

significantly downward, ranging from 1.46 to 2.44 ft/ft. A summary of vertical gradients is included in Table 8.

2.3.4 Groundwater Discharge to Coffeen Lake and the Unnamed Creek

The flow of groundwater to both the Unnamed Creek and Coffeen Lake (via the discharge flume) was estimated using a number of general conservative assumptions regarding creek flow and lake levels. Calculations are included in Appendix D, and the results are summarized as follows:

- Flow from Ash Pond 2 through the Hagarstown along the eastern edge of the impoundment is approximately 0.034 cubic feet per second (cfs), or 2 cubic feet per minute (cfm); and estimated flow in the Unnamed Creek based on its geometry is approximately 43.3 cfs (2,600 cfm).
- Flow from Ash Pond 2 from the Hagarstown into the discharge channel along the southern edge is approximately 0.032 cfs (1.9 cfm), and flow in the discharge channel based on average daily flow (based on the NPDES permit) is approximately 773 cfs (46,400 cfm).

2.4 Conceptual Site Model

The geology and hydrogeology described above is summarized and grouped into the following hydrostratigraphic units for the remaining discussion in this report:

- Ash Unit – Saturated CCR within the various CCR Units
- Upper Confining Unit – Low permeability clays and silts, including the Loess Unit and the upper clayey till portion of the Hagarstown Member
- Uppermost Aquifer (Groundwater Monitoring Zone) – Thin (generally less than 3 feet), moderate permeability sand, silty sand, and sandy silt/clay units which include the Hagarstown Member and the upper Vandalia Member (where weathered).
- Lower Confining Unit – Thick (generally greater that 15 feet), very low permeability sandy silt till or clay till that includes the unweathered lower Vandalia Member, Mulberry Grove Member (discontinous), and Smithboro Member.

Mounding of water within saturated ash in the impoundment creates a component of radial flow. The extent of this groundwater movement appears to be limited, as the elevated heads overlying the Upper Confining Unit dissipate across the Ash Pond 2 berms. Potentially impacted water from the seeps observed along the berms may partially infiltrate through the Upper Confining Unit and/or run off toward the Lake or Unnamed Creek.

The Uppermost Aquifer underlying Ash Pond 2 consists of the Hagarstown Member and the weathered (upper) portions of the Vandalia Member, which is being monitored to define the extent of CCR constituents derived from Ash Pond 2. The Uppermost Aquifer is confined except where the Hagarstown Member is exposed along the eastern side of the impoundment within the former ravine (Figure 4). Based

on hydraulic conductivity values (10^{-3} to 10^{-4} cm/sec) measured in the monitoring wells screened in the Hagarstown Member, groundwater at CPS has previously been classified as Class I in accordance with 35 IAC 620 (Hanson, 2009).

CCR within Ash Pond 2 is underlain by the Upper Confining Unit beneath the majority of the impoundment footprint. However, in former drainage features present prior to construction the saturated ash is in contact with the Hagarstown Beds and underlain by the Vandalia Member. Given the relatively high permeability of the Hagarstown Beds, leachate from Ash Pond 2 infiltrates into this unit, migrates through/under the eastern berm (where the Hagarstown Member is continuous below the berm) and discharges along the slope, as evidenced by the observation of seeps (Figure 4).

Groundwater within the Hagarstown Beds beyond the boundary of Ash Pond 2 flows predominantly to the east and south. Both the southern discharge flume and the Unnamed Creek intersect and cutoff the Hagarstown unit, eliminating further migration of potentially impacted groundwater. Impacted groundwater may also migrate to the north and northwest in the Hagarstown, potentially under the influence of the passive (gravity drain) underdrain system associated with the Recycle Pond and active underdrain system associated with the Landfill.

2.5 Potable Water Well Inventory

A potable water well inventory was completed in 2013 during the Phase I Hydrogeological Assessment (NRT, 2013). Public records were searched to identify water supply wells located within 2,500 feet of the unlined impoundments. The Coffeen property boundary is located in Township 7 North, Range 8 West, and the unlined impoundments are located in the southwest quarter of Section 11. The 2,500 foot boundary spans across Sections 10, 11, 14, and 15. All wells within Sections 10, 11, 14, and 15 are shown on Figure E1 and tabulated in Appendix E.

The following sources of information were queried to identify well locations.

- Illinois State Geological Survey's Illinois Water Well (ILWATER) Internet Map Service
- Illinois State Water Survey Domestic Well Database
- Illinois EPA's web-based Geographic Information System (GIS) files

Twenty-six water well records were identified within the four sections surrounding the unlined impoundments, and are numbered 1 through 26 on Figure E1. Based on state records there are two non-community water supply (NCWS) wells, one industrial/commercial well, ten monitoring wells (associated with the White and Brewer facility), and 13 farm/domestic water wells within the four section search area (Appendix E). The Coffeen Power Station does not have a water supply well. The two NCWS wells, points 25 and 26, are located within Sections 10 and 15 and outside of the 2,500 feet boundary of

the impoundments (Figure E1 and Appendix E). There are no maximum setback zones (as defined by 35 IAC 671) for these two NCWS wells.

All except one of the wells identified in the well search are east or west of Coffeen Lake, which is a hydraulic divide for potentially impacted groundwater. The only water well located between the east and west branches of the lake is well 22, which was reportedly installed in 1981 and completed in sand and gravel at a depth of 39 feet. This well was observed during the original Hydrogeologic Investigation and removed by the Contractor during construction of the Recycle Pond (Rhonald Hasenyager, Hanson Professional Services, Inc.; personal communication).

Public water supply (PWS) wells within a ten mile radius of the Coffeen CCP impoundments were identified via a search of the Illinois State Water Survey's Illinois Water Inventory Program (IWIP) database (not available on-line) by RAPPS (2009). Three wells belonging to the Village of Fillmore are located within the search radius, the closest one is approximately eight miles northeast of the impoundments.

3 GROUNDWATER QUALITY

3.1 Summary of Groundwater Monitoring

Groundwater monitoring at the Coffeen Power Station was initiated in 2006 prior to construction of the Gypsum Management Facilty and Landfill; however, consistent data collection near Ash Pond 2 began in November 2015 to comply with the CCR Rule. There are currently no IEPA monitoring requirements for Ash Pond 2. The following discussion presents an analysis of historical data collected from 2010 to 2012 (in well G402, formerly APW-2) and recent CCR data from November 2015 to 2016. Limited data from monitoring wells near the Landfill, Gypsum Stack Pond and Gypsum Recycle Pond are also included to evaluate historical trends. Groundwater data from monitoring wells near Ash Pond 1 are not included in this analysis.

Groundwater monitoring around Ash Pond 2 that was initiated in November 2015 included seven well locations. Sampling is conducted quarterly at 2 background wells and 5 downgradient wells for the following parameters:

Metals (totals)			
Antimony	Boron	Cobalt	Molybdenum
Arsenic	Cadmium	Lead	Selenium
Barium	Calcium	Lithium	Thallium
Beryllium	Chromium	Mercury	
Inorganics (totals)			
Fluoride	Chloride	Sulfate	Total Dissolved Solids
Field			
pH	Dissolved Oxygen	Specific Conductivity	Turbidity
Oxidation/Reduction Potential	Temperature		

In August 2016, four additional wells (G406, G407, G45D, G46D) were installed to further define the extent of impacts from Ash Pond 2 and refine the GMZ proposed in the CAP. Groundwater samples were collected in August and November, 2016 and results are included in this analysis. Data for the expanded parameter list for the federal CCR sampling will be reported in accordance with the groundwater monitoring plan included with the Closure Plan for Ash Pond 2.

3.2 Groundwater Monitoring Results and Analysis

Analytical results for Ash Pond 2 wells from 2010 (APW-2) through October 2016, and from 2008 to 2016 for select wells around the SW Pond and Recycle Pond are summarized in Appendix F. Statistics

showing the minimum and maximum concentrations detected in the groundwater samples is included for each well in Table 9. Table 9 also includes a comparison of groundwater data from wells to the Groundwater Quality Standards for Class I: Potable Groundwater. The well locations are shown on Figure 3. Note these results include both dissolved and total analytes, and are compared to 35 IAC 620 Class I Standards. Where possible, emphasis is placed on dissolved analyses, but totals are used when no dissolved analysis was available.

Parameters that have been detected in groundwater at concentrations exceeding the Class I groundwater quality standards include the following: arsenic, boron, lead, manganese, sulfate, and total dissolved solids (reported as residue on evapoaration or ROE). A summary of recent exceedances in 2015 and 2016 follows for the parameters of concern. Time-series graphs for each of the groundwater parameters at the 7 monitoring wells around Ash Pond 2 and select wells around the SW Pond and Recycle Pond are included in Appendix F including all historical results for these locations.

Arsenic

Arsenic exceeded the Class I standard (0.010 mg/L) in well G405 (November 2015), and G402 (November 2015, and February and May 2016) which are located at the toe of Ash Pond 2 on the north and southeast side, respectively. Results from other wells on-site are either non-detect or at concentrations well below the standard. However, arsenic is naturally occurring in Illinois groundwater. State agencies (IDNR, IDPH & IEPA, 2001) have noted that “arsenic concentrations that vary dramatically over a relatively short distance indicates that local conditions dictate arsenic concentration in groundwater, and it is difficult to make regional generalizations.” Therefore, it is equally dificcult to make large-scale source determinations because of the concentration variations over these reported short distances.

Boron

Boron exceeded the 2 mg/L Class I standard during all events at wells G401 and G405, located south and north of Ash Pond 2, respectively. Exceedances were also measured in G402, southeast of the unit and G404 and the nearby Recycle Pond well G275, located northeast of the unit. Recently installed deep wells (G45D and G46D) did not exceed the Class I standard, indicating the impacts do not extend vertically through the Vandalia Till. West of the unit, G403 exhibits very low concentrations of CCR parameters which may be related to the relatively thin Hagarstown unit at this location (~0.2 ft). The groundwater elevation at G403 is also the highest measured value around Ash Pond 2, implying the impacted water does not flow toward this location. The highest concentrations of boron in groundwater have been detected in G405 and range from 15 to 17 mg/L. This concentration is significantly higher than other wells located adjacent to the Pond, and may be related to the shallow depth and increased

thickness of the Hagarstown Beds observed at this location. As discussed previously it is unclear if the seeps along the northern berm are infiltrating and resulting in localized increases in concentration.

Ash Pond 2 was closed/capped in the mid-1980's and it is expected that groundwater has reached equilibrium with respect to Ash Pond 2 (both concentrations and heads). Long term data collection at G402 (APW-2) supports this conclusion as boron concentrations have remained relatively stable (Appendix F). Results from sampling at G275 indicate highly variable concentrations of boron which may be related to the well's proximity to the Unnamed Creek, which exhibits significant seasonal fluctuations in discharge. Increasing trends are visible in results from G271, G273, and G274 (located north of the unit between the Recycle Pond and Ash Pond 2), although concentrations are significantly below the standard. The slight increases in concentration at these locations may be attributed to the construction of the Recycle Pond. As discussed in Subsection 2.3.2, construction of the Recycle Pond has likely impacted the groundwater flow dynamics in the area. The removal of the Hagarstown Member and the installation of the passive dewatering system may be allowing the northerly migration of contaminants toward the Recycle Pond monitoring system wells. Additional data is necessary to establish long term trends in boron concetrations at other monitoring wells near Ash Pond 2.

Lead

Lead was detected above standard (0.0075 mg/L) adjacent to Ash Pond 2 in G402 and G405. Concentrations above standard were also reported in G275, G276, G278, and G280 near the GRP. However, with the exception of G402, additional samples collected at these locations did not contain elevated lead concentrations, suggesting exceedances at these locations were anomalous and likely related to turbidity.

Sulfate

Sulfate, like boron, is a primary indicator of CCR leachate, and exceeded the 400 mg/L Class I standard at Ash Pond 2 wells G401, G402, G405, G406 (located around the perimeter of the Pond) and G407 (located approximately 1,000 feet west of the Pond). It also exceeds the standard at G271, G273, G275 and G279 adjacent to the Recycle Pond and north of Ash Pond 2, and G153 adjacent to the SW Pond and northwest of Ash Pond 2. At well G274 exceedances occurred in December 2012 and January 2013, but recent results indicate concentrations are below the standard. Sulfate, when present with elevated boron concentrations, is presumed to be indicative of potential impacts from a CCR unit. The highest concentrations of sulfate are detected in G401, which is located on the south side of Ash Pond 2. Sulfate concentrations generally correlate with boron concentrations with the exception of G271, G273, G279, and G407 where elevated sulfate is present without a significant boron presence. Increasing trends of boron in G71, G273, and G279 suggest that sulfate concentrations may be partially in response to effects from Ash Pond 2, but limited data from G407 (installed in August 2016) does not allow a similar analysis.

Current data does not suggest wells G153 and G407 are impacted by Ash Pond 2; however, without more data a definitive source of the sulfate in G153 and G407 cannot be determined.

Increasing trends are apparent at wells G153, G271, and G272. As discussed previously, increasing concentrations in G271 and G272 may be naturally occurring background in conjunction with changes in groundwater flow and geochemical conditions following construction of the Recycle Pond. It is unclear why sulfate concentrations are increasing in G153; it may be due to similar effects following construction of the Landfill and SW Pond. Sulfate concentrations in this well have been elevated since it was installed in 2011. Background well G270 had increased concentrations following installation in 2008 until December 2014; however, since then the concentration has stabilized and declined. Remaining wells exhibit stable concentration trends, although more data is needed for CCR wells installed in 2015 (G401 to G405).

Manganese

Manganese concentrations exceeded the Class I standard of 0.15 mg/L at monitoring wells G402, G404, G405, and G406 during 2015 and 2016. Wells G401, G402, and G403 are part of the CCR Rule monitoring program and have not been sampled for manganese (not an Appendix III or Appendix IV parameter). Wells around the SW Pond G151, G152, and G153 have exceeded the standard at least once during 2015-2016 and concentrations of manganese around the Recycle Pond are highly variable, however only G270 has exceeded the standard during 2015-2016. In locations where elevated manganese concentrations are present with both elevated boron and sulfate, it is likely related to effects of the impoundment(i.e. changes in geochemical conditions) but not necessarily directly from the CCR leachate. However, in some cases (i.e. G151, G152, G153, G270, and G407) the lack of elevated concentrations of boron (and in some cases sulfate, i.e. G151, G152, and G270) in groundwater indicates that the elevated manganese concentrations may be primarily associated with with changing geochemical factors (following construction of nearby CCR units and only secondarily related to the impoundment. Time concentration plots indicate decreasing manganese trends in groundwater from G270 and G273, no other trends are apparent in monitoring wells evaluated for this analysis.

Total Dissolved Solids

TDS concentrations regularly exceed the Class I standard of 1,200 mg/L at wells G401, G402, G405, G406, and G407 around Ash Pond 2 and also adjacent to the SW Pond (G153) and the GRP (G273 and G275). TDS reflects concentrations of major ions in groundwater and in the wells listed above sulfate concentrations make up the largest component of the TDS exceedances. TDS concentrations mirror trends observed in sulfate concentrations, with slightly increasing trends observed in G153, G271, and G272.

pH

The pH measured in G401 (south of the unit) fell below the lower limit (6.5 standard units, SU) during sampling in 2015 and 2016. Groundwater in this well appears to be impacted (based on boron and sulfate concentrations) and results from recent surface and source water sampling indicates the CCR leachate is slightly acidic, and is likely the source of acidity causing low pH values in groundwater. Monitoring well G402, also located south of the unit, exhibits simalr pH measurements but does not exceed the lower pH standard.

3.3 Impacted Groundwater Discharge to Surface Water

Based on the groundwater discharge calculations discussed in 2.3.4, and maximum concentrations of boron and sulfate detected in groundwater, the concentration of boron and sulfate loading into Coffeen Lake and the Unnamed Creek were calculated to determine if they exceed surface water standards. Calculations are included in Appendix D, and indicate that approximately 12.5 kg of boron are discharged to the creek each day, resulting in a calculated concentration of 0.115 mg/L. The estimated sulfate concentration is 1.9 mg/L.

In the discharge channel to the south, approximately 1.6 kg of boron is discharged via groundwater baseflow each day, resulting in a calculated concentration of 0.01 mg/L; the concentration of sulfate in the discharge flume is estimated at 50.1 mg/L. In both discharge areas the resulting concentrations are significantly below standards. Recent surface water sampling (Table 10) also confirms that Coffeen Lake is not impacted by Ash Pond 2 because measured concentrations of sulfate (~55 mg/L) and boron (≤280 ug/L) are well below standards and similar to background groundwater concentrations measured elsewhere onsite (i.e., at background wells G200 and R201).

4 CONCLUSIONS

Based on extensive site investigation and monitoring, the site has been characterized and a detailed site conceptual model has been developed. In conjunction with the hydrogeologic investigation, a groundwater model has also been developed to predict the effect of ash pond closure via capping on groundwater quality. The groundwater model report is being submitted under separate cover.

CPS and Ash Pond 2 overlie a significant thickness of glacially-derived deposits. The unlithified deposits which occur at Ash Pond 2 include the following hydrstratigraphic/geologic units:

- Ash Unit – Saturated CCR wIthin the various CCR Units
- Upper Confining Unit – Low permeability clays and silts, including the Loess Unit and the upper clayey till portion of the Hagarstown Member
- Uppermost Aquifer (Groundwater Monitoring Zone) – Thin (generally less than 3 feet), moderate to high permeability sand, silty sand, and sandy silt/clay units which include the Hagarstown Member and the upper Vandalia Member (where weathered).
- Lower Confining Unit – Thick (generally greater that 15 feet), very low permeability sandy, silt till, or clay till that include the unweathered Vandalia Member , Mulberry Grove Member (discontinous), and Smithboro Member.

CCR is underlain by the Upper Confining Unit in the majority of the Ash Pond 2 footprint and mounding of water within saturated ash in the impoundment creates a component of radial flow. However, the extent of this groundwater movement appears to be limited, as the elevated heads overlying the Upper Confining Unit dissipate across the Ash Pond 2 berms. Leachate seeps observed along the berms may partially infiltrate through the Upper Confining Unit and/or run off with surface water toward the Lake or Unnamed Creek. In localized areas on the east side of Ash Pond 2, former drainage features that ocurr within the pond footprint eroded through the Upper Confining Unit such that the CCR is in contact with the permeable portions of the Hagarstown Beds. In these areas, CCR leachate appears to migrate in the Hagarstown Beds and discharge through seeps along the ravine into the Unnamed Creek to the east.

The uppermost aquifer underlying Ash Pond 2 consists of the Hagarstown Member and the weathered portions of the Vandalia Member, which is being monitored to define the extent of CCR constituents derived from Ash Pond 2. Groundwater at CPS has previously been classified as Class I Potable Resource Groundwater. The uppermost aquifer is confined except where the Hagarstown Member is exposed along the eastern-side of the impoundment within the former ravine.

Groundwater within the Hagarstown Beds beyond Ash Pond 2 flows predominantly to the east and south. There is limited groundwater flow from Ash Pond 2 toward the west due to a thinning or lower hydraulic

conductivity of the Hagarstown Beds. Based on hydraulic conductivities and vertical gradients, horizontal groundwater flow in the overlying clays and underlying tills are negligible. Groundwater flow occurs primarily in the more permeable zones within the Hagarstown Beds. However, migration of impacts is limited to the east and south by the presence of the Unnamed Creek, Coffeen Lake and a surface water discharge flume, all three of which are areas of groundwater discharge and act as hydraulic barriers and/or groundwater divides.

Exceedances of Class I groundwater quality standards are present in monitoring wells at several locations around Ash Pond 2 for arsenic. boron, lead, manganese, sulfate, and total dissolved solids. The exceedances of Class I groundwater quality standards for arsenic, lead, manganese, sulfate, and TDS at several locations may be only partially attributed to Ash Pond 2, and are primarily a result of natural geochemical variations or background concentrations, specifically in wells where boron concentrations are low. The concurrent detection of elevated boron and sulfate concentrations are key indicators of the presence of CCR constituents related to Ash Pond 2.

Boron concentrations are generally stable with the exception of wells G271, G272, and G274 (located between Ash Pond 2 and the Recycle Pond), which have shown slight increases. However, concentrations remain significantly below the standard (2 mg/L). Increasing trends measured at these wells are attributed to the construction of the GRP north of the wells and the reduction of unimpacted groundwater flow towards these wells, or increased flow from Ash Pond 2, due to the underlying drainage system at the GRP.

Given the current groundwater data and Site information, groundwater quality is expected to improve following closure, as capping will reduce the infiltration of water and leachate generation from Ash Pond 2. Because CCR will remain in Ash Pond 2, a groundwater monitoring plan is being submitted with this Closure and Post-closure Care Plan. l.

5 REFERENCES

AECOM, 2016a. Revised 30% Closure Design Package for Coffeen Power Station, GMF Gypsum Stack Pond. 1/27/2016.

AECOM, 2016b. 30% Design Data Report for Dynegy Coffeen Power Station; Ash Ponds Nos. 1 and 2 CCR Units.1/12/2016.

AECOM, 2016c. Revised 30% Closure Design Package for Coffeen Power Station Ash Pond No. 2. April 16, 2016.

Hanson, 2016a. Corrective Action Plan. Coffeen Power Station, Illinois Power Generating Company, Coffeen, Montgomery County, IL. April 19, 2016.

Hanson 2016b. 40 CFR 257.60 Uppermost Aquifer Considerations, Gypsum Pond, Illinois Power Holdings LLC, Coffeen Energy Center, Montgomery County, Illinois, April 2016.

Hanson, 2015. Ash Landfill Storm Water Runoff Pond - G153 Assessment. Hanson Professional Services, Inc. January 15, 2015.

Hanson, 2014. G153 Assessment. WPC Permit No. 2011-EB-1289, Coffeen Power Station, Illinois Power Generating Company, Coffeen, Montgomery County, Illinois, December 19, 2014.

Hanson, 2009. Section 3: Hydrogeologic Investigation. Initial Facility Report, Hanson Professional Services, Inc. August 2009.

Herzog, B.L., B.J. Stiff, C.A. Chenoweth, K.L. Warner, J.B. Sieverling, and C. Avery, 1994, Buried Bedrock Surface of Illinois: Illinois State Geological Survey map, scale 1:500,000.

IDNR, 2014. Coffeen Lake State Fish and Wildlife Area Park Brochure. DNR – 06/14 • IOCI 0625-14

Kolata, D.R., 2005, Bedrock Geology of Illinois: Illinois State Geological Survey map, scale 1:500,000.

Natural Resource Technology, Inc., 2013. Phase I Hydrogeological Assessment Report. CoalCombustion Product Impoundments, Coffeen Energy Center, Montgomery County, IL.

Rapps Engineering & Applied Science, November, 2009. Site Characterization and Groundwater Monitoring Plan For CCP Impoundments, Ameren Energy Generating Company, Coffeen Power Station, Montgomery County, Illinois.

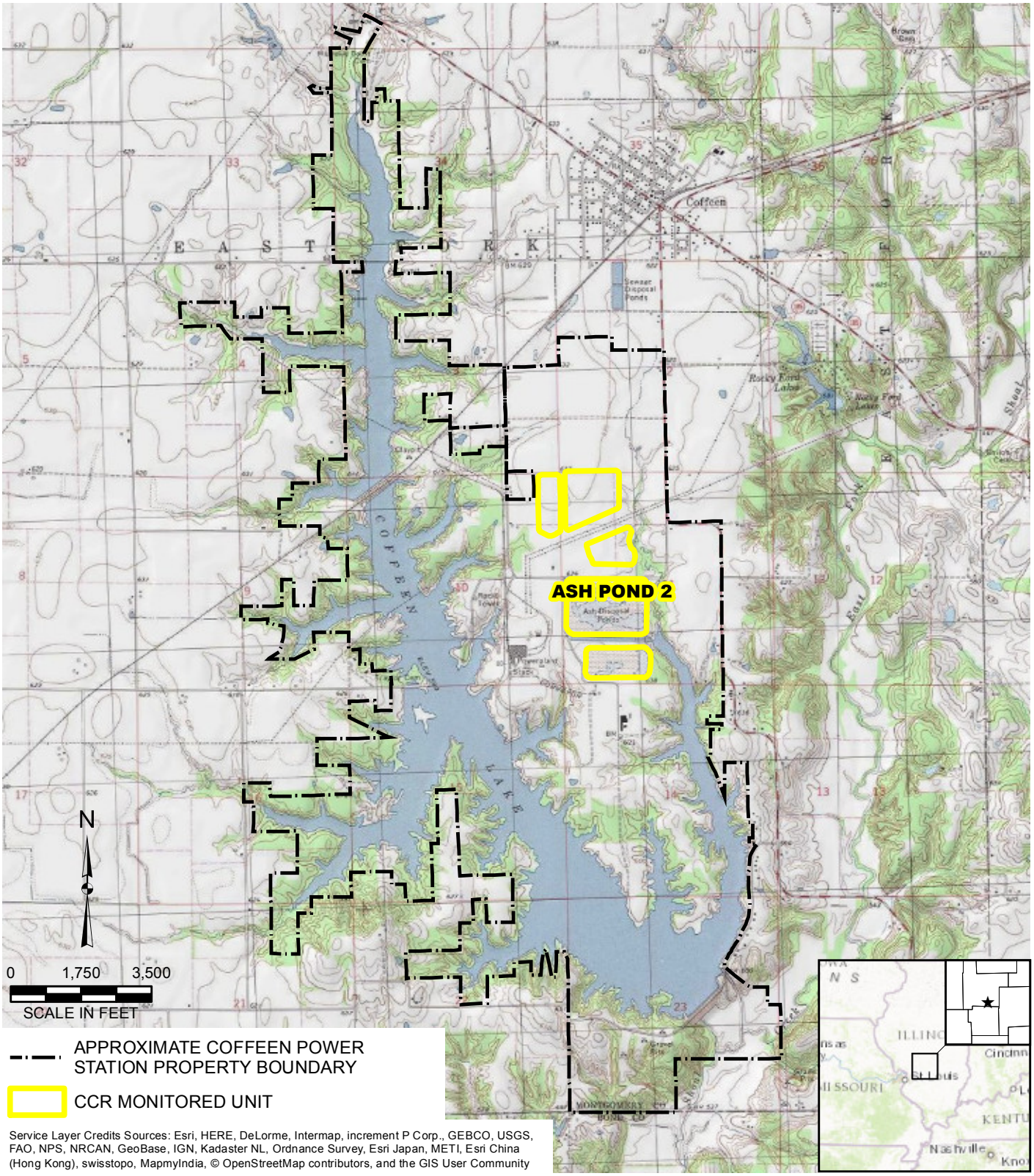
Willman, H.B., and J.C. Frye, 1970, Pleistocene Stratigraphy of Illinois: Illinois State Geological Survey, Bulletin 94, 204 p.

Willman, H.B., J.C. Frye, J.A. Simon, K.E. Clegg, D.H. Swann, E. Atherton, C. Collinson, J.A. Lineback, T.C. Buschbach, and H.B. Willman, 1967, Geologic Map of Illinois: Illinois State Geological Survey map, scale 1:500,000.

Willman, H.B., E. Atherton, T.C. Buschbach, C. Collinson, J.C. Frye, M.E. Hopkins, J.A. Lineback, and J.A. Simon, 1975, Handbook of Illinois Stratigraphy: Illinois State Geological Survey, Bulletin 95, 261 p.

Zeizel, A.J., 1959, Geologic Report on the Ground-Water Geology at Fillmore, Sections 23 and 26, T8N., R2W., Montgomery County: Illinois State Geological Survey, Open File Report

FIGURES



DRAWN BY/DATE:
SDS 12/21/16
REVIEWED BY/DATE:
NRK 12/21/16
APPROVED BY/DATE:
SJC 12/21/16

SITE LOCATION MAP

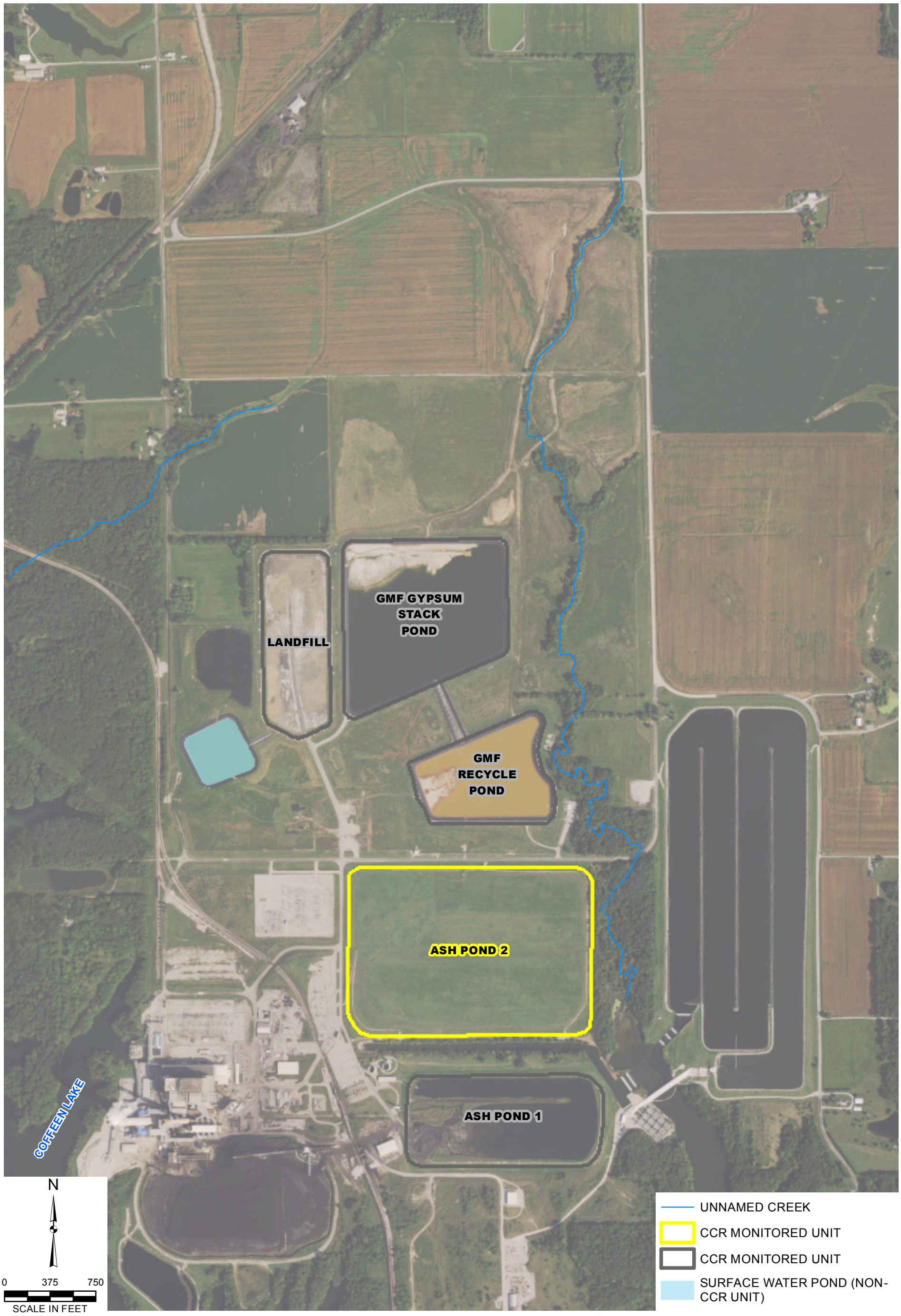
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

PROJECT NO: 2380

FIGURE NO: 1

Natural Resource Technology

Y:\Mapping\Projects\23\2380\MXD\HGCR\Figure 1_Site Location Map.mxd Author: tcushman; Date/Time: 12/22/2016, 2:40:21 PM



DRAWN BY/DATE:
SDS 12/5/16
REVIEWED BY/DATE:
NRK 12/5/16
APPROVED BY/DATE:
SJC 12/20/16

CCR MANAGEMENT UNITS

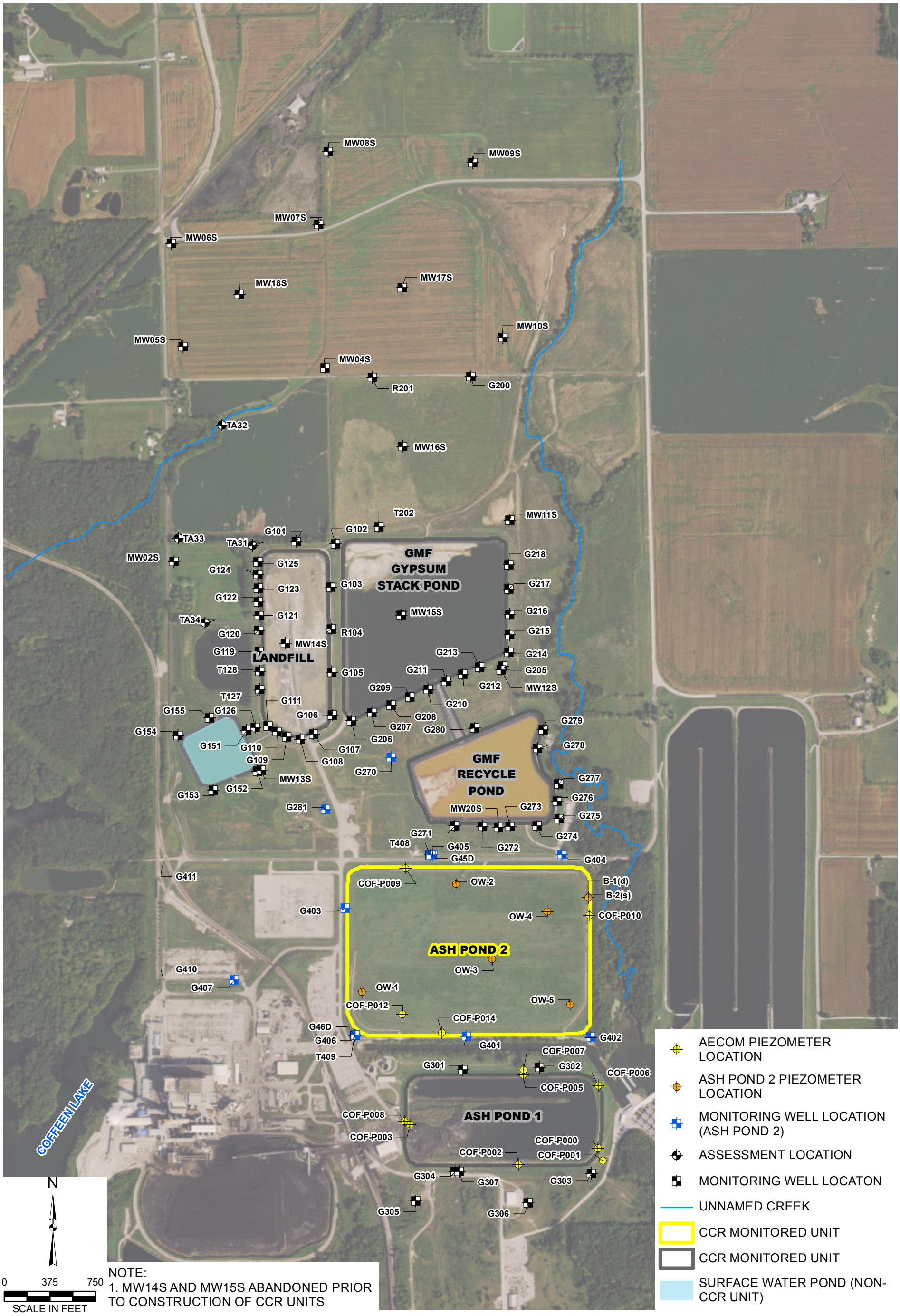
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

PROJECT NO: 2380

FIGURE NO: 2

Natural Resource Technology

Y:\Mapping\Projects\23\2380\MXD\HGCR\Figure 2_CCR Management Units.mxd Author: sstolz Date/Time: 12/20/2016, 3:17:41 PM



NOTE:
1. MW14S AND MW15S ABANDONED PRIOR TO CONSTRUCTION OF CCR UNITS

DRAWN BY/DATE:
SDS 12/8/16
REVIEWED BY/DATE:
NRK 12/8/16
APPROVED BY/DATE:
SJC 12/20/16

MONITORING WELL LOCATION MAP

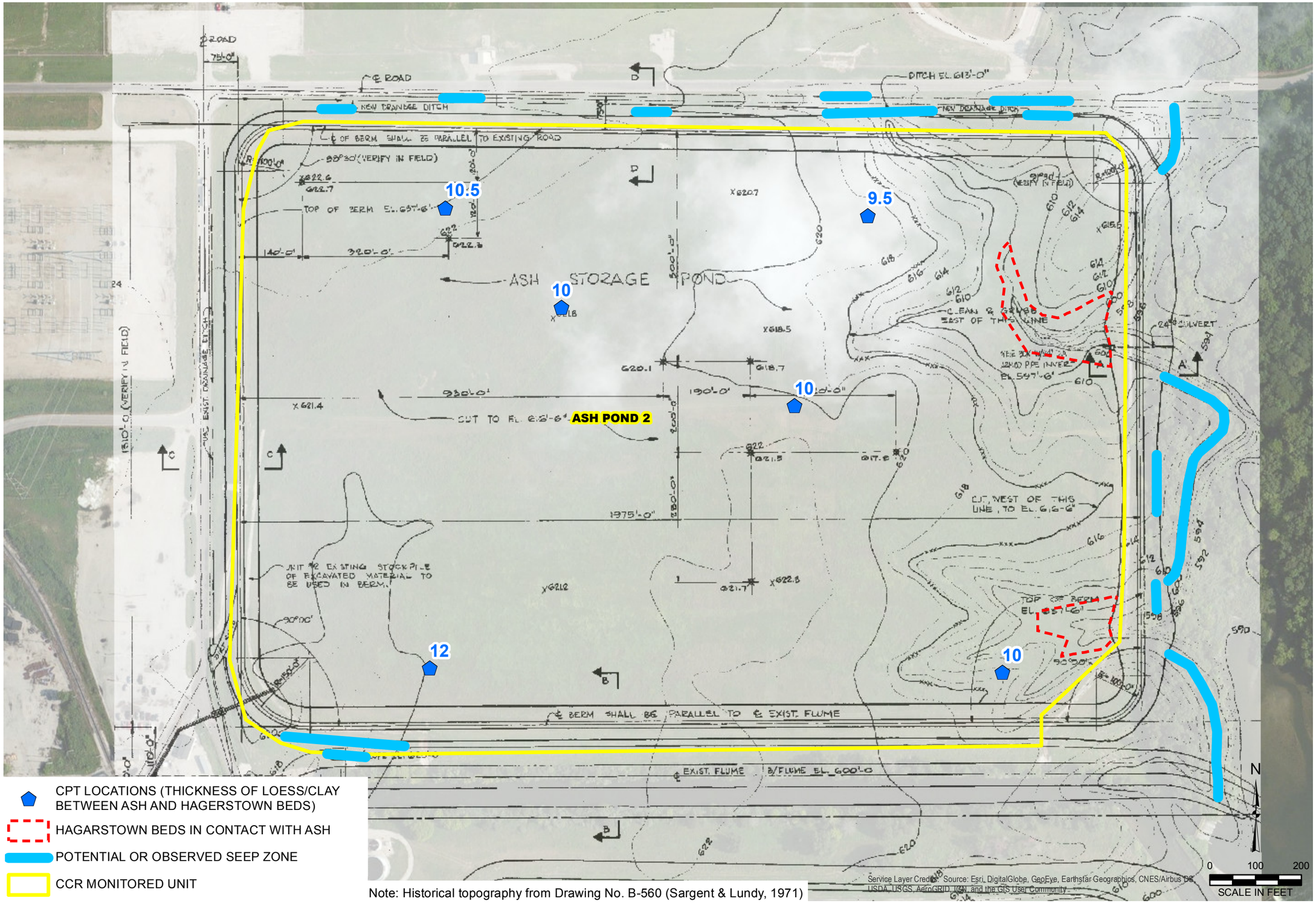
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

PROJECT NO: 2285

FIGURE NO: 3

Natural Resource Technology

Y:\Mapping\Projects\23\2380\MXD\HGC\Figure 3_MW Location Map.mxd Author: tcushman Date/Time: 12/22/2016, 2:45:35 PM



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Note: Historical topography from Drawing No. B-560 (Sargent & Lundy, 1971)

- CPT LOCATIONS (THICKNESS OF LOESS/CLAY BETWEEN ASH AND HAGERSTOWN BEDS)
- HAGARSTOWN BEDS IN CONTACT WITH ASH
- POTENTIAL OR OBSERVED SEEP ZONE
- CCR MONITORED UNIT

DRAWN BY/DATE: SDS 12/05/16
REVIEWED BY/DATE: NRK 12/05/16
APPROVED BY/DATE: SJC 12/20/16

THICKNESS OF LOESS / CLAY BELOW ASH POND 2

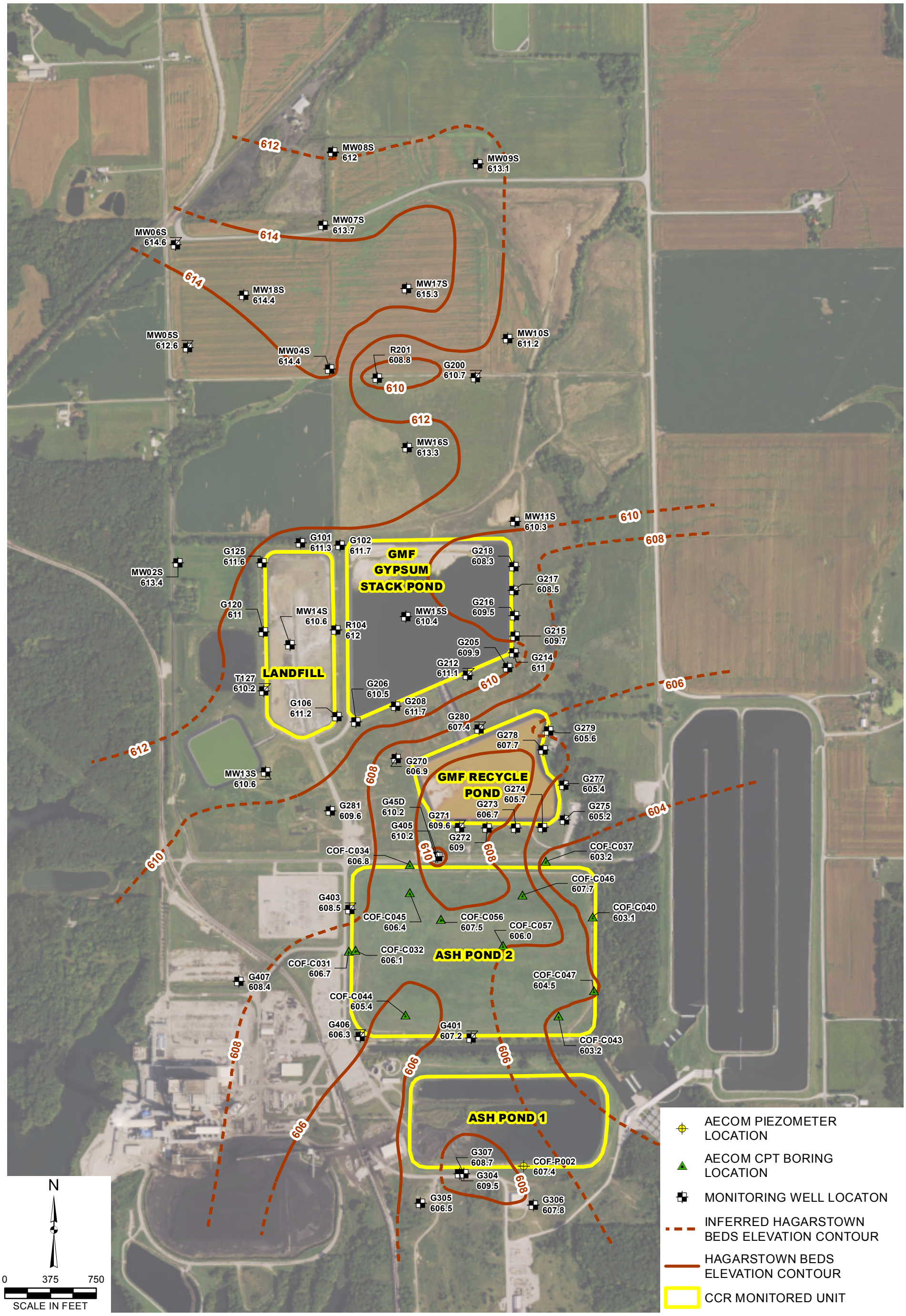
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

PROJECT NO: 2380

FIGURE NO: 4

Natural Resource Technology

Y:\Mapping\Projects\23\2380\MXD\HGCR\Figure 4_Thickness of Loess Clay.mxd Author: tcushman Date/Time: 12/22/2016, 2:50:01 PM



DRAWN BY/DATE:
SDS 11/3/16
REVIEWED BY/DATE:
JJW 11/3/16
APPROVED BY/DATE:
SJC 12/20/16

STRUCTURAL CONTOUR MAP
TOP OF HAGARSTOWN MEMBER

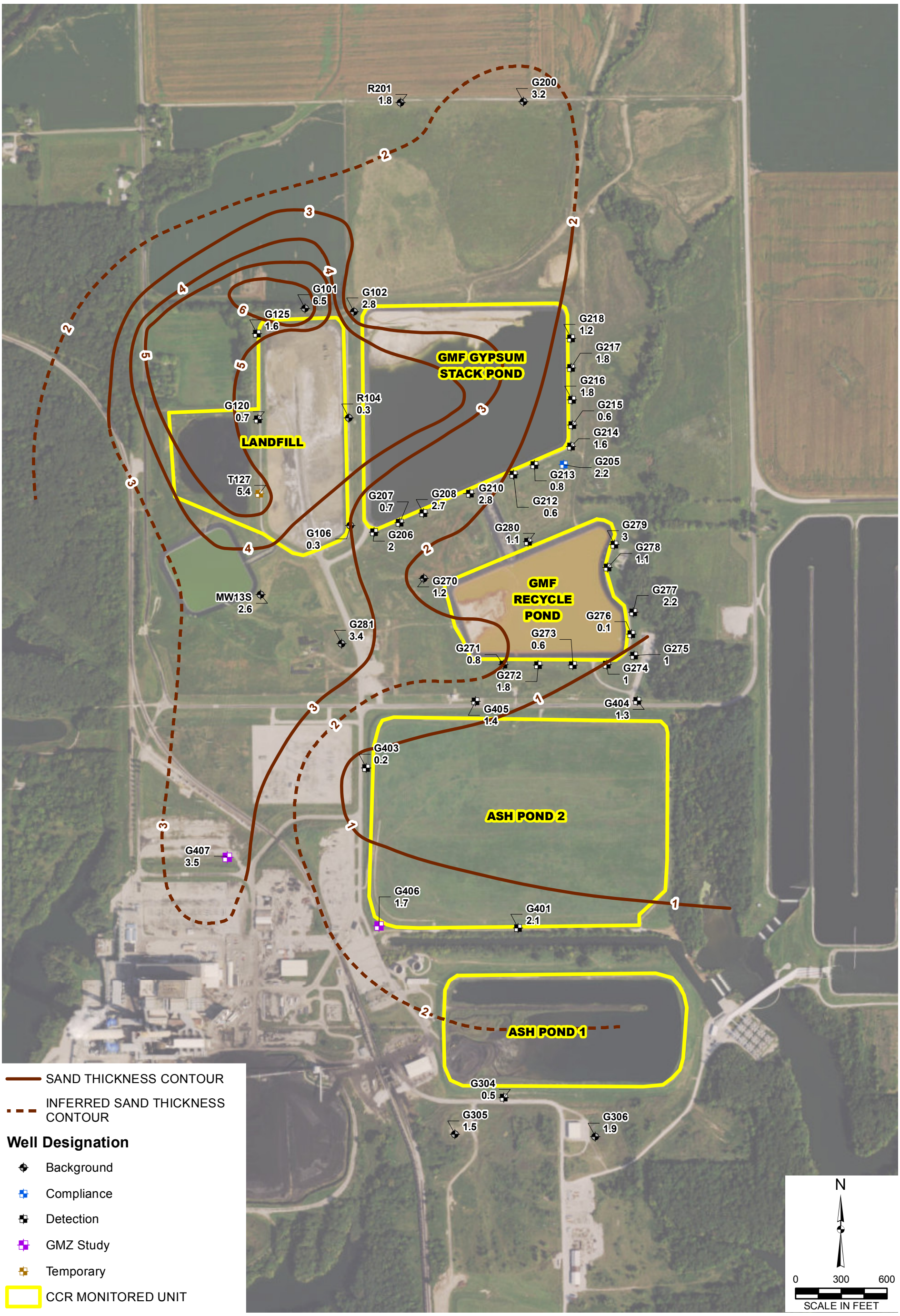
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

PROJECT NO: 2380

FIGURE NO: 5

Natural Resource Technology

Y:\Mapping\Projects\23\2380\MXD\HGCR\Figure 5_Coffeen Hagarstown.mxd Author: sstolz; Date/Time: 12/20/2016, 3:27:16 PM



DRAWN BY/DATE:
MDM 10/11/16
REVIEWED BY/DATE:
JJW 10/13/16
APPROVED BY/DATE:
SJC 12/20/16

THICKNESS OF HAGARSTOWN MEMBER SAND UNIT

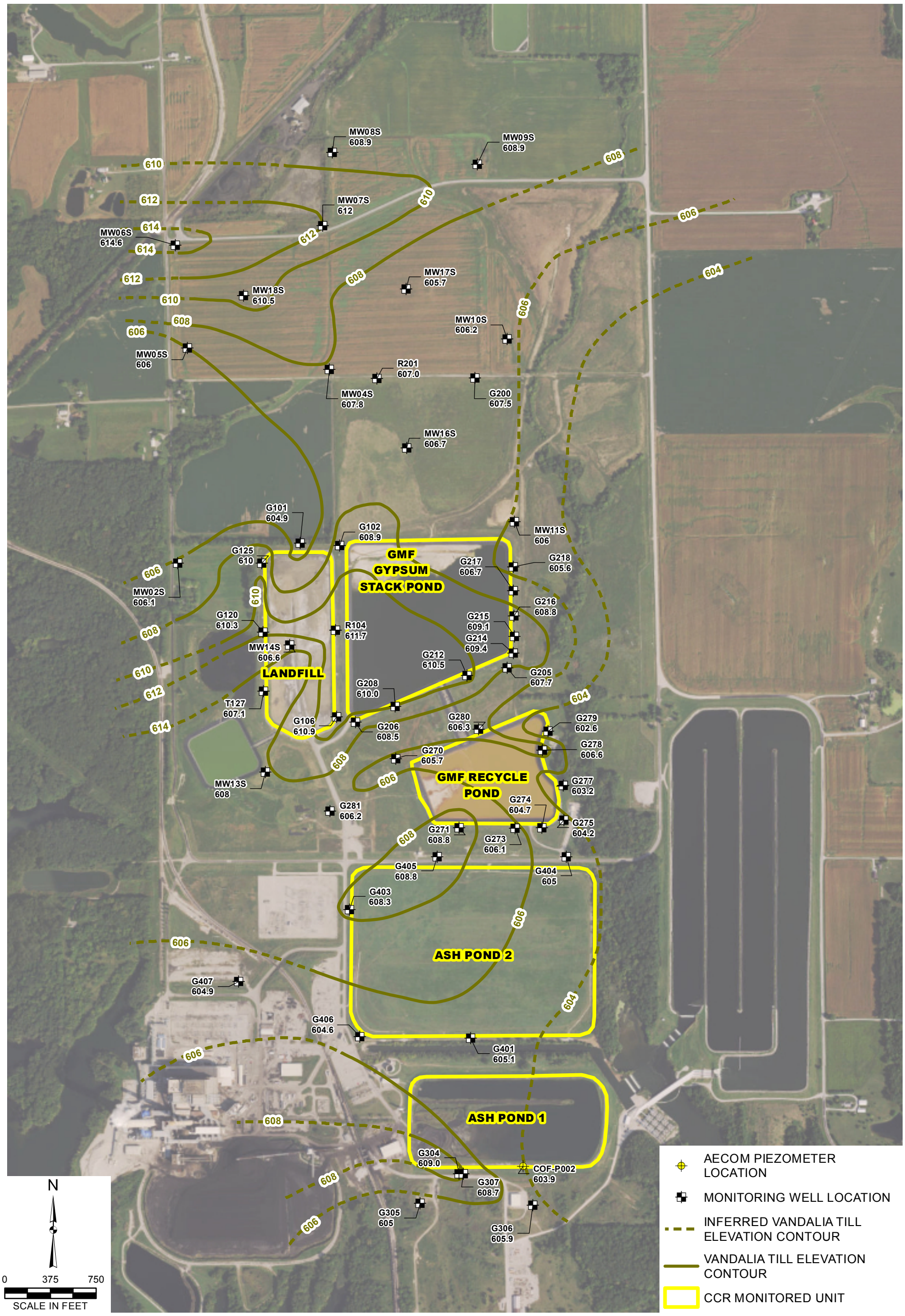
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

PROJECT NO: 2285

FIGURE NO: 6

Natural Resource Technology

Y:\Mapping\Projects\23\2380\MXD\HGCR\Figure 6_Thickness Hagastown.mxd Author: tcushman; Date/Time: 12/22/2016, 2:52:37 PM



DRAWN BY/DATE:
SDS 11/3/16
REVIEWED BY/DATE:
JJW 11/3/16
APPROVED BY/DATE:
SJC 12/20/16

STRUCTURAL CONTOUR MAP
TOP OF VANDALIA TILL

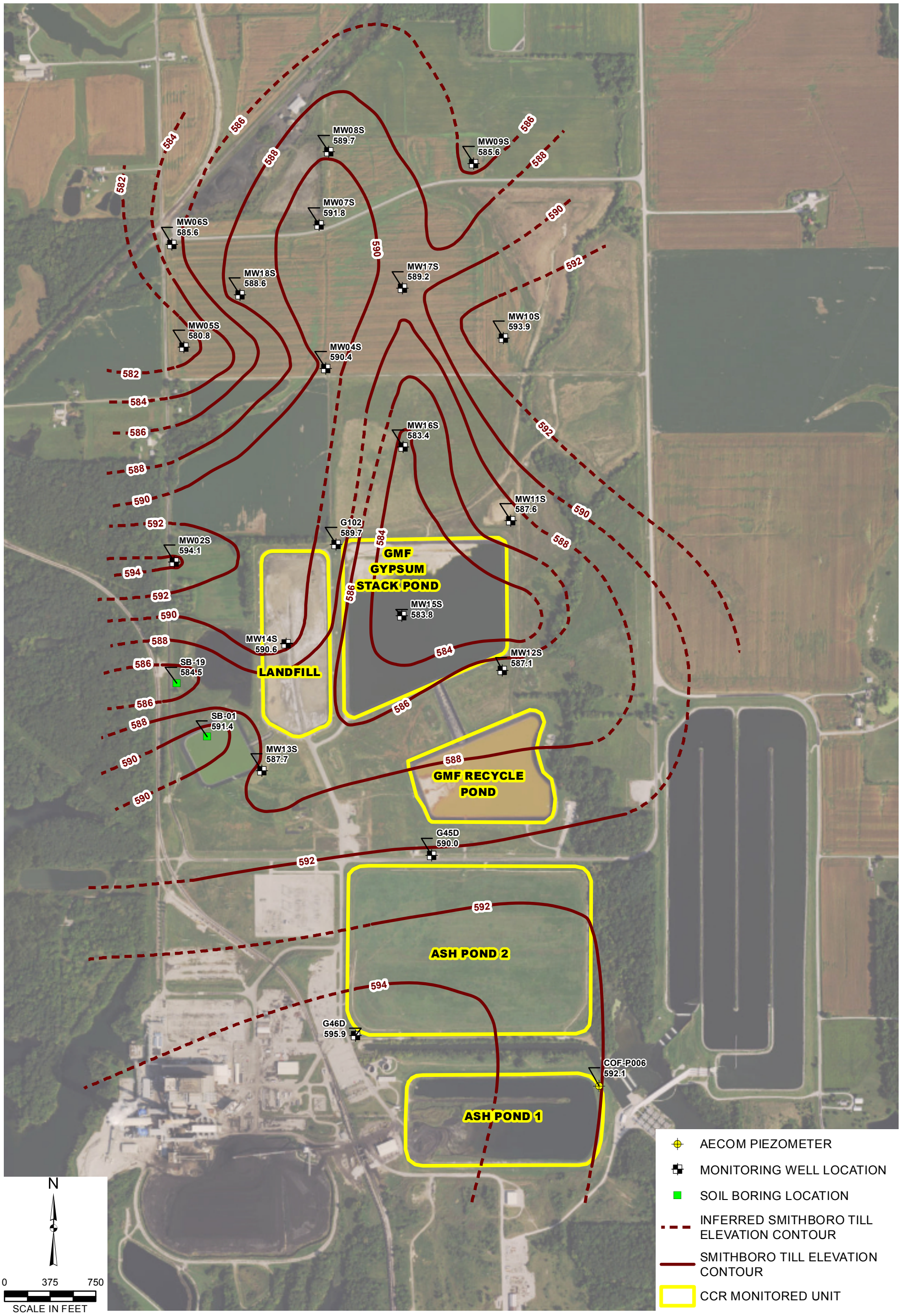
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

PROJECT NO: 2380

FIGURE NO: 7

Natural Resource Technology

Y:\Mapping\Projects\23\2380\MXD\HGCR\Figure 7_Coffeen Vanadalia.mxd Author: sstolz Date/Time: 12/20/2016, 3:30:52 PM



DRAWN BY/DATE:
SDS 11/3/16
REVIEWED BY/DATE:
JJW 11/3/16
APPROVED BY/DATE:
SJC 12/20/26

STRUCTURAL CONTOUR MAP
TOP OF SMITHBORO TILL

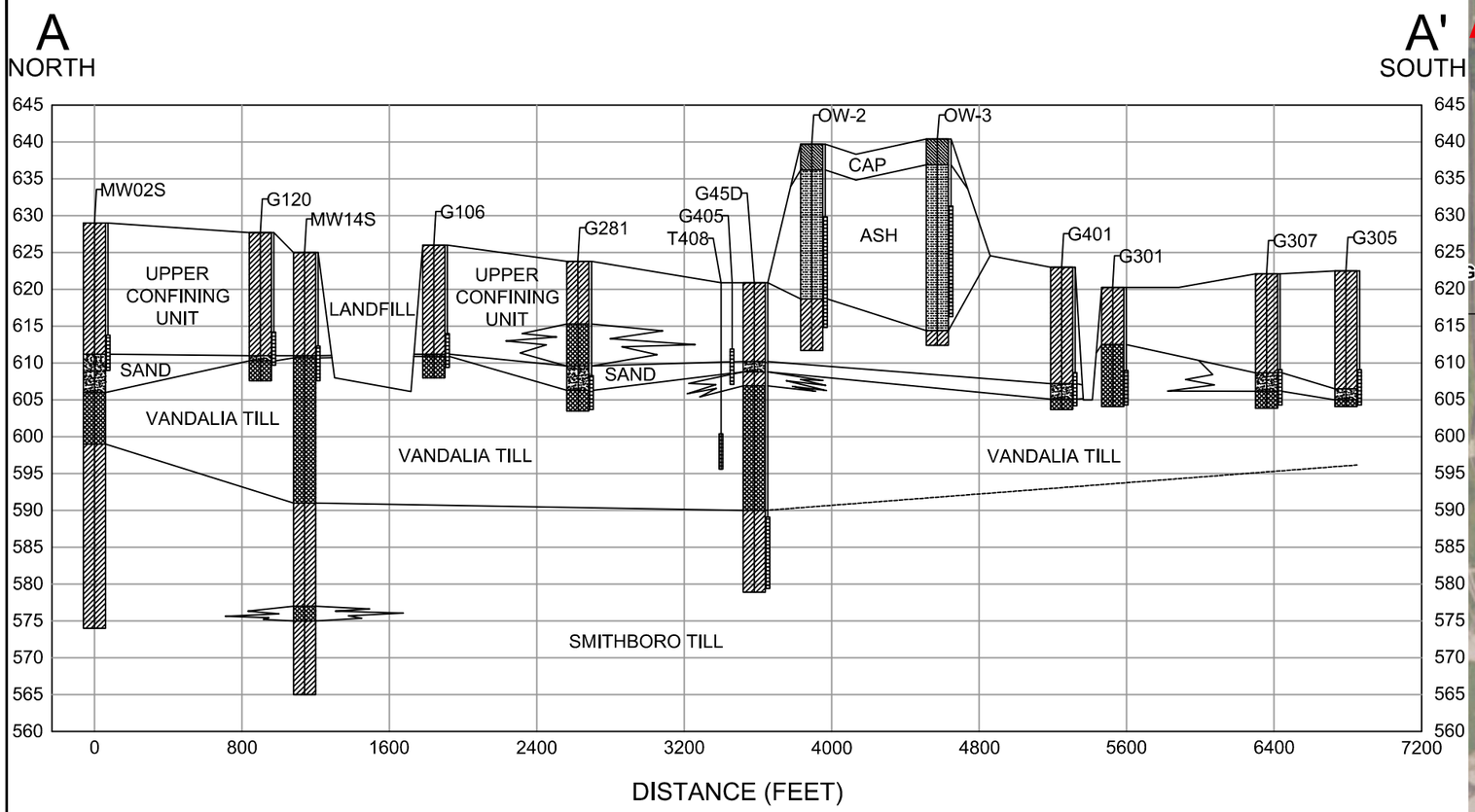
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

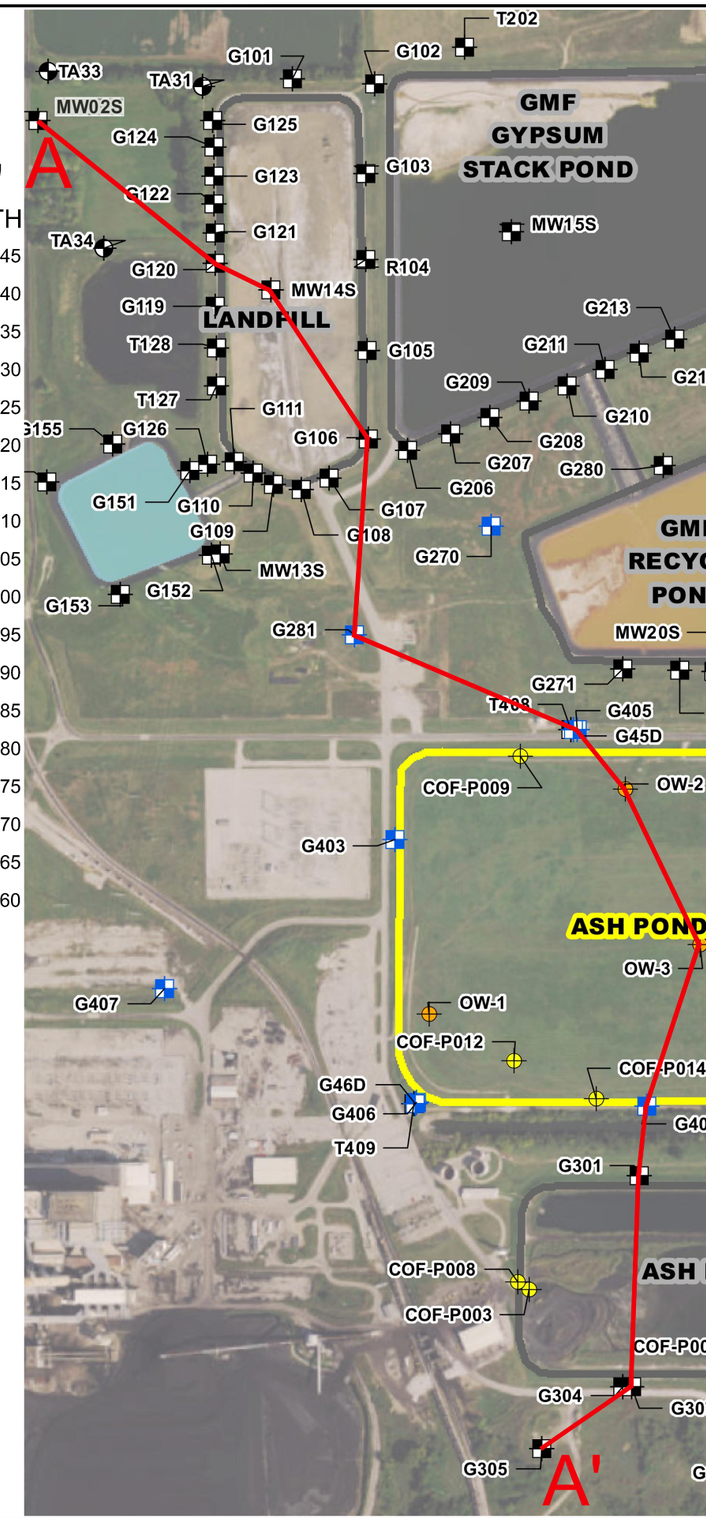
PROJECT NO: 2380

FIGURE NO: 8

Natural Resource Technology

Y:\Mapping\Projects\23\2380\MXD\HGCR\Figure 8_Coffeen Smithboro Till.mxd Author: sstolz; Date/Time: 12/20/2016, 3:31:20 PM





VERTICAL SCALE IN FEET: 20

HORIZONTAL SCALE IN FEET: 800

VERTICAL EXAGGERATION =40

B—B'	CROSS-SECTION TRANSECT
	CLAY
	SOIL
	SAND
	SILT
	ASH
	WELL SCREEN

DRAWN BY: AGC	DATE: 12/6/16	
CHECKED BY: NRK	DATE: 12/20/16	
APPROVED BY: SJC	DATE: 12/20/16	
DRAWING NO: Fig 9_Geologic Cross-Section A-A'	REFERENCE: SEE INFO BLOCK	

GEOLOGIC CROSS-SECTION A-A'

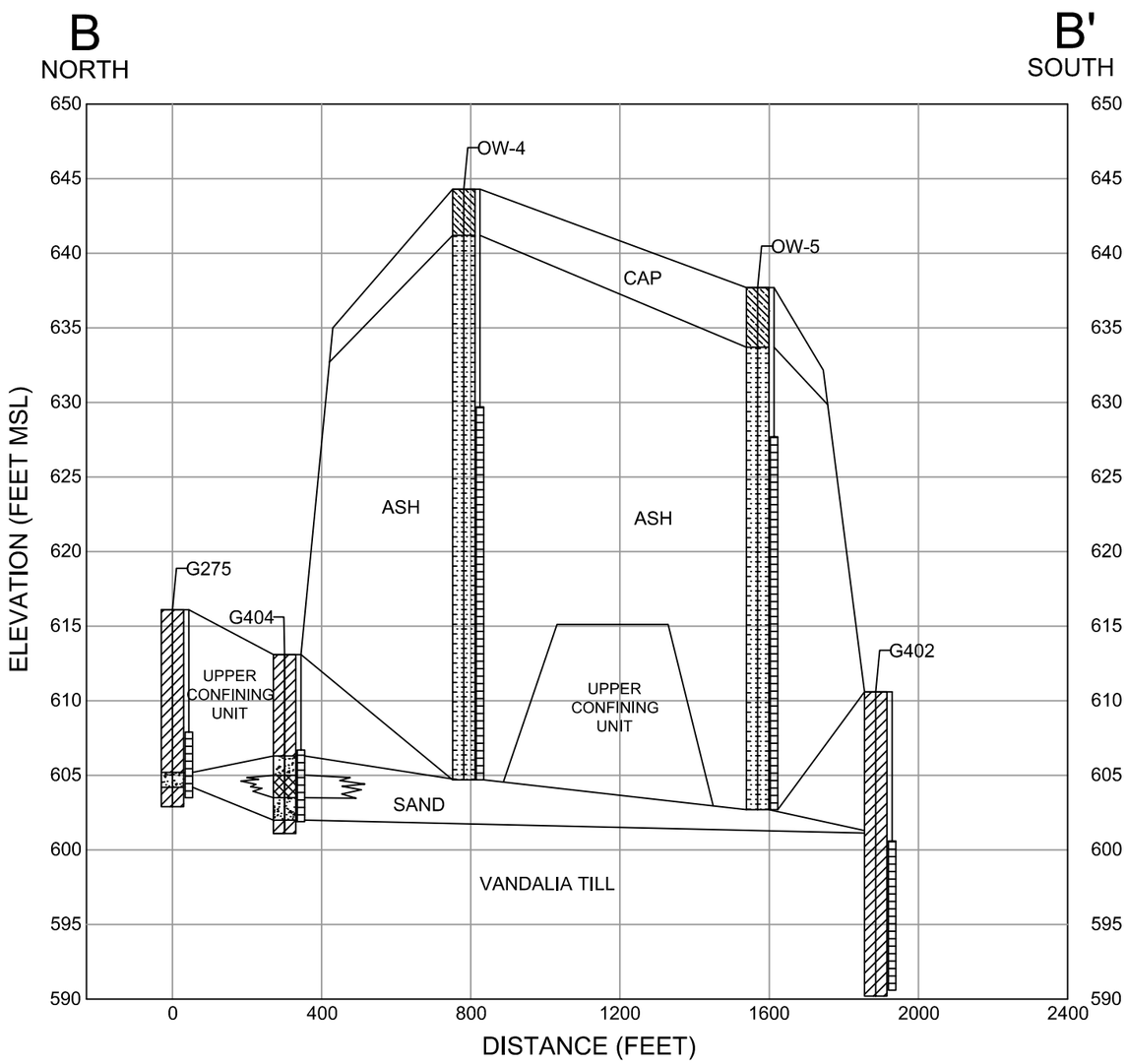
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
2380/2.0

FIGURE NO.
9

Dec 21, 2016 12:07pm PLOTTED BY: amillspaugh SAVED BY: acawrse
Y:\Mapping\Projects\23\2380\CAD\2-0\Figure 9_Geologic Cross-Section A-A'.dwg Layout1
IMAGES: Y:\Mapping\Projects\23\2380\CAD\2-0\Reference\MW02S.JPG;
XREFS:



VERTICAL SCALE IN FEET: 10

HORIZONTAL SCALE IN FEET: 400

VERTICAL EXAGGERATION =40

B — B' CROSS-SECTION TRANSECT

CLAY

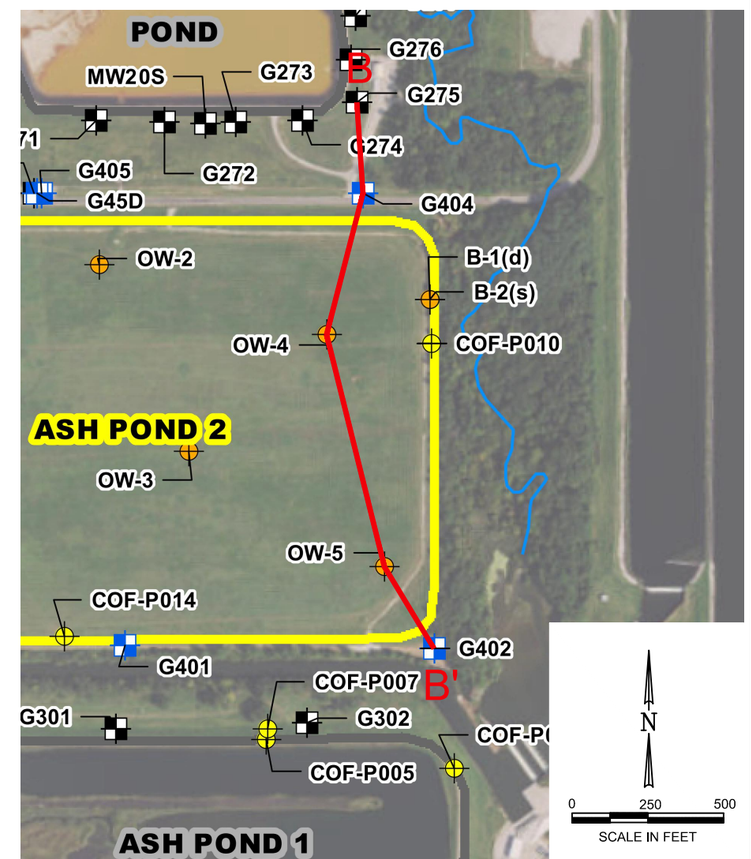
SOIL

SAND

SILT

ASH

WELL SCREEN



DRAWN BY: AGC DATE: 11/30/16

CHECKED BY: NRK DATE: 12/20/16

APPROVED BY: SJC DATE: 12/20/16

DRAWING NO: Fig 10_Geologic Cross-Section B-B'

REFERENCE: SEE INFO BLOCK

GEOLOGIC CROSS-SECTION B-B'

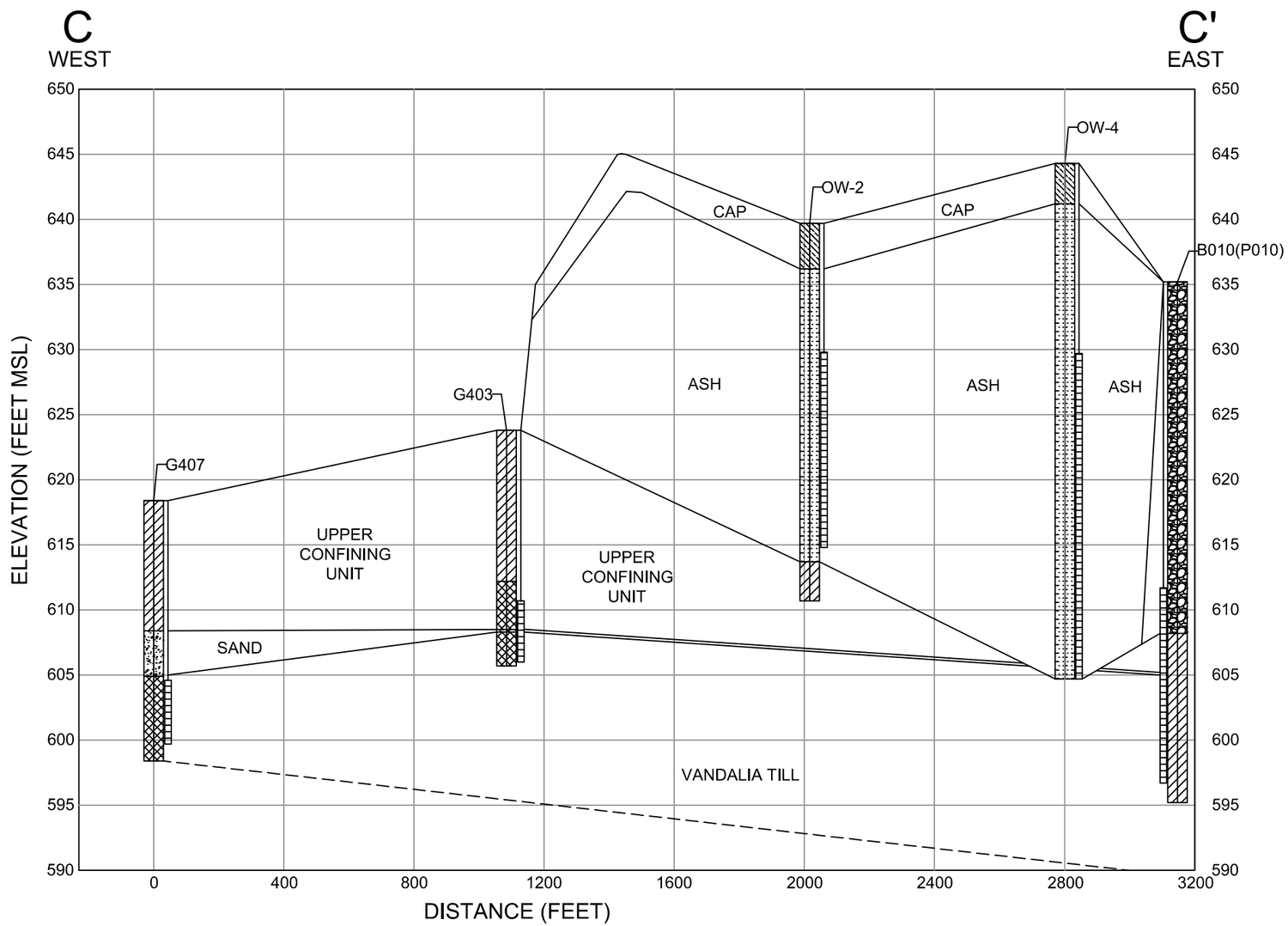
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

NATURAL RESOURCE TECHNOLOGY

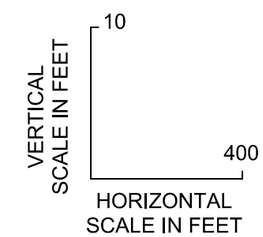
PROJECT NO.
2380/2.0

FIGURE NO.
10

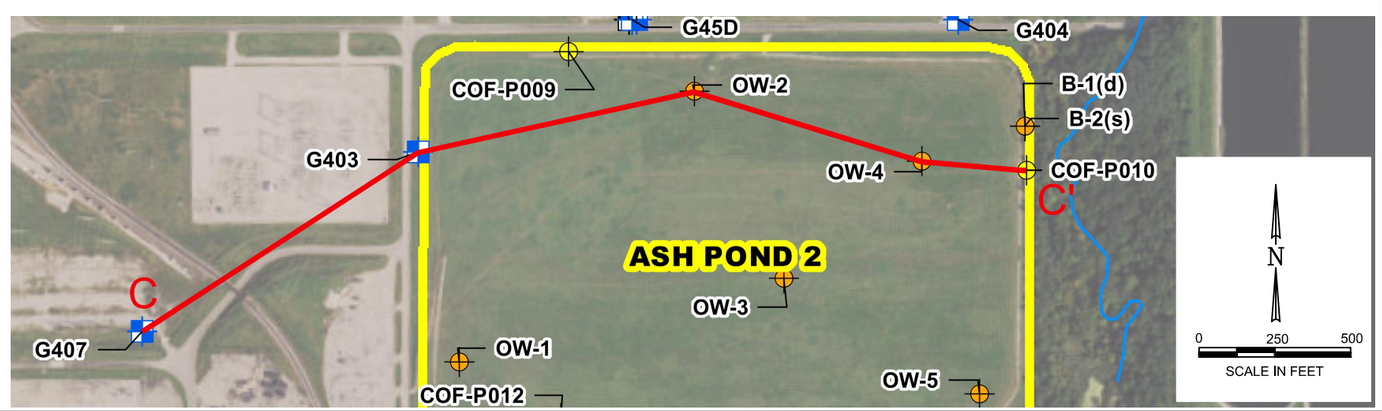
Dec 21, 2016 12:11pm PLOTTED BY: amilispaugh SAVED BY: acawrse
Y:\Mapping\Projects\23\2380\CAD\2-0\Figure 10_Geologic Cross-Section B-B'.dwg Layout1
IMAGES:
XREFS:



B — B' CROSS-SECTION TRANSECT
CLAY
SOIL
SAND
SILT
ASH
FILL
WELL SCREEN



VERTICAL EXAGGERATION =40



DRAWN BY: AGC DATE: 12/1/16
CHECKED BY: NRK DATE: 12/20/16
APPROVED BY: SJC DATE: 12/20/16
DRAWING NO: Fig 11_Geologic Cross-Section C-C'
REFERENCE: SEE INFO BLOCK

GEOLOGIC CROSS-SECTION C-C'

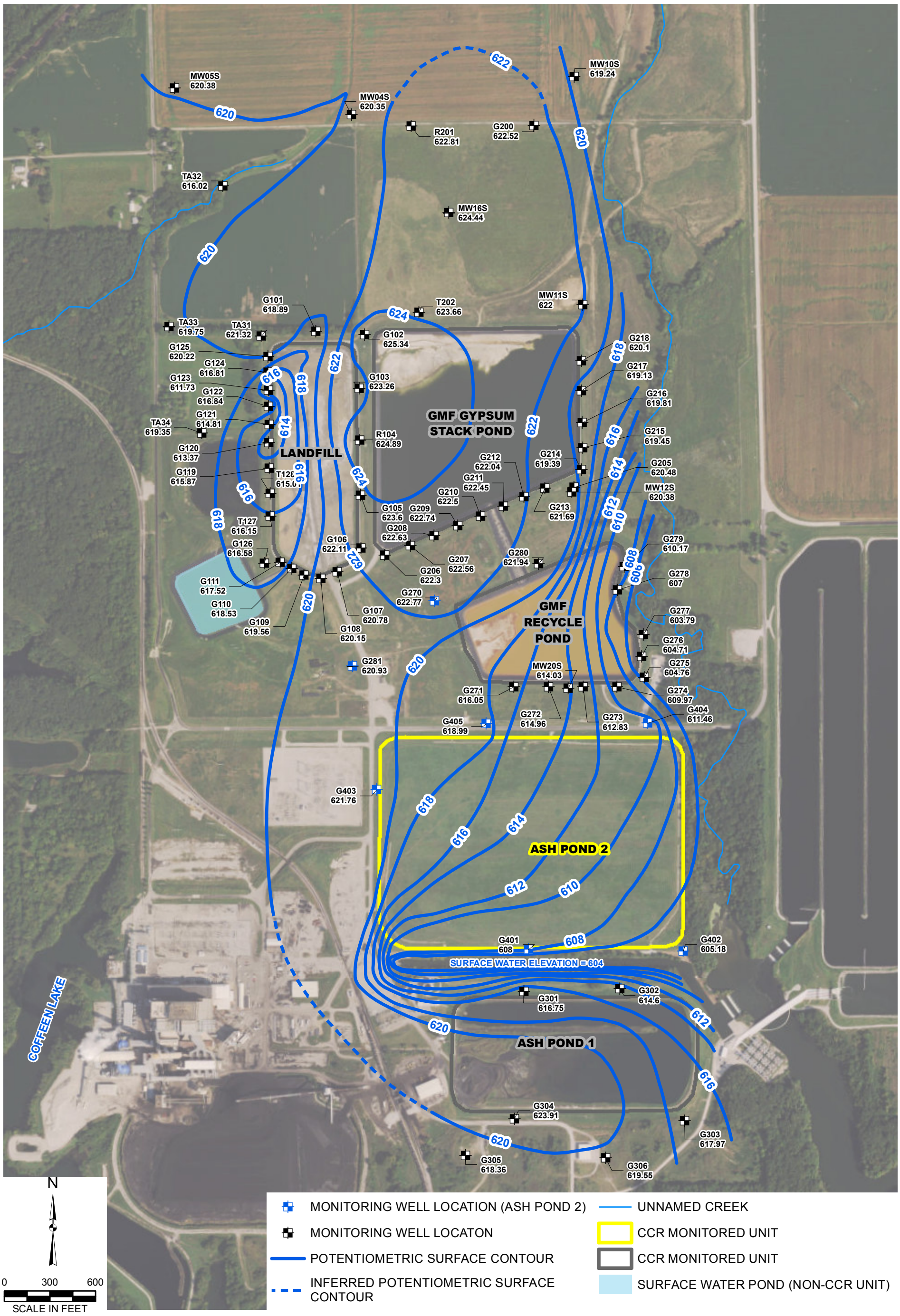
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
2380/2.0

FIGURE NO.
11

Dec 21, 2016 12:13pm PLOTTED BY: amillspaugh SAVED BY: acowrse
Y:\Mapping\Projects\23\2380\CAD\2-0\Figure 11_Geologic Cross-Section C-C'.dwg Layout1
IMAGES:
XREFS:



DRAWN BY/DATE:
SDS 11/30/16
REVIEWED BY/DATE:
NRK 11/30/16
APPROVED BY/DATE:
SJC 12/21/16

POTENTIOMETRIC SURFACE MAP
MAY 2016

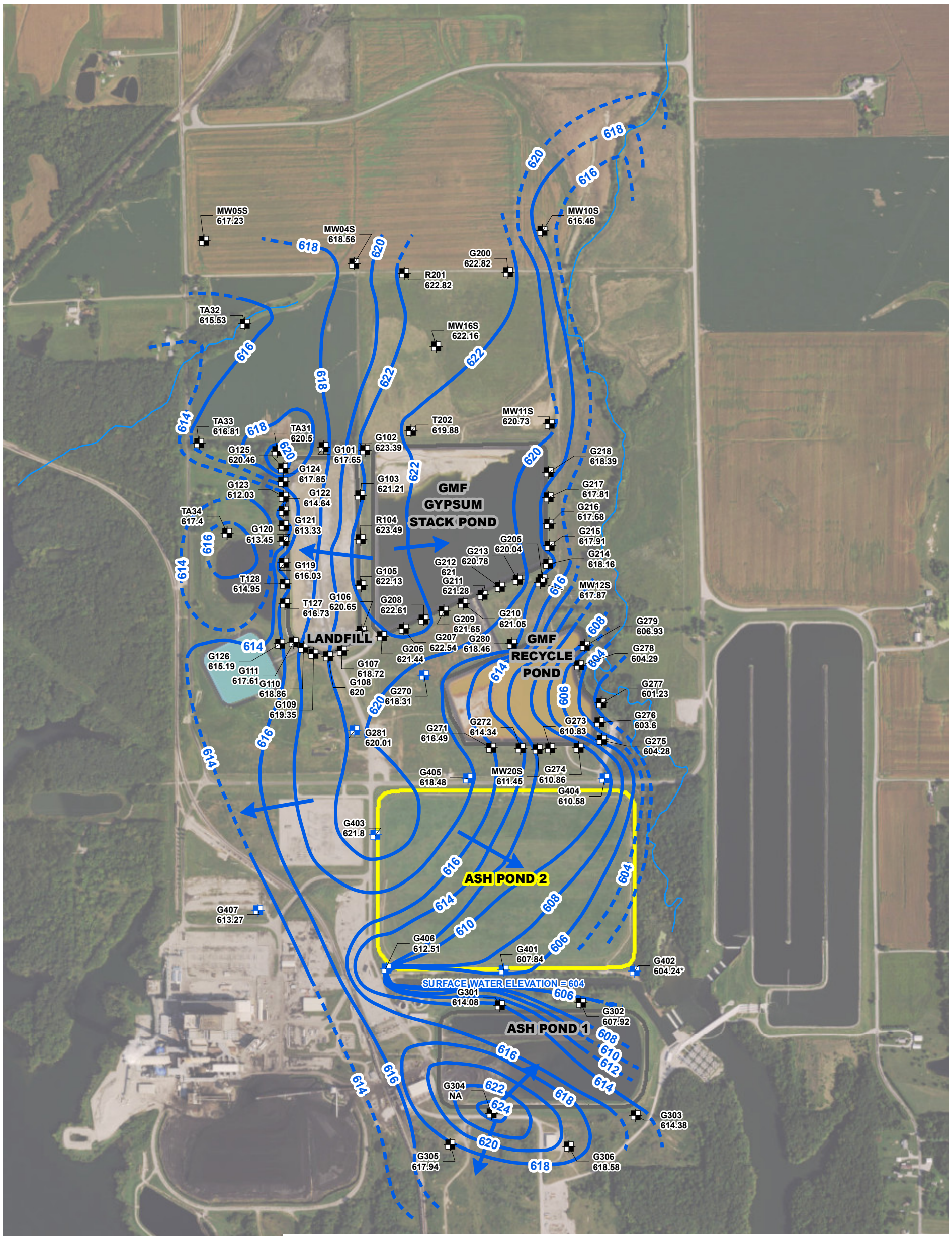
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

PROJECT NO: 2380

FIGURE NO: 12

Natural Resource Technology

X:\Mapping\Projects\23\2380\MXD\HGCR\Figure 12_May 2016 Potentiometric.mxd Author: tcushman Date/Time: 12/22/2016, 2:54:35 PM



DRAWN BY/DATE:
SDS 11/30/16
REVIEWED BY/DATE:
NRK 11/30/16
APPROVED BY/DATE:
SJC 12/21/16

POTENTIOMETRIC SURFACE MAP
NOVEMBER 2016

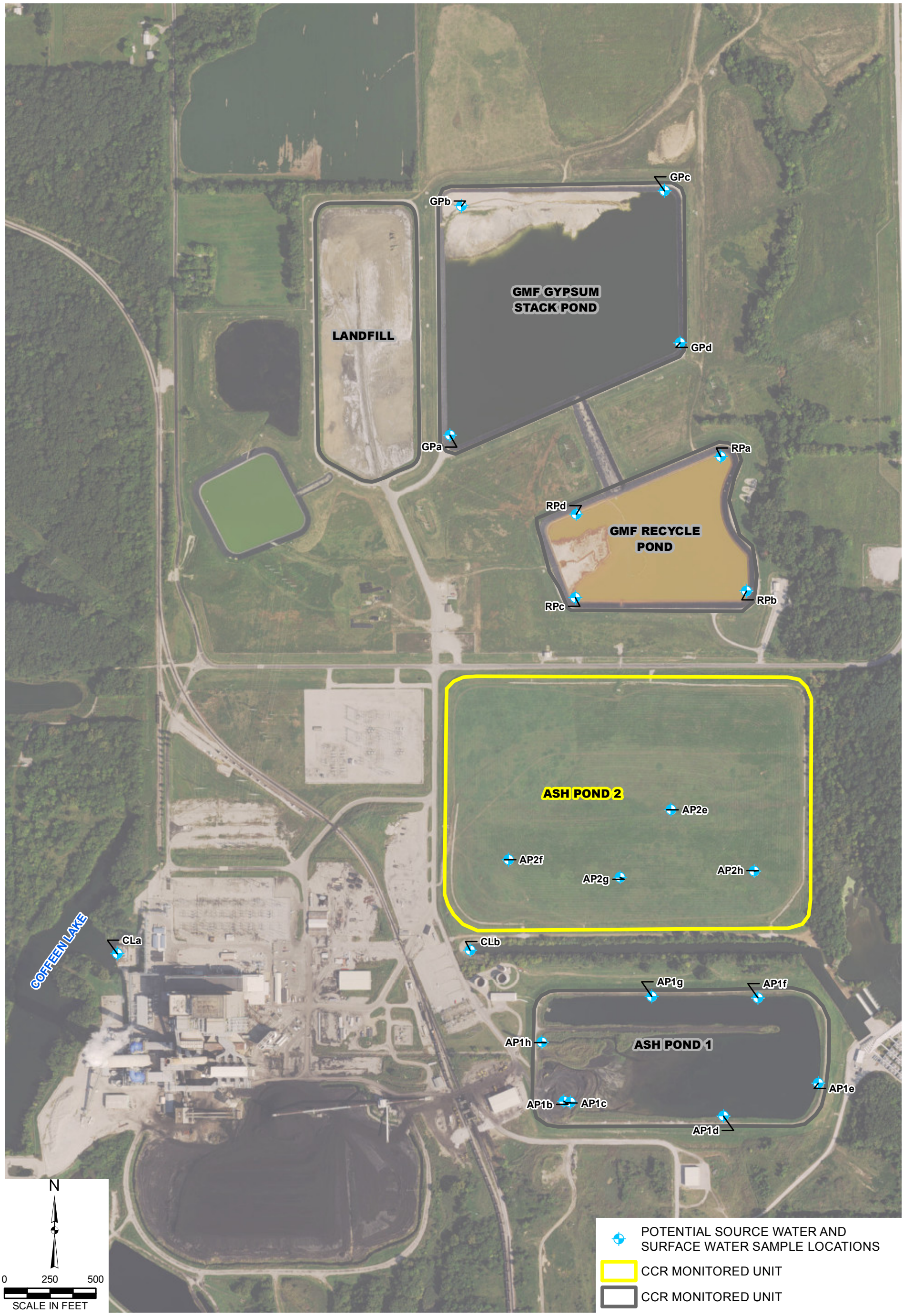
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

PROJECT NO: 2380

FIGURE NO: 13

Natural Resource Technology

Y:\Mapping\Projects\231\2380\MXD\HGC\Figure 13_Nov 2016 Potentiometric.mxd Author: tcushman; Date/Time: 12/22/2016, 2:56:22 PM



DRAWN BY/DATE:
SDS 12/21/16
REVIEWED BY/DATE:
NRK 12/21/16
APPROVED BY/DATE:
SJC 12/22/16

POTENTIAL SOURCE WATER AND SURFACE WATER SAMPLE LOCATIONS

HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

PROJECT NO: 2380

FIGURE NO: 14

Natural Resource Technology

Y:\Mapping\Projects\23\2380\MXD\HGCR\Figure 14_Potential Source Water And Surface Water Sample Locations.mxd Author: tcushman; Date/Time: 12/22/2016, 2:59:50 PM

TABLES

Table 1
Summary of Existing Monitoring Well Networks
Hydrogeologic Characterization Report
Coffeen Energy Center - Ash Pond 2

Well ID	Easting	Northing	Surface Elevation (ft MSL)	TOC Elevation (ft MSL)	Predecessor or prior name	Unit	Well Type	Top of Screen Elevation	Bottom of Screen Elevation	Interpreted Screened Unit	Comments
G301	2,515,582.97	872,234.82	620.27	622.65			MW	609.0	604.3	Upper Vandalia Till	
G302	2,516,214.19	872,252.95	617.95	620.04			MW	604.7	600.1	Upper Vandalia Till	
G303	2,516,639.65	871,382.14	619.10	622.02	AP-3		MW	609.1	599.1	Hagarstown/Vandalia Till Contact	No continuous soil sampling
G304	2,515,519.74	871,397.69	623.46	626.72	AP-4	Ash Pond 1	MW	613.5	603.5	Hagarstown Beds	
G305	2,515,199.36	871,156.33	622.54	625.55			MW	609.1	604.3	Hagarstown Beds	
G306	2,516,120.41	871,140.98	622.84	625.72			MW	609.8	605.2	Hagarstown Beds	
G307	2,515,553.26	871,398.55	622.08	624.47			MW	609.1	604.3	Hagarstown Beds	
G281	2,514,455.48	874,375.37	623.82	626.36			MW	608.31	603.66	Hagarstown Beds	
G401	2,515,614.84	872,510.57	623.03	625.57			MW	608.67	604.24	Hagarstown Beds	
G402	2,516,632.46	872,500.49	610.56	613.37	AP-2		MW	600.6	590.6	Upper Vandalia Till	
G403	2,514,616.63	873,561.34	623.81	626.47			MW	610.7	606.03	Hagarstown Beds	
G404	2,516,397.82	873,999.91	613.10	615.67			MW	606.68	601.93	Hagarstown Beds	
G405	2,515,335.67	873,996.63	620.90	623.63			MW	611.89	607.14	Hagarstown Beds	
G406	2,514,702.38	872,521.34	621.86	621.86			MW	608.3	603.49	Hagarstown Beds	
G407	2,513,705.87	872,973.39	618.35	621.32			MW	604.57	599.74	Hagarstown Beds	
T408	2,515,314.91	873,999.36	621.09	624.08			PZ (Hyd. conductivity only)	600.43	595.6	Vandalia Till	
T409	2,514,693.89	872,517.79	621.85	625.01		Ash Pond 2	PZ (Hyd. conductivity only)	600.06	595.26	Vandalia Till (Sand Seam)	
G45D	2,515,322.23	873,998.03	620.94	623.81	G405D		PZ	589.06	579.42	Smithboro Till	
G46D	2,514,697.78	872,519.70	621.91	625.24	G406D		PZ	580.3	570.65	Smithboro Till	
OW-1	2,514,754.56	872,875.48	639.80	641.14			Ash Pond PZ	634.74	619.74	Ash	
OW-2	2,515,525.87	873,761.43	639.70	641.34			Ash Pond PZ	629.84	614.84	Ash	
OW-3	2,515,824.43	873,147.40	640.40	641.78			Ash Pond PZ	631.28	616.28	Ash	
OW-4	2,516,277.90	873,535.97	644.70	damaged			Ash Pond PZ	629.7	604.7	Ash	
OW-5	2,516,466.21	872,770.83	637.70	638.8			Ash Pond PZ	627.7	602.7	Ash	
B-2(s)	2,516,615.41	873,650.85		639.44			PZ			Fill	in east-side berm
B-1(d)	2,516,615.78	873,647.93		638.7			PZ			Fill	in east-side berm
G101	2,514,215.00	876,575.00	625.27	627.6			MW	609.59	604.95	Hagarstown Beds	
G102	2,514,537.00	876,554.00	625.70	630.96	MW03S		MW	613.68	608.92	Hagarstown Beds	
G103	2,514,500.93	876,200.00	630.99	633.8			MW	615.11	610.32	Hagarstown Beds	
R104	2,514,503.40	875,857.80	629.03	632.84	G104		MW	614.44	609.71	Hagarstown Beds	
G105	2,514,509.03	875,500.00	629.26	632.08			MW	613.15	608.36	Hagarstown Beds	
G106	2,514,513.08	875,150.00	628.39	631.15			MW	614.02	609.43	Hagarstown Beds	
G107	2,514,358.30	874,994.07	627.79	630.23			MW	613.92	609.29	Hagarstown Beds	
G108	2,514,248.46	874,948.69	627.50	630.22			MW	610.68	606	Hagarstown Beds (Silt)	
G109	2,514,137.80	874,970.13	627.20	629.76			MW	611.81	607.27	Hagarstown Beds	
G110	2,514,057.93	875,015.38	627.02	629.65			MW	611.97	607.43	Hagarstown Beds	
G111	2,513,981.89	875,058.47	627.24	629.9			MW	612.63	608.09	Hagarstown Beds	
G119	2,513,910.00	875,675.00	628.85	631.55			MW	611.56	607.02	Hagarstown Beds	
G120	2,513,905.81	875,845.00	629.30	631.87			MW	614.2	609.68	Hagarstown Beds	
G121	2,513,910.00	875,965.00	629.57	632.83		Landfill	MW	612.78	608.1	Hagarstown Beds	
G122	2,513,905.00	876,080.00	629.86	632.69			MW	613.35	608.81	Hagarstown Beds	
G123	2,513,905.00	876,190.00	630.13	632.96			MW	609.19	604.67	Hagarstown Beds	
G124	2,513,900.48	876,305.00	630.42	633.39			MW	614.44	609.91	Hagarstown (Silt)/Vandalia Till Contact	
G125	2,513,900.00	876,410.00	630.68	633.51			MW	613.65	609.12	Hagarstown Beds	
G126	2,513,878.29	875,049.31	622.96	625.39			MW	610.07	605.53	Hagarstown Beds (Sandy clay)	
T127	2,513,915.00	875,360.00	628.07	630.96			MW	610.54	606	Hagarstown Beds	
T128	2,513,915.00	875,510.00	628.44	630.93			MW	611.91	607.4	Hagarstown Beds	
TA31	2,513,856.77	876,542.25	623.89	626.55			MW	608.8	604.32	Hagarstown Beds	
TA32	2,513,605.19	877,532.57	618.93	621.42			MW	607.62	603.25	Hagarstown Beds	
TA33	2,513,248.73	876,605.45	622.51	625.27			MW	610.28	605.62	Hagarstown Beds	
TA34	2,513,466.73	875,906.10	624.10	626.52			MW	613.18	608.69	Hagarstown Beds	

G151	2,513,805.90	875,023.70	622.82	625.93			MW	607.48	602.98	Hagarstown Beds	
G152	2,513,894.50	874,687.50	623.06	626.52			MW	609.47	604.97	Hagarstown Beds	
G153	2,513,532.70	874,532.70	623.30	626.35		SW Pond	MW	607.4	602.96	Hagarstown Beds	
G154	2,513,243.10	874,978.40	623.52	626.35			MW	609.26	604.76	Hagarstown Beds	
G155	2,513,501.80	875,127.70	622.89	625.86			MW	607.8	603.31	Hagarstown Beds	
G200	2,515,650.00	877,930.60	624.20	625.94			MW	612.01	607.22	Hagarstown Beds	
R201	2,514,842.00	877,925.30	624.02	626.34	G201		MW	611.75	607.36	Hagarstown Beds	
T202	2,514,895.00	876,699.40	626.22	628.63			MW	613.95	609.57	Hagarstown Beds	
G205	2,515,914.90	875,550.20	622.15	624.45			MW	612.11	607.62	Hagarstown Beds	
G206	2,514,669.20	875,103.90	630.54	632.82			MW	613.03	608.62	Hagarstown Beds	
G207	2,514,837.90	875,166.40	630.61	633.21			MW	612.37	607.84	Hagarstown Beds	
G208	2,514,993.60	875,231.50	630.57	633.16			MW	613.04	608.51	Hagarstown Beds	
G209	2,515,149.60	875,298.20	630.57	632.91			MW	612.83	608.29	Hagarstown Beds	Low recovery in interval with Hagarstown
G210	2,515,299.00	875,359.70	630.48	632.99		Gypsum Stack	MW	611.09	606.55	Hagarstown Beds	
G211	2,515,449.10	875,424.50	630.31	632.64			MW	612.97	608.43	Hagarstown (Sandy Clay)/Vandalia Till Contact	
G212	2,515,583.00	875,486.50	630.59	632.89			MW	613.85	609.3	Hagarstown Beds	
G213	2,515,723.50	875,544.40	630.34	632.81			MW	613.59	609.05	Hagarstown Beds	
G214	2,515,960.80	875,668.00	630.39	632.85			MW	612.64	608.25	Hagarstown Beds	
G215	2,515,971.60	875,810.20	630.48	633.06			MW	611.07	606.68	Hagarstown Beds	
G216	2,515,968.50	875,976.10	630.28	632.76			MW	610.24	605.86	Hagarstown Beds	
G217	2,515,963.00	876,185.60	630.67	633.1			MW	610.18	605.79	Hagarstown Beds	
G218	2,515,962.20	876,380.90	630.64	633.11			MW	610.31	605.87	Hagarstown Beds	
MW02S	2,513,210.04	876,408.86	624.10	sealed			MW	613.76	608.98		paired with deep well
MW04S	2,514,450.58	877,999.73	622.40	625.79			MW	612.57	608.14	Hagarstown Beds	
MW05S	2,513,285.49	878,175.59	622.60	625.8			MW	609.94	605.19	Hagarstown Beds	paired with deep well
MW06S	2,513,189.40	879,021.15	623.10	626.14			MW	612.06	607.48	Hagarstown Beds	paired with deep well
MW07S	2,514,397.54	879,181.12	624.50	627.54			MW	614.59	610.71	Hagarstown Beds	paired with deep well
MW08S	2,514,478.83	879,776.62	624.70	627.9			MW	613.19	608.7	Hagarstown Beds	paired with deep well
MW09S	2,515,666.24	879,684.90	624.60	627.46			MW	613.39	608.98	Hagarstown Beds	paired with deep well
MW10S	2,515,914.37	878,250.50	621.20	624.22		Hydrogeologic	MW	609.92	605.44	Hagarstown Beds	paired with deep well
MW11S	2,515,971.16	876,749.44	622.00	625.08		Characterization	MW	613.11	608.37	Hagarstown Beds	paired with deep well
MW12S	2,515,900.54	875,520.08	622.20	625.21		Report (historical)	MW	611.59	607.02	Hagarstown Beds	paired with deep well
MW13S	2,513,925.29	874,695.66	622.70	625.89			MW	611.27	606.47	Hagarstown Beds	paired with deep well
MW14S	2,514,125.95	875,737.78	624.60	sealed			MW	612.34	607.58	Hagarstown Beds	
MW15S	2,515,076.27	875,971.13	623.80	sealed			MW	609.39	604.64	Hagarstown Beds	paired with deep well
MW16S	2,515,087.98	877,355.14	626.10	629.37			MW	611.51	606.69	Hagarstown Beds	paired with deep well
MW17S	2,515,084.76	878,658.54	627.10	630.47			MW	613.08	603.54	Hagarstown Beds	paired with deep well
MW18S	2,513,745.20	878,604.67	625.60	628.66			MW	614.29	609.81	Hagarstown Beds	
MW20S	2,515,876.50	874,228.00		622.84			MW				
G270	2,514,996.84	874,801.92	622.92	625.92			MW	609.79	605	Hagarstown Beds	
G271	2,515,517.12	874,239.38	622.89	625.57			MW	612.93	608.58	Hagarstown Beds	
G272	2,515,744.99	874,234.83	620.72	623.81			MW	611.61	606.74	Hagarstown Beds (Silt)	
G273	2,515,975.49	874,235.24	620.17	623.02			MW	611.09	605.61	Hagarstown Beds	
G274	2,516,195.60	874,239.25	621.67	624.04			MW	608.77	604	Hagarstown Beds	
G275	2,516,375.86	874,298.94	616.14	618.26		Recycle Pond	MW	607.92	603.52	Hagarstown Beds	
G276	2,516,358.83	874,438.60	629.14	632.			MW	606.73	601.92	Hagarstown Beds	Very thin sand
G277	2,516,370.51	874,581.80	620.79	623.08			MW	606.5	602.02	Hagarstown Beds	
G278	2,516,200.66	874,875.37	628.85	631.19			MW	609.92	605.15	Hagarstown Beds	
G279	2,516,245.60	875,028.06	629.19	632.04			MW	606.79	602.4	Hagarstown Beds	
G280	2,515,679.48	875,045.11	622.95	625.85			MW	610.16	605.32	Hagarstown Beds	

[O:RJH 9/2016, C: NRK 10/10/2016, O: NRK 11/8/2016, C: JJW 11/10/2016]

Notes:

Ground surface elevations based on information included on boring logs when the well was installed, and top of PVC elevations based on survey completed in Fall 2015.

Table 2
Summary of Laboratory Hydraulic Conductivity in Confining Units
Hydrogeologic Characterization Report
Coffeen Energy Center - Ash Pond 2

Laboratory Tests			
Well/ Soil Boring ID	**Approximate Sample Elevation (ft)**	**Hydraulic Conductivity (cm/sec)**	**Interpreted Unit**
COF-B001	613.0	1.3E-08	Loess - Upper Confining Unit
COF-B003	606.5	2.2E-07	
COF-B004	610.5	5.0E-07	
COF-B007	615.0	7.0E-08	
	Geometric Mean	**1.0E-07**	
G46D	599.2	4.5E-06	Vandalia Till
T408	597.6	1.5E-07	
SB-12	577.7-572.7	6.8E-09	
SB-13	598-593	7.0E-09	
SB-18	603.5-603	8.8E-09	
	Geometric Mean	**4.9E-08**	
SB-09	598.5-598	1.9E-06	Mulberry Grove Silt
SB-16	589-588.5	1.6E-06	
	Geometric Mean	**1.7E-06**	
G45D	586.4	1.0E-07	Smithboro Till
G46D	578.9	2.1E-08	
SB-07	572-571.5	1.1E-09	
	Geometric Mean	**1.3E-08**	
SB-19	569-564	3.4E-09	Deep Confining Unit
SB-16	548-547.5	1.3E-08	
	Geometric Mean	**6.6E-09**	

[O:NRK 10/26/2016]

Table 3
Summary of Field Hydraulic Conductivity Tests
Hydrogeologic Characterization Report
Coffeen Energy Center - Ash Pond 2

Well ID	Unit	Method (fh)	Method (rh)	K (fh)	K (rh)	Well Geometric Mean	Approximate Screened Elevation (ft)	Interpreted Unit
Upper-most Aquifer								
R104	Landfill	KGS	B-R	7.0E-05	2.8E-04	1.4E-04	614.4-609.7	Hagarstown Beds
G105		KGS	KGS	1.5E-04	5.7E-05	9.2E-05	613.2-608.4	
G106		B-R	B-R	4.0E-05	7.4E-04	1.7E-04	614.0-609.4	
G107		KGS	KGS	6.3E-05	8.9E-05	7.5E-05	613.9-609.3	
G110		KGS	KGS	4.7E-05	2.0E-05	3.1E-05	612.0-607.4	
G119		KGS	KGS	8.6E-05	8.2E-05	8.4E-05	611.6-607	
G120		low water elevation; no test conducted					614.2-609.7	
G125		KGS	KGS	4.8E-05	4.1E-05	4.4E-05	613.7-609.1	
T127		KGS	KGS	1.2E-03	1.7E-05	1.4E-04	610.5-606	
			Unit Geometric Mean			8.5E-05		
T202	Gypsum Pond	KGS	KGS	4.5E-04	5.5E-04	5.0E-04	614.0-609.6	Hagarstown Beds
G206		B-R	KGS	3.0E-04	1.6E-04	2.2E-04	613.0-608.6	
G208		KGS	KGS	6.0E-05	2.1E-05	3.5E-05	613.0-608.5	
G209		KGS	KGS	2.0E-04	1.6E-04	1.8E-04	612.8-608.3	
G210		KGS	KGS	5.0E-04	4.8E-04	4.9E-04	611.1-606.6	
G212		KGS	KGS	1.3E-04	1.8E-04	1.5E-04	613.9-609.3	
G215		KGS	KGS	5.0E-04	3.5E-04	4.2E-04	611.1-606.7	
G218		KGS	KGS	4.1E-04	4.1E-04	4.1E-04	610.3-605.9	
			Unit Geometric Mean			2.3E-04		
G270	Recycle Pond	KGS	KGS	5.5E-04	4.8E-04	5.1E-04	609.8-605.0	Hagarstown Beds
G271		KGS	KGS	1.6E-04	1.1E-03	4.2E-04	612.9-608.6	
G273		KGS	KGS	1.0E-03	8.3E-04	9.1E-04	611.1-605.6	
G276		low water					606.7-601.9	Hagarstown Beds, v. thin
G279		KGS	KGS	1.7E-03	1.5E-03	1.6E-03	606.8-602.4	Hagarstown Beds
G280		KGS	KGS	1.3E-03	1.3E-03	1.3E-03	610.2-605.3	
G281		KGS	KGS	2.1E-03	8.9E-04	1.4E-03	608.3-603.7	
			Unit Geometric Mean			9.0E-04		
G301	Ash Pond 1	KGS	KGS	2.7E-04	5.0E-04	3.7E-04	609-604.3	Upper Vandalia Till
G302		KGS	KGS	4.9E-04	6.3E-04	5.6E-04	604.7-600.1	
G303		KGS	KGS	5.6E-05	3.1E-05	4.2E-05	609.1-599.1	Hagarstown/Vandalia Till Contact
G304		KGS	KGS	8.9E-04	1.0E-03	9.4E-04	613.5-603.5	Hagarstown Beds
			Unit Geometric Mean			3.0E-04		
G401	Ash Pond 2	B-R	B-R	1.8E-04	2.8E-04	2.2E-04	608.7-603.7	Hagarstown Beds
G402		KGS	KGS	4.5E-04	1.9E-04	2.9E-04	600.6-590.6	Upper Vandalia Till
G403		KGS	KGS	4.3E-05	7.2E-05	5.6E-05	610.7-606.0	Hagarstown Beds, v. thin
G404		KGS	KGS	4.2E-04	3.8E-04	4.0E-04	606.7-601.9	Hagarstown Beds
G405		KGS	KGS	9.8E-04	9.7E-04	9.7E-04	611.9-607.1	
			Unit Geometric Mean			2.7E-04		
G153	SW Pond	KGS	KGS	2.5E-04	5.4E-04	3.7E-04	607.5-603.0	Hagarstown Beds
			Unit Geometric Mean			3.7E-04		
MW03S	2009 Hydrogeo. Invest.	B-R	B-R	6.0E-04	1.1E-03	8.1E-04	613.7-608.6	Hagarstown Beds
MW04S		B-R	B-R	1.3E-03	8.0E-04	1.0E-03	612.6-607.6	
MW10S		B-R	B-R	8.0E-04	8.0E-04	8.0E-04	610.9-604.9	
MW13S		B-R	B-R	1.0E-03	2.0E-04	4.5E-04	611.3-606.1	
MW14S		B-R	B-R	1.0E-03	5.0E-04	7.1E-04	612.4-607.2	
MW15S		B-R	B-R	1.5E-04	8.1E-05	1.1E-04	609.3-604.2	
MW16S		B-R	B-R	6.0E-04	4.5E-04	5.2E-04	611.5-606.3	
MW17S		B-R	B-R	5.8E-04	5.5E-04	5.6E-04	613.1-603	
			Unit Geometric Mean			5.4E-04		

Lower Confining Unit (Vandalia and Smithboro Till)								
T408	Ash Pond 2	KGS	KGS	2.15E-06	7.50E-08	9.02E-07	600.4-595.2	Vandalia Till
T409		KGS	KGS	3.6E-05	3.20E-05	3.41E-05	600.1-594.9	Vandalia Till (sand seam)
G405D		KGS	KGS			4.90E-07	589.1-579	Smithboro Till
G406D		KGS	KGS			4.00E-08	580.3-570.3	
			Unit Geometric Mean			5.55E-06		

Notes: [O:RJH 9/2016, C: KLT 12/2016)

fh = Falling head test

rh = Rising head test

Hydraulic Conductivity tests analyzed using Aqtesolv® Pro version 4.50 (HydroSOLVE, Inc.)

Test Methods

B-R Bouwer and Rice, 1976. "A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifer with Completely or Partially Penetrating Wells", Water Resources Research v.12, no. 3. American Geophysical Union, Washington, DC. pp. 423-428.

KGS Hyder, Z., J.J. Butler, C.D. McElwee, and W. Liu, 1974. "Slug tests in partially penetrating wells", Water Resources Research, v. 30, no. 11. American Geophysical Union, Washington, DC. pp. 2945-2957.

NATURAL RESOURCE TECHNOLOGY

Table 4
Summary of AECOM Piezometer Construction
Hydrogeologic Characterization Report
Coffeen Energy Center - Ash Pond 2

Well ID	Unit	Coordinates		Ground Surface Elevation (ft)	Location	Well Type	Top of PVC Elevation (ft)	Total Depth (ft)	Top of Screened Inteval (ft bgs)	Bottom of Screeed Interval (ft bgs)	Screened Interval
		Northing	Easting								
COF-P000	Ash Pond 1	871590	2516694	634.9	Crest	PZ	639.3	27.9	619.9	609.9	Fill and Loess/Clay
COF-P001		871488	2516735	615.6	Toe	VWP	VWP	12.0	603.6	603.6	Clay/ Silt
COF-P002		871459	2516042	635.4	Crest	PZ	639.2	39.3	609.9	599.9	Hagarstown Beds
COF-P003		871786	2515150	635.7	Crest	PZ	640.3	48.0	607.2	592.2	Hagarstown Beds
COF-P005		872198	2516077	635.0	Crest	PZ	639.6	23.2	620.0	615.0	Fill/ Clay Contact
COF-P006		872106	2516696	635.1	Crest	PZ	639.7	47.4	605.1	590.1	Hagarstown Beds
COF-P007		872235	2516081	617.5	Toe	VWP	VWP	15.0	602.5	602.5	Hagerstown Beds
COF-P008		871814	2515103	625.1	Toe	VWP	VWP	19.0	606.1	606.1	Hagerstow Beds
COF-P009	Ash Pond 2	873894	2515111	638.0	Crest	PZ	642.6	33.0	618.0	608.0	Clay/ Hagarstown Beds
COF-P010		873505	2516621	635.2	Crest	PZ	639.1	41.5	611.7	596.7	Clay/ Hagarstown Beds
COF-P012		872691	2515086	642.2	Interior (ash)	PZ	646.4	43.3	609.7	599.7	Hagarstown Beds
COF-P014		872538	2515412	635.0	Crest	PZ	639.5	45.4	606.5	596.5	Hagarstown Beds

[O:AECOM, 2016]

Notes:
1. For standpipe piezometers, stickup and WL measurement referenced to top edge of yellow protector cover with hinged cap open.
2. Total Depth = Approx. bottom of screen for standpipe piezometers, or installed depth for VWPs.
3. VWP = vibrating wire peizometer installed at locations not accessible with drill rig.
4. Piezometers COF-P004, -P011, and -P013 were planned but not installed due to access issues.

NATURAL RESOURCE TECHNOLOGY

Table 5
Groundwater Elevations in Monitoring Wells: 2015 - 2016
Hydrogeologic Characterization Report
Coffeen Energy Center - Ash Pond 2

Date	G101	G102	G103	G105	G106	G107	G108	G109	G110	G111	G119	G120	G121	G122	G123	G124	G125	G126	G151	G152
January-15	614.48	619.18	620.82	621.95	620.45	619.23	618.42	617.78	616.76	615.93	615.64	612.75	613.63	610.79	610.84	615.27	617.83	615.22	NM	NM
April-15	618.87	622.06	622.58	623.73	622.19	620.85	620.31	619.71	618.60	617.48	615.86	613.43	614.63	615.94	612.41	617.85	620.45	616.45	NM	NM
July-15	618.53	622.12	621.70	622.72	621.43	620.15	621.22	620.41	619.55	618.03	616.55	613.47	614.09	615.26	612.76	618.25	620.71	616.34	615.43	616.47
October-15	617.15	622.02	620.69	621.65	620.50	619.10	618.92	618.12	617.70	616.79	615.31	612.94	613.31	614.39	611.89	617.27	619.66	614.13	614.86	614.06
November-15	612.95	618.96	NM	NM	619.32	NM	NM	NM	616.55	NM	NM	612.37	NM	NM	NM	NM	614.60	NM	NM	NM
February-16	618.46	624.04	NM	NM	621.55	NM	NM	NM	617.88	NM	NM	613.06	NM	NM	NM	NM	619.95	NM	614.88	616.61
February-16	617.62	623.35	621.29	622.73	621.68	620.70	619.16	618.58	617.25	616.62	616.00	612.89	613.65	615.17	611.58	616.22	619.30	615.80	NM	NM
May-16	618.89	625.34	NM	NM	622.11	NM	NM	NM	618.53	NM	NM	613.37	NM	NM	NM	NM	620.22	NM	615.58	617.37
May-16	618.79	625.33	623.42	623.62	622.00	620.74	620.15	619.58	618.57	617.44	615.85	613.17	614.86	616.82	611.76	616.78	620.21	616.54	NM	NM
June-16	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
July-16	618.44	623.92	NM	NM	620.62	NM	NM	NM	617.64	NM	NM	612.87	NM	NM	NM	NM	621.53	NM	NM	NM

Date	G153	G154	G155	G200	G205	G206	G207	G208	G209	G210	G211	G212	G213	G214	G215	G216	G217	G218	G270	G271
January-15	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
April-15	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
July-15	615.93	614.85	614.45	623.35	NM	621.87	622.31	622.76	622.37	621.88	621.79	621.77	621.55	618.83	618.43	NM	618.10	618.82	618.88	616.57
October-15	614.45	612.24	613.51	621.05	NM	620.69	620.72	620.62	620.56	619.83	619.00	620.76	620.21	617.56	616.56	NM	616.71	616.93	616.07	614.12
November-15	NM	NM	NM	621.66	NM	619.27	NM	NM	620.06	NM	NM	618.54	NM	NM	616.38	NM	NM	617.11	621.06	613.77
February-16	615.93	615.65	614.77	623.29	NM	621.92	622.18	622.06	622.26	621.68	622.03	621.99	621.21	617.95	618.31	618.61	618.20	619.05	622.94	615.87
February-16	NM	NM	NM	622.93	620.32	622.36	NM	NM	622.44	NM	NM	621.85	NM	NM	618.08	NM	NM	619.15	622.67	615.49
May-16	616.90	617.11	615.79	622.52	620.48	622.30	622.55	622.63	622.74	622.41	622.39	622.04	621.59	619.25	619.45	619.62	619.03	620.10	622.77	616.05
May-16	NM	NM	NM	623.13	NM	NM	NM	NM	622.69	NM	NM	622.08	NM	NM	619.27	NM	NM	620.01	623.02	616.19
June-16	NM	NM	NM	NM	NM	620.51	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
July-16	NM	NM	NM	622.82	NM	621.71	NM	NM	621.52	NM	NM	620.89	NM	NM	617.10	NM	NM	618.01	617.73	616.62

Date	G272	G273	G274	G275	G276	G277	G278	G279	G280	G281	G301	G302	G303	G304	G305	G306	G307	G401	G402	G403
January-15	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
April-15	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
July-15	614.62	611.18	611.08	604.26	604.00	NM	NM	607.48	618.68	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
October-15	612.56	610.41	610.06	NM	NM	NM	NM	608.14	614.54	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
November-15		611.82		NM	603.25	NM	NM	607.80	618.45	619.56	616.51	610.74	616.70	623.78	NM	NM	NM	607.82	604.02	621.81
February-16	614.68	613.26	610.14	604.66	603.71	NM	606.40	609.16	621.37	621.21	NM	NM	NM	NM	NM	NM	NM	608.14	604.90	621.78
February-16		612.59		NM	603.77	NM	NM	609.01	621.15	NM	617.21	613.14	617.87	624.07	618.35	619.55	NM	NM	NM	NM
May-16	615.21	612.83	610.49	605.12	604.71	603.84	607.02	610.17	621.94	620.93	616.75	614.60	617.97	623.91	NM	NM	NM	608.00	605.18	621.76
May-16	NM	613.18	NM	NM	604.72	NM	NM	610.21	621.95	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
June-16	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	616.28	615.11	NM	NM	NM	NM
July-16	NM	611.27	NM	NM	604.92	NM	NM	606.94	618.21	620.30	614.65	608.16	614.92	626.72	618.12	619.07	624.42	608.47	604.33	622.16

Date	G404	G405	R104	R201	T127	T128
January-15	NM	NM	623.03	NM	615.65	614.73
April-15	NM	NM	624.77	NM	616.04	614.89
July-15	NM	NM	624.06	623.27	616.04	615.40
October-15	NM	NM	621.69	619.94	615.66	614.67
November-15	611.67	618.85	621.34	622.44	615.91	NM
February-16	611.58	618.90	624.11	623.40	616.04	614.91
February-16	NM	NM	622.37	623.14	615.96	NM
May-16	611.46	618.99	624.89	622.81	616.15	NM
May-16	NM	NM	623.95	623.39	616.12	614.99
June-16	NM	NM	NM	NM	NM	NM
July-16	611.67	618.51	623.65	622.36	615.96	NM

Notes:
NM= Not measured

NATURAL RESOURCE TECHNOLOGY

Table 6
Groundwater Elevations in Piezometers: 2015 - 2016
Hydrogeologic Characterization Report
Coffeen Energy Center - Ash Pond 2

Water Elevation (feet)												
PZ ID	**COF-P000**	**COF-P001**	**COF-P002**	**COF-P003**	**COF-P005**	**COF-P006**	**COF-P007**	**COF-P008**	**COF-P009**	**COF-P010**	**COF-P012**	**COF-P014**
Date	**Ash Pond 1**								**Ash Pond 2**			
8/29/2015	616.97	614.30	624.90	620.38	620.62	612.94	611.40	622.55	621.50	605.62	625.43	613.57
10/5/2015	618.17	- -	624.69	619.93	621.42	612.90	- -	- -	621.40	607.22	624.91	613.29
10/30/2015	617.95	613.29	624.68	619.82	622.15	612.72	610.32	622.11	620.73	607.99	624.53	613.07
11/23/2015	619.15	614.66	625.80	621.06	622.60	612.81	612.14	623.32	623.02	608.98	624.95	613.31
12/23/2015	619.57	614.77	626.19	622.30	622.50	613.22	614.21	623.80	624.31	609.18	625.82	614.08
1/18/2016	619.64	615.03	625.89	620.74	621.89	612.56	614.60	623.27	622.76	610.59	626.04	613.86

Notes:
- - No data available

[O:AECOM, 2016]

NATURAL RESOURCE TECHNOLOGY

Table 7
Ash Pond 2 Leachate Elevations in 2009
Hydrogeologic Characterization Report
Coffeen Energy Center - Ash Pond 2

Well ID	Leachate Elevations (ft)					
	Date					
	4/1/2009[1]	5/29/2009	6/6/2009	8/6/2009	9/21/2009	11/9/2009
OW-1	619.83	636.87	636.59	635.48	635.10	636.15
OW-2	615.14	636.62	636.69	635.24	634.92	635.98
OW-3	616.68	636.57	636.43	635.26	634.90	635.90
OW-4	- -	638.47	- -	- -	- -	- -
OW-5	609.05	636.48	635.81	635.18	634.85	635.77

Notes: [O:Hanson, 2016]
[1] Measurement collected after pumping of Ash Pond 2.
- - No leachate elevation data

NATURAL RESOURCE TECHNOLOGY

Table 8
Summary of Vertical Hydraulic Gradients
Hydrogeologic Characterization Report
Coffeen Energy Center - Ash Pond 2

Well ID	Date	Screen Elev. (ft)[1]	Formation	Groundwater Elevation (ft MSL)	Vertical Gradient [2]
G405	11/12/2016	609.515	Hagarstown Beds	618.48	-0.009
T408	11/12/2016	598.015	Vandalia Till	618.58	
T408	11/12/2016	598.015	Vandalia Till	618.58	2.44
G45D	11/12/2016	584.24	Smithboro Till	584.91	
G406	11/12/2016	605.895	Hagarstown Beds	612.51	-0.42
T409	11/12/2016	597.66	Vandalia Till	615.98	
T409	11/12/2016	597.66	Vandalia Till	615.98	1.46
G46D	11/12/2016	575.475	Smithboro Till	583.59	

Notes: [O:NRK, 12/2016, C:JJW 12/2016]

1. Center of screen
2. Based on dates when both wells were sampled, **negative** vaues indicate upward gradients while **positive** indicate downward gradients

Table 9
Statistical Summary of Groundwater Monitoring Parameters
Hydrogeologic Characterization Report
Coffeen Energy Center

BORON (dissolved - mg/L)

Monitoring Well Number	Number of Data Points	Mean	Median	Maximum	Minimum	Standard Deviation	Percent Non-Detects	Sen Slope Trend
APW-2 (G402)	8	7.245	7.18	8.10	6.30	0.626	0.0%	0.27
G151	16	0.016	0.012	0.052	0.003	0.013	50.0%	0
G152	16	0.047	0.041	0.11	0.015	0.025	0.0%	0.01
G153	16	0.028	0.027	0.058	0.012	0.012	0.0%	-0.01
G154	16	0.036	0.037	0.045	0.021	0.008	0.0%	0
G270	34	0.029	0.012	0.125	0.005	0.034	47.1%	0
G271	29	0.281	0.260	0.610	0.130	0.128	0.0%	**0.05**
G272	29	0.019	0.005	0.27	0.005	0.050	86.2%	0
G273	29	0.224	0.18	0.62	0.019	0.176	6.9%	**0.06**
G274	29	0.295	0.18	0.97	0.005	0.302	27.6%	**0.13**
G275	25	3.176	3.50	4.60	0.91	1.04	0.0%	0.1

BORON (total - mg/L)

Monitoring Well Number	Number of Data Points	Mean	Median	Maximum	Minimum	Standard Deviation	Percent Non-Detects	Sen Slope Trend
G151	3	0.0183	0.019	0.026	0.010	0.008	0%	-0.03
G152	3	0.038	0.036	0.047	0.032	0.008	0%	-0.03
G153	3	0.044	0.036	0.064	0.031	0.018	0%	-0.07
G154	3	0.030	0.031	0.038	0.021	0.009	0%	0.01
G270	38	0.021	0.005	0.125	0.005	0.026	68%	0.00
G271	33	0.309	0.240	0.980	0.110	0.190	0%	**0.03**
G272	29	0.014	0.005	0.060	0.005	0.017	69%	0.00
G273	33	0.208	0.200	0.480	0.016	0.137	9%	**0.05**
G274	29	0.264	0.160	0.740	0.005	0.253	24%	**0.11**
G275	25	3.336	3.600	4.600	1.200	0.965	0%	0.04
G401	4	3.575	3.450	4.100	3.300	0.359	0%	0.79
G402	4	6.500	6.450	7.400	5.700	0.707	0%	1.83
G403	4	0.036	0.033	0.064	0.014	0.021	0%	-0.03
G404	4	2.075	1.850	3.200	1.400	0.806	0%	0.40
G405	4	16.25	16.500	17.000	15.000	0.957	0%	-1.96

MANGANESE (dissolved - mg/L)

Monitoring Well Number	Number of Data Points	Mean	Median	Maximum	Minimum	Standard Deviation	Percent Non-Detects	Sen Slope Trend
APW-2 (G402)	8	0.432	0.414	0.730	0.130	0.166	0%	0.01
G151	16	0.131	0.092	0.560	0.011	0.131	0%	0.00
G152	16	0.294	0.180	0.927	0.034	0.277	0%	0.07
G153	16	0.235	0.175	1.020	0.024	0.249	0%	-0.12
G154	16	0.062	0.035	0.462	0.003	0.112	0%	0.00
G270	34	0.094	0.045	0.470	0.003	0.108	0%	**-0.02**
G271	29	0.015	0.001	0.220	0.001	0.045	62%	0.00
G272	29	0.011	0.001	0.230	0.001	0.043	76%	0.00
G273	29	0.042	0.028	0.330	0.001	0.059	0%	**-0.01**
G274	29	0.003	0.001	0.046	0.001	0.009	69%	0.00
G275	25	0.051	0.019	0.340	0.001	0.086	8%	0.00

Notes:
- Sen Slope Trend is in milligrams per Liter per year; negative value (-) is downward trend; positive value is upward trend, **BOLD** indicates statistical significance (Mann Kendall 95%).Mann Kendall tests not performed on wells with less than 8 data ponts.
- Sample results below the method detection limit (MDL) for that parameter have been replaced by the detection limit.

Wells with groundwater exceeding Class 1 groundwater standard for the given parameter in 2015 or 2016.

Table 9
Statistical Summary of Groundwater Monitoring Parameters
Hydrogeologic Characterization Report
Coffeen Energy Center

MANGANESE (total - mg/L)

Monitoring Well Number	Number of Data Points	Mean	Median	Maximum	Minimum	Standard Deviation	Percent Non-Detects	Sen Slope Trend
G151	3	0.225	0.23	0.36	0.086	0.137	0%	0.56
G152	3	0.32	0.31	0.37	0.27	0.050	0%	0.12
G153	3	0.67	0.51	1.30	0.21	0.563	0%	-2.21
G154	3	0.16	0.16	0.16	0.15	0.006	0%	0.02
G270	34	0.146	0.083	0.62	0.021	0.134	0%	**-0.03**
G271	29	0.058	0.021	0.27	0.001	0.075	0%	-0.01
G272	29	0.029	0.011	0.15	0.002	0.040	0%	0.00
G273	29	0.06	0.043	0.19	0.019	0.043	0%	**-0.01**
G274	29	0.05	0.02	0.37	0.003	0.087	0%	0.00
G275	25	0.17	0.09	0.78	0.01	0.203	0%	0.01

SULFATE (dissolved - mg/L)

Monitoring Well Number	Number of Data Points	Mean	Median	Maximum	Minimum	Standard Deviation	Percent Non-Detects	Sen Slope Trend
APW-2 (G402)	8	805.375	840	1100	500	173.11	13%	5.17
G151	16	112	110	140	100	11.21	0%	**4.8**
G152	16	161	135	300	107.0	61.15	0%	**26.3**
G153	16	1824	1800	2100	1500	206.55	0%	**184.5**
G154	16	110	105	175	82	23.60	0%	**-12.0**
G270	34	54	43	140	2	50.37	0%	**15.7**
G271	29	354	360	520	220	87.45	0%	**35.8**
G272	29	264	270	380	140	63.00	0%	**28.1**
G273	29	524	520	700	46	131.06	0%	9.0
G274	29	340	350	400	240	41.75	0%	0.0
G275	25	678	720	920	280	183.63	0	30.3

SULFATE (total - mg/L)

Monitoring Well Number	Number of Data Points	Mean	Median	Maximum	Minimum	Standard Deviation	Percent Non-Detects	Sen Slope Trend
G151	3	104.333	98	120	95	13.65	0%	6.09
G152	3	120	120	130	110	10	0%	20.3
G153	3	1633	1500	1900	1500.0	231	0%	0.0
G154	3	99	93	110	93	10	0%	34.5
G270	38	59	65	140	2	50	0%	**15.6**
G271	33	357	350	540	230	87	0%	**28.3**
G272	29	253	250	380	120	69	0%	**30.5**
G273	33	530	520	750	340	106	0%	6.5
G274	29	337	330	460	230	55	0%	6.7
G275	25	684	720	990	310	213	0%	0.8
G281	4	330	325	370	300	32	0%	68.7
G401	4	2275	2250	2500	2100	171	0%	-390.6
G402	4	1013	980	1200	890	133	0%	-392.5
G403	4	18	14	35	10	12	0%	-30.9
G404	4	165	165	190	140.0	23.8	0%	-12.3
G405	4	1700	1700	1800	1600.0	81.7	0%	-71.6

Notes:
- Sen Slope Trend is in milligrams per Liter per year; negative value (-) is downward trend; positive value is upward trend, **BOLD** indicates statistical significance (Mann Kendall 95%).Mann Kendall tests not performed on wells with less than 8 data ponts.
- Sample results below the method detection limit (MDL) for that parameter have been replaced by the detection limit.

Wells with groundwater exceeding Class 1 groundwater standard for the given parameter in 2015 or 2016.

Table 9
Statistical Summary of Groundwater Monitoring Parameters
Hydrogeologic Characterization Report
Coffeen Energy Center

TOTAL DISSOLVED SOLIDS (mg/L)

Monitoring Well Number	Number of Data Points	Mean	Median	Maximum	Minimum	Standard Deviation	Percent Non-Detects	Sen Slope Trend
APW-2 (G402)	8	1651.25	1600	1810	1600	78.456	0%	0
G151	17	551	560	660	500	44	0%	0.0
G152	17	677	620	1,100	494	156	0%	**73**
G153	17	3,362	3,300	3,900	2,800	341	0%	**42.5**
G154	17	476	460	624	410	52	0%	17
G270	37	454	460	550	340	53	0%	11
G271	31	862	860	1,000	710	96	0%	**29**
G272	27	703	680	840	570	69	0%	**25.5**
G273	31	1,085	1,100	1,300	840	140	0%	0
G274	27	863	870	980	770	64	0%	**-16.1**
G275	24	1,388	1,500	2,000	840	270	0%	0.0
G281	4	770	760	820	740	38	0%	-28.7
G401	4	2,925	2,950	3,000	2,800	96	0%	-185.3
G402	4	1,600	1,600	1,700	1,500	115	0%	-346
G403	4	325	320	340	320	10	0%	0.0
G404	4	555	570	620	460	68	0%	-14
G405	4	2,325	2,300	2,500	2,200	150	0%	-347

Notes: [O: NRK 12/2016, C: SJC 12/2016]

- Sen Slope Trend is in milligrams per Liter per year; negative value (-) is downward trend; positive value is upward trend, **BOLD** indicates statistical significance (Mann Kendall 95%).Mann Kendall tests not performed on wells with less than 8 data ponts.
- Sample results below the method detection limit (MDL) for that parameter have been replaced by the detection limit.

Wells with groundwater exceeding Class 1 groundwater standard for the given parameter in 2015 or 2016.

Table 10
Potential Source Water and Surface Water Sampling Results - October 24, 2016
Hydrogeologic Characterization Report
Coffeen Energy Center

Sample ID	Sample Location	Alkalinity, bicarbonate mg/L	Alkalinity, carbonate mg/L	Antimony, Total ug/L	Arsenic, Total ug/L	Barium, Total ug/L	Beryllium, Total ug/L	Boron, Total ug/L	Cadmium, Total ug/L	Calcium, Total mg/l	Chloride, Total mg/L	Chromium, Total ug/L	Cobalt, Total ug/L	Fluoride, Total mg/L	Lithium, Total ug/L	Magnesium, Total mg/L	Mercury, Total ug/L	Molybdenum , Total ug/L	pH	Potassium, Total mg/L	Selenium, Total ug/L	Sodium, Total mg/l	Solids - total dissolved solids (TDS) mg/L	Sulfate, Total mg/L	Thallium, Total ug/L
AP1a	Ash Pond 1	90	< 2.0	3.1	7.2	130	< 1.0	3800	< 1.0	380	3.2	< 4.0	< 2.0	< 0.250	39	67	< 0.20	47	6.99	7.3	3.0	33	1800	1500	< 1.0
AP1b		120	< 2.0	3.3	17	100	< 1.0	3100	< 1.0	320	13	< 4.0	< 2.0	0.977	47	52	< 0.20	100	7.01	18	6.9	53	1600	1300	< 1.0
AP1c		80	< 2.0	< 3.0	18	130	< 1.0	2900	< 1.0	390	13	< 4.0	< 2.0	0.614	51	49	< 0.20	81	7.05	18	3.1	59	1900	1600	< 1.0
AP1d		90	< 20	< 3.0	2.0	200	< 1.0	2000	< 1.0	210	18	< 4.0	< 2.0	1.08	55	35	< 0.20	31	7.21	26	1.5	83	980	1000	< 1.0
AP1e		80	< 2.0	< 3.0	1.4	160	< 1.0	2100	< 1.0	200	18	< 4.0	< 2.0	1.00	55	34	< 0.20	30	7.12	26	1.2	80	1200	960	< 1.0
AP1f		110	< 20	< 3.0	1.5	150	< 1.0	2100	< 1.0	200	17	< 4.0	< 2.0	1.00	57	35	< 0.20	31	7.20	26	1.2	82	1200	1000	< 1.0
AP1g		75	< 2.0	< 3.0	1.3	140	< 1.0	2100	< 1.0	210	17	< 4.0	< 2.0	1.00	56	32	< 0.20	29	7.21	26	1.4	100	1200	970	< 1.0
AP1h		90	< 20	< 3.0	1.5	180	< 1.0	2200	< 1.0	230	17	< 4.0	< 2.0	0.980	55	30	< 0.20	31	7.41	27	1.2	110	1200	1000	< 1.0
AP2e	Ash Pond 2	55	< 20	< 3.0	23	26	< 1.0	5300	< 1.0	210	< 5.0	< 4.0	< 2.0	0.438	190	40	< 0.20	90	6.49	27	< 1.0	25	1700	1500	< 1.0
AP2f		100	< 20	< 3.0	1.2	22	< 2.0	2000	< 1.0	170	< 5.0	< 4.0	< 2.0	0.398	130	33	< 0.20	3.2	6.42	21	< 1.0	14	1700	1500	< 1.0
AP2g		4.0	< 2.0	< 3.0	5.5	20	< 2.0	4300	4.6	410	< 5.0	< 4.0	< 2.0	0.506	180	51	< 0.20	41	6.46	29	< 1.0	27	2400	2300	< 1.0
AP2h		140	< 2.0	< 3.0	75	23	< 1.0	14000	< 1.0	310	1.7	< 4.0	< 2.0	0.406	120	29	< 0.20	570	7.17	40	< 1.0	39	1500	1300	< 1.0
CLa	Coffeen Lake	80	< 2.0	< 3.0	1.8	54	< 1.0	270	< 1.0	23	23	< 4.0	< 2.0	0.443	< 10	12	< 0.20	5.0	7.22	7.4	< 1.0	19	190	55	< 1.0
CLb		80	< 2.0	< 3.0	1.8	52	< 1.0	280	< 1.0	23	22	< 4.0	< 2.0	0.425	< 10	11	< 0.20	4.9	7.52	7.8	< 1.0	19	180	56	< 1.0
CLc		75	< 2.0	< 3.0	1.8	56	< 1.0	280	< 1.0	23	22	< 4.0	< 2.0	0.426	< 10	12	< 0.20	4.7	7.62	7.4	< 1.0	19	160	54	< 1.0
CLd		80	< 2.0	< 3.0	1.8	54	< 1.0	270	< 1.0	23	23	< 4.0	< 2.0	0.421	< 10	12	< 0.20	4.8	7.30	7.5	< 1.0	20	170	54	< 1.0
GPa	Gypsum Stack Pond	4.0	< 2.0	< 3.0	4.7	120	2.6	59000	40	450	1900	< 4.0	52	42.7	300	1500	< 0.80	130	7.16	210	890	620	17000	17000	< 1.0
GPb		10	< 2.0	8.6	92	1100	< 20	97000	67	1400	2600	150	110	69.4	480	2500	27	140	6.65	360	1500	1000	28000	27000	< 4.0
GPc		5.5	< 2.0	< 6.0	4.4	110	2.6	72000	41	570	1800	< 4.0	54	49.2	300	1500	< 0.80	120	6.73	260	890	650	17000	20000	< 1.0
GPd		6.0	< 2.0	< 3.0	4.2	110	< 20	66000	38	560	1900	< 4.0	52	51.3	300	1500	< 0.80	120	6.73	230	800	660	16000	19000	< 1.0
RPa	Gypsum Recycle Pond	< 2.0	< 2.0	< 3.0	3.3	89	2.3	60000	37	380	1600	< 4.0	44	47.0	310	1200	< 0.20	63	6.70	190	840	450	16000	17000	< 1.0
RPb		< 2.0	< 2.0	< 3.0	2.8	90	2.1	56000	33	380	1800	< 4.0	45	44.4	310	1200	< 0.40	64	6.49	210	780	470	16000	18000	< 1.0
RPc		< 2.0	< 2.0	< 3.0	3.1	88	2.2	59000	37	380	2000	< 4.0	43	45.0	310	1200	< 0.20	64	6.32	200	830	440	16000	20000	< 1.0
RPd		< 2.0	< 2.0	< 3.0	3.4	89	2.4	59000	36	400	1600	< 4.0	45	51.2	310	1300	< 0.20	66	6.32	200	860	460	17000	16000	< 1.0

[O:MDM 12/2016, NRK 12/2016]

Natural Resource Technology

APPENDIX A

BORING LOGS AND WELL CONSTRUCTION DETAILS

APPENDIX A1

ASH POND 2

FIELD BORING LOG

CLIENT: Natural Resource Technology, Inc.
Site: Coffeen Energy Center
Location: Coffeen, Illinois
Project: 15E0030
DATES: Start: 9/14/2015
Finish: 9/14/2015
WEATHER: Sunny, hi 60's

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: D-50 Turbo Tracked MST 800ATV
Drilling Method: Hollow Stem Auger (3¼"overdrill / 4¼")
FIELD STAFF: Driller: D. Crump
Helper: D. Groves
Eng/Geo: R. Hasenyager

BOREHOLE ID: G401
Well ID: G401
Surface Elev: 623.03 ft. MSL
Completion: 19.30 ft. BGS
Station: 2,515,614.84N
872,510.57E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	16/24 67%	ss	2-2 3-7 N=5	17		
2A	21/24 88%	ss	8-11 8-9 N=19	17		1.80
2B				25		
3A	23/24 96%	ss	3-4 7-8 N=11	23		2.50
4A	24/24 100%	ss	8-9 12-14 N=21	21		3.30
4B				19		2.80
5A	24/24 100%	ss	2-3 4-5 N=7	21		1.30
6A	24/24 100%	ss	2-4 5-6 N=9	17		2.50
7A	24/24 100%	ss	9-7 8-9 N=15	21		1.40
8A	24/24 100%	ss	2-3 2-4 N=5	17		1.30
8B				19		
9A	20/24 83%	ss	5-4 5-10 N=9	21		
9B				16		
10A	12/16 75%	ss	23-41 50/4"	6		4.50

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark grayish brown (10YR4/2), moist, soft, CLAY with little silt and trace very fine- to fine-grained sand - FILL.	
	Yellowish brown (10YR5/6) moist, medium, CLAY with some silt and trace very fine- to coarse-grained sand - FILL.	622
2	Dark gray (10YR4/1), moist, stiff, SILT with little clay and trace very fine-grained sand.	
	Yellowish brown (10YR5/6), moist, stiff, CLAY with some silt and trace very fine- to fine-grained sand.	620
4	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, medium, CLAY with some silt and trace very fine- to fine-grained sand.	618
6		616
8	Gray (10YR5/1) with 30% yellowish brown (10YR5/8) mottles, moist, stiff, SILT and very fine-grained SAND with trace clay.	
10	Gray (10YR5/1) with 30% yellowish brown (10YR5/6) mottles, moist, medium, CLAY with some silt and trace very fine- to fine-grained sand.	614
12		612
14		610
	Gray (10YR6/1), moist soft, CLAY with very fine- to fine-grained sand and little silt.	608
16	Yellowish brown (10YR5/6), wet, loose, very fine- to fine-grained SAND with trace silt.	
	Yellowish brown (10YR5/6), wet medium, SILT with some very fine-grained sand and little clay.	606
	Yellowish brown (10YR5/6), wet, loose, very fine- to medium-grained SAND with trace silt.	
18	Gray (10YR5/1), moist, very hard, SILT with few clay and little very fine- to very coarse sand.	604

End of boring = 19.3 feet

NOTE(S): G401 installed in borehole.

Surface Elevation: 610.56

Datum msl

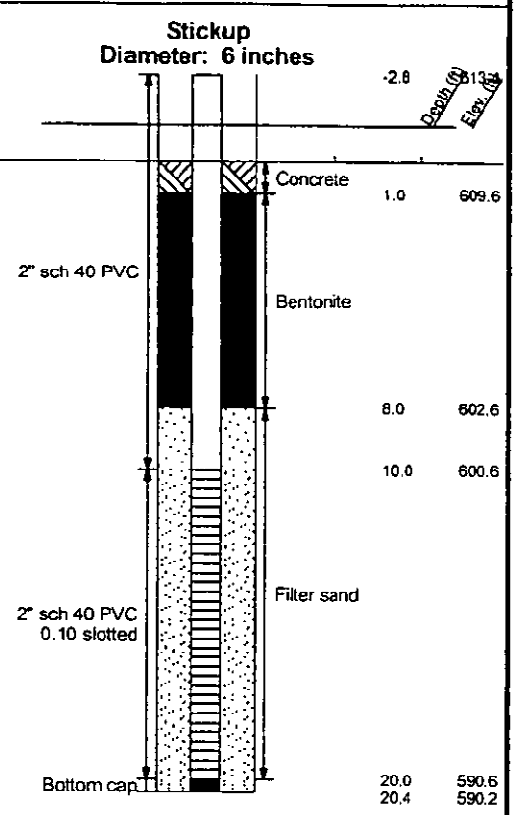
Completion Date: 8/27/10

Northing: 872502.26

Easting: 2516632.59

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium stiff, brown, silty CLAY - CL	6-3-3	SS1
		1-2-4	SS2
5	Medium stiff, gray, silty CLAY, trace sand - CL	1-2-5	SS3
	Hard to stiff, brown to gray, silty CLAY, trace sand seams - CL (TILL)	9-22-28	SS4
10			
15		1-6-12	SS5
20		3-4-9	SS6
	Boring terminated at 20 feet.		
25			
30			
35			

WELL DIAGRAM



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002.WL J017150.01-COFFEEN.GPJ GTINC 0638301.GPJ 12/13/10

GROUNDWATER DATA

ENCOUNTERED AT 7 FEET ▽

DRILLING DATA

___ AUGER 4 1/4" HOLLOW STEM

WASHBORING FROM ___ FEET

MVU DRILLER SWG LOGGER

CME 55TRK DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: DK	App'vd. by: KRB
Date: 9/10/10	Date: 1-4-11	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Ameren-Coffeen Ash Pond Evaluation

LOG OF BORING: APW-2

G402

Project No. J017150.01

FIELD BORING LOG

HANSON

CLIENT: Natural Resource Technology, Inc.
Site: Coffeen Energy Center
Location: Coffeen, Illinois
Project: 15E0030
DATES: Start: 9/11/2015
Finish: 9/11/2015
WEATHER: Raining, hi 60's

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: D-50 Turbo Tracked MST 800ATV
Drilling Method: Hollow Stem Auger (3¼"overdrill / 4¼")
FIELD STAFF: Driller: D. Crump
Helper: D. Groves
Eng/Geo: K. Theesfeld

BOREHOLE ID: G403
Well ID: G403
Surface Elev: 623.81 ft. MSL
Completion: 18.15 ft. BGS
Station: 2,514,616.63N
873,561.34E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 15.00 - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	19/24 79%	SS	2-2 2-2 N=4	25		0.80
2A	22/24 92%	SS	2-2 3-4 N=5	29		
2B				26		1.50
3A	8/24 33%	SS	2-3 4-4 N=7	25		1.50
4A	21/24 88%	SS	8-7 8-7 N=15	20		1.30
5A	20/24 83%	SS	2-2 3-3 N=5	22		0.70
6A	24/24 100%	SS	2-2 3-4 N=5	23		1.40
7A	21/24 88%	SS	5-5 6-5 N=11	20		0.90
8A	24/24 100%	SS	3-2 3-6 N=5	17		
9A	19/24 79%	SS	8-12 21-25 N=33	8		4.50
	0/2 0%	BD				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark brown (10YR2/2) grading to dark grayish brown (10YR4/2), moist, medium, SILT with some clay, trace roots and grass.	622
2	Very dark brown (10YR2/2) grading to dark grayish brown (10YR4/2), moist , stiff, SILT with some clay, trace wood.	
	Yellowish brown (10YR5/4) with 10% very dark brown (10YR2/2) mottles, moist, stiff, CLAY with little silt, trace very fine-grained sand seams (<1/16" thick).	620
4	Yellowish brown (10YR5/4), moist, stiff, CLAY with little silt and trace very fine-grained sand.	618
6	Grayish brown (10YR5/2) with 15% yellowish brown (10YR5/6) and 5% very dark grayish brown (10YR3/2) mottles, moist, stiff, CLAY with little silt and trace very fine-grained sand.	616
8	Grayish brown (10YR5/2) with 5% yellowish brown (10YR5/6) mottles, moist, medium, CLAY with little silt and trace very fine-grained sand.	614
10	Grayish brown (10YR5/2) with 30% yellowish brown (10YR5/6) mottles, moist, very stiff, CLAY with little silt, few very fine- to medium-grained sand, and trace gravel.	612
12	Grayish brown (10YR5/3) with 45% yellowish brown (10YR5/6) and 5% dark brown (10YR3/3) mottles, moist, stiff, SILT with some clay, few very fine- to coarse-grained sand, and trace gravel.	610
14	Grayish brown (10YR5/3) with 40% yellowish brown (10YR5/6) mottles, moist, medium, SILT with little clay, few very fine- to coarse-grained sand, and trace gravel.	
▼	Yellowish brown (10YR5/6) with 30% grayish brown (10YR5/2) mottles, moist, medium, SILT with little clay, few very fine- to coarse-grained sand, and trace gravel.	608
16	Yellowish brown (10YR5/6), wet, loose, SAND with some clay and few silt.	
	Yellowish brown (10YR5/6) with 30% grayish brown (10YR5/2) mottles, moist, stiff, SILT with few clay, very fine- to coarse-grained sand, and gravel.	
	Yellowish brown (10YR5/6), moist, very stiff, SILT with some clay and few sand and gravel.	606
18	Very dark grayish brown (10YR3/2), dry, hard, SILT with little clay and few very fine- to coarse-grained sand and gravel.	

End of boring = 18.15 feet

NOTE(S): G403 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Energy Center
Location: Coffeen, Illinois
Project: 15E0030
DATES: Start: 5/1/2007
Finish: 5/1/2007
WEATHER: Partly sunny, warm

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 4¼" Hollow stem auger with split spoon sampler
FIELD STAFF: Driller: A. Rachford
Helper: M. Brown
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB22
Well ID: G404
Surface Elev: 613.10 ft. MSL
Completion: 12.00 ft. BGS
Station: 873,999.77N
2,516,397.85E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 2.07 - 05/10/2007
▼ =
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type
1A	19/24 *79%*	ss		26		0.85 B
1B				26		
2A	19/24 *79%*	ss		16		2.47 B
3A	18/24 *75%*	ss		19		2.18 B
3B				18		2.33 B
4A	24/24 *100%*	ss		23		0.58 B
4B				18		
5A	23/24 *96%*	ss		10		
5B				19		
6A	19/24 *79%*	ss		19		
6B				11		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Black (10YR2/1), moist, firm, clayey SILT (TOPSOIL)	612
▼ 2	Gray (10YR5/1) with 35% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with sand and trace gravel	610
4	Gray (10YR6/1) with 20% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and trace gravel	608
6	Yellowish brown (10YR5/8), moist, soft, sandy CLAY with slight trace gravel	
	Yellowish brown (10YR5/8), very moist to wet, very soft, clayey, very fine- to medium-grained SAND with trace gravel	606
8	Yellowish brown (10YR5/4) with 30% yellowish brown (10YR5/8) mottles, moist, hard, clayey SILT with sand and trace gravel	604
10	Yellowish brown (10YR5/6), wet, loose, very fine- to medium-grained SAND with coarse-grained sand and slight trace gravel	602
12	Dark yellowish brown (10YR4/6) with 40% yellowish brown (10YR5/8) mottles, moist, very hard, very silty CLAY with sand and gravel	

End of Boring = 12.0 ft. BGS

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Energy Center
Location: Coffeen, Illinois
Project: 15E0030
DATES: Start: 5/1/2007
Finish: 5/1/2007
WEATHER: Partly sunny, warm

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 4¼" Hollow stem auger with split spoon sampler
FIELD STAFF: Driller: A. Rachford
Helper: M. Brown
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB21
Well ID: G405
Surface Elev: 620.90 ft. MSL
Completion: 14.21 ft. BGS
Station: 873,996.79N
2,515,335.70E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 1.28 - 05/10/2007
▼ =
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type
1A	19/24 *79%*	ss		43		0.78 B
1B				26		1.94 B
2A	12/12 *100%*	ss		27		2.52 BSh
3A	24/24 *100%*	ss		24		3.92 BSh
3B				24		2.33 BSh
4A	24/24 *100%*	ss		20		2.33 BSh
5A	24/24 *100%*	ss		24		1.55 BSh
6A	24/24 *100%*	ss		19		
6B				18		
7A	24/24 *100%*	ss		9		7.42 BSh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
▼	Black (10YR2/1), moist, soft, clayey SILT (TOPSOIL)	620
2	Gray (10YR6/1) with 30% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY	618
4	Gray (10YR6/1), moist, firm, silty CLAY slight trace sand	616
6	Gray (10YR5/1), very moist, soft, clayey, very fine- to fine-grained SAND	
	Gray (10YR6/1) with 25% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and trace gravel	614
8	Yellowish brown (10YR5/8) with 40% gray (10YR6/1) mottles, moist, firm, silty CLAY with sand and trace gravel	612
10	Yellowish brown (10YR5/4), wet, loose, very fine- to fine-grained SAND	610
	Dark brown (10YR3/3), very moist, soft, clayey, fine- to very coarse-grained SAND with slight trace gravel	
12	Yellowish brown (10YR5/4), wet, loose, very fine- to fine-grained SAND	
	Dark yellowish brown (10YR4/4), moist, soft, sandy SILT with trace gravel	608
	Yellowish brown (10YR5/4), wet, loose, very fine- to fine-grained SAND	
14	Gray (10YR5/1), moist, very hard, very silty CLAY with sand and gravel	

End of Boring = 14.2 ft. BGS

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/16/2016
Finish: 8/17/2016
WEATHER: Cloudy, rain, (hi-70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

BOREHOLE ID: G405D
Well ID: G45D
Surface Elev: 620.94 ft. MSL
Completion: 42.00 ft. BGS
Station: 873,998.03N
2,515,322.23E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = 16.00 - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
	0/60 0%	BD				
	0/60 0%	BD				
	0/48 0%	BD				
1A	24/24 100%	SS	6-23 37-44 N=60	11		1.50
2A	23/24 96%	SS	14-32 41-45 N=73	7		4.50
3A	14/17 82%	SS	16-47 50/5"	7		4.50

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Black (10YR2/1), moist, soft, clayey SILT (TOPSOIL)	620
2	Gray (10YR6/1) with 30% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY	618
4	Gray (10YR6/1), moist, firm, silty CLAY slight trace sand	616
6	Gray (10YR5/1), very moist, soft, clayey, very fine- to fine-grained SAND	
	Gray (10YR6/1) with 25% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and trace gravel	614
8	Yellowish brown (10YR5/8) with 40% gray (10YR6/1) mottles, moist, firm, silty CLAY with sand and trace gravel	612
10	Yellowish brown (10YR5/4), wet, loose, very fine- to fine-grained SAND	610
	Dark brown (10YR3/3), very moist, soft, clayey, fine- to very coarse-grained SAND with slight trace gravel	
12	Yellowish brown (10YR5/4), wet, loose, very fine- to fine-grained SAND	
	Dark yellowish brown (10YR4/4), moist, soft, sandy SILT with trace gravel	608
	Yellowish brown (10YR5/4), wet, loose, very fine- to fine-grained SAND	
14	Gray (10YR5/1), moist, very hard, very silty CLAY with sand and gravel	606
▼ 16	Dark gray (10YR4/1), moist, hard, SILT with few fine- to coarse-grained sand, little clay and trace small gravel.	604
18	Dark gray (10YR4/1), dry, hard, SILT with few fine- to coarse-grained sand, little clay and trace small gravel.	602
20		

NOTE(S): G45D installed in boring.
Boring was blind drilled to 14.0 feet bgs. Blind drill lithologies from boring G405.

FIELD BORING LOG

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/16/2016
Finish: 8/17/2016
WEATHER: Cloudy, rain, (hi-70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

HANSON

BOREHOLE ID: G405D
Well ID: G45D
Surface Elev: 620.94 ft. MSL
Completion: 42.00 ft. BGS
Station: 873,998.03N
2,515,322.23E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = 16.00 - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
4A	19/24 79%	SS	15-36 32-36 N=68	8		4.50
5A	19/24 79%	SS	10-18 30-33 N=48	8		4.50
6A	11/24 46%	SS	22-42 34-36 N=76	8		4.50
7A	11/24 46%	SS	28-26 23-26 N=49	11		4.50
8A	23/24 96%	SS	7-11 16-25 N=27	10		4.50
9A				16		
9B	17/24 71%	SS	7-14 12-12 N=26	14		
9C				9		
10A	24/24 100%	SS	2-5 8-13 N=13	15		3.25
11-1 11-2 11-3 11-4	22/24 92%	SH		15		
12A	24/24 100%	SS	2-5 8-10 N=13	16		2.00
13A	22/24 92%	SS	2-5 7-8 N=12	16		2.00

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark gray (10YR4/1), dry, hard, SILT with few fine- to coarse-grained sand, little clay and little small gravel.	
	Dark gray (10YR4/1), moist, dense, fine- to coarse-grained SAND.	600
22		
	Dark gray (10YR4/1), dry, hard, SILT with few fine- to coarse-grained sand, little clay and little small gravel.	598
24		
		596
26		
	Dark gray (10YR4/1) with 5% light brownish gray (10YR6/2) mottles, dry, hard, SILT with few fine- to coarse-grained sand, little clay and little small gravel.	594
28		
	Dark gray (10YR4/1) with 5% light brownish gray (10YR6/2) and dark greenish gray (10YR4/2) mottles, dry, hard, SILT with few fine- to coarse-grained sand, little clay and little small gravel.	592
30		
	Dark gray (10YR4/1), dry, hard, SILT with few fine- to coarse-grained sand, little clay and little small gravel.	
	Dark gray (10YR4/1), dry, very stiff, SILT with some very fine-grained SAND.	590
	Very dark gray (10YR3/1), moist, very stiff, CLAY with few silt and little medium-grained sand.	
32		
		588
34	Very dark gray (10YR3/1), moist, very stiff, CLAY with little silt and little medium-grained sand.	
		586
36		
	Very dark gray (10YR3/1), moist, very stiff, CLAY with little silt, little medium-grained sand, and trace small gravel.	584
38		
	Very dark gray (10YR3/1) with 5% black (10YR2/1) mottles, moist, very stiff, CLAY with little silt, little medium-grained sand, and trace small gravel.	582
40		

NOTE(S): G45D installed in boring.
Boring was blind drilled to 14.0 feet bgs. Blind drill lithologies from boring G405.

FIELD BORING LOG

HANSON

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/16/2016
Finish: 8/17/2016
WEATHER: Cloudy, rain, (hi-70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

BOREHOLE ID: G405D
Well ID: G45D
Surface Elev: 620.94 ft. MSL
Completion: 42.00 ft. BGS
Station: 873,998.03N
2,515,322.23E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = 16.00 - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
14A	23/24 *96%*	SS	*1-3* *7-7* N=10	16		*3.50*		Very dark gray (10YR3/1) with 5% black (10YR2/1) mottles, moist, very stiff, CLAY with little silt, little medium-grained sand, and trace small gravel. *[Continued from previous page]*		580	
							42	**End of Boring = 42.0 ft. BGS**			

NOTE(S): G45D installed in boring.
Boring was blind drilled to 14.0 feet bgs. Blind drill lithologies from boring G405.

FIELD BORING LOG

HANSON

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/19/2016
Finish: 8/19/2016
WEATHER: Sunny, (mid-70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

BOREHOLE ID: G406
Well ID: G406
Surface Elev: 621.86 ft. MSL
Completion: 18.75 ft. BGS
Station: 872,521.34N
2,514,702.38E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) % *Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks

Dark brown (10YR3/3), moist, stiff, SILT with few clay and trace organics.

Brown (10YR5/3) with 10% dark brown (10YR3/3) mottles, SILT with some clay and trace small gravel.

Brown (10YR5/3) with 10% dark brown (10YR3/3) mottles, SILT with some clay.

Grayish brown (10YR5/2) with 5% dark yellowish brown (10YR4/6) mottles, moist, stiff, CLAY with few silt and little fine-grained sand.

Very pale brown (10YR7/4) with 25% yellowish brown (10YR5/6) mottles, moist, medium, CLAY with trace silt.

Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with little silt and trace fine- to medium-grained sand.

Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with little silt, little fine- to medium-grained sand and trace small gravel.

Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with few fine- to medium-grained sand, little silt, and trace small gravel.

Gray (10YR6/1) with 25% brownish yellow (10YR6/8) and 5% strong brown (7.5YR4/6) mottles, moist, stiff, CLAY with few fine- to medium-grained sand, little silt, and trace small gravel.

Gray (10YR6/1) with 10% brownish yellow (10YR6/8) and 5% strong brown (7.5YR4/6) mottles, moist, stiff, CLAY with some fine- to medium-grained sand, little silt, and trace small gravel.

Gray (10YR6/1) with 5% brownish yellow (10YR6/6) mottles, wet, loose, fine-grained SAND with some clay.

Gray (10YR6/1) with 5% brownish yellow (10YR6/6) mottles, moist, loose, fine-grained SAND with some clay.

Gray (10YR5/1), dry, hard, SILT with few clay, few fine- to coarse-grained sand and trace small gravel.

Depth (ft. BGS): 2, 4, 6, 8, 10, 12, 14, 16, 18

Elevation (ft. MSL): 620, 618, 616, 614, 612, 610, 608, 606, 604

End of Boring = 18.75 ft. BGS

NOTE(S): G406 installed in boring.
Boring was blind drilled adjacent to G406D.

FIELD BORING LOG

HANSON

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/19/2016
Finish: 8/19/2016
WEATHER: Sunny, (mid-70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

BOREHOLE ID: G406D
Well ID: G46D
Surface Elev: 621.91 ft. MSL
Completion: 52.00 ft. BGS
Station: 872,519.70N
2,514,697.78E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	18/24 75%	ss	4-3 4-6 N=7	11		1.50
1B				15		3.00
2A	12/24 50%	ss	4-6 3-3 N=9	12		2.50
2B				18		2.00
3A	3/24 13%	ss	3-3 4-7 N=7	24		
4A	20/24 83%	ss	2-3 4-5 N=7	21		1.25
5A	19/24 79%	ss	1-3 4-6 N=7	18		1.75
6A	23/24 96%	ss	2-2 4-5 N=6	18		2.50
7A	21/24 88%	ss	1-3 4-5 N=7	16		1.00
8A	23/24 96%	ss	1-2 2-2 N=4	18		0.75
8B				17		0.75
9A	22/24 92%	ss	4-13 27-23 N=40	8		
9B				8		
10A	17/24 71%	ss	13-31 33-42 N=64	7		4.50

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark brown (10YR3/3), moist, stiff, SILT with few clay and trace organics.	
2	Brown (10YR5/3) with 10% dark brown (10YR3/3) mottles, SILT with some clay and trace small gravel.	620
	Brown (10YR5/3) with 10% dark brown (10YR3/3) mottles, SILT with some clay.	
4	Grayish brown (10YR5/2) with 5% dark yellowish brown (10YR4/6) mottles, moist, stiff, CLAY with few silt and little fine-grained sand.	618
	Very pale brown (10YR7/4) with 25% yellowish brown (10YR5/6) mottles, moist, medium, CLAY with trace silt.	
6	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with little silt and trace fine- to medium-grained sand.	616
8	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with little silt, little fine- to medium-grained sand and trace small gravel.	614
10	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with few fine- to medium-grained sand, little silt, and trace small gravel.	612
12	Gray (10YR6/1) with 25% brownish yellow (10YR6/8) and 5% strong brown (7.5YR4/6) mottles, moist, stiff, CLAY with few fine- to medium-grained sand, little silt, and trace small gravel.	610
14	Gray (10YR6/1) with 10% brownish yellow (10YR6/8) and 5% strong brown (7.5YR4/6) mottles, moist, stiff, CLAY with some fine- to medium-grained sand, little silt, and trace small gravel.	608
16	Gray (10YR6/1) with 5% brownish yellow (10YR6/6) mottles, wet, loose, fine-grained SAND with some clay.	606
	Gray (10YR6/1) with 5% brownish yellow (10YR6/6) mottles, moist, loose, fine-grained SAND with some clay.	
18	Gray (10YR5/1), dry, hard, SILT with few clay, few fine- to coarse-grained sand and trace small gravel.	604
20		602

Borehole Detail

NOTE(S): G46D installed in boring.

FIELD BORING LOG

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/19/2016
Finish: 8/19/2016
WEATHER: Sunny, (mid-70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

HANSON

BOREHOLE ID: G406D
Well ID: G46D
Surface Elev: 621.91 ft. MSL
Completion: 52.00 ft. BGS
Station: 872,519.70N
2,514,697.78E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11-1	3/3 100%	SH				
	8/24 33%	DS				
12-1						
13-1						
13-2	24/24 100%	DS				
13-3						
13-4						
14A				19		
14B	21/21 100%	SS	7-30 32-20 N=62	7		
14C				8		4.50
15A	12/24 50%	SS	15-16 10-11 N=26	10		4.50
16A	17/24 71%	SS	2-5 7-11 N=12	16		3.00
17A	17/24 71%	SS	2-5 7-12 N=12	15		2.50
18A	12/24 50%	SS	3-7 12-20 N=19	17		2.50
19A	23/24 96%	SS	4-4 6-9 N=10	25		1.00
20A	22/24 92%	SS	2-2 5-7 N=7	17		1.00
21A	24/24 100%	SS	2-3 4-6 N=7	17		1.00

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
22	Gray (10YR5/1), dry, hard, SILT with few clay, few fine- to coarse-grained sand and trace small gravel. *[Continued from previous page]*	600	
24	Pale brown (10YR6/3), wet, loose, fine-grained SAND.	598	
	Pale brown (10YR6/3), wet, loose, fine-grained SAND and small GRAVEL.		
	Gray (10YR5/1), dry, hard, SILT with some clay, trace fine- to coarse-grained sand and trace small gravel.		
26	Dark gray (10YR4/1), dry, hard, CLAY with some silt, trace fine- to coarse-grained sand and trace small gravel.	596	
28		594	
30	Dark gray (10YR4/1), moist, very stiff, CLAY with few silt, trace fine- to coarse-grained sand and trace small gravel.	592	
32	Dark gray (10YR4/1), moist, very stiff, CLAY with few silt, trace fine- to coarse-grained sand and trace small to large gravel.	590	
	Dark gray (10YR4/1), moist, very stiff, CLAY with few silt, trace fine- to coarse-grained sand and trace small gravel.		
34	Dark gray (10YR4/1) with 5% very dark gray (10YR3/1) and brown (10YR5/3) mottles, moist, very stiff, CLAY with few silt, trace fine- to coarse-grained sand and trace small gravel.	588	
36	Gray (10YR5/1) with 5% very dark gray (10YR3/1) and brown (10YR5/3) mottles, moist, very stiff, CLAY with few silt, trace fine- to coarse-grained sand and trace small gravel.	586	
38	Dark gray (10YR4/1), moist, very stiff, CLAY with few silt, trace fine- to coarse-grained sand and trace small gravel.	584	
40		582	

NOTE(S): G46D installed in boring.

FIELD BORING LOG

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/19/2016
Finish: 8/19/2016
WEATHER: Sunny, (mid-70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

BOREHOLE ID: G406D
Well ID: G46D
Surface Elev: 621.91 ft. MSL
Completion: 52.00 ft. BGS
Station: 872,519.70N
2,514,697.78E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
22A	24/24 100%	SS	1-3 5-6 N=8	17		1.50
23-1						
23-2	24/24 100%	SH				
23-3				16		
23-4						
24A	24/24 100%	SS	3-4 6-7 N=10	17		1.50
25A	24/24 100%	SS	2-2 5-7 N=7	18		1.25
26A	24/24 100%	SS	2-5 6-8 N=11	17		1.75
27A	23/24 96%	SS	2-3 9-12 N=12	15		3.50

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
42	Dark gray (10YR4/1), moist, very stiff, CLAY with few silt, trace fine- to coarse-grained sand and trace small gravel. *[Continued from previous page]*	580	
44		578	
46		576	
48		574	
50		572	
52		570	

End of Boring = 52.0 ft. BGS

NOTE(S): G46D installed in boring.

FIELD BORING LOG

HANSON

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/16/2016
Finish: 8/16/2016
WEATHER: Rain, (mid-70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

BOREHOLE ID: G407
Well ID: G407
Surface Elev: 618.35 ft. MSL
Completion: 20.00 ft. BGS
Station: 872,973.39N
2,513,705.87E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 10, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = 16.00 - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	12/24 50%	ss	4-3 3-3 N=6	14		3.50
2A	20/24 83%	ss	2-2 4-4 N=6	18		1.50
3A	23/24 96%	ss	1-2 3-4 N=5	19		1.75
4A	24/24 100%	ss	1-3 3-5 N=6	19		1.50
5A	21/24 88%	ss	1-2 4-4 N=6	19		0.50
6A	22/24 92%	ss	1-2 2-1 N=4	17		
7A	24/24 100%	ss	7-29 33-17 N=62	8		
8A	24/24 100%	ss	3-7 12-17 N=19	12		4.50
9A	24/24 100%	ss	4-9 14-20 N=23	13		4.00
10A	24/24 100%	ss	2-8 14-19 N=22	14		4.50

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Very dark gray (10YR3/1), wet, medium, SILT with some organics. [Fill]	618	
	Gray (10YR6/1), wet, loose, SAND with some gravel and little clay. [Fill]		
2	Yellowish brown (10YR5/6) with 5% dark yellowish brown (10YR3/6) mottles, moist, very stiff, SILT with some clay and trace very fine- to fine-grained sand.	616	
	Brown (10YR5/3) with 10% yellowish brown (10YR5/6) mottles, moist, stiff, SILT with some clay, little fine- to coarse-grained sand, and trace small gravel.		
4	Brown (10YR5/3) with 25% yellowish brown (10YR5/6) mottles, moist, stiff, CLAY with some silt, trace fine-grained sand and trace small gravel.	614	
6	Brown (10YR5/3) with 10% yellowish brown (10YR5/6) mottles, moist, stiff, CLAY with some silt, little fine- to coarse-grained sand and trace small gravel.	612	
8	Yellowish brown (10YR5/6) with 25% brown (10YR5/3) mottles, moist, medium, CLAY with few silt, few fine-grained sand, and trace small gravel.	610	
10	Yellowish brown (10YR5/8) with 5% gray (10YR5/1) mottles, moist, very loose, fine-grained SAND with some clay and trace small gravel.	608	
12	Gray (10YR5/1) with 25% yellowish brown (10YR5/8) mottles, moist, very dense, fine-grained SAND	606	
14	Brown (10YR5/3), moist, hard, SILT with some clay and little fine- to coarse-grained sand.	604	
	Yellowish brown (10YR5/4) with 5% yellowish brown (10YR5/6) and 5% black (10YR2/1) mottles, SILT with some clay and little fine- to coarse-grained sand.		
▼ 16	Yellowish brown (10YR5/4) with 5% yellowish brown (10YR5/6), 5% dark gray (10YR4/1) and 5% black (10YR2/1) mottles, moist, hard, SILT with little fine- to coarse-grained sand and trace small gravel.	602	
18	Yellowish brown (10YR5/4) with 5% yellowish brown (10YR5/6), 5% dark gray (10YR4/1) and 5% black (10YR2/1) mottles, wet, stiff, SILT with little fine- to coarse-grained sand and little small gravel.	600	
20	Dark grayish brown (10YR4/2) with 10% dark yellowish brown (10YR3/6) mottles, moist, hard, CLAY with some silt, little fine- to coarse-grained sand and trace small gravel.		

End of Boring = 20.0 ft. BGS

NOTE(S): G407 installed in boring.

FIELD BORING LOG

HANSON

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/17/2016
Finish: 8/17/2016
WEATHER: Hazy, (low-80s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

BOREHOLE ID: T408
Well ID: T408
Surface Elev: 621.09 ft. MSL
Completion: 25.92 ft. BGS
Station: 873,999.36N
2,515,314.91E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
	0/60 0%	BD				
	0/60 0%	BD				
	0/60 0%	BD				
4A	22/24 92%	SS	8-16 33-35 N=49			4.50
	0/36 0%	BD				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Black (10YR2/1), moist, soft, clayey SILT (TOPSOIL)	620
2	Gray (10YR6/1) with 30% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY	618
4	Gray (10YR6/1), moist, firm, silty CLAY slight trace sand	616
6	Gray (10YR5/1), very moist, soft, clayey, very fine- to fine-grained SAND	
	Gray (10YR6/1) with 25% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and trace gravel	614
8	Yellowish brown (10YR5/8) with 40% gray (10YR6/1) mottles, moist, firm, silty CLAY with sand and trace gravel	612
10	Yellowish brown (10YR5/4), wet, loose, very fine- to fine-grained SAND	610
	Dark brown (10YR3/3), very moist, soft, clayey, fine- to very coarse-grained SAND with slight trace gravel	
12	Yellowish brown (10YR5/4), wet, loose, very fine- to fine-grained SAND	
	Dark yellowish brown (10YR4/4), moist, soft, sandy SILT with trace gravel	608
	Yellowish brown (10YR5/4), wet, loose, very fine- to fine-grained SAND	
14	Gray (10YR5/1), moist, very hard, very silty CLAY with sand and gravel	606
16	Dark gray (10YR4/1), moist, hard, SILT with few fine- to coarse-grained sand, little clay and trace small gravel.	604
18	Dark gray (10YR4/1), dry, hard, SILT with few fine- to coarse-grained sand, little clay and trace small gravel.	602
20		

Borehole Detail

Remarks

NOTE(S): T408 installed in boring.
Boring was blind drilled to 26.0 feet bgs. Blind drill lithologies from boring G405 and G405D.

FIELD BORING LOG

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/17/2016
Finish: 8/17/2016
WEATHER: Hazy, (low-80s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

BOREHOLE ID: T408
Well ID: T408
Surface Elev: 621.09 ft. MSL
Completion: 25.92 ft. BGS
Station: 873,999.36N
2,515,314.91E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
	0/36 0%	BD						Dark gray (10YR4/1), dry, hard, SILT with few fine- to coarse-grained sand, little clay and little small gravel.			
								Dark gray (10YR4/1), moist, dense, fine- to coarse-grained SAND.		600	
							22				
7-1								Dark gray (10YR4/1), dry, hard, SILT with few fine- to coarse-grained sand, little clay and little small gravel.		598	
7-2	20/24 83%	DS					24				
7-3											
7-4										596	
	0/12 0%	BD									

End of Boring = 25.92 ft. BGS

NOTE(S): T408 installed in boring.
Boring was blind drilled to 26.0 feet bgs. Blind drill lithologies from boring G405 and G405D.

FIELD BORING LOG

HANSON

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/19/2016
Finish: 8/19/2016
WEATHER: Cloudy, (70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

BOREHOLE ID: T409
Well ID: T409
Surface Elev: 621.85 ft. MSL
Completion: 26.99 ft. BGS
Station: 872,517.79N
2,514,693.89E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
								Dark brown (10YR3/3), moist, stiff, SILT with few clay and trace organics.		
	0/60 0%	BD					2	Brown (10YR5/3) with 10% dark brown (10YR3/3) mottles, SILT with some clay and trace small gravel.	620	
							4	Brown (10YR5/3) with 10% dark brown (10YR3/3) mottles, SILT with some clay.	618	
								Grayish brown (10YR5/2) with 5% dark yellowish brown (10YR4/6) mottles, moist, stiff, CLAY with few silt and little fine-grained sand.		
								Very pale brown (10YR7/4) with 25% yellowish brown (10YR5/6) mottles, moist, medium, CLAY with trace silt.		
							6		616	
	0/60 0%	BD						Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with little silt and trace fine- to medium-grained sand.		
							8		614	
								Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with little silt, little fine- to medium-grained sand and trace small gravel.		
							10		612	
								Gray (10YR5/1) with 10% yellowish brown (10YR5/6) and 5% very dark gray (10YR3/1) mottles, moist, stiff, CLAY with few fine- to medium-grained sand, little silt, and trace small gravel.		
	0/60 0%	BD					12	Gray (10YR6/1) with 25% brownish yellow (10YR6/8) and 5% strong brown (7.5YR4/6) mottles, moist, stiff, CLAY with few fine- to medium-grained sand, little silt, and trace small gravel.	610	
							14		608	
								Gray (10YR6/1) with 10% brownish yellow (10YR6/8) and 5% strong brown (7.5YR4/6) mottles, moist, stiff, CLAY with some fine- to medium-grained sand, little silt, and trace small gravel.		
							16	Gray (10YR6/1) with 5% brownish yellow (10YR6/6) mottles, wet, loose, fine-grained SAND with some clay.	606	
								Gray (10YR6/1) with 5% brownish yellow (10YR6/6) mottles, moist, loose, fine-grained SAND with some clay.		
	0/60 0%	BD					18		604	
								Gray (10YR5/1), dry, hard, SILT with few clay, few fine- to coarse-grained sand and trace small gravel.		
							20		602	

NOTE(S): T409 installed in boring.
Boring was blind drilled to 27.0 feet bgs. Blind drill lithologies from boring G406D.

FIELD BORING LOG

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/19/2016
Finish: 8/19/2016
WEATHER: Cloudy, (70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

BOREHOLE ID: T409
Well ID: T409
Surface Elev: 621.85 ft. MSL
Completion: 26.99 ft. BGS
Station: 872,517.79N
2,514,693.89E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	0/36 0%	BD					22	Gray (10YR5/1), dry, hard, SILT with few clay, few fine- to coarse-grained sand and trace small gravel. *[Continued from previous page]*	600	
6-1 6-2 6-3 6-4	0/24 0%	DS					24	Pale brown (10YR6/3), wet, loose, fine-grained SAND. Pale brown (10YR6/3), wet, loose, fine-grained SAND and small GRAVEL.	598	
	0/24 0%	BD					26	Gray (10YR5/1), dry, hard, SILT with some clay, trace fine- to coarse-grained sand and trace small gravel. Dark gray (10YR4/1), dry, hard, CLAY with some silt, trace fine- to coarse-grained sand and trace small gravel.	596	

End of Boring = 26.99 ft. BGS

NOTE(S): T409 installed in boring.
Boring was blind drilled to 27.0 feet bgs. Blind drill lithologies from boring G406D.

Canonie Construction Co.

Canonie Canonie Test Boring Services

Hamilton Lakes, 500 Park Boulevard, Suite 1212, Itasca, Illinois 60143, 312-773-4877

Job No.	DD-0514
Date	Feb. 8, 1985
Total Footage	50'0"
Foreman	W. Holloman
Classification By	Foreman

Client: Hanson Engineers, Inc.

Geographic Location: Coffeen, Illinois

Boring No. OW-1

O.G. EL.

Coordinates

Ground Surface

Description		Depth
very hard brown silty sandy CLAY, with small to medium gravel		0'0"
		5'0"
COAL & CINDERS		
		20'0"
medium brown and gray silty CLAY	PUSHED	22'0"

Installed well with 15' of 2" PVC screen to a depth of 22'0".

Boring No. OW-2

O.G. EL.

Coordinates

Ground Surface

Description		Depth
very hard brown silty sandy CLAY with small to large gravel		0'0"
		3'6"
COAL & CINDERS		
		26'0"
medium brown silty CLAY	PUSHED	28'0"

Installed well with 15'0" of 2" PVC screen to a depth of 28'0".

A....All borings are plotted to a scale of 1"= 8 ft., using ground surface as a fixed datum.

B....Classifications are made from visual inspection of samples and are our opinion thereof.

C....Water Levels (WL). Figure indicates time of reading (hours) after completion of boring. Water levels indicated are those observed when borings were made, or as noted. Porosity of the soil strata, variations of rainfall, site topography, etc., may cause changes in these levels.

D....Figures in right hand column indicate number of blows required to drive 2" O.D. sampling spoon (6" u.n.o.), using a 140 lb. weight falling 30 inches.

Canonie Construction Co.

Canonie Canonie Test Boring Services

Hamilton Lakes, 500 Park Boulevard, Suite 1212, Itasca, Illinois 60143, 312-773-4877

Job No.	DD-0514
Date	Feb. 8, 1985
Total Footage	68'0"
Foreman	W. Holloman
Classification By	Foreman

Client: Hanson Engineers, Inc.

Geographic Location: Coffeen, Illinois

Boring No. OW-3

O.G. EL.

Coordinates

Ground Surface

Description	Depth
very hard brown silty sandy CLAY with small to large gravel and some concrete	0'0" – 3'6"
COAL & CINDERS	3'6" – 26'0"
medium brown silty CLAY	26'0" – 28'0"
PUSHED	28'0"

Installed well with 15'0" of 2" PVC screen to a depth of 28'0".

Boring No. OW-4

O.G. EL.

Coordinates

Ground Surface

Description	Depth
very hard brown silty sandy CLAY with small to medium gravel	0'0" – 3'6"
COAL & CINDERS	3'6" – 40'0"
PUSHED	40'0"

Installed well with 25'0" of 2" PVC screen to a depth of 40'0".

A....All borings are plotted to a scale of 1"=....8.. ft., using ground..surface... as a fixed datum.

B....Classifications are made from visual inspection of samples and are our opinion thereof.

C....Water Levels (WL). Figure indicates time of reading (hours) after completion of boring. Water levels indicated are those observed when borings were made, or as noted. Porosity of the soil strata, variations of rainfall, site topography, etc., may cause changes in these levels.

D....Figures in right hand column indicate number of blows required to drive 2" O.D. sampling spoon (6" u.n.o.), using a 140 lb. weight falling 30 inches.

Sheet ... of ...

Canonie Construction Co.

Canonie Canonie Test Boring Services

Hamilton Lakes, 500 Park Boulevard, Suite 1212, Itasca, Illinois 60143, 312-773-4877

Job No.	DD-0514
Date	Feb. 8, 1985
Total Footage	35'0"
Foreman	W. Holloman
Classification By	Foreman

Client	Hanson Engineers, Inc.	Geographic Location	Coffeen, Illinois
Boring No. OW-5	O.G. EL.	Boring No.	O.G. EL.
Coordinates		Coordinates	

Description		Depth
Ground Surface		0'0"
very hard brown silty sandy CLAY with small to medium gravel		4'0"
COAL & CINDERS mixed with lime		33'0"
soft brown and gray CLAY	PUSHED	35'0"

Installed well with 25'0" of 2" PVC screen to a depth of 35'0".

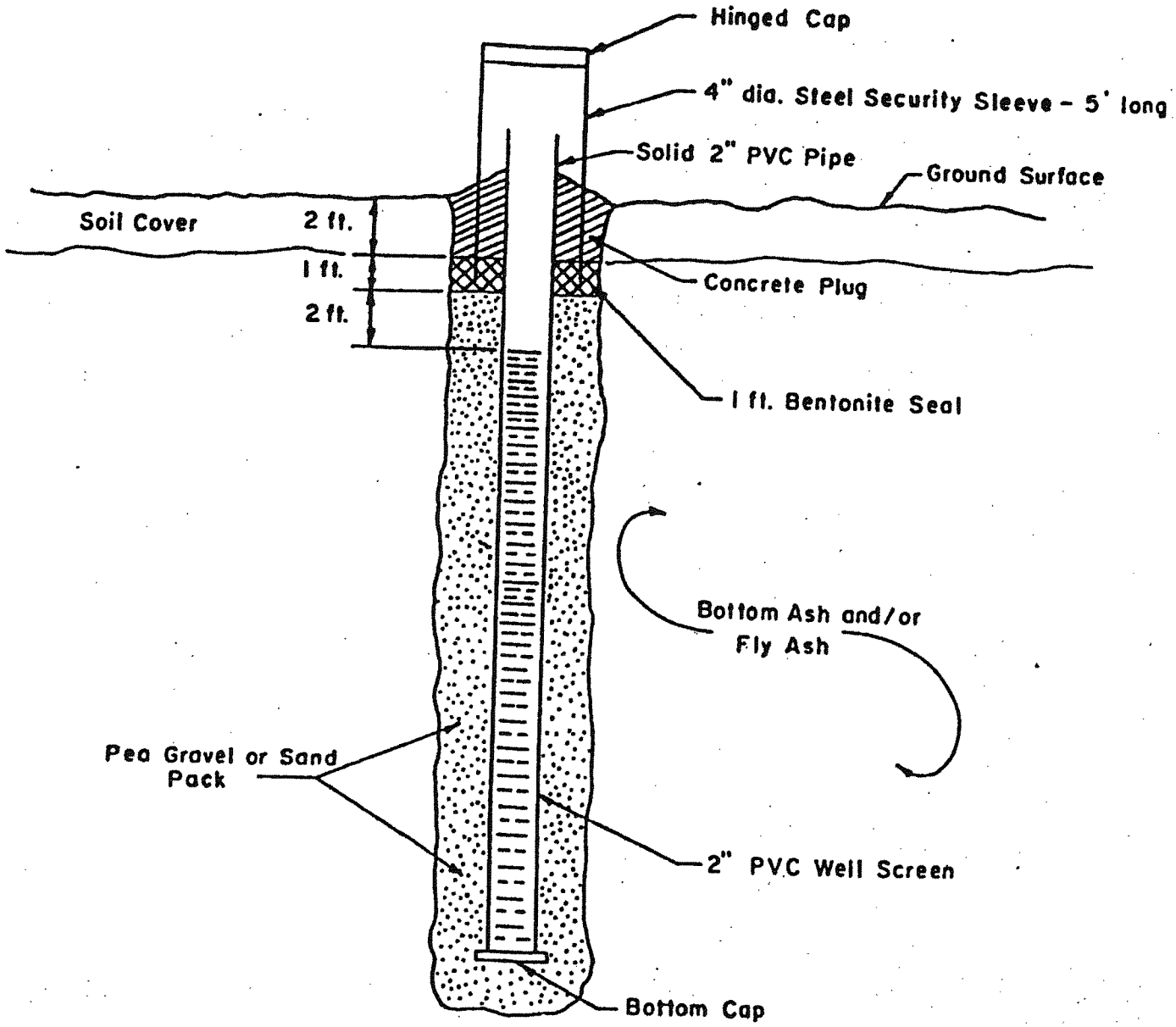
All wells installed in accordance with the attached "Exhibit 2", "Typical Observation Well Construction:.

A....All borings are plotted to a scale of 1"=...8... ft., using ...ground..surface as a fixed datum.

B....Classifications are made from visual inspection of samples and are our opinion thereof.

C....Water Levels (WL). Figure indicates time of reading (hours) after completion of boring. Water levels indicated are those observed when borings were made, or as noted. Porosity of the soil strata, variations of rainfall, site topography, etc., may cause changes in these levels.

D....Figures in right hand column indicate number of blows required to drive 2" O.D. sampling spoon (6" u.n.o.), using a 140 lb. weight falling 30 inches.



NOTE:

Install screen to the base of the pond or as determined in the field during well installations.

NO SCALE

Typical Observation Well Construction	Coffeen Ash Pond No. 2 Coffeen Power Station Central Illinois Public Service Company
HANSON ENGINEERS SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL	Exhibit 2

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G401

Site Name: Coffeen Power Station Borehole #: G401

State Plane Coordinate: X 872,510.6 Y 2,515,614.8 (or) Latitude: _____ Longitude: _____

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Ramsey Driller: D. Crump

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 9/14/2015 Date Finished: 9/14/2015

Report Form Completed By: Suzanna L. Keim Date: 10/7/2015

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite Chips

Installation Method: Gravity

Setting Time: >24 hours

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 minutes

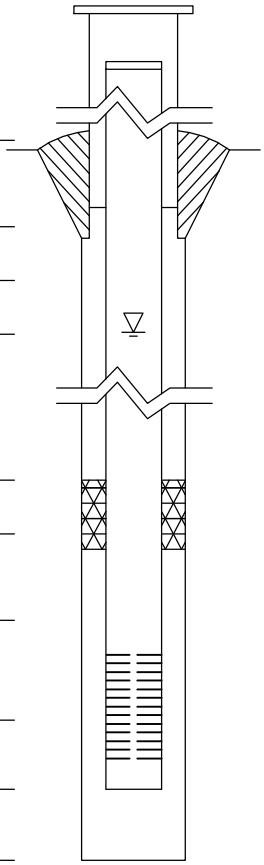
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.84	-2.81	Top of Protective Casing
625.57	-2.54	Top of Riser Pipe
623.03	0.00	Ground Surface
621.33	1.70	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
610.12	12.91	Top of Sand Pack
608.67	14.36	Top of Screen
604.24	18.79	Bottom of Screen
603.74	19.29	Bottom of Well
603.73	19.30	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	16.70
Bottom of Screen to End Cap	(feet)	0.50
Screen Length (1st slot to last slot)	(feet)	4.63
Total Length of Casing	(feet)	21.83
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G403

Site Name: Coffeen Power Station Borehole #: G403

State Plane Coordinate: X 873,561.3 Y 2,514,616.6 (or) Latitude: _____ Longitude: _____

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Ramsey Driller: D. Crump

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Kristen L. Theesfeld Date Started: 9/11/2015 Date Finished: 9/11/2015

Report Form Completed By: Suzanna L. Keim Date: 10/7/2015

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite Chips

Installation Method: Gravity

Setting Time: >24 hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: n/a

Setting Time: n/a

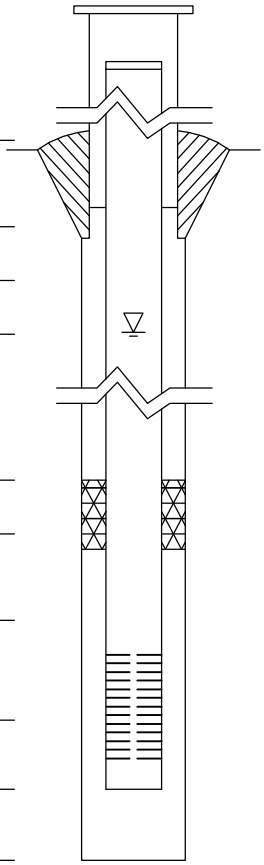
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.72	-2.91	Top of Protective Casing
626.47	-2.66	Top of Riser Pipe
623.81	0.00	Ground Surface
621.81	2.00	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
612.64	11.17	Top of Sand Pack
610.70	13.11	Top of Screen
606.03	17.78	Bottom of Screen
605.66	18.15	Bottom of Well
605.66	18.15	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	15.77
Bottom of Screen to End Cap	(feet)	0.37
Screen Length (1st slot to last slot)	(feet)	4.67
Total Length of Casing	(feet)	20.81
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G404

Site Name: Coffeen Energy Center Borehole #: SB22

State Plane Coordinate: X 2,516,397.9 Y 873,999.8 (or) Latitude: _____ Longitude: _____

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: A. Rachford

Consulting Firm: Hanson Professional Services Inc. Geologist: , LPG #

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 5/1/2007 Date Finished: 5/1/2007

Report Form Completed By: Rhonald W. Hasenyager Date: 5/2/2007

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: gravity

Setting Time: >12 hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: _____

Setting Time: _____

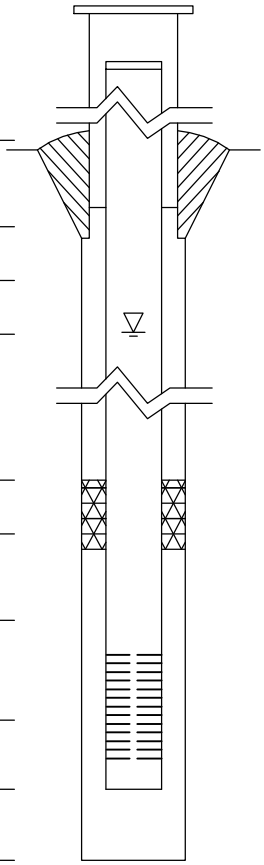
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: Formation sand (if applicable)

Installation Method: slough



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
616.02	-2.92	Top of Protective Casing
615.77	-2.67	Top of Riser Pipe
613.10	0.00	Ground Surface
613.10	0.00	Top of Annular Sealant
611.03	2.07	Static Water Level (After Completion) 5/10/2007
n/a	n/a	Top of Seal
608.05	5.05	Top of Sand Pack
606.68	6.42	Top of Screen
601.93	11.17	Bottom of Screen
601.48	11.62	Bottom of Well
601.10	12.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	9.09
Bottom of Screen to End Cap	(feet)	0.45
Screen Length (1st slot to last slot)	(feet)	4.75
Total Length of Casing	(feet)	14.29
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G405

Site Name: Coffeen Energy Center Borehole #: SB21

State Plane Coordinate: X 2,515,335.7 Y 873,996.8 (or) Latitude: _____ Longitude: _____

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: A. Rachford

Consulting Firm: Hanson Professional Services Inc. Geologist: , LPG #

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 5/1/2007 Date Finished: 5/1/2007

Report Form Completed By: Rhonald W. Hasenyager Date: 5/2/2007

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: gravity

Setting Time: >12 hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: _____

Setting Time: _____

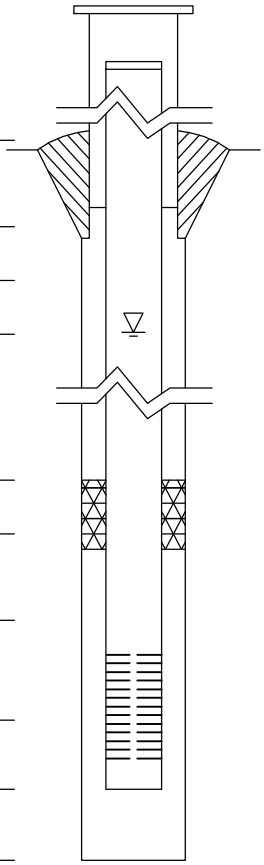
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
624.04	-3.14	Top of Protective Casing
623.78	-2.88	Top of Riser Pipe
620.90	0.00	Ground Surface
620.90	0.00	Top of Annular Sealant
619.67	1.23	Static Water Level (After Completion) 5/10/2007
n/a	n/a	Top of Seal
613.19	7.71	Top of Sand Pack
611.89	9.01	Top of Screen
607.14	13.76	Bottom of Screen
606.69	14.21	Bottom of Well
606.69	14.21	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	11.89
Bottom of Screen to End Cap	(feet)	0.45
Screen Length (1st slot to last slot)	(feet)	4.75
Total Length of Casing	(feet)	17.09
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G45D

Site Name: Coffeen Power Station - Ash Pond 2 Borehole #: G405D

State Plane Coordinate: X 2,515,322.2 Y 873,998.0 (or) Latitude: 39° 3' 51.657" Longitude: -89° 23' 46.612"

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Bulldog Drilling, Inc. Driller: J. Dittmaier

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Kristen L. Theesfeld Date Started: 8/16/2016 Date Finished: 8/17/2016

Report Form Completed By: Suzanna L. Keim Date: 8/24/2016

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hours

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 38 minutes

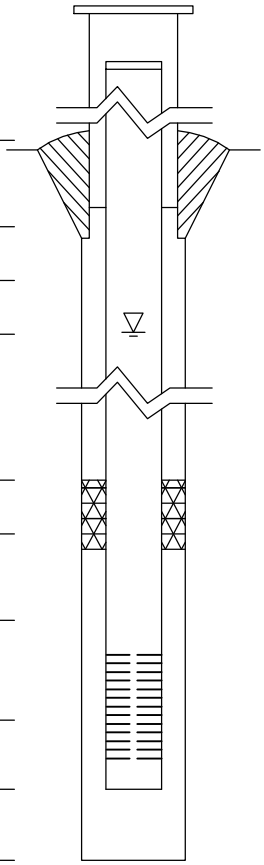
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
624.16	-3.22	Top of Protective Casing
623.81	-2.87	Top of Riser Pipe
620.94	0.00	Ground Surface
618.94	2.00	Top of Annular Sealant
584.66	36.28	Static Water Level (After Completion) 8/29/2016
590.59	30.35	Top of Seal
589.62	31.32	Top of Sand Pack
589.06	31.88	Top of Screen
579.42	41.52	Bottom of Screen
579.02	41.92	Bottom of Well
578.94	42.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	34.75
Bottom of Screen to End Cap	(feet)	0.40
Screen Length (1st slot to last slot)	(feet)	9.64
Total Length of Casing	(feet)	44.79
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G406

Site Name: Coffeen Power Station - Ash Pond 2 Borehole #: G406

State Plane Coordinate: X 2,514,702.4 Y 872,521.3 (or) Latitude: 39° 3' 37.114" Longitude: -89° 23' 54.628"

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Bulldog Drilling, Inc. Driller: J. Dittmaier

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Kristen L. Theesfeld Date Started: 8/19/2016 Date Finished: 8/19/2016

Report Form Completed By: Suzanna L. Keim Date: 8/24/2016

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hours

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 30 minutes

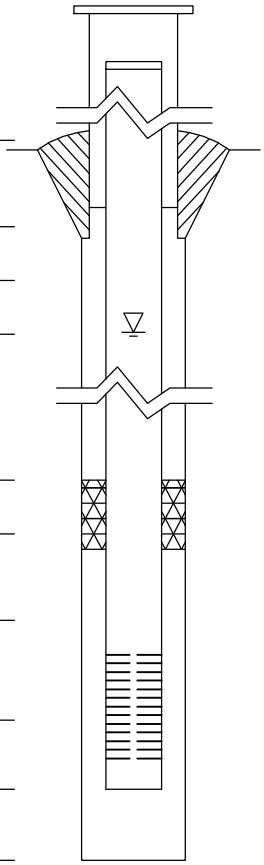
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.70	-3.84	Top of Protective Casing
625.36	-3.50	Top of Riser Pipe
621.86	0.00	Ground Surface
619.86	2.00	Top of Annular Sealant
		Static Water Level (After Completion)
610.74	11.12	Top of Seal
609.65	12.21	Top of Sand Pack
608.30	13.56	Top of Screen
603.49	18.37	Bottom of Screen
603.11	18.75	Bottom of Well
603.11	18.75	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.06
Bottom of Screen to End Cap	(feet)	0.38
Screen Length (1st slot to last slot)	(feet)	4.81
Total Length of Casing	(feet)	22.25
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G46D

Site Name: Coffeen Power Station - Ash Pond 2 Borehole #: G406D

State Plane Coordinate: X 2,514,697.8 Y 872,519.7 (or) Latitude: 39° 3' 37.098" Longitude: -89° 23' 54.687"

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Bulldog Drilling, Inc. Driller: J. Dittmaier

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Kristen L. Theesfeld Date Started: 8/19/2016 Date Finished: 8/19/2016

Report Form Completed By: Suzanna L. Keim Date: 8/24/2016

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hours

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: >12 hours

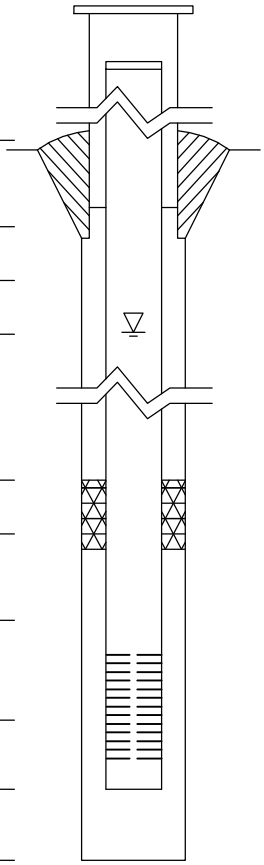
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.53	-3.62	Top of Protective Casing
625.24	-3.33	Top of Riser Pipe
621.91	0.00	Ground Surface
619.91	2.00	Top of Annular Sealant
589.60	32.31	Static Water Level (After Completion) 8/29/2016
582.34	39.57	Top of Seal
581.21	40.70	Top of Sand Pack
580.30	41.61	Top of Screen
570.65	51.26	Bottom of Screen
570.26	51.65	Bottom of Well
569.91	52.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	44.94
Bottom of Screen to End Cap	(feet)	0.39
Screen Length (1st slot to last slot)	(feet)	9.65
Total Length of Casing	(feet)	54.98
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G407

Site Name: Coffeen Power Station - Ash Pond 2 Borehole #: G407

State Plane Coordinate: X 2,513,705.9 Y 872,973.4 (or) Latitude: 39° 3' 41.665" Longitude: -89° 24' 7.213"

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Bulldog Drilling, Inc. Driller: J. Dittmaier

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Kristen L. Theesfeld Date Started: 8/16/2016 Date Finished: 8/16/2016

Report Form Completed By: Suzanna L. Keim Date: 8/24/2016

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 15 minutes

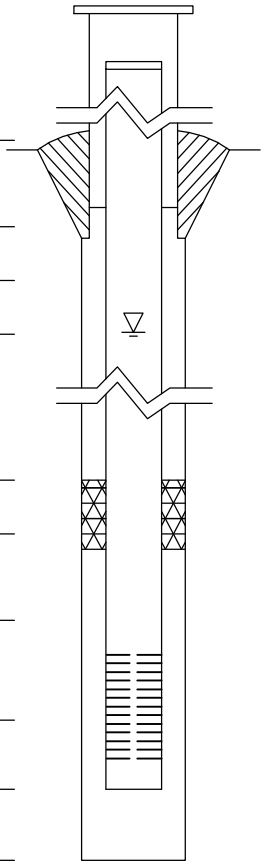
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz Sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
621.70	-3.35	Top of Protective Casing
621.32	-2.97	Top of Riser Pipe
618.35	0.00	Ground Surface
616.35	2.00	Top of Annular Sealant
		Static Water Level (After Completion)
607.50	10.85	Top of Seal
605.50	12.85	Top of Sand Pack
604.57	13.78	Top of Screen
599.74	18.61	Bottom of Screen
599.31	19.04	Bottom of Well
598.35	20.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	16.75
Bottom of Screen to End Cap	(feet)	0.43
Screen Length (1st slot to last slot)	(feet)	4.83
Total Length of Casing	(feet)	22.01
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: T408

Site Name: Coffeen Power Station - Ash Pond 2 Borehole #: T408

State Plane Coordinate: X 2,515,314.9 Y 873,999.4 (or) Latitude: 39° 3' 51.671" Longitude: -89° 23' 46.704"

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Bulldog Drilling, Inc. Driller: J. Dittmaier

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Kristen L. Theesfeld Date Started: 8/17/2016 Date Finished: 8/17/2016

Report Form Completed By: Suzanna L. Keim Date: 8/24/2016

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hours

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 30 minutes

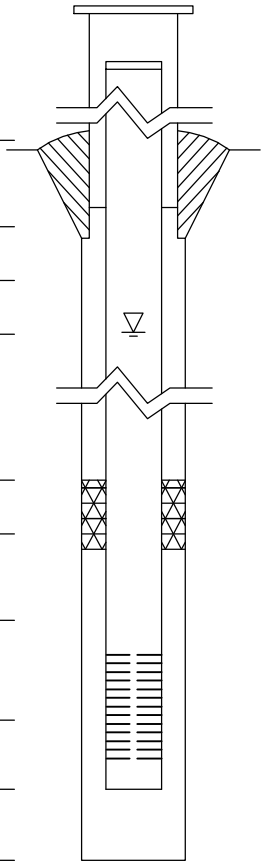
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
624.44	-3.35	Top of Protective Casing
624.08	-2.99	Top of Riser Pipe
621.09	0.00	Ground Surface
619.09	2.00	Top of Annular Sealant
618.21	2.88	Static Water Level (After Completion) 9/1/2016
602.99	18.10	Top of Seal
602.04	19.05	Top of Sand Pack
600.43	20.66	Top of Screen
595.60	25.49	Bottom of Screen
595.17	25.92	Bottom of Well
595.17	25.92	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	23.65
Bottom of Screen to End Cap	(feet)	0.43
Screen Length (1st slot to last slot)	(feet)	4.83
Total Length of Casing	(feet)	28.91
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: T409

Site Name: Coffeen Power Station - Ash Pond 2 Borehole #: T409

State Plane Coordinate: X 2,514,693.9 Y 872,517.8 (or) Latitude: 39° 3' 37.079" Longitude: -89° 23' 54.736"

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Bulldog Drilling, Inc. Driller: J. Dittmaier

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Kristen L. Theesfeld Date Started: 8/19/2016 Date Finished: 8/19/2016

Report Form Completed By: Suzanna L. Keim Date: 8/24/2016

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hours

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 30 minutes

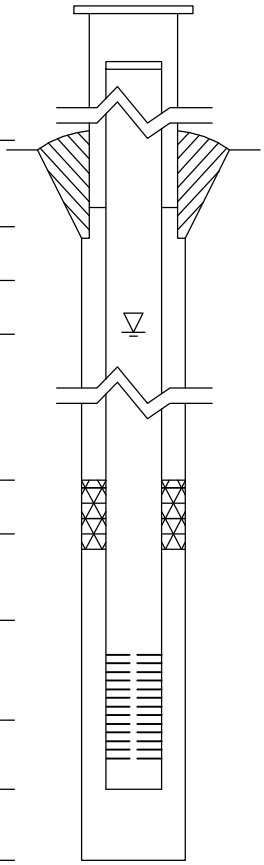
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.35	-3.50	Top of Protective Casing
625.01	-3.16	Top of Riser Pipe
621.85	0.00	Ground Surface
619.85	2.00	Top of Annular Sealant
615.80	6.05	Static Water Level (After Completion) 8/31/2016
602.65	19.20	Top of Seal
601.30	20.55	Top of Sand Pack
600.06	21.79	Top of Screen
595.26	26.59	Bottom of Screen
594.86	26.99	Bottom of Well
594.86	26.99	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	24.95
Bottom of Screen to End Cap	(feet)	0.40
Screen Length (1st slot to last slot)	(feet)	4.80
Total Length of Casing	(feet)	30.15
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

APPENDIX A2

GMF RECYCLE POND

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 9/9/2009
Finish: 9/10/2009
WEATHER: Sunny, warm (70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: G. Mills
Helper: J. Twellman
Eng/Geo: R. Hasenyager

BOREHOLE ID: G271
Well ID: G271
Surface Elev: 622.89 ft. MSL
Completion: 16.00 ft. BGS
Station: 874,239.38N
2,515,517.12E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.70 - While drilling
▼ = 12.50 - 9/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	20/24 83%	ss	2-5 5-6 N=10	27		
2A	24/24 100%	ss	2-6 5-5 N=11	23		
3A	23/24 96%	ss	4-5 4-5 N=9	18		
4A	24/24 100%	ss	2-4 4-5 N=8	17		
5A	24/24 100%	ss	2-4 4-6 N=8	20		
6A	24/24 100%	ss	2-4 4-5 N=8	22		
6B				20		
7A				20		
7B	20/24 83%	ss	2-2 3-7 N=5	19		
8A	24/24 100%	ss	10-19 30-33 N=49	7		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Yellowish brown (10YR5/4), moist, firm, silty CLAY with trace sand.	
	Grayish brown (10YR5/2), dry, friable, clayey SILT.	622
2	Yellowish brown (10YR5/6) with 10% gray (10YR6/1) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	620
4	Gray (10YR6/1), moist, firm, very silty CLAY with slight trace sand.	618
6	Gray (10YR5/1) with 30% brownish yellow (10YR6/6) mottles, moist, firm, silty CLAY with sand and trace gravel.	616
8		614
	Very dark gray (10YR3/1), organic-rich (PEAT), silty CLAY and trace sand.	
10	Brownish yellow (10YR6/8) with 20% gray (10YR5/1) mottles, moist, firm, silty CLAY with sand and trace gravel.	612
12	Gray (10YR6/1) with 20% brownish yellow (10YR6/8) mottles, very moist, soft, sandy CLAY with silt and slight trace gravel.	
	Brownish yellow (10YR6/6), very moist to wet, soft, sandy CLAY with silt and slight trace gravel.	610
	Gray (10YR6/1), wet, loose, very fine to medium SAND with silt.	
14	Gray (10YR5/1), slightly moist, hard, very silty CLAY with sand and gravel.	608
16		

End of Boring = 16.0 ft. BGS

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 9/10/2009
Finish: 9/10/2009
WEATHER: Sunny, warm (70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: G. Mills
Helper: J. Twellman
Eng/Geo: R. Hasenyager

BOREHOLE ID: G272
Well ID: G272
Surface Elev: 620.72 ft. MSL
Completion: 14.32 ft. BGS
Station: 874,234.83N
2,515,744.99E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.00 - While drilling
▼ = 9.49 - 9/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	20/24 83%	ss	3-2 3-4 N=5	18		
2A	24/24 100%	ss	4-5 6-7 N=11	25		
3A	23/24 96%	ss	2-4 4-6 N=8	18		
3B				17		
4A	24/24 100%	ss	3-4 4-4 N=8	20		
5A	23/24 96%	ss	2-3 3-5 N=6	21		
6A	22/24 92%	ss	2-3 3-3 N=6	23		
7A	18/24 75%	ss	2-9 15-21 N=24	14		
7B				10		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	FILL - Brownish yellow (10YR6/6) with 30% gray (10YR5/1) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	620	
2	Brownish yellow (10YR6/6) with 20% brownish yellow (10YR6/8) and 20% gray (10YR5/1) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	618	
4		616	
6	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY with sand and trace gravel.	614	
8		612	
▼ 10	Yellowish brown (10YR5/8) with 15% gray (10YR6/1) mottles, moist, soft, silty CLAY with sand and slight trace gravel.		
	Gray (10YR6/1) with 30% brownish yellow (10YR6/6) mottles, very moist, soft, silty CLAY with sand and slight trace gravel.	610	
12	Gray (10YR6/1), very moist, loose, SILT and very fine sand.	608	
▼	Gray (10YR6/1), wet, loose, SILT and very fine sand.		
14	Yellowish brown (10YR5/6), moist, hard, very silty CLAY with sand and trace gravel.		

End of Boring = 14.3 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 9/10/2009
Finish: 9/10/2009
WEATHER: Sunny, warm (70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: G. Mills
Helper: J. Twellman
Eng/Geo: R. Hasenyager

BOREHOLE ID: G273
Well ID: G273
Surface Elev: 620.17 ft. MSL
Completion: 16.00 ft. BGS
Station: 874,235.24N
2,515,975.49E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.50 - While drilling
▼ = 9.89 - 9/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	16/24 67%	ss	3-3 3-3 N=6	24		
2A	24/24 100%	ss	3-4 5-7 N=9	28		
3A	24/24 100%	ss	3-5 6-8 N=11	18		
3B				25		
4A	24/24 100%	ss	3-5 5-6 N=10	19		
4B				16		
5A	23/24 96%	ss	2-4 5-4 N=9	19		
5B				21		
6A	24/24 100%	ss	1-2 3-4 N=5	19		
7A	24/24 100%	ss	4-8 17-24 N=25	11		
7B				11		
8A	22/24 92%	ss	9-22 22-23 N=44	8		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL -Dark yellowish brown (10YR4/6), moist, firm, silty CLAY with slight trace sand.	620
2	FILL - Gray (10YR5/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with slight trace sand and gravel.	618
4	Brownish yellow (10YR6/8) with 40% gray (10YR5/1) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	616
6	Gray (10YR6/1) with 10% brownish yellow(10YR6/6) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	614
8	Gray (10YR5/1), moist, firm, silty CLAY with sand and trace gravel.	612
▼ 10	Yellowish brown (10YR5/8) with 30% gray (10YR6/1) mottles, moist, soft, sandy CLAY with silty and slight trace gravel.	610
12	Brownish yellow (10YR6/8) with 10% gray (10YR6/1) mottles, very moist, soft, sandy CLAY with silt and slight trace gravel.	608
▼ 14	Gray (10YR6/1), moist, hard, very silty CLAY with sand and trace gravel.	606
	Light yellowish brown (10YR6/4), wet, loose, very fine- to very coarse-grained SAND with trace silt.	
	Light yellowish brown (10YR6/4), wet, dense, sandy, silty CLAY.	
16	Gray (10YR6/1), moist, hard, very silty CLAY with sand and trace gravel.	

End of Boring = 16.0 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 9/16/2009
Finish: 9/16/2009
WEATHER: Sunny, warm (80's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: G. Mills
Helper: J. Twellman
Eng/Geo: R. Hasenyager

BOREHOLE ID: G274
Well ID: G274
Surface Elev: 621.67 ft. MSL
Completion: 18.06 ft. BGS
Station: 874,239.25N
2,516,195.60E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 16.00 - While drilling
▼ = 13.12 - 9/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	20/24 83%	ss	2-3 3-4 N=6	17		
2A	24/24 100%	ss	4-6 7-9 N=13	25		
3A	24/24 100%	ss	3-4 6-9 N=10	26		
3B				21		
4A	16/24 67%	ss	3-6 6-8 N=12	24		
5A	24/24 100%	ss	2-4 4-6 N=8	20		
6A	22/24 92%	ss	1-3 4-6 N=7	19		
7A	23/24 96%	ss	1-2 4-4 N=6	21		
8A	22/24 92%	ss	1-3 3-6 N=6	17		
9A	14/24 58%	ss	wor-4 9-11 N=13	13		
9B				13		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
2	FILL - Gray (10YR5/1) with 30% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	620	
4		618	
6	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY with slight trace sand and gravel.	616	
8		614	
10	Dark gray (10YR4/1) with 15% yellowish brown (10YR5/8) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	612	
12		610	
▼ 14	Gray (10YR5/1) with 30% yellowish brown (10YR5/8) mottles, moist, soft, silty CLAY with sand and trace gravel.	608	
▼ 16	Yellowish brown (10YR5/8), very moist, soft, silty CLAY with sand and trace gravel.	606	
	Brownish yellow (10YR6/6), wet, loose, very fine- to very coarse-grained SAND.		
	Brownish yellow (10YR6/6), moist, firm, very silty CLAY with sand and gravel.	604	
18	Gray (10YR6/1), moist, hard, very silty CLAY with sand and gravel.		

End of Boring = 18.1 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 9/16/2009
Finish: 9/16/2009
WEATHER: Sunny, warm (80's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: G. Mills
Helper: J. Twellman
Eng/Geo: R. Hasenyager

BOREHOLE ID: G275
Well ID: G275
Surface Elev: 616.14 ft. MSL
Completion: 13.19 ft. BGS
Station: 874,298.94N
2,516,375.86E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 10.90 - While drilling
▼ = 10.25 - 9/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	22/24 92%	ss	2-4 4-6 N=8	22		
2A	18/24 75%	ss	3-6 7-7 N=13	19		
3A	24/24 100%	ss	2-4 4-5 N=8	22		
4A	24/24 100%	ss	2-3 4-6 N=7	17		
5A	24/24 100%	ss	1-2 3-3 N=5	18		
5B				21		
6A				16		
6B	20/24 83%	ss	woh-4 5-2 N=9	13		
6C				15		
7A	12/12 100%	ss	10-35	8		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Gray (10YR5/1) with 30% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	616
2	Dark gray (10YR4/1) with 20% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with slight trace sand and gravel.	614
4	Gray (10YR6/1), moist, soft, silty CLAY with sand and slight trace gravel.	612
6	Gray (10YR6/1) with 30% yellowish brown (10YR5/8) mottles, moist, soft, silty CLAY with sand and slight trace gravel.	610
8	Yellowish brown (10YR5/8) with 15% gray (10YR6/1) mottles, very moist, soft, silty CLAY with sand and trace gravel.	608
10	Gray (10YR6/1) with 20% yellowish brown (10YR5/8) mottles, very moist, very soft, silty CLAY with sand and trace gravel.	606
12	Gray (10YR6/1), wet, loose, very fine- to very coarse-grained SAND with trace gravel.	604
	Yellowish brown (10YR5/6), moist, hard, very silty CLAY with sand and gravel.	

End of Boring = 13.2 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 9/16/2009
Finish: 9/16/2009
WEATHER: Sunny, mild (70'S)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: G. Mills
Helper: J. Twellman
Eng/Geo: R. Hasenyager

BOREHOLE ID: G276
Well ID: G276
Surface Elev: 629.14 ft. MSL
Completion: 28.00 ft. BGS
Station: 874,438.60N
2,516,358.83E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = 25.55 - 9/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
1A	17/24 71%	ss	5-8 9-10 N=17	10			2	FILL - Yellowish brown (10YR5/4) with 20% gray (10YR5/1) mottles, moist, hard, silty CLAY with trace sand and slight trace gravel.	628	
2A	19/24 79%	ss	7-7 10-14 N=17	15			4		626	
3A	11/24 46%	ss	5-10 14-27 N=24	14			6		624	Rock fragment in split spoon shoe
4A	24/24 100%	ss	5-9 10-14 N=19	8				FILL - Yellowish brown (10YR5/4) with 20% gray (10YR5/1) mottles, slightly moist, hard, silty CLAY with trace sand and slight trace gravel.		
4B				5			8	FILL - Yellowish brown (10YR5/4) with 10% gray (10YR5/1) mottles, slightly moist, hard, friable, clayey SILT with sand and trace gravel.	622	
5A	17/24 71%	ss	4-4 8-19 N=12	22			10	FILL - Yellowish brown (10YR5/4) with 25% gray (10YR5/1) mottles, slightly moist, firm, silty CLAY with slight trace sand and gravel.	620	
6A	17/24 71%	ss	4-5 8-14 N=13	14			12		618	
7A	16/24 67%	ss	6-7 2-4 N=9	20			14	Gray (10YR6/1) with 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with slight trace sand and gravel.	616	
8A	20/24 83%	ss	2-4 6-6 N=10	21			16		614	
9A	22/24 92%	ss	1-4 5-7 N=9	17						
9B				13			18	Gray (10YR6/1) with 20% yellowish brown (10YR5/6) mottles, moist, soft, sandy CLAY with silt and slight trace gravel.	612	
10A	23/24 96%	ss	2-3 8-12 N=11	20			20	Gray (10YR6/1) with 30% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and slight trace gravel.	610	

NOTE(S):

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 9/16/2009
Finish: 9/16/2009
WEATHER: Sunny, mild (70'S)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: G. Mills
Helper: J. Twellman
Eng/Geo: R. Hasenyager

BOREHOLE ID: G276
Well ID: G276
Surface Elev: 629.14 ft. MSL
Completion: 28.00 ft. BGS
Station: 874,438.60N
2,516,358.83E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = 25.55 - 9/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	24/24 100%	ss	1-3 5-7 N=8	21		
12A	24/24 100%	ss	1-4 6-7 N=10	16		
13A	24/24 100%	ss	2-3 4-6 N=7	16		
14A	24/24 100%	ss	1-5 15-29 N=20	16		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Gray (10YR6/1) with 30% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and slight trace gravel. *[Continued from previous page]*	608
22		
	Yellowish brown (10YR5/8), moist, firm, silty CLAY with sand and slight trace gravel.	606
24		
	Gray (10YR6/1) with 25% yellowish brown (10YR5/6) mottles, very moist, soft, silty CLAY with sand and trace gravel.	604
▼	Gray (10YR6/1), very moist, loose, very fine- to fine-grained, SAND	
26	Gray (10YR6/1) with 25% yellowish brown (10YR5/6) mottles, very moist, soft, silty CLAY with sand and trace gravel.	
	Gray (10YR6/1), very moist, firm, clayey SILT with trace very fine-grained sand.	602
	Gray (10YR6/1) with 40% yellowish brown (10YR5/4) mottles, moist, hard, very silty CLAY with sand and trace gravel.	
28	Yellowish brown (10YR5/4), moist, hard, very silty CLAY with sand and trace gravel.	

End of Boring = 28.0 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 9/14/2009
Finish: 9/14/2009
WEATHER: Sunny, mild (70'S)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: G. Mills
Helper: J. Twellman
Eng/Geo: R. Hasenyager

BOREHOLE ID: G277
Well ID: G277
Surface Elev: 620.79 ft. MSL
Completion: 20.00 ft. BGS
Station: 874,581.80N
2,516,370.51E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 16.40 - While drilling
▼ = 18.23 - 9/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	23/24 96%	ss	2-2 4-6 N=6	21		
2A	24/24 100%	ss	2-4 6-7 N=10	22		
2B				16		
3A				11		
3B	17/24 71%	ss	4-7 9-11 N=16	22		
4A	18/24 75%	ss	4-8 8-6 N=16	13		
5A	19/24 79%	ss	3-7 8-9 N=15	12		
6A	22/24 92%	ss	3-9 9-10 N=18	14		
6B				16		
7A	18/24 75%	ss	3-5 7-9 N=12	17		
8A	22/24 92%	ss	2-5 5-8 N=10	12		
9A	22/24 92%	ss	1-2 3-3 N=5	14		
10A	23/24 96%	ss	1-3 19-47 N=22	11		
10B				9		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Yellowish brown (10YR5/4) with 10% yellowish brown (10YR5/8) mottles, very moist, soft, silty CLAY with slight trace sand and gravel.	620
2	FILL - Yellowish brown (10YR5/4) with 20% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with slight trace sand and gravel.	618
	Yellowish brown (10YR5/4) with 20% gray (10YR5/1) and 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with slight trace sand.	
4	Light brownish gray (10YR6/2), dry, friable, clayey SILT.	616
	Light brownish gray (10YR6/2) with 25% yellowish brown (10YR5/8) mottles, moist, firm, clayey SILT with slight trace sand.	
6		614
	Gray (10YR6/1) with 50% very dark grayish brown (10YR3/2) mottles, moist, hard, clayey SILT with slight trace sand and gravel.	
8		612
	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, hard, very silty CLAY with sand and slight trace gravel.	
10		610
12	Yellowish brown (10YR5/8) with 30% gray (10YR6/1) mottles, moist, hard, silty CLAY with sand and trace gravel.	608
14		606
	Gray (10YR6/1), moist, slightly dense, silty, very fine- to very coarse-grained SAND.	
16 ▼	Gray (10YR6/1) with 30% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and trace gravel.	604
	Gray (10YR6/1) with 20% brownish yellow (10YR6/6) mottles, wet, very soft, silty, very fine- to fine-grained SAND with trace gravel.	
18 ▼	Gray (10YR6/1) with 30% grayish brown (10YR5/2) mottles, moist, soft, sandy CLAY with slight trace gravel.	602
	Brownish yellow (10YR6/6) with 25% gray (10YR6/1) mottles, moist, hard, very silty CLAY with sand and trace gravel.	
20		

End of Boring = 20.0 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 9/11/2009
Finish: 9/11/2009
WEATHER: Sunny, warm (70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: G. Mills
Helper: J. Twellman
Eng/Geo: R. Hasenyager

BOREHOLE ID: G278
Well ID: G278
Surface Elev: 628.85 ft. MSL
Completion: 24.06 ft. BGS
Station: 874,875.37N
2,516,200.66E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = 23.98 - 9/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
1A	16/24 67%	ss	3-4 6-7 N=10	19					628	
2A	24/24 100%	ss	4-7 8-11 N=15	21			2		626	
3A	22/24 92%	ss	9-10 9-35 N=19	10			4		624	Rock fragment in split spoon shoe
4A	4/24 17%	ss	20-7 10-8 N=17				6	FILL - Yellowish brown (10YR5/4) with 15% yellowish brown(10YR5/8) mottles, moist, hard, silty CLAY with trace sand and slight trace gravel.	622	Rock fragment in split spoon shoe
5A	14/24 58%	ss	11-6 8-8 N=14	15			8		620	Rock fragment in split spoon shoe
6A	20/24 83%	ss	6-4 8-9 N=12	26			10		618	
7A	24/24 100%	ss	2-4 8-11 N=12	18			12		616	
8A	20/24 83%	ss	4-7 10-11 N=17	12			14	Gray (10YR6/1) with 30% brownish yellow (10YR6/6) mottles, moist, firm, clayey SILT with slight trace sand. Very dark gray (10YR3/1), moist, firm, clayey SILT with slight trace sand and trace roots.	614	
8B				22			16	Gray (10YR5/1) with 30% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and trace gravel.		
9A	22/24 92%	ss	4-6 6-9 N=12	17					612	
							18	Gray (10YR6/1) with 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and trace gravel.		
10A	20/24 83%	ss	2-4 5-8 N=9	21					610	
							20	Yellowish brown (10YR5/8) with 20% gray (10YR5/1) mottles, moist, firm, silty CLAY with sand and trace gravel.		

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 9/11/2009
Finish: 9/11/2009
WEATHER: Sunny, warm (70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: G. Mills
Helper: J. Twellman
Eng/Geo: R. Hasenyager

BOREHOLE ID: G278
Well ID: G278
Surface Elev: 628.85 ft. MSL
Completion: 24.06 ft. BGS
Station: 874,875.37N
2,516,200.66E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = 23.98 - 9/21/09
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
11A	18/24 *75%*	ss	*2-4* *7-7* N=11	19				Yellowish brown (10YR5/8) with 20% gray (10YR5/1) mottles, moist, firm, silty CLAY with sand and trace gravel. *[Continued from previous page]*		608	
11B							22	Yellowish brown (10YR5/6), very moist, soft, silty, very fine- to medium-grained SAND.			
12A	20/24 *83%*	ss	*1-5* *10-18* N=15	16				Yellowish brown (10YR5/4), moist, hard, very silty CLAY with sand and trace gravel.		606	
12B				10			▼ 24				

End of Boring = 24.1 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 9/10/2009
Finish: 9/10/2009
WEATHER: Sunny, warm (80's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: G. Mills
Helper: J. Twellman
Eng/Geo: R. Hasenyager

BOREHOLE ID: G279
Well ID: G279
Surface Elev: 629.19 ft. MSL
Completion: 28.00 ft. BGS
Station: 875,028.06N
2,516,245.60E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 23.60 - While drilling
▼ = 24.68 - 9/21/09
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type
1A	24/24 *100%*	ss	*3-3 5-6* N=8	18		
2A	24/24 *100%*	ss	*5-9 10-11* N=19	14		
3A	24/24 *100%*	ss	*5-9 9-10* N=18	17		
4A	24/24 *100%*	ss	*4-5 7-6* N=12	21		
5A	24/24 *100%*	ss	*3-3 5-7* N=8	19		
6A	24/24 *100%*	ss	*3-4 6-9* N=10	17		
7A	23/24 *96%*	ss	*2-5 5-6* N=10	23		
8A	24/24 *100%*	ss	*2-3 7-6* N=10	23		
9A	18/24 *75%*	ss	*4-7 8-9* N=15	25		
10A	24/24 *100%*	ss	*3-6 7-10* N=13	17		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
0–3.5	FILL - Brown (10YR4/3) with 30% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY with sand and trace gravel.	628
3.5–14	FILL - dark gray (10YR4/1) with 10% brownish yellow (10YR6/6) mottles, moist, hard, silty CLAY with sand and trace gravel.	626, 624, 622, 620, 618, 616
14–15.5	Brownish yellow (10YR6/8) with 30% gray (10YR5/1) mottles, moist, firm, silty CLAY with slight trace sand and gravel.	614
15.5–18.5	Yellowish brown (10YR5/8) with 20% gray (10YR6/1) mottles, moist, firm, silty CLAY with slight trace sand and gravel.	612
18.5–20	Gray (10YR6/1) with 25% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and trace gravel.	610

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 9/10/2009
Finish: 9/10/2009
WEATHER: Sunny, warm (80's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: G. Mills
Helper: J. Twellman
Eng/Geo: R. Hasenyager

BOREHOLE ID: G279
Well ID: G279
Surface Elev: 629.19 ft. MSL
Completion: 28.00 ft. BGS
Station: 875,028.06N
2,516,245.60E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 23.60 - While drilling
▼ = 24.68 - 9/21/09
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type
11A	23/24 *96%*	ss	*2-4 5-7* N=9	18		
12A	19/24 *79%*	ss	*4-9 8-9* N=17	13		
12B				12		
13A	17/24 *71%*	ss	*1-5 5-7* N=10	18		
14A				16		
14B	24/24 *100%*	ss	*10-10 18-18* N=28	14		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Gray (10YR6/1) with 25% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and trace gravel. *[Continued from previous page]*	608	
22	Yellowish brown (10YR5/8), moist, firm, clayey SILT and very fine-grained SAND with slight trace gravel.	606	
24	Light brownish gray (10YR6/2), wet, loose, very fine- to coarse-grained SAND.	604	
26	Brownish yellow (10YR6/6), moist, hard, very silty CLAY with sand and trace gravel.	602	
	Gray (10YR6/1), moist, hard, very silty CLAY with sand and trace gravel.		
28	**End of Boring = 28.0 ft. BGS**		

NOTE(S):

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G271

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G271

~~State Plane~~ Plant Coordinate: X 2,515,517.1 Y 874,239.4 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: G. Mills

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): _____

Logged By: Rhonald W. Hasenyager Date Started: 9/9/2009 Date Finished: 9/10/2009

Report Form Completed By: Suzanna L. Simpson Date: 10/7/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 10 min

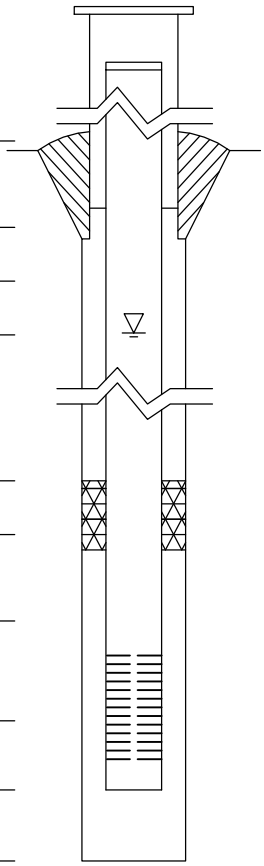
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS) (0.01 ft.)	
625.88	-2.99	Top of Protective Casing
625.57	-2.68	Top of Riser Pipe
622.89	0.00	Ground Surface
619.89	3.00	Top of Annular Sealant
610.39	12.50	Static Water Level (After Completion) 9/21/2009
616.16	6.73	Top of Seal
613.87	9.02	Top of Sand Pack
612.93	9.96	Top of Screen
608.58	14.31	Bottom of Screen
608.10	14.79	Bottom of Well
606.89	16.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	12.64
Bottom of Screen to End Cap	(feet)	0.48
Screen Length (1st slot to last slot)	(feet)	4.35
Total Length of Casing	(feet)	17.47
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G272

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G272

~~State Plane~~ Plant Coordinate: X 2,515,745.0 Y 874,234.8 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: G. Mills

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): _____

Logged By: Rhonald W. Hasenyager Date Started: 9/10/2009 Date Finished: 9/10/2009

Report Form Completed By: Suzanna L. Simpson Date: 10/7/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 10 min

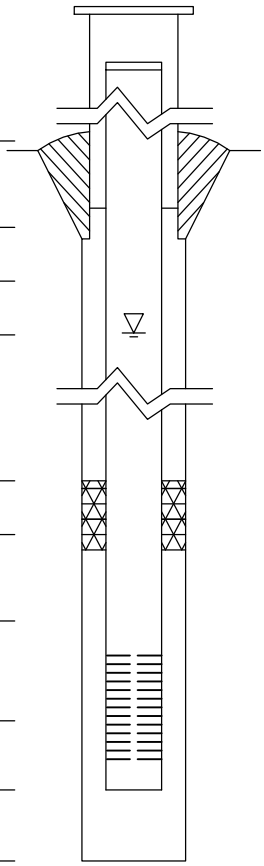
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS) (0.01 ft.)	
624.11	-3.39	Top of Protective Casing
623.81	-3.09	Top of Riser Pipe
620.72	0.00	Ground Surface
617.72	3.00	Top of Annular Sealant
611.23	9.49	Static Water Level (After Completion) 9/21/2009
614.55	6.17	Top of Seal
612.74	7.98	Top of Sand Pack
611.61	9.11	Top of Screen
606.74	13.98	Bottom of Screen
606.40	14.32	Bottom of Well
606.40	14.32	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	12.20
Bottom of Screen to End Cap	(feet)	0.34
Screen Length (1st slot to last slot)	(feet)	4.87
Total Length of Casing	(feet)	17.41
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G273

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G273

~~State Plane~~ Plant Coordinate: X 2,515,975.5 Y 874,235.2 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: G. Mills

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): _____

Logged By: Rhonald W. Hasenyager Date Started: 9/10/2009 Date Finished: 9/10/2009

Report Form Completed By: Suzanna L. Simpson Date: 10/7/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 10 min

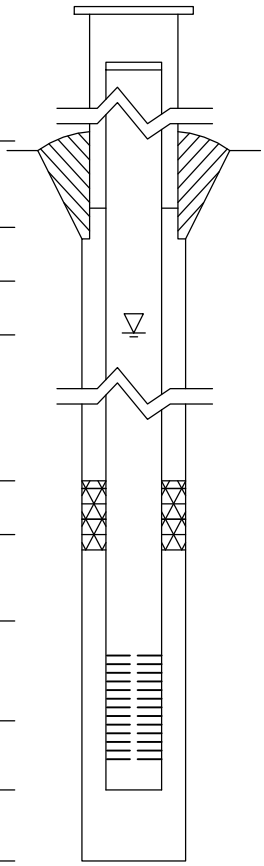
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS) (0.01 ft.)	
623.33	-3.16	Top of Protective Casing
623.02	-2.85	Top of Riser Pipe
620.17	0.00	Ground Surface
617.17	3.00	Top of Annular Sealant
610.28	9.89	Static Water Level (After Completion) 9/21/2009
614.07	6.10	Top of Seal
612.45	7.72	Top of Sand Pack
611.09	9.08	Top of Screen
605.61	14.56	Bottom of Screen
605.07	15.10	Bottom of Well
604.17	16.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: (Steel)
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	11.93
Bottom of Screen to End Cap	(feet)	0.54
Screen Length (1st slot to last slot)	(feet)	5.48
Total Length of Casing	(feet)	17.95
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G274

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G274

~~State Plane~~ Plant Coordinate: X 2,516,195.6 Y 874,239.2 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: G. Mills

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): _____

Logged By: Rhonald W. Hasenyager Date Started: 9/16/2009 Date Finished: 9/16/2009

Report Form Completed By: Suzanna L. Simpson Date: 10/7/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 15 min

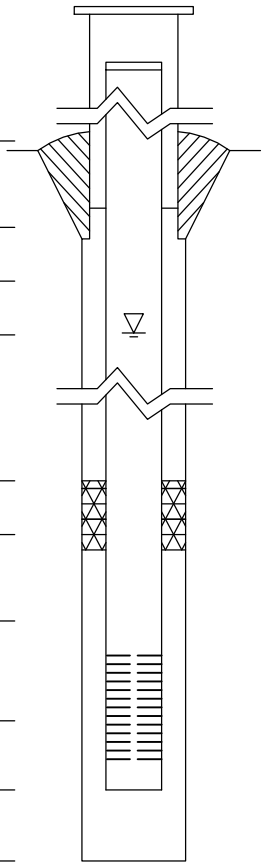
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS) (0.01 ft.)	
624.32	-2.65	Top of Protective Casing
624.04	-2.37	Top of Riser Pipe
621.67	0.00	Ground Surface
618.67	3.00	Top of Annular Sealant
608.55	13.12	Static Water Level (After Completion) 9/21/2009
611.93	9.74	Top of Seal
610.15	11.52	Top of Sand Pack
608.77	12.90	Top of Screen
604.00	17.67	Bottom of Screen
603.61	18.06	Bottom of Well
603.61	18.06	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	15.27
Bottom of Screen to End Cap	(feet)	0.39
Screen Length (1st slot to last slot)	(feet)	4.77
Total Length of Casing	(feet)	20.43
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G275

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G275

~~State Plane~~ Plant Coordinate: X 2,516,375.9 Y 874,298.9 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: G. Mills

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): _____

Logged By: Rhonald W. Hasenyager Date Started: 9/16/2009 Date Finished: 9/16/2009

Report Form Completed By: Suzanna L. Simpson Date: 10/7/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 15 min

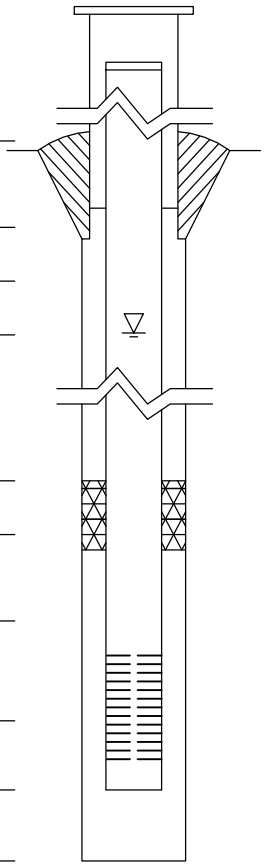
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS) (0.01 ft.)	
618.53	-2.39	Top of Protective Casing
618.26	-2.12	Top of Riser Pipe
616.14	0.00	Ground Surface
613.14	3.00	Top of Annular Sealant
605.89	10.25	Static Water Level (After Completion) 9/21/2009
610.42	5.72	Top of Seal
609.16	6.98	Top of Sand Pack
607.92	8.22	Top of Screen
603.52	12.62	Bottom of Screen
602.95	13.19	Bottom of Well
602.95	13.19	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	10.34
Bottom of Screen to End Cap	(feet)	0.52
Screen Length (1st slot to last slot)	(feet)	4.45
Total Length of Casing	(feet)	15.31
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G276

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G276

~~State Plane~~ Plant Coordinate: X 2,516,358.8 Y 874,438.6 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: G. Mills

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): _____

Logged By: Rhonald W. Hasenyager Date Started: 9/16/2009 Date Finished: 9/16/2009

Report Form Completed By: Suzanna L. Simpson Date: 10/7/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 15 min

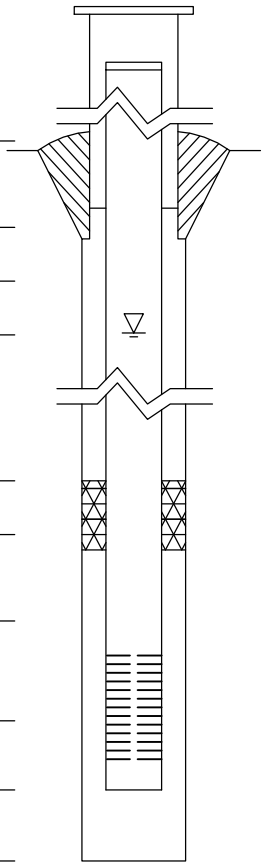
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
632.40	-3.26	Top of Protective Casing
632.00	-2.86	Top of Riser Pipe
629.14	0.00	Ground Surface
626.14	3.00	Top of Annular Sealant
603.59	25.55	Static Water Level (After Completion) 9/21/2009
610.06	19.08	Top of Seal
608.11	21.03	Top of Sand Pack
606.73	22.41	Top of Screen
601.92	27.22	Bottom of Screen
601.49	27.65	Bottom of Well
601.14	28.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	25.27
Bottom of Screen to End Cap	(feet)	0.43
Screen Length (1st slot to last slot)	(feet)	4.81
Total Length of Casing	(feet)	30.51
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G277

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G277

~~State Plane~~ Plant Coordinate: X 2,516,370.5 Y 874,581.8 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: G. Mills

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): _____

Logged By: Rhonald W. Hasenyager Date Started: 9/14/2009 Date Finished: 9/14/2009

Report Form Completed By: Suzanna L. Simpson Date: 10/7/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 18 min

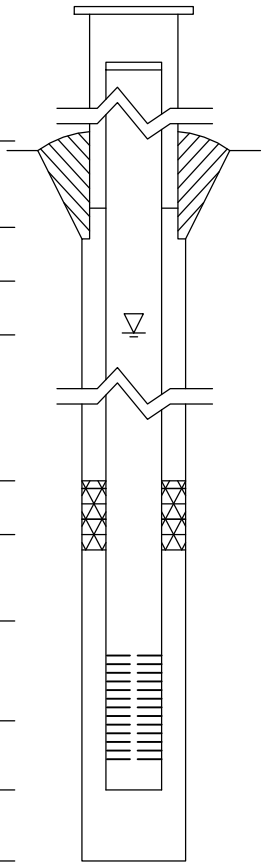
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.35	-2.56	Top of Protective Casing
623.08	-2.29	Top of Riser Pipe
620.79	0.00	Ground Surface
617.79	3.00	Top of Annular Sealant
602.56	18.23	Static Water Level (After Completion) 9/21/2009
608.00	12.79	Top of Seal
607.00	13.79	Top of Sand Pack
606.50	14.29	Top of Screen
602.02	18.77	Bottom of Screen
601.55	19.24	Bottom of Well
600.79	20.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	16.58
Bottom of Screen to End Cap	(feet)	0.47
Screen Length (1st slot to last slot)	(feet)	4.48
Total Length of Casing	(feet)	21.53
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G278

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G278

~~State Plane~~ Plant Coordinate: X 2,516,200.7 Y 874,875.4 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: G. Mills

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): _____

Logged By: Rhonald W. Hasenyager Date Started: 9/11/2009 Date Finished: 9/11/2009

Report Form Completed By: Suzanna L. Simpson Date: 10/7/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 22 min

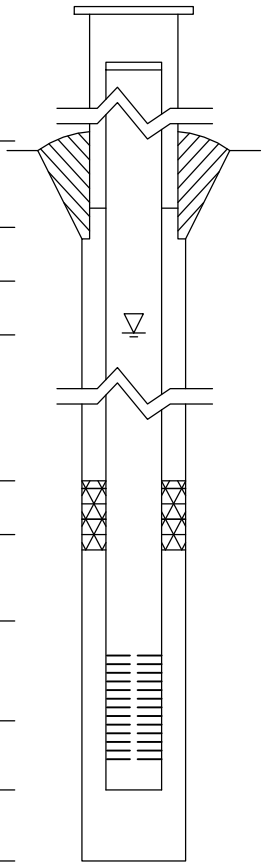
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS) (0.01 ft.)	
631.49	-2.64	Top of Protective Casing
631.17	-2.32	Top of Riser Pipe
628.85	0.00	Ground Surface
625.85	3.00	Top of Annular Sealant
604.87	23.98	Static Water Level (After Completion) 9/21/2009
613.74	15.11	Top of Seal
611.90	16.95	Top of Sand Pack
609.92	18.93	Top of Screen
605.15	23.70	Bottom of Screen
604.79	24.06	Bottom of Well
604.79	24.06	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	21.25
Bottom of Screen to End Cap	(feet)	0.36
Screen Length (1st slot to last slot)	(feet)	4.77
Total Length of Casing	(feet)	26.38
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G279

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G279

~~State Plane~~ Plant Coordinate: X 2,516,245.6 Y 875,028.1 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: G. Mills

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): _____

Logged By: Rhonald W. Hasenyager Date Started: 9/10/2009 Date Finished: 9/10/2009

Report Form Completed By: Suzanna L. Simpson Date: 10/7/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 18 min

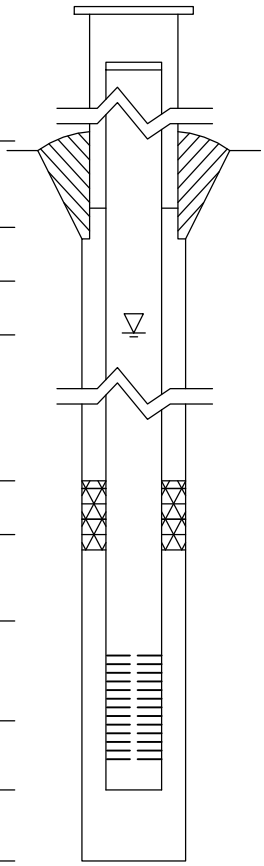
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz Sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
632.33	-3.14	Top of Protective Casing
632.04	-2.85	Top of Riser Pipe
629.19	0.00	Ground Surface
626.19	3.00	Top of Annular Sealant
601.66	27.53	Static Water Level (After Completion) 9/21/2009
610.45	18.74	Top of Seal
608.77	20.42	Top of Sand Pack
606.79	22.40	Top of Screen
602.40	26.79	Bottom of Screen
604.51	24.68	Bottom of Well
601.19	28.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	25.25
Bottom of Screen to End Cap	(feet)	0.53
Screen Length (1st slot to last slot)	(feet)	4.39
Total Length of Casing	(feet)	30.17
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

APPENDIX A3

GMF GYPSUM STACK POND

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 2/25/2008
Finish: 2/25/2008
WEATHER: Overcast, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: S. Simpson

BOREHOLE ID: G200
Well ID: G200
Surface Elev: 624.2 ft. MSL
Completion: 18.0 ft. BGS
Station: 877,930.59N
2,515,649.96E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.50 - While drilling
▼ = 2.75 - 3/12/08
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
	24/24 100%	ss	3-2 3-3 N=5			
1A				31		1.36 B
2A	19/24 79%	ss	3-3 6-6 N=9	26		1.94 BSh
2B				26		2.33 Sh
3A	19/24 79%	ss	3-3 4-5 N=7	26		1.59 B
3B				23		1.55 B
4A	22/24 92%	ss	5-5 5-5 N=10	29		0.31 B
5A	20/24 83%	ss	2-2 3-5 N=5	25		1.09 B
6A	22/24 92%	ss	1-3 2-3 N=5	22		1.01
	24/24 100%	ss	3-3 5-6 N=8			
7A				15		0.50 B
7B				18		
8A	19/24 79%	ss	0-3 5-8 N=8	24		0.27 B
8B				17		
9A	24/24 100%	ss	8-15 30-50 N=45	13		
9B				8		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark grayish brown (10YR3/2), moist, firm, friable, clayey SILT	624
2	Dark gray (10YR4/1) with 5% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY	622
	Dark gray (10YR4/1) with 70% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY	
4	Dark gray (10YR4/1) with 70% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, slight trace sand	620
	Very dark gray (10YR3/1), moist, firm, silty CLAY, slight trace sand	
6		618
	Dark gray (10YR4/1) with 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, trace coarse sand	
8		616
10	Dark gray (10YR4/1) with 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, sand and slight trace gravel	614
12		612
	Yellowish brown (10YR5/8), moist, soft, sandy CLAY	
14	Gray (10YR5/1), wet, soft, fine- to coarse-grained SAND	610
	Gray (10YR5/1), wet, soft, silty CLAY, trace sand and gravel	
	Yellowish brown (10YR5/4), wet, soft, fine- to coarse-grained SAND, trace gravel	
16		608
	Gray (10YR5/1), moist, hard, silty CLAY, trace sand and gravel	
18		

End of Boring = 18.0 ft. BGS

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/15/2010
Finish: 10/15/2010
WEATHER: Sunny (mid-50's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: R. Hasenyager

BOREHOLE ID: R201
Well ID: R201
Surface Elev: 624.02 ft. MSL
Completion: 17.22 ft. BGS
Station: 877,925.26N
2,514,841.96E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
								Very dark grayish brown (10YR3/2), moist, soft, friable, clayey SILT, slight trace sand and gravel		
								Dark brown (10YR3/3), moist, soft, silty CLAY		
							2		622	
								Yellowish brown (10YR5/8) with 20% gray (10YR5/1) mottles, moist, firm, silty CLAY, trace sand, slight trace gravel		
							4		620	
								Gray (10YR5/1) with 5% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY, sand and trace gravel		
							6		618	
								Gray (10YR5/1), moist, firm, sandy CLAY, trace silt and slight trace gravel		
							8		616	
								Yellowish brown (10YR5/8) with 10% gray (10YR5/1) mottles, moist, firm, sandy CLAY, trace gravel		
							10		614	
								Yellowish brown (10YR5/8), wet, soft, silty SAND, trace gravel		
							12		612	
								Yellowish brown (10YR5/8), moist, firm, clayey SILT		
								Greenish gray (5GY6/1), moist, firm, interbedded clayey SILT and SILT		
							14		610	
								Yellowish brown (10YR5/8), wet, soft, fine- to coarse-grained SAND, slight trace gravel		
							16		608	
								Yellowish brown (10YR5/8), wet, firm, very fine- to fine-grained silty SAND		
								Gray (10YR5/1), wet, soft, SILT		
								Gray (10YR5/1), wet, soft, fine- to coarse-grained SAND, slight trace gravel		
								Gray (10YR5/1), moist, hard, very silty CLAY, trace sand and gravel		

End of Boring = 17.22 ft. BGS

NOTE(S): R201 blind drilled in borehole approximately 8 ft. west of G201. Lithology taken from G201.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 2/25/2008
Finish: 2/25/2008
WEATHER: Overcast, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: S. Simpson

BOREHOLE ID: G201
Well ID: G201
Surface Elev: 623.9 ft. MSL
Completion: 18.2 ft. BGS
Station: 877,924.94N
2,514,849.47E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 10.20 - While drilling
▼ = 2.17 - 3/12/08
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*
1A	22/24 *92%*	ss	*3-3 2-3* N=5	23		
1B				33		1.16
2A	22/24 *92%*	ss	*2-3 5-6* N=8	26		2.33 *BSh*
3A	20/24 *83%*	ss	*2-4 5-5* N=9	15		1.94 *B*
4A	24/24 *100%*	ss	*7-7 7-6* N=14	19		1.24 *B*
5A	24/24 *100%*	ss	*1-2 3-3* N=5	23		1.16 *B*
6A	23/24 *96%*	ss	*0-1 1-2* N=2	20		
7A	20/24 *83%*	ss	*3-6 6-12* N=12	22		2.72 *BSh*
8A	24/24 *100%*	ss	*4-7 7-10* N=14	23		1.59 *Sh*
8B				19		
9A				15		
9B	24/24 *100%*	ss	*7-12 25-30* N=37	20		
9C				11		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark grayish brown (10YR3/2), moist, soft, friable, clayey SILT, slight trace sand and gravel	
	Dark brown (10YR3/3), moist, soft, silty CLAY	
▼ 2		622
	Yellowish brown (10YR5/8) with 20% gray (10YR5/1) mottles, moist, firm, silty CLAY, trace sand, slight trace gravel	
4		620
	Gray (10YR5/1) with 5% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY, sand and trace gravel	
6		618
	Gray (10YR5/1), moist, firm, sandy CLAY, trace silt and slight trace gravel	
8		616
	Yellowish brown (10YR5/8) with 10% gray (10YR5/1) mottles, moist, firm, sandy CLAY, trace gravel	
▼ 10		614
	Yellowish brown (10YR5/8), wet, soft, silty SAND, trace gravel	
12		612
	Yellowish brown (10YR5/8), moist, firm, clayey SILT	
	Greenish gray (5GY6/1), moist, firm, interbedded clayey SILT and SILT	
14		610
	Yellowish brown (10YR5/8), wet, soft, fine- to coarse-grained SAND, slight trace gravel	
16		608
	Yellowish brown (10YR5/8), wet, firm, very fine- to fine-grained silty SAND	
	Gray (10YR5/1), wet, soft, SILT	
	Gray (10YR5/1), wet, soft, fine- to coarse-grained SAND, slight trace gravel	
18	Gray (10YR5/1), moist, hard, silty CLAY, trace sand and gravel	606

End of Boring = 18.15 ft. BGS

NOTE(S):

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 2/21/2008
Finish: 2/21/2008
WEATHER: Overcast, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: S. Simpson

BOREHOLE ID: G205
Well ID: G205
Surface Elev: 622.2 ft. MSL
Completion: 16.0 ft. BGS
Station: 875,550.19N
2,515,914.87E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 11.10 - While drilling
▼ = 5.06 - 3/12/08
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	24/24 *100%*	ss	*4-3 4-4* N=7	22		
1B				30		1.67 *Sh*
2A	19/24 *79%*	ss	*3-5 6-5* N=11	24		1.86 *B*
3A	20/24 *83%*	ss	*2-2 5-5* N=7	19		1.55 *B*
4A	19/24 *79%*	ss	*5-6 7-8* N=13	20		1.12 *B*
5A	16/24 *67%*	ss	*2-2 3-5* N=5	20		0.62 *BSh*
6A	22/24 *92%*	ss	*1-2 3-3* N=5	17		0.62 *BSh*
6B				17		
7A				25		
7B	23/24 *96%*	ss	*3-3 5-6* N=8	17		1.36 *BSh*
8A				15		
8B	17/24 *71%*	ss	*5-19 26-35* N=45	10		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark grayish brown (10YR3/2), moist, firm, clayey SILT	622
2	Yellowish brown (10YR5/4) with 30% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, slight trace sand	620
4	Yellowish brown (10YR5/4) with 30% yellowish brown (10YR5/8) mottles, moist, hard, silty CLAY, slight trace sand	618
6	Gray (10YR6/1) with 30% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand, slight trace gravel	616
8	Yellowish brown (10YR5/6), moist, firm, silty CLAY with sand, trace gravel	614
10	Yellowish brown (10YR5/6), moist, soft, sandy SILT, slight trace gravel	612
12	Yellowish brown (10YR 5/4), moist, soft, silty SAND, trace gravel	610
14	Gray (10YR5/1), moist, hard, silty CLAY, trace sand and gravel	608
16		

Borehole Detail

Remarks

End of Boring = 16.0 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/14/2010
Finish: 10/14/2010
WEATHER: Sunny, warm, breezy (lo-70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G206
Well ID: G206
Surface Elev: 630.54 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,103.91N
2,514,669.16E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 22.00 - While drilling
▼ = 21.54 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	12/24 50%	ss	2-2 3-2 N=5	18		
2A	20/24 83%	ss	2-2 3-5 N=5	16		
3A	20/24 83%	ss	4-9 6-8 N=15	19		
4A	19/24 79%	ss	2-4 5-6 N=9	20		
5A	17/24 71%	ss	2-3 4-5 N=7	30		
6A	22/24 92%	ss	2-3 4-6 N=7	19		
7A	23/24 96%	ss	1-2 3-4 N=5	23		
8A	22/24 92%	ss	1-1 3-3 N=4	22		
9A	24/24 100%	ss	1-1 2-2 N=3	21		
10A	24/24 100%	ss	woh-woh 1-5	25		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Grayish brown (10YR5/2), moist, firm, silty CLAY with trace sand and gravel.	630
2		628
4	FILL - Dark gray (10YR4/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	626
6		624
8	Very dark gray (10YR3/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand, trace roots.	622
	Dark grayish brown (10YR4/2) with 35% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand.	
10	Gray (10YR5/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with trace sand and gravel.	620
12	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	618
14	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel.	616
16	Dark yellowish brown (10YR4/6) with 30% gray (10YR5/1) mottles, moist, soft, silty CLAY with trace sand and gravel.	614
	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel.	
18	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, very soft, silty CLAY with trace sand and gravel.	612
	Gray (10YR5/1), moist, very soft, very fine- to fine-grained sandy CLAY with trace gravel.	
20	Gray (10YR5/1), moist, firm, very fine- to fine-grained	

NOTE(S): G206 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/14/2010
Finish: 10/14/2010
WEATHER: Sunny, warm, breezy (lo-70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G206
Well ID: G206
Surface Elev: 630.54 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,103.91N
2,514,669.16E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 22.00 - While drilling
▼ = 21.54 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
11A	22/24 *92%*	ss	*19-6 13-19* N=19	13		
11B				16		
12A	20/24 *83%*	ss	*11-20 19-13* N=39	10		
12B				10		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	sandy CLAY with trace gravel.		
	Dark yellowish brown (10YR4/6), wet dense, silty, fine- to coarse-grained SAND with trace gravel.	610	
	Dark yellowish brown (10YR4/6), moist, hard, clayey SILT with sand and gravel.		
22	Grayish brown (10YR5/2), moist, dense, silty, very fine- to fine-grained SAND.		
	Dark gray (10YR4/1), slightly moist, hard, very silty CLAY with sand and gravel.	608	
	Dark gray (10YR4/1), wet, dense, silty, fine- to coarse-grained SAND with gravel.		
24	Dark gray (10YR4/1), slightly moist, hard, very silty CLAY with sand and gravel.		

End of Boring = 24.0 ft. BGS

NOTE(S): G206 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/8/2010
Finish: 10/8/2010
WEATHER: Sunny, mild

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: R. Hasenyager

BOREHOLE ID: G207
Well ID: G207
Surface Elev: 630.61 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,166.36N
2,514,837.94E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = Dry - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	23/24 96%	ss	6-5 5-8 N=10	15		
2A	24/24 100%	ss	4-4 7-8 N=11	15		
3A	23/24 96%	ss	3-6 7-9 N=13	17		
4A	24/24 100%	ss	3-4 6-7 N=10	16		
5A	24/24 100%	ss	2-2 3-4 N=5	22		
5B				24		
6A	22/24 92%	ss	2-2 2-5 N=4	27		
7A	24/24 100%	ss	2-2 2-3 N=4	27		
8A	24/24 100%	ss	woh-1 2-3 N=3	25		
9A	23/24 96%	ss	woh-2 2-3 N=4	22		
10A	24/24 100%	ss	woh-woh 2-3	19		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	FILL - Yellowish brown (10YR5/6) with 10% gray (10YR6/1) and 5% black (10YR2/1) mottles, slightly moist, hard, silty CLAY with trace sand and slight trace gravel.	630	
2	FILL - Gray (10YR5/1) with 20% yellowish brown (10YR5/8) mottles, moist, hard, silty CLAY with sand and trace gravel.	628	
4	FILL - Yellowish brown (10YR5/8) with 20% gray (10YR6/1) mottles, moist, hard, silty CLAY with sand and trace gravel.	626	
6	FILL - Dark yellowish brown (10YR4/4), moist, hard, silty CLAY with slight trace sand and gravel.	624	
	FILL - Gray (10YR5/1) with 20% yellowish brown (10YR5/8) mottles, moist, hard, silty CLAY with slight trace sand and gravel.		
8	Yellowish brown (10YR5/6) with 25% gray (10YR5/1) mottles, moist, firm, silty CLAY with slight trace sand and gravel.	622	
10	Gray (10YR5/1) with 15% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with slight trace sand and gravel.		
	Gray (10YR5/1) with 40% yellowish brown (10YR5/8) mottles, very moist, firm, silty CLAY with slight trace sand and gravel.	620	
12	Yellowish brown (10YR5/8) with 30% gray (10YR6/1) mottles, very moist, soft, silty CLAY with trace sand and gravel.	618	
14	Gray (10YR6/1) with 30% yellowish brown (10YR5/8) mottles, very moist, soft, silty CLAY with sand and slight trace gravel.	616	
16	Yellowish brown (10YR5/6) with 25% gray (10YR6/1) mottles, very moist, very soft, sandy, silty CLAY with trace gravel.	614	
18	Yellowish brown (10YR5/6) with 30% gray (10YR6/1) mottles, very moist, very soft, sandy CLAY with silt and trace gravel.	612	
20			

NOTE(S): G207 installed in borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/8/2010
Finish: 10/8/2010
WEATHER: Sunny, mild

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: R. Hasenyager

BOREHOLE ID: G207
Well ID: G207
Surface Elev: 630.61 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,166.36N
2,514,837.94E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = Dry - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
11A	22/24 *92%*	ss	*woh-1 2-2* N=3	18				Yellowish brown (10YR5/6) with 30% gray (10YR6/1) mottles, very moist, very soft, sandy CLAY with silt and trace gravel. *[Continued from previous page]*		610	
							22	Gray (10YR6/1) with 40% yellowish brown (10YR5/6) mottles, very moist to wet, loose, silty, very fine- to fine-grained SAND with slight trace gravel.			
12A	24/24 *100%*	ss	*10-24 26-30* N=50					Gray (10YR5/1), slightly moist, hard, very silty CLAY with trace sand and slight trace gravel.		608	
							24				

End of Boring = 24.0 ft. BGS

NOTE(S): G207 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/7/2010
Finish: 10/7/2010
WEATHER: Sunny, warm (lo-70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G208
Well ID: G208
Surface Elev: 630.57 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,231.46N
2,514,993.57E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = 23.92 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	19/24 79%	ss	4-3 3-5 N=6	23		
2A	24/24 100%	ss	2-3 4-6 N=7	14		
3A	24/24 100%	ss	2-4 4-7 N=8	21		
4A	24/24 100%	ss	2-4 6-8 N=10	17		
5A	20/24 83%	ss	2-2 4-5 N=6	24		
6A	23/24 96%	ss	1-2 4-4 N=6	26		
7A	19/24 79%	ss	1-2 2-3 N=4	23		
8A	22/24 92%	ss	1-1 2-3 N=3	24		
9A	24/24 100%	ss	1-1 2-3 N=3	24		
9B				20		
10A	22/24 92%	ss	woh-woh 1-2	20		
10B				17		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Brown (10YR4/3) with 5% dark gray (10YR4/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	630
2		628
4	FILL - Brown (10YR4/3) with 15% dark gray (10YR4/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	626
6		624
8		622
	Very dark gray (10YR3/1), moist, firm, silty CLAY with trace sand and gravel, trace roots.	
	Dark gray (10YR4/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand, trace roots.	
10	Dark gray (10YR4/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand, trace roots.	620
12		618
14	Dark gray (10YR4/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand, trace roots.	616
16	Dark gray (10YR4/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel, trace roots.	614
18	Gray (10YR5/1) with 20% dark yellowish brown (10YR4/6) mottles, very moist, soft, silty, very fine- to fine-grained sandy CLAY with trace gravel.	612
20	Dark yellowish brown (10YR4/6) with 15% gray (10YR5/1) mottles, very moist to wet, soft, clayey, very fine- to medium-grained SAND with trace gravel.	

Borehole Detail

Remarks

NOTE(S): G208 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/7/2010
Finish: 10/7/2010
WEATHER: Sunny, warm (lo-70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers

FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G208
Well ID: G208
Surface Elev: 630.57 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,231.46N
2,514,993.57E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = 23.92 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
11A	20/24 *83%*	SS	*woh-2 5-12* N=7	13				Yellowish brown (10YR5/4), moist, firm, very silty CLAY with sand and gravel.		610	
							22				
12A	24/24 *100%*	SS	*6-11 18-24* N=29	9				Dark gray (10YR4/1), slightly moist, hard, very silty CLAY with sand and gravel.		608	
							▼ 24				

End of Boring = 24.0 ft. BGS

NOTE(S): G208 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/7/2010
Finish: 10/7/2010
WEATHER: Sunny, cool (lo-50's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G209
Well ID: G209
Surface Elev: 630.57 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,298.23N
2,515,149.56E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = 22.40 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	24/24 100%	ss	4-4 4-6 N=8	21		
2A	24/24 100%	ss	3-4 6-6 N=10	13		
3A	24/24 100%	ss	2-3 6-8 N=9	19		
4A	22/24 92%	ss	2-3 6-8 N=9	17		
5A	18/24 75%	ss	2-3 3-5 N=6	20		
6A	24/24 100%	ss	1-2 2-5 N=4	26		
7A	22/24 92%	ss	1-3 4-4 N=7	22		
8A	24/24 100%	ss	woh-1 2-3 N=3	25		
9A	19/24 79%	ss	woh-1 2-3 N=3	24		
10A	14/24 58%	ss	woh-2 3-3 N=5	20		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
0–8	FILL - Brown (10YR5/3) with 10% gray (10YR5/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	630 – 622
8	Grayish brown (10YR5/2), moist, firm, clayey SILT with trace sand and gravel.	
8–12	Dark gray (10YR4/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand.	622 – 618
12–14	Dark gray (10YR4/1) with 25% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand.	618 – 616
14–20	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel.	616 – 612

Borehole Detail

Remarks

NOTE(S): G209 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/7/2010
Finish: 10/7/2010
WEATHER: Sunny, cool (lo-50's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G209
Well ID: G209
Surface Elev: 630.57 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,298.23N
2,515,149.56E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = 22.40 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
11A	1/24 *4%*	ss	*woh-1 1-1* N=2	21				Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel. *[Continued from previous page]*		610	
							22 ▼				
12A	20/24 *83%*	ss	*9-16 17-26* N=33	7				Dark gray (10YR4/1), slightly moist, hard, very silty CLAY with sand and gravel.		608	
							24				

End of Boring = 24.0 ft. BGS

NOTE(S): G209 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/6/2010
Finish: 10/6/2010
WEATHER: Sunny, warm (mid-70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G210
Well ID: G210
Surface Elev: 630.48 ft. MSL
Completion: 25.00 ft. BGS
Station: 875,359.71N
2,515,298.97E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 20.00 - While drilling
▼ = 19.90 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	20/24 *83%*	ss	*4-3 5-6* N=8	16		
2A	24/24 *100%*	ss	*3-4 7-7* N=11	15		
3A	24/24 *100%*	ss	*3-5 10-9* N=15	19		
4A	24/24 *100%*	ss	*3-6 9-11* N=15	17		
5A	24/24 *100%*	ss	*3-4 5-7* N=9	15		
6A	22/24 *92%*	ss	*2-2 4-6* N=6	26		
7A	19/24 *79%*	ss	*1-3 3-5* N=6	23		
8A	24/24 *100%*	ss	*2-2 2-4* N=4	26		
9A	24/24 *100%*	ss	*1-1 2-3* N=3	24		
10A	20/24 *83%*	ss	*1-1 2-2* N=3	24		
10B				31		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
2	FILL - Brown (10YR4/3) with 20% dark gray (N5/1) mottles, moist, firm, silty CLAY with trace sand and gravel.	630	
4		628	
6		626	
8	FILL - Dark grayish brown (10YR4/2), slightly moist, firm, clayey SILT with trace sand and gravel.	624	
10	Gray (10YR5/1) with 10% dark grayish brown (10YR4/2) mottles, moist, firm, silty CLAY with trace sand.	622	
12	Dark gray (10YR4/1), moist, firm, silty CLAY with trace sand, trace roots.	620	
14	Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY with trace sand.	618	
16	Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	616	
18	Gray (10YR5/1) with 5% dark yellowish brown (10YR4/6) mottles, moist to very moist, firm, silty CLAY with sand.	614	
20	Gray (10YR5/1) with 5% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with sand and trace gravel.	612	
	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with sand and trace gravel.		
	Gray (N6/1), very moist, very soft, silty, very fine- to fine-grained sandy CLAY with trace gravel.		

NOTE(S): G210 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/6/2010
Finish: 10/6/2010
WEATHER: Sunny, warm (mid-70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G210
Well ID: G210
Surface Elev: 630.48 ft. MSL
Completion: 25.00 ft. BGS
Station: 875,359.71N
2,515,298.97E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 20.00 - While drilling
▼ = 19.90 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
11A	14/24 *58%*	ss	*woh-5 6-18* N=11	12				Yellowish brown (10YR5/4), moist, medium dense, silty, fine- to coarse-grained SAND with trace gravel.	610	
								Gray (N6/1), moist, medium dense, silty, very fine - to fine-grained SAND.		
							22	Yellowish brown (10YR5/4), slightly moist, hard, clayey SILT with sand and gravel.		
12A	19/24 *79%*	ss	*7-18 26-36* N=44	14				Brown (10YR5/3), very moist, dense, very fine- to fine-grained sandy SILT with trace gravel.	608	
13A	10/12 *83%*	ss	*27-50/6"*	9			24	Gray (N5/1), slightly moist, hard, very silty CLAY with sand and gravel.	606	

End of Boring = 25.0 ft. BGS

NOTE(S): G210 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/11/2010
Finish: 10/11/2010
WEATHER: Sunny, warm (lo-70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers

FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G211
Well ID: G211
Surface Elev: 630.31 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,424.49N
2,515,449.06E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 20.00 - While drilling
▼ = 20.60 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	20/24 *83%*	ss	*5-3* *4-5* N=7	23		
2A	20/24 *83%*	ss	*3-5* *5-8* N=10	17		
3A	24/24 *100%*	ss	*2-3* *5-7* N=8	24		
4A	24/24 *100%*	ss	*3-5* *7-9* N=12	29		
5A	24/24 *100%*	ss	*2-2* *3-5* N=5	31		
6A	17/24 *71%*	ss	*1-2* *4-4* N=6	19		
7A	24/24 *100%*	ss	*1-2* *2-4* N=4	22		
8A	24/24 *100%*	ss	*1-1* *3-2* N=4	28		
9A	22/24 *92%*	ss	*1-1* *1-2* N=2	19		
10A	19/24 *79%*	ss	*1-4* *5-11* N=9	13		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
0–3.5	FILL - Brown (10YR4/3) with 20% dark gray (10YR4/1) mottles, moist, firm, silty CLAY with trace sand and gravel.	630	
3.5–8	FILL - Dark gray (10YR4/1) with 20% brown (10YR4/3) and 5% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	628, 626, 624	
8–10	Dark gray (10YR4/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY, slight trace roots.	622	
10–12	Dark gray (10YR4/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand.	620	
12–16.5	Dark gray (10YR4/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel.	618, 616, 614	
16.5–18.5	Dark yellowish brown (10YR4/6) with 30% gray (10YR5/1) mottles, very moist, soft, very fine- to fine-grained sandy CLAY with trace gravel.	612	
18.5–20	Dark yellowish brown (10YR4/4) with 15% grayish brown (10YR5/2) mottles, moist, firm, clayey SILT with sand and gravel.		

Borehole Detail

NOTE(S): G211 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/11/2010
Finish: 10/11/2010
WEATHER: Sunny, warm (lo-70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers

FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G211
Well ID: G211
Surface Elev: 630.31 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,424.49N
2,515,449.06E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 20.00 - While drilling
▼ = 20.60 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
11A	18/24 *75%*	ss	*7-17 23-21* N=40	10			▼	Grayish brown (10YR5/2), slightly moist, hard, very silty CLAY with sand and gravel.		610	
							22			608	
12A	24/24 *100%*	ss	*4-14 15-17* N=29	13				Dark gray (10YR4/1), slightly moist, hard, very silty CLAY with sand and gravel.			
							24				

End of Boring = 24.0 ft. BGS

NOTE(S): G211 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/11/2010
Finish: 10/11/2010
WEATHER: Sunny, warm (lo-80's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G212
Well ID: G212
Surface Elev: 630.59 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,486.50N
2,515,583.03E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 19.00 - While drilling
▼ = 20.72 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	24/24 100%	ss	4-3 3-6 N=6	17		
2A	24/24 100%	ss	2-3 4-5 N=7	21		
3A	24/24 100%	ss	2-5 6-7 N=11	13		
4A	24/24 100%	ss	2-5 7-10 N=12	15		
5A	24/24 100%	ss	2-2 4-7 N=6	29		
6A	18/24 75%	ss	2-3 4-6 N=7	23		
7A	17/24 71%	ss	1-2 2-2 N=4	25		
8A	24/24 100%	ss	woh-1 2-3 N=3	27		
9A	22/24 92%	ss	1-1 2-2 N=3	25		
10A	24/24 100%	ss	woh-woh 1-2	19		
10B				22		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Brown (10YR4/3), slightly moist, firm, silty CLAY with trace sand and gravel.	630
2	FILL - Dark gray (10YR4/1) with 20% brown (10YR4/3) and 10% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand.	628
4	FILL - Brown (10YR4/3) with 15% dark gray (10YR4/1) and 10% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	626
6		624
8	Dark gray (10YR4/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY, slight trace roots.	622
10	Dark gray (10YR4/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand.	620
12	Dark gray (10YR4/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel.	618
14		616
16		614
18	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, very soft, silty, very fine- to fine-grained sandy CLAY with trace gravel.	612
20	Gray (10YR5/1), loose, wet, silty, very fine- to	

Borehole Detail

Remarks

NOTE(S): G212 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/11/2010
Finish: 10/11/2010
WEATHER: Sunny, warm (lo-80's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G212
Well ID: G212
Surface Elev: 630.59 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,486.50N
2,515,583.03E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 19.00 - While drilling
▼ = 20.72 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
								medium-grained SAND.			
11A	7/24 *29%*	ss	*1-6 10-22* N=16	19			▼	Brown (10YR5/3), moist, medium dense, SILT with trace sand and gravel.		610	
							22	Dark gray (10YR4/1), slightly moist, hard, very silty CLAY with sand and gravel.		608	
12A	20/24 *83%*	ss	*5-21 18-27* N=39	12							
							24				

End of Boring = 24.0 ft. BGS

NOTE(S): G212 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/12/2010
Finish: 10/12/2010
WEATHER: Partly cloudy, mild (mid-50's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G213
Well ID: G213
Surface Elev: 630.34 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,544.37N
2,515,723.51E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 20.00 - While drilling
▼ = 19.92 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	23/24 96%	ss	4-3 4-5 N=7	15		
2A	22/24 92%	ss	2-4 6-8 N=10	21		
3A	22/24 92%	ss	2-4 7-8 N=11	17		
4A	22/24 92%	ss	2-4 4-8 N=8	16		
5A	20/24 83%	ss	1-3 6-6 N=9	12		
6A	20/24 83%	ss	2-2 5-7 N=7	24		
7A	20/24 83%	ss	2-3 3-5 N=6	19		
8A	22/24 92%	ss	1-2 2-3 N=4	24		
9A	24/24 100%	ss	woh-1 2-2 N=3	24		
10A	18/24 75%	ss	woh-woh 1-2	24		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
0–10.5	FILL - Brown (10YR4/3) with 10% dark gray (10YR4/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, silty CLAY with trace sand and gravel.	630–620	
10.5–11.5	Dark gray (10YR4/1) with 25% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand, trace roots.	620–618	
11.5–13.5	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT, trace roots.	618–616	
13.5–16.5	Dark gray (10YR4/1) with 3% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	616–614	
16.5–17.5	Dark gray (10YR4/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel.	614–612	
17.5–18.5	Gray (10YR5/1) with 25% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel.	612–611.5	
18.5–19.5	Gray (10YR5/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, soft, very fine- to fine-grained sandy CLAY with trace gravel.	611.5–611	
19.5–20	Dark yellowish brown (10YR4/6), very moist, soft, sandy CLAY with trace gravel.	611–610.5	

NOTE(S): G213 installed in borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/12/2010
Finish: 10/12/2010
WEATHER: Partly cloudy, mild (mid-50's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G213
Well ID: G213
Surface Elev: 630.34 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,544.37N
2,515,723.51E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 20.00 - While drilling
▼ = 19.92 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
11A	18/24 *75%*	ss	*1-1* *1-2* N=2	18				Dark yellowish brown (10YR4/6), moist, soft, clayey, very fine- to coarse-grained SAND with trace gravel.	610	
								Dark yellowish brown (10YR4/6), moist, firm, very silty CLAY with sand and gravel.		
							22		608	
12A	22/24 *92%*	ss	*10-13* *18-22* N=31	11				Dark gray (10YR4/1), slightly moist, hard, very silty CLAY with sand and gravel.		
							24			

End of Boring = 24.0 ft. BGS

NOTE(S): G213 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/14/2010
Finish: 10/14/2010
WEATHER: Sunny, cool (lo-40's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G214
Well ID: G214
Surface Elev: 630.39 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,668.02N
2,515,960.84E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = Dry - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
1A	24/24 100%	ss	6-7 7-9 N=14	15			2	FILL - Brown (10YR4/3) with 10% dark gray (10YR4/1) and 10% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	630	
2A	24/24 100%	ss	3-3 6-5 N=9	22			4	FILL - Dark gray (10YR4/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	628	
3A	24/24 100%	ss	3-4 6-8 N=10	18			6	FILL - Brown (10YR4/3) with 10% dark yellowish brown (10YR4/6) and 5% dark gray (10YR4/1) mottles, moist, firm, silty CLAY with trace sand and gravel.	626	
4A	24/24 100%	ss	3-4 7-10 N=11	17			8		624	
5A	24/24 100%	ss	3-2 4-5 N=6	19			10	Grayish brown (10YR5/2) with 15% dark gray (10YR4/1) and 10% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with trace sand and gravel.	622	
6A	24/24 100%	ss	2-3 4-7 N=7	24			12	Brown (10YR4/3) with 15% dark gray (10YR4/1) and 10% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	620	
7A 7B	24/24 100%	ss	2-3 4-6 N=7	22 16			14	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY.	618	
8A	24/24 100%	ss	woh-2 3-4 N=5	22			16	Dark gray (10YR4/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	616	
9A	22/24 92%	ss	1-2 2-3 N=4	21			18	Dark gray (10YR4/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel.	614	
10A 10B	22/24 92%	ss	woh-2 2-2 N=4	15 21			20	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel.	612	

NOTE(S): G214 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/14/2010
Finish: 10/14/2010
WEATHER: Sunny, cool (lo-40's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G214
Well ID: G214
Surface Elev: 630.39 ft. MSL
Completion: 24.00 ft. BGS
Station: 875,668.02N
2,515,960.84E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = Dry - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
11A	20/24 *83%*	ss	*woh-woh* *3-12*	24				Gray (10YR5/1), wet, loose, silty, very fine- to medium-grained SAND with trace gravel and clayey seams. *[Continued from previous page]*		610	
11B				14				Dark yellowish brown (10YR4/6), moist, firm, very silty CLAY with trace sand and gravel.			
							22			608	
12A	24/24 *100%*	ss	*12-28* *32-28* N=60	7				Dark gray (10YR4/1), slightly moist, hard, very silty CLAY with trace sand and gravel.			
							24				

End of Boring = 24.0 ft. BGS

NOTE(S): G214 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/13/2010
Finish: 10/13/2010
WEATHER: Sunny, warm, windy (hi-60's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G215
Well ID: G215
Surface Elev: 630.48 ft. MSL
Completion: 24.31 ft. BGS
Station: 875,810.19N
2,515,971.55E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = Dry - Upon completion
▽ = 22.52 - 10/14/10

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	23/24 *96%*	ss	*5-3 3-5* N=6	18		
2A	19/24 *79%*	ss	*3-3 5-6* N=8	17		
3A	20/24 *83%*	ss	*2-3 7-7* N=10	13		
4A	23/24 *96%*	ss	*3-6 6-7* N=12	16		
4B				27		
5A	20/24 *83%*	ss	*3-3 3-5* N=6	20		
6A	13/24 *54%*	ss	*2-2 3-5* N=5	24		
7A	19/24 *79%*	ss	*2-3 4-6* N=7	17		
8A	20/24 *83%*	ss	*2-3 4-5* N=7	19		
9A	22/24 *92%*	ss	*1-3 3-4* N=6	19		
10A	24/24 *100%*	ss	*woh-1 2-2* N=3	17		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	FILL - Brown (10YR4/3) with 30% dark gray (10YR4/1) and 10% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	630	
2		628	
4		626	
6	FILL - Dark grayish brown (10YR4/2), moist, firm, silty CLAY with trace sand and gravel.	624	
8	FILL - Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand.	622	
	Very dark gray (10YR3/1), moist, firm, silty CLAY with trace sand, trace roots.		
10	Dark gray (10YR4/1) with 30% dark yellowish brown (10YR4/6) moist, firm, silty CLAY with trace sand.	620	
12	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with trace sand.	618	
14	Dark gray (10YR4/1), moist, firm, clayey SILT with trace sand.	616	
16	Dark gray (10YR4/1) with 30% Dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	614	
18		612	
20	Dark gray (10YR4/1) with 30% Dark yellowish brown (10YR4/6) mottles, moist, soft, sandy CLAY with trace gravel.		

NOTE(S): G215 installed in borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/13/2010
Finish: 10/13/2010
WEATHER: Sunny, warm, windy (hi-60's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G215
Well ID: G215
Surface Elev: 630.48 ft. MSL
Completion: 24.31 ft. BGS
Station: 875,810.19N
2,515,971.55E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = Dry - Upon completion
▽ = 22.52 - 10/14/10

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
11A	20/24 *83%*	SS	*2-4 4-4* N=8	17				Dark yellowish brown (10YR4/6), moist, medium dense, clayey SILT with sand and trace gravel.	610	
								Yellowish brown (10YR5/6), moist, medium dense, silty, very fine- to fine-grained SAND.		
							22	Dark yellowish brown (10YR4/6) with 30% dark gray (10YR4/1) mottles, moist, firm, sandy CLAY with trace gravel.		
12A	24/24 *100%*	SS	*7-11 17-19* N=28	11				Grayish brown (10YR5/2), slightly moist, very firm, very silty CLAY with sand and gravel.	608	
12B	0/4 *0%*	BD		9			24	Dark gray (10YR4/1), slightly moist, hard, very silty CLAY with sand and gravel.		

End of Boring = 24.3 ft. BGS

NOTE(S): G215 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/13/2010
Finish: 10/13/2010
WEATHER: Partly cloudy, mild, windy (lo-60's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G216
Well ID: G216
Surface Elev: 630.28 ft. MSL
Completion: 26.00 ft. BGS
Station: 875,976.05N
2,515,968.53E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 21.00 - While drilling
▼ = Dry - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	24/24 100%	ss	3-2 2-4 N=4	22		
2A	19/24 79%	ss	2-2 5-4 N=7	28		
3A	24/24 100%	ss	2-2 4-5 N=6	19		
4A	22/24 92%	ss	3-4 6-6 N=10	19		
5A	20/24 83%	ss	2-3 3-6 N=6	18		
6A	18/24 75%	ss	2-3 3-4 N=6	17		
7A	16/24 67%	ss	1-2 3-4 N=5	20		
8A	22/24 92%	ss	2-2 5-5 N=7	20		
9A	23/24 96%	ss	woh-2 3-3 N=5	18		
10A	24/24 100%	ss	woh-woh 1-2	17		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
2	FILL - Brown (10YR4/3) with 20% dark gray (10YR4/6) and 5% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	628	
4		626	
6	FILL - Dark gray (10YR4/1) with 15% brown (10YR4/3) and 10% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with trace sand and gravel.	624	
8	FILL - Dark grayish brown (10YR4/2) with 10% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	622	
10	Dark gray (10YR4/1) with 40% gray (10YR6/1) and 10% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with trace sand.	620	
12	Gray (10YR5/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel.	618	
14	Very dark gray (10YR3/1), moist, firm, silty CLAY with trace sand.	616	
16	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	614	
18	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, firm, sandy CLAY with trace gravel.	612	
20			

NOTE(S): G216 installed in borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/13/2010
Finish: 10/13/2010
WEATHER: Partly cloudy, mild, windy (lo-60's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G216
Well ID: G216
Surface Elev: 630.28 ft. MSL
Completion: 26.00 ft. BGS
Station: 875,976.05N
2,515,968.53E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 21.00 - While drilling
▼ = Dry - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
11A	20/24 *83%*	ss	*2-9 9-7* N=18	14		
12A	22/24 *92%*	ss	*5-10 21-25* N=31	19		
12B				16		
13A	20/24 *83%*	ss	*14-25 27-27* N=52	9		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Dark yellowish brown (10YR4/6) and 40% gray (10YR5/1) mottles, moist, soft, sandy CLAY with trace gravel. *[Continued from previous page]*	610	
	Light brownish gray (10YR6/2), wet, medium dense, very fine- to fine-grained sandy SILT with trace gravel.		
22	Yellowish brown (10YR5/6), wet, medium dense, silty, very fine-to medium-grained SAND.	608	
	Gray (10YR5/1), very moist, medium dense, very fine- to fine-grained sandy SILT.		
	Gray (10YR5/1), wet, medium dense, very fine- to fine-grained sandy SILT.		
24	Dark gray (10YR4/1), wet, dense, silty, fine- to coarse-grained SAND with gravel.	606	
	Dark gray (10YR4/1), slightly moist, hard, very silty CLAY with sand and gravel.		
26	**End of Boring = 26.0 ft. BGS**		

NOTE(S): G216 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/12/2010
Finish: 10/12/2010
WEATHER: Sunny, warm (lo-80's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G217
Well ID: G217
Surface Elev: 630.67 ft. MSL
Completion: 26.00 ft. BGS
Station: 876,185.57N
2,515,963.02E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 23.00 - While drilling
▼ = 24.82 - Upon completion
▽ = 23.98 - 10/13/10

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	20/24 83%	ss	5-2 3-4 N=5	21		
2A	19/24 79%	ss	2-3 5-6 N=8	28		
3A	19/24 79%	ss	2-3 6-7 N=9	14		
4A	23/24 96%	ss	5-6 7-8 N=13	15		
5A	20/24 83%	ss	3-5 7-6 N=12	13		
6A	19/24 79%	ss	3-3 4-5 N=7	27		
7A	18/24 75%	ss	3-4 6-8 N=10	28		
8A	20/24 83%	ss	2-4 6-8 N=10	16		
9A	19/24 79%	ss	2-3 4-5 N=7	26		
10A	19/24 79%	ss	1-2 2-3 N=4	18		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Brown (10YR4/3) with 10% dark gray (10YR4/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	630
2		628
4	FILL - Dark gray (10YR4/1) with 25% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	626
6	FILL - Brown (10YR4/3) with 10% dark gray (10YR4/1) and 10% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	624
8	FILL - Dark grayish brown (10YR4/2) with 5% dark yellowish brown (10YR4/6) slightly moist, firm, clayey SILT with trace sand and gravel.	622
10	FILL - Very dark gray (10YR3/1), moist, firm, silty CLAY with trace sand and gravel.	
	Dark gray (10YR4/1), moist, firm, silty CLAY with trace sand and gravel.	620
	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand, trace roots.	
12	Dark grayish brown (10YR4/2) with 10% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY trace sand, trace roots.	618
14	Dark gray (10YR4/1), moist, firm, silty CLAY with trace sand and gravel.	616
16	Dark gray (10YR4/1) with 10% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	614
18	Gray (10YR5/1) with 5% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with sand and trace gravel.	612
20		

Borehole Detail

Remarks

NOTE(S): G217 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/12/2010
Finish: 10/12/2010
WEATHER: Sunny, warm (lo-80's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G217
Well ID: G217
Surface Elev: 630.67 ft. MSL
Completion: 26.00 ft. BGS
Station: 876,185.57N
2,515,963.02E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 23.00 - While drilling
▼ = 24.82 - Upon completion
▽ = 23.98 - 10/13/10

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
11A	22/24 *92%*	ss	*woh-woh* *1-2*	18		
12A	10/24 *42%*	ss	*4-6* *7-10* N=13	13		
13A	22/24 *92%*	ss	*8-18* *17-17* N=35	12		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Gray (10YR5/1) with 5% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with sand and trace gravel.	610	
	[Continued from previous page]		
22	Gray (10YR5/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with sand and trace gravel.		
▼	Yellowish brown (10 YR5/4), wet, medium dense, silty, very fine- to coarse-grained SAND with trace gravel.	608	
▽ 24			
▼	Dark gray (10YR4/1), slightly moist, hard, very silty CLAY with sand and gravel.	606	
26			

End of Boring = 26.0 ft. BGS

NOTE(S): G217 installed in borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/12/2010
Finish: 10/12/2010
WEATHER: Partly cloudy, warm (lo-70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G218
Well ID: G218
Surface Elev: 630.64 ft. MSL
Completion: 26.00 ft. BGS
Station: 876,380.92N
2,515,962.16E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 24.00 - While drilling
▼ = 24.76 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	18/24 75%	ss	4-1 2-1 N=3	20		
2A	22/24 92%	ss	2-2 3-5 N=5	20		
3A	19/24 79%	ss	2-3 4-8 N=7	17		
4A	22/24 92%	ss	2-5 6-8 N=11	14		
5A	20/24 83%	ss	3-4 8-7 N=12	17		
6A	19/24 79%	ss	2-2 3-5 N=5	19		
6B				25		
7A	22/24 92%	ss	2-3 5-7 N=8	22		
8A	18/24 75%	ss	2-3 4-5 N=7	19		
9A	24/24 100%	ss	2-2 2-4 N=4	19		
10A	24/24 100%	ss	1-2 2-3 N=4	18		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Brown (10YR4/3) with 15% dark gray (10YR4/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel.	630
2		
	FILL - Dark gray (10YR4/1) with 30% brown (10YR4/3) and 10% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.	628
4		626
6		624
	FILL - Brown (10YR5/3) with 10% dark gray (10YR4/1) mottles, slightly moist, firm, clayey SILT with trace sand and gravel.	
8		622
	Dark grayish brown (10YR4/2) with 5% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with trace sand.	
10		620
	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand, slight trace roots.	
12		618
	Dark gray (10YR4/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with trace sand.	
14		616
16		614
	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel.	
18		612
20		

Borehole Detail

Remarks

NOTE(S): G218 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/12/2010
Finish: 10/12/2010
WEATHER: Partly cloudy, warm (lo-70's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: S. Simpson

BOREHOLE ID: G218
Well ID: G218
Surface Elev: 630.64 ft. MSL
Completion: 26.00 ft. BGS
Station: 876,380.92N
2,515,962.16E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 24.00 - While drilling
▼ = 24.76 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
11A	22/24 *92%*	SS	*woh-woh woh-woh*	16				Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, very soft, clayey, very fine- to coarse-grained SAND with trace gravel.	610	
							22			
12A	24/24 *100%*	SS	*1-1 1-3* N=2	10				Yellowish brown, wet, loose, silty, very fine- to coarse-grained SAND with trace gravel.	608	
12B				16				Dark gray (10YR4/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and gravel.		
							▼ 24			
13A	24/24 *100%*	SS	*1-5 9-13* N=14	20			▼	Gray (10YR5/1), wet, loose, silty, very fine- to coarse-grained SAND with trace gravel.	606	
13B				17				Dark gray (10YR4/1), slightly moist, very firm, very silty CLAY with sand and gravel.		
							26			

End of Boring = 26.0 ft. BGS

NOTE(S): G218 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/15/2010
Finish: 10/15/2010
WEATHER: Sunny (mid-50's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: R. Hasenyager

BOREHOLE ID: T202
Well ID: T202
Surface Elev: 626.22 ft. MSL
Completion: 18.00 ft. BGS
Station: 876,699.42N
2,514,895.01E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = 15.42 - Upon completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	23/24 96%	ss	6-4 5-7 N=9	27		
2A	24/24 100%	ss	3-4 6-6 N=10	25		
2B				26		
3A	22/24 92%	ss	2-4 5-6 N=9	22		
4A	23/24 96%	ss	1-2 3-3 N=5	21		
5A	23/24 96%	ss	1-1 3-2 N=4	22		
6A	24/24 100%	ss	woh-1 3-3 N=4	23		
6B				21		
7A	24/24 100%	ss	1-2 1-2 N=3	21		
7B				25		
8A	24/24 100%	ss	woh-2 1-8 N=3	17		
9A	24/24 100%	ss	6-15 20-24 N=35	9		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Yellowish brown (10YR5/6), slightly moist, hard, silty CLAY with trace sand and gravel.	626
2	Yellowish brown (10YR5/6) with 30% gray (10YR5/1) mottles, moist, hard, silty CLAY with slight trace sand and gravel.	624
4	Yellowish brown (10YR5/8) with 35% gray (10YR5/1) and 15% very dark brown (10YR2/2) mottles, moist, hard, silty CLAY with trace sand and slight trace gravel.	622
6		620
8	Gray (10YR6/1) with 30% yellowish brown (10YR5/8) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	618
10	Gray (10YR6/1) with 15% yellowish brown (10YR5/8) mottles, very moist, soft, silty CLAY with sand and slight trace gravel.	616
12	Yellowish brown (10YR5/8) with 10% gray (10YR6/1) mottles, very moist, firm, silty CLAY with sand and trace gravel.	614
14	Gray (10YR6/1) with 10% brownish yellow (10YR6/6) mottles, very moist, soft, sandy CLAY with silt and slight trace gravel.	612
▼	Gray (10YR5/1), wet, loose, very fine- to medium-grained SAND with trace gravel.	
16	Gray (10YR6/1), moist, hard, very silty CLAY with sand and trace gravel.	610
18		

End of Boring = 18.0 ft. BGS

NOTE(S): T202 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 2/26/2008
Finish: 2/26/2008
WEATHER: Overcast, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: S. Simpson

BOREHOLE ID: G270
Well ID: G270
Surface Elev: 622.9 ft. MSL
Completion: 18.3 ft. BGS
Station: 874,801.92N
2,514,996.84E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 16.00 - While drilling
▼ = 5.62 - 3/12/08
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
	20/24 83%	ss	2-2 2-4 N=4			
1A				24		
2A	19/24 79%	ss	3-4 5-9 N=9	22		2.33 B
2B				20		5.04 Sh
3A	20/24 83%	ss	14-5 7-8 N=12	17		2.52 Sh
4A	24/24 100%	ss	8-6 7-5 N=13	21		1.24 BSh
4B				21		1.20 B
5A	22/24 92%	ss	2-3 4-4 N=7	21		1.36 B
6A	24/24 100%	ss	1-2 2-3 N=4	21		0.74 BSh
6B				24		0.78 B
7A	17/24 71%	ss	2-2 2-3 N=4	21		
8A				20		
8B	19/24 79%	ss	1-3 5-6 N=8	17		4.46 Sh
9A	24/24 100%	ss	6-8 30-35 N=38	20		
9B				8		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark grayish brown (10YR4/2), moist, firm, clayey SILT	622
	Dark grayish brown (10YR4/2), moist, firm, silty CLAY	
2	Dark grayish brown (10YR4/2) with 5% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, slight trace sand	620
4	Gray (10YR5/1) with 70% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, slight trace sand and gravel	618
6	Dark gray (10YR4/1) with 5% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, trace sand, slight trace gravel	616
8	Gray (10YR5/1) with 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, trace sand, slight trace gravel	614
10	Gray (10YR5/1) with 60% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, trace sand, slight trace gravel	612
	Gray (10YR5/1), moist, soft, sandy CLAY	
12	Gray (10YR5/1), moist, soft, sandy CLAY, trace gravel	610
14	Gray (10YR5/1), moist, soft, fine- to coarse-grained SAND, trace gravel	
	Dark yellowish brown (10YR4/4), moist, soft, sandy CLAY	608
16	Gray (10YR5/1) with 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, slight trace sand and gravel	
	Yellowish brown (10YR5/4), wet, soft, fine to coarse SAND	606
18	Gray (10YR5/1), moist, hard, silty CLAY, trace sand and gravel	

End of Boring = 18.27 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 2/26/2008
Finish: 2/26/2008
WEATHER: Overcast, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: S. Simpson

BOREHOLE ID: G280
Well ID: G280
Surface Elev: 623.0 ft. MSL
Completion: 18.0 ft. BGS
Station: 875,045.11N
2,515,679.48E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 15.60 - While drilling
▼ = 4.34 - 3/12/08
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	24/24 *100%*	ss	*5-3 4-4* N=7	23		
1B				26		2.33 *B*
2A	24/24 *100%*	ss	*3-4 4-6* N=8	30		1.28 *BSh*
2B				25		
3A	19/24 *79%*	ss	*3-4 6-6* N=10	14		3.10 *Sh*
4A	22/24 *92%*	ss	*9-11 10-8* N=21	18		1.67 *BSh*
5A	19/24 *79%*	ss	*2-2 4-4* N=6	20		1.47 *B*
5B				21		1.28 *B*
6A	22/24 *92%*	ss	*2-3 3-3* N=6	20		
7A	23/24 *96%*	ss	*3-14 23-21* N=37	13		
8A	23/24 *96%*	ss	*12-17 24-26* N=41	9		
8B				15		
9A	24/24 *100%*	ss	*11-27 54-43* N=81	26		
9B				7		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark grayish brown (10YR4/2), moist, firm, clayey SILT	622
	Brown (10YR4/3) with 20% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY	
2	Dark yellowish brown (10YR4/4), moist, firm, silty CLAY	620
4 ▼	Dark gray (10YR4/1) with 40% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY	618
6	Dark gray (10YR4/1) with 40% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, slight trace sand	616
8	Dark gray (10YR4/1) with 40% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, trace sand, slight trace gravel	614
10	Dark gray (10YR4/1) with 40% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, sand, trace gravel	612
12	Yellowish brown (10YR5/8) with 20% light gray (10YR6/1) mottles, moist, soft, sandy CLAY	610
	Yellowish brown (10YR5/8), moist, soft, fine to coarse SAND, trace gravel	
	Yellowish brown (10YR5/8), moist, firm, sandy CLAY, trace gravel	
14	Yellowish brown (10YR5/4), moist, firm, clayey SILT, trace sand and gravel	608
16 ▼	Yellowish brown (10YR5/4), wet, soft, fine- to coarse-grained SAND, trace gravel	606
	Gray (10YR5/1), moist, hard, silty CLAY, trace sand and gravel	

Borehole Detail

Remarks

End of Boring = 17.98 ft. BGS

NOTE(S):

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G200

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G200

~~State Plane~~ Plant Coordinate: X 877,930.6 Y 2,515,650.0 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): _____

Logged By: Suzanna L Simpson Date Started: 2/25/2008 Date Finished: 2/25/2008

Report Form Completed By: Suzanna L Simpson Date: 2/29/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: >24 hr.

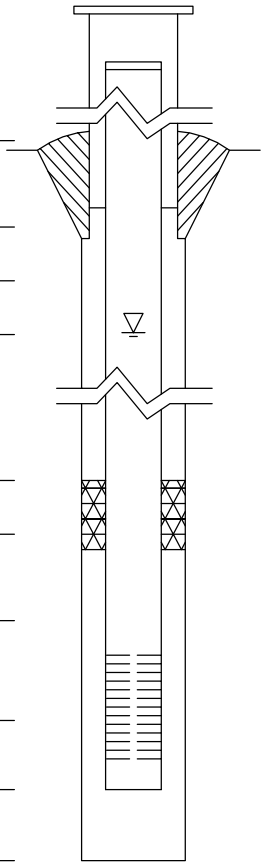
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Formation Sand (if applicable)

Installation Method: Slough



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.54	-2.34	Top of Protective Casing
625.94	-1.74	Top of Riser Pipe
624.20	0.00	Ground Surface
620.70	3.50	Top of Annular Sealant
621.45	2.75	Static Water Level (After Completion) 3/12/2008
620.70	3.50	Top of Seal
614.20	10.00	Top of Sand Pack
612.01	12.19	Top of Screen
607.22	16.98	Bottom of Screen
606.84	17.36	Bottom of Well
606.20	18.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	13.93
Bottom of Screen to End Cap	(feet)	0.38
Screen Length (1st slot to last slot)	(feet)	4.79
Total Length of Casing	(feet)	19.10
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: R201

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: R201

State Plane Coordinate: X 2,514,842.0 Y 877,925.3 (or) Latitude: 39 ° 4 ' 30.5 " Longitude: -89 ° 23 ' 52.3 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Rhonald W. Hasenyager Date Started: 10/15/2010 Date Finished: 10/15/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 48 min

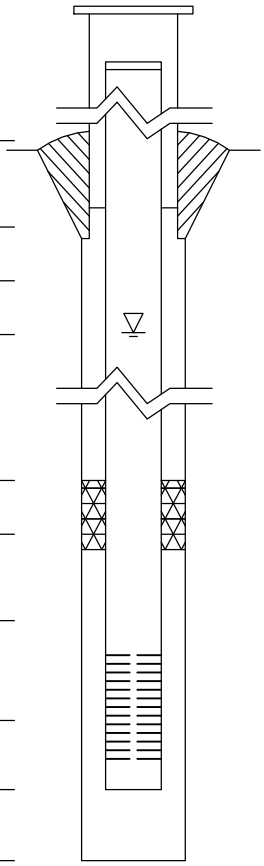
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.51	-2.49	Top of Protective Casing
626.34	-2.32	Top of Riser Pipe
624.02	0.00	Ground Surface
621.52	2.50	Top of Annular Sealant
618.70	5.32	Static Water Level (After Completion) 11/15/2010
614.47	9.55	Top of Seal
612.90	11.12	Top of Sand Pack
611.75	12.27	Top of Screen
607.36	16.66	Bottom of Screen
606.80	17.22	Bottom of Well
606.80	17.22	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	14.59
Bottom of Screen to End Cap	(feet)	0.56
Screen Length (1st slot to last slot)	(feet)	4.39
Total Length of Casing	(feet)	19.54
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G201

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G201

~~State Plane~~ Plant Coordinate: X 877,924.9 Y 2,514,849.5 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): _____

Logged By: Suzanna L Simpson Date Started: 2/25/2008 Date Finished: 2/25/2008

Report Form Completed By: Suzanna L Simpson Date: 2/29/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: >24 hr.

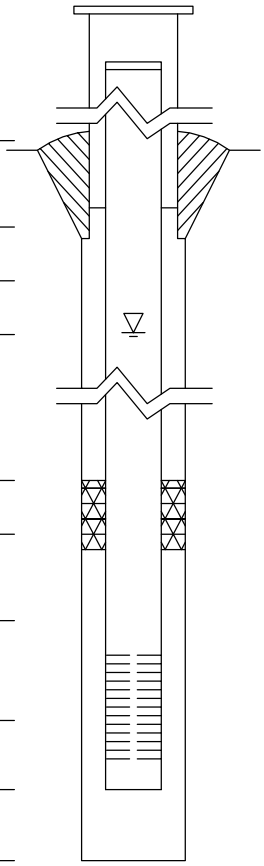
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
627.66	-3.76	Top of Protective Casing
627.12	-3.22	Top of Riser Pipe
623.90	0.00	Ground Surface
620.60	3.30	Top of Annular Sealant
621.73	2.17	Static Water Level (After Completion) 3/12/2008
620.60	3.30	Top of Seal
611.80	12.10	Top of Sand Pack
610.89	13.01	Top of Screen
606.10	17.80	Bottom of Screen
605.75	18.15	Bottom of Well
605.75	18.15	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	16.23
Bottom of Screen to End Cap	(feet)	0.35
Screen Length (1st slot to last slot)	(feet)	4.79
Total Length of Casing	(feet)	21.37
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G205

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G205

~~State Plane~~ Plant Coordinate: X 875,550.2 Y 2,515,914.9 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): _____

Logged By: Suzanna L Simpson Date Started: 2/21/2008 Date Finished: 2/21/2008

Report Form Completed By: Suzanna L Simpson Date: 2/29/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: >24 hr.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: >24 hr.

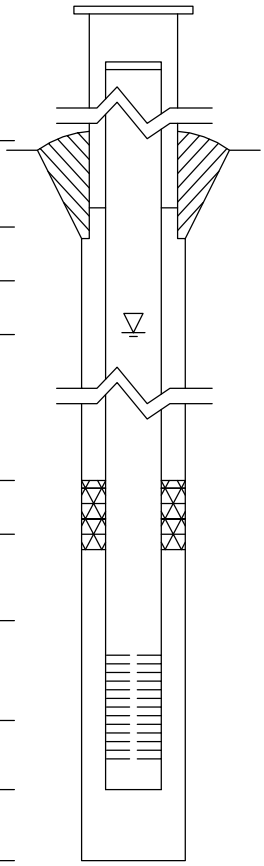
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Formation Sand (if applicable)

Installation Method: Slough



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
624.87	-2.72	Top of Protective Casing
624.45	-2.30	Top of Riser Pipe
622.15	0.00	Ground Surface
619.95	2.20	Top of Annular Sealant
617.09	5.06	Static Water Level (After Completion) 3/12/2008
619.95	2.20	Top of Seal
613.35	8.80	Top of Sand Pack
612.11	10.04	Top of Screen
607.62	14.53	Bottom of Screen
607.08	15.07	Bottom of Well
606.15	16.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: (Steel)
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	12.34
Bottom of Screen to End Cap	(feet)	0.54
Screen Length (1st slot to last slot)	(feet)	4.49
Total Length of Casing	(feet)	17.37
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G206

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G206

State Plane Coordinate: X 2,514,669.2 Y 875,103.9 (or) Latitude: 39 ° 4 ' 2.6 " Longitude: -89 ° 23 ' 54.8 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 10/14/2010 Date Finished: 10/14/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/15/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 15 min

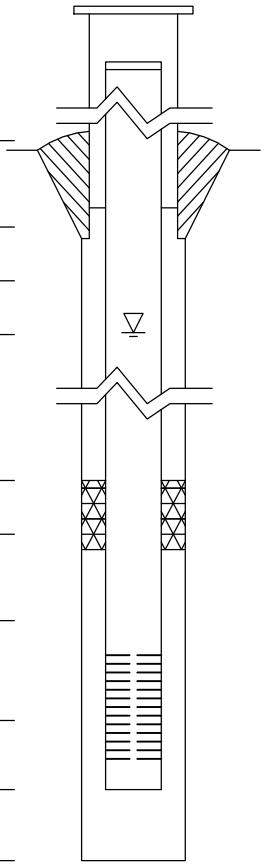
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.07	-2.53	Top of Protective Casing
632.82	-2.28	Top of Riser Pipe
630.54	0.00	Ground Surface
627.84	2.70	Top of Annular Sealant
611.96	18.58	Static Water Level (After Completion) 11/15/2010
616.24	14.30	Top of Seal
615.04	15.50	Top of Sand Pack
613.03	17.51	Top of Screen
608.62	21.92	Bottom of Screen
608.12	22.42	Bottom of Well
606.54	24.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	19.79
Bottom of Screen to End Cap	(feet)	0.50
Screen Length (1st slot to last slot)	(feet)	4.41
Total Length of Casing	(feet)	24.70
Screen Slot Size **	(inches)	0.010

Well Completion Form (revised 02/06/02)

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G207

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G207

State Plane Coordinate: X 2,514,837.9 Y 875,166.4 (or) Latitude: 39 ° 4 ' 3.2 " Longitude: -89 ° 23 ' 52.6 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 10/8/2010 Date Finished: 10/8/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/8/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 15 min

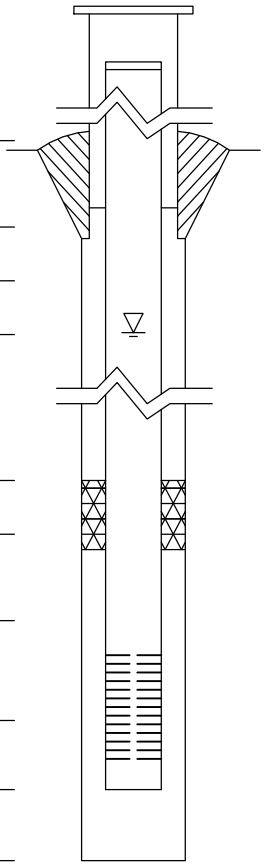
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.37	-2.76	Top of Protective Casing
633.21	-2.60	Top of Riser Pipe
630.61	0.00	Ground Surface
628.61	2.00	Top of Annular Sealant
612.86	17.75	Static Water Level (After Completion) 11/15/2010
614.76	15.85	Top of Seal
613.63	16.98	Top of Sand Pack
612.37	18.24	Top of Screen
607.84	22.77	Bottom of Screen
607.31	23.30	Bottom of Well
606.61	24.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	20.84
Bottom of Screen to End Cap	(feet)	0.53
Screen Length (1st slot to last slot)	(feet)	4.53
Total Length of Casing	(feet)	25.90
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G208

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G208

State Plane Coordinate: X 2,514,993.6 Y 875,231.5 (or) Latitude: 39 ° 4 ' 3.9 " Longitude: -89 ° 23 ' 50.6 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 10/7/2010 Date Finished: 10/7/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/8/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 9 min

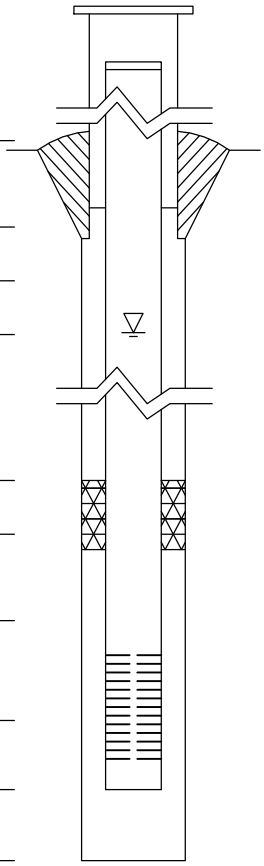
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.43	-2.86	Top of Protective Casing
633.16	-2.59	Top of Riser Pipe
630.57	0.00	Ground Surface
627.77	2.80	Top of Annular Sealant
614.76	15.81	Static Water Level (After Completion) 11/15/2010
616.07	14.50	Top of Seal
613.90	16.67	Top of Sand Pack
613.04	17.53	Top of Screen
608.51	22.06	Bottom of Screen
607.97	22.60	Bottom of Well
606.57	24.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	20.12
Bottom of Screen to End Cap	(feet)	0.54
Screen Length (1st slot to last slot)	(feet)	4.53
Total Length of Casing	(feet)	25.19
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G209

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G209

State Plane Coordinate: X 2,515,149.6 Y 875,298.2 (or) Latitude: 39 ° 4 ' 4.5 " Longitude: -89 ° 23 ' 48.7 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 10/7/2010 Date Finished: 10/7/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/8/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 15 min

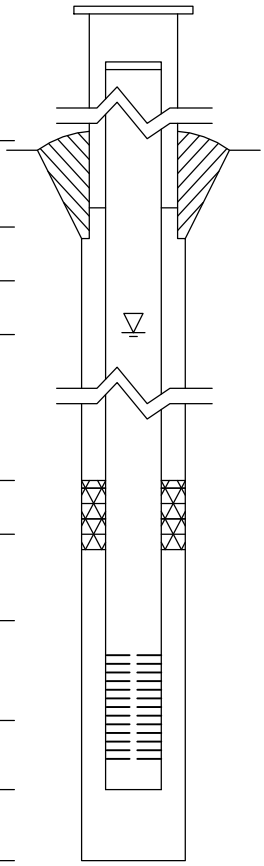
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.16	-2.59	Top of Protective Casing
632.91	-2.34	Top of Riser Pipe
630.57	0.00	Ground Surface
627.57	3.00	Top of Annular Sealant
615.52	15.05	Static Water Level (After Completion) 11/15/2010
616.07	14.50	Top of Seal
614.67	15.90	Top of Sand Pack
612.83	17.74	Top of Screen
608.29	22.28	Bottom of Screen
607.76	22.81	Bottom of Well
606.57	24.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	20.08
Bottom of Screen to End Cap	(feet)	0.53
Screen Length (1st slot to last slot)	(feet)	4.54
Total Length of Casing	(feet)	25.15
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G210

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G210

State Plane Coordinate: X 2,515,299.0 Y 875,359.7 (or) Latitude: 39 ° 4 ' 5.1 " Longitude: -89 ° 23 ' 46.8 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 10/6/2010 Date Finished: 10/6/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/8/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 15 hrs

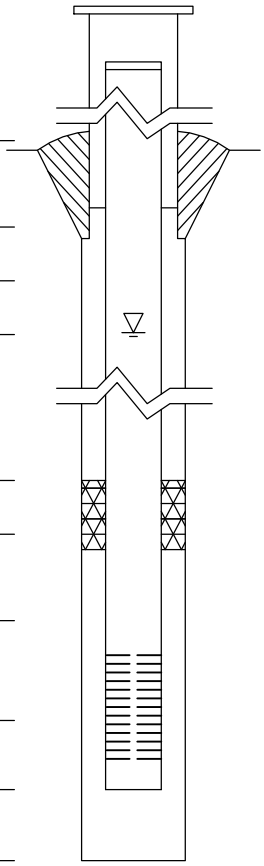
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.17	-2.69	Top of Protective Casing
632.99	-2.51	Top of Riser Pipe
630.48	0.00	Ground Surface
627.48	3.00	Top of Annular Sealant
615.38	15.10	Static Water Level (After Completion) 11/15/2010
614.03	16.45	Top of Seal
612.98	17.50	Top of Sand Pack
611.09	19.39	Top of Screen
606.55	23.93	Bottom of Screen
606.02	24.46	Bottom of Well
605.48	25.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	21.90
Bottom of Screen to End Cap	(feet)	0.53
Screen Length (1st slot to last slot)	(feet)	4.54
Total Length of Casing	(feet)	26.97
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G211

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G211

State Plane Coordinate: X 2,515,449.1 Y 875,424.5 (or) Latitude: 39 ° 4 ' 5.7 " Longitude: -89 ° 23 ' 44.9 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 10/11/2010 Date Finished: 10/11/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/15/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 15 min

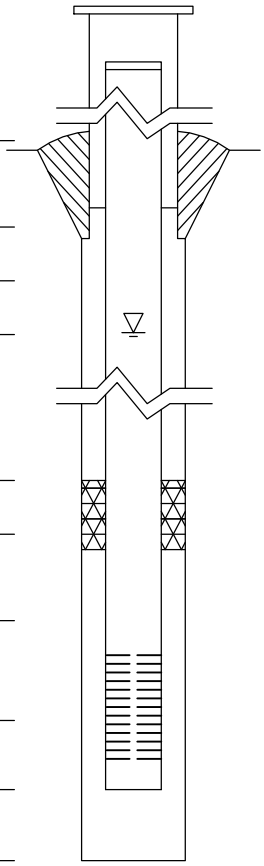
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
632.83	-2.52	Top of Protective Casing
632.64	-2.33	Top of Riser Pipe
630.31	0.00	Ground Surface
627.31	3.00	Top of Annular Sealant
616.17	14.14	Static Water Level (After Completion) 11/15/2010
616.01	14.30	Top of Seal
614.91	15.40	Top of Sand Pack
612.97	17.34	Top of Screen
608.43	21.88	Bottom of Screen
607.90	22.41	Bottom of Well
606.31	24.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	19.67
Bottom of Screen to End Cap	(feet)	0.53
Screen Length (1st slot to last slot)	(feet)	4.54
Total Length of Casing	(feet)	24.74
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G212

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G212

State Plane Coordinate: X 2,515,583.0 Y 875,486.5 (or) Latitude: 39 ° 4 ' 6.3 " Longitude: -89 ° 23 ' 43.1 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 10/11/2010 Date Finished: 10/11/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 17 min

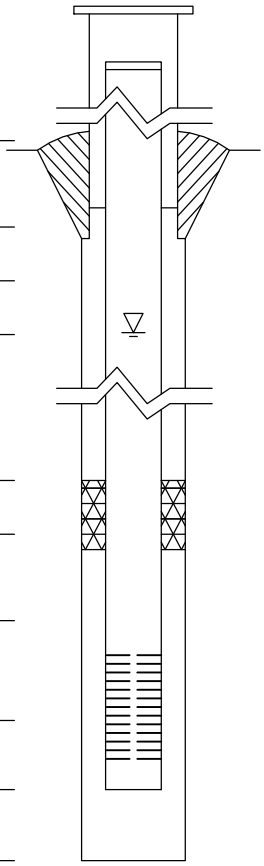
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.12	-2.53	Top of Protective Casing
632.89	-2.30	Top of Riser Pipe
630.59	0.00	Ground Surface
627.59	3.00	Top of Annular Sealant
616.10	14.49	Static Water Level (After Completion) 11/15/2010
616.89	13.70	Top of Seal
615.79	14.80	Top of Sand Pack
613.85	16.74	Top of Screen
609.30	21.29	Bottom of Screen
608.78	21.81	Bottom of Well
606.59	24.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	19.04
Bottom of Screen to End Cap	(feet)	0.52
Screen Length (1st slot to last slot)	(feet)	4.55
Total Length of Casing	(feet)	24.11
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G213

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G213

State Plane Coordinate: X 2,515,723.5 Y 875,544.4 (or) Latitude: 39 ° 4 ' 6.9 " Longitude: -89 ° 23 ' 41.4 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 10/12/2010 Date Finished: 10/12/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 10 min

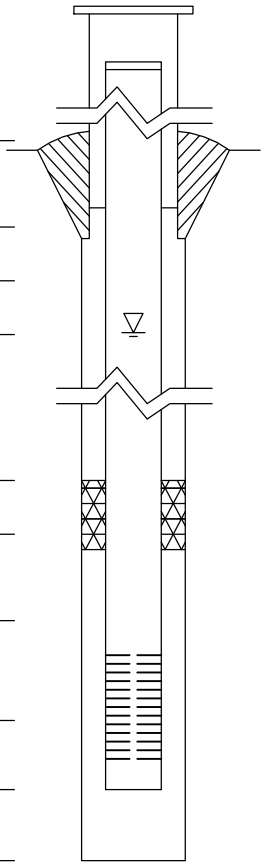
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.08	-2.74	Top of Protective Casing
632.81	-2.47	Top of Riser Pipe
630.34	0.00	Ground Surface
627.64	2.70	Top of Annular Sealant
615.01	15.33	Static Water Level (After Completion) 11/15/2010
616.54	13.80	Top of Seal
615.34	15.00	Top of Sand Pack
613.59	16.75	Top of Screen
609.05	21.29	Bottom of Screen
608.52	21.82	Bottom of Well
606.34	24.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	19.22
Bottom of Screen to End Cap	(feet)	0.53
Screen Length (1st slot to last slot)	(feet)	4.54
Total Length of Casing	(feet)	24.29
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G214

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G214

State Plane Coordinate: X 2,515,960.8 Y 875,668.0 (or) Latitude: 39 ° 4 ' 8.1 " Longitude: -89 ° 23 ' 38.3 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 10/14/2010 Date Finished: 10/14/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 14 min

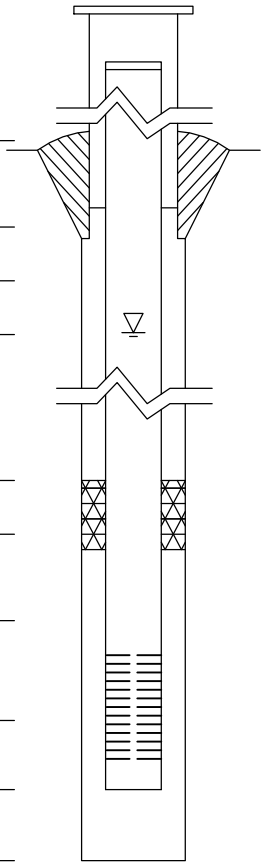
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.08	-2.69	Top of Protective Casing
632.85	-2.46	Top of Riser Pipe
630.39	0.00	Ground Surface
626.99	3.40	Top of Annular Sealant
609.48	20.91	Static Water Level (After Completion) 11/15/2010
615.39	15.00	Top of Seal
614.34	16.05	Top of Sand Pack
612.64	17.75	Top of Screen
608.25	22.14	Bottom of Screen
607.74	22.65	Bottom of Well
606.39	24.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	20.21
Bottom of Screen to End Cap	(feet)	0.51
Screen Length (1st slot to last slot)	(feet)	4.39
Total Length of Casing	(feet)	25.11
Screen Slot Size **	(inches)	0.010

Well Completion Form (revised 02/06/02)

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G215

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G215

State Plane Coordinate: X 2,515,971.6 Y 875,810.2 (or) Latitude: 39 ° 4 ' 9.5 " Longitude: -89 ° 23 ' 38.2 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 10/13/2010 Date Finished: 10/13/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 min

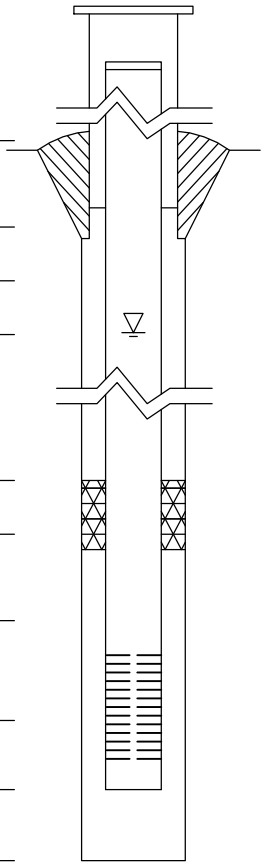
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.30	-2.82	Top of Protective Casing
633.06	-2.58	Top of Riser Pipe
630.48	0.00	Ground Surface
627.58	2.90	Top of Annular Sealant
607.64	22.84	Static Water Level (After Completion) 11/15/2010
614.08	16.40	Top of Seal
612.98	17.50	Top of Sand Pack
611.07	19.41	Top of Screen
606.68	23.80	Bottom of Screen
606.17	24.31	Bottom of Well
606.17	24.31	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	21.99
Bottom of Screen to End Cap	(feet)	0.51
Screen Length (1st slot to last slot)	(feet)	4.39
Total Length of Casing	(feet)	26.89
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G216

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G216

State Plane Coordinate: X 2,515,968.5 Y 875,976.1 (or) Latitude: 39 ° 4 ' 11.2 " Longitude: -89 ° 23 ' 38.2 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 10/13/2010 Date Finished: 10/13/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 15 min

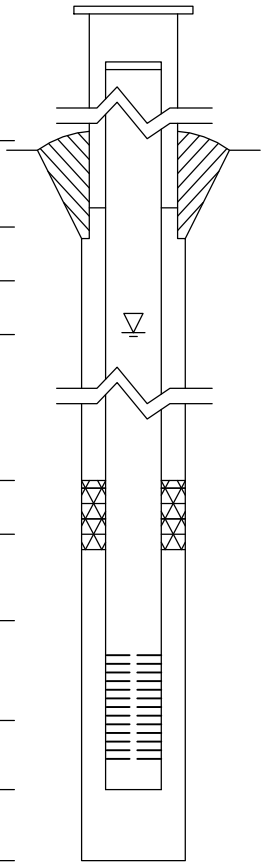
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.02	-2.74	Top of Protective Casing
632.76	-2.48	Top of Riser Pipe
630.28	0.00	Ground Surface
627.78	2.50	Top of Annular Sealant
607.52	22.76	Static Water Level (After Completion) 11/15/2010
613.28	17.00	Top of Seal
612.08	18.20	Top of Sand Pack
610.24	20.04	Top of Screen
605.86	24.42	Bottom of Screen
605.35	24.93	Bottom of Well
604.28	26.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:	[Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:	
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:	
Screen	SS304	SS316	PTFE	[PVC]	OTHER:	

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	22.52
Bottom of Screen to End Cap	(feet)	0.51
Screen Length (1st slot to last slot)	(feet)	4.38
Total Length of Casing	(feet)	27.41
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G217

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G217

State Plane Coordinate: X 2,515,963.0 Y 876,185.6 (or) Latitude: 39 ° 4 ' 13.2 " Longitude: -89 ° 23 ' 38.3 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 10/12/2010 Date Finished: 10/12/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 11 min

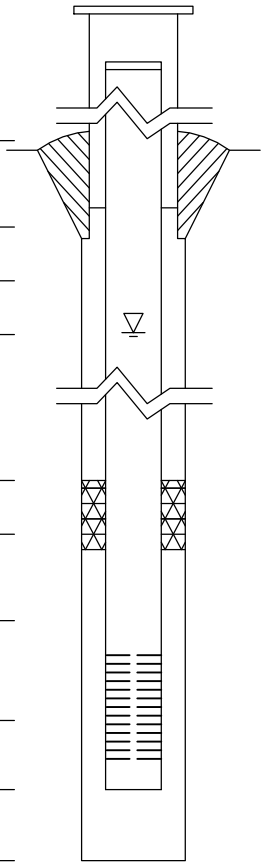
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.34	-2.67	Top of Protective Casing
633.10	-2.43	Top of Riser Pipe
630.67	0.00	Ground Surface
628.27	2.40	Top of Annular Sealant
609.28	21.39	Static Water Level (After Completion) 11/15/2010
612.82	17.85	Top of Seal
611.82	18.85	Top of Sand Pack
610.18	20.49	Top of Screen
605.79	24.88	Bottom of Screen
605.29	25.38	Bottom of Well
604.67	26.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	22.92
Bottom of Screen to End Cap	(feet)	0.50
Screen Length (1st slot to last slot)	(feet)	4.39
Total Length of Casing	(feet)	27.81
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G218

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G218

State Plane Coordinate: X 2,515,962.2 Y 876,380.9 (or) Latitude: 39 ° 4 ' 15.2 " Longitude: -89 ° 23 ' 38.2 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 10/12/2010 Date Finished: 10/12/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 17 min

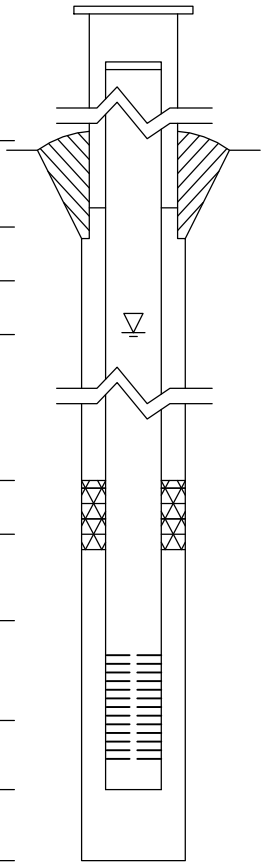
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.34	-2.70	Top of Protective Casing
633.11	-2.47	Top of Riser Pipe
630.64	0.00	Ground Surface
627.14	3.50	Top of Annular Sealant
609.89	20.75	Static Water Level (After Completion) 11/15/2010
613.14	17.50	Top of Seal
612.14	18.50	Top of Sand Pack
610.31	20.33	Top of Screen
605.87	24.77	Bottom of Screen
605.37	25.27	Bottom of Well
604.64	26.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	22.80
Bottom of Screen to End Cap	(feet)	0.50
Screen Length (1st slot to last slot)	(feet)	4.44
Total Length of Casing	(feet)	27.74
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G270

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G270

~~State Plane~~ Plant Coordinate: X 874,801.9 Y 2,514,996.8 (or) Latitude: ____° ____' ____" Longitude: ____° ____' ____"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): _____

Logged By: Suzanna L Simpson Date Started: 2/26/2008 Date Finished: 2/26/2008

Report Form Completed By: Suzanna L Simpson Date: 2/29/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: >24 hr.

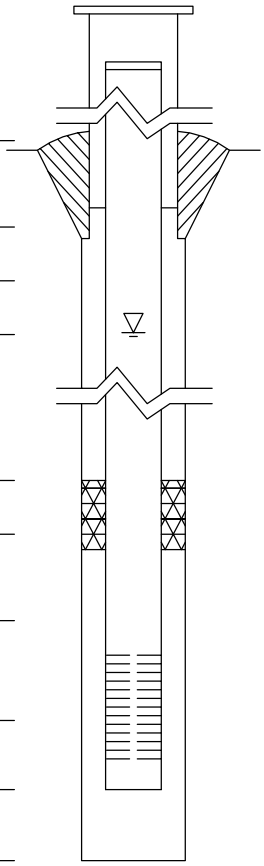
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.41	-3.49	Top of Protective Casing
625.97	-3.05	Top of Riser Pipe
622.92	0.00	Ground Surface
619.92	3.00	Top of Annular Sealant
617.30	5.62	Static Water Level (After Completion) 3/12/2008
619.92	3.00	Top of Seal
610.92	12.00	Top of Sand Pack
609.79	13.13	Top of Screen
605.00	17.92	Bottom of Screen
604.65	18.27	Bottom of Well
604.65	18.27	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	16.18
Bottom of Screen to End Cap	(feet)	0.35
Screen Length (1st slot to last slot)	(feet)	4.79
Total Length of Casing	(feet)	21.32
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G280

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G280

~~State Plane~~ Plant Coordinate: X 875,045.1 Y 2,515,679.5 (or) Latitude: ____° ____' ____" Longitude: ____° ____' ____"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): _____

Logged By: Suzanna L Simpson Date Started: 2/26/2008 Date Finished: 2/26/2008

Report Form Completed By: Suzanna L Simpson Date: 2/29/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: >24 hr.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: >24 hr.

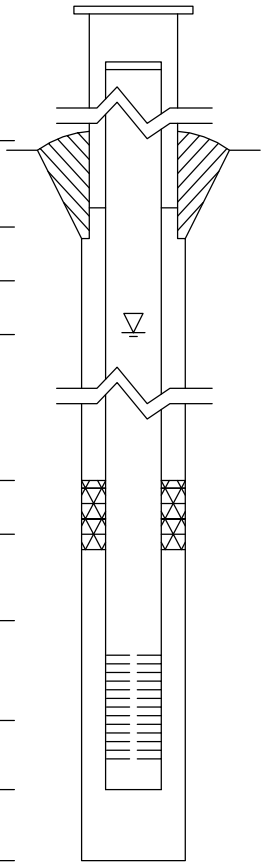
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.79	-2.84	Top of Protective Casing
625.30	-2.35	Top of Riser Pipe
622.95	0.00	Ground Surface
620.85	2.10	Top of Annular Sealant
618.61	4.34	Static Water Level (After Completion) 3/12/2008
620.85	2.10	Top of Seal
611.75	11.20	Top of Sand Pack
610.16	12.79	Top of Screen
605.32	17.63	Bottom of Screen
604.97	17.98	Bottom of Well
604.97	17.98	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: (Steel)
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	15.14
Bottom of Screen to End Cap	(feet)	0.35
Screen Length (1st slot to last slot)	(feet)	4.84
Total Length of Casing	(feet)	20.33
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: T202

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: T202

State Plane Coordinate: X 2,514,895.0 Y 876,699.4 (or) Latitude: 39 ° 4 ' 18.4 " Longitude: -89 ° 23 ' 51.7 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 10/15/2010 Date Finished: 10/15/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 15 min

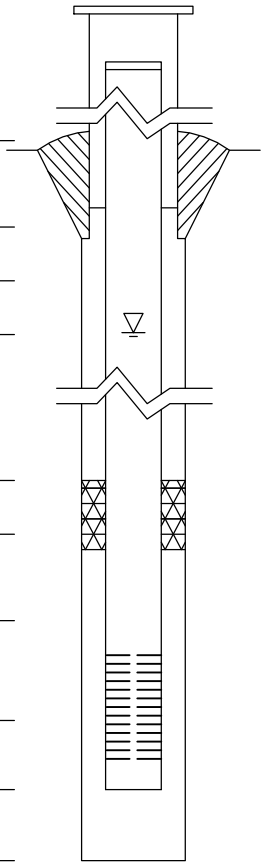
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
628.79	-2.57	Top of Protective Casing
628.63	-2.41	Top of Riser Pipe
626.22	0.00	Ground Surface
623.42	2.80	Top of Annular Sealant
613.72	12.50	Static Water Level (After Completion) 11/15/2010
616.50	9.72	Top of Seal
615.27	10.95	Top of Sand Pack
613.95	12.27	Top of Screen
609.57	16.65	Bottom of Screen
609.01	17.21	Bottom of Well
608.22	18.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	14.68
Bottom of Screen to End Cap	(feet)	0.56
Screen Length (1st slot to last slot)	(feet)	4.38
Total Length of Casing	(feet)	19.62
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

APPENDIX A4

LANDFILL

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/2/2010
Finish: 2/2/2010
WEATHER: Overcast, cold (lo-30's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: G101
Well ID: G101
Surface Elev: 625.27 ft. MSL
Completion: 21.92 ft. BGS
Station: 876,551.76N
2,514,214.31E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 15.50 - While drilling
▼ = 12.38 - Upon Completion
▽ = 7.31 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	18/24 *75%*	ss	*1-1 2-3* N=3	24		
2A	18/24 *75%*	ss	*1-3 3-5* N=6	30		
3A	19/24 *79%*	ss	*2-3 4-4* N=7	26		
4A	19/24 *79%*	ss	*1-3 4-3* N=7	21		
5A	22/24 *92%*	ss	*1-3 3-4* N=6	23		
6A	20/24 *83%*	ss	*1-2 2-3* N=4	24		
7A	22/24 *92%*	ss	*1-2 3-2* N=5	17		
8A 8B	14/24 *58%*	ss	*1-2 5-8* N=7	15 13		
9A	16/24 *67%*	ss	*2-5 15-25* N=20	16		
10A 10B	17/24 *71%*	ss	*19-20 22-18* N=42	14 8		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	TOPSOIL - Brown (10YR5/3), moist, soft, silty CLAY with slight trace sand and gravel, roots.		
	Dark grayish brown (10YR4/2), moist, soft, silty CLAY with slight trace sand, trace roots.	624	
2	Dark grayish brown (10YR4/2) with 15% yellowish brown (10YR5/4) mottles, moist, medium, silty CLAY, slight trace roots.		
	Grayish brown (10YR5/2) with 15% yellowish brown (10YR5/4) mottles, moist, medium, silty CLAY, slight trace roots.	622	
4	Gray (10YR5/1) with 25% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY, slight trace roots.	620	
6	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with slight trace sand.	618	
8	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	616	
10	Gray (10YR6/1) with 35% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	614	
12	Gray (10YR5/1) with 25% yellowish brown (10YR5/6) mottles, very moist, medium, silty, sandy CLAY with trace gravel.	612	
14	Brown (10YR5/3), very moist, medium, silty, clayey, very fine- to coarse-grained SAND with slight trace gravel.	610	
16	Brown (10YR5/3), very moist, loose, silty, very fine- to coarse-grained SAND with slight trace gravel.	608	
18	Brown (10YR5/3), very moist, medium dense, silty, very fine- to coarse-grained SAND with slight trace gravel.	606	
20	Brown (10YR5/3), very moist, dense, silty, very fine- to coarse-grained SAND with slight trace gravel.		

NOTE(S): G101 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/2/2010
Finish: 2/2/2010
WEATHER: Overcast, cold (lo-30's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: G101
Well ID: G101
Surface Elev: 625.27 ft. MSL
Completion: 21.92 ft. BGS
Station: 876,551.76N
2,514,214.31E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 15.50 - While drilling
▼ = 12.38 - Upon Completion
▽ = 7.31 - 3/1/2010

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
11A	16/23 *70%*	ss	*2-16 42-60/5"* N=58	8				Brown (10YR5/3), slightly moist, hard, clayey SILT with slight trace sand and gravel. Dark gray (10YR4/1), slightly moist, hard, clayey SILT with slight trace sand and slight trace gravel.		604	

End of Boring = 21.9 ft. BGS

NOTE(S): G101 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 4/28/2006
Finish: 4/28/2006
WEATHER: Partly cloudy, mild (mid-60's)

CONTRACTOR: TSC
Rig mfg/model: CME-650 Track Drill
Drilling Method: 4¼" HSA (blind drill)
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-03a
Well ID: G102 (MW3S)
Surface Elev: 625.70 ft. MSL
Completion: 17.15 ft. BGS
Station: 876,554.77N
2,514,531.48E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - While drilling
▼ = 7.03 - 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	20/24 83%	SS	2-2 4-6 N=6	17		2.07 SP
1B				20		
1C				26		3.30 B
2A	17/24 71%	SS	2-3 4-5 N=7	25		3.05 B
3A	20/24 83%	SS	2-3 3-5 N=6	16		1.96 B
4A	24/24 100%	SS	4-3 5-6 N=8	21		2.27 B
5A	21/24 88%	SS	1-3 3-4 N=6	20		2.18 B
5B				19		
6A	18/24 75%	SS	1-2 2-4 N=4	24		0.87 B
7A	23/24 96%	SH SS	3-2 2-4 N=4	19		
7B	16/24 67%			12		
8A	23/24 96%	SS	3-12 29-50 N=41	13		
8B				13		
8C				12		
9A	12/12 100%	SS	8-82	10		6.98 B

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil ery dark grayish brown (10YR3/2), lean CLAY	
	Grayish brown (10YR5/2), lean CLAY, trace sand	
	Yellowish brown (10YR5/6), lean CLAY, trace sand	624
2	Yellowish brown (10YR5/6) with 40% gray (N5/1) mottles, lean CLAY, trace sand	622
4	loess Yellowish brown (10YR5/6) with 40% gray (N5/1) mottles, sandy SILT, trace gravel	620
6	Yellowish brown (10YR5/6) with 50% gray (N5/1) mottles, lean CLAY, trace sand and gravel	618
8	Yellowish brown (10YR5/6), lean CLAY, little sand, trace gravel	616
10	Dark gray (10YR4/1), sandy CLAY, trace gravel	614
12	Gray (10YR6/1) with 50% yellowish brown (10YR5/8) mottles, lean CLAY, little sand, trace gravel	612
14	hagarstown Yellowish brown (10YR5/8), silty, fine SAND, little medium sand, trace gravel, wet	610
16	Yellowish brown (10YR5/8), silty, fine SAND, little clay, wet	
	Yellowish brown (10YR5/6), lean CLAY, little sand, trace gravel	
	Yellowish brown (10YR5/6), silty SAND, trace gravel, wet	
	Yellowish brown (10YR5/4), clayey SILT, trace sand and gravel	

End of Boring = 17.15 ft. BGS

NOTE(S): G102 (MW03S) installed in blind-drilled borehole within 10 ft of SB-03.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/15/2010
Finish: 2/15/2010
WEATHER: Cold, snowy (lo-20's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: G103
Well ID: G103
Surface Elev: 627.94 ft. MSL
Completion: 18.03 ft. BGS
Station: 876,199.48N
2,514,501.19E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ =
▽ = 16.99 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	20/24 *83%*	ss	*5-4 5-7* N=9	16		
2A	16/24 *67%*	ss	*3-4 6-7* N=10	25		
3A	17/24 *71%*	ss	*3-5 7-8* N=12	21		
4A	16/24 *67%*	ss	*2-3 5-6* N=8	24		
5A	24/24 *100%*	ss	*3-4 4-4* N=8	22		
6A	20/24 *83%*	ss	*1-1 3-3* N=4	23		
7A	22/24 *92%*	ss	*1-2 2-4* N=4	26		
8A	20/24 *83%*	ss	*1-2 3-3* N=5	22		
9A	22/24 *92%*	ss	*1-10 21-33* N=31	14		
9B				10		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Brown (10YR5/3) with 10% gray (10YR5/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY with trace sand and slight trace gravel.	626
4		624
6	Grayish brown (10YR5/2) with 25% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with slight trace sand, slight trace roots.	622
8	Grayish brown (10YR5/2) with 25% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with slight trace sand.	620
10	Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	618
12	Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, soft, medium, silty CLAY with trace sand and slight trace gravel.	616
14		614
16		612
▽	Brown (10YR5/3) with 15% gray (10YR6/1) mottles, very moist, medium dense, silty, very fine- to medium-grained SAND.	
18	Brown (10YR5/3), slightly moist, hard, clayey SILT with trace sand and gravel.	610

End of Boring = 18.0 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 10/8/2010
Finish: 10/8/2010
WEATHER: Sunny, mild

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA (blind drill)
FIELD STAFF: Driller: D. Mahurin
Helper: J. Litsch/D. Smail
Eng/Geo: R. Hasenyager

BOREHOLE ID: R104
Well ID: R104
Surface Elev: 629.03 ft. MSL
Completion: 19.85 ft. BGS
Station: 875,857.80N
2,514,503.41E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
							2	FILL - Brown (10YR5/3) with 5% gray (10YR5/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, very stiff, silty CLAY with slight trace sand and gravel.	628, 626
							4		
							6	Grayish brown (10YR5/2) with 15% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with slight trace sand, slight trace roots.	624
							8	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with slight trace sand.	622, 620
							10		618
							12	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	616
							14	Gray (10YR6/1) with 10% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	614
							16	Gray (10YR6/1), moist, very soft, clayey, very fine- to coarse-grained SAND with trace gravel.	
								Brown (10YR5/3), slightly moist, hard, very silty CLAY with trace sand and gravel.	612
							18	Gray (10YR4/1), slightly moist, hard, very silty CLAY with sand and gravel.	610

End of Boring = 19.85 ft. BGS

NOTE(S): R104 blind drilled in borehole approximately 8 ft. north of G104. Lithology taken from G104.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/15/2010
Finish: 2/15/2010
WEATHER: Overcast, cold, windy (lo-20's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: G104
Well ID: G104
Surface Elev: 627.96 ft. MSL
Completion: 20.00 ft. BGS
Station: 875,849.26N
2,514,504.98E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ =
▽ = 15.40 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	16/24 *67%*	ss	*9-11 12-14* N=23	16		
2A	20/24 *83%*	ss	*3-5 9-12* N=14	21		
3A	19/24 *79%*	ss	*3-6 8-9* N=14	21		
4A	17/24 *71%*	ss	*2-3 4-7* N=7	25		
5A	22/24 *92%*	ss	*1-2 5-8* N=7	24		
6A	18/24 *75%*	ss	*1-2 3-5* N=5	21		
7A	23/24 *96%*	ss	*woh-2 3-4* N=5	23		
8A	22/24 *92%*	ss	*1-3 3-3* N=6	24		
9A				16		
9B	17/24 *71%*	ss	*woh-6 27-40* N=33	13		
10A	22/24 *92%*	ss	*10-24 44-66* N=68	7		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Brown (10YR5/3) with 5% gray (10YR5/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, very stiff, silty CLAY with slight trace sand and gravel.	626
4		624
6	Grayish brown (10YR5/2) with 15% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with slight trace sand, slight trace roots.	622
8	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with slight trace sand.	620
10		618
12	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	616
14		614
▽	Gray (10YR6/1) with 10% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	
16	Gray (10YR6/1), moist, very soft, clayey, very fine- to coarse-grained SAND with trace gravel.	612
	Brown (10YR5/3), slightly moist, hard, clayey SILT with trace sand and gravel.	
18		610
	Gray (10YR4/1), slightly moist, hard, clayey SILT with sand and gravel.	
20		608

End of Boring = 20.0 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/16/2010
Finish: 2/16/2010
WEATHER: Sunny, cold, windy (mid-20's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: G105
Well ID: G105
Surface Elev: 626.86 ft. MSL
Completion: 19.83 ft. BGS
Station: 875,499.70N
2,514,509.15E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ =
▽ = 16.08 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
1A	18/24 *75%*	ss	*4-4 4-7* N=8	20					626	
2A	19/24 *79%*	ss	*2-4 6-10* N=10	19			2	FILL - Brown (10YR5/3) with 10% gray (10YR5/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, medium, silty CLAY with slight trace sand and gravel.	624	
3A	19/24 *79%*	ss	*2-4 5-6* N=9	29			4	Grayish brown (10YR5/2) with 40% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY, slight trace roots.	622	
4A	20/24 *83%*	ss	*1-4 4-5* N=8	29			6	Gray (10YR5/1) with 30% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with slight trace sand.	620	
5A	22/24 *92%*	ss	*1-3 3-3* N=6	20			8	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with slight trace sand.	618	
6A	24/24 *100%*	ss	*1-2 3-4* N=5	25			10	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	616	
7A	24/24 *100%*	ss	*1-2 3-5* N=5	22			12		614	
8A	19/24 *79%*	ss	*1-2 2-2* N=4	18			14	Gray (10YR6/1) with 15% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with trace sand and gravel.	612	
9A	18/24 *75%*	ss	*1-2 8-10* N=10	18			▽ 16	Gray (10YR5/1), very moist to wet, loose, silty, fine- to coarse-grained SAND with slight trace gravel.	610	
9B				14				Brown (10YR5/3), very moist to wet, loose, silty, very fine- to coarse-grained SAND with slight trace gravel.		
10A	19/22 *86%*	ss	*11-40 53-60/4"* N=93	7			18	Brown (10YR5/3), slightly moist, hard, clayey SILT with trace sand and gravel. Gray (10YR4/1), slightly moist, hard, clayey SILT with sand and gravel.	608	

End of Boring = 19.8 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/16/2010
Finish: 2/16/2010
WEATHER: Overcast, cold, windy (mid-20's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: G106
Well ID: G106
Surface Elev: 625.96 ft. MSL
Completion: 18.00 ft. BGS
Station: 875,149.76N
2,514,512.79E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ =
▽ = 12.62 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	17/24 *71%*	ss	*7-8 13-16* N=21	18		
2A	16/24 *67%*	ss	*2-4 5-7* N=9	16		
3A	17/24 *71%*	ss	*2-4 6-7* N=10	21		
4A	20/24 *83%*	ss	*2-3 5-6* N=8	24		
5A	22/24 *92%*	ss	*1-3 3-5* N=6	21		
6A	22/24 *92%*	ss	*1-2 4-4* N=6	24		
7A	23/24 *96%*	ss	*1-3 4-4* N=7	22		
8A	19/24 *79%*	ss	*1-4 7-7* N=11	20		
8B				14		
9A	23/24 *96%*	ss	*7-15 22-22* N=37	8		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Brown (10YR5/3) with 15% gray (10YR5/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY with trace sand and slight trace gravel.	624
4		622
6	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY with slight trace sand, slight trace roots.	620
8	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, medium, silty CLAY with slight trace sand.	618
10	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	616
12 ▽		614
14	Yellowish brown (10YR5/6) with 10% gray (10YR6/1) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	612
	Gray (10YR6/1) with 10% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with trace sand.	
	Brown (10YR5/3), moist, medium dense, clayey, very fine- to medium-grained SAND with slight trace gravel.	
16	Yellowish brown (10YR5/6) with 5% gray (10YR6/1) mottles, moist, medium, clayey SILT with trace sand and gravel.	610
	Brown (10YR5/3), slightly moist, hard, clayey SILT with trace sand and gravel.	
	Gray (10YR4/1), slightly moist, hard, clayey SILT with trace sand and gravel.	
18		608

End of Boring = 18.0 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/17/2010
Finish: 2/17/2010
WEATHER: Overcast, cold, windy (mid-20's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: G107
Well ID: G107
Surface Elev: 627.11 ft. MSL
Completion: 20.00 ft. BGS
Station: 874,994.33N
2,514,358.25E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 16.80 - While drilling
▼ = 11.56 - Upon Completion
▽ = 10.40 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
	0/18 *0%*	BD				
1A	5/6 *83%*	SS	*3*	12		
2A	14/24 *58%*	SS	*3-3 6-8* N=9	17		
3A	16/24 *67%*	SS	*3-5 5-7* N=10	20		
4A	18/24 *75%*	SS	*2-3 6-7* N=9	27		
5A	22/24 *92%*	SS	*2-3 4-5* N=7	18		
6A	22/24 *92%*	SS	*1-3 3-4* N=6	23		
7A	24/24 *100%*	SS	*1-2 3-4* N=5	27		
8A	2/24 *8%*	SS	*1-3 2-3* N=5	23		
9A	20/24 *83%*	SS	*woh-3 8-12* N=11	22		
9B				10		
10A	20/24 *83%*	SS	*8-25 26-58* N=51	11		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	GRAVEL FILL	626
2	FILL - Brown (10YR5/3) with 10% gray (10YR5/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY with trace sand and slight and gravel.	624
4	Grayish brown (10YR5/2) with 30% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with slight trace sand and gravel.	622
6		620
8		618
10 ▽	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	616
12 ▼		614
14	Gray (10YR6/1) with 35% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	612
16	Brown (10YR5/3), very moist to wet, very loose, clayey, very fine- to coarse-grained SAND.	610
16 ▼	Brown (10YR5/3), slightly moist, stiff, clayey SILT with trace sand and gravel.	
18	Brown (10YR5/3), slightly moist, hard, clayey SILT with trace sand and gravel.	608
	Gray (10YR4/1), slightly moist, hard, clayey SILT with trace sand and gravel.	
20	**End of Boring = 20.0 ft. BGS**	

Borehole Detail

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/12/2010
Finish: 2/12/2010
WEATHER: Overcast, cold ~25F

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: D. Lamb

BOREHOLE ID: G108
Well ID: G108
Surface Elev: 625.58 ft. MSL
Completion: 20.00 ft. BGS
Station: 874,948.81N
2,514,248.25E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.50 - While drilling
▼ = 19.00 - Upon completion
▽ = 8.93 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	23/24 *96%*	ss	*24-25 13-13* N=38	16		
2A	13/24 *54%*	ss	*4-5 8-11* N=13	26		
3A	20/24 *83%*	ss	*2-2 5-7* N=7	28		
4A	24/24 *100%*	ss	*2-3 5-6* N=8	18		
5A	23/24 *96%*	ss	*1-2 3-4* N=5	20		
6A	24/24 *100%*	ss	*1-3 3-5* N=6	19		
7A	19/24 *79%*	ss	*1-1 1-2* N=2	19		
8A	23/24 *96%*	ss	*2-4 7-10* N=11	19		
8B				13		
9A	22/24 *92%*	ss	*10-24 25-10* N=49	11		
9B				8		
10A	24/24 *100%*	ss	*10-25 40-40* N=65	10		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Grayish brown (10YR5/2) with 10% yellowish brown (10YR5/6) mottles, moist, hard, silty CLAY with slight trace gravel.	624
2		
	FILL - Grayish brown (10YR5/2) with 10% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with trace sand and slight trace gravel.	622
4		
	Grayish brown (10YR5/2) with 25% yellowish brown (10YR5/8) and 5% very dark brown (10YR2/2) mottles, moist, medium, clayey SILT with trace sand and slight trace gravel.	620
6		
		618
8		
▽	Gray (10YR5/1) with 10% brownish yellow (10YR6/8) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	616
10		
	Grayish brown (10YR5/2) with brownish yellow (10YR6/8) mottles, moist, soft, sandy CLAY with trace gravel.	614
12		
	Brownish yellow (10YR6/8), very moist, soft, sandy CLAY with trace gravel.	612
14	Brownish yellow (10YR6/8), very moist, soft, sandy SILT with trace gravel.	
▼	Brownish yellow (10YR6/6), wet, medium, SILT.	
		610
16	Light yellowish brown (10YR6/4) with 10% yellowish brown (10YR5/6) mottles, moist, stiff, clayey SILT with trace sand and gravel.	
		608
18	Gray (10YR5/1), slightly moist, hard, SILT with gravel.	
▼	Gray (10YR5/1), wet, hard, SILT with sand and gravel.	
	Gray (10YR5/1), very moist, hard, SILT with gravel.	606
20		

End of Boring = 20.0 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/11/2010
Finish: 2/11/2010
WEATHER: Sunny, cold ~32F

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: D. Lamb

BOREHOLE ID: G109
Well ID: G109
Surface Elev: 624.79 ft. MSL
Completion: 18.00 ft. BGS
Station: 874,970.10N
2,514,137.84E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

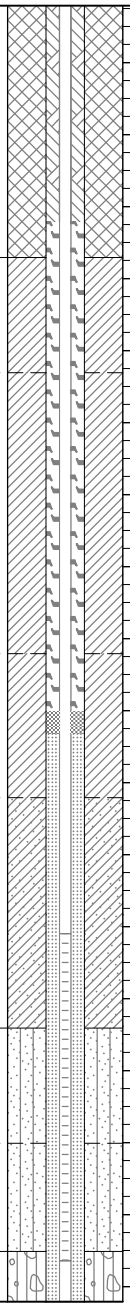
WATER LEVEL INFORMATION:
▼ = 14.20 - While drilling
▼ = 11.50 - Upon completion
▽ = 8.85 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	24/24 *100%*	ss	*6-7 7-8* N=14	22		
2A	19/24 *79%*	ss	*3-5 5-6* N=10	27		
3A	20/24 *83%*	ss	*2-5 6-8* N=11	24		
4A	24/24 *100%*	ss	*2-4 5-6* N=9	19		
5A	22/24 *92%*	ss	*2-3 4-5* N=7	20		
6A	24/24 *100%*	ss	*1-3 3-4* N=6	19		
7A	23/24 *96%*	ss	*1-1 2-2* N=3	19		
8A	22/24 *92%*	ss	*8-15 15-21* N=30	14		
9A	24/24 *100%*	ss	*12-29 44-45* N=73	7		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Grayish brown (10YR5/2) with 40% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with slight trace gravel.	624
2		622
4	Light yellowish brown (10YR6/4) with 50% brownish yellow (10YR6/8) mottles, moist, medium, silty CLAY, slight trace roots.	620
6	Light brownish gray (10YR6/2) with 10% brownish yellow (10YR6/6) mottles, moist, medium, silty CLAY with slight trace sand and gravel.	618
8 ▽		616
10	Light brownish gray (10YR6/2) with 10% brownish yellow (10YR6/6) and 2% very dark gray (10YR3/1) mottles, moist, medium, silty CLAY with slight trace sand and gravel.	614
12 ▼	Light brownish gray (10YR6/2) with 30% brownish yellow (10YR6/8) mottles, moist, medium, sandy CLAY with slight trace gravel.	612
14 ▼	Brownish yellow (10YR6/6), wet, dense, silty SAND with trace gravel.	610
16	Brownish yellow (10YR6/8), wet, dense, SAND with trace gravel.	608
18	Grayish brown (10YR5/2), slightly moist, hard, gravelly SILT with sand.	

End of Boring = 18.0 ft. BGS

Borehole Detail



Remarks

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/11/2010
Finish: 2/11/2010
WEATHER: Sunny, cold 10-20F

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: D. Lamb

BOREHOLE ID: G110
Well ID: G110
Surface Elev: 624.81 ft. MSL
Completion: 18.00 ft. BGS
Station: 875,015.42N
2,514,057.73E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 15.00 - While drilling
▼ =
▽ = 9.50 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	24/24 *100%*	ss	*8-6 6-8* N=12	17		
2A	14/24 *58%*	ss	*2-4 5-7* N=9	25		
3A	22/24 *92%*	ss	*1-4 5-9* N=9	22		
4A	24/24 *100%*	ss	*3-6 8-9* N=14	18		
5A	24/24 *100%*	ss	*1-3 4-6* N=7	21		
6A	24/24 *100%*	ss	*2-4 4-6* N=8	21		
7A	24/24 *100%*	ss	*1-2 3-3* N=5	22		
8A	19/24 *79%*	ss	*1-2 2-1* N=4	24		
9A	24/24 *100%*	ss	*7-26 49-60* N=75	6		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
0–5.5	FILL - Yellowish brown (10YR5/6) with 20% light brownish gray (10YR6/2) mottles, moist, stiff, silty CLAY with slight trace sand.	624 – 619.3
5.5–8	Grayish brown (10YR5/2) with 20% yellowish brown (10YR5/6) and 5% very dark brown (10YR2/2) mottles, moist, medium, silty CLAY.	619.3 – 616.8
8–12	Grayish brown (10YR5/2) with 20% yellowish brown (10YR5/6) and 5% very dark brown (10YR2/2) mottles, moist, medium, silty CLAY with slight trace sand and gravel.	616.8 – 612.8
12–13.5	Light brownish gray (10YR6/2) with 30% brownish yellow (10YR6/8) mottles, moist, medium, clayey SILT with trace sand and gravel.	612.8 – 611.3
13.5–14.5	Light brownish gray (10YR6/2) with 30% brownish yellow (10YR6/8) mottles, very moist, medium, sandy CLAY with trace gravel.	611.3 – 610.3
14.5–16.5	Light brownish gray (10YR6/2) with 30% brownish yellow (10YR6/8) mottles, moist, soft, clayey SILT with trace sand and slight trace gravel.	610.3 – 608.3
16.5–18	Gray (10YR6/1) with 30% brownish yellow (10YR6/8) mottles, wet, soft, sandy CLAY.	608.3 – 606.8
18	Grayish brown (10YR5/2), slightly moist, hard, clayey SILT with trace sand and gravel.	606.8

End of Boring = 18.0 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/10/2010
Finish: 2/11/2010
WEATHER: Sunny, breezy ~25F

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: D. Lamb

BOREHOLE ID: G111
Well ID: G111
Surface Elev: 625.28 ft. MSL
Completion: 18.00 ft. BGS
Station: 875,058.70N
2,513,981.72E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.50 - While drilling
▼ =
▽ = 10.50 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	20/24 *83%*	SS	*7-7 6-9* N=13	18		
2A	13/24 *54%*	SS	*3-5 7-8* N=12	20		
3A	18/24 *75%*	SS	*2-4 6-8* N=10	20		
4A	16/24 *67%*	SS	*4-12 20-17* N=32	18		
5A	22/24 *92%*	SS	*2-3 4-5* N=7	21		
6A	24/24 *100%*	SS	*2-3 6-6* N=9	23		
7A	24/24 *100%*	SS	*1-4 5-6* N=9	20		
8A	24/24 *100%*	SS	*1-2 2-2* N=4	17		
9A	18/18 *100%*	SS	*12-50 66* N=116	7		
	0/6 *0%*	BD				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
2	FILL - Grayish brown (10YR5/2) with 10% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with slight trace sand and gravel.	624, 622, 620	
6	Grayish brown (10YR5/2) with 20% yellowish brown (10YR5/6) and 5% dark brown (10YR3/3) mottles, moist, medium, clayey SILT with slight trace sand, slight trace roots.	618	
8	Grayish brown (10YR5/2) with 5% yellowish brown (10YR5/6) mottles, moist, medium, clayey SILT with trace sand.	616	
10 ▽	Grayish brown (10YR5/2) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with slight trace sand.	614, 612	
14 ▼	Grayish brown (10YR5/2) with 30% yellowish brown (10YR5/8) mottles, moist, stiff, clayey SILT with trace sand and gravel.		
	Yellowish brown (10YR5/8), wet, soft, clayey SAND with trace gravel.	610	
16	Grayish brown (10YR5/2) with 20% brownish yellow (10YR6/6) mottles, slightly moist, hard, clayey SILT with gravel.	608	
18			

End of Boring = 18.0 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/9/2010
Finish: 2/9/2010
WEATHER: Cold, snow, windy (lo-20's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: G119
Well ID: G119
Surface Elev: 626.57 ft. MSL
Completion: 20.10 ft. BGS
Station: 875,675.04N
2,513,907.73E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ =
▽ = 11.26 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	16/24 *67%*	ss	*3-2 3-3* N=5	21		
2A	16/24 *67%*	ss	*2-4 5-5* N=9	20		
3A	10/24 *42%*	ss	*2-5 5-6* N=10	25		
4A	17/24 *71%*	ss	*2-5 4-5* N=9	18		
5A	20/24 *83%*	ss	*2-3 4-5* N=7	19		
6A	19/24 *79%*	ss	*1-3 4-6* N=7	21		
7A	20/24 *83%*	ss	*1-3 3-5* N=6	20		
8A	18/24 *75%*	ss	*1-2 2-2* N=4	18		
9A	22/24 *92%*	ss	*3-9 13-16* N=22	13		
9B				12		
10A	17/24 *71%*	ss	*6-25 33-39* N=58	8		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
0–6	FILL - Brown (10YR5/3) with 10% gray (10YR5/1) and 5% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	626, 624, 622
6–10	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand.	620, 618
10–12 (▽)	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	616
12–14	Gray (10YR6/1) with 30% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and gravel.	614
14–16	Gray (10YR6/1) with 30% yellowish brown (10YR5/6) mottles, moist, soft, sandy CLAY with slight trace gravel.	612
16–17	Brown (10YR5/3), moist, medium, silty CLAY with trace sand and slight trace gravel.	610
17–17.5	Brown (10YR5/3), moist, medium dense, silty, very fine-grained SAND.	
17.5–18	Brown (10YR5/3), slightly moist, hard, clayey SILT with trace sand and gravel.	
18–20	Dark gray (10YR4/1), slightly moist, hard, clayey SILT with trace sand and gravel.	608

End of Boring = 20.1 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/8/2010
Finish: 2/8/2010
WEATHER: Cold, snow, windy (mid-20's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: G120
Well ID: G120
Surface Elev: 627.21 ft. MSL
Completion: 20.00 ft. BGS
Station: 875,854.43N
2,513,905.84E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ =
▽ = 13.85 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	20/24 *83%*	ss	*3-3 4-5* N=7	16		
2A	19/24 *79%*	ss	*3-4 7-9* N=11	20		
3A	16/24 *67%*	ss	*2-3 4-5* N=7	26		
4A	17/24 *71%*	ss	*3-5 6-6* N=11	24		
5A	14/24 *58%*	ss	*2-4 4-6* N=8	22		
6A	22/24 *92%*	ss	*1-3 3-4* N=6	23		
7A	22/24 *92%*	ss	*1-2 3-5* N=5	21		
8A	19/24 *79%*	ss	*woh-2 3-3* N=5	25		
9A	24/24 *100%*	ss	*woh-3 12-21* N=15	21		
9B				10		
10A	24/24 *100%*	ss	*13-36 46-70* N=82	7		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
2	FILL - Brown (10YR5/3) with 10% gray (10YR5/1) and 5% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	626, 624	
4			
6	Gray (10YR5/1) with15% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY with slight trace sand and gravel.	622	
8	Gray (10YR5/1) with15% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY with slight trace sand and gravel, slight trace roots.	620	
10	Gray (10YR5/1) with15% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY with slight trace sand.	618	
12	Gray (10YR5/1) with brownish yellow (10YR6/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	616	
▽ 14	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	614, 612	
16	Brown (10YR5/3), very moist, soft, clayey SAND with slight trace gravel.		
	Brown (10YR5/3), slightly moist, stiff, clayey SILT with trace sand and slight trace gravel.	610	
18	Dark gray (10YR4/1), slightly moist, hard, clayey SILT with trace sand and gravel.	608	
20			

End of Boring = 20.0 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/4/2010
Finish: 2/4/2010
WEATHER: Overcast, cold (lo-30's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: G121
Well ID: G121
Surface Elev: 627.94 ft. MSL
Completion: 22.00 ft. BGS
Station: 875,964.59N
2,513,904.35E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ =
▽ = 14.44 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	22/24 *92%*	ss	*4-4 7-8* N=11	15		
2A	20/24 *83%*	ss	*3-5 8-12* N=13	16		
3A	18/24 *75%*	ss	*1-4 5-6* N=9	27		
4A	18/24 *75%*	ss	*2-3 5-6* N=8	25		
5A	18/24 *75%*	ss	*2-2 3-4* N=5	24		
6A	13/24 *54%*	ss	*2-2 4-4* N=6	23		
7A	19/24 *79%*	ss	*woh-2 3-4* N=5	23		
8A	18/24 *75%*	ss	*1-2 2-2* N=4	23		
9A	23/24 *96%*	ss	*woh-woh 1-2*	21		
10A	22/24 *92%*	ss	*4-12 26-30* N=38	8		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Brown (10YR4/3) with 10% gray (10YR5/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY with slight trace sand and gravel.	626
4		624
6	Dark yellowish brown (10YR4/4), moist, medium, silty CLAY with slight trace sand.	622
	Gray (10YR5/1) with 25% dark yellowish brown (10YR4/6) mottles, moist, medium, clayey SILT with trace sand.	
8		620
10	Gray (10YR6/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with slight trace sand.	618
12		616
14 ▽	Gray (10YR6/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	614
16		612
	Brown, (10YR5/3), very moist, very soft, clayey SAND with slight trace gravel.	
18		610
	Brown (10YR5/3), slightly moist, hard, very silty CLAY with trace sand and gravel.	
20		608

Borehole Detail

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/4/2010
Finish: 2/4/2010
WEATHER: Overcast, cold (lo-30's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: G121
Well ID: G121
Surface Elev: 627.94 ft. MSL
Completion: 22.00 ft. BGS
Station: 875,964.59N
2,513,904.35E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ =
▽ = 14.44 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
11A	24/24 *100%*	ss	*13-23* *31-48* N=54	7			22	Dark gray (10YR4/1), slightly moist, hard, clayey SILT with sand and gravel.		606	

End of Boring = 22.0 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/4/2010
Finish: 2/4/2010
WEATHER: Overcast, cold (lo-30's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: D. Lamb

BOREHOLE ID: G122
Well ID: G122
Surface Elev: 628.05 ft. MSL
Completion: 20.00 ft. BGS
Station: 876,080.14N
2,513,902.82E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 17.00 - While drilling
▼ =
▽ = 12.84 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	23/24 *96%*	ss	*5-5 6-11* N=11	16		
2A	20/24 *83%*	ss	*3-3 5-5* N=8	22		
3A	20/24 *83%*	ss	*3-4 5-6* N=9	25		
4A	19/24 *79%*	ss	*1-5 5-6* N=10	29		
5A	20/24 *83%*	ss	*1-3 3-3* N=6	21		
6A	19/24 *79%*	ss	*1-2 3-3* N=5	22		
7A	16/24 *67%*	ss	*1-2 3-4* N=5	21		
8A	19/24 *79%*	ss	*1-1 2-2* N=3	21		
9A	20/24 *83%*	ss	*1-1 4-16* N=5	14		
10A	24/24 *100%*	ss	*10-38 51-58* N=89	6		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Grayish brown (10YR5/2) with 15% gray (10YR5/1) and 5% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with trace sand and slight trace gravel.	626
4		624
6	Dark yellowish brown (10YR4/4), moist, medium, silty CLAY.	622
8	Gray (10YR5/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, medium, silty CLAY.	620
10	Grayish brown (10YR5/2), moist, medium, clayey SILT with sand.	618
12	Yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace gravel.	616
▽	Gray (10YR5/1), moist, medium, clayey SILT with fine sand.	
14	Brown (10YR4/3), moist, medium, silty CLAY with trace gravel.	614
	Grayish brown (10YR5/2), moist, soft, sandy SILT.	
16	Yellowish brown (10YR5/4) with 40% dark yellowish brown (10YR4/6) mottles, moist, medium, silty CLAY with slight trace sand.	612
▼		
18	Dark yellowish brown (10YR4/6), wet, medium dense, silty SAND.	610
	Brownish yellow (10YR6/6), slightly moist, hard, clayey SILT with trace sand and gravel.	
20	Gray (10YR5/1), slightly moist, hard, clayey SILT with gravel.	

End of Boring = 20.0 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/3/2010
Finish: 2/4/2010
WEATHER: Overcast, cold (lo-30's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: D. Lamb

BOREHOLE ID: G123
Well ID: G123
Surface Elev: 628.12 ft. MSL
Completion: 24.00 ft. BGS
Station: 876,189.60N
2,513,901.46E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 16.50 - While drilling
▼ =
▽ = 15.98 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	22/24 *92%*	ss	*6-8 9-11* N=17	16		
2A	19/24 *79%*	ss	*4-5 6-7* N=11	18		
3A	17/24 *71%*	ss	*2-3 5-6* N=8	24		
4A	18/24 *75%*	ss	*1-3 5-8* N=8	24		
5A	20/24 *83%*	ss	*2-3 4-5* N=7	18		
6A	19/24 *79%*	ss	*1-2 3-5* N=5	21		
7A	23/24 *96%*	ss	*1-3 4-4* N=7	19		
8A	22/24 *92%*	ss	*1-2 3-3* N=5	17		
9A	22/24 *92%*	ss	*1-1 2-2* N=3	19		
10A	12/24 *50%*	ss	*3-3 3-4* N=6	16		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
0–5.5	FILL - Grayish brown (10YR5/2) with 10% gray (10YR5/1) and 5% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with trace sand and slight trace gravel.	628 – 622.5
5.5–6.5	Dark grayish brown (10YR4/2) with 20% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with slight trace sand, slight trace roots.	622.5 – 621.5
6.5–8.5	Gray (10YR5/1) with 30% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with slight trace sand.	621.5 – 619.5
8.5–12.5	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	619.5 – 615.5
12.5–14.5	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with sand and slight trace gravel.	615.5 – 613.5
14.5–15.5	Dark yellowish brown (10YR3/6) with dark yellowish brown (10YR4/6) mottles, moist, medium, silty CLAY with trace gravel.	613.5 – 612.5
15.5–16.5	Gray (10YR6/1) with 30% yellowish brown (10YR5/6) mottles, moist, medium, sandy SILT.	612.5 – 611.5
16.5–18.5	Dark yellowish brown (10YR4/6), wet, soft, clayey SAND.	611.5 – 609.5
18.5–20	Yellowish brown (10YR5/6), wet, medium, sandy SILT with trace gravel.	609.5 – 608.1

Depth ft. BGS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Borehole Detail

Elevation ft. MSL: 628, 626, 624, 622, 620, 618, 616, 614, 612, 610

Remarks

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/3/2010
Finish: 2/4/2010
WEATHER: Overcast, cold (lo-30's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: D. Lamb

BOREHOLE ID: G123
Well ID: G123
Surface Elev: 628.12 ft. MSL
Completion: 24.00 ft. BGS
Station: 876,189.60N
2,513,901.46E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 16.50 - While drilling
▼ =
▽ = 15.98 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
11A	20/24 *83%*	ss	*6-12 12-12* N=24	11				Yellowish brown (10YR5/6), wet, medium, sandy SILT with trace gravel. *[Continued from previous page]*	608	
							22	Gray (10YR5/1), moist, very stiff, clayey SILT with trace gravel.	606	
12A	19/24 *79%*	ss	*3-8 13-9* N=21	9				Dark gray (10YR4/1), moist, very stiff, sandy SILT with trace clay and gravel.		
							24			

End of Boring = 24.0 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/3/2010
Finish: 2/3/2010
WEATHER: Sunny, cold (mid-30's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: G124
Well ID: G124
Surface Elev: 628.70 ft. MSL
Completion: 20.00 ft. BGS
Station: 876,304.85N
2,513,900.34E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ =
▽ = 10.99 - 3/1/2010

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	24/24 100%	ss	6-4 5-6 N=9	17		
2A	22/24 92%	ss	4-5 7-8 N=12	21		
3A	19/24 79%	ss	2-4 6-7 N=10	25		
4A	13/24 54%	ss	3-3 6-6 N=9	28		
5A	20/24 83%	ss	1-3 5-6 N=8	21		
6A	17/24 71%	ss	1-3 3-4 N=6	22		
7A	18/24 75%	ss	1-3 3-4 N=6	23		
8A	20/24 83%	ss	woh-woh 2-3	28		
8B				22		
9A	19/24 79%	ss	1-2 3-3 N=5	22		
9B				17		
10A	20/24 83%	ss	4-10 17-23 N=27	12		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
0–5.5	FILL - Brown (10YR5/3) with 10% gray (10YR5/1) and 5% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with slight trace sand and gravel.	628 – 624
5.5–6	Dark grayish brown (10YR4/2) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY.	624
6–8	Dark grayish brown (10YR4/2) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY, slight trace roots.	624 – 622
8–10	Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with slight trace sand and gravel.	622 – 620
10–16	Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	620 – 614
16–17.5	Gray (10YR5/1) with 30% yellowish brown (10YR5/6) mottles, moist, very soft, silty CLAY with trace sand and slight trace gravel.	614 – 612
17.5–18	Gray (10YR6/1) with 5% yellowish brown (10YR5/6) mottles, moist, medium, sandy CLAY with slight trace gravel.	612
18–18.5	Gray (10YR6/1) with 20% yellowish brown (10YR5/6) mottles, moist, medium, sandy CLAY with slight trace gravel.	612 – 610
18.5–19	Yellowish brown (10YR5/4), moist, medium, clayey SILT with trace sand and slight trace gravel.	610
19–19.5	Yellowish brown (10YR5/4), slightly moist, stiff, clayey SILT with trace sand and slight trace gravel.	610
19.5–20	Gray (10YR5/1), slightly moist, stiff, clayey SILT with trace sand and slight trace gravel.	610

End of Boring = 20.0 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/2/2010
Finish: 2/3/2010
WEATHER: Sunny, cold (mid-30's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: G125
Well ID: G125
Surface Elev: 628.85 ft. MSL
Completion: 20.13 ft. BGS
Station: 876,409.47N
2,513,899.12E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 17.00 - While drilling
▼ = Dry - Upon completion
▽ = 8.58 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	18/24 *75%*	ss	*5-6 7-9* N=13	17		
2A	16/24 *67%*	ss	*3-4 6-9* N=10	17		
3A	20/24 *83%*	ss	*2-5 5-7* N=10	25		
4A	19/24 *79%*	ss	*2-4 5-5* N=9	23		
5A	14/24 *58%*	ss	*3-4 4-6* N=8	25		
6A	18/24 *75%*	ss	*2-3 3-5* N=6	22		
7A	20/24 *83%*	ss	*3-4 3-4* N=7	23		
8A	24/24 *100%*	ss	*3-3 3-3* N=6	23		
9A	24/24 *100%*	ss	*woh-1 2-1* N=3	25		
9B				18		
10A	19/24 *79%*	ss	*woh-1 7-19* N=8	22		
10B				11		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Brown (10YR5/3) with 5% gray (10YR5/1) and 5% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with slight trace sand and gravel.	628
2		626
4	Grayish brown (10YR5/2) with 15% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with slight trace sand and gravel, slight trace roots.	624
6		622
8	Gray (10YR5/1) with 25% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with slight trace sand and gravel, slight trace roots.	620
10	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with slight trace sand.	618
12	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	616
14	Gray (10YR6/1) with 10% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	614
16	Brown (10YR5/3), very moist, very soft, clayey SAND with slight trace gravel.	612
18	Brown (10YR5/3), slightly moist, medium, clayey SILT with trace sand and slight trace gravel.	610
20		

End of Boring = 20.1 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/10/2010
Finish: 2/10/2010
WEATHER: Partly cloudy, wind 10 mph, ~25F

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: D. Lamb

BOREHOLE ID: G126
Well ID: G126
Surface Elev: 622.96 ft. MSL
Completion: 18.00 ft. BGS
Station: 875,062.44N
2,513,895.37E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.20 - While drilling
▼ = 13.00 - Upon completion
▽ = 8.82 - 3/1/2010

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	20/24 *83%*	ss	*9-7 12-10* N=19	15		
2A	19/24 *79%*	ss	*2-4 6-9* N=10	26		
3A	22/24 *92%*	ss	*2-4 5-7* N=9	20		
4A	24/24 *100%*	ss	*2-3 4-5* N=7	22		
5A	24/24 *100%*	ss	*1-3 4-5* N=7	22		
6A	22/24 *92%*	ss	*1-3 4-5* N=7	18		
7A	20/24 *83%*	ss	*1-2 3-4* N=5	19		
8A	24/24 *100%*	ss	*4-15 12-29* N=27	20		
9A	23/24 *96%*	ss	*29-39 39-29* N=78	8		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Dark yellowish brown (10YR4/6), moist, very stiff, sandy CLAY with silt and trace gravel.	622
2	Light grayish brown (10YR6/2), slightly moist, stiff, silty CLAY.	
	Light grayish brown (10YR6/2) with 20% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY, slight trace roots.	620
4		618
6	Dark brown (10YR3/3) with 10% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY.	616
8	▽	614
10	Light grayish brown (10YR6/2) with 30% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	612
12	Grayish brown (10YR5/2) with dark yellowish brown (10YR4/6) mottles, moist, medium, clayey SILT with sand and slight trace gravel.	
	▼	610
14	Gray (10YR6/1). very moist, medium, sandy CLAY with trace gravel.	
	Yellowish brown (10YR5/8) with 40% dark yellowish brown (10YR4/6) mottles, slightly moist, very stiff, clayey SILT with trace gravel.	608
16	Brownish yellow (10YR6/8), moist, very stiff, sandy SILT with gravel.	
	Grayish brown (10YR5/2), moist, hard, sandy SILT with gravel.	606
18		

End of Boring = 18.0 ft. BGS

NOTE(S): G126 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/10/2010
Finish: 2/10/2010
WEATHER: Overcast, wind 15mph, ~10-20F

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: D. Lamb

BOREHOLE ID: T127
Well ID: T127
Surface Elev: 625.53 ft. MSL
Completion: 19.80 ft. BGS
Station: 875,359.21N
2,513,911.02E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 15.30 - While drilling
▼ = 18.00 - Upon completion
▽ = 11.26 - 3/1/10

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
1	24/24 100%	ss	8-5 5-8 N=10				2	FILL - yellowish brown (10YR5/6) with 20% grayish brown (10YR5/2) mottles, moist, stiff, silty CLAY with trace sand and gravel.	624	
2	10/24 42%	ss	5-6 7-11 N=13				4		622	
3	20/24 83%	ss	1-4 5-7 N=9				6	Dark yellowish brown (10YR4/6) with 30% brownish yellow (10YR6/6) and 10% very dark gray (10YR3/1) mottles, moist, medium, clayey SILT with trace sand.	620	
4	24/24 100%	ss	2-4 5-6 N=9				8	Grayish brown (10YR5/2) with 20% dark yellowish brown (10YR4/6) mottles, moist, medium, clayey SILT with sand.	618	
5	24/24 100%	ss	2-4 5-6 N=9				10	Grayish brown (10YR5/2) with 20% dark yellowish brown (10YR4/6) and 5% very dark brown (10YR2/2) mottles, moist, medium, clayey SILT with sand and slight trace gravel.	616	
6	24/24 100%	ss	3-3 5-7 N=8				▽		614	
7	24/24 100%	ss	1-2 3-3 N=5				12	Dark yellowish brown (10YR4/6) with 5% light brownish gray (10YR6/2) mottles, moist, medium, sandy SILT with gravel.	612	
8	24/24 100%	ss	1-1 2-1 N=3				14	Light brownish gray (10YR6/2) with 30% yellowish brown (10YR5/6) mottles, very moist, medium, clayey SAND with silt.	610	
9	24/24 100%	ss	8-12 28-30 N=40				▼ 16	Light brownish gray (10YR6/2) with 30% brownish yellow (10YR6/8) mottles, wet, very loose, silty SAND trace with gravel.	608	
10	22/22 100%	ss	8-44 65-60/4" N=109				▼ 18	Brownish yellow (10YR6/8), wet, medium dense, silty SAND with gravel.	606	
								Grayish brown (10YR5/2), slightly moist, hard, clayey SILT with sand and gravel.		

End of Boring = 19.8 ft. BGS

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/9/2010
Finish: 2/9/2010
WEATHER: Cold, windy, snow (lo-20's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: T128
Well ID: T128
Surface Elev: 626.27 ft. MSL
Completion: 22.00 ft. BGS
Station: 875,509.70N
2,513,909.45E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 16.84 - While drilling
▼ =
▽ = 12.35 - 3/1/10

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	12/24 *50%*	ss	*37-17 15-18* N=32	14		
2A	7/24 *29%*	ss	*4-7 7-13* N=14			
3A	12/24 *50%*	ss	*3-4 6-8* N=10	26		
4A	19/24 *79%*	ss	*2-4 5-7* N=9	24		
5A	22/24 *92%*	ss	*1-3 4-5* N=7	20		
6A	22/24 *92%*	ss	*1-3 5-5* N=8	20		
7A	22/24 *92%*	ss	*2-3 4-5* N=7	19		
8A	20/24 *83%*	ss	*2-2 3-3* N=5	18		
9A	22/24 *92%*	ss	*woh-1 8-7* N=9	19		
9B				18		
10A 10B	18/24 *75%*	ss	*3-10 13-11* N=23	17		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Brown (10YR5/3) with 5% gray (10YR5/1) and 5% yellowish brown (10YR5/6) mottles, moist, hard (frozen), silty CLAY with trace sand and slight trace gravel.	626
	FILL - Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, moist, hard (frozen), silty CLAY with slight trace sand and gravel.	
2	FILL - Brown (10YR5/3) with 10% gray (10YR5/1) and 5% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with slight trace sand and gravel.	624
4	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with slight trace sand, slight trace roots.	622
6	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with trace sand and slight trace gravel.	620
8		618
10		616
12 ▽		614
14	Gray (10YR6/1) with 30% yellowish brown (10YR5/6) mottles, moist, medium, silty CLAY with trace sand and slight trace gravel.	612
16	Brown (10YR5/3), moist, soft, clayey SAND with slight trace gravel.	610
▼	Gray (10YR6/1), wet, loose, silty, very fine- to coarse-grained SAND.	
18	Brown (10YR5/3), wet, loose, silty, very fine- to fine-grained SAND.	608
20	Brown (10YR5/3), slightly moist, very stiff, clayey SILT with trace sand and gravel.	

Borehole Detail

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project:
DATES: Start: 2/9/2010
Finish: 2/9/2010
WEATHER: Cold, windy, snow (lo-20's)

CONTRACTOR: Layne-Western Co
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: T. List
Helper: M. Herbst/S. Hamby
Eng/Geo: S. Simpson

BOREHOLE ID: T128
Well ID: T128
Surface Elev: 626.27 ft. MSL
Completion: 22.00 ft. BGS
Station: 875,509.70N
2,513,909.45E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 16.84 - While drilling
▼ =
▽ = 12.35 - 3/1/10

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
11A	24/24 *100%*	ss	*8-16* *18-25* N=34	16				Dark gray (10YR4/1), slightly moist, hard, clayey SILT with trace sand and gravel.		606	
							22	**End of Boring = 22.0 ft. BGS**			

NOTE(S): Well completed prior to construction of berm road. Boring surface elevation is as of the well install date and not the final constructed elevation.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Holdings
Site: Coffeen Power Station
Location: Coffeen, Montgomery County, Illinois
Project: 14E0078
DATES: Start: 10/28/2014
Finish: 10/28/2014
WEATHER: Overcast, mild - mid 50's

CONTRACTOR: Ramsey
Rig mfg/model: D-50 Turbo Tracked MST 800ATV
Drilling Method: 4¼" Hollow Stem Auger with Split spoon
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: TA31
Well ID: TA31
Surface Elev: 623.89 ft. MSL
Completion: 20.19 ft. BGS
Station: 876,542.25N
2,513,856.77E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 8.11 - 10/30/2014
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1	24/24 100%	ss	1-2 2-2 N=4	26		
2	22/24 92%	ss	2-3 3-4 N=6	28		1.44 B
3	23/24 96%	ss	2-3 4-4 N=7	20		1.71 Sh
4	24/24 100%	ss	6-7 6-6 N=13	22		1.55 Sh
5	22/24 92%	ss	2-2 2-4 N=4	22		1.55 Sh
6	24/24 100%	ss	2-1 3-2 N=4	20		0.93 B
7A	24/24 100%	ss	2-3 3-3 N=6	19		
7B				22		
8A	24/24 100%	ss	4-5 8-7 N=13	12		
8B				13		
9	22/24 92%	ss	5-4 4-4 N=8	18		
10	16/24 67%	ss	2-4 3-5 N=7	12		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	Yellowish brown (10YR5/4), moist, soft, SILT with little clay and trace very fine sand. Brown (10YR4/3), moist, soft, SILT with little clay and trace very fine sand.	622
4		620
6		618
▼ 8	Gray (10YR5/1) with 20% yellowish brown (10YR5/8) mottles, moist, soft, CLAY with few silt and trace very fine to fine sand.	616
10	Brownish yellow (10YR6/6) with 20% gray (10YR6/1) mottles, moist, soft, CLAY with few silt and little very fine to fine sand and trace small gravel.	614
12		612
14	Brownish yellow (10YR6/6), wet, slightly dense, SAND (very fine to coarse) with little sand and silt and trace clay and small gravel.	610
	Brownish yellow (10YR6/6), moist, soft, CLAY with few silt and trace very fine to fine sand and small gravel.	
	Brownish yellow (10YR6/6) wet, loose, SAND (very fine to very coarse) and trace small gravel.	
	Brownish yellow (10YR6/6) very moist, soft, SAND (very fine to medium) with few clay and silt.	
16	Yellowish brown (10YR5/8), moist, soft, CLAY with few silt and trace sand (very fine to very coarse) and small gravel.	608
18	Yellowish brown (10YR5/8), wet, loose, very fine to very coarse SAND.	606
20	Gray (10YR5/1), moist, hard, CLAY with few silt and (very fine to very coarse) sand and small gravel.	604

End of Boring at 20.19 ft.

NOTE(S): Monitoring well TA31 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Holdings
Site: Coffeen Power Station
Location: Coffeen, Montgomery County, Illinois
Project: 14E0078
DATES: Start: 10/27/2014
Finish: 10/27/2014
WEATHER: Partly sunny, mild - mid 70's

CONTRACTOR: Ramsey
Rig mfg/model: D-50 Turbo Tracked MST 800ATV
Drilling Method: 4¼" Hollow Stem Auger with Split spoon
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: TA32
Well ID: TA32
Surface Elev: 618.93 ft. MSL
Completion: 16.47 ft. BGS
Station: 877,532.57N
2,513,605.19E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.05 - 10/30/2014
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1	18/24 75%	ss	2-1 2-3 N=3	21		
	21/24 88%	ss	2-1 1-1 N=2			
2				28		
3A	14/24 58%	ss	1-1 3-3 N=4	24		
3B				22		1.15 Sh
4	20/24 83%	ss	4-5 4-7 N=9	22		0.96 B
5	21/24 88%	ss	4-7 12-22 N=19	9		8.45 Sh
6	21/24 88%	ss	6-16 27-42 N=43	8		10.47 Sh
7	12/24 50%	ss	36-55 50/4"	6		
8	16/24 67%	ss	16-35 69 N=104	8		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark yellowish brown (10YR4/4), moist, soft, clayey SILT with trace sand (very fine).	618
2		
	Black (10YR2/1), moist, soft, clayey SILT with trace sand (very fine).	616
4		
	Very dark gray (10YR3/1), moist, soft, CLAY with little silt and trace sand (very fine to fine).	614
6		
	Yellowish brown (10YR5/6) with 30% gray (10YR5/1) mottles, moist, medium, CLAY with little silt and trace sand (very fine to very coarse) and gravel (small).	612
8		
	Yellowish brown (10YR5/8) with 30% Gray (10YR5/1) mottles, slightly moist, very hard, CLAY with silt and little sand (very fine to very coarse) trace gravel (small).	610
10		
		608
12		
	Yellowish brown (10YR5/8), slightly moist, loose, SAND (very fine to very coarse) and few gravel (small to medium).	606
▼ 14	Gray (10YR5/1), slightly moist, very hard, CLAY with silt and few gravel (small to medium).	
	Gray (10YR5/1), moist, dense, SAND (very fine to coarse).	604
	Gray (10YR5/1), slightly moist, very hard, CLAY with silt and few gravel (small to medium).	
16		

End of Boring at 16.47 ft.

NOTE(S): Monitoring well TA32 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Company
Site: Coffeen Well Sealing & Assmt Well Install
Location: Coffeen, Illinois
Project: 14E0078A
DATES: Start: 6/2/2015
Finish: 6/2/2015
WEATHER: Sunny, calm, hi-60s

CONTRACTOR: Ramsey
Rig mfg/model: Diedrich D-50
Drilling Method: 3 ¼" HSA, split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Keim

BOREHOLE ID: TA33a
Well ID: n/a
Surface Elev: 622.5 ft. MSL
Completion: 30.0 ft. BGS
Station: 876,610.00N
2,513,248.00E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.80 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	21/24 88%	ss	2-3 5-5 N=8			
2A	20/24 83%	ss	3-4 4-5 N=8			
3A	23/24 96%	ss	5-6 6-9 N=12			
4A	24/24 100%	ss	10-10 10-10 N=20			
5A	21/24 88%	ss	2-4 6-6 N=10			
6A	24/24 100%	ss	0-3 4-8 N=7			
7A	24/24 100%	ss	15-27 32-41 N=59			
7B						
8A	20/24 83%	ss	5-12 18-22 N=30			
9A	16/24 67%	ss	23-44 50/5"			
10A	22/24 92%	ss	12-12 22-25 N=34			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Yellowish brown (10YR5/4), moist, stiff, clayey SILT, trace very fine-grained sand, roots.	622
	Light brownish gray (10YR6/2) with 35% yellowish brown (10YR5/6) mottles, moist, stiff to very stiff, clayey SILT, trace very fine- to fine-grained sand.	
2		620
	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, very stiff, clayey SILT, little fine- to medium-grained sand, trace coarse-grained sand.	
4		618
	Gray (10YR5/1) with 5-10% dark yellowish brown (10YR4/6) mottles, moist, very stiff, silty CLAY, little fine- to medium-grained sand, trace coarse-grained sand.	
6		616
8	Dark yellowish brown (10YR4/6) with 3% gray (10YR6/1) mottles, moist, very stiff, silty CLAY, little fine- to coarse-grained sand, trace small gravel.	614
	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY, little fine- to coarse-grained sand, trace small gravel.	
10		612
	Gray (10YR6/1) moist, medium, fine- to coarse-grained sandy CLAY, little silt, trace small to large gravel.	
12		610
	Brown (10YR5/3) with 5% dark yellowish brown (10YR4/6) mottles, slightly moist, very stiff, very fine- to fine-grained sandy SILT, trace medium- to coarse-grained sand, trace small to large gravel, friable.	
▼ 14	Dark yellowish brown (10YR4/6), very moist, dense, silty,very fine- to medium-grained SAND.	608
16	Brown (10YR5/3), slightly moist, hard, clayey SILT, few fine- to coarse-grained sand, trace small gravel.	606
18		604
20	Dark gray (10YR4/1), slightly moist, hard, clayey SILT, few fine- to coarse-grained sand, trace small to large gravel.	

NOTE(S): Borehole sealed with high-solids bentonite grout.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Company
Site: Coffeen Well Sealing & Assmt Well Install
Location: Coffeen, Illinois
Project: 14E0078A
DATES: Start: 6/2/2015
Finish: 6/2/2015
WEATHER: Sunny, calm, hi-60s

CONTRACTOR: Ramsey
Rig mfg/model: Diedrich D-50
Drilling Method: 3 ¼" HSA, split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Keim

BOREHOLE ID: TA33a
Well ID: n/a
Surface Elev: 622.5 ft. MSL
Completion: 30.0 ft. BGS
Station: 876,610.00N
2,513,248.00E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.80 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
11A	24/24 *100%*	ss	*11-17* *25-32* N=42							602	
12A	23/24 *96%*	ss	*17-23* *35-44* N=58				22			600	
13A	21/24 *88%*	ss	*26-30* *30-37* N=60				24	Dark gray (10YR4/1), slightly moist, hard, clayey SILT, few fine- to coarse-grained sand, trace small to large gravel. *[Continued from previous page]*		598	
14A	18/24 *75%*	ss	*19-35* *47-50* N=82				26			596	
15A	24/24 *100%*	ss	*18-27* *34-35* N=61				28			594	
							30				

End of boring = 30.0 feet

NOTE(S): Borehole sealed with high-solids bentonite grout.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Company
Site: Coffeen Well Sealing & Assmt Well Install
Location: Coffeen, Illinois
Project: 14E0078A
DATES: Start: 6/2/2015
Finish: 6/2/2015
WEATHER: Sunny, calm, hi-60s

CONTRACTOR: Ramsey
Rig mfg/model: Diedrich D-50
Drilling Method: 3 ¼" HSA, blind drill
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Keim

BOREHOLE ID: TA33b
Well ID: TA33
Surface Elev: 622.51 ft. MSL
Completion: 17.44 ft. BGS
Station: 876,605.45N
2,513,248.73E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ = 7.00 - 6/16/15
▽ =

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
								Yellowish brown (10YR5/4), moist, stiff, clayey SILT, trace very fine-grained sand, roots.		622	
							2	Light brownish gray (10YR6/2) with 35% yellowish brown (10YR5/6) mottles, moist, stiff to very stiff, clayey SILT, trace very fine- to fine-grained sand.		620	
							4	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, very stiff, clayey SILT, little fine- to medium-grained sand, trace coarse-grained sand.		618	
							6 ▼	Gray (10YR5/1) with 5-10% dark yellowish brown (10YR4/6) mottles, moist, very stiff, silty CLAY, little fine- to medium-grained sand, trace coarse-grained sand.		616	
							8	Dark yellowish brown (10YR4/6) with 3% gray (10YR6/1) mottles, moist, very stiff, silty CLAY, little fine- to coarse-grained sand, trace small gravel.		614	
							10	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY, little fine- to coarse-grained sand, trace small gravel.		612	
							12	Gray (10YR6/1) moist, medium, fine- to coarse-grained sandy CLAY, little silt, trace small to large gravel.		610	
							14	Brown (10YR5/3) with 5% dark yellowish brown (10YR4/6) mottles, slightly moist, very stiff, very fine- to fine-grained sandy SILT, trace medium- to coarse-grained sand, trace small to large gravel, friable.		608	
							16	Dark yellowish brown (10YR4/6), very moist, dense, silty,very fine- to medium-grained SAND.		606	
								Brown (10YR5/3), slightly moist, hard, clayey SILT, few fine- to coarse-grained sand, trace small gravel.			

End of boring = 17.44 feet

NOTE(S): TA33 installed in bore hole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Company
Site: Coffeen Well Sealing & Assmt Well Install
Location: Coffeen, Illinois
Project: 14E0078A
DATES: Start: 6/3/2015
Finish: 6/3/2015
WEATHER: Mostly cloudy, windy, mid-60s

CONTRACTOR: Ramsey
Rig mfg/model: Diedrich D-50
Drilling Method: 3 ¼" HSA, split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Keim

BOREHOLE ID: TA34
Well ID: TA34
Surface Elev: 624.10 ft. MSL
Completion: 16.10 ft. BGS
Station: 875,906.10N
2,513,466.73E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.00 - during drilling
▼ = 8.10 - 6/16/15
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	21/24 88%	ss	3-3 3-3 N=6			
2A	17/24 71%	ss	2-2 4-6 N=6			
3A	22/24 92%	ss	3-3 3-4 N=6			
4A	24/24 100%	ss	3-4 6-7 N=10			
5A	24/24 100%	ss	2-2 5-5 N=7			
6A	22/24 92%	ss	3-3 4-5 N=7			
7A	21/24 88%	ss	3-3 4-5 N=7			
7B 8A 8B 8C	24/24 100%	ss	18-28 25-32 N=53			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Gray (10YR5/1) with 10% dark yellowish brown (10YR3/6) mottles, moist, stiff, SILT, some clay, trace very fine-grained, roots.	624
	Grayish brown (10YR5/2) with 10% yellowish brown (10YR5/6) mottles, moist, very stiff, silty CLAY, trace fine-grained sand.	
2	Light grayish brown (10YR6/2) with 15% yellowish brown (10YR5/6) mottles, slightly moist, very stiff, silty CLAY, trace fine-grained sand.	622
4	Grayish brown (10YR5/2) with 10% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY, little fine-grained sand, trace medium- to coarse-grained sand.	620
6		618
▼ 8	Grayish brown (10YR5/2) with 25% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY, little fine-grained sand, trace medium- to coarse-grained sand, trace small gravel.	616
10		614
12		612
▼	Dark yellowish brown (10YR4/6) with 15% light gray (10YR7/1) mottles, very moist, very soft, fine- to medium-grained sandy CLAY, trace coarse-grained sand.	
14	Gray (10YR6/1), very moist, loose, clayey, silty, fine- to medium-grained SAND, trace coarse grained sand.	610
	Brown (10YR5/3), very moist, very dense, silty,fine- to coarse-grained SAND and small to large GRAVEL.	
	Yellowish brown (10YR5/6), slightly moist, hard, clayey SILT, little fine- to coarse-grained sand, trace small gravel.	
16	Gray (10YR6/1), slightly moist, hard, clayey SILT, few fine- to coarse-grained sand, trace small gravel.	608
	Dark gray (10YR4/1), slightly moist, hard, clayey SILT, few fine- to coarse-grained sand, trace small gravel.	

End of boring = 16.1 feet

NOTE(S): TA34 installed in bore hole.

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G101

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G101

~~State Plane~~ Plant Coordinate: X 2,514,214.3 Y 876,551.8 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 2/2/2010 Date Finished: 2/2/2010

Report Form Completed By: Suzanna L. Simpson Date: 2/4/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 min

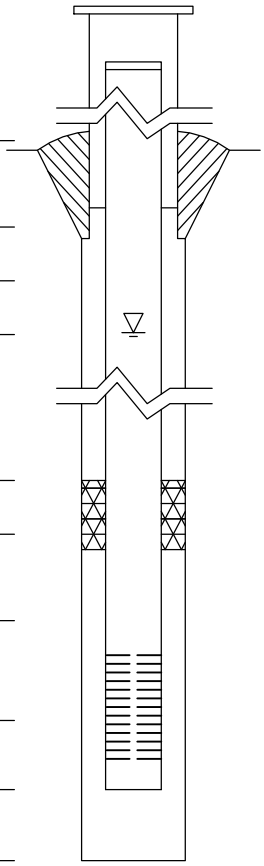
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
627.89	-2.62	Top of Protective Casing
627.60	-2.33	Top of Riser Pipe
625.27	0.00	Ground Surface
622.27	3.00	Top of Annular Sealant
617.96	7.31	Static Water Level (After Completion) 3/1/2010
614.27	11.00	Top of Seal
612.14	13.13	Top of Sand Pack
609.59	15.68	Top of Screen
604.95	20.32	Bottom of Screen
604.38	20.89	Bottom of Well
603.35	21.92	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	18.01
Bottom of Screen to End Cap	(feet)	0.57
Screen Length (1st slot to last slot)	(feet)	4.64
Total Length of Casing	(feet)	23.22
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G102 (MW3S)

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-03a

~~State Plane~~ Plant Coordinate: X 2,514,531.5 Y 876,554.8 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: TSC Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Testing Services Corp. Date Started: 4/28/2006 Date Finished: 4/28/2006

Report Form Completed By: Rhonald W. Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

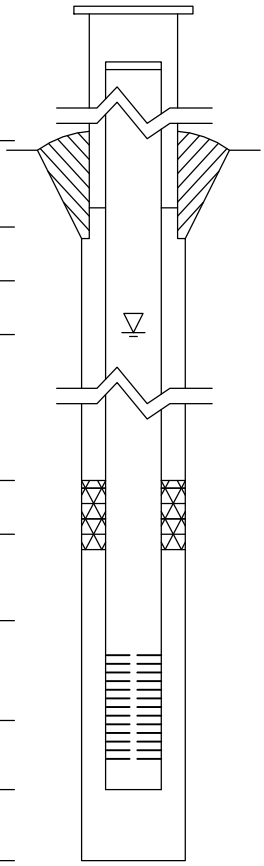
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
629.45	-3.75	Top of Protective Casing
628.96	-3.26	Top of Riser Pipe
625.70	0.00	Ground Surface
623.70	2.00	Top of Annular Sealant
618.67	7.03	Static Water Level (After Completion) 6/1/2006
623.70	2.00	Top of Seal
616.20	9.50	Top of Sand Pack
613.68	12.02	Top of Screen
608.92	16.78	Bottom of Screen
608.55	17.15	Bottom of Well
608.55	17.15	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS
(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	15.28
Bottom of Screen to End Cap	(feet)	0.37
Screen Length (1st slot to last slot)	(feet)	4.76
Total Length of Casing	(feet)	20.41
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G103

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G103

~~State Plane~~ Plant Coordinate: X 2,514,501.2 Y 876,199.5 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 2/15/2010 Date Finished: 2/15/2010

Report Form Completed By: Suzanna L. Simpson Date: 2/18/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 8 min

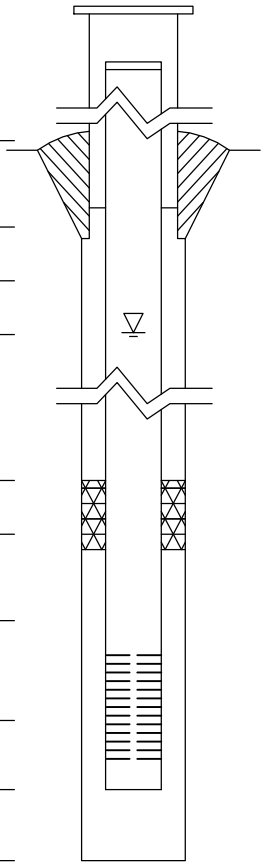
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
634.07	-3.08	Top of Protective Casing
633.80	-2.81	Top of Riser Pipe
630.99	0.00	Ground Surface
624.93	6.06	Top of Annular Sealant
614.00	16.99	Static Water Level (After Completion) 3/1/2010
618.51	12.48	Top of Seal
617.35	13.64	Top of Sand Pack
615.11	15.88	Top of Screen
610.32	20.67	Bottom of Screen
609.90	21.09	Bottom of Well
609.90	21.09	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	18.69
Bottom of Screen to End Cap	(feet)	0.42
Screen Length (1st slot to last slot)	(feet)	4.79
Total Length of Casing	(feet)	23.90
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: R104

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: R104

State Plane Coordinate: X 2,514,503.4 Y 875,857.8 (or) Latitude: 39 ° 4 ' 10 " Longitude: -89 ° 23 ' 56.8 "

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: D. Mahurin

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Rhonald W. Hasenyager Date Started: 10/8/2010 Date Finished: 10/8/2010

Report Form Completed By: Suzanna L. Simpson Date: 10/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 15 min

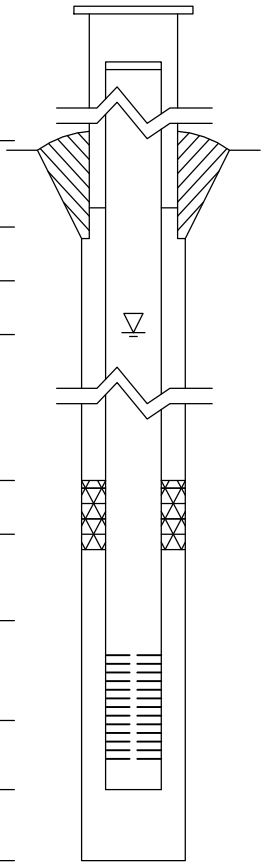
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
632.02	-2.99	Top of Protective Casing
631.84	-2.81	Top of Riser Pipe
629.03	0.00	Ground Surface
627.03	2.00	Top of Annular Sealant
612.85	16.18	Static Water Level (After Completion) 11/15/2010
617.03	12.00	Top of Seal
616.01	13.02	Top of Sand Pack
614.44	14.59	Top of Screen
609.71	19.32	Bottom of Screen
609.18	19.85	Bottom of Well
609.18	19.85	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.60
Bottom of Screen to End Cap	(feet)	0.53
Screen Length (1st slot to last slot)	(feet)	4.53
Total Length of Casing	(feet)	22.66
Screen Slot Size **	(inches)	0.010

Well Completion Form (revised 02/06/02)

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G104

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G104

~~State Plane~~ Plant Coordinate: X 2,514,505.0 Y 875,849.3 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 2/15/2010 Date Finished: 2/15/2010

Report Form Completed By: Suzanna L. Simpson Date: 2/18/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 10 min

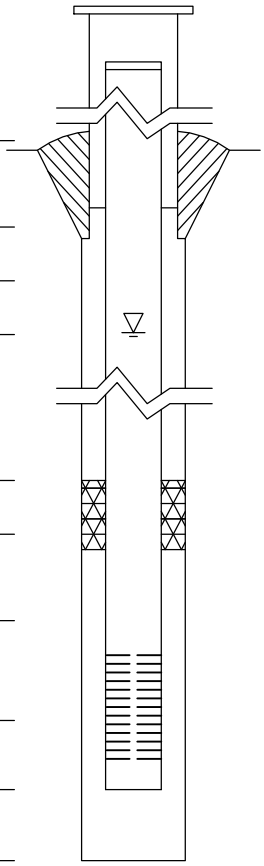
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.29	-3.17	Top of Protective Casing
632.94	-2.82	Top of Riser Pipe
630.12	0.00	Ground Surface
624.92	5.20	Top of Annular Sealant
614.72	15.40	Static Water Level (After Completion) 3/1/2010
619.17	10.95	Top of Seal
617.42	12.70	Top of Sand Pack
615.21	14.91	Top of Screen
610.51	19.61	Bottom of Screen
610.04	20.08	Bottom of Well
607.92	22.20	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:	Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:	
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:	
Screen	SS304	SS316	PTFE	PVC	OTHER:	

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.73
Bottom of Screen to End Cap	(feet)	0.47
Screen Length (1st slot to last slot)	(feet)	4.70
Total Length of Casing	(feet)	22.90
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G105

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G105

~~State Plane~~ Plant Coordinate: X 2,514,509.2 Y 875,499.7 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 2/16/2010 Date Finished: 2/16/2010

Report Form Completed By: Suzanna L. Simpson Date: 2/18/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 10 min

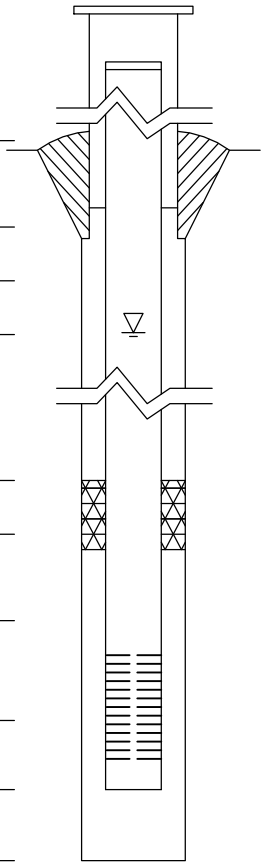
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
632.40	-3.14	Top of Protective Casing
632.08	-2.82	Top of Riser Pipe
629.26	0.00	Ground Surface
623.80	5.46	Top of Annular Sealant
613.18	16.08	Static Water Level (After Completion) 3/1/2010
616.55	12.71	Top of Seal
615.50	13.76	Top of Sand Pack
613.15	16.11	Top of Screen
608.36	20.90	Bottom of Screen
607.89	21.37	Bottom of Well
606.80	22.46	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	18.93
Bottom of Screen to End Cap	(feet)	0.47
Screen Length (1st slot to last slot)	(feet)	4.79
Total Length of Casing	(feet)	24.19
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G106

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G106

~~State Plane~~ Plant Coordinate: X 2,514,512.8 Y 875,149.8 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 2/16/2010 Date Finished: 2/16/2010

Report Form Completed By: Suzanna L. Simpson Date: 2/18/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 10 min

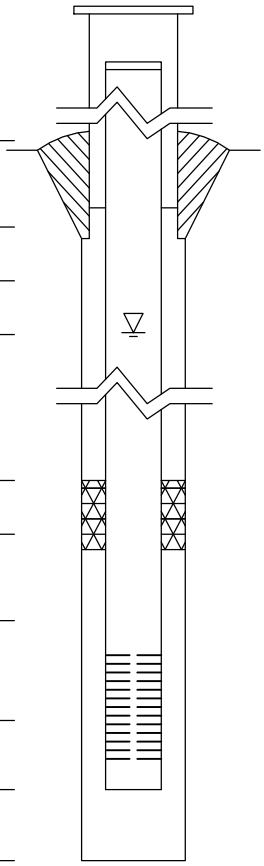
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
631.45	-3.06	Top of Protective Casing
631.15	-2.76	Top of Riser Pipe
628.39	0.00	Ground Surface
622.94	5.45	Top of Annular Sealant
615.77	12.62	Static Water Level (After Completion) 3/1/2010
617.44	10.95	Top of Seal
616.10	12.29	Top of Sand Pack
614.02	14.37	Top of Screen
609.43	18.96	Bottom of Screen
608.95	19.44	Bottom of Well
607.94	20.45	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.13
Bottom of Screen to End Cap	(feet)	0.48
Screen Length (1st slot to last slot)	(feet)	4.69
Total Length of Casing	(feet)	22.30
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G107

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G107

~~State Plane~~ Plant Coordinate: X 2,514,358.3 Y 874,994.3 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 2/17/2010 Date Finished: 2/17/2010

Report Form Completed By: Suzanna L. Simpson Date: 2/18/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 8 min

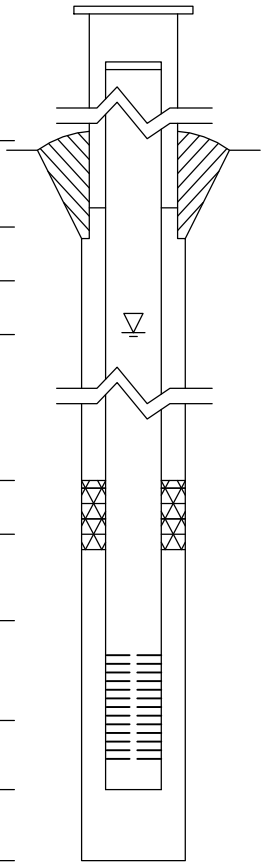
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
630.60	-2.81	Top of Protective Casing
630.23	-2.44	Top of Riser Pipe
627.79	0.00	Ground Surface
624.08	3.71	Top of Annular Sealant
617.39	10.40	Static Water Level (After Completion) 3/1/2010
617.41	10.38	Top of Seal
616.24	11.55	Top of Sand Pack
613.92	13.87	Top of Screen
609.29	18.50	Bottom of Screen
608.82	18.97	Bottom of Well
607.08	20.71	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:	Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:	
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:	
Screen	SS304	SS316	PTFE	PVC	OTHER:	

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	16.31
Bottom of Screen to End Cap	(feet)	0.47
Screen Length (1st slot to last slot)	(feet)	4.63
Total Length of Casing	(feet)	21.41
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G108

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G108

~~State Plane~~ Plant Coordinate: X 2,514,248.3 Y 874,948.8 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Diane M. Lamb Date Started: 2/12/2010 Date Finished: 2/12/2010

Report Form Completed By: Diane M. Lamb Date: 2/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Granular

Setting Time: 10 min

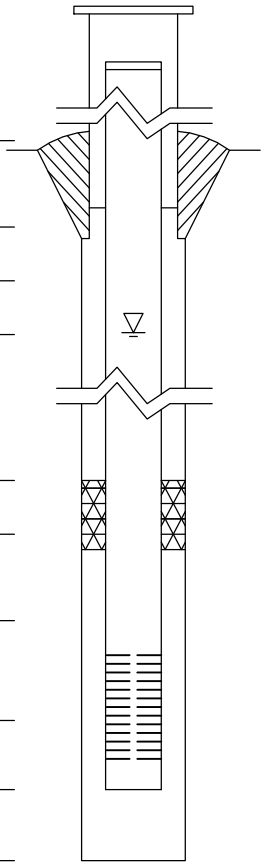
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
630.52	-3.02	Top of Protective Casing
630.22	-2.72	Top of Riser Pipe
627.50	0.00	Ground Surface
622.50	5.00	Top of Annular Sealant
618.57	8.93	Static Water Level (After Completion) 3/1/2010
614.00	13.50	Top of Seal
612.80	14.70	Top of Sand Pack
610.68	16.82	Top of Screen
606.00	21.50	Bottom of Screen
605.50	22.00	Bottom of Well
605.50	22.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	19.54
Bottom of Screen to End Cap	(feet)	0.50
Screen Length (1st slot to last slot)	(feet)	4.68
Total Length of Casing	(feet)	24.72
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G109

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G109

~~State~~ Plant ~~Plane~~ Coordinate: X 2,514,137.8 Y 874,970.1 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Diane M. Lamb Date Started: 2/11/2010 Date Finished: 2/11/2010

Report Form Completed By: Diane M. Lamb Date: 2/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Granular

Setting Time: 10 min

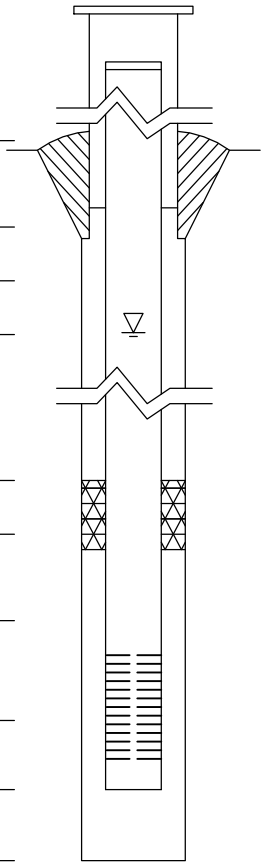
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
630.08	-2.88	Top of Protective Casing
629.76	-2.56	Top of Riser Pipe
627.20	0.00	Ground Surface
621.70	5.50	Top of Annular Sealant
618.35	8.85	Static Water Level (After Completion) 3/1/2010
614.90	12.30	Top of Seal
614.60	12.60	Top of Sand Pack
611.81	15.39	Top of Screen
607.27	19.93	Bottom of Screen
606.70	20.50	Bottom of Well
606.70	20.50	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:	[Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:	
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:	
Screen	SS304	SS316	PTFE	[PVC]	OTHER:	

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.95
Bottom of Screen to End Cap	(feet)	0.57
Screen Length (1st slot to last slot)	(feet)	4.54
Total Length of Casing	(feet)	23.06
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G110

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G110

~~State Plane~~ Plant Coordinate: X 2,514,057.7 Y 875,015.4 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Diane M. Lamb Date Started: 2/11/2010 Date Finished: 2/11/2010

Report Form Completed By: Diane M. Lamb Date: 2/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Granular

Setting Time: 10 min

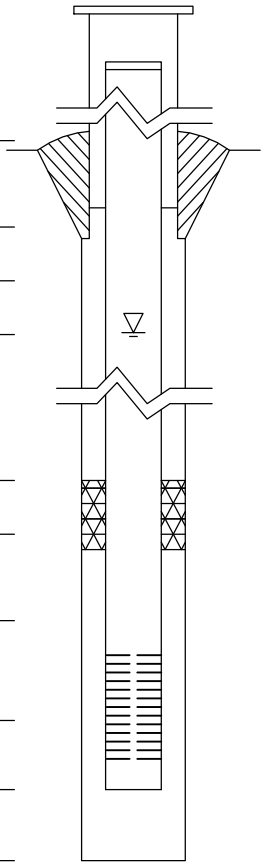
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
629.96	-2.94	Top of Protective Casing
629.65	-2.63	Top of Riser Pipe
627.02	0.00	Ground Surface
621.86	5.16	Top of Annular Sealant
617.52	9.50	Static Water Level (After Completion) 3/1/2010
615.46	11.56	Top of Seal
614.06	12.96	Top of Sand Pack
611.97	15.05	Top of Screen
607.43	19.59	Bottom of Screen
606.86	20.16	Bottom of Well
606.86	20.16	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.68
Bottom of Screen to End Cap	(feet)	0.57
Screen Length (1st slot to last slot)	(feet)	4.54
Total Length of Casing	(feet)	22.79
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G111

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G111

~~State Plane~~ Plant Coordinate: X 2,513,981.7 Y 875,058.7 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Diane M. Lamb Date Started: 2/10/2010 Date Finished: 2/11/2010

Report Form Completed By: Diane M. Lamb Date: 2/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Granular

Setting Time: 10 min

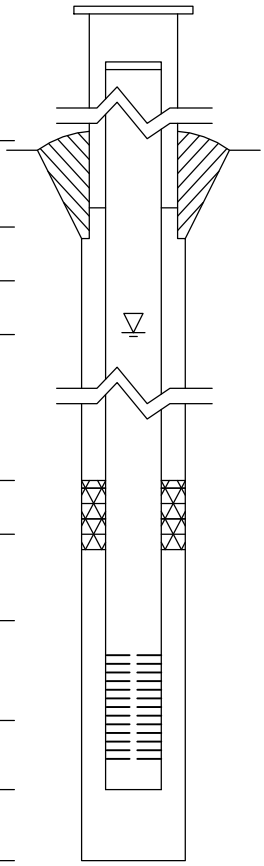
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
630.19	-2.95	Top of Protective Casing
629.90	-2.66	Top of Riser Pipe
627.24	0.00	Ground Surface
622.52	4.72	Top of Annular Sealant
616.74	10.50	Static Water Level (After Completion) 3/1/2010
616.41	10.83	Top of Seal
614.52	12.72	Top of Sand Pack
612.63	14.61	Top of Screen
608.09	19.15	Bottom of Screen
607.52	19.72	Bottom of Well
607.52	19.72	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.27
Bottom of Screen to End Cap	(feet)	0.57
Screen Length (1st slot to last slot)	(feet)	4.54
Total Length of Casing	(feet)	22.38
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G119

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G119

~~State Plane~~ Plant Coordinate: X 2,513,907.7 Y 875,675.0 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 2/9/2010 Date Finished: 2/9/2010

Report Form Completed By: Suzanna L. Simpson Date: 2/18/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 15 min

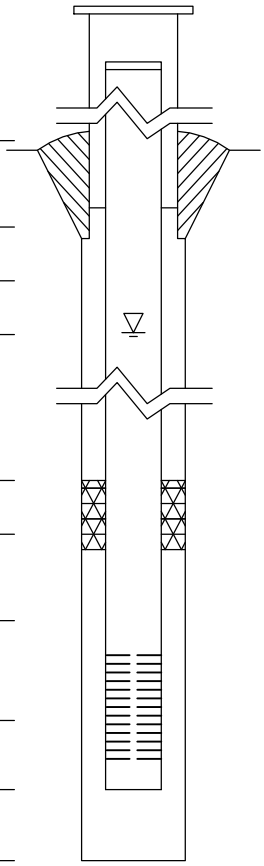
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
631.85	-3.00	Top of Protective Casing
631.55	-2.70	Top of Riser Pipe
628.85	0.00	Ground Surface
623.57	5.28	Top of Annular Sealant
617.59	11.26	Static Water Level (After Completion) 3/1/2010
614.87	13.98	Top of Seal
613.57	15.28	Top of Sand Pack
611.56	17.29	Top of Screen
607.02	21.83	Bottom of Screen
606.47	22.38	Bottom of Well
606.47	22.38	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	19.99
Bottom of Screen to End Cap	(feet)	0.55
Screen Length (1st slot to last slot)	(feet)	4.54
Total Length of Casing	(feet)	25.08
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G120

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G120

~~State Plane~~ Plant Coordinate: X 2,513,905.8 Y 875,854.4 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 2/8/2010 Date Finished: 2/8/2010

Report Form Completed By: Suzanna L. Simpson Date: 2/18/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 8 min

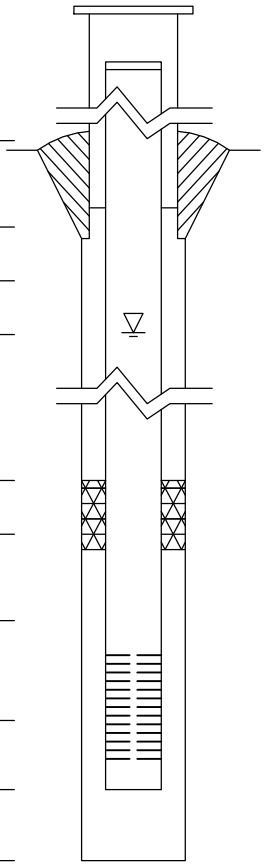
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
632.18	-2.88	Top of Protective Casing
631.87	-2.57	Top of Riser Pipe
629.30	0.00	Ground Surface
624.22	5.08	Top of Annular Sealant
615.45	13.85	Static Water Level (After Completion) 3/1/2010
618.14	11.16	Top of Seal
616.22	13.08	Top of Sand Pack
614.20	15.10	Top of Screen
609.68	19.62	Bottom of Screen
609.09	20.21	Bottom of Well
607.22	22.08	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.67
Bottom of Screen to End Cap	(feet)	0.59
Screen Length (1st slot to last slot)	(feet)	4.52
Total Length of Casing	(feet)	22.78
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G121

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G121

~~State Plane~~ Plant Coordinate: X 2,513,904.4 Y 875,964.6 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 2/4/2010 Date Finished: 2/4/2010

Report Form Completed By: Suzanna L. Simpson Date: 2/18/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 7 min

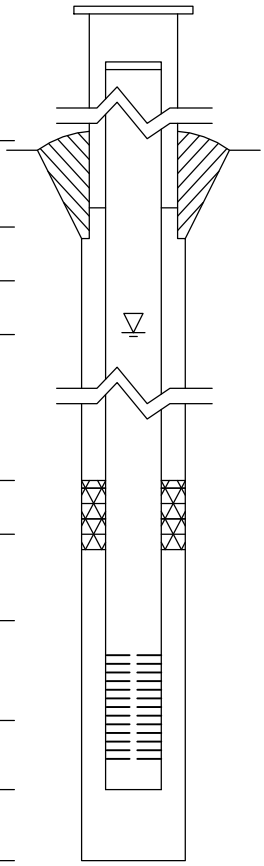
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.14	-3.57	Top of Protective Casing
632.83	-3.26	Top of Riser Pipe
629.57	0.00	Ground Surface
624.41	5.16	Top of Annular Sealant
615.13	14.44	Static Water Level (After Completion) 3/1/2010
616.81	12.76	Top of Seal
615.49	14.08	Top of Sand Pack
612.78	16.79	Top of Screen
608.10	21.47	Bottom of Screen
607.62	21.95	Bottom of Well
605.41	24.16	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: (Steel)
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	20.05
Bottom of Screen to End Cap	(feet)	0.48
Screen Length (1st slot to last slot)	(feet)	4.68
Total Length of Casing	(feet)	25.21
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G122

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G122

~~State Plane~~ Plant Coordinate: X 2,513,902.8 Y 876,080.1 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Diane M. Lamb Date Started: 2/4/2010 Date Finished: 2/4/2010

Report Form Completed By: Diane M. Lamb Date: 2/9/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 10 min

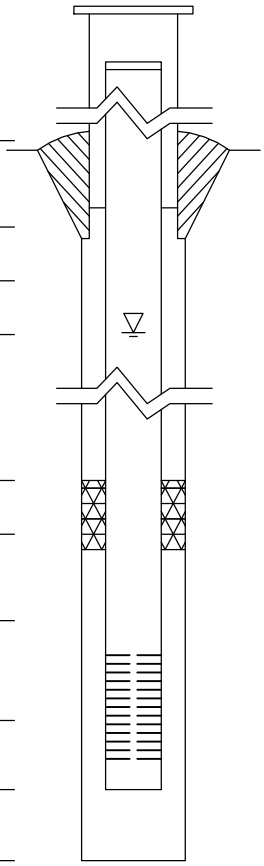
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
632.98	-3.12	Top of Protective Casing
632.69	-2.83	Top of Riser Pipe
629.86	0.00	Ground Surface
625.01	4.85	Top of Annular Sealant
617.02	12.84	Static Water Level (After Completion) 3/1/2010
617.01	12.85	Top of Seal
615.41	14.45	Top of Sand Pack
613.35	16.51	Top of Screen
608.81	21.05	Bottom of Screen
608.20	21.66	Bottom of Well
608.01	21.85	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	19.34
Bottom of Screen to End Cap	(feet)	0.61
Screen Length (1st slot to last slot)	(feet)	4.54
Total Length of Casing	(feet)	24.49
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G123

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G123

~~State Plane~~ Plant Coordinate: X 2,513,901.5 Y 876,189.6 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Diane M. Lamb Date Started: 2/3/2010 Date Finished: 2/4/2010

Report Form Completed By: Diane M. Lamb Date: 2/9/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 10 min

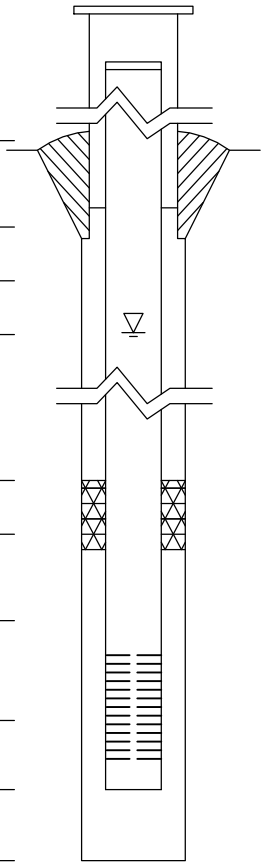
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.29	-3.16	Top of Protective Casing
632.96	-2.83	Top of Riser Pipe
630.13	0.00	Ground Surface
625.06	5.07	Top of Annular Sealant
614.15	15.98	Static Water Level (After Completion) 3/1/2010
612.31	17.82	Top of Seal
611.14	18.99	Top of Sand Pack
609.19	20.94	Top of Screen
604.67	25.46	Bottom of Screen
604.06	26.07	Bottom of Well
604.06	26.07	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	23.77
Bottom of Screen to End Cap	(feet)	0.61
Screen Length (1st slot to last slot)	(feet)	4.52
Total Length of Casing	(feet)	28.90
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G124

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G124

~~State Plane~~ Plant Coordinate: X 2,513,900.3 Y 876,304.9 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 2/3/2010 Date Finished: 2/3/2010

Report Form Completed By: Suzanna L. Simpson Date: 2/5/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 10 min

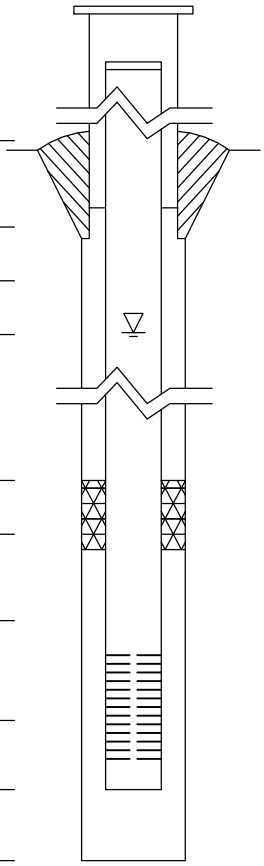
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.70	-3.28	Top of Protective Casing
633.39	-2.97	Top of Riser Pipe
630.42	0.00	Ground Surface
625.45	4.97	Top of Annular Sealant
619.43	10.99	Static Water Level (After Completion) 3/1/2010
618.34	12.08	Top of Seal
616.50	13.92	Top of Sand Pack
614.44	15.98	Top of Screen
609.91	20.51	Bottom of Screen
609.36	21.06	Bottom of Well
608.45	21.97	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	18.95
Bottom of Screen to End Cap	(feet)	0.55
Screen Length (1st slot to last slot)	(feet)	4.53
Total Length of Casing	(feet)	24.03
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G125

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G125

~~State Plane~~ Plant Coordinate: X 2,513,899.1 Y 876,409.5 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 2/2/2010 Date Finished: 2/3/2010

Report Form Completed By: Suzanna L. Simpson Date: 2/5/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 10 min

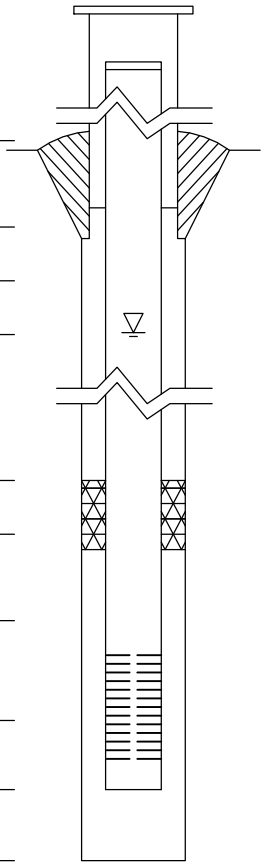
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
633.82	-3.14	Top of Protective Casing
633.51	-2.83	Top of Riser Pipe
630.68	0.00	Ground Surface
625.77	4.91	Top of Annular Sealant
622.10	8.58	Static Water Level (After Completion) 3/1/2010
617.15	13.53	Top of Seal
615.95	14.73	Top of Sand Pack
613.65	17.03	Top of Screen
609.12	21.56	Bottom of Screen
608.64	22.04	Bottom of Well
608.64	22.04	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	19.86
Bottom of Screen to End Cap	(feet)	0.58
Screen Length (1st slot to last slot)	(feet)	4.53
Total Length of Casing	(feet)	24.97
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G126

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: G126

~~State Plane~~ Plant Coordinate: X 2,513,895.4 Y 875,062.4 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Diane M. Lamb Date Started: 2/10/2010 Date Finished: 2/10/2010

Report Form Completed By: Diane M. Lamb Date: 2/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Granular

Setting Time: 10 min

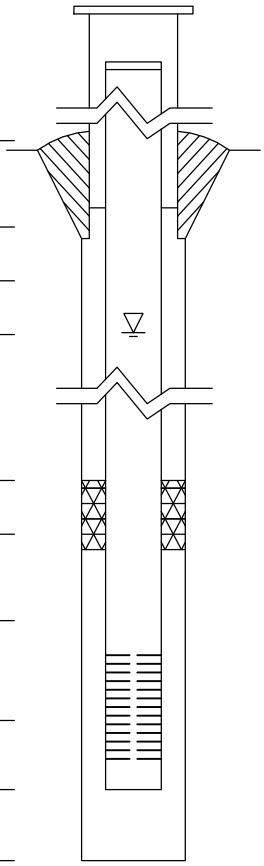
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.69	-2.73	Top of Protective Casing
625.39	-2.43	Top of Riser Pipe
622.96	0.00	Ground Surface
619.96	3.00	Top of Annular Sealant
614.14	8.82	Static Water Level (After Completion) 3/1/2010
613.96	9.00	Top of Seal
612.86	10.10	Top of Sand Pack
610.07	12.89	Top of Screen
605.53	17.43	Bottom of Screen
604.96	18.00	Bottom of Well
604.96	18.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	15.32
Bottom of Screen to End Cap	(feet)	0.57
Screen Length (1st slot to last slot)	(feet)	4.54
Total Length of Casing	(feet)	20.43
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: T127

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: T127

~~State Plane~~ Plant Coordinate: X 2,513,911.0 Y 875,359.2 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: _____ IL Registration #: _____

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Diane M. Lamb Date Started: 2/10/2010 Date Finished: 2/10/2010

Report Form Completed By: Diane M. Lamb Date: 2/19/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Granular

Setting Time: 10 min

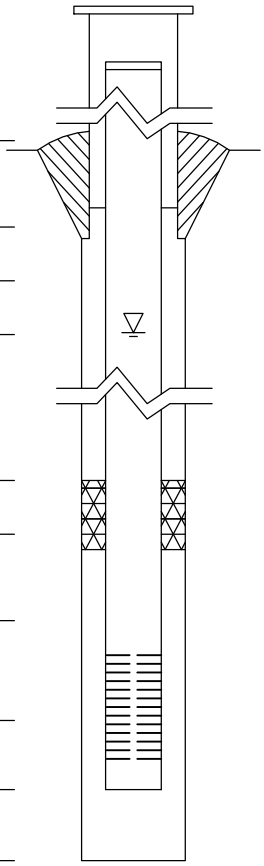
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
631.29	-3.22	Top of Protective Casing
630.96	-2.89	Top of Riser Pipe
628.07	0.00	Ground Surface
622.43	5.64	Top of Annular Sealant
616.81	11.26	Static Water Level (After Completion) 3/1/2010
613.43	14.64	Top of Seal
612.32	15.75	Top of Sand Pack
610.54	17.53	Top of Screen
606.00	22.07	Bottom of Screen
605.43	22.64	Bottom of Well
605.43	22.64	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	20.42
Bottom of Screen to End Cap	(feet)	0.57
Screen Length (1st slot to last slot)	(feet)	4.54
Total Length of Casing	(feet)	25.53
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: T128

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: T128

~~State Plane~~ Plant Coordinate: X 2,513,909.5 Y 875,509.7 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: _____ IL Registration #: _____

Drilling Contractor: Layne-Western Co Driller: T. List

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Suzanna L. Simpson Date Started: 2/9/2010 Date Finished: 2/9/2010

Report Form Completed By: Suzanna L. Simpson Date: 2/18/2010

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Granular

Setting Time: 10 min

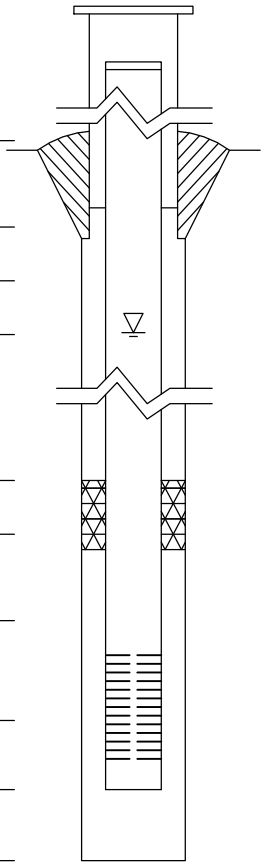
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
631.23	-2.79	Top of Protective Casing
630.93	-2.49	Top of Riser Pipe
628.44	0.00	Ground Surface
623.38	5.06	Top of Annular Sealant
616.09	12.35	Static Water Level (After Completion) 3/1/2010
615.53	12.91	Top of Seal
614.13	14.31	Top of Sand Pack
611.91	16.53	Top of Screen
607.40	21.04	Bottom of Screen
606.80	21.64	Bottom of Well
604.38	24.06	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: (Steel)
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	20.02
Bottom of Screen to End Cap	(feet)	0.60
Screen Length (1st slot to last slot)	(feet)	4.51
Total Length of Casing	(feet)	25.13
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: _____ Well #: TA31

Site Name: Coffeen Power Station Borehole #: TA31

State Plane Coordinate: X 2,513,856.8 Y 876,542.2 (or) Latitude: 39° 4' 16.930" Longitude: 89° 24' 4.920"

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Ramsey Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 10/28/2014 Date Finished: 10/28/2014

Report Form Completed By: Rhonald W. Hasenyager Date: 11/5/2014

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite

Installation Method: tremie

Setting Time: 45 min.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 30 min.

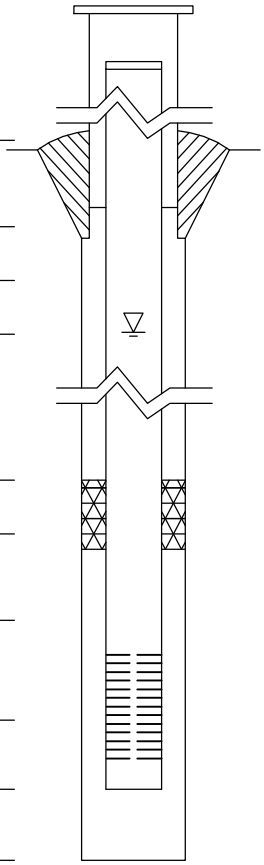
Type of Sand Pack: Quartz Sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity & Surge

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.90	-3.01	Top of Protective Casing
626.55	-2.66	Top of Riser Pipe
623.89	0.00	Ground Surface
620.89	3.00	Top of Annular Sealant
615.78	8.11	Static Water Level (After Completion) 10/30/2014
613.56	10.33	Top of Seal
610.81	13.08	Top of Sand Pack
608.80	15.09	Top of Screen
604.32	19.57	Bottom of Screen
603.70	20.19	Bottom of Well
603.70	20.19	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.82
Bottom of Screen to End Cap	(feet)	0.55
Screen Length (1st slot to last slot)	(feet)	4.48
Total Length of Casing	(feet)	22.85
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: _____ Well #: TA32

Site Name: Coffeen Power Station Borehole #: TA32

State Plane Coordinate: X 2,513,605.2 Y 877,532.6 (or) Latitude: 39° 4' 26.730" Longitude: 89° 24' 8.000"

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Ramsey Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 10/27/2014 Date Finished: 10/27/2014

Report Form Completed By: Rhonald W. Hasenyager Date: 11/5/2014

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite

Installation Method: tremie

Setting Time: 30 min.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 35 min.

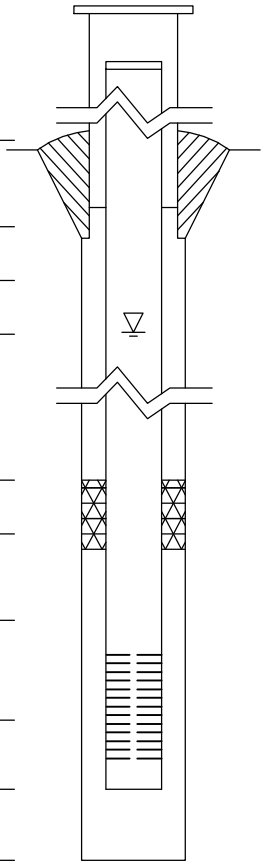
Type of Sand Pack: Quartz Sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
621.76	-2.83	Top of Protective Casing
621.42	-2.49	Top of Riser Pipe
618.93	0.00	Ground Surface
616.03	2.90	Top of Annular Sealant
604.88	14.05	Static Water Level (After Completion) 10/30/2014
611.09	7.84	Top of Seal
609.18	9.75	Top of Sand Pack
607.62	11.31	Top of Screen
603.25	15.68	Bottom of Screen
602.46	16.47	Bottom of Well
602.46	16.47	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	13.94
Bottom of Screen to End Cap	(feet)	0.65
Screen Length (1st slot to last slot)	(feet)	4.37
Total Length of Casing	(feet)	18.96
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: TA33

Site Name: Coffeen Well Sealing & Assmt Well Install Borehole #: TA33b

State Plane Coordinate: X 2,513,248.7 Y 876,605.4 (or) Latitude: 39° 4' 17.500" Longitude: 89° 24' 12.700"

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Ramsey Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): None

Logged By: Suzanna L. Keim Date Started: 6/2/2015 Date Finished: 6/2/2015

Report Form Completed By: Suzanna L. Keim Date: 6/4/2015

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >48 hrs.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 30 minutes

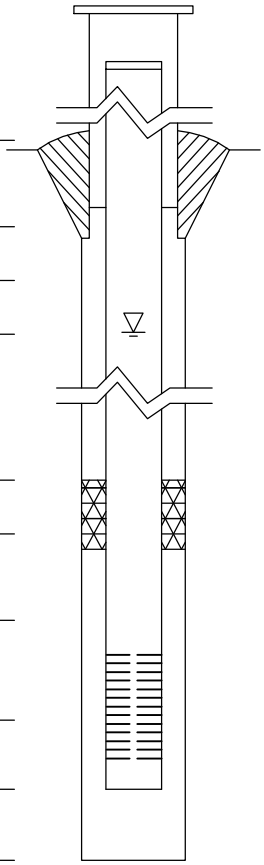
Type of Sand Pack: Quartz sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.05	-2.54	Top of Protective Casing
625.27	-2.76	Top of Riser Pipe
622.51	0.00	Ground Surface
620.51	2.00	Top of Annular Sealant
615.51	7.00	Static Water Level (After Completion) 6/16/2015
614.51	8.00	Top of Seal
612.11	10.40	Top of Sand Pack
610.28	12.23	Top of Screen
605.62	16.89	Bottom of Screen
605.07	17.44	Bottom of Well
605.07	17.44	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	7.5
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	14.99
Bottom of Screen to End Cap	(feet)	0.55
Screen Length (1st slot to last slot)	(feet)	4.66
Total Length of Casing	(feet)	20.20
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: TA34

Site Name: Coffeen Well Sealing & Assmt Well Install Borehole #: TA34

State Plane Coordinate: X 2,513,466.7 Y 875,906.1 (or) Latitude: 39° 4' 10.500" Longitude: 89° 24' 10.000"

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Ramsey Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): None

Logged By: Suzanna L. Keim Date Started: 6/3/2015 Date Finished: 6/3/2015

Report Form Completed By: Suzanna L. Keim Date: 6/4/2015

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: 1 hour

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: n/a

Setting Time: n/a

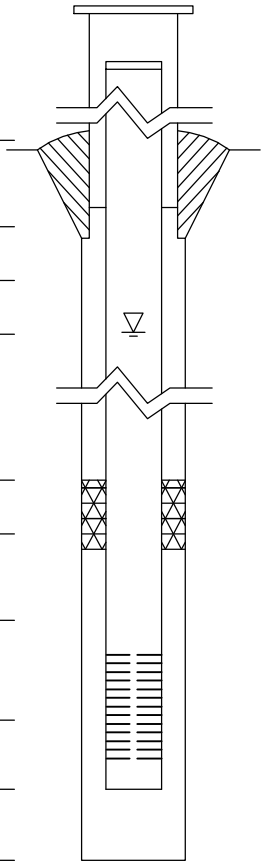
Type of Sand Pack: Quartz sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



	Elevations (MSL)*	Depths (BGS) (0.01 ft.)
Top of Protective Casing	626.77	-2.67
Top of Riser Pipe	626.52	-2.42
Ground Surface	624.10	0.00
Top of Annular Sealant	623.10	1.00
Static Water Level (After Completion) 6/16/2015	616.00	8.10
Top of Seal	n/a	n/a
Top of Sand Pack	615.10	9.00
Top of Screen	613.18	10.92
Bottom of Screen	608.69	15.41
Bottom of Well	608.00	16.10
Bottom of Borehole	608.00	16.10

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	7.5
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	13.34
Bottom of Screen to End Cap	(feet)	0.69
Screen Length (1st slot to last slot)	(feet)	4.49
Total Length of Casing	(feet)	18.52
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

APPENDIX A5

SOUTHWEST POND

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 12/19/2011
Finish: 12/19/2011
WEATHER: Cloudy, rain (mid-60's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. McCuan
Eng/Geo: R. Fiorito

BOREHOLE ID: G151
Well ID: G151
Surface Elev: 622.82 ft. MSL
Completion: 20.46 ft. BGS
Station: 875,023.67N
2,513,805.93E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 16.00 - While drilling
▼ = 11.50 - Upon completion
▽ = 7.79 - 12/21/2011

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	21/24 88%	ss	2-3 4-5 N=7			
2A	19/24 79%	ss	2-3 6-9 N=9			
3A	19/24 79%	ss	2-4 6-8 N=10			
4A	19/24 79%	ss	15-15 18-11 N=33			
5A	18/24 75%	ss	1-3 4-4 N=7			
6A	16/24 67%	ss	3-3 4-6 N=7			
7A	22/24 92%	ss	9-9 10-9 N=19			
8A	19/24 79%	ss	15-15 35-70 N=50			
9A	4/4 100%	ss	50/4"			
10A	10/23 43%	ss	12-18 70-99/5" N=88			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Light yellowish brown (10YR6/4), silty CLAY with some sand and gravel.	622
2	FILL - Brown (10YR5/3), silty CLAY with some sand and slight trace gravel.	620
4	FILL - Brown (10YR5/3), silty CLAY with some sand and slight trace gravel.	618
6	Brown (10YR5/3) with 30% gray (10YR6/1) mottles, clayey SILT with trace sand and slight trace gravel.	616
▽ 8	Brown (10YR5/3) with 30% gray (10YR6/1) mottles, silty CLAY with sand and gravel.	614
10		612
▼ 12	Light gray (10YR5/1) with 40% yellowish brown (10YR5/6) mottles, sandy CLAY with some silt and slight trace gravel.	610
14	Light brown (10YR5/3) silty SAND with slight trace gravel.	608
	Light gray (10YR6/1), silty SAND with slight trace gravel.	
▼ 16	Light brown (10YR6/4), silty SAND with some gravel.	606
18	Dark gray (10YR5/1), very silty CLAY with sand and trace gravel.	604
20		

End of Boring = 20.5 ft. BGS

NOTE(S): G151 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 12/20/2011
Finish: 12/20/2011
WEATHER: Cloudy, (mid-40's), rainy later.

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: B. Williamson
Helper: R. McCuan
Eng/Geo: R. Fiorito

BOREHOLE ID: G152
Well ID: G152
Surface Elev: 623.06 ft. MSL
Completion: 18.57 ft. BGS
Station: 874,687.53N
2,513,894.46E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.50 - While drilling
▼ = 3.05 - Upon completion
▽ = 17.00 - 12/21/2011

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	12/24 50%	ss	2-2 2-3 N=4			
2A	22/24 92%	ss	2-4 9-7 N=13			
2B						
3A	15/24 63%	ss	3-4 5-6 N=9			
3B						
5A	19/24 79%	ss	10-10 12-10 N=22			
5B	20/24 83%	ss	2-4 6-7 N=10			
6A	21/24 88%	ss	2-3 5-7 N=8			
7A	20/24 83%	ss	5-7 9-10 N=16			
8A	21/24 88%	ss	3-4 7-11 N=11			
8B						
9A	23/24 96%	ss	14-35 60-70 N=95			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark brown (10YR4/2), silty CLAY with trace sand and slight trace gravel.	
	Light yellowish brown (10YR6/4), silty CLAY with trace sand and slight trace gravel.	622
2		
	Gray (10YR6/1), silty CLAY with trace sand and slight trace gravel.	620
4		
	Gray (10YR6/1) and 25% brown (10YR5/6) mottles, silty CLAY with trace sand and slight trace gravel.	618
6		
	Gray (10YR5/1), clayey SILT silty CLAY with sand and slight trace gravel.	616
8		
	Gray (10YR5/1) with 25% brown (10YR5/6) mottles, silty CLAY with trace sand and slight trace gravel.	614
10		
	Gray (10YR6/1) with 25% yellowish brown (10YR5/6) mottles, silty CLAY with trace sand and slight trace gravel.	612
12		
	Gray (10YR6/1) with 25% yellowish brown (10YR5/6) mottles, clayey SAND with some silt and slight trace gravel.	610
14		
	Yellowish brown (10YR5/6) with 20% gray (10YR6/1), mottles, clayey SAND with some silt and slight trace gravel.	
	Yellowish brown (10YR5/6), silty SAND.	608
	Yellowish brown (10YR5/6), silty SAND with slight trace gravel.	
16		
	Dark grayish brown (10YR4/2), very silty CLAY with sand and trace gravel.	
	Grayish brown (10YR5/2) silty CLAY with sand and trace gravel.	606
18		

End of Boring = 18.6 ft. BGS

NOTE(S): G152 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 12/15/2011
Finish: 12/15/2011
WEATHER: Cloudy, windy, (mid-high 30's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: B. Williamson
Helper: R. McCuan
Eng/Geo: R. Fiorito

BOREHOLE ID: G153
Well ID: G153
Surface Elev: 623.30 ft. MSL
Completion: 20.76 ft. BGS
Station: 874,532.71N
2,513,532.68E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 16.00 - While drilling
▼ = 15.70 - Upon completion
▽ = 17.55 - 12/21/2011

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	16/24 67%	ss				
1B						
	17/24 71%	ss	woh-3 4-6 N=7			
2A						
3A	18/24 75%	ss	3-4 5-5 N=9			
4A	21/24 88%	ss	4-5 6-8 N=11			
5A	20/24 83%	ss	1-4 4-5 N=8			
	20/24 83%	ss	1-4 4-6 N=8			
6A						
	23/24 96%	ss	7-6 6-15 N=12			
7A						
8A	19/24 79%	ss	15-23 37-50 N=60			
9A	9/12 75%	ss	50-99			
	20/24 83%	ss	23-50 58-109 N=108			
10A	6/7 86%	ss	75-99/1"			
11A						

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	FILL - Light yellowish brown (10YR6/4), silty CLAY with sand and slight trace gravel.		
2	FILL - Gray (10YR6/1), silty CLAY with sand and slight trace gravel.	622	
4	Gray (10YR6/1) with 50% brownish yellow (10YR6/8) mottles, silty CLAY with trace sand.	620	
6	Gray (10YR5/1), silty CLAY with trace sand.	618	
8	Gray (10YR6/1), silty CLAY with sand and slight trace gravel.	616	
10	Gray (10YR6/1), silty CLAY with sand and slight trace gravel.	614	
	Gray (10YR6/1) with 50% brownish yellow (10YR6/8) mottles, silty CLAY with sand and slight trace gravel.	612	
12	Gray (10YR6/1) with 25% brownish yellow (10YR6/8) mottles, clayey SAND with trace silt.	610	
14	Yellowish brown (10YR5/8), silty SAND with slight trace gravel.	608	
16	Brownish yellow (10YR6/8), silty CLAY with sand and trace gravel.	606	
18	Dark gray (10YR4/1), silty CLAY with sand and trace gravel.	604	
20			

End of Boring = 20.8 ft. BGS

NOTE(S): G153 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 12/16/2011
Finish: 12/16/2011
WEATHER: Ptly. cloudy (mid-30's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: B. Williamson
Helper: R. McCuan
Eng/Geo: R. Fiorito

BOREHOLE ID: G154
Well ID: G154
Surface Elev: 623.52 ft. MSL
Completion: 20.00 ft. BGS
Station: 874,978.38N
2,513,243.10E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.45 - While drilling
▼ =
▽ = 11.10 - 12/21/2011

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
1A	14/24 58%	ss	3-4 4-5 N=8					FILL - Light yellowish brown (10YR6/4), silty CLAY with trace sand and slight trace gravel.	622	
							2			
2A	10/24 42%	ss	woh-1 4-5 N=5					Brownish yellow (10YR6/6) with 25% gray (10YR6/1) mottles, silty CLAY with trace sand.	620	
							4			
3A	14/24 58%	ss	2-4 6-7 N=10					Gray (10YR5/1) with 25% yellowish brown (10YR5/4) mottles, silty CLAY with trace sand.	618	
							6			
4A	21/24 88%	ss	6-8 10-10 N=18						616	
							8			
5A	16/24 67%	ss	1-4 6-8 N=10					Gray (10YR6/1) with 25% brownish yellow (10YR6/6) mottles, silty CLAY with trace sand and slight trace gravel.	614	
							10			
6A	13/24 54%	ss	1-4 6-8 N=10				▽		612	
							12			
7A	20/24 83%	ss	4-6 8-12 N=14					Gray (10YR6/1) with 10% brownish yellow (10YR6/8) mottles, silty CLAY with trace sand and slight trace gravel.		
							▼	Gray (10YR6/1), silty CLAY with trace sand and slight trace gravel.	610	
7B							14			
8A	23/24 96%	ss	4-18 30-37 N=48					Gray (10YR6/1), clayey SAND with trace silt.		
8B								Gray (10YR6/1) with 50% yellowish brown (10YR5/6) mottles, silty SAND with slight trace gravel.	608	
8C								Dark yellowish brown (10YR4/4), silty CLAY with sand and trace gravel.		
							16			
9A	21/24 88%	ss	40-75 86-84 N=161					Brown (10YR4/3), silty CLAY with sand and trace gravel.	606	
							18			
10A	20/24 83%	ss	28-28 30-34 N=58					Dark gray (10YR4/1), silty CLAY with sand and trace gravel.	604	
							20			

End of Boring = 20.0 ft. BGS

NOTE(S): G154 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 12/19/2011
Finish: 12/19/2011
WEATHER: Cloudy, rainy, (mid-40's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 4¼" HSA w/SS samplers
FIELD STAFF: Driller: B. Williamson
Helper: R. McCuan
Eng/Geo: R. Fiorito

BOREHOLE ID: G155
Well ID: G155
Surface Elev: 622.89 ft. MSL
Completion: 20.23 ft. BGS
Station: 875,127.65N
2,513,501.75E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.30 - While drilling
▼ = 12.90 - Upon completion
▽ = 7.90 - 12/21/2011

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	20/24 83%	ss	4-6 8-6 N=14			
2A	20/24 83%	ss	2-4 6-7 N=10			
3A	17/24 71%	ss	2-4 5-8 N=9			
4A	24/24 100%	ss	6-7 11-11 N=18			
5A	22/24 92%	ss	woh-3 6-6 N=9			
6A	17/24 71%	ss	2-4 6-6 N=10			
7A	24/24 100%	ss	6-8 10-12 N=18			
8A	23/24 96%	ss	woh-woh 4-15			
8B	16/16 100%	ss	15-50 99/4"			
9A						
10A	15/17 88%	ss	24-68 99/5"			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Yellow (10YR7/6), silty CLAY with trace sand and slight trace gravel.	
	FILL - Brown (10YR5/3), silty CLAY with sand and trace gravel.	622
	FILL - Brown (10YR5/3), silty CLAY with trace sand and slight trace gravel.	
2	FILL - Brownish yellow (10YR6/6), silty CLAY with trace sand and slight trace gravel.	620
	FILL - Dark grayish brown (10YR4/2), silty CLAY with trace sand and slight trace gravel.	
4	Gray (10YR5/1), silty CLAY with trace sand and slight trace gravel.	618
6	Brownish yellow (10YR6/6) with 10% gray (10YR6/1) mottles, silty CLAY with trace sand and slight trace gravel.	616
▽ 8	Dark gray (10YR4/1) with10% brown (10YR4/3) mottles, silty CLAY with trace sand and slight trace gravel.	614
10	Dark yellowish brown (10YR4/6) with 30% grayish brown (10YR5/2) mottles,silty CLAY with trace sand and slight trace gravel.	612
12	Gray (10YR6/1) with 50% yellowish brown (10YR5/6) mottles, clayey SAND with trace silt.	610
▼ 14	Yellowish brown (10YR6/4), clayey SAND with trace silt.	
	Yellowish brown (10YR5/6), silty SAND with slight trace gravel.	608
16	Yellowish brown (10YR5/6), silty SAND with slight trace gravel.	606
	Light brownish gray (10YR6/2), silty CLAY with sand and trace gravel.	
18	Light gray (10YR6/2), silty CLAY with sand and trace gravel.	604
20		

End of Boring = 20.2 ft. BGS

NOTE(S): G155 installed in borehole.

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G151

Site Name: CCB Management Facility Borehole #: G151

State Plane Coordinate: X 2,513,805.9 Y 875,023.7 (or) Latitude: _____ Longitude: _____

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Ryne M. Fiorito Date Started: 12/19/2011 Date Finished: 12/19/2011

Report Form Completed By: Rhonald W. Hasenyager Date: 12/27/2011

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 24 min

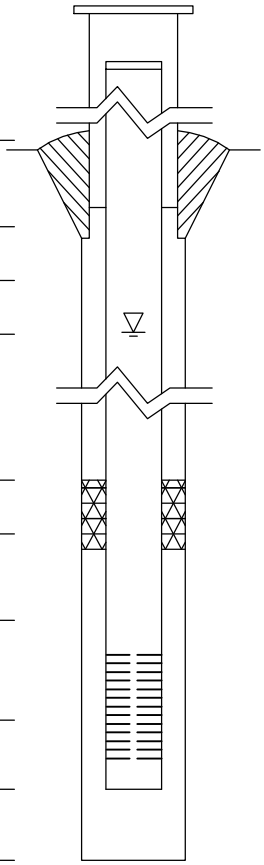
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.24	-3.42	Top of Protective Casing
625.93	-3.11	Top of Riser Pipe
622.82	0.00	Ground Surface
620.49	2.33	Top of Annular Sealant
615.03	7.79	Static Water Level (After Completion) 12/21/2011
611.82	11.00	Top of Seal
609.07	13.75	Top of Sand Pack
607.48	15.34	Top of Screen
602.98	19.84	Bottom of Screen
602.36	20.46	Bottom of Well
602.36	20.46	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	18.45
Bottom of Screen to End Cap	(feet)	0.62
Screen Length (1st slot to last slot)	(feet)	4.50
Total Length of Casing	(feet)	23.57
Screen Slot Size **	(inches)	0.010

Well Completion Form (revised 02/06/02)

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G152

Site Name: CCB Management Facility Borehole #: G152

State Plane Coordinate: X 2,513,894.5 Y 874,687.5 (or) Latitude: _____ Longitude: _____

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Ryne M. Fiorito Date Started: 12/20/2011 Date Finished: 12/20/2011

Report Form Completed By: Rhonald W. Hasenyager Date: 12/27/2011

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Seal extended to near surface

Installation Method: _____

Setting Time: _____

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: >24 hr.

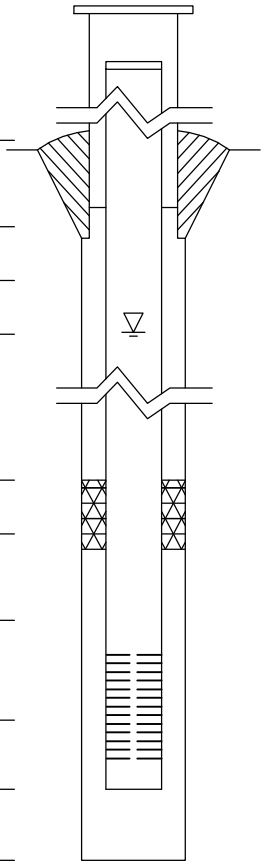
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.67	-3.61	Top of Protective Casing
626.52	-3.46	Top of Riser Pipe
623.06	0.00	Ground Surface
621.06	2.00	Top of Annular Sealant
606.06	17.00	Static Water Level (After Completion) 12/21/2011
621.06	2.00	Top of Seal
611.56	11.50	Top of Sand Pack
609.47	13.59	Top of Screen
604.97	18.09	Bottom of Screen
604.49	18.57	Bottom of Well
604.49	18.57	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.05
Bottom of Screen to End Cap	(feet)	0.48
Screen Length (1st slot to last slot)	(feet)	4.50
Total Length of Casing	(feet)	22.03
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G153

Site Name: CCB Management Facility Borehole #: G153

State Plane Coordinate: X 2,513,532.7 Y 874,532.7 (or) Latitude: _____ Longitude: _____

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Ryne M. Fiorito Date Started: 12/15/2011 Date Finished: 12/15/2011

Report Form Completed By: Rhonald W. Hasenyager Date: 12/27/2011

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: >24 hr.

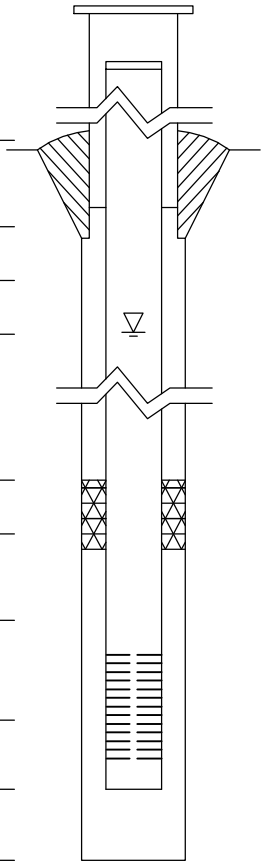
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.59	-3.29	Top of Protective Casing
626.35	-3.05	Top of Riser Pipe
623.30	0.00	Ground Surface
622.63	0.67	Top of Annular Sealant
605.75	17.55	Static Water Level (After Completion) 12/21/2011
610.30	13.00	Top of Seal
608.30	15.00	Top of Sand Pack
607.40	15.90	Top of Screen
602.96	20.34	Bottom of Screen
602.54	20.76	Bottom of Well
602.54	20.76	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	18.95
Bottom of Screen to End Cap	(feet)	0.42
Screen Length (1st slot to last slot)	(feet)	4.44
Total Length of Casing	(feet)	23.81
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G154

Site Name: CCB Management Facility Borehole #: G154

State Plane Coordinate: X 2,513,243.1 Y 874,978.4 (or) Latitude: _____ Longitude: _____

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Ryne M. Fiorito Date Started: 12/16/2011 Date Finished: 12/16/2011

Report Form Completed By: Rhonald W. Hasenyager Date: 12/27/2011

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 24 min

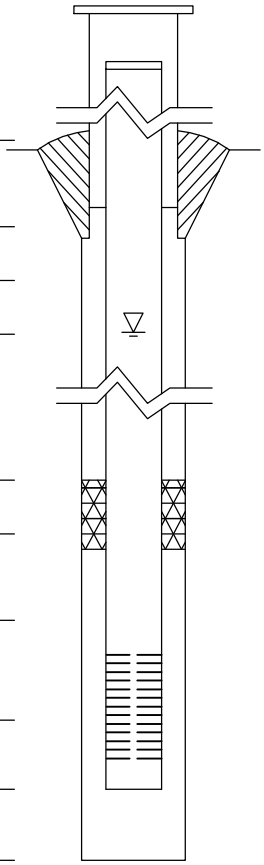
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.55	-3.03	Top of Protective Casing
626.35	-2.83	Top of Riser Pipe
623.52	0.00	Ground Surface
622.44	1.08	Top of Annular Sealant
612.42	11.10	Static Water Level (After Completion) 12/21/2011
613.02	10.50	Top of Seal
610.02	13.50	Top of Sand Pack
609.26	14.26	Top of Screen
604.76	18.76	Bottom of Screen
604.42	19.10	Bottom of Well
603.52	20.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.09
Bottom of Screen to End Cap	(feet)	0.34
Screen Length (1st slot to last slot)	(feet)	4.50
Total Length of Casing	(feet)	21.93
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G155

Site Name: CCB Management Facility Borehole #: G155

State Plane Coordinate: X 2,513,501.8 Y 875,127.7 (or) Latitude: _____ Longitude: _____

Surveyed By: Jeffrey D. Emrick IL Registration #: 035-003507

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): n/a

Logged By: Ryne M. Fiorito Date Started: 12/19/2011 Date Finished: 12/19/2011

Report Form Completed By: Rhonald W. Hasenyager Date: 12/27/2011

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 27 min

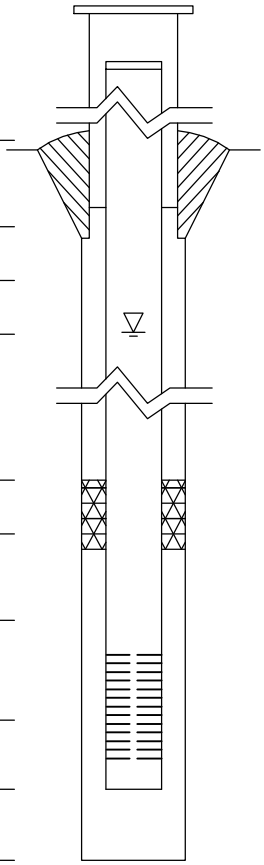
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.07	-3.18	Top of Protective Casing
625.86	-2.97	Top of Riser Pipe
622.89	0.00	Ground Surface
621.39	1.50	Top of Annular Sealant
614.99	7.90	Static Water Level (After Completion) 12/21/2011
611.89	11.00	Top of Seal
609.14	13.75	Top of Sand Pack
607.80	15.09	Top of Screen
603.31	19.58	Bottom of Screen
602.66	20.23	Bottom of Well
602.66	20.23	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	18.28
Bottom of Screen to End Cap	(feet)	0.43
Screen Length (1st slot to last slot)	(feet)	4.49
Total Length of Casing	(feet)	23.20
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

APPENDIX A6

ASH POND 1

FIELD BORING LOG

HANSON

CLIENT: Natural Resource Technology, Inc.
Site: Coffeen Energy Center
Location: Coffeen, Illinois
Project: 15E0030
DATES: Start: 9/8/2015
Finish: 9/8/2015
WEATHER: Sunny, hi 70's

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: D-50 Turbo Tracked MST 800ATV
Drilling Method: Hollow Stem Auger (3¼"overdrill / 4¼")
FIELD STAFF: Driller: D. Crump
Helper: D. Groves
Eng/Geo: K. Theesfeld

BOREHOLE ID: G281
Well ID: G281
Surface Elev: 623.82 ft. MSL
Completion: 20.29 ft. BGS
Station: 2,514,455.48N
874,375.37E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	17/24 71%	SS	15-10 7-6 N=17	14		
2A	19/24 79%	SS	2-4 5-5 N=9	25		1.50
3A	22/24 92%	SS	2-2 3-4 N=5	23		0.40
4A	24/24 100%	SS	5-5 6-6 N=11	19		1.20
5A	20/24 83%	SS	2-2 3-4 N=5	21		1.40
6A	22/24 92%	SS	2-2 3-3 N=5	18		0.50
7A	17/24 71%	SS	3-4 5-5 N=9	19		0.30
	19/24 79%	SS	3-11 21-28 N=32			
	24/24 100%	SS	21-36 39-50 N=75			
8A	11/24 46%	SS	16-9 30-50 N=39	7		4.50
	0/3 0%	BD				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Light gray (10YR7/2), dry, very stiff, SILT with little clay and trace gravel.	
	Yellowish brown (10YR5/4) with 5% dark brown (10YR3/3) mottles, dry, very stiff, SILT with few clay and trace gravel.	622
2	Yellowish brown (10YR5/4) with 15% dark yellowish brown (10YR4/6) and 5% dark brown (10YR3/3) mottles, moist, stiff, SILT with few clay.	
4	Yellowish brown (10YR5/4) with 15% dark yellowish brown (10YR4/6) mottles, moist, medium, CLAY with some silt and trace fine-grained sand and small gravel.	620
6	Yellowish brown (10YR5/4) with 15% dark yellowish brown (10YR4/6) and 5% dark brown (10YR3/3) mottles, moist, stiff, CLAY with some silt and trace fine-grained sand and small gravel.	618
8	Yellowish brown (10YR5/4) with 30% dark yellowish brown (10YR4/6) and 5% dark brown (10YR3/3) mottles, moist, stiff, SILT with some clay and trace very fine- to fine-grained sand and small gravel.	616
10	Dark yellowish brown (01YR4/6) with 30% yellowish brown (10YR5/4) mottles, moist, soft, SILT with few clay and little fine- to coarse-grained sand and small gravel, trace wood fragments.	614
12	Dark yellowish brown (01YR4/6) with 15% yellowish brown (10YR5/4) mottles, moist, soft, SILT with few clay and very fine- to fine-grained sand and trace small gravel.	612
▼ 14	Dark yellowish brown (10YR4/4), wet, dense, very fine- to fine-grained SAND with some silt, few clay and trace small gravel.	610
16	Dark yellowish brown (10YR4/4), wet, dense, very fine- to fine-grained SAND with few silt, little clay and trace small gravel.	608
18	Yellowish brown (10YR5/6) with 5% strong brown (7.5YR5/6) mottles, moist, hard, SILT with few clay and little fine-grained sand and small gravel.	606
20	Dark grayish brown (10YR4/2) with 5% strong brown (7.5YR5/6) mottles, moist, hard, SILT with few clay and little fine-grained sand and small gravel.	604

End of boring = 20.29 feet

NOTE(S): G281 installed in borehole.

FIELD BORING LOG

CLIENT: Natural Resource Technology, Inc.
Site: Coffeen Energy Center
Location: Coffeen, Illinois
Project: 15E0030
DATES: Start: 9/4/2015
Finish: 9/4/2015
WEATHER: Sunny, hi 70's

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: D-50 Turbo Tracked MST 800ATV
Drilling Method: Hollow Stem Auger (3¼"overdrill / 4¼")
FIELD STAFF: Driller: D. Crump
Helper: D. Groves
Eng/Geo: K. Theesfeld

BOREHOLE ID: G301
Well ID: G301
Surface Elev: 620.27 ft. MSL
Completion: 16.21 ft. BGS
Station: 2,515,582.97N
872,234.82E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.00 - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	19/24 79%	SS	4-4 3-5 N=7	18		1.80
2A	22/24 92%	SS	2-4 4-6 N=8	26		2.40
3A	21/24 88%	SS	2-2 3-4 N=5	22		1.30
4A	24/24 100%	SS	6-4 6-6 N=10	19		1.10
5A	21/24 88%	SS	1-2 3-4 N=5	21		
6A	24/24 100%	SS	3-2 3-3 N=5	19		0.80
7A	24/24 100%	SS	2-4 6-21 N=10	13		1.60
8A	21/24 88%	SS	20-27 50 N=77	7		4.50
	0/3 0%	BD				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Brown (10YR4/3), moist, stiff, SILT with few clay, trace organics.	620	
2	Brown (10YR5/3) with 30% yellowish brown (10YR5/6) mottles, moist, stiff, SILT with few clay, trace organics.	618	
	Brown (10YR5/3) with 30% yellowish brown (10YR5/6) mottles, moist, stiff, SILT with few clay, trace very fine- to medium-grained sand.		
4	Brown (10YR5/3) with 15% yellowish brown (10YR5/6) mottles, moist, stiff, CLAY with some silt and trace very fine- to medium-grained sand.	616	
6	Brown (10YR5/3) with 10% yellowish brown (10YR5/6) mottles, moist, medium to stiff, CLAY with some silt and little very fine- to coarse-grained sand and small gravel.	614	
8	Brown (10YR5/3) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, SILT with some clay and little very fine- to coarse-grained sand and small gravel.	612	
10	Brown (10YR5/3) with 20% yellowish brown (10YR5/6) mottles, moist, stiff, SILT with some clay and little very fine- to coarse-grained sand and small gravel.	610	
▼ 12	Yellowish brown (10YR5/6) with 10% grayish brown (10YR5/2) and 5% yellowish brown (10YR5/4) mottles, wet, stiff, SILT with few clay and little fine- to coarse-grained sand and small gravel.	608	
14	Grayish brown (10YR5/2) with 5% brown (10YR5/3) mottles, dry, hard, SILT with few clay, very fine- to coarse-grained sand and small gravel.	606	
16			

End of boring = 16.21 feet

NOTE(S): G301 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Natural Resource Technology, Inc.
Site: Coffeen Energy Center
Location: Coffeen, Illinois
Project: 15E0030
DATES: Start: 9/3/2015
Finish: 9/4/2015
WEATHER: Sunny, hi 70's

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: D-50 Turbo Tracked MST 800ATV
Drilling Method: Hollow Stem Auger (3¼"overdrill / 4¼")
FIELD STAFF: Driller: D. Crump
Helper: D. Groves
Eng/Geo: K. Theesfeld

BOREHOLE ID: G302
Well ID: G302
Surface Elev: 617.95 ft. MSL
Completion: 18.39 ft. BGS
Station: 2,516,214.19N
872,252.95E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	23/24 96%	SS	5-5 5-6 N=10	17		1.50
2A	20/24 83%	SS	2-3 4-4 N=7	27		2.60
3A	21/24 88%	SS	1-2 3-4 N=5	26		1.80
4A	24/24 100%	SS	4-7 8-8 N=15	18		1.60
5A	24/24 100%	SS	2-3 5-5 N=8	17		1.80
6A	18/24 75%	SS	2-2 4-5 N=6	19		
7A	24/24 100%	SS	7-7 8-8 N=15	16		1.70
8A				18		0.80
8B	22/24 92%	SS	2-5 25-32 N=30	12		4.50
9A	24/24 100%	SS	7-24 48-38 N=72	8		4.50
	0/5 0%	BD				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Yellowish brown (10YR5/6) to dark yellowish brown (10YR4/6), moist, hard, SILT with some clay and trace fine-grained sand and small gravel.	
2	Very dark brown (10YR3/1), moist, hard, SILT with some clay and trace fine-grained sand and small gravel.	616
4	Dark grayish brown (10YR4/2) with very dark gray (10YR3/1) mottles, moist, stiff, CLAY with some silt and trace sand.	614
6	Brown (10YR5/3) with dark yellowish brown (10YR4/6) mottles, moist, stiff, CLAY with some silt and trace sand.	612
8	Brown (10YR5/3) with dark yellowish brown (10YR4/6) mottles, moist, stiff, CLAY with some silt and few very fine- to fine-grained sand.	610
10	Brown (10YR4/3) with dark yellowish brown (10YR4/6) mottles, moist, stiff, SILT with some clay and few sand.	608
12	Dark gray (10YR4/1), moist, stiff, SILT with some clay and few sand. Yellowish brown (10YR5/8) with reddish brown (5YR4/4) inclusions, moist, stiff, SILT with some clay and few sand.	606
▼ 14	Dark gray (10YR4/1), moist, stiff, SILT with some clay, few sand and trace small gravel.	604
	Grayish brown (10YR5/2), wet, hard, SILT with little clay and very fine-grained sand and trace small gravel.	
16	Brown (10YR5/3), wet, hard, SILT with little clay and very fine-grained sand and trace small gravel.	602
18	Brown (10YR5/3) grading to yellowish brown (10YR5/4), moist, hard, SILT with some clay, few small gravel.	600

End of boring = 18.39 feet

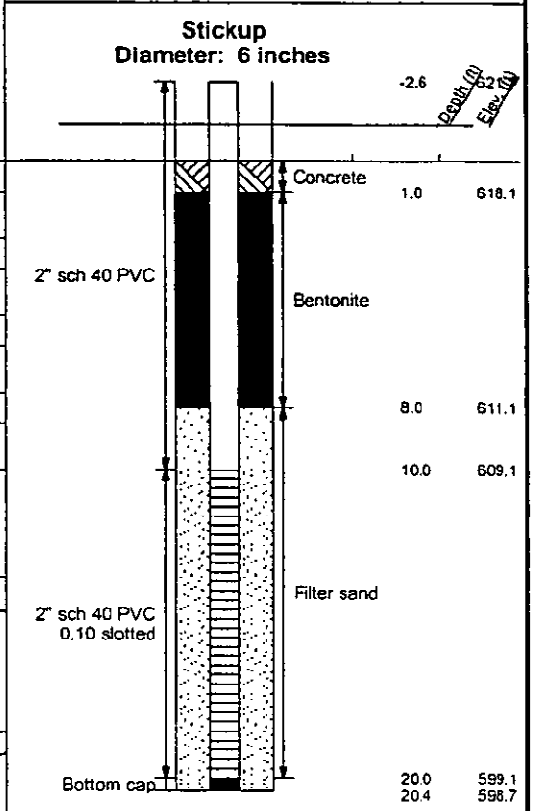
NOTE(S): G302 installed in borehole.

Surface Elevation: 619.10
Datum msl

Completion Date: 8/26/10
Northing: 871382.45
Easting: 2516641.06

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	FILL: brown, silty clay		1-2-3	SS1
	Medium stiff, grayish-brown, silty CLAY with lignite - CL		1-3-3	SS2
5			1-3-4	SS3
	Soft, brown, silty CLAY - CL		2-3-3	SS4
10	Stiff to hard, brown to grayish-brown, silty CLAY - CL (TILL)			
			27-44 -50/1"	SS5
15				
			44-50/2"	SS6
20	Boring terminated at 20 feet.			
25				
30				
35				

WELL DIAGRAM



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01-COFFEEN.GPJ GTINC 063301.GPJ 12/13/10

GROUNDWATER DATA

ENCOUNTERED AT 9 FEET ∇

DRILLING DATA

___ AUGER 4 1/4" HOLLOW STEM
WASHBORING FROM ___ FEET
MVU DRILLER SWG LOGGER
CME 55TRK DRILL RIG
HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: DJK	App'vd. by: RBC
Date: 9/10/10	Date: 1-4-11	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Ameren-Coffeen Ash Pond Evaluation

LOG OF BORING: APW-3
G303

Project No. J017150.01

Surface Elevation: 623.46

Datum msl

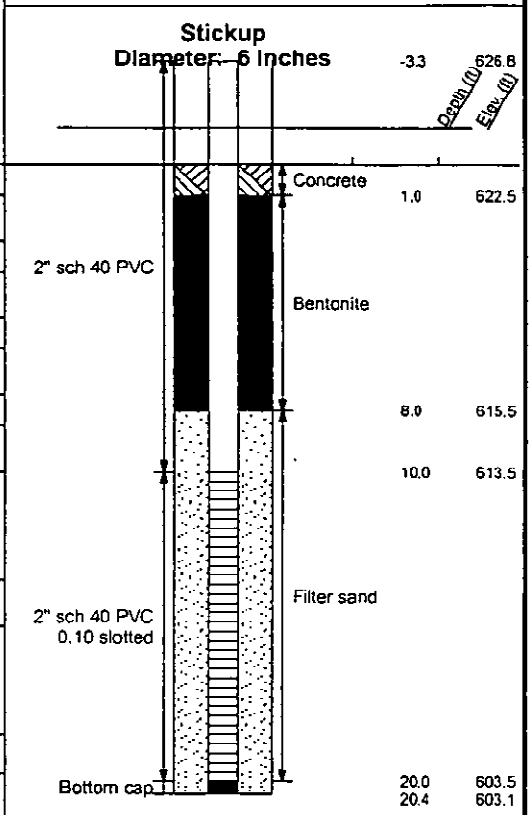
Completion Date: 8/26/10

Northing: 871397.48

Easting: 2515520.23

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium stiff, grayish-brown, silty CLAY - CL			
			0-1-1	SS1
			1-2-5	SS2
5			1-3-4	SS3
			1-2-3	SS4
10				
	Medium to fine SAND - SP		1-2-1	SS5
15	Hard, gray, silty CLAY - CL (TILL)			
			14-47	SS6
20	Boring terminated at 20 feet.			
25				
30				
35				

WELL DIAGRAM



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01- COFFEEN.GPJ GTINC 0638301.GPJ 12/13/10

GROUNDWATER DATA

ENCOUNTERED AT 14 FEET ∇

DRILLING DATA

__ AUGER 4 1/4" HOLLOW STEM

WASHBORING FROM __ FEET

MVU DRILLER SWG LOGGER

CME 55TRK DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: DTK	App'vd. by: RSJ
Date: 9/10/10	Date: 1-4-11	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Ameren-Coffeen Ash Pond Evaluation

LOG OF BORING: APW-4

G304

Project No. J017150.01

FIELD BORING LOG

CLIENT: Natural Resource Technology, Inc.
Site: Coffeen Power Station
Location: Coffeen, Illinois
Project: 15E0030
DATES: Start: 5/3/2016
Finish: 5/3/2016
WEATHER: Cloudy, breezy, warm, lo 60s

CONTRACTOR: Ramsey Geotechnical Engineering LLC
Rig mfg/model: D-50 Turbo Tracked MST 800ATV
Drilling Method: 4 ¼" HSA, split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Keim

BOREHOLE ID: G305
Well ID: G305
Surface Elev: 622.54 ft. MSL
Completion: 18.45 ft. BGS
Station: 2,515,199.36N
871,156.33E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 14, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 3.00 - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	14/24 58%	SS	2-2 5-7 N=7	12		
2A	17/24 71%	SS	6-7 7-6 N=14	19		
3A	18/24 75%	SS	3-3 6-4 N=9	28		
4A	16/24 67%	SS	6-6 7-8 N=13	24		
5A	23/24 96%	SS	1-3 5-6 N=8	21		
6A	21/24 88%	SS	3-4 6-6 N=10	21		
7A	24/24 100%	SS	8-8 9-9 N=17	18		
8A	19/24 79%	SS	3-3 4-4 N=7	18		
9A	22/24 92%	SS	1-3 7-14 N=10	19		
9B	0/5 0%	BD		15		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Grayish brown (10YR5/2), moist, soft, silty CLAY with few small to coarse sand and few small to large gravel.	622
	FILL - Black (10YR2/1), moist, loose, silty, fine- to coarse-grained SAND with little coal fragments.	
2	Gray (10YR6/1) and light yellowish brown (10YR6/4), moist, very stiff, SILT with little clay.	620
4	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, very stiff, silty CLAY with trace very fine-grained sand.	618
6	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY with trace very fine- to coarse-grained sand.	616
8	Dark gray (10YR4/1) with 25% dark yellowish brown (10YR4/6) mottles, moist, very stiff, silty CLAY with few fine- to coarse-grained sand and trace small gravel.	614
10	Gray (10YR5/1) with 35% dark yellowish brown (10YR4/6) mottles, moist, very stiff, silty CLAY with few fine- to coarse-grained sand and trace small gravel.	612
12	Yellowish brown (10YR5/8) with 15% gray (10YR5/1) mottles, moist, very stiff, silty CLAY with few fine- to coarse-grained sand and trace small gravel.	610
14	Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with little fine- to coarse-grained sand and trace small gravel.	608
	Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, moist, stiff, silty CLAY with some fine- to coarse-grained sand and trace small gravel.	
16	Brown (10YR5/3), wet, loose, very silty, very fine- to coarse-grained SAND with trace small gravel.	606
18	Brown (10YR5/3) with 40% yellowish brown (10YR5/8) mottles, moist, very stiff, SILT with little clay and trace fine- to coarse-grained sand.	

End of boring = 18.45 feet

NOTE(S): G305 installed in borehole.

FIELD BORING LOG

CLIENT: Natural Resource Technology, Inc.
Site: Coffeen Power Station
Location: Coffeen, Illinois
Project: 15E0030
DATES: Start: 5/3/2016
Finish: 5/3/2016
WEATHER: Sunny, calm, warm, lo 60s

CONTRACTOR: Ramsey Geotechnical Engineering LLC
Rig mfg/model: D-50 Turbo Tracked MST 800ATV
Drilling Method: 4 ¼" HSA, split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Keim

BOREHOLE ID: G306
Well ID: G306
Surface Elev: 622.84 ft. MSL
Completion: 18.00 ft. BGS
Station: 2,516,120.41N
871,140.98E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 14, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 5.50 - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type
1A	12/24 *50%*	ss	*1-3 3-4* N=6	14		
2A	24/24 *100%*	ss	*5-4 5-4* N=9	21		
2B				19		
3A	22/24 *92%*	ss	*2-2 3-3* N=5	30		
4A	20/24 *83%*	ss	*3-4 6-6* N=10	26		
5A	24/24 *100%*	ss	*2-2 3-3* N=5	23		
6A	22/24 *92%*	ss	*1-2 3-4* N=5	20		
7A	20/24 *83%*	ss	*5-6 6-6* N=12	21		
8A	20/24 *83%*	ss	*2-2 8-14* N=10	15		
8B				12		
9A	23/24 *96%*	ss	*14-17 28-50/5"* N=45	10		
9B				13		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark brown (10YR2/2), moist, medium, SILT with little clay and few very fine- to medium-grained sand, roots, trace coal fragments.	622
2	Dark gray (10YR4/1) with 5% dark yellowish brown (10YR3/6) mottles, moist, stiff, SILT with little clay and trace very fine- to medium-grained sand.	620
	Gray (10YR6/1) with 10% yellowish brown (10YR5/6) mottles, moist, very stiff, SILT with little clay and trace very fine-grained sand.	
4		618
▼ 6	Gray (10YR6/1) with 20% yellowish brown (10YR5/6) mottles, moist, very stiff, SILT with some clay and trace very fine-grained sand.	616
8		614
10	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, very stiff, silty CLAY with trace very fine- to coarse-grained sand.	612
12	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY with few very fine- to coarse-grained sand.	610
14	Yellowish brown (10YR5/6), wet, soft, very fine- to coarse-grained sandy CLAY with little silt.	608
	Yellowish brown (10YR5/6), wet, medium dense, silty, very fine- to medium-grained SAND with trace coarse-grained sand.	
16	Yellowish brown (10YR5/6), moist, dense, fine- to coarse-grained SAND with little silt, little very fine-grained sand, and trace small gravel.	606
	Brown (10YR5/3) with 20% dark yellowish brown (10YR4/6) mottles, moist, hard, SILT with little clay, few very fine- to coarse-grained sand, and trace small gravel.	
18		

End of boring = 18.0 feet

Borehole Detail

Remarks

NOTE(S): G306 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Power Station Ash Pond 1
Location: Coffeen, Illinois
Project: 16E0108
DATES: Start: 07/26/2016
Finish: 07/27/2016
WEATHER: Overcast, warm & humid (mid-80s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME 55LC Track Drill
Drilling Method: 4¼" Hollow Stem Auger w/Continuous Split Spoon
FIELD STAFF: Driller: J. Gates
Helper: C. Clines
Eng/Geo: R. Hasenyager

BOREHOLE ID: G307
Well ID: G307
Surface Elev: 622.08 ft. MSL
Completion: 18.22 ft. BGS
Station: 871,398.55N
2,515,553.26E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - during drilling
▼ = -1.76 - 7/27/2016 @ 07:30
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	18/24 75%	SS	1-3 3-2 N=6	22		
2A	22/24 92%	SS	2-1 3-3 N=4	28		
3A	24/24 100%	SS	1-2 3-4 N=5	26		
4A	24/24 100%	SS	1-3 3-3 N=6	18		
5A	24/24 100%	SS	3-3 4-5 N=7	19		
6A	24/24 100%	SS	3-3 4-5 N=7	20		
7A	24/24 100%	SS	woh-2 5-13 N=7	20		
7B				11		
8A	24/24 100%	SS	12-9 6-9 N=15	20		
9A	18/18 100%	SS	8-30 50 N=80	8		
	0/9 0%	BD				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Brown (10YR5/3), moist, stiff, SILT with few clay, trace sand, gravel and roots.	
2	Gray (10YR5/1), moist, soft, CLAY, with some silt, trace sand, gravel and roots.	620
4	Gray (10YR5/1) with 30% yellowish brown (10YR5/8) mottles, moist, soft, CLAY with some silt, trace sand, gravel and roots.	618
6		616
8	Yellowish brown (10YR5/6) with 20% gray (10YR5/1) mottles, moist, medium CLAY,with some silt, few very fine- to medium-grained sand, and trace gravel.	614
10		612
12	Gray (10YR5/1), moist, medium, CLAY with little silt and very fine to very coarse sand, trace gravel.	610
	Gray (10YR5/1) with 25% yellowish brown (10YR5/8) mottles, moist, soft, CLAY with some silt, trace sand and gravel.	
14	Gray (10YR6/1), wet, medium dense, very fine- to very coarse-grained SAND with few silt and trace clay.	608
	Yellow brown (10YR5/6), wet. medium dense, very fine- to very coarse-grained SAND, with little silt and trace gravel.	
16	Yellowish brown (10YR5/8), moist, hard, SILT with some clay, little very fine- to very coarse-grained sand and trace gravel.	606
	Gray (10YR5/1), moist, hard, SILT with some clay, little very fine- to very coarse-grained sand and trace gravel.	
18		604

End of boring = 18.2 feet

NOTE(S):

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G281

Site Name: Coffeen Power Station Borehole #: G281

State Plane Coordinate: X 874,375.4 Y 2,514,455.5 (or) Latitude: _____ Longitude: _____

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Ramsey Driller: D. Crump

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Kristen L. Theesfeld Date Started: 9/8/2015 Date Finished: 9/8/2015

Report Form Completed By: Suzanna L. Keim Date: 10/6/2015

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 minutes

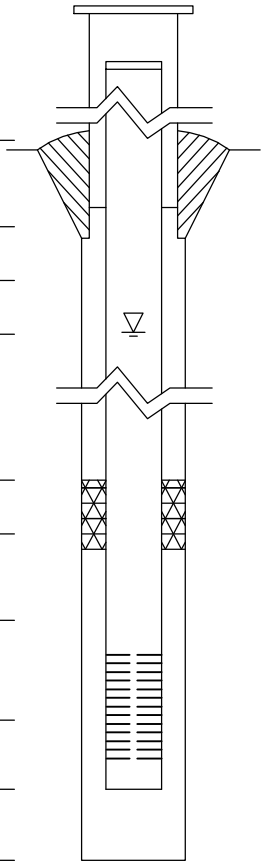
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.64	-2.82	Top of Protective Casing
626.36	-2.54	Top of Riser Pipe
623.82	0.00	Ground Surface
622.82	1.00	Top of Annular Sealant
		Static Water Level (After Completion)
612.59	11.23	Top of Seal
610.37	13.45	Top of Sand Pack
608.31	15.51	Top of Screen
603.66	20.16	Bottom of Screen
603.53	20.29	Bottom of Well
603.53	20.29	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.80
Bottom of Screen to End Cap	(feet)	0.38
Screen Length (1st slot to last slot)	(feet)	4.65
Total Length of Casing	(feet)	22.83
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G301

Site Name: Coffeen Power Station Borehole #: G301

State Plane Coordinate: X 872,234.8 Y 2,515,583.0 (or) Latitude: _____ Longitude: _____

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Ramsey Driller: D. Crump

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Kristen L. Theesfeld Date Started: 9/4/2015 Date Finished: 9/4/2015

Report Form Completed By: Suzanna L. Keim Date: 10/6/2015

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite Chips

Installation Method: Gravity

Setting Time: >24 hours

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 minutes

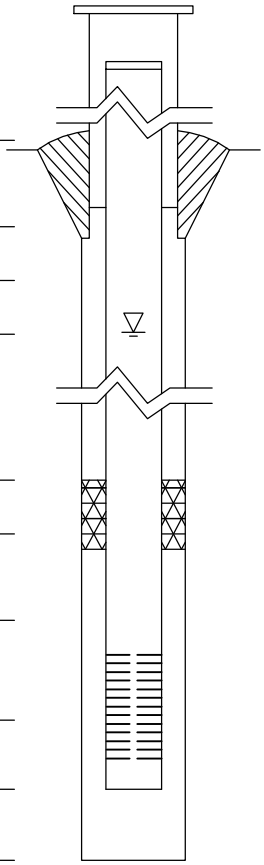
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
622.98	-2.71	Top of Protective Casing
622.65	-2.38	Top of Riser Pipe
620.27	0.00	Ground Surface
618.20	2.07	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
612.75	7.52	Top of Sand Pack
608.96	11.31	Top of Screen
604.31	15.96	Bottom of Screen
604.06	16.21	Bottom of Well
604.06	16.21	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	13.56
Bottom of Screen to End Cap	(feet)	0.38
Screen Length (1st slot to last slot)	(feet)	4.65
Total Length of Casing	(feet)	18.59
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G302

Site Name: Coffeen Power Station Borehole #: G302

State Plane Coordinate: X 872,253.0 Y 2,516,214.2 (or) Latitude: _____ Longitude: _____

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Ramsey Driller: D. Crump

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Kristen L. Theesfeld Date Started: 9/3/2015 Date Finished: 9/4/2015

Report Form Completed By: Suzanna L. Keim Date: 10/7/2015

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 minutes

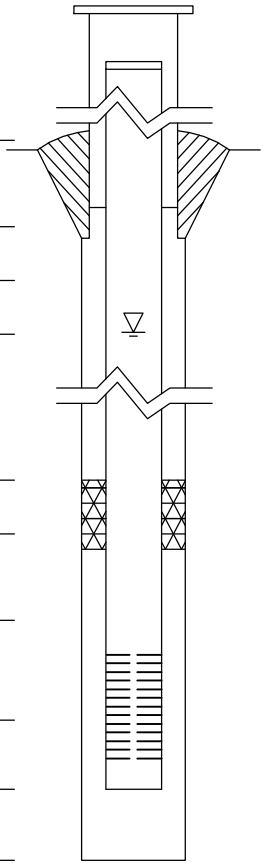
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
620.34	-2.39	Top of Protective Casing
620.04	-2.09	Top of Riser Pipe
617.95	0.00	Ground Surface
615.95	2.00	Top of Annular Sealant
		Static Water Level (After Completion)
607.78	10.17	Top of Seal
605.88	12.07	Top of Sand Pack
604.74	13.21	Top of Screen
600.09	17.86	Bottom of Screen
599.56	18.39	Bottom of Well
599.56	18.39	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	15.30
Bottom of Screen to End Cap	(feet)	0.53
Screen Length (1st slot to last slot)	(feet)	4.65
Total Length of Casing	(feet)	20.48
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G305

Site Name: Coffeen Power Station Borehole #: G305

State Plane Coordinate: X 871,156.3 Y 2,515,199.4 (or) Latitude: _____ Longitude: _____

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Ramsey Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna L. Keim Date Started: 5/3/2016 Date Finished: 5/3/2016

Report Form Completed By: Suzanna L. Keim Date: 5/19/2016

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite Chips

Installation Method: Gravity

Setting Time: >12 hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: n/a

Setting Time: n/a

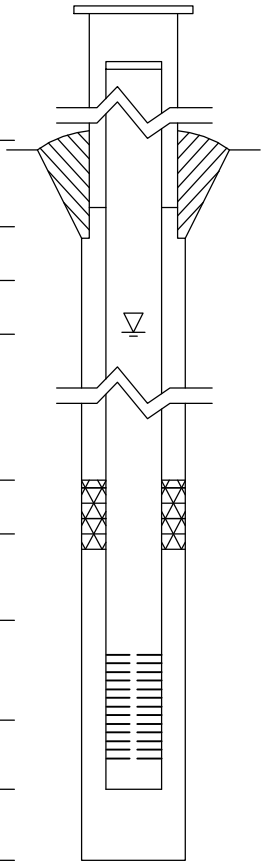
Type of Sand Pack: Quartz Sand

Grain Size: 10-40 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.88	-3.34	Top of Protective Casing
625.55	-3.01	Top of Riser Pipe
622.54	0.00	Ground Surface
621.54	1.00	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
611.04	11.50	Top of Sand Pack
609.10	13.44	Top of Screen
604.27	18.27	Bottom of Screen
604.09	18.45	Bottom of Well
604.09	18.45	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	16.45
Bottom of Screen to End Cap	(feet)	0.18
Screen Length (1st slot to last slot)	(feet)	4.83
Total Length of Casing	(feet)	21.46
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G306

Site Name: Coffeen Power Station Borehole #: G306

State Plane Coordinate: X 871,141.0 Y 2,516,120.4 (or) Latitude: _____ Longitude: _____

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Ramsey Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna L. Keim Date Started: 5/3/2016 Date Finished: 5/3/2016

Report Form Completed By: Suzanna L. Keim Date: 5/19/2016

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite Chips

Installation Method: Gravity

Setting Time: >12 hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: n/a

Setting Time: n/a

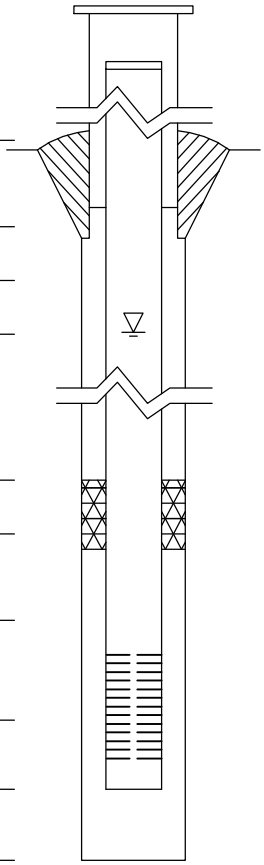
Type of Sand Pack: Quartz Sand

Grain Size: 10-40 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.12	-3.28	Top of Protective Casing
625.72	-2.88	Top of Riser Pipe
622.84	0.00	Ground Surface
621.84	1.00	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
611.24	11.60	Top of Sand Pack
609.77	13.07	Top of Screen
605.16	17.68	Bottom of Screen
604.98	17.86	Bottom of Well
604.84	18.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	15.95
Bottom of Screen to End Cap	(feet)	0.18
Screen Length (1st slot to last slot)	(feet)	4.61
Total Length of Casing	(feet)	20.74
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: G307

Site Name: Coffeen Power Station Ash Pond 1 Borehole #: G307

State Plane Coordinate: X 2,515,553.3 Y 871,398.6 (or) Latitude: _____ Longitude: _____

Surveyed By: Gary C. Rogers IL Registration #: 035-002957

Drilling Contractor: Bulldog Drilling, Inc. Driller: J. Gates

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 7/26/2016 Date Finished: 7/27/2016

Report Form Completed By: Rhonald W. Hasenyager Date: 7/28/2016

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite Chips

Installation Method: Gravity

Setting Time: 18 hrs.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: _____

Setting Time: _____

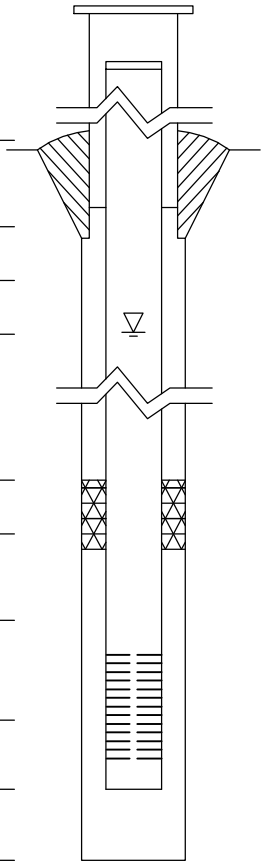
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: none (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
624.72	-2.64	Top of Protective Casing
624.47	-2.39	Top of Riser Pipe
622.08	0.00	Ground Surface
620.08	2.00	Top of Annular Sealant
623.84	-1.76	Static Water Level (After Completion) 7/27/2016
n/a	n/a	Top of Seal
610.10	11.98	Top of Sand Pack
609.12	12.96	Top of Screen
604.28	17.80	Bottom of Screen
603.86	18.22	Bottom of Well
603.86	18.22	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	15.37
Bottom of Screen to End Cap	(feet)	0.40
Screen Length (1st slot to last slot)	(feet)	4.84
Total Length of Casing	(feet)	20.61
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

APPENDIX A7

HISTORICAL BORING LOGS

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/3/2006
Finish: 5/3/2006
WEATHER: Overcast, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-01
Well ID: MW1D
Surface Elev: 607 ft. MSL
Completion: 40 ft. BGS
Station: 874,972.6N
2,513,478.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 34.00 - While drilling
▼ =
▽ = 36.28 - MW01D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	16/24 67%	ss	1-1 1-2 N=2	22		0.78 B
2A	20/24 83%	ss	2-3 5-5 N=8	13		3.71 BSh
3A	22/24 92%	ss	2-2 3-6 N=5	14		2.62 BSh
4A	23/24 96%	ss	8-12 19-19 N=31	13		3.30 BSh
5A	24/24 100%	ss	4-9 13-19 N=22	13		4.80 BSh
6A	22/24 92%	ss	3-6 12-15 N=18	12		8.73 B
7A	24/24 100%	ss	14-19 23-30 N=42	12		7.86 B
8A	24/24 100%	ss	4-8 12-14 N=20	13		7.56 B
9A	24/24 100%	ss	16-16 20-21 N=36	14		7.01 B
10A	24/24 100%	ss	3-5 8-11 N=13	14		5.24 B

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark gray (10YR3/1), clayey SILT, trace sand	606
2	Light gray (10YR7/1) with 40% yellowish brown (10YR5/8) mottles, clayey SILT, trace sand and gravel	604
4	Gray (10YR5/1) with 25% yellowish brown (10YR5/6) mottles, clayey SILT, trace sand and gravel	602
6	Yellowish brown (10YR5/6) with 20% black (10YR2/1) mottles, clayey SILT, little sand and gravel	600
8	Yellowish brown (10YR5/6) with 40% gray (N5/1) mottles, clayey SILT, trace sand and gravel	598
10		596
12	Dark gray (N4/1) with 25% yellowish brown (10YR5/6) mottles, clayey SILT, trace sand and gravel	594
14		592
16	Dark gray (N4/1), clayey SILT, trace sand and gravel	590
18		588
20		

Borehole Detail

Remarks

NOTE(S): MW01D installed in SB-01.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/3/2006
Finish: 5/3/2006
WEATHER: Overcast, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-01
Well ID: MW1D
Surface Elev: 607 ft. MSL
Completion: 40 ft. BGS
Station: 874,972.6N
2,513,478.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 34.00 - While drilling
▼ =
▽ = 36.28 - MW01D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
11A	24/24 100%	SH		15		3.69 B			586	Shelby tube taken from shallow well borehole at indicated depth.
12A	24/24 100%	SS	10-11 12-16 N=23	14		5.24 B	22		584	
13A	6/24 25%	SH		14		3.69 B	24		582	Shelby tube taken from shallow well borehole at indicated depth.
14A	24/24 100%	SS	10-12 18-18 N=30	15		4.27 B	26	Dark gray (N4/1), clayey SILT, trace sand and gravel *[Continued from previous page]*	580	
15A	24/24 100%	SS	5-9 11-16 N=20	14		4.27 B	28		578	
16A	24/24 100%	SS	5-8 10-12 N=18	17		2.72 BSh	30		576	
17A	24/24 100%	SS	8-14 14-16 N=28	14		5.62 B	32		574	
18A	23/24 96%	SS	8-28 40-65 N=68	14			▼ 34	Gray (N4/1), silty, fine to medium SAND, little coarse sand, trace gravel, wet	572	
19A				13			▽ 36			
19B	24/24 100%	SS	24-14 17-16 N=31	19		5.43 B		Very dark gray (10YR3/1), silty CLAY	570	
20A	24/24 100%	SS	3-5 6-10 N=11	24		3.50 BSh	38	Dark gray (N4/1) with 30% dark yellowish brown (10YR4/6) mottles, silty CLAY	568	
							40	**End of Boring = 40.0 ft. BGS**		

NOTE(S): MW01D installed in SB-01.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/5/2006
Finish: 5/5/2006
WEATHER: Partly cloudy, mild (high-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-02
Well ID: n/a
Surface Elev: 624 ft. MSL
Completion: 50 ft. BGS
Station: 876,410.0N
2,513,210.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 7.42 - MW02S on 6/1/06
▽ = 7.36 - MW02D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	24/24 100%	ss	3-3 4-5 N=7	23		
1B				18		1.96 B
1C				29		1.94 B
2A	24/24 100%	ss	3-4 4-6 N=8	25		2.89 B
3A	24/24 100%	ss	3-5 5-7 N=10	20		2.91 B
4A	24/24 100%	ss	10-8 8-10 N=16	17		2.91 B
5A	24/24 100%	ss	3-3 4-5 N=7	19		1.94 B
6A	24/24 100%	ss	2-3 6-5 N=9	18		2.13 B
6B				17		
7A	24/24 100%	ss	4-4 7-10 N=11	14		2.06 B
7B				17		
8A	24/24 100%	ss	15-23 33-68 N=56	10		
9A	10/10 100%	ss	48-62/4"	10		3.92 Sh
10A	12/12 100%	ss	15-45	9		8.07 BSh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil grayish brown (10YR4/2), clayey SILT, trace sand	624
	loess Gray (10YR6/1), clayey SILT, trace sand	
	Yellowish brown (10YR5/4) with 20% gray (10YR6/1) mottles, lean CLAY, trace sand	
2	Yellowish brown (10YR5/8) with 15% gray (10YR6/1) mottles, lean CLAY, trace sand	622
4	Yellowish brown (10YR5/8) with 40% gray (10YR6/1)mottles, lean CLAY, trace sand	620
6	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, lean CLAY, little sand	618
8	Gray (10YR5/1) with 50% yellowish brown (10YR5/6) mottles, lean CLAY, little sand	616
10	Gray (10YR5/1) with 25% yellowish brown (10YR5/6) mottles, clayey SAND, trace gravel	614
12	Gray (10YR6/1) with 30% white (10YR8/1) mottles, sandy CLAY, trace gravel	612
	Yellowish brown (10YR5/4), silty, fine SAND, little medium sand, wet	
14	Pale brown (10YR6/3), silty, fine SAND, trace gravel, wet	610
16		608
18	Dark gray (10YR4/1), clayey SILT, little sand and gravel	606
20		

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/5/2006
Finish: 5/5/2006
WEATHER: Partly cloudy, mild (high-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-02
Well ID: n/a
Surface Elev: 624 ft. MSL
Completion: 50 ft. BGS
Station: 876,410.0N
2,513,210.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 7.42 - MW02S on 6/1/06
▽ = 7.36 - MW02D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
11A				9					604	
	36/60 *60%*	CS					22	Brown (10YR5/3), clayey SILT, little sand, trace gravel	602	
11B				11			24		600	
12A				21			26		598	
	60/60 *100%*	CS					28	Blueish gray (5B5/1), with 30% dark yellowish brown (10YR4/6) mottles, lean CLAY, trace coal	596	
12B				23			30		594	
	60/60 *100%*	CS					32		592	
13A				14			34	Very dark gray (10Y3/1), lean CLAY, trace sand and gravel	590	
	60/60 *100%*	CS					36		588	
14A				14			38		586	
							40			

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/5/2006
Finish: 5/5/2006
WEATHER: Partly cloudy, mild (high-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-02
Well ID: n/a
Surface Elev: 624 ft. MSL
Completion: 50 ft. BGS
Station: 876,410.0N
2,513,210.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 7.42 - MW02S on 6/1/06
▽ = 7.36 - MW02D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
										584	
	60/60 *100%*	CS					42			582	
15A				14			44			580	
								Very dark gray (10Y3/1), lean CLAY, trace sand and gravel *[Continued from previous page]*			
							46			578	
	60/60 *100%*	CS					48			576	
16A				13			50				

End of Boring = 50.0 ft. BGS

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/5/2006
Finish: 5/5/2006
WEATHER: Partly cloudy, mild (high-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA (blind drill)

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-02a
Well ID: MW2S
Surface Elev: 624 ft. MSL
Completion: 16 ft. BGS
Station: 876,408.9N
2,513,210.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 7.42 - MW02S on 6/1/06
▽ = 7.36 - MW02D on 6/1/06

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
								soil grayish brown (10YR4/2), clayey SILT, trace sand	624	
								loess Gray (10YR6/1), clayey SILT, trace sand		
								Yellowish brown (10YR5/4) with 20% gray (10YR6/1) mottles, lean CLAY, trace sand		
							2		622	
								Yellowish brown (10YR5/8) with 15% gray (10YR6/1) mottles, lean CLAY, trace sand		
							4		620	
								Yellowish brown (10YR5/8) with 40% gray (10YR6/1)mottles, lean CLAY, trace sand		
							6		618	
								Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, lean CLAY, little sand		
							8		616	
								Gray (10YR5/1) with 50% yellowish brown (10YR5/6) mottles, lean CLAY, little sand		
							10		614	
								Gray (10YR5/1) with 25% yellowish brown (10YR5/6) mottles, clayey SAND, trace gravel		
							12		612	
								Gray (10YR6/1) with 30% white (10YR8/1) mottles, sandy CLAY, trace gravel		
								Yellowish brown (10YR5/4), silty, fine SAND, little medium sand, wet		
							14		610	
								Pale brown (10YR6/3), silty, fine SAND, trace gravel, wet		

End of Boring = 15.51 ft. BGS
See SB-02 for sample & testing details

NOTE(S): MW02S installed in blind-drilled borehole within 10 ft of SB-02.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/5/2006
Finish: 5/5/2006
WEATHER: Partly cloudy, mild (high-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-02b
Well ID: MW2D
Surface Elev: 624 ft. MSL
Completion: 27 ft. BGS
Station: 876,414.0N
2,513,209.7E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 7.42 - MW02S on 6/1/06
▽ = 7.36 - MW02D on 6/1/06

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								soil grayish brown (10YR4/2), clayey SILT, trace sand	624
								loess Gray (10YR6/1), clayey SILT, trace sand	
								Yellowish brown (10YR5/4) with 20% gray (10YR6/1) mottles, lean CLAY, trace sand	
							2		622
								Yellowish brown (10YR5/8) with 15% gray (10YR6/1) mottles, lean CLAY, trace sand	
							4		620
								Yellowish brown (10YR5/8) with 40% gray (10YR6/1)mottles, lean CLAY, trace sand	
							6		618
								Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, lean CLAY, little sand	
							8		616
								Gray (10YR5/1) with 50% yellowish brown (10YR5/6) mottles, lean CLAY, little sand	
							10		614
								Gray (10YR5/1) with 25% yellowish brown (10YR5/6) mottles, clayey SAND, trace gravel	
							12		612
								Gray (10YR6/1) with 30% white (10YR8/1) mottles, sandy CLAY, trace gravel	
								Yellowish brown (10YR5/4), silty, fine SAND, little medium sand, wet	
							14		610
							16	Pale brown (10YR6/3), silty, fine SAND, trace gravel, wet	608
							18		606
								Dark gray (10YR4/1), clayey SILT, little sand and gravel	
							20		

Borehole Detail

Remarks

NOTE(S): MW02D installed in blind-drilled borehole within 10 ft of SB-02.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/5/2006
Finish: 5/5/2006
WEATHER: Partly cloudy, mild (high-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" HSA (blind drill)

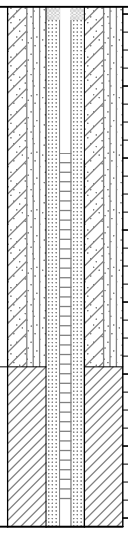
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-02b
Well ID: MW2D
Surface Elev: 624 ft. MSL
Completion: 27 ft. BGS
Station: 876,414.0N
2,513,209.7E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 7.42 - MW02S on 6/1/06
▽ = 7.36 - MW02D on 6/1/06

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
								Brown (10YR5/3), clayey SILT, little sand, trace gravel		604	
							22			602	
							24			600	
							26	Blueish gray (5B5/1), with 30% dark yellowish brown (10YR4/6) mottles, lean CLAY, trace coal		598	



End of Boring = 27.22 ft. BGS
See SB-02 for sample & testing details

NOTE(S): MW02D installed in blind-drilled borehole within 10 ft of SB-02.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/27/2006
Finish: 4/27/2006
WEATHER: Sunny, mild (high-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler & 4¼" HSA overdrill

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-03
Well ID: MW3D
Surface Elev: 626 ft. MSL
Completion: 58 ft. BGS
Station: 876,554.5N
2,514,535.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - While drilling
▼ = 7.03 - MW03S on 6/1/06
▽ = 55.40 - MW03D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	20/24 83%	SS	2-2 4-6 N=6	17		2.07 SP
1B				20		
1C				26		3.30 B
2A	17/24 71%	SS	2-3 4-5 N=7	25		3.05 B
3A	20/24 83%	SS	2-3 3-5 N=6	16		1.96 B
4A	24/24 100%	SS	4-3 5-6 N=8	21		2.27 B
5A	21/24 88%	SS	1-3 3-4 N=6	20		2.18 B
5B				19		
6A	18/24 75%	SS	1-2 2-4 N=4	24		0.87 B
7A	23/24 96%	SH SS	3-2 2-4 N=4	19		
7B	16/24 67%			12		
8A	23/24 96%	SS	3-12 29-50 N=41	13		
8B				13		
8C				12		
9A	14/24 58%	SS	8-82 85-72 N=167	10		6.98 B
9B				13		6.18 BSh
10A	18/24 75%	SS	6-21 32-49 N=53	8		11.95 Sh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	soil — Very dark grayish brown (10YR3/2), lean CLAY		
	Grayish brown (10YR5/2), lean CLAY, trace sand		
	Yellowish brown (10YR5/6), lean CLAY, trace sand	624	
2	Yellowish brown (10YR5/6) with 40% gray (N5/1) mottles, lean CLAY, trace sand		
		622	
4	loess — Yellowish brown (10YR5/6) with 40% gray (N5/1) mottles, sandy SILT, trace gravel		
		620	
6	Yellowish brown (10YR5/6) with 50% gray (N5/1) mottles, lean CLAY, trace sand and gravel		
		618	
8	Yellowish brown (10YR5/6), lean CLAY, little sand, trace gravel		
		616	
10	Dark gray (10YR4/1), sandy CLAY, trace gravel		
12	Gray (10YR6/1) with 50% yellowish brown (10YR5/8) mottles, lean CLAY, little sand, trace gravel	614	Shelby tube taken from shallow well borehole at indicated depth.
		612	
14	hagarstown — Yellowish brown (10YR5/8), silty, fine SAND, little medium sand, trace gravel, wet		
	Yellowish brown (10YR5/8), silty, fine SAND, little clay, wet	610	
16	Yellowish brown (10YR5/6), lean CLAY, little sand, trace gravel		
	Yellowish brown (10YR5/6), silty SAND, trace gravel, wet		
18	vandalia — Yellowish brown (10YR5/4), clayey SILT, trace sand and gravel	608	
	Gray (10YR5/1), sandy SILT, trace gravel		
20		606	

NOTE(S): MW03D installed in SB-03.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/27/2006
Finish: 4/27/2006
WEATHER: Sunny, mild (high-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler & 4¼" HSA overdrill

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-03
Well ID: MW3D
Surface Elev: 626 ft. MSL
Completion: 58 ft. BGS
Station: 876,554.5N
2,514,535.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - While drilling
▼ = 7.03 - MW03S on 6/1/06
▽ = 55.40 - MW03D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
11A	19/24 79%	ss	3-20 35-29 N=55	10		5.36 Sh				Wood fragments
							22	Gray (10YR5/1), sandy SILT, trace gravel *[Continued from previous page]*	604	
12A	20/24 83%	ss	15-25 89-69 N=114	8		13.00 Sh			602	
							24			
13A	23/24 96%	ss	14-19 24-22 N=43	9						
13B				13		6.98 BSh	26	Yellowish brown (10YR5/4), lean CLAY, trace sand and gravel	600	
14A	24/24 100%	ss	19-21 26-32 N=47	15		7.01 BSh		Gray (10YR4/1), clayey SILT, trace sand and gravel	598	
							28	Light gray (10YR6/1), SILT, trace sand		
15A	21/24 88%	ss	10-25 25-23 N=50	12						
15B				13		8.53 BSh	30		596	
16A	24/24 100%	ss	7-12 19-30 N=31	13		9.16 BSh			594	
							32	Gray (10YR4/1), lean CLAY, trace sand and gravel		
17A				14		6.59 B				
17B	24/24 100%	ss	29-35 39-42 N=74	14		3.49 Sh			592	
							34			
18A	23/24 96%	ss	6-8 11-17 N=19	13		7.21 BSh			590	
							36	smithboro		
19A	24/24 100%	ss	19-21 31-31 N=52	13		6.98 BSh		Gray (10YR4/1), clayey SILT, trace sand and gravel	588	
							38			
20A	24/24 100%	ss	6-10 15-24 N=25	14		6.76 BSh		Gray (10YR4/1), lean CLAY, trace sand and gravel	586	
							40			

NOTE(S): MW03D installed in SB-03.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/27/2006
Finish: 4/27/2006
WEATHER: Sunny, mild (high-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler & 4¼" HSA overdrill

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-03
Well ID: MW3D
Surface Elev: 626 ft. MSL
Completion: 58 ft. BGS
Station: 876,554.5N
2,514,535.3E

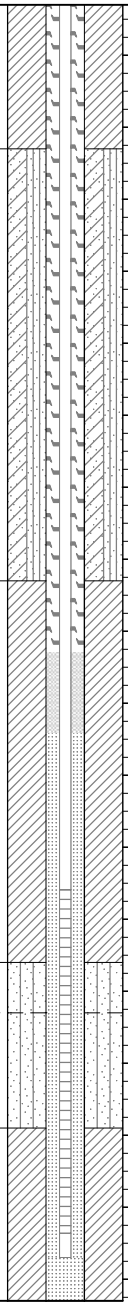
TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - While drilling
▼ = 7.03 - MW03S on 6/1/06
▽ = 55.40 - MW03D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
21A	19/24 *79%*	ss	*4-10 16-23* N=26	13		8.04 *BSh*
22A	21/24 *88%*	ss	*19-27 28-32* N=55	13		7.56 *BSh*
23A	23/24 *96%*	ss	*4-9 14-18* N=23	14		6.98 *BSh*
24A	24/24 *100%*	ss	*20-26 30-33* N=56	14		6.59 *BSh*
25A	24/24 *100%*	ss	*6-10 13-12* N=23	20		3.30 *BSh*
26A	24/24 *100%*	ss	*4-7 6-7* N=13	22		2.91 *BSh*
27A	24/24 *100%*	ss	*7-18 37-85* N=55	16		4.05 *BSh*
27B				13		
28A	23/24 *96%*	ss	*15-34 34-19* N=68	11		3.22 *SP*
28B				13		5.82 *B*
29A	24/24 *100%*	ss	*19-22 28-18* N=50	20		4.36 *BSh*

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Gray (10YR4/1), lean CLAY, trace sand and gravel *[Continued from previous page]*	584
42		
	Gray (10YR4/1), clayey SILT, trace sand and gravel	582
44		
		580
46		
		578
48		
	Gray (10YR4/1), lean CLAY, trace sand and gravel	576
50		
		574
52		
	yarmouth (10Y4/1), silty, fine to medium SAND, wet	572
54		
	Gray (10YR4/1), silty, fine SAND, trace clay, wet	
▽		570
56	lierle	
	Very dark gray (10YR3/1), lean CLAY, trace sand and gravel	
		568
58		

Borehole Detail



Remarks

End of Boring = 58.0 ft. BGS

NOTE(S): MW03D installed in SB-03.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/28/2006
Finish: 4/28/2006
WEATHER: Partly cloudy, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" HSA (blind drill)

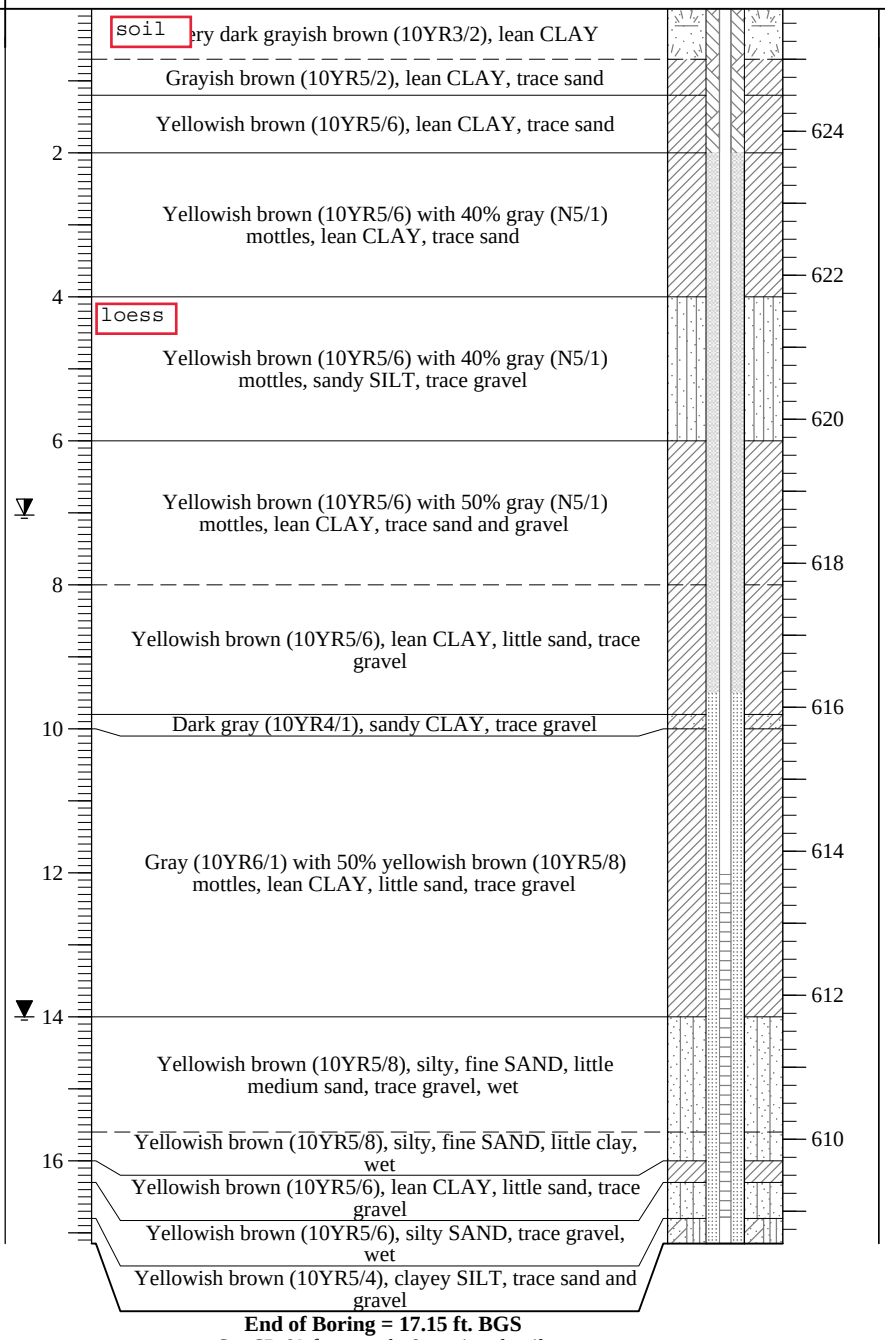
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-03a
Well ID: MW3S
Surface Elev: 626 ft. MSL
Completion: 17 ft. BGS
Station: 876,554.8N
2,514,531.5E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - While drilling
▼ = 7.03 - MW03S on 6/1/06
▽ = 55.40 - MW03D on 6/1/06

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks



End of Boring = 17.15 ft. BGS
See SB-03 for sample & testing details

NOTE(S): MW03S installed in blind-drilled borehole within 10 ft of SB-03.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/11/2006
Finish: 5/11/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-04
Well ID: n/a
Surface Elev: 622 ft. MSL
Completion: 55 ft. BGS
Station: 878,000.0N
2,514,445.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 8.00 - While drilling
▼ = 5.67 - MW04S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	21/24 88%	ss	1-2 2-4 N=4	24		1.09 B
1B				29		
2A	18/24 75%	ss	2-4 5-6 N=9	27		2.72 BSh
3A	16/24 67%	ss	2-3 4-6 N=7	23		1.71 B
4A	24/24 100%	ss	4-5 5-7 N=10	20		1.40 BSP
5A	24/24 100%	ss	1-2 2-2 N=4	23		0.70 B
6A	24/24 100%	ss	0-1 2-3 N=3	24		0.31 BSh
6B				28		
7A	22/24 92%	ss	0-1 3-7 N=4	20		0.08 B
7B				16		
7C				12		
8A	23/24 96%	ss	4-9 22-35 N=31	14		4.36 SP
8B				11		
9A	24/24 100%	ss	27-38 54-50 N=92	7		
10A	24/24 100%	ss	24-29 39-34 N=68	9		2.18 BSh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil / y dark gray (10YR3/1), clayey SILT, trace sand	622
	Dark grayish brown (10YR4/2) with 15% yellowish brown (10YR5/6) mottles, lean CLAY	
2	Yellowish brown (10YR5/8) with 50% grayish brown (10YR5/2) mottles, lean CLAY	620
4	loess / Dark gray (10YR4/1), clayey SILT, trace sand	618
6	Gray (10YR5/1), lean CLAY, trace sand and gravel	616
8	Gray (10YR5/1) with 25% yellowish brown (10YR5/6) mottles, sandy SILT	614
10	Very dark gray (10YR3/1) with 35% gray (10YR6/1) mottles, clayey SILT, wet	612
12	Yellowish brown (10YR5/6), clayey SAND, trace gravel	610
	Light gray (10YR7/1) with 20% brown (10YR5/3) mottles, clayey SILT, trace sand and gravel	
14	Yellowish brown (10YR5/8), silty, fine to medium SAND, trace coarse sand, wet	608
16	Gray (10YR4/1), sandy SILT, trace gravel	606
18		604
20		

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/11/2006
Finish: 5/11/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-04
Well ID: n/a
Surface Elev: 622 ft. MSL
Completion: 55 ft. BGS
Station: 878,000.0N
2,514,445.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 8.00 - While drilling
▼ = 5.67 - MW04S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
	60/60 *100%*	CS					22			602	
										600	
							24				
11A				7						598	
							26				
										596	
	60/60 *100%*	CS					28				
										594	
12A				7							
							30	Gray (10YR4/1), sandy SILT, trace gravel *[Continued from previous page]*			
										592	
							32				
	60/60 *100%*	CS								590	
							34				
13A				8						588	
							36				
										586	
	60/60 *100%*	CS					38				
										584	
14A				13							
							40				

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/11/2006
Finish: 5/11/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-04
Well ID: n/a
Surface Elev: 622 ft. MSL
Completion: 55 ft. BGS
Station: 878,000.0N
2,514,445.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 8.00 - While drilling
▼ = 5.67 - MW04S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	60/60 *100%*	CS					42		582	
									580	
							44	Gray (10YR4/1), sandy SILT, trace gravel *[Continued from previous page]*		
15A				13					578	
							46		576	
	60/60 *100%*	CS					48			
									574	
16A				14						
16B				21			50		572	
								Greenish gray (10BG5/1) with 20% dark yellowish brown (10YR4/6) mottles, lean CLAY, trace sand		
	60/60 *100%*	CS					52		570	
							54			
17A				24					568	

End of Boring = 55.0 ft. BGS

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/11/2006
Finish: 5/11/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-04a
Well ID: MW4S
Surface Elev: 622 ft. MSL
Completion: 15 ft. BGS
Station: 877,999.7N
2,514,450.6E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 8.00 - While drilling
▼ = 5.67 - MW04S on 6/1/06
▽ =

SAMPLE			TESTING				Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*					
								soil y dark gray (10YR3/1), clayey SILT, trace sand		622	
								Dark grayish brown (10YR4/2) with 15% yellowish brown (10YR5/6) mottles, lean CLAY			
							2				
								Yellowish brown (10YR5/8) with 50% grayish brown (10YR5/2) mottles, lean CLAY		620	
							4	loess		618	
								Dark gray (10YR4/1), clayey SILT, trace sand			
							6			616	
								Gray (10YR5/1), lean CLAY, trace sand and gravel			
							8			614	
								Gray (10YR5/1) with 25% yellowish brown (10YR5/6) mottles, sandy SILT			
							10			612	
								Very dark gray (10YR3/1) with 35% gray (10YR6/1) mottles, clayey SILT, wet			
							12			610	
								Yellowish brown (10YR5/6), clayey SAND, trace gravel			
								Light gray (10YR7/1) with 20% brown (10YR5/3) mottles, clayey SILT, trace sand and gravel			
							14	Yellowish brown (10YR5/8), silty, fine to medium SAND, trace coarse sand, wet		608	
								Gray (10YR4/1), sandy SILT, trace gravel			

End of Boring = 14.77 ft. BGS
See SB-04 for sample & testing details

NOTE(S): MW04S installed in blind-drilled borehole within 10 ft of SB-03.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/12/2006
Finish: 5/17/2006
WEATHER: Sunny, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler & 4¼" HSA overdrill

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-05
Well ID: MW5D
Surface Elev: 623 ft. MSL
Completion: 54 ft. BGS
Station: 878,174.8N
2,513,290.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 10.00 - While drilling
▼ = 6.74 - MW05S on 6/1/06
▽ = 50.44 - MW05D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	19/24 79%	ss	0-2 3-4 N=5	29		
1B				28		
2A	22/24 92%	ss	2-5 5-7 N=10	27		2.47 BSh
2B				22		2.13 B
3A	24/24 100%	ss	2-2 3-6 N=5	21		2.33 BSP
4A	24/24 100%	ss	7-6 6-8 N=12	21		1.90 BSh
5A	18/24 75%	ss	1-3 4-5 N=7	22		1.78 B
6A				16		
6B	20/24 83%	ss	0-1 3-4 N=4	22		0.70 BSh
7A	24/24 100%	ss	3-6 17-20 N=23	19		
7B				16		
8A	20/24 83%	ss	4-16 25-25 N=41	20		
8B				11		
9A	24/24 100%	ss	14-18 38-62 N=56	12		
9B				8		
10A	18/24 75%	ss	14-39 77 N=116	9		3.27 Sh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil grayish brown (10YR4/2), clayey SILT, trace sand	622
	loess	
2	Gray (10YR5/1 with 50% yellowish brown (10YR5/6) mottles, clayey SILT	620
4	Very dark brown (10YR2/2) with 20% dark gray (10YR4/1) mottles, clayey SILT, trace sand	618
6	Dark gray (10YR4/1) with 30% light gray (10YR7/1) mottles, lean CLAY	616
8	Gray (10YR6/1), lean CLAY, trace sand	614
10	Gray (10YR6/1) with 50% yellowish brown (10YR5/6) mottles, lean CLAY, trace sand	612
	Yellowish brown (10YR5/6), clayey SAND, trace gravel, wet	
12	Yellowish brown (10YR5/6) with 50% gray 10YR5/1) mottles, sandy CLAY	610
14	Gray 10YR6/1), clayey, fine to medium SAND, trace gravel, wet	608
16	Brownish yellow (10YR6/6), silty, fine SAND, trace medium sand	606
18	Yellowish brown (10YR5/6), silty, fine SAND, wet	604
20	Brown (10YR5/3), silty SAND and GRAVEL, wet	
	Dark gray (10YR4/1), sandy SILT, trace clay and gravel	

Borehole Detail

Remarks

NOTE(S): MW05D installed in SB-05.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/12/2006
Finish: 5/17/2006
WEATHER: Sunny, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler & 4¼" HSA overdrill

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-05
Well ID: MW5D
Surface Elev: 623 ft. MSL
Completion: 54 ft. BGS
Station: 878,174.8N
2,513,290.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 10.00 - While drilling
▼ = 6.74 - MW05S on 6/1/06
▽ = 50.44 - MW05D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
11A	60/60 *100%*	CS		7		
11B				7		
	60/60 *100%*	CS				
12A				7		
	60/60 *100%*	CS				
13A				8		
14A	48/60 *80%*	CS		7		
14B				14		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Dark gray (10YR4/1), sandy SILT, trace clay and gravel *[Continued from previous page]*	602	
22	Dark gray (10YR4/1), silty, fine SAND, trace medium sand	600	
24		598	
26		596	
28		594	
30	Dark gray (10YR4/1), sandy SILT, trace clay and gravel	592	
32		590	
34		588	
36		586	
	Gray (10YR6/1), fine to medium SAND		
38	Dark gray (10YR4/1), sandy SILT, trace clay and gravel	584	
40			

NOTE(S): MW05D installed in SB-05.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/12/2006
Finish: 5/17/2006
WEATHER: Sunny, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler & 4¼" HSA overdrill

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-05
Well ID: MW5D
Surface Elev: 623 ft. MSL
Completion: 54 ft. BGS
Station: 878,174.8N
2,513,290.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 10.00 - While drilling
▼ = 6.74 - MW05S on 6/1/06
▽ = 50.44 - MW05D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
	60/60 *100%*	CS				
15A				16		
	60/60 *100%*	CS				
16A				14		
16B				20		
17A	24/24 *100%*	SS	*7-10 15-16* N=25	12		
18A	24/24 *100%*	SS	*17-18 19-21* N=37	22		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark gray (10YR4/1), sandy SILT, trace clay and gravel *[Continued from previous page]*	582
42	Gray (10YR4/1), clayey SILT, trace sand	
		580
44		
	Dark gray (10YR4/1), sandy SILT, trace clay and gravel	578
46		
		576
48		
	Gray(10YR4/1), silty, fine to medium SAND, trace organics and coal	574
50 ▽		
	Dark gray (10YR4/1), sandy SILT, trace clay and gravel	572
52		
	Greenish gray (5G5/1) with 40% yellowish brown (10YR5/6)mottles, lean CLAY	570
54		

End of Boring = 54.0 ft. BGS

NOTE(S): MW05D installed in SB-05.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/17/2006
Finish: 5/17/2006
WEATHER: Sunny, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" HSA (blind drill)

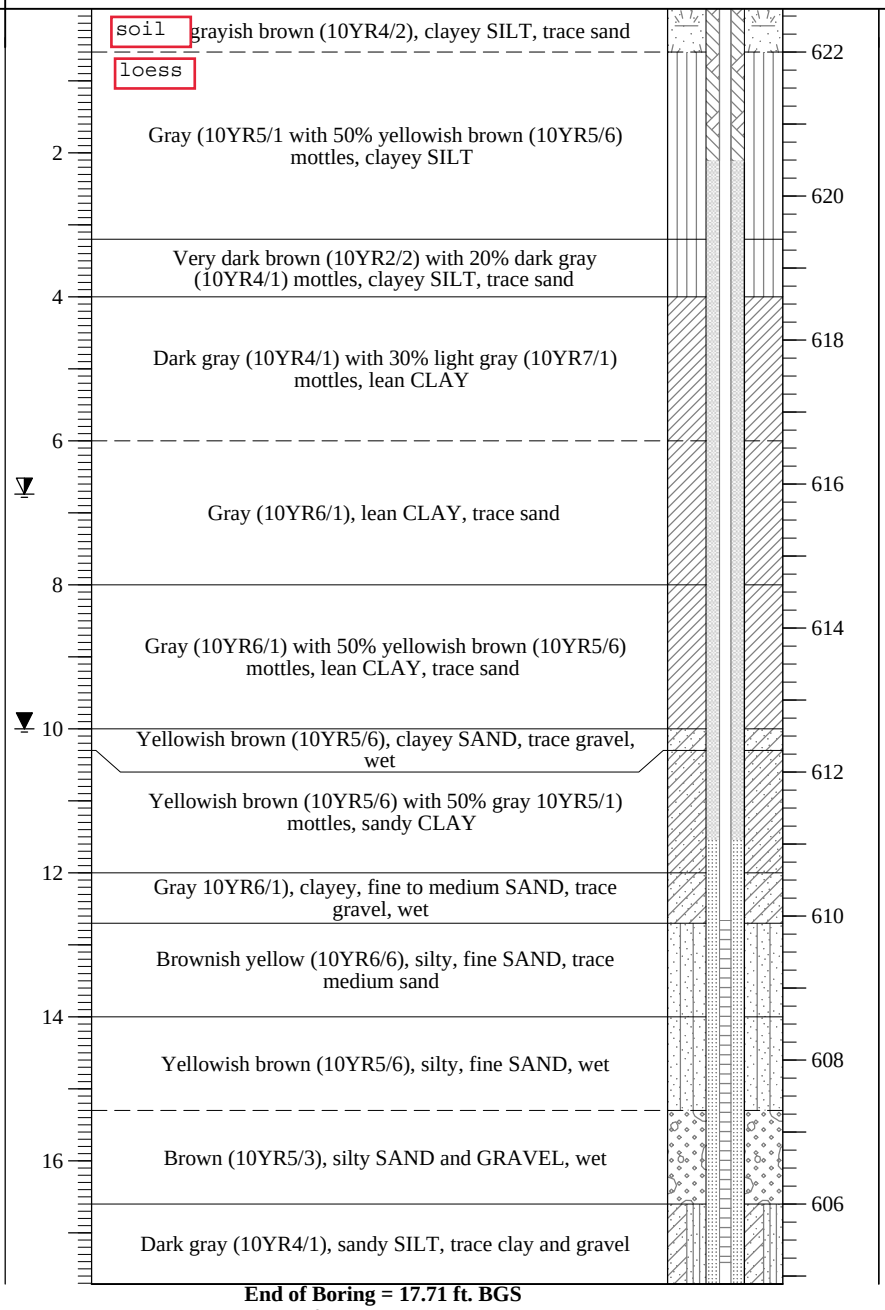
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-05a
Well ID: MW5S
Surface Elev: 623 ft. MSL
Completion: 18 ft. BGS
Station: 878,175.6N
2,513,285.5E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 10.00 - While drilling
▼ = 6.74 - MW05S on 6/1/06
▽ = 50.44 - MW05D on 6/1/06

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks



End of Boring = 17.71 ft. BGS
See SB-05 for sample & testing details

NOTE(S): MW05S installed in blind-drilled borehole within 10 ft of SB-05.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/4/2006
Finish: 5/4/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-06
Well ID: n/a
Surface Elev: 623 ft. MSL
Completion: 60 ft. BGS
Station: 879,015.0N
2,513,190.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 9.30 - While drilling
▼ = 6.21 - MW06S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	24/24 100%	ss	2-3 3-5 N=6	25		1.22 SP
1B				28		1.96 B
2A	24/24 100%	ss	2-4 5-6 N=9	27		1.94 BSh
2B				19		2.52 BSh
3A	24/24 100%	ss	1-3 4 N=7	21		1.36 B
4A	24/24 100%	ss	4-6 6 N=12	17		1.78 B
5A	22/24 92%	ss	1-2 3-3 N=5	18		0.85 BSh
5B				17		0.81 None
5C				21		0.31 None
6A	20/24 83%	ss	0-1 2-4 N=3	25		
7A	24/24 100%	ss	2-4 7-8 N=11	15		
7B				12		1.48 BSh
8B	22/24 92%	ss	11-33 57-35 N=90	8		7.18 Sh
9A	22/24 92%	ss	30-39 46-55 N=85	9		11.35 Sh
8A				11		
10A	24/24 100%	ss	4-23 50-51 N=73	7		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil grayish brown (10YR4/2), clayey SILT, trace sand	
	loess Light brownish gray (10YR6/2) with 20% yellowish brown (10YR5/8) mottles, clayey SILT, trace sand	622
2	Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, lean CLAY, trace sand	620
4		618
▼ 6	Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, clayey SILT, trace sand	616
8	Gray (10YR6/1) with 20% yellowish brown (10YR5/8) mottles, clayey, fine SAND	614
▼	Yellowish brown (10YR5/6), silty, fine SAND, trace clay, wet	
10	Dark yellowish brown (10YR4/6), silty, fine SAND, wet	612
12	Brownish yellow (10YR6/6), silty, fine to medium SAND, little coarse sand, trace gravel, wet	610
	Yellowish brown (10YR5/4), sandy SILT, trace gravel, wet	
14	Brown (10YR5/3), silty, fine SAND, little medium sand, trace gravel, wet	
	Gray (N5/1), clayey SILT, little sand, trace gravel	608
16		606
18	Dark gray (N4/1), clayey SILT, trace sand and gravel	604
20		

Borehole Detail

Remarks

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/4/2006
Finish: 5/4/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-06
Well ID: n/a
Surface Elev: 623 ft. MSL
Completion: 60 ft. BGS
Station: 879,015.0N
2,513,190.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 9.30 - While drilling
▼ = 6.21 - MW06S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
11A	20/24 83%	ss	6-16 33-58 N=49	11		3.49 BSh
12A	20/24 83%	ss	45-56 54-50/3" N=110	9		11.64 Sh
13A	12/24 50%	ss	26-78	12		2.84 Sh
14A	8/24 33%	ss	52-48/2"	9		5.43 BSh
15A	24/24 100%	ss	10-24 30-40 N=54	13		4.95 BSh
16A	21/24 88%	ss	10-16 37-38 N=53	8		10.91 BSh
17A	17/24 71%	ss	36-47 61/5"	9		
18A	22/24 92%	ss	11-36 45-60 N=81	9		10.04 Sh
19A	22/24 92%	ss	40-35 34-29 N=69	10		9.60 Sh
19B				13		8.92 B
20A	24/24 100%	ss	3-8 12-15 N=20	14		8.53 BSh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
22	Dark gray (N4/1), clayey SILT, trace sand and gravel *[Continued from previous page]*	602	
24		600	
26		598	
28		596	
30		594	
32		592	
34		590	
36		588	
38	Very dark greenish gray (10Y3/1), lean CLAY, trace sand	586	
40		584	

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/4/2006
Finish: 5/4/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-06
Well ID: n/a
Surface Elev: 623 ft. MSL
Completion: 60 ft. BGS
Station: 879,015.0N
2,513,190.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 9.30 - While drilling
▼ = 6.21 - MW06S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
21A	23/24 *96%*	ss	*3-5 8-12* N=13	15		4.27 *B*				
							42		582	
22A	22/24 *92%*	ss	*6-6 7-8* N=13	14		3.49 *B*				
							44		580	
23A	24/24 *100%*	ss	*5-7 9-12* N=16	16		2.72 *B*				
							46	Very dark greenish gray (10Y3/1), lean CLAY, trace sand and gravel	578	
24A	24/24 *100%*	ss	*4-8 10-11* N=18	15		4.07 *B*				
							48		576	
25A	24/24 *100%*	ss	*5-6 9-13* N=15	15		3.10 *B*				
							50		574	
26A	24/24 *100%*	ss	*5-6 8-12* N=14	22		1.94 *B*				
							52		572	
27A	24/24 *100%*	ss	*5-6 8-8* N=14	23		2.13 *B*				
							54	Dark greenish gray (10BG4/1), lean CLAY	570	
28A	24/24 *100%*	ss	*3-5 6-8* N=11	24		2.33 *BSh*				
							56		568	
29A	24/24 *100%*	ss	*12-10 12-14* N=22	24		3.30 *BSh*		Greenish gray (5G4/1) with 10% dark yellowish brown (10YR3/4) mottles, lean CLAY, trace sand	566	
							58		564	
30A	24/24 *100%*	ss	*5-8 12-13* N=20	27		2.13 *BSh*		Dark greenish gray (10G4/1), lean CLAY, trace sand		
							60	**End of Boring = 60.0 ft. BGS**		

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/4/2006
Finish: 5/4/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA (blind drill)

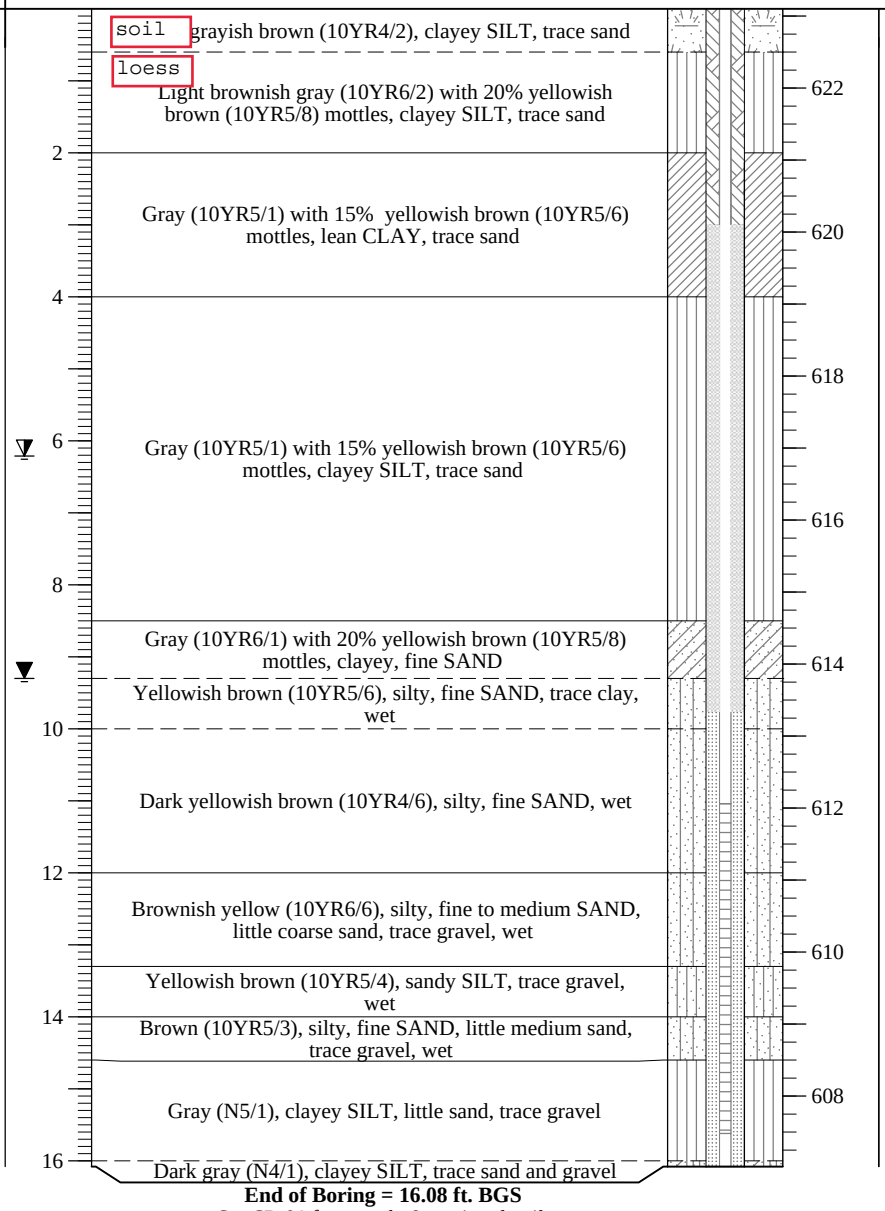
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-06a
Well ID: MW6S
Surface Elev: 623 ft. MSL
Completion: 16 ft. BGS
Station: 879,021.2N
2,513,189.4E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 9.30 - While drilling
▼ = 6.21 - MW06S on 6/1/06
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL



End of Boring = 16.08 ft. BGS
See SB-06 for sample & testing details

NOTE(S): MW06S installed in blind-drilled borehole within 10 ft of SB-06.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/5/2006
Finish: 5/8/2006
WEATHER: Partly cloudy, mild (mid-70s)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: P. McIntire
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-07
Well ID: n/a
Surface Elev: 625 ft. MSL
Completion: 54 ft. BGS
Station: 879,180.0N
2,514,390.0E

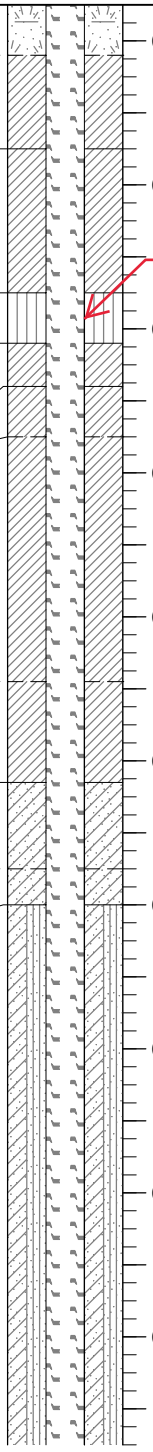
TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 10.80 - While drilling
▼ = 4.90 - MW07S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	18/24 75%	ss	1-1 1-1 N=2	23		2.40 B
1B				24		
2A	24/24 100%	ss	0-0 1-1 N=1	26		2.33 B
3A	24/24 100%	ss	0-1 1-2 N=2	25		4.33 BSh
3B				25		2.52 BSh
3C				22		3.05 B
4A	24/24 100%	ss	0-1 1-2 N=2	22		1.75 B
5A	24/24 100%	ss	0-0 1-1 N=1	22		1.24 B
6A	24/24 100%	ss	0-0 0-1 N=0	24		0.54 B
6B				20		1.65 B
7A	24/24 100%	ss	0-0 1-2 N=1	24		
7B				13		2.89 B
8A	24/24 100%	ss	2-5 7-9 N=12	8		5.04 BSh
9A	24/24 100%	ss	3-6 6-8 N=12	9		9.27 BSh
10A	24/24 100%	ss	3-6 8-11 N=14	9		11.13 BSh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil dark gray (10YR3/1), moist, soft, clayey SILT with trace sand and trace gravel.	624
	Dark gray (10YR4/1), moist, soft, silty CLAY with trace and and trace gravel.	
2	Gray (10YR5/1) with 20% yellowish brown mottles, moist, soft, silty CLAY with trace sand and trace gravel.	622
4	loess Black (10YR2/1), very moist, soft, clayey SILT.	620
	Gray (10YR6/1) with 30% yellowish brown (10YR5/8) mottles, moist soft, silty CLAY with trace sand and trace gravel.	
6	Black (10YR2/1), moist, soft, silty CLAY with trace sand and trace gravel.	618
8	Dark gray (10YR4/1), very moist, soft, silty CLAY with some sand and trace gravel.	616
10	Gray (10YR5/1) with 30% yellowish brown (10YR5/8) mottles, moist, soft, silty CLAY with sand and gravel.	614
	Yellowish brown (10YR5/8) wet, very soft, clayey, very fine- to fine-grained, SAND with trace gravel.	
12	Yellowish brown (10YR5/8) wet, soft, clayey, very fine- to fine-grained, SAND with trace gravel.	612
14	Gray (10YR4/1), moist, very hard, sandy, clayey SILT with gravel.	610
16		608
18		606
20		

Borehole Detail



Remarks

I question whether this is some type of ash based on how soft this is + color

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/5/2006
Finish: 5/8/2006
WEATHER: Partly cloudy, mild (mid-70s)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: P. McIntire
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-07
Well ID: n/a
Surface Elev: 625 ft. MSL
Completion: 54 ft. BGS
Station: 879,180.0N
2,514,390.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 10.80 - While drilling
▼ = 4.90 - MW07S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
								Gray (10YR4/1), moist, very hard, sandy, clayey SILT with gravel. *[Continued from previous page]*	604	
11A				8						
	35/48 *73%*	CS					22	Gray (10YR6/1), wet, loose, fine- to medium-grained SAND.	602	
11B				14						
							24		600	
	50/60 *83%*	CS					26		598	
12A				7			28	Gray (10YR5/1), moist, very hard, sandy, clayey SILT with gravel.	596	
13A				6			30		594	
	56/60 *93%*	CS					32	Gray (10YR5/1), wet, loose, medium- to very coarse-grained SAND and GRAVEL.	592	
13B				6						
13C				8				Gray (10YR5/1), wet, dense, very fine- to fine-grained SAND.		
							34	Gray (10YR5/1), moist, very hard, sandy, clayey SILT with gravel.	590	
	60/60 *100%*	CS					36		588	
14A				14				Gray (10YR5/1), moist, firm, sandy, clayey SILT with gravel.		
							38		586	
							40			

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/5/2006
Finish: 5/8/2006
WEATHER: Partly cloudy, mild (mid-70s)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: P. McIntire
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-07
Well ID: n/a
Surface Elev: 625 ft. MSL
Completion: 54 ft. BGS
Station: 879,180.0N
2,514,390.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 10.80 - While drilling
▼ = 4.90 - MW07S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
15A	60/60 *100%*	CS		14			42		584	
									582	
							44	Gray (10YR5/1), moist, firm, sandy, clayey SILT with gravel. *[Continued from previous page]*	580	
	60/60 *100%*	CS					46		578	
16A				15			48		576	
							50	Dark greenish gray (10BG4/1), moist, soft, silty CLAY with trace sand and trace gravel.	574	
17A	60/60 *100%*	CS		24				Very dark gray (10YR3/1), moist firm, clayey SILT.		
							52	Dark greenish gray (10BG4/1), moist, soft, silty CLAY with trace sand and trace gravel.	572	
17B							54			

End of Boring = 54.0 ft BGS

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/9/2006
Finish: 5/9/2006
WEATHER: Overcast, mild (mid-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: P. McIntire
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-07a
Well ID: MW7S
Surface Elev: 625 ft. MSL
Completion: 14 ft. BGS
Station: 879,181.1N
2,514,397.5E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 10.80 - While drilling
▼ = 4.90 - MW07S on 6/1/06
▽ =

SAMPLE			TESTING				Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*					
								soil dark gray (10YR3/1), moist, soft, clayey SILT with trace sand and trace gravel.		624	
								Dark gray (10YR4/1), moist, soft, silty CLAY with trace and and trace gravel.			
							2	Gray (10YR5/1) with 20% yellowish brown mottles, moist, soft, silty CLAY with trace sand and trace gravel.		622	
							4	loess Black (10YR2/1), very moist, soft, clayey SILT.		620	
							▼	Gray (10YR6/1) with 30% yellowish brown (10YR5/8) mottles, moist soft, silty CLAY with trace sand and trace gravel.			
							6	Black (10YR2/1), moist, soft, silty CLAY with trace sand and trace gravel.		618	
							8	Dark gray (10YR4/1), very moist, soft, silty CLAY with some sand and trace gravel.		616	
							10	Gray (10YR5/1) with 30% yellowish brown (10YR5/8) mottles, moist, soft, silty CLAY with sand and gravel.		614	
							▼	Yellowish brown (10YR5/8) wet, very soft, clayey, very fine- to fine-grained, SAND with trace gravel.			
							12	Yellowish brown (10YR5/8) wet, soft, clayey, very fine- to fine-grained, SAND with trace gravel.		612	
							14	Gray (10YR4/1), moist, very hard, sandy, clayey SILT with gravel.			

End of Boring = 14.39 ft. BGS
See SB-07 for sample & testing details

NOTE(S): MW07S installed in blind-drilled borehole within 10 ft of SB-07.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/9/2006
Finish: 5/10/2006
WEATHER: Foggy to partly sunny, mild (hi-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-08
Well ID: n/a
Surface Elev: 625 ft. MSL
Completion: 59 ft. BGS
Station: 879,770.0N
2,514,480.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.70 - While drilling
▼ = 5.33 - MW08S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
	24/24 100%	ss	1-1 1 N=2			
2A	24/24 100%	ss	1-1 1 N=2	25		1.59 B
3A	24/24 100%	ss	1-1 1 N=2	20		1.86 B
3B				21		1.20 B
4A	24/24 100%	ss	0-1 1 N=2	25		1.01 None
5A	24/24 100%	ss	0-1 1 N=2	21		
6A	24/24 100%	ss	0-1 1 N=2	21		0.70 BSh
6B				31		
7A	20/24 83%	ss	0-1 3 N=4	13		
7B				15		
8A	23/24 96%	ss	7-11 16 N=27	9		5.45 Sh
8B				8		
	24/30 80%	cs				
9A				5		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	soil Very dark gray (10YR3/1), moist, soft, clayey SILT with trace sand and trace gravel.	624	
2	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with little sand.	622	
4	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with little sand.	620	
▼	Gray (10YR5/1) with 40% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with little sand.		
6	loess Gray (10YR5/1), moist, soft, clayey SILTwith little sand and trace gravel.	618	
8	Yellowish brown (10YR5/6) with 20% gray (10YR5/1) mottles, moist, soft, sandy CLAY with sl. trace gravel.	616	
10	Yellowish brown (10YR5/6) with 10% gray (10YR5/1) mottles, moist, soft, sandy CLAY with sl. trace gravel.	614	
12		612	
▼	Gray (10YR5/1), wet, soft, very silty, very fine- to coarse-grained SAND.		
14	Light gray (10YR6/1) with 50% yellowish brown (10YR5/6) mottles, wet, very dense, very fine- to fine-grained SAND.	610	
	Gray (10YR5/1) with 30% yellowish brown (10YR5/6) mottles, wet, dense, fine- to very coarse-grained SAND.		
16		608	
18	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.	606	
20			

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/9/2006
Finish: 5/10/2006
WEATHER: Foggy to partly sunny, mild (hi-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-08
Well ID: n/a
Surface Elev: 625 ft. MSL
Completion: 59 ft. BGS
Station: 879,770.0N
2,514,480.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.70 - While drilling
▼ = 5.33 - MW08S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
	60/60 *100%*	CS								604	
10A				7			22				
										602	
							24				
										600	
11A	36/60 *60%*	CS		10			26				
										598	
							28				
										596	
							30	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel. *[Continued from previous page]*			
	60/60 *100%*	CS								594	
12A				6			32				
										592	
							34				
										590	
	60/60 *100%*	CS					36				
										588	
13A				7							
							38				
										586	
							40				

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/9/2006
Finish: 5/10/2006
WEATHER: Foggy to partly sunny, mild (hi-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-08
Well ID: n/a
Surface Elev: 625 ft. MSL
Completion: 59 ft. BGS
Station: 879,770.0N
2,514,480.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.70 - While drilling
▼ = 5.33 - MW08S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	60/60 100%	CS						Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel. *[Continued from previous page]*	584	
							42			
14A				14				Greenish gray (10BG5/1) with 10% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY with little sand and trace gravel		
14B				11					582	
								Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.		
							44	Dark yellowish brown (10YR4/4), moist, firm, clayey SILT with some sand and trace gravel.		
15A				12					580	
15B				15						
	60/60 100%	CS					46	Gray (10YR4/1), moist, hard, clayey, sandy SILT with trace gravel.		
									578	
							48	Gray (10YR4/1) with 50% very dark grayish brown (10YR3/2), moist, firm, silty CLAY with sand and trace gravel.		
15C				13						
									576	
							50			
16A				14				Gray (10YR4/1), moist, hard, clayey, sandy SILT with trace gravel.		
	60/60 100%	CS							574	
							52			
									572	
16B				19						
							54	Greenish gray (10BG4/1), moist, soft, silty CLAY with little sand and sl. trace gravel.		
17A				24					570	
	60/60 100%	CS					56			
								Yellowish brown (10YR5/6) with 20% Greenish gray (10BG4/1) mottles, moist, soft, silty CLAY with little sand and sl. trace gravel.	568	
							58			
17B				19						

End of Boring = 58.5 ft.

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/10/2006
Finish: 5/10/2006
WEATHER: Foggy to partly sunny, mild (hi-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-08a
Well ID: MW8S
Surface Elev: 625 ft. MSL
Completion: 17 ft. BGS
Station: 879,776.6N
2,514,478.8E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.70 - While drilling
▼ = 5.33 - MW08S on 6/1/06
▽ =

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
								soil Very dark gray (10YR3/1), moist, soft, clayey SILT with trace sand and trace gravel.	624	
							2	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with little sand.	622	
							4	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with little sand.	620	
							▼	Gray (10YR5/1) with 40% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with little sand.		
							6	loess Gray (10YR5/1), moist, soft, clayey SILTwith little sand and trace gravel.	618	
							8	Yellowish brown (10YR5/6) with 20% gray (10YR5/1) mottles, moist, soft, sandy CLAY with sl. trace gravel.	616	
							10	Yellowish brown (10YR5/6) with 10% gray (10YR5/1) mottles, moist, soft, sandy CLAY with sl. trace gravel.	614	
							12		612	
							▼	Gray (10YR5/1), wet, soft, very silty, very fine- to coarse-grained SAND.		
							14	Light gray (10YR6/1) with 50% yellowish brown (10YR5/6) mottles, wet, very dense, very fine- to fine-grained SAND.	610	
								Gray (10YR5/1) with 30% yellowish brown (10YR5/6) mottles, wet, dense, fine- to very coarse-grained SAND.		
							16	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.	608	

End of Boring = 17.08 ft. BGS
See SB-08 for sample & testing details

NOTE(S): MW08S installed in blind-drilled borehole within 10 ft of SB-08.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/3/2006
Finish: 5/3/2006
WEATHER: Overcast, mild (mid-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-09
Well ID: MW9D
Surface Elev: 625 ft. MSL
Completion: 54 ft. BGS
Station: 879,679.7N
2,515,666.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - While drilling
▼ = 5.23 - MW09S on 6/1/06
▽ = 52.46 - MW09D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	22/24 92%	ss	0-1 1-1 N=2	24		1.65 B
2A	20/24 83%	ss	1-2 1-1 N=3	27		2.06 B
3A	24/24 100%	ss	1-1 1-1 N=2	24		1.65 B
4A	24/24 100%	ss	1-1 1-2 N=2	23		1.57 B
5A	24/24 100%	ss	0-1 1-1 N=2	27		1.85 B
6A	24/24 100%	ss	0-0 0-0 N=0	22		1.44 B
7A	24/24 100%	ss	0-0 1-2 N=1	21		0.93 BSh
7B				18		0.97 BSh
7C				15		
8A	24/24 100%	ss	1-3 6-6 N=9	18		
8B				18		
9A	24/24 100%	ss	7-13 19-25 N=32	8		7.86 Sh
	12/12 100%	cs				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil dark gray (10YR3/1), moist, soft, clayey SILT with trace sand and trace gravel.	624
2	Yellowish brown (10YR5/6), moist, soft, silty CLAY with little sand.	622
4		620
▼ 6	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with little sand.	618
8	Gray (10YR5/1) with 50% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with sand.	616
10	Yellowish brown (10YR5/6) with 10% Gray (10YR5/1) mottles, moist, soft, silty CLAY with sand.	614
12	Yellowish brown (10YR5/8), very moist, soft, sandy CLAY with trace gravel.	612
	Yellowish brown (10YR5/6) with 30% gray (10YR5/1) mottles, moist to very moist, clayey SILT with sand and trace gravel.	
▼ 14	Gray (10YR5/1), wet, soft, clayey very fine- to fine-grained SAND.	
	Gray (10YR5/1), wet, loose, fine- to very coarse-grained SAND with trace gravel.	610
	Gray (10YR5/1), wet, dense, silty very fine- to fine-grained SAND.	
16		608
18	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.	606
20		

NOTE(S): MW09D installed in SB-09.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/3/2006
Finish: 5/3/2006
WEATHER: Overcast, mild (mid-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-09
Well ID: MW9D
Surface Elev: 625 ft. MSL
Completion: 54 ft. BGS
Station: 879,679.7N
2,515,666.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - While drilling
▼ = 5.23 - MW09S on 6/1/06
▽ = 52.46 - MW09D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	60/60 *100%*	CS							604	
11A				2			22		602	
							24		600	
	49/60 *82%*	CS					26		598	
12A				3				Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel. *[Continued from previous page]*		2" Sand stringer
							28		596	
							30		594	
	60/60 *100%*	CS					32		592	
13A				3						
							34		590	
							36	Yellowish brown (10YR5/6) with 40% gray (10YR5/1) mottles, moist, very hard, clayey SILT with little sand and occasional dry, silt stringers (<1").	588	
14A	60/60 *100%*	CS		10						
							38	Gray (10YR5/1), moist, very hard, clayey SILT with little sand and trace gravel.	586	
14B				11						
							40	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.		DRILLER NOTE: Appears more plastic

NOTE(S): MW09D installed in SB-09.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/3/2006
Finish: 5/3/2006
WEATHER: Overcast, mild (mid-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-09
Well ID: MW9D
Surface Elev: 625 ft. MSL
Completion: 54 ft. BGS
Station: 879,679.7N
2,515,666.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - While drilling
▼ = 5.23 - MW09S on 6/1/06
▽ = 52.46 - MW09D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	60/60 100%	CS					42	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel. *[Continued from previous page]*	584	
15A				12					582	
							44	Very dark grayish brown (10YR3/2), moist, hard, silty CLAY with trace sand and trace organic matter.		
								Very dark grayish brown (10YR3/2), moist, firm, PEAT.	580	
19	60/60 100%	CS		22			46	Dark greenish gray (10BG4/1), moist, firm, silty CLAY with little sand and trace gravel.	578	
							48	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.		
16A				17				Dark gray (10YR3/1), moist, hard, clayey SILT.	576	
							50		574	
17A	60/60 100%	CS						Dark greenish gray (10BG4/1), moist, firm, silty CLAY with little sand and trace gravel.		
							52 ▽		572	
							54			

End of Boring = 54.0 ft.

NOTE(S): MW09D installed in SB-09.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/3/2006
Finish: 5/3/2006
WEATHER: Overcast, mild (mid-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-09a
Well ID: MW9S
Surface Elev: 625 ft. MSL
Completion: 16 ft. BGS
Station: 879,684.9N
2,515,666.2E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - While drilling
▼ = 5.23 - MW09S on 6/1/06
▽ = 52.46 - MW09D on 6/1/06

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
								soil dark gray (10YR3/1), moist, soft, clayey SILT with trace sand and trace gravel.	624	
							2	Yellowish brown (10YR5/6), moist, soft, silty CLAY with little sand.	622	
							4		620	
							▼ 6	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with little sand.	618	
							8	Gray (10YR5/1) with 50% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with sand.	616	
							10	Yellowish brown (10YR5/6) with 10% Gray (10YR5/1) mottles, moist, soft, silty CLAY with sand.	614	
							12	Yellowish brown (10YR5/8), very moist, soft, sandy CLAY with trace gravel.	612	
								Yellowish brown (10YR5/6) with 30% gray (10YR5/1) mottles, moist to very moist, clayey SILT with sand and trace gravel.		
							▼ 14	Gray (10YR5/1), wet, soft, clayey very fine- to fine-grained SAND.		
								Gray (10YR5/1), wet, loose, fine- to very coarse-grained SAND with trace gravel.	610	
								Gray (10YR5/1), wet, dense, silty very fine- to fine-grained SAND.		
							16	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.		

End of Boring = 16.20 ft. BGS
See SB-09 for sample & testing details

NOTE(S): MW09S installed in blind-drilled borehole within 10 ft of SB-09.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/1/2006
Finish: 5/1/2006
WEATHER: Overcast, mild (mid-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-10
Well ID: MW10D
Surface Elev: 621 ft. MSL
Completion: 49 ft. BGS
Station: 878,245.1N
2,515,914.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 11.80 - While drilling
▼ = 4.91 - MW10S on 6/1/06
▽ = 47.48 - MW10D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	17/24 71%	ss	1-1 1-1 N=2	23		2.33 B
2A	24/24 100%	ss	1-1 2-2 N=3	25		2.47 BSh
3A	24/24 100%	ss	1-2 1-2 N=3	24		2.33 B
4A	24/24 100%	ss	1-1 1-1 N=2	23		1.55 B
4B						
5A	17/24 71%	ss	1-1 1-2 N=2	23		2.06 B
6A	24/24 100%	ss	0-1 1-1 N=2	17		1.16 B
7A	23/24 96%	ss	1-1 3-3 N=4	17		2.84 B
7B				18		
8A	24/24 100%	ss	3-5 9-9 N=14	10		7.64 BSP
10A	12/33 36%	cs		16		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil dark gray (10YR3/1), moist, soft, clayey SILT with trace sand and trace gravel.	
	Gray (10YR5/1) with 30% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with little sand.	620
2		
	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with little sand.	618
4		
		616
6	Gray (10YR5/1), moist, soft, clayey, very fine- to fine-grained SAND.	
		614
8	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with little sand and trace gravel.	
		612
10		
	Gray (10YR5/1) with 10% yellowish brown (10YR5/8) mottles, clayey, very fine- to medium-grained SAND with trace gravel.	610
12		
		608
14	Grayish brown (10YR5/2), wet, loose, very fine- to medium-grained SAND with trace coarse- to very coarse-grained sand.	
	Yellowish brown (10YR5/6), moist, firm, silty CLAY with little sand and trace gravel.	606
16		
	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.	604
18		
		602
20		

NOTE(S): MW10D installed in SB-10.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/1/2006
Finish: 5/1/2006
WEATHER: Overcast, mild (mid-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-10
Well ID: MW10D
Surface Elev: 621 ft. MSL
Completion: 49 ft. BGS
Station: 878,245.1N
2,515,914.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 11.80 - While drilling
▼ = 4.91 - MW10S on 6/1/06
▽ = 47.48 - MW10D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
							22		600	
								Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel. *[Continued from previous page]*	598	
							24			
11A				12					596	
	56/60 *93%*	CS					26			2" Gravel stringer
								Dark grayish brown (10YR4/2), very moist, soft, PEAT.	594	
11B				13						
							28			
11C				196					592	
							30			
	60/60 *100%*	CS							590	
12A				13			32			
									588	
								Gray (10YR4/1), moist, very hard, clayey, sandy SILT with trace gravel.		
							34			
									586	
	60/60 *100%*	CS					36			
									584	
13A				12						
							38			
									582	
							40			

NOTE(S): MW10D installed in SB-10.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/1/2006
Finish: 5/1/2006
WEATHER: Overcast, mild (mid-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-10
Well ID: MW10D
Surface Elev: 621 ft. MSL
Completion: 49 ft. BGS
Station: 878,245.1N
2,515,914.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 11.80 - While drilling
▼ = 4.91 - MW10S on 6/1/06
▽ = 47.48 - MW10D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
14A	60/60 *100%*	CS		14				Gray (10YR4/1), moist, very hard, clayey, sandy SILT with trace gravel. *[Continued from previous page]*	580	
							42			
14B				23				Greenish gray (5G5/1), moist, firm, silty CLAY with little sand and sl. trace gravel.	578	1" Gravel stringer
							44			
15A				13				Greenish gray (5G5/1) with 30% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with little sand and sl. trace gravel.	576	
	60/60 *100%*	CS					46			
15B				25			▽ 48	Greenish gray (5G5/1), moist, firm, silty CLAY with little sand and sl. trace gravel.	574	

End of Boring = 48.75 ft.

NOTE(S): MW10D installed in SB-10.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/2/2006
Finish: 5/2/2006
WEATHER: Sunny, mild (mid-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-10a
Well ID: MW10S
Surface Elev: 621 ft. MSL
Completion: 16 ft. BGS
Station: 878,250.5N
2,515,914.4E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 11.80 - While drilling
▼ = 4.91 - MW10S on 6/1/06
▽ = 47.48 - MW10D on 6/1/06

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
								soil dark gray (10YR3/1), moist, soft, clayey SILT with trace sand and trace gravel.			
								Gray (10YR5/1) with 30% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with little sand.		620	
							2				
								Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with little sand.		618	
							4				
							▼			616	
							6	Gray (10YR5/1), moist, soft, clayey, very fine- to fine-grained SAND.			
										614	
							8	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, soft, silty CLAY with little sand and trace gravel.			
										612	
							10				
								Gray (10YR5/1) with 10% yellowish brown (10YR5/8) mottles, clayey, very fine- to medium-grained SAND with trace gravel.		610	
							▼ 12				
								Grayish brown (10YR5/2), wet, loose, very fine- to medium-grained SAND with trace coarse- to very coarse-grained sand.		608	
							14				
								Yellowish brown (10YR5/6), moist, firm, silty CLAY with little sand and trace gravel.			
								Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.		606	
							16				

End of Boring = 16.30 ft. BGS
See SB-10 for sample & testing details

NOTE(S): MW10S installed in blind-drilled borehole within 10 ft of SB-10.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/27/2006
Finish: 4/28/2006
WEATHER: Partly cloudy, mild (mid-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-850 Track Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-11
Well ID: MW11D
Surface Elev: 622 ft. MSL
Completion: 36 ft. BGS
Station: 876,749.6N
2,515,976.7E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 11.70 - While drilling
▼ = 5.42 - MW11S on 6/1/06
▽ = 6.03 - MW11D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	24/24 100%	ss	3-3 4-4 N=7	16		
1B				34		1.09 B
2A	24/24 100%	ss	4-7 14-21 N=21	27		2.13 BSh
3A	24/24 100%	ss	4-6 7-8 N=13	24		2.27 BSh
3B				19		2.33 B
4A	24/24 100%	ss	7-8 13-14 N=21	21		2.13 None
5A	24/24 100%	ss	3-4 4-4 N=8	20		1.55 Sh
6A	24/24 100%	ss	3-2 2-3 N=4	19		0.78 BSh
6B				18		
7A	24/24 100%	ss	3-6 14-21 N=20	16		
7B				9		5.45 BSP
8A	11/12 92%	ss	41-61/5"	7		
9A	48/54 89%	cs		8		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	soil Very dark grey (10YR3/1), moist, soft, clayey SILT.		
	Yellowish brown (10YR5/6) with 20% gray (10YR5/1) mottles, moist , soft, silty CLAY.		
2		620	
	Yellowish brown (10YR5/6) with 40% gray (10YR5/1) mottles, moist , soft, silty CLAY.		
4		618	
	Gray (10YR5/1), moist, soft, clayey SILT.		
6		616	
	Gray (10YR4/1), moist, firm, silty CLAY with little sand and trace gravel.		
8		614	
10		612	
12	Gray (10YR4/1), wet, soft, sandy CLAY.	610	
	Yellowish brown (10YR5/6) with 50% gray (10YR5/1) mottles, wet, soft, sandy CLAY with trace gravel.		
	Gray (10YR5/1), moist, very hard, sandy, clayey SILT with gravel.		
14		608	
	Gray (10YR5/1), moist, hard, silty CLAY with little sand and trace gravel.		
	Light gray (10YR7/1) with 10% yellowish brown (10YR5/8) mottles, moist, hard, silty CLAY with little sand and trace gravel.		
16		606	
18	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.	604	
20		602	

DRILLER NOTE: sampler recovered wet.

NOTE(S): MW11D installed in SB-11.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/27/2006
Finish: 4/28/2006
WEATHER: Partly cloudy, mild (mid-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-850 Track Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-11
Well ID: MW11D
Surface Elev: 622 ft. MSL
Completion: 36 ft. BGS
Station: 876,749.6N
2,515,976.7E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 11.70 - While drilling
▼ = 5.42 - MW11S on 6/1/06
▽ = 6.03 - MW11D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
										DRILLER NOTE: soft drilling 20.5' to 21.0'
	54/60 *90%*	CS					22		600	
10A				6						Wet, gravelly zone from 22.4' to 22.8'
							24	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel. *[Continued from previous page]*	598	
							26		596	
11A	58/60 *97%*	CS		8						
							28		594	
							30		592	
								Gray (10YR5/1), wet, loose, clayey, very fine- to medium-grained SAND with little coarse-grained sand and trace gravel.		
12A	32/60 *53%*	CS		9			32		590	
							34	Gray (10YR6/1) with occasional black (10YR2/1) varves, dry, dense, SILT with trace sand.	588	
12B				9						
	22/22 *100%*	SS	*7-19 41-50/4"* N=60							
							36	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.	586	
13B				14		4.85 *BSh*				

End of Boring = 36.33 ft.

NOTE(S): MW11D installed in SB-11.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/28/2006
Finish: 4/28/2006
WEATHER: Partly cloudy, mild (mid-60's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-850 Track Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-11a
Well ID: MW11S
Surface Elev: 622 ft. MSL
Completion: 14 ft. BGS
Station: 876,749.4N
2,515,971.2E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 11.70 - While drilling
▼ = 5.42 - MW11S on 6/1/06
▽ = 6.03 - MW11D on 6/1/06

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
								soil Very dark grey (10YR3/1), moist, soft, clayey SILT.		
								Yellowish brown (10YR5/6) with 20% gray (10YR5/1) mottles, moist , soft, silty CLAY.		
							2		620	
								Yellowish brown (10YR5/6) with 40% gray (10YR5/1) mottles, moist , soft, silty CLAY.		
							4		618	
								Gray (10YR5/1), moist, soft, clayey SILT.		
							▼ ▽ 6		616	
							8	Gray (10YR4/1), moist, firm, silty CLAY with little sand and trace gravel.	614	
							10		612	
							▼ 12	Gray (10YR4/1), wet, soft, sandy CLAY.	610	
								Yellowish brown (10YR5/6) with 50% gray (10YR5/1) mottles, wet, soft, sandy CLAY with trace gravel.		
								Gray (10YR5/1), moist, very hard, sandy, clayey SILT with gravel.		
							14		608	

End of Boring = 14.08 ft. BGS
See SB-11 for sample & testing details

NOTE(S): MW11S installed in blind-drilled borehole within 10 ft of SB-11.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/10/2006
Finish: 5/10/2006
WEATHER: Foggy to partly sunny, mild (hi-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-12
Well ID: MW12D
Surface Elev: 622 ft. MSL
Completion: 50 ft. BGS
Station: 875,515.1N
2,515,900.6E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.00 - While drilling
▼ = 6.76 - MW12S on 6/1/06
▽ = 46.90 - MW12D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	24"/24	ss	2-3 4-5 N=7	22		1.27 Sh
1B				27		2.33 B
2A	19"/24	ss	2-4 5-7 N=9	24		2.91 B
3A	20"/24	ss	2-2 3-4 N=5	21		2.13 B
4A	24/24 100%	ss	4-5 5-6 N=10	21		1.36 BSh
5A	24"/24	ss	1-2 2-5 N=4	20		1.47 BSh
6A	20"/24	ss	0-1 3-3 N=4	21		0.62 B
7A	21"/24	ss	2-2 3-5 N=5	22		0.19 B
7B				22		
7C				15		3.71 B
8A	24"/24	ss	4-13 18-29 N=31	9		5.15 BSh
9A	24"/24	ss	26-32 46-50 N=78	9		6.59 Sh
10A	24"/24	ss	21-31 63-71 N=94	11		6.39 Sh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil: Very dark gray (10YR3/1), clayey SILT, trace sand	622
	Dark gray (10YR4/1) with 15% yellowish brown (10YR5/6) mottles, lean CLAY	
2	loess: Yellowish brown (10YR5/8) with 40% grayish brown (10YR5/2) mottles, lean CLAY	620
4	Gray (10YR5/1), lean CLAY, trace sand and gravel	618
6	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, lean CLAY, trace sand	616
8	Yellowish brown (10YR5/8) with 20% gray (10YR6/1) mottles, lean CLAY, trace sand and gravel	614
10	hagarstown: Yellowish brown (10YR 5/8) with 25% gray (10YR6/1) mottles, clayey SAND, trace gravel	612
12	Gray (10YR6/1), clayey SAND, trace gravel, wet	610
	Dark yellowish brown (10YR4/6), clayey SAND, trace gravel, wet	
14	Light yellowish brown (10YR6/4) with 30% brownish yellow (10YR6/6) mottles, clayey SILT, trace sand and gravel	608
	vandalia	
16	Dark greenish gray (N4/1), clayey SILT, trace sand and gravel	606
18		604
20		

NOTE(S): MW12D installed in SB-12.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/10/2006
Finish: 5/10/2006
WEATHER: Foggy to partly sunny, mild (hi-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-12
Well ID: MW12D
Surface Elev: 622 ft. MSL
Completion: 50 ft. BGS
Station: 875,515.1N
2,515,900.6E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.00 - While drilling
▼ = 6.76 - MW12S on 6/1/06
▽ = 46.90 - MW12D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
							22	Dark greenish gray (N4/1), clayey SILT, trace sand and gravel *[Continued from previous page]*	602	
	60/60 *100%*	CS							600	
							24		598	
11A				6						
							26		596	
	60/60 *100%*	CS								
							28		594	
12A				7						
							30	Dark greenish gray (N4/1), sandy SILT, trace gravel	592	
	60/60 *100%*	CS					32		590	
							34		588	
13A				13						
								smithboro		
							36		586	
	60/60 *100%*	CS						Very dark gray (N3/1), clayey SILT, trace sand and gravel		
							38		584	
14A				16						
							40			

NOTE(S): MW12D installed in SB-12.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/10/2006
Finish: 5/10/2006
WEATHER: Foggy to partly sunny, mild (hi-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-12
Well ID: MW12D
Surface Elev: 622 ft. MSL
Completion: 50 ft. BGS
Station: 875,515.1N
2,515,900.6E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.00 - While drilling
▼ = 6.76 - MW12S on 6/1/06
▽ = 46.90 - MW12D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	60/60 *100%*	CS					42	Very dark gray (N3/1), clayey SILT, trace sand and gravel *[Continued from previous page]*	580	
15A				14			44		578	
								Very dark gray (N3/1), PEAT		
							46		576	
	60/60 *100%*	CS					48	Gray (N5/1) with 30% yellowish brown (10YR5/6) mottles, lean CLAY	574	
16A				45			50			

End of Boring = 50.0 ft. BGS

NOTE(S): MW12D installed in SB-12.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/10/2006
Finish: 5/10/2006
WEATHER: Foggy to partly sunny, mild (hi-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA (blind drill)

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-12a
Well ID: MW12S
Surface Elev: 622 ft. MSL
Completion: 16 ft. BGS
Station: 875,520.1N
2,515,900.5E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
								soil Very dark gray (10YR3/1), clayey SILT, trace sand	622	
								Dark gray (10YR4/1) with 15% yellowish brown (10YR5/6) mottles, lean CLAY		
							2	Yellowish brown (10YR5/8) with 40% grayish brown (10YR5/2) mottles, lean CLAY	620	
							4	Gray (10YR5/1), lean CLAY, trace sand and gravel	618	
							6	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, lean CLAY, trace sand	616	
							8	Yellowish brown (10YR5/8) with 20% gray (10YR6/1) mottles, lean CLAY, trace sand and gravel	614	
							10	Yellowish brown (10YR 5/8) with 25% gray (10YR6/1) mottles, clayey SAND, trace gravel	612	
							12	Gray (10YR6/1), clayey SAND, trace gravel, wet	610	
								Dark yellowish brown (10YR4/6), clayey SAND, trace gravel, wet		
							14	Light yellowish brown (10YR6/4) with 30% brownish yellow (10YR6/6) mottles, clayey SILT, trace sand and gravel	608	
								Dark greenish gray (N4/1), clayey SILT, trace sand and gravel		

End of Boring = 15.61 ft. BGS
See SB-12 for sample & testing details

NOTE(S): MW12S installed in blind-drilled borehole within 10 ft of SB-12.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/9/2006
Finish: 5/9/2006
WEATHER: Overcast, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler & 4¼" HSA overdrill

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-13
Well ID: MW13D
Surface Elev: 623 ft. MSL
Completion: 55 ft. BGS
Station: 874,694.3N
2,513,929.9E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.40 - While drilling
▼ = 8.24 - MW12S on 6/1/06
▽ = 56.03 - MW13D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	22/24 *92%*	ss	*4-5 4-4* N=9	21		
1B				15		
1C				28		2.13 *B*
2A	21/24 *88%*	ss	*3-4 5-8* N=9	25		2.13 *BSh*
3A	24/24 *100%*	ss	*4-5 6-8* N=11	22		2.84 *Sh*
3B				21		2.91 *BSh*
4A	24/24 *100%*	ss	*9-12 10-10* N=22	23		2.33 *B*
5A	24/24 *100%*	ss	*3-4 6-7* N=10	21		2.72 *Sh*
6A	19/24 *79%*	ss	*1-3 6-8* N=9	23		1.94 *Sh*
7A	21/24 *88%*	ss	*6-8 10-12* N=18	18		1.94 *Sh*
7B				13		1.55 *BSh*
8A	22/24 *92%*	ss	*7-21 29-30* N=50	11		
8B				9		
9A	23/24 *96%*	ss	*25-28 28-45* N=56	9		9.16 *Sh*
10A	24/24 *100%*	ss	*18-27 31-36* N=58	8		12.00 *Sh*

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil / yish brown (10YR5/2), clayey SILT, trace sand	622
	Light gray (10YR7/2), clayey SILT, trace sand	
2	Light brownish gray (10YR6/2) with 15%yellowish brown (10YR5/6) mottles, lean CLAY, trace sand	620
4	Gray (10YR6/1) with 40% yellowish brown (10YR5/6) mottles, lean CLAY, trace sand	618
6	Dark gray (10YR4/1), lean CLAY, trace sand and gravel	616
8 ▼	Gray (10YR5/1) with 25% yellowish brown (10YR5/6) mottles, lean CLAY, trace sand and gravel	614
10		612
12 ▼		610
14	Yellowish brown (10YR5/6), silty SAND, trace gravel, wet	608
16	Yellowish brown (10YR5/8) with 30% light brownish gray (10YR6/2) mottles, sandy SILT, trace gravel	606
18	Dark gray (10YR4/1), sandy SILT, trace gravel	604
20		

Borehole Detail

Remarks

NOTE(S): MW13D installed in SB-13.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/9/2006
Finish: 5/9/2006
WEATHER: Overcast, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler & 4¼" HSA overdrill

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-13
Well ID: MW13D
Surface Elev: 623 ft. MSL
Completion: 55 ft. BGS
Station: 874,694.3N
2,513,929.9E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.40 - While drilling
▼ = 8.24 - MW12S on 6/1/06
▽ = 56.03 - MW13D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	60/60 *100%*	CS					22		602	
									600	
							24			
11A				13					598	
							26			
									596	
	60/60 *100%*	CS					28	Dark gray (10YR4/1), sandy SILT, trace gravel *[Continued from previous page]*		
									594	
12A										
							30			
									592	
							32			
	60/60 *100%*	CS							590	
							34			
13A				15					588	
							36			
									586	
	60/60 *100%*	CS					38	Dark gray (10YR4/1), lean CLAY, trace sand and gravel		
									584	
14A				15						
							40			

NOTE(S): MW13D installed in SB-13.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/9/2006
Finish: 5/9/2006
WEATHER: Overcast, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler & 4¼" HSA overdrill

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-13
Well ID: MW13D
Surface Elev: 623 ft. MSL
Completion: 55 ft. BGS
Station: 874,694.3N
2,513,929.9E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.40 - While drilling
▼ = 8.24 - MW12S on 6/1/06
▽ = 56.03 - MW13D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	60/60 *100%*	CS					42		582	
									580	
							44			
15A				15					578	
							46	Dark gray (10YR4/1), lean CLAY, trace sand and gravel *[Continued from previous page]*		
									576	
	60/60 *100%*	CS					48			
									574	
16A				15						
							50			
									572	
17A				14			52	Gray (10YR4/1), silty, fine to medium SAND, wet		
17B	60/60 *100%*	CS		20				Gray (10YR4/1), sandy SILT	570	
17C				14						
							54	Dark greenish gray (5GY4/1) with 25% yellowish brown (10YR5/6) mottles, lean CLAY		
17D				22					568	

End of Boring = 55.0 ft. BGS

NOTE(S): MW13D installed in SB-13.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/9/2006
Finish: 5/9/2006
WEATHER: Overcast, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA (blind drill)

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-13a
Well ID: MW13S
Surface Elev: 623 ft. MSL
Completion: 17 ft. BGS
Station: 874,695.7N
2,513,925.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.00 - While drilling
▼ = 6.76 - MW13S on 6/1/06
▽ = 46.90 - MW12D on 6/1/06

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil yish brown (10YR5/2), clayey SILT, trace sand	622
	Light gray (10YR7/2), clayey SILT, trace sand	
	Light brownish gray (10YR6/2) with 15%yellowish brown (10YR5/6) mottles, lean CLAY, trace sand	
2	Gray (10YR6/1) with 40% yellowish brown (10YR5/6) mottles, lean CLAY, trace sand	620
4		618
	Dark gray (10YR4/1), lean CLAY, trace sand and gravel	
6	Gray (10YR5/1) with 25% yellowish brown (10YR5/6) mottles, lean CLAY, trace sand and gravel	616
8		614
10		612
12		610
14	Yellowish brown (10YR5/6), silty SAND, trace gravel, wet	608
	Yellowish brown (10YR5/8) with 30% light brownish gray (10YR6/2) mottles, sandy SILT, trace gravel	
16	Dark gray (10YR4/1), sandy SILT, trace gravel	

End of Boring = 16.62 ft. BGS
See SB-13 for sample & testing details

NOTE(S): MW13S installed in blind-drilled borehole within 10 ft of SB-13.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/1/2006
Finish: 5/2/2006
WEATHER: Sunny, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-14
Well ID: n/a
Surface Elev: 625 ft. MSL
Completion: 60 ft. BGS
Station: 875,740.0N
2,514,130.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - While drilling
▼ = 4.49 - MW14S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	23/24 96%	ss	2-3 2-3 N=5	16		
1B				26		2.33 B
2A	24/24 100%	ss	3-4 5-7 N=9	23		3.10 B
3A	23/24 96%	ss	3-3 5-5 N=8	19		2.33 B
4A	24/24 100%	ss	5-6 5-7 N=11	23		2.68 BSh
5A	24/24 100%	ss	2-2 3-4 N=5	26		1.83 B
6A	19/24 79%	ss	2-2 3-5 N=5	17		2.18 B
7A	20/24 83%	ss	2-3 3-3 N=6	22		1.16 B
8A	24/24 100%	ss	5-14 14-20 N=28	16		1.36 B
8B				11		5.77 BSh
9A	12/24 50%	ss	57-65	10		
10A	24/24 100%	ss	6-8 16-18 N=24	12		5.04 BSh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil Grayish brown (10YR5/2), clayey SILT, trace sand	624
	Gray (10YR6/1) with 30% yellowish brown (10YR6/8) mottles, lean CLAY, trace sand	
2	Light gray (10YR7/1) with 30% yellowish brown (10YR6/8) mottles, lean CLAY, trace sand	622
4 ▼		620
6	Light gray (10YR7/1) with 15% yellowish brown (10YR6/8) mottles, lean CLAY, trace sand	618
8		616
10	Yellowish brown (10YR5/8) with 50% light gray (10YR7/1) mottles, sandy CLAY	614
12		612
14 ▼	Yellowish brown (10YR5/6), silty, fine SAND, trace medium sand and gravel, wet	610
	Yellowish brown (10YR5/6), sandy SILT, trace gravel	
16	Yellowsh brown (10YR5/6) with 40% gray (10YR6/1) mottles, sandy SILT, trace gravel	608
18	Dark gray (10YR4/1), clayey SILT, trace sand and gravel	606
20		

Borehole Detail

Remarks

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/1/2006
Finish: 5/2/2006
WEATHER: Sunny, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-14
Well ID: n/a
Surface Elev: 625 ft. MSL
Completion: 60 ft. BGS
Station: 875,740.0N
2,514,130.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - While drilling
▼ = 4.49 - MW14S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
11A	24/24 100%	ss	2-7 13-30 N=20	13		9.70 B
12A	24/24 100%	ss	26-40 36-40 N=76	9		13.09 BSP
13A	24/24 100%	ss	8-18 28-34 N=46	9		8.73 BSP
14A	22/24 92%	ss	20-18 24-30 N=42	9		7.42 BSP
15A	19/24 79%	ss	8-27 33-67 N=60	9		
16A	24/24 100%	ss	8-25 27-33 N=52	10		9.60 BSh
17A	20/24 83%	ss	11-15 20-24 N=35	14		6.80 B
18A	24/24 100%	ss	3-4 7-9 N=11	16		3.88 B
19A	24/24 100%	ss	8-12 13-15 N=25	16		6.18 B
20A	24/24 100%	ss	3-7 10-13 N=17	14		3.10 B

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
22	Dark gray (10YR4/1), clayey SILT, trace sand and gravel *[Continued from previous page]*	604	
24		602	
26		600	
28		598	
30		596	
32		594	
34		592	
36	Dark gray (N4/1), lean CLAY, trace sand and gravel	590	
38		588	
40		586	

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/1/2006
Finish: 5/2/2006
WEATHER: Sunny, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-14
Well ID: n/a
Surface Elev: 625 ft. MSL
Completion: 60 ft. BGS
Station: 875,740.0N
2,514,130.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - While drilling
▼ = 4.49 - MW14S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
21A	23/24 96%	SS	3-6 8-13 N=14	15		4.80 B
22A	24/24 100%	SS	13-15 16-18 N=31	14		5.62 B
23A	24/24 100%	SS	4-8 11-13 N=19	15		4.65 B
24A	24/24 100%	SS	18-18 20-20 N=38	15		4.65 B
25A	24/24 100%	SS	4-7 9-11 N=16	19		2.13 BSh
26A	22/24 92%	SS	3-5 6-8 N=11	22		3.30 BSh
27A	24/24 100%	SS	3-5 5-7 N=10	25		2.89 BSh
28A	21/24 88% 0/24 0%	SS SH	4-6 7-8 N=13	22		3.71 BSh
29A	14/24 58%	SS	0-0 0-0 N=0	22		3.09 BSh
30A	22/24 92%	SS	5-6 8-12 N=14	19		4.46 BSh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
		584
42		
		582
44	Dark gray (N4/1), lean CLAY, trace sand and gravel *[Continued from previous page]*	
		580
46		
		578
48		
	Dark gray (N4/1), clayey SILT, trace sand and gravel	576
	Gray (N4/1), wet, loose, fine- to medium-grained SAND	
50	Dark gray (N4/1), clayey SILT, trace sand and gravel	
	Greenish gray (5BG5/1), lean CLAY	574
52		
	Greenish gray (5BG5/1) with 15% yellowish brown (10YR5/6) mottles, lean CLAY	572
54		
	Greenish gray (5BG5/1) with 25% yellowish brown (10YR5/6) mottles, lean CLAY	570
56		
	Greenish gray (5BG5/1) with 50% yellowish brown (10YR5/6) mottles, lean CLAY	568
58		
	Yellowish brown (10YR4/6) with 10% greenish gray (5BG5/1) mottles, lean CLAY	566
60	**End of Boring = 60.0 ft. BGS**	

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/2/2006
Finish: 5/2/2006
WEATHER: Sunny, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: Sb-14a
Well ID: MW14S
Surface Elev: 625 ft. MSL
Completion: 17 ft. BGS
Station: 875,737.8N
2,514,125.9E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - While drilling
▼ = 4.49 - MW14S on 6/1/06
▽ =

SAMPLE			TESTING				Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*					

soil

Grayish brown (10YR5/2), clayey SILT, trace sand

Gray (10YR6/1) with 30% yellowish brown (10YR6/8) mottles, lean CLAY, trace sand

Light gray (10YR7/1) with 30% yellowish brown (10YR6/8) mottles, lean CLAY, trace sand

Light gray (10YR7/1) with 15% yellowish brown (10YR6/8) mottles, lean CLAY, trace sand

Yellowish brown (10YR5/8) with 50% light gray (10YR7/1) mottles, sandy CLAY

Yellowish brown (10YR5/6), silty, fine SAND, trace medium sand and gravel, wet

Yellowish brown (10YR5/6), sandy SILT, trace gravel

Yellowsh brown (10YR5/6) with 40% gray (10YR6/1) mottles, sandy SILT, trace gravel

Depth: 2, 4, 6, 8, 10, 12, 14, 16

Elevation: 624, 622, 620, 618, 616, 614, 612, 610, 608

End of Boring = 17.38 ft. BGS
See SB-14 for sample & testing details

NOTE(S): MW14S installed in blind-drilled borehole within 10 ft of SB-14.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/24/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (lo-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-15
Well ID: n/a
Surface Elev: 624 ft. MSL
Completion: 84 ft. BGS
Station: 875,970.0N
2,515,080.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.40 - While drilling
▼ = 4.99 - MW15S on 6/1/06
▽ = 5.24 - MW15D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	24/24 *100%*	SS	*2-2 3-4* N=5	19		
1B				27		1.94 *B*
2A	24/24 *100%*	SS	*2-2 4-6* N=6	25		3.10 *B*
3A	20/24 *83%*	SS	*2-3 3-5* N=6	29		2.10 *B*
4A	24/24 *100%*	SS	*4-6 5-5* N=11	24		1.75 *B*
5A	22/24 *92%*	SS	*1-2 3-4* N=5	26		1.55 *B*
6A	22/24 *92%*	SS	*2-3 3-4* N=6	22		1.85 *B*
	19/24 *79%*	SH				
7A	24/24 *100%*	SS	*4-4 5-5* N=9	23		1.22 *B*
7B				17		
8A	21/24 *88%*	SS	*2-6 15-19* N=21	11		3.22 *BSP*
9A	24/24 *100%*	SS	*18-29 40-50* N=69	20		
9B				21		
9C				9		
10A	17/24 *71%*	SS	*11-43 59/5"*	7		7.42 *B*

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	soil — Dark brown (10YR3/3), clayey SILT		
	Dark grayish brown (10YR3/2), clayey SILT, trace sand		
2	Grayish brown (10YR5/2), with 50% very dark gray (10YR3/1) mottles, lean CLAY, trace sand	622	
	Gray (10YR6/1), lean CLAY, trace sand		
4	loess	620	
	Yellowish brown (10YR5/6) with 40% gray (10YR6/1) mottles, lean CLAY, trace sand		
6		618	
	Gray (10YR6/1), lean CLAY, trace sand		
8		616	
10	Gray (10YR6/1) with 50% yellowish brown (10YR5/6) mottles, lean CLAY, little sand, trace gravel	614	
12		612	Shelby tube taken from shallow well borehole at indicated depth.
14	hagarstown — (10YR6/1) with 30% yellowish brown (10YR5/6) mottles, silty, fine to medium SAND, trace coarse sand and gravel, wet	610	
	Pale brown (10YR6/3), clayey SILT, little sand, trace gravel		
16	Yellowish brown (10YR5/4), silty, fine to coarse SAND, wet	608	
	Yellowish brown (10YR5/4) silty fine SAND, wet		
	Gray (10YR6/1), sandy SILT, trace medium to coarse sand and trace gravel	606	
18	vandalia		
	Dark gray (10YR4/1), clayey SILT, little sand, trace gravel		
20		604	

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/24/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (lo-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-15
Well ID: n/a
Surface Elev: 624 ft. MSL
Completion: 84 ft. BGS
Station: 875,970.0N
2,515,080.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.40 - While drilling
▼ = 4.99 - MW15S on 6/1/06
▽ = 5.24 - MW15D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
11A	14/24 *58%*	ss	*14-55 45/2"*	8		
12A	8/24 *33%*	ss	*100/8"*	8		6.76 *SP*
13A	23/24 *96%*	ss	*12-28 43-57/5"* N=71	5		
14A	8/24 *33%*	ss	*59-41/2"*	6		7.95 *BSh*
15A	16/24 *67%*	ss	*11-26 74/4"*	12		4.74 *BSh*
16A	12/24 *50%*	ss	*39-61*	7		
17A	10/24 *42%*	ss	*49-51/4"*	9		5.43 *B*
18A	11/24 *46%*	ss	*100-95*	11		
19A	8/24 *33%*	ss	*61-39/2"*	10		
20A	24/24 *100%*	ss	*21-41 21-24* N=62	12		16.00 *None*
20B				13		9.38

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
22	Dark gray (10YR4/1), clayey SILT, little sand, trace gravel *[Continued from previous page]*	602	
24		600	
26		598	
28		596	
30		594	
32		592	
34		590	
36	mulberry grove Dark gray (10YR4/1), silty, fine to medium SAND, trace coarse sand and gravel, wet	588	
38	Very dark gray (10YR3/1), clayey SILT, little sand, trace gravel	586	
40	Very dark gray (10YR3/1) with 20% dark grayish brown (10YR4/2) mottles, clayey SILT, trace sand and gravel	584	

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/24/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (lo-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-15
Well ID: n/a
Surface Elev: 624 ft. MSL
Completion: 84 ft. BGS
Station: 875,970.0N
2,515,080.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.40 - While drilling
▼ = 4.99 - MW15S on 6/1/06
▽ = 5.24 - MW15D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
						BSh
21A	22/24 92%	ss	3-7 11-18 N=18	19		6.11 BSh
22A	24/24 100%	ss	4-7 8-10 N=15	23		4.46 B
23A	24/24 100%	ss	3-6 6-10 N=12	21		
23B				16		3.69 B
24A	24/24 100%	ss	10-12 10-15 N=22	16		4.58 B
25A	24/24 100%	ss	2-4 7-9 N=11	16		4.65 B
26A	19/24 79%	ss	3-5 7-13 N=12	21		3.88 B
27A	24/24 100%	ss	8-10 8-13 N=18	25		3.49 BSh
28A	24/24 100%	ss	4-5 8-12 N=13	22		3.49 BSh
29A	24/24 100%	ss	5-9 15-18 N=24	20		
30A	24/24 100%	ss	8-9 14-18 N=23	18		5.82 BSh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	smithboro	
	Dark gray (10YR4/1), clayey SILT, trace sand and gravel	582
42		
	Dark greenish gray (5GY4/1) with 30% dark gray (N4/1) mottles, lean CLAY, trace sand	580
44		
46		578
48	Dark gray (N4/1), lean CLAY, trace sand and gravel	576
50		574
52		572
	yarmouth	
	Dark yellowish brown (10YR3/4) with 50% dark grayish brown (10YR4/2) mottles, lean CLAY, trace sand and gravel	570
54		
	lierle	
56	Greenish gray (10YR5/1) with 20% dark yellowish brown (10YR4/4) mottles, lean CLAY, trace sand and gravel	568
58		566
	banner	
	Olive (5Y4/3) with 15% greenish gray (10GY5/1) mottles, lean CLAY, trace sand and gravel	564
60		

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/24/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (lo-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-15
Well ID: n/a
Surface Elev: 624 ft. MSL
Completion: 84 ft. BGS
Station: 875,970.0N
2,515,080.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.40 - While drilling
▼ = 4.99 - MW15S on 6/1/06
▽ = 5.24 - MW15D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
31A	24/24 100%	ss	4-7 13-15 N=20	18		5.42 BSh
32A	24/24 100%	ss	10-15 11-16 N=26	20		4.74 BSh
33A	24/24 100%	ss	6-10 11-13 N=21	16		6.98 BSh
34A	24/24 100%	ss	11-14 18-31 N=32	18		6.98 BSh
35A	23/24 96%	ss	9-18 27-40 N=45	15		11.95 BSh
36A	24/24 100%	ss	4-12 18-24 N=30	16		7.15 BSh
37A	24/24 100%	ss	17-29 36-47 N=65	17		8.24 BSh
38A	20/24 83%	ss	12-18 23-28 N=41	17		6.59 BSh
39A	9/24 38%	ss	29-39 48-66 N=87	16		
40A	24/24 100%	ss	5-9 13-18 N=22	18		6.21 B

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
62	Olive (5Y4/3) with 15% greenish gray (10GY5/1) mottles, lean CLAY, trace sand and gravel *[Continued from previous page]*	562
64	Greenish gray (10Y5), lean CLAY, trace sand and gravel	560
66	Dark yellowish brown (10YR4/4), lean CLAY, trace sand and gravel	558
68		556
70		554
72		552
74		550
76		548
78		546
80		544

Borehole Detail

Remarks

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/24/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (lo-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-15
Well ID: n/a
Surface Elev: 624 ft. MSL
Completion: 84 ft. BGS
Station: 875,970.0N
2,515,080.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.40 - While drilling
▼ = 4.99 - MW15S on 6/1/06
▽ = 5.24 - MW15D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
41A	24/24 *100%*	ss	*6-8* *13-16* N=21	17		5.82 *B*					
							82	Dark yellowish brown (10YR4/4), lean CLAY, trace sand and gravel *[Continued from previous page]*		542	
42A	24/24 *100%*	ss	*18-28* *25-25* N=53	18		5.82 *BSh*					
							84			540	

End of Boring = 84.0 ft. BGS

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/25/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (lo-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" HSA (blind drill)

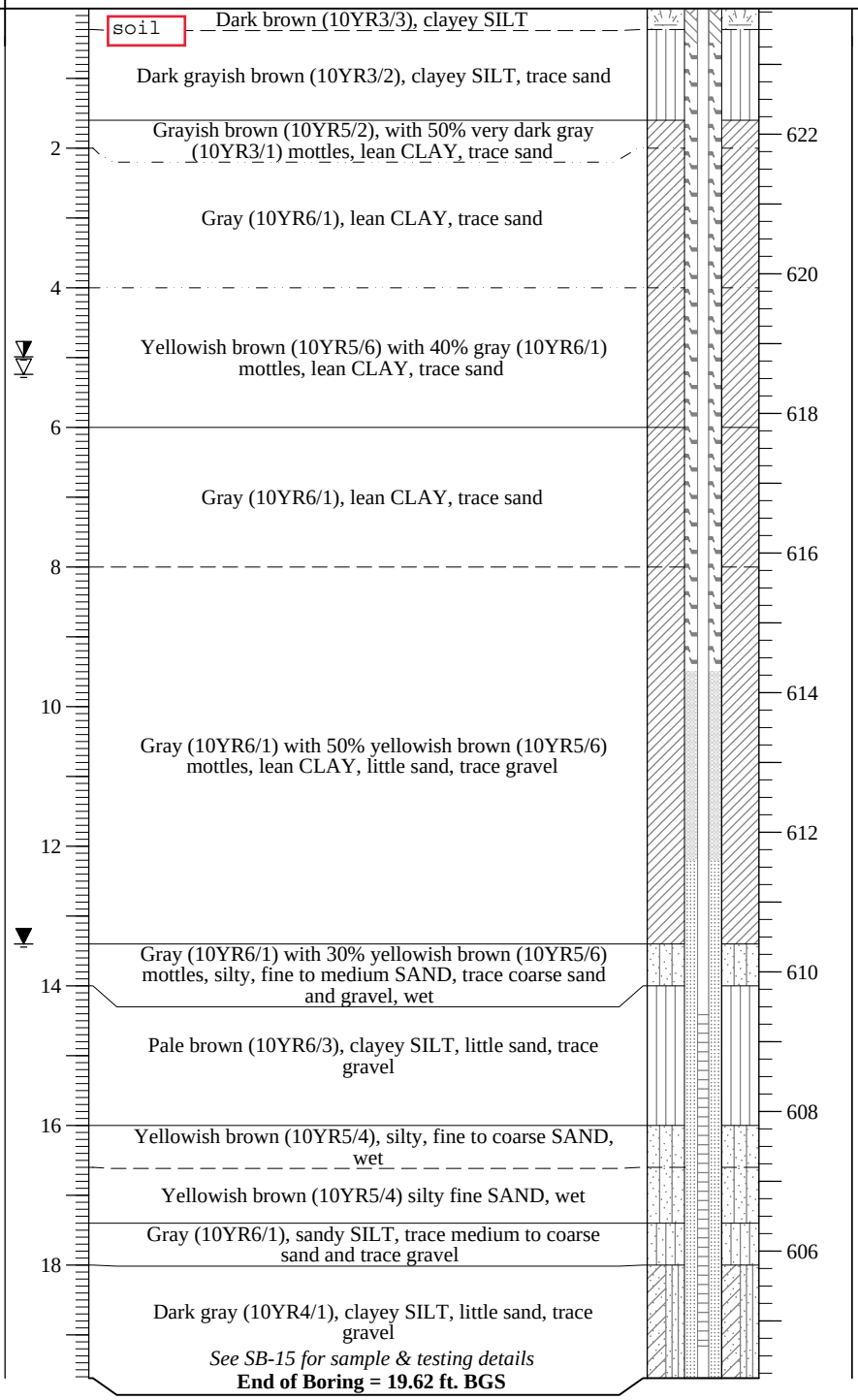
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-15a
Well ID: MW15S
Surface Elev: 624 ft. MSL
Completion: 20 ft. BGS
Station: 875,971.1N
2,515,076.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.40 - While drilling
▼ = 4.99 - MW15S on 6/1/06
▽ = 5.24 - MW15D on 6/1/06

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks



NOTE(S): MW15S installed in blind-drilled borehole within 10 ft of SB-15.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/24/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (lo-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" HSA (blind drill)

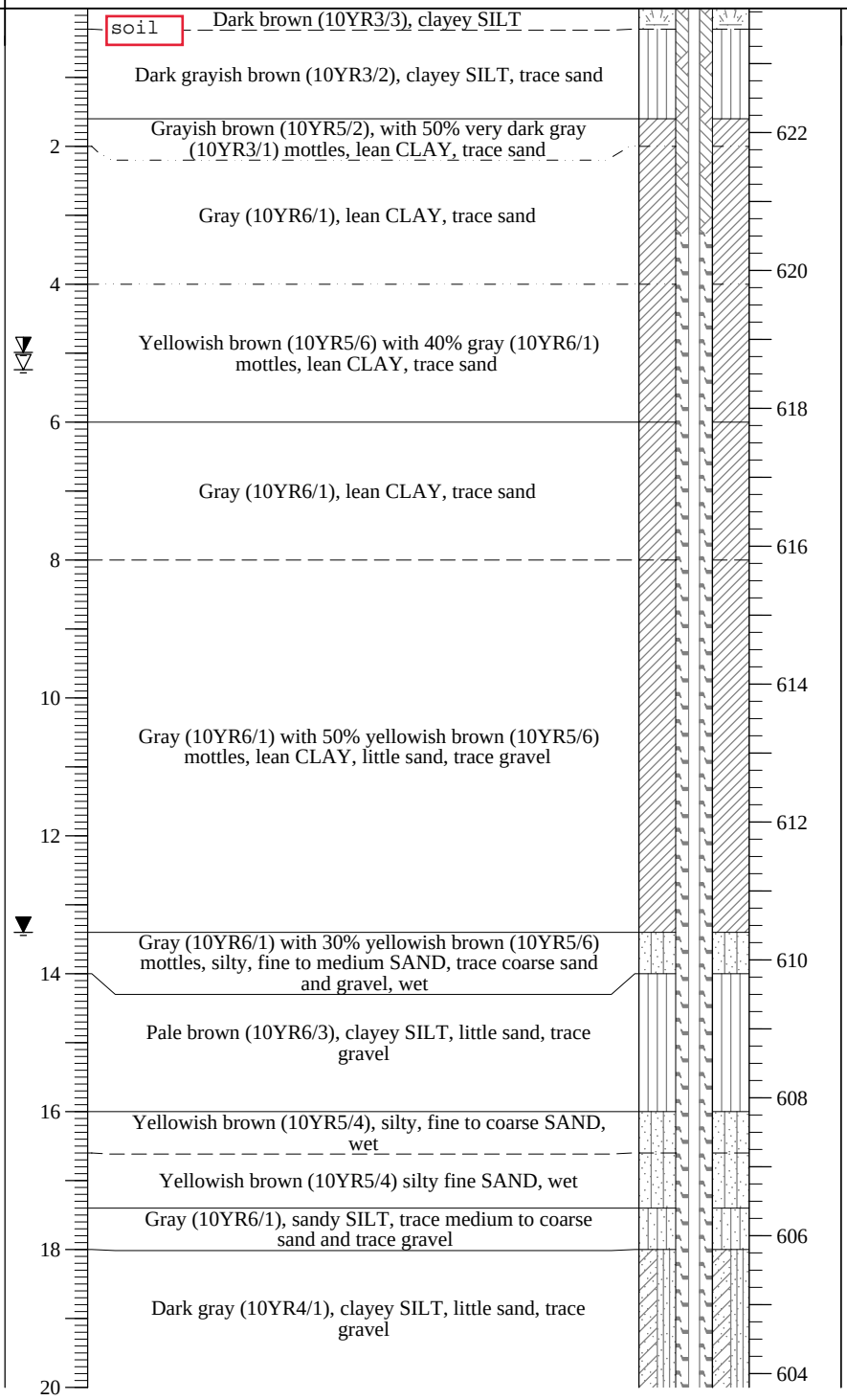
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-15b
Well ID: MW15D
Surface Elev: 624 ft. MSL
Completion: 39 ft. BGS
Station: 875,970.5N
2,515,080.7E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.40 - While drilling
▼ = 4.99 - MW15S on 6/1/06
▽ = 5.24 - MW15D on 6/1/06

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks



NOTE(S): MW15D installed in blind-drilled borehole within 10 ft of SB-15.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/24/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (lo-50's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-15b
Well ID: MW15D
Surface Elev: 624 ft. MSL
Completion: 39 ft. BGS
Station: 875,970.5N
2,515,080.7E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 13.40 - While drilling
▼ = 4.99 - MW15S on 6/1/06
▽ = 5.24 - MW15D on 6/1/06

SAMPLE			TESTING				Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*					
							22			602	
							24			600	
							26			598	
							28	Dark gray (10YR4/1), clayey SILT, little sand, trace gravel *[Continued from previous page]*		596	
							30			594	
							32			592	
							34			590	
							36			588	
								Dark gray (10YR4/1), silty, fine to medium SAND, trace coarse sand and gravel, wet			
							38			586	
								Very dark gray (10YR3/1), clayey SILT, little sand, trace gravel			

End of Boring = 38.80 ft. BGS
See SB-15 for sample & testing details

NOTE(S): MW15D installed in blind-drilled borehole within 10 ft of SB-15.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/21/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (mid-40's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-850 Track Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-16
Well ID: n/a
Surface Elev: 626 ft. MSL
Completion: 92 ft. BGS
Station: 877,355.0N
2,515,080.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 5.74 - MW16S on 6/1/06
▽ = 51.37 - MW16D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	21/24 *88%*	SS	*4-4 6-7* N=10	22		
1B				29		2.13 *B*
2A	24/24 *100%*	SS	*4-6 7-9* N=13	25		2.13 *B*
3A	20/24 *83%*	SS	*3-4 5-7* N=9	21		2.33 *B*
4A	24/24 *100%*	SS	*2-3 4-6* N=7	25		2.13 *B*
5A	24/24 *100%*	SS	*3-4 5-5* N=9	24		2.33 *B*
6A	24/24 *100%* 24/24 *100%*	SS SH	*2-4 4-5* N=8	24		1.75 *B*
7A	24/24 *100%*	SS	*4-7 7-7* N=14	22		1.94 *BSh*
7B				18		
8A	21/24 *88%*	SS	*1-2 2-4* N=4	20		
9A	18/24 *75%*	SS	*4-3 4-10* N=7	14		
9B				15		
10A				10		
10B	20/24 *83%*	SS	*27-54 59-59* N=113	17		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	soil (10YR2/1), sl. moist, firm, clayey SILT with trace sand and trace gravel.	626	
2	Brown (10YR4/3), sl. moist, firm, silty CLAY with trace sand.	624	
4	Gray (10YR5/1) with 25% yellowish brown (10YR5/8) mottles, moist, very soft, very silty CLAY with trace sand.	622	
6	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, very soft, very silty CLAY with trace sand.	620	
8		618	
10	Gray (10YR5/1) with 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with some sand and trace gravel.	616	Shelby tube taken from shallow well borehole at indicated depth.
12		614	
	Dark yellowish brown (10YR4/6), wet, sl. dense, silty, very fine- to fine-grained SAND.		
14	Dark yellowish brown (10YR4/6), moist, firm, silty CLAY with sand and trace gravel.	612	
	Dark yellowish brown (10YR4/6), wet, loose, silty, very fine- to fine-grained SAND.		
	Dark yellowish brown (10YR4/6), wet, soft, silty CLAY with sand and trace gravel.		
16		610	
	Yellowish brown (10YR5/6), wet, loose, very fine- to very coarse-grained SAND.		
	Gray (10YR5/1), wet, loose, fine- to medium-grained SAND.		
18	Gray (10YR5/1), moist, hard, clayey SILT with sand and trace gravel.	608	
	Gray (10YR5/1), wet, loose, very fine- to fine-grained SAND.		
	Gray (10YR4/1), moist, very hard, clayey, sandy SILT with trace gravel.		
20			

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/21/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (mid-40's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-850 Track Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-16
Well ID: n/a
Surface Elev: 626 ft. MSL
Completion: 92 ft. BGS
Station: 877,355.0N
2,515,080.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 5.74 - MW16S on 6/1/06
▽ = 51.37 - MW16D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
11A	10/24 *42%*	ss	*10-96*	8					606	
							22		604	
12A	14/24 *58%*	ss	*84-132*	10		3.10 *BSh*				
							24		602	
13A	20/24 *83%*	ss	*41-68* *82* N=150	10		7.56 *B*				
							26		600	
14A	12/24 *50%*	ss	*58-119*	10		9.89 *B*				Dusky red (7.5YR3/4) staining.
							28		598	
15A	24/24 *100%*	ss	*30-48* *70-71* N=118	9		5.62 *B*		Gray (10YR4/1), moist, very hard, clayey, sandy SILT with trace gravel. *[Continued from previous page]*		
							30		596	
16A	24/24 *100%*	ss	*50-54* *68-93* N=122	9						
							32		594	
17A	35/36 *97%*	cs		17						
							34		592	
							36		590	
18A	60/60 *100%*	cs		10						
							38		588	
							40			Wood fragments.

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/21/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (mid-40's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-850 Track Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-16
Well ID: n/a
Surface Elev: 626 ft. MSL
Completion: 92 ft. BGS
Station: 877,355.0N
2,515,080.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 5.74 - MW16S on 6/1/06
▽ = 51.37 - MW16D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
19A				19		
	60/60 100%	CS				
19B				11		
20A	60/60 100%	CS		13		
21A	24/24 100%	SS	6-14 18-22 N=32	19		1.94 B
	0/48 0%	CS				
22A	24/24 100%	SS	2-7 7-15 N=14	21		3.71 BSh
	24/24 100%	SS	4-8 11-13 N=19			
23A	0/12 0%	BD		26		2.13 BSh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Gray (10YR5/1) with 50% black (10YR2/1) varves, very moist, soft SILT.	586	
42	Gray (10YR4/1), moist, very hard, clayey, sandy SILT with trace gravel.	584	
44		582	
46	Very dark greenish gray (10Y3/1), moist, hard, silty CLAY with sand and trace gravel.	580	
48		578	
50		576	
52	Very dark bluish gray (5BG3/1), moist, firm, silty CLAY with trace sand and trace gravel.	574	Possible rock at end of auger.
54		572	
56	Greenish gray (5G6/1) with 40% yellowish brown (10YR5/6) mottles, moist, hard, silty CLAY with sl. trace sand.	570	
58		568	
60			

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/21/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (mid-40's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-850 Track Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-16
Well ID: n/a
Surface Elev: 626 ft. MSL
Completion: 92 ft. BGS
Station: 877,355.0N
2,515,080.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 5.74 - MW16S on 6/1/06
▽ = 51.37 - MW16D on 6/1/06

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
	0/48 *0%*	RC				
26A	24/24 *100%*	SS	*32-34 42-51* N=76	25		2.72 *BSh*
	0/24 *0%*	RC				
	24/24 *100%*	SS	*15-21 21-21* N=42			
28A				18		2.72 *BSh*
29A	24/24 *100%*	SS	*14-17 21-25* N=38	20		2.91 *BSh*
30A	24/24 *100%*	SS	*12-21 34-35* N=55	18		5.04 *BSh*
31A	24/24 *100%*	SS	*16-21 27-35* N=48	16		8.15 *BSh*
	60/60 *100%*	CS				
32A				19		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Greenish gray (5G6/1) with 40% yellowish brown (10YR5/6) mottles, moist, hard, silty CLAY with sl. trace sand. *[Continued from previous page]*	566	
62		564	
64		562	
66	Yellowish brown (10YR5/6) with 20% greenish gray (5G6/1) mottles, moist, hard, silty CLAY with trace sand and trace coal fragments.	560	
68		558	
70		556	70' to 79.5' - possible oxidation rinds.
72		554	
74	Yellowish brown (10YR5/6) with zones of gray (10YR4/1) mottles, moist, hard, clayey SILT with some sand and trace gravel.	552	
76		550	
78		548	
80			

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/21/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (mid-40's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-850 Track Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-16
Well ID: n/a
Surface Elev: 626 ft. MSL
Completion: 92 ft. BGS
Station: 877,355.0N
2,515,080.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 5.74 - MW16S on 6/1/06
▽ = 51.37 - MW16D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
								Yellowish brown (10YR5/6) with zones of gray (10YR4/1) mottles, moist, hard, clayey SILT with some sand and trace gravel. *[Continued from previous page]*	546	
	60/60 *100%*	CS					82		544	
33A				16			84	Yellow brown (10YR5/6), very moist, very soft, clayey, very fine-grained SAND and SILT.	542	
							86		540	
	0/60 *0%*	CS					88	Yellowish brown (10YR5/6), moist, hard, silty CLAY with sand and trace gravel.	538	Possible rock at end of auger.
							90		536	
35A	24/24 *100%*	SS	*9* *11-16* N=20			2.72 *BSh*		Dark gray (10YR3/1), moist, firm, silty CLAY with sand and trace gravel.		
							92			

End of Boring = 92.0 ft. BGS

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/25/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (mid-40's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-850 Track Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-16a
Well ID: MW16S
Surface Elev: 626 ft. MSL
Completion: 20 ft. BGS
Station: 877,355.1N
2,515,088.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 5.74 - MW16S on 6/1/06
▽ = 51.37 - MW16D on 6/1/06

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
								soil (10YR2/1), sl. moist, firm, clayey SILT with trace sand and trace gravel.		
							2	Brown (10YR4/3), sl. moist, firm, silty CLAY with trace sand.	624	
							4	Gray (10YR5/1) with 25% yellowish brown (10YR5/8) mottles, moist, very soft, very silty CLAY with trace sand.	622	
							6	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, very soft, very silty CLAY with trace sand.	620	
							8	Gray (10YR5/1) with 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with some sand and trace gravel.	618	
							10		616	
							12	Dark yellowish brown (10YR4/6), wet, sl. dense, silty, very fine- to fine-grained SAND.	614	
							14	Dark yellowish brown (10YR4/6), moist, firm, silty CLAY with sand and trace gravel.	612	
								Dark yellowish brown (10YR4/6), wet, loose, silty, very fine- to fine-grained SAND.		
							16	Dark yellowish brown (10YR4/6), wet, soft, silty CLAY with sand and trace gravel.	610	
								Yellowish brown (10YR5/6), wet, loose, very fine- to very coarse-grained SAND.		
							18	Gray (10YR5/1), wet, loose, fine- to medium-grained SAND.	608	
								Gray (10YR5/1), moist, hard, clayey SILT with sand and trace gravel.		
								Gray (10YR5/1), wet, loose, very fine- to fine-grained SAND.		
								Gray (10YR4/1), moist, very hard, clayey, sandy SILT with trace gravel.		

End of Boring = 19.90 ft. BGS
See SB-16 for sample & testing details

NOTE(S): MW16S installed in blind-drilled borehole within 10 ft of SB-16.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/21/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (mid-40's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-850 Track Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-16b
Well ID: MW16D
Surface Elev: 626 ft. MSL
Completion: 51 ft. BGS
Station: 877,354.9N
2,515,079.4E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 5.74 - MW16S on 6/1/06
▽ = 51.37 - MW16D on 6/1/06

SAMPLE: Number	SAMPLE: Recov / Total (in) % Recovery	SAMPLE: Type	TESTING: Blows / 6 in N - Value RQD	TESTING: Moisture (%)	TESTING: Dry Den. (lb/ft³)	TESTING: Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
								soil (10YR2/1), sl. moist, firm, clayey SILT with trace sand and trace gravel.		626	
							2	Brown (10YR4/3), sl. moist, firm, silty CLAY with trace sand.		624	
							4	Gray (10YR5/1) with 25% yellowish brown (10YR5/8) mottles, moist, very soft, very silty CLAY with trace sand.		622	
							6 ▼	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, very soft, very silty CLAY with trace sand.		620	
							8	Gray (10YR5/1) with 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with some sand and trace gravel.		618	
							10			616	
							12 ▼			614	
								Dark yellowish brown (10YR4/6), wet, sl. dense, silty, very fine- to fine-grained SAND.			
							14	Dark yellowish brown (10YR4/6), moist, firm, silty CLAY with sand and trace gravel.		612	
								Dark yellowish brown (10YR4/6), wet, loose, silty, very fine- to fine-grained SAND.			
								Dark yellowish brown (10YR4/6), wet, soft, silty CLAY with sand and trace gravel.			
							16	Yellowish brown (10YR5/6), wet, loose, very fine- to very coarse-grained SAND.		610	
								Gray (10YR5/1), wet, loose, fine- to medium-grained SAND.			
							18	Gray (10YR5/1), moist, hard, clayey SILT with sand and trace gravel.		608	
								Gray (10YR5/1), wet, loose, very fine- to fine-grained SAND.			
							20	Gray (10YR4/1), moist, very hard, clayey, sandy SILT with trace gravel.			

NOTE(S): MW16D installed in blind-drilled borehole within 10 ft of SB-16.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/21/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (mid-40's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-850 Track Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-16b
Well ID: MW16D
Surface Elev: 626 ft. MSL
Completion: 51 ft. BGS
Station: 877,354.9N
2,515,079.4E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 5.74 - MW16S on 6/1/06
▽ = 51.37 - MW16D on 6/1/06

SAMPLE			TESTING				Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*					
										606	
							22			604	
							24			602	
							26			600	
							28			598	
							30	Gray (10YR4/1), moist, very hard, clayey, sandy SILT with trace gravel. *[Continued from previous page]*		596	
							32			594	
							34			592	
							36			590	
							38			588	
							40				

NOTE(S): MW16D installed in blind-drilled borehole within 10 ft of SB-16.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 4/21/2006
Finish: 4/25/2006
WEATHER: Overcast, cool (mid-40's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-850 Track Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-16b
Well ID: MW16D
Surface Elev: 626 ft. MSL
Completion: 51 ft. BGS
Station: 877,354.9N
2,515,079.4E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.80 - While drilling
▼ = 5.74 - MW16S on 6/1/06
▽ = 51.37 - MW16D on 6/1/06

SAMPLE			TESTING				Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*					
								Gray (10YR5/1) with 50% black (10YR2/1) varves, very moist, soft SILT.		586	
							42	Gray (10YR4/1), moist, very hard, clayey, sandy SILT with trace gravel.		584	
							44			582	
							46	Very dark greenish gray (10Y3/1), moist, hard, silty CLAY with sand and trace gravel.		580	
							48			578	
							50	Very dark bluish gray (5BG3/1), moist, firm, silty CLAY with trace sand and trace gravel.		576	

End of Boring = 51.00 ft. BGS
See SB-16 for sample & testing details

NOTE(S): MW16D installed in blind-drilled borehole within 10 ft of SB-16.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/4/2006
Finish: 5/4/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-17
Well ID: MW17D
Surface Elev: 627 ft. MSL
Completion: 54 ft. BGS
Station: 878,659.0N
2,515,090.4E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 11.70 - While drilling
▼ = 6.89 - MW17S on 6/1/06
▽ = 54.45 - MW17D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	20/24 *83%*	ss	*1-1 1-1* N=2	29		
2A	24/24 *100%*	ss	*1-1 2-2* N=3	26		1.71 *None*
3A	24/24 *100%*	ss	*1-1 1-3* N=2	16		2.62 *BSh*
4A	24/24 *100%*	ss	*1-2 2-3* N=4	18		2.33 *B*
5A	24/24 *100%*	ss	*1-1 2-3* N=3	18		
6A	24/24 *100%*	ss	*1-1 1-1* N=2	21		0.58 *B*
6B				18		
7A	24/24 *100%*	ss	*1-1 3-7* N=4	21		
7B				19		
8A	24/24 *100%*	ss	*2-5 5-7* N=10	15		
8B				13		
8C				13		
9A	24/24 *100%*	ss	*0-6 6-6* N=12	17		
10A	24/24 *100%*	ss	*0-2 2-3* N=4	19		
10B				23		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil grayish brown (10YR4/2), moist, soft, clayey SILT with trace sand and trace gravel.	
	Yellowish brown (10YR5/8), moist, soft, silty CLAY.	626
2	Gray (10YR5/1) with 40% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY with little sand and trace gravel.	624
4	Yellowish brown (10YR5/6) with 10% gray (10YR5/1) mottles, moist, firm sandy, clayey SILT.	622
6	Yellowish brown (10YR5/6) with 30% gray (10YR5/1) mottles, moist, firm sandy, clayey SILT.	620
8	Yellowish brown (10YR5/6), moist, soft, very sandy, clayey SILT.	618
10	Gray (10YR5/1) with 30% yellowish brown (10YR5/6) mottles, very moist, soft, very sandy, clayey SILT.	616
12	Moderate yellowish brown (10YR5/4), wet, loose, very fine- to fine-grained SAND. Yellowish brown (10YR5/6), wet, dense, silty, very fine- to fine-grained SAND.	614
14	Yellowish brown (10YR5/6), very moist, dense, silty, very fine-grained SAND. Yellowish brown (10YR5/6) wet, dense, fine- to medium-grained SAND. Moderate yellowish brown (10YR5/4), wet, dense, SILT and very fine-grained SAND.	612
16	Yellowish brown (10YR5/6), moist, clayey SILT and very fine-grained SAND with trace gravel. Yellowish brown (10YR5/6), wet, loose, very fine- to medium-grained SAND.	610
18	Yellowish brown (10YR5/6), wet, loose, very fine- to fine-grained SAND.	608
20	Yellowish brown (10YR5/6), wet, sl. dense, SILT with some very fine-grained SAND. Gray (10YR5/1), wet, sl. dense, SILT with some very	

NOTE(S): CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/4/2006
Finish: 5/4/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-17
Well ID: MW17D
Surface Elev: 627 ft. MSL
Completion: 54 ft. BGS
Station: 878,659.0N
2,515,090.4E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 11.70 - While drilling
▼ = 6.89 - MW17S on 6/1/06
▽ = 54.45 - MW17D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
								fine-grained SAND.		
11A	12/24 *50%*	SS	*0-1 1-2* N=2	21			22	Yellowish brown (10YR5/6), wet, loose, very fine- to fine-grained SAND.	606	
12A	24/24 *100%*	SS	*2-2 5-7* N=7	18				Gray (10YR5/1), wet, loose, very fine- to fine-grained SAND.	604	
12B				9		4.65 *BSh*	24			
									602	
	25/60 *42%*	CS					26			
									600	
13A							28			
									598	
							30	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.		
	60/60 *100%*	CS							596	
14A				9			32			
									594	
							34			
									592	
							36			
	60/60 *100%*	CS							590	
15A				16				Gray (10YR5/1), wet, dense, very fine- to fine-grained SAND.		
							38			
15B				8				Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.	588	
							40			

NOTE(S): CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/4/2006
Finish: 5/4/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-17
Well ID: MW17D
Surface Elev: 627 ft. MSL
Completion: 54 ft. BGS
Station: 878,659.0N
2,515,090.4E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 11.70 - While drilling
▼ = 6.89 - MW17S on 6/1/06
▽ = 54.45 - MW17D on 6/1/06

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
	48/60 *80%*	CS				
16A				14		
16B				8		
	60/60 *100%*	CS				
17A				13		
	60/60 *100%*	CS				
18A				22		
18B				16		
18C				11		

Depth ft. BGS | Lithologic Description | Borehole Detail | Elevation ft. MSL | Remarks

42, 44, 46, 48, 50, 52

586, 584, 582, 580, 578, 576, 574

Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.
[Continued from previous page]

Dark bluish gray (10BG4/1), moist, hard, silty CLAY with little sand.

Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.

Gray (10YR5/1), moist, firm, silty, very fine-grained to fine-grained SAND.

Dark bluish gray (10BG4/1), moist, hard, silty CLAY with little sand.

End of Boring = 53.87 ft.

NOTE(S): CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/4/2006
Finish: 5/4/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-17a
Well ID: MW17S
Surface Elev: 627 ft. MSL
Completion: 24 ft. BGS
Station: 878,658.5N
2,515,084.8E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 11.70 - While drilling
▼ = 6.89 - MW17S on 6/1/06
▽ = 54.45 - MW17D on 6/1/06

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks

soil

grayish brown (10YR4/2), moist, soft, clayey SILT with trace sand and trace gravel.

Yellowish brown (10YR5/8), moist, soft, silty CLAY.

Gray (10YR5/1) with 40% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY with little sand and trace gravel.

Yellowish brown (10YR5/6) with 10% gray (10YR5/1) mottles, moist, firm sandy, clayey SILT.

Yellowish brown (10YR5/6) with 30% gray (10YR5/1) mottles, moist, firm sandy, clayey SILT.

Yellowish brown (10YR5/6), moist, soft, very sandy, clayey SILT.

Gray (10YR5/1) with 30% yellowish brown (10YR5/6) mottles, very moist, soft, very sandy, clayey SILT.

Moderate yellowish brown (10YR5/4), wet, loose, very fine- to fine-grained SAND.

Yellowish brown (10YR5/6), wet, dense, silty, very fine- to fine-grained SAND.

Yellowish brown (10YR5/6), very moist, dense, silty, very fine-grained SAND.

Yellowish brown (10YR5/6) wet, dense, fine- to medium-grained SAND.

Moderate yellowish brown (10YR5/4), wet, dense, SILT and very fine-grained SAND.

Yellowish brown (10YR5/6), moist, clayey SILT and very fine-grained SAND with trace gravel.

Yellowish brown (10YR5/6), wet, loose, very fine- to medium-grained SAND.

Yellowish brown (10YR5/6), wet, loose, very fine- to fine-grained SAND.

Yellowish brown (10YR5/6), wet, sl. dense, SILT with some very fine-grained SAND.

Gray (10YR5/1), wet, sl. dense, SILT with some very

Depth (ft. BGS): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Elevation (ft. MSL): 626, 624, 622, 620, 618, 616, 614, 612, 610, 608

NOTE(S): MW17S installed in blind-drilled borehole within 10 ft of SB-17.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/4/2006
Finish: 5/4/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA (blind drill)

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-17a
Well ID: MW17S
Surface Elev: 627 ft. MSL
Completion: 24 ft. BGS
Station: 878,658.5N
2,515,084.8E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 11.70 - While drilling
▼ = 6.89 - MW17S on 6/1/06
▽ = 54.45 - MW17D on 6/1/06

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks

fine-grained SAND.

Yellowish brown (10YR5/6), wet, loose, very fine- to fine-grained SAND.

22

606

Gray (10YR5/1), wet, loose, very fine- to fine-grained SAND.

604

Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.

24

End of Boring = 24.11 ft. BGS

See SB-17 for sample & testing details

NOTE(S): MW17S installed in blind-drilled borehole within 10 ft of SB-17.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/11/2006
Finish: 5/11/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-18
Well ID: n/a
Surface Elev: 626 ft. MSL
Completion: 54 ft. BGS
Station: 878,605.0N
2,513,750.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.20 - While drilling
▼ = 6.87 - MW18S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	18/24 75%	ss	0-1 1-1 N=2	24		1.31 BSh
2A	24/24 100%	ss	1-2 2-2 N=4	28		1.78 Sh
3A	24/24 100%	ss	1-2 2-2 N=4	23		1.32 BSh
4A	24/24 100%	ss	1-1 1-2 N=2	24		1.09 B
5A	24/24 100%	ss	1-1 1-2 N=2	28		0.54 BSh
6A	24/24 100%	ss	0-0 1-2 N=1	21		0.39 B
7A	24/24 100%	ss	3-5 9-15 N=14	17		
7B				15		
8A				14		
8B	24/24 100%	ss	8-9 9-10 N=18	11		
8C				9		
9A	24/36 67%	cs				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil; Dark grayish brown (10YR4/2), moist, soft, clayey SILT with trace sand and trace gravel.	
	Yellowish brown (10YR5/6) with 50% gray (10YR4/1) mottles, moist, silty CLAY with little sand.	624
2	Yellowish brown (10YR5/6) with 10% gray (10YR4/1) mottles, moist, silty CLAY with little sand.	622
4		620
6	▼ Gray (10YR4/1)with 10% Yellowish brown (10YR5/6) mottles, moist, silty CLAY with little sand.	618
8		616
10		614
12 ▼	Light gray (10YR6/1) moist, soft, clayey, very fine- to fine-grained SAND.	612
	Light gray (10YR6/1) moist, soft, silty, very fine- to fine-grained SAND.	
	Yellowish brown (10YR5/6), very moist, soft, silty, very fine- to fine-grained, SAND with trace gravel.	
14	Yellowish brown (10YR5/6), wet, loose, fine- to medium-grained SAND.	610
	Yellowish brown (10YR5/6), very moist, soft, sandy (very fine- to fine-grained) SILT.	
16	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.	608
18		606
20		

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/11/2006
Finish: 5/11/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-18
Well ID: n/a
Surface Elev: 626 ft. MSL
Completion: 54 ft. BGS
Station: 878,605.0N
2,513,750.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.20 - While drilling
▼ = 6.87 - MW18S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	60/60 *100%*	CS					22		604	
10A										
							24		602	
							26		600	
	60/60 *100%*	CS								
							28		598	
11A				5				Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel. *[Continued from previous page]*		
							30		596	
	60/60 *100%*	CS							594	Coal fragment seam
12A				11			32			
							34		592	
							36		590	
	60/60 *100%*	CS								
13A				10			38	Gray (10YR5/1), moist, dense, SILT.	588	
13B				12				Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel.		
							40		586	

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/11/2006
Finish: 5/11/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: K. Doetzel
Helper: S. McCartney
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-18
Well ID: n/a
Surface Elev: 626 ft. MSL
Completion: 54 ft. BGS
Station: 878,605.0N
2,513,750.0E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.20 - While drilling
▼ = 6.87 - MW18S on 6/1/06
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	60/60 100%	CS					42		584	Appears more clayey
14A				13			44		582	
	60/60 100%	CS					46	Gray (10YR5/1), moist, very hard, clayey, sandy SILT with trace gravel. *[Continued from previous page]*	580	
15A				13			48		578	
							50		576	
16A	60/60 100%	CS		13			52		574	
16B				22			54	Greenish gray (10BG5/1), moist, firm, silty CLAY with little sand and trace gravel.	572	

End of Boring = 54.0 ft.

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.
CME-1050 had 280# hammer for SPT.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/11/2006
Finish: 5/11/2006
WEATHER: Partly sunny, cool (mid-50's)

CONTRACTOR: Reynolds Drilling Corp.
Rig mfg/model: CME-1050 ATV Rig
Drilling Method: 4¼" HSA (blind drill)

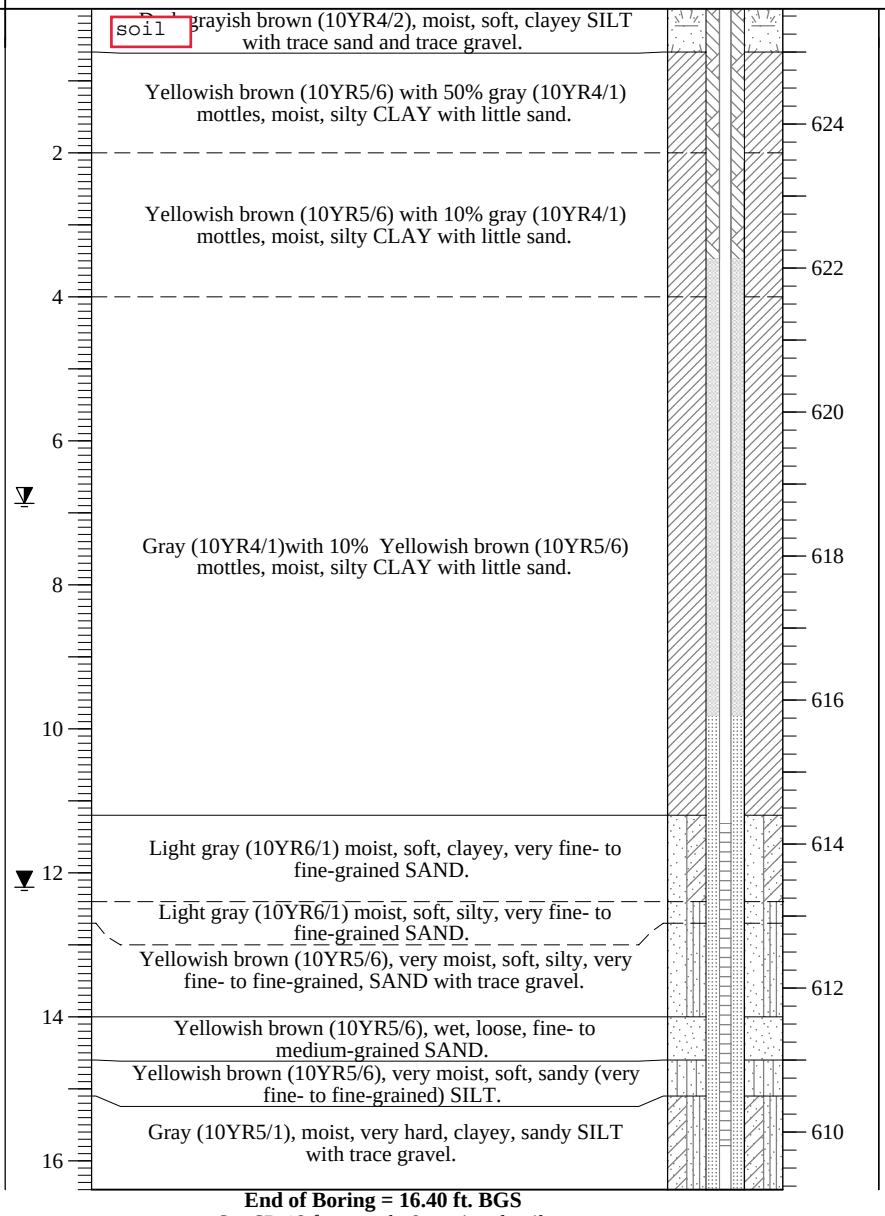
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-18a
Well ID: MW18S
Surface Elev: 626 ft. MSL
Completion: 16 ft. BGS
Station: 878,604.7N
2,513,745.2E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.20 - While drilling
▼ = 6.87 - MW18S on 6/1/06
▽ =

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks



End of Boring = 16.40 ft. BGS
See SB-18 for sample & testing details

NOTE(S): MW18S installed in blind-drilled borehole within 10 ft of SB-18.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/17/2006
Finish: 5/17/2006
WEATHER: Sunny, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-19
Well ID: n/a
Surface Elev: 624 ft. MSL
Completion: 60 ft. BGS
Station: 875,415.4N
2,513,226.4E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.00 - While drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
1A	20/24 *83%*	ss	*2-2 3-4* N=5	21		
1B				22		
2A	22/24 *92%*	ss	*2-2 5-6* N=7	23		2.89 *B*
3A	23/24 *96%*	ss	*2-3 5-6* N=8	17		1.82 *B*
4A	24/24 *100%*	ss	*6-8 10-8* N=18	19		2.52 *B*
5A	24/24 *100%*	ss	*3-4 6-8* N=10	18		2.52 *B*
6A	24/24 *100%*	ss	*2-3 4-5* N=7	16		1.24 *None*
7A	24/24 *100%*	ss	*4-8 10-10* N=18	25		
7B				13		
8A	22/24 *92%*	ss	*3-5 18-25* N=23	18		
9A	24/24 *100%*	ss	*20-40 59-68* N=99	12		4.26 *BSh*
10A	24/24 *100%*	ss	*29-38 56-79* N=94	9		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	soil Dark grayish brown (10YR4/2), clayey SILT, trace sand	
	Pale brown (10YR6/3) with 50% brown (10YR5/3) mottles, clayey SILT	622
2	Pale brown (10YR6/3) with 40% yellowish brown (10YR5/6) mottles, lean CLAY	620
4	Gray (10YR6/1) with 25% yellowish brown (10YR5/6) mottles, clayey SILT, trace sand	618
6		616
8	Yellowish brown (10YR5/6) with 30% gray (10YR6/1) mottles, sandy CLAY	614
10	Yellowish brown (10YR5/6) with 30% gray (10YR6/1) mottles, clayey SAND	612
▼ 12	Brownish yellow (10YR6/6), silty, fine to medium SAND, wet	
	Yellowish brown (10YR5/6), sandy SILT, trace gravel	610
14	Yellowish brown (10YR5/8), silty, fine SAND, wet	608
16	Light gray (10YR7/1), silty, fine SAND, trace gravel	606
18	Dark gray (10YR4/1), sandy SILT, trace gravel	604
20		

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/17/2006
Finish: 5/17/2006
WEATHER: Sunny, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

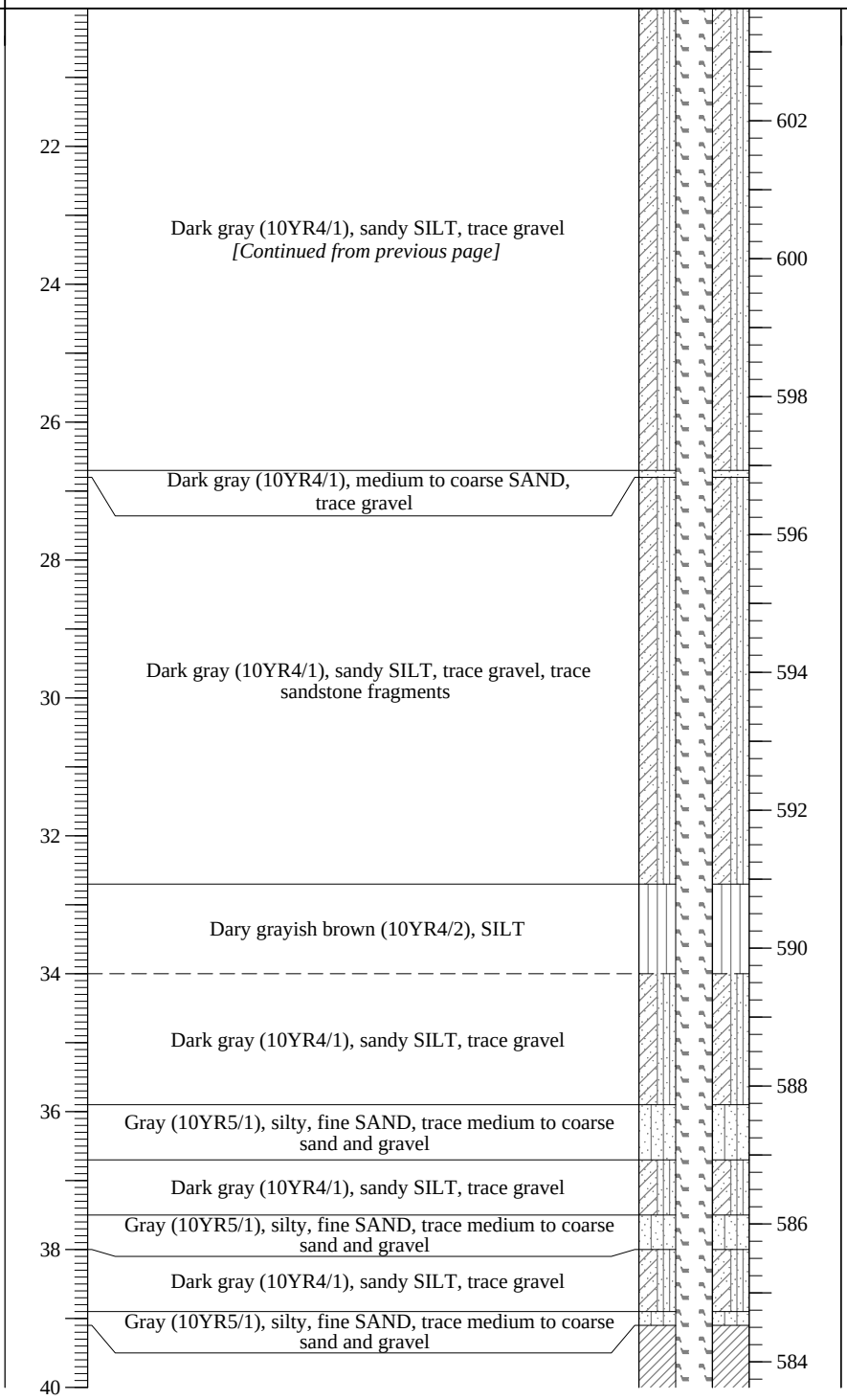
BOREHOLE ID: SB-19
Well ID: n/a
Surface Elev: 624 ft. MSL
Completion: 60 ft. BGS
Station: 875,415.4N
2,513,226.4E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.00 - While drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
	60/60 100%	CS				
11A				8		
12A				10		
	60/60 100%	CS				
12B				6		
	60/60 100%	CS				
13A				11		
13B				10		
14A				10		
14B				10		
14C	60/60 100%	CS		8		
14D				21		

Depth ft. BGS | Lithologic Description | Borehole Detail | Elevation ft. MSL | Remarks



NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

FIELD BORING LOG

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 5/17/2006
Finish: 5/17/2006
WEATHER: Sunny, mild (mid-60's)

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: SB-19
Well ID: n/a
Surface Elev: 624 ft. MSL
Completion: 60 ft. BGS
Station: 875,415.4N
2,513,226.4E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 3, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 12.00 - While drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
15A				24				Dark greenish gray (5G4/1) with 20% yellowish brown (10YR5/6) mottles, lean CLAY *[Continued from previous page]*		
	60/60 *100%*	CS					42		582	
							44		580	
15B				14						
							46	Dark gray (10YR4/1), clayey SILT, trace sand and gravel	578	
	60/60 *100%*	CS					48		576	
16A				15						
							50		574	
							52		572	
	60/60 *100%*	CS						Dark gray (10YR4/1), sandy SILT, some gravel		
17A				10			54		570	
								Dark gray (10YR4/1), clayey SILT, trace sand and gravel		
17B				14						
							56		568	
	60/60 *100%*	CS						Dark greenish gray (10BG4/1) with 30% yellowish brown (10YR5/6) mottles, lean CLAY		
							58		566	
18A										
							60	**End of Boring = 60.0 ft. BGS**	564	

NOTE(S): Borehole abandoned using bentonite grout pumped from bottom of borehole.

APPENDIX 3-A-4
Well Completion Reports

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW1D

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-01

State Plane Coordinate: X 874,972.6 Y 2,513,478.0 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Testing Services Corp. Date Started: 5/3/2006 Date Finished: 5/3/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite grout

Installation Method: Tremie

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 21 min.

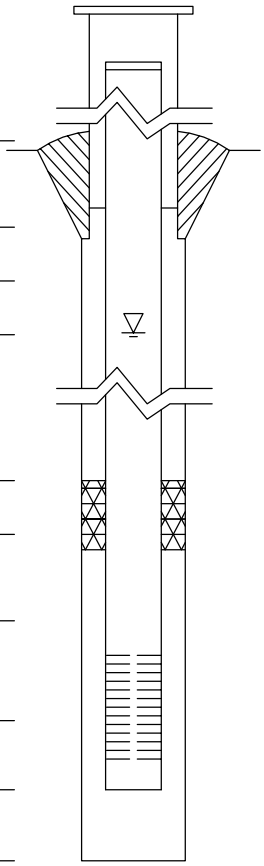
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
609.29	-1.89	Top of Protective Casing
609.01	-1.61	Top of Riser Pipe
607.40	0.00	Ground Surface
604.80	2.60	Top of Annular Sealant
571.12	36.28	Static Water Level (After Completion) 6/1/2006
578.90	28.50	Top of Seal
575.82	31.58	Top of Sand Pack
574.11	33.29	Top of Screen
569.35	38.05	Bottom of Screen
568.99	38.41	Bottom of Well
567.40	40.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	7.3
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	35.17
Bottom of Screen to End Cap	(feet)	0.36
Screen Length (1st slot to last slot)	(feet)	4.76
Total Length of Casing	(feet)	40.29
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW2S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-02a

State Plane Coordinate: X 876,408.9 Y 2,513,210.0 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Testing Services Corp. Date Started: 5/5/2006 Date Finished: 5/5/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

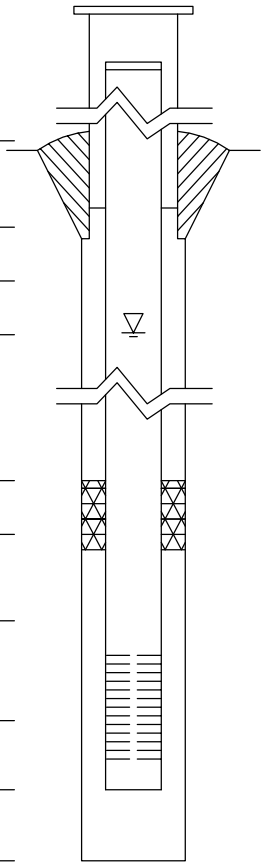
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
627.55	-3.45	Top of Protective Casing
627.07	-2.97	Top of Riser Pipe
624.10	0.00	Ground Surface
619.72	4.38	Top of Annular Sealant
616.68	7.42	Static Water Level (After Completion) 6/1/2006
619.72	4.38	Top of Seal
614.60	9.50	Top of Sand Pack
613.76	10.34	Top of Screen
608.98	15.12	Bottom of Screen
608.59	15.51	Bottom of Well
608.59	15.51	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	7.3
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	13.31
Bottom of Screen to End Cap	(feet)	0.39
Screen Length (1st slot to last slot)	(feet)	4.78
Total Length of Casing	(feet)	18.48
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW2D

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-02b

State Plane Coordinate: X 876,414.0 Y 2,513,209.7 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Testing Services Corp. Date Started: 5/5/2006 Date Finished: 5/5/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite grout

Installation Method: Tremie

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 min.

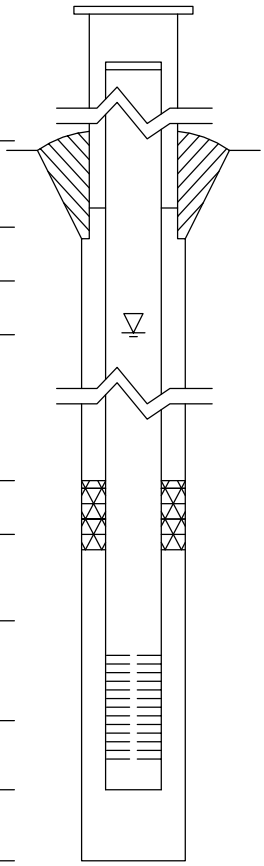
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: Re-drill borehole



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
627.52	-3.42	Top of Protective Casing
627.07	-2.97	Top of Riser Pipe
624.10	0.00	Ground Surface
621.00	3.10	Top of Annular Sealant
616.74	7.36	Static Water Level (After Completion) 6/1/2006
606.00	18.10	Top of Seal
603.92	20.18	Top of Sand Pack
602.07	22.03	Top of Screen
597.27	26.83	Bottom of Screen
596.88	27.22	Bottom of Well
596.88	27.22	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	25.00
Bottom of Screen to End Cap	(feet)	0.39
Screen Length (1st slot to last slot)	(feet)	4.80
Total Length of Casing	(feet)	30.19
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW3D

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-03

State Plane Coordinate: X 876,554.5 Y 2,514,535.3 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Testing Services Corp. Date Started: 4/27/2006 Date Finished: 4/27/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite grout

Installation Method: Tremie

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 min.

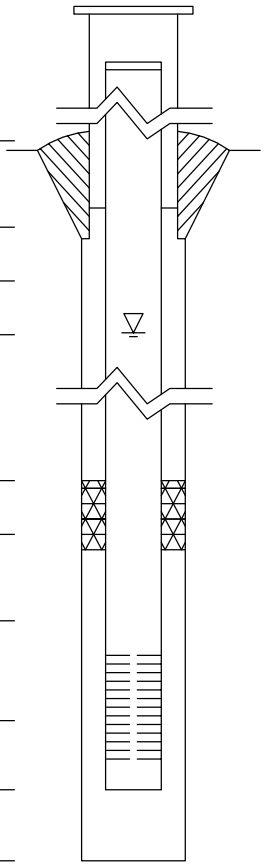
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Cuttings (if applicable)

Installation Method: Over-drill borehole



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
629.37	-3.67	Top of Protective Casing
628.94	-3.24	Top of Riser Pipe
625.70	0.00	Ground Surface
623.00	2.70	Top of Annular Sealant
570.30	55.40	Static Water Level (After Completion) 6/1/2006
576.70	49.00	Top of Seal
575.60	50.10	Top of Sand Pack
573.41	52.29	Top of Screen
568.64	57.06	Bottom of Screen
568.30	57.40	Bottom of Well
567.70	58.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	55.51
Bottom of Screen to End Cap	(feet)	0.36
Screen Length (1st slot to last slot)	(feet)	4.77
Total Length of Casing	(feet)	60.64
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW3S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-03a

State Plane Coordinate: X 876,554.8 Y 2,514,531.5 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Testing Services Corp. Date Started: 4/28/2006 Date Finished: 4/28/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

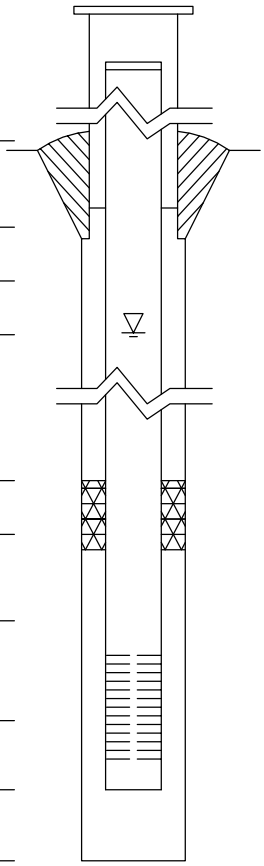
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
629.45	-3.75	Top of Protective Casing
628.96	-3.26	Top of Riser Pipe
625.70	0.00	Ground Surface
623.70	2.00	Top of Annular Sealant
618.67	7.03	Static Water Level (After Completion) 6/1/2006
623.70	2.00	Top of Seal
616.20	9.50	Top of Sand Pack
613.68	12.02	Top of Screen
608.92	16.78	Bottom of Screen
608.55	17.15	Bottom of Well
608.55	17.15	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	15.28
Bottom of Screen to End Cap	(feet)	0.37
Screen Length (1st slot to last slot)	(feet)	4.76
Total Length of Casing	(feet)	20.41
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW4S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-04a

State Plane Coordinate: X 877,999.7 Y 2,514,450.6 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Testing Services Corp. Date Started: 5/11/2006 Date Finished: 5/11/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

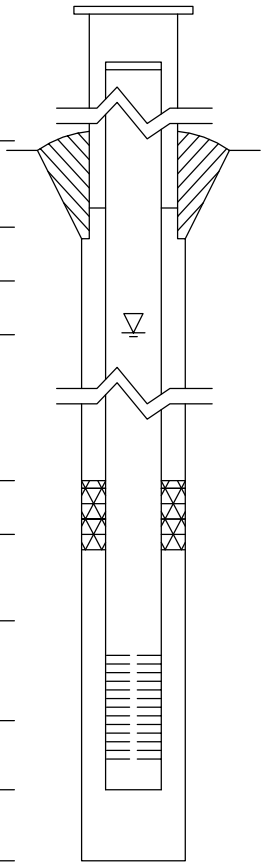
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.07	-3.67	Top of Protective Casing
625.60	-3.20	Top of Riser Pipe
622.40	0.00	Ground Surface
619.57	2.83	Top of Annular Sealant
616.73	5.67	Static Water Level (After Completion) 6/1/2006
619.57	2.83	Top of Seal
614.15	8.25	Top of Sand Pack
612.57	9.83	Top of Screen
608.14	14.26	Bottom of Screen
607.63	14.77	Bottom of Well
607.63	14.77	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	7.3
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	14.25
Bottom of Screen to End Cap	(feet)	0.51
Screen Length (1st slot to last slot)	(feet)	4.43
Total Length of Casing	(feet)	19.19
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW5D

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-05

State Plane Coordinate: X 878,174.8 Y 2,513,290.3 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Testing Services Corp. Date Started: 5/12/2006 Date Finished: 5/17/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite grout

Installation Method: Tremie

Setting Time: +24 hr.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 18 min.

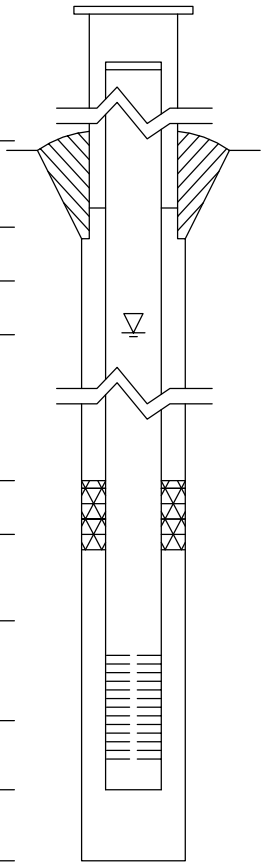
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.21	-3.61	Top of Protective Casing
625.78	-3.18	Top of Riser Pipe
622.60	0.00	Ground Surface
620.77	1.83	Top of Annular Sealant
572.16	50.44	Static Water Level (After Completion) 6/1/2006
582.29	40.31	Top of Seal
579.14	43.46	Top of Sand Pack
577.03	45.57	Top of Screen
572.27	50.33	Bottom of Screen
571.88	50.72	Bottom of Well
568.60	54.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: (Steel)
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	48.74
Bottom of Screen to End Cap	(feet)	0.39
Screen Length (1st slot to last slot)	(feet)	4.76
Total Length of Casing	(feet)	53.89
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW5S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-05a

State Plane Coordinate: X 878,175.6 Y 2,513,285.5 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Testing Services Corp. Date Started: 5/17/2006 Date Finished: 5/17/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

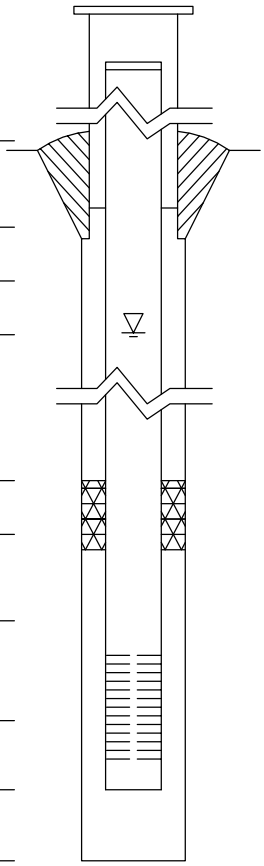
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Cuttings (if applicable)

Installation Method: Over-drill borehole



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.14	-3.54	Top of Protective Casing
625.73	-3.13	Top of Riser Pipe
622.60	0.00	Ground Surface
620.49	2.11	Top of Annular Sealant
615.86	6.74	Static Water Level (After Completion) 6/1/2006
620.49	2.11	Top of Seal
611.06	11.54	Top of Sand Pack
609.94	12.66	Top of Screen
605.19	17.41	Bottom of Screen
604.89	17.71	Bottom of Well
604.89	17.71	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: (Steel)
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	15.69
Bottom of Screen to End Cap	(feet)	0.40
Screen Length (1st slot to last slot)	(feet)	4.75
Total Length of Casing	(feet)	20.84
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW6S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-06a

State Plane Coordinate: X 879,021.2 Y 2,513,189.4 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Testing Services Corp. Date Started: 5/4/2006 Date Finished: 5/4/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

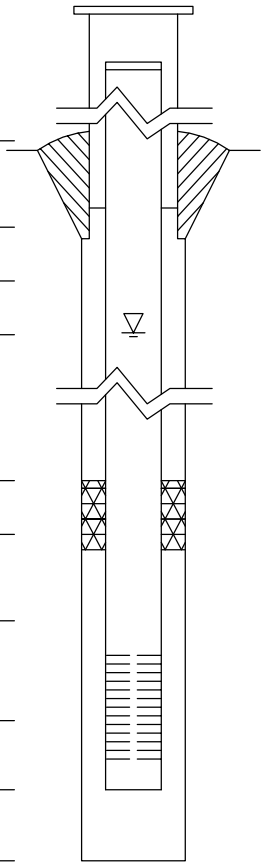
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.67	-3.57	Top of Protective Casing
626.21	-3.11	Top of Riser Pipe
623.10	0.00	Ground Surface
620.10	3.00	Top of Annular Sealant
616.89	6.21	Static Water Level (After Completion) 6/1/2006
620.10	3.00	Top of Seal
613.34	9.76	Top of Sand Pack
612.06	11.04	Top of Screen
607.48	15.62	Bottom of Screen
607.02	16.08	Bottom of Well
607.02	16.08	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	7.3
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	14.15
Bottom of Screen to End Cap	(feet)	0.46
Screen Length (1st slot to last slot)	(feet)	4.58
Total Length of Casing	(feet)	19.19
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW7S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-07a

State Plane Coordinate: X 879,181.1 Y 2,514,397.5 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: P. McIntire

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Rhonald W Hasenyager Date Started: 5/9/2006 Date Finished: 5/9/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

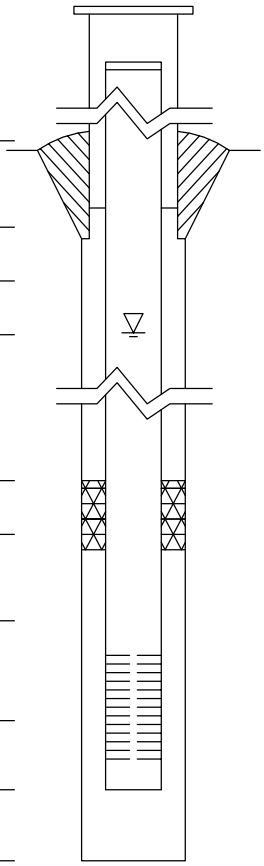
Type of Sand Pack: Quartz sand

Grain Size: #JC50FS (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
627.71	-3.21	Top of Protective Casing
627.56	-3.06	Top of Riser Pipe
624.50	0.00	Ground Surface
621.70	2.80	Top of Annular Sealant
619.60	4.90	Static Water Level (After Completion) 6/1/2006
621.70	2.80	Top of Seal
616.23	8.27	Top of Sand Pack
614.59	9.91	Top of Screen
610.71	13.79	Bottom of Screen
610.11	14.39	Bottom of Well
610.11	14.39	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	12.37
Bottom of Screen to End Cap	(feet)	0.60
Screen Length (1st slot to last slot)	(feet)	4.48
Total Length of Casing	(feet)	17.45
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW8S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-08a

State Plane Coordinate: X 879,776.6 Y 2,514,478.8 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: K. Doetzel

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 5/10/2006 Date Finished: 5/10/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

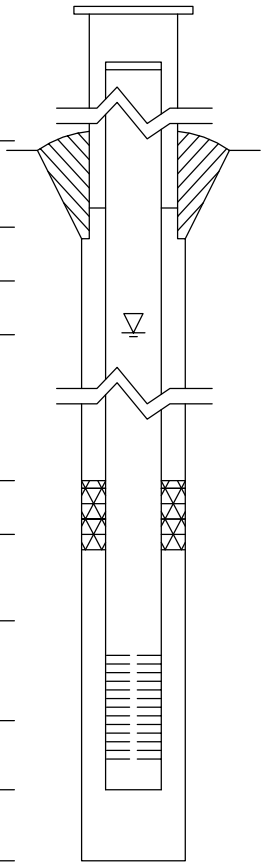
Type of Sand Pack: Quartz sand

Grain Size: #JC50FS (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
628.26	-3.56	Top of Protective Casing
627.92	-3.22	Top of Riser Pipe
624.70	0.00	Ground Surface
622.20	2.50	Top of Annular Sealant
619.37	5.33	Static Water Level (After Completion) 6/1/2006
622.20	2.50	Top of Seal
614.72	9.98	Top of Sand Pack
613.19	11.51	Top of Screen
608.70	16.00	Bottom of Screen
608.10	16.60	Bottom of Well
607.62	17.08	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	14.73
Bottom of Screen to End Cap	(feet)	0.60
Screen Length (1st slot to last slot)	(feet)	4.49
Total Length of Casing	(feet)	19.82
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW9D

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-09

State Plane Coordinate: X 879,679.7 Y 2,515,666.3 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: K. Doetzel

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 5/3/2006 Date Finished: 5/3/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite grout

Installation Method: Tremie

Setting Time: +24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 15 min.

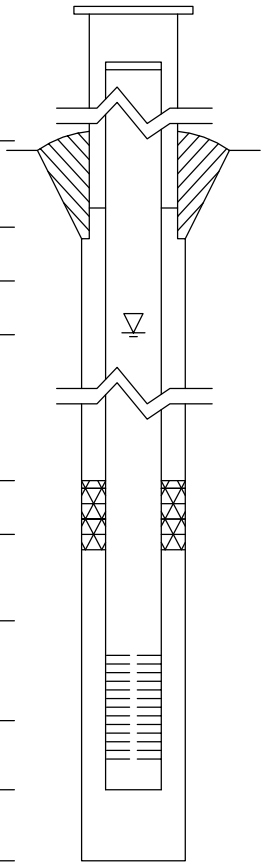
Type of Sand Pack: Quartz sand

Grain Size: #JC50FS (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
627.84	-3.24	Top of Protective Casing
627.52	-2.92	Top of Riser Pipe
624.60	0.00	Ground Surface
621.70	2.90	Top of Annular Sealant
572.14	52.46	Static Water Level (After Completion) 6/1/2006
582.60	42.00	Top of Seal
580.80	43.80	Top of Sand Pack
578.79	45.81	Top of Screen
574.03	50.57	Bottom of Screen
573.60	51.00	Bottom of Well
570.60	54.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	52.25
Bottom of Screen to End Cap	(feet)	0.43
Screen Length (1st slot to last slot)	(feet)	4.76
Total Length of Casing	(feet)	57.44
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW9S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-09a

State Plane Coordinate: X 879,684.9 Y 2,515,666.2 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: K. Doetzel

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 5/3/2006 Date Finished: 5/3/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

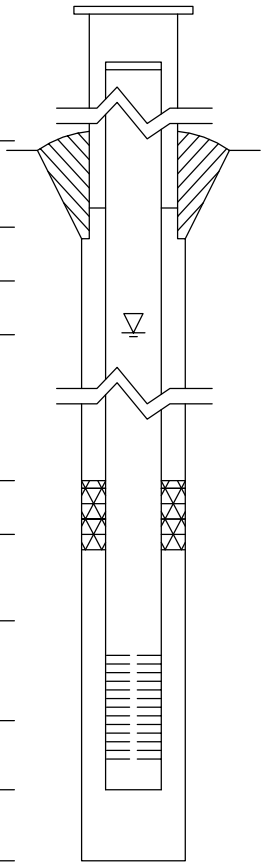
Type of Sand Pack: Quartz sand

Grain Size: #JC50FS (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
627.84	-3.24	Top of Protective Casing
627.51	-2.91	Top of Riser Pipe
624.60	0.00	Ground Surface
621.35	3.25	Top of Annular Sealant
619.37	5.23	Static Water Level (After Completion) 6/1/2006
621.35	3.25	Top of Seal
615.49	9.11	Top of Sand Pack
613.39	11.21	Top of Screen
608.98	15.62	Bottom of Screen
608.40	16.20	Bottom of Well
608.40	16.20	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	14.12
Bottom of Screen to End Cap	(feet)	0.58
Screen Length (1st slot to last slot)	(feet)	4.41
Total Length of Casing	(feet)	19.11
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW10D

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-10

State Plane Coordinate: X 878,245.1 Y 2,515,914.0 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: K. Doetzel

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 5/1/2006 Date Finished: 5/1/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite grout

Installation Method: Tremie

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet [Slurry] (choose one)

Installation Method: Tremie

Setting Time: 22 min.

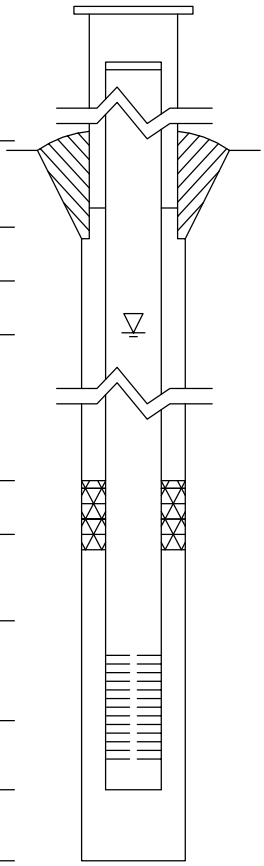
Type of Sand Pack: Quartz sand

Grain Size: #JC50FS (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
624.72	-3.52	Top of Protective Casing
624.42	-3.22	Top of Riser Pipe
621.20	0.00	Ground Surface
619.77	1.43	Top of Annular Sealant
573.72	47.48	Static Water Level (After Completion) 6/1/2006
619.77	1.43	Top of Seal
581.65	39.55	Top of Sand Pack
579.46	41.74	Top of Screen
574.63	46.57	Bottom of Screen
574.18	47.02	Bottom of Well
572.45	48.75	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	45.06
Bottom of Screen to End Cap	(feet)	0.45
Screen Length (1st slot to last slot)	(feet)	4.73
Total Length of Casing	(feet)	50.24
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW10S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-10a

State Plane Coordinate: X 878,250.5 Y 2,515,914.4 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: K. Doetzel

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 5/2/2006 Date Finished: 5/2/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

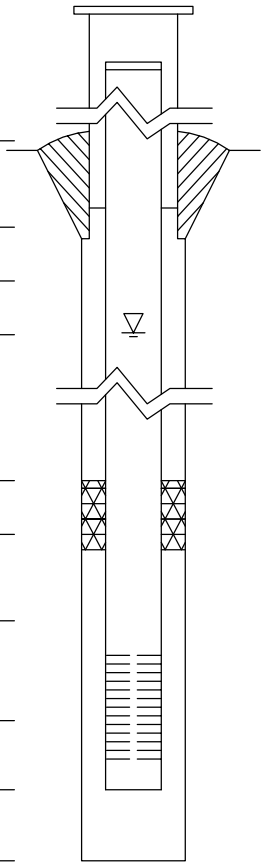
Type of Sand Pack: Quartz sand

Grain Size: #JC50FS (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
624.55	-3.35	Top of Protective Casing
624.24	-3.04	Top of Riser Pipe
621.20	0.00	Ground Surface
618.83	2.37	Top of Annular Sealant
616.29	4.91	Static Water Level (After Completion) 6/1/2006
618.83	2.37	Top of Seal
611.90	9.30	Top of Sand Pack
609.92	11.28	Top of Screen
605.44	15.76	Bottom of Screen
604.90	16.30	Bottom of Well
604.90	16.30	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: (Steel)
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	14.32
Bottom of Screen to End Cap	(feet)	0.54
Screen Length (1st slot to last slot)	(feet)	4.48
Total Length of Casing	(feet)	19.34
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW11D

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-11

State Plane Coordinate: X 876,749.6 Y 2,515,976.7 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: K. Doetzel

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 4/27/2006 Date Finished: 4/28/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite grout

Installation Method: Tremie

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 18 min.

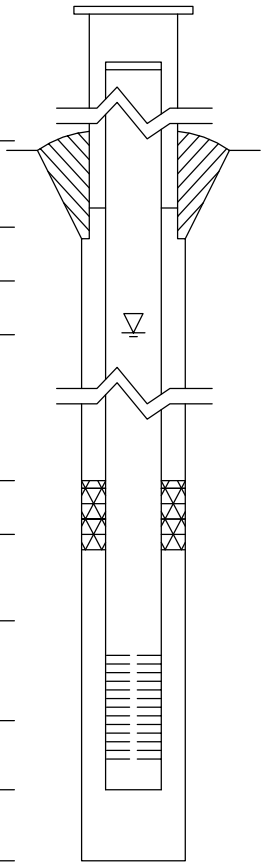
Type of Sand Pack: Quartz sand

Grain Size: #JC50FS (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.70	-3.70	Top of Protective Casing
625.36	-3.36	Top of Riser Pipe
622.00	0.00	Ground Surface
618.89	3.11	Top of Annular Sealant
615.97	6.03	Static Water Level (After Completion) 6/1/2006
597.20	24.80	Top of Seal
595.59	26.41	Top of Sand Pack
593.69	28.31	Top of Screen
588.96	33.04	Bottom of Screen
588.50	33.50	Bottom of Well
585.67	36.33	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	31.67
Bottom of Screen to End Cap	(feet)	0.46
Screen Length (1st slot to last slot)	(feet)	4.73
Total Length of Casing	(feet)	36.86
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW11S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-11a

State Plane Coordinate: X 876,749.4 Y 2,515,971.2 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: K. Doetzel

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 4/28/2006 Date Finished: 4/28/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 26 min.

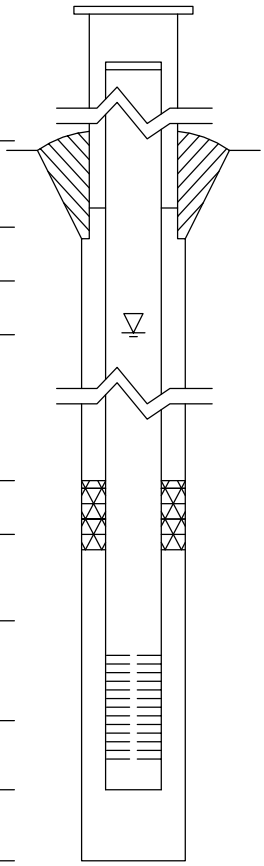
Type of Sand Pack: Quartz sand

Grain Size: #JC50FS (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.47	-3.47	Top of Protective Casing
625.16	-3.16	Top of Riser Pipe
622.00	0.00	Ground Surface
620.00	2.00	Top of Annular Sealant
616.58	5.42	Static Water Level (After Completion) 6/1/2006
620.00	2.00	Top of Seal
615.25	6.75	Top of Sand Pack
613.11	8.89	Top of Screen
608.37	13.63	Bottom of Screen
607.92	14.08	Bottom of Well
607.92	14.08	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	12.04
Bottom of Screen to End Cap	(feet)	0.46
Screen Length (1st slot to last slot)	(feet)	4.74
Total Length of Casing	(feet)	17.24
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW12D

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-12

State Plane Coordinate: X 875,515.1 Y 2,515,900.6 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 5/10/2006 Date Finished: 5/10/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite grout

Installation Method: Tremie

Setting Time: +24 hr.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

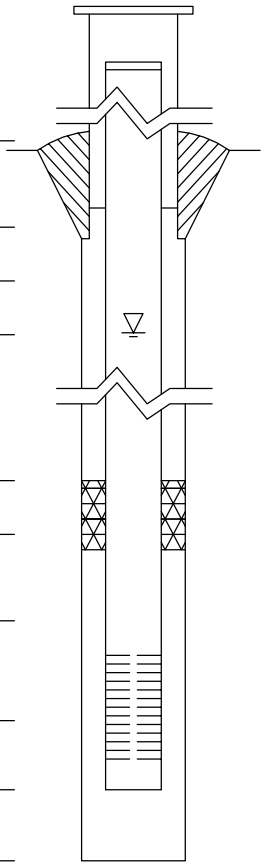
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: Over-drill borehole



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.49	-3.29	Top of Protective Casing
625.03	-2.83	Top of Riser Pipe
622.20	0.00	Ground Surface
619.43	2.77	Top of Annular Sealant
575.30	46.90	Static Water Level (After Completion) 6/1/2006
585.50	36.70	Top of Seal
581.69	40.51	Top of Sand Pack
579.74	42.46	Top of Screen
575.21	46.99	Bottom of Screen
574.73	47.47	Bottom of Well
572.20	50.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: (Steel)
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	45.29
Bottom of Screen to End Cap	(feet)	0.48
Screen Length (1st slot to last slot)	(feet)	4.53
Total Length of Casing	(feet)	50.30
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW12S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-12a

State Plane Coordinate: X 875,520.1 Y 2,515,900.5 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 5/10/2006 Date Finished: 5/10/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 18 min.

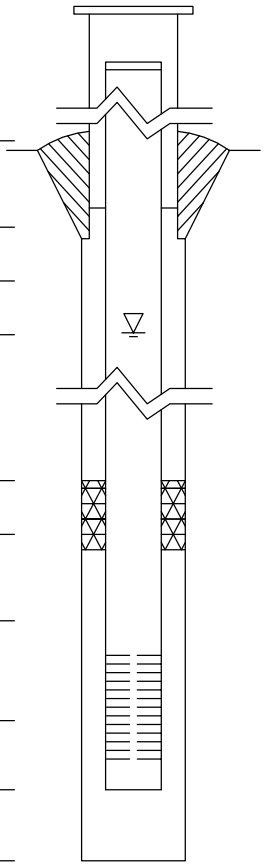
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.58	-3.38	Top of Protective Casing
625.10	-2.90	Top of Riser Pipe
622.20	0.00	Ground Surface
619.20	3.00	Top of Annular Sealant
615.44	6.76	Static Water Level (After Completion) 6/1/2006
619.20	3.00	Top of Seal
613.95	8.25	Top of Sand Pack
611.59	10.61	Top of Screen
607.02	15.18	Bottom of Screen
606.59	15.61	Bottom of Well
606.59	15.61	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: (Steel)
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	7.3
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	13.51
Bottom of Screen to End Cap	(feet)	0.43
Screen Length (1st slot to last slot)	(feet)	4.57
Total Length of Casing	(feet)	18.51
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW13D

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-13

State Plane Coordinate: X 874,694.3 Y 2,513,929.9 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 5/9/2006 Date Finished: 5/9/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite grout

Installation Method: Tremie

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

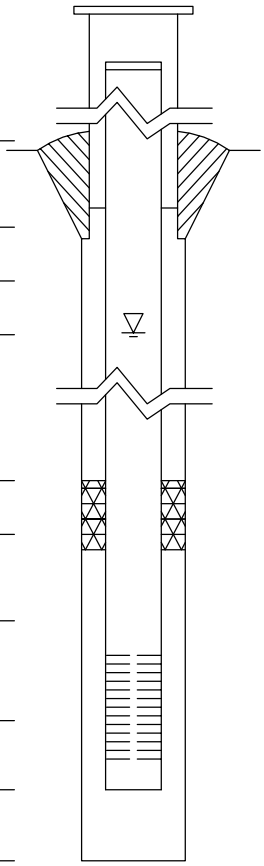
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.33	-3.63	Top of Protective Casing
625.87	-3.17	Top of Riser Pipe
622.70	0.00	Ground Surface
619.64	3.06	Top of Annular Sealant
566.67	56.03	Static Water Level (After Completion) 6/1/2006
577.48	45.22	Top of Seal
574.76	47.94	Top of Sand Pack
572.89	49.81	Top of Screen
568.10	54.60	Bottom of Screen
567.70	55.00	Bottom of Well
567.70	55.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	52.98
Bottom of Screen to End Cap	(feet)	0.40
Screen Length (1st slot to last slot)	(feet)	4.79
Total Length of Casing	(feet)	58.17
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW13S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-13a

State Plane Coordinate: X 874,695.7 Y 2,513,925.3 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 5/9/2006 Date Finished: 5/9/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 21 min.

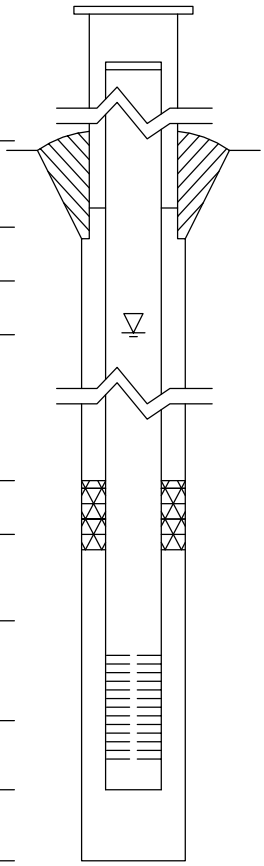
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.42	-3.72	Top of Protective Casing
625.92	-3.22	Top of Riser Pipe
622.70	0.00	Ground Surface
619.35	3.35	Top of Annular Sealant
614.46	8.24	Static Water Level (After Completion) 6/1/2006
619.35	3.35	Top of Seal
612.65	10.05	Top of Sand Pack
611.27	11.43	Top of Screen
606.47	16.23	Bottom of Screen
606.08	16.62	Bottom of Well
606.08	16.62	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: (Steel)
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	7.3
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	14.65
Bottom of Screen to End Cap	(feet)	0.39
Screen Length (1st slot to last slot)	(feet)	4.80
Total Length of Casing	(feet)	19.84
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW14S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: Sb-14a

State Plane Coordinate: X 875,737.8 Y 2,514,125.9 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 5/2/2006 Date Finished: 5/2/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 23 min.

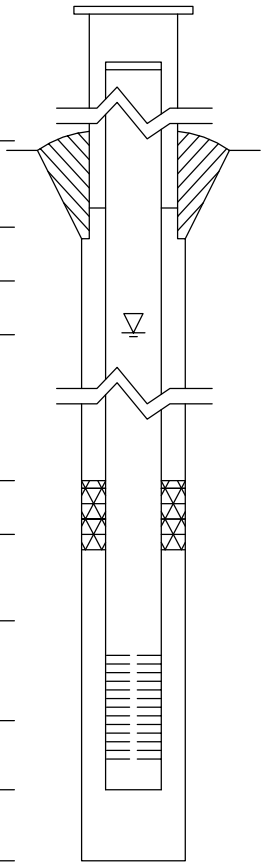
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
627.23	-2.63	Top of Protective Casing
626.82	-2.22	Top of Riser Pipe
624.60	0.00	Ground Surface
622.20	2.40	Top of Annular Sealant
620.11	4.49	Static Water Level (After Completion) 6/1/2006
622.20	2.40	Top of Seal
613.67	10.93	Top of Sand Pack
612.34	12.26	Top of Screen
607.58	17.02	Bottom of Screen
607.22	17.38	Bottom of Well
607.22	17.38	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: (Steel)
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	14.48
Bottom of Screen to End Cap	(feet)	0.36
Screen Length (1st slot to last slot)	(feet)	4.76
Total Length of Casing	(feet)	19.60
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW15S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-15a

State Plane Coordinate: X 875,971.1 Y 2,515,076.3 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 4/25/2006 Date Finished: 4/25/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 min.

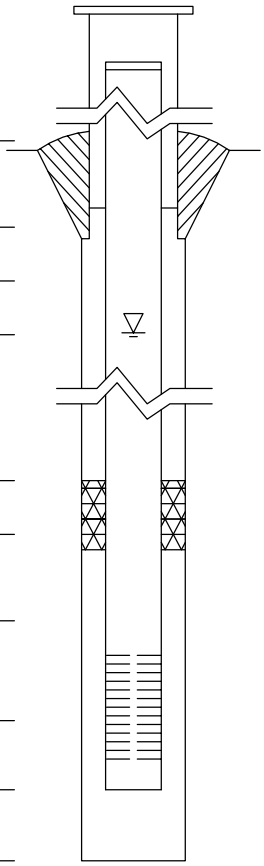
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
627.06	-3.26	Top of Protective Casing
626.60	-2.80	Top of Riser Pipe
623.80	0.00	Ground Surface
623.30	0.50	Top of Annular Sealant
618.81	4.99	Static Water Level (After Completion) 6/1/2006
614.30	9.50	Top of Seal
611.60	12.20	Top of Sand Pack
609.39	14.41	Top of Screen
604.64	19.16	Bottom of Screen
604.18	19.62	Bottom of Well
604.18	19.62	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.28
Bottom of Screen to End Cap	(feet)	19.62
Screen Length (1st slot to last slot)	(feet)	4.77
Total Length of Casing	(feet)	41.67
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW15D

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-15b

State Plane Coordinate: X 875,970.5 Y 2,515,080.7 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 4/24/2006 Date Finished: 4/25/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite grout

Installation Method: Tremie

Setting Time: +24 hr.

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

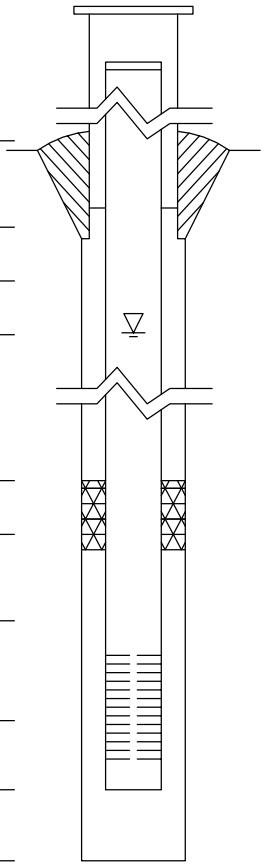
Type of Sand Pack: Quartz sand

Grain Size: #5 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: Re-drill borehole



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
626.93	-3.13	Top of Protective Casing
626.45	-2.65	Top of Riser Pipe
623.80	0.00	Ground Surface
620.55	3.25	Top of Annular Sealant
618.56	5.24	Static Water Level (After Completion) 6/1/2006
594.80	29.00	Top of Seal
591.80	32.00	Top of Sand Pack
590.12	33.68	Top of Screen
585.35	38.45	Bottom of Screen
585.00	38.80	Bottom of Well
585.00	38.80	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: (Steel)
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	36.32
Bottom of Screen to End Cap	(feet)	0.36
Screen Length (1st slot to last slot)	(feet)	4.77
Total Length of Casing	(feet)	41.45
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW16S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-16a

State Plane Coordinate: X 877,355.1 Y 2,515,088.0 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: K. Doetzel

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Rhonald W Hasenyager Date Started: 4/25/2006 Date Finished: 4/25/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 17 min.

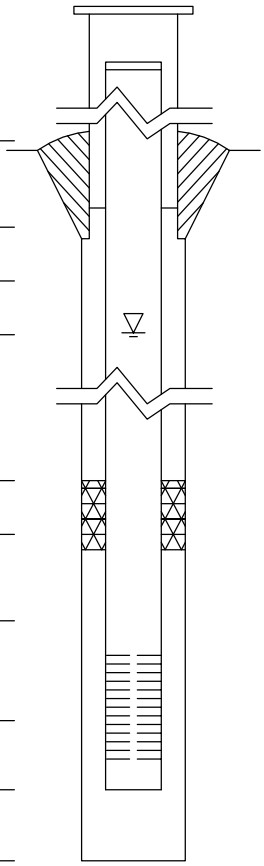
Type of Sand Pack: Quartz sand

Grain Size: #JC50FS (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
629.62	-3.52	Top of Protective Casing
629.28	-3.18	Top of Riser Pipe
626.10	0.00	Ground Surface
624.66	1.44	Top of Annular Sealant
620.36	5.74	Static Water Level (After Completion) 6/1/2006
624.66	1.44	Top of Seal
612.40	13.70	Top of Sand Pack
611.51	14.59	Top of Screen
606.69	19.41	Bottom of Screen
606.34	19.76	Bottom of Well
606.20	19.90	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.74
Bottom of Screen to End Cap	(feet)	0.38
Screen Length (1st slot to last slot)	(feet)	4.82
Total Length of Casing	(feet)	22.94
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW16D

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-16b

State Plane Coordinate: X 877,354.9 Y 2,515,079.4 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: K. Doetzel

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Rhonald W Hasenyager Date Started: 4/21/2006 Date Finished: 4/25/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite grout

Installation Method: Tremie

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

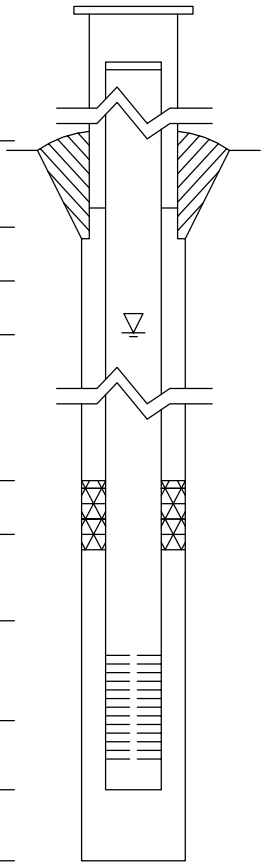
Type of Sand Pack: Quartz sand

Grain Size: #JC50FS (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: Re-drill borehole



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
629.68	-3.58	Top of Protective Casing
629.33	-3.23	Top of Riser Pipe
626.10	0.00	Ground Surface
623.77	2.33	Top of Annular Sealant
574.73	51.37	Static Water Level (After Completion) 6/1/2006
584.65	41.45	Top of Seal
582.65	43.45	Top of Sand Pack
580.20	45.90	Top of Screen
575.76	50.34	Bottom of Screen
575.32	50.78	Bottom of Well
575.10	51.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	48.83
Bottom of Screen to End Cap	(feet)	0.44
Screen Length (1st slot to last slot)	(feet)	4.74
Total Length of Casing	(feet)	54.01
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW17D

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-17

State Plane Coordinate: X 878,659.0 Y 2,515,090.4 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: K. Doetzel

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 5/4/2006 Date Finished: 5/4/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite grout

Installation Method: Tremie

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: +24 hr.

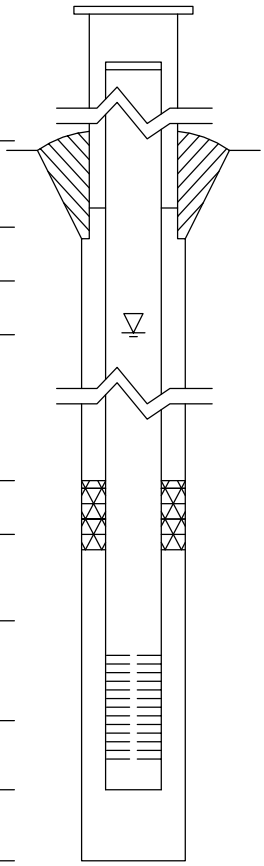
Type of Sand Pack: Quartz sand

Grain Size: #JC50FS (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
630.62	-3.52	Top of Protective Casing
630.29	-3.19	Top of Riser Pipe
627.10	0.00	Ground Surface
624.92	2.18	Top of Annular Sealant
572.65	54.45	Static Water Level (After Completion) 6/1/2006
581.55	45.55	Top of Seal
580.25	46.85	Top of Sand Pack
578.28	48.82	Top of Screen
573.78	53.32	Bottom of Screen
573.23	53.87	Bottom of Well
573.23	53.87	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	52.01
Bottom of Screen to End Cap	(feet)	0.55
Screen Length (1st slot to last slot)	(feet)	4.50
Total Length of Casing	(feet)	57.06
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW17S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-17a

State Plane Coordinate: X 878,658.5 Y 2,515,084.8 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: K. Doetzel

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 5/4/2006 Date Finished: 5/4/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 22 min.

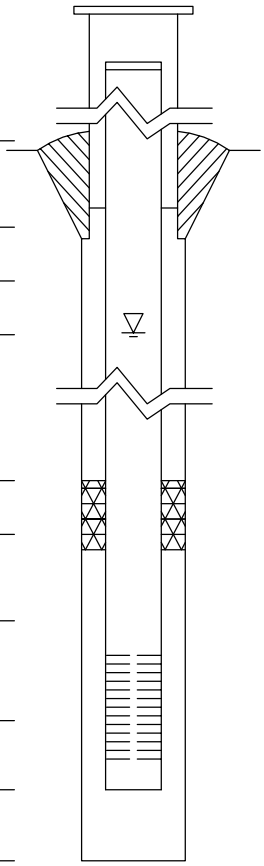
Type of Sand Pack: Quartz sand

Grain Size: #JC50FS (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
630.68	-3.58	Top of Protective Casing
630.34	-3.24	Top of Riser Pipe
627.10	0.00	Ground Surface
626.40	0.70	Top of Annular Sealant
620.21	6.89	Static Water Level (After Completion) 6/1/2006
617.33	9.77	Top of Seal
614.80	12.30	Top of Sand Pack
613.08	14.02	Top of Screen
603.54	23.56	Bottom of Screen
602.99	24.11	Bottom of Well
602.99	24.11	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.26
Bottom of Screen to End Cap	(feet)	0.55
Screen Length (1st slot to last slot)	(feet)	9.54
Total Length of Casing	(feet)	27.35
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Montgomery Well #: MW18S

Site Name: AEG Coffeen Power Station CCB Management Facility Borehole #: SB-18a

State Plane Coordinate: X 878,604.7 Y 2,513,745.2 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Darren E. Forgy IL Registration #: 035-003637

Drilling Contractor: Reynolds Drilling Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): Potable water

Logged By: Reynolds Drilling Corp. Date Started: 5/11/2006 Date Finished: 5/11/2006

Report Form Completed By: Rhonald W Hasenyager Date: 6/7/2006

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: +24 hr.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 min.

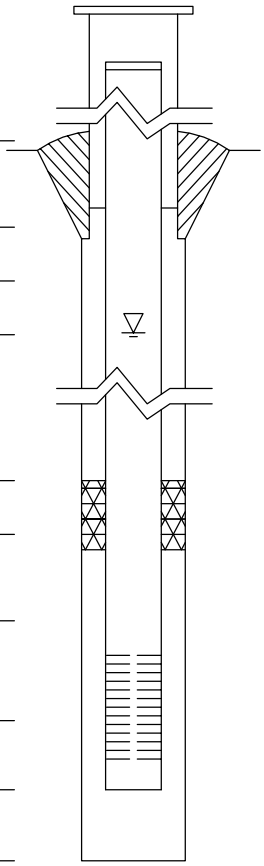
Type of Sand Pack: Quartz sand

Grain Size: #JC50FS (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: n/a



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
629.02	-3.42	Top of Protective Casing
628.71	-3.11	Top of Riser Pipe
625.60	0.00	Ground Surface
622.13	3.47	Top of Annular Sealant
618.73	6.87	Static Water Level (After Completion) 6/1/2006
622.13	3.47	Top of Seal
615.79	9.81	Top of Sand Pack
614.29	11.31	Top of Screen
609.81	15.79	Bottom of Screen
609.20	16.40	Bottom of Well
609.20	16.40	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	14.42
Bottom of Screen to End Cap	(feet)	0.61
Screen Length (1st slot to last slot)	(feet)	4.48
Total Length of Casing	(feet)	19.51
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

APPENDIX A8

AECOM BORING LOGS AND PIEZOMETER CONSTRUCTION DOCUMENTATION

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B001

Date(s) Drilled	08/07/2015 8:40 AM to 08/07/2015 4:10 PM	Logged By	E. Drumright	Checked By	D. Swanson
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7.5 inch O.D. HSA	Borehole Depth	35.0 ft
Drill Rig Type	CME 550X	Drilling Contractor	Geotechnology	Surface Elevation	634.8 ft NAVD88
Borehole Backfill	Cement-Bentonite Grout (Installed COF-P000 5 ft South of COF-B001)	Sampling Method(s)	SS / ST	Hammer Data	Automatic
Boring Location	N 871595.4 E 2516695.5 (ft NAD83)	Groundwater Level(s)	Not Encountered		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
	0						634.8 / 0.0								
		S1		3 4 6	67		Stiff, moist, brown and gray, silty and sandy CLAY, trace fine gravel, topsoil upper 2 inches, (CL) (EMBANKMENT FILL).	12.9				3.5			
630	5	S2		2 4 6	61		Stiff, moist, brown and gray, medium plasticity, silty and sandy CLAY, trace fine gravel, (CL) (EMBANKMENT FILL).	20.3		31	17	2.5			
		S3		2 5 7	72		Stiff, very moist, brown and gray, medium plastic, silty and sandy CLAY, trace gravel (CL) (EMBANKMENT FILL).	15.4				1.75			
625	10	S4		2 4 5	83		Stiff, moist, brown and gray, sandy CLAY, trace fine gravel, with gray silt seams, (CL) (EMBANKMENT FILL).	16.1				1.5			
620	15	S5			92		Very stiff, very moist, dark grayish brown with yellowish brown and dark gray, medium plastic, CLAY, with sand, (CL) (EMBANKMENT FILL).	14.7	129.4	35	20	2.5			
							Very stiff to 19' 615.8 / 19.0								
615	20	S6		1 2 2	83		Soft, wet, brown and gray, silty CLAY, trace fine sand and decayed organic matter, organic odor, (CL) (NATIVE). 613.8 / 21.0	23.2							
		S7			92		Gray with yellowish brown, very plastic, CLAY, with sand, (CH). 611.8 / 23.0	23.4	125.7	66	44				
610	25	S8		1 4 5	100		Stiff, very moist, brown and gray, high plasticity, sandy CLAY, trace fine gravel, (CL).	19.6		41	26	1.5			
605	30	S9		1 3 3	100		605.3 / 29.5	16.8				< 0.25			

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:42:56 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B001

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
	30		S10		58		Medium stiff, very wet, orange brown, sandy CLAY, trace silt, (CL) (TILL). 603.6 / 31.2					4.5			*Pushed 14" then refused. Hard at tip of tube.*
							Hard, sandy CLAY, trace fine gravel, trace silt , (CL) (TILL).								
			S11	8 17 24	78		Hard, brown and gray, medium plastic, CLAY, trace fine gravel, trace silt, (CL) (TILL). 599.8 / 35.0	11.7		30	17	4.5			
600	35						End of Boring at 35 ft								*Installed Piezometer COF-P000 with 5 ft offset to the South.*
595	40														
590	45														
585	50														
580	55														
575	60														
570	65														

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:42:56 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B002

Date(s) Drilled	08/06/2015 9:30 AM to 08/06/2015 3:00 PM	Logged By	E. Drumright	Checked By	D. Swanson
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7.5 inch O.D. HSA	Borehole Depth	35.5 ft
Drill Rig Type	CME 550X	Drilling Contractor	Geotechnology	Surface Elevation	635.4 ft NAVD88
Borehole Backfill	Piezometer COF-P002	Sampling Method(s)	SS / ST	Hammer Data	Automatic
Boring Location	N 871459.5 E 2516041.9 (ft NAD83)	Groundwater Level(s)	28 ft on 8/6/2015 1:00:00 PM		

Elevation (feet)	Depth (feet)	Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
635	0						635.4 / 0.0								
		S1		1 2 4	78		Medium stiff, very moist, brown and gray, CLAY, trace organics, (CL) (EMBANKMENT FILL).	25.4				2.0			
		S2		2 3 5	89		Stiff, very moist, brown and gray, medium plastic, sandy CLAY, trace fine gravel, (CL) (EMBANKMENT FILL).	25.9		35	18	1.0			
630	5	S3		1 3 5	83		Medium stiff, very moist, brown and gray, sandy CLAY, trace fine gravel, (CL) (EMBANKMENT FILL).	25.9				1.25			
	10	S4			100		Very stiff, very moist, gray with yellowish brown, high plasticity, CLAY, with sand, (CL) (EMBANKMENT FILL).	17.8	134.5	40	25	3.5			
625															
	15	S5		1 1 2	78		Soft, moist to wet, brown and gray, CLAY, with fine sand, trace fine gravel, (CL) (EMBANKMENT FILL).	23.3				0.75			
620		S6			100		Soft, very moist, gray with brown, low plasticity, silty CLAY, (CL) (EMBANKMENT FILL).	26.7	120.2	25	7	0.75			
							618.4 / 17.0								
	20	S7		2 3 5	94		Medium stiff, very moist, brown and gray, high plasticity, CLAY, trace fine sand, with brown silt seams, (CL) (NATIVE).	25.4		47	29	1.5			
615															
	25	S8		2 3 4	100			18.9				0.75			
610															
							607.4 / 28.0								
	30	S9		1 2 4			Loose, very wet, brown fine to coarse clayey SAND, trace gravel, (SP-SC) (NATIVE).	13.6							

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:03 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B002

Sheet 2 of 2

Elevation (feet)	Depth (feet)	Type Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
605	30					603.9 / 31.5 Very dense, moist, brown, low plasticity, sandy silty CLAY, trace fine gravel, with iron staining, (CL) (TILL).								*Till ~ 31.5' harder drilling*
		S10	34/50 4"				9.5		20	7				
600	35					599.9 / 35.5 End of Boring at 35.5 ft								*Very hard drilling with new teeth. Installed Piezometer COF-P002 in boring.*
595	40													
590	45													
585	50													
580	55													
575	60													
	65													

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:03 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B003

Date(s) Drilled	08/05/2015 11:30 AM to 08/05/2015 5:30 PM	Logged By	E. Drumright	Checked By	D. Swanson
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7.5 inch O.D. HSA	Borehole Depth	45.0 ft
Drill Rig Type	CME 550X (Rubber Tire ATV)	Drilling Contractor	Geotechnology	Surface Elevation	635.7 ft NAVD88
Borehole Backfill	Piezometer COF-P003	Sampling Method(s)	SS / ST	Hammer Data	Automatic
Boring Location	N 871786.2 E 2515149.7 (ft NAD83)	Groundwater Level(s)	Not Encountered		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
635.7	0.0														
635	0	S1		3 5 4	50		Stiff, dry, brown and gray, sandy CLAY, trace fine gravel, trace coarse ash, (CL) (EMBANKMENT FILL).	14.2				4.5			
		S2		2 3 4	67		Medium stiff, moist, brown and gray, high plasticity, sandy CLAY, trace fine gravel, trash coarse ash, (CL) (EMBANKMENT FILL).	18.1		42	26	1.25			
630	5	S3		2 2 5	67		Medium stiff, moist, brown and gray, sandy CLAY, trace fine gravel, (CL) (EMBANKMENT FILL).	15.0				2.5			
		S4		2 4 8			Stiff, very moist, brown and gray, sandy CLAY, trace fine gravel, (CL) (EMBANKMENT FILL).	17.4				1.5			
625	10														
621.7	14.0														
620	15	S5			92		Stiff, very moist, dark gray trace yellowish brown, high plasticity, CLAY, (CH).	21.8	127.5	54	36	1.75			
		S6		2 3 4	83		Medium stiff, very moist, brown and gray, medium plasticity, CLAY, trace fine sand, (CH).	26.0				1.75			
615	20														
		S7		WOH 2 3	100		Medium stiff, very moist, brown and gray, high plasticity, CLAY, with sand, with iron stained seams, (CH).	20.8		50	34	1.75			
610	25														
606.7	29.0														
		S8		2 1 9	100		Stiff, very moist, brown, low plasticity, sandy silty CLAY, trace fine gravel, (CL) (TILL).	12.5		21	6	3.5			
	30														

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:10 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B003

Elevation (feet)	Depth (feet)	Type Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
605	30	S9		100			11.8	141.7			4.5			*S9 refusal at 30.8'*
						604.7 / 31.0 Dense, wet, dark yellowish brown with grayish brown, silty SAND, trace gravel, (SM), (TILL).								
		S10	2 2 6			602.2 / 33.5 Loose, very wet, brown, fine to coarse SAND, (SP) (TILL).								*Top of S10 full of water*
600	35													
		S11	19 34 40	61		Very dense, very wet, brown, silty fine to coarse SAND, trace gravel, (SP) (TILL).	9.5							
595	40													
		S12	30 60 50/3"	100		592.2 / 43.5 Very dense, very wet, brown and gray, fine to coarse clayey SAND, trace fine gravel, (SC) (TILL). 590.7 / 45.0	9.9							*Installed Piezometer COF-P003 in boring.*
590	45					End of Boring at 45 ft								
585	50													
580	55													
575	60													
	65													

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:10 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B004

Date(s) Drilled	08/04/2015 10:20 AM to 08/05/2015 11:00 AM	Logged By	E. Drumright	Checked By	D. Swanson
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7.5 inch O.D. HSA	Borehole Depth	45.0 ft
Drill Rig Type	CME 550X (Rubber Tire ATV)	Drilling Contractor	Geotechnology	Surface Elevation	635.0 ft NAVD88
Borehole Backfill	Cement-Bentonite Grout (Installed COF-P005 5 ft West of COF-B004)	Sampling Method(s)	SS / ST	Hammer Data	Automatic
Boring Location	N 872197.6 E 2516082 (ft NAD83)	Groundwater Level(s)	Not Encountered		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
635	0						635.0 / 0.0								
		S1		2 3 5	67		Medium stiff, moist, brown, CLAY, with fine sand, trace fine gravel, (CL) (EMBANKMENT FILL).	18.0				1.75			
		S2		3 4 5	67		Stiff, moist, brown and gray, sandy CLAY, trace fine gravel, (CL) (EMBANKMENT FILL).	10.9				3.5			
630	5														
		S3		2 4 4	72		Medium stiff, moist, brown and gray, sandy CLAY, trace fine gravel, (CL) (EMBANKMENT FILL).	11.0				2.25			
		S4			79		Medium stiff, moist, yellowish brown with gray, high plasticity, CLAY, with sand, (CL) (EMBANKMENT FILL).	12.8	136.6	39	24	2.25			
625	10														
		S5		3 5 6	94		Stiff, moist, brown and gray, medium plastic, sandy CLAY, trace fine gravel, (CL) (EMBANKMENT FILL).	13.1		26	12	4.0			
620	15														
							617.0 / 18.0								
		S6		2 3 7	83		Stiff, very moist, brown and gray, sandy CLAY, trace fine gravel, with gray silt seams, (CL) (NATIVE).	21.8				1.75			
615	20														
		S7			92		Very stiff, very moist, reddish brown, high plasticity, silty CLAY, trace fine sand, with dark gray silt seams, (CL).	20.6	129.5	51	34	2.75			
610	25														
		S8		1 4 5	100		Stiff, very moist, brown and gray silt seams, high plasticity, CLAY, with fine to medium sand, (CL).	24.2		43	27	1.75			
605	30														

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:17 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B004

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
605	30						602.5 / 32.5								
							Hard, moist, brown and gray, low plasticity, sandy CLAY, trace fine gravel, (CL) (TILL).								
			S9	16 31 37	100			8.4		21	8	4.5+			
600	35														
			S10	14 45 44	83		Hard, moist, brown and gray, sandy silty CLAY, trace fine to coarse gravel, (CL) (TILL).	8.8				4.5+			
595	40						38.5' - 39.2' gray silt seams								
							591.5 / 43.5								
			S11	19 54 50/4"	94		Hard, wet, brown and gray, sandy silty CLAY, trace gravel, (CL) (TILL).	14.8				-			
590	45						590.0 / 45.0								
							End of Boring at 45 ft								*Installed Piezometer COF-P005 with 5 ft offset to the West.*
585	50														
580	55														
575	60														
570	65														

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:17 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B005

Date(s) Drilled	08/08/2015 7:45 AM to 08/08/2015 12:00 PM	Logged By	E. Drumright	Checked By	D. Swanson
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7.5 inch O.D. HSA	Borehole Depth	60.0 ft
Drill Rig Type	CME 550X	Drilling Contractor	Geotechnology	Surface Elevation	635.1 ft NAVD88
Borehole Backfill	Cement-Bentonite Grout (Installed COF-P006 5 ft South of COF-B005)	Sampling Method(s)	SS / ST	Hammer Data	Automatic
Boring Location	N 872109.6 E 2516693.3 (ft NAD83)	Groundwater Level(s)	Not Encountered		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
635	0						635.1 / 0.0								
			S1	2 3 4	83		Medium stiff, moist, brown and gray, CLAY, (CL) (EMBANKMENT FILL).	21.1				1.5			
630	5		S2		54		Stiff, moist, brown, low plasticity, sandy CLAY, (CL) (EMBANKMENT FILL).	8.0	136.6	22	9	3.0			
			S3	1 3 4	72		Medium stiff, moist, brown, sandy CLAY, (CL) (EMBANKMENT FILL).	13.1				0.75			
625	10		S4	2 7 6	89		Stiff, moist, brown, low plasticity, sandy silty CLAY, trace fine gravel, (CL) (EMBANKMENT FILL).	9.9		20	6	3.0			*Shale in tip*
620	15		S5	2 6 6	78		Stiff, moist, brown and gray, sandy CLAY, trace fine gravel, (CL) (EMBANKMENT FILL).	10.3				2.0			
615	20		S6	WOH 2 3	67		Medium stiff, moist, brown and gray, sandy CLAY, trace fine gravel, (CL) (EMBANKMENT FILL).	9.4				1.0			
							612.1 / 23.0								
610	25		S7		92		Stiff to very stiff, gray with grayish brown, medium plastic, CLAY, with sand, with organics, (CL) (NATIVE).	18.7	131.4	37	20	1.5			
							606.6 / 28.5								
	30		S8	1 4 6	89		Stiff, brown and gray, medium plastic, CLAY, trace fine sand, trace organics, (CH).	21.9				2.0			

AECOM

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:24 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B005

Elevation (feet)	Depth (feet)	Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
605	30						603.1 / 32.0 Very stiff, low plasticity, sandy CLAY, with organics, (CL).								
			S9	1 1 1	100		601.1 / 34.0 Very loose, saturated, brown and gray, silty, clayey SAND, (SC-SM) (TILL).	26.7		22	6	2.5			
600	35						599.6 / 35.5								*35': Attempt ST refusal at 35.5'*
			S10	8 22 27	100		Dense, wet, brown and gray, clayey SAND, trace fine gravel, (SC) (TILL).	11.6				-			
595	40						592.1 / 43.0								
			S11	4 7 11	100		Very stiff, very moist, brown and gray, medium plastic, sandy CLAY, trace gravel, iron stained vertical seams, (CL) (TILL).	12.8		32	17	3.25			
590	45														
			S12	2 6 8	100		Stiff, saturated, brown and gray, medium plastic, sandy CLAY, trace gravel, iron stained vertical seams, (CL) (TILL).	15.5		32	17	3.0			
585	50														
			S13	2 5 7	100		Stiff, very moist, brown and gray, sandy CLAY, trace gravel, iron stained vertical seams, (CL) (TILL).	23.2				1.25			
580	55														
			S14	2 3 6	100		Stiff, brown and gray, high plasticity, CLAY, with sand, (CL).	23.3		47	30	1.25			
575	60						575.1 / 60.0 End of Boring at 60 ft								*Installed Piezometer COF-P006 with 5 ft offset to the South.*
	65														

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:25 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B006

Sheet 1 of 2

Date(s) Drilled	08/06/2015 4:00 PM to 08/07/2015 7:30 AM	Logged By	E. Drumright	Checked By	D. Swanson
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7.5 inch O.D. HSA	Borehole Depth	33.5 ft
Drill Rig Type	CME 550X	Drilling Contractor	Geotechnology	Surface Elevation	631.9 ft NAVD88
Borehole Backfill	Cement-Bentonite Grout	Sampling Method(s)	SS / ST	Hammer Data	Automatic
Boring Location	N 871654.5 E 2515234.7 (ft NAD83)	Groundwater Level(s)	4 ft on 8/6/2015 5:00:00 PM		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
	0						631.9 / 0.0 Medium dense, moist, black CINDERS, well-graded sand, with silt, trace fine gravel, (ASH).								
630			S1	5 13 15	78			6.6							
							Very loose, wet, black CINDERS, with clay, (ASH).								
			S2	2 2 2	100			48.3							
	5														
625			S3		17			22.2							
			S4	3 4 6	100		Loose, wet, black CINDERS, well-graded sand, with clay, (FILL).	16.7							
	10														
620															
			S5	WOH 2 3			617.9 / 14.0	24.4		57	37	1.75			
	15						Medium stiff, very moist, brown and gray, high plasticity CLAY, trace fine sand, (CH) (NATIVE).								
615															
			S6	1 3 4	67			21.9				1.25			
	20														
610							608.9 / 23.0								
			S7	1 1 1	100		Very soft, very wet, brown, low plasticity, sandy CLAY, (CL) (TILL).	19.8		23	9	0.5			
	25						605.9 / 26.0								
605															
			S8	20 50/4"			Hard, very wet, brown and gray, sandy CLAY, (CL) (TILL).	16.1							
	30														

AECOM

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:32 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B006

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION Elevation (feet)	Depth (feet)	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
	30															
600		S9		24 34 50/5"	94		Hard, moist, brown and gray, medium plastic, sandy CLAY, trace fine gravel, (CL).	598.4 33.5	8.1		25	12				*Hard augering below 32'*
							End of Boring at 33.5 ft									
	35															
595																
	40															
590																
	45															
585																
	50															
580																
	55															
575																
	60															
570																
	65															

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:32 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B006A

Sheet 1 of 1

Date(s) Drilled	08/19/2015 7:15 AM to 08/19/2015 10:15 AM	Logged By	A. Grossman	Checked By	D. Swanson
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7.5 inch O.D. HSA	Borehole Depth	25.5 ft
Drill Rig Type	CME 550X	Drilling Contractor	Geotechnology	Surface Elevation	632 ft NAVD88
Borehole Backfill	Cement-Bentonite Grout	Sampling Method(s)	Piston	Hammer Data	-
Boring Location	N 871649.5 E 2515234.7 (ft NAD83)	Groundwater Level(s)	Not Encountered		

Elevation (feet)	Depth (feet)	SAMPLES Type Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
632.0	0.0													
630	0					Loose, moist, black, medium to coarse grained , CINDERS, (ASH).								
		PS-1		75										
625	5													
		PS-2		20										
620	10													
619.5	12.5													
		PS-3		70		Stiff, light grayish brown, silty CLAY, some ash, (CL).					1.25			
615	15	PS-4		83							1.25			
		PS-5		73							1.25			
610	20													
		PS-6		93		Stiff to very stiff, grayish brown CLAY, (CL).					2.0			
606.5	25.5													
605	25					End of Boring at 25.5 ft								*Auger refusal at 25.5' bgs.*
	30													

AECOM

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:39 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B007

Date(s) Drilled	08/11/2015 12:00 AM to	Logged By	A. Grossman	Checked By	D. Swanson
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7.5 inch O.D. HSA	Borehole Depth	37.5 ft
Drill Rig Type	CME 550X	Drilling Contractor	Geotechnology	Surface Elevation	638.0 ft NAVD88
Borehole Backfill	Piezometer COF-P009	Sampling Method(s)	SS / ST	Hammer Data	Automatic
Boring Location	N 873894 E 2515111.2 (ft NAD83)	Groundwater Level(s)	Not Encountered		

Elevation (feet)	Depth (feet)	Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
	0						638.0 / 0.0								
			S1	6 9 12	89		Very stiff, slightly moist, brown, silty and sandy CLAY, some fine to coarse gravel, trace silt, (CL) (EMBANKMENT FILL).	21.4							
635															
	5		S2		83		Very stiff, moist, gray, high plasticity, silty CLAY, well sorted, (CL) (EMBANKMENT FILL).	23.2	126.8	46	27				
			S3		100		Medium stiff to stiff, moist, gray trace yellowish brown, medium plastic, CLAY, well sorted, with sand, (CL) (EMBANKMENT FILL).	21.7							
630															
	10		S4	2 5 7	78		Stiff, moist, brown and gray, medium plastic, CLAY, trace fine sand, well sorted, (CL) (EMBANKMENT FILL).	25.3							
625															
	15		S5	2 7 9	83		Very stiff, moist, brown and gray, high plasticity, CLAY, trace fine sand and gravel, (CL) (EMBANKMENT FILL).	21.6		47	28				
							621.0 / 17.0								
620															
	20		S6	2 2 4	94		Medium stiff, moist, brown and gray, high plasticity, CLAY, trace fine to coarse sand, (CH).	24.5							
			S7		92		Firm, moist, yellowish brown with dark gray, high plasticity, CLAY, with sand, trace gravel, (CH).	22.5	127.0	52	35				
615			S8		100			18.3	128.5	43	27				
	25														
610															
							609.0 / 29.0								
	30		S9	1	72		Soft, wet to saturated, brown and gray, sandy CLAY (CL).	20.3							

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:42 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B007

Elevation (feet)	Depth (feet)	Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
	30	S9		1 3	72										
605							605.0 / 33.0								
	35	S10		12 15 21	89		Hard, moist, gray, medium plastic, sandy CLAY, well sorted, (CL) (TILL).	11.0		34	19				
		S11		8 12 9	89		Very stiff, saturated, gray, CLAY, with sand, well sorted, (CL).	13.6							
600							600.5 / 37.5 End of Boring at 37.5 ft								*Auger refusal at 37.5' Grouted to 30 ft-set overnight, then installed Piezometer COF-P009 in boring.*
	40														
595															
	45														
590															
	50														
585															
	55														
580															
	60														
575															
	65														

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:43 PM

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:50 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B008

Date(s) Drilled	08/13/2015 8:00 AM to 08/14/2015 9:30 AM	Logged By	A. Grossman	Checked By	D. Swanson
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7.5 inch O.D. HSA	Borehole Depth	38.5 ft
Drill Rig Type	CME 550X	Drilling Contractor	Geotechnology	Surface Elevation	635.7 ft NAVD88
Borehole Backfill	Cement-Bentonite Grout	Sampling Method(s)	SS / ST	Hammer Data	Automatic
Boring Location	N 873886.6 E 2516222.7 (ft NAD83)	Groundwater Level(s)	Not Encountered		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
	0						635.7 / 0.0								
635			S1	2 4 5	89		Stiff, moist, brown and gray, CLAY, trace sand, with roots, (CL) (EMBANKMENT FILL).	19.7							
			S2	2 1 2	67		Soft, moist, brown, high plasticity, CLAY, with roots, (CL) (EMBANKMENT FILL).	16.3		46	29				
	5						628.7 / 7.0								
630			S3	1 3 6	78		Stiff, moist, brown and gray, medium plastic, CLAY, trace sand, with roots, (CH) (EMBANKMENT FILL).	21.7				3.25			
	10		S4	2 4 8	78			21.6		54	36	2.25			
625							624.7 / 11.0								
			S5		83		Very stiff to hard, moist to wet, dark gray with trace grayish brown, high plasticity, CLAY, with sand, with roots, (CL) (EMBANKMENT FILL).	16.6	131.5	43	27	> 4.5			
			S6		100		Stiff, wet, light yellowish brown with light gray, medium plastic, CLAY, with sand, with roots, (CL) (EMBANKMENT FILL).	13.9	137.2	35	20	2.25			
	15														
620															
	20						615.7 / 20.0								
615			S7	2 3 6	83		Stiff, moist, brown and gray, medium plastic, CLAY, trace sand, (CH) (NATIVE).	20.5				2.0			
	25														
610			S8	2 6 7	78		Stiff, moist, brown and gray , medium plastic, CLAY, with sand, (CH).	16.4				3.25			
							607.7 / 28.0								
			S9		96		Soft, moist to wet, grayish brown, medium plastic, CLAY, some silt, (CL) (NATIVE).	19.1	128.4			0.5			
	30														

AECOM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B008

Elevation (feet)	Depth (feet)	SAMPLES Type Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
605	30	S10		0										*ST refusal at 30.5'*
		S11	50/6"	100		Hard, moist, brown and gray, sandy CLAY, trace fine gravel, poorly sorted, (CL).	5.8							
600	35													
						597.2 / 38.5								
						End of Boring at 38.5 ft								*Auger refusal at 38.5'*
595	40													
590	45													
585	50													
580	55													
575	60													
	65													

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:50 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B009

Date(s) Drilled	08/13/2015 9:00 AM to 08/13/2015 12:15 PM	Logged By	E. Drumright/A.Grossman	Checked By	D. Swanson
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7.5 inch O.D. HSA	Borehole Depth	40.0 ft
Drill Rig Type	CME 550X	Drilling Contractor	Geotechnology	Surface Elevation	635.2 ft NAVD88
Borehole Backfill	Piezometer COF-B010	Sampling Method(s)	SS / ST	Hammer Data	Automatic
Boring Location	N 873505 E 2516620.8 (ft NAD83)	Groundwater Level(s)	Not Encountered		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
635	0						635.2 / 0.0								
			S1	3 4 6	83		Medium dense, moist, 2" sandy clay layer over 12" black, fine to coarse CINDERS, (ASH).	2.6							
							631.7 / 3.5								
			S2	1 2 3	44		Medium stiff, very moist, 2" ash layer over brown and gray, silty CLAY, trace sand, (CH) (EMBANKMENT FILL).	26.1				1.25			
630	5														
			S3	2 4 5	83		Stiff, very moist, dark grayish brown, high plasticity, CLAY, (CH) (EMBANKMENT FILL).	17.1		58	40	2.0			
			S4	2 5 6	61		Stiff, very moist, brown and gray, CLAY, trace sand, (CH) (EMBANKMENT FILL).	22.4				2.0			
625	10														
			S5		79		Very stiff, very moist, olive gray and grayish brown, high plasticity, CLAY, with sand, (CH) (EMBANKMENT FILL).	18.4	131.5	50	35	2.25			
620	15						619.7 / 15.5								
			S6		75		Stiff, very moist, brown and gray, CLAY, (CL-CH) (EMBANKMENT FILL).	23.3	128.5			1.75			
			S7	1 3 6	100			29.3				1.75			
615	20														
			S8	1 3 5	89		Medium stiff, very moist, brown and gray, high plasticity, CLAY, trace sand, (CL) (EMBANKMENT FILL).	23.1		48	30	1.75			
610	25						608.2 / 27.0								
			S9		92		Very stiff, brown and gray, high plasticity, CLAY, (CH) (NATIVE).	24.9	124.9	62	40	2.25			
	30														

AECOM

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:57 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B009

Elevation (feet)	Depth (feet)	SAMPLES Type Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
605	30	S9		92				124.9		40	2.25			
		S10	5 6 7	94		Stiff, moist to wet, brown and gray, CLAY, trace sand, (CH).	20.1				1.75			
600	35					599.2 / 36.0								*36': harder drilling*
		S11	4 7 9	100		Very stiff, very moist, brown and gray, high plasticity, CLAY, (CL) (TILL).	21.6		49	32	2.25			
595	40					595.2 / 40.0 End of Boring at 40 ft								*Installed Piezometer COF-P010 in boring.*
590	45													
585	50													
580	55													
575	60													
	65													

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:43:57 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B010

Sheet 1 of 2

Date(s) Drilled	08/10/2015 3:00 PM to 08/11/2015 10:00 AM	Logged By	E. Drumright/A.Grossman	Checked By	D. Swanson
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	HSA	Borehole Depth	44.0 ft
Drill Rig Type	CME 550X	Drilling Contractor	Geotechnology	Surface Elevation	642.2 ft NAVD88
Borehole Backfill	Piezometer COF-P012	Sampling Method(s)	SS / ST	Hammer Data	Automatic
Boring Location	N 872690.8 E 2515090.7 (ft NAD83)	Groundwater Level(s)	10 ft on 8/10/2015 3:30:00 PM		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
	0						642.2 / 0.0								
640		S1		3 6 7	89		Stiff, moist, brown and gray, CLAY, trace fine gravel and ash, with orange-brown seams, (CL) (FILL).	15.1				4.5			
							638.5 / 3.7								
	5	S2		3 7 7	72		Medium dense, moist, 2" layer of well-graded SAND, over medium to coarse grained CINDERS (ASH).	5.8							
635		S3		8 14 16	72		Dense, moist, black medium to coarse grained CINDERS (ASH).	3.8							
	10	S4		3 9 13	72		Medium dense, moist to wet, black medium to coarse grained, CINDERS (ASH).	9.6							
630															
	15	S5		2 7 12	89		Medium dense, wet, black medium to coarse grained CINDERS, (ASH).	14.2							
625															
	20	S6		4 6 6	67		Medium dense, black, non-plastic, CINDERS, (ASH).	14.8		NP	NP				
620															
							618.2 / 24.0								
	25	S7		3 3 5	100		Medium stiff, wet, brown and gray, CLAY, trace fine sand, (CH) (NATIVE).	13.9/24.1							
615															
							613.7 / 28.5								
	30	S8		3 3 5	100		Medium stiff, brown and gray, high plasticity, sandy CLAY, (CL).	21.9		48	31				

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:44:04 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B010

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
610	30														
		S9		1 3 5	100		Medium stiff, wet, brown and gray, high plasticity, sandy CLAY, trace fine gravel, (CL).	18.6							
605	35						603.7 / 38.5								
		S10		7 27 29	100		Hard, very moist, gray, high plasticity, sandy CLAY (CL).	9.1		47	28				
600	40														
		S11		12 22 50/2"	100		Hard, gray, sandy silty CLAY, trace fine gravel, (CL).	9.6							
							598.2 / 44.0								
595	45						End of Boring at 44 ft								*Installed Piezometer COF-P012 in boring.*
590	50														
585	55														
580	60														
	65														

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:44:04 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B011

Sheet 1 of 2

Date(s) Drilled	08/11/2015 9:45 AM to 08/11/2015 1:15 PM	Logged By	E. Drumright	Checked By	D. Swanson
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	7.5 inch O.D. HSA	Borehole Depth	40.0 ft
Drill Rig Type	CME 550X	Drilling Contractor	Geotechnology	Surface Elevation	635.1 ft NAVD88
Borehole Backfill	Piezometer COF-P014	Sampling Method(s)	SS / ST	Hammer Data	Automatic
Boring Location	N 872538.3 E 2515411.6 (ft NAD83)	Groundwater Level(s)	Not Encountered		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
635	0						635.1 / 0.0								
			S1	2 3 6	67		Stiff, moist, brown and gray, CLAY, with fine to medium sand, with roots, (CL-CH) (EMBANKMENT FILL).	23.9				2.5			
							631.6 / 3.5								
			S2	2 4 5	94		Stiff, moist, brown and gray, very plastic, CLAY, with roots, one ash seam, (CH) (EMBANKMENT FILL).	23.5		67	47	1.75			
630	5						630.1 / 5.0								
			S3	2 4 6	89		Stiff, moist, brown and gray, CLAY, trace fine sand, with roots, (CL) (EMBANKMENT FILL).	26.1				2.0			
			S4	30/3"	17			21.8							*S4: Concrete or boulder chips in tip of spoon. Drill through to continue.*
			S5	4 8 8	83		Very stiff, very moist, brown and gray, medium plastic, sandy CLAY, trace fine gravel, limestone rock in middle of sample, (CL) (EMBANKMENT FILL).	10.9		32	18	4.0			
625	10														
			S6		58		Very stiff, yellowish brown with grayish brown, medium plastic, sandy CLAY, (CL) (EMBANKMENT FILL).	11.5	139.4	34	20	4.0			*Gravel in tip. Bent tip of tube.*
620	15														
			S7		54		Hard, very moist, yellowish brown trace gray, medium plastic, sandy CLAY, trace gravel, (CL) (EMBANKMENT FILL).	12.0	134.1	30	16	4.5+			
							617.1 / 18.0								
			S8	2 3 6	83		Stiff, very moist, brown and gray, CLAY, with orange-brown silt seams, (CL-CH) (NATIVE).	27.3				1.75			
615	20														
			S9	2 4 5	100		Stiff, brown and gray, CLAY, trace fine to medium sand, (CL).	19.4				1.5			
610	25														
			S10	1 2 3	100		Medium stiff, brown and gray, medium plastic, sandy CLAY, trace fine gravel, (CL).	17.3		32	17	0.25			
							605.6 / 29.5								
	30														

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:44:11 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-B011

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
605	30		S11		100		Soft to stiff, wet, with orange brown, sandy CLAY TILL, trace fine sand, with orange-brown silt seams, (CL). (603.1 / 32.0)	9.9	144.5						
			S12				Brown and gray, sand CLAY, trace fine gravel, (CL). (602.1 / 33.0)	8.9							
			S13	16 32 41	94		Very dense, very moist, gray, silty clayey SAND, trace gravel, with orange-brown silt seams, (SC-SM) (TILL). (596.6 / 38.5)	9.3				4.5+			
600	35														
			S14	20 46 50/4"	83		Hard, wet, gray, sandy silty CLAY, trace fine grave, (CL) (TILL). (595.1 / 40.0)	9.8				4.5+			
595	40						End of Boring at 40 ft								*Installed Piezometer COF-P014 in boring.*
590	45														
585	50														
580	55														
575	60														
	65														

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:44:11 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-HA1

Sheet 1 of 1

Date(s) Drilled	08/30/2015 12:00 AM to	Logged By	E. Drumright	Checked By	D. Swanson
Drilling Method	Hand Auger	Drill Bit Size/Type	2.25" O.D Hand Auger	Borehole Depth	8.0 ft
Drill Rig Type		Drilling Contractor	AECOM	Surface Elevation	610.5 ft NAVD88
Borehole Backfill	Drill Cuttings	Sampling Method(s)	Bag	Hammer Data	None
Boring Location	N 872484.5 E 2516572.3 (ft NAD83)	Groundwater Level(s)	7.3' ft on 8/30/2015		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
610	0		S1				610.5 / 0.0 Very stiff to stiff, moist to very moist, brown to brown and gray, medium plastic, CLAY (CL-CH), (FILL).	12.9							
			S2					13.3		35	14				
			S3					21.7							
			S4				607.5 / 3.0 Stiff to very stiff, very moist, brown and gray, CLAY, trace sand to with sand, (CL-CH).	19.0							
			S5					18.1							
605	5		S6					18.0							
			S7				604.5 / 6.0 Stiff, very wet, brown and gray, high plasticity, sandy CLAY, (CL) (TILL).	16.0		35	21				
			S8					22.9							
							602.5 / 8.0 End of Boring at 8 ft								
600	10														
595	15														
590	20														
585	25														
	30														

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:44:18 PM

Project: Dynegy

Project Location: Coffeen Power Station, IL

Project Number: 60440742

Log of Boring COF-HA2

Sheet 1 of 1

Date(s) Drilled	08/30/2015 12:00 AM to	Logged By	E. Drumright	Checked By	D. Swanson
Drilling Method	Hand Auger	Drill Bit Size/Type	2.25" O.D Hand Auger	Borehole Depth	5.5 ft
Drill Rig Type		Drilling Contractor	AECOM	Surface Elevation	594.6 ft NAVD88
Borehole Backfill	Drill Cuttings	Sampling Method(s)	Bag	Hammer Data	None
Boring Location	N 873496.7 E 2516761.2 (ft NAD83)	Groundwater Level(s)	Not Encountered		

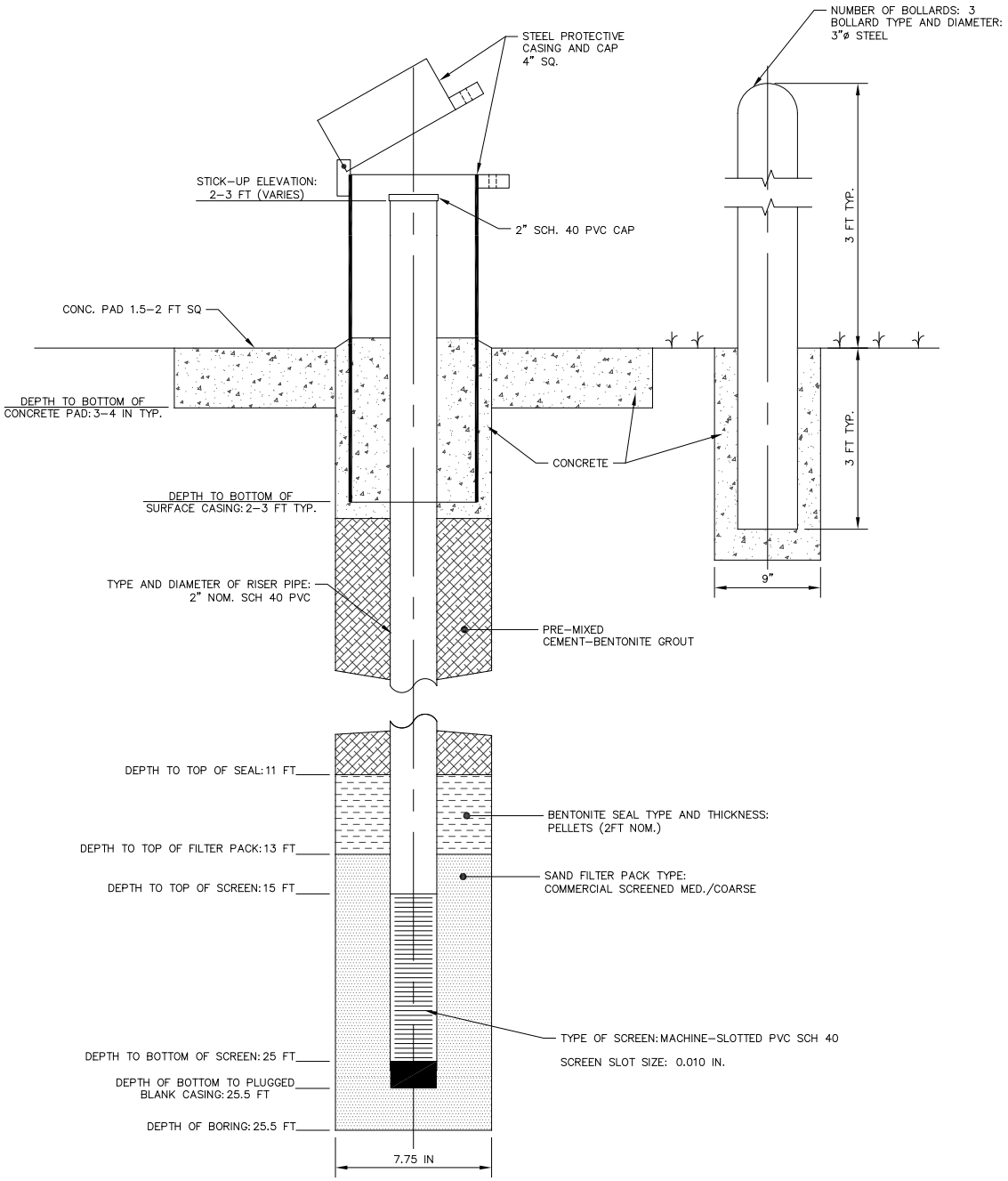
Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
	0						594.6 / 0.0								
			S1				593.9 / 0.7 Dark brown, high plasticity, CLAY, with sand, cinders and organics, (CH) (TOPSOIL).	18.6		51	25				
			S2				Very stiff, very moist, brown, CLAY, (CL).	20.9		47	27				
			S3				591.6 / 3.0	22.8							
			S4				Stiff to very stiff, very moist, brown, high plasticity, CLAY, trace sand to sandy, none to trace fine gravel, (CL) (TILL).	15.8							
590			S5					13.4		43	27				
	5		S6				589.1 / 5.5	11.4							
							End of Boring at 5.5 ft								
585	10														
580	15														
575	20														
570	25														
565	30														

AECOM

Report: GEO_SOIL; File N:\PROJECTS\60428794_DYNEGY_CCR_RULEASMT\SUB_00\10.0_CALCULATIONS_ANALYSIS_DATA\SITE INVESTIGATION\COFFEEN\BORINGS\GINT TEMPLATE\DYNEGY_COFFEEN_2015.GPJ; 12/29/2015 5:44:22 PM

Project: Dynegy	Log of Piezometer
Project Location: COFFEEN POWER STATION, ILLINOIS	Sheet 1 of 1
Project Number: 60440742	

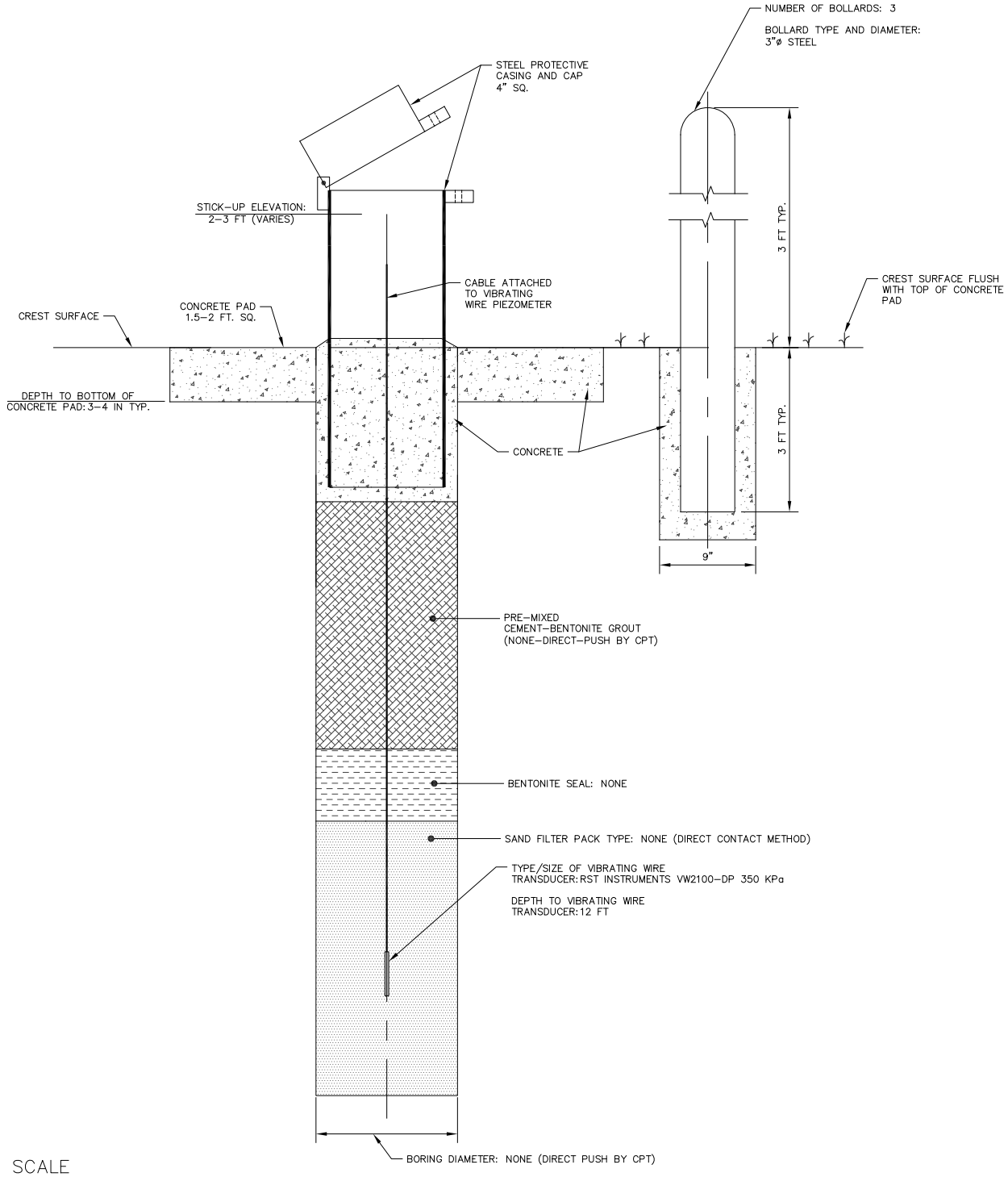
Piezometer Location	COF-P000	Date Installed	8/7/2015	Time	
Installed By		Observed By	AECOM	Total Depth	25 FT
Method of Installation	HOLLOW STEM AUGER	Drilling Contractor	GEOTECHNOLOGY, INC.	Surface Elevation	
Screened Interval	15-25 FT	Completion Zone	EMBANKMENT/FOUNDATION		
Remarks	OFFSET 5 FT SOUTH FROM COF-B001	Groundwater Level(s)	17.9 FT ON 8/29/2015		



NOT TO SCALE

Project: Dynegy Project Location: COFFEEN POWER STATION, ILLINOIS Project Number: 60440742	Log of Piezometer Sheet 1 of 1

Piezometer Location	COF-P001	Date Installed	8/12/2015	Time	
Installed By		Observed By	AECOM	Total Depth	12 FT
Method of Installation	CPT - DIRECT PUSH	Drilling Contractor	CONETEC, INC.	Surface Elevation	615.6 FT
Screened Interval	N/A	Completion Zone	POND #1 FOUNDATION		
Remarks		Groundwater Level(s)	1.3 FT ON 8/29/2015		



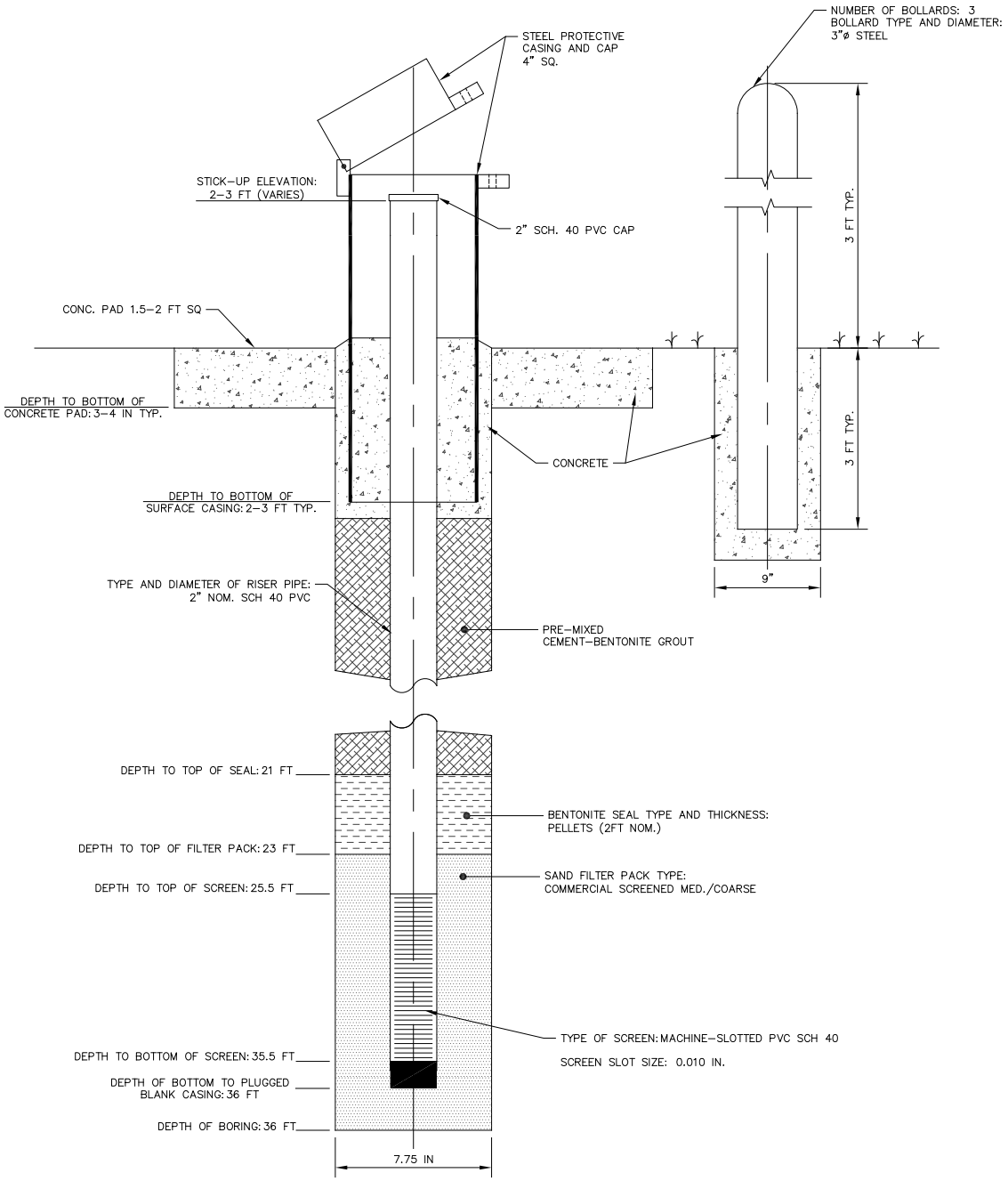
NOT TO SCALE

AECOM

NOT TO SCALE

Project: Dynegy	Log of Piezometer
Project Location: COFFEEN POWER STATION, ILLINOIS	Sheet 1 of 1
Project Number: 60440742	

Piezometer Location	COF-P002	Date Installed	8/6/2015	Time	
Installed By		Observed By	AECOM	Total Depth	35.5 FT
Method of Installation	HOLLOW STEM AUGER	Drilling Contractor	GEOTECHNOLOGY, INC.	Surface Elevation	635.4 FT
Screened Interval	25.5-35.5 FT	Completion Zone	POND #1 FOUNDATION		
Remarks	INSTALL IN COF-B002	Groundwater Level(s)	10.5 FT ON 8/29/2015		



NOT TO SCALE

Project: Dynegy

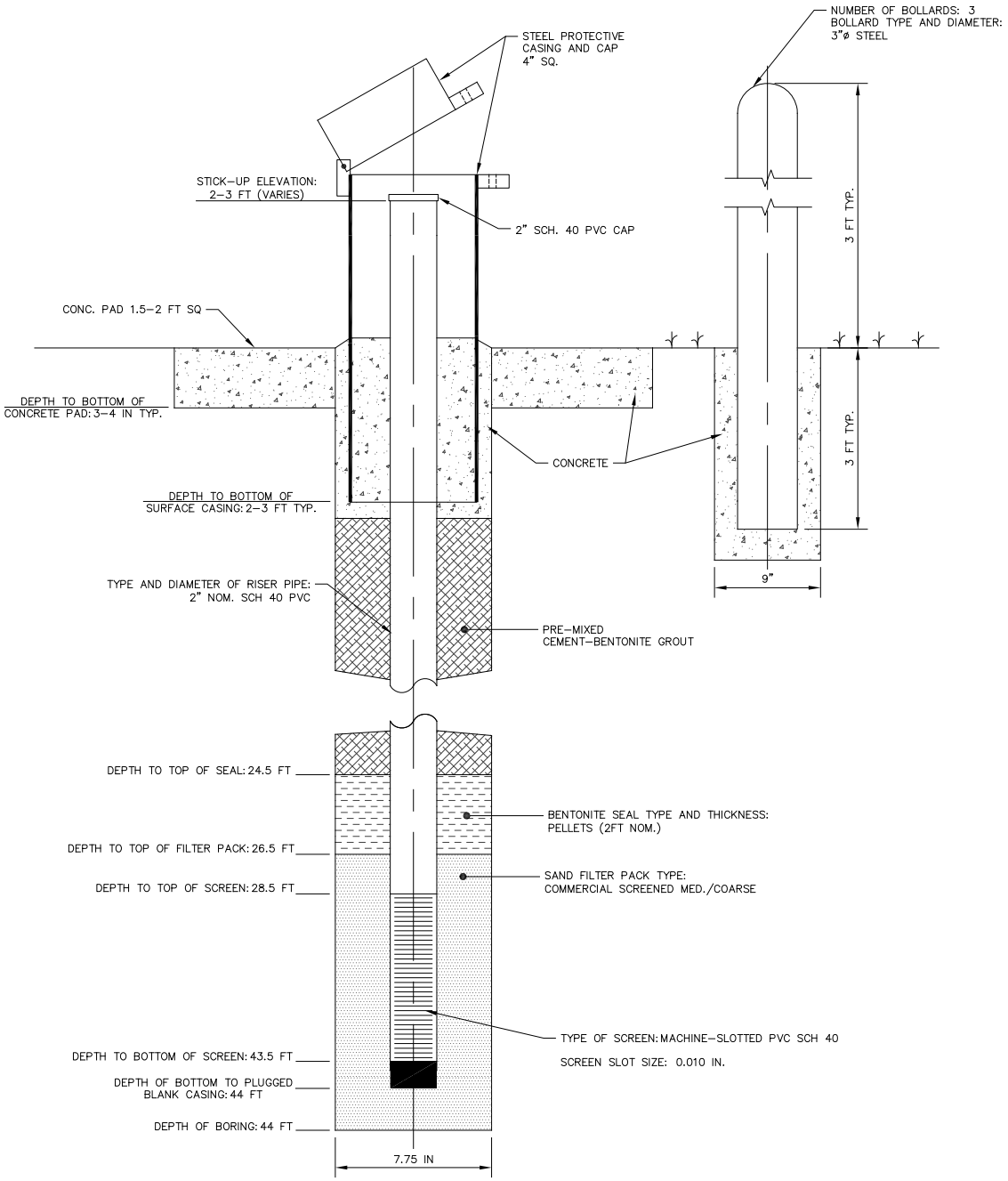
Project Location: COFFEEN POWER STATION, ILLINOIS

Project Number: 60440742

Log of Piezometer

Sheet 1 of 1

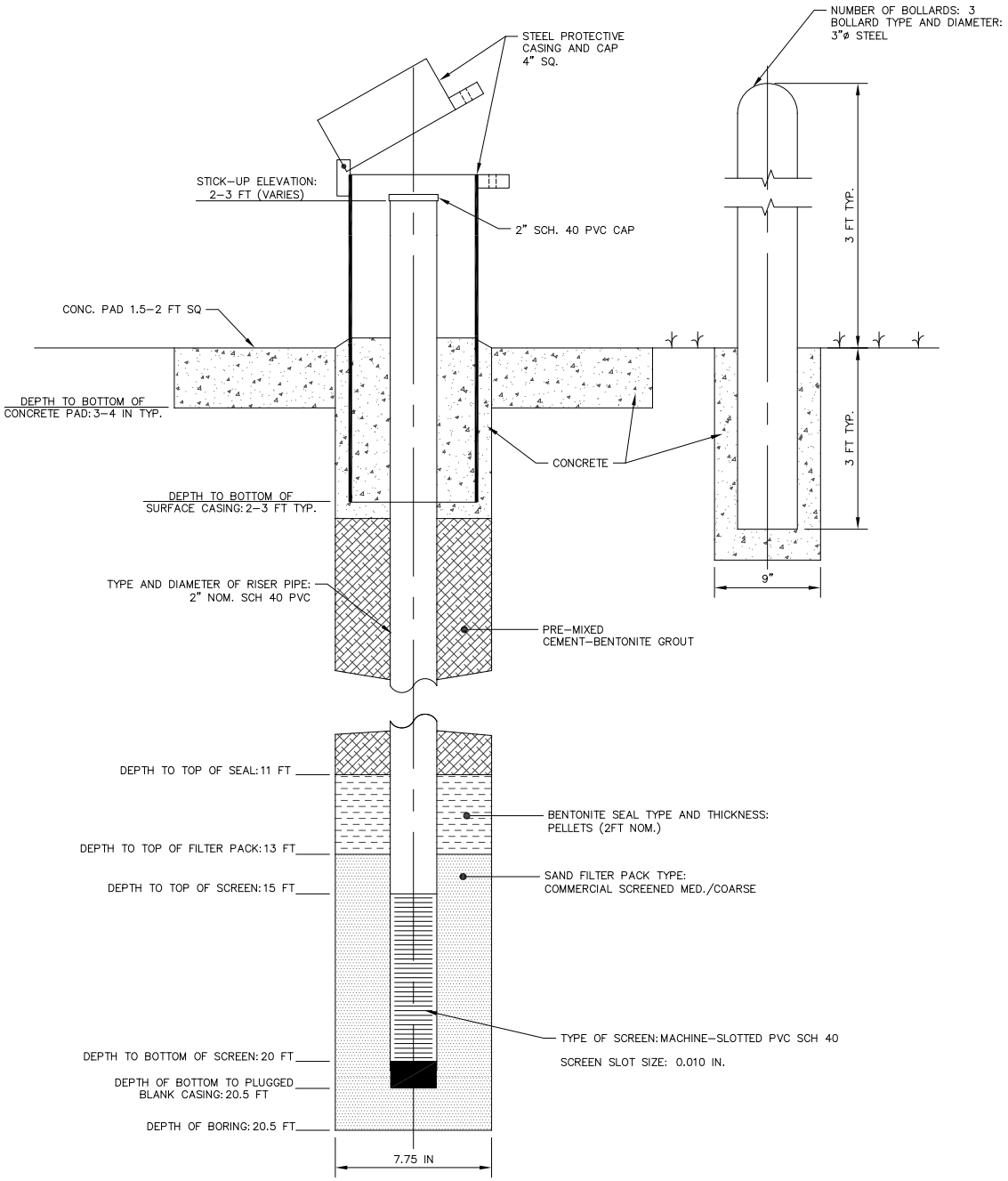
Piezometer Location	COF-P003	Date Installed	8/5/2015	Time	
Installed By		Observed By	AECOM	Total Depth	43.5 FT
Method of Installation	HOLLOW STEM AUGER	Drilling Contractor	GEOTECHNOLOGY, INC.	Surface Elevation	635.7 FT
Screened Interval	28.5-43.5 FT	Completion Zone	POND #1 FOUNDATION		
Remarks	INSTALL IN COF-B003	Groundwater Level(s)	15.3 FT ON 8/29/2015		



NOT TO SCALE

Project: Dynegy Project Location: COFFEEN POWER STATION, ILLINOIS Project Number: 60440742	Log of Piezometer Sheet 1 of 1

Piezometer Location	COF-P005	Date Installed	8/5/2015	Time	
Installed By		Observed By	AECOM	Total Depth	20 FT
Method of Installation	HOLLOW STEM AUGER	Drilling Contractor	GEOTECHNOLOGY, INC.	Surface Elevation	635.0 FT
Screened Interval	15-20 FT	Completion Zone	EMBANKMENT		
Remarks	OFFSET 5' WEST OF COF-B004	Groundwater Level(s)	14.4 FT ON 8/29/2015		



NOT TO SCALE

Project: Dynegy

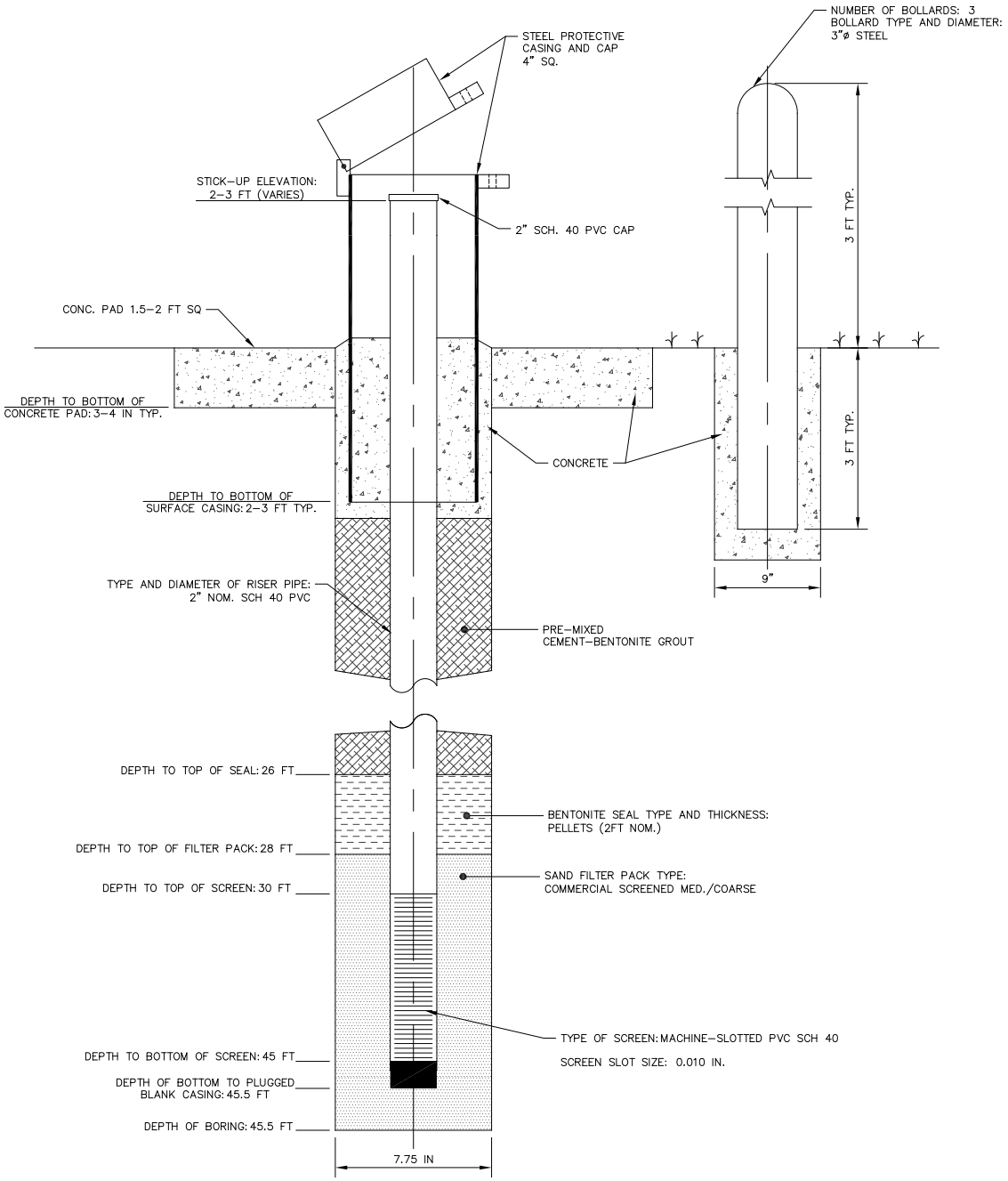
Project Location: COFFEEN POWER STATION, ILLINOIS

Project Number: 60440742

Log of Piezometer

Sheet 1 of 1

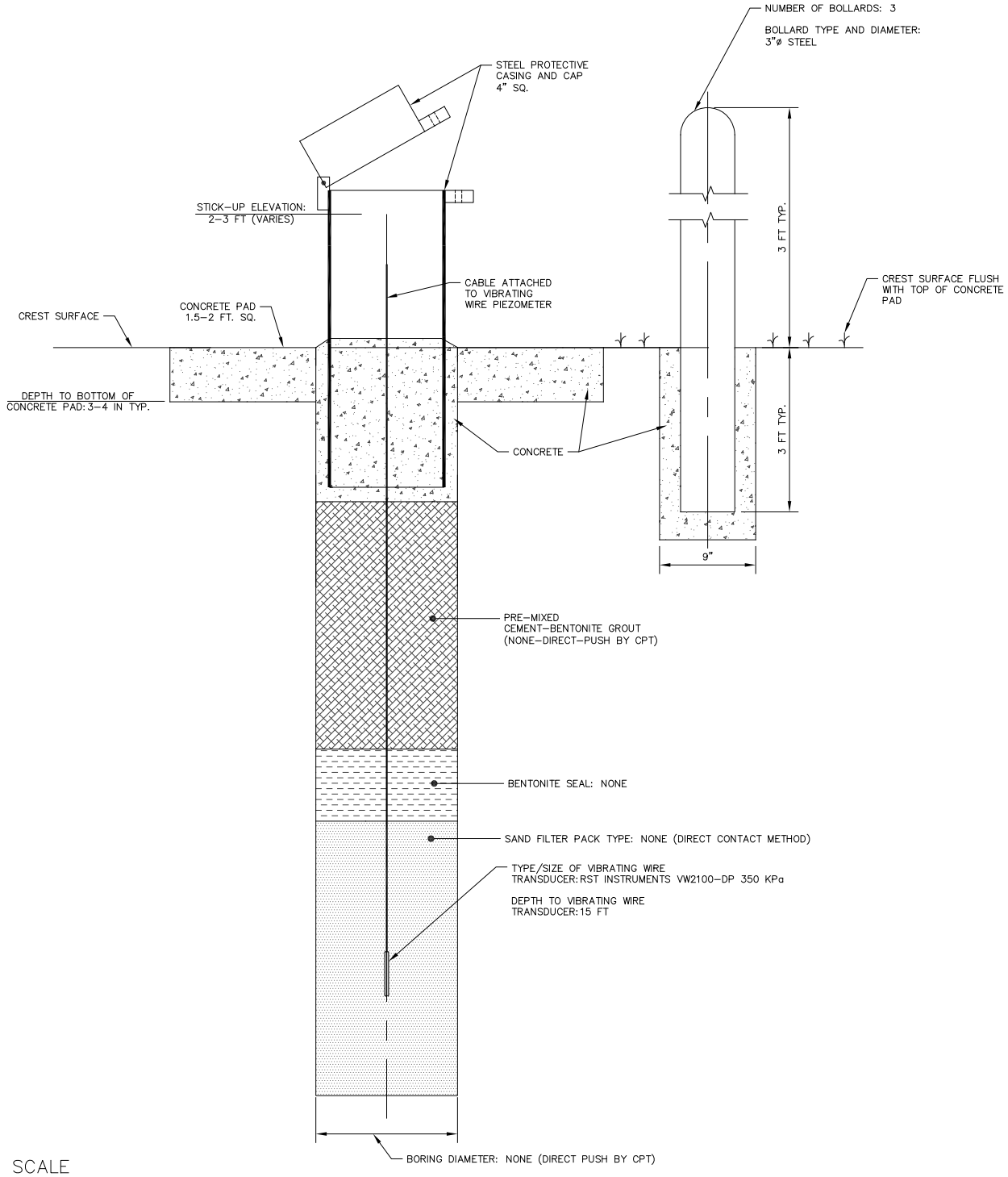
Piezometer Location	COF-P006	Date Installed	8/10/2015	Time	
Installed By		Observed By	AECOM	Total Depth	45 FT
Method of Installation	HOLLOW STEM AUGER	Drilling Contractor	GEOTECHNOLOGY, INC.	Surface Elevation	635.1 FT
Screened Interval	30-45 FT	Completion Zone	POND #1 FOUNDATION		
Remarks	OFFSET 5' SOUTH FROM COF-B005	Groundwater Level(s)	22.2 FT ON 8/29/2015		



NOT TO SCALE

Project: Dynegy Project Location: COFFEEN POWER STATION, ILLINOIS Project Number: 60440742	Log of Piezometer Sheet 1 of 1

Piezometer Location	COF-P007	Date Installed	8/12/2015	Time	
Installed By		Observed By	AECOM	Total Depth	15 FT
Method of Installation	CPT - DIRECT PUSH	Drilling Contractor	CONETEC, INC.	Surface Elevation	617.5 FT
Screened Interval	N/A	Completion Zone	POND #1 FOUNDATION		
Remarks		Groundwater Level(s)	6.1 FT ON 8/29/2015		



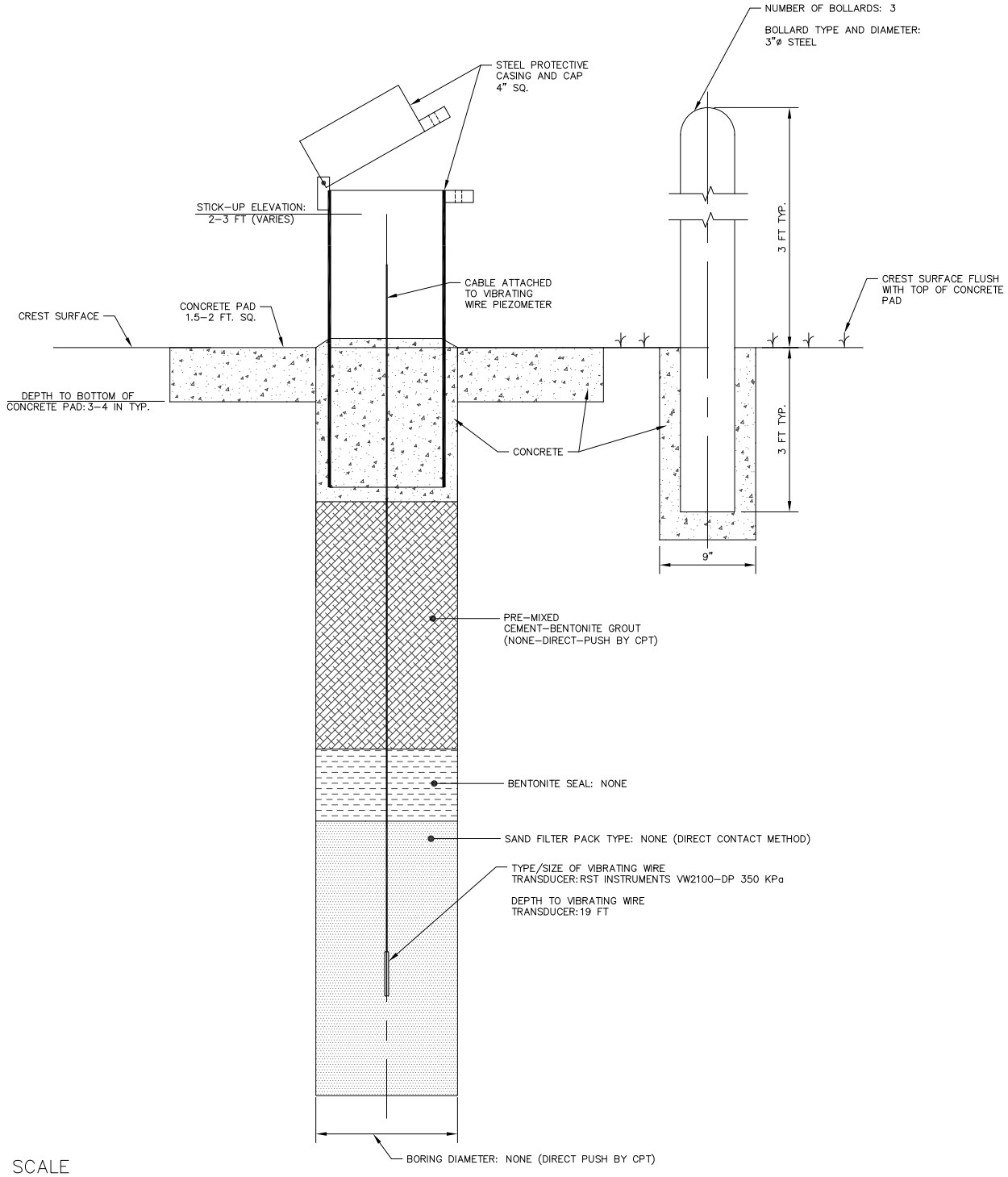
NOT TO SCALE

AECOM

NOT TO SCALE

Project: Dynegy Project Location: COFFEEN POWER STATION, ILLINOIS Project Number: 60440742	Log of Piezometer Sheet 1 of 1

Piezometer Location	COF-P008	Date Installed	8/12/2015	Time	
Installed By		Observed By	AECOM	Total Depth	19 FT
Method of Installation	CPT - DIRECT PUSH	Drilling Contractor	CONETEC, INC.	Surface Elevation	625.1 FT
Screened Interval	N/A	Completion Zone	POND #1 FOUNDATION		
Remarks		Groundwater Level(s)	2.6 FT ON 8/29/2015		



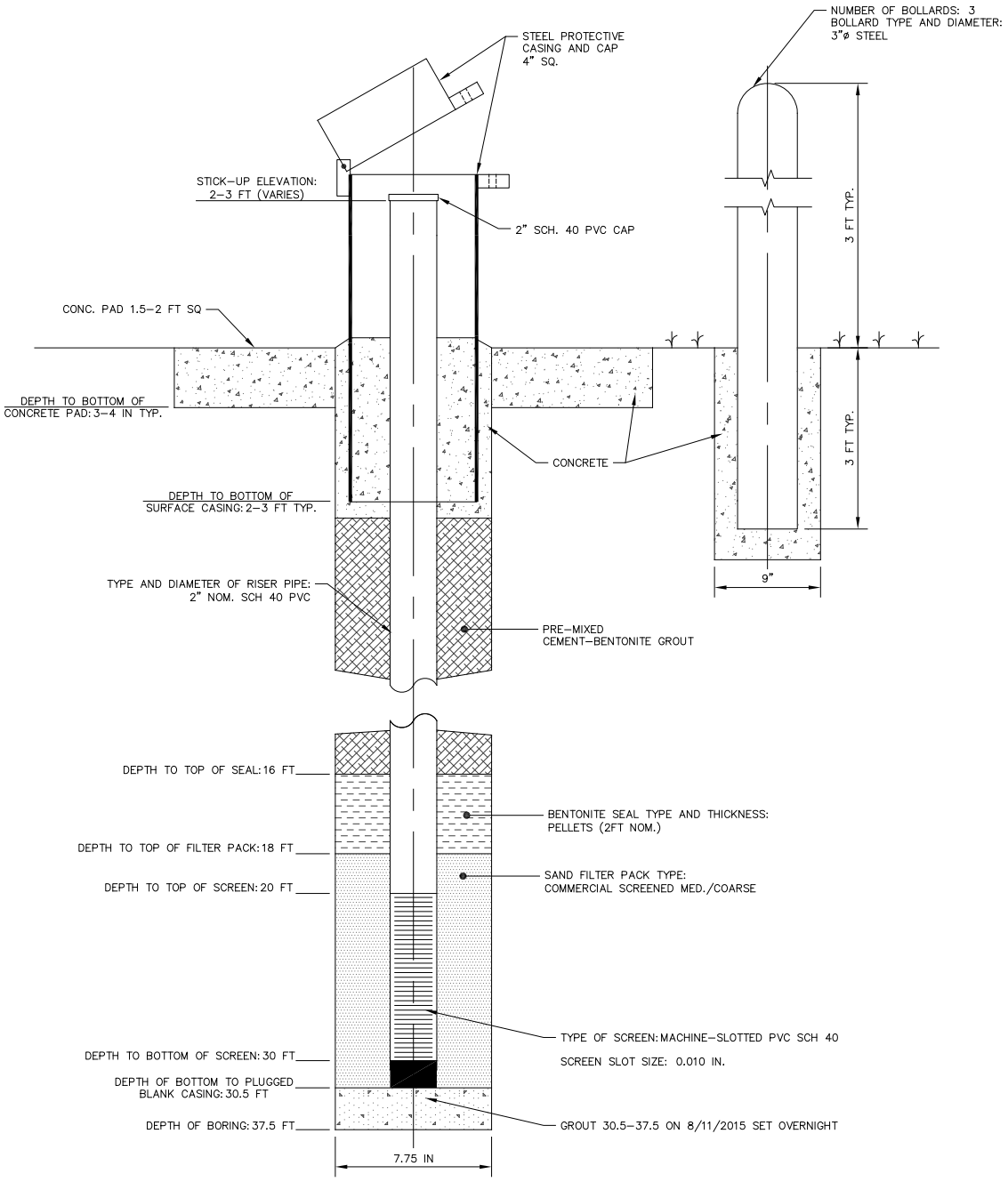
NOT TO SCALE

AECOM

NOT TO SCALE

Project: Dynegy	Log of Piezometer
Project Location: COFFEEN POWER STATION, ILLINOIS	Sheet 1 of 1
Project Number: 60440742	

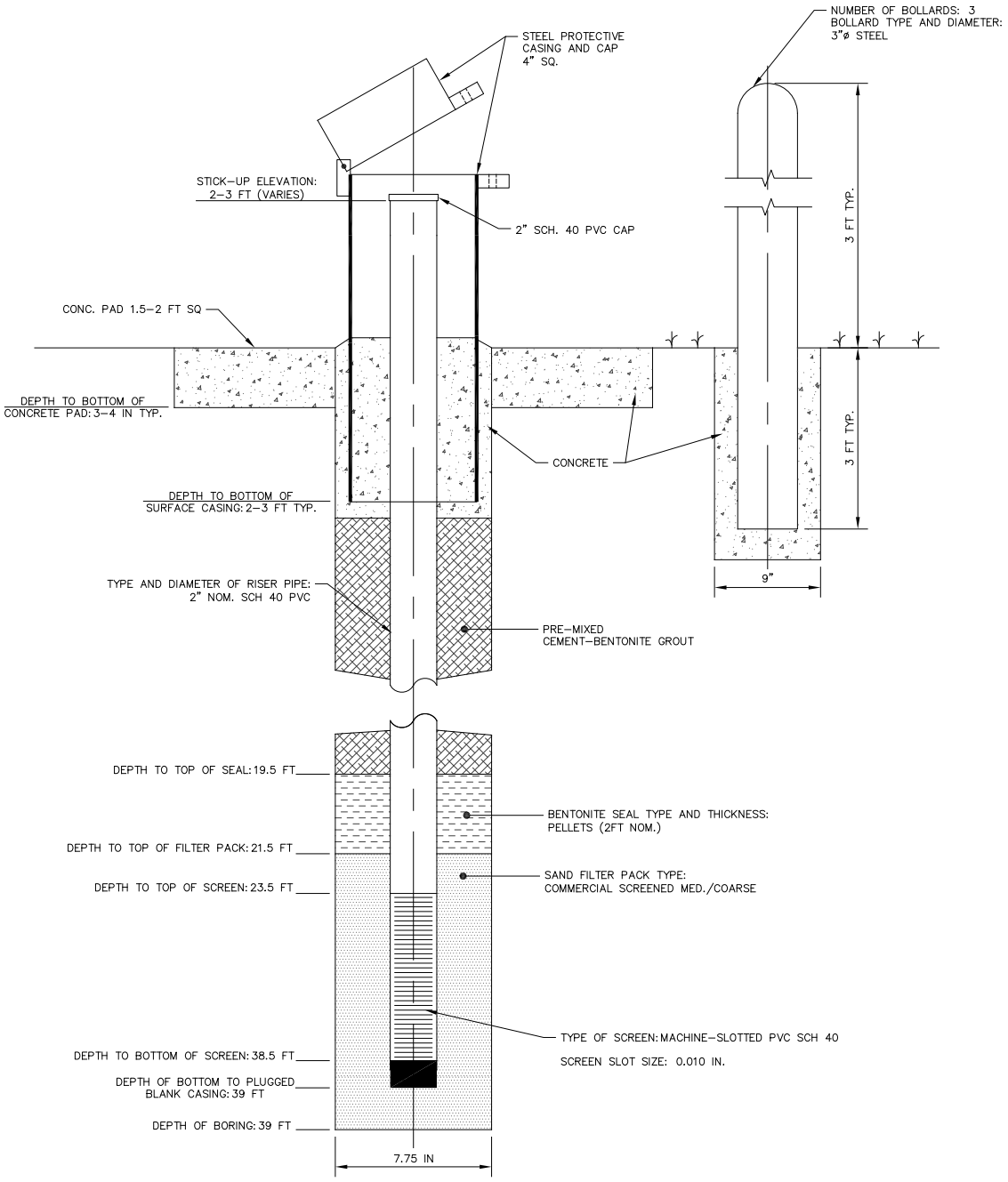
Piezometer Location	COF-P009	Date Installed	8/12/2015	Time	
Installed By		Observed By	AECOM	Total Depth	37.5 FT
Method of Installation	HOLLOW STEM AUGER	Drilling Contractor	GEOTECHNOLOGY, INC.	Surface Elevation	638.0 FT
Screened Interval	20-30 FT	Completion Zone	POND #2 FOUNDATION		
Remarks	INSTALL IN COF-B007	Groundwater Level(s)			



NOT TO SCALE

Project: Dynegy	Log of Piezometer
Project Location: COFFEEN POWER STATION, ILLINOIS	Sheet 1 of 1
Project Number: 60440742	

Piezometer Location	COF-P010	Date Installed	8/13/2015	Time	
Installed By		Observed By	AECOM	Total Depth	38.5 FT
Method of Installation	HOLLOW STEM AUGER	Drilling Contractor	GEOTECHNOLOGY, INC.	Surface Elevation	635.2 FT
Screened Interval	23.5-38.5 FT	Completion Zone	POND #2 FOUNDATION		
Remarks	INSTALL IN COF-B009	Groundwater Level(s)	29.6 FT ON 8/29/2015		



NOT TO SCALE

Project: Dynegy

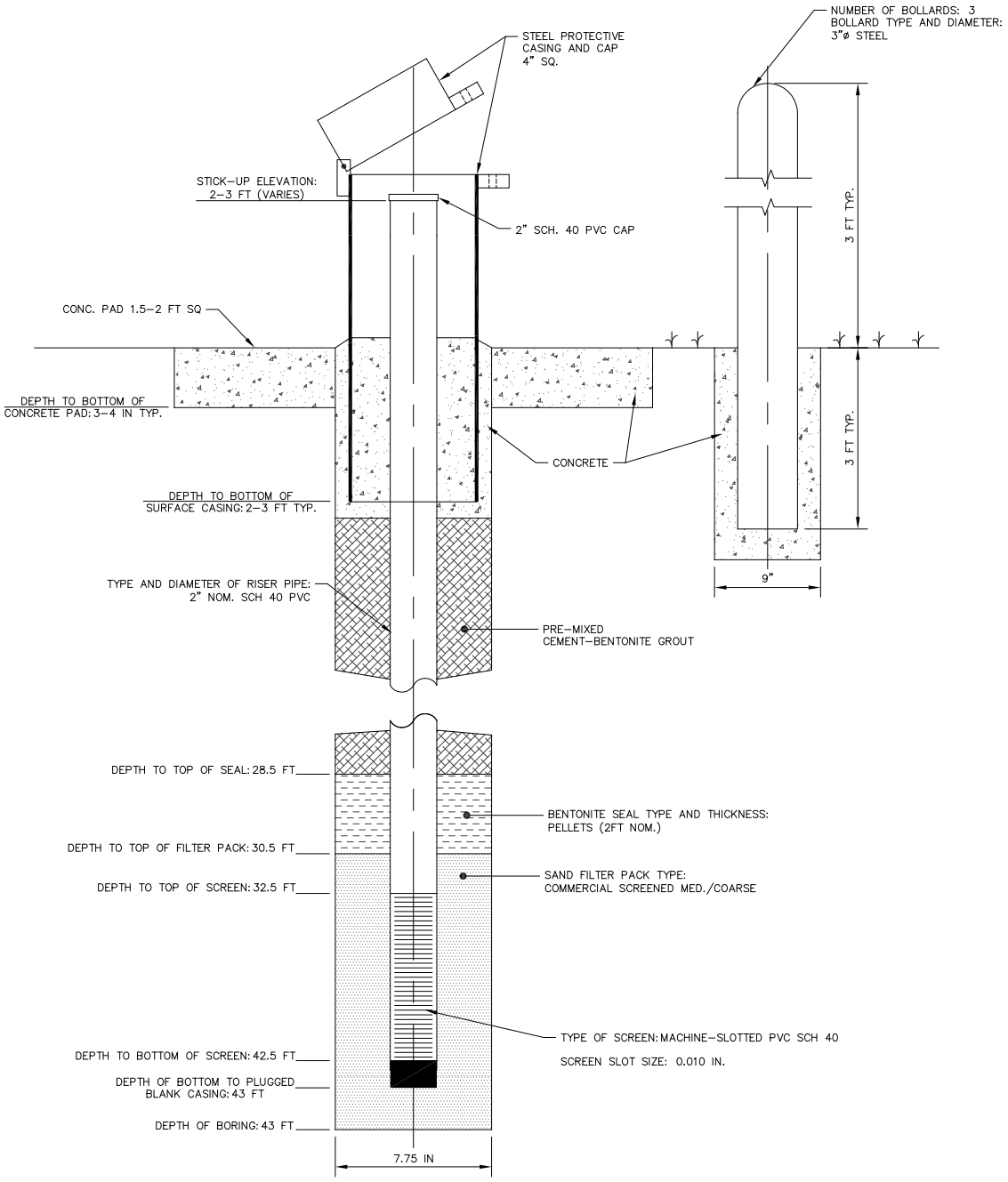
Project Location: COFFEEN POWER STATION, ILLINOIS

Project Number: 60440742

Log of Piezometer

Sheet 1 of 1

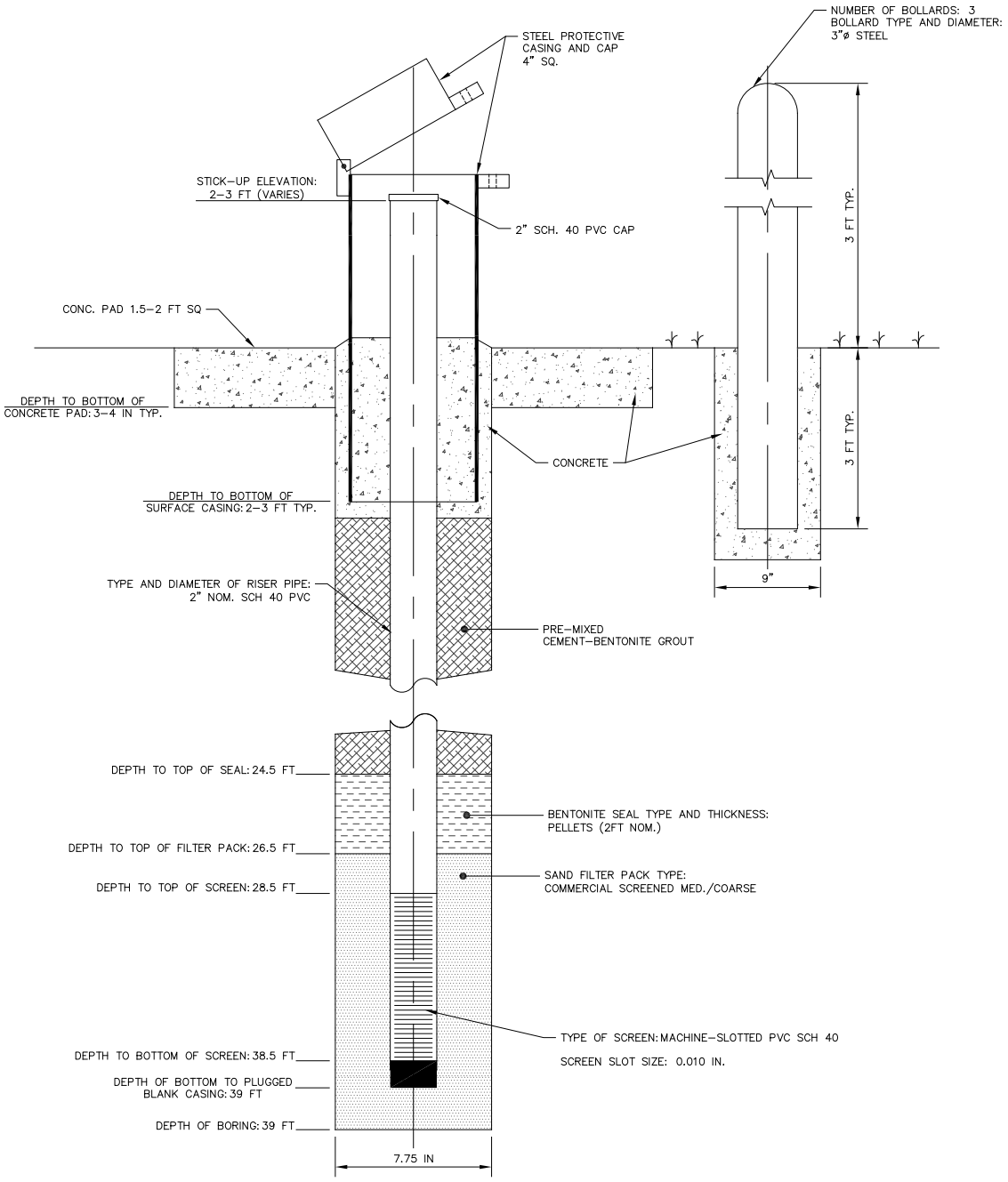
Piezometer Location	COF-P012	Date Installed	8/11/2015	Time	
Installed By		Observed By	AECOM	Total Depth	42.5 FT
Method of Installation	HOLLOW STEM AUGER	Drilling Contractor	GEOTECHNOLOGY, INC.	Surface Elevation	635.1 FT
Screened Interval	32.5-42.5 FT	Completion Zone	POND #2 FOUNDATION		
Remarks	INSTALL IN COF-B010	Groundwater Level(s)	16.8 FT ON 8/29/2015		



NOT TO SCALE

Project: Dynegy Project Location: COFFEEN POWER STATION, ILLINOIS Project Number: 60440742	Log of Piezometer Sheet 1 of 1

Piezometer Location	COF-P014	Date Installed	8/11/2015	Time	
Installed By		Observed By	AECOM	Total Depth	38.5 FT
Method of Installation	HOLLOW STEM AUGER	Drilling Contractor	GEOTECHNOLOGY, INC.	Surface Elevation	642.2 FT
Screened Interval	28.5-38.5 FT	Completion Zone	POND #2 FOUNDATION		
Remarks	INSTALL IN COF-B011	Groundwater Level(s)	21.5 FT ON 8/29/2015		



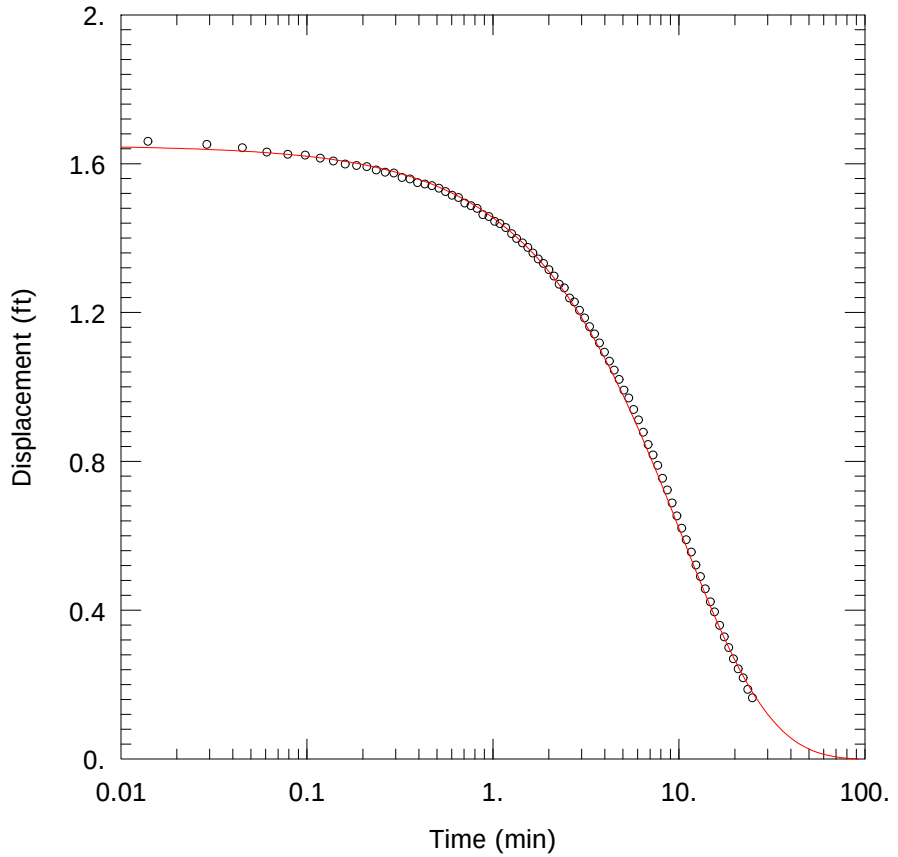
NOT TO SCALE

APPENDIX B

HYDRAULIC CONDUCTIVITY TEST RESULTS

APPENDIX B1

HYDRAULIC CONDUCTIVITY ANALYSES (WELLS)



G105 @ CCR LANDFILL – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G105
Test Date: 16 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.00015 cm/sec
Ss = 6.0E-5 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 14.82 ft

WELL DATA (G105)

Initial Displacement: 1.65 ft
Total Well Penetration Depth: 14.82 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 14.82 ft
Screen Length: 4.58 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G105fh.aqt
Title: G105 @ CCR Landfill – Falling Head Test
Date: 11/11/16
Time: 11:38:43

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 16 Jun 2016
Test Well: G105

AQUIFER DATA

Saturated Thickness: 14.82 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G105

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.65 ft
Static Water Column Height: 14.82 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.58 ft
Total Well Penetration Depth: 14.82 ft

No. of Observations: 82

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	1.656	0.953	1.458	5.723	0.939
0.014	1.66	1.023	1.445	6.073	0.911
0.029	1.652	1.093	1.439	6.443	0.878
0.045	1.643	1.173	1.428	6.843	0.845
0.061	1.631	1.263	1.412	7.263	0.817
0.079	1.625	1.343	1.399	7.703	0.789
0.098	1.623	1.443	1.387	8.173	0.754
0.118	1.615	1.543	1.375	8.673	0.723
0.139	1.607	1.643	1.36	9.203	0.688
0.161	1.599	1.753	1.344	9.763	0.653
0.185	1.595	1.873	1.332	10.36	0.62
0.21	1.592	2.003	1.315	10.96	0.589
0.236	1.583	2.133	1.298	11.66	0.556

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.264	1.577	2.273	1.276	12.36	0.521
0.294	1.575	2.423	1.266	13.06	0.49
0.325	1.563	2.583	1.239	13.86	0.457
0.359	1.559	2.743	1.228	14.76	0.422
0.394	1.549	2.923	1.206	15.56	0.395
0.431	1.545	3.113	1.185	16.56	0.359
0.471	1.541	3.313	1.162	17.56	0.328
0.513	1.534	3.523	1.142	18.56	0.299
0.557	1.525	3.743	1.118	19.66	0.269
0.604	1.515	3.983	1.093	20.86	0.242
0.654	1.509	4.233	1.069	22.16	0.218
0.707	1.494	4.493	1.045	23.46	0.187
0.763	1.487	4.773	1.02	24.86	0.164
0.823	1.48	5.073	0.991		
0.883	1.463	5.383	0.97		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00015	cm/sec
Ss	6.0E-5	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.06776 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0001464	1.653E-5	+/- 3.29E-5	8.858	cm/sec
Ss	5.669E-5	3.386E-5	+/- 6.739E-5	1.674	ft^{-1}
Kz/Kr	1.	1.041	+/- 2.071	0.961	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.06614 cm^2/sec

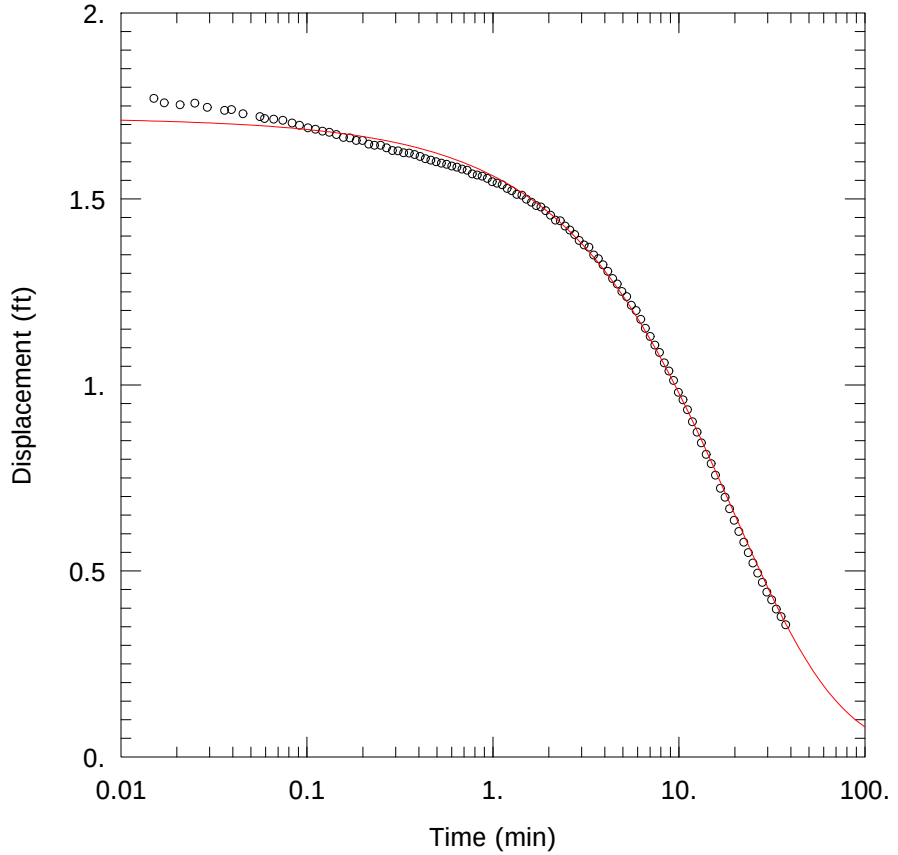
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-1.00
Ss	-0.99	1.00	0.99
Kz/Kr	-1.00	0.99	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.006265 ft^2
Variance . . . . . 7.93E-5 ft^2
Std. Deviation . . . . . 0.008905 ft
Mean. . . . . -0.002224 ft
No. of Residuals 82
No. of Estimates. 3



G105 @CCR LANDFILL – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G105
Test Date: 16 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 5.7E-5 cm/sec
Ss = 0.001 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 14.82 ft

WELL DATA (G105)

Initial Displacement: 1.72 ft
Total Well Penetration Depth: 14.82 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 14.82 ft
Screen Length: 4.58 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G105rh.aqt
Title: G105 @CCR Landfill – Rising Head Test
Date: 11/11/16
Time: 11:43:09

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 16 Jun 2016
Test Well: G105

AQUIFER DATA

Saturated Thickness: 14.82 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G105

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.72 ft
Static Water Column Height: 14.82 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.58 ft
Total Well Penetration Depth: 14.82 ft

No. of Observations: 112

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	1.834	0.4953	1.6	4.943	1.251
0.004167	1.767	0.5293	1.596	5.243	1.237
0.008333	1.773	0.5643	1.593	5.553	1.214
0.01505	1.77	0.6013	1.588	5.893	1.2
0.01712	1.758	0.6413	1.585	6.243	1.176
0.02083	1.753	0.6833	1.58	6.613	1.152
0.025	1.757	0.7273	1.577	7.013	1.13
0.02917	1.746	0.7746	1.567	7.433	1.107
0.03612	1.738	0.8243	1.564	7.873	1.087
0.03933	1.74	0.8773	1.561	8.343	1.059
0.04537	1.729	0.9333	1.555	8.843	1.037
0.05595	1.721	0.9933	1.546	9.373	1.012
0.05933	1.716	1.053	1.542	9.933	0.98

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.06633	1.714	1.123	1.538	10.53	0.96
0.07433	1.711	1.193	1.528	11.13	0.933
0.08333	1.704	1.263	1.522	11.83	0.901
0.09133	1.698	1.343	1.512	12.53	0.873
0.1013	1.691	1.433	1.51	13.23	0.844
0.1113	1.687	1.513	1.499	14.03	0.813
0.1213	1.682	1.613	1.491	14.93	0.788
0.1323	1.679	1.713	1.482	15.73	0.757
0.1443	1.673	1.813	1.478	16.73	0.722
0.1573	1.665	1.923	1.468	17.73	0.698
0.1703	1.664	2.043	1.456	18.73	0.667
0.1843	1.657	2.173	1.443	19.83	0.636
0.1993	1.657	2.303	1.441	21.03	0.606
0.2153	1.647	2.443	1.427	22.33	0.577
0.2313	1.644	2.593	1.416	23.63	0.549
0.2493	1.644	2.753	1.404	25.03	0.521
0.2683	1.637	2.913	1.388	26.53	0.494
0.2883	1.63	3.093	1.376	28.13	0.469
0.3093	1.629	3.283	1.37	29.73	0.443
0.3313	1.624	3.483	1.349	31.53	0.422
0.3553	1.623	3.693	1.339	33.43	0.397
0.3803	1.619	3.913	1.323	35.43	0.377
0.4063	1.614	4.153	1.305	37.53	0.355
0.4343	1.608	4.403	1.286		
0.4643	1.604	4.663	1.271		

SOLUTION

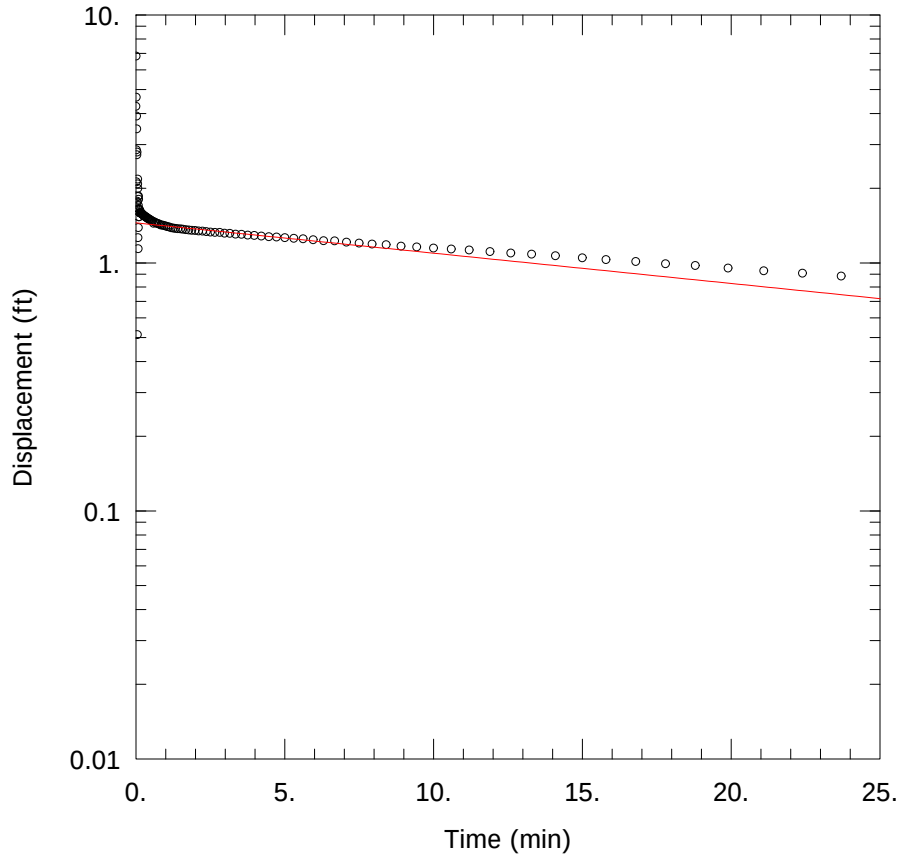
Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	5.7E-5	cm/sec
Ss	0.001	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.02575 cm^2/sec



G106 @ CCR LANDFILL – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G106
Test Date: 15 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 4.0E-5 cm/sec
y0 = 1.45 ft

AQUIFER DATA

Saturated Thickness: 12.5 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (G106)

Initial Displacement: 1.67 ft
Total Well Penetration Depth: 12.5 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 12.5 ft
Screen Length: 4.58 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G106fh.aqt
Title: G106 @ CCR Landfill – Falling Head Test
Date: 12/01/16
Time: 09:04:15

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 15 Jun 2016
Test Well: G106

AQUIFER DATA

Saturated Thickness: 12.5 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G106

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.67 ft
Static Water Column Height: 12.5 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.58 ft
Total Well Penetration Depth: 12.5 ft

No. of Observations: 121

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.00455	4.279	0.282	1.547	2.98	1.317
0.008333	6.825	0.298	1.542	3.16	1.316
0.0125	4.654	0.316	1.537	3.35	1.306
0.01667	2.121	0.335	1.534	3.55	1.303
0.02083	2.856	0.355	1.527	3.76	1.294
0.025	3.905	0.376	1.518	3.98	1.29
0.02917	3.468	0.398	1.516	4.22	1.283
0.03745	2.726	0.422	1.505	4.47	1.274
0.04113	2.798	0.447	1.499	4.73	1.271
0.0448	1.772	0.473	1.496	5.01	1.263
0.04847	0.514	0.501	1.487	5.31	1.257
0.05212	1.755	0.531	1.477	5.62	1.25
0.0603	2.176	0.562	1.474	5.96	1.24

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.06397	2.082	0.596	1.444	6.31	1.229
0.06767	1.996	0.631	1.461	6.68	1.226
0.07133	1.85	0.668	1.451	7.08	1.213
0.075	1.264	0.708	1.444	7.5	1.202
0.07865	1.141	0.75	1.44	7.94	1.191
0.08232	1.388	0.794	1.432	8.41	1.183
0.08598	1.706	0.841	1.421	8.91	1.168
0.08965	1.859	0.891	1.42	9.44	1.159
0.09332	1.805	0.944	1.414	10.	1.148
0.09697	1.651	1.	1.408	10.6	1.137
0.1006	1.533	1.06	1.399	11.2	1.127
0.106	1.534	1.12	1.396	11.9	1.11
0.112	1.644	1.19	1.386	12.6	1.095
0.1208	1.639	1.26	1.382	13.3	1.085
0.126	1.59	1.33	1.378	14.1	1.068
0.133	1.594	1.41	1.374	15.	1.048
0.141	1.623	1.5	1.371	15.8	1.031
0.15	1.59	1.58	1.367	16.8	1.013
0.158	1.592	1.68	1.362	17.8	0.992
0.168	1.594	1.78	1.358	18.8	0.976
0.178	1.583	1.88	1.353	19.9	0.953
0.188	1.584	1.99	1.351	21.1	0.929
0.199	1.58	2.11	1.344	22.4	0.909
0.211	1.573	2.24	1.343	23.7	0.884
0.224	1.569	2.37	1.337	25.1	0.858
0.237	1.565	2.51	1.332	26.6	0.833
0.251	1.56	2.66	1.328		
0.266	1.552	2.82	1.327		

SOLUTION

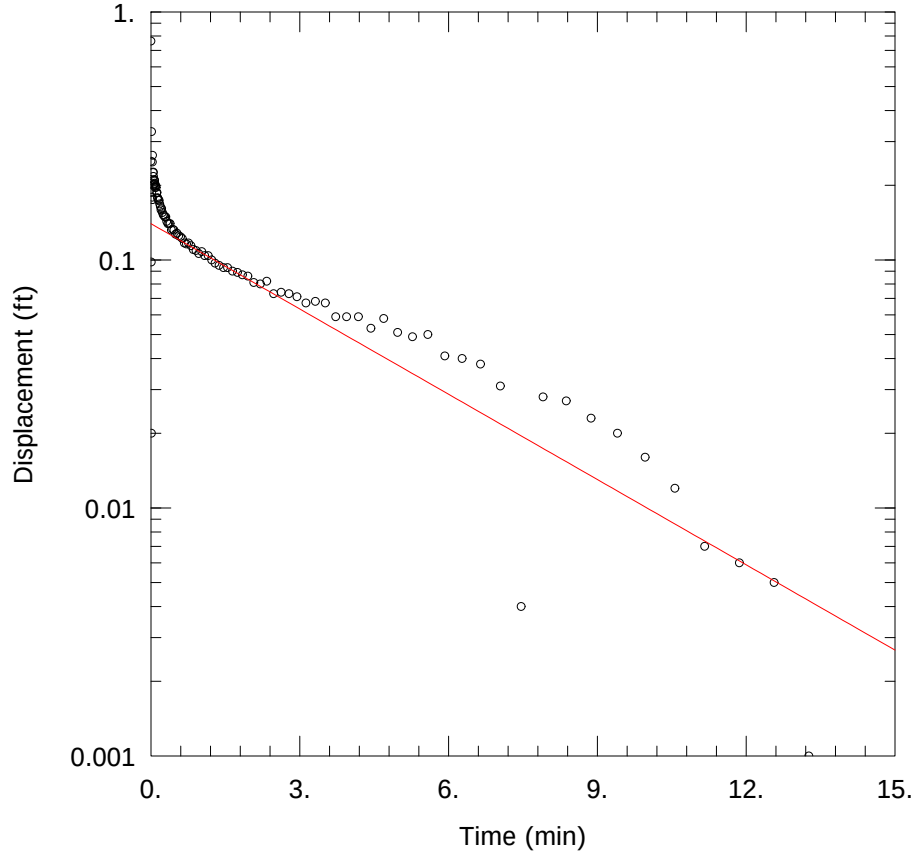
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.694

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	4.0E-5	cm/sec
y0	1.45	ft

T = K*b = 0.01524 cm²/sec



G106 @CCR LANDFILL – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G106
Test Date: 15 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.00074 cm/sec
y0 = 0.14 ft

AQUIFER DATA

Saturated Thickness: 12.5 ft

Anisotropy Ratio (Kz/Kr): 0.001

WELL DATA (G106)

Initial Displacement: 0.25 ft
Total Well Penetration Depth: 12.5 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 12.5 ft
Screen Length: 4.58 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G106rh.aqt
Title: G106 @CCR Landfill – Rising Head Test
Date: 11/18/16
Time: 11:53:58

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 15 Jun 2016
Test Well: G106

AQUIFER DATA

Saturated Thickness: 12.5 ft
Anisotropy Ratio (Kz/Kr): 0.001

SLUG TEST WELL DATA

Test Well: G106

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 0.25 ft
Static Water Column Height: 12.5 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.58 ft
Total Well Penetration Depth: 12.5 ft

No. of Observations: 102

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	0.763	0.2487	0.152	1.957	0.086
0.00785	0.098	0.2647	0.151	2.077	0.081
0.01152	0.02	0.2827	0.149	2.207	0.08
0.0152	0.329	0.3017	0.149	2.337	0.082
0.01887	0.187	0.3217	0.143	2.477	0.073
0.02662	0.179	0.3427	0.14	2.627	0.074
0.03028	0.248	0.3647	0.14	2.787	0.073
0.03395	0.264	0.3887	0.14	2.947	0.071
0.03762	0.175	0.4137	0.132	3.127	0.067
0.04558	0.225	0.4397	0.133	3.317	0.068
0.04927	0.226	0.4677	0.132	3.517	0.067
0.05293	0.217	0.4977	0.127	3.727	0.059
0.05662	0.202	0.5287	0.128	3.947	0.059

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.06387	0.2	0.5627	0.125	4.187	0.059
0.06753	0.21	0.5977	0.124	4.437	0.053
0.07125	0.21	0.6347	0.122	4.697	0.058
0.07532	0.208	0.6747	0.117	4.977	0.051
0.079	0.204	0.7167	0.116	5.277	0.049
0.08268	0.202	0.7607	0.117	5.587	0.05
0.08637	0.196	0.8077	0.114	5.927	0.041
0.09267	0.198	0.8577	0.11	6.277	0.04
0.09967	0.199	0.9107	0.109	6.647	0.038
0.1077	0.196	0.9667	0.106	7.047	0.031
0.1167	0.186	1.027	0.108	7.467	0.004
0.1247	0.187	1.087	0.104	7.907	0.028
0.1347	0.178	1.157	0.104	8.377	0.027
0.1447	0.177	1.227	0.1	8.877	0.023
0.1547	0.174	1.297	0.097	9.407	0.02
0.1657	0.174	1.377	0.095	9.967	0.016
0.1777	0.168	1.467	0.093	10.57	0.012
0.1907	0.164	1.547	0.093	11.17	0.007
0.2037	0.159	1.647	0.09	11.87	0.006
0.2177	0.161	1.747	0.089	12.57	0.005
0.2327	0.155	1.847	0.087	13.27	0.001

SOLUTION

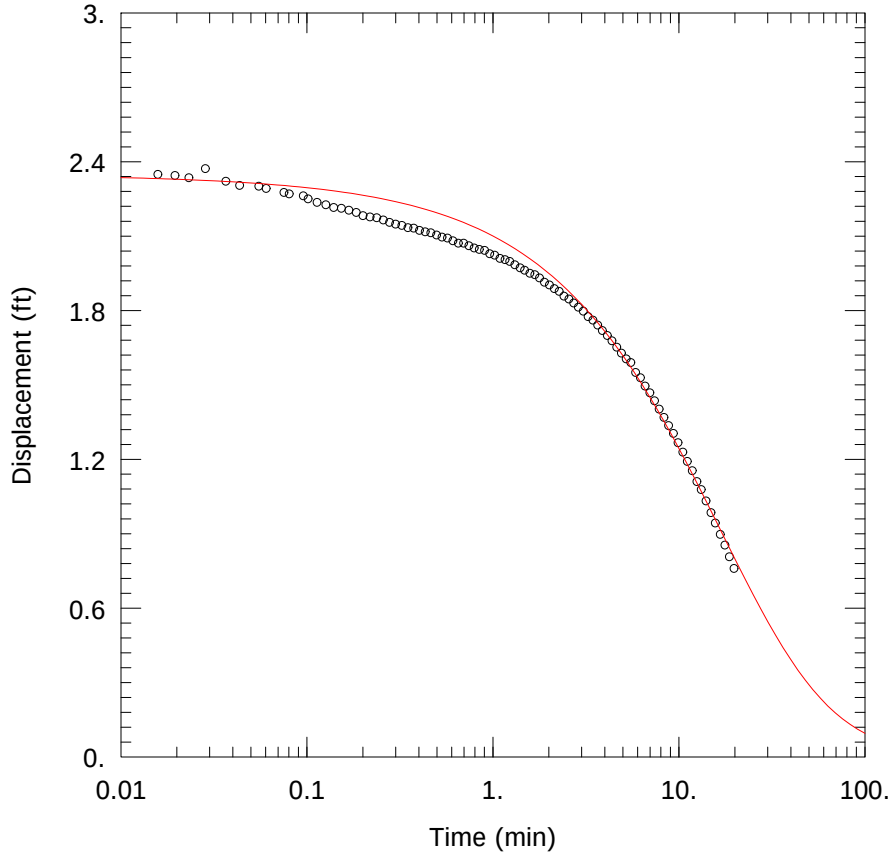
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 7.28

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.00074	cm/sec
y0	0.14	ft

T = K*b = 0.2819 cm²/sec



G107 @ CCR LANDFILL – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G107
Test Date: 15 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 6.3E-5 cm/sec
Ss = 0.0015 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 10.86 ft

WELL DATA (G107)

Initial Displacement: 2.35 ft
Total Well Penetration Depth: 10.86 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 10.86 ft
Screen Length: 4.48 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G107fh.aqt
Title: G107 @ CCR Landfill – Falling Head Test
Date: 11/28/16
Time: 10:25:40

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 15 Jun 2016
Test Well: G107

AQUIFER DATA

Saturated Thickness: 10.86 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G107

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.35 ft
Static Water Column Height: 10.86 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.48 ft
Total Well Penetration Depth: 10.86 ft

No. of Observations: 103

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
-0.03917	2.789	0.3245	2.143	3.063	1.797
-0.035	2.535	0.3495	2.134	3.252	1.775
-0.03078	2.269	0.3755	2.132	3.453	1.761
-0.02297	2.403	0.4035	2.123	3.663	1.741
-0.01928	2.442	0.4335	2.117	3.882	1.719
-0.01558	2.401	0.4645	2.113	4.122	1.699
-0.0119	2.368	0.4985	2.104	4.372	1.678
-0.003683	2.371	0.5335	2.096	4.633	1.652
0.	2.38	0.5705	2.092	4.912	1.628
0.003683	2.362	0.6105	2.081	5.213	1.605
0.00735	2.355	0.6525	2.071	5.523	1.59
0.01582	2.349	0.6965	2.071	5.862	1.55
0.01953	2.344	0.7435	2.061	6.213	1.529

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.02323	2.335	0.7935	2.052	6.582	1.495
0.0285	2.372	0.8465	2.046	6.982	1.468
0.03668	2.321	0.9025	2.042	7.402	1.436
0.0435	2.304	0.9625	2.029	7.843	1.402
0.05523	2.301	1.023	2.023	8.313	1.369
0.0605	2.292	1.093	2.01	8.813	1.336
0.07527	2.276	1.163	2.005	9.342	1.304
0.0805	2.27	1.232	1.998	9.902	1.267
0.09568	2.262	1.313	1.984	10.5	1.229
0.1015	2.25	1.403	1.972	11.1	1.191
0.1135	2.236	1.482	1.962	11.8	1.154
0.1265	2.226	1.583	1.95	12.5	1.11
0.1395	2.215	1.683	1.944	13.2	1.078
0.1535	2.212	1.783	1.931	14.	1.032
0.1685	2.204	1.893	1.914	14.9	0.985
0.1845	2.195	2.013	1.903	15.7	0.943
0.2005	2.182	2.143	1.888	16.7	0.897
0.2185	2.177	2.273	1.877	17.7	0.854
0.2375	2.174	2.413	1.858	18.7	0.807
0.2575	2.165	2.563	1.846	19.8	0.76
0.2785	2.155	2.723	1.83		
0.3005	2.148	2.882	1.813		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	6.3E-5	cm/sec
Ss	0.0015	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.02085 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	4.079E-5	3.684E-6	+/- 7.31E-6	11.07	cm/sec
Ss	0.008117	0.001889	+/- 0.003747	4.297	ft^{-1}
Kz/Kr	1.	1.82	+/- 3.611	0.5494	

C.I. is approximate 95% confidence interval for parameter

t-ratio = estimate/std. error
No estimation window

T = K*b = 0.0135 cm²/sec

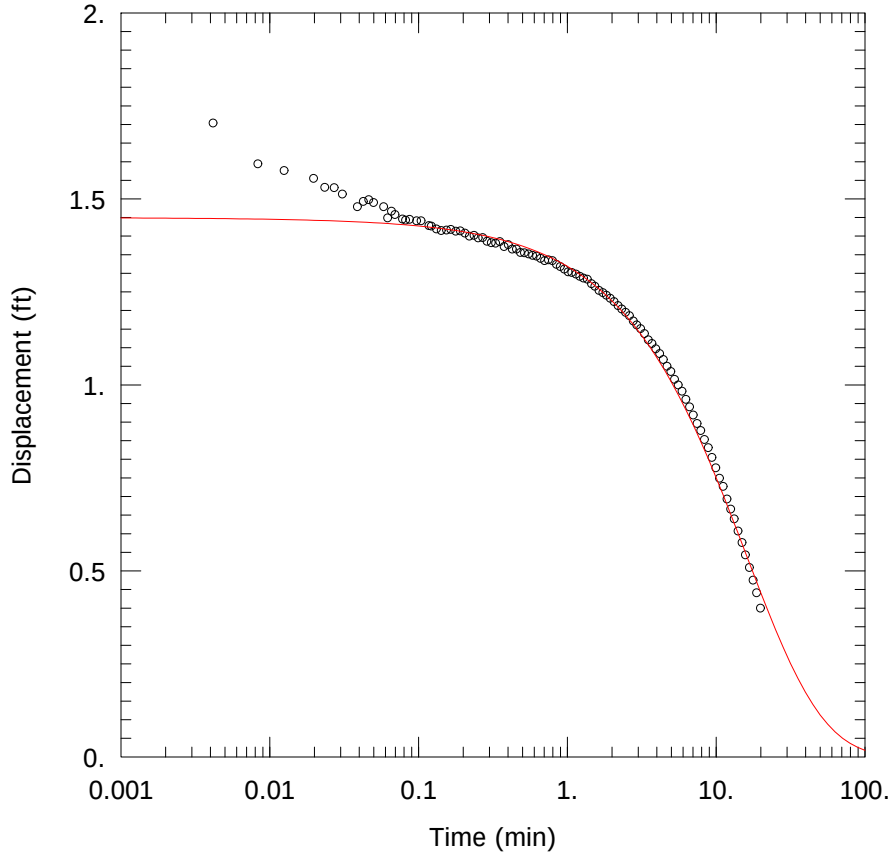
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.96	-0.37
Ss	-0.96	1.00	0.19
Kz/Kr	-0.37	0.19	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.3683 ft^2
Variance . . . . . 0.003683 ft^2
Std. Deviation . . . . . 0.06069 ft
Mean. . . . . 0.002549 ft
No. of Residuals 103
No. of Estimates. 3



G107 @CCR LANDFILL – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G107
Test Date: 15 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 8.9E-5 cm/sec
Ss = 0.0002 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 10.86 ft

WELL DATA (G107)

Initial Displacement: 1.45 ft
Total Well Penetration Depth: 10.86 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 10.86 ft
Screen Length: 4.48 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G107rh.aqt
Title: G107 @CCR Landfill – Rising Head Test
Date: 11/18/16
Time: 11:55:10

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 15 Jun 2016
Test Well: G107

AQUIFER DATA

Saturated Thickness: 10.86 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G107

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.45 ft
Static Water Column Height: 10.86 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.48 ft
Total Well Penetration Depth: 10.86 ft

No. of Observations: 106

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	1.826	0.3302	1.381	2.934	1.161
0.004167	1.704	0.3522	1.385	3.114	1.151
0.008333	1.594	0.3762	1.372	3.304	1.138
0.0125	1.576	0.4012	1.377	3.504	1.121
0.01975	1.555	0.4272	1.365	3.714	1.111
0.02345	1.531	0.4552	1.365	3.934	1.097
0.02713	1.53	0.4852	1.356	4.174	1.084
0.0308	1.513	0.5162	1.355	4.424	1.068
0.03893	1.479	0.5502	1.352	4.684	1.05
0.04263	1.493	0.5852	1.348	4.964	1.036
0.04632	1.498	0.6222	1.346	5.264	1.015
0.04998	1.49	0.6622	1.34	5.574	1.
0.05843	1.479	0.7042	1.334	5.914	0.983

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.06212	1.449	0.7482	1.336	6.264	0.961
0.06582	1.467	0.7952	1.334	6.634	0.941
0.06952	1.458	0.8452	1.324	7.034	0.919
0.07817	1.446	0.8982	1.318	7.454	0.896
0.08188	1.443	0.9542	1.311	7.894	0.877
0.08717	1.445	1.014	1.304	8.364	0.853
0.09723	1.441	1.074	1.302	8.864	0.831
0.1042	1.441	1.144	1.298	9.394	0.805
0.1175	1.428	1.214	1.292	9.954	0.777
0.1222	1.427	1.284	1.287	10.55	0.749
0.1322	1.419	1.364	1.284	11.15	0.727
0.1422	1.415	1.454	1.272	11.85	0.693
0.1544	1.416	1.534	1.265	12.55	0.666
0.1652	1.418	1.634	1.254	13.25	0.64
0.1782	1.413	1.734	1.248	14.05	0.607
0.1912	1.414	1.834	1.241	14.95	0.576
0.2052	1.408	1.944	1.233	15.75	0.543
0.2202	1.4	2.064	1.224	16.75	0.509
0.2362	1.402	2.194	1.213	17.75	0.475
0.2522	1.395	2.324	1.204	18.75	0.441
0.2702	1.396	2.464	1.195	19.85	0.4
0.2892	1.386	2.614	1.186		
0.3092	1.382	2.774	1.172		

SOLUTION

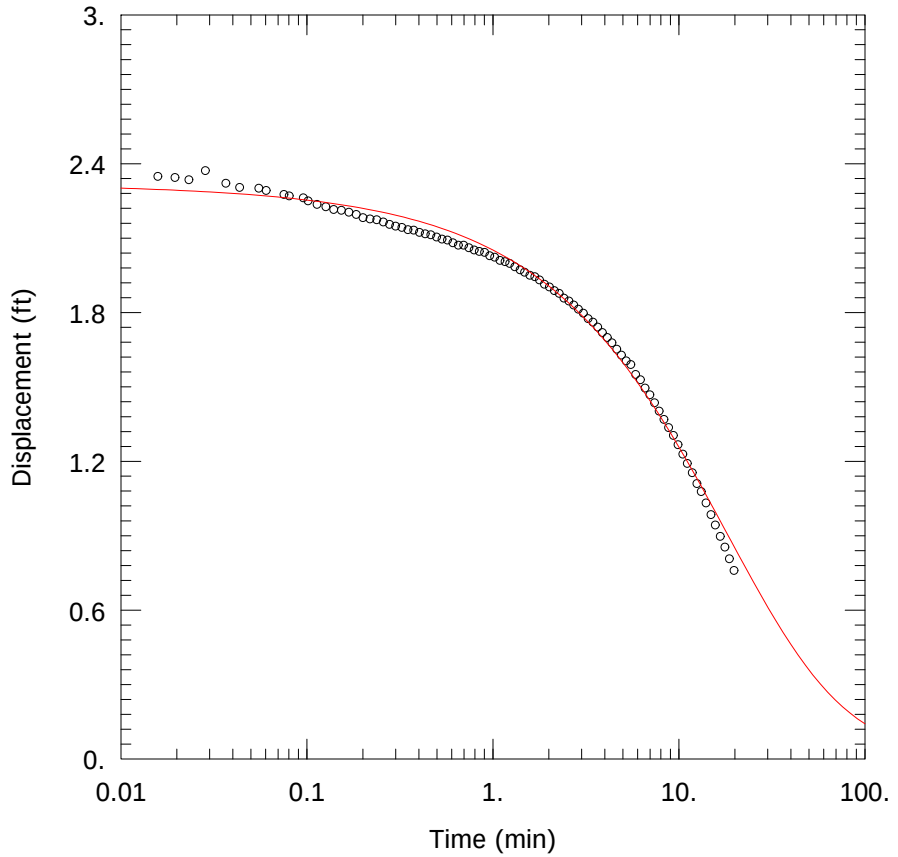
Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	8.9E-5	cm/sec
Ss	0.0002	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.02946 cm^2/sec



G110 @ CCR LANDFILL – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G110
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 4.7E-5 cm/sec
Ss = 0.004 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 10.21 ft

WELL DATA (G110)

Initial Displacement: 2.32 ft
Total Well Penetration Depth: 10.21 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 10.21 ft
Screen Length: 4.54 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G110fh.aqt
Title: G110 @ CCR Landfill – Falling Head Test
Date: 11/28/16
Time: 10:27:16

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: G110

AQUIFER DATA

Saturated Thickness: 10.21 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G110

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.32 ft
Static Water Column Height: 10.21 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.54 ft
Total Well Penetration Depth: 10.21 ft

No. of Observations: 103

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
-0.03917	2.789	0.3245	2.143	3.063	1.797
-0.035	2.535	0.3495	2.134	3.252	1.775
-0.03078	2.269	0.3755	2.132	3.453	1.761
-0.02297	2.403	0.4035	2.123	3.663	1.741
-0.01928	2.442	0.4335	2.117	3.882	1.719
-0.01558	2.401	0.4645	2.113	4.122	1.699
-0.0119	2.368	0.4985	2.104	4.372	1.678
-0.003683	2.371	0.5335	2.096	4.633	1.652
0.	2.38	0.5705	2.092	4.912	1.628
0.003683	2.362	0.6105	2.081	5.213	1.605
0.00735	2.355	0.6525	2.071	5.523	1.59
0.01582	2.349	0.6965	2.071	5.862	1.55
0.01953	2.344	0.7435	2.061	6.213	1.529

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.02323	2.335	0.7935	2.052	6.582	1.495
0.0285	2.372	0.8465	2.046	6.982	1.468
0.03668	2.321	0.9025	2.042	7.402	1.436
0.0435	2.304	0.9625	2.029	7.843	1.402
0.05523	2.301	1.023	2.023	8.313	1.369
0.0605	2.292	1.093	2.01	8.813	1.336
0.07527	2.276	1.163	2.005	9.342	1.304
0.0805	2.27	1.232	1.998	9.902	1.267
0.09568	2.262	1.313	1.984	10.5	1.229
0.1015	2.25	1.403	1.972	11.1	1.191
0.1135	2.236	1.482	1.962	11.8	1.154
0.1265	2.226	1.583	1.95	12.5	1.11
0.1395	2.215	1.683	1.944	13.2	1.078
0.1535	2.212	1.783	1.931	14.	1.032
0.1685	2.204	1.893	1.914	14.9	0.985
0.1845	2.195	2.013	1.903	15.7	0.943
0.2005	2.182	2.143	1.888	16.7	0.897
0.2185	2.177	2.273	1.877	17.7	0.854
0.2375	2.174	2.413	1.858	18.7	0.807
0.2575	2.165	2.563	1.846	19.8	0.76
0.2785	2.155	2.723	1.83		
0.3005	2.148	2.882	1.813		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	4.7E-5	cm/sec
Ss	0.004	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.01463 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	4.675E-5	2.299E-5	+/- 4.561E-5	2.034	cm/sec
Ss	0.004389	0.004059	+/- 0.008053	1.081	ft^{-1}
Kz/Kr	1.	19.63	+/- 38.94	0.05095	

C.I. is approximate 95% confidence interval for parameter

t-ratio = estimate/std. error
No estimation window

T = K*b = 0.01455 cm²/sec

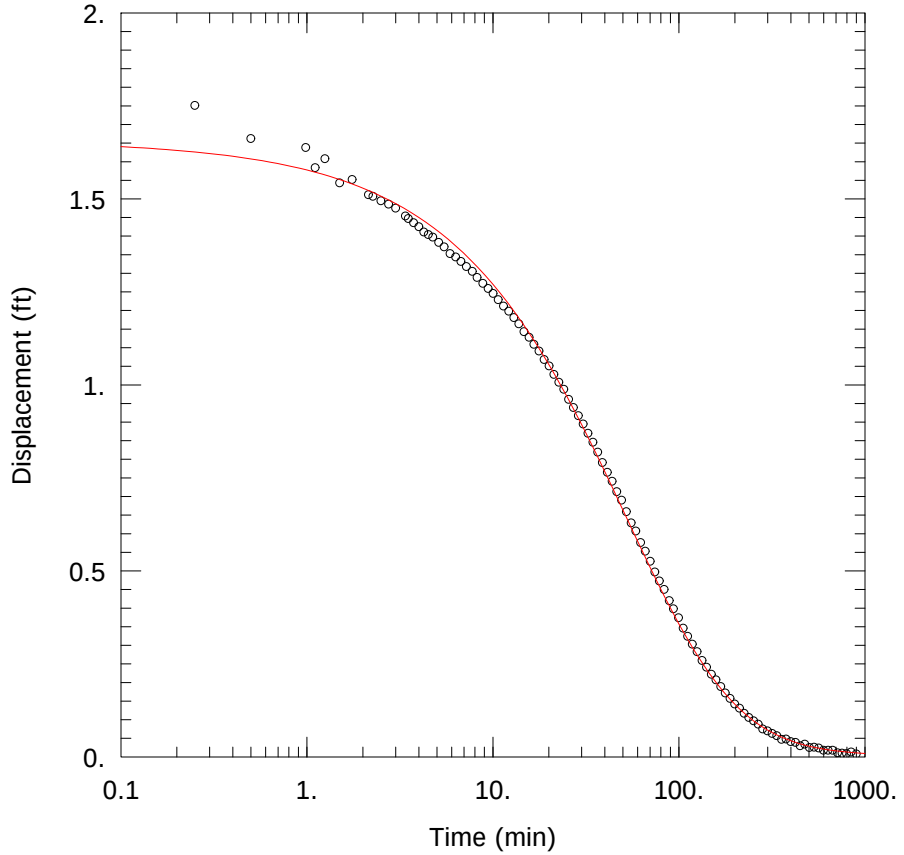
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.98
Ss	-0.99	1.00	0.95
Kz/Kr	-0.98	0.95	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.4068 ft^2
Variance . . . . . 0.004068 ft^2
Std. Deviation . . . . . 0.06378 ft
Mean. . . . . 0.009142 ft
No. of Residuals 103
No. of Estimates. 3



G110 @ CCR LANDFILL – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G110
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 2.0E-5 cm/sec
Ss = 0.0015 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 10.21 ft

WELL DATA (G110)

Initial Displacement: 1.66 ft
Total Well Penetration Depth: 10.21 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 10.21 ft
Screen Length: 4.54 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G110rh.aqt
Title: G110 @ CCR Landfill – Rising Head Test
Date: 11/18/16
Time: 11:56:09

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: G110

AQUIFER DATA

Saturated Thickness: 10.21 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G110

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.66 ft
Static Water Column Height: 10.21 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.54 ft
Total Well Penetration Depth: 10.21 ft

No. of Observations: 107

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	1.475	14.71	1.143	125.3	0.283
0.25	1.751	15.67	1.128	133.1	0.259
0.5	1.662	16.63	1.109	140.9	0.241
0.986	1.638	17.71	1.091	149.3	0.222
1.108	1.584	18.85	1.068	158.3	0.207
1.25	1.608	20.05	1.051	167.9	0.189
1.5	1.543	21.31	1.028	177.5	0.172
1.75	1.552	22.63	1.007	188.3	0.157
2.142	1.511	24.07	0.988	199.7	0.142
2.265	1.507	25.57	0.961	211.7	0.131
2.5	1.495	27.13	0.939	224.3	0.117
2.75	1.486	28.81	0.917	237.5	0.106
3.	1.475	30.61	0.895	251.9	0.097

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
3.386	1.454	32.47	0.87	266.9	0.088
3.509	1.447	34.51	0.846	282.5	0.075
3.75	1.436	36.61	0.819	299.3	0.07
4.	1.425	38.83	0.791	317.3	0.063
4.25	1.411	41.23	0.765	335.9	0.057
4.5	1.404	43.75	0.741	356.4	0.047
4.75	1.397	46.39	0.713	377.3	0.048
5.11	1.383	49.21	0.69	399.5	0.041
5.47	1.371	52.21	0.659	423.5	0.039
5.89	1.353	55.39	0.629	448.7	0.03
6.31	1.344	58.75	0.607	475.1	0.034
6.73	1.332	62.35	0.576	503.3	0.025
7.21	1.318	65.95	0.553	533.3	0.026
7.75	1.305	70.15	0.526	565.1	0.024
8.23	1.289	74.35	0.497	598.7	0.018
8.83	1.273	78.55	0.473	634.9	0.018
9.43	1.259	83.35	0.45	670.7	0.018
10.03	1.246	88.75	0.42	712.7	0.011
10.69	1.229	93.55	0.398	754.7	0.01
11.41	1.212	99.55	0.374	796.7	0.009
12.19	1.198	105.5	0.346	844.7	0.013
12.97	1.181	111.5	0.324	898.7	0.008
13.81	1.164	118.1	0.303		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	2.0E-5	cm/sec
Ss	0.0015	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.006224 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	1.835E-5	1.521E-6	+/- 3.015E-6	12.07	cm/sec
Ss	0.002304	0.0005947	+/- 0.001179	3.874	ft^{-1}
Kz/Kr	1.	1.446	+/- 2.867	0.6918	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.00571 cm²/sec

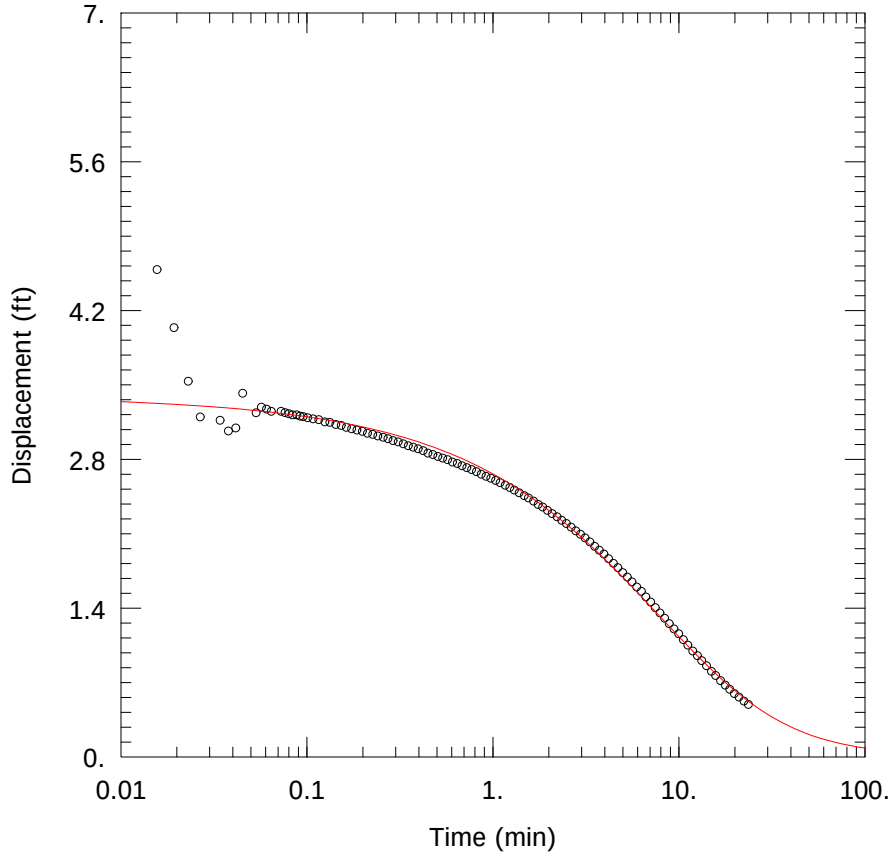
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.98	-0.95
Ss	-0.98	1.00	0.88
Kz/Kr	-0.95	0.88	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.074 ft^2
Variance . . . . . 0.0007115 ft^2
Std. Deviation . . . . . 0.02667 ft
Mean. . . . . -0.002906 ft
No. of Residuals 107
No. of Estimates. 3



G119 @ CCR LANDFILL – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G119
Test Date: 15 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 8.6E-5 cm/sec
Ss = 0.01 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 9.17 ft

WELL DATA (G119)

Initial Displacement: 3.4 ft
Total Well Penetration Depth: 9.17 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 9.17 ft
Screen Length: 4.58 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G119fh.aqt
Title: G119 @ CCR Landfill – Falling Head Test
Date: 11/18/16
Time: 11:57:05

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 15 Jun 2016
Test Well: G119

AQUIFER DATA

Saturated Thickness: 9.17 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G119

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 3.4 ft
Static Water Column Height: 9.17 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.58 ft
Total Well Penetration Depth: 9.17 ft

No. of Observations: 114

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	5.641	0.291	2.976	2.795	2.126
0.004167	6.01	0.31	2.963	2.955	2.094
0.008333	5.281	0.33	2.945	3.135	2.06
0.01565	4.584	0.351	2.927	3.325	2.023
0.01932	4.038	0.373	2.913	3.525	1.981
0.02303	3.534	0.397	2.899	3.735	1.944
0.02672	3.198	0.422	2.881	3.955	1.908
0.03417	3.166	0.448	2.858	4.195	1.864
0.03785	3.065	0.476	2.845	4.445	1.821
0.04152	3.094	0.506	2.826	4.705	1.78
0.0452	3.421	0.537	2.812	4.985	1.734
0.05333	3.237	0.571	2.796	5.285	1.691
0.05702	3.29	0.606	2.773	5.595	1.646

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.06068	3.272	0.643	2.76	5.935	1.598
0.0644	3.251	0.683	2.739	6.285	1.557
0.07275	3.251	0.725	2.721	6.655	1.504
0.07642	3.239	0.769	2.703	7.055	1.456
0.0801	3.228	0.816	2.683	7.475	1.404
0.08383	3.218	0.866	2.66	7.915	1.354
0.08827	3.217	0.919	2.64	8.385	1.305
0.09195	3.206	0.975	2.622	8.885	1.253
0.09563	3.201	1.035	2.601	9.415	1.203
0.101	3.19	1.095	2.579	9.975	1.158
0.108	3.18	1.165	2.556	10.57	1.103
0.116	3.172	1.235	2.534	11.18	1.051
0.125	3.151	1.305	2.51	11.88	0.996
0.133	3.147	1.385	2.484	12.57	0.952
0.143	3.128	1.475	2.458	13.28	0.906
0.153	3.119	1.555	2.437	14.07	0.858
0.163	3.101	1.655	2.406	14.98	0.805
0.174	3.087	1.755	2.375	15.78	0.765
0.186	3.075	1.855	2.35	16.77	0.718
0.199	3.063	1.965	2.319	17.77	0.675
0.212	3.045	2.085	2.289	18.77	0.636
0.226	3.034	2.215	2.259	19.88	0.595
0.241	3.019	2.345	2.226	21.07	0.563
0.257	3.007	2.485	2.195	22.38	0.524
0.273	2.993	2.635	2.161	23.68	0.493

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	8.6E-5	cm/sec
Ss	0.01	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.02404 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	8.635E-5	7.858E-5	+/- 0.0001557	1.099	cm/sec
Ss	0.01033	0.01841	+/- 0.03648	0.5609	ft^{-1}

Kz/Kr	0.03458	7.758	+/- 15.38	0.004457

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.02413 cm²/sec

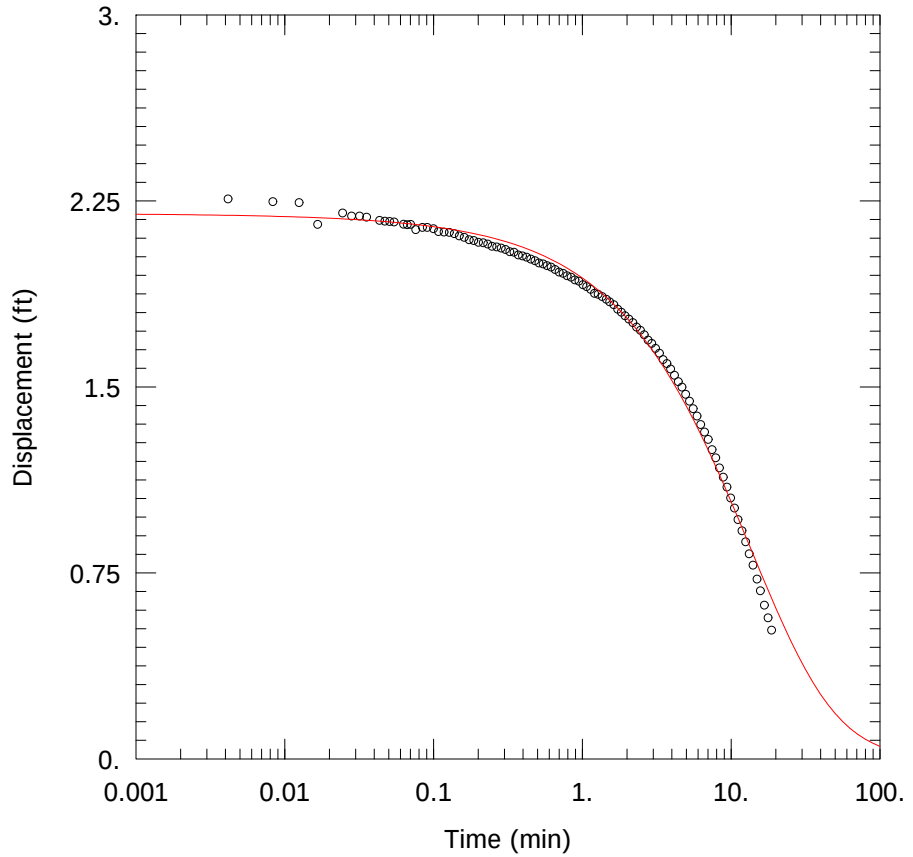
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.96
Ss	-0.99	1.00	0.91
Kz/Kr	-0.96	0.91	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 18.21 ft^2
Variance . . . . . 0.164 ft^2
Std. Deviation . . . . . 0.405 ft
Mean. . . . . 0.06266 ft
No. of Residuals 114
No. of Estimates. 3



G119 @CCR LANDFILL – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G119
Test Date: 15 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 8.2E-5 cm/sec
Ss = 0.001 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 9.17 ft

WELL DATA (G119)

Initial Displacement: 2.2 ft
Total Well Penetration Depth: 9.17 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 9.17 ft
Screen Length: 4.58 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G119rh.aqt
Title: G119 @CCR Landfill – Rising Head Test
Date: 11/28/16
Time: 10:28:38

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 15 Jun 2016
Test Well: G119

AQUIFER DATA

Saturated Thickness: 9.17 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G119

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.2 ft
Static Water Column Height: 9.17 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.58 ft
Total Well Penetration Depth: 9.17 ft

No. of Observations: 104

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.268	0.326	2.045	2.77	1.689
0.004167	2.258	0.348	2.043	2.93	1.675
0.008333	2.247	0.372	2.032	3.11	1.655
0.0125	2.243	0.397	2.028	3.3	1.636
0.01667	2.155	0.423	2.023	3.5	1.61
0.02452	2.201	0.451	2.015	3.71	1.594
0.0282	2.189	0.481	2.009	3.93	1.572
0.03187	2.189	0.512	2.	4.17	1.547
0.03555	2.184	0.546	1.996	4.42	1.521
0.04347	2.171	0.581	1.989	4.68	1.499
0.04715	2.168	0.618	1.983	4.96	1.47
0.05082	2.167	0.658	1.973	5.26	1.442
0.0545	2.165	0.7	1.963	5.57	1.412

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.06295	2.156	0.744	1.958	5.91	1.382
0.06663	2.154	0.791	1.948	6.26	1.348
0.07033	2.155	0.841	1.942	6.63	1.318
0.076	2.134	0.894	1.931	7.03	1.288
0.08445	2.143	0.95	1.926	7.45	1.247
0.091	2.143	1.01	1.912	7.89	1.214
0.1	2.138	1.07	1.904	8.36	1.173
0.108	2.126	1.14	1.893	8.86	1.136
0.118	2.124	1.21	1.877	9.39	1.096
0.128	2.123	1.28	1.873	9.95	1.052
0.138	2.118	1.36	1.864	10.55	1.011
0.149	2.109	1.45	1.853	11.15	0.965
0.161	2.103	1.53	1.843	11.85	0.92
0.174	2.093	1.63	1.831	12.55	0.875
0.187	2.09	1.73	1.813	13.25	0.827
0.201	2.083	1.83	1.801	14.05	0.781
0.216	2.081	1.94	1.787	14.95	0.725
0.232	2.076	2.06	1.773	15.75	0.678
0.248	2.067	2.19	1.759	16.75	0.62
0.266	2.064	2.32	1.741	17.75	0.569
0.285	2.06	2.46	1.728	18.75	0.519
0.305	2.054	2.61	1.71		

SOLUTION

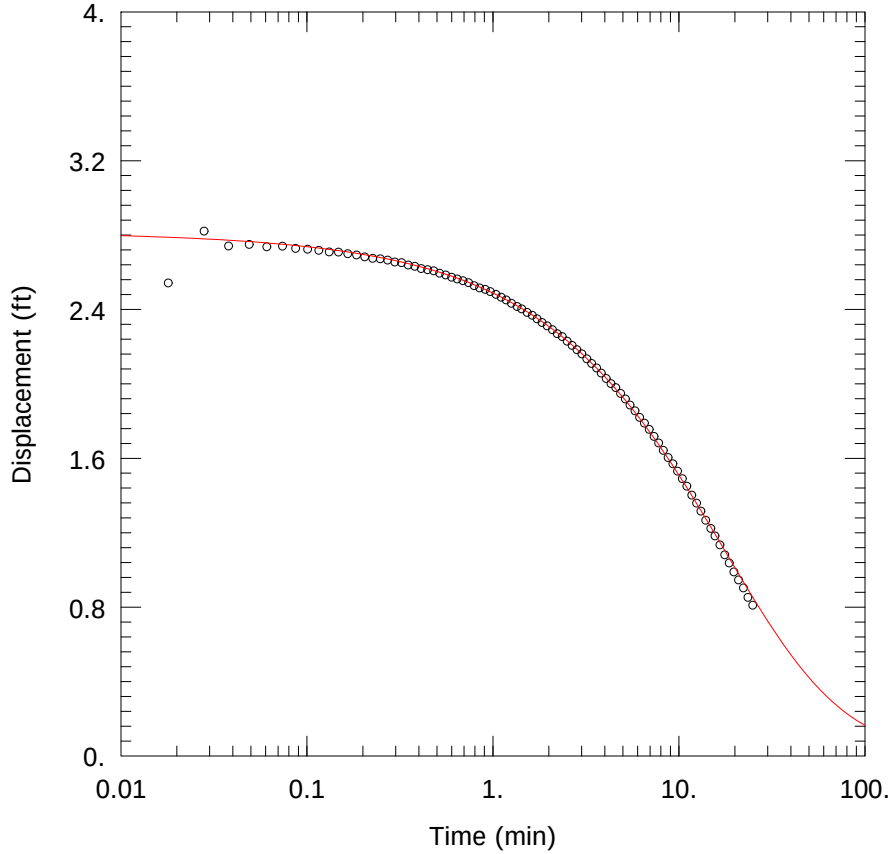
Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	8.2E-5	cm/sec
Ss	0.001	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.02292 cm^2/sec



G125 @ CCR LANDFILL – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G125
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 4.8E-5 cm/sec
Ss = 0.004 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 8.72 ft

WELL DATA (G125)

Initial Displacement: 2.82 ft
Total Well Penetration Depth: 8.67 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 8.72 ft
Screen Length: 4.53 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G125fh.aqt
Title: G125 @ CCR Landfill – Falling Head Test
Date: 11/28/16
Time: 09:18:08

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: G125

AQUIFER DATA

Saturated Thickness: 8.72 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G125

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.82 ft
Static Water Column Height: 8.72 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.53 ft
Total Well Penetration Depth: 8.67 ft

No. of Observations: 90

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	1.869	0.691	2.554	4.58	1.98
0.008	3.276	0.741	2.544	4.86	1.949
0.018	2.542	0.794	2.528	5.16	1.919
0.02802	2.821	0.85	2.516	5.47	1.886
0.038	2.741	0.91	2.508	5.81	1.855
0.049	2.75	0.97	2.496	6.16	1.82
0.061	2.737	1.04	2.481	6.53	1.789
0.074	2.74	1.11	2.466	6.93	1.755
0.087	2.728	1.18	2.451	7.35	1.717
0.101	2.724	1.26	2.433	7.79	1.682
0.116	2.718	1.35	2.416	8.26	1.643
0.132	2.709	1.43	2.403	8.76	1.604
0.148	2.708	1.53	2.384	9.29	1.57

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.166	2.7	1.63	2.369	9.85	1.531
0.185	2.693	1.73	2.35	10.45	1.49
0.205	2.683	1.84	2.33	11.05	1.45
0.226	2.675	1.96	2.312	11.75	1.402
0.248	2.672	2.09	2.291	12.45	1.359
0.272	2.665	2.22	2.27	13.15	1.316
0.297	2.655	2.36	2.254	13.95	1.267
0.323	2.652	2.51	2.229	14.85	1.223
0.351	2.639	2.67	2.207	15.65	1.182
0.381	2.632	2.83	2.184	16.65	1.134
0.412	2.62	3.01	2.161	17.65	1.081
0.446	2.614	3.2	2.135	18.65	1.037
0.481	2.608	3.4	2.11	19.75	0.989
0.518	2.595	3.61	2.086	20.95	0.946
0.558	2.585	3.83	2.058	22.25	0.903
0.6	2.573	4.07	2.029	23.55	0.852
0.644	2.564	4.32	2.001	24.95	0.81

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	4.8E-5	cm/sec
Ss	0.004	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.01276 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	4.918E-5	3.398E-5	+/- 6.756E-5	1.447	cm/sec
Ss	0.003764	0.005048	+/- 0.01004	0.7457	ft^{-1}
Kz/Kr	1.	23.17	+/- 46.07	0.04315	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.01307 cm²/sec

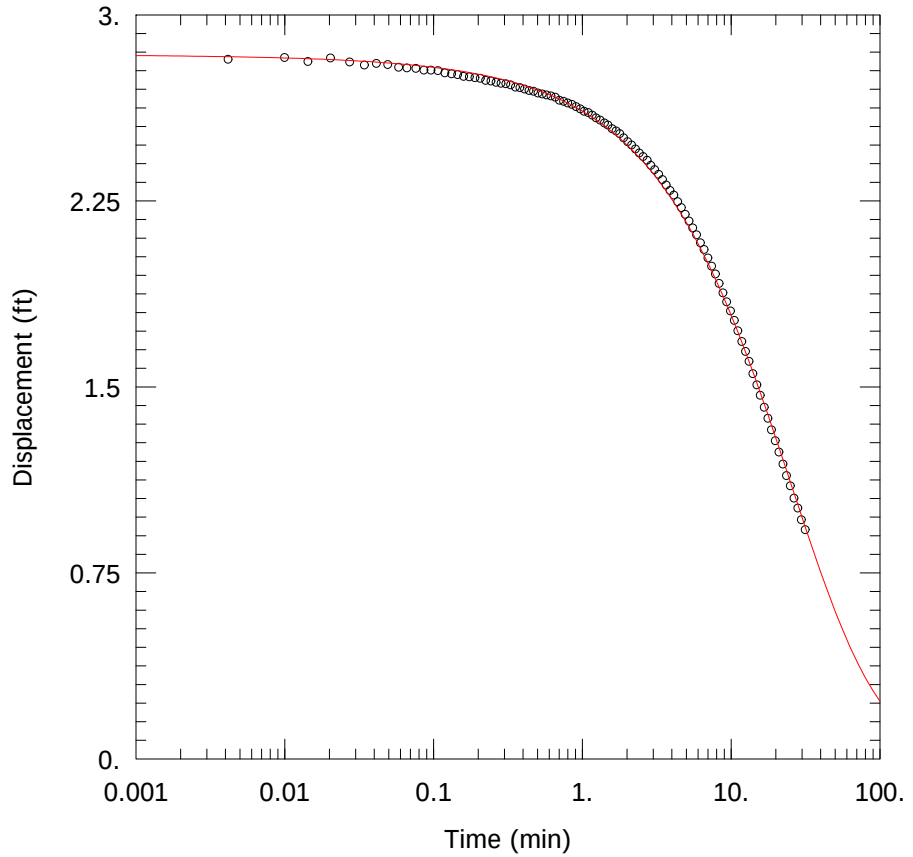
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.99
Ss	-0.99	1.00	0.95
Kz/Kr	-0.99	0.95	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 1.205 ft^2
Variance . . . . . 0.01385 ft^2
Std. Deviation . . . . . 0.1177 ft
Mean. . . . . -0.01063 ft
No. of Residuals 90
No. of Estimates. 3



G125 @CCR LANDFILL – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G125
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 4.1E-5 cm/sec
Ss = 0.0015 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 8.72 ft

WELL DATA (G125)

Initial Displacement: 2.84 ft
Total Well Penetration Depth: 8.72 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 8.72 ft
Screen Length: 4.53 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G125rh.aqt
Title: G125 @CCR Landfill – Rising Head Test
Date: 11/28/16
Time: 09:18:43

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: G125

AQUIFER DATA

Saturated Thickness: 8.72 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G125

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.84 ft
Static Water Column Height: 8.72 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.53 ft
Total Well Penetration Depth: 8.72 ft

No. of Observations: 113

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
-0.04167	2.799	0.3553	2.709	3.888	2.292
-0.0375	2.992	0.3813	2.707	4.128	2.273
-0.03098	2.871	0.4093	2.701	4.378	2.247
-0.02893	2.922	0.4393	2.695	4.638	2.223
-0.025	2.865	0.4703	2.692	4.918	2.196
-0.02083	2.851	0.5043	2.685	5.218	2.169
-0.01667	2.867	0.5393	2.681	5.528	2.141
-0.009933	2.861	0.5763	2.677	5.868	2.113
-0.007867	2.868	0.6163	2.673	6.218	2.081
-0.004167	2.838	0.6583	2.668	6.588	2.054
0.	2.846	0.7023	2.656	6.988	2.02
0.004167	2.821	0.7493	2.651	7.408	1.987
0.009984	2.828	0.7993	2.645	7.848	1.955

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.01433	2.812	0.8523	2.639	8.318	1.917
0.02033	2.826	0.9083	2.63	8.818	1.879
0.02733	2.81	0.9683	2.621	9.348	1.843
0.03433	2.798	1.028	2.611	9.908	1.806
0.04133	2.804	1.098	2.606	10.51	1.768
0.04933	2.8	1.168	2.596	11.11	1.726
0.05833	2.789	1.238	2.585	11.81	1.683
0.06633	2.786	1.318	2.576	12.51	1.643
0.07633	2.784	1.409	2.564	13.21	1.603
0.08633	2.777	1.488	2.556	14.01	1.553
0.09633	2.777	1.588	2.541	14.91	1.508
0.1073	2.775	1.688	2.532	15.71	1.466
0.1193	2.766	1.788	2.521	16.71	1.418
0.1323	2.762	1.898	2.504	17.71	1.373
0.1453	2.759	2.018	2.489	18.71	1.327
0.1593	2.752	2.148	2.475	19.81	1.283
0.1743	2.75	2.278	2.459	21.01	1.237
0.1903	2.747	2.418	2.443	22.31	1.189
0.2063	2.744	2.568	2.429	23.61	1.142
0.2243	2.736	2.728	2.414	25.01	1.101
0.2433	2.733	2.888	2.393	26.51	1.051
0.2633	2.728	3.068	2.376	28.11	1.011
0.2843	2.724	3.258	2.357	29.71	0.964
0.3063	2.722	3.458	2.336	31.51	0.924
0.3303	2.718	3.668	2.314		

SOLUTION

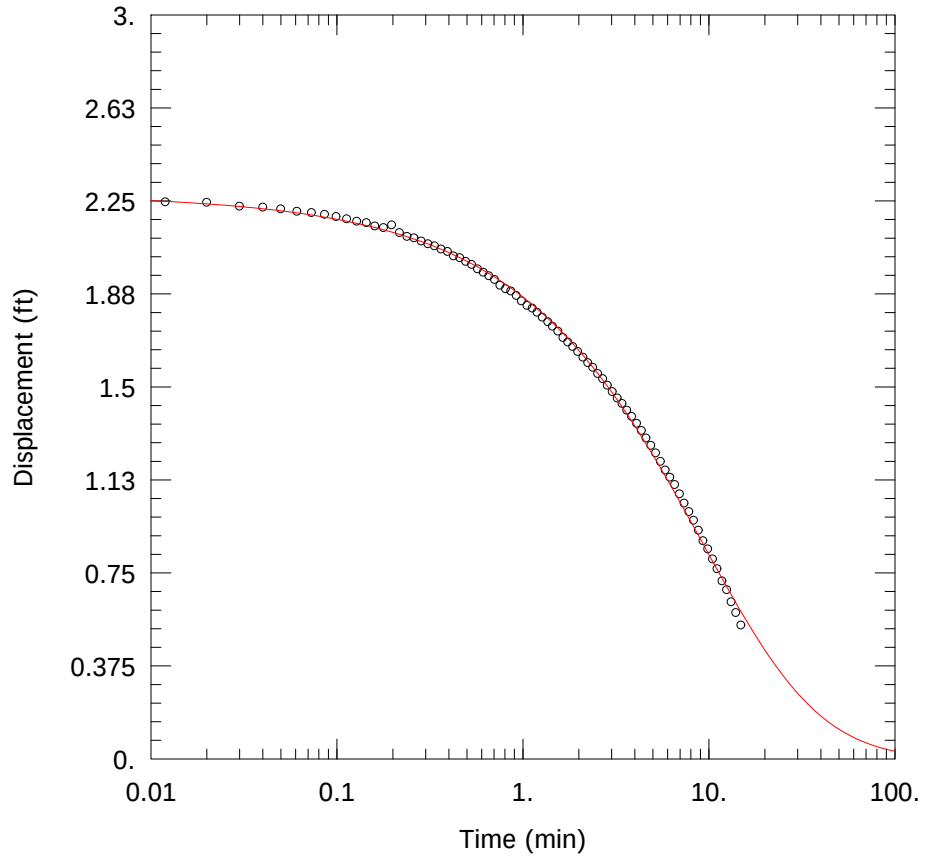
Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	4.1E-5	cm/sec
Ss	0.0015	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.0109 cm^2/sec



G153 @ SW DETENTION POND – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G153
Test Date: 16 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.00025 cm/sec
Ss = 0.015 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 3. ft

WELL DATA (G153)

Initial Displacement: 2.28 ft
Total Well Penetration Depth: 11.78 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 11.78 ft
Screen Length: 4.44 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G153fh.aqt
Title: G153 @ SW Detention Pond – Falling Head Test
Date: 11/28/16
Time: 09:19:16

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 16 Jun 2016
Test Well: G153

AQUIFER DATA

Saturated Thickness: 3. ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G153

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.28 ft
Static Water Column Height: 11.78 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.44 ft
Total Well Penetration Depth: 11.78 ft

No. of Observations: 83

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.241	0.5299	1.994	3.212	1.455
0.0037	2.266	0.5699	1.976	3.412	1.433
0.01193	2.246	0.6119	1.962	3.622	1.406
0.01993	2.244	0.656	1.948	3.842	1.381
0.02993	2.229	0.7029	1.933	4.082	1.353
0.03995	2.225	0.7529	1.91	4.332	1.324
0.04993	2.218	0.806	1.896	4.592	1.294
0.06093	2.208	0.8619	1.887	4.872	1.264
0.07293	2.203	0.9219	1.869	5.172	1.234
0.08593	2.196	0.9819	1.847	5.482	1.2
0.09893	2.187	1.052	1.829	5.822	1.165
0.1129	2.178	1.122	1.818	6.172	1.136
0.128	2.168	1.192	1.801	6.542	1.106

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.1439	2.162	1.272	1.781	6.942	1.069
0.16	2.149	1.362	1.763	7.362	1.031
0.178	2.142	1.442	1.745	7.802	0.997
0.1969	2.153	1.542	1.725	8.272	0.962
0.2169	2.122	1.642	1.699	8.772	0.922
0.2379	2.107	1.742	1.681	9.302	0.88
0.2599	2.101	1.852	1.663	9.862	0.847
0.2839	2.088	1.972	1.643	10.46	0.806
0.309	2.077	2.102	1.62	11.06	0.767
0.335	2.069	2.232	1.598	11.76	0.718
0.3629	2.056	2.372	1.579	12.46	0.682
0.3929	2.046	2.522	1.554	13.16	0.633
0.4239	2.028	2.682	1.533	13.96	0.59
0.458	2.021	2.842	1.507	14.86	0.54
0.4929	2.006	3.022	1.481		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00025	cm/sec
Ss	0.015	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.02286 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0002498	2.214E-5	+/- 4.406E-5	11.28	cm/sec
Ss	0.0138	0.002624	+/- 0.005222	5.259	ft^{-1}
Kz/Kr	1.	1.248	+/- 2.484	0.801	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.02284 cm²/sec

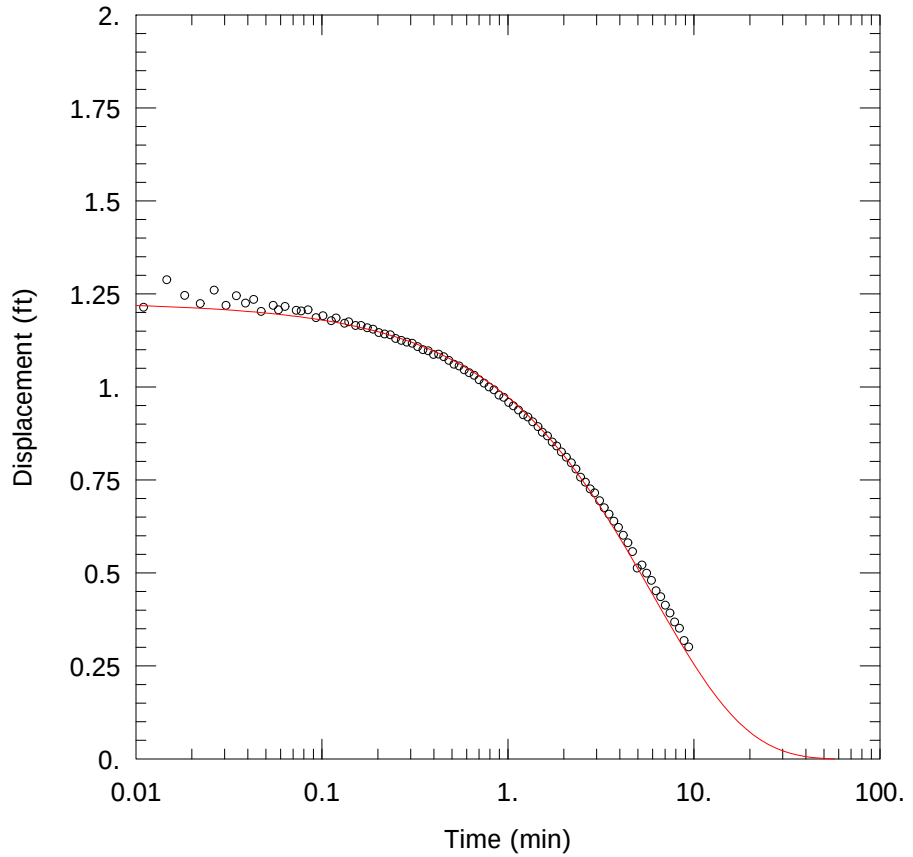
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.98
Ss	-0.99	1.00	0.95
Kz/Kr	-0.98	0.95	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.02333 ft^2
Variance . . . . . 0.0002916 ft^2
Std. Deviation . . . . . 0.01708 ft
Mean. . . . . 0.0007214 ft
No. of Residuals 83
No. of Estimates. 3



G153 @ SW DETENTION POND – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G153
Test Date: 16 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.00054 cm/sec
Ss = 0.0025 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 3. ft

WELL DATA (G153)

Initial Displacement: 1.23 ft
Total Well Penetration Depth: 11.78 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 11.78 ft
Screen Length: 4.44 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G153rh.aqt
Title: G153 @ SW Detention Pond – Rising Head Test
Date: 11/28/16
Time: 09:19:48

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 16 Jun 2016
Test Well: G153

AQUIFER DATA

Saturated Thickness: 3. ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G153

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.23 ft
Static Water Column Height: 11.78 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.44 ft
Total Well Penetration Depth: 11.78 ft

No. of Observations: 93

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	1.222	0.2334	1.14	1.631	0.868
0.003666	1.261	0.2494	1.13	1.731	0.852
0.007333	1.285	0.2674	1.125	1.831	0.841
0.011	1.214	0.2864	1.12	1.941	0.825
0.01467	1.288	0.3064	1.117	2.061	0.811
0.01832	1.246	0.3274	1.108	2.191	0.796
0.02222	1.224	0.3494	1.1	2.321	0.779
0.02638	1.26	0.3734	1.097	2.461	0.757
0.03055	1.219	0.3984	1.087	2.611	0.744
0.03472	1.245	0.4244	1.088	2.771	0.726
0.03888	1.225	0.4524	1.081	2.931	0.715
0.04305	1.235	0.4824	1.071	3.111	0.694
0.04722	1.203	0.5134	1.061	3.301	0.675

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.05473	1.219	0.5474	1.056	3.503	0.658
0.05843	1.207	0.5824	1.046	3.711	0.639
0.06338	1.216	0.6194	1.038	3.931	0.622
0.0728	1.206	0.6594	1.031	4.171	0.601
0.07738	1.204	0.7014	1.019	4.421	0.581
0.08438	1.207	0.7454	1.01	4.681	0.557
0.09303	1.186	0.7924	1.	4.961	0.513
0.1014	1.191	0.8424	0.992	5.261	0.521
0.1124	1.178	0.8954	0.978	5.571	0.499
0.1194	1.185	0.9514	0.972	5.911	0.48
0.1325	1.171	1.011	0.958	6.261	0.452
0.1394	1.175	1.071	0.949	6.631	0.436
0.1518	1.165	1.141	0.938	7.031	0.413
0.1626	1.165	1.211	0.925	7.451	0.392
0.1754	1.159	1.281	0.919	7.891	0.368
0.1884	1.155	1.361	0.906	8.361	0.351
0.2024	1.146	1.451	0.893	8.861	0.318
0.2174	1.142	1.531	0.878	9.391	0.301

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00054	cm/sec
Ss	0.0025	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.04938 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0005399	9.804E-5	+/- 0.0001948	5.507	cm/sec
Ss	0.00256	0.001483	+/- 0.002947	1.726	ft^{-1}
Kz/Kr	1.	1.411	+/- 2.803	0.7089	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.04937 cm²/sec

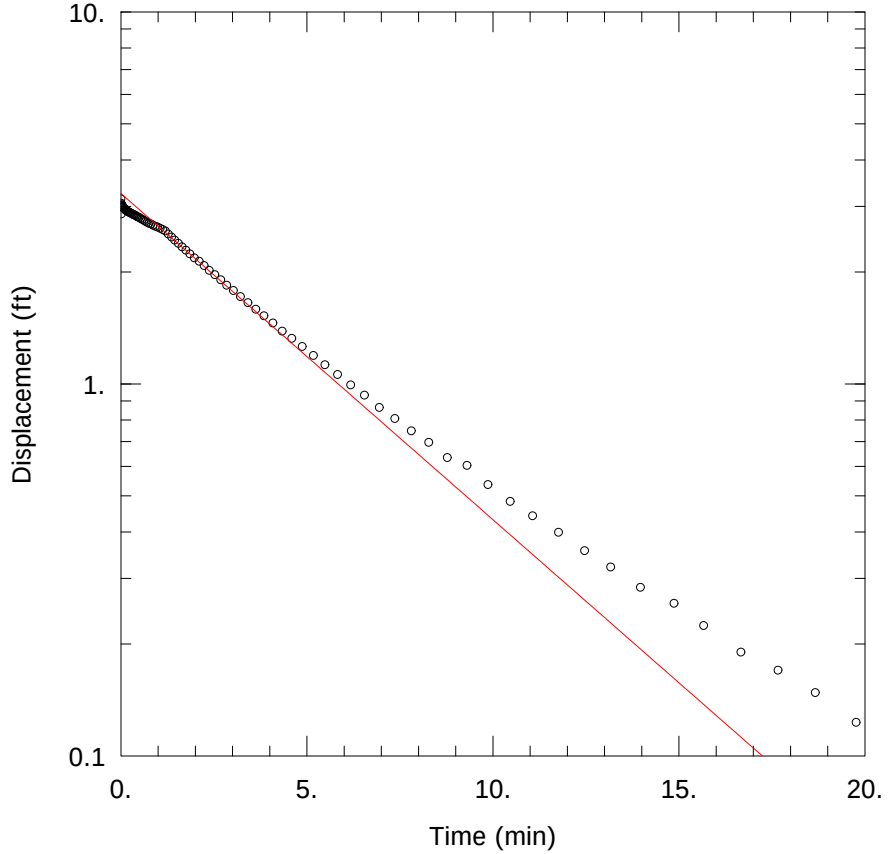
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.99
Ss	-0.99	1.00	0.97
Kz/Kr	-0.99	0.97	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.0362 ft^2
Variance . . . . . 0.0004022 ft^2
Std. Deviation . . . . . 0.02005 ft
Mean. . . . . -0.005578 ft
No. of Residuals 93
No. of Estimates. 3



G206 @ GMF GYPSUM POND – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G206
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.0003 cm/sec
y0 = 3.25 ft

AQUIFER DATA

Saturated Thickness: 13.15 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (G206)

Initial Displacement: 3.01 ft
Total Well Penetration Depth: 13.15 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 13.15 ft
Screen Length: 4.41 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G206fh.aqt
Title: G206 @ GMF Gypsum Pond – Falling Head Test
Date: 11/28/16
Time: 10:38:25

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: G206

AQUIFER DATA

Saturated Thickness: 13.15 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G206

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 3.01 ft
Static Water Column Height: 13.15 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.41 ft
Total Well Penetration Depth: 13.15 ft

No. of Observations: 89

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	3.143	0.617	2.752	4.087	1.458
0.008	3.062	0.661	2.737	4.337	1.386
0.017	2.865	0.708	2.718	4.597	1.325
0.025	3.029	0.758	2.701	4.877	1.26
0.035	3.023	0.811	2.69	5.177	1.192
0.045	2.995	0.867	2.669	5.487	1.126
0.055	2.986	0.927	2.655	5.827	1.06
0.066	2.978	0.987	2.64	6.177	0.994
0.078	2.97	1.057	2.619	6.547	0.933
0.091	2.963	1.127	2.599	6.947	0.864
0.104	2.95	1.197	2.576	7.367	0.807
0.118	2.941	1.277	2.527	7.807	0.748
0.133	2.926	1.367	2.48	8.277	0.696

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.149	2.927	1.447	2.434	8.777	0.634
0.165	2.92	1.547	2.388	9.307	0.604
0.183	2.906	1.647	2.336	9.867	0.536
0.202	2.901	1.747	2.288	10.47	0.483
0.222	2.895	1.857	2.236	11.07	0.442
0.243	2.887	1.977	2.182	11.77	0.399
0.265	2.878	2.107	2.136	12.47	0.356
0.289	2.874	2.237	2.081	13.17	0.322
0.314	2.859	2.377	2.019	13.97	0.284
0.34	2.849	2.527	1.965	14.87	0.257
0.368	2.846	2.687	1.905	15.67	0.224
0.398	2.836	2.847	1.841	16.67	0.19
0.429	2.819	3.027	1.782	17.67	0.17
0.463	2.81	3.217	1.717	18.67	0.148
0.498	2.8	3.417	1.653	19.77	0.123
0.535	2.784	3.627	1.588	20.97	0.112
0.575	2.77	3.847	1.524		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.715

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.0003	cm/sec
y0	3.25	ft

T = K*b = 0.1202 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
K	0.0002598	2.211E-6	+/- 4.395E-6	117.5	cm/sec
y0	3.047	0.007694	+/- 0.0153	396.	ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.1041 cm²/sec

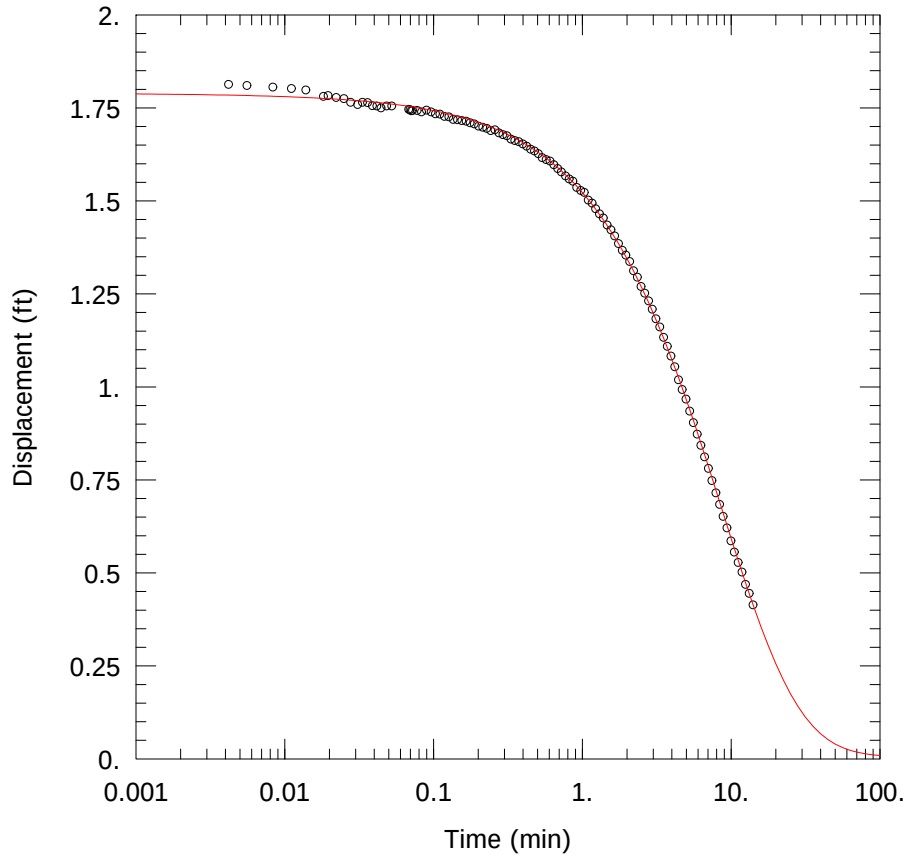
Parameter Correlations

	K	y0
K	1.00	0.55
y0	0.55	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.168 ft^2
Variance . . . . . 0.001931 ft^2
Std. Deviation . . . . . 0.04394 ft
Mean. . . . . 0.0007809 ft
No. of Residuals 89
No. of Estimates. 2



G206 @ GMF GYPSUM POND – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G206
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00016 cm/sec
Ss = 0.0003 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 13.15 ft

WELL DATA (G206)

Initial Displacement: 1.79 ft
Total Well Penetration Depth: 13.15 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 13.15 ft
Screen Length: 4.41 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G206rh.aqt
Title: G206 @ GMF Gypsum Pond – Rising Head Test
Date: 11/28/16
Time: 09:20:24

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: G206

AQUIFER DATA

Saturated Thickness: 13.15 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G206

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.79 ft
Static Water Column Height: 13.15 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.41 ft
Total Well Penetration Depth: 13.15 ft

No. of Observations: 110

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	1.857	0.2011	1.701	1.858	1.367
0.0042	1.813	0.2144	1.698	1.964	1.354
0.005578	1.81	0.2284	1.695	2.084	1.337
0.008333	1.806	0.2431	1.689	2.211	1.312
0.01111	1.802	0.2591	1.691	2.344	1.295
0.01389	1.798	0.2758	1.683	2.484	1.27
0.01823	1.781	0.2931	1.678	2.631	1.252
0.0196	1.783	0.3118	1.675	2.791	1.231
0.02222	1.778	0.3318	1.666	2.958	1.209
0.025	1.775	0.3524	1.662	3.131	1.183
0.02778	1.765	0.3751	1.659	3.318	1.161
0.03093	1.759	0.3984	1.653	3.518	1.133
0.03333	1.765	0.4231	1.647	3.724	1.109

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.03611	1.764	0.4498	1.639	3.951	1.083
0.03889	1.756	0.4778	1.634	4.184	1.054
0.04167	1.755	0.5071	1.627	4.431	1.019
0.04444	1.75	0.5384	1.616	4.698	0.993
0.04843	1.755	0.5718	1.611	4.978	0.967
0.05244	1.755	0.6071	1.607	5.271	0.935
0.06822	1.746	0.6444	1.597	5.584	0.904
0.0696	1.745	0.6844	1.587	5.918	0.873
0.07099	1.742	0.7244	1.578	6.271	0.843
0.07236	1.743	0.7711	1.567	6.644	0.812
0.07777	1.743	0.8178	1.559	7.044	0.781
0.0831	1.739	0.8644	1.553	7.444	0.748
0.08977	1.744	0.9178	1.536	7.911	0.715
0.09644	1.739	0.9778	1.528	8.378	0.684
0.1031	1.734	1.031	1.523	8.844	0.652
0.1104	1.733	1.098	1.502	9.378	0.621
0.1184	1.727	1.164	1.494	9.978	0.586
0.1271	1.726	1.231	1.479	10.51	0.556
0.1358	1.719	1.304	1.465	11.18	0.528
0.1451	1.718	1.384	1.454	11.84	0.502
0.1551	1.716	1.471	1.435	12.51	0.469
0.1658	1.714	1.558	1.422	13.24	0.445
0.1764	1.71	1.651	1.406	14.04	0.414
0.1884	1.707	1.751	1.385		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00016	cm/sec
Ss	0.0003	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.06413 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0001598	1.133E-5	+/- 2.245E-5	14.1	cm/sec
Ss	0.0003168	8.69E-5	+/- 0.0001722	3.645	ft^{-1}
Kz/Kr	1.	0.8787	+/- 1.742	1.138	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.06404 cm²/sec

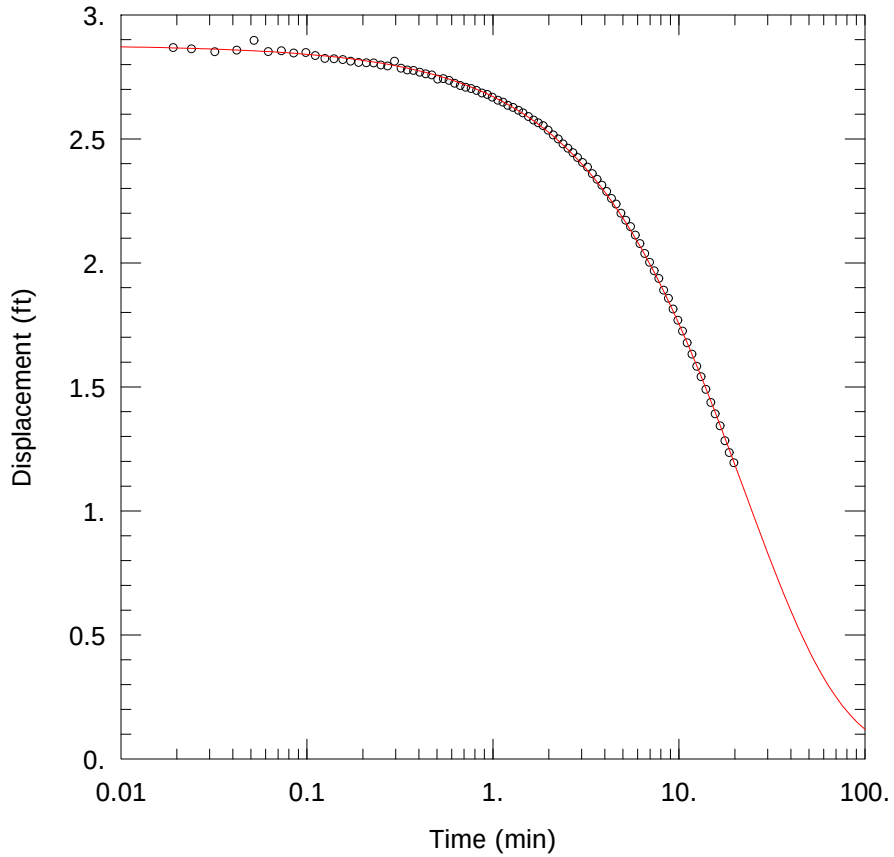
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.99
Ss	-0.99	1.00	0.96
Kz/Kr	-0.99	0.96	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.01105 ft^2
Variance . . . . . 0.0001033 ft^2
Std. Deviation . . . . . 0.01016 ft
Mean. . . . . -7.742E-5 ft
No. of Residuals 110
No. of Estimates. 3



G208 @ GMF GYPSUM POND – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G208
Test Date: 16 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 6.0E-5 cm/sec
Ss = 0.0003 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 18.08 ft

WELL DATA (G208)

Initial Displacement: 2.88 ft
Total Well Penetration Depth: 18.08 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 18.08 ft
Screen Length: 4.53 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G208fh.aqt
Title: G208 @ GMF Gypsum Pond – Falling Head Test
Date: 11/28/16
Time: 09:21:07

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 16 Jun 2016
Test Well: G208

AQUIFER DATA

Saturated Thickness: 18.08 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G208

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.88 ft
Static Water Column Height: 18.08 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.53 ft
Total Well Penetration Depth: 18.08 ft

No. of Observations: 89

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.84	0.582	2.736	3.854	2.313
0.007	2.857	0.624	2.724	4.095	2.288
0.01912	2.868	0.668	2.715	4.344	2.26
0.024	2.863	0.715	2.708	4.604	2.237
0.032	2.851	0.765	2.703	4.884	2.2
0.042	2.858	0.818	2.695	5.184	2.172
0.052	2.897	0.874	2.685	5.494	2.146
0.062	2.852	0.934	2.679	5.834	2.112
0.073	2.855	0.994	2.668	6.184	2.078
0.085	2.846	1.064	2.656	6.554	2.038
0.09877	2.848	1.134	2.648	6.954	2.002
0.111	2.836	1.204	2.635	7.374	1.968
0.125	2.824	1.284	2.627	7.814	1.937

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.14	2.823	1.374	2.615	8.284	1.89
0.156	2.82	1.454	2.605	8.784	1.857
0.172	2.813	1.554	2.59	9.314	1.814
0.19	2.808	1.654	2.576	9.874	1.769
0.209	2.807	1.754	2.565	10.47	1.725
0.229	2.806	1.864	2.553	11.07	1.678
0.25	2.798	1.984	2.535	11.77	1.632
0.272	2.794	2.114	2.516	12.47	1.583
0.296	2.813	2.244	2.5	13.18	1.541
0.321	2.785	2.384	2.48	13.97	1.49
0.347	2.778	2.534	2.462	14.87	1.437
0.375	2.776	2.694	2.444	15.68	1.391
0.405	2.769	2.854	2.425	16.67	1.343
0.436	2.762	3.034	2.405	17.67	1.283
0.47	2.758	3.224	2.386	18.67	1.235
0.505	2.741	3.424	2.36	19.77	1.194
0.542	2.743	3.634	2.337		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	6.0E-5	cm/sec
Ss	0.0003	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.03306 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	6.04E-5	4.084E-6	+/- 8.118E-6	14.79	cm/sec
Ss	0.0002752	6.697E-5	+/- 0.0001331	4.109	ft^{-1}
Kz/Kr	1.	0.9578	+/- 1.904	1.044	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.03329 cm²/sec

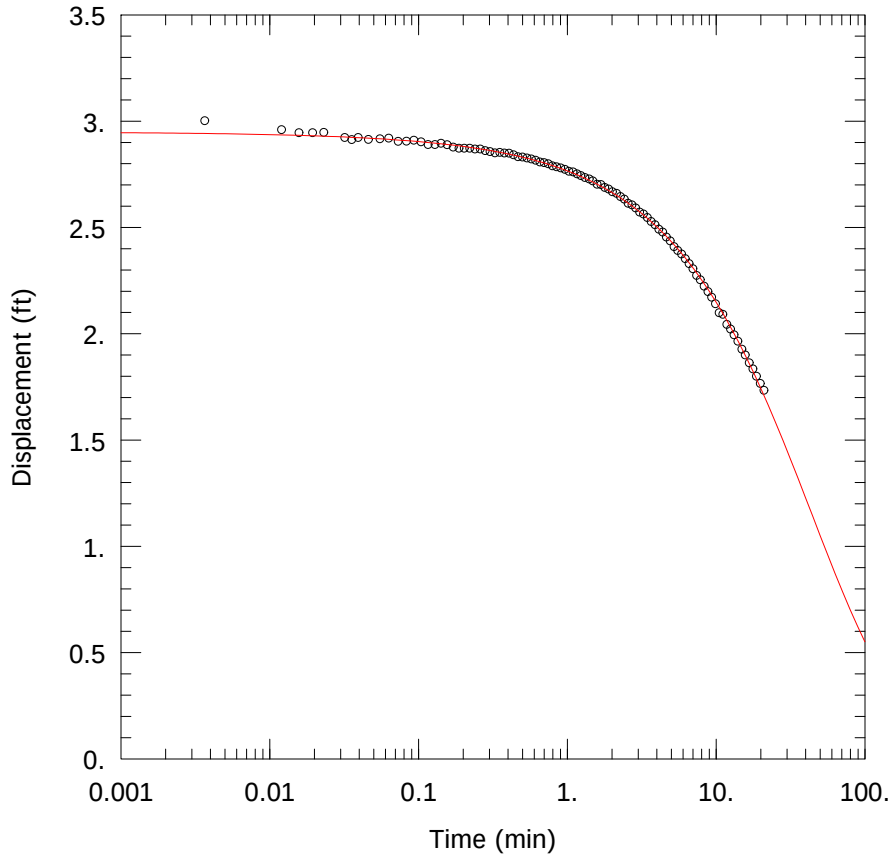
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.99
Ss	-0.99	1.00	0.96
Kz/Kr	-0.99	0.96	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.007952 ft^2
Variance . . . . . 9.246E-5 ft^2
Std. Deviation . . . . . 0.009616 ft
Mean. . . . . -0.001847 ft
No. of Residuals 89
No. of Estimates. 3



G208 @ GMF GYPSUM POND – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G208
Test Date: 16 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 2.1E-5 cm/sec
Ss = 0.0028 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 18.08 ft

WELL DATA (G208)

Initial Displacement: 2.95 ft
Total Well Penetration Depth: 18.08 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 18.08 ft
Screen Length: 4.53 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G208rh.aqt
Title: G208 @ GMF Gypsum Pond – Rising Head Test
Date: 11/28/16
Time: 09:21:28

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 16 Jun 2016
Test Well: G208

AQUIFER DATA

Saturated Thickness: 18.08 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G208

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.95 ft
Static Water Column Height: 18.08 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.53 ft
Total Well Penetration Depth: 18.08 ft

No. of Observations: 97

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	3.003	0.4671	2.833	3.665	2.528
0.003667	3.002	0.5011	2.831	3.885	2.513
0.01203	2.96	0.5361	2.827	4.125	2.492
0.01573	2.946	0.5731	2.822	4.375	2.478
0.01943	2.946	0.6131	2.816	4.635	2.455
0.02312	2.947	0.6551	2.808	4.915	2.437
0.03195	2.923	0.6991	2.805	5.215	2.41
0.03565	2.913	0.7461	2.8	5.525	2.392
0.03937	2.923	0.7961	2.79	5.865	2.375
0.04613	2.914	0.8491	2.785	6.215	2.353
0.05507	2.917	0.9051	2.78	6.585	2.33
0.06312	2.92	0.9651	2.773	6.985	2.306
0.07312	2.905	1.025	2.764	7.405	2.274

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.08313	2.906	1.095	2.761	7.845	2.254
0.09312	2.91	1.165	2.752	8.315	2.224
0.1041	2.903	1.235	2.744	8.815	2.198
0.1161	2.89	1.315	2.735	9.345	2.172
0.1291	2.89	1.405	2.728	9.905	2.141
0.1421	2.896	1.485	2.719	10.51	2.099
0.1561	2.889	1.585	2.703	11.11	2.091
0.1711	2.878	1.685	2.702	11.81	2.044
0.1871	2.873	1.785	2.688	12.51	2.022
0.2031	2.873	1.895	2.681	13.21	1.995
0.2211	2.873	2.015	2.668	14.01	1.965
0.2401	2.869	2.145	2.66	14.91	1.927
0.2601	2.869	2.275	2.645	15.71	1.9
0.2811	2.861	2.416	2.633	16.71	1.863
0.3031	2.857	2.565	2.614	17.71	1.835
0.3271	2.851	2.725	2.606	18.71	1.8
0.3521	2.853	2.885	2.592	19.81	1.766
0.3781	2.85	3.065	2.572	21.01	1.734
0.4061	2.849	3.255	2.563		
0.4361	2.842	3.455	2.547		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	2.1E-5	cm/sec
Ss	0.0028	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.01157 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	2.111E-5	2.793E-6	+/- 5.544E-6	7.557	cm/sec
Ss	0.002783	0.000655	+/- 0.0013	4.25	ft^{-1}
Kz/Kr	1.	5.786	+/- 11.48	0.1728	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.01163 cm²/sec

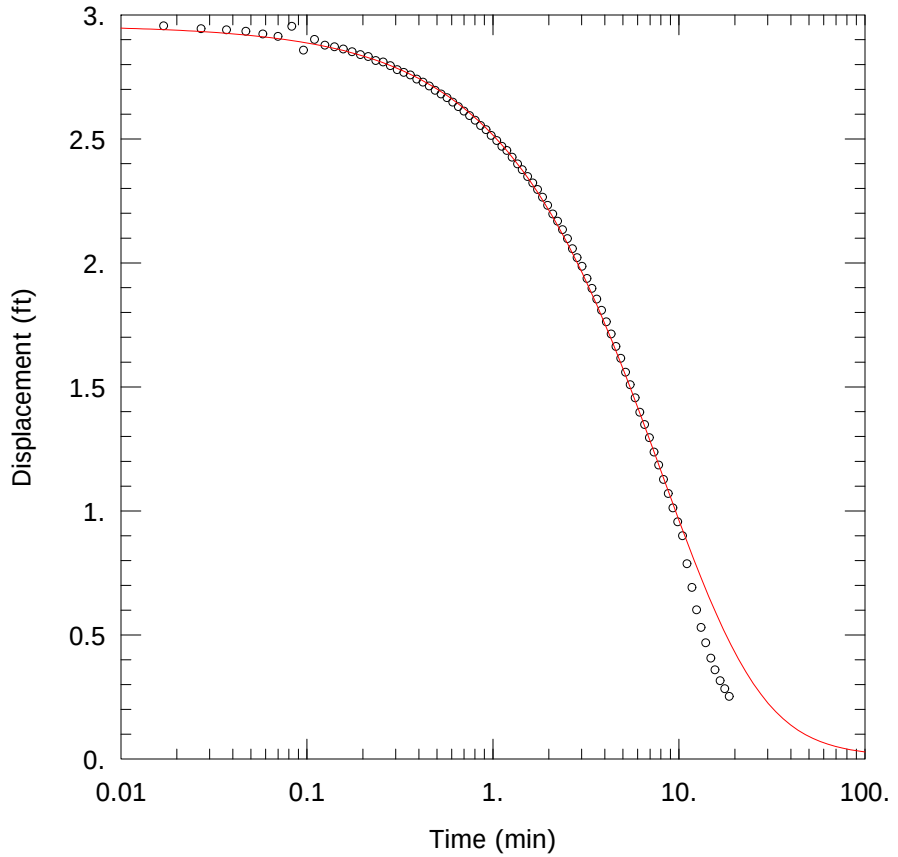
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.99
Ss	-0.99	1.00	0.96
Kz/Kr	-0.99	0.96	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.01242 ft^2
Variance . . . . . 0.0001321 ft^2
Std. Deviation . . . . . 0.01149 ft
Mean. . . . . 0.001463 ft
No. of Residuals 97
No. of Estimates. 3



G209 @ GMF GYPSUM POND – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G209
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0002 cm/sec
Ss = 0.0001 ft^{-1}
Kz/Kr = 0.01

AQUIFER DATA

Saturated Thickness: 25.48 ft

WELL DATA (G209)

Initial Displacement: 2.96 ft
Total Well Penetration Depth: 25.48 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 25.48 ft
Screen Length: 4.54 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G209fh.aqt
Title: G209 @ GMF Gypsum Pond – Falling Head Test
Date: 11/28/16
Time: 09:22:04

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: G209

AQUIFER DATA

Saturated Thickness: 25.48 ft
Anisotropy Ratio (Kz/Kr): 0.01

SLUG TEST WELL DATA

Test Well: G209

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.96 ft
Static Water Column Height: 25.48 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.54 ft
Total Well Penetration Depth: 25.48 ft

No. of Observations: 86

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.947	0.609	2.648	3.839	1.809
0.009	2.943	0.653	2.63	4.079	1.762
0.017	2.956	0.7	2.612	4.329	1.713
0.027	2.944	0.75	2.594	4.589	1.663
0.037	2.94	0.803	2.575	4.869	1.615
0.047	2.934	0.859	2.554	5.169	1.559
0.058	2.923	0.919	2.537	5.479	1.509
0.07	2.913	0.979	2.514	5.819	1.456
0.083	2.954	1.049	2.493	6.169	1.398
0.096	2.858	1.119	2.47	6.539	1.348
0.11	2.901	1.189	2.453	6.939	1.295
0.125	2.878	1.269	2.426	7.359	1.237
0.141	2.871	1.359	2.399	7.799	1.185

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.157	2.862	1.439	2.376	8.269	1.127
0.175	2.851	1.539	2.348	8.769	1.07
0.194	2.84	1.639	2.322	9.299	1.012
0.214	2.832	1.739	2.296	9.859	0.956
0.235	2.816	1.849	2.265	10.46	0.9
0.257	2.81	1.969	2.232	11.06	0.787
0.281	2.795	2.099	2.197	11.76	0.691
0.306	2.779	2.229	2.168	12.46	0.601
0.332	2.768	2.369	2.134	13.16	0.53
0.36	2.758	2.519	2.098	13.96	0.468
0.39	2.741	2.679	2.057	14.86	0.406
0.421	2.729	2.839	2.021	15.66	0.359
0.455	2.713	3.019	1.986	16.66	0.315
0.49	2.696	3.209	1.937	17.66	0.283
0.527	2.681	3.409	1.897	18.66	0.252
0.567	2.666	3.619	1.854		

SOLUTION

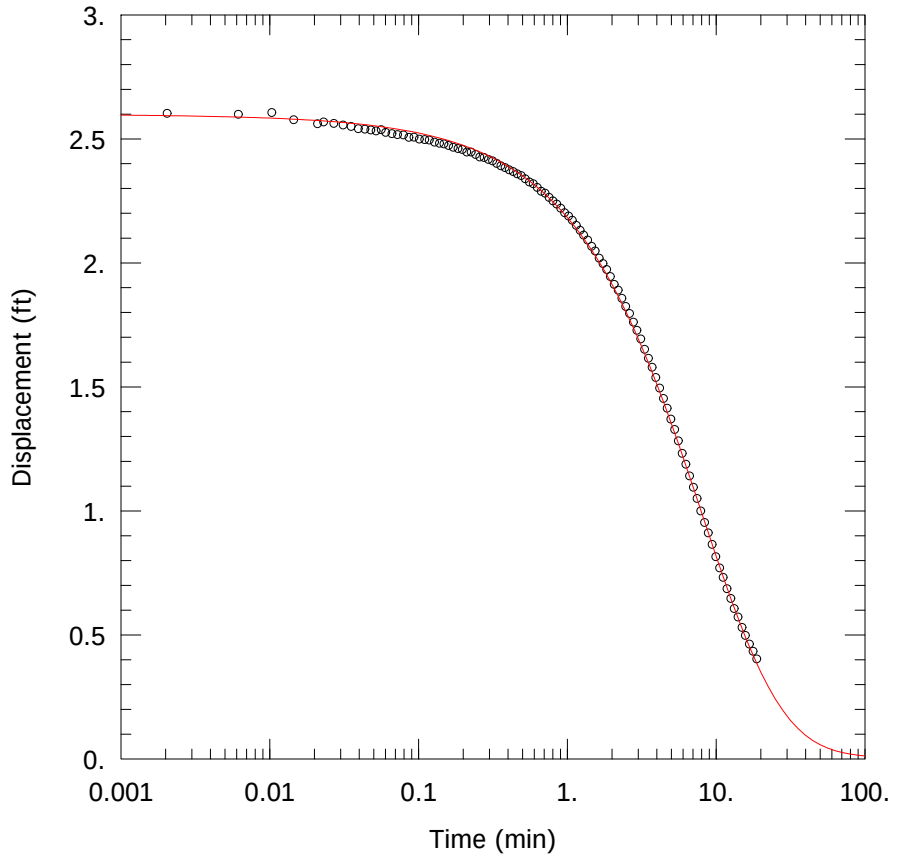
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.0002	cm/sec
Ss	0.0001	ft^{-1}
Kz/Kr	0.01	

T = K*b = 0.1553 cm^2/sec



G209 @ GMF GYPSUM POND – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G209
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00016 cm/sec
Ss = 0.0004 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 25.48 ft

WELL DATA (G209)

Initial Displacement: 2.6 ft
Total Well Penetration Depth: 25.48 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 25.48 ft
Screen Length: 4.54 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G209rh.aqt
Title: G209 @ GMF Gypsum Pond – Rising Head Test
Date: 11/28/16
Time: 09:22:32

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: G209

AQUIFER DATA

Saturated Thickness: 25.48 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G209

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.6 ft
Static Water Column Height: 25.48 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.54 ft
Total Well Penetration Depth: 25.48 ft

No. of Observations: 107

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.613	0.2953	2.417	2.62	1.796
0.00205	2.603	0.3153	2.411	2.78	1.761
0.006167	2.599	0.3363	2.401	2.94	1.728
0.01033	2.606	0.3583	2.391	3.12	1.693
0.0145	2.577	0.3823	2.384	3.31	1.651
0.02102	2.561	0.4073	2.375	3.51	1.615
0.02307	2.568	0.4333	2.368	3.72	1.579
0.027	2.562	0.4613	2.359	3.94	1.538
0.03117	2.556	0.4913	2.352	4.18	1.495
0.03533	2.55	0.5223	2.339	4.43	1.453
0.0395	2.541	0.5563	2.326	4.69	1.414
0.04367	2.539	0.5913	2.319	4.97	1.37
0.04783	2.536	0.6283	2.304	5.27	1.328

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.052	2.532	0.6683	2.289	5.581	1.282
0.05617	2.537	0.7103	2.281	5.92	1.232
0.06033	2.526	0.7543	2.264	6.27	1.188
0.06633	2.521	0.8013	2.25	6.64	1.141
0.07233	2.517	0.8513	2.237	7.04	1.095
0.07933	2.516	0.9043	2.22	7.46	1.05
0.08633	2.506	0.9603	2.202	7.9	1.
0.09333	2.507	1.02	2.189	8.37	0.953
0.1013	2.499	1.08	2.172	8.87	0.911
0.1103	2.497	1.15	2.151	9.4	0.865
0.1183	2.495	1.22	2.131	9.96	0.815
0.1283	2.487	1.29	2.112	10.56	0.77
0.1383	2.482	1.37	2.092	11.16	0.732
0.1483	2.48	1.46	2.067	11.86	0.686
0.1593	2.473	1.54	2.048	12.56	0.647
0.1713	2.466	1.64	2.019	13.26	0.606
0.1843	2.461	1.74	1.997	14.06	0.572
0.1973	2.457	1.84	1.973	14.96	0.53
0.2113	2.447	1.95	1.945	15.76	0.498
0.2263	2.447	2.07	1.913	16.76	0.463
0.2423	2.437	2.2	1.89	17.76	0.434
0.2583	2.427	2.33	1.857	18.76	0.403
0.2763	2.425	2.47	1.824		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00016	cm/sec
Ss	0.0004	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.1243 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0001569	8.484E-6	+/- 1.682E-5	18.49	cm/sec
Ss	0.0004212	8.747E-5	+/- 0.0001734	4.816	ft^{-1}
Kz/Kr	1.	0.6918	+/- 1.372	1.446	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.1218 cm²/sec

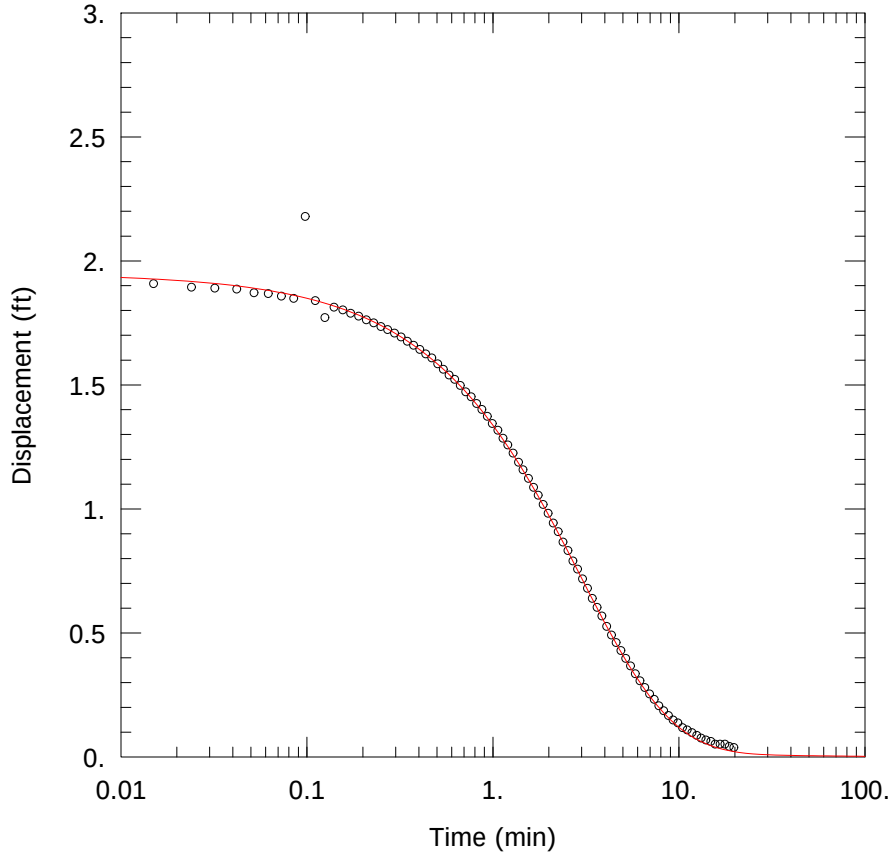
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.99
Ss	-0.99	1.00	0.95
Kz/Kr	-0.99	0.95	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.02054 ft^2
Variance . . . . . 0.0001975 ft^2
Std. Deviation . . . . . 0.01405 ft
Mean. . . . . -0.004298 ft
No. of Residuals 107
No. of Estimates. 3



G210 @ GMF GYPSUM POND – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G210
Test Date: 16 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0005 cm/sec
Ss = 0.0001 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 15.7 ft

WELL DATA (G210)

Initial Displacement: 1.95 ft
Total Well Penetration Depth: 15.7 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 15.7 ft
Screen Length: 4.54 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G210fh.aqt
Title: G210 @ GMF Gypsum Pond – Falling Head Test
Date: 11/28/16
Time: 09:23:01

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 16 Jun 2016
Test Well: G210

AQUIFER DATA

Saturated Thickness: 15.7 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G210

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.95 ft
Static Water Column Height: 15.7 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.54 ft
Total Well Penetration Depth: 15.7 ft

No. of Observations: 89

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	1.988	0.582	1.54	3.854	0.568
0.007	1.947	0.624	1.522	4.094	0.526
0.015	1.908	0.668	1.498	4.344	0.491
0.024	1.894	0.715	1.472	4.604	0.461
0.032	1.89	0.765	1.452	4.884	0.429
0.042	1.886	0.818	1.425	5.184	0.397
0.052	1.871	0.874	1.401	5.494	0.367
0.062	1.868	0.934	1.373	5.834	0.335
0.073	1.858	0.994	1.344	6.184	0.307
0.085	1.849	1.064	1.317	6.554	0.28
0.098	2.179	1.134	1.285	6.954	0.254
0.111	1.84	1.204	1.258	7.374	0.232
0.125	1.771	1.284	1.225	7.814	0.206

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.14	1.813	1.374	1.188	8.284	0.186
0.156	1.802	1.454	1.158	8.784	0.167
0.172	1.789	1.554	1.123	9.314	0.149
0.19	1.777	1.654	1.087	9.874	0.137
0.209	1.762	1.754	1.055	10.47	0.118
0.229	1.75	1.864	1.018	11.07	0.109
0.25	1.735	1.984	0.982	11.77	0.098
0.272	1.723	2.114	0.943	12.47	0.087
0.296	1.709	2.244	0.908	13.17	0.076
0.321	1.693	2.384	0.866	13.97	0.068
0.347	1.676	2.534	0.832	14.87	0.062
0.375	1.66	2.694	0.79	15.67	0.051
0.405	1.643	2.854	0.757	16.67	0.051
0.436	1.625	3.034	0.718	17.67	0.051
0.47	1.609	3.224	0.68	18.67	0.042
0.505	1.585	3.424	0.639	19.77	0.038
0.542	1.563	3.634	0.603		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.0005	cm/sec
Ss	0.0001	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.2393 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0004908	0.000128	+/- 0.0002545	3.835	cm/sec
Ss	0.0001094	0.0001408	+/- 0.0002798	0.7771	ft^{-1}
Kz/Kr	1.	2.525	+/- 5.019	0.3961	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.2349 cm²/sec

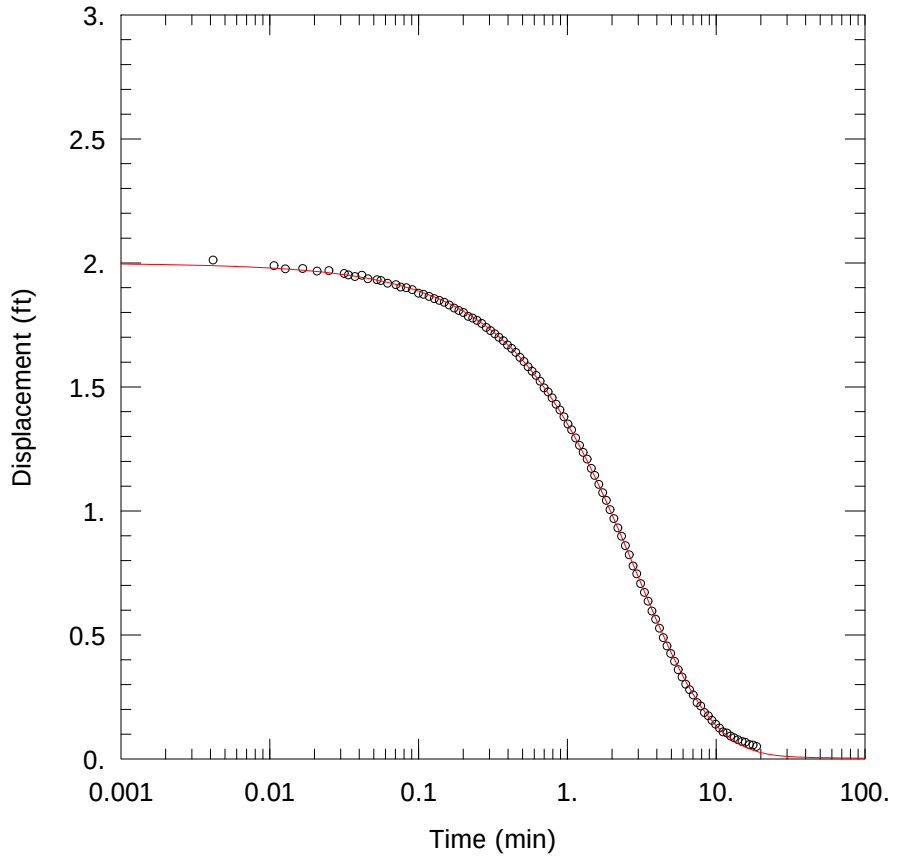
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-1.00
Ss	-0.99	1.00	0.98
Kz/Kr	-1.00	0.98	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.1181 ft^2
Variance . . . . . 0.001373 ft^2
Std. Deviation . . . . . 0.03705 ft
Mean. . . . . 0.003124 ft
No. of Residuals 89
No. of Estimates. 3



G210 @ GMF GYPSUM POND – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G210
Test Date: 16 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00048 cm/sec
Ss = 0.0002 ft^{-1}
Kz/Kr = 0.9532

AQUIFER DATA

Saturated Thickness: 15.7 ft

WELL DATA (G210)

Initial Displacement: 2. ft
Total Well Penetration Depth: 15.7 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 15.7 ft
Screen Length: 4.54 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G210rh.aqt
Title: G210 @ GMF Gypsum Pond – Rising Head Test
Date: 11/28/16
Time: 09:23:24

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 16 Jun 2016
Test Well: G210

AQUIFER DATA

Saturated Thickness: 15.7 ft
Anisotropy Ratio (Kz/Kr): 0.9532

SLUG TEST WELL DATA

Test Well: G210

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2. ft
Static Water Column Height: 15.7 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.54 ft
Total Well Penetration Depth: 15.7 ft

No. of Observations: 104

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.058	0.326	1.714	2.77	0.778
0.004167	2.011	0.348	1.7	2.93	0.746
0.01072	1.989	0.372	1.686	3.11	0.707
0.01277	1.976	0.397	1.669	3.3	0.671
0.01667	1.977	0.423	1.655	3.5	0.636
0.02083	1.967	0.451	1.639	3.71	0.596
0.025	1.969	0.481	1.619	3.93	0.563
0.03177	1.957	0.512	1.602	4.17	0.527
0.03382	1.951	0.546	1.581	4.42	0.489
0.0375	1.945	0.581	1.563	4.68	0.455
0.04167	1.95	0.618	1.546	4.96	0.425
0.04583	1.936	0.658	1.523	5.26	0.393
0.05278	1.932	0.7	1.496	5.57	0.36

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.056	1.929	0.744	1.48	5.91	0.33
0.06203	1.918	0.791	1.456	6.26	0.301
0.07057	1.912	0.841	1.43	6.63	0.279
0.076	1.902	0.894	1.407	7.03	0.258
0.083	1.9	0.95	1.379	7.45	0.227
0.091	1.892	1.01	1.35	7.89	0.213
0.1	1.878	1.07	1.327	8.36	0.187
0.108	1.873	1.14	1.294	8.86	0.174
0.118	1.865	1.21	1.264	9.39	0.155
0.128	1.856	1.28	1.236	9.95	0.14
0.138	1.849	1.36	1.209	10.55	0.124
0.149	1.841	1.45	1.171	11.15	0.109
0.161	1.83	1.53	1.143	11.85	0.104
0.174	1.818	1.63	1.107	12.55	0.092
0.187	1.808	1.73	1.073	13.25	0.085
0.201	1.8	1.83	1.042	14.05	0.077
0.216	1.784	1.94	1.005	14.95	0.07
0.232	1.777	2.06	0.969	15.75	0.067
0.248	1.768	2.19	0.931	16.75	0.058
0.266	1.756	2.32	0.898	17.75	0.056
0.285	1.74	2.46	0.86	18.75	0.05
0.305	1.727	2.61	0.823		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00048	cm/sec
Ss	0.0002	ft^{-1}
Kz/Kr	0.9532	

T = K*b = 0.2297 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0004796	2.439E-5	+/- 4.839E-5	19.66	cm/sec
Ss	0.0002031	4.796E-5	+/- 9.515E-5	4.235	ft^{-1}
Kz/Kr	0.9532	0.495	+/- 0.9822	1.925	

C.I. is approximate 95% confidence interval for parameter

t-ratio = estimate/std. error
No estimation window

T = K*b = 0.2295 cm²/sec

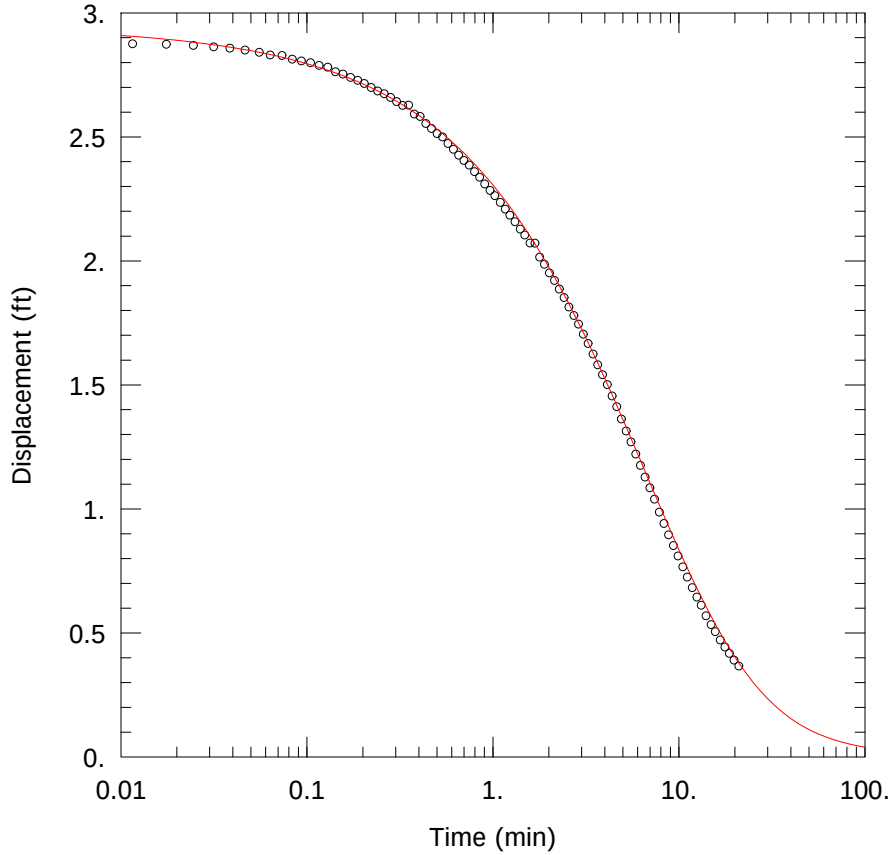
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.99
Ss	-0.99	1.00	0.98
Kz/Kr	-0.99	0.98	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.008583 ft^2
Variance . . . . . 8.498E-5 ft^2
Std. Deviation . . . . . 0.009219 ft
Mean. . . . . 0.001622 ft
No. of Residuals 104
No. of Estimates. 3



G212 @ GMF GYPSUM POND – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G212
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00013 cm/sec
Ss = 0.004 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 12.71 ft

WELL DATA (G212)

Initial Displacement: 2.95 ft
Total Well Penetration Depth: 12.71 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 12.71 ft
Screen Length: 4.55 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G212fh.aqt
Title: G212 @ GMF Gypsum Pond – Falling Head Test
Date: 11/28/16
Time: 09:23:53

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: G212

AQUIFER DATA

Saturated Thickness: 12.71 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G212

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.95 ft
Static Water Column Height: 12.71 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.55 ft
Total Well Penetration Depth: 12.71 ft

No. of Observations: 96

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.913	0.4676	2.534	3.456	1.624
0.00365	2.884	0.5016	2.513	3.666	1.581
0.0073	2.877	0.5366	2.5	3.886	1.541
0.01157	2.875	0.5736	2.473	4.126	1.501
0.01758	2.873	0.6136	2.45	4.376	1.455
0.02457	2.869	0.6556	2.426	4.636	1.412
0.03157	2.863	0.6996	2.405	4.916	1.362
0.03857	2.858	0.7466	2.386	5.216	1.314
0.04657	2.85	0.7966	2.36	5.526	1.27
0.05557	2.841	0.8496	2.337	5.866	1.221
0.06357	2.83	0.9056	2.31	6.216	1.175
0.07357	2.828	0.9656	2.284	6.586	1.128
0.08357	2.813	1.026	2.263	6.986	1.085

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.09357	2.806	1.096	2.236	7.406	1.039
0.1046	2.799	1.166	2.209	7.846	0.987
0.1166	2.788	1.236	2.184	8.316	0.941
0.1296	2.781	1.316	2.158	8.816	0.895
0.1426	2.762	1.406	2.128	9.346	0.852
0.1566	2.753	1.486	2.104	9.906	0.81
0.1716	2.74	1.586	2.072	10.51	0.766
0.1876	2.728	1.686	2.071	11.11	0.725
0.2036	2.715	1.786	2.015	11.81	0.682
0.2216	2.699	1.896	1.986	12.51	0.644
0.2406	2.685	2.016	1.951	13.21	0.611
0.2606	2.674	2.146	1.921	14.01	0.569
0.2816	2.659	2.276	1.886	14.91	0.533
0.3036	2.642	2.416	1.852	15.71	0.505
0.3276	2.627	2.566	1.814	16.71	0.471
0.3526	2.628	2.726	1.78	17.71	0.443
0.3786	2.592	2.886	1.745	18.71	0.417
0.4066	2.582	3.066	1.704	19.81	0.39
0.4366	2.554	3.256	1.667	21.01	0.366

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00013	cm/sec
Ss	0.004	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.05036 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0001337	5.707E-6	+/- 1.133E-5	23.42	cm/sec
Ss	0.004071	0.0003972	+/- 0.0007888	10.25	ft^{-1}
Kz/Kr	1.	1.219	+/- 2.421	0.8205	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.05178 cm²/sec

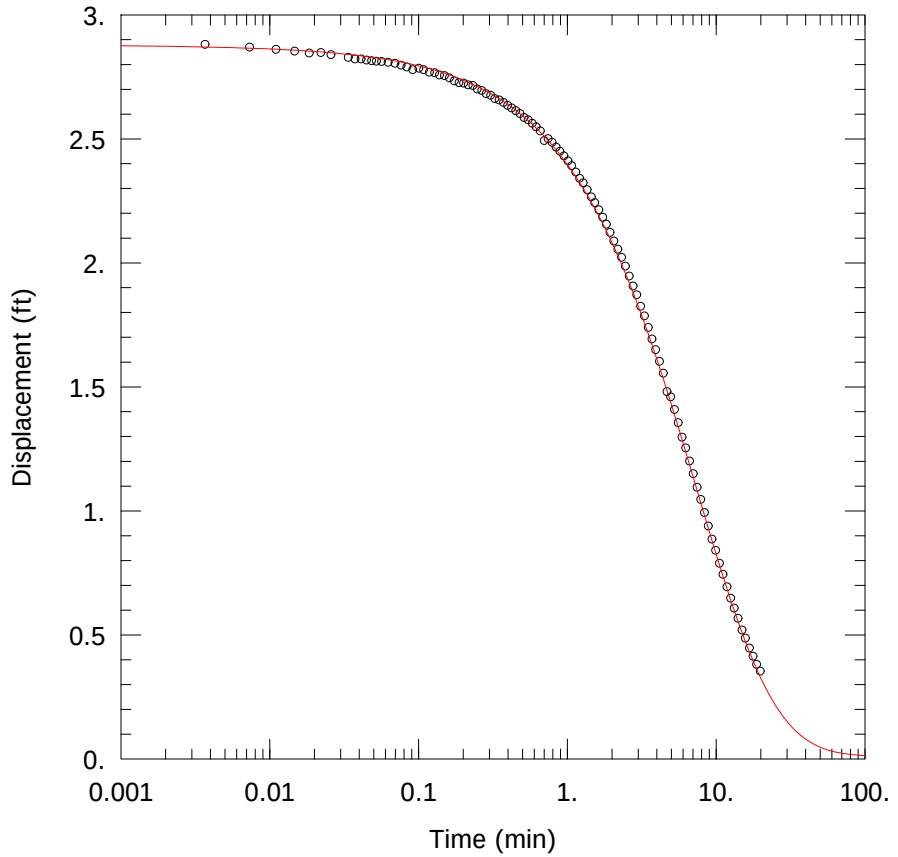
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.98	-0.97
Ss	-0.98	1.00	0.93
Kz/Kr	-0.97	0.93	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.01956 ft^2
Variance . . . . . 0.0002103 ft^2
Std. Deviation . . . . . 0.0145 ft
Mean. . . . . -0.002036 ft
No. of Residuals 96
No. of Estimates. 3



G212 @ GMF GYPSUM POND – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G212
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00018 cm/sec
Ss = 0.0003 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 12.71 ft

WELL DATA (G212)

Initial Displacement: 2.88 ft
Total Well Penetration Depth: 12.71 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 12.71 ft
Screen Length: 4.55 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G212rh.aqt
Title: G212 @ GMF Gypsum Pond – Rising Head Test
Date: 11/28/16
Time: 09:24:15

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: G212

AQUIFER DATA

Saturated Thickness: 12.71 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G212

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.88 ft
Static Water Column Height: 12.71 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.55 ft
Total Well Penetration Depth: 12.71 ft

No. of Observations: 106

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.866	0.3265	2.662	2.93	1.871
0.003683	2.881	0.3485	2.657	3.111	1.825
0.007333	2.87	0.3725	2.647	3.301	1.786
0.01102	2.861	0.3975	2.635	3.501	1.74
0.01473	2.854	0.4235	2.625	3.711	1.693
0.01843	2.846	0.4515	2.614	3.93	1.65
0.02213	2.848	0.4815	2.602	4.17	1.603
0.02583	2.84	0.5125	2.586	4.42	1.555
0.0338	2.829	0.5465	2.577	4.681	1.481
0.03748	2.822	0.5815	2.563	4.96	1.46
0.04115	2.822	0.6185	2.549	5.261	1.409
0.0448	2.818	0.6585	2.532	5.571	1.356
0.04847	2.815	0.7005	2.493	5.911	1.297

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.05215	2.813	0.7445	2.501	6.261	1.254
0.0565	2.812	0.7915	2.486	6.63	1.201
0.0625	2.809	0.8415	2.467	7.031	1.15
0.0695	2.805	0.8945	2.45	7.45	1.095
0.0765	2.797	0.9505	2.431	7.891	1.046
0.0835	2.79	1.011	2.411	8.361	0.993
0.0915	2.779	1.071	2.392	8.861	0.939
0.1005	2.785	1.141	2.366	9.39	0.886
0.1085	2.779	1.21	2.341	9.95	0.841
0.1185	2.769	1.281	2.323	10.55	0.789
0.1285	2.767	1.361	2.295	11.15	0.744
0.1385	2.758	1.45	2.266	11.85	0.694
0.1495	2.755	1.531	2.243	12.55	0.648
0.1615	2.746	1.631	2.214	13.25	0.608
0.1745	2.734	1.73	2.184	14.05	0.567
0.1875	2.727	1.831	2.156	14.95	0.52
0.2015	2.725	1.94	2.123	15.75	0.487
0.2165	2.718	2.061	2.088	16.75	0.447
0.2325	2.715	2.191	2.055	17.75	0.414
0.2485	2.701	2.321	2.022	18.75	0.381
0.2665	2.695	2.461	1.987	19.85	0.354
0.2855	2.682	2.611	1.947		
0.3055	2.676	2.771	1.907		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00018	cm/sec
Ss	0.0003	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.06973 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0001762	7.1E-6	+/- 1.408E-5	24.81	cm/sec
Ss	0.0002962	4.965E-5	+/- 9.845E-5	5.966	ft^{-1}
Kz/Kr	1.	0.4616	+/- 0.9153	2.166	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.06825 cm²/sec

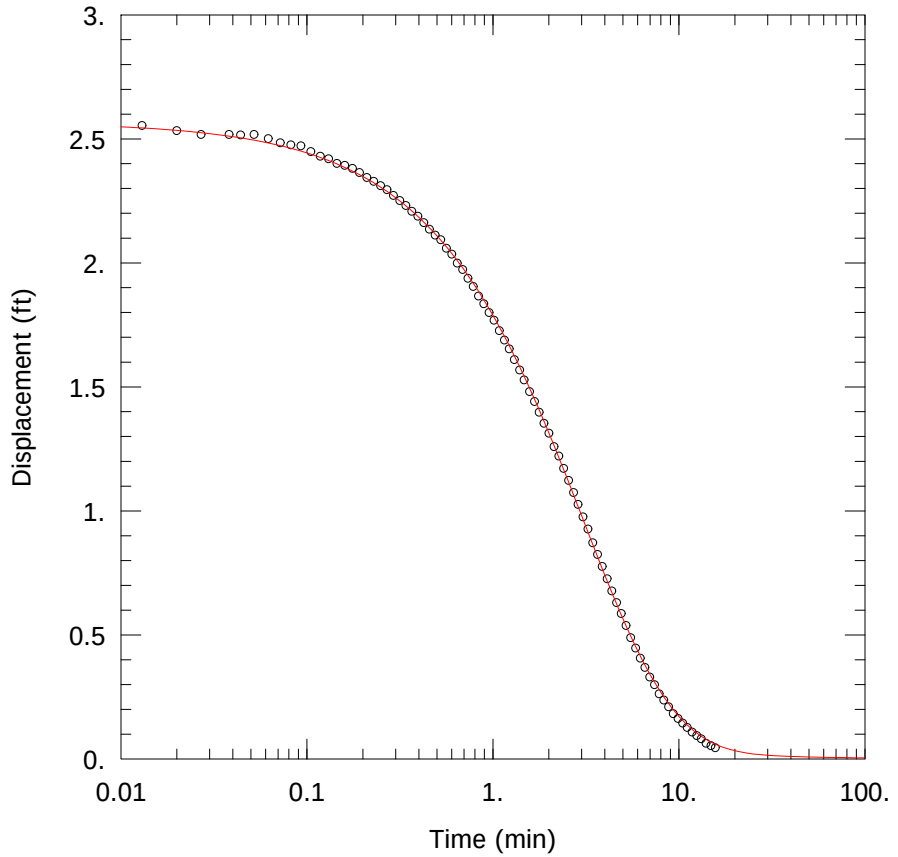
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.99
Ss	-0.99	1.00	0.96
Kz/Kr	-0.99	0.96	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.01265 ft^2
Variance . . . . . 0.0001228 ft^2
Std. Deviation . . . . . 0.01108 ft
Mean. . . . . -0.003437 ft
No. of Residuals 106
No. of Estimates. 3



G215 @ GMF GYPSUM POND – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G215
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0005 cm/sec
Ss = 9.0E-5 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 12.7 ft

WELL DATA (G215)

Initial Displacement: 2.57 ft
Total Well Penetration Depth: 12.7 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 12.7 ft
Screen Length: 4.39 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G215fh.aqt
Title: G215 @ GMF Gypsum Pond – Falling Head Test
Date: 11/28/16
Time: 09:24:40

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: G215

AQUIFER DATA

Saturated Thickness: 12.7 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G215

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.57 ft
Static Water Column Height: 12.7 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.39 ft
Total Well Penetration Depth: 12.7 ft

No. of Observations: 88

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.543	0.49	2.112	3.244	0.927
0.006	2.561	0.525	2.093	3.444	0.871
0.013	2.554	0.562	2.059	3.654	0.824
0.02	2.533	0.602	2.035	3.874	0.776
0.027	2.518	0.644	1.999	4.114	0.726
0.03818	2.518	0.688	1.973	4.364	0.677
0.044	2.516	0.735	1.938	4.624	0.63
0.052	2.518	0.785	1.905	4.904	0.586
0.062	2.501	0.838	1.866	5.204	0.538
0.072	2.484	0.894	1.835	5.514	0.489
0.082	2.476	0.954	1.8	5.854	0.447
0.093	2.472	1.014	1.769	6.204	0.406
0.105	2.449	1.084	1.727	6.574	0.369

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.118	2.43	1.154	1.689	6.974	0.33
0.131	2.42	1.224	1.653	7.394	0.299
0.145	2.401	1.304	1.61	7.834	0.262
0.16	2.393	1.394	1.568	8.304	0.237
0.176	2.381	1.474	1.528	8.804	0.21
0.192	2.364	1.574	1.481	9.339	0.182
0.21	2.344	1.674	1.441	9.894	0.163
0.229	2.329	1.774	1.398	10.49	0.144
0.249	2.311	1.884	1.353	11.09	0.127
0.27	2.295	2.004	1.313	11.79	0.108
0.292	2.272	2.134	1.259	12.49	0.094
0.316	2.251	2.264	1.221	13.19	0.081
0.341	2.231	2.404	1.171	13.99	0.063
0.367	2.208	2.554	1.123	14.89	0.053
0.395	2.188	2.714	1.074	15.69	0.045
0.425	2.162	2.874	1.026		
0.456	2.136	3.054	0.976		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.0005	cm/sec
Ss	9.0E-5	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.1935 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0005031	5.308E-5	+/- 0.0001055	9.478	cm/sec
Ss	8.802E-5	4.315E-5	+/- 8.578E-5	2.04	ft^{-1}
Kz/Kr	1.	1.055	+/- 2.097	0.9479	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.1948 cm²/sec

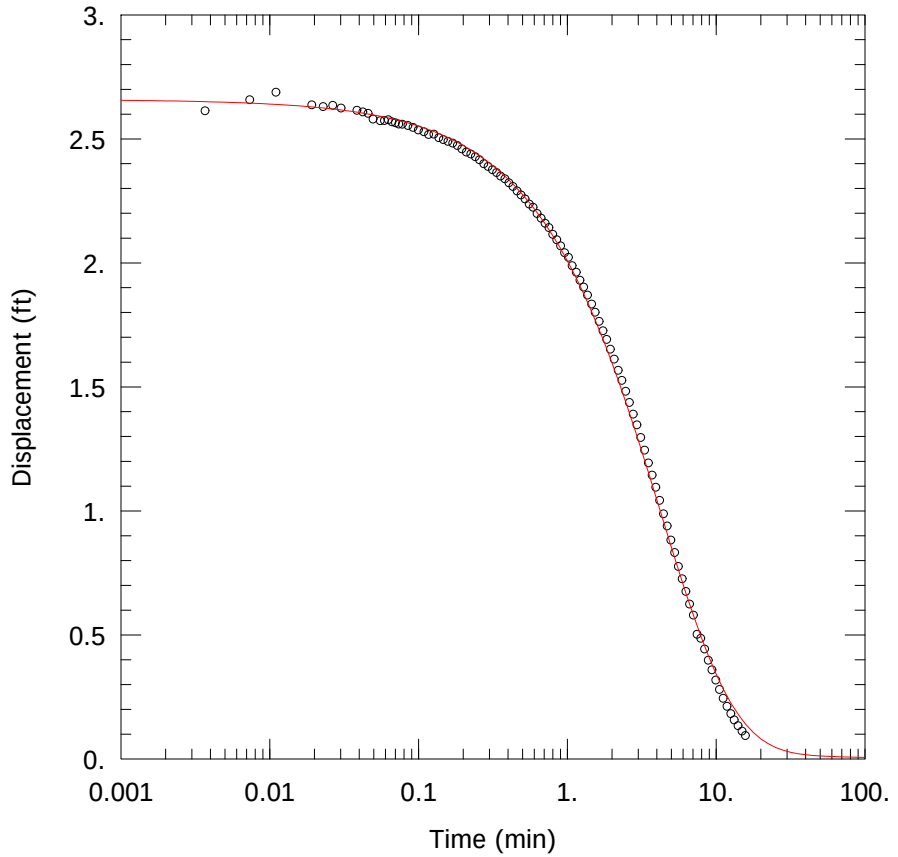
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-1.00	-1.00
Ss	-1.00	1.00	0.99
Kz/Kr	-1.00	0.99	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.00943 ft^2
Variance . . . . . 0.0001109 ft^2
Std. Deviation . . . . . 0.01053 ft
Mean. . . . . 3.96E-5 ft
No. of Residuals 88
No. of Estimates. 3



G215 @ GMF GYPSUM POND – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G215
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00035 cm/sec
Ss = 0.00015 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 12.7 ft

WELL DATA (G215)

Initial Displacement: 2.66 ft
Total Well Penetration Depth: 12.7 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 12.7 ft
Screen Length: 4.39 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G215rh.aqt
Title: G215 @ GMF Gypsum Pond – Rising Head Test
Date: 11/28/16
Time: 09:25:02

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: G215

AQUIFER DATA

Saturated Thickness: 12.7 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G215

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.66 ft
Static Water Column Height: 12.7 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.39 ft
Total Well Penetration Depth: 12.7 ft

No. of Observations: 104

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.653	0.275	2.4	2.329	1.526
0.003683	2.613	0.2939	2.389	2.469	1.482
0.00735	2.658	0.314	2.376	2.619	1.437
0.01102	2.688	0.335	2.364	2.779	1.39
0.01922	2.637	0.3569	2.35	2.939	1.347
0.02288	2.63	0.381	2.339	3.119	1.296
0.02657	2.635	0.4059	2.323	3.309	1.245
0.03023	2.624	0.432	2.308	3.509	1.193
0.03862	2.615	0.46	2.29	3.719	1.144
0.04228	2.609	0.49	2.274	3.939	1.095
0.04595	2.603	0.521	2.258	4.179	1.042
0.04962	2.58	0.555	2.237	4.429	0.988
0.05535	2.573	0.5899	2.224	4.689	0.939

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.05905	2.574	0.627	2.199	4.969	0.882
0.06277	2.577	0.667	2.18	5.269	0.832
0.06643	2.569	0.7089	2.16	5.588	0.776
0.07012	2.565	0.753	2.142	5.921	0.726
0.0738	2.56	0.8	2.115	6.269	0.675
0.07795	2.559	0.8499	2.093	6.639	0.624
0.08495	2.554	0.903	2.069	7.039	0.58
0.09195	2.546	0.9589	2.041	7.459	0.502
0.09995	2.536	1.019	2.022	7.899	0.486
0.109	2.529	1.079	1.989	8.369	0.443
0.117	2.518	1.149	1.962	8.869	0.398
0.127	2.519	1.219	1.93	9.399	0.359
0.1369	2.505	1.289	1.902	9.959	0.318
0.147	2.497	1.369	1.87	10.56	0.28
0.158	2.49	1.459	1.834	11.16	0.244
0.1699	2.483	1.539	1.801	11.86	0.212
0.183	2.473	1.639	1.764	12.56	0.182
0.196	2.46	1.739	1.726	13.26	0.157
0.21	2.447	1.839	1.691	14.06	0.134
0.225	2.439	1.949	1.652	14.96	0.112
0.241	2.428	2.069	1.612	15.76	0.094
0.257	2.416	2.199	1.567		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00035	cm/sec
Ss	0.00015	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.1355 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0003512	5.917E-5	+/- 0.0001174	5.935	cm/sec
Ss	0.0001143	8.861E-5	+/- 0.0001758	1.29	ft^{-1}
Kz/Kr	1.	1.688	+/- 3.348	0.5925	

C.I. is approximate 95% confidence interval for parameter

t-ratio = estimate/std. error
No estimation window

T = K*b = 0.1359 cm²/sec

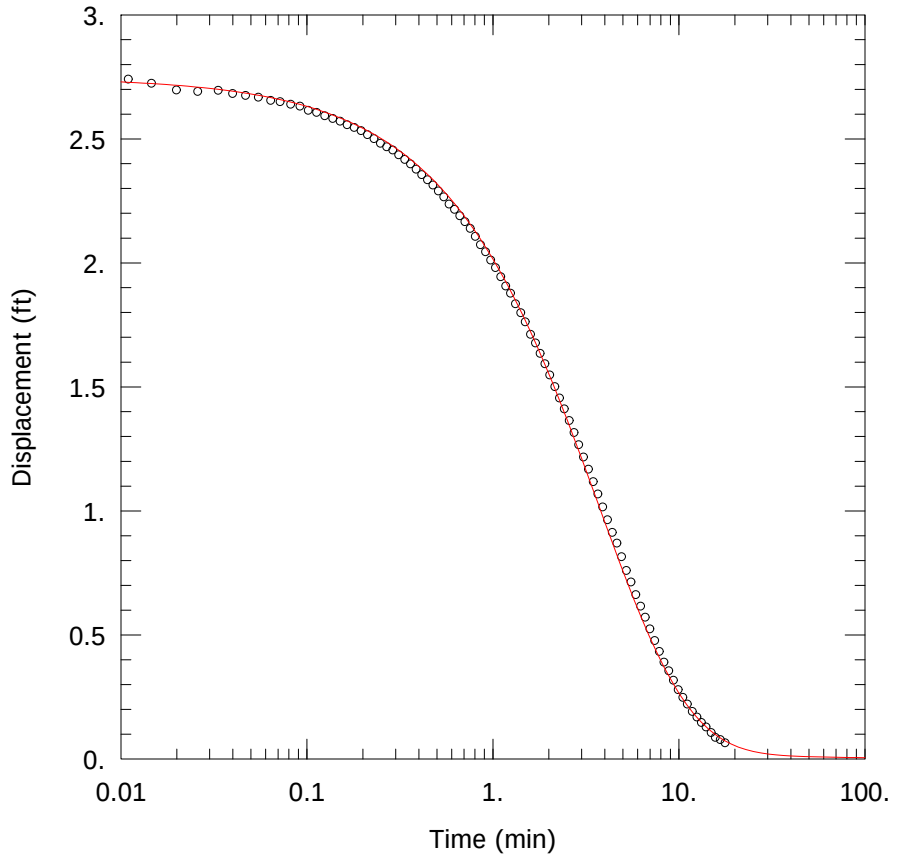
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-1.00
Ss	-0.99	1.00	0.99
Kz/Kr	-1.00	0.99	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.05196 ft^2
Variance . . . . . 0.0005144 ft^2
Std. Deviation . . . . . 0.02268 ft
Mean. . . . . -0.007737 ft
No. of Residuals 104
No. of Estimates. 3



G218 @ GMF GYPSUM POND – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G218
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00041 cm/sec
Ss = 0.0001 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 14.16 ft

WELL DATA (G218)

Initial Displacement: 2.75 ft
Total Well Penetration Depth: 14.16 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 14.16 ft
Screen Length: 4.44 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G218fh.aqt
Title: G218 @ GMF Gypsum Pond – Falling Head Test
Date: 11/28/16
Time: 09:25:29

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: G218

AQUIFER DATA

Saturated Thickness: 14.16 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G218

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.75 ft
Static Water Column Height: 14.16 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.44 ft
Total Well Penetration Depth: 14.16 ft

No. of Observations: 95

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.731	0.4149	2.356	3.074	1.217
0.00365	2.758	0.4449	2.335	3.264	1.168
0.007317	2.755	0.4759	2.314	3.464	1.118
0.01097	2.741	0.5099	2.29	3.674	1.068
0.01462	2.724	0.5449	2.266	3.894	1.016
0.01988	2.697	0.5819	2.237	4.134	0.964
0.02588	2.691	0.6219	2.216	4.384	0.913
0.03338	2.696	0.6639	2.19	4.644	0.87
0.03988	2.683	0.7079	2.166	4.924	0.815
0.04687	2.675	0.7549	2.139	5.224	0.76
0.05488	2.668	0.8049	2.107	5.534	0.713
0.06387	2.655	0.8579	2.073	5.874	0.662
0.07187	2.65	0.9139	2.045	6.224	0.616

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.08188	2.64	0.9739	2.011	6.594	0.571
0.09188	2.632	1.034	1.981	6.994	0.524
0.1019	2.615	1.104	1.944	7.414	0.477
0.1129	2.607	1.174	1.907	7.854	0.433
0.1249	2.593	1.244	1.878	8.324	0.39
0.1379	2.582	1.324	1.835	8.824	0.355
0.1509	2.571	1.414	1.799	9.354	0.317
0.1649	2.557	1.494	1.762	9.918	0.279
0.1799	2.546	1.594	1.712	10.51	0.248
0.1959	2.533	1.694	1.677	11.11	0.221
0.2119	2.517	1.794	1.635	11.81	0.191
0.2299	2.501	1.904	1.593	12.51	0.169
0.2489	2.482	2.024	1.548	13.21	0.147
0.2689	2.468	2.154	1.501	14.01	0.129
0.2899	2.455	2.284	1.455	14.91	0.106
0.3119	2.436	2.424	1.411	15.71	0.087
0.3359	2.417	2.574	1.364	16.71	0.078
0.3609	2.399	2.734	1.316	17.71	0.065
0.3869	2.378	2.894	1.267		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00041	cm/sec
Ss	0.0001	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.177 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0004038	6.674E-5	+/- 0.0001326	6.05	cm/sec
Ss	9.763E-5	7.71E-5	+/- 0.0001531	1.266	ft^{-1}
Kz/Kr	1.	1.614	+/- 3.206	0.6195	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.1743 cm²/sec

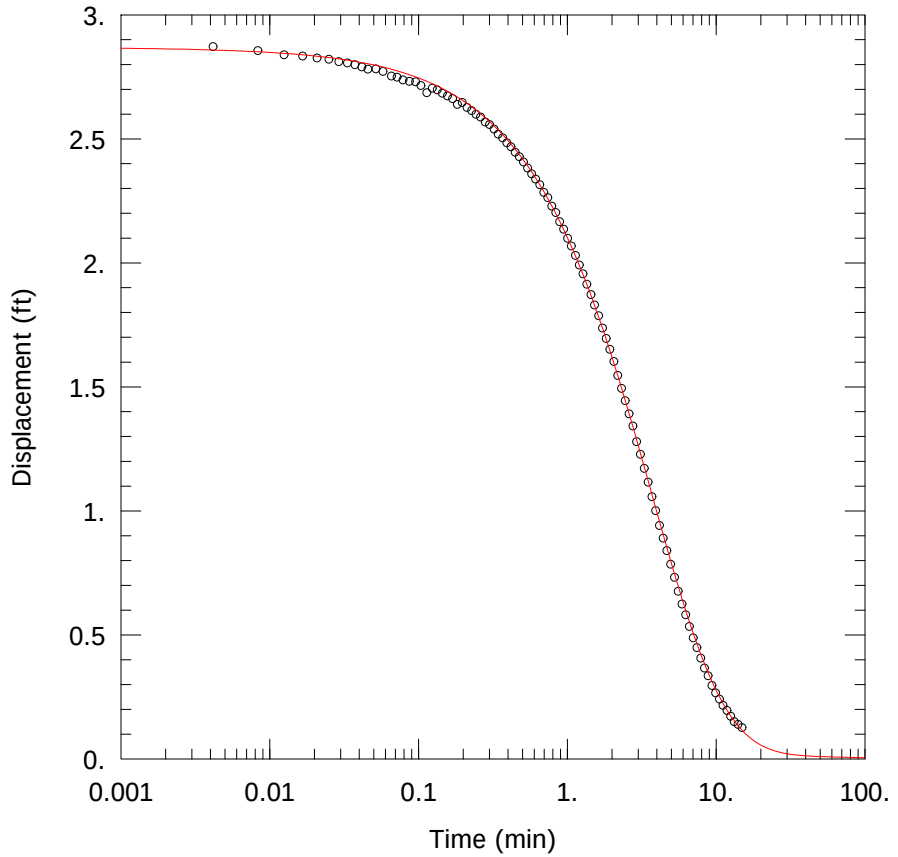
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-1.00	-1.00
Ss	-1.00	1.00	0.99
Kz/Kr	-1.00	0.99	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.03742 ft^2
Variance . . . . . 0.0004068 ft^2
Std. Deviation . . . . . 0.02017 ft
Mean. . . . . -0.006913 ft
No. of Residuals 95
No. of Estimates. 3



G218 @ GMF GYPSUM POND – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G218
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00041 cm/sec
Ss = 0.0001 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 14.16 ft

WELL DATA (G218)

Initial Displacement: 2.87 ft
Total Well Penetration Depth: 14.16 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 14.16 ft
Screen Length: 4.44 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G218rh.aqt
Title: G218 @ GMF Gypsum Pond – Rising Head Test
Date: 11/28/16
Time: 09:25:51

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: G218

AQUIFER DATA

Saturated Thickness: 14.16 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G218

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.87 ft
Static Water Column Height: 14.16 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.44 ft
Total Well Penetration Depth: 14.16 ft

No. of Observations: 99

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.887	0.3008	2.558	2.316	1.494
0.004167	2.872	0.3218	2.54	2.456	1.444
0.008333	2.856	0.3438	2.519	2.606	1.391
0.0125	2.839	0.3678	2.504	2.766	1.342
0.01667	2.834	0.3928	2.484	2.926	1.279
0.02083	2.826	0.4188	2.468	3.106	1.228
0.025	2.821	0.4469	2.446	3.296	1.171
0.02917	2.811	0.4768	2.428	3.496	1.116
0.03333	2.806	0.5078	2.407	3.706	1.057
0.0375	2.799	0.5418	2.382	3.926	1.001
0.04167	2.79	0.5768	2.359	4.166	0.941
0.04583	2.781	0.6138	2.338	4.416	0.89
0.05183	2.782	0.6538	2.315	4.676	0.84

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.05785	2.772	0.6958	2.284	4.956	0.785
0.06585	2.753	0.7398	2.263	5.256	0.732
0.07183	2.749	0.7868	2.229	5.566	0.676
0.07883	2.738	0.8368	2.203	5.906	0.624
0.08693	2.732	0.8898	2.166	6.256	0.581
0.09583	2.73	0.9458	2.136	6.626	0.534
0.104	2.715	1.006	2.099	7.026	0.488
0.1138	2.686	1.066	2.068	7.446	0.449
0.1238	2.704	1.136	2.03	7.886	0.406
0.1338	2.698	1.206	1.991	8.356	0.366
0.1448	2.684	1.276	1.956	8.856	0.335
0.1568	2.673	1.356	1.914	9.386	0.296
0.1698	2.662	1.446	1.872	9.946	0.266
0.1828	2.639	1.526	1.83	10.55	0.241
0.1968	2.647	1.626	1.787	11.15	0.216
0.2118	2.627	1.726	1.737	11.85	0.195
0.2278	2.614	1.826	1.695	12.55	0.172
0.2438	2.599	1.936	1.651	13.25	0.15
0.2618	2.588	2.056	1.602	14.05	0.139
0.2808	2.568	2.186	1.546	14.95	0.126

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00041	cm/sec
Ss	0.0001	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.177 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0004113	3.569E-5	+/- 7.084E-5	11.53	cm/sec
Ss	0.0001095	4.481E-5	+/- 8.895E-5	2.444	ft^{-1}
Kz/Kr	1.	0.8554	+/- 1.698	1.169	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.1775 cm²/sec

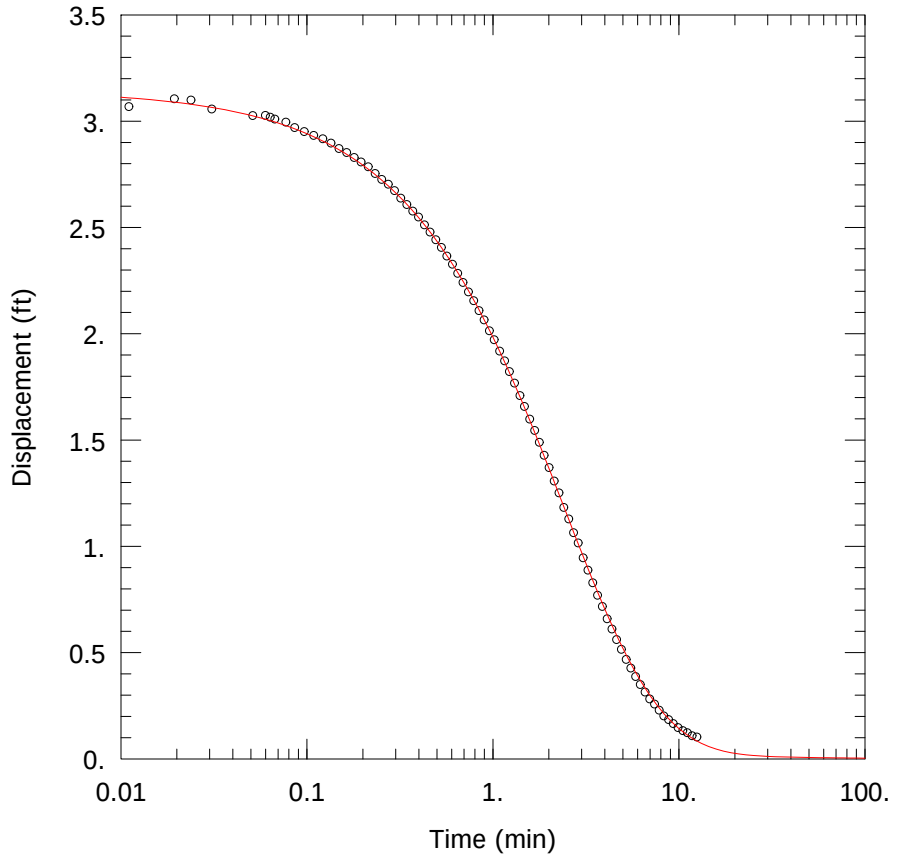
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-1.00	-1.00
Ss	-1.00	1.00	0.99
Kz/Kr	-1.00	0.99	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.01553 ft^2
Variance . . . . . 0.0001617 ft^2
Std. Deviation . . . . . 0.01272 ft
Mean. . . . . -0.004094 ft
No. of Residuals 99
No. of Estimates. 3



G270 @ GMF RECYCLE POND – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G270
Test Date: 16 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00055 cm/sec
Ss = 0.0002 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 16.41 ft

WELL DATA (G270)

Initial Displacement: 3.15 ft
Total Well Penetration Depth: 16.41 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 16.41 ft
Screen Length: 4.79 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G270fh.aqt
Title: G270 @ GMF Recycle Pond – Falling Head Test
Date: 11/28/16
Time: 09:26:15

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 16 Jun 2016
Test Well: G270

AQUIFER DATA

Saturated Thickness: 16.41 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G270

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 3.15 ft
Static Water Column Height: 16.41 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.79 ft
Total Well Penetration Depth: 16.41 ft

No. of Observations: 86

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	3.166	0.3988	2.549	2.558	1.129
0.003684	3.185	0.4288	2.512	2.718	1.064
0.007367	3.122	0.4598	2.478	2.878	1.016
0.01105	3.068	0.4938	2.442	3.058	0.946
0.0194	3.105	0.5288	2.406	3.248	0.888
0.02382	3.099	0.5658	2.365	3.448	0.828
0.03082	3.057	0.6059	2.327	3.658	0.77
0.05118	3.026	0.6478	2.284	3.878	0.717
0.05982	3.027	0.6918	2.241	4.118	0.659
0.06355	3.019	0.7388	2.197	4.368	0.611
0.06725	3.01	0.7888	2.155	4.628	0.561
0.07712	2.995	0.8418	2.109	4.908	0.515
0.08595	2.97	0.8978	2.065	5.208	0.468

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.09682	2.951	0.9578	2.014	5.518	0.427
0.1088	2.933	1.018	1.972	5.858	0.387
0.1218	2.917	1.088	1.918	6.208	0.35
0.1348	2.897	1.158	1.872	6.578	0.314
0.1488	2.871	1.228	1.822	6.978	0.282
0.1638	2.852	1.308	1.768	7.398	0.258
0.1798	2.829	1.398	1.709	7.838	0.229
0.1958	2.808	1.478	1.658	8.308	0.202
0.2138	2.785	1.578	1.598	8.808	0.185
0.2328	2.754	1.678	1.545	9.338	0.166
0.2528	2.726	1.778	1.489	9.898	0.147
0.2738	2.703	1.888	1.428	10.5	0.133
0.2958	2.673	2.008	1.37	11.1	0.123
0.3198	2.638	2.138	1.307	11.8	0.109
0.3448	2.608	2.268	1.251	12.5	0.103
0.3708	2.577	2.408	1.183		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00055	cm/sec
Ss	0.0002	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.2751 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0005615	2.665E-5	+/- 5.3E-5	21.07	cm/sec
Ss	0.0001649	3.741E-5	+/- 7.442E-5	4.408	ft^{-1}
Kz/Kr	1.	0.4806	+/- 0.9559	2.081	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.2809 cm²/sec

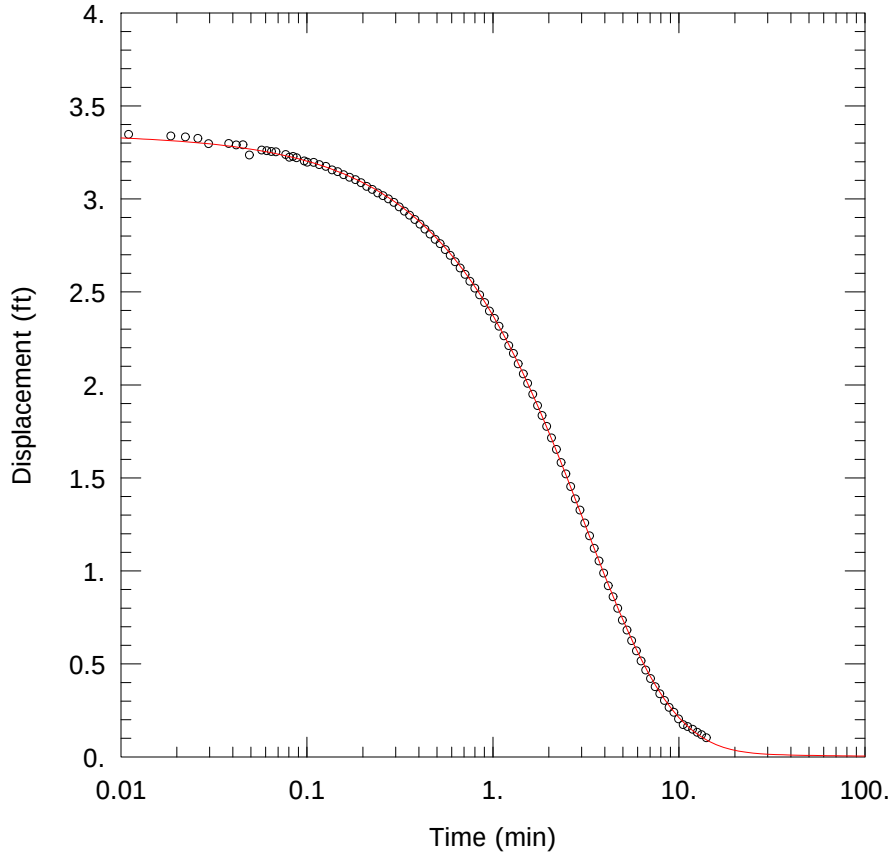
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-1.00
Ss	-0.99	1.00	0.98
Kz/Kr	-1.00	0.98	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.01042 ft^2
Variance . . . . . 0.0001255 ft^2
Std. Deviation . . . . . 0.0112 ft
Mean. . . . . 0.001403 ft
No. of Residuals 86
No. of Estimates. 3



G270 @ GMF RECYCLE POND – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G270
Test Date: 16 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00048 cm/sec
Ss = 3.0E-5 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 16.41 ft

WELL DATA (G270)

Initial Displacement: 3.35 ft
Total Well Penetration Depth: 16.41 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 16.41 ft
Screen Length: 4.79 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G270rh.aqt
Title: G270 @ GMF Recycle Pond – Rising Head Test
Date: 11/28/16
Time: 09:26:36

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 16 Jun 2016
Test Well: G270

AQUIFER DATA

Saturated Thickness: 16.41 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G270

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 3.35 ft
Static Water Column Height: 16.41 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.79 ft
Total Well Penetration Depth: 16.41 ft

No. of Observations: 102

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	3.415	0.2566	3.017	2.069	1.715
0.003683	3.383	0.2747	3.	2.199	1.653
0.00735	3.366	0.2937	2.981	2.329	1.582
0.01102	3.347	0.3136	2.957	2.469	1.521
0.01857	3.338	0.3347	2.934	2.619	1.453
0.02223	3.333	0.3567	2.912	2.779	1.387
0.02595	3.325	0.3806	2.889	2.939	1.327
0.02962	3.297	0.4057	2.864	3.119	1.257
0.03803	3.298	0.4316	2.837	3.309	1.188
0.04172	3.29	0.4597	2.811	3.509	1.121
0.0454	3.291	0.4896	2.782	3.719	1.053
0.04907	3.236	0.5206	2.759	3.939	0.988
0.05722	3.262	0.5546	2.727	4.179	0.92

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.06092	3.259	0.5897	2.696	4.429	0.861
0.06458	3.255	0.6267	2.662	4.689	0.799
0.06827	3.253	0.6666	2.628	4.969	0.735
0.07693	3.238	0.7087	2.594	5.269	0.682
0.08063	3.224	0.7527	2.557	5.579	0.625
0.08433	3.228	0.7996	2.52	5.919	0.57
0.08803	3.221	0.8497	2.484	6.269	0.516
0.09683	3.204	0.9026	2.443	6.639	0.467
0.1006	3.197	0.9587	2.397	7.039	0.421
0.1089	3.196	1.019	2.357	7.459	0.377
0.1167	3.184	1.079	2.315	7.899	0.339
0.1267	3.175	1.149	2.264	8.369	0.303
0.1366	3.156	1.219	2.211	8.869	0.266
0.1467	3.146	1.289	2.169	9.399	0.24
0.1577	3.13	1.369	2.113	9.959	0.204
0.1697	3.116	1.459	2.059	10.56	0.173
0.1827	3.103	1.539	2.008	11.16	0.163
0.1956	3.087	1.639	1.95	11.86	0.148
0.2097	3.067	1.739	1.889	12.56	0.132
0.2246	3.051	1.839	1.835	13.26	0.119
0.2407	3.032	1.949	1.777	14.06	0.103

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00048	cm/sec
Ss	3.0E-5	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.2401 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0004785	5.292E-5	+/- 0.000105	9.043	cm/sec
Ss	3.353E-5	1.819E-5	+/- 3.61E-5	1.843	ft^{-1}
Kz/Kr	1.	1.096	+/- 2.175	0.912	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error

No estimation window

T = K*b = 0.2394 cm²/sec

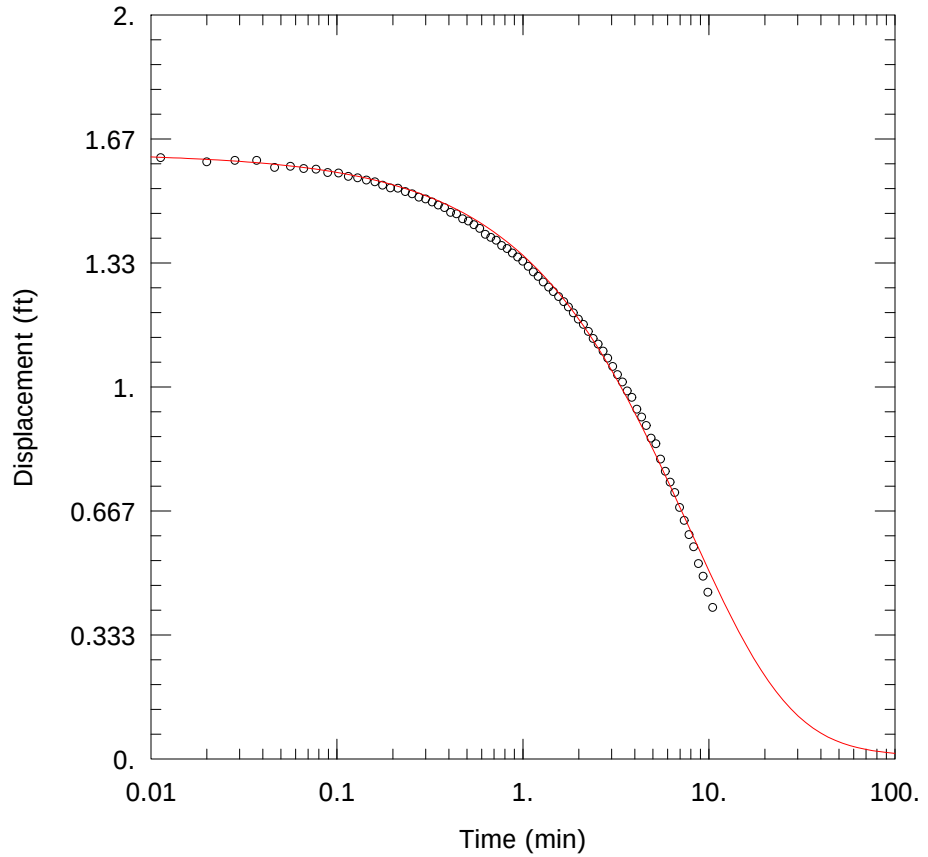
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-1.00
Ss	-0.99	1.00	0.99
Kz/Kr	-1.00	0.99	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.01528 ft^2
Variance . . . . . 0.0001544 ft^2
Std. Deviation . . . . . 0.01242 ft
Mean. . . . . 0.001996 ft
No. of Residuals 102
No. of Estimates. 3



G271 @ GMF RECYCLE POND – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G271
Test Date: 15 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00016 cm/sec
Ss = 0.0007 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 7.36 ft

WELL DATA (G271)

Initial Displacement: 1.63 ft
Total Well Penetration Depth: 7.36 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 7.36 ft
Screen Length: 4.35 ft
Well Radius: 0.08333 ft

Diagnostic Statistics

Estimation complete! Parameter change criterion (ETOL) reached.

Aquifer Model: Confined
Solution Method: KGS Model

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.000162	1.925E-5	+/- 3.835E-5	8.418	cm/sec
Ss	0.0007608	0.0002807	+/- 0.0005592	2.71	ft^{-1}
Kz/Kr	1.	1.965	+/- 3.914	0.5089	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.03635 cm^2/sec

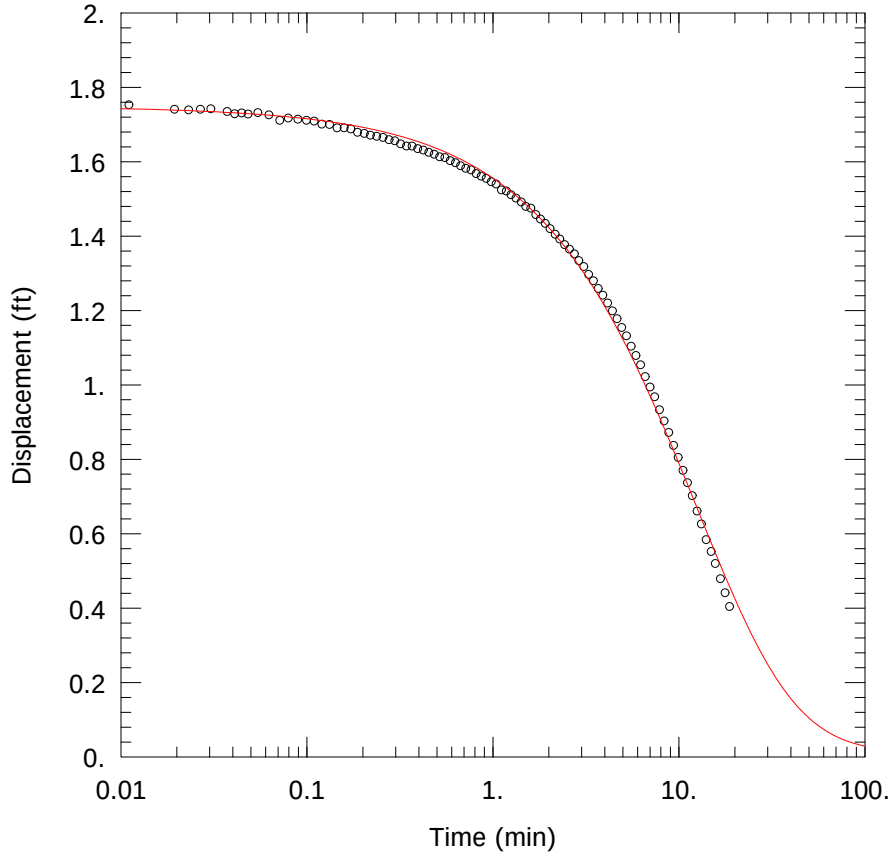
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.97	-0.97
Ss	-0.97	1.00	0.88
Kz/Kr	-0.97	0.88	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.02832 ft^2
Variance . . . . . 0.0003726 ft^2
Std. Deviation . . . . . 0.0193 ft
Mean. . . . . -0.002737 ft
No. of Residuals 79
No. of Estimates. 3



G271 @ GMF RECYCLE POND – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G271
Test Date: 15 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00011 cm/sec
Ss = 0.0003 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 7.36 ft

WELL DATA (G271)

Initial Displacement: 1.75 ft
Total Well Penetration Depth: 7.36 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 7.36 ft
Screen Length: 4.35 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G271rh.aqt
Title: G271 @ GMF Recycle Pond – Rising Head Test
Date: 11/28/16
Time: 09:27:29

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 15 Jun 2016
Test Well: G271

AQUIFER DATA

Saturated Thickness: 7.36 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G271

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.75 ft
Static Water Column Height: 7.36 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.35 ft
Total Well Penetration Depth: 7.36 ft

No. of Observations: 99

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	1.752	0.3685	1.642	2.902	1.334
0.003667	1.759	0.3945	1.635	3.082	1.318
0.00735	1.758	0.4225	1.631	3.272	1.297
0.01105	1.753	0.4525	1.625	3.471	1.28
0.01943	1.741	0.4835	1.62	3.682	1.259
0.02312	1.739	0.5175	1.613	3.902	1.241
0.02678	1.741	0.5525	1.611	4.141	1.22
0.03045	1.742	0.5895	1.603	4.391	1.199
0.03727	1.735	0.6295	1.597	4.652	1.178
0.04097	1.729	0.6715	1.589	4.931	1.154
0.04467	1.731	0.7155	1.582	5.231	1.132
0.04837	1.728	0.7625	1.578	5.542	1.104
0.0545	1.732	0.8125	1.568	5.882	1.079

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.06252	1.726	0.8655	1.561	6.231	1.054
0.0715	1.711	0.9215	1.555	6.601	1.022
0.0795	1.717	0.9815	1.546	7.002	0.994
0.0895	1.714	1.042	1.54	7.422	0.968
0.09952	1.711	1.111	1.524	7.862	0.933
0.1095	1.709	1.182	1.521	8.332	0.903
0.1205	1.701	1.252	1.511	8.832	0.872
0.1325	1.7	1.331	1.502	9.361	0.837
0.1455	1.691	1.422	1.492	9.922	0.805
0.1585	1.691	1.502	1.48	10.52	0.77
0.1725	1.688	1.601	1.475	11.13	0.737
0.1875	1.679	1.702	1.458	11.82	0.702
0.2035	1.676	1.802	1.446	12.52	0.661
0.2195	1.671	1.912	1.434	13.22	0.626
0.2375	1.668	2.031	1.42	14.02	0.584
0.2565	1.665	2.162	1.405	14.92	0.552
0.2765	1.659	2.292	1.392	15.72	0.52
0.2975	1.656	2.432	1.377	16.72	0.479
0.3195	1.648	2.582	1.365	17.72	0.441
0.3435	1.642	2.741	1.352	18.72	0.404

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00011	cm/sec
Ss	0.0003	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.02468 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0001097	2.066E-5	+/- 4.102E-5	5.308	cm/sec
Ss	0.0002898	0.0001997	+/- 0.0003965	1.451	ft^{-1}
Kz/Kr	1.	2.523	+/- 5.007	0.3964	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.02461 cm²/sec

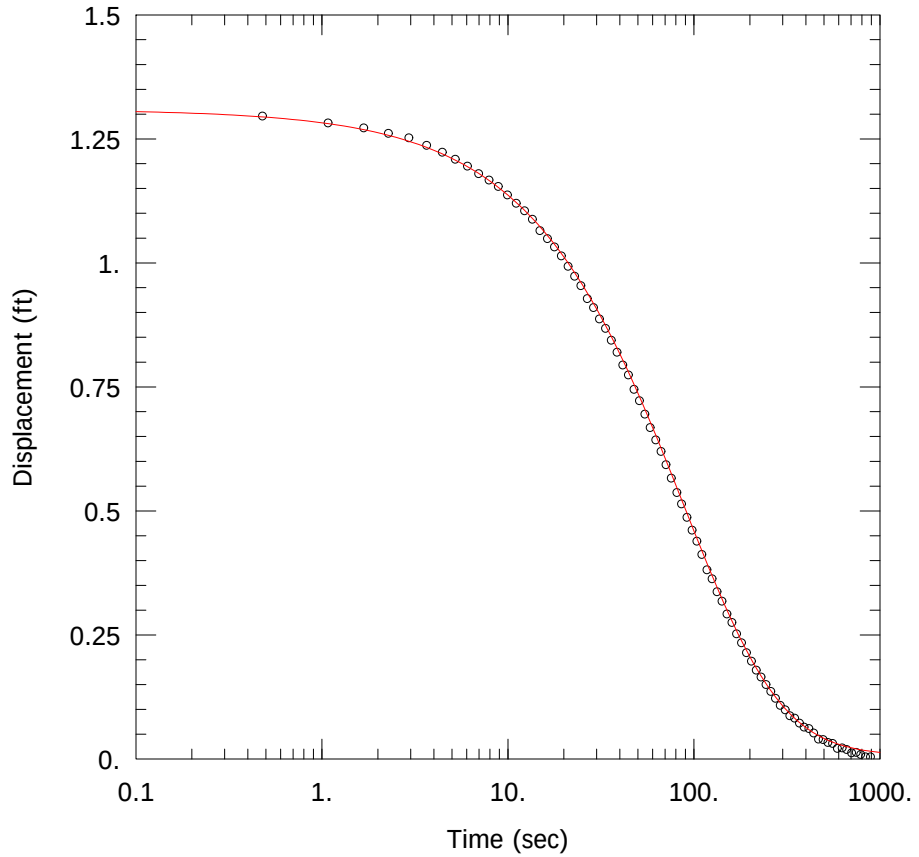
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.99
Ss	-0.99	1.00	0.97
Kz/Kr	-0.99	0.97	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.02807 ft^2
Variance . . . . . 0.0002924 ft^2
Std. Deviation . . . . . 0.0171 ft
Mean. . . . . -0.003834 ft
No. of Residuals 99
No. of Estimates. 3



G273 @ GMF RECYCLE POND – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G273
Test Date: 16 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.001 cm/sec
Ss = 9.0E-5 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 6.69 ft

WELL DATA (G273)

Initial Displacement: 1.31 ft
Total Well Penetration Depth: 6.69 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 6.69 ft
Screen Length: 4.48 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G273fh.aqt
Title: G273 @ GMF Recycle Pond – Falling Head Test
Date: 11/28/16
Time: 09:27:52

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 16 Jun 2016
Test Well: G273

AQUIFER DATA

Saturated Thickness: 6.69 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G273

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.31 ft
Static Water Column Height: 6.69 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.48 ft
Total Well Penetration Depth: 6.69 ft

No. of Observations: 89

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
-3.499	1.386	22.86	0.973	169.8	0.252
-3.249	1.325	24.72	0.954	180.6	0.234
-2.85	1.405	26.76	0.928	192.	0.214
-2.639	1.363	28.86	0.91	204.	0.197
-2.279	1.387	31.08	0.887	216.6	0.179
-1.859	1.36	33.48	0.868	229.8	0.165
-1.439	1.343	36.	0.844	244.2	0.15
-1.02	1.331	38.64	0.82	259.2	0.136
0.	1.307	41.46	0.794	274.8	0.122
0.48	1.296	44.46	0.774	291.6	0.108
1.081	1.282	47.64	0.745	309.6	0.099
1.681	1.272	51.	0.722	328.2	0.087
2.281	1.261	54.6	0.695	348.6	0.082

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
2.94	1.252	58.2	0.668	369.6	0.072
3.66	1.237	62.4	0.643	391.8	0.064
4.44	1.223	66.6	0.62	415.8	0.061
5.22	1.209	70.8	0.593	441.	0.052
6.061	1.195	75.65	0.566	467.4	0.04
6.96	1.18	81.	0.537	495.6	0.039
7.92	1.167	85.8	0.514	525.6	0.033
8.88	1.154	91.8	0.487	557.4	0.031
9.96	1.137	97.8	0.461	591.	0.021
11.1	1.12	103.8	0.439	627.	0.022
12.3	1.105	110.4	0.412	663.	0.019
13.56	1.088	117.6	0.381	705.	0.012
14.88	1.065	125.4	0.363	747.	0.013
16.32	1.049	133.2	0.337	789.	0.009
17.82	1.032	141.6	0.318	837.	0.004
19.38	1.014	150.6	0.292	891.	0.004
21.06	0.993	160.2	0.275		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.001	cm/sec
Ss	9.0E-5	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.2039 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.001024	0.0001056	+/- 0.0002099	9.693	cm/sec
Ss	8.684E-5	3.541E-5	+/- 7.039E-5	2.452	ft^{-1}
Kz/Kr	1.	2.292	+/- 4.557	0.4362	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.2087 cm²/sec

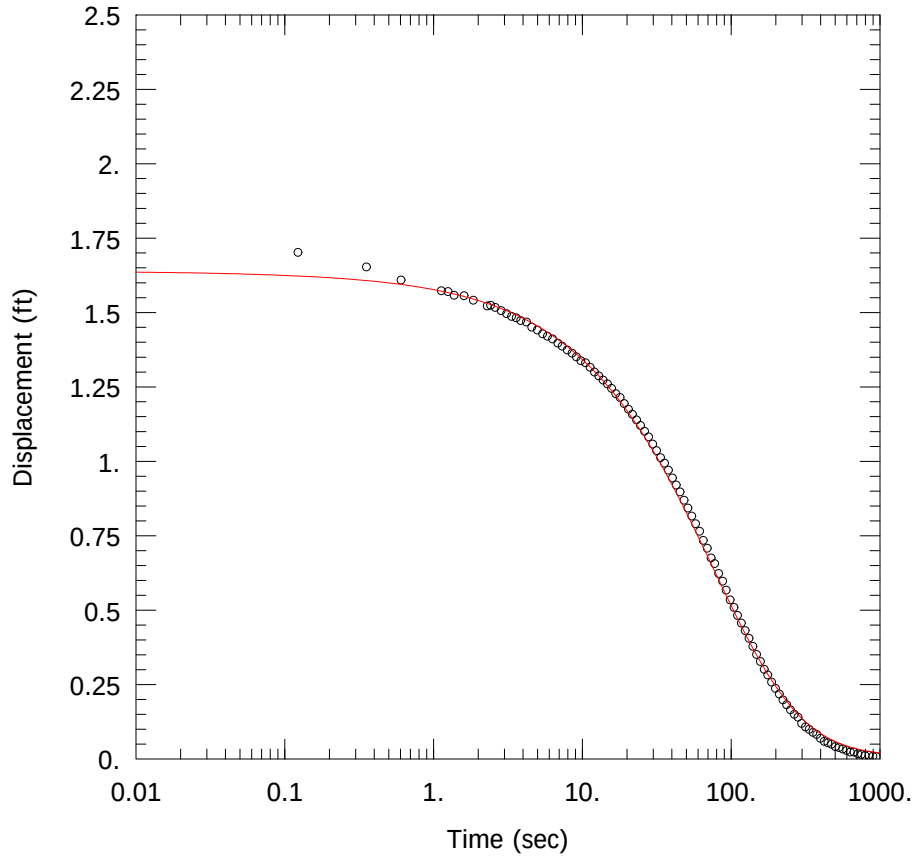
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.47	-0.92
Ss	-0.47	1.00	0.11
Kz/Kr	-0.92	0.11	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.02896 ft^2
Variance . . . . . 0.0003367 ft^2
Std. Deviation . . . . . 0.01835 ft
Mean. . . . . 0.004437 ft
No. of Residuals 89
No. of Estimates. 3



G273 @ GMF RECYCLE POND – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G273
Test Date: 16 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00083 cm/sec
Ss = 0.0015 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 6.69 ft

WELL DATA (G273)

Initial Displacement: 1.64 ft
Total Well Penetration Depth: 6.69 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 6.69 ft
Screen Length: 4.48 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G273rh.aqt
Title: G273 @ GMF Recycle Pond – Rising Head Test
Date: 11/28/16
Time: 09:28:15

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 16 Jun 2016
Test Well: G273

AQUIFER DATA

Saturated Thickness: 6.69 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G273

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.64 ft
Static Water Column Height: 6.69 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.48 ft
Total Well Penetration Depth: 6.69 ft

No. of Observations: 105

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	1.692	15.73	1.245	132.3	0.405
0.123	1.702	16.82	1.227	140.1	0.378
0.355	1.653	17.95	1.214	148.5	0.351
0.605	1.609	19.16	1.194	157.5	0.327
1.131	1.573	20.41	1.175	167.1	0.301
1.254	1.57	21.73	1.158	176.7	0.282
1.377	1.558	23.18	1.139	187.5	0.258
1.605	1.556	24.68	1.12	198.9	0.237
1.855	1.541	26.23	1.101	210.9	0.218
2.298	1.522	27.91	1.082	223.5	0.198
2.421	1.524	29.73	1.058	236.7	0.182
2.605	1.517	31.57	1.036	251.1	0.165
2.855	1.506	33.62	1.012	266.1	0.15

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
3.105	1.496	35.72	0.994	281.7	0.14
3.355	1.487	37.94	0.97	298.5	0.119
3.605	1.482	40.34	0.944	316.5	0.107
3.855	1.473	42.85	0.92	335.1	0.099
4.215	1.468	45.49	0.897	355.5	0.089
4.575	1.451	48.31	0.869	376.5	0.082
4.995	1.441	51.31	0.843	398.7	0.069
5.415	1.428	54.49	0.816	422.7	0.059
5.835	1.42	57.85	0.79	447.9	0.054
6.315	1.411	61.45	0.765	474.3	0.049
6.855	1.397	65.06	0.734	502.5	0.041
7.335	1.387	69.25	0.708	532.5	0.038
7.935	1.374	73.45	0.675	564.3	0.033
8.535	1.363	77.66	0.656	597.9	0.028
9.136	1.351	82.45	0.623	633.9	0.023
9.795	1.338	87.86	0.597	669.9	0.023
10.52	1.331	92.66	0.567	711.9	0.017
11.3	1.316	98.66	0.534	753.9	0.015
12.07	1.3	104.7	0.509	795.9	0.011
12.91	1.287	110.7	0.482	843.9	0.012
13.82	1.273	117.3	0.456	897.9	0.009
14.78	1.26	124.5	0.431	945.9	0.008

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00083	cm/sec
Ss	0.0015	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.1692 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0008319	7.881E-5	+/- 0.0001563	10.56	cm/sec
Ss	0.001271	0.0003781	+/- 0.0007497	3.362	ft^{-1}
Kz/Kr	1.	1.63	+/- 3.232	0.6135	

C.I. is approximate 95% confidence interval for parameter

t-ratio = estimate/std. error
No estimation window

T = K*b = 0.1696 cm^2/sec

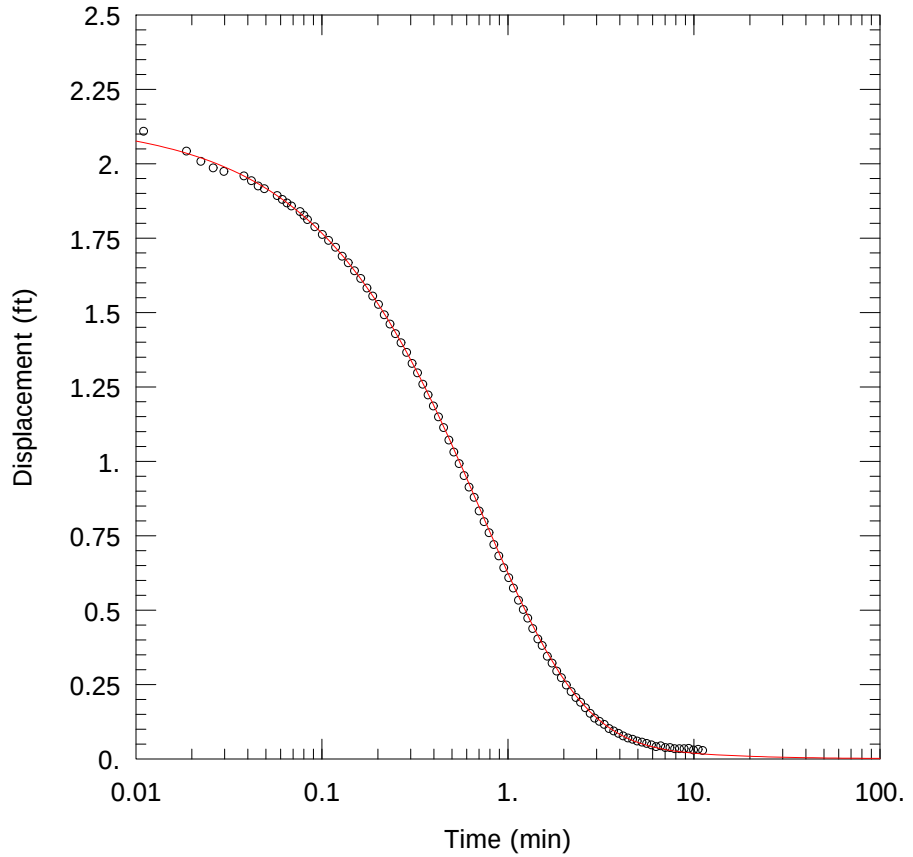
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.98
Ss	-0.99	1.00	0.95
Kz/Kr	-0.98	0.95	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.02784 ft^2
Variance . . . . . 0.000273 ft^2
Std. Deviation . . . . . 0.01652 ft
Mean. . . . . -0.003839 ft
No. of Residuals 105
No. of Estimates. 3



G279 @ GMF RECYCLE POND – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G279
Test Date: 15 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0017 cm/sec
Ss = 0.0007 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 7. ft

WELL DATA (G279)

Initial Displacement: 2.15 ft
Total Well Penetration Depth: 7. ft
Casing Radius: 0.08333 ft

Static Water Column Height: 7. ft
Screen Length: 4.39 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G279fh.aqt
Title: G279 @ GMF Recycle Pond – Falling Head Test
Date: 11/28/16
Time: 09:28:43

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 15 Jun 2016
Test Well: G279

AQUIFER DATA

Saturated Thickness: 7. ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G279

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.15 ft
Static Water Column Height: 7. ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.39 ft
Total Well Penetration Depth: 7. ft

No. of Observations: 96

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.068	0.2487	1.429	1.831	0.295
0.003683	2.003	0.2667	1.398	1.941	0.273
0.00735	2.023	0.2857	1.366	2.061	0.248
0.011	2.109	0.3057	1.329	2.191	0.226
0.0187	2.042	0.3267	1.297	2.321	0.206
0.02238	2.008	0.3487	1.259	2.461	0.19
0.02607	1.986	0.3727	1.223	2.611	0.172
0.02973	1.974	0.3977	1.186	2.771	0.153
0.0381	1.959	0.4237	1.149	2.931	0.137
0.0418	1.943	0.4517	1.113	3.111	0.126
0.04547	1.925	0.4817	1.071	3.301	0.116
0.04915	1.916	0.5127	1.031	3.501	0.102
0.05758	1.893	0.5467	0.992	3.711	0.094

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.06127	1.88	0.5817	0.952	3.931	0.086
0.06497	1.868	0.6187	0.913	4.171	0.077
0.06865	1.858	0.6587	0.879	4.421	0.07
0.07633	1.839	0.7007	0.833	4.681	0.066
0.08003	1.826	0.7447	0.797	4.961	0.06
0.08372	1.812	0.7917	0.76	5.261	0.056
0.09167	1.788	0.8417	0.72	5.571	0.052
0.1007	1.762	0.8947	0.682	5.911	0.047
0.1087	1.742	0.9507	0.642	6.261	0.041
0.1187	1.719	1.011	0.609	6.631	0.044
0.1287	1.689	1.071	0.574	7.031	0.038
0.1387	1.667	1.141	0.533	7.451	0.038
0.1497	1.64	1.211	0.502	7.891	0.034
0.1617	1.614	1.281	0.473	8.361	0.034
0.1747	1.582	1.361	0.438	8.861	0.034
0.1877	1.555	1.451	0.403	9.391	0.035
0.2017	1.527	1.531	0.381	9.951	0.03
0.2167	1.492	1.631	0.345	10.55	0.032
0.2327	1.461	1.731	0.322	11.15	0.028

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.0017	cm/sec
Ss	0.0007	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.3627 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.001719	0.0001754	+/- 0.0003483	9.798	cm/sec
Ss	0.0007021	0.0002498	+/- 0.000496	2.811	ft^{-1}
Kz/Kr	1.	1.488	+/- 2.955	0.672	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.3667 cm^2/sec

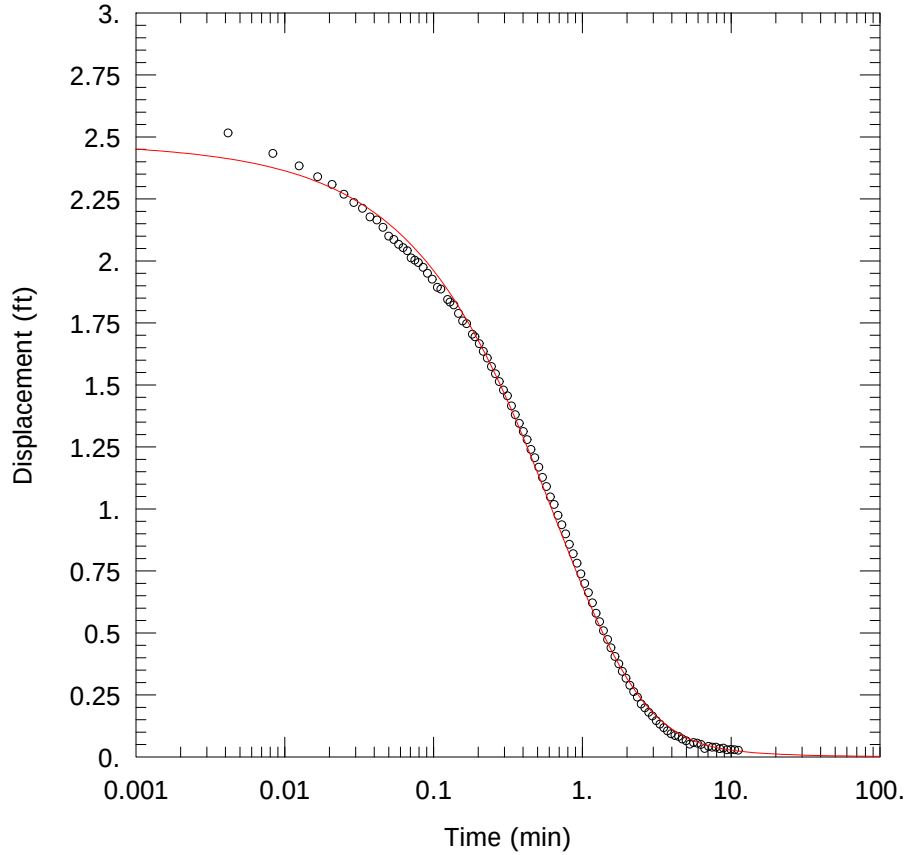
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.99
Ss	-0.99	1.00	0.97
Kz/Kr	-0.99	0.97	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.02749 ft^2
Variance . . . . . 0.0002956 ft^2
Std. Deviation . . . . . 0.01719 ft
Mean. . . . . -0.0009089 ft
No. of Residuals 96
No. of Estimates. 3



G279 @ GMF RECYCLE POND – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G279
Test Date: 15 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0015 cm/sec
Ss = 0.0025 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 7. ft

WELL DATA (G279)

Initial Displacement: 2.48 ft
Total Well Penetration Depth: 7. ft
Casing Radius: 0.08333 ft

Static Water Column Height: 7. ft
Screen Length: 4.39 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G279rh.aqt
Title: G279 @ GMF Recycle Pond – Rising Head Test
Date: 11/28/16
Time: 10:43:04

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 15 Jun 2016
Test Well: G279

AQUIFER DATA

Saturated Thickness: 7. ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G279

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.48 ft
Static Water Column Height: 7. ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.39 ft
Total Well Penetration Depth: 7. ft

No. of Observations: 102

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.581	0.2162	1.635	1.659	0.405
0.004167	2.516	0.2302	1.608	1.759	0.375
0.008333	2.433	0.2452	1.574	1.859	0.345
0.0125	2.383	0.2612	1.545	1.969	0.317
0.01667	2.339	0.2772	1.513	2.089	0.289
0.02083	2.308	0.2952	1.479	2.219	0.263
0.025	2.269	0.3142	1.456	2.349	0.241
0.02917	2.235	0.3342	1.415	2.489	0.213
0.03333	2.212	0.3552	1.38	2.639	0.198
0.0375	2.177	0.3772	1.345	2.799	0.18
0.04167	2.165	0.4012	1.312	2.959	0.165
0.04583	2.135	0.4262	1.279	3.139	0.146
0.05	2.1	0.4522	1.24	3.329	0.132

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.05417	2.086	0.4802	1.206	3.529	0.118
0.05833	2.067	0.5102	1.168	3.739	0.105
0.0625	2.053	0.5412	1.127	3.959	0.093
0.06667	2.041	0.5752	1.09	4.199	0.086
0.07083	2.012	0.6102	1.048	4.449	0.082
0.075	2.003	0.6472	1.018	4.709	0.072
0.07917	1.993	0.6872	0.974	4.989	0.065
0.08517	1.974	0.7292	0.936	5.291	0.051
0.09117	1.95	0.7732	0.899	5.599	0.058
0.09817	1.926	0.8202	0.857	5.939	0.055
0.1062	1.893	0.8702	0.819	6.289	0.05
0.1122	1.886	0.9232	0.781	6.659	0.034
0.1245	1.844	0.9792	0.738	7.059	0.042
0.1292	1.834	1.039	0.699	7.479	0.039
0.1372	1.822	1.099	0.662	7.919	0.039
0.1472	1.788	1.169	0.621	8.389	0.033
0.1572	1.758	1.239	0.579	8.889	0.035
0.1672	1.747	1.309	0.545	9.419	0.029
0.1829	1.704	1.389	0.509	9.979	0.03
0.1902	1.694	1.479	0.473	10.58	0.029
0.2032	1.666	1.559	0.44	11.18	0.027

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.0015	cm/sec
Ss	0.0025	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.32 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.001475	0.0001155	+/- 0.0002292	12.77	cm/sec
Ss	0.00256	0.0005911	+/- 0.001173	4.331	ft^{-1}
Kz/Kr	1.	1.448	+/- 2.872	0.6908	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error

No estimation window

T = K*b = 0.3147 cm²/sec

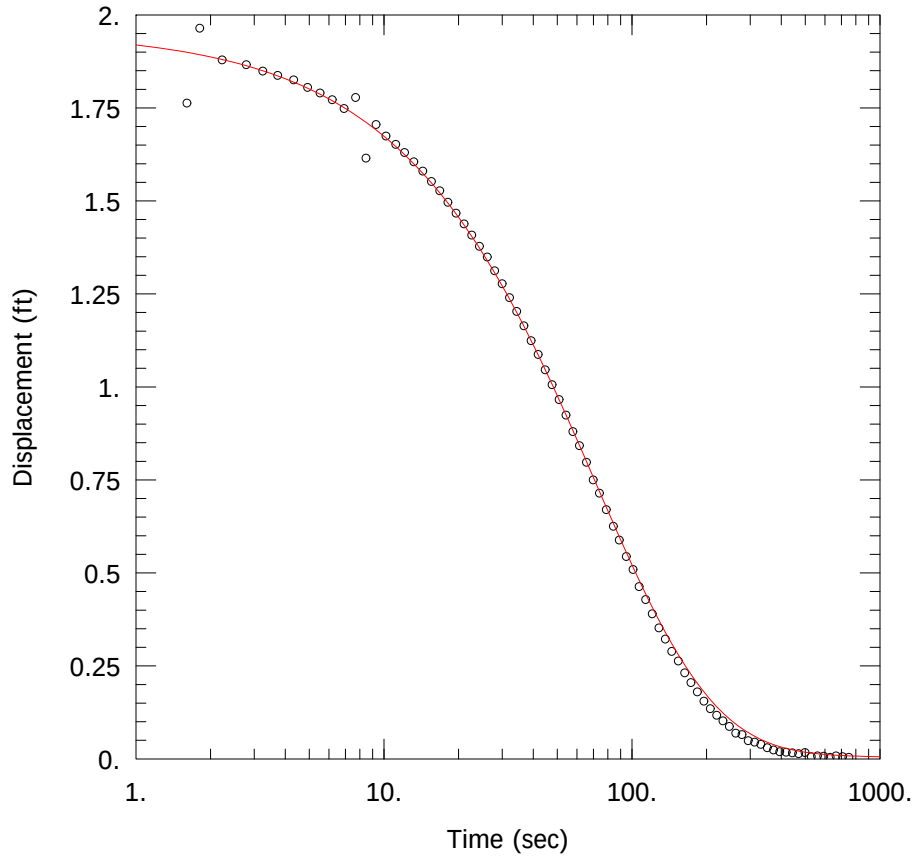
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.98	-0.96
Ss	-0.98	1.00	0.91
Kz/Kr	-0.96	0.91	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.08946 ft^2
Variance . . . . . 0.0009036 ft^2
Std. Deviation . . . . . 0.03006 ft
Mean. . . . . -0.004822 ft
No. of Residuals 102
No. of Estimates. 3



G280 @ GMF RECYCLE POND – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G280
Test Date: 17 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00125 cm/sec
Ss = 2.0E-5 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 15.26 ft

WELL DATA (G280)

Initial Displacement: 1.96 ft
Total Well Penetration Depth: 15.26 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 15.26 ft
Screen Length: 4.84 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G280fh.aqt
Title: G280 @ GMF Recycle Pond – Falling Head Test
Date: 11/28/16
Time: 09:29:18

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 17 Jun 2016
Test Well: G280

AQUIFER DATA

Saturated Thickness: 15.26 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G280

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.96 ft
Static Water Column Height: 15.26 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.84 ft
Total Well Penetration Depth: 15.26 ft

No. of Observations: 86

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	1.974	24.31	1.378	153.8	0.263
0.417	1.933	26.11	1.349	163.4	0.231
0.61	1.928	27.97	1.312	173.1	0.205
0.971	1.913	30.01	1.277	183.8	0.18
1.607	1.763	32.11	1.24	195.3	0.155
1.81	1.964	34.33	1.203	207.3	0.135
2.23	1.879	36.73	1.164	219.8	0.117
2.789	1.866	39.25	1.124	233.1	0.102
3.25	1.849	41.89	1.087	247.4	0.087
3.73	1.837	44.71	1.046	262.4	0.069
4.33	1.825	47.71	1.006	278.	0.065
4.93	1.805	50.89	0.966	294.8	0.049
5.53	1.79	54.25	0.924	312.8	0.045

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
6.19	1.772	57.85	0.88	331.4	0.039
6.91	1.748	61.45	0.842	351.8	0.03
7.69	1.778	65.65	0.797	372.8	0.024
8.47	1.615	69.85	0.75	395.	0.019
9.31	1.705	74.05	0.714	419.	0.018
10.21	1.674	78.85	0.67	444.3	0.016
11.17	1.652	84.25	0.625	470.6	0.014
12.13	1.63	89.05	0.588	499.	0.017
13.21	1.605	95.05	0.544	528.8	0.006
14.35	1.58	101.1	0.509	560.6	0.008
15.55	1.552	107.1	0.463	594.2	0.007
16.81	1.527	113.6	0.428	630.4	0.004
18.13	1.496	120.8	0.39	666.2	0.008
19.57	1.467	128.7	0.352	708.2	0.006
21.07	1.438	136.4	0.322	750.2	0.004
22.63	1.408	144.8	0.289		

SOLUTION

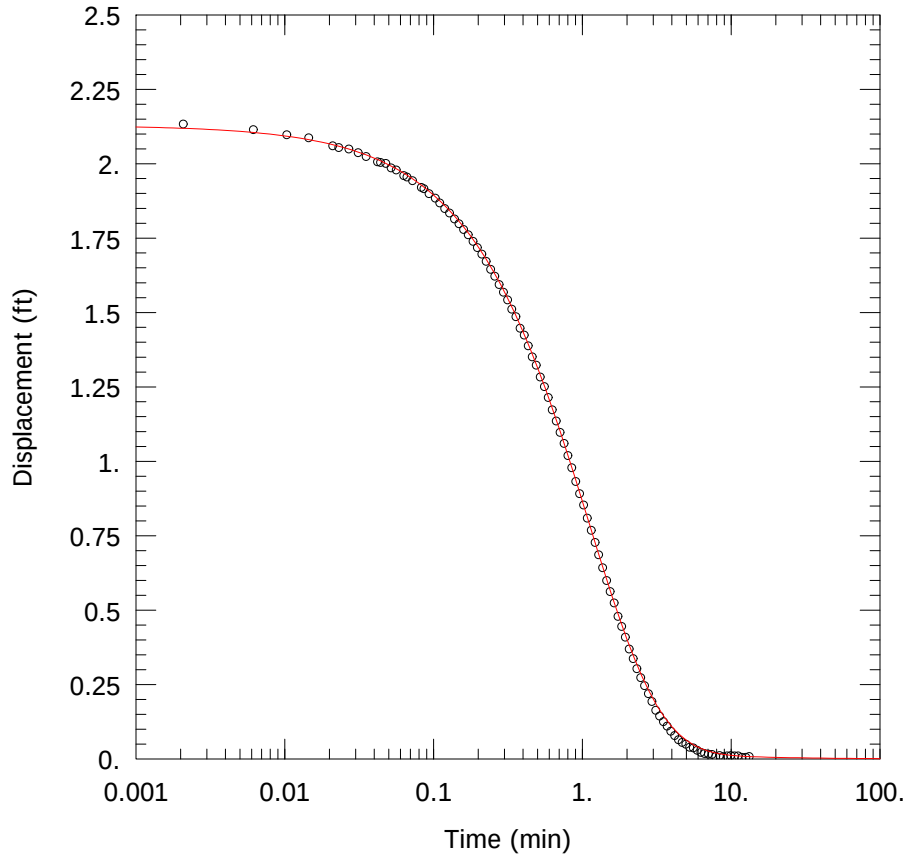
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00125	cm/sec
Ss	2.0E-5	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.5814 cm^2/sec



G280 @ GMF RECYCLE POND – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G280
Test Date: 17 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0013 cm/sec
Ss = 6.0E-5 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 15.26 ft

WELL DATA (G280)

Initial Displacement: 2.13 ft
Total Well Penetration Depth: 15.26 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 15.26 ft
Screen Length: 4.84 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G280rh.aqt
Title: G280 @ GMF Recycle Pond – Rising Head Test
Date: 11/28/16
Time: 09:29:41

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 17 Jun 2016
Test Well: G280

AQUIFER DATA

Saturated Thickness: 15.26 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G280

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.13 ft
Static Water Column Height: 15.26 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.84 ft
Total Well Penetration Depth: 15.26 ft

No. of Observations: 101

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.135	0.2583	1.622	2.07	0.369
0.002083	2.133	0.2763	1.594	2.2	0.337
0.006167	2.114	0.2953	1.568	2.33	0.303
0.01033	2.097	0.3153	1.542	2.47	0.273
0.0145	2.087	0.3363	1.511	2.62	0.246
0.02105	2.06	0.3583	1.486	2.78	0.219
0.0231	2.054	0.3823	1.447	2.94	0.193
0.027	2.049	0.4073	1.424	3.12	0.163
0.03117	2.037	0.4333	1.388	3.31	0.144
0.03533	2.024	0.4613	1.351	3.51	0.125
0.04208	2.006	0.4913	1.323	3.72	0.11
0.04413	2.004	0.5223	1.283	3.94	0.093
0.04783	2.001	0.5563	1.251	4.18	0.078

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.052	1.986	0.5913	1.214	4.43	0.064
0.05617	1.979	0.6283	1.173	4.69	0.055
0.0631	1.96	0.6683	1.135	4.97	0.049
0.06633	1.955	0.7103	1.097	5.27	0.039
0.07235	1.943	0.7543	1.06	5.58	0.037
0.08297	1.92	0.8013	1.019	5.921	0.029
0.08633	1.916	0.8513	0.978	6.27	0.022
0.09333	1.899	0.9043	0.932	6.64	0.018
0.103	1.884	0.9603	0.891	7.04	0.016
0.1103	1.868	1.02	0.853	7.46	0.015
0.1191	1.849	1.08	0.809	7.9	0.008
0.1283	1.834	1.15	0.768	8.37	0.011
0.1383	1.814	1.22	0.727	8.87	0.007
0.1483	1.798	1.29	0.686	9.4	0.01
0.1593	1.779	1.37	0.642	9.96	0.011
0.1713	1.761	1.46	0.599	10.56	0.01
0.1843	1.739	1.54	0.562	11.16	0.01
0.1973	1.718	1.64	0.524	11.86	0.005
0.2113	1.696	1.74	0.479	12.56	0.005
0.2263	1.672	1.84	0.445	13.26	0.008
0.2423	1.645	1.95	0.409		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.0013	cm/sec
Ss	6.0E-5	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.6047 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.001322	0.0001102	+/- 0.0002187	11.99	cm/sec
Ss	5.714E-5	2.337E-5	+/- 4.636E-5	2.445	ft^{-1}
Kz/Kr	1.	0.8362	+/- 1.659	1.196	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error

No estimation window

T = K*b = 0.6148 cm²/sec

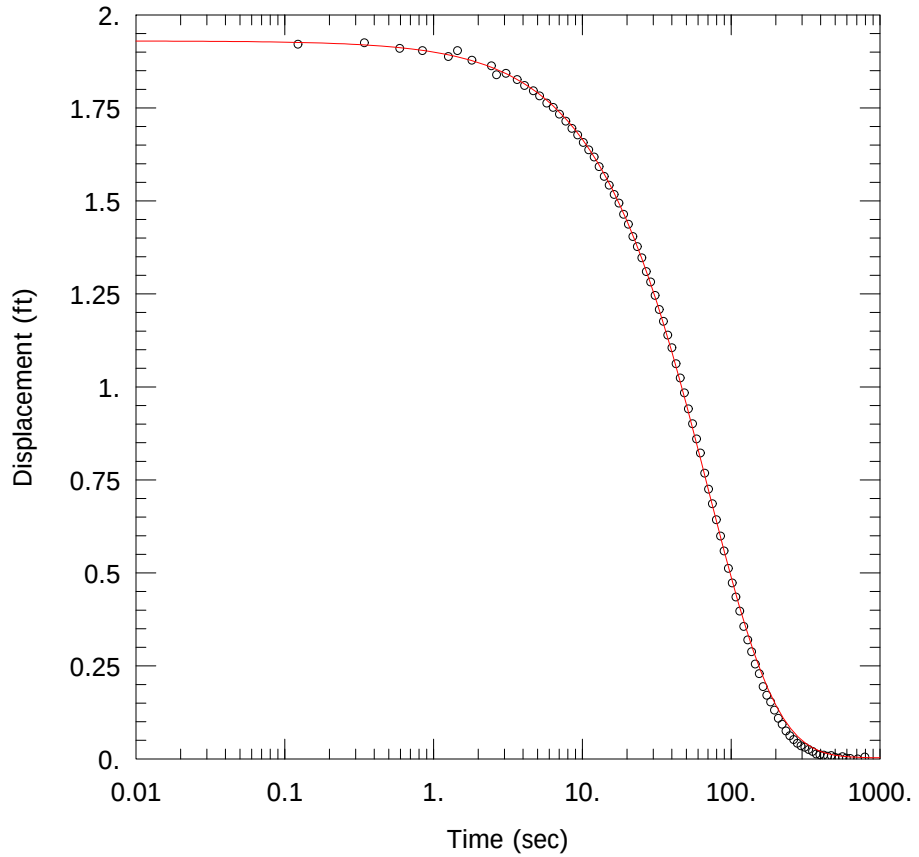
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-1.00
Ss	-0.99	1.00	0.99
Kz/Kr	-1.00	0.99	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.005558 ft^2
Variance . . . . . 5.672E-5 ft^2
Std. Deviation . . . . . 0.007531 ft
Mean. . . . . -0.002476 ft
No. of Residuals 101
No. of Estimates. 3



G281 @ ASH POND 2 – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G281
Test Date: 17 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0021 cm/sec
Ss = 2.0E-12 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 15.8 ft

WELL DATA (G281)

Initial Displacement: 1.93 ft
Total Well Penetration Depth: 15.8 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 15.8 ft
Screen Length: 4.65 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G281fh.aqt
Title: G281 @ Ash Pond 2 – Falling Head Test
Date: 11/28/16
Time: 09:30:07

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 17 Jun 2016
Test Well: G281

AQUIFER DATA

Saturated Thickness: 15.8 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G281

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.93 ft
Static Water Column Height: 15.8 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.65 ft
Total Well Penetration Depth: 15.8 ft

No. of Observations: 91

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	1.951	21.91	1.404	154.7	0.229
0.123	1.921	23.47	1.377	164.3	0.194
0.344	1.925	25.15	1.347	173.9	0.171
0.594	1.91	26.95	1.31	184.7	0.153
0.844	1.904	28.81	1.282	196.1	0.131
1.261	1.888	30.85	1.246	208.1	0.109
1.453	1.904	32.95	1.208	220.7	0.093
1.816	1.878	35.17	1.176	233.9	0.075
2.451	1.863	37.57	1.139	248.3	0.062
2.653	1.839	40.09	1.105	263.3	0.052
3.073	1.843	42.73	1.062	278.9	0.042
3.651	1.826	45.55	1.024	295.7	0.035
4.093	1.81	48.55	0.984	313.7	0.031

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
4.689	1.796	51.73	0.941	332.3	0.025
5.173	1.782	55.09	0.901	352.7	0.02
5.774	1.763	58.69	0.86	373.7	0.013
6.374	1.751	62.29	0.822	395.9	0.011
7.033	1.733	66.49	0.768	419.9	0.01
7.753	1.714	70.69	0.725	445.1	0.007
8.533	1.695	74.89	0.686	471.5	0.009
9.313	1.677	79.69	0.643	499.7	0.004
10.15	1.657	85.09	0.599	529.7	0.002
11.05	1.637	89.89	0.559	561.5	0.006
12.01	1.618	95.89	0.512	595.1	0.002
12.97	1.592	101.9	0.473	631.1	0.001
14.05	1.566	107.9	0.435	667.1	-0.001
15.19	1.542	114.5	0.397	709.1	0.
16.39	1.517	121.7	0.356	751.1	-0.003
17.65	1.494	129.5	0.32	793.2	0.005
18.97	1.464	137.3	0.288		
20.41	1.437	145.7	0.255		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.0021	cm/sec
Ss	2.0E-12	ft^{-1}
Kz/Kr	1.	

T = K*b = 1.011 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.002112	0.0008403	+/- 0.00167	2.513	cm/sec
Ss	1.86E-12	9.133E-9	+/- 1.815E-8	0.0002036	ft^{-1}
Kz/Kr	1.	2098.5	+/- 4169.8	0.0004765	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 1.017 cm²/sec

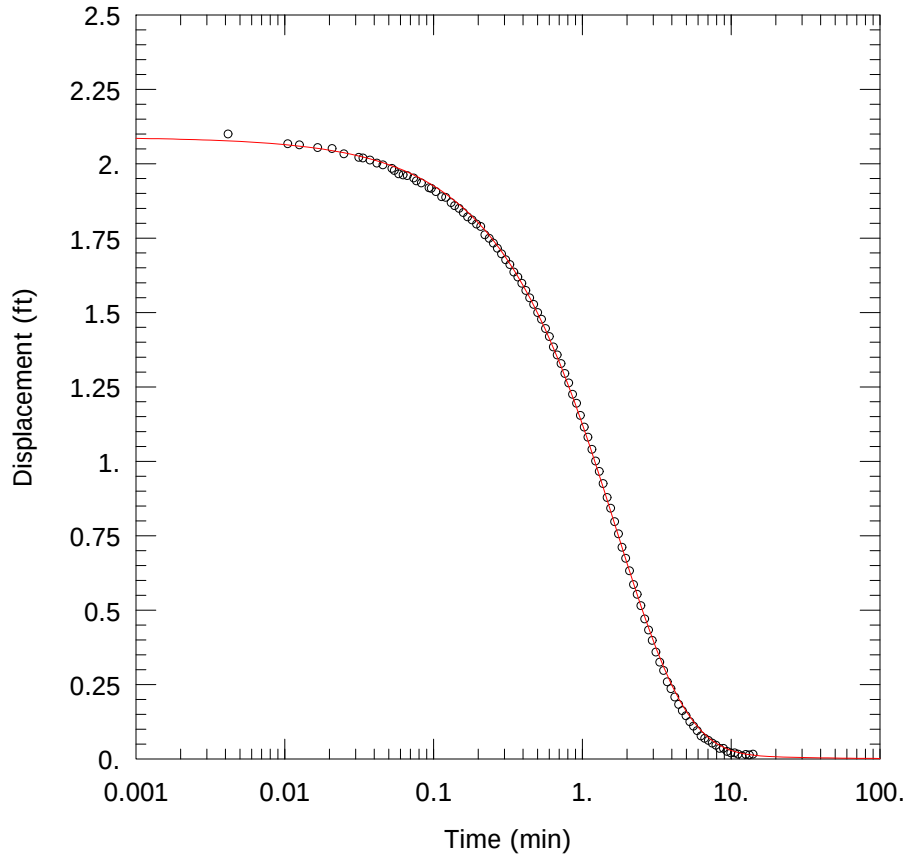
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.97	0.97
Ss	-0.97	1.00	-1.00
Kz/Kr	0.97	-1.00	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.01011 ft^2
Variance . . . . . 0.0001149 ft^2
Std. Deviation . . . . . 0.01072 ft
Mean. . . . . -0.00248 ft
No. of Residuals 91
No. of Estimates. 3



G281 @ ASH POND 2 – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G281
Test Date: 17 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00089 cm/sec
Ss = 6.2E-5 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 15.8 ft

WELL DATA (G281)

Initial Displacement: 2.09 ft
Total Well Penetration Depth: 15.8 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 15.8 ft
Screen Length: 4.65 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G281rh.aqt
Title: G281 @ Ash Pond 2 – Rising Head Test
Date: 11/28/16
Time: 09:31:04

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 17 Jun 2016
Test Well: G281

AQUIFER DATA

Saturated Thickness: 15.8 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G281

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.09 ft
Static Water Column Height: 15.8 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.65 ft
Total Well Penetration Depth: 15.8 ft

No. of Observations: 104

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.116	0.2528	1.733	2.081	0.632
0.004167	2.1	0.2688	1.716	2.211	0.586
0.0105	2.067	0.2868	1.697	2.341	0.553
0.01257	2.063	0.3058	1.677	2.481	0.515
0.01667	2.054	0.3258	1.661	2.631	0.47
0.02083	2.051	0.3468	1.636	2.791	0.433
0.025	2.033	0.3688	1.619	2.951	0.398
0.03152	2.021	0.3928	1.598	3.131	0.359
0.03358	2.019	0.4178	1.574	3.321	0.325
0.0375	2.012	0.4438	1.549	3.521	0.297
0.04167	2.002	0.4718	1.527	3.731	0.259
0.04583	1.996	0.5018	1.5	3.951	0.236
0.05258	1.984	0.5328	1.477	4.191	0.208

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.05465	1.977	0.5668	1.446	4.441	0.183
0.05833	1.966	0.6018	1.419	4.701	0.162
0.0625	1.962	0.6388	1.384	4.981	0.145
0.06667	1.96	0.6788	1.357	5.281	0.125
0.07362	1.952	0.7208	1.328	5.591	0.11
0.07682	1.942	0.7648	1.295	5.931	0.095
0.08287	1.935	0.8118	1.263	6.281	0.077
0.09345	1.919	0.8618	1.225	6.651	0.069
0.09682	1.917	0.9148	1.195	7.051	0.062
0.1038	1.906	0.9708	1.154	7.471	0.053
0.1135	1.889	1.031	1.115	7.911	0.046
0.1208	1.887	1.091	1.081	8.381	0.035
0.1316	1.869	1.161	1.04	8.881	0.035
0.1388	1.859	1.231	1.001	9.411	0.025
0.1488	1.85	1.301	0.966	9.971	0.02
0.1588	1.836	1.381	0.925	10.57	0.02
0.1698	1.821	1.471	0.878	11.17	0.016
0.1818	1.811	1.551	0.842	11.87	0.01
0.1948	1.797	1.651	0.797	12.57	0.015
0.2078	1.789	1.751	0.756	13.27	0.013
0.2218	1.761	1.851	0.711	14.07	0.016
0.2368	1.749	1.961	0.674		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00089	cm/sec
Ss	6.2E-5	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.4286 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0008928	0.0001189	+/- 0.0002359	7.51	cm/sec
Ss	6.185E-5	4.021E-5	+/- 7.978E-5	1.538	ft^{-1}
Kz/Kr	1.	1.309	+/- 2.598	0.7637	

C.I. is approximate 95% confidence interval for parameter

t-ratio = estimate/std. error
No estimation window

T = K*b = 0.4299 cm²/sec

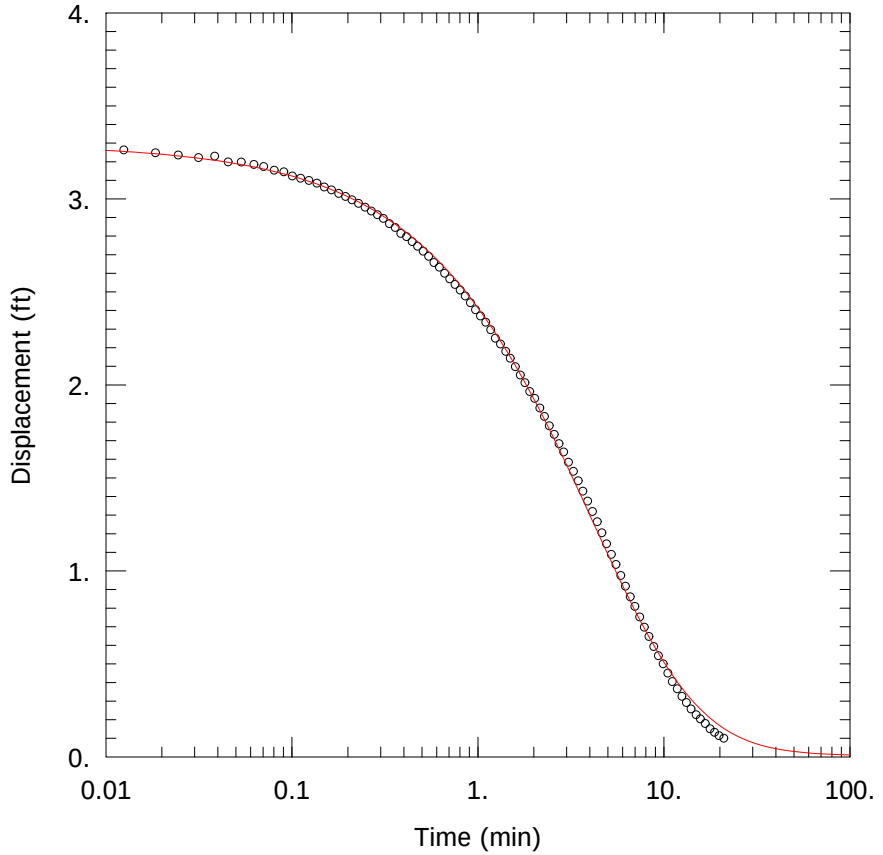
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-1.00	-1.00
Ss	-1.00	1.00	0.99
Kz/Kr	-1.00	0.99	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.01291 ft^2
Variance . . . . . 0.0001278 ft^2
Std. Deviation . . . . . 0.01131 ft
Mean. . . . . -0.003426 ft
No. of Residuals 104
No. of Estimates. 3



G301 @ ASH POND 1 – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G301
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00027 cm/sec
Ss = 0.0009 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 11.82 ft

WELL DATA (G301)

Initial Displacement: 3.3 ft
Total Well Penetration Depth: 11.82 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 11.82 ft
Screen Length: 4.65 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G301fh.aqt
Title: G301 @ Ash Pond 1 – Falling Head Test
Date: 11/28/16
Time: 09:31:30

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G301

AQUIFER DATA

Saturated Thickness: 11.82 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G301

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 3.3 ft
Static Water Column Height: 11.82 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.65 ft
Total Well Penetration Depth: 11.82 ft

No. of Observations: 97

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	3.31	0.4745	2.745	3.672	1.428
0.004167	3.255	0.5085	2.719	3.893	1.375
0.008333	3.267	0.5435	2.691	4.133	1.319
0.0125	3.263	0.5805	2.658	4.383	1.264
0.0185	3.248	0.6205	2.633	4.643	1.205
0.02452	3.236	0.6625	2.6	4.923	1.145
0.0315	3.222	0.7065	2.57	5.223	1.089
0.0385	3.23	0.7535	2.54	5.532	1.034
0.0455	3.199	0.8035	2.51	5.872	0.975
0.0535	3.198	0.8565	2.478	6.223	0.917
0.0625	3.185	0.9125	2.442	6.593	0.861
0.0705	3.174	0.9725	2.404	6.992	0.809
0.0805	3.154	1.033	2.37	7.412	0.752

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0905	3.145	1.103	2.337	7.853	0.697
0.1005	3.123	1.173	2.296	8.322	0.647
0.1115	3.111	1.242	2.251	8.822	0.593
0.1235	3.099	1.323	2.22	9.352	0.544
0.1365	3.084	1.413	2.18	9.912	0.5
0.1495	3.064	1.492	2.143	10.51	0.45
0.1635	3.048	1.593	2.098	11.11	0.405
0.1785	3.029	1.692	2.053	11.81	0.366
0.1945	3.013	1.793	2.012	12.51	0.326
0.2105	2.995	1.903	1.964	13.21	0.292
0.2285	2.976	2.023	1.927	14.01	0.258
0.2475	2.955	2.152	1.876	14.91	0.227
0.2675	2.935	2.283	1.83	15.71	0.204
0.2885	2.915	2.422	1.78	16.71	0.179
0.3105	2.895	2.572	1.734	17.72	0.151
0.3345	2.867	2.732	1.684	18.72	0.132
0.3595	2.846	2.893	1.639	19.81	0.114
0.3855	2.814	3.072	1.584	21.01	0.1
0.4135	2.797	3.263	1.535		
0.4435	2.77	3.462	1.484		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00027	cm/sec
Ss	0.0009	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.09727 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0002698	1.629E-5	+/- 3.234E-5	16.56	cm/sec
Ss	0.0008799	0.0001922	+/- 0.0003815	4.579	ft^{-1}
Kz/Kr	1.	0.8564	+/- 1.7	1.168	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.09719 cm²/sec

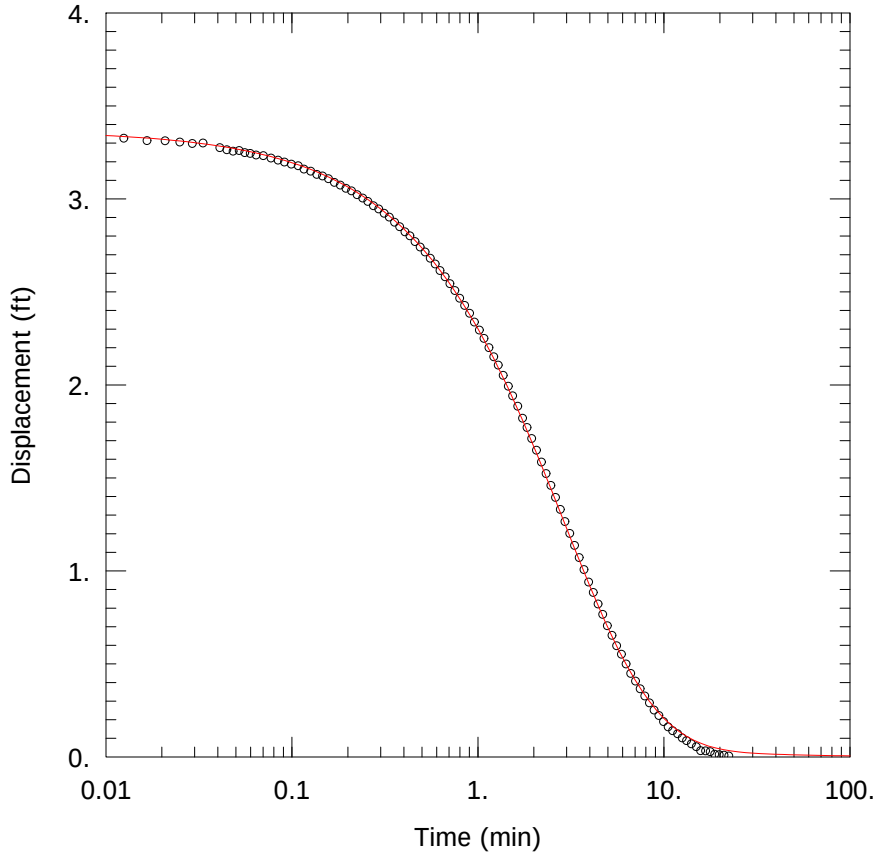
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.98	-0.97
Ss	-0.98	1.00	0.93
Kz/Kr	-0.97	0.93	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.07757 ft^2
Variance . . . . . 0.0008252 ft^2
Std. Deviation . . . . . 0.02873 ft
Mean. . . . . -0.006371 ft
No. of Residuals 97
No. of Estimates. 3



G301 @ ASH POND 1 – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G301
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0005 cm/sec
Ss = 9.0E-5 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 11.82 ft

WELL DATA (G301)

Initial Displacement: 3.37 ft
Total Well Penetration Depth: 11.82 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 11.82 ft
Screen Length: 4.65 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G301rh.aqt
Title: G301 @ Ash Pond 1 – Rising Head Test
Date: 11/28/16
Time: 09:32:12

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G301

AQUIFER DATA

Saturated Thickness: 11.82 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G301

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 3.37 ft
Static Water Column Height: 11.82 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.65 ft
Total Well Penetration Depth: 11.82 ft

No. of Observations: 112

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
-0.02083	3.462	0.2933	2.946	2.938	1.265
-0.01667	3.446	0.3133	2.923	3.118	1.201
-0.0125	3.401	0.3343	2.902	3.308	1.137
0.	3.35	0.3563	2.874	3.508	1.071
0.004167	3.343	0.3803	2.85	3.718	1.007
0.008333	3.341	0.4053	2.823	3.938	0.94
0.0125	3.326	0.4313	2.801	4.178	0.884
0.01667	3.313	0.4593	2.77	4.428	0.822
0.02083	3.312	0.4893	2.741	4.688	0.766
0.025	3.305	0.5203	2.714	4.968	0.705
0.02917	3.298	0.5543	2.681	5.268	0.653
0.03333	3.3	0.5893	2.65	5.578	0.597
0.04102	3.275	0.6263	2.615	5.918	0.552

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.04472	3.264	0.6663	2.581	6.268	0.499
0.04838	3.256	0.7083	2.544	6.638	0.449
0.05208	3.26	0.7523	2.507	7.038	0.407
0.0559	3.249	0.7993	2.466	7.465	0.366
0.05975	3.244	0.8493	2.427	7.898	0.327
0.06433	3.236	0.9023	2.385	8.368	0.29
0.07033	3.232	0.9583	2.338	8.868	0.252
0.07733	3.219	1.018	2.295	9.398	0.222
0.08433	3.208	1.078	2.25	9.958	0.19
0.09133	3.198	1.148	2.2	10.56	0.161
0.09933	3.187	1.218	2.151	11.16	0.141
0.1083	3.178	1.288	2.106	11.86	0.124
0.1163	3.16	1.368	2.051	12.56	0.102
0.1263	3.149	1.458	1.993	13.26	0.087
0.1363	3.132	1.538	1.941	14.06	0.07
0.1463	3.123	1.638	1.885	14.96	0.055
0.1573	3.108	1.738	1.821	15.76	0.033
0.1693	3.089	1.838	1.771	16.76	0.032
0.1823	3.074	1.948	1.711	17.76	0.028
0.1953	3.057	2.068	1.649	18.76	0.014
0.2093	3.043	2.198	1.585	19.86	0.012
0.2243	3.022	2.328	1.523	21.06	0.009
0.2403	3.004	2.468	1.459	22.36	0.005
0.2563	2.986	2.618	1.395		
0.2743	2.963	2.778	1.33		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.0005	cm/sec
Ss	9.0E-5	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.1801 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0004957	5.04E-5	+/- 9.988E-5	9.836	cm/sec
Ss	9.396E-5	4.339E-5	+/- 8.599E-5	2.166	ft^{-1}

Kz/Kr	1.	1.072	+/- 2.124	0.933

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.1786 cm²/sec

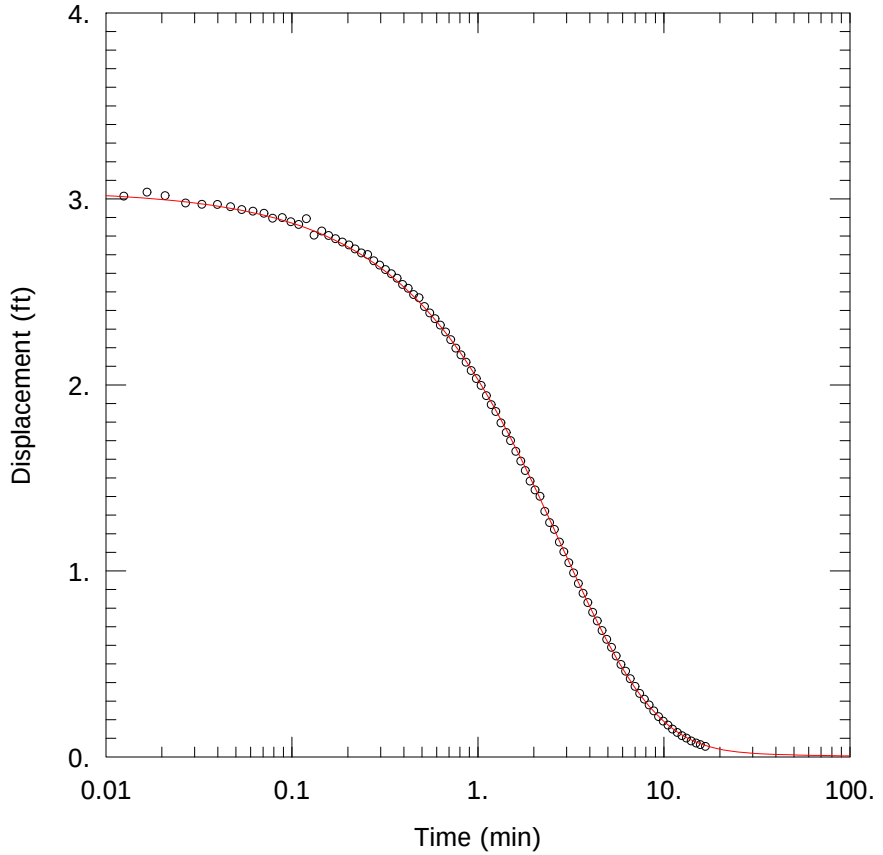
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-1.00
Ss	-0.99	1.00	0.98
Kz/Kr	-1.00	0.98	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.03615 ft^2
Variance . . . . . 0.0003317 ft^2
Std. Deviation . . . . . 0.01821 ft
Mean. . . . . -0.004631 ft
No. of Residuals 112
No. of Estimates. 3



G302 @ ASH POND 1 – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G302
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00049 cm/sec
Ss = 0.0002 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 11.37 ft

WELL DATA (G302)

Initial Displacement: 3.05 ft
Total Well Penetration Depth: 11.37 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 11.37 ft
Screen Length: 4.65 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G302fh.aqt
Title: G302 @ Ash Pond 1 – Falling Head Test
Date: 11/28/16
Time: 09:32:35

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G302

AQUIFER DATA

Saturated Thickness: 11.37 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G302

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 3.05 ft
Static Water Column Height: 11.37 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.65 ft
Total Well Penetration Depth: 11.37 ft

No. of Observations: 95

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	3.007	0.3938	2.54	2.901	1.102
0.004167	2.93	0.4218	2.519	3.081	1.044
0.008333	2.962	0.4518	2.486	3.271	0.989
0.0125	3.015	0.4828	2.468	3.471	0.932
0.01667	3.036	0.5168	2.421	3.681	0.88
0.02083	3.017	0.5518	2.387	3.901	0.83
0.02683	2.978	0.5888	2.356	4.141	0.777
0.03283	2.971	0.6288	2.321	4.391	0.731
0.03983	2.97	0.6708	2.284	4.651	0.679
0.04683	2.958	0.7148	2.243	4.931	0.632
0.05382	2.942	0.7618	2.197	5.231	0.589
0.06183	2.934	0.8118	2.161	5.541	0.542
0.07083	2.923	0.8648	2.122	5.881	0.497

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.07883	2.896	0.9208	2.077	6.231	0.461
0.08883	2.899	0.9808	2.034	6.601	0.42
0.09883	2.877	1.041	1.997	7.001	0.379
0.1088	2.862	1.111	1.942	7.421	0.341
0.1198	2.893	1.181	1.894	7.861	0.31
0.1318	2.805	1.251	1.857	8.331	0.279
0.1448	2.827	1.331	1.796	8.831	0.247
0.1578	2.803	1.421	1.744	9.361	0.216
0.1718	2.786	1.501	1.7	9.921	0.192
0.1868	2.768	1.601	1.643	10.52	0.171
0.2028	2.752	1.701	1.59	11.12	0.149
0.2188	2.731	1.801	1.539	11.82	0.131
0.2368	2.709	1.911	1.483	12.52	0.114
0.2558	2.701	2.031	1.435	13.22	0.101
0.2758	2.667	2.161	1.401	14.02	0.086
0.2968	2.644	2.291	1.32	14.92	0.074
0.3188	2.62	2.431	1.26	15.72	0.066
0.3428	2.597	2.581	1.223	16.72	0.056
0.3678	2.573	2.741	1.155		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00049	cm/sec
Ss	0.0002	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.1698 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0004933	4.307E-5	+/- 8.553E-5	11.45	cm/sec
Ss	0.0001891	7.368E-5	+/- 0.0001463	2.566	ft^{-1}
Kz/Kr	1.	0.9375	+/- 1.862	1.067	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.171 cm²/sec

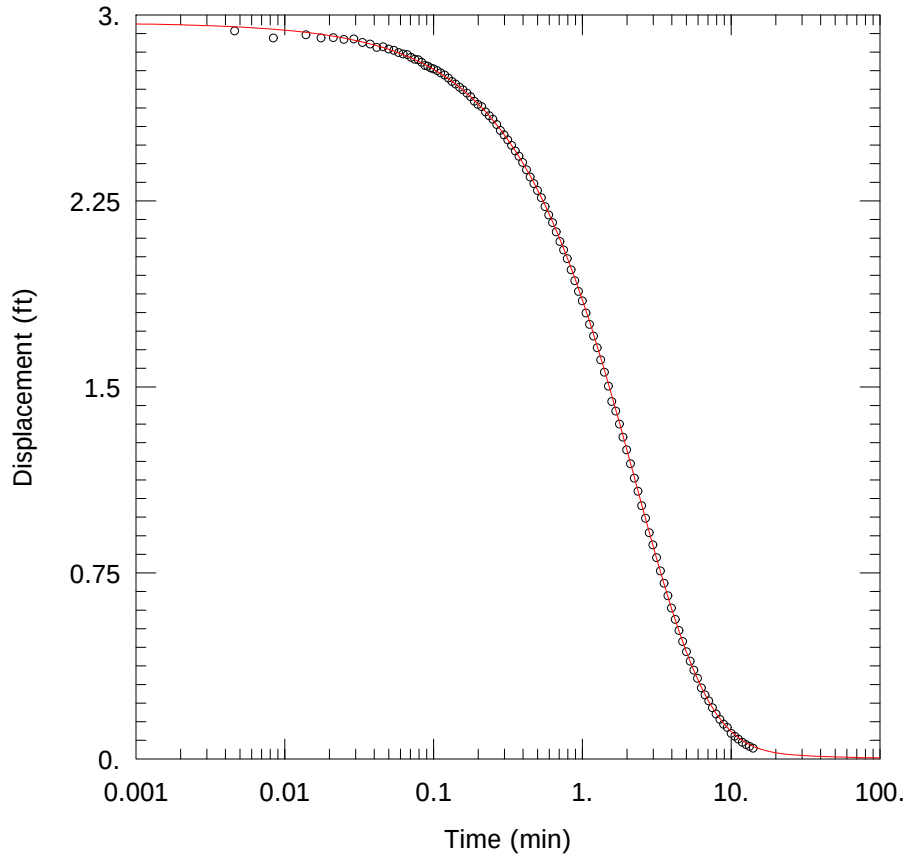
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-1.00
Ss	-0.99	1.00	0.98
Kz/Kr	-1.00	0.98	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.02827 ft^2
Variance . . . . . 0.0003073 ft^2
Std. Deviation . . . . . 0.01753 ft
Mean. . . . . 0.0006103 ft
No. of Residuals 95
No. of Estimates. 3



G302 @ ASH POND 1 – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G302
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00063 cm/sec
Ss = 0.0001 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 11.37 ft

WELL DATA (G302)

Initial Displacement: 2.97 ft
Total Well Penetration Depth: 11.37 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 11.37 ft
Screen Length: 4.65 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G302rh.aqt
Title: G302 @ Ash Pond 1 – Rising Head Test
Date: 11/28/16
Time: 09:32:58

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G302

AQUIFER DATA

Saturated Thickness: 11.37 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G302

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.97 ft
Static Water Column Height: 11.37 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.65 ft
Total Well Penetration Depth: 11.37 ft

No. of Observations: 110

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.004617	2.935	0.224	2.609	1.88	1.297
0.0084	2.907	0.237	2.593	1.99	1.246
0.01393	2.92	0.251	2.579	2.11	1.19
0.01758	2.907	0.266	2.558	2.24	1.132
0.02123	2.908	0.282	2.534	2.37	1.079
0.02502	2.901	0.298	2.516	2.511	1.021
0.02918	2.903	0.316	2.496	2.66	0.97
0.03335	2.889	0.335	2.474	2.82	0.912
0.03752	2.882	0.355	2.451	2.98	0.863
0.04168	2.869	0.376	2.43	3.16	0.811
0.04585	2.871	0.398	2.405	3.35	0.758
0.05002	2.862	0.422	2.375	3.55	0.708
0.05418	2.857	0.447	2.346	3.763	0.658

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.05835	2.848	0.473	2.32	3.98	0.608
0.06252	2.842	0.501	2.292	4.22	0.562
0.06668	2.84	0.531	2.263	4.47	0.518
0.07085	2.829	0.562	2.227	4.73	0.473
0.07502	2.821	0.596	2.193	5.015	0.432
0.07918	2.819	0.631	2.162	5.31	0.394
0.08335	2.809	0.668	2.125	5.62	0.358
0.08752	2.796	0.708	2.086	5.96	0.325
0.09168	2.793	0.75	2.052	6.31	0.286
0.09585	2.786	0.794	2.017	6.684	0.258
0.1	2.782	0.841	1.972	7.08	0.234
0.106	2.775	0.891	1.928	7.5	0.206
0.112	2.766	0.944	1.885	7.94	0.181
0.119	2.757	1.	1.847	8.41	0.159
0.126	2.745	1.06	1.798	8.91	0.14
0.133	2.731	1.12	1.752	9.44	0.127
0.141	2.721	1.19	1.705	10.	0.103
0.15	2.708	1.26	1.658	10.6	0.091
0.158	2.698	1.33	1.609	11.2	0.08
0.168	2.684	1.41	1.559	11.9	0.067
0.178	2.67	1.5	1.503	12.6	0.058
0.188	2.652	1.58	1.441	13.3	0.05
0.199	2.639	1.68	1.402	14.1	0.043
0.211	2.63	1.78	1.35		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00063	cm/sec
Ss	0.0001	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.2183 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.00063	2.361E-5	+/- 4.679E-5	26.69	cm/sec
Ss	0.0001057	1.773E-5	+/- 3.513E-5	5.966	ft^{-1}
Kz/Kr	1.	0.4005	+/- 0.7939	2.497	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.2183 cm²/sec

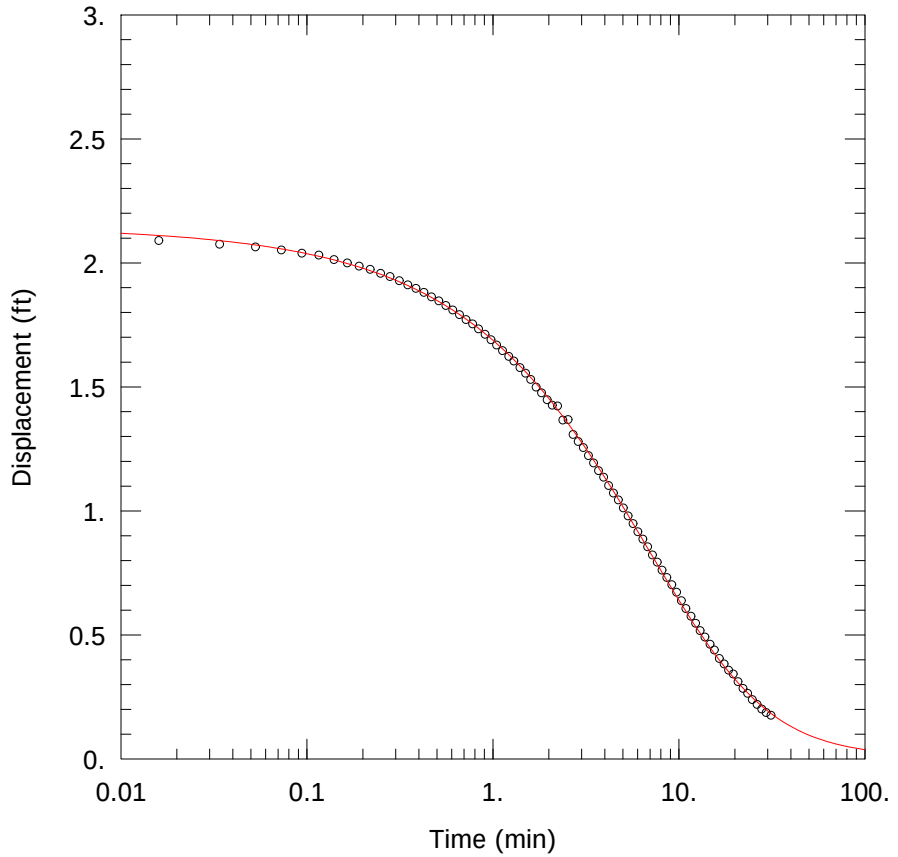
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-1.00
Ss	-0.99	1.00	0.99
Kz/Kr	-1.00	0.99	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.00378 ft^2
Variance . . . . . 3.532E-5 ft^2
Std. Deviation . . . . . 0.005943 ft
Mean. . . . . -0.0002972 ft
No. of Residuals 110
No. of Estimates. 3



G303 @ ASH POND 1 – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G303
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 5.6E-5 cm/sec
Ss = 0.002 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 17.03 ft

WELL DATA (G303)

Initial Displacement: 2.15 ft
Total Well Penetration Depth: 17.03 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 17.03 ft
Screen Length: 10. ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G303fh.aqt
Title: G303 @ Ash Pond 1 – Falling Head Test
Date: 11/28/16
Time: 09:33:23

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G303

AQUIFER DATA

Saturated Thickness: 17.03 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G303

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.15 ft
Static Water Column Height: 17.03 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 10. ft
Total Well Penetration Depth: 17.03 ft

No. of Observations: 103

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
-0.1886	2.358	0.386	1.897	4.728	1.044
-0.185	2.423	0.426	1.881	5.028	1.012
-0.1813	2.411	0.468	1.863	5.338	0.98
-0.176	2.312	0.512	1.847	5.678	0.949
-0.17	2.203	0.559	1.828	6.028	0.916
-0.163	2.162	0.609	1.81	6.398	0.886
-0.156	2.193	0.662	1.791	6.798	0.855
-0.149	2.224	0.718	1.771	7.218	0.822
-0.141	2.219	0.778	1.754	7.658	0.793
-0.132	2.193	0.838	1.734	8.128	0.761
-0.124	2.178	0.908	1.712	8.628	0.731
-0.114	2.174	0.978	1.69	9.158	0.702
-0.104	2.174	1.048	1.669	9.718	0.672

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
-0.09402	2.163	1.128	1.646	10.32	0.638
-0.08302	2.151	1.218	1.623	10.92	0.606
-0.07102	2.147	1.298	1.604	11.62	0.575
-0.05802	2.138	1.398	1.578	12.32	0.547
-0.04502	2.124	1.498	1.555	13.02	0.517
-0.03102	2.118	1.598	1.53	13.82	0.491
-0.016	2.111	1.708	1.499	14.72	0.462
0.	2.094	1.828	1.476	15.52	0.439
0.016	2.09	1.958	1.448	16.52	0.405
0.034	2.075	2.088	1.426	17.52	0.383
0.053	2.064	2.228	1.423	18.52	0.358
0.073	2.052	2.378	1.366	19.62	0.342
0.09398	2.039	2.538	1.368	20.82	0.311
0.116	2.031	2.698	1.308	22.12	0.284
0.14	2.013	2.878	1.28	23.42	0.264
0.165	2.	3.068	1.255	24.82	0.239
0.191	1.987	3.268	1.223	26.32	0.22
0.219	1.974	3.478	1.193	27.92	0.201
0.249	1.958	3.698	1.162	29.52	0.187
0.28	1.945	3.938	1.136	31.32	0.176
0.314	1.928	4.188	1.102		
0.349	1.911	4.448	1.072		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	5.6E-5	cm/sec
Ss	0.002	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.02907 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	5.383E-5	3.02E-6	+/- 5.993E-6	17.82	cm/sec
Ss	0.002308	0.0004271	+/- 0.0008474	5.403	ft^{-1}
Kz/Kr	1.	1.674	+/- 3.321	0.5974	

C.I. is approximate 95% confidence interval for parameter

t-ratio = estimate/std. error
No estimation window

T = K*b = 0.02794 cm²/sec

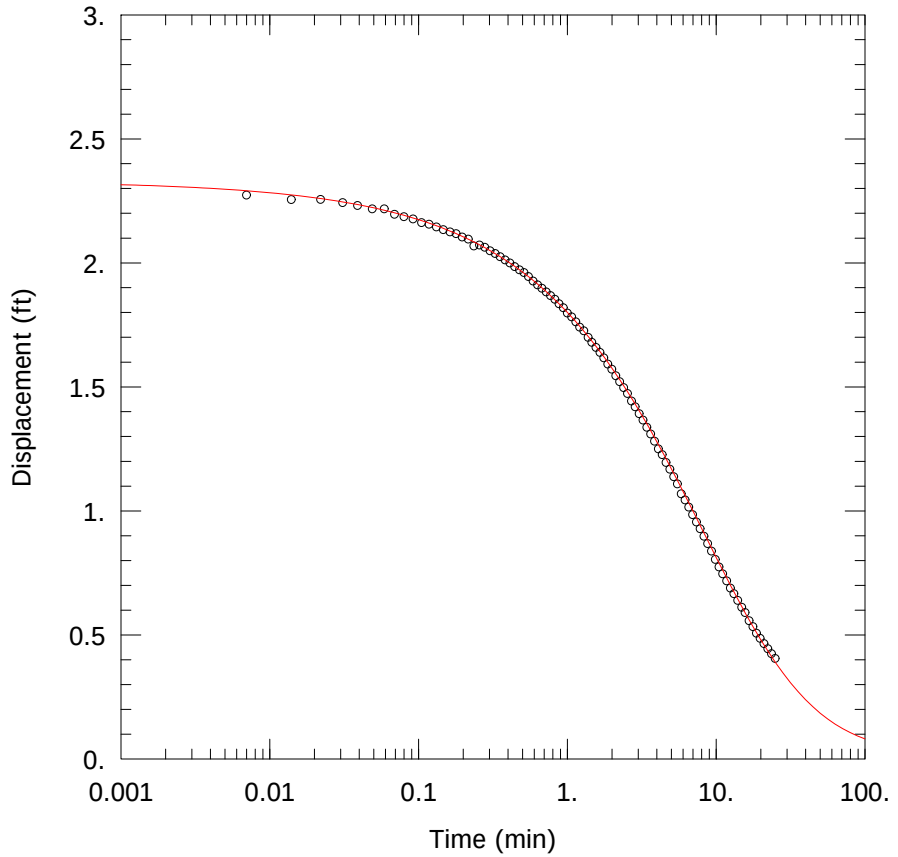
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.94	-0.51
Ss	-0.94	1.00	0.32
Kz/Kr	-0.51	0.32	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.2436 ft^2
Variance . . . . . 0.002436 ft^2
Std. Deviation . . . . . 0.04936 ft
Mean. . . . . 0.01078 ft
No. of Residuals 103
No. of Estimates. 3



G303 @ ASH POND 1 – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G303
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 3.1E-5 cm/sec
Ss = 0.0085 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 17.03 ft

WELL DATA (G303)

Initial Displacement: 2.33 ft
Total Well Penetration Depth: 17.03 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 17.03 ft
Screen Length: 10. ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G303rh.aqt
Title: G303 @ Ash Pond 1 – Rising Head Test
Date: 11/28/16
Time: 09:33:48

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G303

AQUIFER DATA

Saturated Thickness: 17.03 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G303

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.33 ft
Static Water Column Height: 17.03 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 10. ft
Total Well Penetration Depth: 17.03 ft

No. of Observations: 100

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
-0.0315	2.324	0.477	1.972	4.101	1.25
-0.02733	2.297	0.512	1.961	4.351	1.227
-0.02317	2.301	0.549	1.945	4.611	1.195
-0.019	2.32	0.589	1.927	4.891	1.168
-0.013	2.313	0.631	1.911	5.191	1.138
-0.007	2.282	0.675	1.898	5.501	1.109
0.	2.279	0.722	1.883	5.841	1.069
0.007	2.273	0.772	1.868	6.191	1.044
0.014	2.255	0.825	1.853	6.561	1.015
0.022	2.256	0.881	1.835	6.961	0.985
0.031	2.243	0.941	1.819	7.381	0.955
0.039	2.231	1.001	1.798	7.821	0.928
0.049	2.218	1.071	1.782	8.291	0.898

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.059	2.218	1.141	1.762	8.791	0.868
0.069	2.196	1.211	1.741	9.321	0.838
0.08	2.186	1.291	1.726	9.881	0.804
0.092	2.177	1.381	1.7	10.48	0.774
0.105	2.162	1.461	1.68	11.08	0.746
0.118	2.156	1.561	1.659	11.78	0.718
0.132	2.145	1.661	1.639	12.48	0.689
0.147	2.134	1.761	1.617	13.18	0.666
0.163	2.125	1.871	1.592	13.98	0.639
0.179	2.118	1.991	1.571	14.88	0.611
0.197	2.104	2.121	1.545	15.68	0.59
0.216	2.096	2.251	1.521	16.68	0.557
0.236	2.068	2.391	1.497	17.68	0.533
0.257	2.072	2.541	1.473	18.68	0.507
0.279	2.063	2.701	1.443	19.78	0.486
0.303	2.049	2.861	1.42	20.98	0.465
0.328	2.038	3.041	1.392	22.28	0.444
0.354	2.025	3.231	1.366	23.58	0.424
0.382	2.012	3.431	1.337	24.98	0.405
0.412	2.	3.641	1.31		
0.443	1.985	3.861	1.281		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	3.1E-5	cm/sec
Ss	0.0085	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.01609 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	3.152E-5	1.915E-6	+/- 3.801E-6	16.46	cm/sec
Ss	0.008559	0.0008401	+/- 0.001668	10.19	ft^{-1}
Kz/Kr	1.	7.083	+/- 14.06	0.1412	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error

No estimation window

T = K*b = 0.01636 cm²/sec

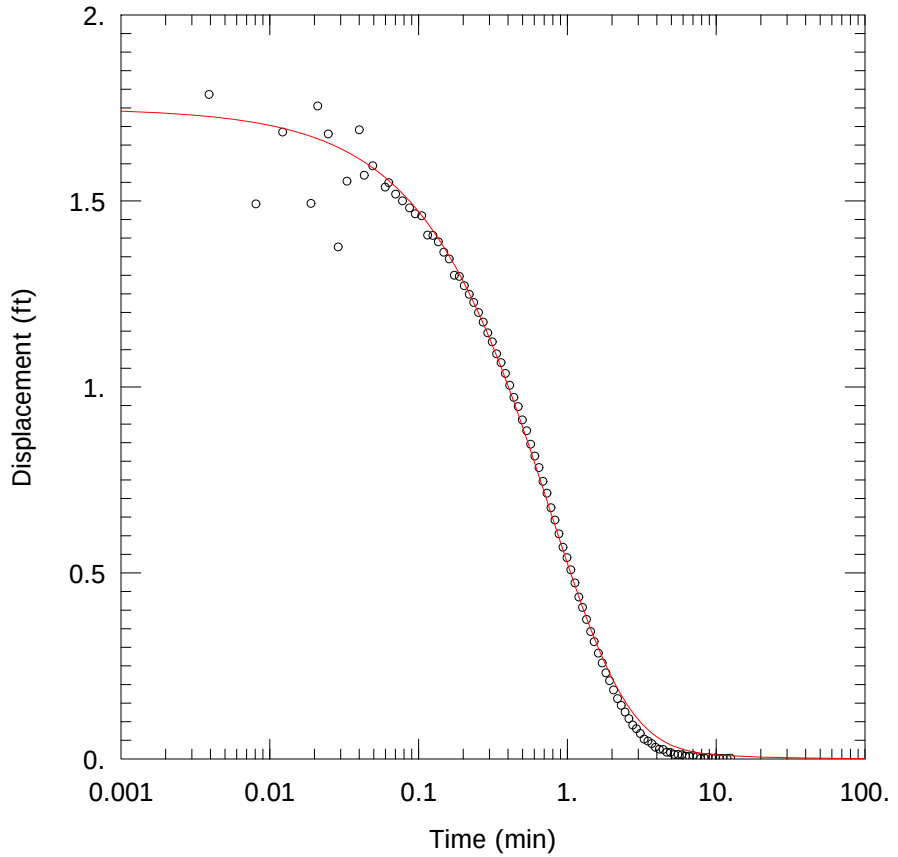
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.98
Ss	-0.99	1.00	0.96
Kz/Kr	-0.98	0.96	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.01115 ft^2
Variance . . . . . 0.0001149 ft^2
Std. Deviation . . . . . 0.01072 ft
Mean. . . . . -0.001744 ft
No. of Residuals 100
No. of Estimates. 3



G304 @ ASH POND 1 – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G304
Test Date: 17 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00089 cm/sec
Ss = 7.0E-5 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 18.81 ft

WELL DATA (G304)

Initial Displacement: 1.75 ft
Total Well Penetration Depth: 18.81 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 18.81 ft
Screen Length: 10. ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G304fh.aqt
Title: G304 @ Ash Pond 1 – Falling Head Test
Date: 11/28/16
Time: 09:40:21

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 17 Jun 2016
Test Well: G304

AQUIFER DATA

Saturated Thickness: 18.81 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G304

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.75 ft
Static Water Column Height: 18.81 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 10. ft
Total Well Penetration Depth: 18.81 ft

No. of Observations: 95

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	1.867	0.3132	1.121	2.307	0.144
0.003917	1.786	0.3352	1.089	2.447	0.126
0.008083	1.492	0.3592	1.065	2.597	0.108
0.01225	1.685	0.3842	1.036	2.757	0.091
0.01897	1.493	0.4102	1.004	2.917	0.081
0.02103	1.755	0.4382	0.972	3.097	0.068
0.02475	1.68	0.4682	0.947	3.287	0.053
0.02892	1.376	0.4992	0.911	3.487	0.048
0.03308	1.553	0.5332	0.882	3.697	0.041
0.04002	1.691	0.5682	0.846	3.917	0.031
0.04323	1.569	0.6052	0.814	4.157	0.026
0.04927	1.594	0.6452	0.783	4.407	0.025
0.05982	1.537	0.6872	0.746	4.667	0.018

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.06323	1.549	0.7312	0.714	4.947	0.017
0.07023	1.518	0.7782	0.675	5.247	0.012
0.07825	1.5	0.8282	0.642	5.557	0.012
0.08723	1.481	0.8812	0.605	5.897	0.011
0.09523	1.465	0.9372	0.569	6.247	0.007
0.1052	1.46	0.9972	0.541	6.617	0.007
0.1152	1.408	1.057	0.508	7.017	0.009
0.1252	1.407	1.127	0.473	7.437	0.006
0.1362	1.39	1.197	0.435	7.877	0.001
0.1482	1.362	1.267	0.407	8.347	0.002
0.1612	1.344	1.347	0.375	8.847	0.004
0.1742	1.3	1.437	0.342	9.377	0.002
0.1882	1.297	1.517	0.315	9.937	0.003
0.2032	1.272	1.617	0.284	10.54	0.001
0.2192	1.249	1.717	0.258	11.14	0.001
0.2352	1.227	1.817	0.231	11.84	0.001
0.2532	1.2	1.927	0.21	12.54	0.002
0.2722	1.174	2.047	0.185	13.24	-0.002
0.2922	1.145	2.177	0.162		

SOLUTION

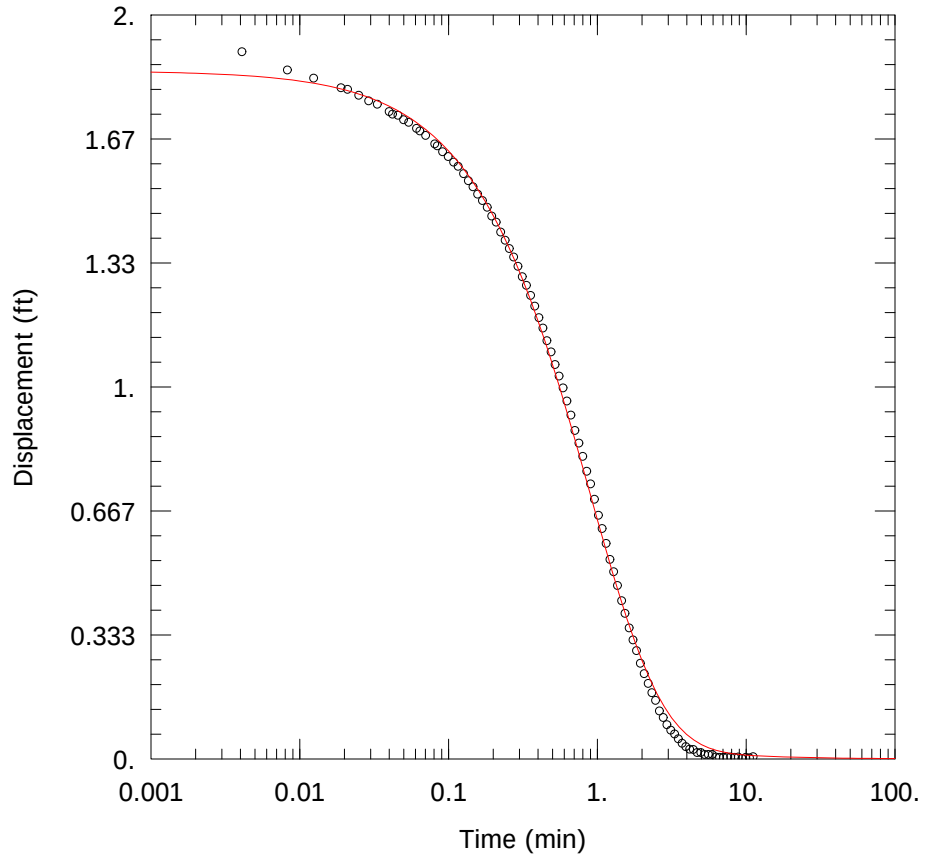
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00089	cm/sec
Ss	7.0E-5	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.5103 cm^2/sec



G304 @ ASH POND 1 – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G304
Test Date: 17 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.001 cm/sec
Ss = 1.0E-6 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 18.81 ft

WELL DATA (G304)

Initial Displacement: 1.85 ft
Total Well Penetration Depth: 18.81 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 18.81 ft
Screen Length: 10. ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G304rh.aqt
Title: G304 @ Ash Pond 1 – Rising Head Test
Date: 11/28/16
Time: 09:40:55

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 17 Jun 2016
Test Well: G304

AQUIFER DATA

Saturated Thickness: 18.81 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G304

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.85 ft
Static Water Column Height: 18.81 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 10. ft
Total Well Penetration Depth: 18.81 ft

No. of Observations: 97

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	1.977	0.2563	1.372	1.948	0.257
0.0041	1.901	0.2743	1.349	2.068	0.229
0.008267	1.852	0.2933	1.324	2.198	0.203
0.01243	1.83	0.3133	1.296	2.328	0.178
0.01895	1.804	0.3343	1.273	2.468	0.157
0.02102	1.8	0.3563	1.246	2.618	0.129
0.02493	1.784	0.3803	1.217	2.778	0.111
0.0291	1.769	0.4053	1.186	2.938	0.092
0.03327	1.76	0.4313	1.158	3.118	0.077
0.04	1.74	0.4593	1.124	3.308	0.067
0.04207	1.733	0.4893	1.094	3.508	0.054
0.04577	1.73	0.5203	1.06	3.718	0.042
0.04993	1.718	0.5543	1.029	3.938	0.033

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0541	1.711	0.5893	0.997	4.178	0.026
0.06107	1.695	0.6263	0.962	4.428	0.025
0.06427	1.688	0.6663	0.924	4.688	0.017
0.07027	1.676	0.7083	0.883	4.968	0.017
0.08085	1.653	0.7523	0.849	5.268	0.012
0.08427	1.648	0.7993	0.813	5.578	0.012
0.09127	1.632	0.8493	0.773	5.918	0.012
0.09967	1.619	0.9023	0.739	6.268	0.005
0.1083	1.604	0.9583	0.698	6.638	0.004
0.1163	1.593	1.018	0.655	7.038	0.004
0.1263	1.573	1.078	0.619	7.458	0.005
0.1363	1.554	1.148	0.579	7.898	0.005
0.1463	1.538	1.218	0.536	8.368	0.004
0.1573	1.518	1.288	0.503	8.868	0.005
0.1693	1.501	1.368	0.466	9.398	0.001
0.1823	1.483	1.458	0.425	9.958	0.004
0.1953	1.459	1.538	0.391	10.56	0.003
0.2093	1.443	1.638	0.352	11.16	0.006
0.2243	1.416	1.738	0.32		
0.2403	1.394	1.838	0.291		

SOLUTION

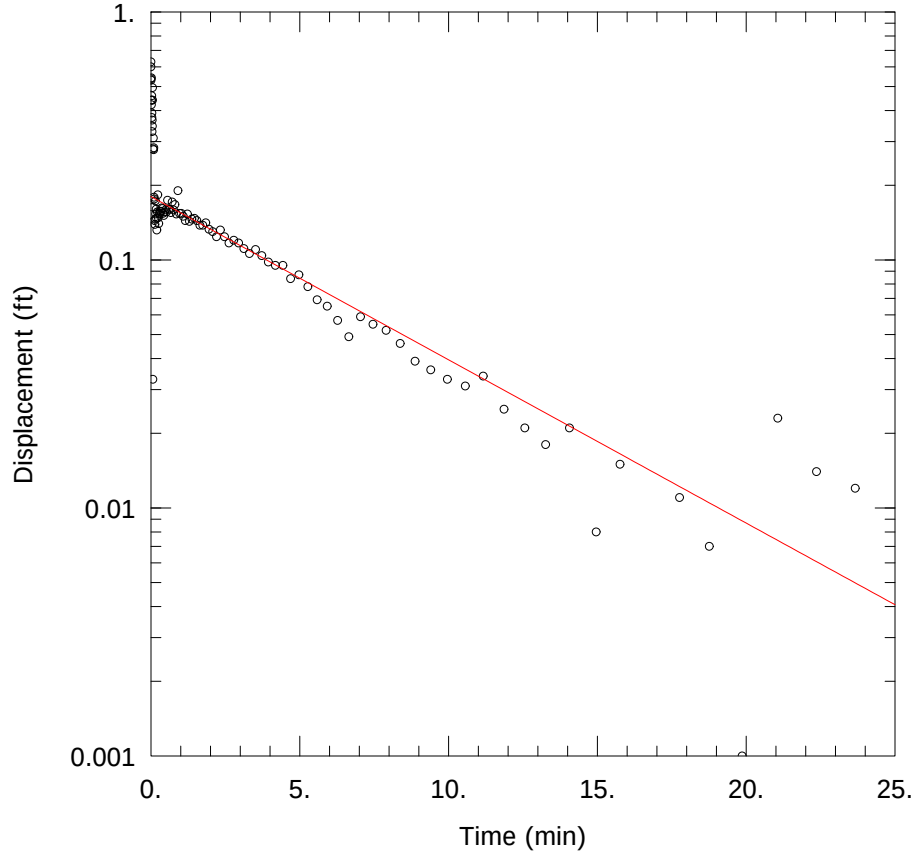
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.001	cm/sec
Ss	1.0E-6	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.5733 cm^2/sec



G401 @ ASH POND 2 – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G401
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.00018 cm/sec
y0 = 0.18 ft

AQUIFER DATA

Saturated Thickness: 4.92 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (G401)

Initial Displacement: 0.6 ft
Total Well Penetration Depth: 4.92 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 4.92 ft
Screen Length: 4.63 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G401fh.aqt
Title: G401 @ Ash Pond 2 – Falling Head Test
Date: 11/28/16
Time: 10:44:18

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G401

AQUIFER DATA

Saturated Thickness: 4.92 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G401

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 0.6 ft
Static Water Column Height: 4.92 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.63 ft
Total Well Penetration Depth: 4.92 ft

No. of Observations: 112

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	0.629	0.3217	0.157	3.127	0.111
0.00417	0.537	0.3427	0.157	3.317	0.106
0.00834	0.531	0.3647	0.162	3.517	0.11
0.0125	0.441	0.3887	0.161	3.727	0.104
0.01667	0.542	0.4137	0.154	3.947	0.098
0.02084	0.422	0.4397	0.151	4.187	0.095
0.025	0.44	0.4677	0.156	4.437	0.095
0.02917	0.459	0.4977	0.159	4.697	0.084
0.03334	0.375	0.5287	0.156	4.977	0.087
0.0375	0.391	0.5627	0.174	5.277	0.078
0.04167	0.329	0.5977	0.16	5.587	0.069
0.04584	0.366	0.6347	0.16	5.927	0.065
0.05	0.346	0.6747	0.155	6.277	0.057

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.05417	0.441	0.7167	0.171	6.651	0.049
0.05834	0.495	0.7607	0.159	7.047	0.059
0.0625	-0.542	0.8077	0.167	7.467	0.055
0.06667	0.033	0.8577	0.153	7.907	0.052
0.07267	0.28	0.9107	0.19	8.377	0.046
0.07867	0.163	0.9667	0.154	8.877	0.039
0.08567	0.31	1.027	0.154	9.407	0.036
0.09267	0.278	1.087	0.15	9.967	0.033
0.09967	0.283	1.157	0.144	10.57	0.031
0.1077	0.179	1.227	0.153	11.17	0.034
0.1167	0.176	1.297	0.143	11.87	0.025
0.1247	0.144	1.377	0.146	12.57	0.021
0.1347	0.139	1.467	0.147	13.27	0.018
0.1447	0.146	1.547	0.144	14.07	0.021
0.1547	0.173	1.647	0.138	14.97	0.008
0.1657	0.153	1.747	0.138	15.77	0.015
0.1777	0.16	1.847	0.141	16.77	0.
0.1907	0.147	1.957	0.133	17.77	0.011
0.2037	0.132	2.077	0.13	18.77	0.007
0.2177	0.156	2.207	0.124	19.87	0.001
0.2327	0.183	2.337	0.132	21.07	0.023
0.2487	0.148	2.477	0.124	22.37	0.014
0.2647	0.14	2.627	0.117	23.67	0.012
0.2827	0.154	2.787	0.12		
0.3017	0.153	2.947	0.117		

SOLUTION

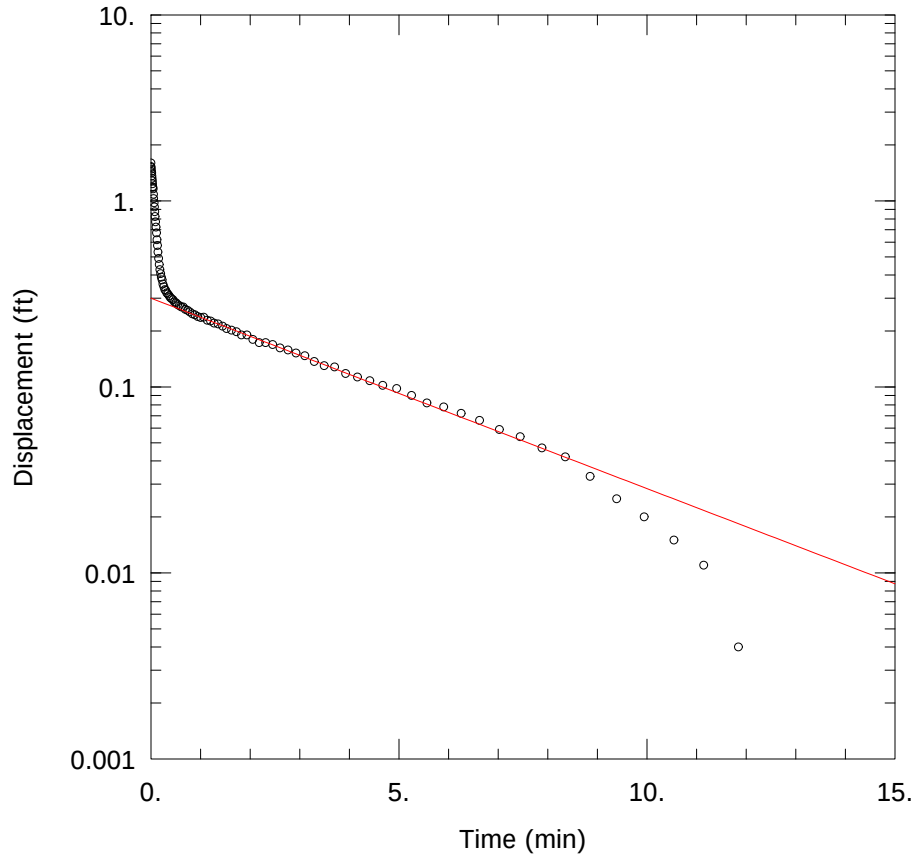
Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.118

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.00018	cm/sec
y0	0.18	ft

T = K*b = 0.02699 cm^2/sec



G401 @ ASH POND 2 – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G401
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.00028 cm/sec
y0 = 0.3 ft

AQUIFER DATA

Saturated Thickness: 4.92 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (G401)

Initial Displacement: 1.6 ft
Total Well Penetration Depth: 4.92 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 4.92 ft
Screen Length: 4.63 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G401rh.aqt
Title: G401 @ Ash Pond 2 – Rising Head Test
Date: 11/28/16
Time: 10:45:18

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G401

AQUIFER DATA

Saturated Thickness: 4.92 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G401

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.6 ft
Static Water Column Height: 4.92 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.63 ft
Total Well Penetration Depth: 4.92 ft

No. of Observations: 96

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	1.532	0.2808	0.333	2.056	0.18
0.004167	1.512	0.3008	0.33	2.187	0.173
0.008333	1.479	0.3218	0.32	2.316	0.173
0.0125	1.44	0.3438	0.316	2.456	0.169
0.01667	1.414	0.3678	0.309	2.606	0.162
0.02083	1.362	0.3928	0.302	2.766	0.158
0.025	1.322	0.4188	0.298	2.926	0.152
0.02917	1.28	0.4468	0.294	3.106	0.147
0.03333	1.237	0.4768	0.286	3.296	0.137
0.0375	1.191	0.5078	0.283	3.496	0.13
0.04167	1.182	0.5418	0.277	3.706	0.128
0.04583	1.161	0.5768	0.273	3.926	0.118
0.05183	1.085	0.6138	0.269	4.166	0.113

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.05783	1.029	0.6538	0.269	4.416	0.108
0.06483	0.977	0.6958	0.261	4.676	0.102
0.07183	0.928	0.7398	0.258	4.956	0.098
0.07883	0.874	0.7868	0.253	5.256	0.09
0.08683	0.824	0.8368	0.247	5.566	0.082
0.09583	0.771	0.8898	0.244	5.906	0.078
0.1038	0.722	0.9458	0.239	6.256	0.072
0.1138	0.673	1.006	0.236	6.626	0.066
0.1238	0.618	1.066	0.237	7.026	0.059
0.1338	0.576	1.136	0.228	7.446	0.054
0.1448	0.531	1.206	0.226	7.886	0.047
0.1568	0.49	1.276	0.22	8.356	0.042
0.1698	0.455	1.356	0.218	8.856	0.033
0.1828	0.427	1.446	0.212	9.39	0.025
0.1968	0.406	1.526	0.206	9.946	0.02
0.2118	0.389	1.626	0.202	10.55	0.015
0.2278	0.376	1.726	0.198	11.15	0.011
0.2438	0.357	1.826	0.19	11.85	0.004
0.2618	0.345	1.936	0.19	12.55	0.

SOLUTION

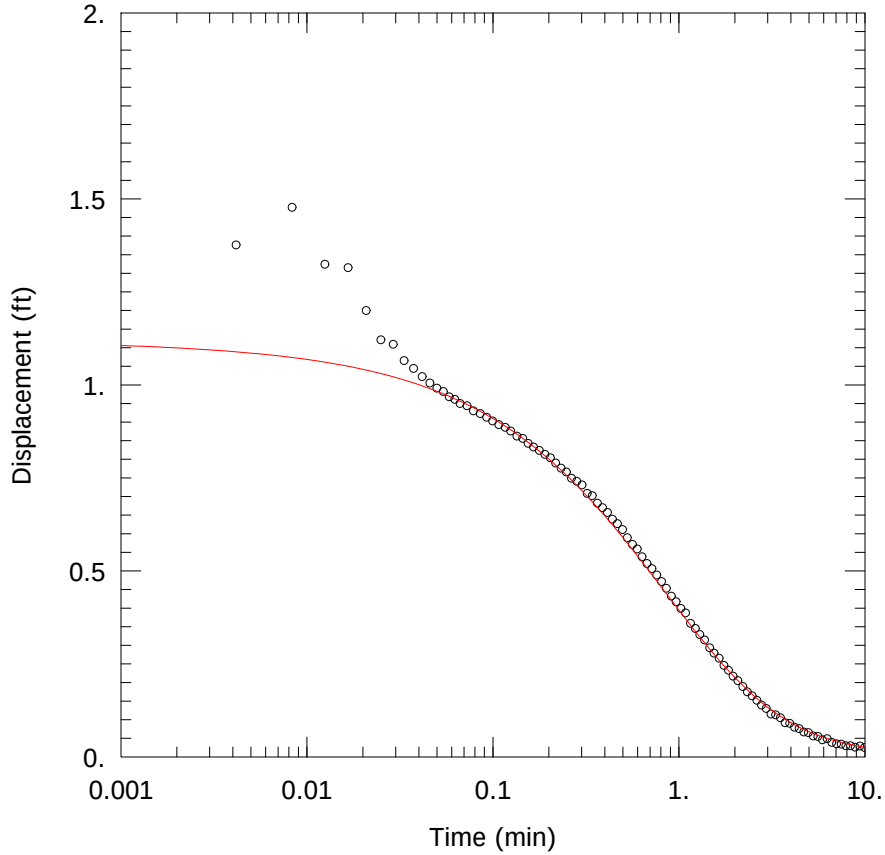
Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.118

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.00028	cm/sec
y0	0.3	ft

T = K*b = 0.04199 cm²/sec



G402 @ ASH POND 2 – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G402
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.00045 cm/sec
Ss = 0.002 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 13.25 ft

WELL DATA (G402)

Initial Displacement: 1.12 ft
Total Well Penetration Depth: 13.25 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 13.25 ft
Screen Length: 10. ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G402fh.aqt
Title: G402 @ Ash Pond 2 – Falling Head Test
Date: 11/28/16
Time: 09:41:35

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G402

AQUIFER DATA

Saturated Thickness: 13.25 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G402

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.12 ft
Static Water Column Height: 13.25 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 10. ft
Total Well Penetration Depth: 13.25 ft

No. of Observations: 97

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	1.302	0.2327	0.776	1.747	0.246
0.004167	1.376	0.2487	0.766	1.847	0.233
0.008333	1.477	0.2647	0.749	1.957	0.217
0.0125	1.324	0.2827	0.741	2.077	0.205
0.01667	1.315	0.3017	0.731	2.207	0.189
0.02083	1.2	0.3217	0.708	2.337	0.175
0.025	1.121	0.3427	0.702	2.477	0.164
0.02917	1.109	0.3646	0.682	2.627	0.152
0.03333	1.065	0.3887	0.67	2.787	0.139
0.0375	1.044	0.4137	0.657	2.947	0.13
0.04167	1.022	0.4396	0.639	3.127	0.115
0.04583	1.005	0.4677	0.627	3.317	0.113
0.05	0.991	0.4976	0.611	3.517	0.105

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.05417	0.982	0.5287	0.589	3.727	0.092
0.05833	0.968	0.5627	0.571	3.947	0.09
0.0625	0.961	0.5977	0.559	4.187	0.08
0.06667	0.95	0.6347	0.538	4.437	0.076
0.07267	0.944	0.6747	0.52	4.697	0.067
0.07867	0.93	0.7167	0.506	4.977	0.065
0.08567	0.923	0.7607	0.489	5.277	0.056
0.09267	0.913	0.8077	0.471	5.587	0.055
0.09967	0.903	0.8577	0.453	5.927	0.046
0.1077	0.893	0.9106	0.432	6.277	0.049
0.1167	0.886	0.9667	0.417	6.647	0.039
0.1247	0.876	1.027	0.399	7.047	0.035
0.1347	0.862	1.087	0.387	7.467	0.034
0.1447	0.856	1.157	0.359	7.907	0.03
0.1547	0.843	1.227	0.345	8.377	0.03
0.1656	0.833	1.297	0.329	8.877	0.026
0.1777	0.824	1.377	0.314	9.407	0.029
0.1906	0.813	1.467	0.293	9.967	0.025
0.2037	0.804	1.547	0.279		
0.2177	0.79	1.647	0.265		

SOLUTION

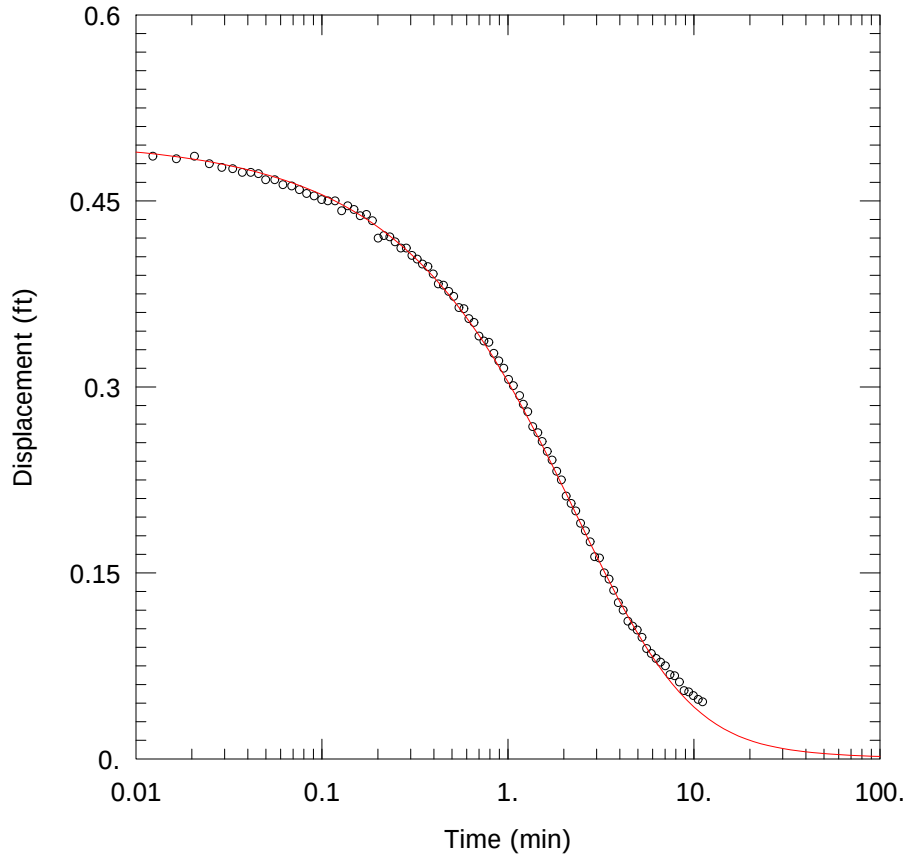
Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00045	cm/sec
Ss	0.002	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.1817 cm^2/sec



G402 @ ASH POND 2 – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G402
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00019 cm/sec
Ss = 0.001 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 13.25 ft

WELL DATA (G402)

Initial Displacement: 0.5 ft
Total Well Penetration Depth: 13.25 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 13.25 ft
Screen Length: 10. ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G402rh.aqt
Title: G402 @ Ash Pond 2 – Rising Head Test
Date: 11/28/16
Time: 09:41:57

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G402

AQUIFER DATA

Saturated Thickness: 13.25 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G402

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 0.5 ft
Static Water Column Height: 13.25 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 10. ft
Total Well Penetration Depth: 13.25 ft

No. of Observations: 95

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
-0.0001503	0.49	0.2658	0.412	1.94	0.225
0.004016	0.51	0.2848	0.412	2.06	0.212
0.009716	0.481	0.3049	0.406	2.19	0.206
0.01235	0.486	0.3258	0.403	2.32	0.2
0.01652	0.484	0.3478	0.399	2.46	0.19
0.02068	0.486	0.3719	0.397	2.61	0.184
0.02485	0.48	0.3968	0.391	2.77	0.175
0.02902	0.477	0.4228	0.383	2.93	0.163
0.03318	0.476	0.4508	0.382	3.11	0.162
0.03735	0.473	0.4808	0.377	3.3	0.15
0.04152	0.473	0.5119	0.373	3.5	0.145
0.04568	0.472	0.5458	0.364	3.71	0.136
0.04985	0.467	0.5808	0.363	3.93	0.126

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.05585	0.467	0.6178	0.355	4.17	0.12
0.06185	0.463	0.6579	0.352	4.42	0.111
0.06885	0.462	0.6998	0.341	4.68	0.107
0.07585	0.459	0.7438	0.337	4.96	0.104
0.08285	0.456	0.7909	0.336	5.26	0.098
0.09085	0.454	0.8408	0.327	5.57	0.089
0.09985	0.451	0.8939	0.321	5.91	0.085
0.1079	0.45	0.9498	0.315	6.26	0.081
0.1179	0.45	1.01	0.306	6.63	0.078
0.1278	0.442	1.07	0.301	7.03	0.075
0.1379	0.446	1.157	0.293	7.45	0.068
0.1489	0.443	1.21	0.286	7.89	0.067
0.1608	0.438	1.28	0.28	8.36	0.062
0.1739	0.439	1.36	0.268	8.86	0.055
0.1868	0.434	1.45	0.263	9.39	0.054
0.2009	0.42	1.53	0.256	9.95	0.051
0.2158	0.422	1.63	0.248	10.55	0.048
0.2319	0.421	1.73	0.241	11.15	0.046
0.2478	0.417	1.83	0.232		

SOLUTION

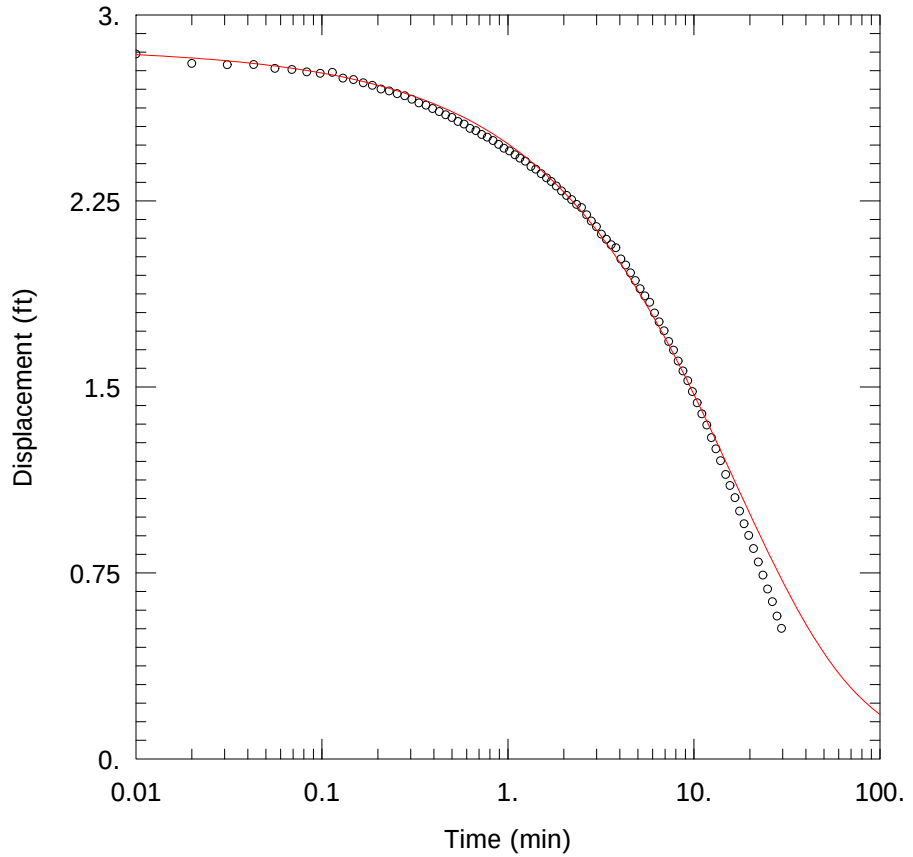
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00019	cm/sec
Ss	0.001	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.07673 cm^2/sec



G403 @ ASH POND 2 – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G403
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 4.3E-5 cm/sec
Ss = 0.0075 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 13.99 ft

WELL DATA (G403)

Initial Displacement: 2.87 ft
Total Well Penetration Depth: 13.99 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 13.99 ft
Screen Length: 4.67 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G403fh.aqt
Title: G403 @ Ash Pond 2 – Falling Head Test
Date: 11/28/16
Time: 09:42:29

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G403

AQUIFER DATA

Saturated Thickness: 13.99 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G403

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.87 ft
Static Water Column Height: 13.99 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.67 ft
Total Well Penetration Depth: 13.99 ft

No. of Observations: 91

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.798	0.832	2.493	5.792	1.841
0.01	2.842	0.892	2.478	6.142	1.798
0.02	2.804	0.952	2.462	6.512	1.762
0.031	2.799	1.022	2.451	6.912	1.726
0.043	2.8	1.092	2.436	7.332	1.683
0.056	2.784	1.162	2.422	7.772	1.648
0.069	2.78	1.242	2.41	8.242	1.604
0.083	2.77	1.332	2.389	8.742	1.564
0.098	2.764	1.412	2.378	9.272	1.525
0.114	2.768	1.512	2.36	9.832	1.481
0.13	2.745	1.612	2.343	10.43	1.436
0.148	2.739	1.712	2.328	11.03	1.391
0.167	2.726	1.822	2.31	11.73	1.346

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.187	2.716	1.942	2.29	12.43	1.295
0.208	2.701	2.072	2.272	13.13	1.25
0.23	2.693	2.202	2.255	13.93	1.202
0.254	2.682	2.342	2.236	14.83	1.147
0.279	2.674	2.492	2.223	15.63	1.102
0.305	2.66	2.652	2.194	16.63	1.053
0.333	2.645	2.812	2.169	17.63	0.999
0.363	2.636	2.992	2.146	18.63	0.948
0.394	2.622	3.182	2.116	19.73	0.901
0.428	2.61	3.382	2.095	20.93	0.848
0.463	2.597	3.592	2.073	22.23	0.794
0.5	2.586	3.812	2.061	23.53	0.741
0.54	2.57	4.052	2.016	24.93	0.685
0.582	2.56	4.302	1.991	26.43	0.634
0.626	2.542	4.562	1.96	28.03	0.576
0.673	2.533	4.842	1.929	29.63	0.526
0.723	2.518	5.142	1.896		
0.776	2.507	5.452	1.867		

SOLUTION

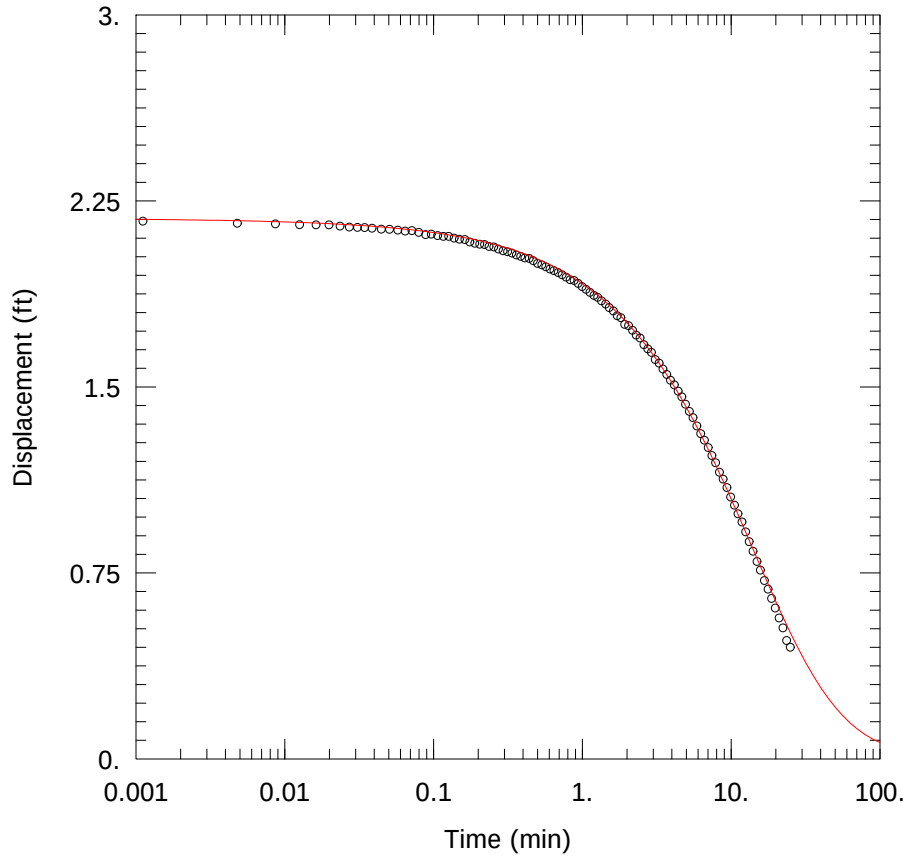
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	4.3E-5	cm/sec
Ss	0.0075	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.01834 cm^2/sec



G403 @ ASH POND 2 – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G403
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 7.2E-5 cm/sec
Ss = 0.0015 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 13.99 ft

WELL DATA (G403)

Initial Displacement: 2.18 ft
Total Well Penetration Depth: 13.99 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 13.99 ft
Screen Length: 4.67 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G403rh.aqt
Title: G403 @ Ash Pond 2 – Rising Head Test
Date: 11/28/16
Time: 09:42:50

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G403

AQUIFER DATA

Saturated Thickness: 13.99 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G403

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.18 ft
Static Water Column Height: 13.99 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.67 ft
Total Well Penetration Depth: 13.99 ft

No. of Observations: 108

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.159	0.3607	2.032	3.289	1.596
0.001117	2.168	0.3857	2.026	3.489	1.572
0.004817	2.16	0.4117	2.02	3.699	1.55
0.008684	2.157	0.4397	2.018	3.919	1.527
0.0126	2.154	0.4697	2.009	4.159	1.508
0.01625	2.153	0.5007	1.998	4.409	1.483
0.0199	2.153	0.5347	1.992	4.669	1.46
0.02357	2.148	0.5697	1.984	4.949	1.43
0.02722	2.144	0.6067	1.975	5.249	1.401
0.03087	2.143	0.6467	1.969	5.559	1.376
0.03452	2.142	0.6887	1.961	5.899	1.342
0.03867	2.14	0.7327	1.952	6.249	1.311
0.04467	2.136	0.7797	1.942	6.619	1.285

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.05067	2.135	0.8297	1.932	7.019	1.255
0.05767	2.132	0.8827	1.929	7.439	1.223
0.06467	2.128	0.9387	1.917	7.879	1.194
0.07167	2.13	0.9987	1.904	8.349	1.156
0.07967	2.123	1.059	1.893	8.849	1.128
0.08867	2.114	1.129	1.881	9.379	1.094
0.09667	2.116	1.199	1.869	9.939	1.056
0.1067	2.11	1.269	1.861	10.54	1.023
0.1167	2.107	1.349	1.847	11.14	0.988
0.1267	2.107	1.439	1.834	11.84	0.955
0.1377	2.1	1.519	1.82	12.54	0.915
0.1497	2.095	1.619	1.806	13.24	0.876
0.1627	2.094	1.719	1.787	14.04	0.837
0.1757	2.084	1.819	1.779	14.94	0.796
0.1897	2.079	1.931	1.752	15.74	0.761
0.2047	2.075	2.049	1.747	16.74	0.719
0.2207	2.074	2.179	1.728	17.74	0.684
0.2367	2.066	2.309	1.709	18.74	0.647
0.2547	2.064	2.449	1.697	19.84	0.608
0.2737	2.056	2.599	1.67	21.04	0.568
0.2937	2.049	2.759	1.653	22.34	0.528
0.3147	2.045	2.919	1.639	23.64	0.477
0.3367	2.04	3.099	1.61	25.04	0.45

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	7.2E-5	cm/sec
Ss	0.0015	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.0307 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	7.191E-5	5.079E-6	+/- 1.007E-5	14.16	cm/sec
Ss	0.001636	0.0003018	+/- 0.0005986	5.42	ft^{-1}
Kz/Kr	1.	1.686	+/- 3.343	0.5931	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.03066 cm²/sec

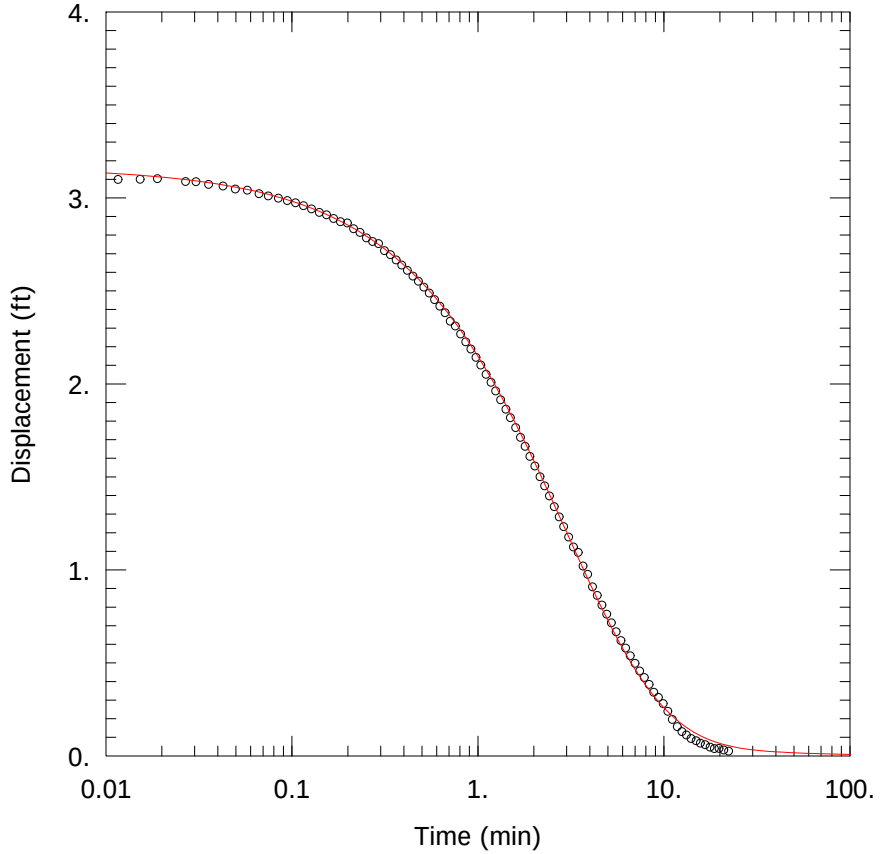
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.98
Ss	-0.99	1.00	0.94
Kz/Kr	-0.98	0.94	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.01972 ft^2
Variance . . . . . 0.0001878 ft^2
Std. Deviation . . . . . 0.01371 ft
Mean. . . . . -0.004 ft
No. of Residuals 108
No. of Estimates. 3



G404 @ ASH POND 2 – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G404
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00042 cm/sec
Ss = 0.00033 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 8.95 ft

WELL DATA (G404)

Initial Displacement: 3.17 ft
Total Well Penetration Depth: 8.95 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 8.95 ft
Screen Length: 4.75 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G404fh.aqt
Title: G404 @ Ash Pond 2 – Falling Head Test
Date: 11/28/16
Time: 09:43:12

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G404

AQUIFER DATA

Saturated Thickness: 8.95 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G404

X Location: 1. ft
Y Location: 0. ft

Initial Displacement: 3.17 ft
Static Water Column Height: 8.95 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.75 ft
Total Well Penetration Depth: 8.95 ft

No. of Observations: 99

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	3.136	0.4477	2.579	3.467	1.094
0.007967	3.119	0.4787	2.552	3.677	1.021
0.01163	3.099	0.5127	2.52	3.897	0.976
0.0153	3.1	0.5476	2.488	4.137	0.909
0.01895	3.103	0.5847	2.453	4.387	0.862
0.02685	3.088	0.6247	2.418	4.647	0.811
0.03055	3.087	0.6667	2.382	4.927	0.762
0.03567	3.072	0.7107	2.337	5.227	0.715
0.04267	3.064	0.7577	2.311	5.537	0.667
0.04967	3.047	0.8077	2.268	5.877	0.62
0.05767	3.041	0.8607	2.226	6.227	0.579
0.06667	3.022	0.9166	2.187	6.597	0.538
0.07467	3.01	0.9767	2.142	6.997	0.498

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.08467	2.998	1.037	2.101	7.417	0.456
0.09467	2.985	1.107	2.051	7.857	0.421
0.1047	2.973	1.177	2.008	8.327	0.384
0.1157	2.958	1.247	1.962	8.827	0.342
0.1277	2.941	1.327	1.914	9.357	0.314
0.1407	2.922	1.417	1.864	9.917	0.281
0.1537	2.909	1.497	1.818	10.52	0.24
0.1677	2.889	1.597	1.765	11.12	0.196
0.1827	2.872	1.697	1.712	11.82	0.157
0.1986	2.865	1.797	1.664	12.52	0.13
0.2147	2.834	1.907	1.61	13.22	0.112
0.2327	2.814	2.027	1.558	14.02	0.093
0.2517	2.785	2.157	1.501	14.93	0.081
0.2717	2.765	2.287	1.452	15.72	0.068
0.2927	2.754	2.427	1.397	16.72	0.06
0.3147	2.716	2.577	1.34	17.72	0.047
0.3387	2.695	2.737	1.285	18.72	0.039
0.3637	2.666	2.897	1.232	19.82	0.04
0.3897	2.639	3.077	1.176	21.02	0.031
0.4177	2.61	3.267	1.123	22.32	0.025

SOLUTION

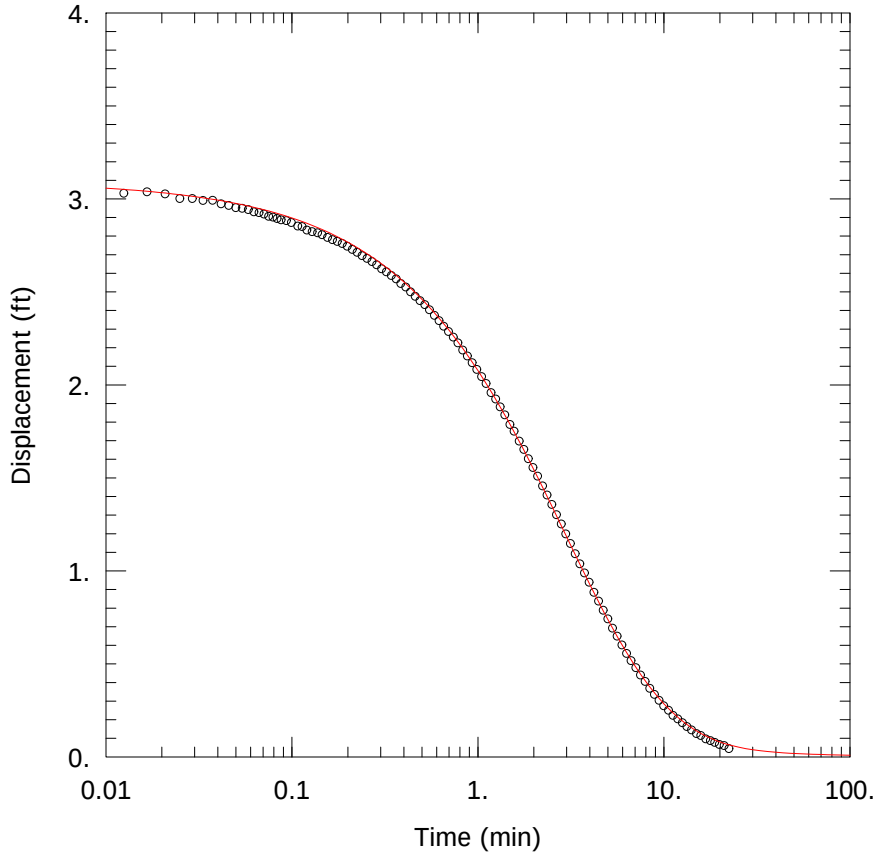
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00042	cm/sec
Ss	0.00033	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.1146 cm^2/sec



G404 @ ASH POND 2 – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G404
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00038 cm/sec
Ss = 0.0007 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 8.95 ft

WELL DATA (G404)

Initial Displacement: 3.1 ft
Total Well Penetration Depth: 8.95 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 8.95 ft
Screen Length: 4.75 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G404rh.aqt
Title: G404 @ Ash Pond 2 – Rising Head Test
Date: 11/28/16
Time: 09:43:34

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G404

AQUIFER DATA

Saturated Thickness: 8.95 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G404

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 3.1 ft
Static Water Column Height: 8.95 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.75 ft
Total Well Penetration Depth: 8.95 ft

No. of Observations: 116

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	3.022	0.2695	2.663	2.648	1.302
0.004167	3.042	0.2855	2.646	2.807	1.252
0.008333	3.052	0.3035	2.624	2.967	1.199
0.0125	3.03	0.3225	2.608	3.147	1.147
0.01667	3.038	0.3425	2.588	3.337	1.092
0.02083	3.027	0.3635	2.57	3.537	1.038
0.025	3.002	0.3855	2.545	3.747	0.989
0.02917	3.002	0.4095	2.526	3.967	0.939
0.03333	2.991	0.4345	2.5	4.207	0.885
0.0375	2.992	0.4605	2.476	4.457	0.837
0.04167	2.973	0.4885	2.453	4.717	0.788
0.04583	2.965	0.5185	2.431	4.997	0.742
0.05	2.953	0.5495	2.404	5.297	0.692

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.05417	2.949	0.5835	2.374	5.607	0.649
0.05833	2.942	0.6185	2.345	5.947	0.602
0.0625	2.93	0.6555	2.315	6.297	0.556
0.06667	2.926	0.6955	2.287	6.667	0.517
0.07083	2.918	0.7375	2.257	7.067	0.48
0.075	2.906	0.7815	2.226	7.487	0.44
0.07917	2.902	0.8285	2.187	7.927	0.406
0.08333	2.894	0.8785	2.155	8.397	0.369
0.0875	2.887	0.9315	2.119	8.897	0.336
0.0935	2.883	0.9875	2.083	9.428	0.304
0.0995	2.873	1.047	2.044	9.987	0.275
0.1075	2.854	1.107	2.007	10.59	0.251
0.1135	2.851	1.178	1.958	11.19	0.223
0.1205	2.832	1.247	1.924	11.89	0.204
0.1286	2.824	1.317	1.882	12.59	0.184
0.1375	2.818	1.397	1.839	13.29	0.163
0.1455	2.807	1.488	1.787	14.09	0.145
0.1555	2.793	1.567	1.751	14.99	0.125
0.1655	2.781	1.668	1.698	15.79	0.115
0.1755	2.771	1.767	1.653	16.79	0.097
0.1865	2.76	1.867	1.603	17.79	0.087
0.1985	2.745	1.978	1.556	18.79	0.078
0.2115	2.728	2.097	1.509	19.89	0.067
0.2245	2.713	2.227	1.457	21.09	0.061
0.2385	2.695	2.357	1.408	22.39	0.044
0.2535	2.68	2.498	1.357		

SOLUTION

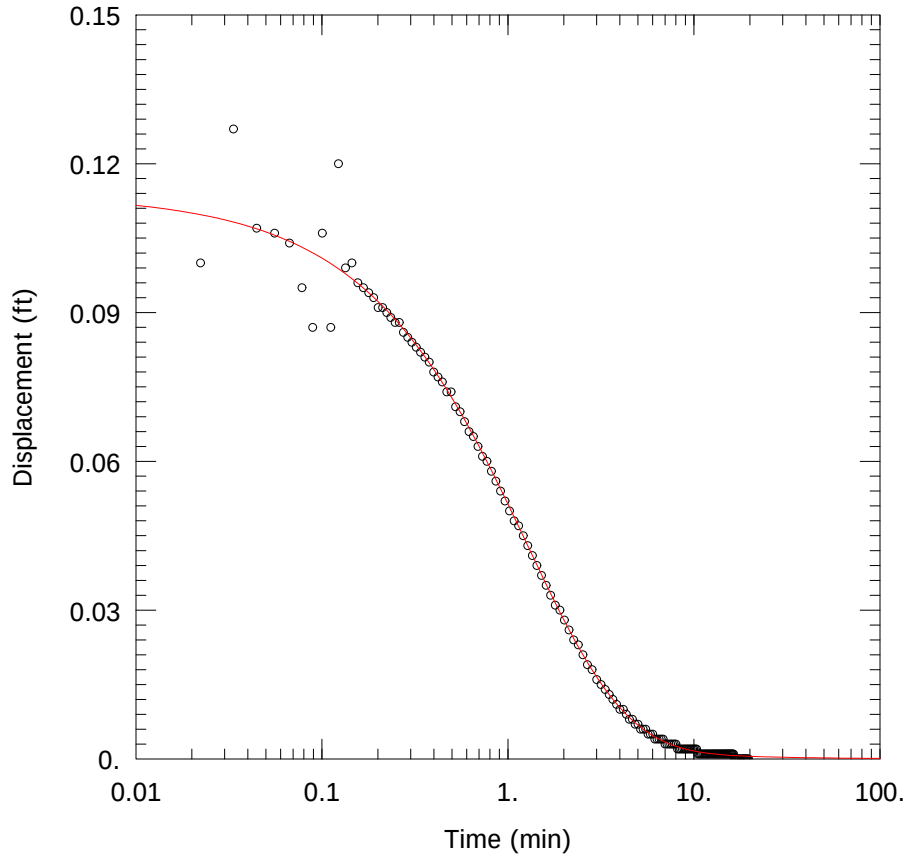
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00038	cm/sec
Ss	0.0007	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.1037 cm^2/sec



G405 @ ASH POND 2 – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G405
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00098 cm/sec
Ss = 0.00037 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 11.12 ft

WELL DATA (G405)

Initial Displacement: 0.114 ft
Total Well Penetration Depth: 11.12 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 11.12 ft
Screen Length: 4.75 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G405fh2.aqt
Title: G405 @ Ash Pond 2 – Falling Head Test
Date: 11/28/16
Time: 09:43:55

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G405

AQUIFER DATA

Saturated Thickness: 11.12 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G405

X Location: 1. ft
Y Location: 0. ft

Initial Displacement: 0.114 ft
Static Water Column Height: 11.12 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.75 ft
Total Well Penetration Depth: 11.12 ft

No. of Observations: 166

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0223	0.1	1.799	0.031	10.84	0.001
0.0335	0.127	1.904	0.03	11.01	0.001
0.0447	0.107	2.016	0.028	11.17	0.001
0.0558	0.106	2.134	0.026	11.34	0.001
0.067	0.104	2.259	0.024	11.51	0.001
0.0782	0.095	2.392	0.023	11.67	0.001
0.0893	0.087	2.532	0.021	11.84	0.001
0.1005	0.106	2.681	0.019	12.01	0.001
0.1117	0.087	2.838	0.018	12.17	0.001
0.1228	0.12	3.005	0.016	12.34	0.001
0.134	0.099	3.172	0.015	12.51	0.001
0.1452	0.1	3.338	0.014	12.67	0.001
0.1563	0.096	3.505	0.013	12.84	0.001

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.1675	0.095	3.672	0.012	13.01	0.001
0.1787	0.094	3.838	0.011	13.17	0.001
0.1898	0.093	4.005	0.01	13.34	0.001
0.201	0.091	4.172	0.01	13.51	0.001
0.2122	0.091	4.338	0.009	13.67	0.001
0.2233	0.09	4.505	0.008	13.84	0.001
0.235	0.089	4.672	0.008	14.01	0.001
0.2475	0.088	4.838	0.007	14.17	0.001
0.2607	0.088	5.005	0.007	14.34	0.001
0.2747	0.086	5.172	0.006	14.51	0.001
0.2895	0.085	5.338	0.006	14.67	0.001
0.3052	0.084	5.505	0.006	14.84	0.001
0.3218	0.083	5.672	0.005	15.01	0.001
0.3395	0.082	5.838	0.005	15.17	0.001
0.3582	0.081	6.005	0.005	15.34	0.001
0.378	0.08	6.172	0.004	15.51	0.001
0.399	0.078	6.338	0.004	15.67	0.001
0.4212	0.077	6.505	0.004	15.84	0.001
0.4447	0.076	6.672	0.004	16.	0.001
0.4695	0.074	6.838	0.004	16.17	0.001
0.4958	0.074	7.005	0.003	16.34	0.001
0.5238	0.071	7.172	0.003	16.5	0.
0.5535	0.07	7.338	0.003	16.67	0.
0.5848	0.068	7.505	0.003	16.84	0.
0.618	0.066	7.672	0.003	17.	0.
0.6532	0.065	7.838	0.003	17.17	0.
0.6905	0.063	8.005	0.003	17.34	0.
0.73	0.061	8.172	0.002	17.5	0.
0.7718	0.06	8.338	0.002	17.67	0.
0.8162	0.058	8.505	0.002	17.84	0.
0.8632	0.056	8.672	0.002	18.	0.
0.913	0.054	8.838	0.002	18.17	0.
0.9657	0.052	9.005	0.002	18.34	0.
1.022	0.05	9.172	0.002	18.5	0.
1.081	0.048	9.338	0.002	18.67	0.
1.143	0.047	9.505	0.002	18.84	0.
1.21	0.045	9.672	0.002	19.	0.
1.28	0.043	9.838	0.002	19.17	0.
1.355	0.041	10.01	0.002	19.34	0.
1.434	0.039	10.17	0.002	19.5	0.
1.517	0.037	10.34	0.002	19.67	0.
1.606	0.035	10.51	0.001		
1.7	0.033	10.67	0.001		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00098	cm/sec
Ss	0.00037	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.3322 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0009828	0.0002457	+/- 0.0004853	4.	cm/sec
Ss	0.0003762	0.0004077	+/- 0.0008052	0.9227	ft^{-1}
Kz/Kr	1.	2.807	+/- 5.544	0.3562	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.3331 cm^2/sec

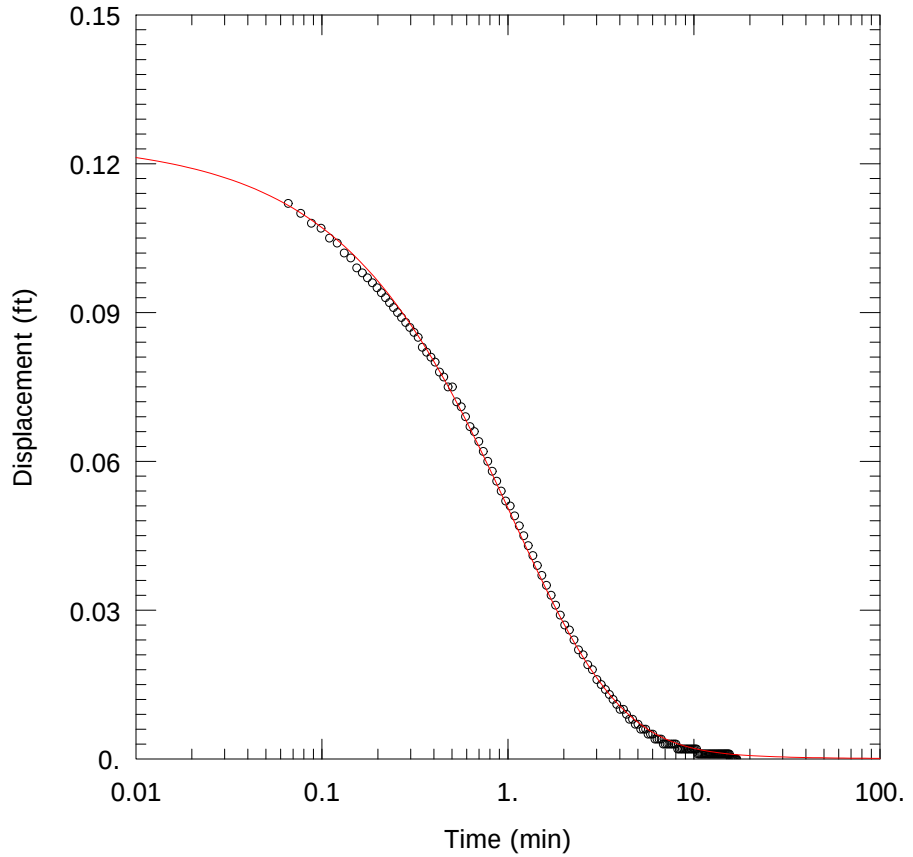
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.99	-0.99
Ss	-0.99	1.00	0.97
Kz/Kr	-0.99	0.97	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.001412 ft^2
Variance . . . . . 8.661E-6 ft^2
Std. Deviation . . . . . 0.002943 ft
Mean. . . . . -3.208E-5 ft
No. of Residuals 166
No. of Estimates. 3



G405 @ ASH POND 2 – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G405
Test Date: 13 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00097 cm/sec
Ss = 0.0012 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 11.12 ft

WELL DATA (G405)

Initial Displacement: 0.125 ft
Total Well Penetration Depth: 11.12 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 11.12 ft
Screen Length: 4.75 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\G405rh2.aqt
Title: G405 @ Ash Pond 2 – Rising Head Test
Date: 11/28/16
Time: 09:44:19

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 13 Jun 2016
Test Well: G405

AQUIFER DATA

Saturated Thickness: 11.12 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G405

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 0.125 ft
Static Water Column Height: 11.12 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.75 ft
Total Well Penetration Depth: 11.12 ft

No. of Observations: 147

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.066	0.112	1.441	0.039	9.013	0.002
0.077	0.11	1.525	0.037	9.179	0.002
0.088	0.108	1.613	0.035	9.346	0.002
0.099	0.107	1.707	0.033	9.513	0.002
0.11	0.105	1.807	0.031	9.679	0.002
0.121	0.104	1.912	0.029	9.846	0.002
0.132	0.102	2.023	0.027	10.01	0.002
0.143	0.101	2.142	0.026	10.18	0.002
0.154	0.099	2.267	0.024	10.35	0.002
0.165	0.098	2.399	0.022	10.51	0.001
0.176	0.097	2.54	0.021	10.68	0.001
0.187	0.096	2.688	0.019	10.85	0.001
0.198	0.095	2.846	0.018	11.01	0.001

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.209	0.094	3.013	0.016	11.18	0.001
0.22	0.093	3.179	0.015	11.35	0.001
0.231	0.092	3.346	0.014	11.51	0.001
0.2427	0.091	3.513	0.013	11.68	0.001
0.2552	0.09	3.679	0.012	11.85	0.001
0.2683	0.089	3.846	0.011	12.01	0.001
0.2823	0.088	4.013	0.01	12.18	0.001
0.2972	0.087	4.179	0.01	12.35	0.001
0.3128	0.086	4.346	0.009	12.51	0.001
0.3295	0.085	4.513	0.008	12.68	0.001
0.3472	0.083	4.679	0.008	12.85	0.001
0.3658	0.082	4.846	0.007	13.01	0.001
0.3857	0.081	5.013	0.007	13.18	0.001
0.4067	0.08	5.179	0.006	13.35	0.001
0.4288	0.078	5.346	0.006	13.51	0.001
0.4523	0.077	5.513	0.006	13.68	0.001
0.4772	0.075	5.679	0.005	13.85	0.001
0.5035	0.075	5.846	0.005	14.01	0.001
0.5315	0.072	6.013	0.005	14.18	0.001
0.5612	0.071	6.179	0.004	14.35	0.001
0.5925	0.069	6.346	0.004	14.51	0.001
0.6257	0.067	6.513	0.004	14.68	0.001
0.6608	0.066	6.679	0.004	14.85	0.001
0.6982	0.064	6.846	0.003	15.01	0.001
0.7377	0.062	7.013	0.003	15.18	0.001
0.7795	0.06	7.179	0.003	15.35	0.001
0.8238	0.058	7.346	0.003	15.51	0.001
0.8708	0.056	7.513	0.003	15.68	0.
0.9207	0.054	7.679	0.003	15.85	0.
0.9733	0.052	7.846	0.003	16.01	0.
1.029	0.051	8.013	0.003	16.18	0.
1.088	0.049	8.179	0.002	16.35	0.
1.151	0.047	8.346	0.002	16.51	0.
1.217	0.045	8.513	0.002	16.68	0.
1.288	0.043	8.679	0.002	16.85	0.
1.362	0.041	8.846	0.002	17.01	0.

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00097	cm/sec
Ss	0.0012	ft^{-1}

Kz/Kr 1.

T = K*b = 0.3288 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0009567	3.216E-5	+/- 6.357E-5	29.75	cm/sec
Ss	0.001278	0.0001631	+/- 0.0003224	7.835	ft^{-1}
Kz/Kr	1.	0.4379	+/- 0.8657	2.284	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.3243 cm²/sec

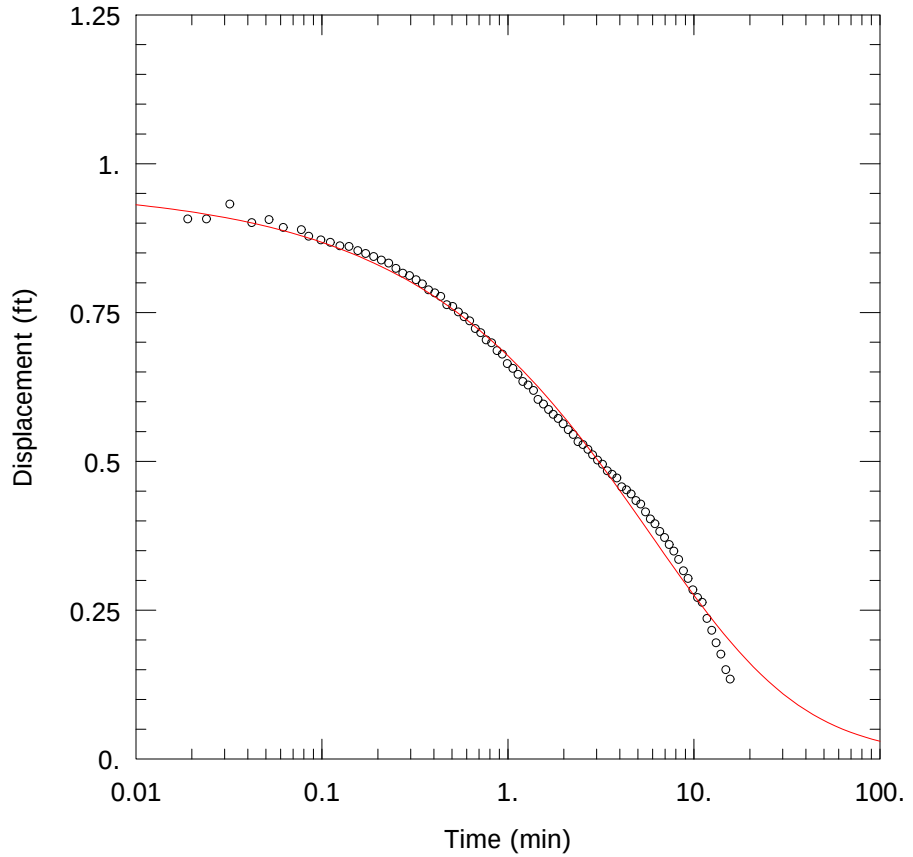
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.98	-0.96
Ss	-0.98	1.00	0.92
Kz/Kr	-0.96	0.92	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 9.007E-5 ft^2
Variance . . . . . 6.255E-7 ft^2
Std. Deviation . . . . . 0.0007909 ft
Mean. . . . . -0.0003511 ft
No. of Residuals 147
No. of Estimates. 3



R104 @ CCR LANDFILL – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: R104
Test Date: 15 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 7.0E-5 cm/sec
Ss = 0.045 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 14.17 ft

WELL DATA (R104)

Initial Displacement: 0.96 ft
Total Well Penetration Depth: 14.17 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 14.17 ft
Screen Length: 4.43 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\R104fh.aqt
Title: R104 @ CCR Landfill – Falling Head Test
Date: 11/28/16
Time: 10:46:31

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 15 Jun 2016
Test Well: R104

AQUIFER DATA

Saturated Thickness: 14.17 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: R104

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 0.96 ft
Static Water Column Height: 14.17 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.43 ft
Total Well Penetration Depth: 14.17 ft

No. of Observations: 91

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
-0.03432	1.004	0.405	0.783	3.034	0.502
-0.03015	0.97	0.436	0.777	3.224	0.495
-0.02598	0.932	0.47	0.763	3.424	0.484
-0.01998	0.905	0.505	0.76	3.634	0.478
-0.01398	0.897	0.542	0.751	3.854	0.472
-0.006983	0.913	0.582	0.743	4.094	0.457
0.	0.909	0.624	0.736	4.344	0.452
0.007	0.907	0.668	0.723	4.604	0.445
0.01902	0.907	0.715	0.716	4.884	0.434
0.024	0.907	0.765	0.704	5.184	0.428
0.032	0.932	0.818	0.699	5.494	0.415
0.04202	0.901	0.874	0.686	5.834	0.403
0.05202	0.906	0.934	0.68	6.184	0.395

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.062	0.893	0.994	0.664	6.554	0.382
0.07762	0.889	1.064	0.656	6.954	0.372
0.085	0.878	1.134	0.646	7.374	0.36
0.09885	0.872	1.204	0.634	7.814	0.349
0.111	0.868	1.284	0.628	8.284	0.335
0.125	0.862	1.374	0.619	8.784	0.316
0.14	0.861	1.454	0.604	9.314	0.303
0.156	0.854	1.554	0.596	9.874	0.284
0.172	0.849	1.654	0.587	10.47	0.271
0.19	0.844	1.754	0.579	11.07	0.263
0.209	0.838	1.864	0.572	11.77	0.236
0.229	0.833	1.984	0.563	12.47	0.216
0.25	0.824	2.114	0.553	13.17	0.195
0.2722	0.816	2.244	0.545	13.97	0.176
0.296	0.812	2.384	0.533	14.87	0.15
0.321	0.805	2.534	0.528	15.67	0.134
0.347	0.798	2.694	0.52		
0.375	0.788	2.854	0.511		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	7.0E-5	cm/sec
Ss	0.045	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.03023 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	6.961E-5	2.932E-5	+/- 5.826E-5	2.374	cm/sec
Ss	0.04481	0.0257	+/- 0.05106	1.744	ft^{-1}
Kz/Kr	1.	31.19	+/- 61.98	0.03206	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.03006 cm²/sec

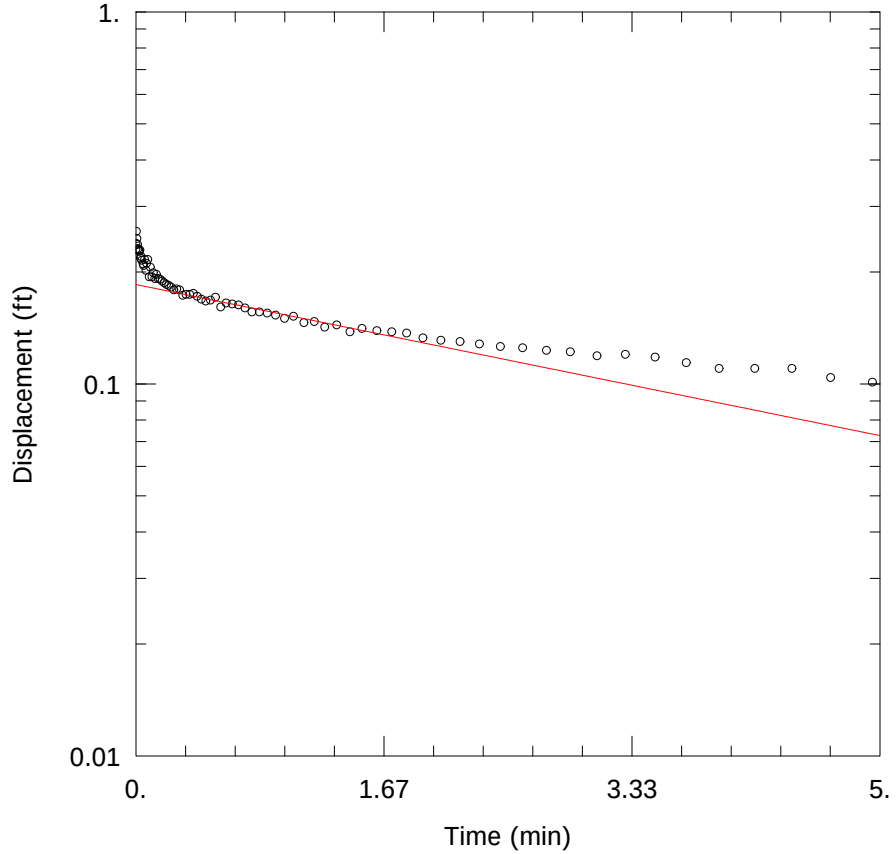
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-1.00	-0.99
Ss	-1.00	1.00	0.97
Kz/Kr	-0.99	0.97	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.04042 ft^2
Variance . . . . . 0.0004593 ft^2
Std. Deviation . . . . . 0.02143 ft
Mean. . . . . -0.002289 ft
No. of Residuals 91
No. of Estimates. 3



R104 @CCR LANDFILL – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: R104
Test Date: 15 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.00028 cm/sec
y0 = 0.185 ft

AQUIFER DATA

Saturated Thickness: 14.17 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (R104)

Initial Displacement: 0.23 ft
Total Well Penetration Depth: 14.17 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 14.17 ft
Screen Length: 4.43 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\R104rh.aqt
Title: R104 @CCR Landfill – Rising Head Test
Date: 12/01/16
Time: 09:05:00

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 15 Jun 2016
Test Well: R104

AQUIFER DATA

Saturated Thickness: 14.17 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: R104

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 0.23 ft
Static Water Column Height: 14.17 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.43 ft
Total Well Penetration Depth: 14.17 ft

No. of Observations: 93

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	0.239	0.2745	0.18	1.929	0.133
0.00365	0.257	0.2945	0.179	2.049	0.131
0.007317	0.246	0.3155	0.173	2.179	0.13
0.01098	0.237	0.3375	0.174	2.309	0.128
0.01465	0.231	0.3615	0.174	2.449	0.126
0.01863	0.229	0.3865	0.175	2.599	0.125
0.0228	0.227	0.4125	0.172	2.759	0.123
0.02697	0.229	0.4405	0.169	2.919	0.122
0.03113	0.218	0.4705	0.167	3.099	0.119
0.0353	0.22	0.5015	0.168	3.289	0.12
0.03947	0.215	0.5355	0.171	3.489	0.118
0.04867	0.21	0.5705	0.161	3.699	0.114
0.05237	0.208	0.6075	0.165	3.919	0.11

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.05847	0.216	0.6475	0.164	4.159	0.11
0.06835	0.202	0.6895	0.163	4.409	0.11
0.07247	0.211	0.7335	0.16	4.669	0.104
0.08047	0.216	0.7805	0.156	4.949	0.101
0.08947	0.194	0.8305	0.156	5.249	0.1
0.09748	0.206	0.8835	0.155	5.559	0.1
0.108	0.194	0.9395	0.153	5.899	0.096
0.1175	0.199	0.9995	0.15	6.249	0.093
0.1275	0.192	1.059	0.152	6.619	0.089
0.1385	0.197	1.129	0.146	7.019	0.086
0.1505	0.192	1.199	0.147	7.439	0.085
0.1635	0.191	1.269	0.142	7.879	0.076
0.1765	0.189	1.349	0.144	8.349	0.073
0.1905	0.187	1.439	0.138	8.849	0.072
0.2055	0.185	1.519	0.141	9.379	0.066
0.2215	0.184	1.619	0.139	9.939	0.059
0.2375	0.182	1.719	0.138	10.54	0.06
0.2555	0.179	1.819	0.137	11.14	0.051

SOLUTION

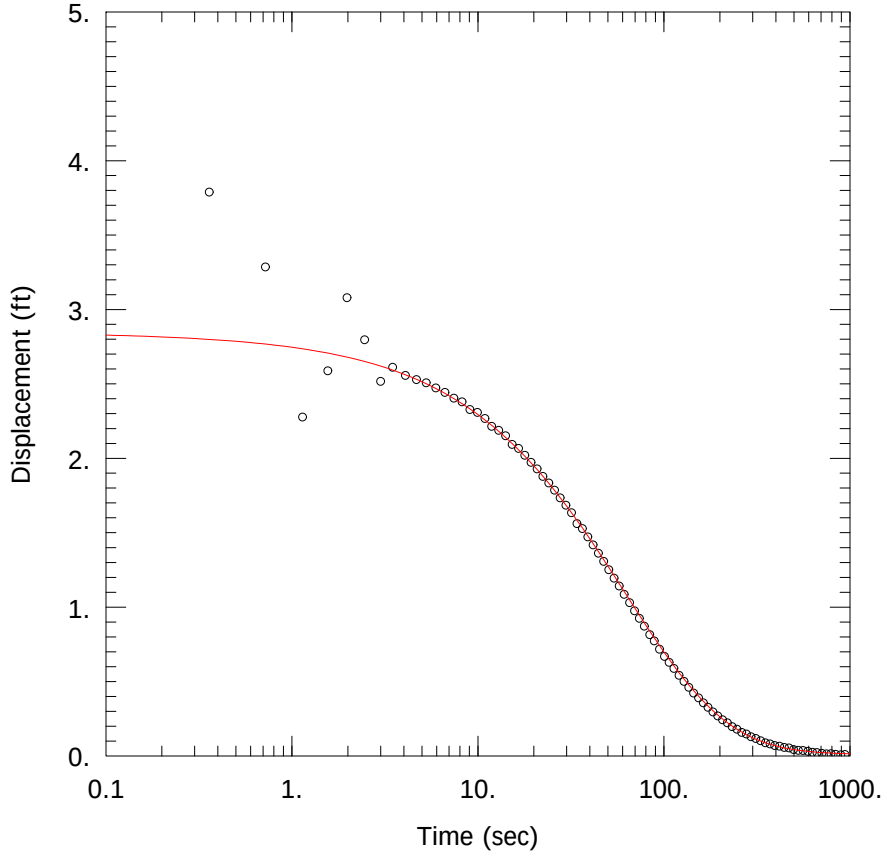
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.761

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.00028	cm/sec
y0	0.185	ft

T = K*b = 0.1209 cm²/sec



T127 @ CCR LANDFILL – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: T127
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0012 cm/sec
Ss = 0.0005 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 10.28 ft

WELL DATA (T127)

Initial Displacement: 2.85 ft
Total Well Penetration Depth: 10.28 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 10.28 ft
Screen Length: 4.54 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\T127fh.aqt
Title: T127 @ CCR Landfill – Falling Head Test
Date: 11/28/16
Time: 09:44:57

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: T127

AQUIFER DATA

Saturated Thickness: 10.28 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: T127

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.85 ft
Static Water Column Height: 10.28 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.54 ft
Total Well Penetration Depth: 10.28 ft

No. of Observations: 89

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	4.12	27.72	1.734	183.6	0.295
0.36	3.789	29.76	1.684	195.	0.268
0.721	3.285	31.86	1.634	207.	0.242
1.141	2.277	34.08	1.561	219.6	0.222
1.56	2.588	36.48	1.527	232.8	0.196
1.98	3.079	39.	1.471	247.2	0.179
2.461	2.796	41.64	1.418	262.2	0.157
3.	2.517	44.46	1.362	278.	0.147
3.48	2.611	47.46	1.307	294.6	0.129
4.08	2.556	50.64	1.251	312.6	0.117
4.681	2.528	54.	1.194	331.2	0.102
5.28	2.507	57.6	1.141	351.6	0.088
5.94	2.473	61.2	1.086	372.6	0.08

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
6.66	2.442	65.4	1.03	394.8	0.069
7.44	2.404	69.6	0.975	418.8	0.065
8.22	2.379	73.8	0.924	444.	0.056
9.06	2.327	78.6	0.871	470.4	0.053
9.96	2.308	84.	0.815	498.6	0.042
10.92	2.267	88.8	0.773	528.6	0.037
11.88	2.214	94.8	0.717	560.4	0.036
12.96	2.188	100.8	0.668	594.	0.031
14.1	2.151	106.8	0.628	630.	0.024
15.3	2.093	113.4	0.588	666.	0.022
16.56	2.066	120.6	0.541	708.	0.017
17.88	2.02	128.4	0.501	750.	0.013
19.32	1.973	136.2	0.461	792.	0.015
20.82	1.928	144.6	0.422	840.	0.01
22.38	1.878	153.6	0.39	894.2	0.007
24.06	1.834	163.2	0.356	942.	0.009
25.86	1.786	172.8	0.326		

SOLUTION

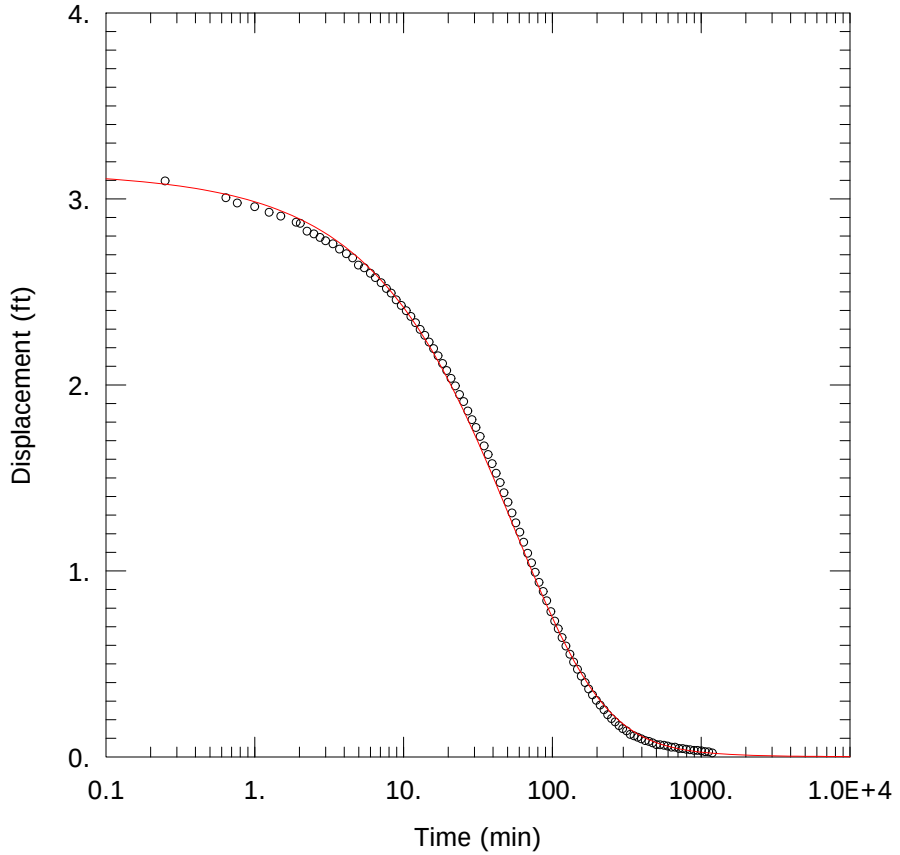
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.0012	cm/sec
Ss	0.0005	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.376 cm^2/sec



T127 @ CCR LANDFILL – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: T127
Test Date: 14 Jun 2016

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 1.7E-5 cm/sec
Ss = 0.0025 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 10.28 ft

WELL DATA (T127)

Initial Displacement: 3.15 ft
Total Well Penetration Depth: 10.28 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 10.28 ft
Screen Length: 4.54 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\T127rh.aqt
Title: T127 @ CCR Landfill – Rising Head Test
Date: 11/28/16
Time: 09:45:21

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 14 Jun 2016
Test Well: T127

AQUIFER DATA

Saturated Thickness: 10.28 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: T127

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 3.15 ft
Static Water Column Height: 10.28 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.54 ft
Total Well Penetration Depth: 10.28 ft

No. of Observations: 105

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	3.236	19.56	2.077	166.2	0.4
0.25	3.096	20.88	2.035	175.8	0.365
0.641	3.006	22.32	1.994	186.6	0.333
0.764	2.978	23.82	1.948	198.	0.304
1.	2.958	25.38	1.91	210.	0.278
1.25	2.928	27.06	1.859	222.6	0.253
1.5	2.907	28.86	1.813	235.8	0.227
1.903	2.874	30.72	1.771	250.2	0.206
2.027	2.868	32.76	1.723	265.2	0.188
2.25	2.826	34.86	1.672	280.8	0.168
2.5	2.812	37.08	1.625	297.6	0.152
2.75	2.793	39.48	1.576	315.6	0.14
3.	2.775	42.	1.525	334.2	0.121

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
3.36	2.758	44.64	1.475	354.8	0.113
3.72	2.73	47.46	1.42	375.6	0.105
4.14	2.705	50.46	1.369	397.8	0.097
4.56	2.683	53.64	1.311	421.8	0.087
4.98	2.644	57.	1.258	447.	0.083
5.46	2.629	60.6	1.208	473.4	0.075
6.	2.6	64.2	1.154	501.6	0.066
6.48	2.577	68.4	1.095	531.6	0.065
7.08	2.549	72.6	1.043	563.4	0.062
7.68	2.518	76.8	0.992	597.	0.058
8.28	2.493	81.6	0.938	633.	0.052
8.94	2.457	87.	0.889	669.	0.052
9.66	2.427	91.8	0.839	711.	0.045
10.44	2.399	97.8	0.781	753.	0.044
11.22	2.368	103.8	0.73	795.	0.041
12.06	2.334	109.8	0.689	843.	0.038
12.96	2.298	116.4	0.641	897.	0.035
13.92	2.266	123.6	0.596	945.	0.035
14.88	2.23	131.4	0.552	1005.	0.032
15.96	2.195	139.2	0.51	1065.	0.028
17.1	2.156	147.6	0.471	1125.	0.027
18.3	2.115	156.6	0.434	1191.	0.021

SOLUTION

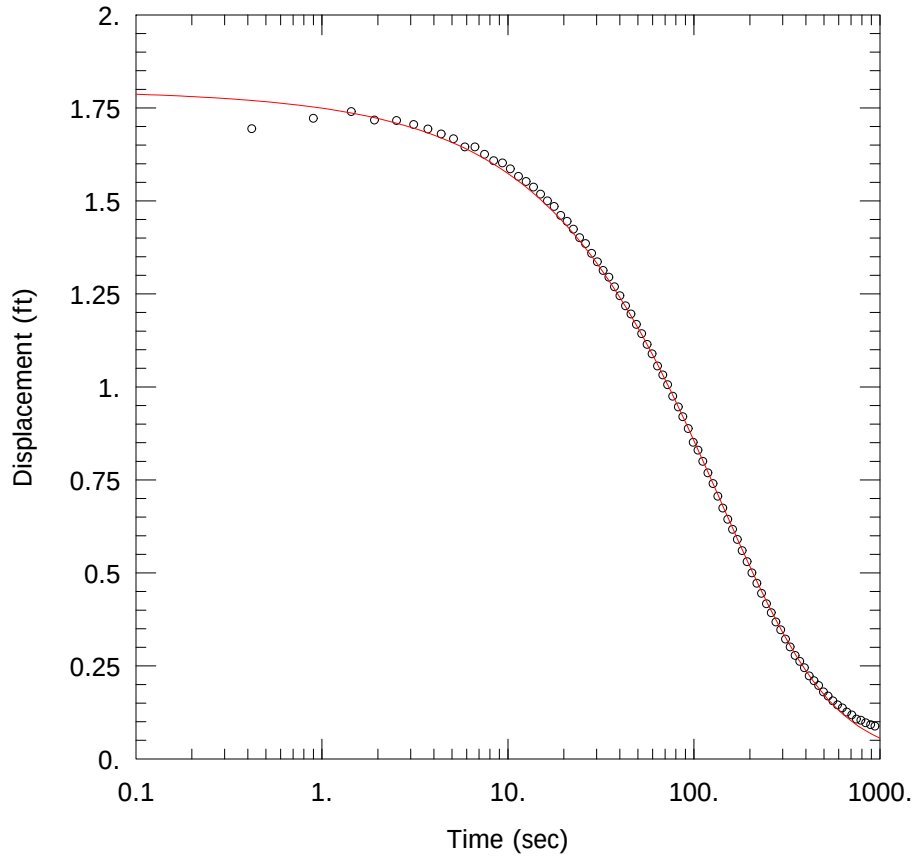
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	1.7E-5	cm/sec
Ss	0.0025	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.005327 cm^2/sec



T202 @ GMF GYPSUM POND – FALLING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: T202
Test Date: 16 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.00045 cm/sec
Ss = 0.002 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 13.29 ft

WELL DATA (T202)

Initial Displacement: 1.8 ft
Total Well Penetration Depth: 13.29 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 13.29 ft
Screen Length: 4.38 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\T202fh.aqt
Title: T202 @ GMF Gypsum Pond – Falling Head Test
Date: 11/28/16
Time: 09:45:43

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 16 Jun 2016
Test Well: T202

AQUIFER DATA

Saturated Thickness: 13.29 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: T202

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.8 ft
Static Water Column Height: 13.29 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.38 ft
Total Well Penetration Depth: 13.29 ft

No. of Observations: 89

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	1.742	34.92	1.295	231.2	0.445
0.42	1.694	37.44	1.269	245.6	0.417
0.9	1.722	40.08	1.245	260.6	0.393
1.44	1.74	42.9	1.218	276.2	0.368
1.92	1.717	45.9	1.196	293.	0.347
2.52	1.716	49.08	1.168	311.	0.322
3.12	1.705	52.44	1.143	329.6	0.301
3.72	1.693	56.04	1.114	350.	0.278
4.38	1.68	59.64	1.089	371.	0.262
5.1	1.667	63.84	1.056	393.2	0.245
5.88	1.645	68.04	1.032	417.2	0.223
6.66	1.645	72.24	1.006	442.4	0.21
7.5	1.625	77.04	0.975	468.8	0.197

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
8.4	1.608	82.44	0.946	497.	0.18
9.36	1.602	87.24	0.92	527.	0.169
10.32	1.586	93.24	0.888	558.8	0.156
11.4	1.566	99.24	0.851	592.4	0.145
12.54	1.552	105.2	0.83	628.4	0.137
13.74	1.537	111.8	0.8	664.4	0.126
15.	1.518	119.	0.769	706.4	0.118
16.32	1.5	126.8	0.74	748.4	0.107
17.76	1.485	134.6	0.706	790.4	0.104
19.26	1.461	143.	0.674	838.4	0.097
20.82	1.445	152.	0.644	892.4	0.092
22.5	1.424	161.6	0.617	940.6	0.088
24.3	1.401	171.2	0.59	1000.4	0.079
26.16	1.385	182.	0.56	1060.4	0.077
28.2	1.359	193.4	0.53	1120.4	0.07
30.3	1.336	205.4	0.5	1186.4	0.069
32.52	1.313	218.	0.472		

SOLUTION

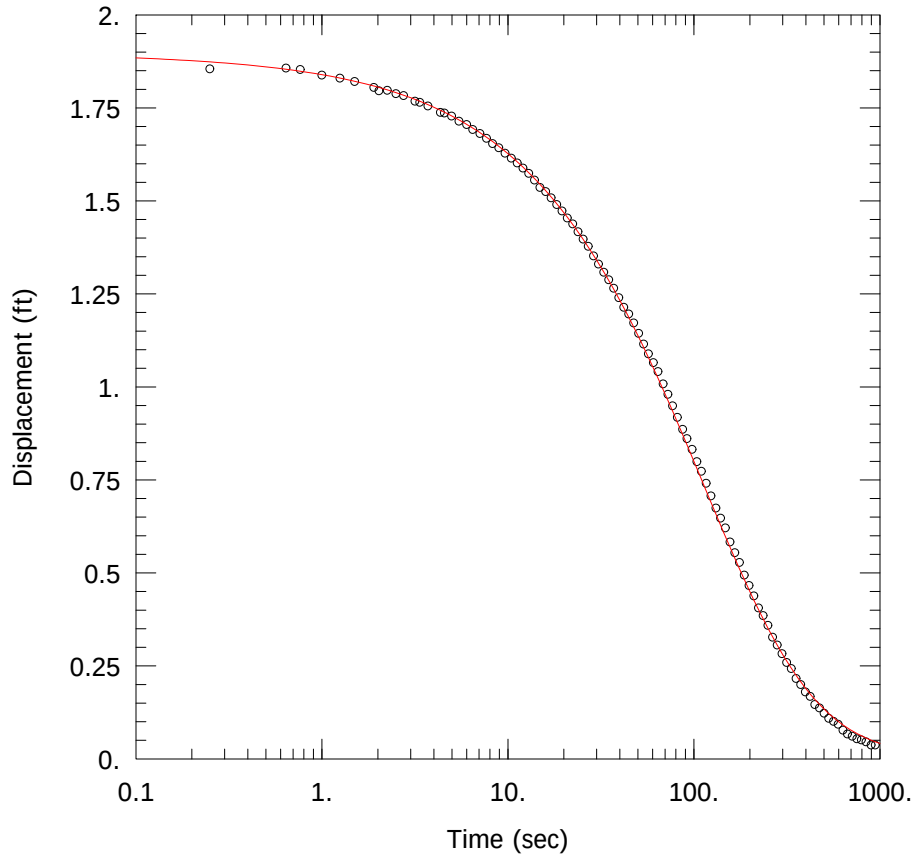
Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00045	cm/sec
Ss	0.002	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.1823 cm^2/sec



T202 @ GMF GYPSUM POND – RISING HEAD TEST

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: T202
Test Date: 16 Jun 2016

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.00055 cm/sec
Ss = 0.002 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 13.29 ft

WELL DATA (T202)

Initial Displacement: 1.9 ft
Total Well Penetration Depth: 13.29 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 13.29 ft
Screen Length: 4.38 ft
Well Radius: 0.08333 ft

Data Set: C:\Users\ktheesfeld\AppData\Local\Temp\Temp1_CoffeenAqtesolvFiles.zip\T202rh.aqt
Title: T202 @ GMF Gypsum Pond – Rising Head Test
Date: 11/28/16
Time: 09:46:07

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 16 Jun 2016
Test Well: T202

AQUIFER DATA

Saturated Thickness: 13.29 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: T202

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.9 ft
Static Water Column Height: 13.29 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 4.38 ft
Total Well Penetration Depth: 13.29 ft

No. of Observations: 105

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	1.832	19.56	1.473	166.2	0.554
0.25	1.855	20.88	1.454	175.8	0.528
0.642	1.857	22.32	1.438	186.6	0.494
0.765	1.853	23.82	1.417	198.	0.466
1.	1.838	25.38	1.397	210.	0.438
1.25	1.83	27.06	1.378	222.6	0.406
1.5	1.821	28.86	1.352	235.8	0.385
1.903	1.805	30.72	1.33	250.2	0.359
2.027	1.796	32.76	1.308	265.2	0.327
2.25	1.797	34.86	1.288	280.8	0.306
2.5	1.788	37.08	1.265	297.6	0.283
2.75	1.783	39.48	1.24	315.6	0.259
3.167	1.768	42.	1.214	334.2	0.243

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
3.36	1.765	44.64	1.196	354.6	0.216
3.721	1.755	47.46	1.172	375.6	0.2
4.338	1.738	50.46	1.144	397.8	0.18
4.56	1.736	53.64	1.115	421.8	0.168
4.98	1.728	57.	1.089	447.	0.146
5.46	1.714	60.6	1.065	473.4	0.137
6.	1.705	64.2	1.041	501.6	0.123
6.48	1.692	68.4	1.008	531.6	0.109
7.08	1.681	72.6	0.98	563.4	0.101
7.68	1.668	76.8	0.949	597.	0.093
8.28	1.654	81.6	0.918	633.	0.077
8.94	1.643	87.	0.886	669.	0.067
9.66	1.628	91.8	0.861	711.	0.061
10.44	1.615	97.8	0.832	753.	0.054
11.22	1.602	103.8	0.799	795.	0.051
12.06	1.588	109.8	0.773	843.	0.046
12.96	1.574	116.4	0.741	897.	0.037
13.92	1.556	123.6	0.707	945.	0.037
14.88	1.536	131.4	0.674	1005.	0.031
15.96	1.525	139.2	0.647	1065.	0.026
17.1	1.508	147.6	0.621	1125.1	0.023
18.3	1.49	156.6	0.583	1191.	0.025

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.00055	cm/sec
Ss	0.002	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.2228 cm^2/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0005307	2.017E-5	+/- 4.0E-5	26.31	cm/sec
Ss	0.002349	0.0002737	+/- 0.0005428	8.581	ft^{-1}
Kz/Kr	1.	0.6606	+/- 1.31	1.514	

C.I. is approximate 95% confidence interval for parameter

t-ratio = estimate/std. error
No estimation window

T = K*b = 0.215 cm²/sec

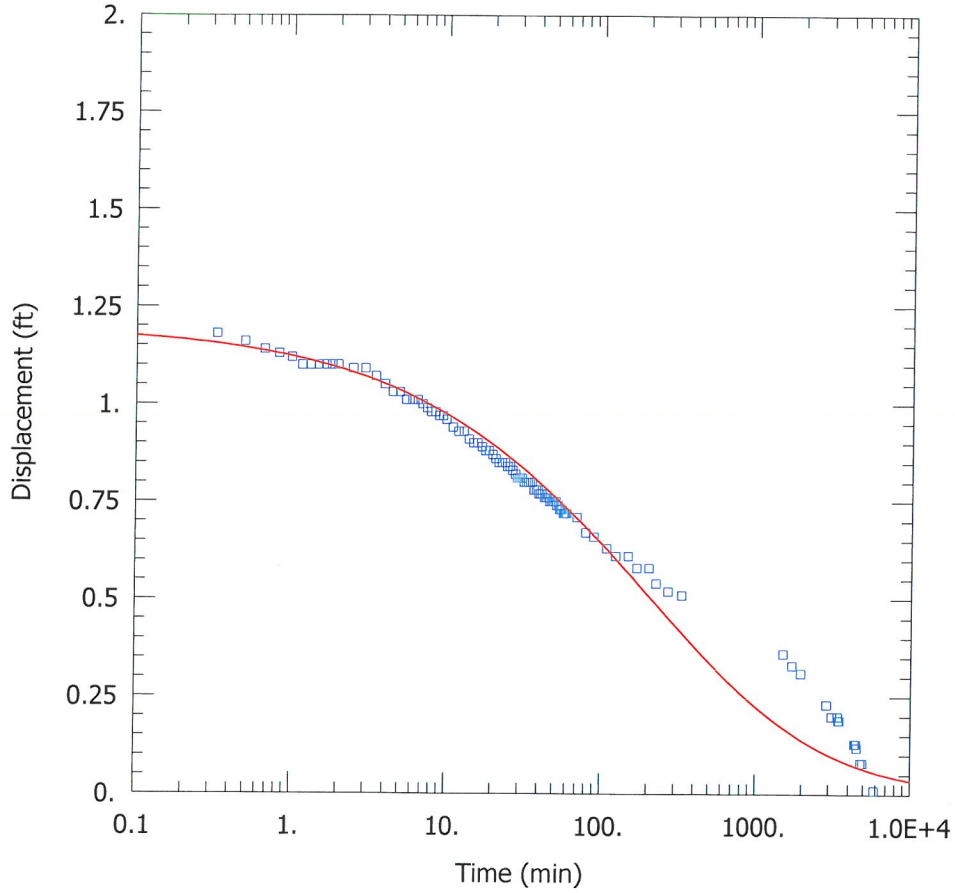
Parameter Correlations

	Kr	Ss	Kz/Kr
Kr	1.00	-0.98	-0.95
Ss	-0.98	1.00	0.89
Kz/Kr	-0.95	0.89	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.01824 ft^2
Variance . . . . . 0.0001788 ft^2
Std. Deviation . . . . . 0.01337 ft
Mean. . . . . -0.005597 ft
No. of Residuals 105
No. of Estimates. 3



G45D FALLING HEAD #1

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G45D
Test Date: 29 Aug 2016

AQUIFER DATA

Saturated Thickness: 5.64 ft

WELL DATA (G45D)

Initial Displacement: 1.2 ft
Total Well Penetration Depth: 9.64 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 5.64 ft
Screen Length: 9.64 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined

Kr = 4.9E-7 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 0.2 ft^{-1}

Data Set: I:\16jobs\16E0080\Admin\15-Field-Laboratory Data\SlugTest2\G45D_fh1.aqt
Title: G45D Falling Head #1
Date: 09/27/16
Time: 14:28:20

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 29 Aug 2016
Test Well: G45D

AQUIFER DATA

Saturated Thickness: 5.64 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G45D

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.2 ft
Static Water Column Height: 5.64 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.25 ft
Screen Length: 9.64 ft
Total Well Penetration Depth: 9.64 ft

No. of Observations: 104

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.33	1.18	36.	0.8
0.5	1.16	37.13	0.78
0.67	1.14	38.27	0.78
0.83	1.13	39.2	0.78
1.	1.12	40.02	0.77
1.17	1.1	41.	0.77
1.33	1.1	42.	0.77
1.5	1.1	43.37	0.76
1.67	1.1	44.2	0.76
1.83	1.1	45.	0.76
2.	1.1	46.	0.76
2.5	1.09	47.	0.75
3.	1.09	48.	0.75
3.5	1.07	49.	0.75
4.	1.05	50.	0.75
4.5	1.03	51.23	0.75
5.	1.03	52.	0.74
5.5	1.01	53.07	0.74
6.	1.01	54.03	0.73

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
6.5	1.01	55.	0.73
7.	1.	56.05	0.73
7.5	0.99	57.32	0.72
8.	0.98	58.	0.72
8.5	0.98	59.	0.72
9.	0.97	60.	0.72
9.5	0.97	70.	0.71
10.	0.96	80.	0.67
11.	0.94	90.	0.66
12.	0.93	108.6	0.63
13.	0.93	123.8	0.61
14.	0.91	149.	0.61
15.	0.9	170.4	0.58
16.	0.9	204.4	0.58
17.13	0.89	226.	0.54
18.	0.88	270.9	0.52
19.	0.88	331.8	0.51
20.	0.87	1506.	0.36
21.	0.86	1722.	0.33
22.	0.85	1960.	0.31
23.03	0.85	2879.	0.23
24.23	0.85	3117.	0.2
25.	0.84	3380.	0.2
26.	0.84	3427.	0.19
27.	0.83	3464.	0.19
28.12	0.82	4328.	0.13
29.	0.81	4405.	0.13
30.	0.81	4431.	0.13
31.	0.81	4456.	0.13
32.	0.8	4499.	0.12
33.1	0.8	4775.	0.08
34.05	0.8	4899.	0.08
35.	0.8	5848.	0.01

SOLUTION

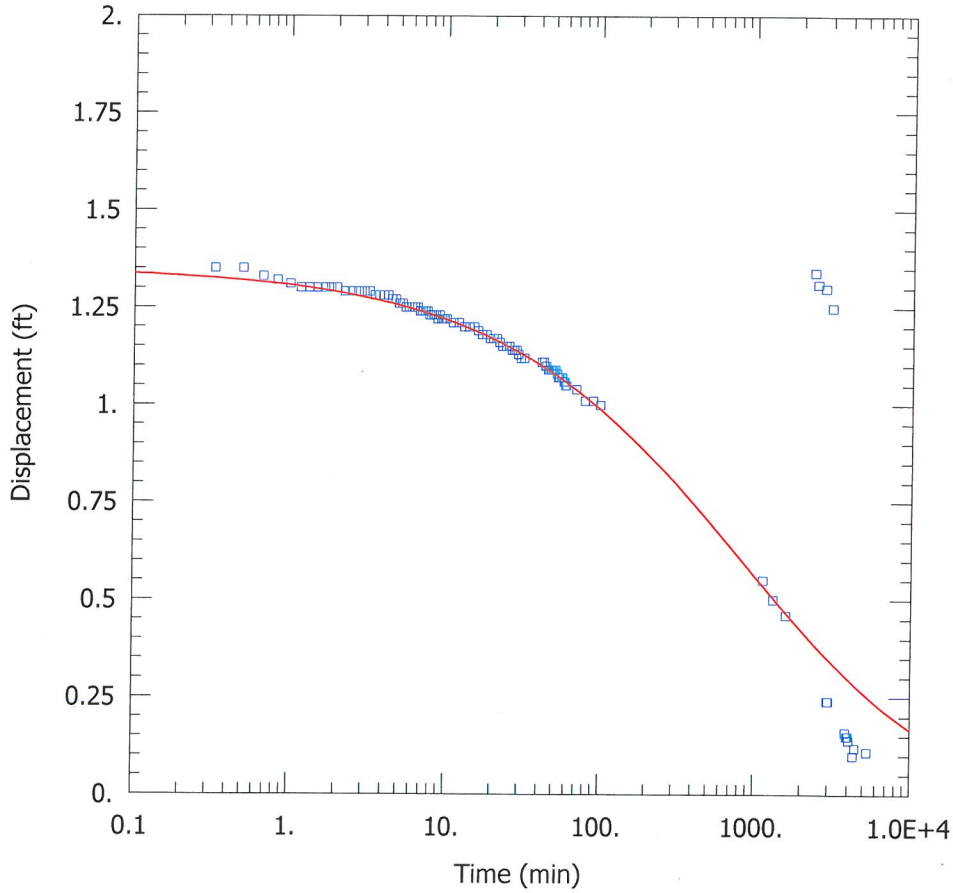
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	4.9E-7	cm/sec
Ss	0.2	ft^{-1}
Kz/Kr	1.	

T = K*b = 8.423E-5 cm^2/sec



G46D FALLING HEAD #1

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: G46D
Test Date: 29 Aug 2016

AQUIFER DATA

Saturated Thickness: 19.34 ft

WELL DATA (G46D)

Initial Displacement: 1.35 ft
Total Well Penetration Depth: 18.95 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 19.34 ft
Screen Length: 9.65 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined

Kr = 4.0E-8 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 0.2 ft^{-1}

Data Set: I:\16jobs\16E0080\Admin\15-Field-Laboratory Data\SlugTest2\G46D_fh1.aqt
Title: G46D Falling Head #1
Date: 09/27/16
Time: 14:28:21

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 29 Aug 2016
Test Well: G46D

AQUIFER DATA

Saturated Thickness: 19.34 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: G46D

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.35 ft
Static Water Column Height: 19.34 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.25 ft
Screen Length: 9.65 ft
Total Well Penetration Depth: 18.95 ft

No. of Observations: 105

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.33	1.35	21.07	1.17
0.5	1.35	22.	1.16
0.67	1.33	23.	1.15
0.83	1.32	24.3	1.15
1.	1.31	25.35	1.15
1.17	1.3	26.47	1.14
1.33	1.3	27.33	1.14
1.5	1.3	28.28	1.14
1.67	1.3	29.13	1.13
1.83	1.3	30.25	1.12
2.	1.3	31.9	1.12
2.25	1.29	41.25	1.11
2.5	1.29	42.63	1.11
2.75	1.29	43.55	1.1
3.	1.29	44.42	1.1
3.25	1.29	45.33	1.09
3.5	1.28	46.18	1.09
3.75	1.28	47.12	1.09
4.	1.28	48.	1.09

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
4.25	1.28	49.	1.09
4.5	1.27	50.	1.09
4.75	1.27	51.	1.09
5.	1.26	52.05	1.08
5.25	1.26	53.23	1.07
5.5	1.25	54.	1.07
5.75	1.25	55.35	1.07
6.	1.25	56.57	1.07
6.25	1.25	57.48	1.06
6.5	1.25	58.28	1.06
6.75	1.24	59.	1.05
7.	1.24	60.	1.05
7.25	1.24	70.	1.04
7.5	1.24	80.	1.01
7.75	1.23	90.	1.01
8.	1.23	100.	1.
8.25	1.23	1143.	0.55
8.5	1.23	1332.	0.5
8.75	1.22	1607.	0.46
9.	1.23	2397.	1.34
9.25	1.22	2507.	1.31
9.5	1.22	2778.	1.3
9.75	1.22	2962.	0.24
10.	1.22	3001.	0.24
11.	1.21	3056.	1.25
12.	1.21	3856.	0.16
13.	1.2	3930.	0.15
14.	1.2	3975.	0.15
15.05	1.2	4012.	0.15
16.	1.19	4057.	0.14
17.	1.18	4337.	0.1
18.13	1.18	4445.	0.12
19.07	1.17	5325.	0.11
20.	1.17		

SOLUTION

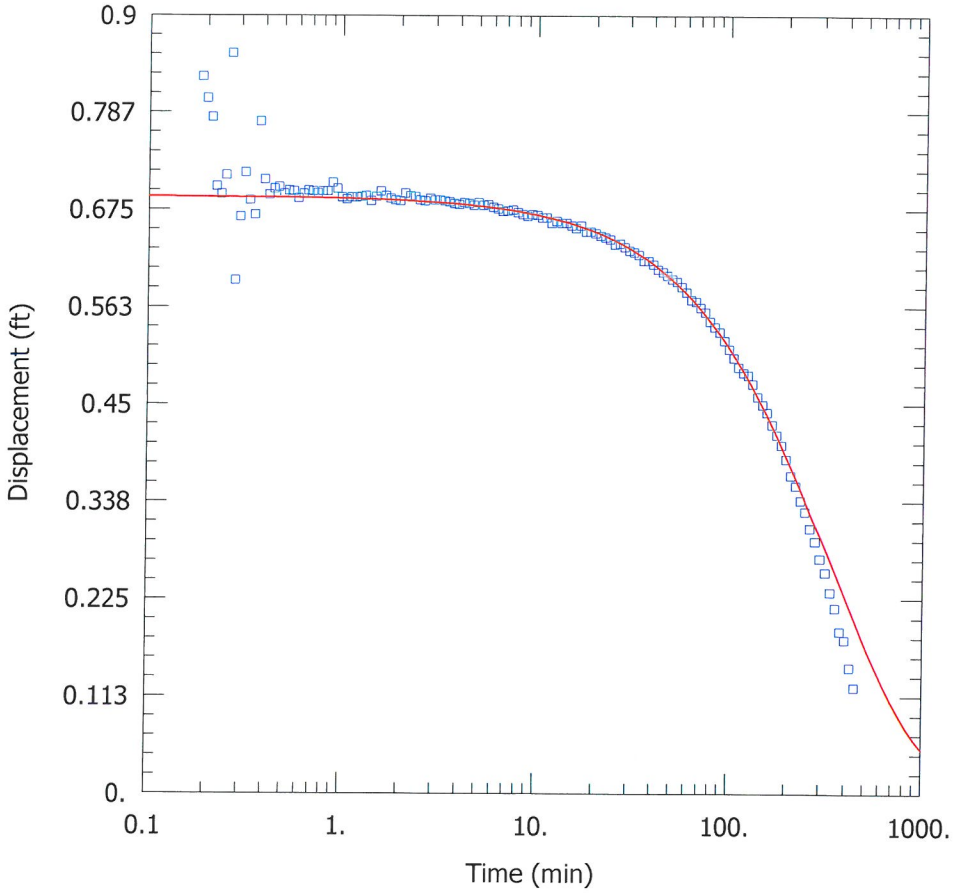
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	4.0E-8	cm/sec
Ss	0.2	ft^{-1}
Kz/Kr	1.	

T = K*b = 2.358E-5 cm^2/sec



T408 FALLING HEAD #1

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: T408
Test Date: 1 Sept 2016

AQUIFER DATA

Saturated Thickness: 22.87 ft

WELL DATA (T408)

Initial Displacement: 0.69 ft
Total Well Penetration Depth: 22.44 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 22.87 ft
Screen Length: 4.83 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined

Kr = 4.7E-6 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 1.0E-7 ft^{-1}

Data Set: I:\16jobs\16E0080\Admin\15-Field-Laboratory Data\SlugTest2\T408_fh1.aqt
Title: T408 Falling Head #1
Date: 09/27/16
Time: 14:28:22

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 1 Sept 2016
Test Well: T408

AQUIFER DATA

Saturated Thickness: 22.87 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: T408

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 0.69 ft
Static Water Column Height: 22.87 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.25 ft
Screen Length: 4.83 ft
Total Well Penetration Depth: 22.44 ft

No. of Observations: 136

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.188	0.829	9.44	0.67
0.199	0.804	10.	0.669
0.211	0.782	10.6	0.666
0.224	0.702	11.2	0.666
0.237	0.693	11.9	0.66
0.251	0.715	12.6	0.662
0.266	0.856	13.3	0.66
0.282	0.593	14.1	0.66
0.298	0.667	15.	0.657
0.316	0.718	15.8	0.654
0.335	0.686	16.8	0.657
0.355	0.669	17.8	0.65
0.376	0.777	18.8	0.65
0.398	0.71	19.9	0.648
0.422	0.692	21.1	0.645
0.447	0.699	22.4	0.643
0.473	0.701	23.7	0.641
0.501	0.693	25.1	0.635
0.531	0.697	26.6	0.636

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.562	0.696	28.2	0.632
0.596	0.688	29.8	0.628
0.631	0.693	31.6	0.626
0.668	0.697	33.5	0.623
0.708	0.696	35.5	0.616
0.75	0.694	37.6	0.616
0.794	0.696	39.8	0.612
0.841	0.696	42.2	0.606
0.891	0.706	44.7	0.603
0.944	0.699	47.3	0.599
1.	0.689	50.1	0.595
1.06	0.687	53.1	0.592
1.12	0.689	56.2	0.586
1.19	0.689	59.6	0.58
1.26	0.69	63.1	0.571
1.33	0.691	66.8	0.569
1.41	0.685	70.8	0.562
1.5	0.69	75.	0.557
1.58	0.696	79.4	0.546
1.68	0.691	84.1	0.54
1.78	0.688	89.1	0.534
1.88	0.686	94.4	0.524
1.99	0.685	100.	0.514
2.11	0.694	106.	0.504
2.24	0.691	112.	0.493
2.37	0.69	119.	0.487
2.51	0.686	126.	0.484
2.66	0.685	133.	0.474
2.82	0.688	141.	0.459
2.98	0.686	150.	0.45
3.16	0.686	158.	0.441
3.35	0.685	168.	0.427
3.55	0.684	178.	0.415
3.76	0.682	188.	0.403
3.98	0.681	199.	0.387
4.22	0.683	211.	0.368
4.47	0.682	224.	0.356
4.73	0.68	237.	0.339
5.01	0.683	251.	0.326
5.31	0.68	266.	0.307
5.62	0.681	282.	0.292
5.96	0.678	298.	0.272
6.31	0.676	316.	0.256
6.68	0.673	335.	0.233
7.08	0.674	355.	0.215
7.5	0.675	376.	0.188
7.94	0.672	398.	0.178
8.41	0.67	422.	0.146
8.91	0.668	447.	0.123

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	4.7E-6	cm/sec
Ss	1.0E-7	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.003276 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	6.277E-6	7.768E-6	+/- 1.537E-5	0.8081	cm/sec
Ss	4.0E-12	2.586E-10	+/- 5.116E-10	0.01547	ft^{-1}
Kz/Kr	1.	not estimated			

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.004376 cm²/sec

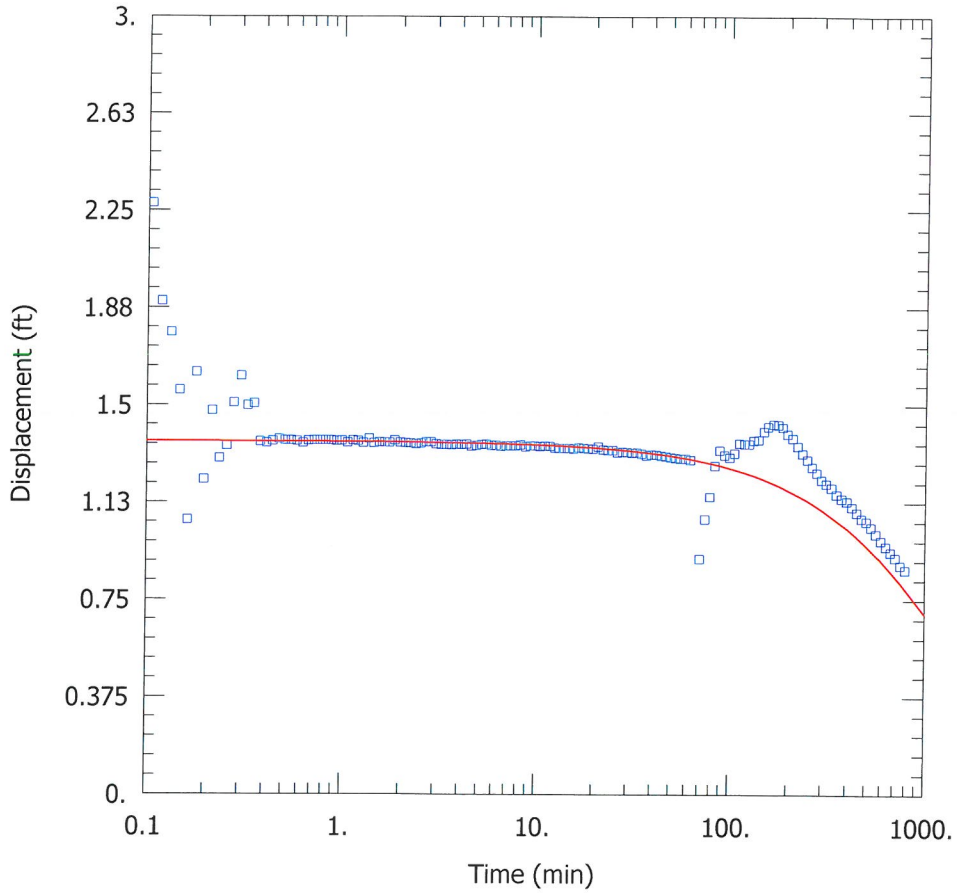
Parameter Correlations

	Kr	Ss
Kr	1.00	-1.00
Ss	-1.00	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.103 ft^2
Variance . . . . . 0.0007689 ft^2
Std. Deviation . . . . . 0.02773 ft
Mean. . . . . 0.006273 ft
No. of Residuals 136
No. of Estimates 2



T408 FALLING HEAD #2

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: T408
Test Date: 1 Sept 2016

AQUIFER DATA

Saturated Thickness: 22.74 ft

WELL DATA (T408)

Initial Displacement: 1.36 ft
Total Well Penetration Depth: 22.31 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 22.74 ft
Screen Length: 4.83 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined

Kr = 9.8E-7 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 1.0E-5 ft^{-1}

Data Set: I:\16jobs\16E0080\Admin\15-Field-Laboratory Data\SlugTest2\T408_fh2.aqt
Title: T408 Falling Head #2
Date: 09/27/16
Time: 14:28:23

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 1 Sept 2016
Test Well: T408

AQUIFER DATA

Saturated Thickness: 22.74 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: T408

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.36 ft
Static Water Column Height: 22.74 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.25 ft
Screen Length: 4.83 ft
Total Well Penetration Depth: 22.31 ft

No. of Observations: 142

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.105	2.278	13.18	1.334
0.118	1.901	13.98	1.334
0.132	1.781	14.88	1.334
0.147	1.557	15.68	1.332
0.163	1.058	16.68	1.336
0.179	1.627	17.68	1.334
0.197	1.213	18.68	1.333
0.216	1.478	19.78	1.332
0.236	1.294	20.98	1.34
0.257	1.342	22.28	1.329
0.279	1.508	23.58	1.327
0.303	1.612	24.98	1.327
0.328	1.498	26.48	1.318
0.354	1.505	28.08	1.32
0.382	1.359	29.68	1.319
0.412	1.354	31.48	1.317
0.443	1.361	33.38	1.318
0.477	1.368	35.38	1.313
0.512	1.363	37.48	1.307

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.549	1.363	39.68	1.311
0.589	1.361	42.08	1.309
0.631	1.354	44.58	1.306
0.675	1.362	47.18	1.303
0.722	1.363	49.98	1.3
0.772	1.364	52.98	1.297
0.825	1.363	56.08	1.294
0.881	1.363	59.48	1.294
0.941	1.361	62.98	1.289
1.001	1.362	70.68	0.908
1.071	1.355	74.88	1.061
1.141	1.363	79.28	1.148
1.211	1.361	83.98	1.267
1.291	1.354	88.98	1.327
1.381	1.37	94.28	1.308
1.461	1.353	99.88	1.3
1.561	1.356	105.9	1.316
1.661	1.355	111.9	1.354
1.761	1.355	118.9	1.351
1.871	1.363	125.9	1.351
1.991	1.355	132.9	1.365
2.121	1.354	140.9	1.367
2.251	1.352	149.9	1.399
2.391	1.35	157.9	1.418
2.541	1.352	167.9	1.428
2.701	1.358	177.9	1.425
2.861	1.358	187.9	1.416
3.041	1.35	198.9	1.39
3.231	1.347	210.9	1.374
3.431	1.348	223.9	1.343
3.641	1.346	236.9	1.314
3.861	1.349	250.9	1.291
4.101	1.347	265.9	1.262
4.351	1.349	281.9	1.24
4.611	1.341	297.9	1.213
4.891	1.344	315.9	1.198
5.191	1.348	334.9	1.183
5.501	1.349	354.9	1.157
5.841	1.344	375.9	1.141
6.191	1.345	397.9	1.131
6.561	1.34	421.9	1.109
6.961	1.343	446.9	1.088
7.381	1.343	472.9	1.065
7.821	1.342	500.9	1.054
8.291	1.346	530.9	1.032
8.791	1.339	561.9	1.005
9.321	1.342	595.9	0.98
9.881	1.343	630.9	0.957
10.48	1.34	667.9	0.935
11.08	1.342	707.9	0.914
11.78	1.341	749.9	0.885
12.48	1.335	793.9	0.867

SOLUTION

Slug Test

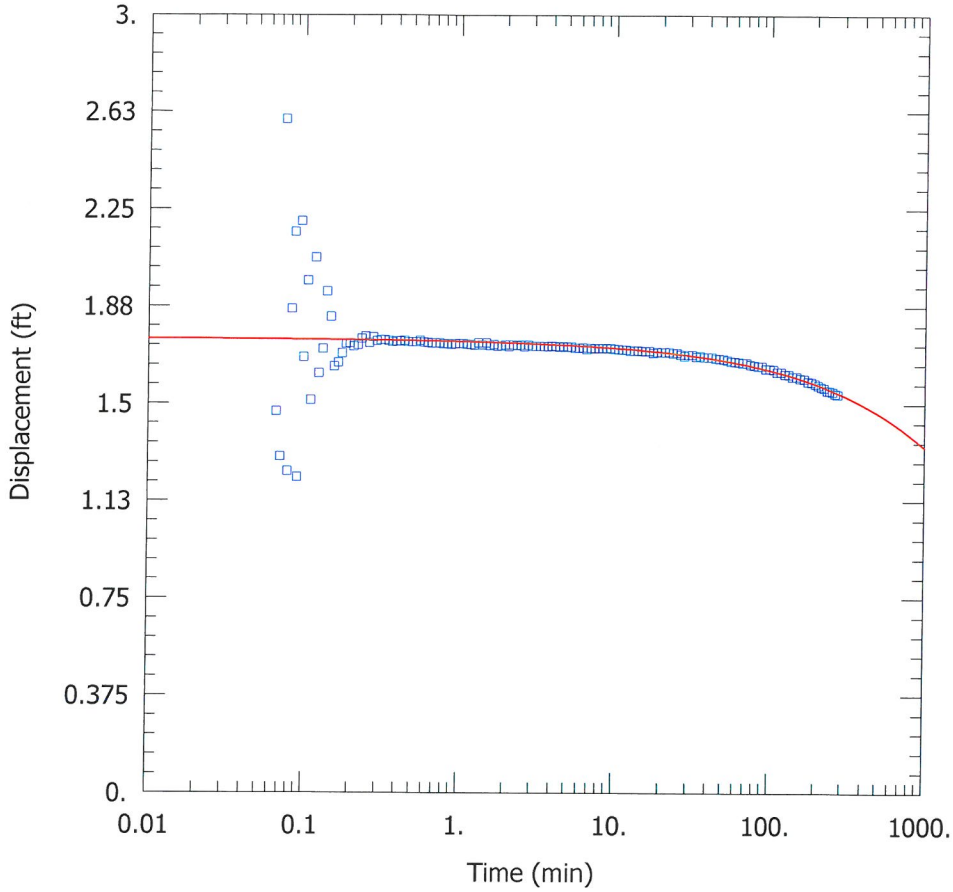
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	9.8E-7	cm/sec
Ss	1.0E-5	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.0006793 cm^2/sec



T408 RISING HEAD #1

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: T408
Test Date: 1 Sept 2016

AQUIFER DATA

Saturated Thickness: 24.46 ft

WELL DATA (T408)

Initial Displacement: 1.75 ft
Total Well Penetration Depth: 24.03 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 24.46 ft
Screen Length: 4.83 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined

Kr = 7.5E-8 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 0.015 ft^{-1}

Data Set: I:\16jobs\16E0080\Admin\15-Field-Laboratory Data\SlugTest2\T408_rh1.aqt
Title: T408 Rising Head #1
Date: 09/27/16
Time: 14:28:24

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 1 Sept 2016
Test Well: T408

AQUIFER DATA

Saturated Thickness: 24.46 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: T408

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.75 ft
Static Water Column Height: 24.46 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.25 ft
Screen Length: 4.83 ft
Total Well Penetration Depth: 24.03 ft

No. of Observations: 149

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.06667	1.47	4.73	1.722
0.07083	1.296	5.01	1.719
0.075	2.597	5.31	1.72
0.07917	1.239	5.62	1.716
0.08333	1.865	5.96	1.716
0.0875	2.161	6.31	1.717
0.09167	1.215	6.68	1.71
0.09583	2.203	7.08	1.716
0.1	1.678	7.5	1.713
0.106	1.974	7.94	1.714
0.112	1.513	8.41	1.716
0.119	2.062	8.91	1.713
0.126	1.617	9.44	1.715
0.133	1.711	10.	1.712
0.141	1.932	10.6	1.711
0.15	1.834	11.2	1.709
0.158	1.643	11.9	1.709
0.168	1.658	12.6	1.705
0.178	1.693	13.3	1.705

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.188	1.73	14.1	1.707
0.199	1.733	15.	1.704
0.211	1.72	15.8	1.703
0.224	1.725	16.8	1.704
0.237	1.75	17.8	1.697
0.251	1.759	18.8	1.701
0.266	1.734	19.9	1.7
0.282	1.756	21.1	1.7
0.298	1.741	22.4	1.701
0.316	1.745	23.7	1.696
0.335	1.745	25.1	1.697
0.355	1.742	26.6	1.691
0.376	1.738	28.2	1.685
0.398	1.74	29.8	1.689
0.422	1.74	31.6	1.69
0.447	1.742	33.5	1.682
0.473	1.738	35.5	1.686
0.501	1.738	37.6	1.681
0.531	1.738	39.8	1.681
0.562	1.743	42.2	1.681
0.596	1.736	44.7	1.676
0.631	1.735	47.3	1.675
0.668	1.733	50.1	1.674
0.708	1.733	53.1	1.67
0.75	1.734	56.2	1.665
0.794	1.73	59.6	1.663
0.841	1.731	63.1	1.662
0.891	1.728	66.8	1.659
0.944	1.73	70.8	1.659
1.	1.731	75.	1.652
1.06	1.732	79.4	1.65
1.12	1.729	84.1	1.646
1.19	1.728	89.1	1.646
1.26	1.725	94.4	1.636
1.33	1.734	100.	1.636
1.41	1.727	106.	1.634
1.5	1.734	112.	1.624
1.58	1.724	119.	1.624
1.68	1.728	126.	1.616
1.78	1.722	133.	1.614
1.88	1.723	141.	1.605
1.99	1.727	150.	1.605
2.11	1.72	158.	1.6
2.24	1.727	168.	1.597
2.37	1.724	178.	1.587
2.51	1.726	188.	1.584
2.66	1.72	198.	1.578
2.82	1.726	208.	1.572
2.98	1.721	218.	1.566
3.16	1.722	228.	1.562
3.35	1.722	238.	1.552
3.55	1.722	248.	1.551
3.76	1.72	258.	1.547
3.98	1.723	268.	1.541
4.22	1.721	278.	1.538
4.47	1.719		

SOLUTION

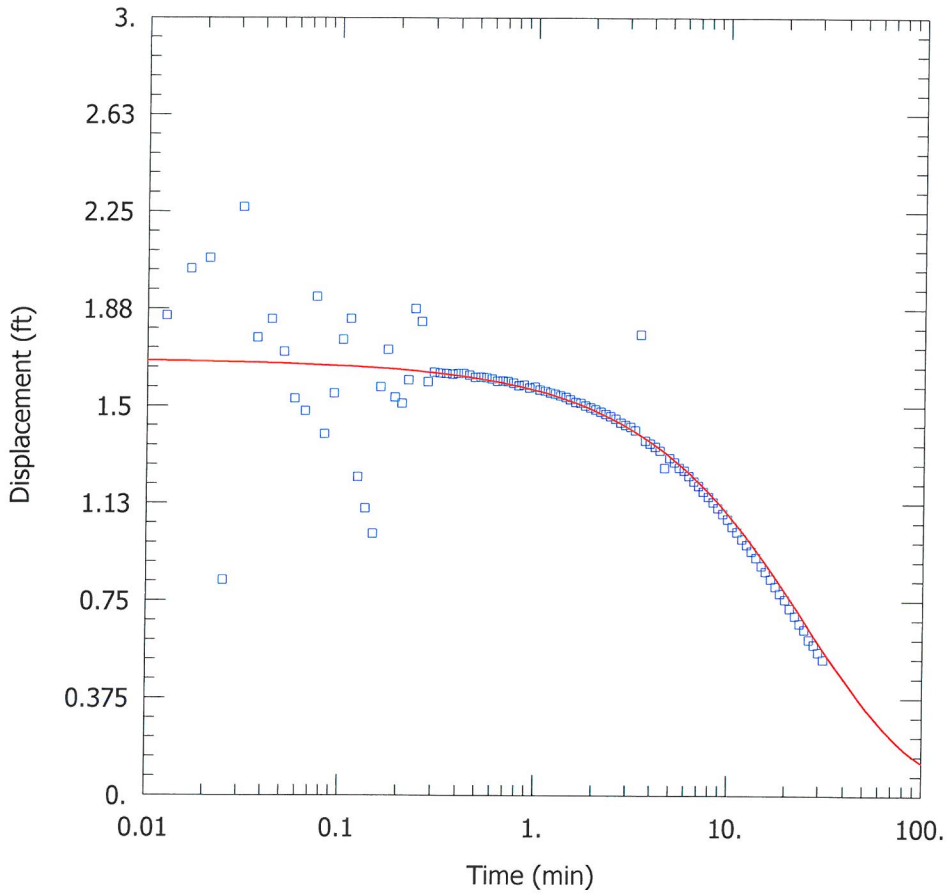
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	7.5E-8	cm/sec
Ss	0.015	ft^{-1}
Kz/Kr	1.	

T = K*b = 5.592E-5 cm^2/sec



T409 FALLING HEAD #1

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: T409
Test Date: 31 Aug 2016

AQUIFER DATA

Saturated Thickness: 21.11 ft

WELL DATA (T409)

Initial Displacement: 1.68 ft
Total Well Penetration Depth: 20.71 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 21.11 ft
Screen Length: 4.8 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined

Kr = 4.0E-5 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 0.00075 ft^{-1}

Data Set: I:\16jobs\16E0080\Admin\15-Field-Laboratory Data\SlugTest2\T409_fh1.aqt
Title: T409 Falling Head #1
Date: 09/27/16
Time: 14:28:25

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 31 Aug 2016
Test Well: T409

AQUIFER DATA

Saturated Thickness: 21.11 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: T409

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.68 ft
Static Water Column Height: 21.11 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.25 ft
Screen Length: 4.8 ft
Total Well Penetration Depth: 20.71 ft

No. of Observations: 107

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	1.591	1.505	1.526
0.004167	1.749	1.605	1.517
0.008333	2.437	1.705	1.513
0.0125	1.849	1.805	1.503
0.01667	2.03	1.915	1.496
0.02083	2.071	2.035	1.488
0.025	0.829	2.165	1.48
0.031	2.267	2.295	1.471
0.037	1.763	2.435	1.462
0.044	1.835	2.585	1.453
0.051	1.709	2.745	1.438
0.058	1.529	2.905	1.429
0.066	1.481	3.085	1.421
0.075	1.922	3.275	1.408
0.083	1.392	3.475	1.777
0.093	1.549	3.685	1.368
0.103	1.756	3.905	1.357
0.113	1.836	4.145	1.345
0.124	1.226	4.395	1.33

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.136	1.106	4.655	1.264
0.149	1.008	4.935	1.302
0.162	1.574	5.235	1.286
0.176	1.718	5.545	1.265
0.191	1.534	5.885	1.254
0.207	1.511	6.235	1.233
0.223	1.601	6.605	1.212
0.241	1.876	7.005	1.195
0.26	1.826	7.425	1.172
0.28	1.595	7.865	1.153
0.301	1.632	8.335	1.132
0.323	1.628	8.835	1.109
0.347	1.627	9.365	1.087
0.372	1.624	9.925	1.066
0.398	1.626	10.53	1.038
0.426	1.626	11.13	1.017
0.456	1.62	11.82	0.989
0.487	1.612	12.53	0.967
0.521	1.613	13.23	0.943
0.556	1.611	14.03	0.918
0.593	1.605	14.93	0.886
0.633	1.597	15.73	0.863
0.675	1.598	16.73	0.835
0.719	1.596	17.73	0.807
0.766	1.589	18.73	0.78
0.816	1.58	19.82	0.756
0.869	1.582	21.02	0.721
0.925	1.571	22.32	0.693
0.985	1.575	23.63	0.664
1.045	1.563	25.02	0.64
1.115	1.559	26.52	0.602
1.185	1.553	28.13	0.582
1.255	1.548	29.73	0.553
1.335	1.541	31.52	0.525
1.425	1.535		

SOLUTION

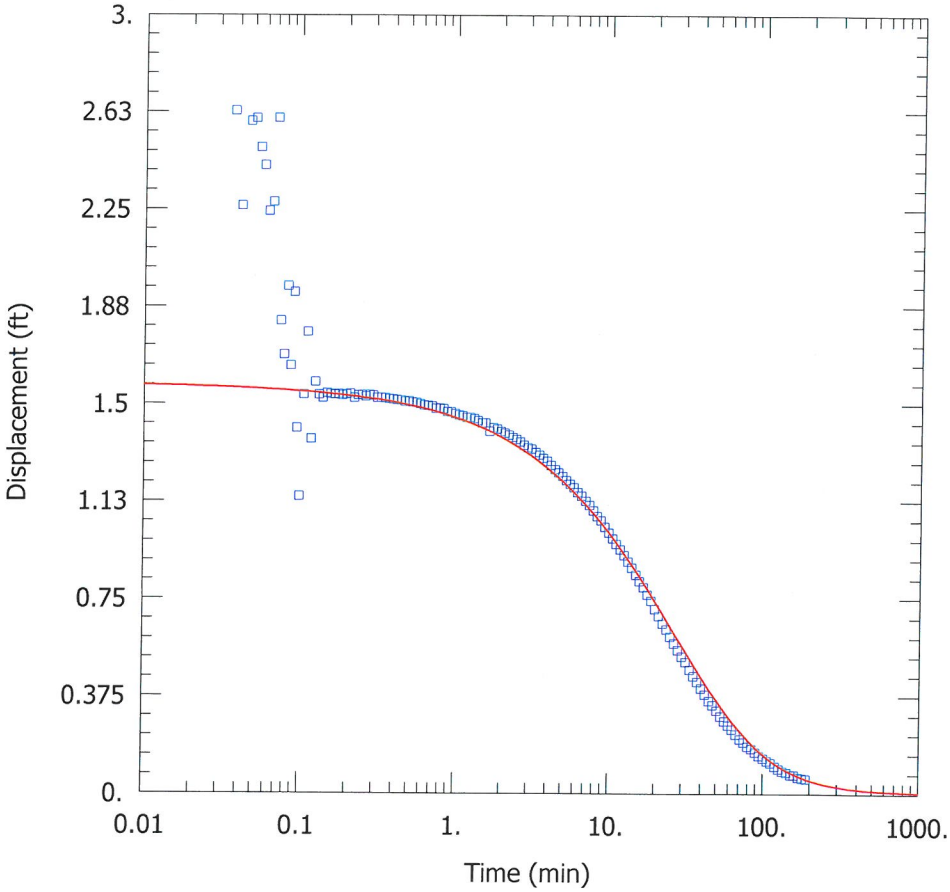
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	4.0E-5	cm/sec
Ss	0.00075	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.02574 cm^2/sec



T409 FALLING HEAD #2

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: T409
Test Date: 31 Aug 2016

AQUIFER DATA

Saturated Thickness: 21.12 ft

WELL DATA (T409)

Initial Displacement: 1.58 ft
Total Well Penetration Depth: 20.72 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 21.12 ft
Screen Length: 4.8 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined

Kr = 3.2E-5 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 0.0025 ft^{-1}

Data Set: I:\16jobs\16E0080\Admin\15-Field-Laboratory Data\SlugTest2\T409_fh2.aqt
Title: T409 Falling Head #2
Date: 09/27/16
Time: 14:28:26

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 31 Aug 2016
Test Well: T409

AQUIFER DATA

Saturated Thickness: 21.12 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: T409

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.58 ft
Static Water Column Height: 21.12 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.25 ft
Screen Length: 4.8 ft
Total Well Penetration Depth: 20.72 ft

No. of Observations: 147

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0375	2.629	2.98	1.331
0.04167	2.264	3.16	1.327
0.0474	2.589	3.35	1.313
0.05112	2.601	3.55	1.303
0.0548	2.488	3.76	1.291
0.05848	2.419	3.98	1.28
0.0625	2.243	4.22	1.264
0.06667	2.278	4.47	1.248
0.07083	2.602	4.73	1.235
0.075	1.82	5.01	1.222
0.07917	1.69	5.31	1.205
0.08333	1.954	5.62	1.192
0.0875	1.648	5.96	1.178
0.09167	1.93	6.31	1.16
0.09583	1.407	6.68	1.146
0.1	1.144	7.08	1.126
0.106	1.537	7.5	1.111
0.112	1.777	7.94	1.089
0.119	1.365	8.41	1.067

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.126	1.584	8.91	1.051
0.133	1.535	9.44	1.026
0.141	1.523	10.	1.004
0.15	1.541	10.6	0.982
0.158	1.538	11.2	0.961
0.168	1.535	11.9	0.94
0.178	1.538	12.6	0.918
0.188	1.533	13.3	0.893
0.199	1.537	14.1	0.87
0.211	1.539	15.	0.843
0.224	1.523	15.8	0.818
0.237	1.533	16.8	0.795
0.251	1.534	17.8	0.766
0.266	1.528	18.8	0.742
0.282	1.534	19.9	0.711
0.298	1.531	21.1	0.683
0.316	1.523	22.4	0.655
0.335	1.523	23.7	0.633
0.355	1.521	25.1	0.604
0.376	1.518	26.6	0.579
0.398	1.517	28.2	0.552
0.422	1.514	29.8	0.528
0.447	1.513	31.6	0.507
0.473	1.508	33.5	0.477
0.501	1.51	35.5	0.453
0.531	1.505	37.6	0.43
0.562	1.504	39.8	0.406
0.596	1.499	42.2	0.382
0.631	1.494	44.7	0.357
0.668	1.493	47.3	0.341
0.708	1.491	50.1	0.32
0.75	1.482	53.1	0.298
0.794	1.483	56.2	0.28
0.841	1.481	59.6	0.263
0.891	1.47	63.1	0.247
0.944	1.469	66.8	0.229
1.	1.462	70.8	0.211
1.06	1.457	75.	0.198
1.12	1.454	79.4	0.182
1.19	1.447	84.1	0.174
1.26	1.447	89.1	0.16
1.33	1.442	94.4	0.146
1.41	1.435	100.	0.137
1.5	1.427	106.	0.126
1.58	1.426	112.	0.119
1.68	1.394	119.	0.106
1.78	1.408	126.	0.096
1.88	1.403	133.	0.087
1.99	1.393	141.	0.082
2.11	1.387	150.	0.074
2.24	1.38	158.	0.072
2.37	1.371	168.	0.064
2.51	1.364	178.	0.06
2.66	1.354	188.	0.058
2.82	1.341		

SOLUTION

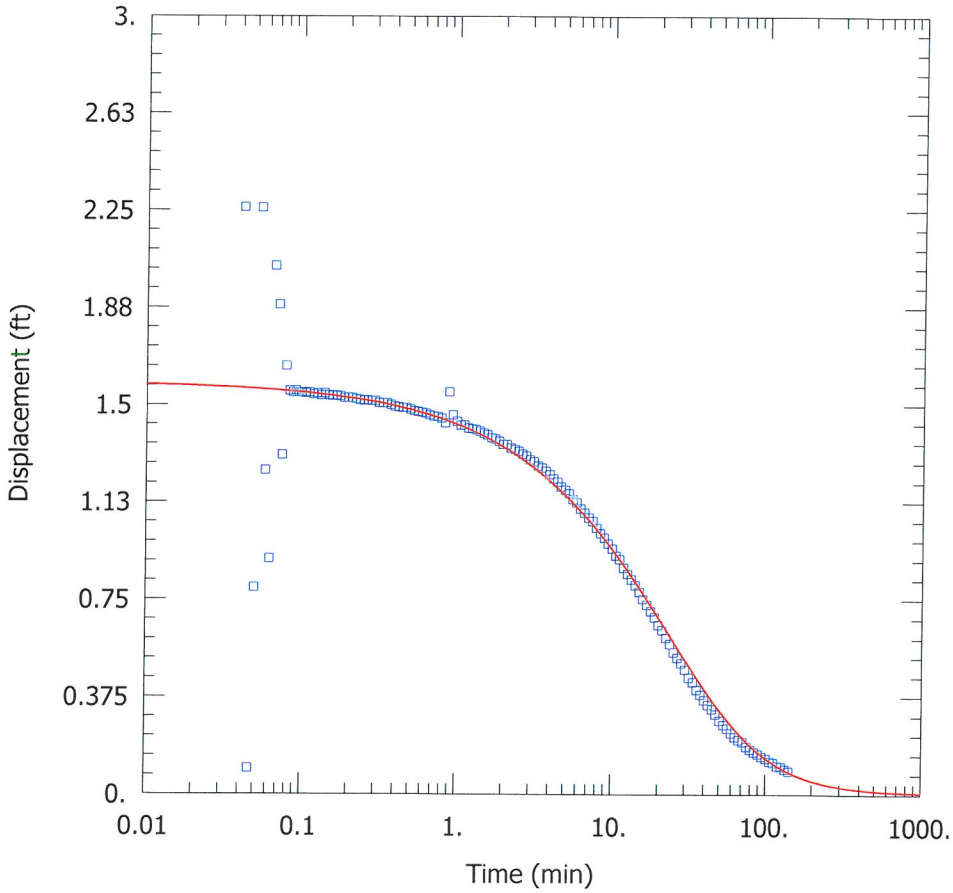
Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	3.2E-5	cm/sec
Ss	0.0025	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.0206 cm^2/sec



T409 RISING HEAD #1

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: T409
Test Date: 31 Aug 2016

AQUIFER DATA

Saturated Thickness: 21.19 ft

WELL DATA (T409)

Initial Displacement: 1.59 ft
Total Well Penetration Depth: 20.79 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 21.19 ft
Screen Length: 4.8 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined

Kr = 3.2E-5 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 0.005 ft^{-1}

Data Set: I:\16jobs\16E0080\Admin\15-Field-Laboratory Data\SlugTest2\T409_rh1.aqt
Title: T409 Rising Head #1
Date: 09/27/16
Time: 14:28:27

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 31 Aug 2016
Test Well: T409

AQUIFER DATA

Saturated Thickness: 21.19 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: T409

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.59 ft
Static Water Column Height: 21.19 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.25 ft
Screen Length: 4.8 ft
Total Well Penetration Depth: 20.79 ft

No. of Observations: 141

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.04167	2.261	2.66	1.311
0.04623	0.099	2.82	1.303
0.04998	0.796	2.98	1.288
0.05417	2.26	3.16	1.281
0.05833	1.248	3.35	1.265
0.0625	0.907	3.55	1.257
0.06667	2.035	3.76	1.245
0.07083	1.886	3.98	1.232
0.075	1.307	4.22	1.216
0.07917	1.65	4.47	1.203
0.08333	1.554	4.73	1.184
0.0875	1.548	5.01	1.172
0.09167	1.555	5.31	1.159
0.09583	1.548	5.62	1.137
0.1	1.548	5.96	1.124
0.106	1.545	6.31	1.101
0.112	1.548	6.68	1.085
0.119	1.54	7.08	1.066
0.126	1.544	7.5	1.052

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.133	1.537	7.94	1.027
0.141	1.544	8.41	1.005
0.15	1.537	8.91	0.988
0.158	1.534	9.44	0.966
0.168	1.535	10.	0.946
0.178	1.533	10.6	0.919
0.188	1.527	11.2	0.905
0.199	1.526	11.9	0.872
0.211	1.526	12.6	0.849
0.224	1.521	13.3	0.828
0.237	1.518	14.1	0.805
0.251	1.516	15.	0.78
0.266	1.517	15.8	0.753
0.282	1.514	16.8	0.73
0.298	1.514	17.8	0.705
0.316	1.507	18.8	0.682
0.335	1.506	19.9	0.652
0.355	1.505	21.1	0.633
0.376	1.5	22.4	0.603
0.398	1.493	23.7	0.58
0.422	1.491	25.1	0.548
0.447	1.488	26.6	0.526
0.473	1.488	28.2	0.506
0.501	1.482	29.8	0.481
0.531	1.476	31.6	0.45
0.562	1.473	33.5	0.433
0.596	1.471	35.5	0.403
0.631	1.467	37.6	0.384
0.668	1.461	39.8	0.363
0.708	1.456	42.2	0.345
0.75	1.455	44.7	0.329
0.794	1.449	47.3	0.309
0.841	1.43	50.1	0.285
0.891	1.55	53.1	0.269
0.944	1.461	56.2	0.255
1.	1.437	59.6	0.237
1.06	1.421	63.1	0.222
1.12	1.423	66.8	0.211
1.19	1.41	70.8	0.203
1.26	1.408	75.	0.185
1.33	1.404	79.4	0.173
1.41	1.398	84.1	0.164
1.5	1.391	89.1	0.156
1.58	1.385	94.4	0.146
1.68	1.374	100.	0.139
1.78	1.369	106.	0.128
1.88	1.36	112.	0.123
1.99	1.348	119.	0.11
2.11	1.347	126.	0.107
2.24	1.334	133.	0.097
2.37	1.328	141.	0.09
2.51	1.321		

SOLUTION

Slug Test

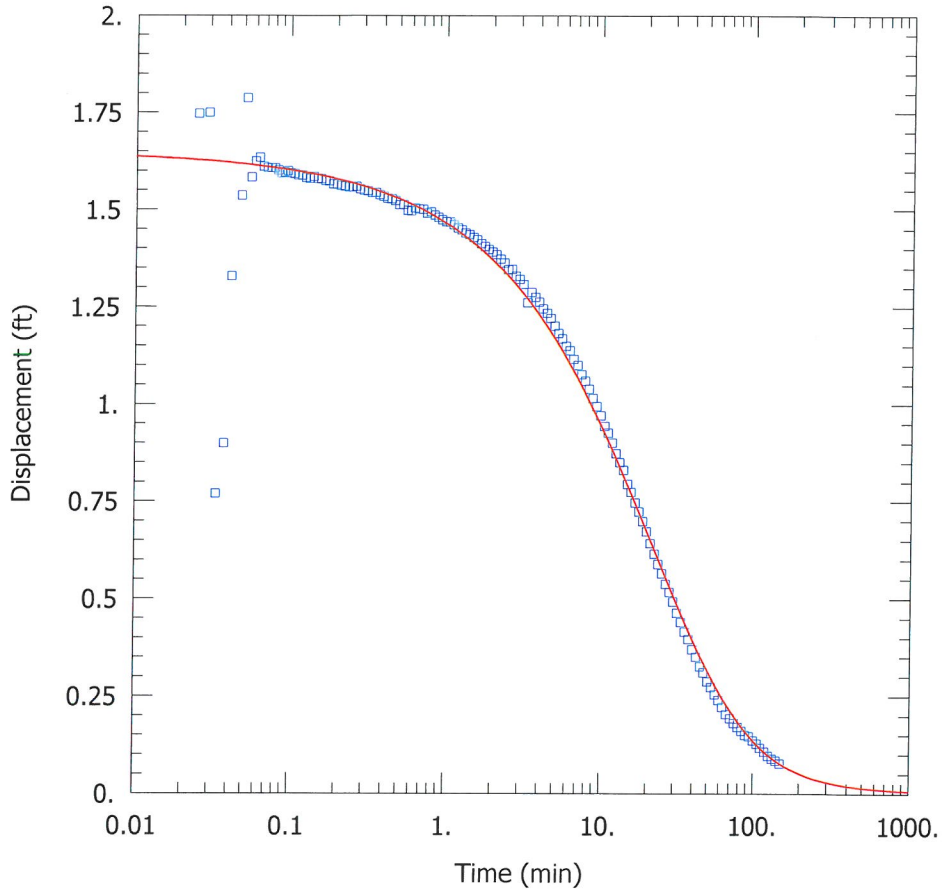
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	3.2E-5	cm/sec
Ss	0.005	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.02067 cm^2/sec



T409 RISING HEAD #2

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Well: T409
Test Date: 31 Aug 2016

AQUIFER DATA

Saturated Thickness: 21.18 ft

WELL DATA (T409)

Initial Displacement: 1.65 ft
Total Well Penetration Depth: 20.78 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 21.18 ft
Screen Length: 4.8 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined

Kr = 3.3E-5 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 0.006 ft^{-1}

Data Set: I:\16jobs\16E0080\Admin\15-Field-Laboratory Data\SlugTest2\T409_rh2.aqt
Title: T409 Rising Head #2
Date: 09/27/16
Time: 14:28:28

PROJECT INFORMATION

Company: Hanson Professional Services
Client: Natural Resources Technology,
Project: 16E0080
Location: Coffeen Power Station
Test Date: 31 Aug 2016
Test Well: T409

AQUIFER DATA

Saturated Thickness: 21.18 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: T409

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.65 ft
Static Water Column Height: 21.18 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.25 ft
Screen Length: 4.8 ft
Total Well Penetration Depth: 20.78 ft

No. of Observations: 146

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.02502	1.747	2.37	1.363
0.02918	1.749	2.512	1.346
0.03335	0.77	2.66	1.347
0.03752	0.899	2.82	1.33
0.04168	1.329	2.98	1.321
0.04823	1.536	3.16	1.308
0.05192	1.787	3.35	1.261
0.05568	1.583	3.55	1.288
0.05937	1.624	3.76	1.275
0.06303	1.634	3.98	1.263
0.0667	1.611	4.22	1.246
0.07085	1.608	4.47	1.234
0.07502	1.607	4.73	1.221
0.07918	1.607	5.01	1.201
0.08335	1.601	5.31	1.182
0.08752	1.594	5.62	1.168
0.09168	1.596	5.96	1.149
0.09585	1.6	6.31	1.138
0.1	1.594	6.68	1.116

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.106	1.592	7.08	1.1
0.112	1.589	7.5	1.076
0.119	1.588	7.94	1.06
0.126	1.582	8.41	1.039
0.133	1.58	8.91	1.015
0.141	1.585	9.44	0.995
0.15	1.58	10.	0.971
0.158	1.579	10.6	0.944
0.168	1.575	11.2	0.926
0.178	1.573	11.9	0.901
0.188	1.566	12.6	0.874
0.199	1.565	13.3	0.851
0.211	1.562	14.1	0.831
0.224	1.56	15.	0.795
0.237	1.558	15.8	0.774
0.251	1.558	16.8	0.747
0.266	1.559	17.8	0.724
0.282	1.553	18.8	0.699
0.298	1.549	19.9	0.673
0.316	1.548	21.1	0.642
0.335	1.544	22.4	0.615
0.355	1.544	23.7	0.589
0.376	1.538	25.1	0.565
0.398	1.534	26.6	0.538
0.422	1.529	28.2	0.517
0.447	1.527	29.8	0.493
0.473	1.523	31.6	0.464
0.501	1.512	33.5	0.44
0.531	1.513	35.5	0.415
0.564	1.498	37.6	0.396
0.596	1.497	39.8	0.37
0.631	1.504	42.2	0.351
0.668	1.502	44.7	0.326
0.708	1.501	47.3	0.311
0.75	1.491	50.1	0.288
0.794	1.494	53.1	0.273
0.841	1.486	56.2	0.255
0.891	1.48	59.6	0.24
0.944	1.474	63.1	0.222
1.	1.469	66.8	0.204
1.06	1.468	70.8	0.193
1.12	1.461	75.	0.181
1.19	1.453	79.4	0.171
1.26	1.448	84.1	0.161
1.33	1.44	89.1	0.15
1.41	1.436	94.4	0.147
1.5	1.428	100.	0.136
1.58	1.423	106.	0.128
1.68	1.413	112.	0.117
1.78	1.405	119.	0.107
1.88	1.398	126.	0.097
1.99	1.391	133.	0.089
2.11	1.385	141.	0.084
2.24	1.373	150.	0.077

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: KGS Model

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	3.3E-5	cm/sec
Ss	0.006	ft^{-1}
Kz/Kr	1.	

T = K*b = 0.0213 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	3.2E-5	3.191E-6	+/- 6.309E-6	10.03	cm/sec
Ss	0.006332	0.002124	+/- 0.0042	2.981	ft^{-1}
Kz/Kr	1.	not estimated			

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = K*b = 0.02066 cm²/sec

Parameter Correlations

	Kr	Ss
Kr	1.00	-0.93
Ss	-0.93	1.00

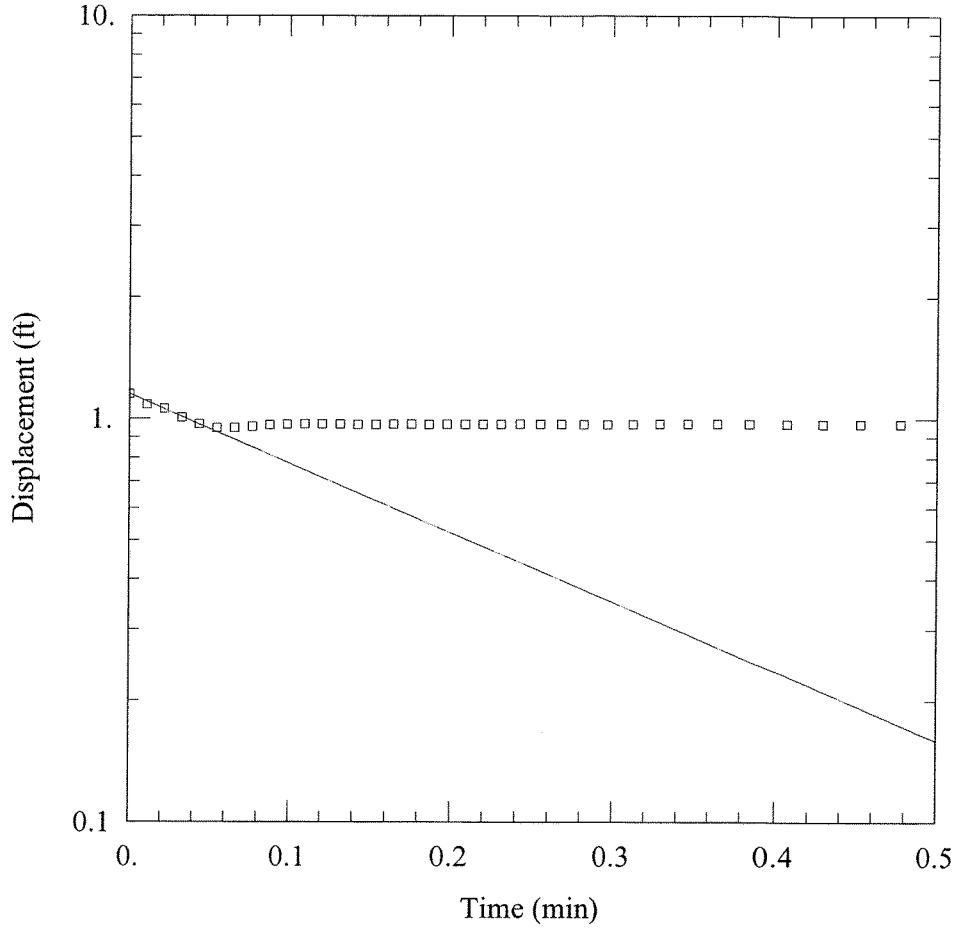
Residual Statistics

for weighted residuals

Sum of Squares . . . . . 1.445 ft^2
Variance . . . . . 0.01003 ft^2
Std. Deviation . . . . . 0.1002 ft
Mean. . . . . -0.01263 ft
No. of Residuals 146
No. of Estimates 2

APPENDIX B2

HYDRAULIC CONDUCTIVITY ANALYSES (ASH POND PIEZOMETERS)



FALLING HEAD TEST

Data Set: I:\...\CPS_OW1_FH.aqt
Date: 11/11/16 Time: 13:53:32

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Well: OW1
Test Date: 9 Jun 2009

AQUIFER DATA

Saturated Thickness: 16.8 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OW1)

Initial Displacement: 1.15 ft
Total Well Penetration Depth: 20. ft
Casing Radius: 0.08333 ft
Static Water Column Height: 16.8 ft
Screen Length: 13. ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.00225 cm/sec y0 = 1.15 ft

Data Set: I:\09jobs\09E0045\Admin\15-Field-Laboratory Data\AshPond2_Slug_Tests\CPS_OW1_FH.aqt
Title: Falling Head Test
Date: 11/11/16
Time: 13:53:32

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Date: 9 Jun 2009
Test Well: OW1

AQUIFER DATA

Saturated Thickness: 16.8 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: OW1

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.15 ft
Static Water Column Height: 16.8 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.333 ft
Screen Length: 13. ft
Total Well Penetration Depth: 20. ft

No. of Observations: 87

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.011	1.082	0.8238	0.972
0.022	1.057	0.8708	0.972
0.033	1.006	0.9207	0.972
0.044	0.969	0.9733	0.972
0.055	0.948	1.029	0.973
0.066	0.948	1.088	0.973
0.077	0.955	1.151	0.972
0.088	0.963	1.217	0.973
0.099	0.967	1.288	0.973
0.11	0.969	1.362	0.973
0.121	0.969	1.441	0.973
0.132	0.969	1.525	0.973
0.143	0.967	1.613	0.975
0.154	0.967	1.707	0.973
0.165	0.969	1.807	0.973
0.176	0.969	1.912	0.973
0.187	0.967	2.023	0.973
0.198	0.969	2.142	0.973

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.209	0.969	2.267	0.973
0.22	0.969	2.399	0.973
0.231	0.969	2.54	0.973
0.2427	0.97	2.688	0.973
0.2552	0.969	2.846	0.975
0.2683	0.969	3.013	0.975
0.2823	0.969	3.179	0.975
0.2972	0.969	3.346	0.975
0.3128	0.969	3.513	0.976
0.3295	0.97	3.679	0.975
0.3472	0.97	3.846	0.976
0.3658	0.97	4.013	0.975
0.3857	0.97	4.179	0.975
0.4067	0.97	4.346	0.975
0.4288	0.97	4.513	0.975
0.4523	0.97	4.679	0.975
0.4772	0.97	4.846	0.976
0.5035	0.972	5.013	0.976
0.5315	0.972	5.179	0.975
0.5612	0.972	5.346	0.975
0.5925	0.972	5.513	0.975
0.6257	0.972	5.679	0.976
0.6608	0.972	5.846	0.975
0.6982	0.972	6.013	0.976
0.7377	0.972	6.179	0.975
0.7795	0.972		

SOLUTION

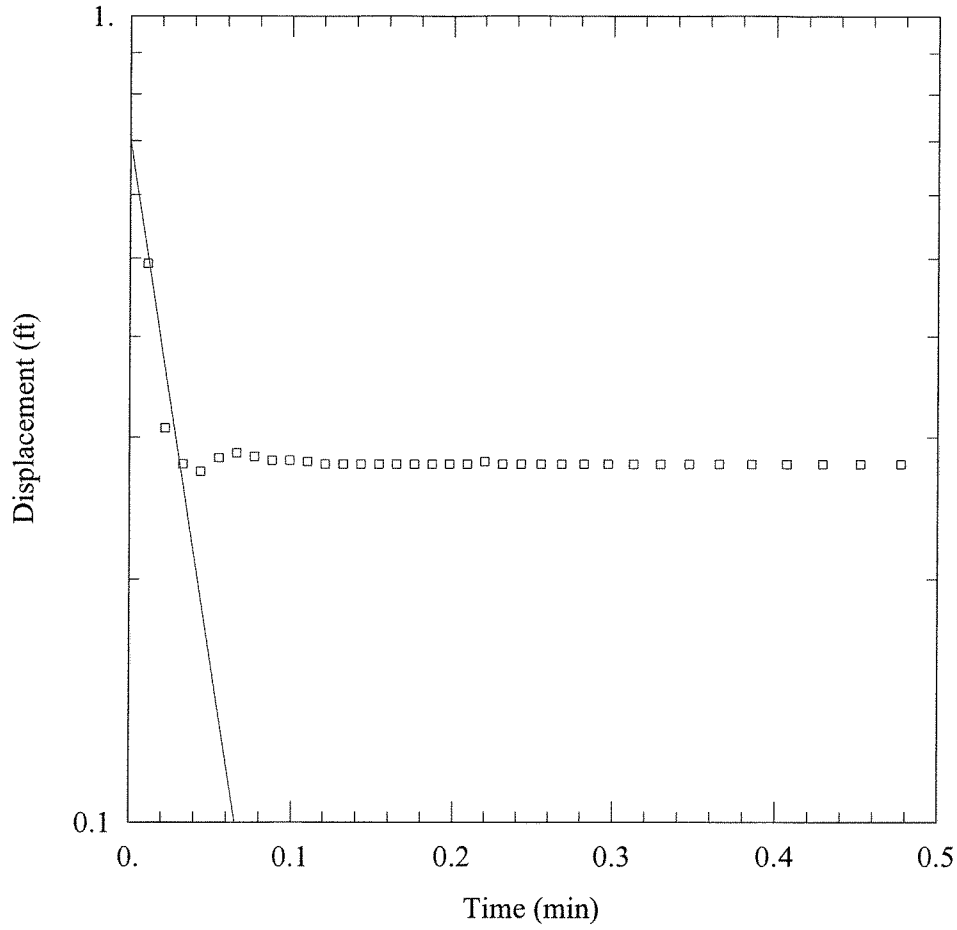
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.192

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.00225	cm/sec
y0	1.15	ft

T = K*b = 1.152 cm^2/sec



RISING HEAD TEST

Data Set: I:\...\CPS_OW1_RH.aqt
Date: 11/11/16 Time: 13:53:33

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Well: OW1
Test Date: 9 Jun 2009

AQUIFER DATA

Saturated Thickness: 16.8 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OW1)

Initial Displacement: 1.1 ft
Total Well Penetration Depth: 20. ft
Casing Radius: 0.08333 ft
Static Water Column Height: 16.8 ft
Screen Length: 13. ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.017 cm/sec y0 = 0.7 ft

Data Set: I:\09jobs\09E0045\Admin\15-Field-Laboratory Data\AshPond2_Slug_Tests\CPS_OW1_RH.aqt
Title: Rising Head Test
Date: 11/11/16
Time: 13:53:33

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Date: 9 Jun 2009
Test Well: OW1

AQUIFER DATA

Saturated Thickness: 16.8 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: OW1

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.1 ft
Static Water Column Height: 16.8 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.333 ft
Screen Length: 13. ft
Total Well Penetration Depth: 20. ft

No. of Observations: 88

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.011	0.493	0.8238	0.278
0.022	0.308	0.8708	0.278
0.033	0.278	0.9207	0.278
0.044	0.272	0.9733	0.278
0.055	0.283	1.029	0.278
0.066	0.287	1.088	0.278
0.077	0.284	1.151	0.28
0.088	0.281	1.217	0.28
0.099	0.281	1.288	0.28
0.11	0.28	1.362	0.28
0.121	0.278	1.441	0.278
0.132	0.278	1.525	0.28
0.143	0.278	1.613	0.28
0.154	0.278	1.707	0.278
0.165	0.278	1.807	0.28
0.176	0.278	1.912	0.281
0.187	0.278	2.023	0.28
0.198	0.278	2.142	0.28

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.209	0.278	2.267	0.28
0.22	0.28	2.399	0.28
0.231	0.278	2.54	0.28
0.2427	0.278	2.688	0.281
0.2552	0.278	2.846	0.281
0.2683	0.278	3.013	0.281
0.2823	0.278	3.179	0.281
0.2972	0.278	3.346	0.281
0.3128	0.278	3.513	0.283
0.3295	0.278	3.679	0.281
0.3472	0.278	3.846	0.283
0.3658	0.278	4.013	0.281
0.3857	0.278	4.179	0.281
0.4067	0.278	4.346	0.281
0.4288	0.278	4.513	0.283
0.4523	0.278	4.679	0.281
0.4772	0.278	4.846	0.281
0.5035	0.28	5.013	0.283
0.5315	0.28	5.179	0.281
0.5612	0.28	5.346	0.283
0.5925	0.281	5.513	0.283
0.6257	0.28	5.679	0.281
0.6608	0.28	5.846	0.283
0.6982	0.28	6.013	0.281
0.7377	0.278	6.179	0.283
0.7795	0.277	6.346	0.283

SOLUTION

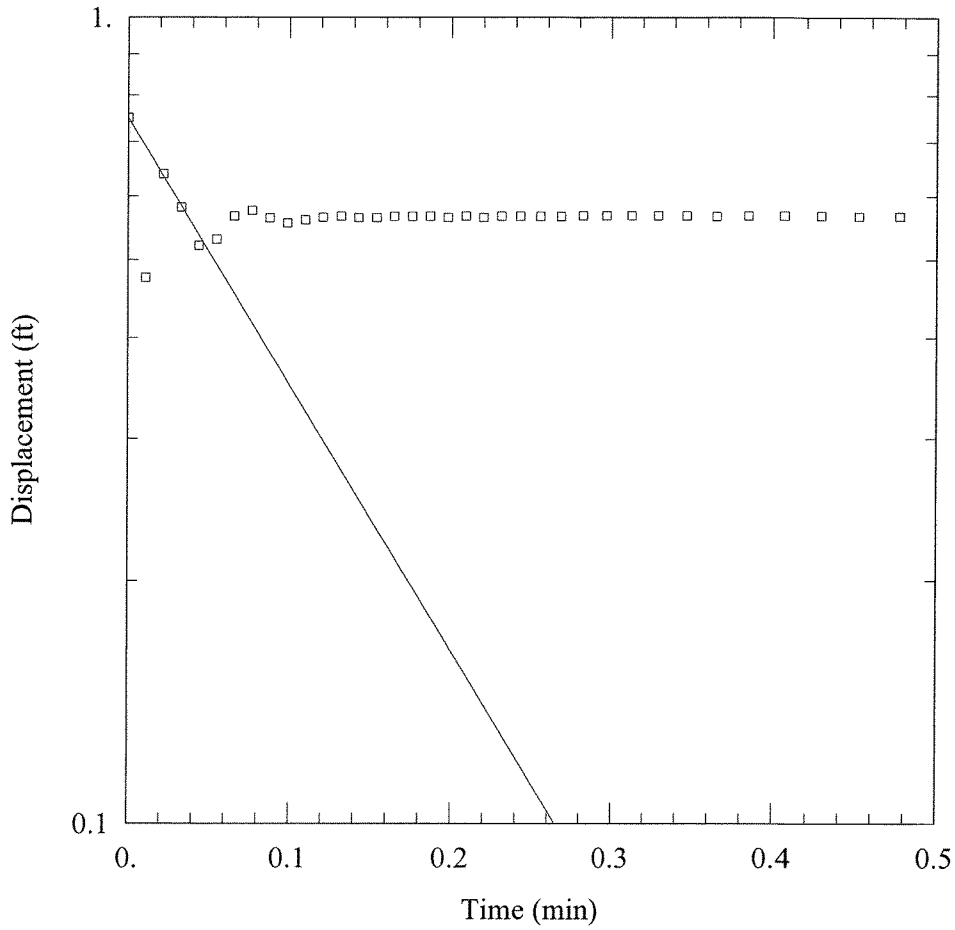
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.192

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.017	cm/sec
y0	0.7	ft

T = K*b = 8.705 cm^2/sec



FALLING HEAD TEST

Data Set: I:\...\CPS_OW2_FH.aqt
Date: 11/11/16 Time: 13:53:34

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Well: OW2
Test Date: 9 Jun 2009

AQUIFER DATA

Saturated Thickness: 22.7 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OW2)

Initial Displacement: 0.75 ft Static Water Column Height: 22.7 ft
Total Well Penetration Depth: 26. ft Screen Length: 13. ft
Casing Radius: 0.08333 ft Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0045 cm/sec y0 = 0.75 ft

Data Set: I:\09jobs\09E0045\Admin\15-Field-Laboratory Data\AshPond2_Slug_Tests\CPS_OW2_FH.aqt
Title: Falling Head Test
Date: 11/11/16
Time: 13:53:34

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Date: 9 Jun 2009
Test Well: OW2

AQUIFER DATA

Saturated Thickness: 22.7 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: OW2

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 0.75 ft
Static Water Column Height: 22.7 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.333 ft
Screen Length: 13. ft
Total Well Penetration Depth: 26. ft

No. of Observations: 80

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.011	0.475	0.6608	0.567
0.022	0.639	0.6982	0.567
0.033	0.581	0.7377	0.567
0.044	0.521	0.7795	0.567
0.055	0.53	0.8238	0.567
0.066	0.566	0.8708	0.567
0.077	0.575	0.9207	0.567
0.088	0.563	0.9733	0.567
0.099	0.555	1.029	0.567
0.11	0.56	1.088	0.567
0.121	0.564	1.151	0.567
0.132	0.566	1.217	0.567
0.143	0.564	1.288	0.567
0.154	0.564	1.362	0.567
0.165	0.566	1.441	0.566
0.176	0.566	1.525	0.566
0.187	0.566	1.613	0.567
0.198	0.564	1.707	0.566

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.209	0.566	1.807	0.567
0.22	0.564	1.912	0.567
0.231	0.566	2.023	0.567
0.2427	0.566	2.142	0.567
0.2552	0.566	2.267	0.567
0.2683	0.566	2.399	0.567
0.2823	0.567	2.54	0.567
0.2972	0.567	2.688	0.567
0.3128	0.567	2.846	0.567
0.3295	0.567	3.013	0.567
0.3472	0.567	3.179	0.567
0.3658	0.566	3.346	0.567
0.3857	0.567	3.513	0.567
0.4067	0.567	3.679	0.567
0.4288	0.567	3.846	0.567
0.4523	0.566	4.013	0.569
0.4772	0.566	4.179	0.569
0.5035	0.567	4.346	0.567
0.5315	0.567	4.513	0.567
0.5612	0.567	4.679	0.567
0.5925	0.567	4.846	0.569
0.6257	0.567	5.013	0.569

SOLUTION

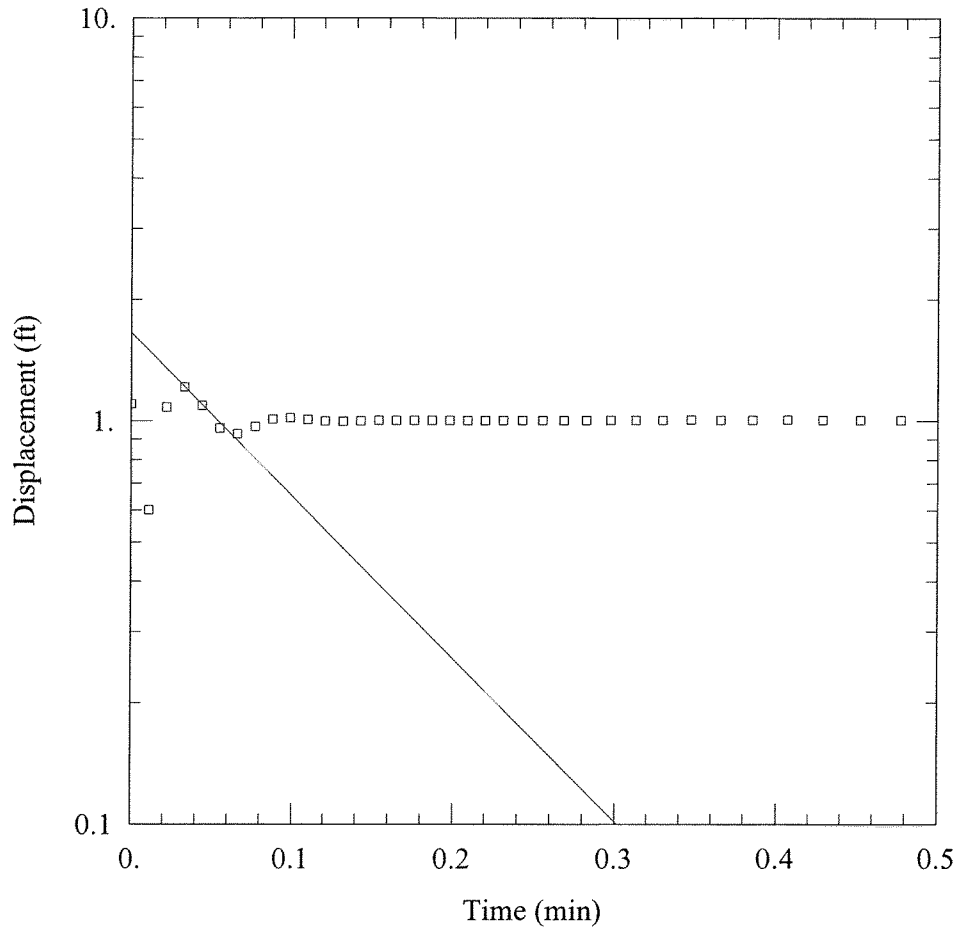
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.359

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.0045	cm/sec
y0	0.75	ft

T = K*b = 3.114 cm^2/sec



RISING HEAD TEST

Data Set: I:\...\CPS_OW2_RH.aqt
Date: 11/11/16 Time: 13:53:34

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Well: OW2
Test Date: 9 Jun 2009

AQUIFER DATA

Saturated Thickness: 22.7 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OW2)

Initial Displacement: 1.1 ft Static Water Column Height: 22.7 ft
Total Well Penetration Depth: 26. ft Screen Length: 13. ft
Casing Radius: 0.08333 ft Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0055 cm/sec y0 = 1.65 ft

Data Set: I:\09jobs\09E0045\Admin\15-Field-Laboratory Data\AshPond2_Slug_Tests\CPS_OW2_RH.aqt
Title: Rising Head Test
Date: 11/11/16
Time: 13:53:35

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Date: 9 Jun 2009
Test Well: OW2

AQUIFER DATA

Saturated Thickness: 22.7 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: OW2

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.1 ft
Static Water Column Height: 22.7 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.333 ft
Screen Length: 13. ft
Total Well Penetration Depth: 26. ft

No. of Observations: 86

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.011	0.601	0.7795	1.005
0.022	1.081	0.8238	1.005
0.033	1.212	0.8708	1.005
0.044	1.093	0.9207	1.005
0.055	0.959	0.9733	1.005
0.066	0.929	1.029	1.005
0.077	0.969	1.088	1.005
0.088	1.011	1.151	1.005
0.099	1.017	1.217	1.005
0.11	1.009	1.288	1.005
0.121	1.	1.362	1.005
0.132	0.997	1.441	1.003
0.143	1.	1.525	1.005
0.154	1.002	1.613	1.005
0.165	1.003	1.707	1.005
0.176	1.003	1.807	1.005
0.187	1.003	1.912	1.005
0.198	1.003	2.023	1.005

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.209	1.003	2.142	1.003
0.22	1.003	2.267	1.003
0.231	1.003	2.399	1.005
0.2427	1.003	2.54	1.003
0.2552	1.003	2.688	1.005
0.2683	1.003	2.846	1.003
0.2823	1.003	3.013	1.005
0.2972	1.005	3.179	1.003
0.3128	1.005	3.346	1.005
0.3295	1.005	3.513	1.008
0.3472	1.006	3.679	1.008
0.3658	1.005	3.846	1.008
0.3857	1.005	4.013	1.006
0.4067	1.006	4.179	1.005
0.4288	1.005	4.346	1.005
0.4523	1.005	4.513	1.005
0.4772	1.005	4.679	1.005
0.5035	1.005	4.846	1.003
0.5315	1.005	5.013	1.003
0.5612	1.003	5.179	1.003
0.5925	1.005	5.346	1.003
0.6257	1.005	5.513	1.003
0.6608	1.005	5.679	1.003
0.6982	1.005	5.846	1.005
0.7377	1.005	6.013	1.005

SOLUTION

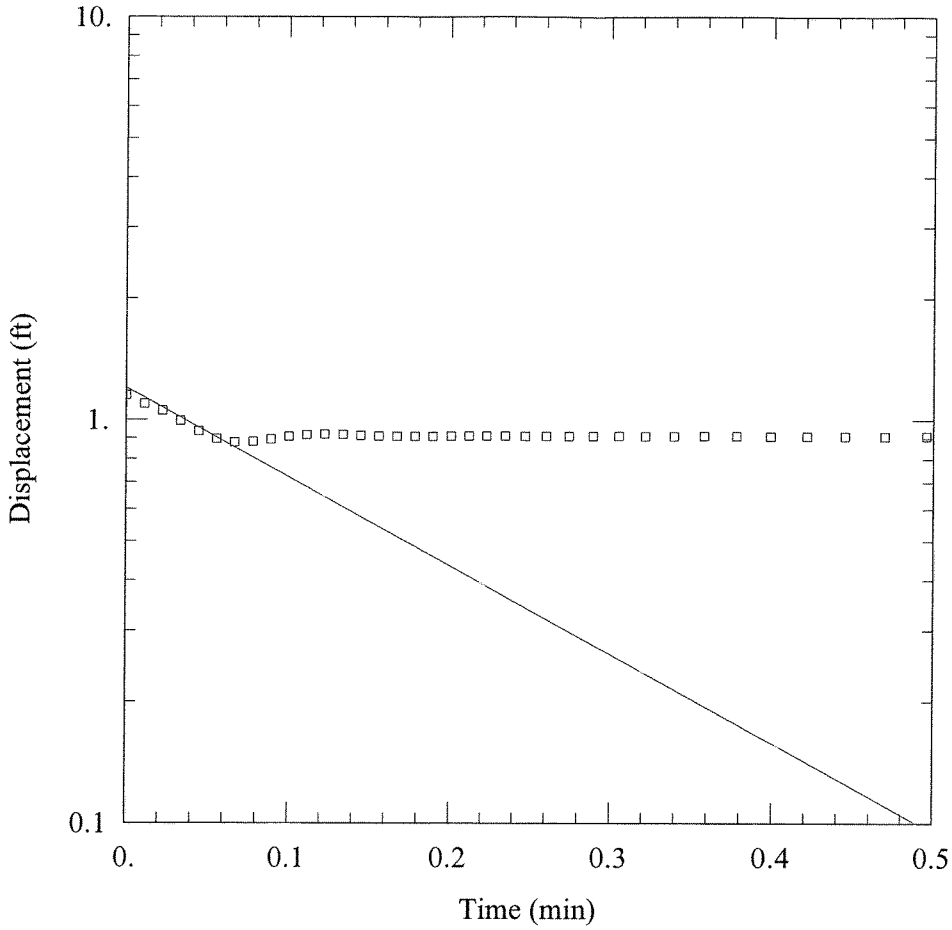
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.359

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.0055	cm/sec
y0	1.65	ft

T = K*b = 3.805 cm^2/sec



FALLING HEAD TEST

Data Set: I:\...\CPS_OW3_FH.aqt
Date: 11/11/16 Time: 13:53:35

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Well: OW3
Test Date: 9 Jun 2009

AQUIFER DATA

Saturated Thickness: 21.9 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OW3)

Initial Displacement: 1.15 ft
Total Well Penetration Depth: 26. ft
Casing Radius: 0.08333 ft
Static Water Column Height: 21.9 ft
Screen Length: 13. ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.003 cm/sec y0 = 1.2 ft

Data Set: I:\09jobs\09E0045\Admin\15-Field-Laboratory Data\AshPond2_Slug_Tests\CPS_OW3_FH.aqt
Title: Falling Head Test
Date: 11/11/16
Time: 13:53:36

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Date: 9 Jun 2009
Test Well: OW3

AQUIFER DATA

Saturated Thickness: 21.9 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: OW3

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.15 ft
Static Water Column Height: 21.9 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.333 ft
Screen Length: 13. ft
Total Well Penetration Depth: 26. ft

No. of Observations: 75

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0112	1.095	0.618	0.911
0.0223	1.054	0.6532	0.911
0.0335	0.994	0.6905	0.912
0.0447	0.937	0.73	0.911
0.0558	0.897	0.7718	0.912
0.067	0.879	0.8162	0.912
0.0782	0.882	0.8632	0.911
0.0893	0.894	0.913	0.912
0.1005	0.909	0.9657	0.912
0.1117	0.917	1.022	0.912
0.1228	0.92	1.081	0.912
0.134	0.918	1.143	0.911
0.1452	0.914	1.21	0.912
0.1563	0.911	1.28	0.912
0.1675	0.908	1.355	0.912
0.1787	0.908	1.434	0.912
0.1898	0.909	1.517	0.912
0.201	0.911	1.606	0.912

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.2122	0.912	1.7	0.912
0.2233	0.912	1.799	0.914
0.235	0.912	1.904	0.914
0.2475	0.911	2.016	0.914
0.2607	0.911	2.134	0.914
0.2747	0.911	2.259	0.914
0.2895	0.911	2.392	0.912
0.3052	0.912	2.532	0.914
0.3218	0.911	2.681	0.914
0.3395	0.911	2.838	0.914
0.3582	0.912	3.005	0.914
0.378	0.912	3.172	0.914
0.399	0.911	3.338	0.914
0.4212	0.911	3.505	0.914
0.4447	0.911	3.672	0.915
0.4695	0.911	3.838	0.914
0.4958	0.912	4.005	0.914
0.5238	0.911	4.172	0.914
0.5535	0.912	4.338	0.915
0.5848	0.912		

SOLUTION

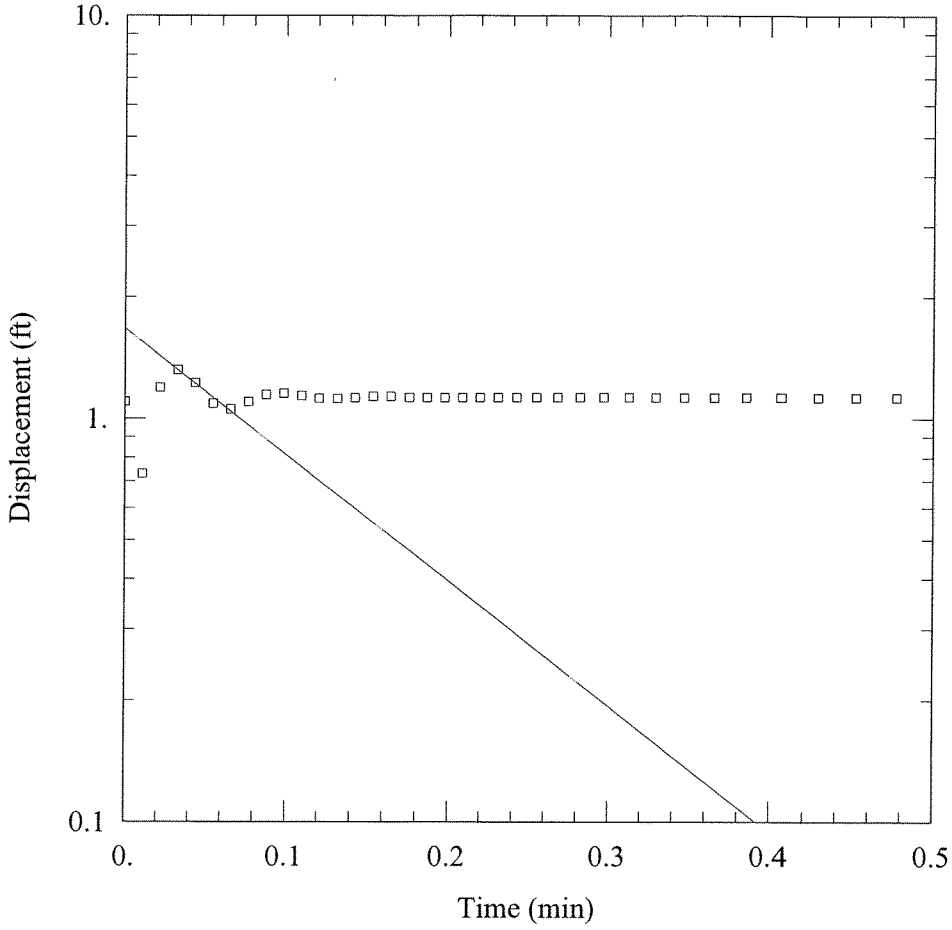
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.359

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.003	cm/sec
y0	1.2	ft

T = K*b = 2.003 cm^2/sec



RISING HEAD TEST

Data Set: I:\...\CPS_OW3_RH.aqt
Date: 11/11/16 Time: 13:53:36

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Well: OW3
Test Date: 9 Jun 2009

AQUIFER DATA

Saturated Thickness: 21.9 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OW3)

Initial Displacement: 1.1 ft
Total Well Penetration Depth: 26. ft
Casing Radius: 0.08333 ft
Static Water Column Height: 21.9 ft
Screen Length: 13. ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.00425 cm/sec y0 = 1.67 ft

Data Set: I:\09jobs\09E0045\Admin\15-Field-Laboratory Data\AshPond2_Slug_Tests\CPS_OW3_RH.aqt
Title: Rising Head Test
Date: 11/11/16
Time: 13:53:37

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Date: 9 Jun 2009
Test Well: OW3

AQUIFER DATA

Saturated Thickness: 21.9 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: OW3

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.1 ft
Static Water Column Height: 21.9 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.333 ft
Screen Length: 13. ft
Total Well Penetration Depth: 26. ft

No. of Observations: 72

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.011	0.729	0.5315	1.127
0.022	1.192	0.5612	1.127
0.033	1.32	0.5925	1.127
0.044	1.223	0.6257	1.128
0.055	1.088	0.6608	1.128
0.066	1.054	0.6982	1.127
0.077	1.098	0.7377	1.127
0.088	1.144	0.7795	1.127
0.099	1.153	0.8238	1.127
0.11	1.137	0.8708	1.127
0.121	1.121	0.9207	1.127
0.132	1.118	0.9733	1.128
0.143	1.125	1.029	1.127
0.154	1.133	1.088	1.127
0.165	1.133	1.151	1.127
0.176	1.128	1.217	1.128
0.187	1.127	1.288	1.127
0.198	1.127	1.362	1.127

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.209	1.128	1.441	1.127
0.22	1.128	1.525	1.127
0.231	1.128	1.613	1.127
0.2427	1.128	1.707	1.127
0.2552	1.128	1.807	1.127
0.2683	1.128	1.912	1.127
0.2823	1.128	2.023	1.128
0.2972	1.128	2.142	1.128
0.3128	1.128	2.267	1.127
0.3295	1.128	2.399	1.127
0.3472	1.128	2.54	1.128
0.3658	1.128	2.688	1.128
0.3857	1.128	2.846	1.128
0.4067	1.128	3.013	1.128
0.4288	1.128	3.179	1.137
0.4523	1.128	3.346	1.137
0.4772	1.128	3.513	1.137
0.5035	1.127	3.679	1.137

SOLUTION

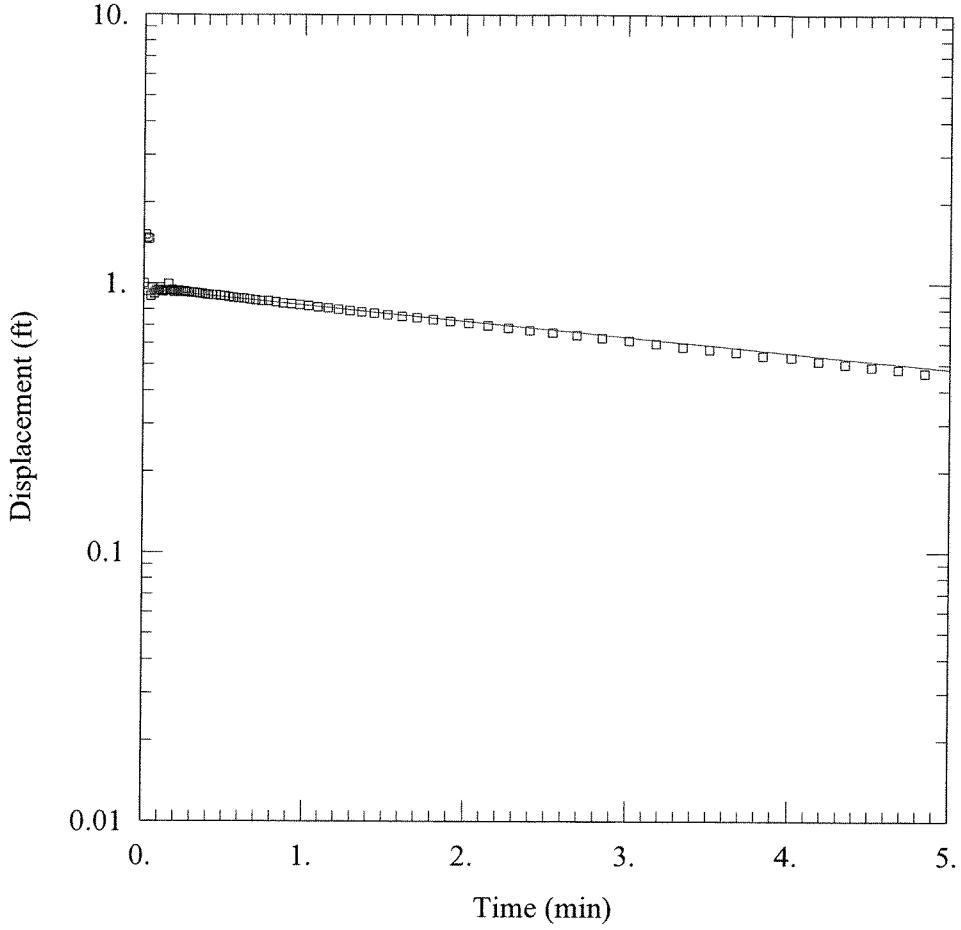
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.359

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.00425	cm/sec
y0	1.67	ft

T = K*b = 2.837 cm^2/sec



FALLING HEAD TEST

Data Set: I:\...\CPS_OW5_FH.aqt
Date: 11/11/16 Time: 13:53:37

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Well: OW5
Test Date: 9 Jun 2009

AQUIFER DATA

Saturated Thickness: 26.89 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OW5)

Initial Displacement: 1. ft
Total Well Penetration Depth: 30. ft
Casing Radius: 0.08333 ft
Static Water Column Height: 26.89 ft
Screen Length: 20. ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 5.5E-5 cm/sec
y0 = 0.95 ft

Data Set: I:\09jobs\09E0045\Admin\15-Field-Laboratory Data\AshPond2_Slug_Tests\CPS_OW5_FH.aqt
Title: Falling Head Test
Date: 11/11/16
Time: 13:53:38

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Date: 9 Jun 2009
Test Well: OW5

AQUIFER DATA

Saturated Thickness: 26.89 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: OW5

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1. ft
Static Water Column Height: 26.89 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.333 ft
Screen Length: 20. ft
Total Well Penetration Depth: 30. ft

No. of Observations: 145

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.011	1.516	4.013	0.532
0.022	1.474	4.179	0.514
0.033	1.459	4.346	0.502
0.044	0.895	4.513	0.49
0.055	0.962	4.679	0.479
0.066	0.914	4.846	0.465
0.077	0.938	5.013	0.456
0.088	0.944	5.179	0.446
0.099	0.937	5.346	0.435
0.11	0.932	5.513	0.426
0.121	0.931	5.679	0.414
0.132	0.941	5.846	0.405
0.143	0.941	6.013	0.395
0.154	0.992	6.179	0.386
0.165	0.938	6.346	0.376
0.176	0.946	6.513	0.365
0.187	0.928	6.679	0.358
0.198	0.932	6.846	0.35

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.209	0.935	7.013	0.341
0.22	0.937	7.179	0.332
0.231	0.925	7.346	0.323
0.2427	0.932	7.513	0.317
0.2552	0.932	7.679	0.307
0.2683	0.928	7.846	0.298
0.2823	0.925	8.013	0.291
0.2972	0.923	8.179	0.283
0.3128	0.922	8.346	0.276
0.3295	0.919	8.513	0.268
0.3472	0.917	8.679	0.262
0.3658	0.914	8.846	0.255
0.3857	0.911	9.013	0.247
0.4067	0.908	9.179	0.241
0.4288	0.905	9.346	0.234
0.4523	0.904	9.513	0.226
0.4772	0.901	9.679	0.219
0.5035	0.898	9.846	0.213
0.5315	0.89	10.01	0.206
0.5612	0.884	10.18	0.2
0.5925	0.88	10.35	0.194
0.6257	0.877	10.51	0.188
0.6608	0.871	10.68	0.182
0.6982	0.866	10.85	0.174
0.7377	0.86	11.01	0.168
0.7795	0.86	11.18	0.165
0.8238	0.852	11.35	0.161
0.8708	0.843	11.51	0.152
0.9207	0.838	11.68	0.147
0.9733	0.831	11.85	0.141
1.029	0.825	12.01	0.135
1.088	0.816	12.18	0.131
1.151	0.808	12.35	0.125
1.217	0.799	12.51	0.121
1.288	0.79	12.68	0.116
1.362	0.783	12.85	0.112
1.441	0.774	13.01	0.106
1.525	0.764	13.18	0.103
1.613	0.753	13.35	0.095
1.707	0.744	13.51	0.091
1.807	0.732	13.68	0.086
1.912	0.723	13.85	0.08
2.023	0.71	14.01	0.077
2.142	0.698	14.18	0.073
2.267	0.684	14.35	0.068
2.399	0.67	14.51	0.064
2.54	0.656	14.68	0.059
2.688	0.643	14.85	0.053
2.846	0.626	15.01	0.05
3.013	0.613	15.18	0.044
3.179	0.598	15.35	0.041
3.346	0.58	15.51	0.037
3.513	0.567	15.68	0.034
3.679	0.555	15.85	0.03
3.846	0.538		

SOLUTION

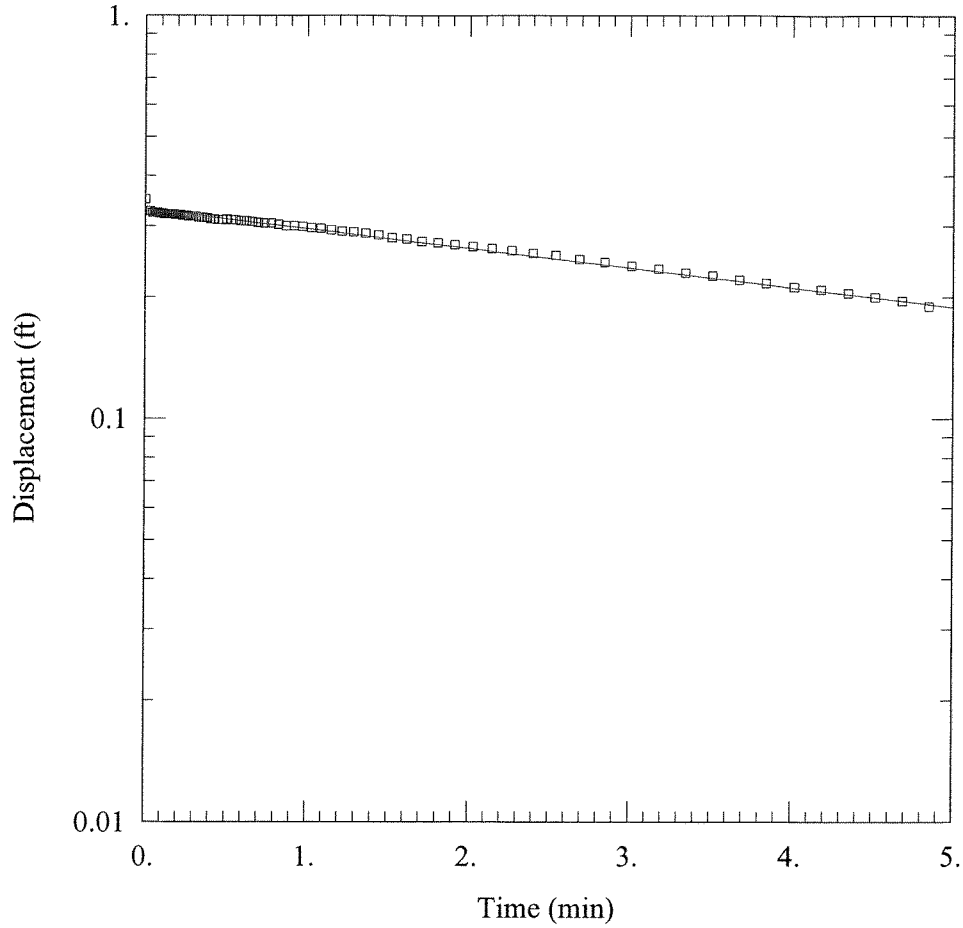
Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.57

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	5.5E-5	cm/sec
y0	0.95	ft

T = K*b = 0.04508 cm^2/sec



RISING HEAD TEST

Data Set: I:\...\CPS_OW5_RH.aqt
Date: 11/11/16 Time: 13:53:38

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Well: OW5
Test Date: 9 Jun 2009

AQUIFER DATA

Saturated Thickness: 26.89 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OW5)

Initial Displacement: 0.35 ft
Total Well Penetration Depth: 30. ft
Casing Radius: 0.08333 ft
Static Water Column Height: 26.89 ft
Screen Length: 20. ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 4.5E-5 cm/sec y0 = 0.33 ft

Data Set: I:\09jobs\09E0045\Admin\15-Field-Laboratory Data\AshPond2_Slug_Tests\CPS_OW5_RH.aqt
Title: Rising Head Test
Date: 11/11/16
Time: 13:53:38

PROJECT INFORMATION

Company: Hanson Professional Services
Client: AEG Coffeen Power Station
Project: 09E0045/3001
Location: Coffeen, IL
Test Date: 9 Jun 2009
Test Well: OW5

AQUIFER DATA

Saturated Thickness: 26.89 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: OW5

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 0.35 ft
Static Water Column Height: 26.89 ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft
Well Skin Radius: 0.333 ft
Screen Length: 20. ft
Total Well Penetration Depth: 30. ft

No. of Observations: 122

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.011	0.327	2.142	0.264
0.022	0.327	2.267	0.261
0.033	0.327	2.399	0.257
0.044	0.324	2.54	0.254
0.055	0.324	2.688	0.248
0.066	0.324	2.846	0.244
0.077	0.324	3.013	0.239
0.088	0.323	3.179	0.235
0.099	0.323	3.346	0.23
0.11	0.323	3.513	0.226
0.121	0.321	3.679	0.221
0.132	0.321	3.846	0.217
0.143	0.321	4.013	0.212
0.154	0.321	4.179	0.209
0.165	0.321	4.346	0.205
0.176	0.321	4.513	0.2
0.187	0.32	4.679	0.196
0.198	0.32	4.846	0.19

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.209	0.32	5.013	0.185
0.22	0.32	5.179	0.181
0.231	0.318	5.346	0.178
0.2427	0.318	5.513	0.173
0.2552	0.318	5.679	0.169
0.2683	0.317	5.846	0.165
0.2823	0.317	6.013	0.162
0.2972	0.317	6.179	0.157
0.3128	0.317	6.346	0.153
0.3295	0.315	6.513	0.147
0.3472	0.315	6.679	0.142
0.3658	0.315	6.846	0.139
0.3857	0.314	7.013	0.135
0.4067	0.312	7.179	0.132
0.4288	0.312	7.346	0.127
0.4523	0.311	7.513	0.123
0.4772	0.311	7.679	0.118
0.5035	0.312	7.846	0.115
0.5315	0.311	8.013	0.112
0.5612	0.311	8.179	0.108
0.5925	0.309	8.346	0.105
0.6257	0.309	8.513	0.099
0.6608	0.308	8.679	0.096
0.6982	0.306	8.846	0.091
0.7377	0.305	9.013	0.088
0.7795	0.305	9.179	0.084
0.8238	0.303	9.346	0.08
0.8708	0.3	9.513	0.077
0.9207	0.3	9.679	0.074
0.9733	0.299	9.846	0.071
1.029	0.297	10.01	0.066
1.088	0.296	10.18	0.062
1.151	0.293	10.35	0.059
1.217	0.291	10.51	0.054
1.288	0.29	10.68	0.05
1.362	0.288	10.85	0.047
1.441	0.285	11.01	0.044
1.525	0.281	11.18	0.041
1.613	0.279	11.35	0.038
1.707	0.275	11.51	0.033
1.807	0.273	11.68	0.03
1.912	0.27	11.85	0.026
2.023	0.267	12.01	0.023

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.57

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	4.5E-5	cm/sec
y0	0.33	ft

T = K*b = 0.03688 cm^2/sec

APPENDIX B3

LABORATORY HYDRAULIC CONDUCTIVITY TESTS

HISTORICAL LABORATORY RESULTS

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER:	05S3004A	TEST DATE:	7/10/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-7
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	17B
SAMPLE DESCRIPTION:	Gray vf. sandy silty clay.	DEPTH (FT):	53.0-53.5
		FILE NAME:	05S3004A

SPECIMEN WEIGHT (G)	693.83
SPECIMEN HEIGHT (IN)	3.442
DIAMETER (IN)	2.766
AREA (SQ IN)	6.009
VOLUME (CU IN)	20.683
WET DENSITY (PCF)	127.80
DRY DENSITY (PCF)	103.28
WT. DRY SOIL (G)	560.74
VOLUME DRY SOIL (CU IN)	12.674
SP.GR. ASSUMED	2.70
POROSITY (%)	38.72
HEIGHT OF HEAD (PSI)	3.70
HYDRAULIC GRADIANT	29.8
1/4 PORE VOLUME	32.81

WATER CONTENT OF TRIMMINGS

	BEFORE TEST	AFTER TEST
TARE + WET SOIL (G)	74.53	752.87
TARE + DRY SOIL (G)	60.94	613.65
TARE (G)	3.68	50.10
WATER (G)	13.59	139.22
DRY SOIL (G)	57.26	563.55
WATER CONTENT (%)	23.73	24.70

STD. MAX. DEN.(LBS/CU.FT.)	112.00
OPTIMUM MOISTURE (%)	14.70
% COMPACTION	92.22
PRESSURE HEAD (CM H2O)	260.17
PANEL NUMBER	6

TEST METHOD USED: IEPA ASTM D5084

PERMEANT USED: TAP WATER

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	7/10/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-7
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	17B
SAMPLE DESCRIPTION:	Gray vf. sandy silty clay.	DEPTH (FT):	53.0-53.5

SPECIMEN HEIGHT (IN)	3.442	HEIGHT OF HEAD (PSI)	3.70
DIAMETER (IN)	2.766	PRESSURE HEAD (CM H2O)	260.17
AREA (SQ IN)	6.009	PANEL NUMBER	6
1/4 PORE VOLUME	32.81	FILE NAME:	05S3004A

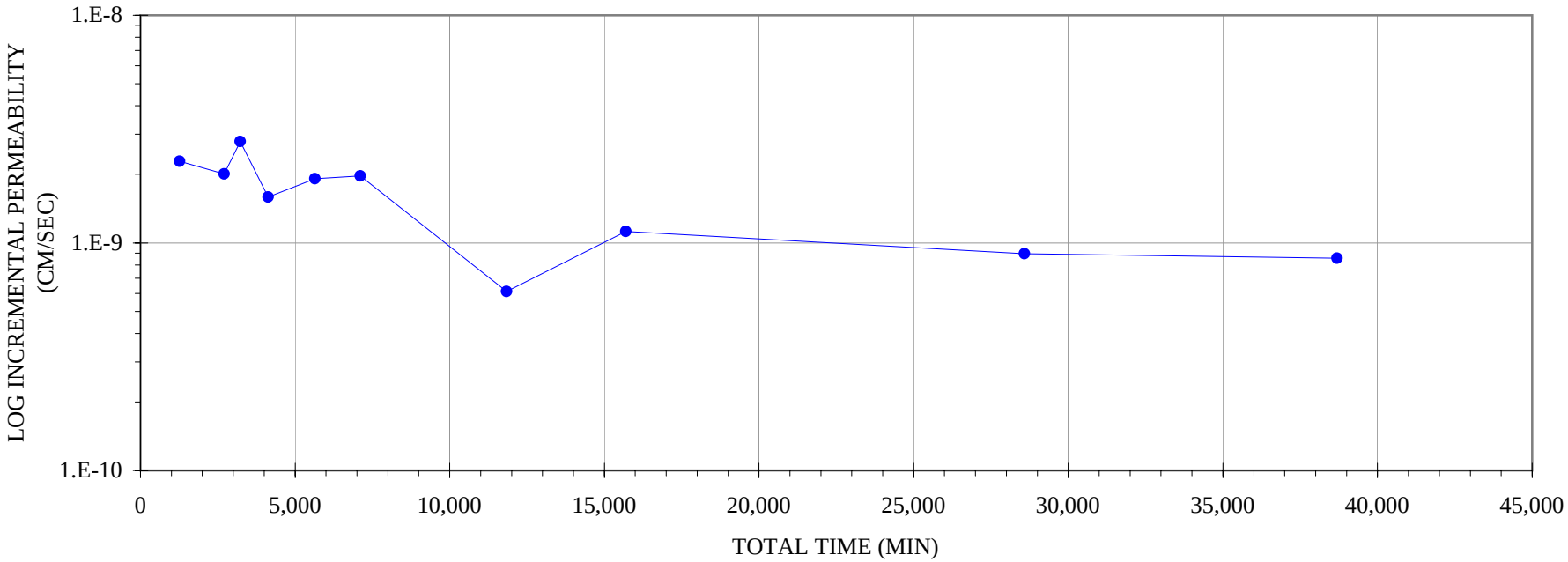
START DATE	START TIME	STOP DATE	STOP TIME	INCREMENT. FLOW (CC)	TOTAL FLOW (CC)	INCREMENT. TIME (MIN)	TOTAL TIME (MIN)	PERMEABILITY (cm/sec) INCREMENTAL	PERMEABILITY (cm/sec) MOVING AVG. GEOMEAN
7/17/2006	10:56:30	7/18/2006	8:03:00	0.20	0.2000	1266.50	1266.50	2.28E-09	2.28E-09
7/18/2006	8:03:00	7/19/2006	8:02:00	0.20	0.4000	1439.00	2705.50	2.01E-09	2.14E-09
7/19/2006	8:02:00	7/19/2006	16:41:00	0.10	0.5000	519.00	3224.50	2.78E-09	2.34E-09
7/19/2006	16:41:00	7/20/2006	7:49:00	0.10	0.6000	908.00	4132.50	1.59E-09	2.12E-09
7/20/2006	7:49:00	7/21/2006	9:00:45	0.20	0.8000	1511.75	5644.25	1.91E-09	2.03E-09
7/31/2006	9:20:35	8/1/2006	9:48:00	0.20	1.0000	1467.42	7111.67	1.97E-09	2.02E-09
8/1/2006	9:48:00	8/4/2006	16:36:15	0.20	1.2000	4728.25	11839.92	6.11E-10	1.38E-09
8/4/2006	16:36:15	8/7/2006	8:56:38	0.30	1.5000	3860.38	15700.30	1.12E-09	1.27E-09
8/7/2006	8:56:38	8/16/2006	7:41:00	0.80	2.3000	12884.37	28584.67	8.97E-10	1.05E-09
8/16/2006	7:41:00	8/23/2006	8:12:52	0.60	2.9000	10111.87	38696.53	8.57E-10	8.52E-10

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	7/10/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-7
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	17B
SAMPLE DESCRIPTION:	Gray vf. sandy silty clay.	DEPTH (FT):	53.0-53.5

SPECIMEN HEIGHT (IN)	3.442	HEIGHT OF HEAD (PSI)	3.70
DIAMETER (IN)	2.766	PRESSURE HEAD (CM H2O)	260.17
AREA (SQ IN)	6.009	PANEL NUMBER	6
1/4 PORE VOLUME	32.81	FILE NAME:	05S3004A



Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER:	05S3004A	TEST DATE:	7/7/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-9
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	14
SAMPLE DESCRIPTION:	Gray vf. sandy silt / so. clay (tr. c. sand	DEPTH (FT):	26.5-27.0
	& sm. gravel).	FILE NAME:	05S3004A

SPECIMEN WEIGHT (G)	438.57
SPECIMEN HEIGHT (IN)	1.951
DIAMETER (IN)	2.775
AREA (SQ IN)	6.048
VOLUME (CU IN)	11.800
WET DENSITY (PCF)	141.59
DRY DENSITY (PCF)	130.87
WT. DRY SOIL (G)	405.36
VOLUME DRY SOIL (CU IN)	9.162
SP.GR. ASSUMED	2.70
POROSITY (%)	22.36
HEIGHT OF HEAD (PSI)	2.10
HYDRAULIC GRADIANT	29.8
1/4 PORE VOLUME	10.81

WATER CONTENT OF TRIMMINGS

	BEFORE TEST	AFTER TEST
TARE + WET SOIL (G)	112.90	56.90
TARE + DRY SOIL (G)	104.63	50.64
TARE (G)	3.69	3.67
WATER (G)	8.27	6.26
DRY SOIL (G)	100.94	46.97
WATER CONTENT (%)	8.19	13.33

STD. MAX. DEN.(LBS/CU.FT.)	N/A
OPTIMUM MOISTURE (%)	N/A
% COMPACTION	N/A
PRESSURE HEAD (CM H2O)	147.67
PANEL NUMBER	5

TEST METHOD USED: IEPA ASTM D5084

PERMEANT USED: TAP WATER

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

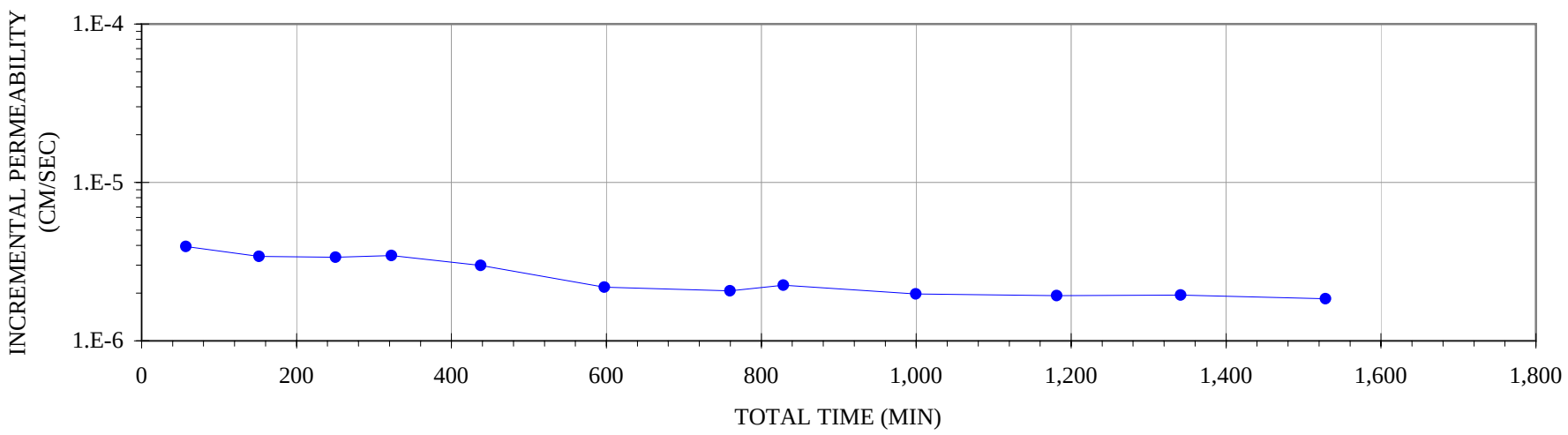
JOB NUMBER:	05S3004A	TEST DATE:	8/30/2007
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-9
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	14
SAMPLE DESCRIPTION:	Gray vf. sandy silt / so. clay (tr. c. sand & sm. gravel).	DEPTH (FT):	26.5-27.0
SPECIMEN HEIGHT (IN)	1.951	HEIGHT OF HEAD (PSI)	2.10
DIAMETER (IN)	2.775	PRESSURE HEAD (CM H2O)	147.67
AREA (SQ IN)	6.048	PANEL NUMBER	5
1/4 PORE VOLUME	10.81	FILE NAME:	05S3004A

START DATE	START TIME	STOP DATE	STOP TIME	INCREMENT. FLOW (CC)	TOTAL FLOW (CC)	INCREMENT. TIME (MIN)	TOTAL TIME (MIN)	PERMEABILITY (cm/sec) INCREMENTAL	PERMEABILITY (cm/sec) MOVING AVG. GEOMEAN
7/17/2006	10:39:00	7/17/2006	11:36:15	15.70	15.7000	57.25	57.25	3.93E-06	3.93E-06
7/17/2006	11:39:00	7/17/2006	13:13:30	22.50	38.2000	94.50	151.75	3.41E-06	3.66E-06
7/17/2006	13:16:30	7/17/2006	14:55:00	23.20	61.4000	98.50	250.25	3.38E-06	3.56E-06
7/17/2006	14:57:30	7/17/2006	16:10:00	17.50	78.9000	72.50	322.75	3.46E-06	3.54E-06
7/18/2006	8:02:00	7/18/2006	9:57:00	24.00	102.9000	115.00	437.75	2.99E-06	3.30E-06
7/18/2006	9:58:40	7/18/2006	12:38:30	24.30	127.2000	159.83	597.58	2.18E-06	2.95E-06
7/18/2006	12:41:00	7/18/2006	15:23:00	23.40	150.6000	162.00	759.58	2.07E-06	2.61E-06
7/18/2006	15:27:00	7/18/2006	16:36:00	10.80	161.4000	69.00	828.58	2.24E-06	2.35E-06
7/19/2006	8:01:00	7/19/2006	10:52:00	23.60	185.0000	171.00	999.58	1.98E-06	2.12E-06
7/19/2006	10:53:30	7/19/2006	13:55:30	24.50	209.5000	182.00	1181.58	1.93E-06	2.05E-06
7/19/2006	13:59:00	7/19/2006	16:39:00	21.70	231.2000	160.00	1341.58	1.94E-06	2.02E-06
7/20/2006	12:57:00	7/20/2006	16:04:00	24.00	255.2000	187.00	1528.58	1.84E-06	1.92E-06

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	8/30/2007
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-9
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	14
SAMPLE DESCRIPTION:	Gray vf. sandy silt / so. clay (tr. c. sand & sm. gravel).	DEPTH (FT):	26.5-27.0
SPECIMEN HEIGHT (IN)	1.951	HEIGHT OF HEAD (PSI)	2.10
DIAMETER (IN)	2.775	PRESSURE HEAD (CM H2O)	147.67
AREA (SQ IN)	6.048	PANEL NUMBER	5
1/4 PORE VOLUME	10.81	FILE NAME:	05S3004A



Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER:	05S3004A	TEST DATE:	4/3/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-11
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	BAG
SAMPLE DESCRIPTION:	Dk. brn. vf. sandy silty clay.	DEPTH (FT):	4.0-8.0
		FILE NAME:	05S3004A

SPECIMEN WEIGHT (G)	349.45
SPECIMEN HEIGHT (IN)	3.998
DIAMETER (IN)	1.879
AREA (SQ IN)	2.773
VOLUME (CU IN)	11.086
WET DENSITY (PCF)	120.08
DRY DENSITY (PCF)	103.14
WT. DRY SOIL (G)	300.16
VOLUME DRY SOIL (CU IN)	6.784
SP.GR. ASSUMED	2.70
POROSITY (%)	38.81
HEIGHT OF HEAD (PSI)	4.30
HYDRAULIC GRADIANT	29.8
1/4 PORE VOLUME	17.62

WATER CONTENT OF TRIMMINGS

	BEFORE TEST	AFTER TEST
TARE + WET SOIL (G)	219.92	369.93
TARE + DRY SOIL (G)	208.47	305.36
TARE (G)	138.74	3.72
WATER (G)	11.45	64.57
DRY SOIL (G)	69.73	301.64
WATER CONTENT (%)	16.42	21.41

STD. MAX. DEN.(LBS/CU.FT.)	108.80
OPTIMUM MOISTURE (%)	16.10
% COMPACTION	94.80
PRESSURE HEAD (CM H2O)	302.36
PANEL NUMBER	7

TEST METHOD USED: IEPA ASTM D5084

PERMEANT USED: Tap Water

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	4/3/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-11
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	BAG
		DEPTH (FT):	4.0-8.0

SPECIMEN HEIGHT (IN)	3.998	HEIGHT OF HEAD (PSI)	4.30
DIAMETER (IN)	1.879	PRESSURE HEAD (CM H2O)	302.36
AREA (SQ IN)	2.773	PANEL NUMBER	7
1/4 PORE VOLUME	17.62	FILE NAME:	05S3004A

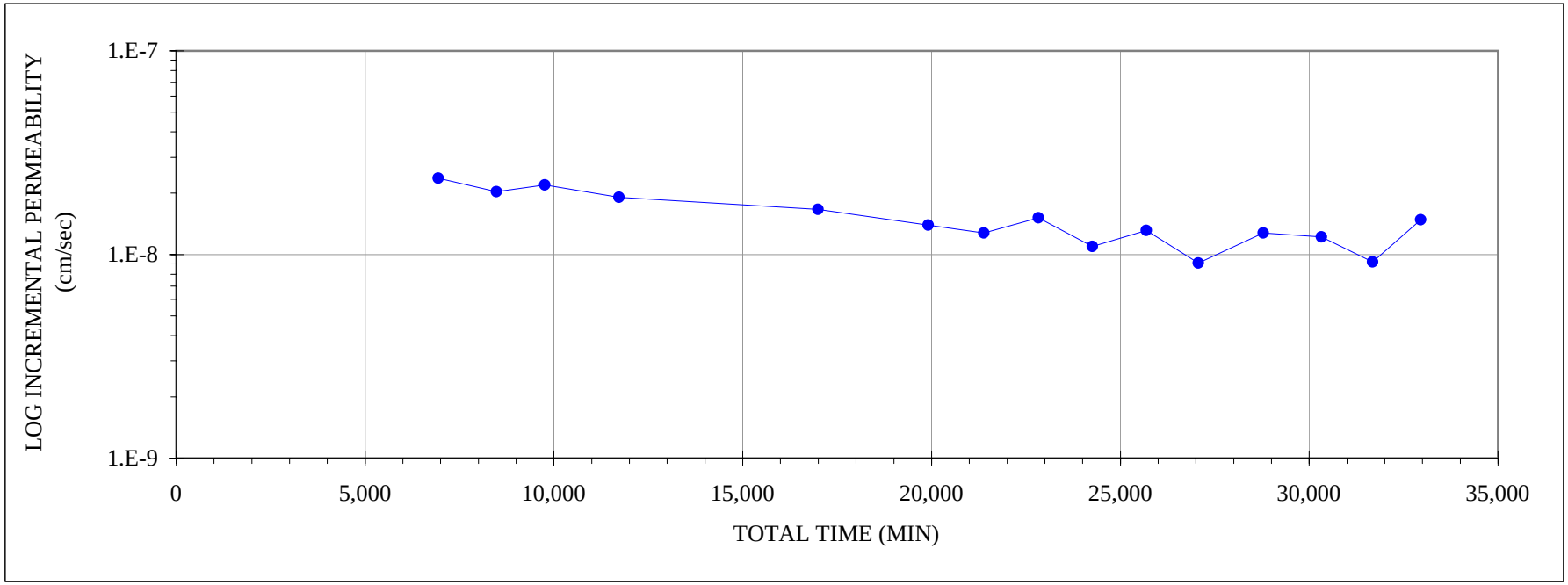
START DATE	START TIME	STOP DATE	STOP TIME	INCREMENT. FLOW (CC)	TOTAL FLOW (CC)	INCREMENT. TIME (MIN)	TOTAL TIME (MIN)	PERMEABILITY (cm/sec) INCREMENTAL	PERMEABILITY (cm/sec) MOVING AVG. GEOMEAN
5/10/2006	13:14:25	5/11/2006	8:22:00	0.80	0.8000	1147.58	1147.58	2.18E-08	2.18E-08
5/11/2006	8:22:00	5/12/2006	8:11:35	1.90	2.7000	1429.58	2577.17	4.16E-08	3.01E-08
5/12/2006	8:11:35	5/15/2006	8:53:00	3.30	6.0000	4361.42	6938.58	2.37E-08	2.78E-08
5/15/2006	8:53:00	5/16/2006	10:31:25	1.00	7.0000	1538.42	8477.00	2.03E-08	2.57E-08
5/16/2006	10:31:25	5/17/2006	7:53:35	0.90	7.9000	1282.17	9759.17	2.20E-08	2.58E-08
5/17/2006	7:53:35	5/18/2006	16:41:40	1.20	9.1000	1968.08	11727.25	1.91E-08	2.12E-08
5/18/2006	16:41:40	5/22/2006	8:25:20	2.80	11.9000	5263.67	16990.92	1.66E-08	1.94E-08
5/22/2006	8:25:20	5/24/2006	9:06:25	1.30	13.2000	2921.08	19912.00	1.39E-08	1.77E-08
5/24/2006	9:06:25	5/25/2006	9:36:40	0.60	13.8000	1470.25	21382.25	1.28E-08	1.54E-08
5/25/2006	9:36:40	5/26/2006	9:44:45	0.70	14.5000	1448.08	22830.33	1.51E-08	1.45E-08
5/26/2006	9:44:45	5/27/2006	9:31:35	0.50	15.0000	1426.83	24257.17	1.10E-08	1.31E-08
5/27/2006	9:31:35	5/28/2006	9:24:15	0.60	15.6000	1432.67	25689.83	1.31E-08	1.29E-08
5/28/2006	9:24:15	5/29/2006	8:21:20	0.40	16.0000	1377.08	27066.92	9.09E-09	1.19E-08
5/29/2006	8:21:20	5/30/2006	12:56:30	0.70	16.7000	1715.17	28782.08	1.28E-08	1.14E-08
5/30/2006	12:56:30	5/31/2006	14:36:35	0.60	17.3000	1540.08	30322.17	1.22E-08	1.17E-08
5/31/2006	14:36:35	6/1/2006	13:16:30	0.40	17.7000	1359.92	31682.08	9.20E-09	1.07E-08
6/1/2006	13:16:30	6/2/2006	10:24:00	0.60	18.3000	1267.50	32949.58	1.48E-08	1.21E-08

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	4/3/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-11
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	BAG
		DEPTH (FT):	4.0-8.0

SPECIMEN HEIGHT (IN)	3.998	HEIGHT OF HEAD (PSI)	4.30
DIAMETER (IN)	1.879	PRESSURE HEAD (CM H2O)	302.36
AREA (SQ IN)	2.773	PANEL NUMBER	7
1/4 PORE VOLUME	17.62	FILE NAME:	05S3004A



Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER:	05S3004A	TEST DATE:	7/7/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-12
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	6B
SAMPLE DESCRIPTION:	Gray vf. sandy silty clay (tr. c. sand).	DEPTH (FT):	45.0-50.0
		FILE NAME:	05S3004A

SPECIMEN WEIGHT (G)	459.74
SPECIMEN HEIGHT (IN)	3.419
DIAMETER (IN)	2.347
AREA (SQ IN)	4.326
VOLUME (CU IN)	14.792
WET DENSITY (PCF)	118.40
DRY DENSITY (PCF)	96.94
WT. DRY SOIL (G)	376.40
VOLUME DRY SOIL (CU IN)	8.507
SP.GR. ASSUMED	2.70
POROSITY (%)	42.49
HEIGHT OF HEAD (PSI)	3.60
HYDRAULIC GRADIANT	29.1
1/4 PORE VOLUME	25.75

WATER CONTENT OF TRIMMINGS

	BEFORE TEST	AFTER TEST
TARE + WET SOIL (G)	65.87	513.41
TARE + DRY SOIL (G)	54.60	427.45
TARE (G)	3.70	50.03
WATER (G)	11.27	85.96
DRY SOIL (G)	50.90	377.42
WATER CONTENT (%)	22.14	22.78

STD. MAX. DEN.(LBS/CU.FT.)	112.00
OPTIMUM MOISTURE (%)	14.70
% COMPACTION	86.55
PRESSURE HEAD (CM H2O)	253.14
PANEL NUMBER	8

TEST METHOD USED: IEPA ASTM D5084

PERMEANT USED: TAP WATER

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	7/7/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-12
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	6B
SAMPLE DESCRIPTION:	Gray vf. sandy silty clay (tr. c. sand).	DEPTH (FT):	45.0-50.0

SPECIMEN HEIGHT (IN)	3.419	HEIGHT OF HEAD (PSI)	3.60
DIAMETER (IN)	2.347	PRESSURE HEAD (CM H2O)	253.14
AREA (SQ IN)	4.326	PANEL NUMBER	8
1/4 PORE VOLUME	25.75	FILE NAME:	05S3004A

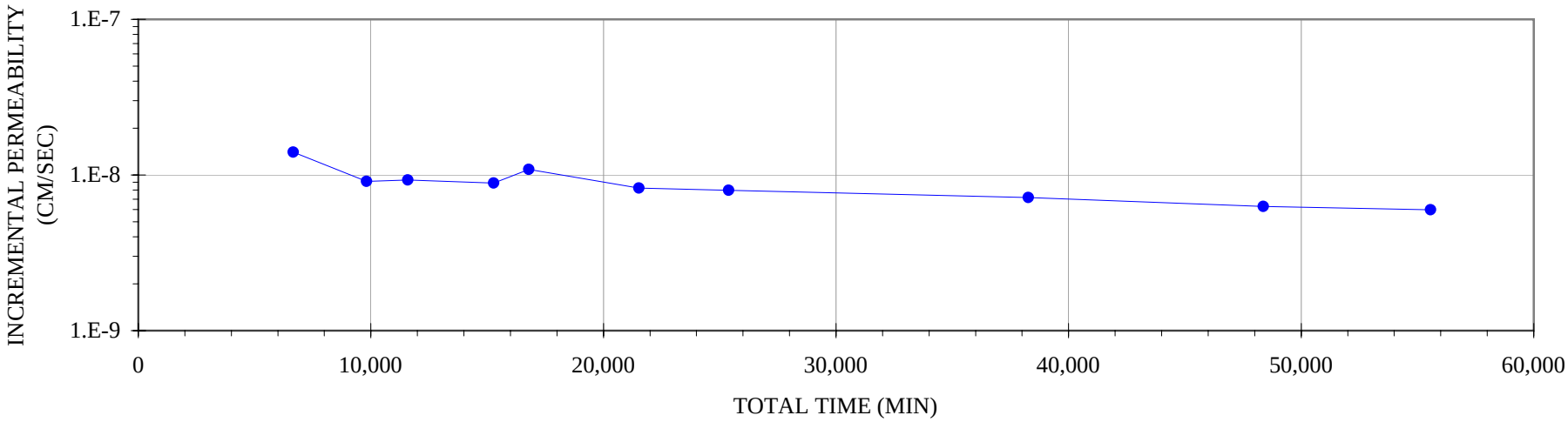
START DATE	START TIME	STOP DATE	STOP TIME	INCREMENT. FLOW (CC)	TOTAL FLOW (CC)	INCREMENT. TIME (MIN)	TOTAL TIME (MIN)	PERMEABILITY (cm/sec) INCREMENTAL	PERMEABILITY (cm/sec) MOVING AVG. GEOMEAN
7/17/2006	13:26:30	7/18/2006	8:11:00	0.40	0.4000	1124.50	1124.50	7.29E-09	7.29E-09
7/18/2006	8:11:00	7/19/2006	8:09:30	0.30	0.7000	1438.50	2563.00	4.27E-09	5.58E-09
7/19/2006	8:09:30	7/20/2006	7:57:30	0.20	0.9000	1428.00	3991.00	2.87E-09	4.47E-09
7/20/2006	7:57:30	7/21/2006	9:07:45	0.20	1.1000	1510.25	5501.25	2.71E-09	3.95E-09
7/24/2006	13:38:15	7/25/2006	9:05:25	0.80	1.9000	1167.17	6668.42	1.40E-08	4.65E-09
7/25/2006	9:05:25	7/27/2006	13:38:00	1.40	3.3000	3152.58	9821.00	9.10E-09	5.62E-09
7/27/2006	13:38:00	7/28/2006	19:03:30	0.80	4.1000	1765.50	11586.50	9.28E-09	7.53E-09
7/28/2006	19:03:30	7/31/2006	8:43:30	1.60	5.7000	3700.00	15286.50	8.86E-09	1.01E-08
7/31/2006	8:43:30	8/1/2006	9:52:15	0.80	6.5000	1508.75	16795.25	1.09E-08	9.49E-09
8/1/2006	9:52:15	8/4/2006	16:38:10	1.90	8.4000	4725.92	21521.17	8.24E-09	9.26E-09
8/4/2006	16:38:10	8/7/2006	8:58:40	1.50	9.9000	3860.50	25381.67	7.96E-09	8.91E-09
8/7/2006	8:58:40	8/16/2006	7:49:00	4.50	14.4000	12890.33	38272.00	7.15E-09	8.45E-09
8/16/2006	7:49:00	8/23/2006	8:14:00	3.10	17.5000	10105.00	48377.00	6.28E-09	7.37E-09
8/23/2006	8:14:00	8/28/2006	8:02:30	2.10	19.6000	7188.50	55565.50	5.98E-09	6.80E-09

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	7/7/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-12
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	6B
SAMPLE DESCRIPTION:	Gray vf. sandy silty clay (tr. c. sand).	DEPTH (FT):	45.0-50.0

SPECIMEN HEIGHT (IN)	3.419	HEIGHT OF HEAD (PSI)	3.60
DIAMETER (IN)	2.347	PRESSURE HEAD (CM H2O)	253.14
AREA (SQ IN)	4.326	PANEL NUMBER	8
1/4 PORE VOLUME	25.75	FILE NAME:	05S3004A



Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER:	05S3004A	TEST DATE:	7/10/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-13
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	12
SAMPLE DESCRIPTION:	Gray vf. sandy silty clay (tr. c. sand	DEPTH (FT):	25.0-30.0
	& sm. gravel).	FILE NAME:	05S3004A

SPECIMEN WEIGHT (G)	483.73
SPECIMEN HEIGHT (IN)	3.259
DIAMETER (IN)	2.279
AREA (SQ IN)	4.079
VOLUME (CU IN)	13.294
WET DENSITY (PCF)	138.62
DRY DENSITY (PCF)	123.13
WT. DRY SOIL (G)	429.70
VOLUME DRY SOIL (CU IN)	9.712
SP.GR. ASSUMED	2.70
POROSITY (%)	26.95
HEIGHT OF HEAD (PSI)	3.50
HYDRAULIC GRADIANT	29.7
1/4 PORE VOLUME	14.68

WATER CONTENT OF TRIMMINGS

	BEFORE TEST	AFTER TEST
TARE + WET SOIL (G)	125.78	534.14
TARE + DRY SOIL (G)	112.15	475.18
TARE (G)	3.75	50.14
WATER (G)	13.63	58.96
DRY SOIL (G)	108.40	425.04
WATER CONTENT (%)	12.57	13.87

STD. MAX. DEN.(LBS/CU.FT.)	N/A
OPTIMUM MOISTURE (%)	N/A
% COMPACTION	
PRESSURE HEAD (CM H2O)	246.11
PANEL NUMBER	1
PERMEANT USED:	TAP WATER

TEST METHOD USED: IEPA ASTM D5084

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

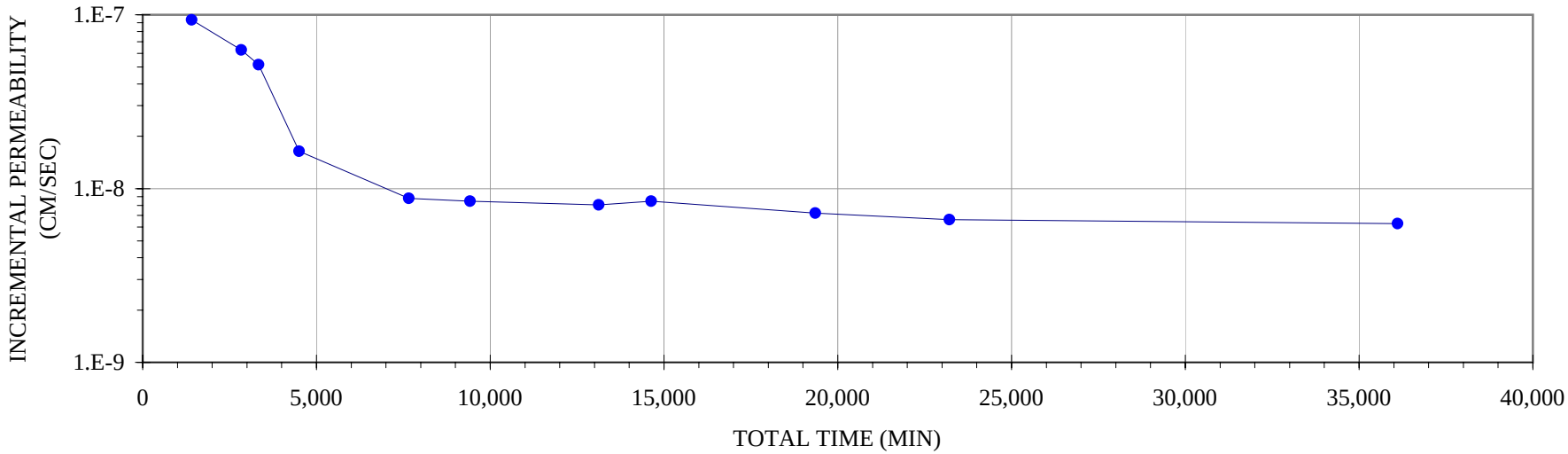
JOB NUMBER:	05S3004A	TEST DATE:	7/10/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-13
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	12
SAMPLE DESCRIPTION:	Gray vf. sandy silty clay (tr. c. sand & sm. gravel).	DEPTH (FT):	25.0-30.0
SPECIMEN HEIGHT (IN)	3.259	HEIGHT OF HEAD (PSI)	3.50
DIAMETER (IN)	2.279	PRESSURE HEAD (CM H2O)	246.11
AREA (SQ IN)	4.079	PANEL NUMBER	1
1/4 PORE VOLUME	14.68	FILE NAME:	05S3004A

START DATE	START TIME	STOP DATE	STOP TIME	INCREMENT. FLOW (CC)	TOTAL FLOW (CC)	INCREMENT. TIME (MIN)	TOTAL TIME (MIN)	PERMEABILITY (cm/sec) INCREMENTAL	PERMEABILITY (cm/sec) MOVING AVG. GEOMEAN
7/19/2006	8:38:00	7/20/2006	8:11:10	6.20	6.2000	1413.17	1413.17	9.35E-08	9.35E-08
7/20/2006	8:11:10	7/21/2006	7:58:00	4.20	10.4000	1426.83	2840.00	6.27E-08	7.65E-08
7/21/2006	7:58:00	7/21/2006	16:13:00	1.20	11.6000	495.00	3335.00	5.16E-08	6.71E-08
7/24/2006	13:37:50	7/25/2006	9:06:10	0.90	12.5000	1168.33	4503.33	1.64E-08	4.72E-08
7/25/2006	9:06:10	7/27/2006	13:38:40	1.30	13.8000	3152.50	7655.83	8.78E-09	2.61E-08
7/27/2006	13:38:40	7/28/2006	19:01:35	0.70	14.5000	1762.92	9418.75	8.46E-09	1.58E-08
7/28/2006	19:01:35	7/31/2006	8:44:10	1.40	15.9000	3702.58	13121.33	8.05E-09	9.95E-09
7/31/2006	8:44:10	8/1/2006	9:53:15	0.60	16.5000	1509.08	14630.42	8.47E-09	8.44E-09
8/1/2006	9:53:15	8/4/2006	16:38:45	1.60	18.1000	4725.50	19355.92	7.21E-09	8.03E-09
8/4/2006	16:38:45	8/7/2006	8:59:19	1.20	19.3000	3860.57	23216.48	6.62E-09	7.55E-09
8/7/2006	8:59:19	8/16/2006	7:49:30	3.80	23.1000	12890.18	36106.67	6.28E-09	7.10E-09

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	7/10/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-13
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	12
SAMPLE DESCRIPTION:	Gray vf. sandy silty clay (tr. c. sand & sm. gravel).	DEPTH (FT):	25.0-30.0
SPECIMEN HEIGHT (IN)	3.259	HEIGHT OF HEAD (PSI)	3.50
DIAMETER (IN)	2.279	PRESSURE HEAD (CM H2O)	246.11
AREA (SQ IN)	4.079	PANEL NUMBER	1
1/4 PORE VOLUME	14.68	FILE NAME:	05S3004A



Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER:	05S3004A	TEST DATE:	5/5/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-14
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	BAG
SAMPLE DESCRIPTION:	Brn. vf. sandy silty clay (tr. sm. gravel).	DEPTH (FT):	5.0-10.0
		FILE NAME:	05S3004A

SPECIMEN WEIGHT (G)	356.11
SPECIMEN HEIGHT (IN)	3.998
DIAMETER (IN)	1.879
AREA (SQ IN)	2.773
VOLUME (CU IN)	11.086
WET DENSITY (PCF)	122.37
DRY DENSITY (PCF)	106.70
WT. DRY SOIL (G)	310.52
VOLUME DRY SOIL (CU IN)	7.018
SP.GR. ASSUMED	2.70
POROSITY (%)	36.69
HEIGHT OF HEAD (PSI)	4.30
HYDRAULIC GRADIANT	29.8
1/4 PORE VOLUME	16.67

WATER CONTENT OF TRIMMINGS

	BEFORE TEST	AFTER TEST
TARE + WET SOIL (G)	214.34	378.18
TARE + DRY SOIL (G)	204.66	316.21
TARE (G)	138.73	3.78
WATER (G)	9.68	61.97
DRY SOIL (G)	65.93	312.43
WATER CONTENT (%)	14.68	19.83

STD. MAX. DEN.(LBS/CU.FT.)	111.80
OPTIMUM MOISTURE (%)	14.90
% COMPACTION	95.44
PRESSURE HEAD (CM H2O)	302.36
PANEL NUMBER	3

TEST METHOD USED: IEPA ASTM D5084

PERMEANT USED: TAP WATER

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	5/5/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-14
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	BAG
		DEPTH (FT):	5.0-10.0

SPECIMEN HEIGHT (IN)	3.998	HEIGHT OF HEAD (PSI)	4.30
DIAMETER (IN)	1.879	PRESSURE HEAD (CM H2O)	302.36
AREA (SQ IN)	2.773	PANEL NUMBER	3
1/4 PORE VOLUME	16.67	FILE NAME:	05S3004A

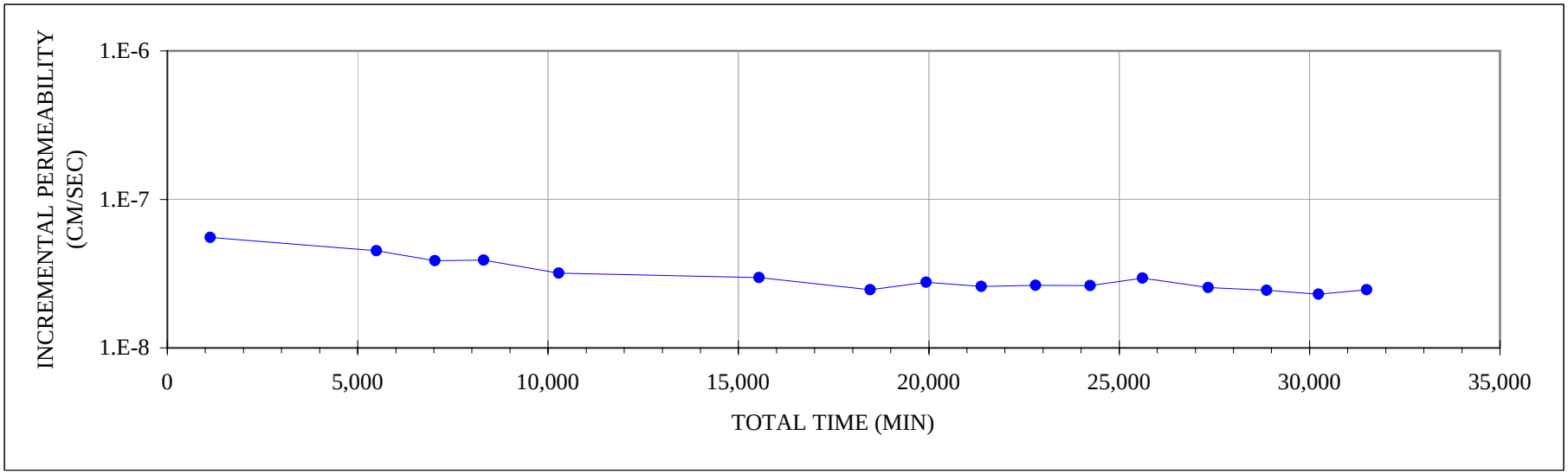
START DATE	START TIME	STOP DATE	STOP TIME	INCREMENT. FLOW (CC)	TOTAL FLOW (CC)	INCREMENT. TIME (MIN)	TOTAL TIME (MIN)	PERMEABILITY (cm/sec) INCREMENTAL	PERMEABILITY (cm/sec) MOVING AVG. GEOMEAN
5/11/2006	13:24:00	5/12/2006	8:13:00	2.00	2.0000	1129.00	1129.00	5.54E-08	5.54E-08
5/12/2006	8:13:00	5/15/2006	8:54:20	6.30	8.3000	4361.33	5490.33	4.52E-08	5.01E-08
5/15/2006	8:54:20	5/16/2006	10:33:00	1.90	10.2000	1538.67	7029.00	3.86E-08	4.59E-08
5/16/2006	10:33:00	5/17/2006	7:54:30	1.60	11.8000	1281.50	8310.50	3.91E-08	4.41E-08
5/17/2006	7:54:30	5/18/2006	16:42:10	2.00	13.8000	1967.67	10278.17	3.18E-08	3.84E-08
5/18/2006	16:42:10	5/22/2006	8:26:15	5.00	18.8000	5264.08	15542.25	2.97E-08	3.46E-08
5/22/2006	8:27:45	5/24/2006	9:07:00	2.30	21.1000	2919.25	18461.50	2.47E-08	3.09E-08
5/24/2006	9:07:00	5/25/2006	9:37:25	1.30	22.4000	1470.42	19931.92	2.77E-08	2.83E-08
5/25/2006	9:37:25	5/26/2006	9:45:15	1.20	23.6000	1447.83	21379.75	2.59E-08	2.69E-08
5/26/2006	9:45:15	5/27/2006	9:30:50	1.20	24.8000	1425.58	22805.33	2.63E-08	2.61E-08
5/27/2006	9:30:50	5/28/2006	9:22:30	1.20	26.0000	1431.67	24237.00	2.62E-08	2.65E-08
5/28/2006	9:22:30	5/29/2006	8:22:00	1.30	27.3000	1379.50	25616.50	2.95E-08	2.70E-08
5/29/2006	8:22:00	5/30/2006	13:01:00	1.40	28.7000	1719.00	27335.50	2.55E-08	2.68E-08
5/30/2006	13:01:00	5/31/2006	14:38:00	1.20	29.9000	1537.00	28872.50	2.44E-08	2.63E-08
5/31/2006	14:38:00	6/1/2006	13:19:00	1.00	30.9000	1361.00	30233.50	2.30E-08	2.55E-08
6/1/2006	13:19:00	6/2/2006	10:27:00	1.00	31.9000	1268.00	31501.50	2.47E-08	2.44E-08

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	5/5/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-14
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	BAG
		DEPTH (FT):	5.0-10.0

SPECIMEN HEIGHT (IN)	3.998	HEIGHT OF HEAD (PSI)	4.30
DIAMETER (IN)	1.879	PRESSURE HEAD (CM H2O)	302.36
AREA (SQ IN)	2.773	PANEL NUMBER	3
1/4 PORE VOLUME	16.67	FILE NAME:	05S3004A



Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER:	05S3004A	TEST DATE:	7/7/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-16
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	18A
SAMPLE DESCRIPTION:	Brn. & gray f. sandy silt (tr. clay) / so.	DEPTH (FT):	37.0-37.5
	c. sand & sm. gravel.	FILE NAME:	05S3004A

SPECIMEN WEIGHT (G)	855.13
SPECIMEN HEIGHT (IN)	3.811
DIAMETER (IN)	2.735
AREA (SQ IN)	5.875
VOLUME (CU IN)	22.389
WET DENSITY (PCF)	145.50
DRY DENSITY (PCF)	132.33
WT. DRY SOIL (G)	777.72
VOLUME DRY SOIL (CU IN)	17.578
SP.GR. ASSUMED	2.70
POROSITY (%)	21.49
HEIGHT OF HEAD (PSI)	4.10
HYDRAULIC GRADIANT	29.8
1/4 PORE VOLUME	19.71

WATER CONTENT OF TRIMMINGS

	BEFORE TEST	AFTER TEST
TARE + WET SOIL (G)	128.66	124.70
TARE + DRY SOIL (G)	117.35	113.65
TARE (G)	3.72	3.71
WATER (G)	11.31	11.05
DRY SOIL (G)	113.63	109.94
WATER CONTENT (%)	9.95	10.05

STD. MAX. DEN.(LBS/CU.FT.)	112.00
OPTIMUM MOISTURE (%)	14.70
% COMPACTION	118.15
PRESSURE HEAD (CM H2O)	288.30
PANEL NUMBER	3

TEST METHOD USED: IEPA ASTM D5084

PERMEANT USED: TAP WATER

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

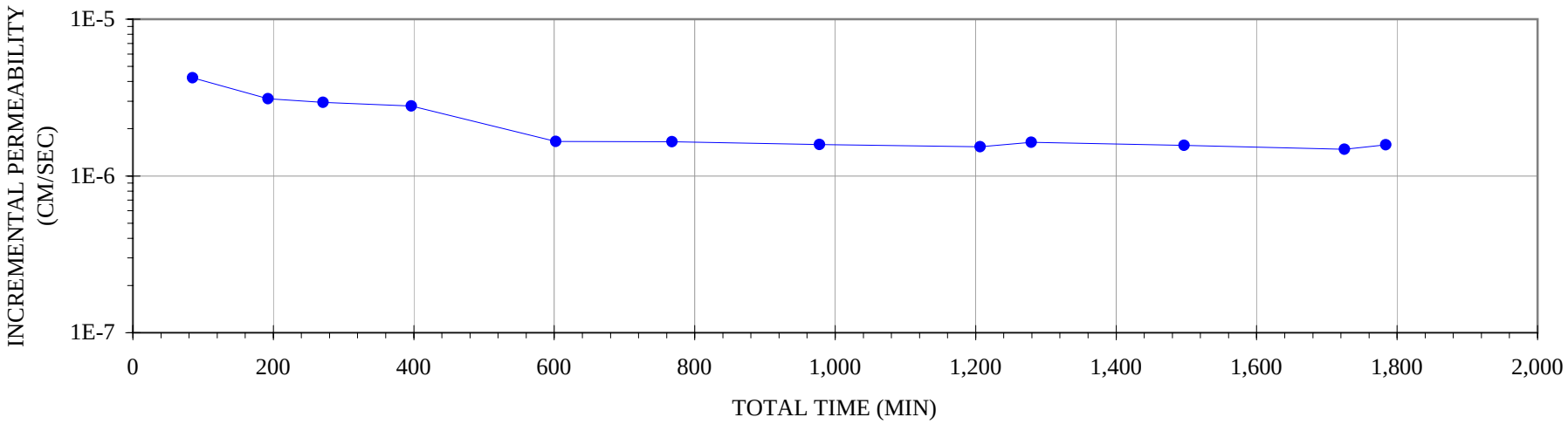
JOB NUMBER:	05S3004A	TEST DATE:	7/7/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-16
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	18A
SAMPLE DESCRIPTION:	Brn. & gray f. sandy silt (tr. clay) / so. c. sand & sm. gravel.	DEPTH (FT):	37.0-37.5
SPECIMEN HEIGHT (IN)	3.811	HEIGHT OF HEAD (PSI)	4.10
DIAMETER (IN)	2.735	PRESSURE HEAD (CM H2O)	288.30
AREA (SQ IN)	5.875	PANEL NUMBER	3
1/4 PORE VOLUME	19.71	FILE NAME:	05S3004A

START DATE	START TIME	STOP DATE	STOP TIME	INCREMENT. FLOW (CC)	TOTAL FLOW (CC)	INCREMENT. TIME (MIN)	TOTAL TIME (MIN)	PERMEABILITY (cm/sec) INCREMENTAL	PERMEABILITY (cm/sec) MOVING AVG. GEOMEAN
7/17/2006	11:36:30	7/17/2006	13:01:30	24.30	24.3000	85.00	85.00	4.22E-06	4.22E-06
7/17/2006	13:04:30	7/17/2006	14:52:00	22.60	46.9000	107.50	192.50	3.10E-06	3.62E-06
7/17/2006	14:54:00	7/17/2006	16:12:15	15.60	62.5000	78.25	270.75	2.94E-06	3.38E-06
7/18/2006	8:08:00	7/18/2006	10:14:00	23.80	86.3000	126.00	396.75	2.79E-06	3.22E-06
7/18/2006	10:21:30	7/18/2006	13:47:00	23.10	109.4000	205.50	602.25	1.66E-06	2.55E-06
7/18/2006	13:48:30	7/18/2006	16:34:00	18.50	127.9000	165.50	767.75	1.65E-06	2.18E-06
7/19/2006	8:08:00	7/19/2006	11:38:00	22.60	150.5000	210.00	977.75	1.59E-06	1.87E-06
7/19/2006	11:40:00	7/19/2006	15:28:30	23.80	174.3000	228.50	1206.25	1.54E-06	1.61E-06
7/19/2006	15:30:30	7/19/2006	16:43:30	8.10	182.4000	73.00	1279.25	1.64E-06	1.60E-06
7/20/2006	7:55:00	7/20/2006	11:32:30	23.10	205.5000	217.50	1496.75	1.57E-06	1.58E-06
7/20/2006	11:35:30	7/20/2006	15:23:50	22.90	228.4000	228.33	1725.08	1.48E-06	1.56E-06
7/20/2006	15:27:00	7/20/2006	16:26:00	6.30	234.7000	59.00	1784.08	1.58E-06	1.56E-06

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	7/7/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-16
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	18A
SAMPLE DESCRIPTION:	Brn. & gray f. sandy silt (tr. clay) / so. c. sand & sm. gravel.	DEPTH (FT):	37.0-37.5
SPECIMEN HEIGHT (IN)	3.811	HEIGHT OF HEAD (PSI)	4.10
DIAMETER (IN)	2.735	PRESSURE HEAD (CM H2O)	288.30
AREA (SQ IN)	5.875	PANEL NUMBER	3
1/4 PORE VOLUME	19.71	FILE NAME:	05S3004A



Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER:	05S3004A	TEST DATE:	7/10/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-16
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	32A
SAMPLE DESCRIPTION:	Yel. brn. vf.-f. sandy silty clay / so. c.	DEPTH (FT):	78.0-78.5
	sand & sm. gravel & cobbles.	FILE NAME:	05S3004A

SPECIMEN WEIGHT (G)	203.47
SPECIMEN HEIGHT (IN)	1.873
DIAMETER (IN)	1.949
AREA (SQ IN)	2.983
VOLUME (CU IN)	5.588
WET DENSITY (PCF)	138.71
DRY DENSITY (PCF)	121.11
WT. DRY SOIL (G)	177.64
VOLUME DRY SOIL (CU IN)	4.015
SP.GR. ASSUMED	2.70
POROSITY (%)	28.15
HEIGHT OF HEAD (PSI)	2.00
HYDRAULIC GRADIANT	29.6
1/4 PORE VOLUME	6.44
TEST METHOD USED:	IEPA ASTM D5084

WATER CONTENT OF TRIMMINGS

	BEFORE TEST	AFTER TEST
TARE + WET SOIL (G)	159.86	258.48
TARE + DRY SOIL (G)	140.04	227.76
TARE (G)	3.71	50.15
WATER (G)	19.82	30.72
DRY SOIL (G)	136.33	177.61
WATER CONTENT (%)	14.54	17.30

STD. MAX. DEN.(LBS/CU.FT.)	112.00
OPTIMUM MOISTURE (%)	14.70
% COMPACTION	108.13
PRESSURE HEAD (CM H2O)	140.63
PANEL NUMBER	4
PERMEANT USED:	TAP WATER

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

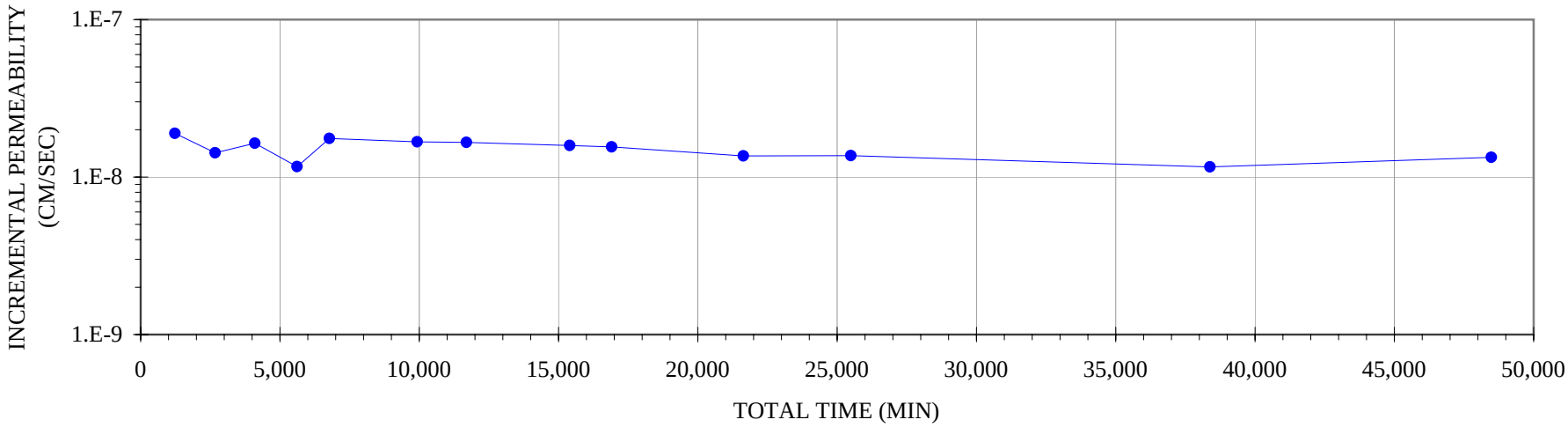
JOB NUMBER:	05S3004A	TEST DATE:	7/10/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-16
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	32A
SAMPLE DESCRIPTION:	Yel. brn. vf.-f. sandy silty clay / so. c. sand & sm. gravel & cobbles.	DEPTH (FT):	78.0-78.5
SPECIMEN HEIGHT (IN)	1.873	HEIGHT OF HEAD (PSI)	2.00
DIAMETER (IN)	1.949	PRESSURE HEAD (CM H2O)	140.63
AREA (SQ IN)	2.983	PANEL NUMBER	4
1/4 PORE VOLUME	6.444	FILE NAME:	05S3004A

START DATE	START TIME	STOP DATE	STOP TIME	INCREMENT. FLOW (CC)	TOTAL FLOW (CC)	INCREMENT. TIME (MIN)	TOTAL TIME (MIN)	PERMEABILITY (cm/sec) INCREMENTAL	PERMEABILITY (cm/sec) MOVING AVG. GEOMEAN
7/17/2006	11:33:00	7/18/2006	8:09:00	0.80	0.8000	1236.00	1236.00	1.90E-08	1.90E-08
7/18/2006	8:09:00	7/19/2006	8:09:00	0.70	1.5000	1440.00	2676.00	1.42E-08	1.64E-08
7/19/2006	8:09:00	7/20/2006	7:56:00	0.80	2.3000	1427.00	4103.00	1.64E-08	1.64E-08
7/20/2006	7:56:00	7/21/2006	9:06:10	0.60	2.9000	1510.17	5613.17	1.16E-08	1.51E-08
7/24/2006	13:37:15	7/25/2006	9:04:50	0.70	3.6000	1167.58	6780.75	1.76E-08	1.48E-08
7/25/2006	9:04:50	7/27/2006	13:37:20	1.80	5.4000	3152.50	9933.25	1.67E-08	1.54E-08
7/27/2006	13:37:20	7/28/2006	19:03:10	1.00	6.4000	1765.83	11699.08	1.66E-08	1.54E-08
7/28/2006	19:03:10	7/31/2006	8:43:10	2.00	8.4000	3700.00	15399.08	1.58E-08	1.67E-08
7/31/2006	8:43:10	8/1/2006	9:51:30	0.80	9.2000	1508.33	16907.42	1.55E-08	1.62E-08
8/1/2006	9:51:30	8/4/2006	16:37:45	2.20	11.4000	4726.25	21633.67	1.36E-08	1.54E-08
8/4/2006	16:37:45	8/7/2006	8:58:05	1.80	13.2000	3860.33	25494.00	1.37E-08	1.46E-08
8/7/2006	8:58:05	8/16/2006	7:45:30	5.10	18.3000	12887.42	38381.42	1.16E-08	1.35E-08
8/16/2006	7:45:30	8/23/2006	8:13:36	4.60	22.9000	10108.10	48489.52	1.33E-08	1.30E-08

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	7/10/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-16
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	32A
SAMPLE DESCRIPTION:	Yel. brn. vf.-f. sandy silty clay / so. c. sand & sm. gravel & cobbles.	DEPTH (FT):	78.0-78.5
SPECIMEN HEIGHT (IN)	1.873	HEIGHT OF HEAD (PSI)	2.00
DIAMETER (IN)	1.949	PRESSURE HEAD (CM H2O)	140.63
AREA (SQ IN)	2.983	PANEL NUMBER	4
1/4 PORE VOLUME	6.444	FILE NAME:	05S3004A



Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER:	05S3004A	TEST DATE:	7/7/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-18
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	12
SAMPLE DESCRIPTION:	Gray f. sandy silt / so. c. sand	DEPTH (FT):	22.5-23.0
	& sm. gravel.	FILE NAME:	05S3004A

SPECIMEN WEIGHT (G)	733.77
SPECIMEN HEIGHT (IN)	3.163
DIAMETER (IN)	2.746
AREA (SQ IN)	5.922
VOLUME (CU IN)	18.732
WET DENSITY (PCF)	149.22
DRY DENSITY (PCF)	142.56
WT. DRY SOIL (G)	700.99
VOLUME DRY SOIL (CU IN)	15.843
SP.GR. ASSUMED	2.70
POROSITY (%)	15.42
HEIGHT OF HEAD (PSI)	3.40
HYDRAULIC GRADIANT	29.8
1/4 PORE VOLUME	11.83

WATER CONTENT OF TRIMMINGS

	BEFORE TEST	AFTER TEST
TARE + WET SOIL (G)	87.91	784.05
TARE + DRY SOIL (G)	82.64	736.02
TARE (G)	3.73	49.33
WATER (G)	3.69	48.03
DRY SOIL (G)	78.91	686.69
WATER CONTENT (%)	4.68	6.99

STD. MAX. DEN.(LBS/CU.FT.)	112.00
OPTIMUM MOISTURE (%)	14.70
% COMPACTION	127.28
PRESSURE HEAD (CM H2O)	239.08
PANEL NUMBER	7

TEST METHOD USED: IEPA ASTM D5084

PERMEANT USED: TAP WATER

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

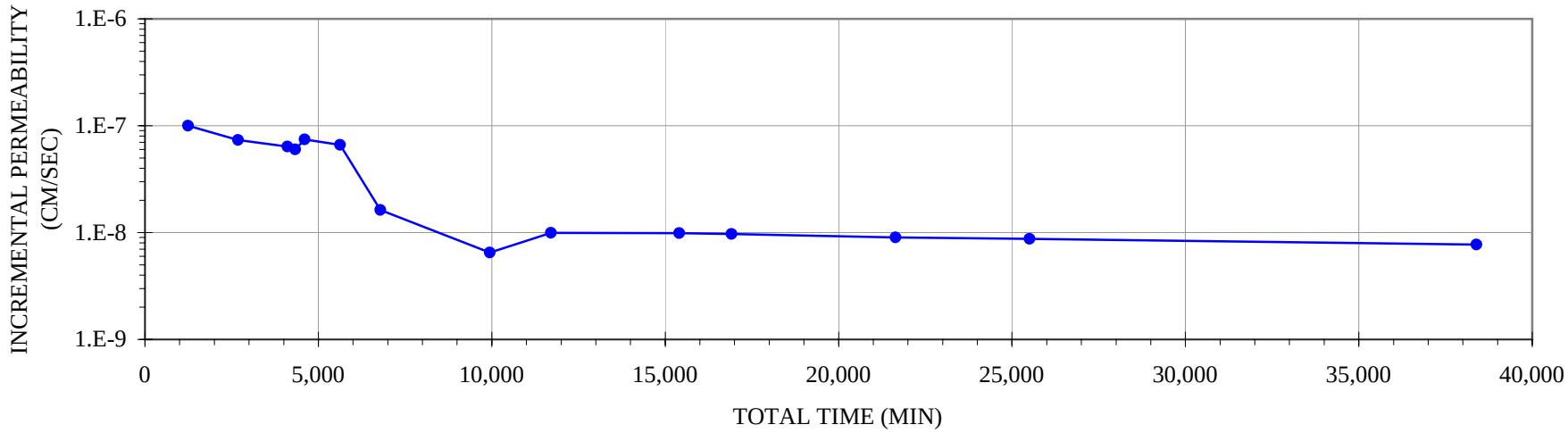
JOB NUMBER:	05S3004A	TEST DATE:	7/7/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-18
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	12
SAMPLE DESCRIPTION:	Gray f. sandy silt / so. c. sand & sm. gravel.	DEPTH (FT):	22.5-23.0
SPECIMEN HEIGHT (IN)	3.163	HEIGHT OF HEAD (PSI)	3.40
DIAMETER (IN)	2.746	PRESSURE HEAD (CM H2O)	239.08
AREA (SQ IN)	5.922	PANEL NUMBER	7
1/4 PORE VOLUME	11.83	FILE NAME:	05S3004A

START DATE	START TIME	STOP DATE	STOP TIME	INCREMENT. FLOW (CC)	TOTAL FLOW (CC)	INCREMENT. TIME (MIN)	TOTAL TIME (MIN)	PERMEABILITY (cm/sec) INCREMENTAL	PERMEABILITY (cm/sec) MOVING AVG. GEOMEAN
7/17/2006	11:18:00	7/18/2006	8:05:00	8.50	8.5000	1247.00	1247.00	9.99E-08	9.99E-08
7/18/2006	8:05:00	7/19/2006	8:03:00	7.20	15.7000	1438.00	2685.00	7.34E-08	8.56E-08
7/19/2006	8:03:00	7/20/2006	7:50:00	6.20	21.9000	1427.00	4112.00	6.37E-08	7.76E-08
7/20/2006	7:50:00	7/20/2006	11:29:30	0.90	22.8000	219.50	4331.50	6.01E-08	7.28E-08
7/20/2006	11:31:30	7/20/2006	16:07:00	1.40	24.2000	275.50	4607.00	7.45E-08	6.76E-08
7/20/2006	16:07:00	7/21/2006	9:03:20	4.60	28.8000	1016.33	5623.33	6.63E-08	6.59E-08
7/24/2006	13:35:30	7/25/2006	9:04:20	1.30	30.1000	1168.83	6792.17	1.63E-08	4.69E-08
7/25/2006	9:04:20	7/27/2006	13:36:50	1.40	31.5000	3152.50	9944.67	6.51E-09	2.69E-08
7/27/2006	13:36:50	7/28/2006	19:02:50	1.20	32.7000	1766.00	11710.67	9.96E-09	1.63E-08
7/28/2006	19:02:50	7/31/2006	8:42:30	2.50	35.2000	3699.67	15410.33	9.91E-09	1.01E-08
7/31/2006	8:42:30	8/1/2006	9:50:45	1.00	36.2000	1508.25	16918.58	9.72E-09	8.89E-09
8/1/2006	9:50:45	8/4/2006	16:37:20	2.90	39.1000	4726.58	21645.17	8.99E-09	9.64E-09
8/4/2006	16:37:20	8/7/2006	8:57:34	2.30	41.4000	3860.23	25505.40	8.73E-09	9.33E-09
8/7/2006	8:57:34	8/16/2006	7:43:30	6.80	48.2000	12885.93	38391.33	7.74E-09	8.77E-09

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	7/7/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-18
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	12
SAMPLE DESCRIPTION:	Gray f. sandy silt / so. c. sand & sm. gravel.	DEPTH (FT):	22.5-23.0
SPECIMEN HEIGHT (IN)	3.163	HEIGHT OF HEAD (PSI)	3.40
DIAMETER (IN)	2.746	PRESSURE HEAD (CM H2O)	239.08
AREA (SQ IN)	5.922	PANEL NUMBER	7
1/4 PORE VOLUME	11.83	FILE NAME:	05S3004A



Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER:	05S3004A	TEST DATE:	7/10/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-19
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	18
SAMPLE DESCRIPTION:	Brn. & gray vf. sandy silty clay.	DEPTH (FT):	55.0-60.0
		FILE NAME:	05S3004A

SPECIMEN WEIGHT (G)	438.75
SPECIMEN HEIGHT (IN)	3.586
DIAMETER (IN)	2.165
AREA (SQ IN)	3.681
VOLUME (CU IN)	13.201
WET DENSITY (PCF)	126.61
DRY DENSITY (PCF)	102.66
WT. DRY SOIL (G)	355.75
VOLUME DRY SOIL (CU IN)	8.041
SP.GR. ASSUMED	2.70
POROSITY (%)	39.09
HEIGHT OF HEAD (PSI)	3.90
HYDRAULIC GRADIANT	30.1
1/4 PORE VOLUME	21.14

WATER CONTENT OF TRIMMINGS

	BEFORE TEST	AFTER TEST
TARE + WET SOIL (G)	103.57	491.35
TARE + DRY SOIL (G)	84.68	406.17
TARE (G)	3.71	49.88
WATER (G)	18.89	85.18
DRY SOIL (G)	80.97	356.29
WATER CONTENT (%)	23.33	23.91

STD. MAX. DEN.(LBS/CU.FT.)	N/A
OPTIMUM MOISTURE (%)	N/A
% COMPACTION	
PRESSURE HEAD (CM H2O)	274.24
PANEL NUMBER	2
PERMEANT USED:	TAP WATER

TEST METHOD USED: IEPA ASTM D5084

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	7/10/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-19
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	18
SAMPLE DESCRIPTION:	Brn. & gray vf. sandy silty clay.	DEPTH (FT):	55.0-60.0

SPECIMEN HEIGHT (IN)	3.586	HEIGHT OF HEAD (PSI)	3.90
DIAMETER (IN)	2.165	PRESSURE HEAD (CM H2O)	274.24
AREA (SQ IN)	3.681	PANEL NUMBER	2
1/4 PORE VOLUME	21.142	FILE NAME:	05S3004A

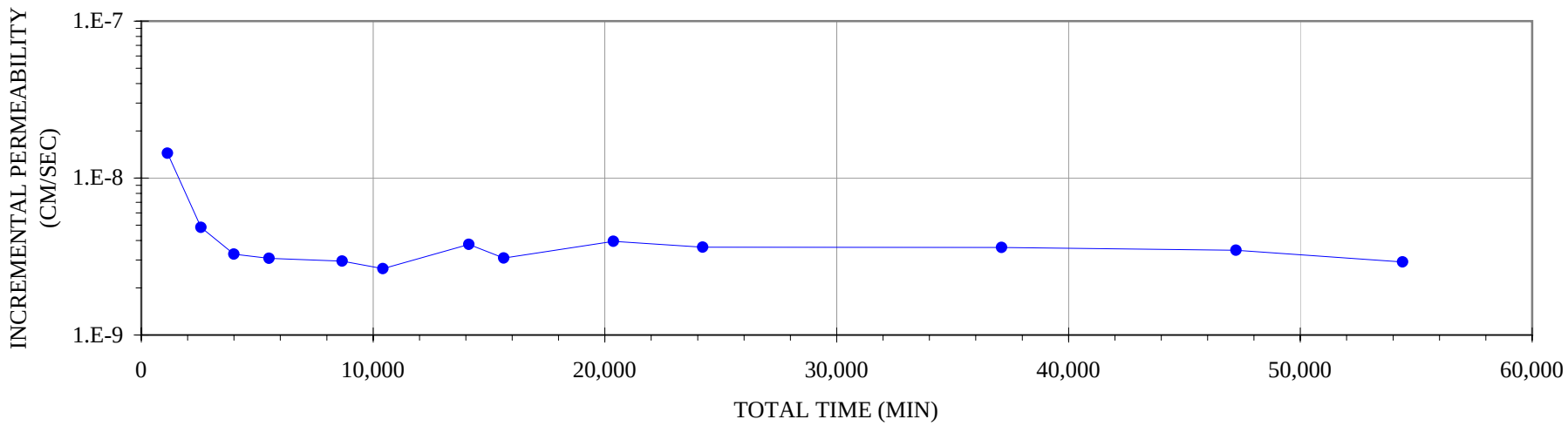
START DATE	START TIME	STOP DATE	STOP TIME	INCREMENT. FLOW (CC)	TOTAL FLOW (CC)	INCREMENT. TIME (MIN)	TOTAL TIME (MIN)	PERMEABILITY (cm/sec) INCREMENTAL	PERMEABILITY (cm/sec) MOVING AVG. GEOMEAN
7/17/2006	13:19:45	7/18/2006	8:13:00	0.70	0.7000	1133.25	1133.25	1.44E-08	1.44E-08
7/18/2006	8:13:00	7/19/2006	8:12:30	0.30	1.0000	1439.50	2572.75	4.86E-09	8.36E-09
7/19/2006	8:12:30	7/20/2006	7:59:00	0.20	1.2000	1426.50	3999.25	3.27E-09	6.11E-09
7/20/2006	7:59:00	7/21/2006	9:12:50	0.20	1.4000	1513.83	5513.08	3.08E-09	5.15E-09
7/25/2006	9:06:45	7/27/2006	13:39:04	0.40	1.8000	3152.32	8665.40	2.96E-09	3.47E-09
7/27/2006	13:39:04	7/28/2006	19:02:15	0.20	2.0000	1763.18	10428.58	2.64E-09	2.98E-09
7/28/2006	19:02:15	7/31/2006	8:44:30	0.60	2.6000	3702.25	14130.83	3.78E-09	3.09E-09
7/31/2006	8:44:30	8/1/2006	9:54:00	0.20	2.8000	1509.50	15640.33	3.09E-09	3.09E-09
8/1/2006	9:54:00	8/4/2006	16:39:20	0.80	3.6000	4725.33	20365.67	3.95E-09	3.32E-09
8/4/2006	16:39:20	8/7/2006	8:59:50	0.60	4.2000	3860.50	24226.17	3.62E-09	3.59E-09
8/7/2006	8:59:50	8/16/2006	7:51:30	2.00	6.2000	12891.67	37117.83	3.62E-09	3.55E-09
8/16/2006	7:51:30	8/23/2006	8:15:00	1.50	7.7000	10103.50	47221.33	3.46E-09	3.66E-09
8/23/2006	8:15:00	8/28/2006	8:03:30	0.90	8.6000	7188.50	54409.83	2.92E-09	3.39E-09

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	05S3004A	TEST DATE:	7/10/2006
CLIENT:	AEG Coffeen Power Station	BORING #:	SB-19
JOB DESCRIPTION:	CCB Management Facility	SAMPLE #:	18
SAMPLE DESCRIPTION:	Brn. & gray vf. sandy silty clay.	DEPTH (FT):	55.0-60.0

SPECIMEN HEIGHT (IN)	3.586	HEIGHT OF HEAD (PSI)	3.90
DIAMETER (IN)	2.165	PRESSURE HEAD (CM H2O)	274.24
AREA (SQ IN)	3.681	PANEL NUMBER	2
1/4 PORE VOLUME	21.142	FILE NAME:	05S3004A



AECOM 2015 LABORATORY RESULTS

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER
ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N $CaSO_4$

PROJECT NAME:	DYNEGY	PROJECT NUMBER:	15151122
LOCATION:	COFFEEN, ILLINOIS	DATE:	7/30/2015
		PANEL IDENTIFICATION:	Lenexa Perm Board
SAMPLE ID:	COF-B001 S7 21.0 - 23.0 feet	BURETTE AREA:	0.312 cm^2
SAMPLE DESCR.:	FAT CLAY WITH SAND, GRAY WITH YELLOWISH BROWN	BURETTE INCREMENT LENGTH:	1.000 cm
		VOLUME PER INCREMENT:	0.312 cm^3

INITIAL

MOISTURE%		DENSITY			
W & T, g	145.02	WET WT, g	475.6		
D & T, g	123.94	DIA, in	2.872	7.29	cm
T, g	33.98	HT, in	2.225	5.65	cm
		AREA		41.80	cm^2
MOIST-		DENSITY:	125.7	PCF WET	
URE, %	**23.4**	DENSITY:	**101.8**	PCF DRY	

ADDITIONAL DATA

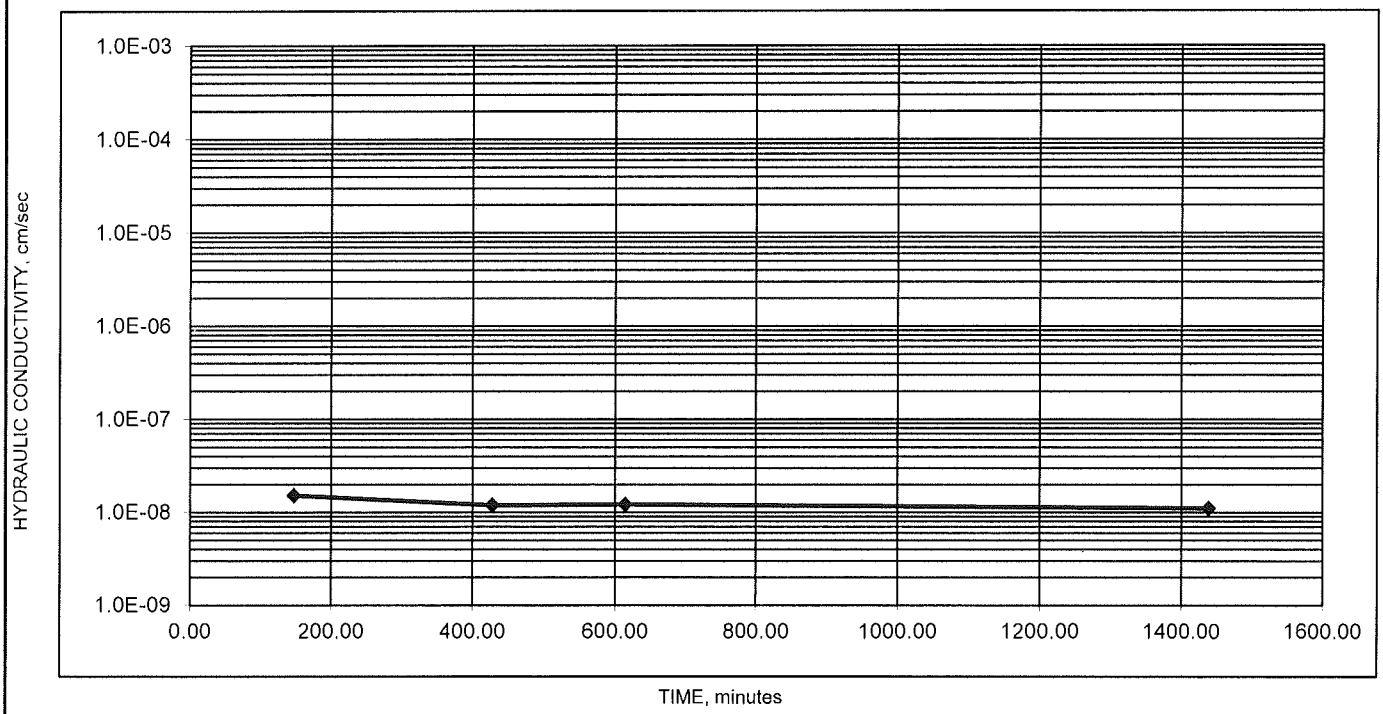
SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	NO
SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
POROSITY, %:	39.6	OPTIMUM, %:	NA
SATURATION, %:	96.6	COMPACTION, %:	NA
VOID RATIO:	0.66	OVER OPTIMUM, %:	NA

SATURATION:	LATERAL PRESS.:	104.0 psi	BACK PRESSURE (=UPPER=LOWER):	100.0 psi		
DURING TEST:	LATERAL PRESS.:	104.0 psi	H2: 100.0 psi	H1: 100.0 psi		
			BIAS PRESSURE (=H1-H2)	0.0 psi		

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm^3	IN FLOW cm^3	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP.; C	TEMP. CORR.:
8.8	67.6	0.00	58.8									
9.0	67.4	147.00	58.4	0.006826	1.52E-08	0.06	0.06	1.00	10.3	21	23.0	0.931
9.3	67.1	428.00	57.8	0.010327	1.20E-08	0.09	0.09	1.00	10.2	5	23.3	0.925
9.5	66.9	614.00	57.4	0.006944	1.22E-08	0.06	0.06	1.00	10.2	3	23.2	0.927
10.3	66.1	1439.00	55.8	0.028270	1.11E-08	0.25	0.25	1.00	9.9	12	23.6	0.918

HYDRAULIC CONDUCTIVITY (k_{20}) = AVERAGE **1.3E-08** **cm/sec**

MAXIMUM	1.0E-03 TO 1.0E-04	2	0.75<	30	% < 25 AT
HYDRAULIC	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
GRADIENT	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC	OR
	1.0E-06 TO 1.0E-07	20		GRADIENT	% < 50 AT
	less than 1.0E-07	30		ALLOWED	< 1.0E-8



Terracon

N:\CM\LAB_DATA\00 Projects in Progress\2015 Projects in Progress\15151122 Lab Data\[15151122 Permeability D5084-C COF-B001-S7-21.0

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER
ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4

PROJECT NAME:	DYNEGY	PROJECT NUMBER:	15151122
LOCATION:	COFFEEN, ILLINOIS	DATE:	7/30/2015
		PANEL IDENTIFICATION:	Lenexa Perm Board
SAMPLE ID:	COF-B002 S4 8.5 - 10.5 feet	BURETTE AREA:	0.312 cm^2
SAMPLE DESCR.:	LEAN CLAY WITH SAND, GRAY WITH YELLOWISH BROWN	BURETTE INCREMENT LENGTH:	1.000 cm
		VOLUME PER INCREMENT:	0.312 cm^3

INITIAL

MOISTURE%		DENSITY			
W & T, g	143.03	WET WT, g	495.1		
D & T, g	126.58	DIA, in	2.861	7.27	cm
T, g	33.92	HT, in	2.182	5.54	cm
		AREA		41.48	cm^2
MOIST-		DENSITY:	134.5	PCF WET	
URE, %	**17.8**	DENSITY:	**114.2**	PCF DRY	

ADDITIONAL DATA

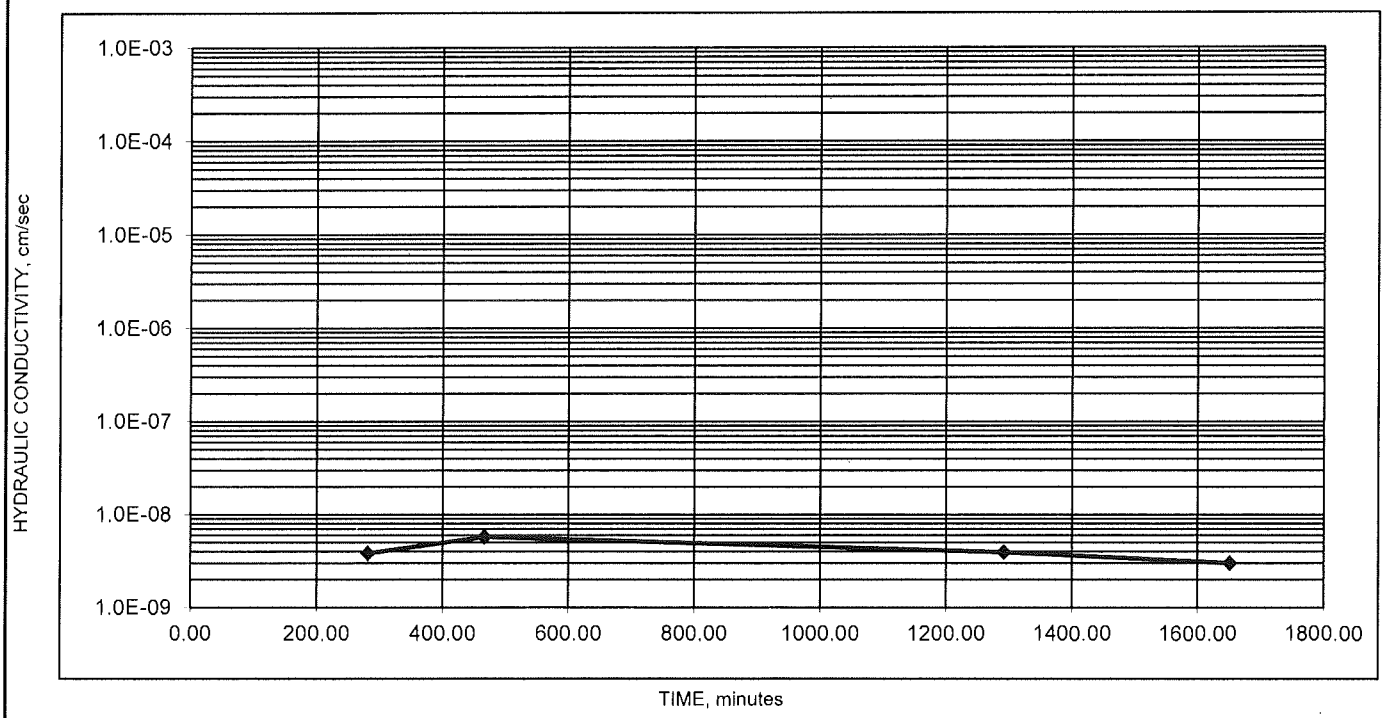
SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	NO
SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
POROSITY, %:	32.3	OPTIMUM, %:	NA
SATURATION, %:	100.7	COMPACTION, %:	NA
VOID RATIO:	0.48	OVER OPTIMUM, %:	NA

SATURATION:	LATERAL PRESS.: 104.0 psi	BACK PRESSURE (=UPPER=LOWER): 100.0 psi		
DURING TEST:	LATERAL PRESS.: 104.0 psi	H2: 100.0 psi	H1: 100.0 psi	
		BIAS PRESSURE (=H1-H2) 0.0 psi		

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm^3	IN FLOW cm^3	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP.: C	TEMP. CORR.:
7.4	67.7	0.00	60.3									
7.5	67.6	281.00	60.1	0.003322	3.83E-09	0.03	0.03	1.00	10.8	7	23.0	0.931
7.6	67.5	467.00	59.9	0.003333	5.76E-09	0.03	0.03	1.00	10.8	39	23.3	0.925
7.9	67.2	1292.00	59.3	0.010067	3.93E-09	0.09	0.09	1.00	10.7	5	23.2	0.927
8.0	67.1	1651.00	59.1	0.003378	3.01E-09	0.03	0.03	1.00	10.7	27	23.6	0.918

HYDRAULIC CONDUCTIVITY (k_{20}) = AVERAGE 4.1E-09 cm/sec

MAXIMUM	1.0E-03 TO 1.0E-04	2	0.75<	30	% < 25 AT
HYDRAULIC	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
GRADIENT	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC	OR
	1.0E-06 TO 1.0E-07	20		GRADIENT	% < 50 AT
	less than 1.0E-07	30		ALLOWED	< 1.0E-8



N:\CM\LAB_DATA\00 Projects in Progress\2015 Projects in Progress\15151122 Lab Data\[15151122 Permeability D5084-C COF-B002-S4-8.5.x

Terracon

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER
ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4

PROJECT NAME:	DYNEGY	PROJECT NUMBER:	15151122
LOCATION:	COFFEEN, ILLINOIS	DATE:	9/9/2015
		PANEL IDENTIFICATION:	Lenexa Perm Board
SAMPLE ID:	COF-B003 S9 30.0 - 30.0 feet	BURETTE AREA:	0.312 cm^2
SAMPLE DESCR.:	SILTY SAND, DARK YELLOWISH BROWN WITH GRAYISH BROWN	BURETTE INCREMENT LENGTH:	1.000 cm
		VOLUME PER INCREMENT:	0.312 cm^3

INITIAL

MOISTURE%		DENSITY			
W & T, g	170.46	WET WT, g	482.1		
D & T, g	155.96	DIA, in	2.858	7.26	cm
T, g	32.90	HT, in	2.022	5.14	cm
		AREA		41.39	cm^2
MOIST-		DENSITY:	141.6	PCF WET	
URE, %	**11.8**	DENSITY:	**126.7**	PCF DRY	

ADDITIONAL DATA

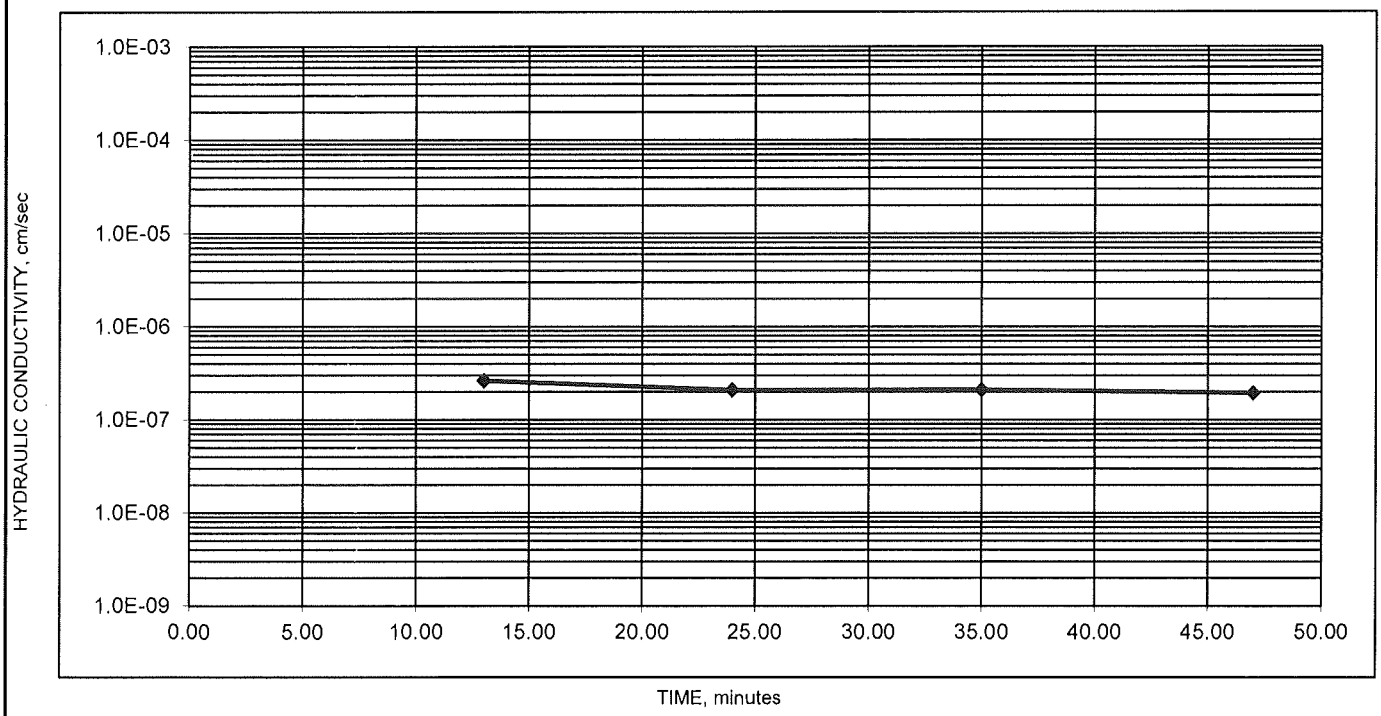
SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	NO
SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
POROSITY, %:	24.9	OPTIMUM, %:	NA
SATURATION, %:	96.2	COMPACTION, %:	NA
VOID RATIO:	0.33	OVER OPTIMUM, %:	NA

SATURATION:	LATERAL PRESS.:	104.0 psi	BACK PRESSURE (=UPPER=LOWER):	100.0 psi		
DURING TEST:	LATERAL PRESS.:	104.0 psi	H2: 100.0 psi	H1: 100.0 psi		
			BIAS PRESSURE (=H1-H2)	0.0 psi		

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm^3	IN FLOW cm^3	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP.: C	TEMP. CORR.:
11.8	64.6	0.00	52.8									
12.1	64.3	13.00	52.2	0.011429	2.63E-07	0.09	0.09	1.00	10.2	20	23.3	0.925
12.3	64.1	24.00	51.8	0.007692	2.09E-07	0.06	0.06	1.00	10.1	5	23.3	0.925
12.5	63.9	35.00	51.4	0.007752	2.10E-07	0.06	0.06	1.00	10.0	4	23.3	0.925
12.7	63.7	47.00	51.0	0.007813	1.94E-07	0.06	0.06	1.00	9.9	11	23.3	0.925

HYDRAULIC CONDUCTIVITY (k_{20}) = AVERAGE 2.2E-07 cm/sec

MAXIMUM	1.0E-03 TO 1.0E-04	2	0.75<	20	% < 25 AT
HYDRAULIC	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
GRADIENT	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC	OR
	1.0E-06 TO 1.0E-07	20		GRADIENT	% < 50 AT
	less than 1.0E-07	30		ALLOWED	< 1.0E-8



N:\CM\LAB_DATA\00 Projects in Progress\2015 Projects in Progress\15151122 Lab Data\[15151122 Permeability D5084-C COF-B003-S9-30.0

Terracon

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER
ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4

PROJECT NAME:	DYNEGY	PROJECT NUMBER:	15151122
LOCATION:	COFFEEN, ILLINOIS	DATE:	9/4/2015
		PANEL IDENTIFICATION:	Lenexa Perm Board
SAMPLE ID:	COF-B004 S7 23.5.0 - 25.5 feet	BURETTE AREA:	0.312 cm^2
SAMPLE DESCR.:	SANDY FAT CLAY, REDDISH BROWN WITH DARK GRAY	BURETTE INCREMENT LENGTH:	1.000 cm
		VOLUME PER INCREMENT:	0.312 cm^3

INITIAL

MOISTURE%		DENSITY			
W & T, g	140.98	WET WT, g	438.0		
D & T, g	122.69	DIA, in	2.857	7.26	cm
T, g	33.88	HT, in	2.010	5.11	cm
		AREA		41.36	cm^2
MOIST-		DENSITY:	129.5	PCF WET	
URE, %	**20.6**	DENSITY:	**107.4**	PCF DRY	

ADDITIONAL DATA

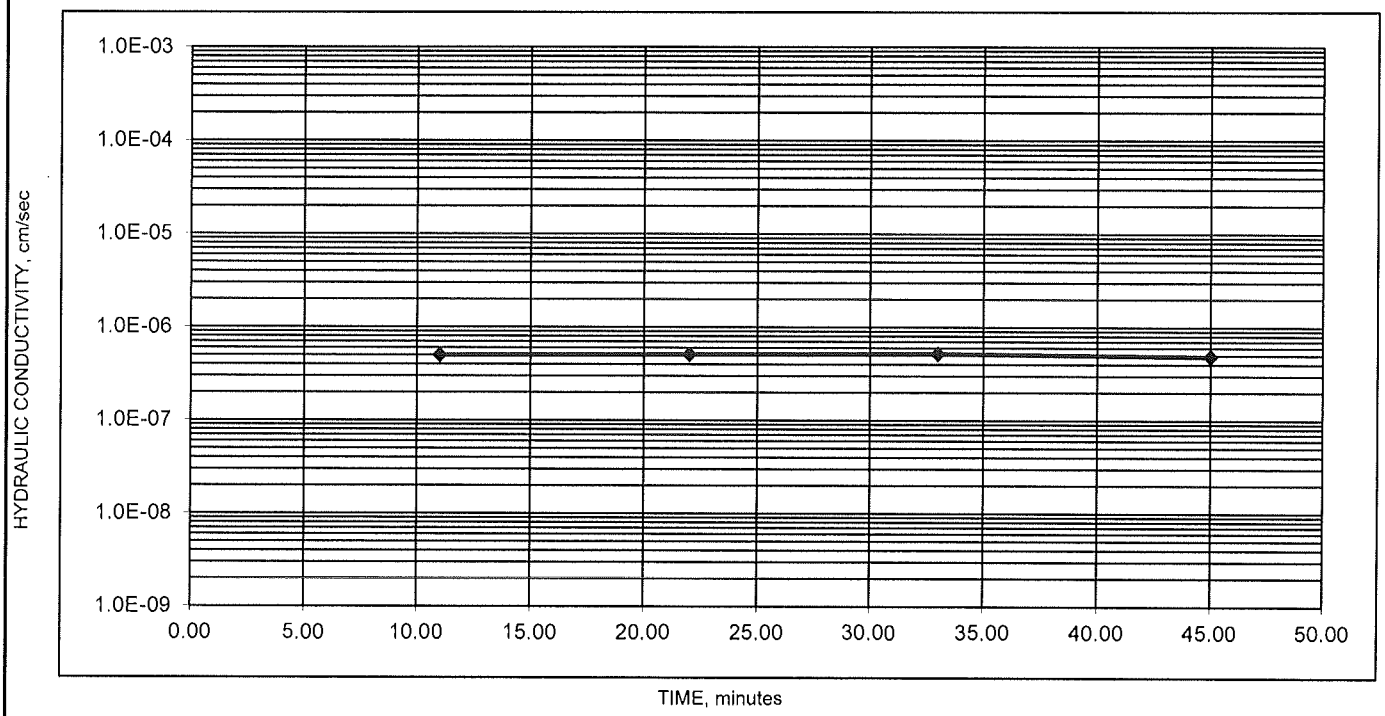
SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	NO
SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
POROSITY, %:	36.3	OPTIMUM, %:	NA
SATURATION, %:	97.6	COMPACTION, %:	NA
VOID RATIO:	0.57	OVER OPTIMUM, %:	NA

SATURATION:	LATERAL PRESS.:	104.0 psi	BACK PRESSURE (=UPPER=LOWER):	100.0 psi	
DURING TEST:	LATERAL PRESS.:	104.0 psi	H2: 100.0 psi	H1: 100.0 psi	
			BIAS PRESSURE (=H1-H2)	0.0 psi	

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm^3	IN FLOW cm^3	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP.: C	TEMP. CORR.:
15.6	59.2	0.00	43.6									
16.0	58.8	11.00	42.8	0.018519	5.00E-07	0.12	0.12	1.00	8.4	1	23.3	0.925
16.4	58.4	22.00	42.0	0.018868	5.10E-07	0.12	0.12	1.00	8.2	1	23.3	0.925
16.8	58.0	33.00	41.2	0.019231	5.19E-07	0.12	0.12	1.00	8.1	3	23.3	0.925
17.2	57.6	45.00	40.4	0.019608	4.85E-07	0.12	0.12	1.00	7.9	4	23.3	0.925

HYDRAULIC CONDUCTIVITY (k_{20}) = AVERAGE **5.0E-07** cm/sec

MAXIMUM	1.0E-03 TO 1.0E-04	2	0.75<	20	% < 25 AT
HYDRAULIC	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
GRADIENT	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC	OR
	1.0E-06 TO 1.0E-07	20		GRADIENT	% < 50 AT
	less than 1.0E-07	30		ALLOWED	< 1.0E-8



N:\CM\LAB_DATA\00 Projects in Progress\2015 Projects in Progress\15151122 Lab Data\[15151122 Permeability D5084-C COF-B004-S7-23.5

Terracon

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER
ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4

PROJECT NAME:	DYNEGY	PROJECT NUMBER:	15151122
LOCATION:	COFFEEN, ILLINOIS	DATE:	9/4/2015
		PANEL IDENTIFICATION:	Lenexa Perm Board
SAMPLE ID:	COF-B005 S2 3.5 - 5.5 feet	BURETTE AREA:	0.312 cm^2
SAMPLE DESCR.:	SANDY LEAN CLAY, BROWN	BURETTE INCREMENT LENGTH:	1.000 cm
		VOLUME PER INCREMENT:	0.312 cm^3

INITIAL

MOISTURE%		DENSITY			
W & T, g	177.91	WET WT, g	409.4		
D & T, g	167.15	DIA, in	2.882	7.32	cm
T, g	33.00	HT, in	1.750	4.45	cm
		AREA		42.09	cm^2
MOIST-		DENSITY:	136.6	PCF WET	
URE, %	**8.0**	DENSITY:	**126.5**	PCF DRY	

ADDITIONAL DATA

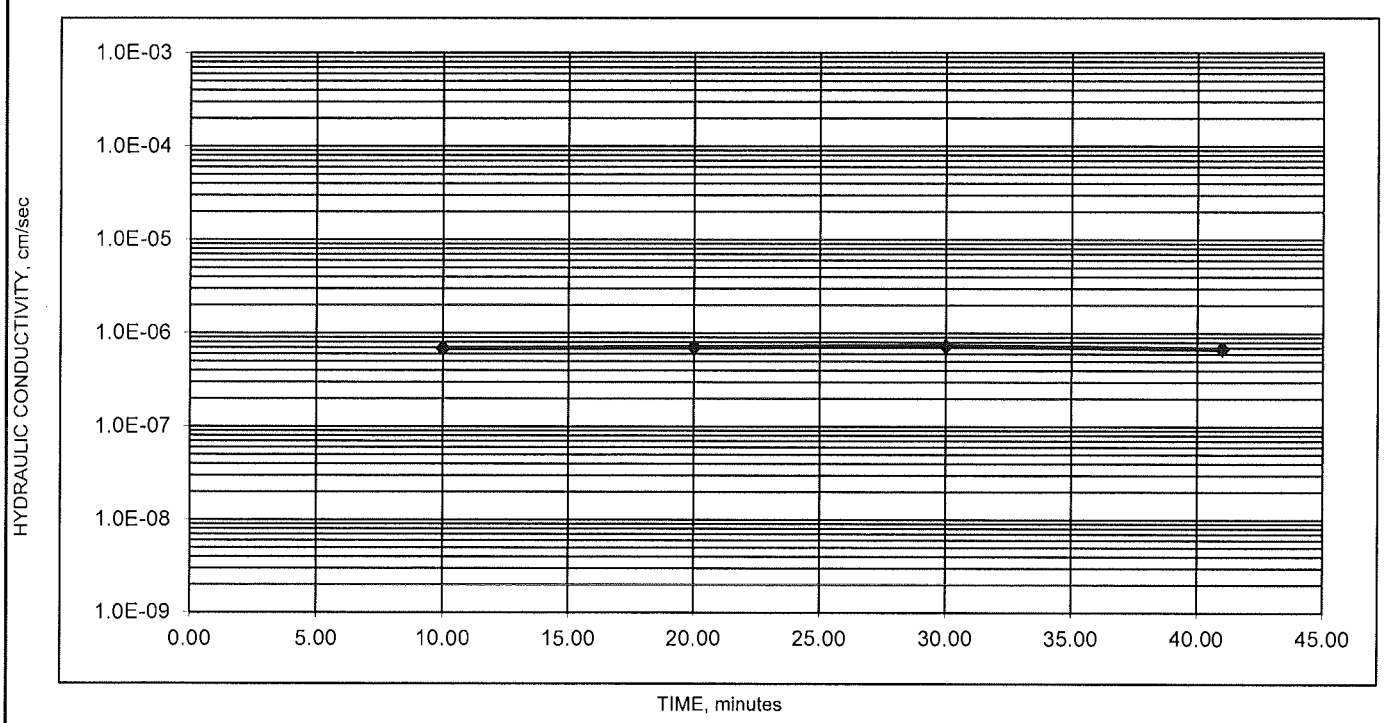
SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	NO
SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
POROSITY, %:	25.0	OPTIMUM, %:	NA
SATURATION, %:	65.1	COMPACTION, %:	NA
VOID RATIO:	0.33	OVER OPTIMUM, %:	NA

SATURATION:	LATERAL PRESS.:	104.0 psi	BACK PRESSURE (=UPPER=LOWER):	100.0 psi		
DURING TEST:	LATERAL PRESS.:	104.0 psi	H2: 100.0 psi	H1: 100.0 psi		
			BIAS PRESSURE (=H1-H2)	0.0 psi		

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm^3	IN FLOW cm^3	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP.: C	TEMP. CORR.:
18.5	55.8	0.00	37.3									
19.0	55.3	10.00	36.3	0.027176	6.88E-07	0.16	0.16	1.00	8.2	2	23.5	0.920
19.5	54.8	20.00	35.3	0.027935	7.07E-07	0.16	0.16	1.00	7.9	1	23.5	0.920
20.0	54.3	30.00	34.3	0.028738	7.29E-07	0.16	0.16	1.00	7.7	4	23.4	0.923
20.5	53.8	41.00	33.3	0.029588	6.82E-07	0.16	0.16	1.00	7.5	3	23.4	0.923

HYDRAULIC CONDUCTIVITY (k_{20}) = AVERAGE **7.0E-07** **cm/sec**

MAXIMUM	1.0E-03 TO 1.0E-04	2	0.75<	20	% < 25 AT
HYDRAULIC	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
GRADIENT	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC	OR
	1.0E-06 TO 1.0E-07	20		GRADIENT	% < 50 AT
	less than 1.0E-07	30		ALLOWED	< 1.0E-8



N:\CM\LAB_DATA\00 Projects in Progress\2015 Projects in Progress\15151122 Lab Data\(15151122 Permeability D5084-C COF-B005-S2-3.5.)

Terracon

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER
ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4

PROJECT NAME:	DYNEGY	PROJECT NUMBER:	15151122
LOCATION:	COFFEEN, ILLINOIS	DATE:	7/30/2015
		PANEL IDENTIFICATION:	Lenexa Perm Board
SAMPLE ID:	COF-B007 S8 22.0 - 24.0 feet	BURETTE AREA:	0.312 cm^2
SAMPLE DESCR.:	SANDY LEAN CLAY, YELLOWISH BROWN	BURETTE INCREMENT LENGTH:	1.000 cm
		VOLUME PER INCREMENT:	0.312 cm^3

INITIAL

MOISTURE%		DENSITY			
W & T, g	142.44	WET WT, g	432.7		
D & T, g	125.52	DIA, in	2.863	7.27	cm
T, g	33.26	HT, in	1.992	5.06	cm
		AREA		41.53	cm^2
MOIST-		DENSITY:	128.5	PCF WET	
URE, %	**18.3**	DENSITY:	**108.6**	PCF DRY	

ADDITIONAL DATA

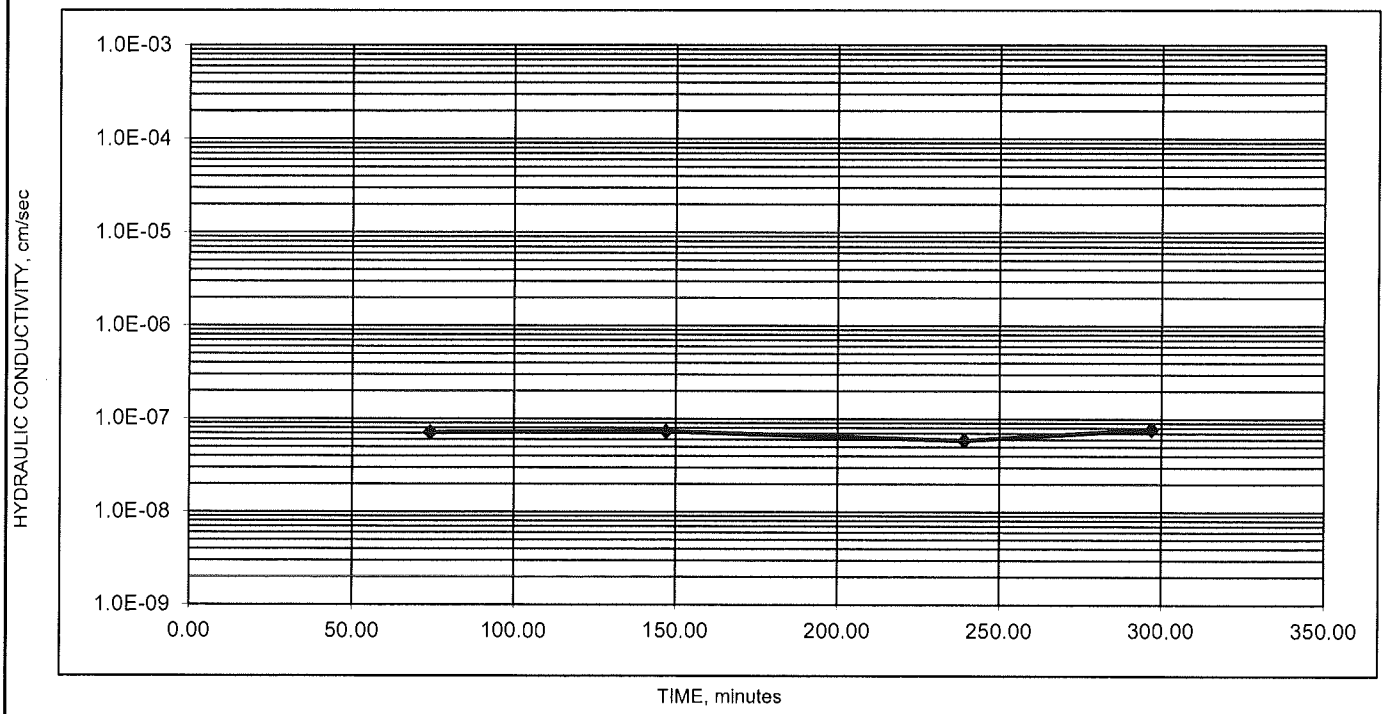
SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	NO
SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
POROSITY, %:	35.6	OPTIMUM, %:	NA
SATURATION, %:	89.7	COMPACTION, %:	NA
VOID RATIO:	0.55	OVER OPTIMUM, %:	NA

SATURATION:	LATERAL PRESS.:	104.0 psi	BACK PRESSURE (=UPPER=LOWER):	100.0 psi	
DURING TEST:	LATERAL PRESS.:	104.0 psi	H2: 100.0 psi	H1: 100.0 psi	
			BIAS PRESSURE (=H1-H2)	0.0 psi	

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm^3	IN FLOW cm^3	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP.: C	TEMP. CORR.:
9.2	64.7	0.00	55.5									
9.7	64.2	74.00	54.5	0.018182	7.14E-08	0.16	0.16	1.00	10.8	2	23.7	0.916
10.2	63.7	147.00	53.5	0.018519	7.32E-08	0.16	0.16	1.00	10.6	4	24.0	0.910
10.7	63.2	239.00	52.5	0.018868	5.88E-08	0.16	0.16	1.00	10.4	16	24.3	0.904
11.1	62.8	297.00	51.7	0.015355	7.76E-08	0.12	0.12	1.00	10.2	11	23.3	0.925

HYDRAULIC CONDUCTIVITY (k_{20}) = **AVERAGE 7.0E-08 cm/sec**

MAXIMUM	1.0E-03 TO 1.0E-04	2	0.75<	30	% < 25 AT
HYDRAULIC	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
GRADIENT	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC	OR
	1.0E-06 TO 1.0E-07	20		GRADIENT	% < 50 AT
	less than 1.0E-07	30		ALLOWED	< 1.0E-8



N:\CM\LAB_DATA\00 Projects in Progress\2015 Projects in Progress\15151122 Lab Data\[15151122 Permeability D5084-C COF-B007-S8-22.0

Terracon

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER
ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4

PROJECT NAME:	DYNEGY	PROJECT NUMBER:	15151122
LOCATION:	COFFEEN, ILLINOIS	DATE:	9/4/2015
		PANEL IDENTIFICATION:	Lenexa Perm Board
SAMPLE ID:	COF-B004 S7 23.5.0 - 25.5 feet	BURETTE AREA:	0.312 cm^2
SAMPLE DESCR.:	SANDY FAT CLAY, REDDISH BROWN WITH DARK GRAY	BURETTE INCREMENT LENGTH:	1.000 cm
		VOLUME PER INCREMENT:	0.312 cm^3

INITIAL

MOISTURE%		DENSITY			
W & T, g	140.98	WET WT, g	438.0		
D & T, g	122.69	DIA, in	2.857	7.26	cm
T, g	33.88	HT, in	2.010	5.11	cm
		AREA		41.36	cm^2
MOIST-		DENSITY:	129.5	PCF WET	
URE, %	**20.6**	DENSITY:	**107.4**	PCF DRY	

ADDITIONAL DATA

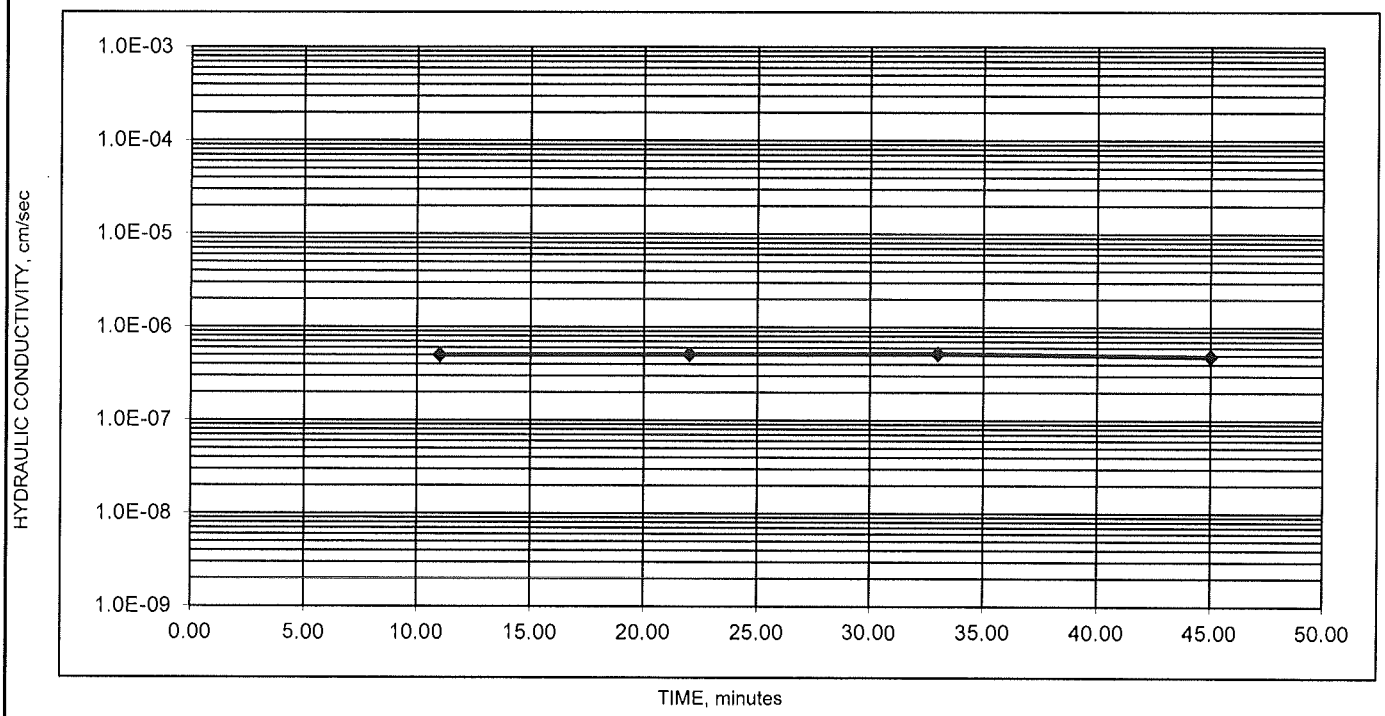
SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	NO
SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
POROSITY, %:	36.3	OPTIMUM, %:	NA
SATURATION, %:	97.6	COMPACTION, %:	NA
VOID RATIO:	0.57	OVER OPTIMUM, %:	NA

SATURATION:	LATERAL PRESS.:	104.0 psi	BACK PRESSURE (=UPPER=LOWER):	100.0 psi	
DURING TEST:	LATERAL PRESS.:	104.0 psi	H2: 100.0 psi	H1: 100.0 psi	
			BIAS PRESSURE (=H1-H2)	0.0 psi	

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm^3	IN FLOW cm^3	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP.: C	TEMP. CORR.:
15.6	59.2	0.00	43.6									
16.0	58.8	11.00	42.8	0.018519	5.00E-07	0.12	0.12	1.00	8.4	1	23.3	0.925
16.4	58.4	22.00	42.0	0.018868	5.10E-07	0.12	0.12	1.00	8.2	1	23.3	0.925
16.8	58.0	33.00	41.2	0.019231	5.19E-07	0.12	0.12	1.00	8.1	3	23.3	0.925
17.2	57.6	45.00	40.4	0.019608	4.85E-07	0.12	0.12	1.00	7.9	4	23.3	0.925

HYDRAULIC CONDUCTIVITY (k_{20}) = AVERAGE **5.0E-07** cm/sec

MAXIMUM	1.0E-03 TO 1.0E-04	2	0.75<	20	% < 25 AT
HYDRAULIC	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
GRADIENT	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC	OR
	1.0E-06 TO 1.0E-07	20		GRADIENT	% < 50 AT
	less than 1.0E-07	30		ALLOWED	< 1.0E-8



N:\CM\LAB_DATA\00 Projects in Progress\2015 Projects in Progress\15151122 Lab Data\[15151122 Permeability D5084-C COF-B004-S7-23.5

Terracon

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER
ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4

PROJECT NAME:	DYNEGY	PROJECT NUMBER:	15151122
LOCATION:	COFFEEN, ILLINOIS	DATE:	9/4/2015
		PANEL IDENTIFICATION:	Lenexa Perm Board
SAMPLE ID:	COF-B005 S2 3.5 - 5.5 feet	BURETTE AREA:	0.312 cm^2
SAMPLE DESCR.:	SANDY LEAN CLAY, BROWN	BURETTE INCREMENT LENGTH:	1.000 cm
		VOLUME PER INCREMENT:	0.312 cm^3

INITIAL

MOISTURE%		DENSITY			
W & T, g	177.91	WET WT, g	409.4		
D & T, g	167.15	DIA, in	2.882	7.32	cm
T, g	33.00	HT, in	1.750	4.45	cm
		AREA		42.09	cm^2
MOIST-		DENSITY:	136.6	PCF WET	
URE, %	**8.0**	DENSITY:	**126.5**	PCF DRY	

ADDITIONAL DATA

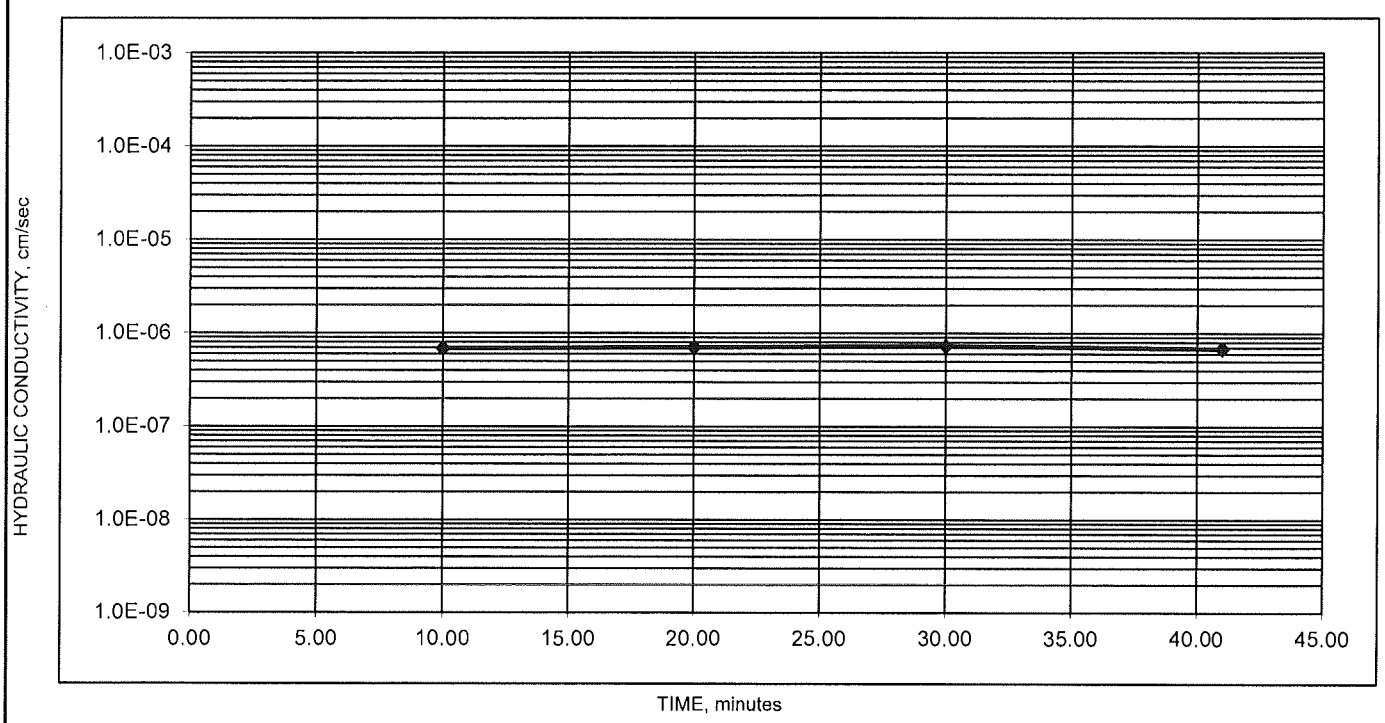
SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	NO
SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
POROSITY, %:	25.0	OPTIMUM, %:	NA
SATURATION, %:	65.1	COMPACTION, %:	NA
VOID RATIO:	0.33	OVER OPTIMUM, %:	NA

SATURATION:	LATERAL PRESS.:	104.0 psi	BACK PRESSURE (=UPPER=LOWER):	100.0 psi		
DURING TEST:	LATERAL PRESS.:	104.0 psi	H2: 100.0 psi	H1: 100.0 psi		
			BIAS PRESSURE (=H1-H2)	0.0 psi		

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm^3	IN FLOW cm^3	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP.: C	TEMP. CORR.:
18.5	55.8	0.00	37.3									
19.0	55.3	10.00	36.3	0.027176	6.88E-07	0.16	0.16	1.00	8.2	2	23.5	0.920
19.5	54.8	20.00	35.3	0.027935	7.07E-07	0.16	0.16	1.00	7.9	1	23.5	0.920
20.0	54.3	30.00	34.3	0.028738	7.29E-07	0.16	0.16	1.00	7.7	4	23.4	0.923
20.5	53.8	41.00	33.3	0.029588	6.82E-07	0.16	0.16	1.00	7.5	3	23.4	0.923

HYDRAULIC CONDUCTIVITY (k_{20}) = AVERAGE **7.0E-07** **cm/sec**

MAXIMUM	1.0E-03 TO 1.0E-04	2	0.75<	20	% < 25 AT
HYDRAULIC	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
GRADIENT	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC	OR
	1.0E-06 TO 1.0E-07	20		GRADIENT	% < 50 AT
	less than 1.0E-07	30		ALLOWED	< 1.0E-8



N:\CM\LAB_DATA\00 Projects in Progress\2015 Projects in Progress\15151122 Lab Data\(15151122 Permeability D5084-C COF-B005-S2-3.5.)

Terracon

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER
ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4

PROJECT NAME:	DYNEGY	PROJECT NUMBER:	15151122
LOCATION:	COFFEEN, ILLINOIS	DATE:	7/30/2015
		PANEL IDENTIFICATION:	Lenexa Perm Board
SAMPLE ID:	COF-B007 S8 22.0 - 24.0 feet	BURETTE AREA:	0.312 cm^2
SAMPLE DESCR.:	SANDY LEAN CLAY, YELLOWISH BROWN	BURETTE INCREMENT LENGTH:	1.000 cm
		VOLUME PER INCREMENT:	0.312 cm^3

INITIAL

MOISTURE%		DENSITY			
W & T, g	142.44	WET WT, g	432.7		
D & T, g	125.52	DIA, in	2.863	7.27	cm
T, g	33.26	HT, in	1.992	5.06	cm
		AREA		41.53	cm^2
MOIST-		DENSITY:	128.5	PCF WET	
URE, %	**18.3**	DENSITY:	**108.6**	PCF DRY	

ADDITIONAL DATA

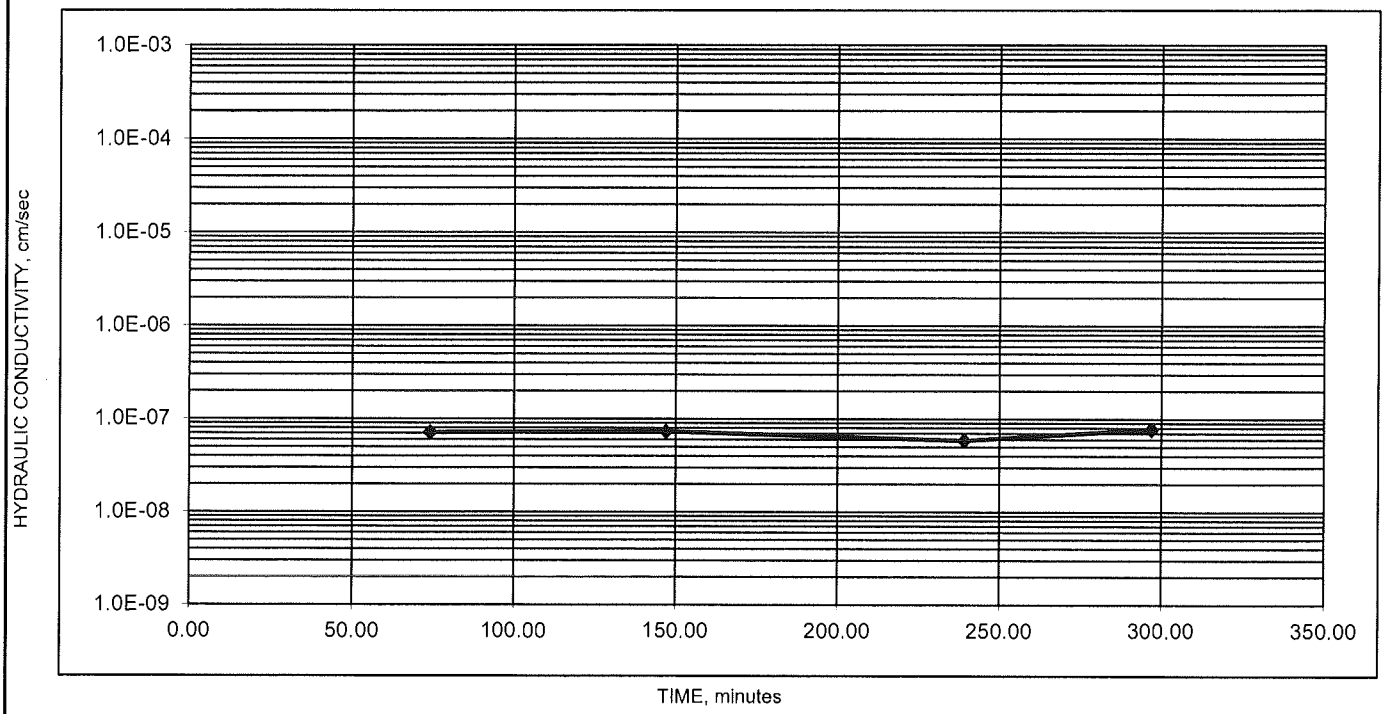
SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	NO
SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
POROSITY, %:	35.6	OPTIMUM, %:	NA
SATURATION, %:	89.7	COMPACTION, %:	NA
VOID RATIO:	0.55	OVER OPTIMUM, %:	NA

SATURATION:	LATERAL PRESS.:	104.0 psi	BACK PRESSURE (=UPPER=LOWER):	100.0 psi	
DURING TEST:	LATERAL PRESS.:	104.0 psi	H2: 100.0 psi	H1: 100.0 psi	
			BIAS PRESSURE (=H1-H2)	0.0 psi	

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm^3	IN FLOW cm^3	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP.: C	TEMP. CORR.:
9.2	64.7	0.00	55.5									
9.7	64.2	74.00	54.5	0.018182	7.14E-08	0.16	0.16	1.00	10.8	2	23.7	0.916
10.2	63.7	147.00	53.5	0.018519	7.32E-08	0.16	0.16	1.00	10.6	4	24.0	0.910
10.7	63.2	239.00	52.5	0.018868	5.88E-08	0.16	0.16	1.00	10.4	16	24.3	0.904
11.1	62.8	297.00	51.7	0.015355	7.76E-08	0.12	0.12	1.00	10.2	11	23.3	0.925

HYDRAULIC CONDUCTIVITY (k_{20}) = **AVERAGE 7.0E-08 cm/sec**

MAXIMUM	1.0E-03 TO 1.0E-04	2	0.75<	30	% < 25 AT
HYDRAULIC	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
GRADIENT	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC	OR
	1.0E-06 TO 1.0E-07	20		GRADIENT	% < 50 AT
	less than 1.0E-07	30		ALLOWED	< 1.0E-8



N:\CM\LAB_DATA\00 Projects in Progress\2015 Projects in Progress\15151122 Lab Data\[15151122 Permeability D5084-C COF-B007-S8-22.0

Terracon

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER
ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4

PROJECT NAME:	DYNEGY	PROJECT NUMBER:	15151122
LOCATION:	COFFEEN, ILLINOIS	DATE:	9/10/2015
		PANEL IDENTIFICATION:	Lenexa Perm Board
SAMPLE ID:	COF-B008 S5 11.0 - 13.0 feet	BURETTE AREA:	0.312 cm^2
SAMPLE DESCR.:	LEAN CLAY WITH SAND, DARK GRAY WITH GRAY TRACE GRAYISH BROWN	BURETTE INCREMENT LENGTH:	1.000 cm
		VOLUME PER INCREMENT:	0.312 cm^3

INITIAL

MOISTURE%		DENSITY			
W & T, g	125.65	WET WT, g	468.5		
D & T, g	112.54	DIA, in	2.865	7.28	cm
T, g	33.72	HT, in	2.105	5.35	cm
		AREA		41.59	cm^2
MOIST-		DENSITY:	131.5	PCF WET	
URE, %	**16.6**	DENSITY:	**112.8**	PCF DRY	

ADDITIONAL DATA

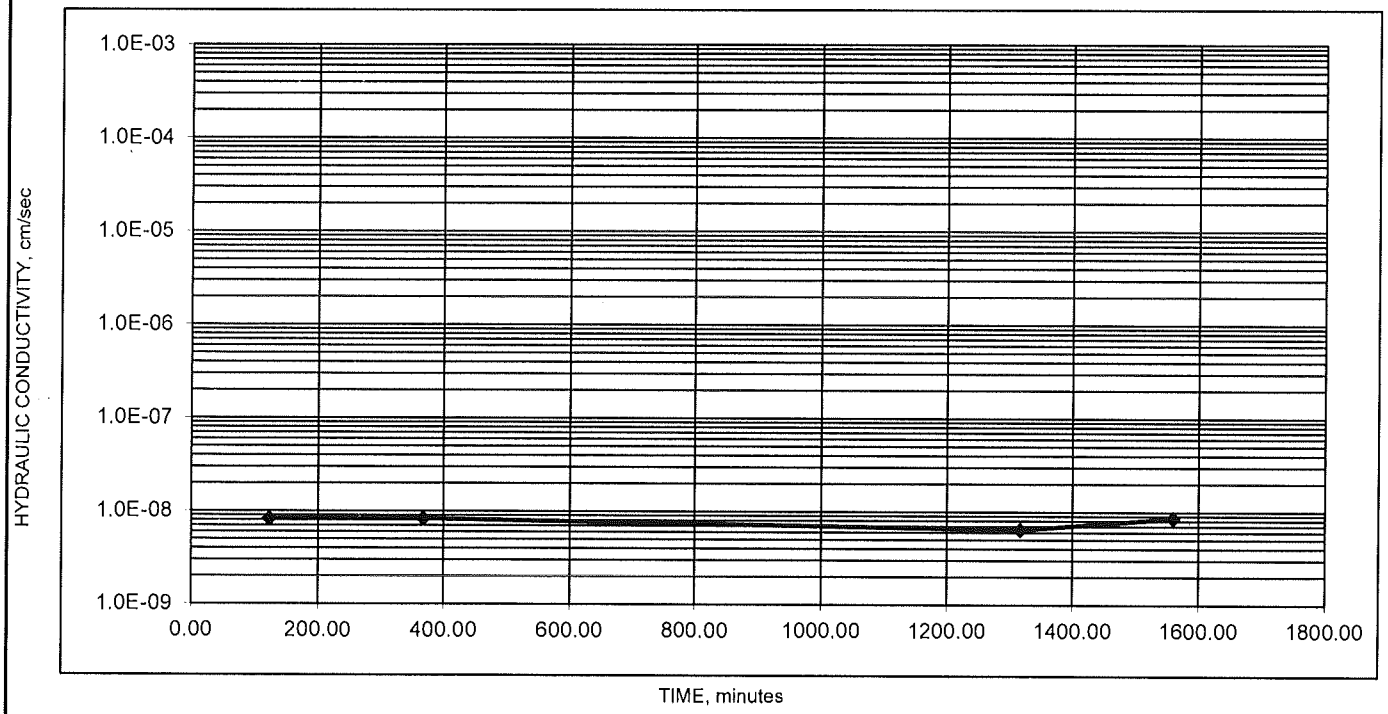
SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	NO
SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
POROSITY, %:	33.1	OPTIMUM, %:	NA
SATURATION, %:	90.8	COMPACTION, %:	NA
VOID RATIO:	0.49	OVER OPTIMUM, %:	NA

SATURATION:	LATERAL PRESS.:	104.0 psi	BACK PRESSURE (=UPPER=LOWER):	100.0 psi		
DURING TEST:	LATERAL PRESS.:	104.0 psi	H2: 100.0 psi	H1: 100.0 psi		
			BIAS PRESSURE (=H1-H2)	0.0 psi		

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm^3	IN FLOW cm^3	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP.: C	TEMP. CORR.:
7.4	69.0	0.00	61.6									
7.5	68.9	123.00	61.4	0.003252	8.22E-09	0.03	0.03	1.00	11.5	4	23.1	0.929
7.7	68.7	368.00	61.0	0.006536	8.29E-09	0.06	0.06	1.00	11.4	5	23.1	0.929
8.3	68.1	1317.00	59.8	0.019868	6.43E-09	0.19	0.19	1.00	11.2	18	23.6	0.918
8.5	67.9	1560.00	59.4	0.006711	8.55E-09	0.06	0.06	1.00	11.1	9	23.3	0.925

HYDRAULIC CONDUCTIVITY (k_{20}) = AVERAGE **7.9E-09** **cm/sec**

MAXIMUM	1.0E-03 TO 1.0E-04	2	0.75<	30	% < 25 AT
HYDRAULIC	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
GRADIENT	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC	OR
	1.0E-06 TO 1.0E-07	20		GRADIENT	% < 50 AT
	less than 1.0E-07	30		ALLOWED	< 1.0E-8



N:\CM\LAB_DATA\00 Projects in Progress\2015 Projects in Progress\15151122 Lab Data\[15151122 Permeability D5084-C COF-B008-S5-11.0

Terracon

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER
ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4

PROJECT NAME:	DYNEGY	PROJECT NUMBER:	15151122
LOCATION:	COFFEEN, ILLINOIS	DATE:	9/4/2015
		PANEL IDENTIFICATION:	Lenexa Perm Board
SAMPLE ID:	COF-B011 S6 13.5 - 15.5 feet	BURETTE AREA:	0.312 cm^2
SAMPLE DESCR.:	SANDY LEAN CLAY, YELLOWISH BROWN WITH GRAYISH BROWN	BURETTE INCREMENT LENGTH:	1.000 cm
		VOLUME PER INCREMENT:	0.312 cm^3

INITIAL

MOISTURE%		DENSITY			
W & T, g	151.23	WET WT, g	464.3		
D & T, g	139.17	DIA, in	2.861	7.27	cm
T, g	33.87	HT, in	1.975	5.02	cm
		AREA		41.48	cm^2
MOIST-		DENSITY:	139.3	PCF WET	
URE, %	**11.5**	DENSITY:	**125.0**	PCF DRY	

ADDITIONAL DATA

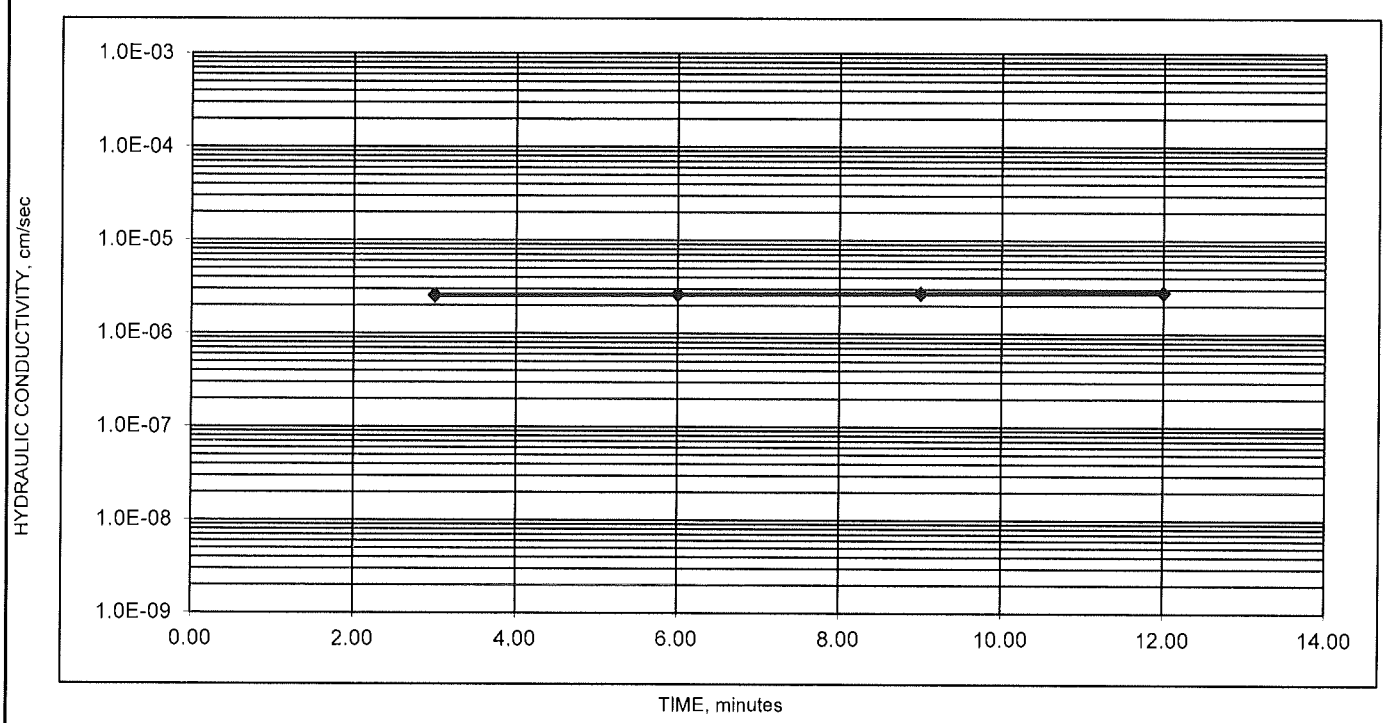
SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	NO
SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
POROSITY, %:	25.8	OPTIMUM, %:	NA
SATURATION, %:	88.7	COMPACTION, %:	NA
VOID RATIO:	0.35	OVER OPTIMUM, %:	NA

SATURATION:	LATERAL PRESS.:	104.0 psi	BACK PRESSURE (=UPPER=LOWER):	100.0 psi	
DURING TEST:	LATERAL PRESS.:	104.0 psi	H2: 100.0 psi	H1: 100.0 psi	
			BIAS PRESSURE (=H1-H2)	0.0 psi	

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm^3	IN FLOW cm^3	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP.: C	TEMP. CORR.:
8.5	23.9	0.00	15.4									
8.7	23.7	3.00	15.0	0.026317	2.55E-06	0.06	0.06	1.00	3.0	4	23.4	0.923
8.9	23.5	6.00	14.6	0.027029	2.62E-06	0.06	0.06	1.00	2.9	1	23.4	0.923
9.1	23.3	9.00	14.2	0.027780	2.69E-06	0.06	0.06	1.00	2.8	1	23.4	0.923
9.3	23.1	12.00	13.8	0.028573	2.77E-06	0.06	0.06	1.00	2.8	4	23.4	0.923

HYDRAULIC CONDUCTIVITY (k_{20}) = AVERAGE 2.7E-06 cm/sec

MAXIMUM	1.0E-03 TO 1.0E-04	2	0.75<	10	% < 25 AT
HYDRAULIC	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
GRADIENT	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC	OR
	1.0E-06 TO 1.0E-07	20		GRADIENT	% < 50 AT
	less than 1.0E-07	30		ALLOWED	< 1.0E-8



N:\CM\LAB_DATA\00 Projects in Progress\2015 Projects in Progress\15151122 Lab Data\15151122 Permeability D5084-C COF-B011-S6-13.5

Terracon

HANSON 2016 LABORATORY RESULTS

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER:	16E0080	TEST DATE:	08/23/2016
CLIENT:	Natural Resource Technology, Inc.	BORING #:	G405D
JOB DESCRIPTION:	Coffeen Ash Pond 2	SAMPLE #:	11-2
SAMPLE DESCRIPTION:	Gray silty CLAY, trace coarse sand and small gravel.	DEPTH (FT):	34.5-35.0

FOR ESTIMATING PORE VOLUME ONLY

SPECIMEN WEIGHT (G)	868.38	
SPECIMEN HEIGHT (IN)	3.748	
DIAMETER (IN)	2.861	
AREA (SQ IN)	6.429	
VOLUME (CU IN)	24.095	
WET DENSITY (PCF)	137.30	
DRY DENSITY (PCF)	119.68	*
WT. DRY SOIL (G)	756.96	*
WT. DRY SOIL (G)	756.22	
VOLUME DRY SOIL (CU IN)	17.431	*
SP.GR. ASSUMED	2.65	
POROSITY (%)	27.66	*
HEIGHT OF HEAD (PSI)	4.00	
HYDRAULIC GRADIANT	29.5	*
PRESSURE HEAD (CM H2O)	281.27	

WATER CONTENT OF TRIMMINGS

	BEFORE TEST	AFTER TEST
TARE + WET SOIL (G)	280.51	924.55
TARE + DRY SOIL (G)	245.00	806.34
TARE (G)	3.75	50.12
WET SOIL(G)	n/a	874.43
WATER (G)	35.51	118.21
DRY SOIL (G)	241.25	756.22
WATER CONTENT (%)	14.72	15.63
INITIAL DEGREE OF SATURATION		102.03
FINAL DEGREE OF SATURATION		107.98
STD. MAX. DEN.(LBS/CU.FT.)		N/A
OPTIMUM MOISTURE (%)		N/A
% COMPACTION		N/A
SAMPLE PREPARATION		Tube
PANEL NUMBER		5

TEST METHOD USED: ASTM D5084

PERMEANT USED: Tap Water

* **Estimates Only**

Remarks:

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER: 16E0080
CLIENT: Dynegy
JOB DESCRIPTION: Coffeen Ash Pond 2

TEST DATE: 8/25/2016
BORING #: G405D
SAMPLE #: 11-2
DEPTH (FT): 34.5-35.0

SPECIMEN HEIGHT (IN) 3.748
DIAMETER (IN) 2.861
AREA (SQ IN) 6.429
INITIAL DEGREE OF SATURATION 102.03

HEIGHT OF HEAD (PSI) 4.00
PRESSURE HEAD (CM H2O) 281.27
PANEL NUMBER 5

* 4 Readings - Ratio of Outflow to Inflow is between .75 to 1.25 or Steady.

** Mean Ratio is Steady if 4 or more incremental readings are ±25% or better of the mean, or within ± 50% or better for $k < 1 \times 10^{-8}$ cm/sec.

START DATE	START TIME	STOP DATE	STOP TIME	INC. INFLOW (CC)	INC. OUTFLOW (CC)	TEMP. (°C)	AVG, INC. FLOW (CC)	OUTFLOW INFLOW (RATIO) *	INC. TIME (MIN)	TOTAL TIME (MIN)	INC. PERM. (CM/SEC)	AVG. PERM. (CM/SEC)	INC. MEAN RATIO **
08/25/2016	9:21:00	08/25/2016	15:24:00	9.50	10.6	23.4	10.0500	1.116	363.	363.	3.47E-07	3.47E-07	1.000
08/25/2016	15:30:00	08/26/2016	8:19:00	9.10	9.0	24.4	9.0500	0.989	1009.	1372.	1.10E-07	2.29E-07	0.481
08/26/2016	8:19:00	08/26/2016	13:58:00	3.00	3.0	23.4	3.0000	1.000	339.	1711.	1.11E-07	1.89E-07	0.586
08/29/2016	8:01:00	08/29/2016	16:19:00	10.90	10.5	23.4	10.7000	0.963	498.	2209.	2.70E-07	2.09E-07	1.287
8/29/2016	16:22:00	08/30/2016	7:51:00	18.80	18.7	24.2	18.7500	0.995	929.	3138.	2.49E-07	1.85E-07	1.345
08/30/2016	7:53:00	08/31/2016	8:19:00	21.70	21.8	24.2	21.7500	1.005	1466.	4604.	1.83E-07	2.03E-07	0.900
08/31/2016	8:22:00	09/01/2016	8:05:00	15.20	15.2	23.8	15.2000	1.000	1423.	6027.	1.33E-07	2.08E-07	0.637
09/01/2016	8:07:00	09/02/2016	8:02:00	13.60	13.7	23.8	13.6500	1.007	1435.	7462.	1.18E-07	1.71E-07	0.693
09/02/2016	8:02:00	09/02/2016	14:59:00	3.10	3.0	23.4	3.0500	0.968	417.	7879.	9.18E-08	1.31E-07	0.698
09/06/2016	8:14:00	09/07/2016	8:19:00	13.20	13.3	24.4	13.2500	1.008	1445.	9324.	1.12E-07	1.14E-07	0.988
09/07/2016	8:24:00	09/08/2016	7:56:00	10.20	10.2	24.4	10.2000	1.000	1412.	10736.	8.86E-08	1.03E-07	0.862
09/08/2016	7:56:00	09/09/2016	8:18:00	6.30	6.4	24.2	6.3500	1.016	1462.	12198.	5.35E-08	8.66E-08	0.618
09/09/2016	8:18:00	09/09/2016	14:26:00	1.40	1.2	23.6	1.3000	0.857	368.	12566.	4.41E-08	7.47E-08	0.591
09/12/2016	8:37:00	09/13/2016	8:10:00	7.40	7.4	23.6	7.4000	1.000	1413.	13979.	6.54E-08	6.29E-08	1.040
09/14/2016	8:52:00	09/15/2016	8:10:00	1.50	2.7	24.2	2.1000	1.800	1398.	15377.	1.85E-08	4.54E-08	0.408
09/15/2016	16:00:00	09/16/2016	8:12:00	0.50	0.8	24.2	0.6500	1.600	972.	16349.	8.24E-09	3.41E-08	0.242

Hanson Professional Services Inc.

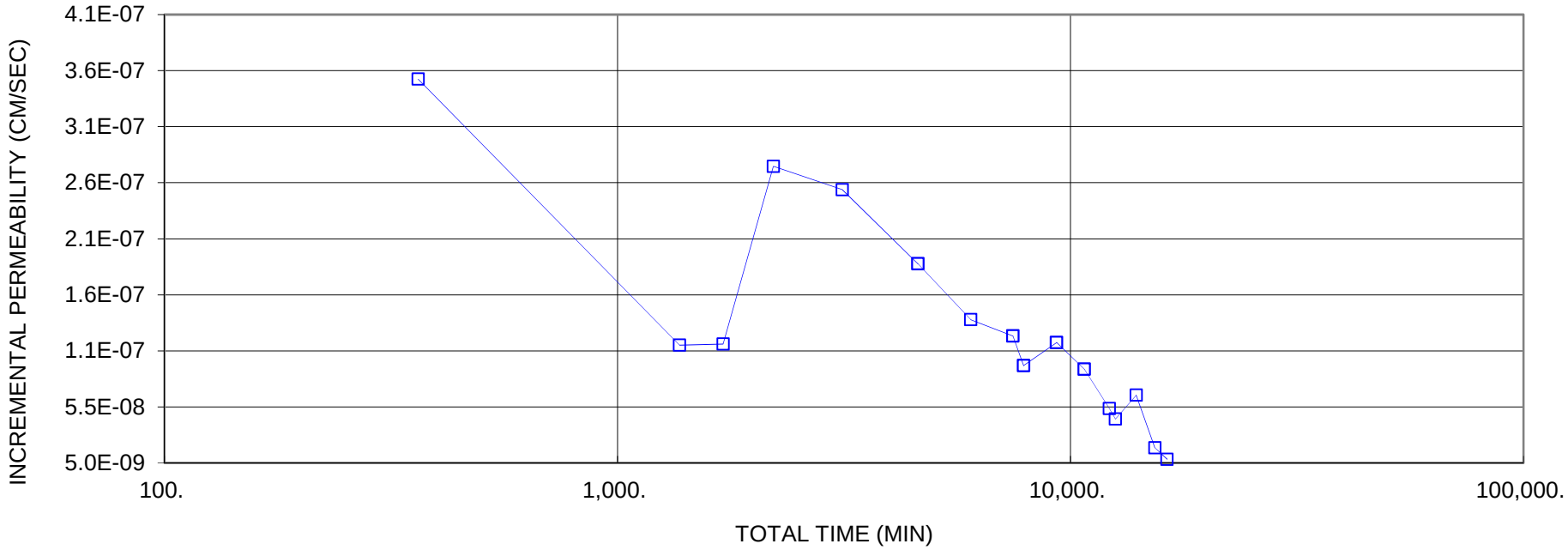
CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	16E0080	TEST DATE:	8/25/2016
CLIENT:	Dynegy	BORING #:	G405D
JOB DESCRIPTION:	Coffeen Ash Pond 2	SAMPLE #:	11-2
		DEPTH (FT):	34.5-35.0

SPECIMEN HEIGHT (IN)	3.748	HEIGHT OF HEAD (PSI)	4.00
DIAMETER (IN)	2.861	PRESSURE HEAD (CM H2O)	281.27
AREA (SQ IN)	6.429	PANEL NUMBER	5
INITIAL DEGREE OF SATURATION	102.03		

* 4 Readings - Ratio of Outflow to Inflow is between .75 to 1.25 or Steady.

** Mean Ratio is Steady if 4 or more incremental readings are ±25% or better of the mean, or within ± 50% or better for $k < 1 \times 10^{-8}$ cm/sec.



Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER:	16E0080	TEST DATE:	08/23/2016
CLIENT:	Natural Resource Technology, Inc.	BORING #:	G406D
JOB DESCRIPTION:	Coffeen Ash Pond 2	SAMPLE #:	23-3
SAMPLE DESCRIPTION:	Gray silty CLAY, trace coarse sand and small gravel	DEPTH (FT):	43.0-43.5

FOR ESTIMATING PORE VOLUME ONLY

SPECIMEN WEIGHT (G)	827.45	
SPECIMEN HEIGHT (IN)	3.592	
DIAMETER (IN)	2.861	
AREA (SQ IN)	6.429	
VOLUME (CU IN)	23.092	
WET DENSITY (PCF)	136.51	
DRY DENSITY (PCF)	117.59	*
WT. DRY SOIL (G)	712.77	*
WT. DRY SOIL (G)	713.55	
VOLUME DRY SOIL (CU IN)	16.414	*
SP.GR. ASSUMED	2.65	
POROSITY (%)	28.92	*
HEIGHT OF HEAD (PSI)	3.80	
HYDRAULIC GRADIANT	29.3	*
PRESSURE HEAD (CM H2O)	267.21	

WATER CONTENT OF TRIMMINGS

	BEFORE TEST	AFTER TEST
TARE + WET SOIL (G)	333.17	880.57
TARE + DRY SOIL (G)	287.51	763.54
TARE (G)	3.71	49.99
WET SOIL(G)	329.46	830.58
WATER (G)	45.66	117.03
DRY SOIL (G)	283.80	713.55
WATER CONTENT (%)	16.09	16.40
INITIAL DEGREE OF SATURATION		104.79
FINAL DEGREE OF SATURATION		107.22
STD. MAX. DEN.(LBS/CU.FT.)		N/A
OPTIMUM MOISTURE (%)		N/A
% COMPACTION		N/A
SAMPLE PREPARATION		Tube
PANEL NUMBER		6

TEST METHOD USED: ASTM D5084

PERMEANT USED: Tap Water

* **Estimates Only**

Remarks:

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER: 16E0080
CLIENT: Natural Resource Technology, Inc.
JOB DESCRIPTION: Coffeen Ash Pond 2

TEST DATE: 8/23/2016
BORING #: G406D
SAMPLE #: 23-3
DEPTH (FT): 43.0-43.5

SPECIMEN HEIGHT (IN) 3.592
DIAMETER (IN) 2.861
AREA (SQ IN) 6.429
INITIAL DEGREE OF SATURATION 104.79

HEIGHT OF HEAD (PSI) 3.80
PRESSURE HEAD (CM H2O) 267.21
PANEL NUMBER 6

* 4 Readings - Ratio of Outflow to Inflow is between .75 to 1.25 or Steady.

** Mean Ratio is Steady if 4 or more incremental readings are ±25% or better of the mean, or within ± 50% or better for $k < 1 \times 10^{-8}$ cm/sec.

START DATE	START TIME	STOP DATE	STOP TIME	INC. INFLOW (CC)	INC. OUTFLOW (CC)	TEMP. (°C)	AVG, INC. FLOW (CC)	OUTFLOW INFLOW (RATIO) *	INC. TIME (MIN)	TOTAL TIME (MIN)	INC. PERM. (CM/SEC)	AVG. PERM. (CM/SEC)	INC. MEAN RATIO **
08/25/2016	9:27:00	08/25/2016	15:25:00	3.20	5.4	23.4	4.3000	1.688	358.	358.	1.52E-07	1.52E-07	1.000
08/25/2016	16:18:00	08/26/2016	8:20:00	3.90	2.1	24.2	3.0000	0.538	962.	1320.	3.88E-08	9.54E-08	0.406
08/26/2016	8:20:00	08/26/2016	14:00:00	1.10	1.0	23.4	1.0500	0.909	340.	1660.	3.91E-08	7.66E-08	0.510
08/29/2016	8:03:00	08/29/2016	16:22:00	1.30	1.0	23.4	1.1500	0.769	499.	2159.	2.92E-08	6.48E-08	0.450
08/29/2016	16:22:00	08/30/2016	7:54:00	1.90	1.9	24.2	1.9000	1.000	932.	3091.	2.53E-08	3.31E-08	0.766
08/30/2016	7:54:00	08/31/2016	8:22:00	2.60	2.7	24.2	2.6500	1.038	1468.	4559.	2.24E-08	2.90E-08	0.773
08/31/2016	8:22:00	09/01/2016	8:08:00	2.40	2.3	23.8	2.3500	0.958	1426.	5985.	2.07E-08	2.44E-08	0.847
09/01/2016	8:08:00	09/02/2016	8:04:00	2.10	2.1	23.8	2.1000	1.000	1436.	7421.	1.83E-08	2.17E-08	0.845
09/02/2016	8:04:00	09/02/2016	15:00:00	0.60	0.5	23.4	0.5500	0.833	416.	7837.	1.67E-08	1.95E-08	0.856
09/06/2016	8:16:00	09/07/2016	8:25:00	2.00	2.0	24.6	2.0000	1.000	1449.	9286.	1.70E-08	1.82E-08	0.935

Hanson Professional Services Inc.

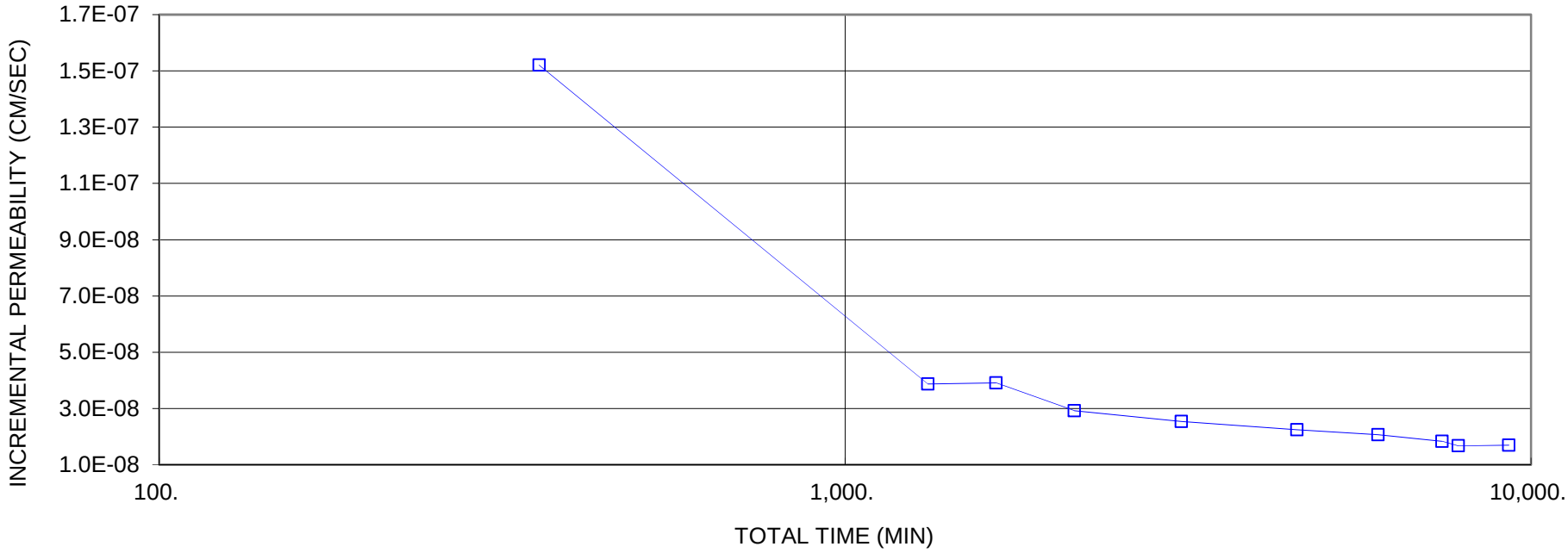
CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	16E0080	TEST DATE:	8/23/2016
CLIENT:	Natural Resource Technology, Inc.	BORING #:	G406D
JOB DESCRIPTION:	Coffeen Ash Pond 2	SAMPLE #:	23-3
		DEPTH (FT):	43.0-43.5

SPECIMEN HEIGHT (IN)	3.592	HEIGHT OF HEAD (PSI)	3.80
DIAMETER (IN)	2.861	PRESSURE HEAD (CM H2O)	267.21
AREA (SQ IN)	6.429	PANEL NUMBER	6
INITIAL DEGREE OF SATURATION	104.79		

* 4 Readings - Ratio of Outflow to Inflow is between .75 to 1.25 or Steady.

** Mean Ratio is Steady if 4 or more incremental readings are ±25% or better of the mean, or within ± 50% or better for $k < 1 \times 10^{-8}$ cm/sec.



Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER:	16E0080	TEST DATE:	08/30/2016
CLIENT:	Natural Resource Technology, Inc.	BORING #:	G406D
JOB DESCRIPTION:	Coffeen Ash Pond 2	SAMPLE #:	13-2
SAMPLE DESCRIPTION:	Brn & gray fine sandy SILT, some clay, coarse sand and small gravel.	DEPTH (FT):	22.75-23.25

FOR ESTIMATING PORE VOLUME ONLY

SPECIMEN WEIGHT (G)	560.94	
SPECIMEN HEIGHT (IN)	3.605	
DIAMETER (IN)	2.301	
AREA (SQ IN)	4.158	
VOLUME (CU IN)	14.991	
WET DENSITY (PCF)	142.55	
DRY DENSITY (PCF)	131.65	*
WT. DRY SOIL (G)	518.06	*
WT. DRY SOIL (G)	518.28	
VOLUME DRY SOIL (CU IN)	11.709	*
SP.GR. ASSUMED	2.70	
POROSITY (%)	21.89	*
HEIGHT OF HEAD (PSI)	3.90	
HYDRAULIC GRADIANT	29.9	*
PRESSURE HEAD (CM H2O)	274.24	

WATER CONTENT OF TRIMMINGS

	BEFORE TEST	AFTER TEST
TARE + WET SOIL (G)	95.16	615.02
TARE + DRY SOIL (G)	88.98	568.27
TARE (G)	14.31	49.99
WET SOIL(G)	80.85	565.03
WATER (G)	6.18	46.75
DRY SOIL (G)	74.67	518.28
WATER CONTENT (%)	8.28	9.02
INITIAL DEGREE OF SATURATION		79.72
FINAL DEGREE OF SATURATION		87.06
STD. MAX. DEN.(LBS/CU.FT.)	N/A	
OPTIMUM MOISTURE (%)	N/A	
% COMPACTION	N/A	
SAMPLE PREPARATION	Tube	
PANEL NUMBER	8	

TEST METHOD USED: ASTM D5084

PERMEANT USED: Tap Water

* **Estimates Only**

Remarks:

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER: 16E0080
CLIENT: Natural Resource Technology, Inc.
JOB DESCRIPTION: Coffeen Ash Pond 2

TEST DATE: 08/30/16
BORING #: G406D
SAMPLE #: 13-2
DEPTH (FT): 22.75-23.25

SPECIMEN HEIGHT (IN) 3.605
DIAMETER (IN) 2.301
AREA (SQ IN) 4.158
INITIAL DEGREE OF SATURATION 79.72

HEIGHT OF HEAD (PSI) 3.90
PRESSURE HEAD (CM H2O) 274.24
PANEL NUMBER 8

* 4 Readings - Ratio of Outflow to Inflow is between .75 to 1.25 or Steady.

** Mean Ratio is Steady if 4 or more incremental readings are ±25% or better of the mean, or within ± 50% or better for $k < 1 \times 10^{-8}$ cm/sec.

START DATE	START TIME	STOP DATE	STOP TIME	INC. INFLOW (CC)	INC. OUTFLOW (CC)	TEMP. (°C)	AVG, INC. FLOW (CC)	OUTFLOW INFLOW (RATIO) *	INC. TIME (MIN)	TOTAL TIME (MIN)	INC. PERM. (CM/SEC)	AVG. PERM. (CM/SEC)	INC. MEAN RATIO **
09/01/2016	9:10:00	09/01/2016	9:33:00	24.00	24.7	24.2	24.3500	1.029	23.	23.	1.99E-05	1.99E-05	1.000
09/01/2016	13:39:00	09/01/2016	16:17:00	66.78	65.2	24.0	65.9900	0.976	158.	181.	7.88E-06	1.39E-05	0.568
09/02/2016	8:21:00	09/02/2016	15:18:00	121.80	116.8	23.8	119.3000	0.959	417.	598.	5.42E-06	1.11E-05	0.490
09/06/2016	8:27:00	09/06/2016	13:56:00	91.14	90.0	25.6	90.5700	0.987	329.	927.	5.01E-06	9.55E-06	0.524
09/06/2016	14:04:00	09/06/2016	16:25:00	32.34	31.6	24.2	31.9700	0.977	141.	1068.	4.26E-06	5.64E-06	0.755
09/07/2016	8:54:00	09/07/2016	16:06:00	81.48	79.6	25.0	80.5400	0.977	432.	1500.	3.44E-06	4.53E-06	0.759
09/08/2016	8:02:00	09/08/2016	16:19:00	61.32	60.0	25.2	60.6600	0.978	497.	1997.	2.24E-06	3.74E-06	0.600
09/09/2016	8:23:00	09/09/2016	14:35:00	41.16	41.4	23.8	41.2800	1.006	372.	2369.	2.10E-06	3.01E-06	0.699
09/14/2016	9:45:00	09/15/2016	8:30:00	17.22	17.2	24.2	17.2100	0.999	1365.	3734.	2.37E-07	2.01E-06	0.118
09/15/2016	8:30:00	09/15/2016	16:10:00	4.62	4.8	25.2	4.7100	1.039	460.	4194.	1.88E-07	1.19E-06	0.158
09/15/2016	16:10:00	09/16/2016	8:29:00	9.66	9.2	24.2	9.4300	0.952	979.	5173.	1.81E-07	6.77E-07	0.267

Hanson Professional Services Inc.

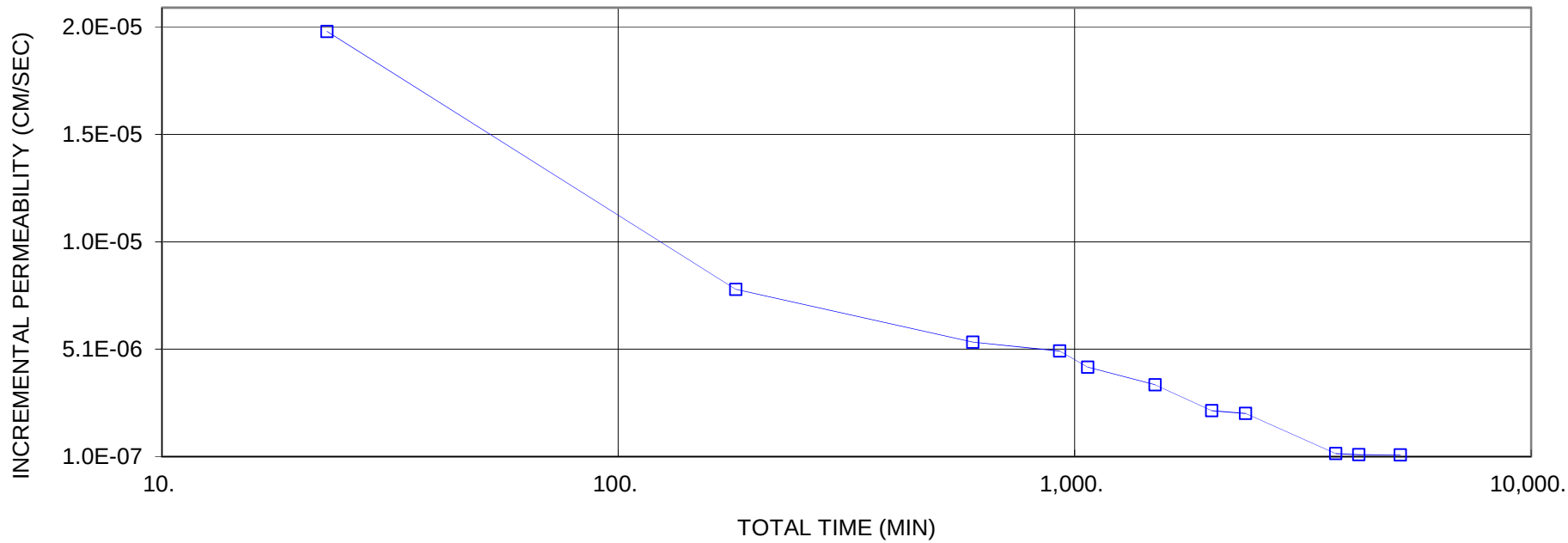
CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	16E0080	TEST DATE:	08/30/16
CLIENT:	Natural Resource Technology, Inc.	BORING #:	G406D
JOB DESCRIPTION:	Coffeen Ash Pond 2	SAMPLE #:	13-2
		DEPTH (FT):	22.75-23.25

SPECIMEN HEIGHT (IN)	3.605	HEIGHT OF HEAD (PSI)	3.90
DIAMETER (IN)	2.301	PRESSURE HEAD (CM H2O)	274.24
AREA (SQ IN)	4.158	PANEL NUMBER	8
INITIAL DEGREE OF SATURATION	79.72		

* 4 Readings - Ratio of Outflow to Inflow is between .75 to 1.25 or Steady.

** Mean Ratio is Steady if 4 or more incremental readings are ±25% or better of the mean, or within ± 50% or better for $k < 1 \times 10^{-8}$ cm/sec.



Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER:	16E0080	TEST DATE:	09/02/2016
CLIENT:	Natural Resource Technology, Inc.	BORING #:	T408
JOB DESCRIPTION:	Coffeen Ash Pond 2	SAMPLE #:	7-2A
SAMPLE DESCRIPTION:	Brn & gray fine sandy SILT, some clay, coarse sand and small gravel.	DEPTH (FT):	23.5-24.0

FOR ESTIMATING PORE VOLUME ONLY

SPECIMEN WEIGHT (G)	474.47	
SPECIMEN HEIGHT (IN)	3.491	
DIAMETER (IN)	2.165	
AREA (SQ IN)	3.681	
VOLUME (CU IN)	12.852	
WET DENSITY (PCF)	140.64	
DRY DENSITY (PCF)	129.82	*
WT. DRY SOIL (G)	437.96	*
WT. DRY SOIL (G)	437.59	
VOLUME DRY SOIL (CU IN)	9.898	*
SP.GR. ASSUMED	2.70	
POROSITY (%)	22.98	*
HEIGHT OF HEAD (PSI)	3.70	
HYDRAULIC GRADIANT	29.3	*
PRESSURE HEAD (CM H2O)	260.17	

WATER CONTENT OF TRIMMINGS

	BEFORE TEST	AFTER TEST
TARE + WET SOIL (G)	99.67	523.99
TARE + DRY SOIL (G)	92.29	487.75
TARE (G)	3.77	50.16
WET SOIL(G)	95.90	473.83
WATER (G)	7.38	36.24
DRY SOIL (G)	88.52	437.59
WATER CONTENT (%)	8.34	8.28
INITIAL DEGREE OF SATURATION		75.45
FINAL DEGREE OF SATURATION		74.68
STD. MAX. DEN.(LBS/CU.FT.)		N/A
OPTIMUM MOISTURE (%)		N/A
% COMPACTION		N/A
SAMPLE PREPARATION		Tube
PANEL NUMBER		7

TEST METHOD USED: ASTM D5084

PERMEANT USED: Tap Water

* **Estimates Only**

Remarks:

Hanson Professional Services Inc.

CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER: 16E0080
CLIENT: Natural Resource Technology, Inc.
JOB DESCRIPTION: Coffeen Ash Pond 2

TEST DATE: 9/2/2016
BORING #: T408
SAMPLE #: 7-2A
DEPTH (FT): 23.5-24.0

SPECIMEN HEIGHT (IN) 3.491
DIAMETER (IN) 2.165
AREA (SQ IN) 3.681
INITIAL DEGREE OF SATURATION 79.72

HEIGHT OF HEAD (PSI) 3.70
PRESSURE HEAD (CM H2O) 260.17
PANEL NUMBER 7

* 4 Readings - Ratio of Outflow to Inflow is between .75 to 1.25 or Steady.

** Mean Ratio is Steady if 4 or more incremental readings are ±25% or better of the mean, or within ± 50% or better for $k < 1 \times 10^{-8}$ cm/sec.

START DATE	START TIME	STOP DATE	STOP TIME	INC. INFLOW (CC)	INC. OUTFLOW (CC)	TEMP. (°C)	AVG, INC. FLOW (CC)	OUTFLOW INFLOW (RATIO) *	INC. TIME (MIN)	TOTAL TIME (MIN)	INC. PERM. (CM/SEC)	AVG. PERM. (CM/SEC)	INC. MEAN RATIO **
09/06/2016	8:53:00	09/06/2016	16:18:00	19.70	20.2	24.2	19.9500	1.025	445.	445.	9.71E-07	9.71E-07	1.000
09/06/2016	16:30:00	09/07/2016	8:33:00	32.76	29.52	26.2	31.1400	0.901	963.	1408.	6.69E-07	8.20E-07	0.816
09/07/2016	16:29:00	09/08/2016	7:58:00	4.29	4.32	25.6	4.3050	1.007	929.	2337.	9.72E-08	5.79E-07	0.168
09/08/2016	8:24:00	09/09/2016	8:20:00	7.80	8.0	25.2	7.9000	1.026	1436.	3773.	1.16E-07	4.64E-07	0.251
09/09/2016	8:20:00	09/09/2016	14:31:00	9.80	10.0	24.2	9.9000	1.020	371.	4144.	5.78E-07	3.65E-07	1.582
09/12/2016	8:38:00	09/13/2016	8:12:00	7.20	7.5	23.8	7.3500	1.042	1414.	5558.	1.14E-07	2.26E-07	0.502
09/14/2016	8:58:00	09/15/2016	8:21:00	10.60	10.8	24.4	10.7000	1.019	1403.	6961.	1.64E-07	2.43E-07	0.676
09/15/2016	8:21:00	09/15/2016	16:05:00	3.60	3.7	25.2	3.6500	1.028	464.	7425.	1.67E-07	2.56E-07	0.651
09/15/2016	16:05:00	09/16/2016	8:16:00	7.40	7.3	24.2	7.3500	0.986	971.	8396.	1.64E-07	1.52E-07	1.078

Hanson Professional Services Inc.

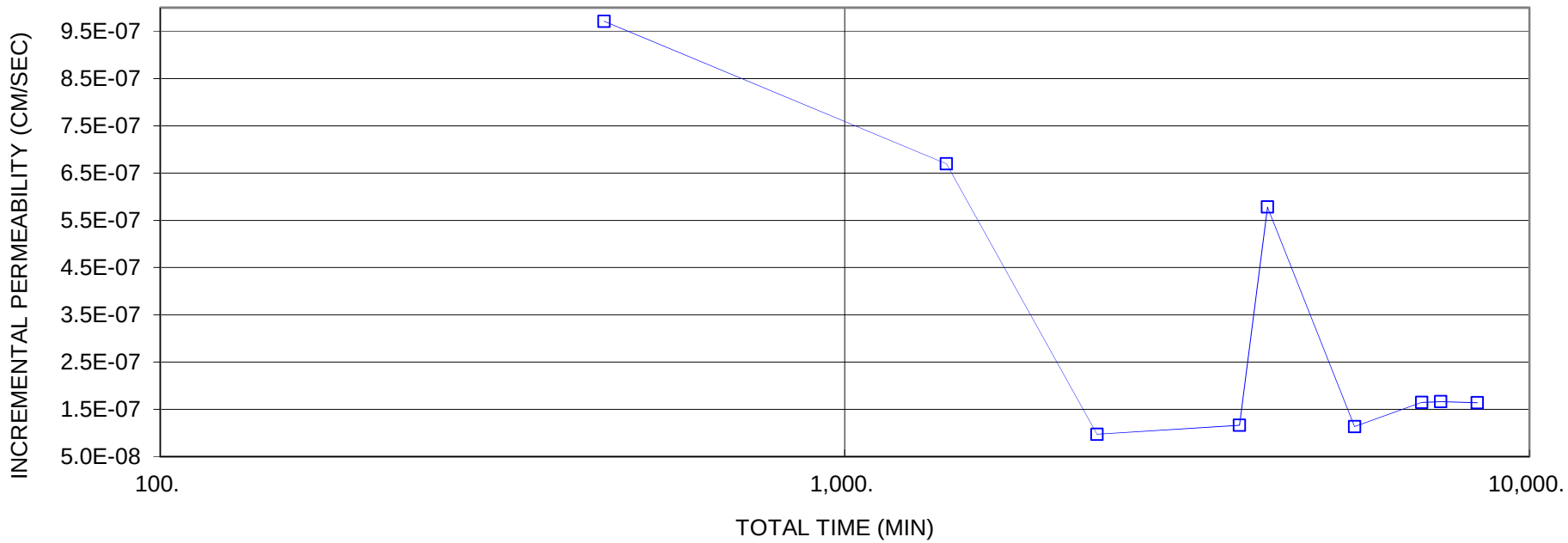
CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER:	16E0080	TEST DATE:	9/2/2016
CLIENT:	Natural Resource Technology, Inc.	BORING #:	T408
JOB DESCRIPTION:	Coffeen Ash Pond 2	SAMPLE #:	7-2A
		DEPTH (FT):	23.5-24.0

SPECIMEN HEIGHT (IN)	3.491	HEIGHT OF HEAD (PSI)	3.70
DIAMETER (IN)	2.165	PRESSURE HEAD (CM H2O)	260.17
AREA (SQ IN)	3.681	PANEL NUMBER	7
INITIAL DEGREE OF SATURATION	79.72		

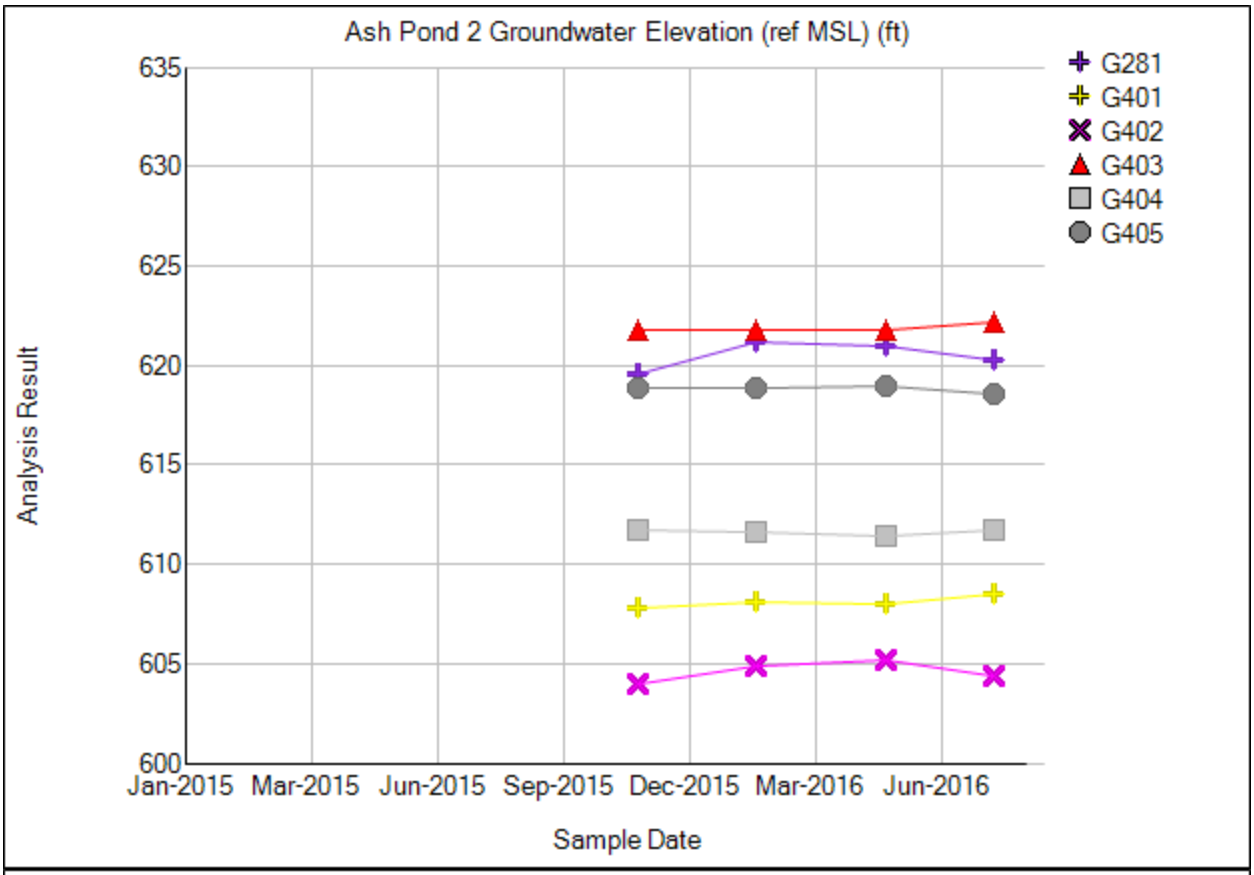
* 4 Readings - Ratio of Outflow to Inflow is between .75 to 1.25 or Steady.

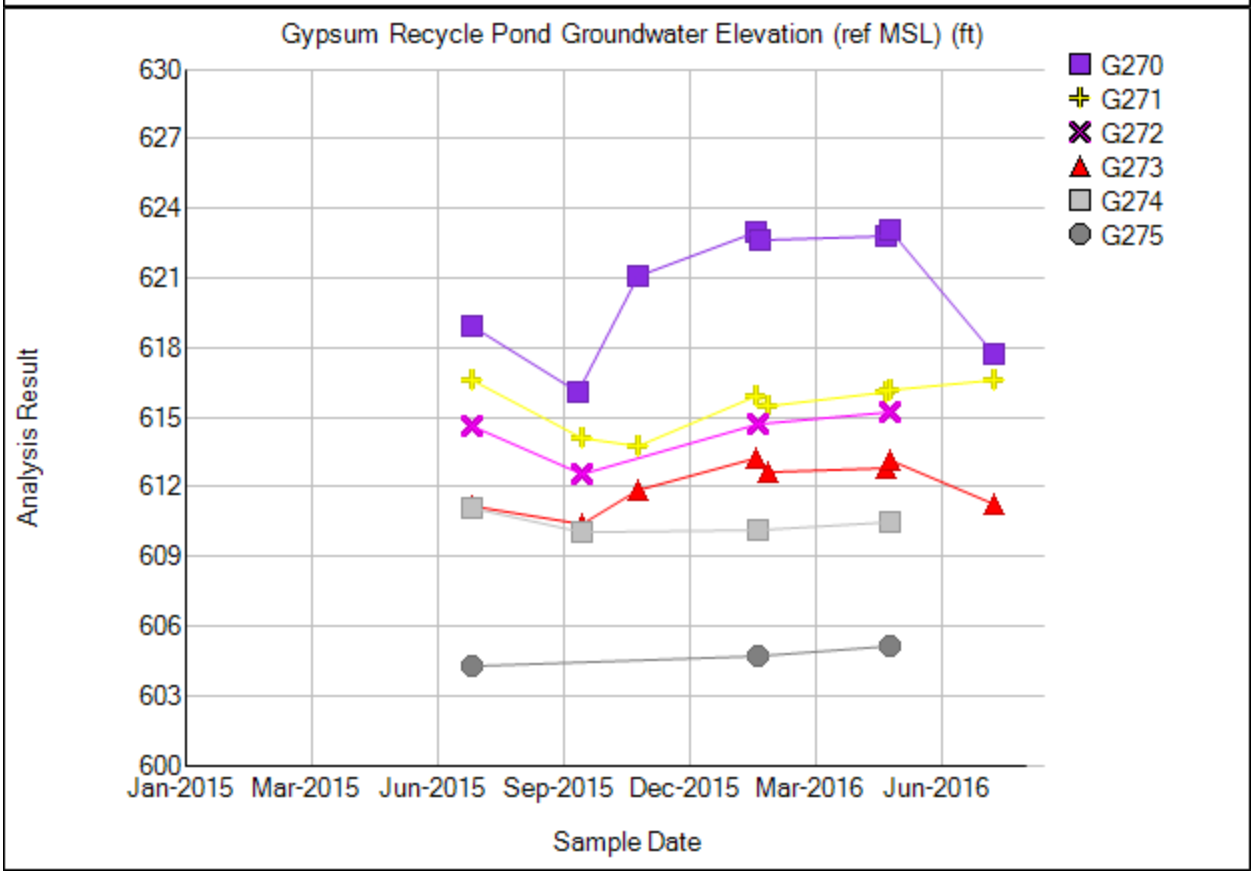
** Mean Ratio is Steady if 4 or more incremental readings are ±25% or better of the mean, or within ± 50% or better for $k < 1 \times 10^{-8}$ cm/sec.

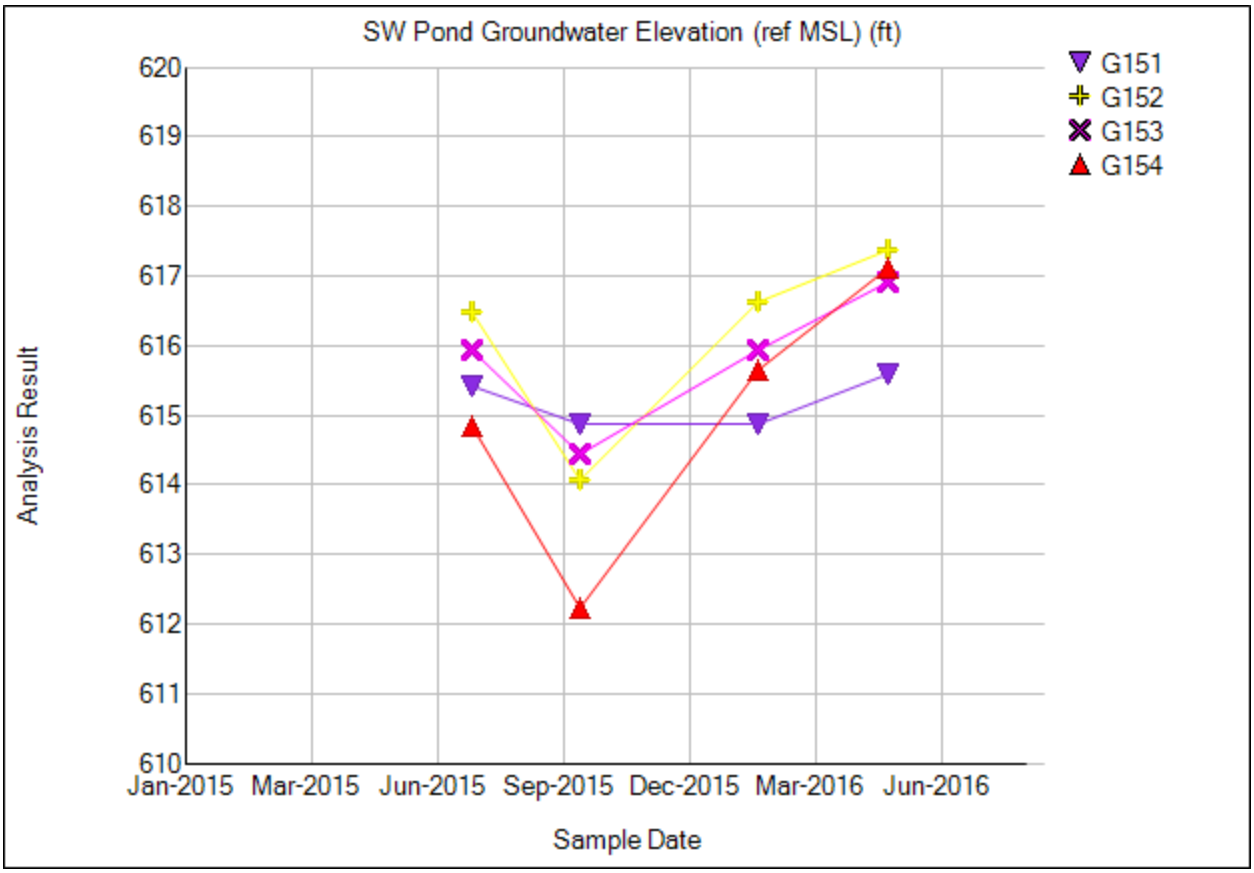


APPENDIX C

MONITORING WELL HYDROGRAPHS
(2015-2016)


Ash Pond 2 Groundwater Elevation (ref MSL) (ft)
Analysis Result
635
630
625
620
615
610
605
600
Jan-2015
Mar-2015
Jun-2015
Sep-2015
Dec-2015
Mar-2016
Jun-2016
Sample Date
G281
G401
G402
G403
G404
G405


Gypsum Recycle Pond Groundwater Elevation (ref MSL) (ft)
Analysis Result
630
627
624
621
618
615
612
609
606
603
600
Jan-2015
Mar-2015
Jun-2015
Sep-2015
Dec-2015
Mar-2016
Jun-2016
Sample Date
G270
G271
G272
G273
G274
G275


SW Pond Groundwater Elevation (ref MSL) (ft)
Analysis Result
620
619
618
617
616
615
614
613
612
611
610
Jan-2015
Mar-2015
Jun-2015
Sep-2015
Dec-2015
Mar-2016
Jun-2016
Sample Date
G151
G152
G153
G154

APPENDIX D

DISCHARGE TO SURFACE WATER CALCULATIONS

NATURAL RESOURCE TECHNOLOGY	CALCULATION SHEET Flux into Unnamed Creek Coffeen Ash Pond No. 2 Closure Plan	By: NRK		Date: 12/19/16	
		Chkd by: EJT/SJC		Date: 12/20/16	
		Revision:	*Date:*	*By:*	*App'd:*
Client: Dynegy					
NRT Project #: 2380					

Problem Statement:

Calculate the flux of impacted groundwater into the unnamed creek located east of Coffeen Ash Pond No. 2.

Assumptions:

1. Groundwater can enter the creek through the eastern berm as shown in conceptualized cross-sections.
2. Coal Combustion Residuals (CCR) are in contact with Hagarstown Formation within Ash Pond No. 2.
3. Groundwater flow is through Hagarstown Formation only:
   a. Hydraulic conductivity of Hagarstown Formation = $1x10^{-4}$ cm/s (Subsection 2.2.3)
   b. Hydraulic conductivity of Ash Pond No. 2 embankment fill = $5.4x10^{-8}$ cm/s (AECOM, 2015; from samples of embankment fill from Ash Pond No. 1)
4. Hagarstown Formation discharges directly to unnamed creek throughout 75% of eastern edge of Ash Pond No. 2 (as shown in conceptualized cross-section C-C') and Hagarstown Formation daylights to bottom of Ash Pond No. 2 with CCR in contact with Hagarstown Formation (absence of clay layer between bottom of Ash Pond No. 2 and Hagarstown Formation).

Calculations:

$$Conc_{(creek)} = \frac{Q_{(GW)}\ x\ Conc_{(GW)} + (Q_{(creek)} - Q_{(GW)})\ x\ Conc_{(creek)}}{Q_{(creek)}}$$

Where:

$$Q_{(GW)} = KIA$$

K = Hydraulic Conductivity of Hagarstown Formation (ft/min)
I = Hydraulic Gradient

$$I = \frac{Ash\ Pond\ No.2\ water\ elev - elev\ of\ top\ of\ Hagarstown\ Formation}{width\ of\ berm}$$

$$I = \frac{631\ ft - 601\ ft}{30\ ft}$$

$$I = 1$$

A = Area of Flow (ft²)

$$A = L\ x\ t$$

L = length (ft)
t = thickness (ft)

$$A = 1{,}400\ ft\ x\ 0.75\ x\ 2\ ft$$

$$A = 2{,}100\ ft^2$$

$$Q_{(GW)} = 5x10^{-4}\ cm/\sec\ x\ 1\ x\ 2{,}100\ ft^2$$

$$Q_{(GW)} = 0.000016\ ft/s\ x\ 2{,}100\ ft^2$$

$$Q_{(GW)} = 0.0336\ cfs\ or\ 0.95\ L/sec$$

$$Q_{(creek)} = \frac{1.49}{n} A\, R^{\frac{2}{3}} \sqrt{S}$$

A = Flow Area (ft²)
n = Manning's Roughness Coefficient (~0.05)
R = Hydraulic Radius (ft)
S = Channel Slope (ft/ft) (see attached Google Earth calculation)

$$Q_{(creek)} = \frac{1.49}{0.05} x 18\, ft^2\ x\ 1.44\, ft^{\frac{2}{3}} \sqrt{0.004}$$

$$Q_{(creek)} = 29.8\ x\ 18\ x\ 1.28\ x\ 0.063$$

$$Q_{(creek)} = 43.3\ cfs\ or\ 1{,}226\ L/sec$$

$$R = \frac{A}{P}$$

A = Flow Area of creek channel (ft²)
P = Wetted Perimeter of creek channel (ft)

$$R = \frac{18\, ft^2}{12.5\, ft}$$

$$R = 1.44\, ft$$

$$P = b + 2\sqrt{(\frac{T-b}{2})^2 + h^2}$$

b = channel width at base of creek (ft) (see assumed geometry at discharge to lake)
T = channel width at top of creek (ft) (see assumed geometry at discharge to lake)
h = depth of creek channel (ft) (see assumed geometry at discharge to lake)

$$P = 8\, ft + 2\sqrt{(\frac{10\, ft - 8\, ft}{2})^2 + 2\, ft^2}$$

$$P = 8\, ft + 2\sqrt{5 ft^2}$$

$$P = 12.5\, ft$$

Boron

$$Conc_{(creek)} = \frac{0.95\ L/sec\ x\ 20\ mg/L + (1{,}226\ L/\text{sec} - 0.95\ L/sec)\ x\ 0.1\ mg/L}{1{,}226\ L/sec}$$

$$Conc_{(creek)} = \frac{19\ mg/sec + 122.5\ \ mg/sec}{1{,}226\ L/sec}$$

$$Conc_{(creek)} = 0.115\ mg/L$$

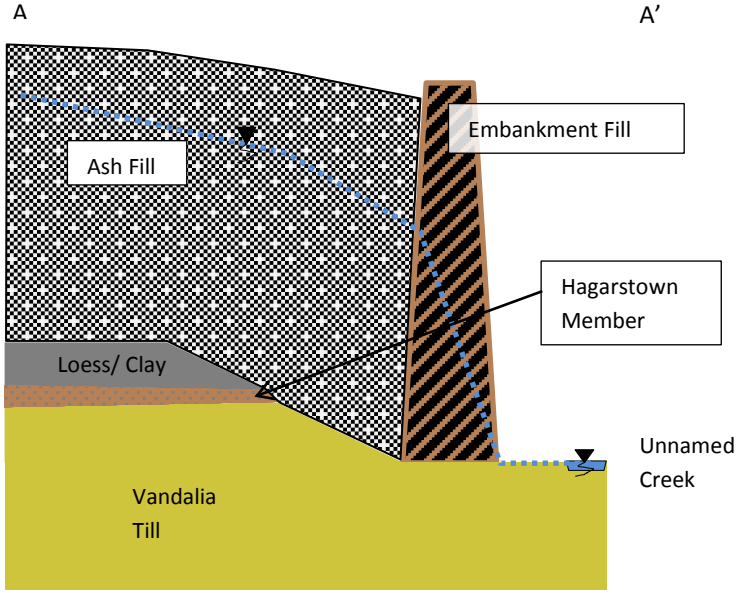
Sulfate

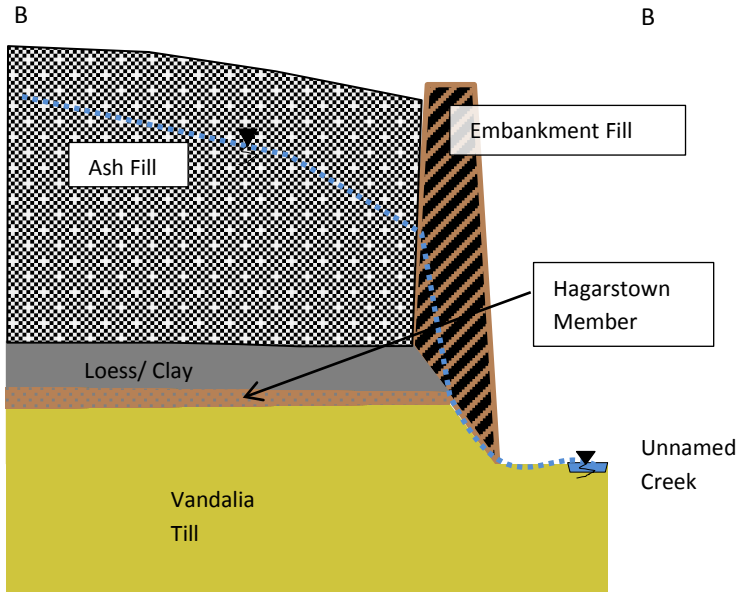
$$Conc_{(creek)} = \frac{0.95\ L/sec\ x\ 2{,}400\ mg/L + (1{,}226\ L/\text{sec} - 0.95\ L/sec)\ x\ 0.05\ mg/L}{1{,}226\ L/sec}$$

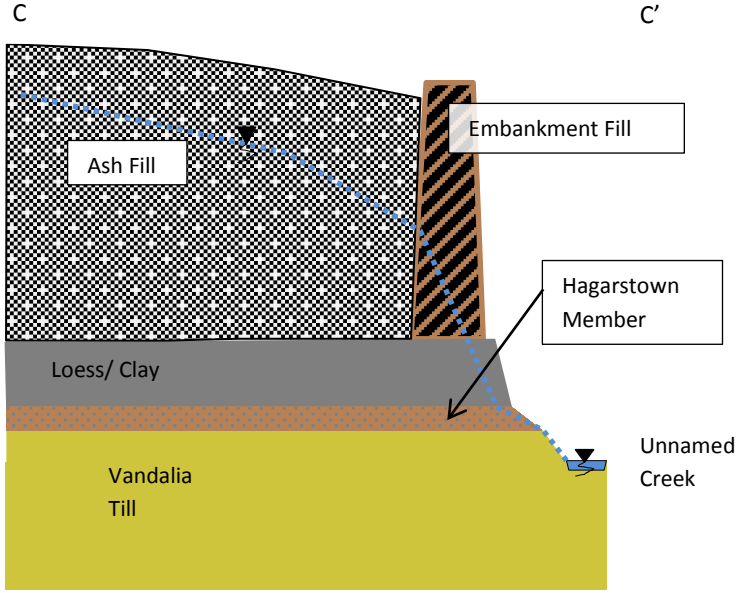
$$Conc_{(creek)} = \frac{2{,}280\ mg/sec + 61.3\ mg/sec}{1{,}226\ L/sec}$$

$$Conc_{(creek)} = 1.9\ mg/L$$

APPENDIX D – ASH POND 2 EAST BERM CONCEPTUAL CROSS SECTIONS







NATURAL RESOURCE TECHNOLOGY	CALCULATION SHEET Flux into Condenser Cooling Water Discharge Flume	By: NRK		Date: 12/19/16	
		Chkd by: EJT/SJC		Date: 12/20/16	
		Revision:	*Date:*	*By:*	*App'd:*
Client: Dynegy	Coffeen Ash Pond No. 2 Closure Plan				
NRT Project #: 2380					

Problem Statement:

Calculate the flux of impacted groundwater into the Condenser Cooling Water Discharge Flume located south of Ash Pond No. 2.

Assumptions:

1. Average flow in flume per NPDES permit is ~500 MGD or approximately 21,900 L/sec.
2. Groundwater can enter the flume through the southern berm as shown in cross-section A-A'.
3. Coal Combustion Residuals (CCR) are in contact with Hagarstown Formation within Ash Pond No. 2.
4. Groundwater flow is through Hagarstown Formation only:
   a. Hydraulic conductivity of Hagarstown Formation = $1x10^{-4}$ cm/s (Subsection 2.2.3, this report)
   b. Hydraulic conductivity of Ash Pond No. 2 embankment fill = $5.4x10^{-8}$ cm/s (AECOM, 2015; from samples of embankment fill from Ash Pond No. 1)
5. Hagarstown Formation discharges directly to flume throughout entire southern edge of Ash Pond No. 2 (as shown in conceptualized cross-section C-C') and Hagarstown Formation daylights to bottom of Ash Pond No. 2 with CCR in contact with Hagarstown Formation (absence of clay layer between bottom of Ash Pond No. 2 and Hagarstown Formation).

Calculations:

$$Conc_{(flume)} = \frac{Q_{(GW)}\, x\, Conc_{(GW)} + \left(Q_{(flume)} - Q_{(GW)}\right) x\, Conc_{(flume)}}{Q_{(flume)}}$$

Where:

$$Q_{(GW)} = KIA$$

K = Hydraulic Conductivity of Hagarstown Formation (ft/min)
I = Hydraulic Gradient

$$I = \frac{Ash\ Pond\ No.2\ water\ elev - elev\ of\ top\ of\ Hagarstown\ Formation}{width\ of\ berm}$$

$$I = \frac{610\ ft - 600\ ft}{20\ ft}$$

$$I = 0.5$$

A = Area of Flow (ft^2)

$$A = L\, x\, t$$

L = length (ft)
t = thickness (ft)

$$A = 1{,}950\ ft\ \ x\, 2\ ft$$

$$A = 3{,}900\ ft^2$$

$$Q_{(GW)} = 5x10^{-4}\ cm/\sec x\ 0.5\ x\ 3{,}900\ ft^2$$
$$Q_{(GW)} = 1.6x10^{-5}\ ft/\sec x\ 1{,}950\ ft^2$$
$$Q_{(GW)} = 0.03\ ft^3/sec\ or\ 0.88\ L/sec$$

$$Q_{(flume)} = 21{,}900\ L/sec$$

$$SO_4\ Conc_{(flume)} = \frac{\frac{0.88L}{sec} x \frac{3{,}000mg}{L} + \left(\frac{21{,}900L}{sec} - \frac{0.88L}{sec}\right) x \frac{50mg}{L}}{21{,}900\ \frac{L}{sec}}$$

$$= \frac{2640\ mg/\sec\ +\ 1.1\ x\ 10^6\ mg/sec}{21{,}900\ \frac{L}{sec}}$$

$$= 50.1\ mg/L$$

Summary and Conclusions:

Since $Q_{(flume)}$ is so much larger in magnitude than $Q_{(GW)}$, the flux of impacted groundwater into the flume is negligible.

APPENDIX E

WATER WELL LOCATIONS AND RECORDS WITHIN 2,500-FOOT RADIUS OF COFFEEN ASH POND 2

E WELL SEARCH

E.1 Well Search Overview

The following sources of information were utilized in order to determine community water source and water well locations:

- Illinois State Geological Survey's Illinois Water Well (ILWATER) Internet Map Service
- Illinois State Water Survey Domestic Well Database
- Illinois EPA web-based Geographic Information System (GIS) files
- Illinois Department of Public Health
- Montgomery County Health Department

E.2 Illinois State Geological Survey (ISGS)

The ISGS website provided an ArcIMS View Map as well as a database query for water wells. ISGS database information including any boring logs and well construction information is provided in this Appendix.

E.3 Illinois State Water Survey (ISWS)

All of the wells found on-line through the ISWS Domestic Well Database were previously identified on the ISGS website. Hard copy records contained within the ISWS database, consisting of public, industrial, and commercial water wells, were not all received as of the date of this report. Since the ISWS database generally contains the same well information as the ISGS and Illinois EPA databases, some ISWS well entries on the Appendix E-1 Table were marked as pending. Should any new information be acquired from the ISWS including additional water wells not previously identified from the on-line sources of well information, it will be provided as an addendum to this report. Table E-2 lists wells located by RAPPS (2009) that were not located and identified in the on-line search for this report.

E.4 Illinois Environmental Protection Agency (IEPA)

The Illinois EPA database website provided ArcIMS Viewer Maps showing information on community, non-community, and public water supply wells as defined on the Illinois EPA website:

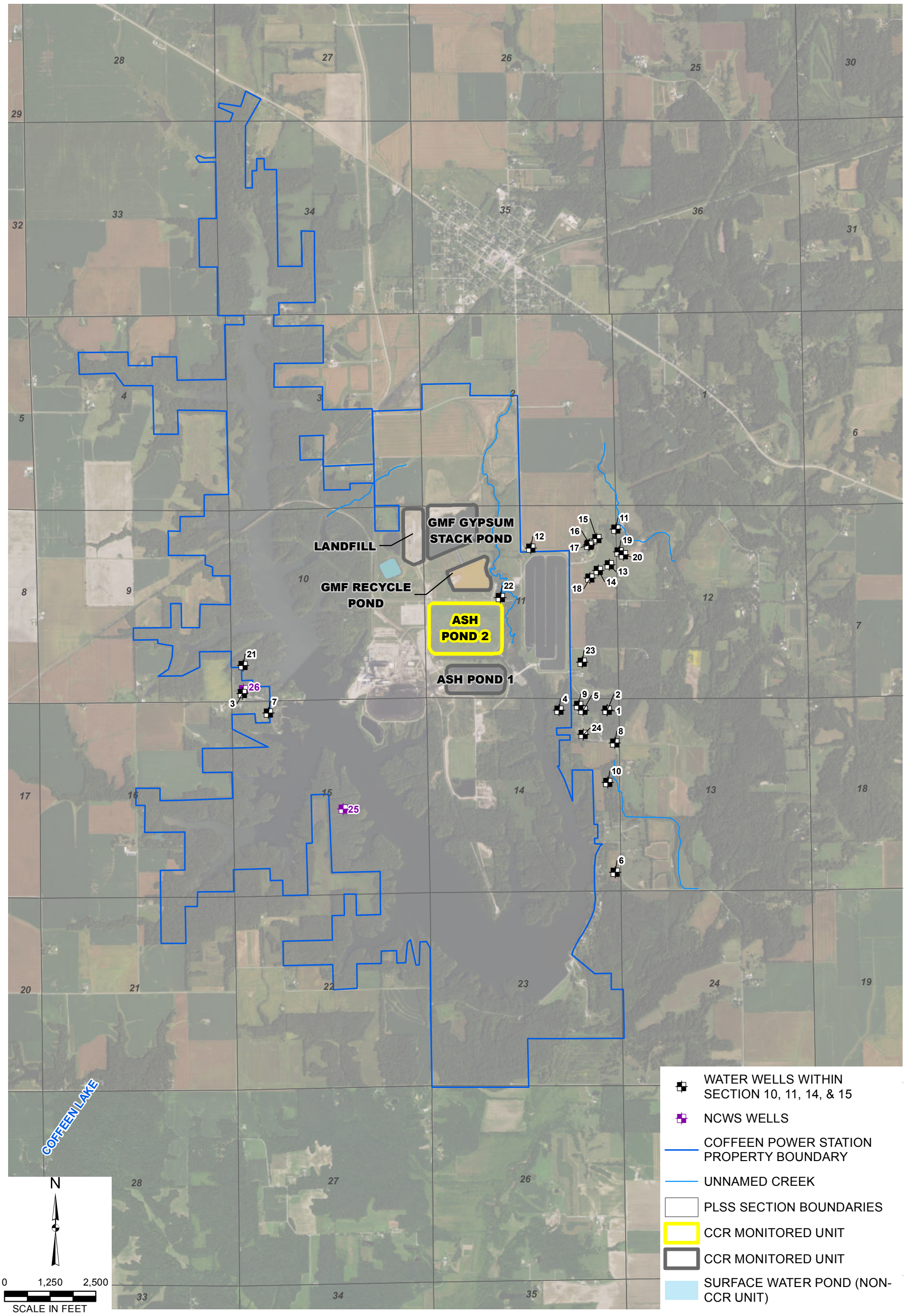
- Community Water Supply: a public water supply that serves or is intended to serve at least 15 service connections used by residents or regularly serves at least 25 residents.

- Non-Community Water Supply: a public water supply that is not a community water supply.
- Public Water Supply: all mains, pipes and structures through which water is obtained and distributed to the public, including wells and well structures, intakes and cribs, pumping stations, treatment plants, reservoirs, storage tanks and appurtenances, collectively or severally, actually used or intended for use for the purpose of furnishing water for drinking or general domestic use and which serve at least 15 service connections or which regularly serve at least 25 persons at least 60 days per year. A public water supply is either a community water supply or a non-community water supply.

Based on the IEPA maps, two non-CWS wells are located within Sections 10 and 15. Both non-CWS were identified in the ISGS records.

E.5 Montgomery County Health Department

Personnel from the Montgomery County Health Department confirmed the two non-CWS well systems were present within the area and noted that they were used at a campground and wildlife preserve. No additional information was provided about the area.



DRAWN BY/DATE:
SDS 11/3/16
REVIEWED BY/DATE:
JJW 11/3/16
APPROVED BY/DATE:
SJC 12/21/16

DRAFT

WATER WELL LOCATION MAP

HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

PROJECT NO: 2285

FIGURE NO: 1

Natural Resource Technology

Y:\Mapping\Projects\23\2380\MXD\HGCR\Figure E-1 Well Search Results-Coffeen_1117.mxd Author: sstolz Date/Time: 12/21/2016, 3:40:12 PM

Table E-1. Well Search Results
Hydrogeologic Characterization Report
Coffeen Energy Center

Map Well #	Source of Well Information				Location Name at Time of Well Completion	Well Depth	County	Location				Year Drilled	Aquifer Type	Formation	Well Use*
	ISGS	ISWS***	IEPA	Other				Township	Range	Section	Subsection				
1	121352182400	115230	21824	--	Hueitt, Bill	32	Montgomery	7N	3W	14	NE,NE,NE	1974	Unconsolidated	clay	FD
2	121352182500	115229	21825	--	Stahl, Louis	32	Montgomery	7N	3W	14	NE,NE,NE	1974	Unconsolidated	clay	FD
3	121350164400	115213	1644	--	Flori, Eugene	20	Montgomery	7N	3W	10	--	1969	Unconsolidated	sand	FD
4	121350171700	115228	1717	--	Marfield, Mac	29	Montgomery	7N	3W	14	NE,NW,NE	1970	Unconsolidated	clay	FD
5	121350172600	115224	1726	--	Schuler, Paul	32	Montgomery	7N	3W	14	NW,NE,NE	1971	Unconsolidated	sand	FD
6	121352300600	115226	23006	--	Jump, James	41	Montgomery	7N	3W	14	SE,SE,SE	1986	Unconsolidated	ground-clay	FD
7	121352310800	***	23108	--	Dept. of Conservation	70	Montgomery	7N	3W	15	NE,NW,NW	1987	Unconsolidated	sandy clay	IC
8	121352221300	115222	22213	--	Gadshlen, Clarence	156	Montgomery	7N	3W	14	SE,NE,NE	1977	Bedrock	sandstone	FD
9	121352221400	115223	22214	--	Warfield, William	151	Montgomery	7N	3W	14	NE	1978	Bedrock	sandstone	FD
10	121352334900	243174	23349	--	Monk, Lawrence & Anita	382	Montgomery	7N	3W	14	SE,SE,NE	1993	Bedrock	gray sandstone	FD
11	121352361400	***	23614	--	White & Brewer	40	Montgomery	7N	3W	11	SE,NE,NE	1993	Unconsolidated	silt	MW
12	121352361500	***	23615	--	White & Brewer	35	Montgomery	7N	3W	11	NE	1993	Unconsolidated	silt	MW
13	121352361600	***	23616	--	White & Brewer	17	Montgomery	7N	3W	11	--	--	Unconsolidated	silt	MW
14	121352361700	***	23617	--	White & Brewer	25	Montgomery	7N	3W	11	--	--	Unconsolidated	silty clay	MW
15	121352361800	***	23618	--	White & Brewer	23	Montgomery	7N	3W	11	--	--	Unconsolidated	silty clay	MW
16	121352361900	***	23619	--	White & Brewer	40	Montgomery	7N	3W	11	--	--	Unconsolidated	sandy silt	MW
17	121352362000	***	23620	--	White & Brewer	20	Montgomery	7N	3W	11	--	--	Unconsolidated	sandy silt	MW
18	121352362100	***	23621	--	White & Brewer	33	Montgomery	7N	3W	11	--	--	Unconsolidated	sandy silt	MW
19	121352362300	***	23623	--	White & Brewer	48	Montgomery	7N	3W	12	--	--	Unconsolidated	clay and silt	MW
20	121352362400	***		--	White & Brewer	24	Montgomery	7N	3W	12	--	--	Unconsolidated	sandy silt	MW
21	121352283100	115350	22831	--	Sidner, Joe	50	Montgomery	7N	3W	10	NW,SW,SW	1984	Unconsolidated	gravel	FD
22	121352283200	115215	22832	--	Wibel, William	39	Montgomery	7N	3W	11	SE,SE,NW (A)	1981	Unconsolidated	sand and gravel	FD
23	121352380200	290232	23802	--	O'Dell, Kenneth & Chong	363	Montgomery	7N	3W	11	NW,SE,SE	1996	Bedrock	light gray sandstone	FD
24	121352380300	290231	23803	--	Childers, Joe	401	Montgomery	7N	3W	14	SW,NE,NE	1996	Bedrock	light gray sandstone	FD
25	121352396900	***	13500061	--	Coffeen Lake Fish & Wildlife	--	Montgomery	7N	3W	15	NW,NW,SE	--	--	--	NCWS
26	121352400700	***	13500012	--	Indian Grove Campground	--	Montgomery	7N	3W	10	SW,SW,SW	--	--	--	NCWS

Sources of Information

IEPA	Illinois Environmental Protection Agency
ISGS	Illinois State Geological Survey
ISWS	Illinois State Water Survey (Private Well Database)
SWA	IEPA Source Water Assessment

*Well Use

FD	Farm and/or Domestic Water Well
IC	Industrial/Commercial Water Well
CWS	Community Water Supply
NCWS	Non-Community Water Supply
MW	Monitoring well

Notes

- -	Not applicable or no information available
***	ISWS data pending
(A)	Well is mislocated in ISGS and/or IEPA databases

Table E-2. Other Water Wells, Precise Location Not Available
Hydrogeologic Characterization Report
Coffeen Energy Center

Well ID	Depth	Location			Well Use	Driller	Date Drilled
		Township	Range	Section			
400397		7N	3W	10	IC		//
43308	16	7N	3W	10	IC	DAN KOHNEN	//
433123	20	7N	3W	10	IC	DAN KOHNEN	//
115214	500	7N	3W	11	IC		7/14/1996
250603	40	7N	3W	11	MO	FOX DRILLING INC.	11/17/1993
250604	35	7N	3W	11	MO	FOX DRILLING INC.	11/18/1993
250605	17	7N	3W	11	MO	FOX DRILLING INC.	1/28/1994
250610	25	7N	3W	11	MO	FOX DRILLING INC.	1/28/1994
250611	23	7N	3W	11	MO	FOX DRILLING INC.	1/28/1994
250612	40	7N	3W	11	MO	FOX DRILLING INC.	1/28/1994
250613	20	7N	3W	11	MO	FOX DRILLING INC.	1/28/1994
250614	33	7N	3W	11	MO	FOX DRILLING INC.	2/3/1994
433009	15	7N	3W	11	MO	DAN KOHNEN	//
290231	401	7N	3W	14	IC	KOHEN CONCR.	8/5/1996
377373	483	7N	3W	14	IC	SCWHARTZ	1997
377374	504	7N	3W	14	IC	SCWHARTZ	1997
377375	490	7N	3W	14	IC	SCWHARTZ	1997
377376	408	7N	3W	14	IC	SCWHARTZ	1997
377377	417	7N	3W	14	IC	SCWHARTZ	1997
377378	418	7N	3W	14	IC	SCWHARTZ	1997
377380	416	7N	3W	14	IC	SCWHARTZ	1997
403162		7N	3W	14			//
403163		7N	3W	14			//
115231	70	7N	3W	15	ST	H LINK	6/23/1987

Well Use

DO	Domestic
MO	not specified
IC	not specified
ST	not specified

These wells are listed in RAPPS (2009). NRT has ordered but not yet received these records from the ISWS Domestic Wells Database.

APPENDIX F

GROUNDWATER QUALITY DATA

Summary of Groundwater Data
Units: mg/L

Well ID	Date	Arsenic, dissolved	Arsenic, total	Barium, total	Beryllium, total	Boron, dissolved	Boron, total	Cadmium, total	Calcium, total L	Chloride, total	Chromium, total	Cobalt, total	Fluoride, total	Lead, dissolved	Lead, total	Lithium, total	Manganese, dissolved	Mercury, total	Molybdenum, total	Selenium, total	Sulfate, total	Thallium, total	Total Dissolved Solids
G151	12/21/2011	< 0.003				0.0218								< 0.002			0.257						510
G151	01/25/2012		0.0012	0.057	< 0.001		0.026	< 0.001		50	< 0.004	< 0.002	0.691		< 0.001			< 0.0002		0.0021	95	< 0.001	510
G151	03/13/2012		< 0.001	0.069	< 0.001		0.019	< 0.001		67	< 0.004	< 0.002	0.486		< 0.001			< 0.0002		0.0029	120	< 0.001	580
G151	05/22/2012	0.0014				0.052								< 0.001			0.11						520
G151	07/23/2012		< 0.001	0.067	< 0.001		0.01	< 0.001		58	< 0.004	< 0.002	0.649		< 0.001			< 0.0002		0.0024	98	< 0.001	570
G151	11/14/2012	< 0.001				0.013								< 0.001			0.091						660
G151	01/30/2013	< 0.001				< 0.02								< 0.001			0.071						560
G151	05/20/2013	< 0.001				< 0.005								< 0.001			0.031						520
G151	07/22/2013	< 0.001				0.02								< 0.001			0.12						500
G151	02/19/2014	< 0.001				0.014								< 0.001			0.072						
G151	05/12/2014	< 0.001				0.024								< 0.001			0.069						
G151	08/11/2014	< 0.001				< 0.01								< 0.001			0.14						560
G151	10/14/2014	< 0.001				< 0.01								< 0.001			0.031						570
G151	01/21/2015	< 0.001				< 0.01								< 0.001			0.066						500
G151	04/08/2015	< 0.002				< 0.02								< 0.002			0.19						600
G151	07/23/2015	< 0.001				0.018								< 0.001			0.093						550
G151	10/06/2015	< 0.001				0.036								< 0.001			0.56						600
G151	02/09/2016	< 0.001				< 0.01								< 0.001			0.18						560
G151	05/11/2016	< 0.002				< 0.02								< 0.002			0.011						500
G152	12/21/2011	< 0.003				0.0513								< 0.002			0.927						494
G152	01/25/2012		0.0023	0.13	< 0.001		0.047	< 0.001		40	0.008	0.0023	0.642		0.0026			< 0.0002		0.003	110	< 0.001	520
G152	03/13/2012		0.0014	0.13	< 0.001		0.036	< 0.001		42	< 0.004	< 0.002	0.422		< 0.001			< 0.0002		0.0043	130	< 0.001	580
G152	05/22/2012	0.0011				0.044								< 0.001			0.21						580
G152	07/23/2012		0.0011	0.1	< 0.001		0.032	< 0.001		45	< 0.004	< 0.002	0.587		< 0.001			< 0.0002		0.0035	120	< 0.001	670
G152	11/14/2012	< 0.001				0.031								< 0.001			0.14						620
G152	01/30/2013	< 0.001				0.033								< 0.001			0.14						600
G152	05/20/2013	< 0.001				0.015								< 0.001			0.034						570
G152	07/22/2013	< 0.001				0.024								0.0014			0.21						580
G152	02/19/2014	< 0.001				0.038								< 0.001			0.12						
G152	05/12/2014	< 0.001				0.044								< 0.001			0.05						
G152	08/11/2014	< 0.001				0.044								< 0.001			0.31						820
G152	10/14/2014	< 0.001				0.034								< 0.001			0.15						620
G152	01/21/2015	< 0.001				0.03								< 0.001			0.15						620
G152	04/08/2015	< 0.002				0.025								< 0.002			0.07						680
G152	07/23/2015	0.0078				0.079								< 0.001			0.89						730
G152	10/06/2015	0.0054				0.11								< 0.001			0.53						1100
G152	02/09/2016	0.0034				0.082								< 0.001			0.47						920
G152	05/11/2016	< 0.002				0.066								< 0.002			0.31						800
G152	11/19/2016			0.073			0.017			51			0.509								130		680
G153	12/21/2011	< 0.003				0.0575								< 0.002			1.02						3150
G153	01/25/2012		0.0056	0.036	< 0.001		0.064	< 0.001		130	0.0053	0.0068	0.369		< 0.001			< 0.0002		0.021	1500	< 0.001	3000
G153	03/13/2012		0.0059	0.022	< 0.001		0.036	< 0.001		160	0.0041	0.0034	0.293		< 0.001			< 0.0002		0.027	1900	< 0.001	3200
G153	05/22/2012	0.004				0.032								< 0.001			0.42						3100
G153	07/23/2012		0.0052	0.016	< 0.001		0.031	< 0.001		130	0.0041	< 0.002	0.341		< 0.001			< 0.0002		0.021	1500	< 0.001	3200
G153	11/14/2012	0.0023				0.04								< 0.001			0.19						3300
G153	01/30/2013	0.0022				0.039								< 0.001			0.28						3000
G153	05/20/2013	< 0.001				0.012								< 0.001			0.13						2800
G153	07/22/2013	0.0027				0.028								< 0.001			0.1						3000
G153	02/19/2014	< 0.001				0.042							0.4	< 0.001			0.16						
G153	05/12/2014	< 0.001				0.021							0.41	< 0.001			0.05						

Well ID	Date	Arsenic, dissolved	Arsenic, total	Barium, total	Beryllium, total	Boron, dissolved	Boron, total	Cadmium, total	Calcium, total L	Chloride, total	Chromium, total	Cobalt, total	Fluoride, total	Lead, dissolved	Lead, total	Lithium, total	Manganese, dissolved	Mercury, total	Molybdenum, total	Selenium, total	Sulfate, total	Thallium, total	Total Dissolved Solids
G153	08/11/2014	< 0.001				0.026								< 0.001			0.24						3500
G153	10/14/2014	0.0016				0.028								< 0.001			0.51						3400
G153	01/21/2015	< 0.001				0.02								< 0.001			0.2						3600
G153	04/08/2015	0.003				0.02								< 0.002			0.024						3700
G153	07/23/2015	< 0.001				0.015								< 0.001			0.16						3900
G153	10/06/2015	< 0.001				0.03								< 0.001			0.19						3700
G153	02/09/2016	< 0.001				0.016								< 0.001			0.046						3800
G153	05/11/2016	0.0035				0.026								< 0.002			0.037						3800
G153	11/19/2016			0.017			0.013			230			0.491								2500		4000
G154	12/21/2011	< 0.003				0.0452								< 0.002			0.462						624
G154	01/25/2012		0.0014	0.037	< 0.001		0.031	< 0.001		10	< 0.004	< 0.002	1.01		< 0.001			< 0.0002		0.0042	93	< 0.001	410
G154	03/13/2012		< 0.001	0.032	< 0.001		0.021	< 0.001		4.6	< 0.004	< 0.002	0.971		< 0.001			< 0.0002		0.0062	93	< 0.001	440
G154	05/22/2012	0.0017				0.025								< 0.001			0.038						470
G154	07/23/2012		< 0.001	0.033	< 0.001		0.038	< 0.001		4.9	< 0.004	< 0.002	1.06		< 0.001			< 0.0002		0.0058	110	< 0.001	490
G154	11/14/2012	< 0.001				0.04								< 0.001			0.043						500
G154	01/30/2013	< 0.001				0.043								< 0.001			0.032						440
G154	05/20/2013	< 0.001				0.021								< 0.001			0.046						460
G154	07/22/2013	< 0.001				0.035								< 0.001			0.045						500
G154	02/19/2014	< 0.001				0.043								< 0.001			0.018						
G154	05/12/2014	< 0.001				0.044								< 0.001			0.014						
G154	08/11/2014	< 0.001				0.035								< 0.001			0.081						480
G154	10/14/2014	< 0.001				0.035								< 0.001			0.0077						440
G154	01/21/2015	< 0.001				0.037								< 0.001			0.0092						450
G154	04/08/2015	< 0.002				0.023								< 0.002			0.003						440
G154	07/23/2015	< 0.001				0.024								< 0.001			0.14						430
G154	10/06/2015	< 0.001				0.044								< 0.001			0.01						500
G154	02/09/2016	< 0.001				0.041								< 0.001			0.041						560
G154	05/11/2016	< 0.002				0.037								< 0.002			0.0085						460
G270	03/11/2008	< 0.005	< 0.005	0.076	< 0.005	< 0.25	< 0.25	< 0.0025	77	9.5	< 0.025	< 0.005	0.36	< 0.0025	< 0.0025		0.19	< 0.0002		< 0.012	2.3	< 0.002	440
G270	04/21/2008	< 0.001	0.0016	0.076	< 0.001	0.078	0.071	< 0.0005	72	11	< 0.005	0.0017	0.36	< 0.0005	0.0021		0.21	< 0.0002		< 0.0025	2.4	< 0.002	420
G270	06/11/2008	< 0.001	0.0012	0.072	< 0.001	< 0.05	< 0.05	< 0.0005	70	< 10	< 0.005	0.001	0.33	< 0.0005	0.0021		0.21	< 0.0002		< 0.0025	2.8	< 0.002	430
G270	08/13/2008	< 0.001	< 0.001	0.069	< 0.001	0.052	< 0.05	< 0.0005	67	8.9	< 0.005	< 0.001	0.38	< 0.0005	< 0.0005		0.26	< 0.0002		< 0.0025	4.2	< 0.002	440
G270	10/14/2008	< 0.001	< 0.001	0.068	< 0.001	0.073	< 0.05	< 0.0005	71	9.4	< 0.005	< 0.001	0.35	< 0.0005	< 0.0005		0.22	< 0.0002		< 0.0025	4.7	< 0.002	440
G270	12/02/2008	< 0.001	< 0.001	0.068	< 0.001	0.052	0.051	< 0.0005	69	9.6	< 0.005	< 0.001	0.31	< 0.0005	0.00054		0.22	< 0.0002		< 0.0025	4.4	< 0.002	400
G270	09/21/2009	< 0.001	0.001			0.054	0.058	< 0.0005	77	9.4				< 0.0005	0.0011		0.26				3.2		430
G270	11/10/2009	< 0.001	0.001			0.054	0.057	< 0.0005	75	11				< 0.0005	0.0011		0.23				5.1		450
G270	01/28/2010	< 0.001	< 0.001			0.053	0.052	< 0.0005	74	19				< 0.0005	0.0031		0.14				8.2		430
G270	02/11/2010			0.056	< 0.001						< 0.005	< 0.001	0.3					< 0.0002		< 0.0025		< 0.002	460
G270	06/09/2010	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	61	39				< 0.001	< 0.001		0.058				6.8		470
G270	07/27/2010	< 0.001	< 0.001			0.011	< 0.01	< 0.001	58	40				< 0.001	< 0.001		0.062				9.1		480
G270	11/15/2010	< 0.001	0.0011			0.013	0.016	< 0.001	60	40				< 0.001	0.0021		0.069				7.6		490
G270	01/28/2011	< 0.001	< 0.001	0.064	< 0.001	< 0.01	0.012	< 0.001	80	45	< 0.004	0.002	0.36	< 0.001	0.0041		0.032	< 0.0002		0.002	9.6	< 0.001	470
G270	05/03/2011	< 0.001	< 0.001			0.01	< 0.01	< 0.001	57	57				< 0.001	< 0.001		0.023				13		430
G270	07/27/2011	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	59	57				< 0.001	< 0.001		0.046				18		480
G270	11/11/2011	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	61	64				< 0.001	< 0.001		0.05				23		440
G270	01/26/2012	< 0.001	< 0.001	0.049	< 0.001	< 0.01	< 0.01	< 0.001	64	73	< 0.004	< 0.002	0.363	< 0.001	< 0.001		0.0094	< 0.0002		0.0046	40	< 0.001	420
G270	05/22/2012	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	67	83				< 0.001	< 0.001		0.04				57		460
G270	07/24/2012	< 0.001	< 0.001			0.092	0.018	< 0.001	73	66				< 0.001	< 0.001		0.045				43		480
G270	11/14/2012	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	65	76				< 0.001	< 0.001		0.017				77		500
G270	01/30/2013	< 0.001	0.001	0.062	< 0.001	< 0.01	< 0.01	< 0.001	65	91	< 0.004	< 0.002	0.372	< 0.001	< 0.001		0.011	< 0.0002		0.0078	96	< 0.001	540
G270	05/20/2013	0.0011	< 0.001			< 0.01	< 0.01	< 0.001	72	85				< 0.001	< 0.001		0.025				120		480
G270	07/22/2013	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	70	79				< 0.001	< 0.001		0.045				120		500
G270	10/14/2013	< 0.001	< 0.001			0.014	< 0.01	< 0.001	81	72				< 0.001	< 0.001		0.041				85		520

Well ID	Date	Arsenic, dissolved	Arsenic, total	Barium, total	Beryllium, total	Boron, dissolved	Boron, total	Cadmium, total	Calcium, total L	Chloride, total	Chromium, total	Cobalt, total	Fluoride, total	Lead, dissolved	Lead, total	Lithium, total	Manganese, dissolved	Mercury, total	Molybdenum, total	Selenium, total	Sulfate, total	Thallium, total	Total Dissolved Solids
G270	02/19/2014	< 0.001	< 0.001	0.041	< 0.001	< 0.01	< 0.01	< 0.001	67	56	< 0.004	< 0.002	0.279	< 0.001	< 0.001		0.0029	< 0.0002		0.0022	140	< 0.001	
G270	05/13/2014	< 0.001	0.0013			0.026	0.025	< 0.001	68	30				< 0.001	< 0.001		0.016				140		
G270	08/11/2014	< 0.001	0.0034			< 0.01	< 0.01	< 0.001	62	34				< 0.001	< 0.001		0.04				130		500
G270	10/14/2014	< 0.001	0.011			0.12	0.057	0.008	67	21				< 0.001	0.0073		0.04				140		500
G270	01/20/2015	< 0.001	< 0.001			0.011	< 0.01	< 0.001	70	18				< 0.001	< 0.001		0.011				140		500
G270	04/13/2015	< 0.002	< 0.001	0.05	< 0.001	0.025	0.047	< 0.001	70	20	< 0.004	< 0.002	0.334	< 0.002	< 0.001		0.0055	< 0.0002		0.0016	120	< 0.001	540
G270	07/22/2015	< 0.001	< 0.001	0.049	< 0.001	< 0.01	< 0.01	< 0.001		15	< 0.004	< 0.002	0.427	< 0.001	0.0018		0.47	< 0.0002	0.0011	< 0.001	110	< 0.001	550
G270	10/05/2015	< 0.001	< 0.001	0.037	< 0.001	0.013	< 0.01	< 0.001		11	< 0.004	< 0.002	0.411	< 0.001	< 0.001		0.056	< 0.0002	< 0.001	< 0.001	82	< 0.001	480
G270	11/20/2015		0.001	0.045	< 0.001		< 0.01	< 0.001	59	12	< 0.004	< 0.002	0.362		0.0015	< 0.01		< 0.0002	0.001	< 0.001	89	< 0.001	400
G270	02/10/2016	< 0.001	< 0.001	0.037	< 0.001	0.02	< 0.01	< 0.001	49	16	< 0.004	< 0.002	0.472	< 0.001	< 0.001	< 0.01	0.012	< 0.0002	< 0.001	0.0013	77	< 0.001	400
G270	05/12/2016	< 0.002	< 0.001	0.034	< 0.001	< 0.02	< 0.01	< 0.001	57	15	< 0.004	< 0.002	0.504	< 0.002	< 0.001	< 0.01	0.029	< 0.0002	< 0.001	< 0.001	77	< 0.001	370
G270	08/01/2016		< 0.001	0.037	< 0.001		< 0.01	< 0.001	50	15	< 0.004	< 0.002	0.397		< 0.001	< 0.01		< 0.0002	< 0.001	< 0.001	76	< 0.001	360
G271	09/22/2009		0.003	0.08	< 0.001		0.33	< 0.0005	110	37	0.0064	0.0023	0.46		0.0054			< 0.0002		0.0038	230	< 0.002	770
G271	11/09/2009		0.0049	0.11	< 0.001		0.33	< 0.0005	140	34	0.014	0.0047	0.41		0.011			< 0.0002		0.0034	290	< 0.002	770
G271	11/10/2009	< 0.001				0.34								< 0.0005			0.11						
G271	01/19/2010	< 0.001	0.001	0.055	< 0.001	0.18	0.24	< 0.0005	110	33	< 0.005	< 0.001	0.34	< 0.0005	0.0018		0.007	< 0.0002		0.0035	320	< 0.002	860
G271	03/08/2010	< 0.001	< 0.001	0.055	< 0.001	0.25	0.23	< 0.0005	120	36	< 0.005	< 0.001	0.39	0.00061	0.0023		< 0.0025	< 0.0002		0.0053	300	< 0.002	880
G271	05/27/2010	< 0.001	0.0016	0.053	< 0.001	0.26	0.16	< 0.001	130	40	0.0056	< 0.002	0.42	< 0.001	0.0029		0.028	< 0.0002		0.0051	330	< 0.001	870
G271	07/27/2010	< 0.001	< 0.001	0.041	< 0.001	0.24	0.15	< 0.001	120	40	< 0.004	< 0.002	0.34	< 0.001	< 0.001		0.016	< 0.0002		0.005	350	< 0.001	840
G271	09/20/2010	< 0.001				0.16								< 0.001			0.0015						
G271	11/16/2010	< 0.001	< 0.001			0.14	0.15	< 0.001	110	44				< 0.001	< 0.001		< 0.001				280		830
G271	01/28/2011	< 0.001	0.0015	0.05	< 0.001	0.17	0.14	< 0.001	110	44	< 0.004	< 0.002	0.48	< 0.001	0.0035		0.0013	< 0.0002		0.0079	270	< 0.001	730
G271	05/04/2011	< 0.001	< 0.001			0.16	0.11	< 0.001	100	53				< 0.001	< 0.001		< 0.001				240		750
G271	07/27/2011	< 0.001	< 0.001			0.13	0.17	< 0.001	96	49				< 0.001	< 0.001		< 0.001				240		800
G271	11/14/2011	< 0.001	0.0013			0.15	0.21	< 0.001	110	50				< 0.001	< 0.001		< 0.001				250		710
G271	01/26/2012	< 0.001	0.0013	0.034	< 0.001	0.19	0.18	< 0.001	110	44	< 0.004	< 0.002	0.393	< 0.001	< 0.001		< 0.001	< 0.0002		0.0099	240	< 0.001	750
G271	05/22/2012	< 0.001	< 0.001			0.16	0.14	< 0.001	110	5.1				< 0.001	< 0.001		< 0.001				240		710
G271	07/24/2012	< 0.001	< 0.001			0.18	0.13	< 0.001	110	45				< 0.001	< 0.001		< 0.001				280		770
G271	11/14/2012	< 0.001	0.0014			0.28	0.19	< 0.001	130	50				< 0.001	0.0012		0.0021				300		940
G271	01/31/2013	< 0.001	0.0031	0.063	< 0.001	0.32	0.32	< 0.001	150	58	0.0066	0.0026	0.458	< 0.001	0.005		0.024	< 0.0002		0.005	380	< 0.001	880
G271	05/20/2013	0.0013	< 0.001			0.17	0.19	< 0.001	120	47				< 0.001	< 0.001		< 0.001				350		790
G271	07/22/2013	< 0.001	< 0.001			0.16	0.15	< 0.001	99	49				< 0.001	< 0.001		< 0.001				360		800
G271	10/14/2013	< 0.001	< 0.001			0.3	0.18	< 0.001	120	47				< 0.001	< 0.001		< 0.001				390		840
G271	02/19/2014	< 0.001	0.0028	0.062	< 0.001	0.26	0.24	< 0.001	150	51	0.0087	0.0023	0.298	< 0.001	0.0056		< 0.001	< 0.0002		0.0045	420	< 0.001	
G271	05/13/2014	0.16	0.0017			0.45	0.33	< 0.001	140	47				0.15	0.0018		0.22				440		
G271	08/11/2014	< 0.001	0.0027			0.39	0.44	< 0.001	140	42				< 0.001	0.0061		< 0.001				500		1000
G271	10/14/2014	< 0.001	0.0019			0.44	0.5	< 0.001	150	45				< 0.001	0.0062		0.0021				480		940
G271	01/21/2015	< 0.001	< 0.001			0.42	0.51	< 0.001	120	39				< 0.001	0.0014		< 0.001				490		870
G271	04/10/2015	< 0.002	< 0.001	0.029	< 0.001	0.37	0.31	< 0.001	130	45	< 0.004	< 0.002	0.406	< 0.002	< 0.001		< 0.002	< 0.0002		0.0035	440	< 0.001	1000
G271	07/22/2015	< 0.001	< 0.001	0.028	< 0.001	0.32	0.24	< 0.001		35	< 0.004	< 0.002	0.406	0.0017	0.0036		0.001	< 0.0002	< 0.001	0.0026	350	< 0.001	1000
G271	10/08/2015	< 0.001	< 0.001	0.03	< 0.001	0.44	0.33	< 0.001		38	< 0.004	< 0.002	0.402	< 0.001	< 0.001		< 0.001	< 0.0002	0.0036	0.0035	400	< 0.001	1000
G271	11/23/2015		< 0.001	0.031	< 0.001		0.5	< 0.001	130	38	< 0.004	< 0.002	0.347		0.0012	< 0.01		< 0.0002	0.0012	0.0024	420	< 0.001	860
G271	02/16/2016	< 0.001	< 0.001	0.029	< 0.001	0.51	0.61	< 0.001	130	38	< 0.004	< 0.002	0.481	< 0.001	< 0.001	< 0.01	< 0.001	< 0.0002	< 0.001	0.0032	440	< 0.001	980
G271	05/12/2016	< 0.002	< 0.001	0.028	< 0.001	0.61	0.98	< 0.001	170	39	< 0.004	< 0.002	0.562	< 0.002	< 0.001	< 0.01	< 0.002	< 0.0002	< 0.001	0.0021	540	< 0.001	940
G271	08/05/2016		< 0.001	0.032	< 0.001		0.63	< 0.001	110	37	< 0.004	< 0.002	0.414		0.0027	< 0.01		< 0.0002	< 0.001	0.0022	440	< 0.001	840
G271	11/21/2016		< 0.001	0.031	< 0.001		0.4	< 0.001		29	< 0.004	< 0.002	0.484		< 0.001	< 0.01		< 0.0002	< 0.001	0.0029	400	< 0.001	910
G272	09/22/2009		0.0012	0.079	< 0.001		0.06	< 0.0005	84	53	< 0.005	0.0017	0.48		0.0039			< 0.0002		< 0.0025	120	< 0.002	570
G272	11/10/2009	< 0.001	< 0.001	0.073	< 0.001	0.057	< 0.05	< 0.0005	88	46	< 0.005	0.0012	0.5	< 0.0005	0.0025		0.056	< 0.0002		< 0.0025	130	< 0.002	610
G272	01/19/2010	< 0.001	< 0.001	0.068	< 0.001	< 0.05	0.051	< 0.0005	85	45	< 0.005	< 0.001	0.42	< 0.0005	0.002		0.006	< 0.0002		< 0.0025	160	< 0.002	610
G272	03/04/2010	< 0.001	< 0.001	0.061	< 0.001	< 0.05	0.05	< 0.0005	93	44	< 0.005	< 0.001	0.41	< 0.0005	0.00058		< 0.0025	< 0.0002		< 0.0025	160	< 0.002	630
G272	05/27/2010	< 0.001	< 0.001	0.062	< 0.001	< 0.01	< 0.01	< 0.001	92	46	0.0049	< 0.002	0.41	< 0.001	0.0011		0.0029	< 0.0002		0.0021	190	< 0.001	670
G272	07/27/2010	< 0.001	< 0.001	0.062	< 0.001	< 0.01	< 0.01	< 0.001	92	44	< 0.004	< 0.002	0.43	< 0.001	< 0.001		0.0019	< 0.0002		0.0039	210	< 0.001	690

Well ID	Date	Arsenic, dissolved	Arsenic, total	Barium, total	Beryllium, total	Boron, dissolved	Boron, total	Cadmium, total	Calcium, total L	Chloride, total	Chromium, total	Cobalt, total	Fluoride, total	Lead, dissolved	Lead, total	Lithium, total	Manganese, dissolved	Mercury, total	Molybdenum, total	Selenium, total	Sulfate, total	Thallium, total	Total Dissolved Solids
G272	09/20/2010	< 0.001				< 0.01								< 0.001			< 0.001						
G272	11/16/2010	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	84	42				< 0.001	< 0.001		< 0.001				200		670
G272	01/31/2011	< 0.001	< 0.001	0.07	< 0.001	< 0.01	0.013	< 0.001	98	43	< 0.004	< 0.002	0.48	< 0.001	< 0.001		< 0.001	< 0.0002		0.0042	230	< 0.001	660
G272	05/04/2011	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	92	42				< 0.001	< 0.001		< 0.001				210		690
G272	07/27/2011	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	99	< 100				< 0.001	< 0.001		< 0.001				250		740
G272	11/14/2011	< 0.001	< 0.001			< 0.01	0.01	< 0.001	98	41				< 0.001	< 0.001		< 0.001				230		670
G272	01/26/2012	< 0.001	0.001	0.068	< 0.001	< 0.01	< 0.01	< 0.001	98	43	< 0.004	< 0.002	0.459	< 0.001	< 0.001		< 0.001	< 0.0002		0.0021	240	< 0.001	660
G272	05/22/2012	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	82	42				< 0.001	< 0.001		< 0.001				190		750
G272	07/24/2012	< 0.001	< 0.001			0.032	< 0.01	< 0.001	100	43				< 0.001	< 0.001		< 0.001				220		710
G272	11/14/2012	< 0.001	0.0011			< 0.01	< 0.01	< 0.001	110	40				< 0.001	0.0011		0.0012				220		780
G272	01/31/2013	< 0.001	< 0.001	0.072	< 0.001	< 0.01	< 0.01	< 0.001	110	44	< 0.004	< 0.002	0.461	< 0.001	< 0.001		< 0.001	< 0.0002		0.0029	330	< 0.001	760
G272	05/20/2013	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	98	37				< 0.001	< 0.001		< 0.001				280		680
G272	07/22/2013	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	100	35				< 0.001	< 0.001		< 0.001				260		680
G272	10/14/2013	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	100	32				< 0.001	< 0.001		< 0.001				300		740
G272	02/19/2014	< 0.001	< 0.001	0.06	< 0.001	< 0.01	< 0.01	< 0.001	110	40	< 0.004	< 0.002	0.355	< 0.001	< 0.001		< 0.001	< 0.0002		< 0.001	340	< 0.001	
G272	05/13/2014	0.17	< 0.001			0.27	0.015	< 0.001	93	36				0.15	< 0.001		0.23				310		
G272	08/11/2014	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	110	34				< 0.001	0.0014		< 0.001				330		740
G272	10/14/2014	< 0.001	< 0.001			0.036	0.022	< 0.001	110	37				< 0.001	0.0026		< 0.001				310		840
G272	01/21/2015	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	99	31				< 0.001	0.0022		< 0.001				380		790
G272	04/10/2015	< 0.002	< 0.001	0.059	< 0.001	< 0.02	< 0.01	< 0.001	110	37	< 0.004	< 0.002	0.399	< 0.002	< 0.001		< 0.002	< 0.0002		0.0012	340	< 0.001	800
G272	07/23/2015	< 0.001	< 0.001	0.06	< 0.001	< 0.01	0.031	< 0.001		29	< 0.004	< 0.002	0.493	< 0.001	< 0.001		< 0.001	< 0.0002	< 0.001	< 0.001	270	< 0.001	840
G272	10/08/2015	< 0.001	< 0.001	0.058	< 0.001	< 0.01	0.046	< 0.001		33	< 0.004	< 0.002	0.361	< 0.001	< 0.001		< 0.001	< 0.0002	0.0024	0.0016	340	< 0.001	660
G272	02/09/2016	< 0.001	0.0013	0.099	< 0.001	< 0.01	< 0.01	< 0.001		29	0.011	0.0022	0.516	< 0.001	0.0049		0.0013	< 0.0002	0.0013	< 0.001	290	< 0.001	660
G272	05/12/2016	< 0.001	< 0.001	0.059	< 0.001	< 0.01	< 0.01	< 0.001		29	< 0.004	< 0.002	0.561	< 0.001	< 0.001		< 0.001	< 0.0002	< 0.001	< 0.001	310	< 0.001	680
G273	09/23/2009		< 0.001	0.094	< 0.001		< 0.05	< 0.0005	120	35	< 0.005	< 0.001	0.38		< 0.0005			< 0.0002		< 0.0025	340	< 0.002	890
G273	11/10/2009	< 0.001	< 0.001	0.09	< 0.001	< 0.05	0.051	< 0.0005	140	28	< 0.005	< 0.001	0.33	< 0.0005	0.00093		0.097	< 0.0002		< 0.0025	400	< 0.002	980
G273	01/21/2010	< 0.001	< 0.001	0.085	< 0.001	0.054	< 0.05	< 0.0005	150	30	< 0.005	< 0.001	0.29	< 0.0005	< 0.0005		0.063	< 0.0002		< 0.0025	560	< 0.002	1200
G273	03/04/2010	< 0.001	< 0.001	0.079	< 0.001	< 0.05	< 0.05	< 0.0005	190	25	< 0.005	< 0.001	0.26	< 0.0005	< 0.0005		0.055	< 0.0002		< 0.0025	570	< 0.002	1300
G273	05/27/2010	< 0.001	0.0011	0.055	< 0.001	0.019	0.016	< 0.001	180	31	0.034	< 0.002	0.33	< 0.001	< 0.001		0.041	< 0.0002		0.0016	620	< 0.001	1300
G273	07/27/2010	< 0.001	< 0.001	0.048	< 0.001	0.023	0.023	< 0.001	160	30	< 0.004	< 0.002	0.37	< 0.001	< 0.001		0.048	< 0.0002		< 0.001	490	< 0.001	1100
G273	09/20/2010	< 0.001				0.024								< 0.001			0.052						
G273	11/16/2010	< 0.001	< 0.001			0.035	0.039	< 0.001	130	27				< 0.001	< 0.001		0.058				420		960
G273	01/31/2011	< 0.001	0.001	0.05	< 0.001	0.16	0.21	< 0.001	170	33	< 0.004	< 0.002	0.38	< 0.001	< 0.001		0.047	< 0.0002		< 0.001	520	< 0.001	1100
G273	05/03/2011	< 0.001	< 0.001			0.16	0.14	< 0.001	160	59				< 0.001	< 0.001		0.042				640		1200
G273	07/27/2011	< 0.001	< 0.001			0.097	0.12	< 0.001	150	29				< 0.001	< 0.001		0.029				510		1100
G273	11/14/2011	< 0.001	0.0013			0.13	0.15	< 0.001	150	29				< 0.001	< 0.001		0.041				510		990
G273	01/26/2012	< 0.001	0.001	0.043	< 0.001	0.27	0.26	< 0.001	180	27	< 0.004	< 0.002	0.359	< 0.001	< 0.001		0.033	< 0.0002		0.0012	750	< 0.001	1300
G273	05/22/2012	< 0.001	< 0.001			0.21	0.2	< 0.001	160	27				< 0.001	< 0.001		0.028				470		1100
G273	07/24/2012	< 0.001	< 0.001			0.12	0.094	< 0.001	140	32				< 0.001	< 0.001		0.022				360		910
G273	11/14/2012	0.0016	0.0034			0.27	0.2	< 0.001	160	33				< 0.001	0.0037		0.026				630		1100
G273	01/31/2013	< 0.001	< 0.001	0.046	< 0.001	0.48	0.46	< 0.001	180	37	< 0.004	< 0.002	0.33	< 0.001	< 0.001		0.03	< 0.0002		< 0.002	740	< 0.001	1300
G273	05/20/2013	0.0014	< 0.001			0.18	0.29	< 0.001	180	4				< 0.001	< 0.001		0.013				670		1100
G273	07/22/2013	< 0.001	< 0.001			0.21	0.25	< 0.001	160	35				< 0.001	< 0.001		0.022				510		980
G273	10/14/2013	< 0.001	< 0.001			0.18	0.18	< 0.001	140	37				< 0.001	< 0.001		0.015				450		900
G273	02/19/2014	< 0.001	< 0.001	0.039	< 0.001	0.52	0.36	< 0.001	150	38	< 0.004	< 0.002	0.286	< 0.001	< 0.001		0.015	< 0.0002		< 0.001	570	< 0.001	
G273	05/13/2014	0.24	< 0.001			0.62	0.35	< 0.001	160	47				0.22	< 0.001		0.33				620		
G273	08/11/2014	< 0.001	< 0.001			0.25	0.26	< 0.001	140	37				< 0.001	< 0.001		0.01				530		1000
G273	10/14/2014	< 0.001	0.0011			0.32	0.29	< 0.001	150	37				< 0.001	0.0011		0.013				500		1100
G273	01/21/2015	< 0.001	< 0.001			0.58	0.45	< 0.001	150	46				< 0.001	< 0.001		0.018				650		1200
G273	04/13/2015	< 0.002	< 0.001	0.028	< 0.001	0.29	0.48	< 0.001	200	41	< 0.004	< 0.002	0.32	< 0.002	< 0.001		0.019	< 0.0002		< 0.001	690	< 0.001	1300
G273	07/23/2015	< 0.001	< 0.001	0.044	< 0.001	0.4	0.12	< 0.001		39	< 0.004	< 0.002	0.382	< 0.001	< 0.001		0.0011	< 0.0002	< 0.001	< 0.001	390	< 0.001	1200
G273	10/08/2015	< 0.001	< 0.001	0.039	< 0.001	0.1	0.15	< 0.001		46	< 0.004	< 0.002	< 0.25	< 0.001	< 0.001		0.014	< 0.0002	0.0019	< 0.001	450	< 0.001	930
G273	11/24/2015		< 0.001	0.049	< 0.001		0.2	< 0.001	140	41	< 0.004	< 0.002	< 0.25		0.0011	< 0.01		< 0.0002	< 0.001	< 0.001	420	< 0.001	890

Well ID	Date	Arsenic, dissolved	Arsenic, total	Barium, total	Beryllium, total	Boron, dissolved	Boron, total	Cadmium, total	Calcium, total L	Chloride, total	Chromium, total	Cobalt, total	Fluoride, total	Lead, dissolved	Lead, total	Lithium, total	Manganese, dissolved	Mercury, total	Molybdenum, total	Selenium, total	Sulfate, total	Thallium, total	Total Dissolved Solids
G273	02/16/2016	< 0.001	< 0.001	0.043	< 0.001	0.43	0.42	< 0.001	150	45	< 0.004	< 0.002	0.401	< 0.001	< 0.001	< 0.01	0.01	< 0.0002	< 0.001	< 0.001	550	< 0.001	1200
G273	05/12/2016	< 0.001	< 0.001	0.031	< 0.001	0.31	0.29	< 0.001	170	44	< 0.004	< 0.002	0.537	< 0.001	< 0.001	< 0.01	0.012	< 0.0002	< 0.001	< 0.001	520	< 0.001	980
G273	08/05/2016		< 0.001	0.032	< 0.001		0.17	< 0.001	120	46	< 0.004	< 0.002	0.294		< 0.001	< 0.01		< 0.0002	< 0.001	< 0.001	400	< 0.001	840
G273	11/21/2016		< 0.001	0.036	< 0.001		0.15	< 0.001		48	< 0.004	< 0.002	0.39		< 0.001	< 0.01		< 0.0002	< 0.001	< 0.001	440	< 0.001	900
G274	09/24/2009		0.0024	0.12	< 0.001		0.053	< 0.0005	100	55	0.0059	0.0028	0.34		0.0091			< 0.0002		< 0.0025	230	< 0.002	830
G274	11/11/2009	< 0.001	< 0.001	0.092	< 0.001	0.057	< 0.05	< 0.0005	100	54	< 0.005	< 0.001	0.35	< 0.0005	0.0012		0.007	< 0.0002		< 0.0025	250	< 0.002	820
G274	01/27/2010	< 0.001	< 0.001	0.09	< 0.001	< 0.05	< 0.05	< 0.0005	100	50	< 0.005	< 0.001	0.32	< 0.0005	< 0.0005		0.0039	< 0.0002		< 0.0025	260	< 0.002	850
G274	03/08/2010	< 0.001	< 0.001	0.091	< 0.001	< 0.05	< 0.05	< 0.0005	110	49	< 0.005	< 0.001	0.32	< 0.0005	< 0.0005		0.0056	< 0.0002		< 0.0025	270	< 0.002	870
G274	05/27/2010	< 0.001	< 0.001	0.09	< 0.001	< 0.01	< 0.01	< 0.001	110	45	< 0.004	< 0.002	0.32	< 0.001	0.0015		< 0.001	< 0.0002		0.0022	300	< 0.001	910
G274	07/27/2010	< 0.001	< 0.001	0.08	< 0.001	< 0.01	< 0.01	< 0.001	110	44	< 0.004	< 0.002	0.35	< 0.001	< 0.001		< 0.001	< 0.0002		< 0.001	320	< 0.001	900
G274	09/20/2010	< 0.001				< 0.01								< 0.001			< 0.001						
G274	11/16/2010	< 0.001	< 0.001			< 0.01	0.012	< 0.001	120	38				< 0.001	< 0.001		< 0.001				360		940
G274	01/31/2011	< 0.001	0.0023	0.077	0.0018	< 0.01	0.012	0.0014	110	39	< 0.004	< 0.002	0.36	< 0.001	0.0018		< 0.001	< 0.0002		< 0.001	370	0.0013	950
G274	05/03/2011	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	120	36				< 0.001	< 0.001		< 0.001				400		980
G274	07/27/2011	< 0.001	< 0.001			0.013	< 0.01	< 0.001	120	37				< 0.001	< 0.001		< 0.001				370		980
G274	11/14/2011	< 0.001	< 0.001			0.035	0.039	< 0.001	120	37				< 0.001	< 0.001		< 0.001				370		900
G274	01/26/2012	< 0.001	< 0.001	0.068	< 0.001	0.076	0.052	< 0.001	110	34	< 0.004	< 0.002	0.379	< 0.001	< 0.001		0.001	< 0.0002		0.0014	370	< 0.001	880
G274	05/22/2012	< 0.001	< 0.001			0.12	0.11	< 0.001	120	36				< 0.001	< 0.001		< 0.001				330		920
G274	07/24/2012	< 0.001	< 0.001			0.15	0.13	< 0.001	120	40				< 0.001	< 0.001		< 0.001				300		880
G274	11/14/2012	< 0.001	0.0022			0.18	0.16	< 0.001	120	37				< 0.001	0.0031		< 0.001				420		910
G274	01/31/2013	< 0.001	< 0.001	0.059	< 0.001	0.26	0.25	< 0.001	130	36	< 0.004	< 0.002	0.382	< 0.001	< 0.001		< 0.001	< 0.0002		0.0015	460	< 0.001	870
G274	05/20/2013	0.001	< 0.001			0.25	0.27	< 0.001	120	3.6				< 0.001	< 0.001		0.0073				350		800
G274	07/22/2013	< 0.001	< 0.001			0.31	0.31	< 0.001	110	32				< 0.001	0.0015		< 0.001				330		820
G274	10/14/2013	< 0.001	< 0.001			0.52	0.46	< 0.001	110	31				< 0.001	< 0.001		< 0.001				380		840
G274	02/19/2014	< 0.001	< 0.001	0.063	< 0.001	0.79	0.47	< 0.001	110	32	< 0.004	< 0.002	0.262	< 0.001	< 0.001		< 0.001	< 0.0002		< 0.001	300	< 0.001	
G274	05/13/2014	0.0055	< 0.001			0.52	0.52	< 0.001	98	27				0.0034	< 0.001		0.0059				370		
G274	08/11/2014	< 0.001	< 0.001			0.57	0.61	< 0.001	120	25				< 0.001	< 0.001		< 0.001				400		880
G274	10/14/2014	< 0.001	0.004			0.62	0.55	< 0.001	100	23				< 0.001	0.01		< 0.001				320		770
G274	01/21/2015	< 0.001	0.0011			0.68	0.5	< 0.001	110	19				< 0.001	0.0029		0.0036				260		770
G274	04/13/2015	< 0.002	< 0.001	0.052	< 0.001	0.57	0.53	< 0.001	110	24	< 0.004	< 0.002	0.341	< 0.002	< 0.001		< 0.002	< 0.0002		< 0.001	390	< 0.001	770
G274	07/23/2015	< 0.001	< 0.001	0.068	< 0.001	0.48	0.49	< 0.001		24	< 0.004	< 0.002	0.403	< 0.001	0.0018		0.0015	< 0.0002	< 0.001	0.0014	320	< 0.001	890
G274	10/08/2015	< 0.001	< 0.001	0.061	< 0.001	0.43	0.74	< 0.001		22	< 0.004	< 0.002	0.265	< 0.001	< 0.001		< 0.001	< 0.0002	0.0012	< 0.001	320	< 0.001	770
G274	02/09/2016	< 0.001	< 0.001	0.07	< 0.001	0.87	0.65	< 0.001		22	< 0.004	< 0.002	0.455	< 0.001	0.001		< 0.001	< 0.0002	< 0.001	< 0.001	290	< 0.001	820
G274	05/12/2016	< 0.001	< 0.001	0.057	< 0.001	0.97	0.63	< 0.001		22	< 0.004	< 0.002	0.417	< 0.001	< 0.001		0.046	< 0.0002	< 0.001	< 0.001	350	< 0.001	770
G275	09/22/2009		< 0.005	0.12	< 0.001		4.5	< 0.0005	300	14	< 0.025	< 0.005	0.22		0.01			< 0.0002		< 0.012	990	< 0.002	2000
G275	11/11/2009	< 0.001	< 0.001	0.032	< 0.001	2.4	2.5	< 0.0005	140	12	< 0.005	< 0.001	0.32	< 0.0005	< 0.0005		0.032	< 0.0002		< 0.0025	350	< 0.002	910
G275	01/21/2010	< 0.001	< 0.001	0.032	< 0.001	1.2	1.2	< 0.0005	120	13	< 0.005	< 0.001	0.32	< 0.0005	< 0.0005		0.023	< 0.0002		< 0.0025	390	< 0.002	870
G275	03/08/2010	< 0.001	< 0.001	0.035	< 0.001	1.3	1.3	< 0.0005	160	23	< 0.005	< 0.001	0.27	< 0.0005	0.00053		0.029	< 0.0002		< 0.0025	460	< 0.002	1100
G275	05/28/2010	< 0.001	0.0016	0.047	< 0.001	2.9	2.9	< 0.001	180	18	0.0087	< 0.002	0.33	< 0.001	0.0017		0.018	< 0.0002		0.0014	540	< 0.001	1200
G275	07/26/2010	< 0.001	< 0.001	0.038	< 0.001	2.9	2.8	< 0.001	180	9.9	< 0.004	< 0.002	0.4	< 0.001	< 0.001		0.019	< 0.0002		< 0.001	550	< 0.001	1200
G275	09/20/2010	< 0.001				2.6								< 0.001			0.026						
G275	11/16/2010	< 0.001	0.0028			3.7	4.1	< 0.001	260	9.7				< 0.001	0.0045		0.16				970		1700
G275	01/31/2011	< 0.001	0.0015	0.046	< 0.001	3.6	3.6	< 0.001	230	11	< 0.004	< 0.002	0.34	< 0.001	< 0.001		0.016	< 0.0002		< 0.001	840	< 0.001	1500
G275	05/03/2011	< 0.001	< 0.001			3.6	3.8	< 0.001	240	13				< 0.001	< 0.001		0.04				790		1600
G275	07/27/2011	< 0.001	< 0.001			4.3	4.2	< 0.001	200	9.2				< 0.001	< 0.001		0.03				720		1300
G275	11/14/2011	0.0015	0.0041			4.3	4.4	< 0.001	260	17				< 0.001	0.0059		0.09				820		1500
G275	01/31/2012	< 0.001	0.0011	0.039	< 0.001	3.8	3.6	< 0.001	310	15	0.0047	< 0.002	0.281	< 0.001	< 0.001		0.0081	< 0.0002		0.0015	370	< 0.001	1300
G275	05/22/2012	< 0.001	0.0017			3.7	3.4	< 0.001	240	11				< 0.001	0.0015		0.01				670		1500
G275	07/24/2012	< 0.001	0.0018			4.6	4.2	< 0.001	260	13				< 0.001	0.0024		0.09				900		1600
G275	11/14/2012	< 0.001	0.0025			3.7	3.9	< 0.001	270	19				< 0.001	0.0037		0.28				950		1600
G275	05/20/2013	0.0013	0.0025			3.4	3.8	< 0.001	250	24				< 0.001	0.0015		< 0.001				840		1400
G275	07/22/2013	< 0.001	< 0.001			3.5	3.1	< 0.001	210	19				< 0.001	0.0013		0.0017				700		1400
G275	05/13/2014	0.25	0.0019			2.8	3.4	< 0.001	210	20				0.2	0.0037		0.34				750		

Well ID	Date	Arsenic, dissolved	Arsenic, total	Barium, total	Beryllium, total	Boron, dissolved	Boron, total	Cadmium, total	Calcium, total L	Chloride, total	Chromium, total	Cobalt, total	Fluoride, total	Lead, dissolved	Lead, total	Lithium, total	Manganese, dissolved	Mercury, total	Molybdenum, total	Selenium, total	Sulfate, total	Thallium, total	Total Dissolved Solids
G275	08/11/2014	< 0.001	0.0043			4.2	4.1	< 0.001	240	20				< 0.001	0.0078		< 0.001				880		1500
G275	10/14/2014	< 0.001	0.0011			1.9	3.5	< 0.001	200	16				< 0.001	0.0012		0.003				500		840
G275	01/21/2015	< 0.001	0.0043			4.6	4.6	< 0.001	230	20				< 0.001	0.0079		0.025				940		1500
G275	04/13/2015	< 0.002	< 0.001	0.056	< 0.001	0.91	1.8	< 0.001	180	22	< 0.004	< 0.002	< 0.25	< 0.002	< 0.001		0.0024	< 0.0002		0.0012	650	< 0.001	1500
G275	07/23/2015	< 0.001	< 0.001	0.035	< 0.001	3	4	< 0.001		30	< 0.004	< 0.002	0.307	< 0.001	0.001		0.012	< 0.0002	0.0014	0.0014	750	< 0.001	1500
G275	02/09/2016	< 0.001	< 0.001	0.042	< 0.001	4	2.3	< 0.001		26	< 0.004	< 0.002	0.349	0.0044	0.0016		0.0064	< 0.0002	< 0.001	< 0.001	470	< 0.001	1500
G275	05/12/2016	< 0.001	< 0.001	0.039	< 0.001	2.5	2.4	< 0.001		14	< 0.004	< 0.002	0.452	< 0.001	< 0.001		0.0036	< 0.0002	< 0.001	< 0.001	310	< 0.001	1300
G276	09/23/2009		< 0.005	0.16	0.0026		0.087	< 0.0025	94	38	< 0.025	< 0.005	0.75		0.035			< 0.0002		< 0.012	170	< 0.002	620
G276	11/11/2009	< 0.001	< 0.001	0.079	< 0.001	0.057	0.062	< 0.0005	91	40	0.0059	< 0.001	0.57	< 0.0005	0.0037		0.03	< 0.0002		< 0.0025	170	< 0.002	670
G276	01/21/2010	< 0.001	< 0.001	0.075	< 0.001	0.057	0.052	< 0.0005	91	36	< 0.005	< 0.001	0.53	< 0.0005	0.00079		0.0093	< 0.0002		< 0.0025	190	< 0.002	660
G276	03/09/2010									38			0.51								180		650
G276	03/10/2010	< 0.001	< 0.001	0.083	< 0.001	0.057	0.058	< 0.0005	110		< 0.005	< 0.001		< 0.0005	0.0016		0.01	< 0.0002		< 0.0025		< 0.002	
G276	05/28/2010	< 0.001	< 0.001	0.067	< 0.001	0.035	0.033	< 0.001	100	40	0.0051	< 0.002	0.49	< 0.001	< 0.001		0.012	< 0.0002		0.0014	190	< 0.001	720
G276	07/26/2010	< 0.001	< 0.001	0.063	< 0.001	0.023	0.022	< 0.001	93	40	< 0.004	< 0.002	0.54	< 0.001	< 0.001		0.0054	< 0.0002		< 0.001	230	< 0.001	710
G276	09/20/2010	< 0.001				0.024								< 0.001			0.005						
G276	11/16/2010	< 0.001	< 0.001			0.013	0.044	< 0.001	96	35				< 0.001	< 0.001		0.0018				200		670
G276	01/31/2011	< 0.001	0.0026	0.078	< 0.001	0.036	0.052	< 0.001	96	36	< 0.004	< 0.002	0.53	< 0.001	0.001		0.0041	< 0.0002		< 0.001	200	< 0.001	710
G276	05/03/2011	< 0.001	< 0.001			0.043	0.039	< 0.001	95	36				< 0.001	< 0.001		0.0016				200		650
G276	07/27/2011	< 0.001	< 0.001			0.011	< 0.01	< 0.001	96	37				< 0.001	< 0.001		0.001				170		670
G276	11/14/2011	< 0.001	0.0013			0.081	0.08	< 0.001	94	35				< 0.001	< 0.001		< 0.001				180		620
G276	01/31/2012	< 0.001	< 0.001	0.075	< 0.001	< 0.01	0.06	< 0.001	130	32	0.0052	< 0.002	0.501	< 0.001	< 0.001		< 0.001	< 0.0002		0.0022	190	< 0.001	650
G276	05/22/2012	< 0.001	0.0011			0.066	0.073	< 0.001	97	38				< 0.001	< 0.001		0.0014				160		660
G276	07/24/2012	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	100	38				< 0.001	< 0.001		< 0.001				190		680
G276	11/14/2012	< 0.001	0.0015			0.012	0.083	< 0.001	100	36				< 0.001	< 0.001		< 0.001				190		680
G276	01/31/2013	< 0.001	< 0.001	0.081	< 0.001	0.014	0.023	< 0.001	110	35	< 0.004	< 0.002	0.51	< 0.001	0.0011		< 0.001	< 0.0002		0.0031	250	< 0.001	680
G276	05/20/2013	< 0.001	< 0.001			0.036	0.031	< 0.001	99	3.8				< 0.001	< 0.001		< 0.001				180		640
G276	07/22/2013	< 0.001	< 0.001			0.022	< 0.01	< 0.001	100	32				< 0.001	< 0.001		< 0.001				220		670
G276	05/13/2014	< 0.001	0.0013			< 0.01	0.021	< 0.001	130	31				< 0.001	< 0.001		< 0.001				230		
G276	08/12/2014	< 0.001	0.0013			0.018	0.027	< 0.001	120	29				< 0.001	0.006		< 0.001				220		640
G276	10/14/2014	< 0.001	< 0.001			0.028	0.019	< 0.001	100	28				< 0.001	0.0024		< 0.001				220		700
G276	01/21/2015	< 0.001	< 0.001			0.015	0.021	< 0.001	100	30				< 0.001	< 0.001		< 0.001				260		700
G276	04/13/2015	< 0.002	0.0057	0.34	0.0016	< 0.02	0.036	< 0.001	170	34	0.043	0.0047	0.486	< 0.002	0.022		< 0.002	< 0.0002		0.0034	310	< 0.001	780
G276	07/23/2015	< 0.001	< 0.001	0.096	< 0.001	0.037	0.015	< 0.001		26	< 0.004	< 0.002	0.377	< 0.001	0.0012		< 0.001	< 0.0002	0.0012	0.001	180	< 0.001	800
G276	11/24/2015		< 0.001	0.077	< 0.001		0.043	< 0.001	120	28	< 0.004	< 0.002	0.345		< 0.001	0.013		< 0.0002	0.0017	< 0.001	190	< 0.001	710
G276	02/16/2016		< 0.001	0.09	< 0.001		0.021	< 0.001	120	23	< 0.004	< 0.002	0.456		0.0014	0.015		< 0.0002	0.0013	0.0018	230	< 0.001	760
G276	02/17/2016	< 0.001	< 0.001	0.089	< 0.001	0.027	0.029	< 0.001		28	< 0.004	< 0.002	0.456	< 0.001	< 0.001		< 0.001	< 0.0002	< 0.001	< 0.001	230	< 0.001	700
G276	05/12/2016	< 0.001	< 0.001	0.079	< 0.001	0.013	< 0.01	< 0.001	130	22	< 0.004	< 0.002	0.549	< 0.001	< 0.001	0.012	< 0.001	< 0.0002	< 0.001	0.0017	240	< 0.001	720
G276	08/03/2016		< 0.001	0.085	< 0.001		0.019	< 0.001	110	23	< 0.004	< 0.002	0.443		< 0.001	< 0.01		< 0.0002	< 0.001	0.0017	1900	< 0.001	680
G276	11/21/2016		< 0.001	0.081	< 0.001		< 0.01	< 0.001		23	< 0.004	< 0.002	0.445		< 0.001	0.011		< 0.0002	< 0.001	0.002	210	< 0.001	720
G277	09/23/2009		0.027	0.61	0.0027		0.11	< 0.0025	190	41	0.052	0.04	0.79		0.072			0.00023		< 0.012	79	< 0.002	
G277	09/24/2009																						430
G277	11/11/2009	0.021	0.02	0.22	0.0011	< 0.05	0.074	< 0.0005	110	43	0.037	0.017	0.47	0.028	0.029		1.6	< 0.0002		< 0.0025	49	< 0.002	680
G277	01/19/2010	< 0.001	0.0019	0.093	< 0.001	< 0.05	0.062	< 0.0005	92	39	0.0094	0.0019	0.41	< 0.0005	0.0037		0.02	< 0.0002		< 0.0025	63	< 0.002	
G277	01/20/2010																						550
G277	03/08/2010		< 0.001	0.075	< 0.001		0.065	< 0.0005	93	43	< 0.005	< 0.001	0.4		0.00092			< 0.0002		< 0.0025	49	< 0.002	540
G277	03/09/2010	< 0.001				0.073								< 0.0005			0.0037						
G277	05/28/2010	< 0.001	0.0023	0.092	< 0.001	0.02	0.021	< 0.001	100	46	0.033	< 0.002	0.4	< 0.001	0.0031		0.0011	< 0.0002		0.0032	58	< 0.001	580
G277	07/26/2010	< 0.001	0.0018	0.085	< 0.001	0.015	0.019	< 0.001	85	46	0.0092	< 0.002	0.42	< 0.001	0.0029		0.003	< 0.0002		0.0021	58	< 0.001	790
G277	09/20/2010	< 0.001				0.012								< 0.001			0.0055						
G277	11/16/2010	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	86					< 0.001	< 0.001		0.0021						
G277	01/31/2011	< 0.001	0.0015	0.085	< 0.001	0.016	0.025	< 0.001	97	40	< 0.004	< 0.002	0.38	< 0.001	0.0024		0.0031	< 0.0002		0.003	52	< 0.001	610
G277	05/03/2011	< 0.001	< 0.001			0.02	0.02	< 0.001	100	42				< 0.001	< 0.001		< 0.001				56		600
G277	07/27/2011	< 0.001	< 0.001			0.012	< 0.01	< 0.001	110	49				< 0.001	< 0.001		< 0.001				61		650

Well ID	Date	Arsenic, dissolved	Arsenic, total	Barium, total	Beryllium, total	Boron, dissolved	Boron, total	Cadmium, total	Calcium, total L	Chloride, total	Chromium, total	Cobalt, total	Fluoride, total	Lead, dissolved	Lead, total	Lithium, total	Manganese, dissolved	Mercury, total	Molybdenum, total	Selenium, total	Sulfate, total	Thallium, total	Total Dissolved Solids
G277	11/14/2011	< 0.001	0.0039			0.031	0.044	< 0.001	110	36				< 0.001	0.0056		0.0054				51		580
G277	01/31/2012		0.003	0.12	< 0.001		0.027	< 0.001	160	37	0.012	0.0022	0.326		0.0035			< 0.0002		0.0014	45	< 0.001	
G277	05/22/2012	< 0.001	< 0.001			0.021	0.026	< 0.001	110	30				< 0.001	< 0.001		0.0052				49		580
G277	07/24/2012									34											52		580
G277	07/25/2012	< 0.001	0.0011			< 0.01	< 0.01	< 0.001	110					< 0.001	0.0011		0.013						
G277	11/14/2012		0.001				< 0.01	< 0.001	120	11					0.0012						42		
G277	05/20/2013	< 0.001	< 0.001			0.022	0.018	< 0.001	110	3.3				< 0.001	< 0.001		< 0.001				5.7		520
G277	07/22/2013	< 0.001	< 0.001			0.02	0.021	< 0.001	93	18				< 0.001	< 0.001		< 0.001				45		500
G277	05/13/2014	< 0.001	0.0021			0.012	0.053	< 0.001	130	30				< 0.001	0.0019		< 0.001				60		
G277	10/15/2014		0.0023				0.024	< 0.001	84	3.6					0.0033						18		
G277	10/16/2014	< 0.001				0.032								< 0.001			0.003						360
G277	05/12/2016	< 0.001	0.0011	0.09	< 0.001	0.047	0.025	< 0.001		1.2	< 0.004	< 0.002	0.495	< 0.001	0.0013		0.0017	< 0.0002	0.001	< 0.001	15	< 0.001	460
G278	05/26/2010		0.0011	0.078	< 0.001		0.026	< 0.001	93	82	0.016	< 0.002	0.41		< 0.001			< 0.0002		0.0058	87	< 0.001	640
G278	05/28/2010	< 0.001				0.012								< 0.001			0.052						
G278	03/23/2011	< 0.001	0.0026	0.069	< 0.001	0.014	0.014	< 0.001	90	55	0.0063	< 0.002	0.55	< 0.001	0.0025		0.1	< 0.0002		0.0019	91	< 0.001	630
G278	05/03/2011	< 0.001	0.0056	0.15	< 0.001	< 0.01	0.026	< 0.001	97	60	0.022	0.0055	0.43	< 0.001	0.013		0.027	< 0.0002		0.0032	110	< 0.001	670
G278	07/25/2011	< 0.001	0.016	0.34	0.0018	< 0.01	0.023	< 0.001	170	62	0.034	0.018	0.42	< 0.001	0.033		0.032	< 0.0002		0.0029	100	< 0.001	690
G278	09/19/2011	< 0.001	0.0018	0.086	< 0.001	0.093	0.023	< 0.001	100	85	0.048	< 0.002	0.51	< 0.001	0.0031		0.04	< 0.0002		0.012	120	< 0.001	640
G278	05/22/2012	< 0.001	0.0032	0.098	< 0.001	0.017	0.017	< 0.001	110	82	0.007	0.0028	0.359	< 0.001	0.0059		0.46	< 0.0002		0.0025	120	< 0.001	730
G278	02/09/2016	< 0.001	0.004	0.11	< 0.001	0.54	0.54	< 0.001		310	0.0092	0.0034	0.336	< 0.001	0.008		0.14	< 0.0002	0.0014	0.041	680	< 0.001	1800
G278	05/13/2016	< 0.001	0.0067	0.19	< 0.001	0.5	0.2	< 0.001		180	0.017	0.0066	0.441	< 0.001	0.015		0.39	< 0.0002	0.0026	0.014	450	< 0.001	1500
G279	09/23/2009		0.0064	0.095	< 0.001		0.062	< 0.0005	90	59	0.01	0.0059	0.5		0.0092			< 0.0002		< 0.0025	99	< 0.002	620
G279	11/09/2009	< 0.001	< 0.001	0.065	< 0.001	0.062	0.056	< 0.0005	81	50	< 0.005	< 0.001	0.5	< 0.0005	0.00068		0.26	< 0.0002		< 0.0025	92	< 0.002	620
G279	01/27/2010	< 0.001	< 0.001	0.067	< 0.001	< 0.05	0.057	< 0.0005	80	54	< 0.005	< 0.001	0.43	< 0.0005	0.0013		0.094	< 0.0002		< 0.0025	88	< 0.002	630
G279	03/04/2010	< 0.001	< 0.001	0.065	< 0.001	< 0.05	< 0.05	< 0.0005	85	57	< 0.005	< 0.001	0.42	< 0.0005	0.00068		0.059	< 0.0002		< 0.0025	83	< 0.002	610
G279	05/26/2010	< 0.001	< 0.001	0.068	< 0.001	< 0.01	0.01	< 0.001	89	69	0.011	< 0.002	0.42	< 0.001	< 0.001		0.022	< 0.0002		0.005	100	< 0.001	680
G279	07/26/2010	< 0.001	< 0.001	0.062	< 0.001	< 0.01	< 0.01	< 0.001	91	64	< 0.004	< 0.002	0.43	< 0.001	< 0.001		0.019	< 0.0002		0.0015	88	< 0.001	670
G279	09/20/2010	< 0.001				< 0.01								< 0.001			0.014						
G279	11/16/2010	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	89	52				< 0.001	< 0.001		0.0088				96		600
G279	01/28/2011	< 0.001	0.0026	0.098	< 0.001	< 0.01	0.016	< 0.001	100	50	< 0.004	0.0029	0.44	< 0.001	0.0052		0.014	< 0.0002		0.0038	93	< 0.001	600
G279	05/04/2011	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	130	49				< 0.001	< 0.001		0.0033				100		630
G279	07/27/2011	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	83	51				< 0.001	< 0.001		0.0071				95		600
G279	11/14/2011	< 0.001	< 0.001			0.017	0.019	< 0.001	84	53				< 0.001	< 0.001		0.0035				95		580
G279	01/30/2012	< 0.001	< 0.001	0.05	< 0.001	< 0.01	< 0.01	< 0.001	120	51	< 0.004	< 0.002	0.54	< 0.001	< 0.001		0.0049	< 0.0002		0.0041	160	< 0.001	630
G279	05/22/2012	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	69	54				< 0.001	< 0.001		0.042				96		590
G279	07/24/2012	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	98	71				< 0.001	< 0.001		0.002				130		660
G279	11/14/2012	0.0019	0.0018			< 0.01	< 0.01	< 0.001	97	62				< 0.001	0.001		0.019				140		750
G279	01/31/2013	0.0014	< 0.001	0.06	< 0.001	< 0.01	< 0.01	< 0.001	120	60	< 0.004	< 0.002	0.418	< 0.001	< 0.001		0.0019	< 0.0002		0.0034	390	< 0.001	1200
G279	05/20/2013	< 0.001	0.0012			0.01	0.011	< 0.001	87	56				< 0.001	< 0.001		0.0011				180		600
G279	07/22/2013	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	88	55				< 0.001	< 0.001		0.0078				140		560
G279	10/14/2013	< 0.001	< 0.001			0.015	0.011	< 0.001	97	55				< 0.001	< 0.001		0.078				120		640
G279	02/19/2014	< 0.001	< 0.001	0.058	< 0.001	0.022	0.015	< 0.001	86	54	< 0.004	< 0.002	0.331	< 0.001	< 0.001		0.029	< 0.0002		< 0.001	110	< 0.001	
G279	05/13/2014	0.017	< 0.001			0.038	0.016	< 0.001	94	50				0.022	< 0.001		0.034				110		
G279	08/12/2014	< 0.001	< 0.001			0.015	0.11	< 0.001	97	56				< 0.001	< 0.001		0.024				120		600
G279	10/14/2014	< 0.001	< 0.001			0.025	0.012	< 0.001	92	63				< 0.001	< 0.001		0.026				140		650
G279	01/21/2015	< 0.001	< 0.001			0.032	0.031	< 0.001	100	74				< 0.001	< 0.001		0.017				230		810
G279	04/13/2015	< 0.002	0.0013	0.029	< 0.001	0.047	0.016	< 0.001	170	46	< 0.004	< 0.002	0.518	< 0.002	< 0.001		0.0033	0.00024		0.0056	470	< 0.001	800
G279	07/23/2015	< 0.001	0.002	0.11	< 0.001	0.031	0.065	< 0.001		96	0.0042	0.0025	0.361	< 0.001	0.0041		0.013	< 0.0002	0.0015	0.02	470	< 0.001	1200
G279	10/08/2015	< 0.001	0.0015	0.096	< 0.001	1.3	1.4	< 0.001		120	0.0047	0.0033	< 0.25	< 0.001	0.0025		0.032	< 0.0002	0.0015	0.017	810	< 0.001	1700
G279	11/24/2015		< 0.001	0.053	< 0.001		0.63	< 0.001	140	61	< 0.004	< 0.002	0.334		0.0015	0.014		< 0.0002	< 0.001	0.0041	520	< 0.001	1100
G279	02/16/2016	< 0.001	< 0.001	0.082	< 0.001	0.29	0.26	< 0.001	180	130	< 0.004	< 0.002	0.392	< 0.001	< 0.001	0.012	0.011	< 0.0002	0.043	0.017	610	< 0.001	1500
G279	05/13/2016	< 0.001	< 0.001	0.055	< 0.001	0.11	0.073	< 0.001	120	31	< 0.004	< 0.002	0.608	< 0.001	< 0.001	< 0.01	0.0061	< 0.0002	0.024	0.0043	270	< 0.001	700
G279	08/03/2016		< 0.001	0.069	< 0.001		0.24	< 0.001	210	110	< 0.004	< 0.002	0.394		< 0.001	< 0.01		< 0.0002	< 0.001	0.02	570	< 0.001	1300

Well ID	Date	Arsenic, dissolved	Arsenic, total	Barium, total	Beryllium, total	Boron, dissolved	Boron, total	Cadmium, total	Calcium, total L	Chloride, total	Chromium, total	Cobalt, total	Fluoride, total	Lead, dissolved	Lead, total	Lithium, total	Manganese, dissolved	Mercury, total	Molybdenum, total	Selenium, total	Sulfate, total	Thallium, total	Total Dissolved Solids
G279	11/22/2016		< 0.001	0.057	< 0.001		0.49	< 0.001		130	< 0.004	< 0.002	0.272		< 0.001	0.011		< 0.0002	< 0.001	0.017	720	< 0.001	1300
G280	03/11/2008	< 0.01	< 0.01	0.049	< 0.01	< 0.5	< 0.5	< 0.005	63	47	< 0.05	< 0.01	0.37	< 0.005	< 0.005		0.11	< 0.0002		< 0.025	60	< 0.002	420
G280	04/21/2008	< 0.001	< 0.001	0.058	< 0.001	0.06	0.062	< 0.0005	59	51	< 0.005	< 0.001	0.37	< 0.0005	0.00055		0.18	< 0.0002		0.0028	58	< 0.002	400
G280	06/11/2008	< 0.001	< 0.001	0.052	< 0.001	< 0.05	< 0.05	< 0.0005	66	43	< 0.005	< 0.001	0.33	< 0.0005	< 0.0005		0.13	< 0.0002		0.0027	62	< 0.002	430
G280	08/13/2008	< 0.001	< 0.001	0.053	< 0.001	0.05	< 0.05	< 0.0005	63	44	< 0.005	< 0.001	0.39	< 0.0005	< 0.0005		0.13	< 0.0002		0.0026	59	< 0.002	410
G280	10/13/2008	< 0.001	< 0.001	0.05	< 0.001	< 0.05	< 0.05	< 0.0005	69	45	< 0.005	< 0.001	0.35	< 0.0005	< 0.0005		0.078	< 0.0002		< 0.0025	60	< 0.002	450
G280	12/03/2008	< 0.001	< 0.001	0.11	< 0.001	< 0.05	< 0.05	< 0.0005	120	110	< 0.005	< 0.001	0.26	< 0.0005	0.0007		0.24	< 0.0002		< 0.0025	230	< 0.002	760
G280	09/21/2009	< 0.001	< 0.001			< 0.05	< 0.05	< 0.0005	59	40				< 0.0005	< 0.0005		0.012				43		380
G280	11/12/2009	< 0.001	< 0.001			< 0.05	< 0.05	< 0.0005	61	40				< 0.0005	< 0.0005		0.019				42		370
G280	01/28/2010	< 0.001	< 0.001			< 0.05	< 0.05	< 0.0005	60	41				< 0.0005	0.0006		0.0069				47		400
G280	02/11/2010			0.039	< 0.001						< 0.005	< 0.001	0.32					< 0.0002		0.0042		< 0.002	440
G280	06/09/2010	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	66	65				< 0.001	< 0.001		0.0031				82		510
G280	07/27/2010	< 0.001	< 0.001			0.01	< 0.01	< 0.001	60	60				< 0.001	< 0.001		< 0.001				80		520
G280	11/16/2010	< 0.001	0.001			< 0.01	< 0.01	< 0.001	58	35				< 0.001	< 0.001		0.018				43		370
G280	01/28/2011	< 0.001	0.0012	0.082	< 0.001	< 0.01	0.012	< 0.001	100	57	< 0.004	0.0024	0.36	< 0.001	0.0055		< 0.001	< 0.0002		0.0051	76	< 0.001	500
G280	05/04/2011	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	< 0.1	87				< 0.001	< 0.001		< 0.001				98		560
G280	07/27/2011	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	63	45				< 0.001	< 0.001		0.015				54		420
G280	11/11/2011	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	60	51				< 0.001	< 0.001		0.0033				59		390
G280	01/30/2012	< 0.001	< 0.001	0.047	< 0.001	< 0.01	< 0.01	< 0.001	81	54	< 0.004	< 0.002	0.44	< 0.001	< 0.001		< 0.001	< 0.0002		0.0055	68	< 0.001	440
G280	05/22/2012	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	65	67				< 0.001	< 0.001		< 0.001				93		470
G280	07/24/2012	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	72	48				< 0.001	0.0026		0.0073				51		360
G280	11/14/2012	0.0013	0.0021			< 0.01	< 0.01	< 0.001	63	46				< 0.001	0.0014		0.0081				48		440
G280	01/31/2013	< 0.001	< 0.001	0.036	< 0.001	< 0.01	< 0.01	< 0.001	63	46	< 0.004	< 0.002	0.423	< 0.001	< 0.001		< 0.001	< 0.0002		0.0042	54	< 0.001	380
G280	05/20/2013	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	67	59				< 0.001	< 0.001		< 0.001				71		410
G280	07/22/2013	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	73	52				< 0.001	< 0.001		< 0.001				67		400
G280	10/14/2013	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	72	51				< 0.001	< 0.001		< 0.001				65		480
G280	02/19/2014	< 0.001	< 0.001	0.041	< 0.001	< 0.01	< 0.01	< 0.001	69	56	< 0.004	< 0.002	0.338	< 0.001	< 0.001		< 0.001	< 0.0002		0.0031	74	< 0.001	
G280	05/13/2014	< 0.001	0.0014			0.017	0.029	< 0.001	73	55				< 0.001	0.001		< 0.001				78		
G280	08/12/2014	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	75	55				< 0.001	< 0.001		< 0.001				76		490
G280	10/14/2014	< 0.001	0.0012			0.013	< 0.01	< 0.001	76	60				< 0.001	0.002		< 0.001				83		480
G280	01/21/2015	< 0.001	< 0.001			< 0.01	< 0.01	< 0.001	74	62				< 0.001	< 0.001		< 0.001				87		540
G280	04/13/2015	< 0.002	< 0.001	0.045	< 0.001	0.025	< 0.01	< 0.001	71	67	< 0.004	< 0.002	0.358	< 0.002	< 0.001		0.026	< 0.0002		0.0037	86	< 0.001	480
G280	07/23/2015	< 0.001	< 0.001	0.049	< 0.001	0.01	< 0.01	< 0.001		53	< 0.004	< 0.002	0.415	< 0.001	< 0.001		0.074	< 0.0002	0.0019	0.0033	74	< 0.001	480
G280	10/08/2015	< 0.001	< 0.001	0.056	< 0.001	0.025	0.024	< 0.001		54	< 0.004	< 0.002	0.318	< 0.001	< 0.001		0.0035	< 0.0002	0.0074	0.0017	92	< 0.001	450
G280	11/24/2015		0.0066	0.11	< 0.001		0.029	< 0.001	120	54	0.019	0.0059	0.343		0.012	0.019		< 0.0002	0.0045	0.0032	94	< 0.001	460
G280	02/10/2016	< 0.001	< 0.001	0.048	< 0.001	0.012	< 0.01	< 0.001	60	55	< 0.004	< 0.002	0.466	< 0.001	0.0019	< 0.01	< 0.001	< 0.0002	0.0016	0.0033	84	< 0.001	410
G280	05/10/2016		< 0.001	0.045	< 0.001		< 0.01	< 0.001	63	50	< 0.004	< 0.002	0.429		< 0.001	< 0.01		< 0.0002	0.0014	0.0044	80	< 0.001	350
G280	05/13/2016	< 0.001	< 0.001	0.044	< 0.001	< 0.01	< 0.01	< 0.001		45	< 0.004	< 0.002	0.497	< 0.001	0.0014		< 0.001	< 0.0002	0.0014	0.0035	75	< 0.001	410
G280	08/03/2016		< 0.001	0.045	< 0.001		< 0.01	< 0.001	65	46	< 0.004	< 0.002	0.397		0.0014	< 0.01		< 0.0002	0.0016	0.0048	55	< 0.001	350
G280	11/20/2016		< 0.001	0.044	< 0.001		< 0.01	< 0.001		49	< 0.004	< 0.002	0.473		< 0.001	< 0.01		< 0.0002	0.0014	0.0034	67	< 0.001	430
G281	11/20/2015		0.0043	0.14	< 0.001		< 0.01	< 0.001	150	74	0.011	0.0056	0.349		0.0063	0.013		< 0.0002	0.0015	< 0.001	300	< 0.001	820
G281	02/11/2016		< 0.001	0.067	< 0.001		0.01	< 0.001	120	55	< 0.004	< 0.002	0.411		< 0.001	< 0.01		< 0.0002	< 0.001	< 0.001	340	< 0.001	740
G281	05/10/2016		< 0.001	0.072	< 0.001		< 0.01	< 0.001	130	72	< 0.004	< 0.002	0.405		< 0.001	< 0.01		< 0.0002	< 0.001	< 0.001	370	< 0.001	740
G281	08/01/2016		< 0.001	0.078	< 0.001		0.012	< 0.001	140	70	< 0.004	< 0.002	0.368		0.0011	< 0.01		< 0.0002	< 0.001	< 0.001	310	< 0.001	780
G281	08/31/2016	< 0.001				< 0.01								< 0.001			0.48						800
G401	11/21/2015		0.0046	0.037	< 0.001		3.3	< 0.001	440	3.6	0.0053	0.25	< 0.25		0.0031	0.055		< 0.0002	< 0.001	0.002	2300	< 0.001	3000
G401	02/22/2016		< 0.002	0.015	< 0.001		3.4	< 0.001	330	6	< 0.004	0.24	< 0.25		< 0.001	0.05		< 0.0002	< 0.001	< 0.002	2500	< 0.001	3000
G401	05/19/2016		0.0015	0.014	< 0.001		3.5	< 0.001	380	3	< 0.004	0.27	0.758		< 0.001	0.046		< 0.0002	< 0.001	< 0.001	2200	< 0.001	2800
G401	08/01/2016		0.004	0.053	< 0.001		4.1	0.0012	450	5.3	0.0096	0.28	< 0.25		0.0048	0.051		0.00093	< 0.001	0.0055	2100	< 0.001	2900
G401	11/17/2016		0.0027	0.021	< 0.001		4	0.0013		< 5	< 0.004	0.27	< 0.25		0.0029	0.054		< 0.0002	< 0.001	0.001	3400	< 0.001	3200
G402	11/21/2015		0.024	0.082	< 0.001		6.6	0.001	270	2.8	0.019	0.014	< 0.25		0.015	0.054		< 0.0002	0.006	0.002	1200	< 0.001	1700
G402	02/22/2016		0.027	0.11	< 0.001		5.7	< 0.001	220	2.8	0.031	0.015	0.355		0.018	0.057		< 0.0002	0.0049	0.0033	1000	< 0.001	1700
G402	05/19/2016		0.023	0.085	< 0.001		6.3	< 0.001	270	1.5	0.022	0.019	0.367		0.015	0.036		< 0.0002	0.0044	0.0016	960	< 0.001	1500

Well ID	Date	Arsenic, dissolved	Arsenic, total	Barium, total	Beryllium, total	Boron, dissolved	Boron, total	Cadmium, total	Calcium, total L	Chloride, total	Chromium, total	Cobalt, total	Fluoride, total	Lead, dissolved	Lead, total	Lithium, total	Manganese, dissolved	Mercury, total	Molybdenum, total	Selenium, total	Sulfate, total	Thallium, total	Total Dissolved Solids
G402	08/02/2016		0.01	0.047	< 0.001		7.4	< 0.001	240	2.2	0.0085	0.0074	0.33		0.0072	0.033		< 0.0002	0.0033	< 0.001	890	< 0.001	1500
G402	11/17/2016		0.012	0.054	< 0.001		6.9	< 0.001		2.6	0.011	0.007	0.463		0.0079	0.047		< 0.0002	0.0034	0.0012	1100	< 0.001	1700
G403	11/23/2015		0.0017	0.14	< 0.001		0.039	< 0.001	78	6.8	0.0062	< 0.002	0.442		0.0021	< 0.01		< 0.0002	0.004	< 0.001	35	< 0.001	320
G403	02/22/2016		< 0.001	0.13	< 0.001		0.064	< 0.001	69	4.1	< 0.004	< 0.002	0.518		< 0.001	< 0.01		< 0.0002	< 0.001	< 0.001	17	< 0.001	340
G403	05/18/2016		< 0.001	0.16	< 0.001		0.014	< 0.001	71	2.7	< 0.004	< 0.002	0.478		< 0.001	< 0.01		< 0.0002	0.0012	< 0.001	11	< 0.001	320
G403	08/01/2016		0.0033	0.24	< 0.001		0.027	< 0.001	140	4.5	0.0073	0.0029	0.485		0.0021	< 0.01		< 0.0002	0.0055	0.0068	9.9	< 0.001	320
G403	11/17/2016		0.0026	0.2	< 0.001		0.042	< 0.001		4	< 0.004	0.0024	0.539		< 0.001	< 0.01		< 0.0002	0.001	< 0.001	8.9	< 0.001	350
G404	11/21/2015		< 0.001	0.05	< 0.001		2.1	< 0.001	110	53	< 0.004	< 0.002	< 0.25		< 0.001	< 0.01		< 0.0002	< 0.001	< 0.001	180	< 0.001	580
G404	02/15/2016		< 0.001	0.043	< 0.001		1.6	< 0.001	110	49	< 0.004	< 0.002	< 0.25		< 0.001	< 0.01		< 0.0002	< 0.001	< 0.001	150	< 0.001	560
G404	05/19/2016		< 0.001	0.041	< 0.001		1.4	< 0.001	89	46	< 0.004	< 0.002	0.287		< 0.001	< 0.01		< 0.0002	< 0.001	< 0.001	140	< 0.001	460
G404	08/02/2016		< 0.001	0.055	< 0.001		3.2	< 0.001	120	62	< 0.004	< 0.002	< 0.25		< 0.001	< 0.01		< 0.0002	< 0.001	< 0.001	190	< 0.001	620
G404	11/22/2016		< 0.001	0.052	< 0.001		3.4	< 0.001		61	< 0.004	< 0.002	< 0.25		< 0.001	< 0.01		< 0.0002	< 0.001	< 0.001	380	< 0.001	880
G405	11/21/2015		0.014	0.051	< 0.001		17	0.0012	330	14	0.0051	0.0034	0.454		0.0085	< 0.01		< 0.0002	0.001	< 0.001	1700	< 0.001	2400
G405	02/15/2016		0.0028	0.018	< 0.001		16	< 0.001	320	11	< 0.004	< 0.002	0.459		0.0023	< 0.01		< 0.0002	< 0.001	< 0.001	1700	< 0.001	2500
G405	05/18/2016		0.0025	0.02	< 0.001		15	< 0.001	320	9.3	< 0.004	< 0.002	0.544		0.0011	< 0.01		< 0.0002	< 0.001	< 0.001	1800	< 0.001	2200
G405	08/02/2016		0.0063	0.028	< 0.001		17	< 0.001	280	3.4	< 0.004	0.0038	< 0.25		0.0018	< 0.01		< 0.0002	0.0016	< 0.001	1600	< 0.001	2200
G405	11/22/2016		0.0024	0.022	< 0.001		13	< 0.001		19	< 0.004	0.0021	0.525		0.0023	< 0.01		< 0.0002	0.0011	< 0.001	1400	< 0.001	2100
G406	08/30/2016	< 0.001				1.6								< 0.001			5.5						1300
G406	11/18/2016			0.024			1.9			4.4			0.345								910		1400
G407	08/30/2016	< 0.001				0.052								< 0.001			0.21						1400
G407	11/18/2016			0.024			0.078			14			0.289								830		1400
G45D	09/02/2016	0.0014				0.35								< 0.001			0.035						370
G46D	09/02/2016	0.0028				0.14								< 0.001			0.094						460

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**

Locations: APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405

Location Type Class

APW-2

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
B, diss	mg/L	8	7.245	7.180	8.100	6.300	0.626	0.27	Yes / Yes	0.00
Mn, diss	mg/L	8	0.432	0.414	0.730	0.130	0.166	0.01	Yes / No	0.00
SO4, diss	mg/L	8	805.375	840.000	1,100.000	500.000	173.105	5.17	Yes / Yes	12.50
TDS	mg/L	8	1,651.250	1,600.000	1,810.000	1,600.000	78.456	0.00	No / No	0.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**
Locations: APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405
Location Type Class
G151

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	3	0.0007	0.0005	0.0012	0.0005	0.0004	0.00	No / No	66.67
B, diss	mg/L	16	0.016	0.012	0.052	0.003	0.013	0.00	No / Yes	50.00
B, tot	mg/L	3	0.0183	0.0190	0.0260	0.0100	0.0080	-0.03	Yes / Yes	0.00
Ba, tot	mg/L	3	0.0643	0.0670	0.0690	0.0570	0.0064	0.02	Yes / Yes	0.00
Be, tot	mg/L	3	0.00050	0.00050	0.00050	0.00050	0.00000	0.00	No / No	100.00
Cd,tot	mg/L	3	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
Cl, tot	mg/L	3	58.333	58.000	67.000	50.000	8.505	16.23	Yes / Yes	0.00
Co, tot	mg/L	3	0.0010	0.0010	0.0010	0.0010	0.0000	0.00	No / No	100.00
Cr, tot	mg/L	3	0.0020	0.0020	0.0020	0.0020	0.0000	0.00	No / No	100.00
F, tot	mg/L	3	0.609	0.649	0.691	0.486	0.108	-0.09	Yes / Yes	0.00
Hg, tot	mg/L	3	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Mn, diss	mg/L	16	0.131	0.092	0.560	0.011	0.131	0.00	No / Yes	0.00
Mn, tot	mg/L	3	0.225	0.230	0.360	0.086	0.137	0.56	Yes / Yes	0.00
Pb, tot	mg/L	3	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
Sb, tot	mg/L	3	0.0015	0.0015	0.0015	0.0015	0.0000	0.00	No / No	100.00
Se, tot	mg/L	3	0.0025	0.0024	0.0029	0.0021	0.0004	0.00	Yes / Yes	0.00
SO4, diss	mg/L	16	111.563	110.000	140.000	100.000	11.213	4.79	No / No	0.00
SO4, tot	mg/L	3	104.333	98.000	120.000	95.000	13.650	6.09	Yes / Yes	0.00
TDS	mg/L	17	551.176	560.000	660.000	500.000	44.424	0.00	Yes / Yes	0.00
Tl, tot	mg/L	3	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**
Locations: APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405
Location Type Class
G152

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	3	0.0016	0.0014	0.0023	0.0011	0.0006	0.00	Yes / Yes	0.00
B, diss	mg/L	16	0.047	0.041	0.110	0.015	0.025	0.01	No / Yes	0.00
B, tot	mg/L	3	0.0383	0.0360	0.0470	0.0320	0.0078	-0.03	Yes / Yes	0.00
Ba, tot	mg/L	3	0.1200	0.1300	0.1300	0.1000	0.0173	-0.06	No / No	0.00
Be, tot	mg/L	3	0.00050	0.00050	0.00050	0.00050	0.00000	0.00	No / No	100.00
Cd,tot	mg/L	3	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
Cl, tot	mg/L	3	42.333	42.000	45.000	40.000	2.517	10.15	Yes / Yes	0.00
Co, tot	mg/L	3	0.0014	0.0010	0.0023	0.0010	0.0008	0.00	No / No	66.67
Cr, tot	mg/L	3	0.0040	0.0020	0.0080	0.0020	0.0035	-0.01	No / No	66.67
F, tot	mg/L	3	0.550	0.587	0.642	0.422	0.114	-0.11	Yes / Yes	0.00
Hg, tot	mg/L	3	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Mn, diss	mg/L	16	0.294	0.180	0.927	0.034	0.277	0.07	No / Yes	0.00
Mn, tot	mg/L	3	0.317	0.310	0.370	0.270	0.050	0.12	Yes / Yes	0.00
Pb, tot	mg/L	3	0.0012	0.0005	0.0026	0.0005	0.0012	0.00	No / No	66.67
Sb, tot	mg/L	3	0.0015	0.0015	0.0015	0.0015	0.0000	0.00	No / No	100.00
Se, tot	mg/L	3	0.0036	0.0035	0.0043	0.0030	0.0007	0.00	Yes / Yes	0.00
SO4, diss	mg/L	16	161.063	135.000	300.000	107.000	61.151	26.31	No / No	0.00
SO4, tot	mg/L	3	120.000	120.000	130.000	110.000	10.000	20.29	Yes / Yes	0.00
TDS	mg/L	17	676.706	620.000	1,100.000	494.000	156.107	72.77	No / Yes	0.00
Tl, tot	mg/L	3	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**
Locations: APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405
Location Type Class
G153

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	3	0.0056	0.0056	0.0059	0.0052	0.0004	0.00	Yes / Yes	0.00
B, diss	mg/L	16	0.028	0.027	0.058	0.012	0.012	-0.01	Yes / Yes	0.00
B, tot	mg/L	3	0.0437	0.0360	0.0640	0.0310	0.0178	-0.07	Yes / Yes	0.00
Ba, tot	mg/L	3	0.0247	0.0220	0.0360	0.0160	0.0103	-0.04	Yes / Yes	0.00
Be, tot	mg/L	3	0.00050	0.00050	0.00050	0.00050	0.00000	0.00	No / No	100.00
Cd,tot	mg/L	3	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
Cl, tot	mg/L	3	140.000	130.000	160.000	130.000	17.321	0.00	No / No	0.00
Co, tot	mg/L	3	0.0037	0.0034	0.0068	0.0010	0.0029	-0.01	Yes / Yes	33.33
Cr, tot	mg/L	3	0.0045	0.0041	0.0053	0.0041	0.0007	0.00	No / No	0.00
F, tot	mg/L	5	0.363	0.369	0.410	0.293	0.047	-0.01	Yes / Yes	0.00
Hg, tot	mg/L	3	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Mn, diss	mg/L	16	0.235	0.175	1.020	0.024	0.249	-0.12	No / Yes	0.00
Mn, tot	mg/L	3	0.673	0.510	1.300	0.210	0.563	-2.21	Yes / Yes	0.00
Pb, tot	mg/L	3	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
Sb, tot	mg/L	3	0.0015	0.0015	0.0015	0.0015	0.0000	0.00	No / No	100.00
Se, tot	mg/L	3	0.0230	0.0210	0.0270	0.0210	0.0035	0.00	No / No	0.00
SO4, diss	mg/L	16	1,823.750	1,800.000	2,100.000	1,500.000	206.458	184.47	Yes / Yes	0.00
SO4, tot	mg/L	3	1,633.333	1,500.000	1,900.000	1,500.000	230.940	0.00	No / No	0.00
TDS	mg/L	17	3,361.765	3,300.000	3,900.000	2,800.000	340.739	42.47	Yes / Yes	0.00
Tl, tot	mg/L	3	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**
Locations: APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405
Location Type Class
G154

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	3	0.0008	0.0005	0.0014	0.0005	0.0005	0.00	No / No	66.67
B, diss	mg/L	16	0.036	0.037	0.045	0.021	0.008	0.00	No / No	0.00
B, tot	mg/L	3	0.0300	0.0310	0.0380	0.0210	0.0085	0.01	Yes / Yes	0.00
Ba, tot	mg/L	3	0.0340	0.0330	0.0370	0.0320	0.0026	-0.01	Yes / Yes	0.00
Be, tot	mg/L	3	0.00050	0.00050	0.00050	0.00050	0.00000	0.00	No / No	100.00
Cd,tot	mg/L	3	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
Cl, tot	mg/L	3	6.500	4.900	10.000	4.600	3.035	-10.35	Yes / Yes	0.00
Co, tot	mg/L	3	0.0010	0.0010	0.0010	0.0010	0.0000	0.00	No / No	100.00
Cr, tot	mg/L	3	0.0020	0.0020	0.0020	0.0020	0.0000	0.00	No / No	100.00
F, tot	mg/L	3	1.014	1.010	1.060	0.971	0.045	0.10	Yes / Yes	0.00
Hg, tot	mg/L	3	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Mn, diss	mg/L	16	0.062	0.035	0.462	0.003	0.112	0.00	No / Yes	0.00
Mn, tot	mg/L	3	0.157	0.160	0.160	0.150	0.006	0.02	No / No	0.00
Pb, tot	mg/L	3	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
Sb, tot	mg/L	3	0.0015	0.0015	0.0015	0.0015	0.0000	0.00	No / No	100.00
Se, tot	mg/L	3	0.0054	0.0058	0.0062	0.0042	0.0011	0.00	Yes / Yes	0.00
SO4, diss	mg/L	16	110.250	105.000	175.000	82.000	23.601	-11.96	No / Yes	0.00
SO4, tot	mg/L	3	98.667	93.000	110.000	93.000	9.815	34.50	No / No	0.00
TDS	mg/L	17	476.118	460.000	624.000	410.000	52.309	17.11	No / No	0.00
Tl, tot	mg/L	3	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**
Locations: APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405
Location Type Class
G270

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	38	0.0010	0.0005	0.0110	0.0005	0.0018	0.00	No / No	73.68
B, diss	mg/L	34	0.029	0.012	0.125	0.005	0.034	0.00	No / No	47.06
B, tot	mg/L	38	0.0207	0.0050	0.1250	0.0050	0.0264	0.00	No / No	68.42
Ba, tot	mg/L	20	0.0527	0.0495	0.0760	0.0320	0.0155	0.00	Yes / Yes	0.00
Be, tot	mg/L	20	0.00060	0.00050	0.00250	0.00050	0.00045	0.00	No / No	100.00
Ca, tot	mg/L	34	66.588	67.000	81.000	49.000	7.785	-0.34	Yes / Yes	0.00
Cd,tot	mg/L	38	0.0007	0.0005	0.0080	0.0003	0.0012	0.00	No / No	97.37
Cl, tot	mg/L	38	35.521	20.500	91.000	5.000	27.343	2.03	No / No	2.63
Co, tot	mg/L	20	0.0011	0.0010	0.0025	0.0005	0.0005	0.00	No / No	85.00
Cr, tot	mg/L	20	0.0027	0.0020	0.0125	0.0020	0.0023	0.00	No / No	100.00
F, tot	mg/L	20	0.373	0.361	0.504	0.279	0.058	0.00	Yes / Yes	0.00
Hg, tot	mg/L	20	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Li, tot	mg/L	4	0.0050	0.0050	0.0050	0.0050	0.0000	0.00	No / No	100.00
Mn, diss	mg/L	34	0.094	0.045	0.470	0.003	0.108	-0.02	No / Yes	0.00
Mn, tot	mg/L	34	0.146	0.083	0.620	0.021	0.134	-0.03	No / No	0.00
Mo, tot	mg/L	8	0.0007	0.0005	0.0011	0.0005	0.0003	0.00	No / No	62.50
Pb, tot	mg/L	38	0.0011	0.0005	0.0073	0.0003	0.0013	0.00	No / No	68.42
Ra-226,228, tot	pCi/L	4	0.5815	0.5340	0.9970	0.2610	0.3415	0.82	Yes / Yes	25.00
Sb, tot	mg/L	20	0.0013	0.0015	0.0015	0.0010	0.0002	0.00	No / No	100.00
Se, tot	mg/L	20	0.0019	0.0013	0.0078	0.0005	0.0020	0.00	No / No	60.00
SO4, diss	mg/L	34	54.312	42.500	140.000	2.100	50.372	15.70	No / No	0.00
SO4, tot	mg/L	38	58.747	65.000	140.000	2.300	50.239	15.58	No / No	0.00
TDS	mg/L	37	453.514	460.000	550.000	340.000	52.769	10.59	Yes / Yes	0.00
Tl, tot	mg/L	20	0.0007	0.0005	0.0010	0.0005	0.0002	0.00	No / No	100.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**
Locations: APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405
Location Type Class
G271

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	33	0.0012	0.0005	0.0049	0.0005	0.0011	0.00	No / No	60.61
B, diss	mg/L	29	0.281	0.260	0.610	0.130	0.128	0.05	No / Yes	0.00
B, tot	mg/L	33	0.3088	0.2400	0.9800	0.1100	0.1904	0.03	No / Yes	0.00
Ba, tot	mg/L	19	0.0456	0.0340	0.1100	0.0280	0.0220	0.00	No / No	0.00
Be, tot	mg/L	19	0.00050	0.00050	0.00050	0.00050	0.00000	0.00	No / No	100.00
Ca, tot	mg/L	29	123.276	120.000	170.000	96.000	17.834	2.68	Yes / Yes	0.00
Cd,tot	mg/L	33	0.0005	0.0005	0.0005	0.0003	0.0001	0.00	No / No	100.00
Cl, tot	mg/L	33	41.427	42.000	58.000	5.100	9.067	0.00	No / No	0.00
Co, tot	mg/L	19	0.0014	0.0010	0.0047	0.0005	0.0010	0.00	No / No	78.95
Cr, tot	mg/L	19	0.0037	0.0020	0.0140	0.0020	0.0032	0.00	No / No	73.68
F, tot	mg/L	19	0.415	0.410	0.562	0.298	0.062	0.01	Yes / Yes	0.00
Hg, tot	mg/L	19	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Li, tot	mg/L	4	0.0050	0.0050	0.0050	0.0050	0.0000	0.00	No / No	100.00
Mn, diss	mg/L	29	0.015	0.001	0.220	0.001	0.045	0.00	No / No	62.07
Mn, tot	mg/L	29	0.058	0.021	0.270	0.001	0.075	-0.01	No / Yes	0.00
Mo, tot	mg/L	8	0.0010	0.0005	0.0036	0.0005	0.0011	0.00	No / No	62.50
Pb, tot	mg/L	33	0.0022	0.0012	0.0110	0.0005	0.0024	0.00	No / No	45.45
Ra-226,228, tot	pCi/L	4	0.5905	0.5785	1.0200	0.1850	0.4251	-1.19	Yes / Yes	0.00
Sb, tot	mg/L	19	0.0014	0.0015	0.0015	0.0010	0.0002	0.00	No / No	100.00
Se, tot	mg/L	19	0.0040	0.0035	0.0099	0.0018	0.0021	0.00	No / Yes	0.00
SO4, diss	mg/L	29	354.483	360.000	520.000	220.000	87.447	35.77	Yes / Yes	0.00
SO4, tot	mg/L	33	356.970	350.000	540.000	230.000	87.446	28.25	Yes / Yes	0.00
TDS	mg/L	31	861.935	860.000	1,000.000	710.000	96.035	29.19	No / No	0.00
Tl, tot	mg/L	19	0.0006	0.0005	0.0010	0.0005	0.0002	0.00	No / No	100.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**

Locations: **APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405**

Location	Type	Class
G272	**Groundwater**	

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	29	0.0006	0.0005	0.0013	0.0005	0.0002	0.00	No / No	86.21
B, diss	mg/L	29	0.019	0.005	0.270	0.005	0.050	0.00	No / No	86.21
B, tot	mg/L	29	0.0144	0.0050	0.0600	0.0050	0.0167	0.00	No / No	68.97
Ba, tot	mg/L	15	0.0673	0.0620	0.0990	0.0580	0.0108	0.00	No / No	0.00
Be, tot	mg/L	15	0.00050	0.00050	0.00050	0.00050	0.00000	0.00	No / No	100.00
Ca, tot	mg/L	25	97.400	98.000	110.000	82.000	9.000	3.90	No / No	0.00
Cd,tot	mg/L	29	0.0005	0.0005	0.0005	0.0003	0.0001	0.00	No / No	100.00
Cl, tot	mg/L	29	39.552	41.000	53.000	29.000	6.294	-2.64	Yes / Yes	3.45
Co, tot	mg/L	15	0.0011	0.0010	0.0022	0.0005	0.0004	0.00	No / No	80.00
Cr, tot	mg/L	15	0.0029	0.0020	0.0110	0.0020	0.0024	0.00	No / No	86.67
F, tot	mg/L	15	0.449	0.459	0.561	0.355	0.058	0.00	Yes / Yes	0.00
Hg, tot	mg/L	15	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Mn, diss	mg/L	29	0.011	0.001	0.230	0.001	0.043	0.00	No / No	75.86
Mn, tot	mg/L	29	0.029	0.011	0.150	0.002	0.040	0.00	No / Yes	0.00
Mo, tot	mg/L	4	0.0012	0.0009	0.0024	0.0005	0.0009	0.00	Yes / Yes	50.00
Pb, tot	mg/L	29	0.0011	0.0005	0.0049	0.0005	0.0011	0.00	No / No	65.52
Sb, tot	mg/L	15	0.0014	0.0015	0.0015	0.0010	0.0002	0.00	No / No	100.00
Se, tot	mg/L	15	0.0017	0.0013	0.0042	0.0005	0.0012	0.00	No / Yes	53.33
SO4, diss	mg/L	29	264.483	270.000	380.000	140.000	62.996	28.10	Yes / Yes	0.00
SO4, tot	mg/L	29	253.448	250.000	380.000	120.000	68.935	30.52	Yes / Yes	0.00
TDS	mg/L	27	702.963	680.000	840.000	570.000	68.770	25.54	Yes / Yes	0.00
Tl, tot	mg/L	15	0.0006	0.0005	0.0010	0.0005	0.0002	0.00	No / No	100.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**
Locations: APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405
Location Type Class
G273

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	33	0.0008	0.0005	0.0045	0.0005	0.0009	0.00	No / No	75.76
B, diss	mg/L	29	0.224	0.180	0.620	0.019	0.176	0.06	No / No	6.90
B, tot	mg/L	33	0.2084	0.2000	0.4800	0.0160	0.1368	0.05	Yes / No	9.09
Ba, tot	mg/L	19	0.0503	0.0440	0.0940	0.0280	0.0210	-0.01	No / Yes	0.00
Be, tot	mg/L	19	0.00050	0.00050	0.00050	0.00050	0.00000	0.00	No / No	100.00
Ca, tot	mg/L	29	156.207	150.000	200.000	120.000	19.533	0.00	Yes / Yes	0.00
Cd,tot	mg/L	33	0.0005	0.0005	0.0005	0.0003	0.0001	0.00	No / No	100.00
Cl, tot	mg/L	33	35.788	37.000	59.000	4.000	9.591	2.49	Yes / No	0.00
Co, tot	mg/L	19	0.0009	0.0010	0.0010	0.0005	0.0002	0.00	No / No	100.00
Cr, tot	mg/L	19	0.0038	0.0020	0.0340	0.0020	0.0073	0.00	No / No	94.74
F, tot	mg/L	19	0.335	0.330	0.537	0.125	0.099	0.01	Yes / No	10.53
Hg, tot	mg/L	19	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Li, tot	mg/L	4	0.0050	0.0050	0.0050	0.0050	0.0000	0.00	No / No	100.00
Mn, diss	mg/L	29	0.042	0.028	0.330	0.001	0.059	-0.01	No / No	0.00
Mn, tot	mg/L	29	0.057	0.043	0.190	0.019	0.043	-0.01	No / Yes	0.00
Mo, tot	mg/L	8	0.0007	0.0005	0.0019	0.0005	0.0005	0.00	No / No	87.50
Pb, tot	mg/L	33	0.0006	0.0005	0.0037	0.0003	0.0006	0.00	No / No	87.88
Ra-226,228, tot	pCi/L	4	1.2503	1.1420	2.0600	0.6570	0.6588	-2.20	Yes / Yes	0.00
Sb, tot	mg/L	19	0.0014	0.0015	0.0015	0.0010	0.0002	0.00	No / No	100.00
Se, tot	mg/L	19	0.0010	0.0005	0.0051	0.0005	0.0011	0.00	No / No	84.21
SO4, diss	mg/L	29	524.000	520.000	700.000	46.000	131.055	8.97	No / No	0.00
SO4, tot	mg/L	33	529.697	520.000	750.000	340.000	105.874	6.45	Yes / Yes	0.00
TDS	mg/L	31	1,085.484	1,100.000	1,300.000	840.000	140.139	0.00	No / No	0.00
Tl, tot	mg/L	19	0.0006	0.0005	0.0010	0.0005	0.0002	0.00	No / No	100.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**

Locations: **APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405**

Location	Type	Class
G274	**Groundwater**	

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	29	0.0008	0.0005	0.0040	0.0005	0.0008	0.00	No / No	82.76
B, diss	mg/L	29	0.295	0.180	0.970	0.005	0.302	0.13	No / No	27.59
B, tot	mg/L	29	0.2636	0.1600	0.7400	0.0050	0.2533	0.11	No / No	24.14
Ba, tot	mg/L	15	0.0759	0.0700	0.1200	0.0520	0.0181	-0.01	Yes / Yes	0.00
Be, tot	mg/L	15	0.00059	0.00050	0.00180	0.00050	0.00034	0.00	No / No	93.33
Ca, tot	mg/L	25	112.320	110.000	130.000	98.000	8.440	0.00	No / No	0.00
Cd,tot	mg/L	29	0.0005	0.0005	0.0014	0.0003	0.0002	0.00	No / No	96.55
Cl, tot	mg/L	29	33.572	36.000	55.000	3.600	11.500	-4.55	Yes / No	0.00
Co, tot	mg/L	15	0.0010	0.0010	0.0028	0.0005	0.0005	0.00	No / No	93.33
Cr, tot	mg/L	15	0.0024	0.0020	0.0059	0.0020	0.0010	0.00	No / No	93.33
F, tot	mg/L	15	0.351	0.350	0.455	0.262	0.052	0.01	Yes / Yes	0.00
Hg, tot	mg/L	15	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Mn, diss	mg/L	29	0.003	0.001	0.046	0.001	0.009	0.00	No / No	68.97
Mn, tot	mg/L	29	0.049	0.022	0.370	0.003	0.087	0.00	No / Yes	0.00
Mo, tot	mg/L	4	0.0007	0.0005	0.0012	0.0005	0.0003	0.00	No / No	75.00
Pb, tot	mg/L	29	0.0015	0.0005	0.0100	0.0003	0.0024	0.00	No / No	65.52
Sb, tot	mg/L	15	0.0014	0.0015	0.0015	0.0010	0.0002	0.00	No / No	100.00
Se, tot	mg/L	15	0.0010	0.0013	0.0022	0.0005	0.0005	0.00	No / No	73.33
SO4, diss	mg/L	29	340.000	350.000	400.000	240.000	41.748	0.00	No / No	0.00
SO4, tot	mg/L	29	336.552	330.000	460.000	230.000	54.725	6.69	Yes / Yes	0.00
TDS	mg/L	27	862.593	870.000	980.000	770.000	64.307	-16.05	Yes / Yes	0.00
Tl, tot	mg/L	15	0.0007	0.0005	0.0013	0.0005	0.0003	0.00	No / No	93.33

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**

Locations: **APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405**

Location	Type	Class
G275	**Groundwater**	

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	25	0.0016	0.0011	0.0043	0.0005	0.0013	0.00	No / No	48.00
B, diss	mg/L	25	3.176	3.500	4.600	0.910	1.040	0.10	Yes / No	0.00
B, tot	mg/L	25	3.3360	3.6000	4.6000	1.2000	0.9652	0.04	No / No	0.00
Ba, tot	mg/L	12	0.0468	0.0390	0.1200	0.0320	0.0241	0.00	No / No	0.00
Be, tot	mg/L	12	0.00050	0.00050	0.00050	0.00050	0.00000	0.00	No / No	100.00
Ca, tot	mg/L	22	221.364	230.000	310.000	120.000	48.726	5.01	Yes / Yes	0.00
Cd,tot	mg/L	25	0.0005	0.0005	0.0005	0.0003	0.0001	0.00	No / No	100.00
Cl, tot	mg/L	25	16.752	16.000	30.000	9.200	5.504	1.57	Yes / Yes	0.00
Co, tot	mg/L	12	0.0010	0.0010	0.0025	0.0005	0.0005	0.00	No / No	100.00
Cr, tot	mg/L	12	0.0038	0.0023	0.0125	0.0020	0.0034	0.00	No / No	83.33
F, tot	mg/L	12	0.310	0.320	0.452	0.125	0.083	0.01	Yes / No	8.33
Hg, tot	mg/L	12	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Mn, diss	mg/L	25	0.051	0.019	0.340	0.001	0.086	0.00	No / Yes	8.00
Mn, tot	mg/L	25	0.168	0.085	0.780	0.012	0.203	0.01	No / Yes	0.00
Mo, tot	mg/L	3	0.0008	0.0005	0.0014	0.0005	0.0005	0.00	No / No	66.67
Pb, tot	mg/L	25	0.0024	0.0013	0.0100	0.0003	0.0028	0.00	No / Yes	36.00
Sb, tot	mg/L	12	0.0014	0.0015	0.0015	0.0010	0.0002	0.00	No / No	100.00
Se, tot	mg/L	12	0.0014	0.0013	0.0060	0.0005	0.0015	0.00	No / No	66.67
SO4, diss	mg/L	25	677.600	720.000	920.000	280.000	183.627	30.33	No / No	0.00
SO4, tot	mg/L	25	684.000	720.000	990.000	310.000	213.288	0.84	Yes / No	0.00
TDS	mg/L	24	1,388.333	1,500.000	2,000.000	840.000	270.373	0.00	Yes / No	0.00
Tl, tot	mg/L	12	0.0007	0.0005	0.0010	0.0005	0.0002	0.00	No / No	100.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**
Locations: APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405
Location Type Class
G281

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	4	0.0015	0.0005	0.0043	0.0005	0.0019	0.00	No / No	75.00
B, tot	mg/L	4	0.0080	0.0075	0.0120	0.0050	0.0036	0.01	Yes / Yes	50.00
Ba, tot	mg/L	4	0.0893	0.0750	0.1400	0.0670	0.0341	-0.03	Yes / Yes	0.00
Be, tot	mg/L	4	0.00050	0.00050	0.00050	0.00050	0.00000	0.00	No / No	100.00
Ca, tot	mg/L	4	135.000	135.000	150.000	120.000	12.910	13.36	Yes / Yes	0.00
Cd,tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
Cl, tot	mg/L	4	67.750	71.000	74.000	55.000	8.655	-4.99	Yes / Yes	0.00
Co, tot	mg/L	4	0.0022	0.0010	0.0056	0.0010	0.0023	0.00	No / No	75.00
Cr, tot	mg/L	4	0.0043	0.0020	0.0110	0.0020	0.0045	-0.01	No / No	75.00
F, tot	mg/L	4	0.383	0.387	0.411	0.349	0.030	0.00	Yes / Yes	0.00
Hg, tot	mg/L	4	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Li, tot	mg/L	4	0.0070	0.0050	0.0130	0.0050	0.0040	-0.01	No / No	75.00
Mo, tot	mg/L	4	0.0008	0.0005	0.0015	0.0005	0.0005	0.00	No / No	75.00
Pb, tot	mg/L	4	0.0021	0.0008	0.0063	0.0005	0.0028	0.00	No / Yes	50.00
Ra-226,228, tot	pCi/L	4	0.7225	0.5910	1.4900	0.2180	0.5416	0.80	Yes / Yes	25.00
Sb, tot	mg/L	4	0.0015	0.0015	0.0015	0.0015	0.0000	0.00	No / No	100.00
Se, tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
SO4, tot	mg/L	4	330.000	325.000	370.000	300.000	31.623	68.72	Yes / Yes	0.00
TDS	mg/L	4	770.000	760.000	820.000	740.000	38.297	-28.65	Yes / Yes	0.00
Tl, tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**
Locations: APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405
Location Type Class
G401

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	4	0.0028	0.0028	0.0046	0.0010	0.0018	0.00	Yes / Yes	25.00
B, tot	mg/L	4	3.5750	3.4500	4.1000	3.3000	0.3594	0.79	Yes / Yes	0.00
Ba, tot	mg/L	4	0.0298	0.0260	0.0530	0.0140	0.0188	0.01	Yes / Yes	0.00
Be, tot	mg/L	4	0.00050	0.00050	0.00050	0.00050	0.00000	0.00	No / No	100.00
Ca, tot	mg/L	4	400.000	410.000	450.000	330.000	55.976	112.15	Yes / Yes	0.00
Cd,tot	mg/L	4	0.0007	0.0005	0.0012	0.0005	0.0003	0.00	No / No	75.00
Cl, tot	mg/L	4	4.475	4.450	6.000	3.000	1.408	0.61	Yes / Yes	0.00
Co, tot	mg/L	4	0.2600	0.2600	0.2800	0.2400	0.0183	0.05	Yes / Yes	0.00
Cr, tot	mg/L	4	0.0047	0.0037	0.0096	0.0020	0.0036	0.00	Yes / Yes	50.00
F, tot	mg/L	4	0.283	0.125	0.758	0.125	0.317	0.00	No / No	75.00
Hg, tot	mg/L	4	0.00031	0.00010	0.00093	0.00010	0.00042	0.00	No / No	75.00
Li, tot	mg/L	4	0.0505	0.0505	0.0550	0.0460	0.0037	-0.01	Yes / Yes	0.00
Mo, tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
Pb, tot	mg/L	4	0.0022	0.0018	0.0048	0.0005	0.0021	0.00	Yes / Yes	50.00
Ra-226,228, tot	pCi/L	4	1.3010	1.3150	1.6300	0.9440	0.3593	-0.17	Yes / Yes	0.00
Sb, tot	mg/L	4	0.0015	0.0015	0.0015	0.0015	0.0000	0.00	No / No	100.00
Se, tot	mg/L	4	0.0023	0.0015	0.0055	0.0005	0.0023	0.00	Yes / Yes	50.00
SO4, tot	mg/L	4	2,275.000	2,250.000	2,500.000	2,100.000	170.783	-390.59	Yes / Yes	0.00
TDS	mg/L	4	2,925.000	2,950.000	3,000.000	2,800.000	95.743	-185.33	Yes / Yes	0.00
Tl, tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**
Locations: APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405
Location Type Class
G402

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	4	0.0210	0.0235	0.0270	0.0100	0.0075	-0.02	Yes / Yes	0.00
B, tot	mg/L	4	6.5000	6.4500	7.4000	5.7000	0.7071	1.83	Yes / Yes	0.00
Ba, tot	mg/L	4	0.0810	0.0835	0.1100	0.0470	0.0259	-0.08	Yes / Yes	0.00
Be, tot	mg/L	4	0.00050	0.00050	0.00050	0.00050	0.00000	0.00	No / No	100.00
Ca, tot	mg/L	4	250.000	255.000	270.000	220.000	24.495	-21.49	Yes / Yes	0.00
Cd,tot	mg/L	4	0.0006	0.0005	0.0010	0.0005	0.0003	0.00	No / No	75.00
Cl, tot	mg/L	4	2.325	2.500	2.800	1.500	0.618	-1.11	Yes / Yes	0.00
Co, tot	mg/L	4	0.0139	0.0145	0.0190	0.0074	0.0048	0.00	Yes / Yes	0.00
Cr, tot	mg/L	4	0.0201	0.0205	0.0310	0.0085	0.0093	-0.03	Yes / Yes	0.00
F, tot	mg/L	4	0.294	0.343	0.367	0.125	0.114	0.17	No / No	25.00
Hg, tot	mg/L	4	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Li, tot	mg/L	4	0.0450	0.0450	0.0570	0.0330	0.0122	-0.03	Yes / Yes	0.00
Mo, tot	mg/L	4	0.0047	0.0047	0.0060	0.0033	0.0011	0.00	Yes / Yes	0.00
Pb, tot	mg/L	4	0.0138	0.0150	0.0180	0.0072	0.0046	-0.01	Yes / Yes	0.00
Ra-226,228, tot	pCi/L	4	3.1500	3.5500	4.4600	1.0400	1.5553	-2.49	Yes / Yes	0.00
Sb, tot	mg/L	4	0.0015	0.0015	0.0015	0.0015	0.0000	0.00	No / No	100.00
Se, tot	mg/L	4	0.0019	0.0018	0.0033	0.0005	0.0012	0.00	Yes / Yes	25.00
SO4, tot	mg/L	4	1,012.500	980.000	1,200.000	890.000	133.010	-392.46	Yes / Yes	0.00
TDS	mg/L	4	1,600.000	1,600.000	1,700.000	1,500.000	115.470	-346.15	No / No	0.00
Tl, tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**
Locations: APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405
Location Type Class
G403

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	4	0.0015	0.0011	0.0033	0.0005	0.0013	0.00	Yes / Yes	50.00
B, tot	mg/L	4	0.0360	0.0330	0.0640	0.0140	0.0213	-0.03	Yes / Yes	0.00
Ba, tot	mg/L	4	0.1675	0.1500	0.2400	0.1300	0.0499	0.14	Yes / Yes	0.00
Be, tot	mg/L	4	0.00050	0.00050	0.00050	0.00050	0.00000	0.00	No / No	100.00
Ca, tot	mg/L	4	89.500	74.500	140.000	69.000	33.887	49.18	No / Yes	0.00
Cd,tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
Cl, tot	mg/L	4	4.525	4.300	6.800	2.700	1.702	-4.64	Yes / Yes	0.00
Co, tot	mg/L	4	0.0015	0.0010	0.0029	0.0010	0.0010	0.00	No / No	75.00
Cr, tot	mg/L	4	0.0044	0.0041	0.0073	0.0020	0.0028	0.00	Yes / Yes	50.00
F, tot	mg/L	4	0.481	0.482	0.518	0.442	0.031	0.05	Yes / Yes	0.00
Hg, tot	mg/L	4	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Li, tot	mg/L	4	0.0050	0.0050	0.0050	0.0050	0.0000	0.00	No / No	100.00
Mo, tot	mg/L	4	0.0028	0.0026	0.0055	0.0005	0.0024	0.00	Yes / Yes	25.00
Pb, tot	mg/L	4	0.0013	0.0013	0.0021	0.0005	0.0009	0.00	No / No	50.00
Ra-226,228, tot	pCi/L	4	0.3674	0.1973	0.9680	0.1070	0.4057	0.85	Yes / Yes	25.00
Sb, tot	mg/L	4	0.0015	0.0015	0.0015	0.0015	0.0000	0.00	No / No	100.00
Se, tot	mg/L	4	0.0021	0.0005	0.0068	0.0005	0.0032	0.00	No / No	75.00
SO4, tot	mg/L	4	18.225	14.000	35.000	9.900	11.610	-30.93	Yes / Yes	0.00
TDS	mg/L	4	325.000	320.000	340.000	320.000	10.000	0.00	No / No	0.00
Tl, tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**
Locations: APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405
Location Type Class
G404

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
B, tot	mg/L	4	2.0750	1.8500	3.2000	1.4000	0.8057	0.40	Yes / Yes	0.00
Ba, tot	mg/L	4	0.0473	0.0465	0.0550	0.0410	0.0064	0.00	Yes / Yes	0.00
Be, tot	mg/L	4	0.00050	0.00050	0.00050	0.00050	0.00000	0.00	No / No	100.00
Ca, tot	mg/L	4	107.250	110.000	120.000	89.000	13.048	7.16	Yes / Yes	0.00
Cd,tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
Cl, tot	mg/L	4	52.500	51.000	62.000	46.000	6.952	0.62	Yes / Yes	0.00
Co, tot	mg/L	4	0.0010	0.0010	0.0010	0.0010	0.0000	0.00	No / No	100.00
Cr, tot	mg/L	4	0.0020	0.0020	0.0020	0.0020	0.0000	0.00	No / No	100.00
F, tot	mg/L	4	0.166	0.125	0.287	0.125	0.081	0.00	No / No	75.00
Hg, tot	mg/L	4	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Li, tot	mg/L	4	0.0050	0.0050	0.0050	0.0050	0.0000	0.00	No / No	100.00
Mo, tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
Pb, tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
Ra-226,228, tot	pCi/L	4	1.1275	1.0655	2.0700	0.3090	0.8526	2.14	Yes / Yes	25.00
Sb, tot	mg/L	4	0.0015	0.0015	0.0015	0.0015	0.0000	0.00	No / No	100.00
Se, tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
SO4, tot	mg/L	4	165.000	165.000	190.000	140.000	23.805	-12.27	Yes / Yes	0.00
TDS	mg/L	4	555.000	570.000	620.000	460.000	68.069	-13.82	Yes / Yes	0.00
Tl, tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Coffeen
Ash Pond 2 - Statistical Summary for Select Monitoring Wells

User Supplied Information

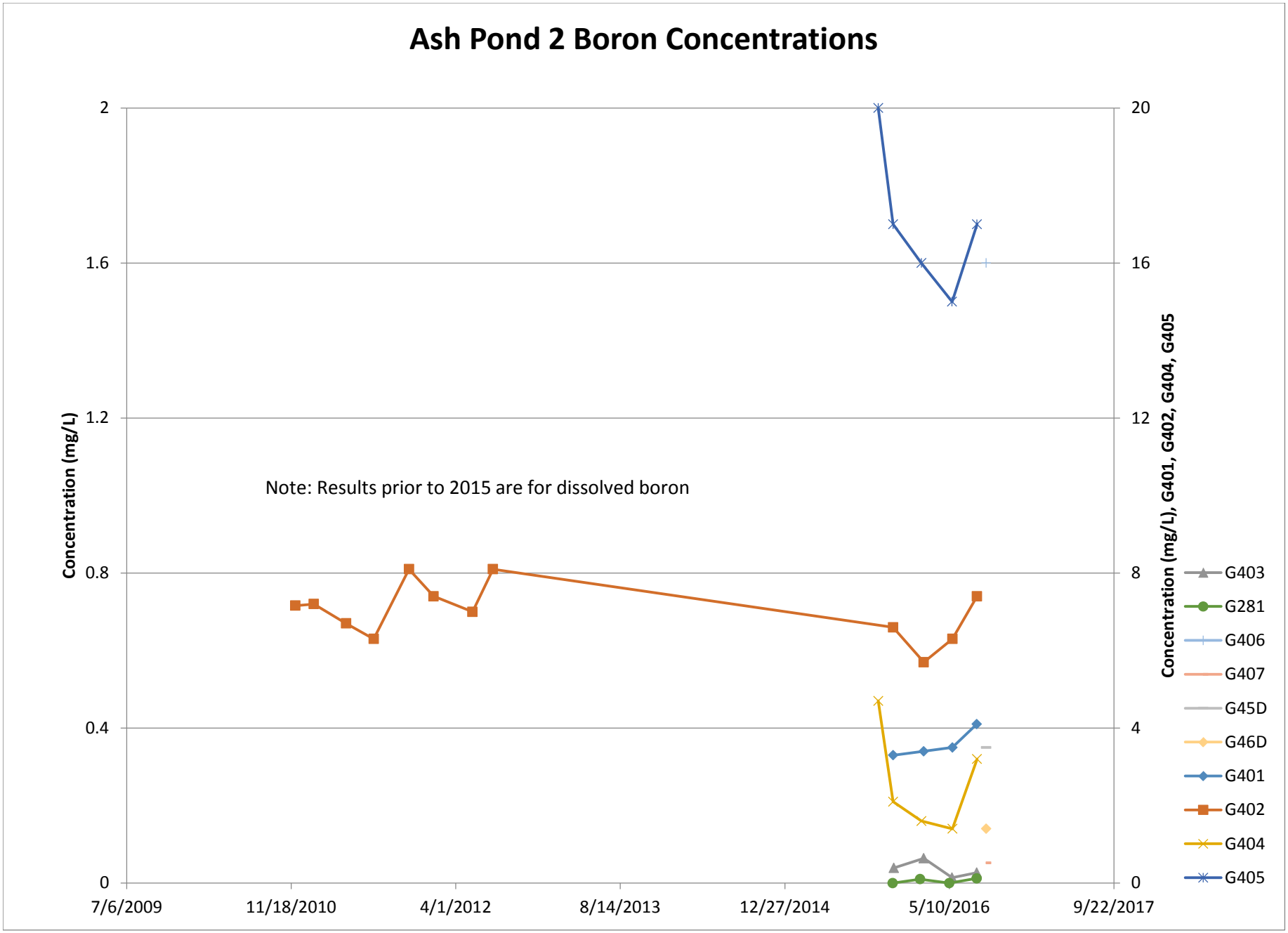
Date Range: 03/11/2008 to 08/16/2016 **Option for LT Pts: x 0.5**
Locations: APW-2,G151,G152,G153,G154,G270,G271,G272,G273,G274,G275,G281,G401,G402,G403,G404,G405
Location Type Class
G405

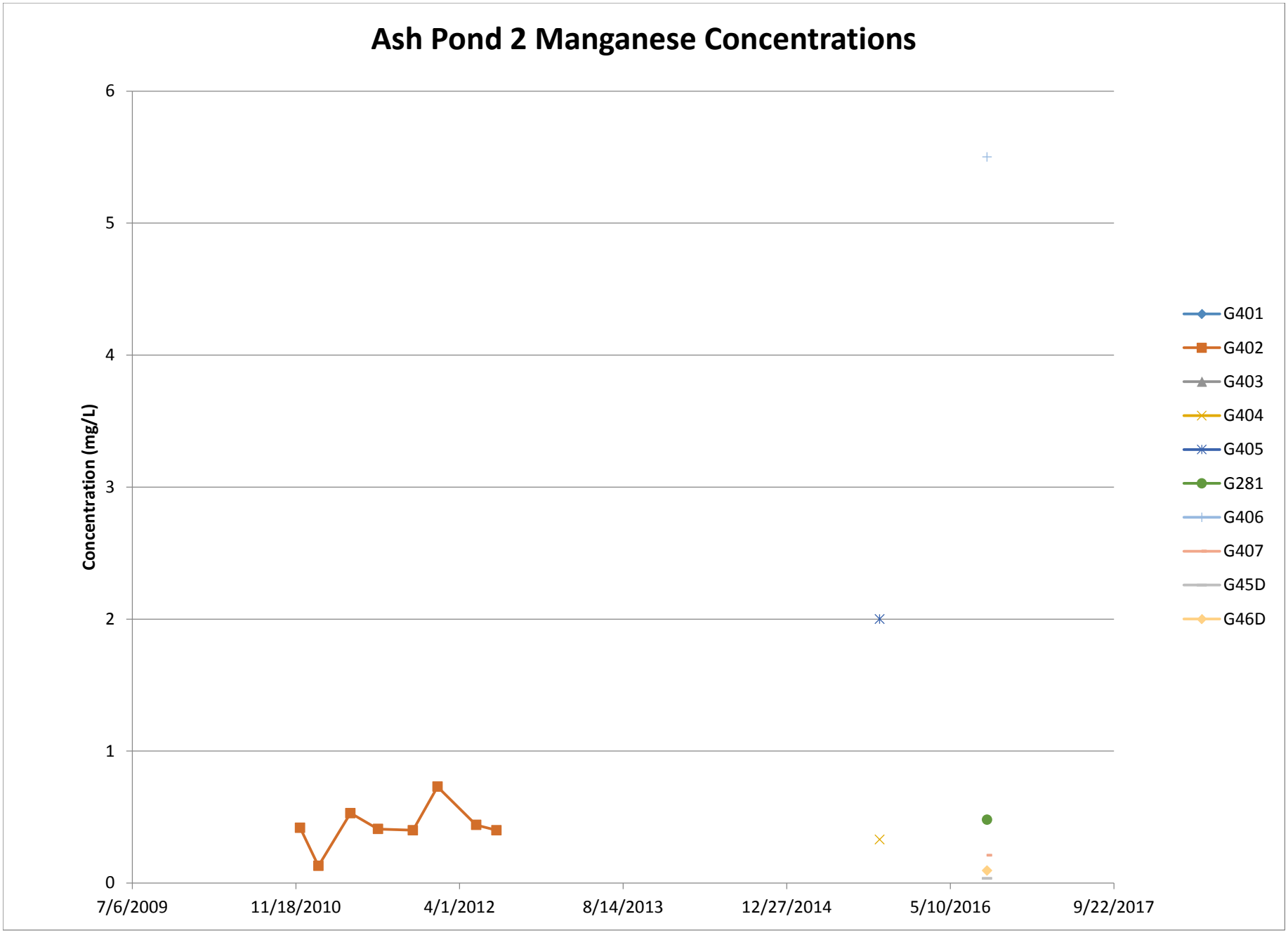
Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
As, tot	mg/L	4	0.0064	0.0046	0.0140	0.0025	0.0054	-0.01	Yes / Yes	0.00
B, tot	mg/L	4	16.2500	16.5000	17.0000	15.0000	0.9574	-1.96	Yes / Yes	0.00
Ba, tot	mg/L	4	0.0293	0.0240	0.0510	0.0180	0.0151	-0.01	Yes / Yes	0.00
Be, tot	mg/L	4	0.00050	0.00050	0.00050	0.00050	0.00000	0.00	No / No	100.00
Ca, tot	mg/L	4	312.500	320.000	330.000	280.000	22.174	-57.04	Yes / Yes	0.00
Cd,tot	mg/L	4	0.0007	0.0005	0.0012	0.0005	0.0003	0.00	No / No	75.00
Cl, tot	mg/L	4	9.425	10.150	14.000	3.400	4.462	-13.96	Yes / Yes	0.00
Co, tot	mg/L	4	0.0023	0.0022	0.0038	0.0010	0.0015	0.00	Yes / Yes	50.00
Cr, tot	mg/L	4	0.0028	0.0020	0.0051	0.0020	0.0016	0.00	No / No	75.00
F, tot	mg/L	4	0.396	0.457	0.544	0.125	0.185	-0.23	Yes / No	25.00
Hg, tot	mg/L	4	0.00010	0.00010	0.00010	0.00010	0.00000	0.00	No / No	100.00
Li, tot	mg/L	4	0.0050	0.0050	0.0050	0.0050	0.0000	0.00	No / No	100.00
Mo, tot	mg/L	4	0.0009	0.0008	0.0016	0.0005	0.0005	0.00	Yes / Yes	50.00
Pb, tot	mg/L	4	0.0034	0.0021	0.0085	0.0011	0.0034	-0.01	Yes / Yes	0.00
Ra-226,228, tot	pCi/L	4	0.6429	0.4678	1.3700	0.2660	0.4976	1.01	Yes / Yes	25.00
Sb, tot	mg/L	4	0.0015	0.0015	0.0015	0.0015	0.0000	0.00	No / No	100.00
Se, tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00
SO4, tot	mg/L	4	1,700.000	1,700.000	1,800.000	1,600.000	81.650	-71.62	Yes / Yes	0.00
TDS	mg/L	4	2,325.000	2,300.000	2,500.000	2,200.000	150.000	-347.29	Yes / Yes	0.00
Tl, tot	mg/L	4	0.0005	0.0005	0.0005	0.0005	0.0000	0.00	No / No	100.00

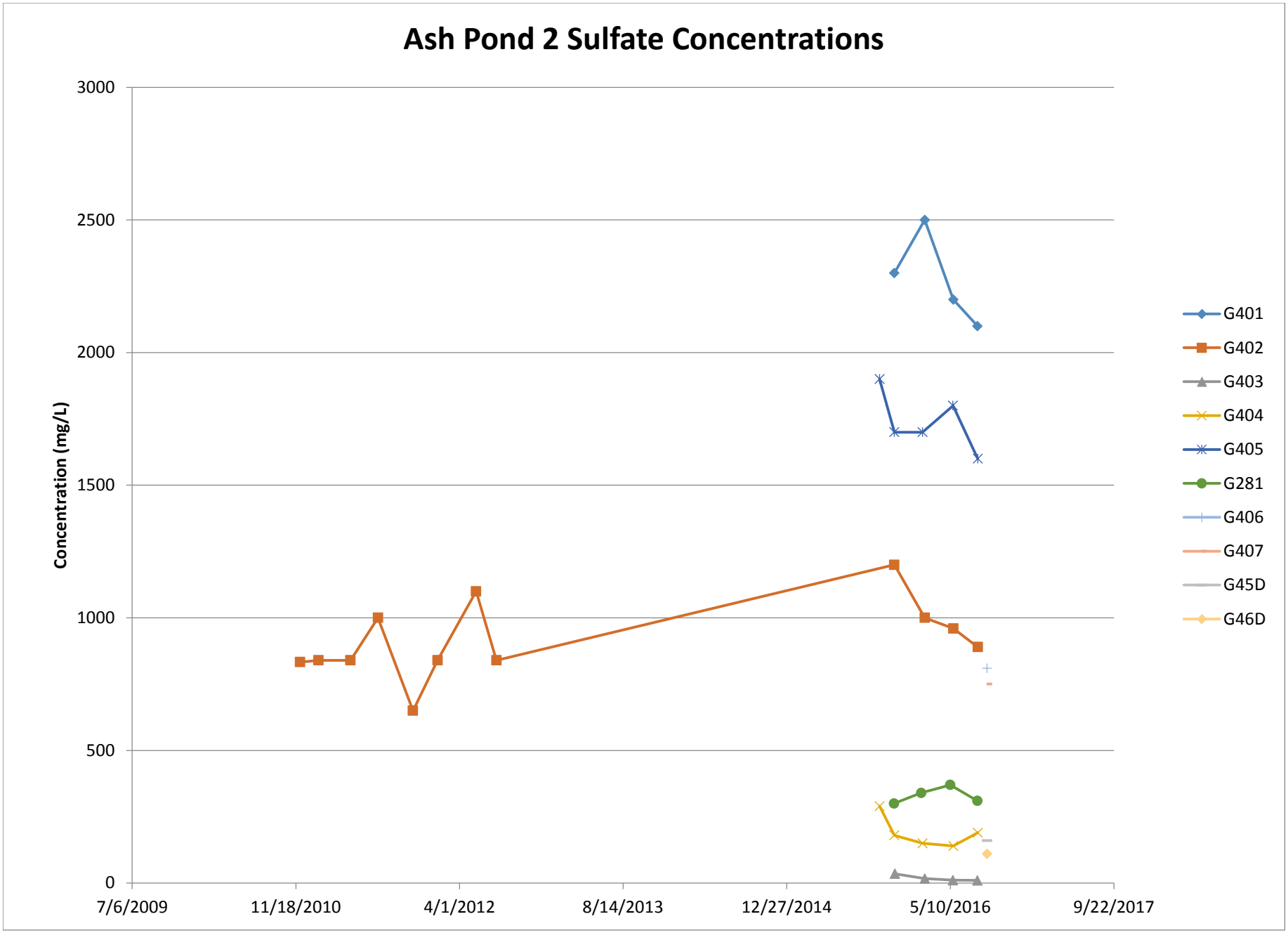
Shapiro-Wilk Normality test performed at 0.05 significance level.

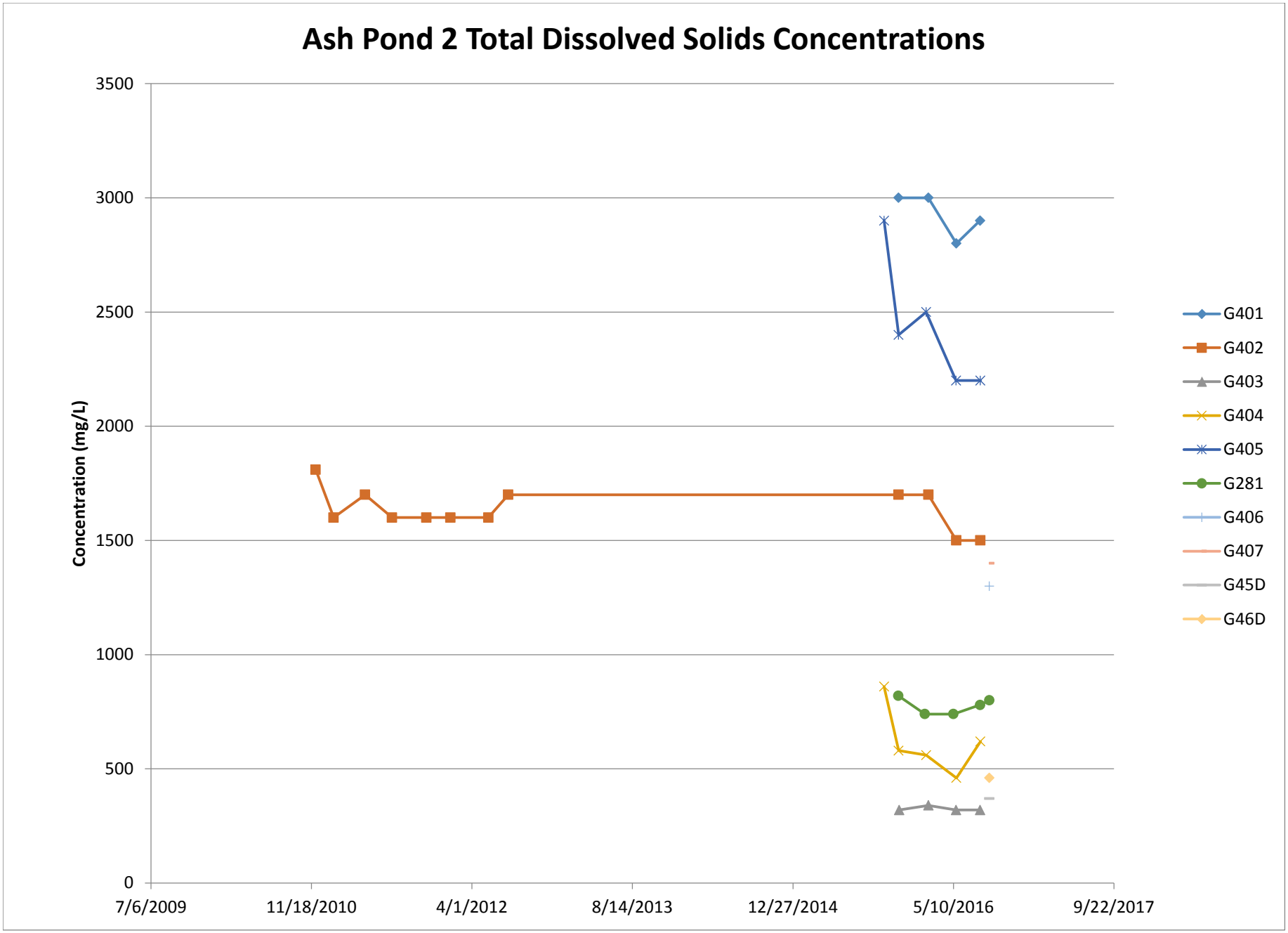
APPENDIX G

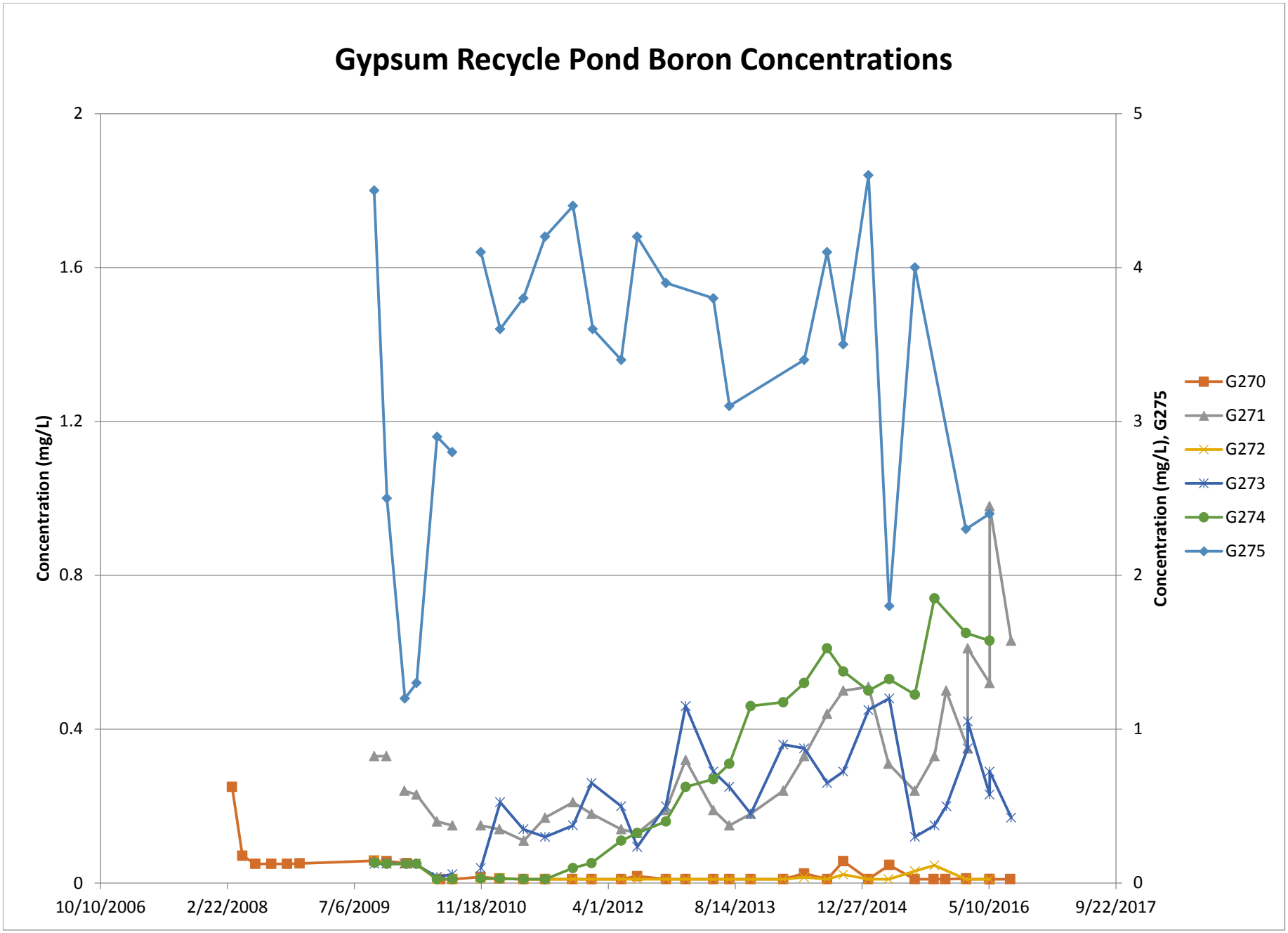
WATER QUALITY TREND GRAPHS

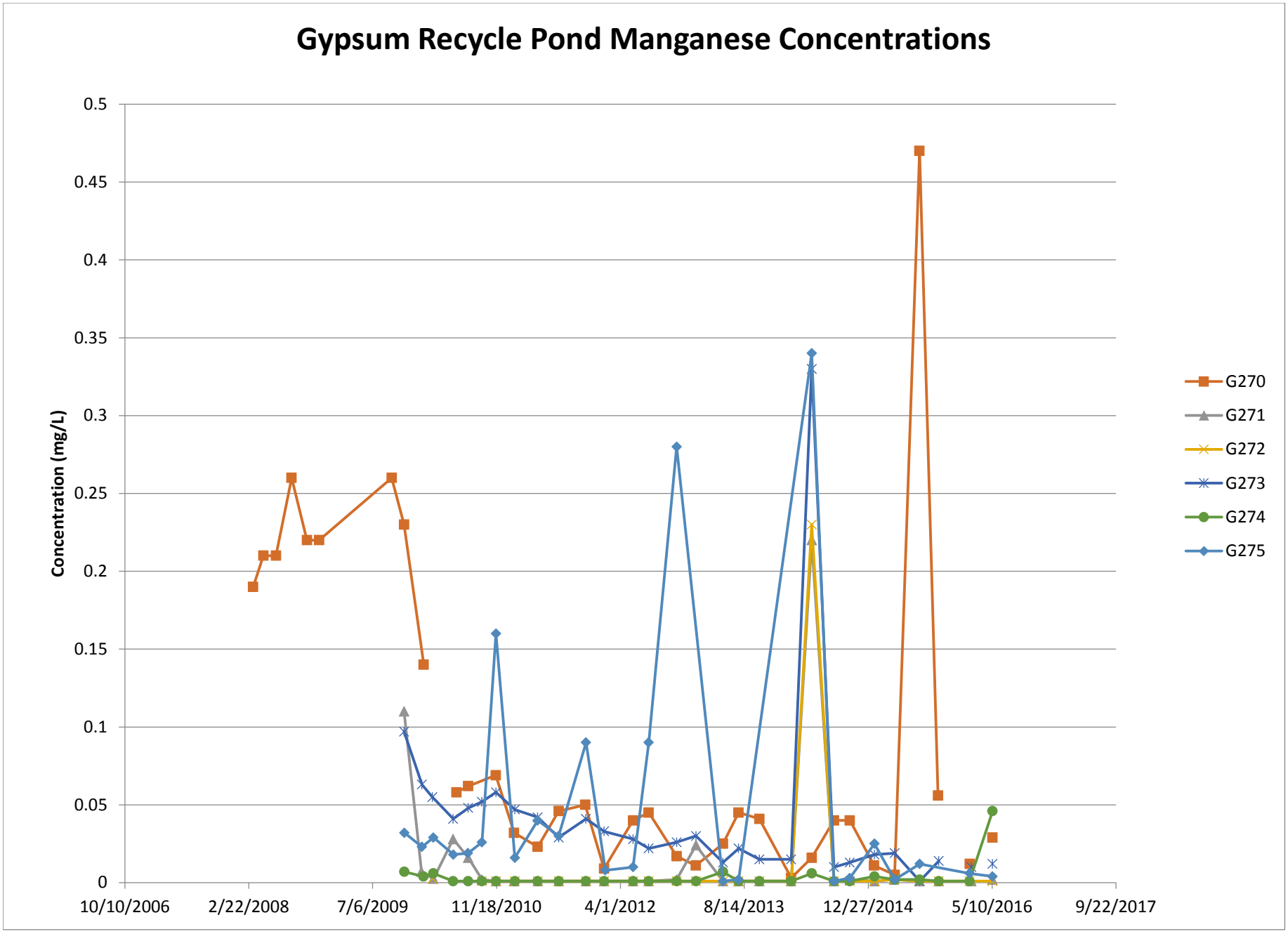

Ash Pond 2 Boron Concentrations
Concentration (mg/L)
Concentration (mg/L), G401, G402, G404, G405
2
1.6
1.2
0.8
0.4
0
20
16
12
8
4
0
7/6/2009
11/18/2010
4/1/2012
8/14/2013
12/27/2014
5/10/2016
9/22/2017
Note: Results prior to 2015 are for dissolved boron
G403
G281
G406
G407
G45D
G46D
G401
G402
G404
G405

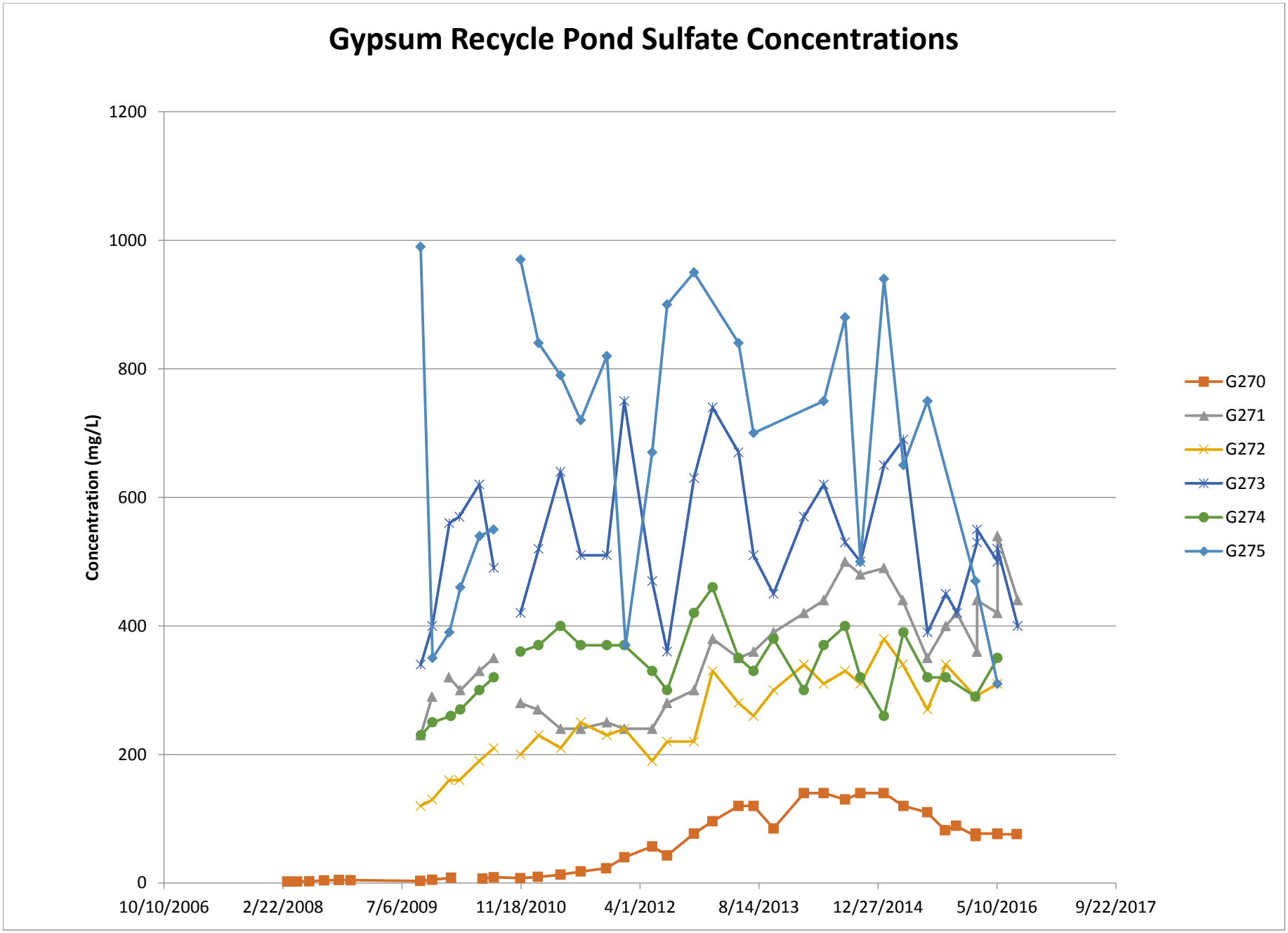

Ash Pond 2 Manganese Concentrations
Concentration (mg/L)
6
5
4
3
2
1
0
7/6/2009
11/18/2010
4/1/2012
8/14/2013
12/27/2014
5/10/2016
9/22/2017
G401
G402
G403
G404
G405
G281
G406
G407
G45D
G46D

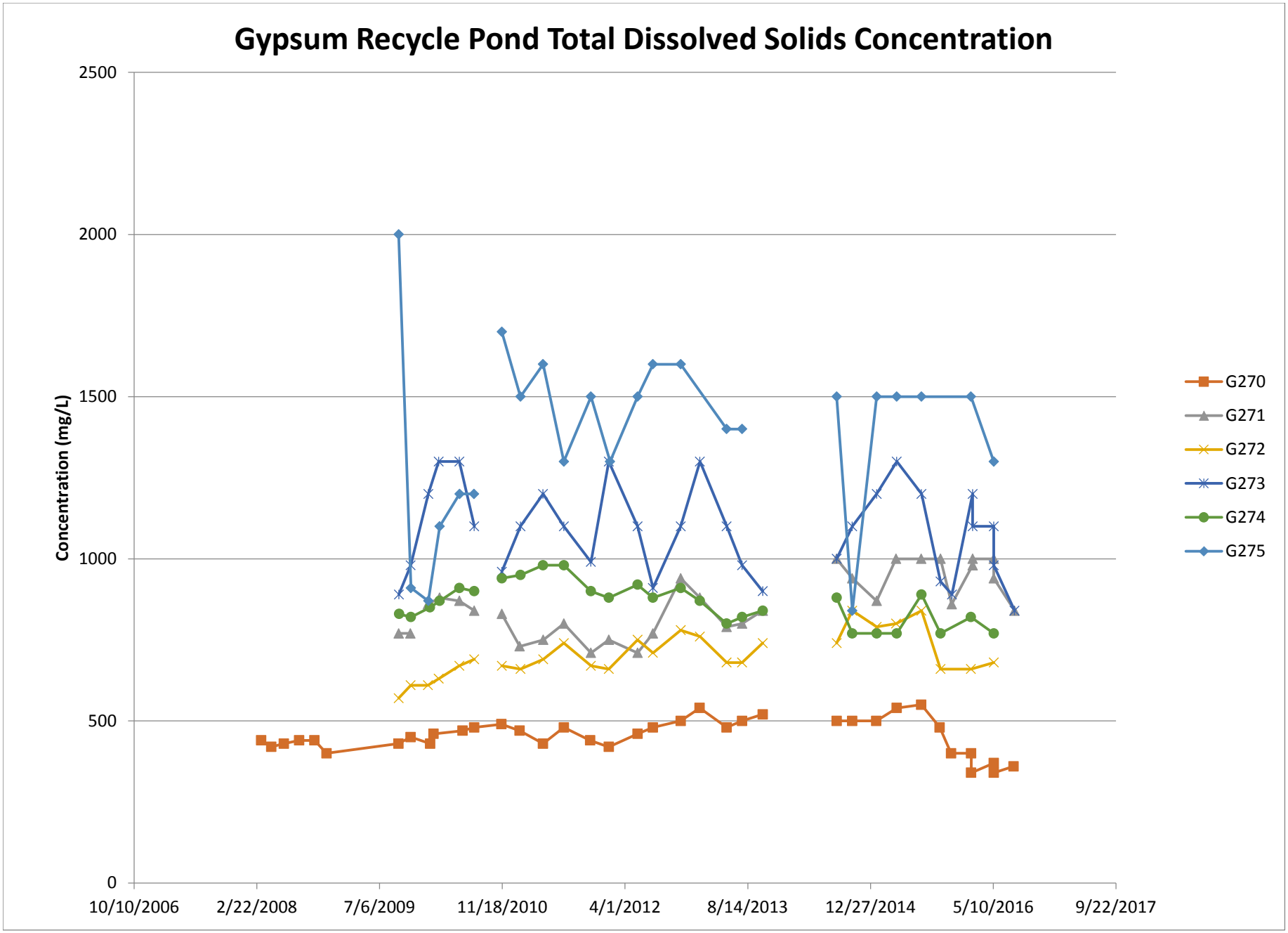

Ash Pond 2 Sulfate Concentrations
Concentration (mg/L)
3000
2500
2000
1500
1000
500
0
7/6/2009
11/18/2010
4/1/2012
8/14/2013
12/27/2014
5/10/2016
9/22/2017
G401
G402
G403
G404
G405
G281
G406
G407
G45D
G46D

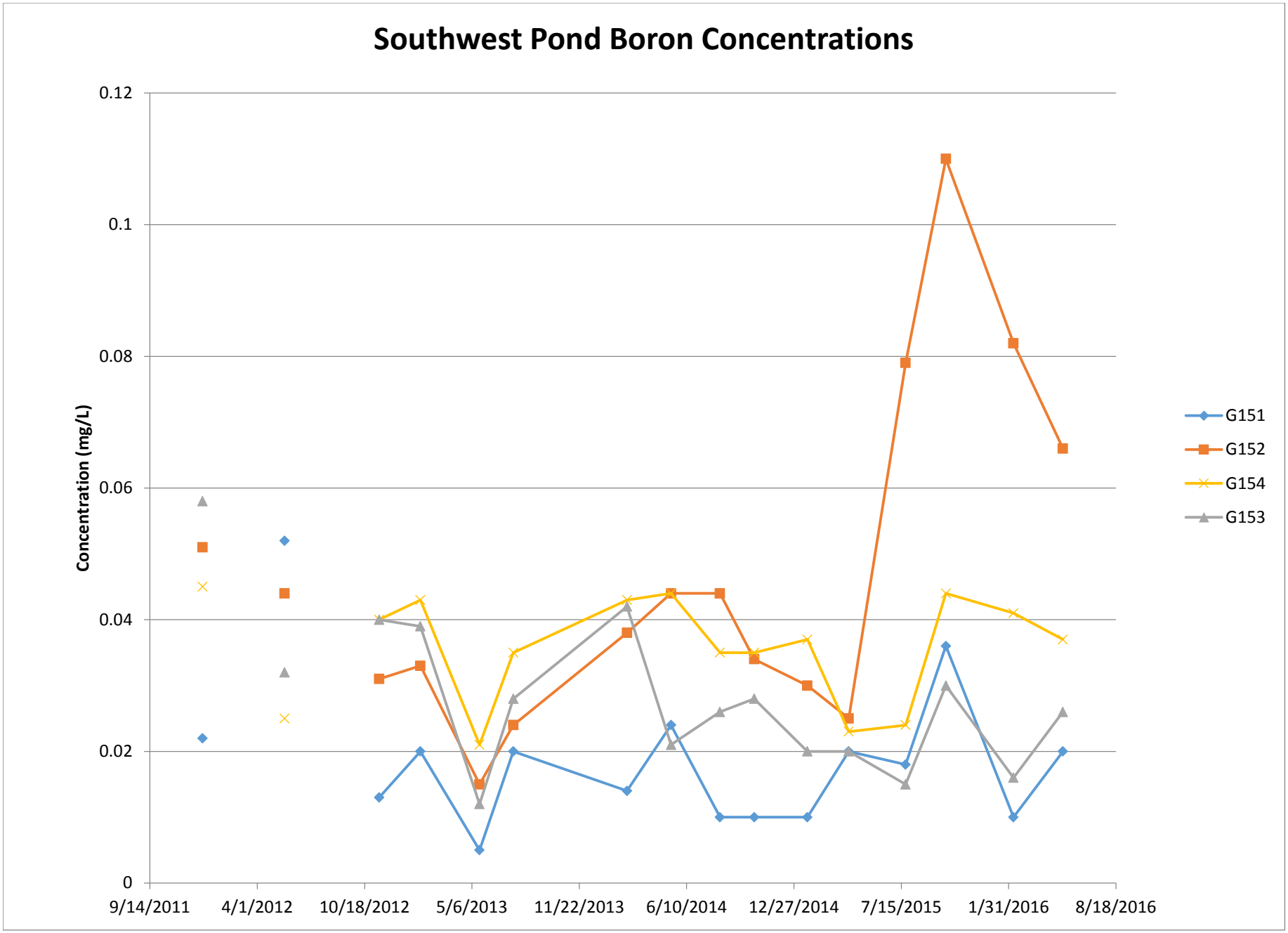

Ash Pond 2 Total Dissolved Solids Concentrations
Concentration (mg/L)
3500
3000
2500
2000
1500
1000
500
0
7/6/2009
11/18/2010
4/1/2012
8/14/2013
12/27/2014
5/10/2016
9/22/2017
G401
G402
G403
G404
G405
G281
G406
G407
G45D
G46D

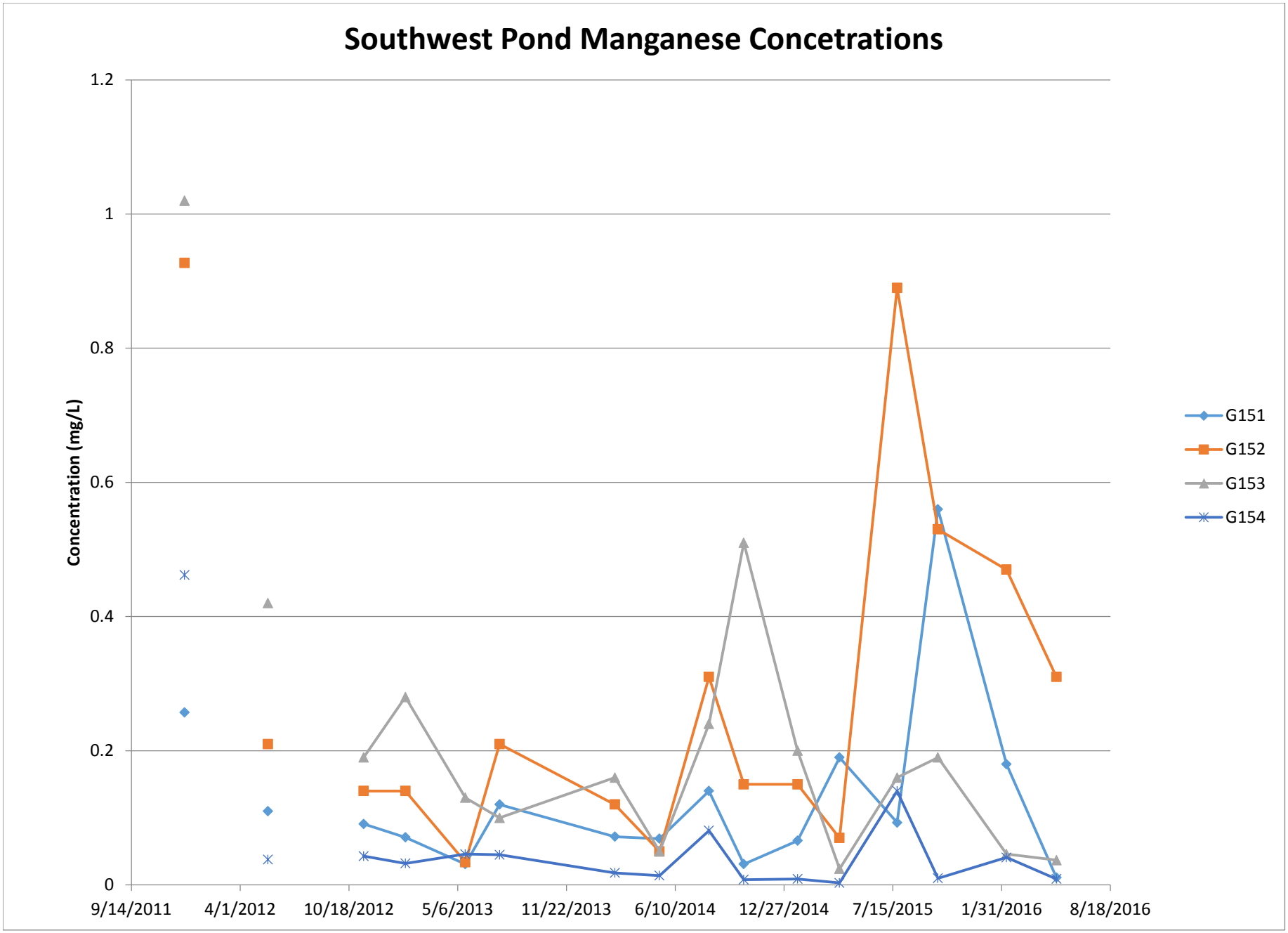

Gypsum Recycle Pond Boron Concentrations
Concentration (mg/L)
Concentration (mg/L), G275
2
1.6
1.2
0.8
0.4
0
5
4
3
2
1
0
10/10/2006
2/22/2008
7/6/2009
11/18/2010
4/1/2012
8/14/2013
12/27/2014
5/10/2016
9/22/2017
G270
G271
G272
G273
G274
G275

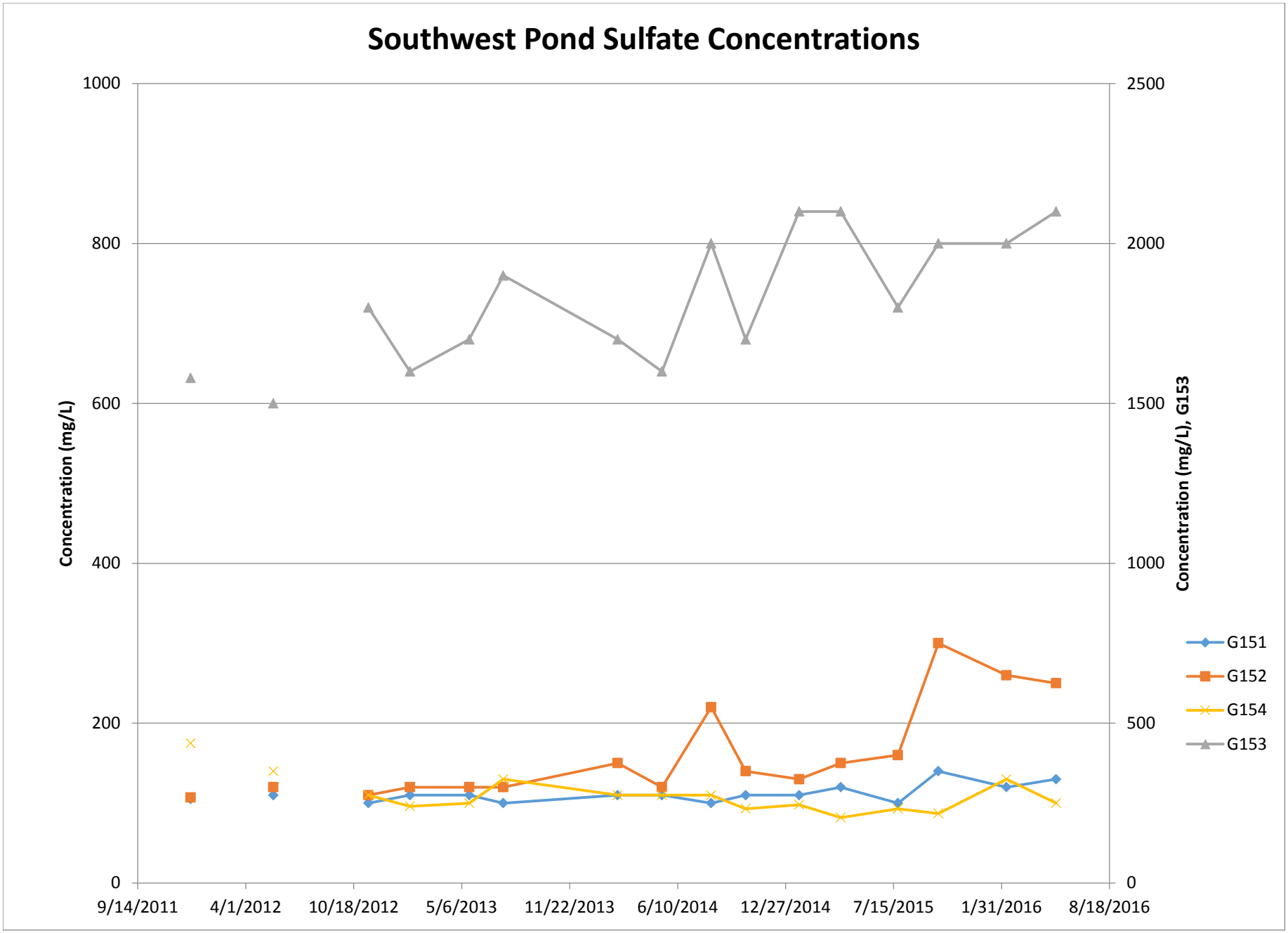

Gypsum Recycle Pond Manganese Concentrations
Concentration (mg/L)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/10/2006
2/22/2008
7/6/2009
11/18/2010
4/1/2012
8/14/2013
12/27/2014
5/10/2016
9/22/2017
G270
G271
G272
G273
G274
G275

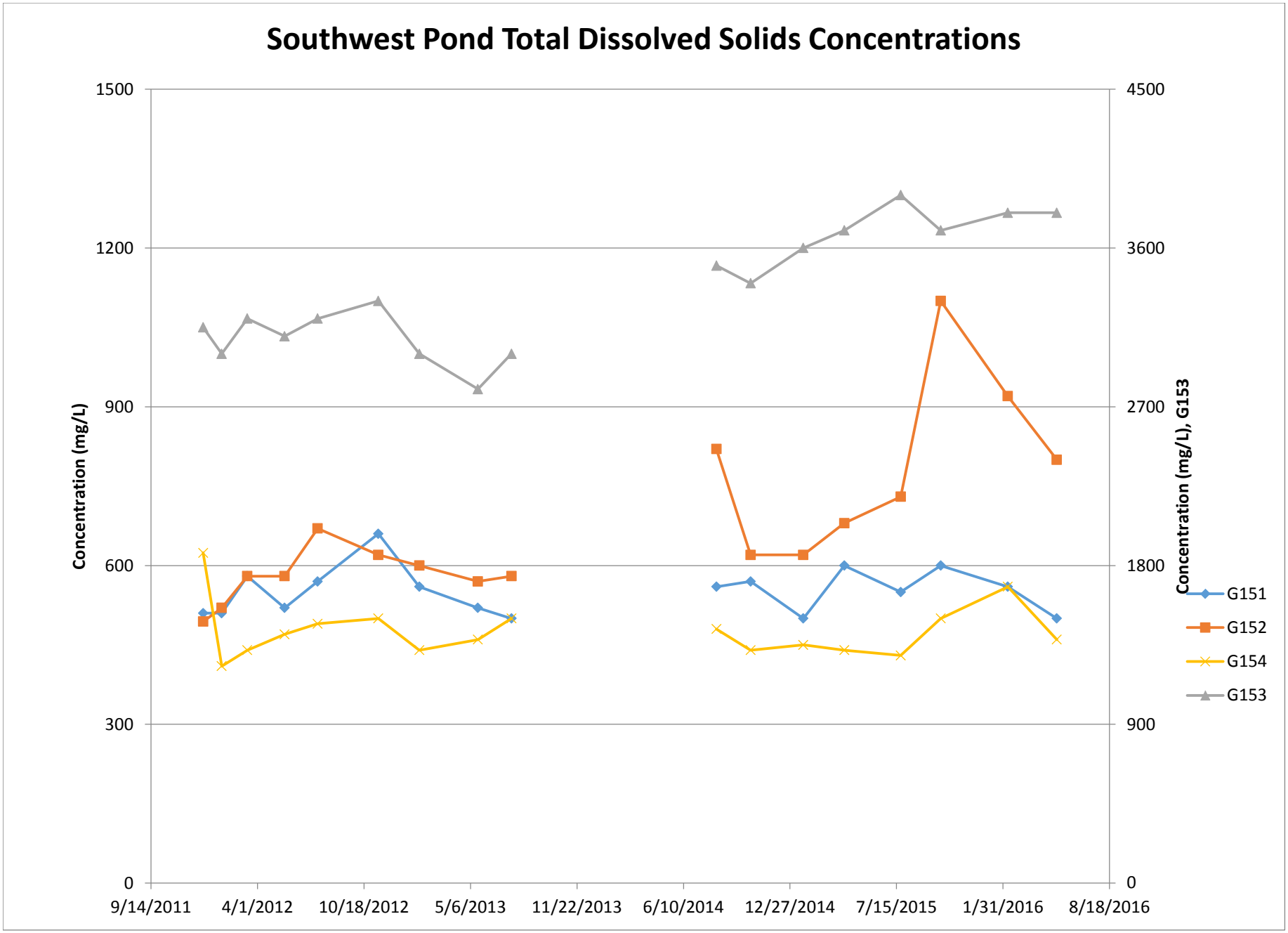

Gypsum Recycle Pond Sulfate Concentrations
Concentration (mg/L)
1200
1000
800
600
400
200
0
10/10/2006
2/22/2008
7/6/2009
11/18/2010
4/1/2012
8/14/2013
12/27/2014
5/10/2016
9/22/2017
G270
G271
G272
G273
G274
G275


Gypsum Recycle Pond Total Dissolved Solids Concentration
Concentration (mg/L)
2500
2000
1500
1000
500
0
10/10/2006
2/22/2008
7/6/2009
11/18/2010
4/1/2012
8/14/2013
12/27/2014
5/10/2016
9/22/2017
G270
G271
G272
G273
G274
G275


Southwest Pond Boron Concentrations
Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
9/14/2011
4/1/2012
10/18/2012
5/6/2013
11/22/2013
6/10/2014
12/27/2014
7/15/2015
1/31/2016
8/18/2016
G151
G152
G154
G153


Southwest Pond Manganese Concetrations
Concentration (mg/L)
1.2
1
0.8
0.6
0.4
0.2
0
9/14/2011
4/1/2012
10/18/2012
5/6/2013
11/22/2013
6/10/2014
12/27/2014
7/15/2015
1/31/2016
8/18/2016
G151
G152
G153
G154


Southwest Pond Sulfate Concentrations
Concentration (mg/L)
Concentration (mg/L), G153
1000
800
600
400
200
0
2500
2000
1500
1000
500
0
9/14/2011
4/1/2012
10/18/2012
5/6/2013
11/22/2013
6/10/2014
12/27/2014
7/15/2015
1/31/2016
8/18/2016
G151
G152
G154
G153


Southwest Pond Total Dissolved Solids Concentrations
Concentration (mg/L)
Concentration (mg/L), G153
1500
1200
900
600
300
0
4500
3600
2700
1800
900
0
9/14/2011
4/1/2012
10/18/2012
5/6/2013
11/22/2013
6/10/2014
12/27/2014
7/15/2015
1/31/2016
8/18/2016
G151
G152
G154
G153

APPENDIX C
HISTORY OF CONSTRUCTION (845.220(a)(1))

October 2016

Illinois Power Generating Company
134 CIPS Lane
Coffeen, IL 62017

RE: History of Construction
USEPA Final CCR Rule, 40 CFR § 257.73(c)
Coffeen Power Station
Coffeen, Illinois

On behalf of Illinois Power Generating Company, AECOM has prepared the following history of construction for Ash Pond No. 1, Ash Pond No. 2, the GMF Pond, and the GMF Recycle Pond at the Coffeen Power Station in accordance with 40 CFR § 257.73(c).

BACKGROUND

40 CFR § 257.73(c)(1) requires the owner or operator of an existing coal combustion residual (CCR) surface impoundment that either (1) has a height of five feet or more and a storage volume of 20 acre-feet or more, or (2) has a height of 20 feet or more to compile a history of construction by October 17, 2016 that contains, to the extent feasible, the information specified in 40 CFR § 257.73(c)(1)(i)–(xii).

The history of construction presented herein was compiled based on existing documentation, to the extent that it is reasonably and readily available (see 80 Fed. Reg. 21302, 21380 [April 17, 2015]), and AECOM's site experience. AECOM's document review included record drawings, geotechnical investigations, construction specifications, etc. for Ash Pond No. 1, Ash Pond No. 2, the GMF Pond, and the GMF Recycle Pond at the Coffeen Power Station.

HISTORY OF CONSTRUCTION

§ 257.73(c)(1)(i): The name and address of the person(s) owning or operating the CCR unit; the name associated with the CCR unit; and the identification number of the CCR unit if one has been assigned by the state.

Owner: Illinois Power Generating Company

Address: 1500 Eastport Plaza Drive
Collinsville, IL 62234

CCR Units: Ash Pond No. 1
Ash Pond No. 2
GMF Pond, IDNR Dam ID No. IL50579
GMF Recycle Pond, IDNR Dam ID No. IL50578

Ash Pond No. 1 and Ash Pond No. 2 do not have a state assigned identification number.

§ 257.73(c)(1)(ii): The location of the CCR unit identified on the most recent USGS $7^1/_2$ or 15 minute topographic quadrangle map or a topographic map of equivalent scale if a USGS map is not available.

The locations of Ash Pond No. 1, Ash Pond No. 2, the GMF Pond, and the GMF Recycle Pond have been identified on an USGS 7-1/2 minute topographic quadrangle map in **Appendix A**.

§ 257.73(c)(1)(iii): A statement of the purpose for which the CCR unit is being used.

The following captures the purposes of the CCR units:

- Ash Pond No. 1 is being used to store and dispose of bottom ash and other-non-CCR waste and to clarify recycled process water for plant operations. Ash Pond No. 2 (inactive) was used to store and dispose of bottom ash and fly ash.
- The GMF Pond is being used to store and dispose of gypsum and to clarify recycled process water for plant operations.
- The GMF Recycle Pond was used to store and dispose of gypsum from the plant's scrubber operations prior to the in-service date of the GMF Pond in 2010. The GMF Recycle Pond currently only receives and stores clear process water from the GMF Pond.

Notice of intent to close Ash Pond No. 2 was provided in November, 2015.[1]

[1] This history of construction report was prepared on a facility-wide basis for CCR surface impoundments at the Coffeen Power Station. The inclusion of Ash Pond No. 2 in this history of construction report does not concede and should not be construed to concede that Ash Pond No. 2 is subject to the Design Criteria or all Operating Criteria in the CCR Rule.

§ 257.73(c)(1)(iv): The name and size in acres of the watershed where the CCR unit is located.

Ash Pond No. 1, Ash Pond No. 2, the GMF Pond, and the GMF Recycle Pond are located in the Coffeen Lake Watershed with a 12-digit Hydrologic Unit Code (HUC) of 071402030304 and a drainage area of 11,695 acres (USGS, 2016).

§ 257.73(c)(1)(v): A description of the physical and engineering properties of the foundation and abutment materials on which the CCR unit is constructed.

The foundation and abutment materials of Ash Pond No. 1, Ash Pond No. 2, the GMF Pond, and the GMF Recycle Pond consist of native fine-grained soils of wind-blown origin (loess), with some coarse-grained layers, underlain by glacial till. The physical properties of the fine-grained soils are described as low- to medium-plasticity silty clay, sandy lean clay, or lean clay with sand, often with trace amounts of gravel; or high plasticity fat clay, often with trace amounts of sand. The clay soils vary from soft to very stiff, moist to wet, and brown to gray. The physical properties of the coarse-grained soils are described as clayey sand, silty sand, or fine to coarse sand, with trace amounts of gravel. The sand is wet and varies from loose to dense and brown to gray. A thin layer of native silty or sandy lean clay is located immediately above the glacial till deposits. The clay is very soft to medium stiff, low to medium plasticity, wet, and orange brown to gray. The physical properties of the glacial till are described as lean clay, or silty to sandy lean clay, with trace amounts of fine gravel, hard, low plasticity, moist to wet, and brown to gray. An available summary of the engineering property typical ranges of the foundation and abutment materials is presented in **Table 1** below. The engineering properties are based on previous geotechnical explorations and laboratory testing.

Ash Pond No. 1 and Ash Pond No. 2 are enclosed impoundments with embankments and do not have abutments. The GMF Pond and GMF Recycle Pond were constructed as incised impoundments enclosed by embankments.

Table 1. Summary of Foundation and Abutment Material Engineering Properties

Material	Unit Weight (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters	Post-Earthquake Shear Strength
		Cohesion, c′ (psf)	Friction Angle, ϕ’ (deg)	S_u/p'	S_{ur}/p'
Foundation Clay (Under Embankment)	125	0	32	S_u/p' = 0.39-0.45, Min. S_u = 700 psf	Peak Undrained
Foundation Clay (Free Field)	125	0	30	S_u/p' = 0.24-0.28, Min. S_u = 450 psf	Peak Undrained
Soft Foundation Clay	125	0	30	S_u/p' = 0.22-0.28, Min. S_u = 275 psf	S_u/p' = 0.13-0.16, Min. S_{ur} = 200 psf
Glacial Till	135	0	40	S_u/p' = 0.45-0.64, Min. S_u = 700 psf	Peak Undrained

§ 257.73(c)(1)(vi): A statement of the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR unit; the method of site preparation and construction of each zone of the CCR unit; and the approximate dates of construction of each successive stage of construction of the CCR unit.

Physical properties for the embankment construction materials for Ash Pond No. 1, Ash Pond No. 2, GMF Pond, and GMF Recycle Pond are described as silty clay, sandy lean clay, or lean clay with sand, with trace amounts of fine gravel. The fill is soft to very stiff in consistency, low to medium plasticity, moist to wet, and brown to gray. Trace amounts of organic material and ash are present. The embankment fill generally appears to be well-compacted. An available summary of the engineering properties of the embankment construction materials is presented in **Table 2** below. The engineering properties are based on previous geotechnical explorations and laboratory testing.

Table 2. Summary of Construction Material Engineering Properties for Embankments

Material	Unit Weight (pcf)	Peak Drained Shear Strength		Peak Undrained Shear Strength	Post-Earthquake Shear Strength
		Cohesion, c′ (psf)	Friction Angle, f ’ (deg)	S_u/p'	S_{ur}/p'
Embankment Fill	135	0	31	S_u/p' = 0.60, Min. S_u = 450 psf	Peak Undrained

The GMF Pond and GMF Recycle Pond contain liner systems. The liner system within the GMF Pond consists of a 60-mil textured high density polyethylene (HDPE) geomembrane underlain by a 3-foot thick layer of compacted clay. A typical cross section profile of the GMF Pond liner system is shown on drawing C-10206 (sh. 9) presented in **Appendix B**. An available summary of the engineering properties of the GMF Pond liner construction materials from Hanson (2008) is presented in **Table 3** below. The liner system within the GMF Recycle Pond consists of a 60-mil textured HDPE geomembrane underlain by smooth-drum rolled native soil. A typical cross section profile of the GMF Recycle Pond liner system is shown on drawing C-10206 (sh. 20) presented in **Appendix B**.

Table 3. Summary of Construction Material Engineering Properties for Liner

Material	Unit Weight (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters	
		c’ (psf)	Φ’ (°)	c (psf)	Φ (°)
Clay Liner	121.2	0	28.3	1950	0

The method of site preparation and construction of Ash Pond No. 1 and Ash Pond No. 2 is not reasonably and readily available. Site preparation and construction of the GMF Pond and GMF Recycle Pond were completed in accordance with the applicable construction specification (see § 257.73(c)(1)(xi) below).

The approximate dates of construction of each successive stage of construction of Ash Pond No. 1, Ash Pond No. 2, the GMF Pond, and the GMF Recycle Pond are provided in **Table 4** below.

Table 4. Approximate dates of construction of each successive stage of construction.

Date	Event
1964	Construction of Ash Pond No. 1
1971	Construction of Ash Pond No. 2
1978-1979	Installation of internal embankment and new recycle intake structure in Ash Pond No. 1 and abandonment of existing outfall structure
1984-1985	Closure of Ash Pond No. 2 by installing a clay cover
2000	Installation of a sheet pile wall to facilitate construction of drainage flume along the northeast corner of the Ash Pond No. 1
2009	Installation of well dewatering system in Ash Pond No. 2
2008-2010	Construction of the GMF Pond and the GMF Recycle Pond

§ 257.73(c)(1)(vii): At a scale that details engineering structures and appurtenances relevant to the design, construction, operation, and maintenance of the CCR unit, detailed dimensional drawings of the CCR unit, including a plan view and cross sections of the length and width of the CCR unit, showing all zones, foundation improvements, drainage provisions, spillways, diversion ditches, outlets, instrument locations, and slope protection, in addition to the normal operating pool surface elevation and the maximum pool surface elevation following peak discharge from the inflow design flood, the expected maximum depth of CCR within the CCR surface impoundment, and any identifiable natural or manmade features that could adversely affect operation of the CCR unit due to malfunction or mis-operation.

Drawings that contain items pertaining to the requested information for Ash Pond No. 1, Ash Pond No. 2, the GMF Pond, and the GMF Recycle Pond are listed in **Table 5** below. Items marked as "Not Available" are items not found during a review of the reasonably and readily available record documentation.

Table 5. List of drawings containing items pertaining to the information requested in § 257.73(c)(1)(vii).

	Ash Pond No. 1	Ash Pond No. 2	GMF Pond	GMF Recycle Pond
Dimensional plan view (all zones)	B-35, S-44, S-45	B-560, A1000 (sh. 1)	C-10206 (sh. 4, 9, 10)	C-10206 (sh. 4, 19)
Dimensional cross sections	B-35, S-47 to S-50	B-561	C-10206 (sh. 9)	C-10206 (sh. 20)
Foundation Improvements	Not Applicable	Not Applicable	C-10206 (sh. 10)	C-10206 (sh. 20)
Drainage Provisions	Not Applicable	A1000 (sh. 4)	C-10206 (sh. 15, 16, 20)	C-10206 (sh. 21)
Spillways and Outlets	S-8, S-49	W1008 (sh. 2)	C-10206 (sh. 20)	C-10206 (sh. 22)
Diversion Ditches	Not Applicable	A1000 (sh. 1)	Not Applicable	Not Applicable
Instrument Locations	Plate 2, Figure 2A	Figure 2B	Not Applicable	C-10206 (sh. 19)
Slope Protection	S-49	B-561	C-10206 (sh. 9)	C-10206 (sh. 20)
Normal Operating Pool Elevation	S-8, S-49	Not Applicable	C-10201-25	Not Available
Maximum Pool Elevation	S-8	Not Applicable	C-10201-25	Not Available
Approximate Maximum Depth of CCR in 2016	15 feet	28 feet	16 feet	12 feet

All drawings referenced in **Table 5** above can be found in **Appendix B** and **Appendix C**.

Based on the review of the drawings listed above, no natural or manmade features that could adversely affect operation of these CCR units due to malfunction or mis-operation were identified.

§ 257.73(c)(1)(viii): A description of the type, purpose, and location of existing instrumentation.

Existing instrumentation at Ash Pond No. 1 and Ash Pond No. 2 include vibrating-wire and open-standpipe piezometers. The purpose of the piezometers is to measure the phreatic surface within and around the impoundments. Two (2) open-standpipe piezometers (AP-P1 and AP-P2) were installed at Ash Pond No. 2 in 2009 and the locations are presented on Figure 2A in **Appendix C**. Two (2) open-standpipe piezometers (B-2 and B-4) were installed at Ash Pond No. 1 in 2010 and the locations are presented on Plate 2 in **Appendix C**. Twelve (12) open-standpipe and vibrating-wire piezometers were installed at Ash Pond No. 1 and Ash Pond No. 2 in 2015 and the locations are presented on Figure 2A in **Appendix C**.

The GMF Pond does not contain existing instrumentation. Existing instrumentation at the GMF Recycle Pond consists of one (1) ultrasonic level transmitter. The purpose of the ultrasonic level transmitter is to measure the water level within the GMF Recycle Pond. The location of the ultrasonic level transmitter is shown on drawing C-10206 (sh. 19) presented in **Appendix B**.

§ 257.73(c)(1)(ix): Area-capacity curves for the CCR unit.

Area-capacity curves for Ash Pond No. 2 and the GMF Recycle Pond are not reasonably and readily available. The area-capacity curves for Ash Pond No. 1 and the GMF Pond are presented in **Figures 1** and **2**, respectively, below. "Area-capacity curves", as defined by 40 CFR § 257.53, "means graphic curves which readily show the reservoir water surface area, in acres, at different elevations from the bottom of the reservoir to the maximum water surface, and the capacity or volume, in acre-feet, of the water contained in the reservoir at various elevations."

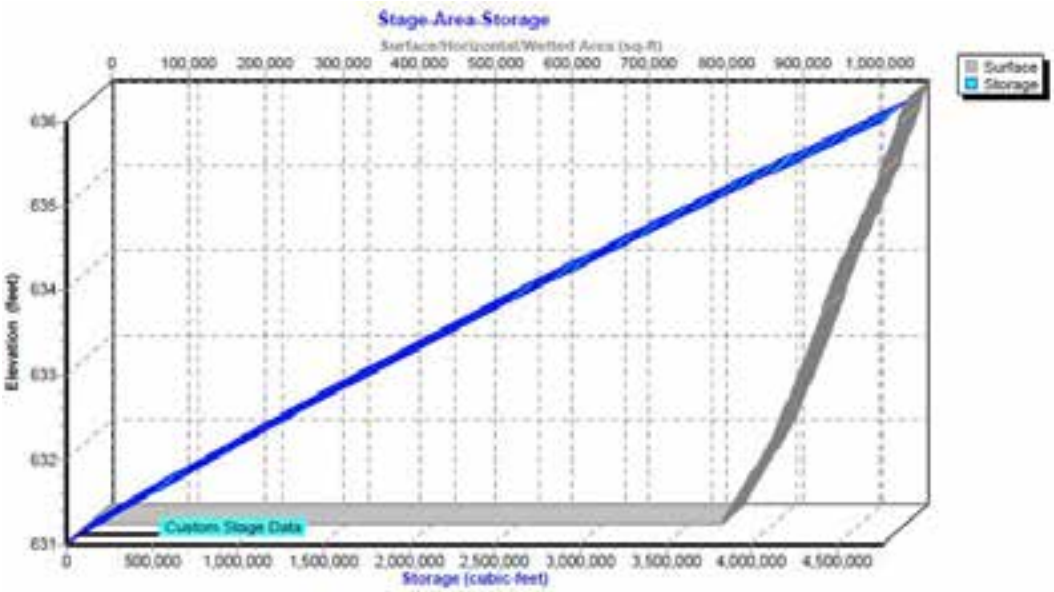


Figure 1. Area-capacity curve for Ash Pond No. 1

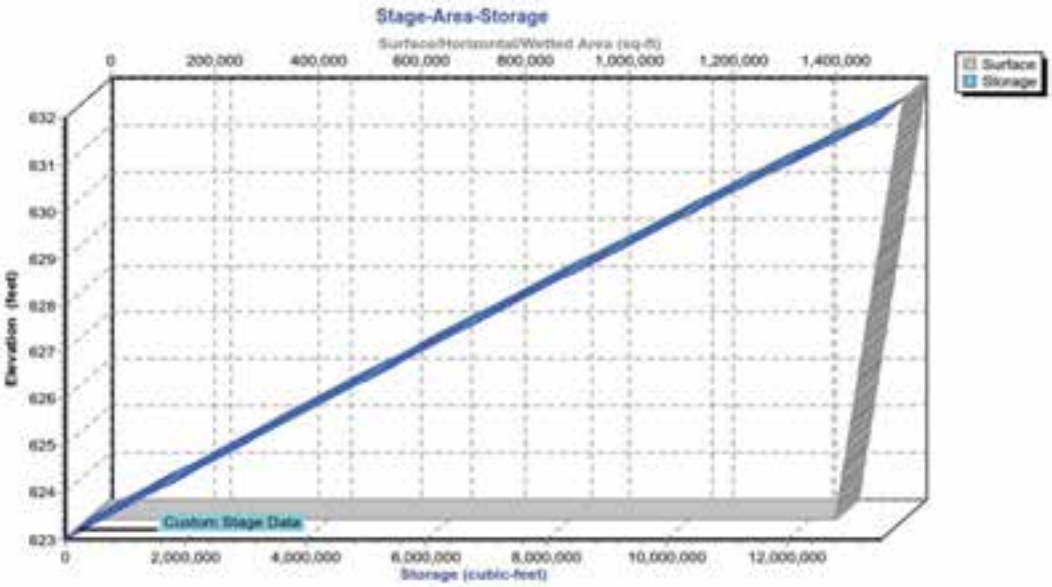


Figure 2. Area-capacity curve for GMF Pond

The area-capacity curves shown were taken from the pond modeling analysis. Actual pond capacity is limited to the approximate berm elevation listed in **Table 6** below. Any information above berm elevation should be disregarded.

§ 257.73(c)(1)(x): A description of each spillway and diversion design features and capacities and calculations used in their determination.

Ash Pond No. 1 contains a concrete intake structure that drains into a 48-inch diameter (dia.) steel pipe. The steel pipe leads to the recycle pump house. In 2016, the discharge capacity of Ash Pond No. 1 was evaluated using HydroCAD 10 software modeling a 1,000-year, 24-hour rainfall event. The results of the HydroCAD 10 analysis are presented below in **Table 6**.

Ash Pond No. 2 was closed in 1984-1985 by installing a clay cover. Non-contact stormwater is collected in ditches along the clay cover and drain off the pond cover via concrete-lined ditch outlets. CCR-contact stormwater collected within the pond is pumped into the GMF Pond via the well dewatering system at the discretion of plant personnel. The capacity of the diversion ditches and well pumps during a model rainfall event has not been evaluated.

The GMF Pond contains a 14-inch high-density polyethylene (HDPE) pipe culvert for normal flow and a weir-like spillway for high water flow. The GMF Pond also contains a 10-inch dia. HDPE siphon pipe used for dewatering. In 2016, the discharge capacity of the GMF Pond was evaluated using HydroCAD 10 software modeling a 1,000-year, 24-hour rainfall event. The results of the HydroCAD 10 analysis are presented below in **Table 6**.

The GMF Recycle Pond contains a decant structure that drains into two (2) 18-inch dia. HDPE pipes that lead to a pump house. The capacity of the decant structure during a model rainfall event has not been evaluated.

Table 6. Results of HydroCAD 10 analyses

	Ash Pond No. 1	GMF Pond
Approximate Minimum Berm Elevation[1] (ft)	635.0	631.0
Approximate Emergency Spillway Elevation[1] (ft)	Not Applicable	624.0
Starting Pool Elevation[1] (ft)	631.0	621.2
Peak Elevation[1] (ft)	632.0	623.8
Time to Peak (hr)	24.4	24.1
Surface Area (ac)	20.4	33.4
Storage[2] (ac-ft)	19.5	88.3

Note: 1. Elevations are based on NAVD88 datum
2. Storage given is from Starting Pool Elevation to Peak Elevation.

§ 257.73(c)(1)(xi): The construction specifications and provisions for surveillance, maintenance, and repair of the CCR unit.

The construction specifications for Ash Pond No. 1 and Ash Pond No. 2 are not reasonably and readily available. The construction specifications for the GMF Pond and the GMF Recycle Pond are located in *Project Specifications, Gypsum Stack and Recycle Pond Construction* presented in **Appendix D**.

The provisions for surveillance, maintenance, and repair of Ash Pond No. 1 are located in *Operation & Maintenance Manual for #1 Ash Pond* presented in **Appendix E**. The provisions for surveillance, maintenance, and repair of Ash Pond No. 2 are not reasonably and readily available. The provisions for surveillance, maintenance, and repair of the GMF Pond and the GMF Recycle Pond are located in *Operation and Maintenance Manual, Gypsum Management Facility* presented in **Appendix F**.

The operations and maintenance plans for the CCR units identified in this report are currently being revised by Illinois Power Generating Company.

§ 257.73(c)(1)(xii): Any record or knowledge of structural instability of the CCR unit.

In March, 2009, shallow sloughing was observed along the eastern embankment of Ash Pond No. 2. The sloughing was inspected by Hanson Professional Services Inc. A dewatering

system was installed in Ash Pond No. 2 to lower the phreatic surface within the pond. In December, 2015, additional sloughing was observed on the embankment of Ash Pond No. 2 and on the embankment of Ash Pond No. 1. The sloughing was believed to be caused by recent heavy rains and was repaired. Photos of the 2015 sloughing repair are presented in **Appendix G**.

There is no record or knowledge of structural instability at the GMF Pond and the GMF Recycle Pond at Coffeen Power Station.

LIMITATIONS

The signature of AECOM's authorized representative on this document represents that to the best of AECOM's knowledge, information and belief in the exercise of its professional judgment, it is AECOM's professional opinion that the aforementioned information is accurate as of the date of such signature. Any recommendation, opinion or decisions by AECOM are made on the basis of AECOM's experience, qualifications and professional judgment and are not to be construed as warranties or guaranties. In addition, opinions relating to environmental, geologic, and geotechnical conditions or other estimates are based on available data and that actual conditions may vary from those encountered at the times and locations where data are obtained, despite the use of due care.

Sincerely,

Claudia Prado
Program Manager

Victor Modeer, P.E., D.GE
Senior Project Manager

REFERENCES

Hanson Professional Services Inc. (2008), *Support Document for IDNR/OWR Permit Application, Coffeen Power Generating Station Gypsum Management Facility Montgomery County, Illinois*

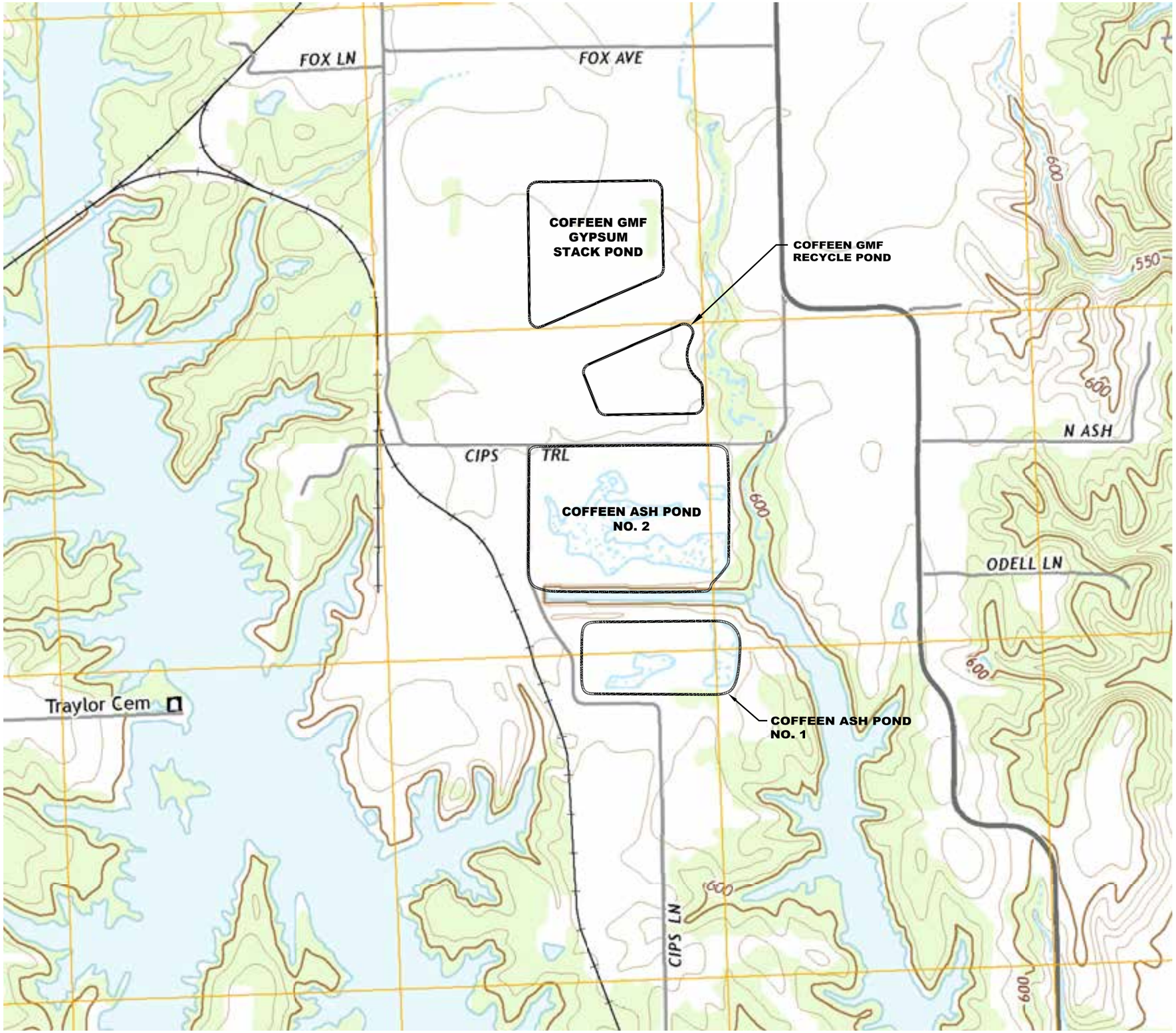
United States Environmental Protection Agency (USEPA). (2015). *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule.* 40 CFR Parts 257 and 261, 80 Fed. Reg. 21302, 21380 April 17, 2015.

United States Geological Survey (USGS). (2016). The National Map Viewer. http://viewer.nationalmap.gov/viewer/. USGS data first accessed in March of 2016.

APPENDICES

Appendix A: History of Construction Vicinity Map
Appendix B: Coffeen Power Station Drawings
Appendix C: Coffeen Power Station Boring and Piezometer Locations
Appendix D: Project Specifications, Gypsum Stack and Recycle Pond Construction (Hanson 2008)
Appendix E: Operation & Maintenance Manual for #1 Ash Pond
Appendix F: Operation and Maintenance Manual, Gypsum Management Facility Operation (2015)
Appendix G: Photos of 2015 Sloughing Repair

Appendix A: History of Construction Vicinity Map



LEGEND

CCR UNITS

SOURCE:
MAP PROVIDED FROM ELECTRONIC USGS DIGITAL RASTER GRAPHIC 7.5 MINUTE TOPOGRAPHIC MAP OF COFFEEN, ILLINOIS, REVISED 2015.

N

0 500 1000 1500
SCALE IN FEET

AECOM
1001 Highlands Plaza Drive, Suite 300
St. Louis, Mo. 63110
314 429-0100 (phone)
314-429-0462 (fax)

ILLINOIS POWER GENERATING COMPANY
134 CIPS Lane
Coffeen, IL 62017

HISTORY OF CONSTRUCTION

COFFEEN POWER STATION
COFFEEN, ILLINOIS

ISSUED FOR BIDDING — DATE BY

ISSUED FOR CONSTRUCTION — DATE BY

REVISIONS

NO.	DESCRIPTION	DATE
△		
△		
△		
△		
△		

AECOM PROJECT NO:	60489731
DRAWN BY:	DJD
DESIGNED BY:	DJD
CHECKED BY:	MN
DATE CREATED:	2016-04-13
PLOT DATE:	
SCALE:	1" = 500'
ACAD VER:	2014

SHEET TITLE

HISTORY OF CONSTRUCTION VICINITY MAP

01

AECOM DRAWING PATH: P:\Projects\Geotech\60428794_DynegyCCR\13_Construction History\04 Technical Production\10_Coffeen\References\Vicinity Location Map References\Figures\C-01 History of Construction Vicinity Map (Coffeen)_ZJF.dwg NAWAK, MATT. 8/30/2016 10:52 AM

Appendix B: Coffeen Power Station Drawings

1. "Earthwork & Grading Plan", Drawing No. B-35, Revision S, 8 September, 1995, Sargent & Lundy Engineers.
2. "Concrete Recycle Pump House – Intake Structure", Drawing No. S-8, Revision 6, 23 February, 1996, Stearns-Roger Incorporated.
3. "Civil Layout & Grading Plan Sheet 4", Drawing No. S-44, Revision 6, 23 February, 1996, Stearns-Roger Incorporated.
4. "Civil Layout & Grading Plan Sheet 5", Drawing No. S-45, Revision 9, 23 February, 1996, Stearns-Roger Incorporated.
5. "Civil Miscellaneous Sections and Details, Sheet 2", Drawing No. S-47, Revision 2, 23 February, 1996, Stearns-Roger Incorporated.
6. "Civil Ash Pond No 1 – Sections and Details", Drawing No. S-48, Revision 2, 23 February, 1996, Stearns-Roger Incorporated.
7. "Civil Miscellaneous Sections and Details, Sheet 4", Drawing No. S-49, Revision 4, 23 February, 1996, Stearns-Roger Incorporated.
8. "Civil Miscellaneous Sections and Details", Drawing No. S-50, Revision 4, 23 February, 1996, Stearns-Roger Incorporated.
9. "Ash Storage Area, Plan", Drawing No. B-560, Revision A, 9 February, 1971, Sargent & Lundy Engineers.
10. "Ash Storage Area, Sections & Details", Drawing No. B-561, Revision A, 9 February, 1971, Sargent & Lundy Engineers.
11. "Overall Site Plan, Dewatering System, Ash Pond #2", Drawing No. A1000 (sh. 1), Revision A, 12 October, 2009, Ameren Energy Resources Generating.
12. "Site Details, Dewatering System, Ash Pond #2", Drawing No. A1000 (sh. 4), Revision A, 12 October, 2009, Ameren Energy Resources Generating.
13. "Proposed Site Plan, CCB Management Facility", Drawing No. C-10206 (sh. 4), Revision 0, 5 January, 2011, Ameren Energy Generating.
14. "Groundwater Monitoring & Boring Plan, CCB Management Facility", Drawing No. C-10206 (sh. 5), Revision 0, 5 January, 2011, Ameren Energy Generating.
15. "Anchor Trench and Liner System, CCB Management Facility", Drawing No. C-10206 (sh. 9), Revision 0, 5 January, 2011, Ameren Energy Generating.
16. "Cell G1-Foundation Grade & Control Data, CCB Management Facility", Drawing No. C-10206 (sh. 10), Revision 0, 5 January, 2011, Ameren Energy Generating.
17. "Cell G1-Process Water Recovery System, CCB Management Facility", Drawing No. C-10206 (sh. 15), Revision 0, 5 January, 2011, Ameren Energy Generating.
18. "Cell G1-PWRS Drain Details, CCB Management Facility", Drawing No. C-10206 (sh. 16), Revision 0, 5 January, 2011, Ameren Energy Generating.
19. "Recycle Pond Plan & Control Data, CCB Management Facility", Drawing No. C-10206 (sh. 19), Revision 0, 5 January, 2011, Ameren Energy Generating.
20. "Recycle Pond – Process Water Transfer Channel Details, CCB Management Facility", Drawing No. C-10206 (sh. 20), Revision 0, 5 January, 2011, Ameren Energy Generating.

Appendix B: Coffeen Power Station Drawings (continued)

21. "Recycle Pond–Process Water Decant Sections & Details, CCB Management Facility", Drawing No. C-10206 (sh. 21), Revision 0, 5 January, 2011, Ameren Energy Generating.
22. "Recycle Pond – Emergency Spillway Sections & Details, CCB Management Facility", Drawing No. C-10206 (sh. 22), Revision 0, 5 January, 2011, Ameren Energy Generating.
23. "Ash Pond #2, Drainage Modifications", Drawing No. W1008 (sh. 2), Ameren Energy Generating.

B-35

SECTION C-C

SECTION A-A

SECTION B-B

SECTION D-D

SECTION E-E

SUBSTRUCTURE BIDS
1-5-69
THIS DWG. FOR
REFERENCE ONLY

NOTES

REFERENCE DRAWINGS

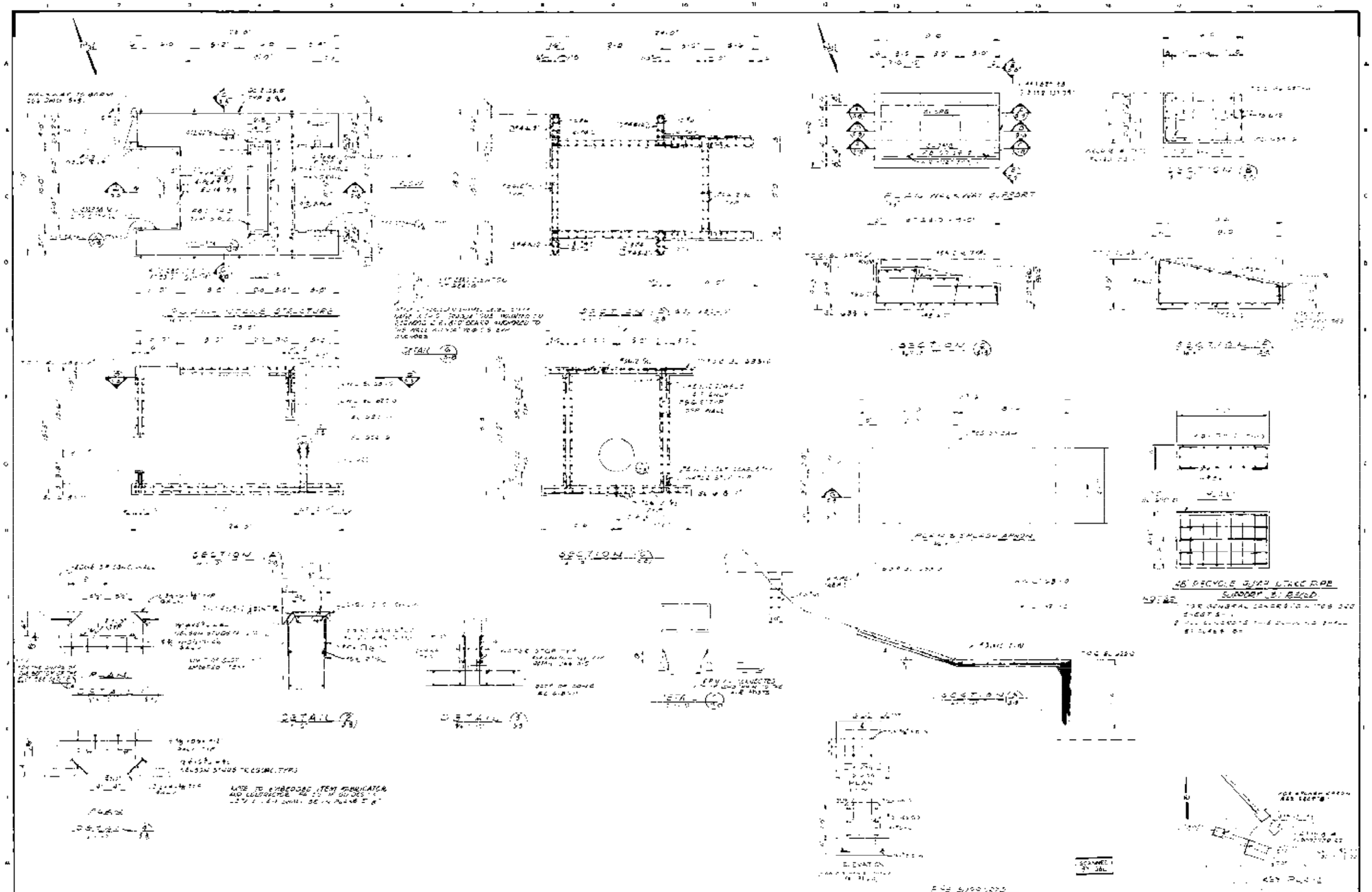
SCANNED BY SDL

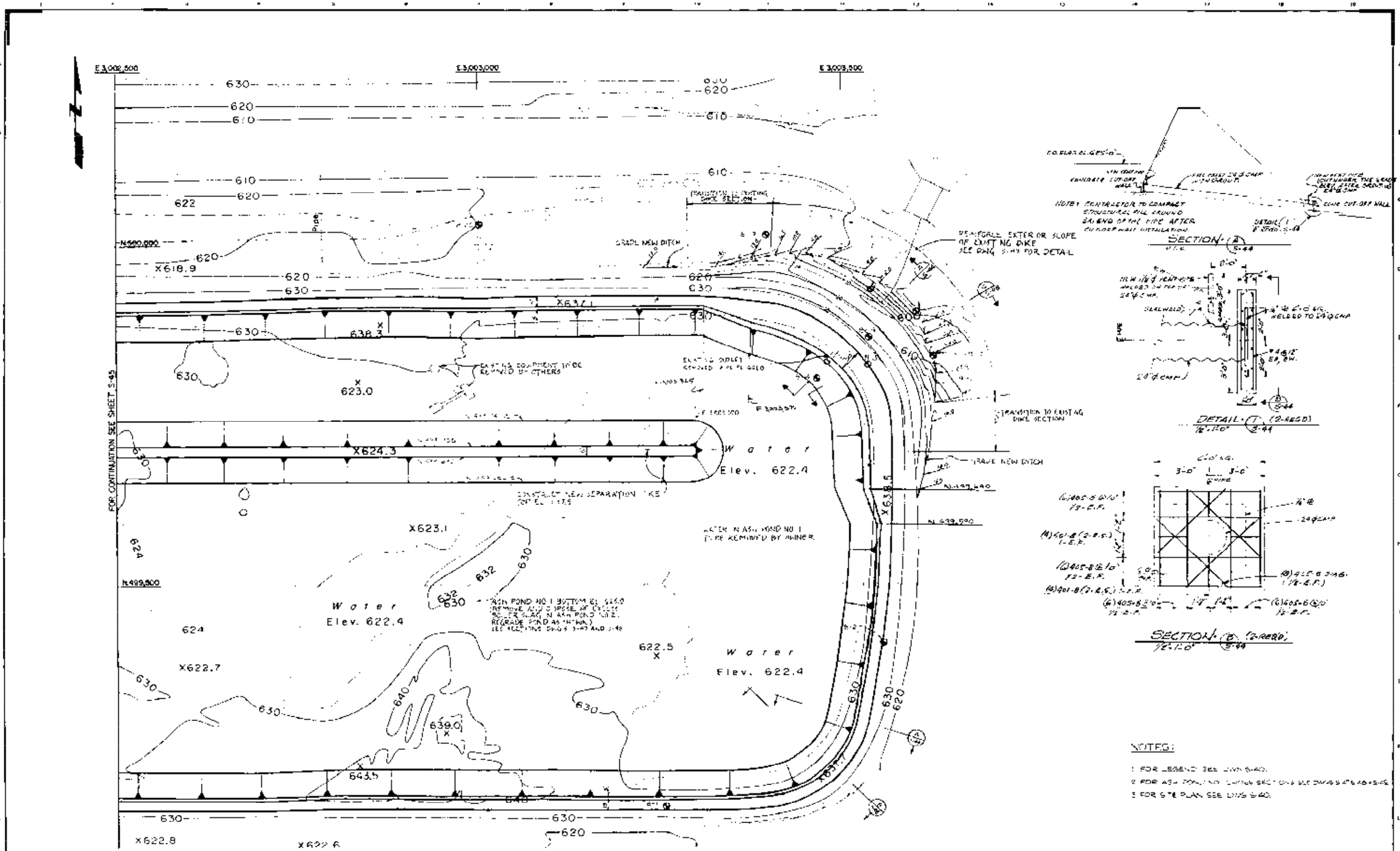
NORTH

EARTHWORK & GRADING PLAN
UNIT I
COFFEEN POWER STATION
CENTRAL ILL. PUBLIC SERVICE CO.
COFFEEN, ILLINOIS

SARGENT & LUNDY
ENGINEERS
CHICAGO 3, ILLINOIS

DRAWING NO.
B-35


SECTION (A)
SECTION (B)
DETAIL (D)
DETAIL (E)
PLAN
SECTION (F)
PLAN
ELEVATION
SECTION (G)
SECTION (H)
SECTION (I)
PLAN
SECTION (J)
PLAN
SECTION (K)
PLAN
SECTION (L)
PLAN
SECTION (M)
PLAN
SECTION (N)
PLAN
SECTION (O)
PLAN
SECTION (P)
PLAN
SECTION (Q)
PLAN
SECTION (R)
PLAN
SECTION (S)
PLAN
SECTION (T)
PLAN
SECTION (U)
PLAN
SECTION (V)
PLAN
SECTION (W)
PLAN
SECTION (X)
PLAN
SECTION (Y)
PLAN
SECTION (Z)
PLAN
SECTION (AA)
PLAN
SECTION (AB)
PLAN
SECTION (AC)
PLAN
SECTION (AD)
PLAN
SECTION (AE)
PLAN
SECTION (AF)
PLAN
SECTION (AG)
PLAN
SECTION (AH)
PLAN
SECTION (AI)
PLAN
SECTION (AJ)
PLAN
SECTION (AK)
PLAN
SECTION (AL)
PLAN
SECTION (AM)
PLAN
SECTION (AN)
PLAN
SECTION (AO)
PLAN
SECTION (AP)
PLAN
SECTION (AQ)
PLAN
SECTION (AR)
PLAN
SECTION (AS)
PLAN
SECTION (AT)
PLAN
SECTION (AU)
PLAN
SECTION (AV)
PLAN
SECTION (AW)
PLAN
SECTION (AX)
PLAN
SECTION (AY)
PLAN
SECTION (AZ)
PLAN
SECTION (BA)
PLAN
SECTION (BB)
PLAN
SECTION (BC)
PLAN
SECTION (BD)
PLAN
SECTION (BE)
PLAN
SECTION (BF)
PLAN
SECTION (BG)
PLAN
SECTION (BH)
PLAN
SECTION (BI)
PLAN
SECTION (BJ)
PLAN
SECTION (BK)
PLAN
SECTION (BL)
PLAN
SECTION (BM)
PLAN
SECTION (BN)
PLAN
SECTION (BO)
PLAN
SECTION (BP)
PLAN
SECTION (BQ)
PLAN
SECTION (BR)
PLAN
SECTION (BS)
PLAN
SECTION (BT)
PLAN
SECTION (BU)
PLAN
SECTION (BV)
PLAN
SECTION (BW)
PLAN
SECTION (BX)
PLAN
SECTION (BY)
PLAN
SECTION (BZ)
PLAN
SECTION (CA)
PLAN
SECTION (CB)
PLAN
SECTION (CC)
PLAN
SECTION (CD)
PLAN
SECTION (CE)
PLAN
SECTION (CF)
PLAN
SECTION (CG)
PLAN
SECTION (CH)
PLAN
SECTION (CI)
PLAN
SECTION (CJ)
PLAN
SECTION (CK)
PLAN
SECTION (CL)
PLAN
SECTION (CM)
PLAN
SECTION (CN)
PLAN
SECTION (CO)
PLAN
SECTION (CP)
PLAN
SECTION (CQ)
PLAN
SECTION (CR)
PLAN
SECTION (CS)
PLAN
SECTION (CT)
PLAN
SECTION (CU)
PLAN
SECTION (CV)
PLAN
SECTION (CW)
PLAN
SECTION (CX)
PLAN
SECTION (CY)
PLAN
SECTION (CZ)
PLAN
SECTION (DA)
PLAN
SECTION (DB)
PLAN
SECTION (DC)
PLAN
SECTION (DD)
PLAN
SECTION (DE)
PLAN
SECTION (DF)
PLAN
SECTION (DG)
PLAN
SECTION (DH)
PLAN
SECTION (DI)
PLAN
SECTION (DJ)
PLAN
SECTION (DK)
PLAN
SECTION (DL)
PLAN
SECTION (DM)
PLAN
SECTION (DN)
PLAN
SECTION (DO)
PLAN
SECTION (DP)
PLAN
SECTION (DQ)
PLAN
SECTION (DR)
PLAN
SECTION (DS)
PLAN
SECTION (DT)
PLAN
SECTION (DU)
PLAN
SECTION (DV)
PLAN
SECTION (DW)
PLAN
SECTION (DX)
PLAN
SECTION (DY)
PLAN
SECTION (DZ)
PLAN
SECTION (EA)
PLAN
SECTION (EB)
PLAN
SECTION (EC)
PLAN
SECTION (ED)
PLAN
SECTION (EE)
PLAN
SECTION (EF)
PLAN
SECTION (EG)
PLAN
SECTION (EH)
PLAN
SECTION (EI)
PLAN
SECTION (EJ)
PLAN
SECTION (EK)
PLAN
SECTION (EL)
PLAN
SECTION (EM)
PLAN
SECTION (EN)
PLAN
SECTION (EO)
PLAN
SECTION (EP)
PLAN
SECTION (EQ)
PLAN
SECTION (ER)
PLAN
SECTION (ES)
PLAN
SECTION (ET)
PLAN
SECTION (EU)
PLAN
SECTION (EV)
PLAN
SECTION (EW)
PLAN
SECTION (EX)
PLAN
SECTION (EY)
PLAN
SECTION (EZ)
PLAN
SECTION (FA)
PLAN
SECTION (FB)
PLAN
SECTION (FC)
PLAN
SECTION (FD)
PLAN
SECTION (FE)
PLAN
SECTION (FF)
PLAN
SECTION (FG)
PLAN
SECTION (FH)
PLAN
SECTION (FI)
PLAN
SECTION (FJ)
PLAN
SECTION (FK)
PLAN
SECTION (FL)
PLAN
SECTION (FM)
PLAN
SECTION (FN)
PLAN
SECTION (FO)
PLAN
SECTION (FP)
PLAN
SECTION (FQ)
PLAN
SECTION (FR)
PLAN
SECTION (FS)
PLAN
SECTION (FT)
PLAN
SECTION (FU)
PLAN
SECTION (FV)
PLAN
SECTION (FW)
PLAN
SECTION (FX)
PLAN
SECTION (FY)
PLAN
SECTION (FZ)
PLAN
SECTION (GA)
PLAN
SECTION (GB)
PLAN
SECTION (GC)
PLAN
SECTION (GD)
PLAN
SECTION (GE)
PLAN
SECTION (GF)
PLAN
SECTION (GG)
PLAN
SECTION (GH)
PLAN
SECTION (GI)
PLAN
SECTION (GJ)
PLAN
SECTION (GK)
PLAN
SECTION (GL)
PLAN
SECTION (GM)
PLAN
SECTION (GN)
PLAN
SECTION (GO)
PLAN
SECTION (GP)
PLAN
SECTION (GQ)
PLAN
SECTION (GR)
PLAN
SECTION (GS)
PLAN
SECTION (GT)
PLAN
SECTION (GU)
PLAN
SECTION (GV)
PLAN
SECTION (GW)
PLAN
SECTION (GX)
PLAN
SECTION (GY)
PLAN
SECTION (GZ)
PLAN
SECTION (HA)
PLAN
SECTION (HB)
PLAN
SECTION (HC)
PLAN
SECTION (HD)
PLAN
SECTION (HE)
PLAN
SECTION (HF)
PLAN
SECTION (HG)
PLAN
SECTION (HH)
PLAN
SECTION (HI)
PLAN
SECTION (HJ)
PLAN
SECTION (HK)
PLAN
SECTION (HL)
PLAN
SECTION (HM)
PLAN
SECTION (HN)
PLAN
SECTION (HO)
PLAN
SECTION (HP)
PLAN
SECTION (HQ)
PLAN
SECTION (HR)
PLAN
SECTION (HS)
PLAN
SECTION (HT)
PLAN
SECTION (HU)
PLAN
SECTION (HV)
PLAN
SECTION (HW)
PLAN
SECTION (HX)
PLAN
SECTION (HY)
PLAN
SECTION (HZ)
PLAN
SECTION (IA)
PLAN
SECTION (IB)
PLAN
SECTION (IC)
PLAN
SECTION (ID)
PLAN
SECTION (IE)
PLAN
SECTION (IF)
PLAN
SECTION (IG)
PLAN
SECTION (IH)
PLAN
SECTION (II)
PLAN
SECTION (IJ)
PLAN
SECTION (IK)
PLAN
SECTION (IL)
PLAN
SECTION (IM)
PLAN
SECTION (IN)
PLAN
SECTION (IO)
PLAN
SECTION (IP)
PLAN
SECTION (IQ)
PLAN
SECTION (IR)
PLAN
SECTION (IS)
PLAN
SECTION (IT)
PLAN
SECTION (IU)
PLAN
SECTION (IV)
PLAN
SECTION (IW)
PLAN
SECTION (IX)
PLAN
SECTION (IY)
PLAN
SECTION (IZ)
PLAN
SECTION (JA)
PLAN
SECTION (JB)
PLAN
SECTION (JC)
PLAN
SECTION (JD)
PLAN
SECTION (JE)
PLAN
SECTION (JF)
PLAN
SECTION (JG)
PLAN
SECTION (JH)
PLAN
SECTION (JI)
PLAN
SECTION (JJ)
PLAN
SECTION (JK)
PLAN
SECTION (JL)
PLAN
SECTION (JM)
PLAN
SECTION (JN)
PLAN
SECTION (JO)
PLAN
SECTION (JP)
PLAN
SECTION (JQ)
PLAN
SECTION (JR)
PLAN
SECTION (JS)
PLAN
SECTION (JT)
PLAN
SECTION (JU)
PLAN
SECTION (JV)
PLAN
SECTION (JW)
PLAN
SECTION (JX)
PLAN
SECTION (JY)
PLAN
SECTION (JZ)
PLAN
SECTION (KA)
PLAN
SECTION (KB)
PLAN
SECTION (KC)
PLAN
SECTION (KD)
PLAN
SECTION (KE)
PLAN
SECTION (KF)
PLAN
SECTION (KG)
PLAN
SECTION (KH)
PLAN
SECTION (KI)
PLAN
SECTION (KJ)
PLAN
SECTION (KK)
PLAN
SECTION (KL)
PLAN
SECTION (KM)
PLAN
SECTION (KN)
PLAN
SECTION (KO)
PLAN
SECTION (KP)
PLAN
SECTION (KQ)
PLAN
SECTION (KR)
PLAN
SECTION (KS)
PLAN
SECTION (KT)
PLAN
SECTION (KU)
PLAN
SECTION (KV)
PLAN
SECTION (KW)
PLAN
SECTION (KX)
PLAN
SECTION (KY)
PLAN
SECTION (KZ)
PLAN
SECTION (LA)
PLAN
SECTION (LB)
PLAN
SECTION (LC)
PLAN
SECTION (LD)
PLAN
SECTION (LE)
PLAN
SECTION (LF)
PLAN
SECTION (LG)
PLAN
SECTION (LH)
PLAN
SECTION (LI)
PLAN
SECTION (LJ)
PLAN
SECTION (LK)
PLAN
SECTION (LL)
PLAN
SECTION (LM)
PLAN
SECTION (LN)
PLAN
SECTION (LO)
PLAN
SECTION (LP)
PLAN
SECTION (LQ)
PLAN
SECTION (LR)
PLAN
SECTION (LS)
PLAN
SECTION (LT)
PLAN
SECTION (LU)
PLAN
SECTION (LV)
PLAN
SECTION (LW)
PLAN
SECTION (LX)
PLAN
SECTION (LY)
PLAN
SECTION (LZ)
PLAN
SECTION (MA)
PLAN
SECTION (MB)
PLAN
SECTION (MC)
PLAN
SECTION (MD)
PLAN
SECTION (ME)
PLAN
SECTION (MF)
PLAN
SECTION (MG)
PLAN
SECTION (MH)
PLAN
SECTION (MI)
PLAN
SECTION (MJ)
PLAN
SECTION (MK)
PLAN
SECTION (ML)
PLAN
SECTION (MM)
PLAN
SECTION (MN)
PLAN
SECTION (MO)
PLAN
SECTION (MP)
PLAN
SECTION (MQ)
PLAN
SECTION (MR)
PLAN
SECTION (MS)
PLAN
SECTION (MT)
PLAN
SECTION (MU)
PLAN
SECTION (MV)
PLAN
SECTION (MW)
PLAN
SECTION (MX)
PLAN
SECTION (MY)
PLAN
SECTION (MZ)
PLAN
SECTION (NA)
PLAN
SECTION (NB)
PLAN
SECTION (NC)
PLAN
SECTION (ND)
PLAN
SECTION (NE)
PLAN
SECTION (NF)
PLAN
SECTION (NG)
PLAN
SECTION (NH)
PLAN
SECTION (NI)
PLAN
SECTION (NJ)
PLAN
SECTION (NK)
PLAN
SECTION (NL)
PLAN
SECTION (NM)
PLAN
SECTION (NN)
PLAN
SECTION (NO)
PLAN
SECTION (NP)
PLAN
SECTION (NQ)
PLAN
SECTION (NR)
PLAN
SECTION (NS)
PLAN
SECTION (NT)
PLAN
SECTION (NU)
PLAN
SECTION (NV)
PLAN
SECTION (NW)
PLAN
SECTION (NX)
PLAN
SECTION (NY)
PLAN
SECTION (NZ)
PLAN
SECTION (OA)
PLAN
SECTION (OB)
PLAN
SECTION (OC)
PLAN
SECTION (OD)
PLAN
SECTION (OE)
PLAN
SECTION (OF)
PLAN
SECTION (OG)
PLAN
SECTION (OH)
PLAN
SECTION (OI)
PLAN
SECTION (OJ)
PLAN
SECTION (OK)
PLAN
SECTION (OL)
PLAN
SECTION (OM)
PLAN
SECTION (ON)
PLAN
SECTION (OO)
PLAN
SECTION (OP)
PLAN
SECTION (OQ)
PLAN
SECTION (OR)
PLAN
SECTION (OS)
PLAN
SECTION (OT)
PLAN
SECTION (OU)
PLAN
SECTION (OV)
PLAN
SECTION (OW)
PLAN
SECTION (OX)
PLAN
SECTION (OY)
PLAN
SECTION (OZ)
PLAN
SECTION (PA)
PLAN
SECTION (PB)
PLAN
SECTION (PC)
PLAN
SECTION (PD)
PLAN
SECTION (PE)
PLAN
SECTION (PF)
PLAN
SECTION (PG)
PLAN
SECTION (PH)
PLAN
SECTION (PI)
PLAN
SECTION (PJ)
PLAN
SECTION (PK)
PLAN
SECTION (PL)
PLAN
SECTION (PM)
PLAN
SECTION (PN)
PLAN
SECTION (PO)
PLAN
SECTION (PP)
PLAN
SECTION (PQ)
PLAN
SECTION (PR)
PLAN
SECTION (PS)
PLAN
SECTION (PT)
PLAN
SECTION (PU)
PLAN
SECTION (PV)
PLAN
SECTION (PW)
PLAN
SECTION (PX)
PLAN
SECTION (PY)
PLAN
SECTION (PZ)
PLAN
SECTION (QA)
PLAN
SECTION (QB)
PLAN
SECTION (QC)
PLAN
SECTION (QD)
PLAN
SECTION (QE)
PLAN
SECTION (QF)
PLAN
SECTION (QG)
PLAN
SECTION (QH)
PLAN
SECTION (QI)
PLAN
SECTION (QJ)
PLAN
SECTION (QK)
PLAN
SECTION (QL)
PLAN
SECTION (QM)
PLAN
SECTION (QN)
PLAN
SECTION (QO)
PLAN
SECTION (QP)
PLAN
SECTION (QQ)
PLAN
SECTION (QR)
PLAN
SECTION (QS)
PLAN
SECTION (QT)
PLAN
SECTION (QU)
PLAN
SECTION (QV)
PLAN
SECTION (QW)
PLAN
SECTION (QX)
PLAN
SECTION (QY)
PLAN
SECTION (QZ)
PLAN
SECTION (RA)
PLAN
SECTION (RB)
PLAN
SECTION (RC)
PLAN
SECTION (RD)
PLAN
SECTION (RE)
PLAN
SECTION (RF)
PLAN
SECTION (RG)
PLAN
SECTION (RH)
PLAN
SECTION (RI)
PLAN
SECTION (RJ)
PLAN
SECTION (RK)
PLAN
SECTION (RL)
PLAN
SECTION (RM)
PLAN
SECTION (RN)
PLAN
SECTION (RO)
PLAN
SECTION (RP)
PLAN
SECTION (RQ)
PLAN
SECTION (RR)
PLAN
SECTION (RS)
PLAN
SECTION (RT)
PLAN
SECTION (RU)
PLAN
SECTION (RV)
PLAN
SECTION (RW)
PLAN
SECTION (RX)
PLAN
SECTION (RY)
PLAN
SECTION (RZ)
PLAN
SECTION (SA)
PLAN
SECTION (SB)
PLAN
SECTION (SC)
PLAN
SECTION (SD)
PLAN
SECTION (SE)
PLAN
SECTION (SF)
PLAN
SECTION (SG)
PLAN
SECTION (SH)
PLAN
SECTION (SI)
PLAN
SECTION (SJ)
PLAN
SECTION (SK)
PLAN
SECTION (SL)
PLAN
SECTION (SM)
PLAN
SECTION (SN)
PLAN
SECTION (SO)
PLAN
SECTION (SP)
PLAN
SECTION (SQ)
PLAN
SECTION (SR)
PLAN
SECTION (SS)
PLAN
SECTION (ST)
PLAN
SECTION (SU)
PLAN
SECTION (SV)
PLAN
SECTION (SW)
PLAN
SECTION (SX)
PLAN
SECTION (SY)
PLAN
SECTION (SZ)
PLAN
SECTION (TA)
PLAN
SECTION (TB)
PLAN
SECTION (TC)
PLAN
SECTION (TD)
PLAN
SECTION (TE)
PLAN
SECTION (TF)
PLAN
SECTION (TG)
PLAN
SECTION (TH)
PLAN
SECTION (TI)
PLAN
SECTION (TJ)
PLAN
SECTION (TK)
PLAN
SECTION (TL)
PLAN
SECTION (TM)
PLAN
SECTION (TN)
PLAN
SECTION (TO)
PLAN
SECTION (TP)
PLAN
SECTION (TQ)
PLAN
SECTION (TR)
PLAN
SECTION (TS)
PLAN
SECTION (TT)
PLAN
SECTION (TU)
PLAN
SECTION (TV)
PLAN
SECTION (TW)
PLAN
SECTION (TX)
PLAN
SECTION (TY)
PLAN
SECTION (TZ)
PLAN
SECTION (UA)
PLAN
SECTION (UB)
PLAN
SECTION (UC)
PLAN
SECTION (UD)
PLAN
SECTION (UE)
PLAN
SECTION (UF)
PLAN
SECTION (UG)
PLAN
SECTION (UH)
PLAN
SECTION (UI)
PLAN
SECTION (UJ)
PLAN
SECTION (UK)
PLAN
SECTION (UL)
PLAN
SECTION (UM)
PLAN
SECTION (UN)
PLAN
SECTION (UO)
PLAN
SECTION (UP)
PLAN
SECTION (UQ)
PLAN
SECTION (UR)
PLAN
SECTION (US)
PLAN
SECTION (UT)
PLAN
SECTION (UU)
PLAN
SECTION (UV)
PLAN
SECTION (UW)
PLAN
SECTION (UX)
PLAN
SECTION (UY)
PLAN
SECTION (UZ)
PLAN
SECTION (VA)
PLAN
SECTION (VB)
PLAN
SECTION (VC)
PLAN
SECTION (VD)
PLAN
SECTION (VE)
PLAN
SECTION (VF)
PLAN
SECTION (VG)
PLAN
SECTION (VH)
PLAN
SECTION (VI)
PLAN
SECTION (VJ)
PLAN
SECTION (VK)
PLAN
SECTION (VL)
PLAN
SECTION (VM)
PLAN
SECTION (VN)
PLAN
SECTION (VO)
PLAN
SECTION (VP)
PLAN
SECTION (VQ)
PLAN
SECTION (VR)
PLAN
SECTION (VS)
PLAN
SECTION (VT)
PLAN
SECTION (VU)
PLAN
SECTION (VV)
PLAN
SECTION (VW)
PLAN
SECTION (VX)
PLAN
SECTION (VY)
PLAN
SECTION (VZ)
PLAN
SECTION (WA)
PLAN
SECTION (WB)
PLAN
SECTION (WC)
PLAN
SECTION (WD)
PLAN
SECTION (WE)
PLAN
SECTION (WF)
PLAN
SECTION (WG)
PLAN
SECTION (WH)
PLAN
SECTION (WI)
PLAN
SECTION (WJ)
PLAN
SECTION (WK)
PLAN
SECTION (WL)
PLAN
SECTION (WM)
PLAN
SECTION (WN)
PLAN
SECTION (WO)
PLAN
SECTION (WP)
PLAN
SECTION (WQ)
PLAN
SECTION (WR)
PLAN
SECTION (WS)
PLAN
SECTION (WT)
PLAN
SECTION (WU)
PLAN
SECTION (WV)
PLAN
SECTION (WW)
PLAN
SECTION (WX)
PLAN
SECTION (WY)
PLAN
SECTION (WZ)
PLAN
SECTION (XA)
PLAN
SECTION (XB)
PLAN
SECTION (XC)
PLAN
SECTION (XD)
PLAN
SECTION (XE)
PLAN
SECTION (XF)
PLAN
SECTION (XG)
PLAN
SECTION (XH)
PLAN
SECTION (XI)
PLAN
SECTION (XJ)
PLAN
SECTION (XK)
PLAN
SECTION (XL)
PLAN
SECTION (XM)
PLAN
SECTION (XN)
PLAN
SECTION (XO)
PLAN
SECTION (XP)
PLAN
SECTION (XQ)
PLAN
SECTION (XR)
PLAN
SECTION (XS)
PLAN
SECTION (XT)
PLAN
SECTION (XU)
PLAN
SECTION (XV)
PLAN
SECTION (XW)
PLAN
SECTION (XX)
PLAN
SECTION (XY)
PLAN
SECTION (XZ)
PLAN
SECTION (YA)
PLAN
SECTION (YB)
PLAN
SECTION (YC)
PLAN
SECTION (YD)
PLAN
SECTION (YE)
PLAN
SECTION (YF)
PLAN
SECTION (YG)
PLAN
SECTION (YH)
PLAN
SECTION (YI)
PLAN
SECTION (YJ)
PLAN
SECTION (YK)
PLAN
SECTION (YL)
PLAN
SECTION (YM)
PLAN
SECTION (YN)
PLAN
SECTION (YO)
PLAN
SECTION (YP)
PLAN
SECTION (YQ)
PLAN
SECTION (YR)
PLAN
SECTION (YS)
PLAN
SECTION (YT)
PLAN
SECTION (YU)
PLAN
SECTION (YV)
PLAN
SECTION (YW)
PLAN
SECTION (YX)
PLAN
SECTION (YY)
PLAN
SECTION (YZ)
PLAN
SECTION (ZA)
PLAN
SECTION (ZB)
PLAN
SECTION (ZC)
PLAN
SECTION (ZD)
PLAN
SECTION (ZE)
PLAN
SECTION (ZF)
PLAN
SECTION (ZG)
PLAN
SECTION (ZH)
PLAN
SECTION (ZI)
PLAN
SECTION (ZJ)
PLAN
SECTION (ZK)
PLAN
SECTION (ZL)
PLAN
SECTION (ZM)
PLAN
SECTION (ZN)
PLAN
SECTION (ZO)
PLAN
SECTION (ZP)
PLAN
SECTION (ZQ)
PLAN
SECTION (ZR)
PLAN
SECTION (ZS)
PLAN
SECTION (ZT)
PLAN
SECTION (ZU)
PLAN
SECTION (ZV)
PLAN
SECTION (ZW)
PLAN
SECTION (ZX)
PLAN
SECTION (ZY)
PLAN
SECTION (ZZ)
PLAN
SECTION (AA)
PLAN
SECTION (AB)
PLAN
SECTION (AC)
PLAN
SECTION (AD)
PLAN
SECTION (AE)
PLAN
SECTION (AF)
PLAN
SECTION (AG)
PLAN
SECTION (AH)
PLAN
SECTION (AI)
PLAN
SECTION (AJ)
PLAN
SECTION (AK)
PLAN
SECTION (AL)
PLAN
SECTION (AM)
PLAN
SECTION (AN)
PLAN
SECTION (AO)
PLAN
SECTION (AP)
PLAN
SECTION (AQ)
PLAN
SECTION (AR)
PLAN
SECTION (AS)
PLAN
SECTION (AT)
PLAN
SECTION (AU)
PLAN
SECTION (AV)
PLAN
SECTION (AW)
PLAN
SECTION (AX)
PLAN
SECTION (AY)
PLAN
SECTION (AZ)
PLAN
SECTION (BA)
PLAN
SECTION (BB)
PLAN
SECTION (BC)
PLAN
SECTION (BD)
PLAN
SECTION (BE)
PLAN
SECTION (BF)
PLAN
SECTION (BG)
PLAN
SECTION (BH)
PLAN
SECTION (BI)
PLAN
SECTION (BJ)
PLAN
SECTION (BK)
PLAN
SECTION (BL)
PLAN
SECTION (BM)
PLAN
SECTION (BN)
PLAN
SECTION (BO)
PLAN
SECTION (BP)
PLAN
SECTION (BQ)
PLAN
SECTION (BR)
PLAN
SECTION (BS)
PLAN
SECTION (BT)
PLAN
SECTION (BU)
PLAN
SECTION (BV)
PLAN
SECTION (BW)
PLAN
SECTION (BX)
PLAN
SECTION (BY)
PLAN
SECTION (BZ)
PLAN
SECTION (CA)
PLAN
SECTION (CB)
PLAN
SECTION (CC)
PLAN
SECTION (CD)
PLAN
SECTION (CE)
PLAN
SECTION (CF)
PLAN
SECTION (CG)
PLAN
SECTION (CH)
PLAN
SECTION (CI)
PLAN
SECTION (CJ)
PLAN
SECTION (CK)
PLAN
SECTION (CL)
PLAN
SECTION (CM)
PLAN
SECTION (CN)
PLAN
SECTION (CO)
PLAN
SECTION (CP)
PLAN
SECTION (CQ)
PLAN
SECTION (CR)
PLAN
SECTION (CS)
PLAN
SECTION (CT)
PLAN
SECTION (CU)
PLAN
SECTION (CV)
PLAN
SECTION (CW)
PLAN
SECTION (CX)
PLAN
SECTION (CY)
PLAN
SECTION (CZ)
PLAN
SECTION (DA)
PLAN
SECTION (DB)
PLAN
SECTION (DC)
PLAN
SECTION (DD)
PLAN
SECTION (DE)
PLAN
SECTION (DF)
PLAN
SECTION (DG)
PLAN
SECTION (DH)
PLAN
SECTION (DI)
PLAN
SECTION (DJ)
PLAN
SECTION (DK)
PLAN
SECTION (DL)
PLAN
SECTION (DM)
PLAN
SECTION (DN)
PLAN
SECTION (DO)
PLAN
SECTION (DP)
PLAN
SECTION (DQ)
PLAN
SECTION (DR)
PLAN
SECTION (DS)
PLAN
SECTION (DT)
PLAN
SECTION (DU)
PLAN
SECTION (DV)
PLAN
SECTION (DW)
PLAN
SECTION (DX)
PLAN
SECTION (DY)
PLAN
SECTION (DZ)
PLAN
SECTION (EA)
PLAN
SECTION (EB)
PLAN
SECTION (EC)
PLAN
SECTION (ED)
PLAN
SECTION (EE)
PLAN
SECTION (EF)
PLAN
SECTION (EG)
PLAN
SECTION (EH)
PLAN
SECTION (EI)
PLAN
SECTION (EJ)
PLAN
SECTION (EK)
PLAN
SECTION (EL)
PLAN
SECTION (EM)
PLAN
SECTION (EN)
PLAN
SECTION (EO)
PLAN
SECTION (EP)
PLAN
SECTION (EQ)
PLAN
SECTION (ER)
PLAN
SECTION (ES)
PLAN
SECTION (ET)
PLAN
SECTION (EU)
PLAN
SECTION (EV)
PLAN
SECTION (EW)
PLAN
SECTION (EX)
PLAN
SECTION (EY)
PLAN
SECTION (EZ)
PLAN
SECTION (FA)
PLAN
SECTION (FB)
PLAN
SECTION (FC)
PLAN
SECTION (FD)
PLAN
SECTION (FE)
PLAN
SECTION (FF)
PLAN
SECTION (FG)
PLAN
SECTION (FH)
PLAN
SECTION (FI)
PLAN
SECTION (FJ)
PLAN
SECTION (FK)
PLAN
SECTION (FL)
PLAN
SECTION (FM)
PLAN
SECTION (FN)
PLAN
SECTION (FO)
PLAN
SECTION (FP)
PLAN
SECTION (FQ)
PLAN
SECTION (FR)
PLAN
SECTION (FS)
PLAN
SECTION (FT)
PLAN
SECTION (FU)
PLAN
SECTION (FV)
PLAN
SECTION (FW)
PLAN
SECTION (FX)
PLAN
SECTION (FY)
PLAN
SECTION (FZ)
PLAN
SECTION (GA)
PLAN
SECTION (GB)
PLAN
SECTION (GC)
PLAN
SECTION (GD)
PLAN
SECTION (GE)
PLAN
SECTION (GF)
PLAN
SECTION (GG)
PLAN
SECTION (GH)
PLAN
SECTION (GI)
PLAN
SECTION (GJ)
PLAN
SECTION (GK)
PLAN
SECTION (GL)
PLAN
SECTION (GM)
PLAN
SECTION (GN)
PLAN
SECTION (GO)
PLAN
SECTION (GP)
PLAN
SECTION (GQ)
PLAN
SECTION (GR)
PLAN
SECTION (GS)
PLAN
SECTION (GT)
PLAN
SECTION (GU)
PLAN
SECTION (GV)
PLAN
SECTION (GW)
PLAN
SECTION (GX)
PLAN
SECTION (GY)
PLAN
SECTION (GZ)
PLAN
SECTION (HA)
PLAN
SECTION (HB)
PLAN
SECTION (HC)
PLAN
SECTION (HD)
PLAN
SECTION (HE)
PLAN
SECTION (HF)
PLAN
SECTION (HG)
PLAN
SECTION (HH)
PLAN
SECTION (HI)
PLAN
SECTION (HJ)
PLAN
SECTION (HK)
PLAN
SECTION (HL)
PLAN
SECTION (HM)
PLAN
SECTION (HN)
PLAN
SECTION (HO)
PLAN
SECTION (HP)
PLAN
SECTION (HQ)
PLAN
SECTION (HR)
PLAN
SECTION (HS)
PLAN
SECTION (HT)
PLAN
SECTION (HU)
PLAN
SECTION (HV)
PLAN
SECTION (HW)
PLAN
SECTION (HX)
PLAN
SECTION (HY)
PLAN
SECTION (HZ)
PLAN
SECTION (IA)
PLAN
SECTION (IB)
PLAN
SECTION (IC)
PLAN
SECTION (ID)
PLAN
SECTION (IE)
PLAN
SECTION (IF)
PLAN
SECTION (IG)
PLAN
SECTION (IH)
PLAN
SECTION (II)
PLAN
SECTION (IJ)
PLAN
SECTION (IK)
PLAN
SECTION (IL)
PLAN
SECTION (IM)
PLAN
SECTION (IN)
PLAN
SECTION (IO)
PLAN
SECTION (IP)
PLAN
SECTION (IQ)
PLAN
SECTION (IR)
PLAN
SECTION (IS)
PLAN
SECTION (IT)
PLAN
SECTION (IU)
PLAN
SECTION (IV)
PLAN
SECTION (IW)
PLAN
SECTION (IX)
PLAN
SECTION (IY)
PLAN
SECTION (IZ)
PLAN
SECTION (JA)
PLAN
SECTION (JB)
PLAN
SECTION (JC)
PLAN
SECTION (JD)
PLAN
SECTION (JE)
PLAN
SECTION (JF)
PLAN
SECTION (JG)
PLAN
SECTION (JH)
PLAN
SECTION (JI)
PLAN
SECTION (JJ)
PLAN
SECTION (JK)
PLAN
SECTION (JL)
PLAN
SECTION (JM)
PLAN
SECTION (JN)
PLAN
SECTION (JO)
PLAN
SECTION (JP)
PLAN
SECTION (JQ)
PLAN
SECTION (JR)
PLAN
SECTION (JS)
PLAN
SECTION (JT)
PLAN
SECTION (JU)
PLAN
SECTION (JV)
PLAN
SECTION (JW)
PLAN
SECTION (JX)
PLAN
SECTION (JY)
PLAN
SECTION (JZ)
PLAN
SECTION (KA)
PLAN
SECTION (KB)
PLAN
SECTION (KC)
PLAN
SECTION (KD)
PLAN
SECTION (KE)
PLAN
SECTION (KF)
PLAN
SECTION (KG)
PLAN
SECTION (KH)
PLAN
SECTION (KI)
PLAN
SECTION (KJ)
PLAN
SECTION (KK)
PLAN
SECTION (KL)
PLAN
SECTION (KM)
PLAN
SECTION (KN)
PLAN
SECTION (KO)
PLAN
SECTION (KP)
PLAN
SECTION (KQ)
PLAN
SECTION (KR)
PLAN
SECTION (KS)
PLAN
SECTION (KT)
PLAN
SECTION (KU)
PLAN
SECTION (KV)
PLAN
SECTION (KW)
PLAN
SECTION (KX)
PLAN
SECTION (KY)
PLAN
SECTION (KZ)
PLAN
SECTION (LA)
PLAN
SECTION (LB)
PLAN
SECTION (LC)
PLAN
SECTION (LD)
PLAN
SECTION (LE)
PLAN
SECTION (LF)
PLAN
SECTION (LG)
PLAN
SECTION (LH)
PLAN
SECTION (LI)
PLAN
SECTION (LJ)
PLAN
SECTION (LK)
PLAN
SECTION (LL)
PLAN
SECTION (LM)
PLAN
SECTION (LN)
PLAN
SECTION (LO)
PLAN
SECTION (LP)
PLAN
SECTION (LQ)
PLAN
SECTION (LR)
PLAN
SECTION (LS)
PLAN
SECTION (LT)
PLAN
SECTION (LU)
PLAN
SECTION (LV)
PLAN
SECTION (LW)
PLAN
SECTION (LX)
PLAN
SECTION (LY)
PLAN
SECTION (LZ)
PLAN
SECTION (MA)
PLAN
SECTION (MB)
PLAN
SECTION (MC)
PLAN
SECTION (MD)
PLAN
SECTION (ME)
PLAN
SECTION (MF)
PLAN
SECTION (MG)
PLAN
SECTION (MH)
PLAN
SECTION (MI)
PLAN
SECTION (MJ)
PLAN
SECTION (MK)
PLAN
SECTION (ML)
PLAN
SECTION (MM)
PLAN
SECTION (MN)
PLAN
SECTION (MO)
PLAN
SECTION (MP)
PLAN
SECTION (MQ)
PLAN
SECTION (MR)
PLAN
SECTION (MS)
PLAN
SECTION (MT)
PLAN
SECTION (MU)
PLAN
SECTION (MV)
PLAN
SECTION (MW)
PLAN
SECTION (MX)
PLAN
SECTION (MY)
PLAN
SECTION (MZ)
PLAN
SECTION (NA)
PLAN
SECTION (NB)
PLAN
SECTION (NC)
PLAN
SECTION (ND)
PLAN
SECTION (NE)
PLAN
SECTION (NF)
PLAN
SECTION (NG)
PLAN
SECTION (NH)
PLAN
SECTION (NI)
PLAN
SECTION (NJ)
PLAN
SECTION (NK)
PLAN
SECTION (NL)
PLAN
SECTION (NM)
PLAN
SECTION (NN)
PLAN
SECTION (NO)
PLAN
SECTION (NP)
PLAN
SECTION (NQ)
PLAN
SECTION (NR)
PLAN
SECTION (NS)
PLAN
SECTION (NT)
PLAN
SECTION (NU)
PLAN
SECTION (NV)
PLAN
SECTION (NW)
PLAN
SECTION (NX)
PLAN
SECTION (NY)
PLAN
SECTION (NZ)
PLAN
SECTION (OA)
PLAN
SECTION (OB)
PLAN
SECTION (OC)
PLAN
SECTION (OD)
PLAN
SECTION (OE)
PLAN
SECTION (OF)
PLAN
SECTION (OG)
PLAN
SECTION (OH)
PLAN
SECTION (OI)
PLAN
SECTION (OJ)
PLAN
SECTION (OK)
PLAN
SECTION (OL)
PLAN
SECTION (OM)
PLAN
SECTION (ON)
PLAN
SECTION (OO)
PLAN
SECTION (OP)
PLAN
SECTION (OQ)
PLAN
SECTION (OR)
PLAN
SECTION (OS)
PLAN
SECTION (OT)
PLAN
SECTION (OU)
PLAN
SECTION (OV)
PLAN
SECTION (OW)
PLAN
SECTION (OX)
PLAN
SECTION (OY)
PLAN
SECTION (OZ)
PLAN
SECTION (PA)
PLAN
SECTION (PB)
PLAN
SECTION (PC)
PLAN
SECTION (PD)
PLAN
SECTION (PE)
PLAN
SECTION (PF)
PLAN
SECTION (PG)
PLAN
SECTION (PH)
PLAN
SECTION (PI)
PLAN
SECTION (PJ)
PLAN
SECTION (PK)
PLAN
SECTION (PL)
PLAN
SECTION (PM)
PLAN
SECTION (PN)
PLAN
SECTION (PO)
PLAN
SECTION (PP)
PLAN
SECTION (PQ)
PLAN
SECTION (PR)
PLAN
SECTION (PS)
PLAN
SECTION (PT)
PLAN
SECTION (PU)
PLAN
SECTION (PV)
PLAN
SECTION (PW)
PLAN
SECTION (PX)
PLAN
SECTION (PY)
PLAN
SECTION (PZ)
PLAN
SECTION (QA)
PLAN
SECTION (QB)
PLAN
SECTION (QC)
PLAN
SECTION (QD)
PLAN
SECTION (QE)
PLAN
SECTION (QF)
PLAN
SECTION (QG)
PLAN
SECTION (QH)
PLAN
SECTION (QI)
PLAN
SECTION (QJ)
PLAN
SECTION (QK)
PLAN
SECTION (QL)
PLAN
SECTION (



NOTES:

1. FOR LEGEND SEE DWG S-40.
2. FOR ASH POND NO 1 CROSS SECTIONS SEE DWGS S-47 & 48 & S-49.
3. FOR SITE PLAN SEE DWG S-40.

SCANNED BY SEL

S.R. NO. Y2-4

REVISIONS	REFERENCE DRAWINGS	PRINT RECORD	ENG RECORD	DRAWING STATUS
GENERAL REVISIONS				
APPROVED FOR CONSTRUCTION				
ADD'D SECTION "A" & "B" AND DETAIL "1"				
UNLOCATED N.E. CORNER ENGAGEMENT ASH POND "1"				
SCALED BY SEL				

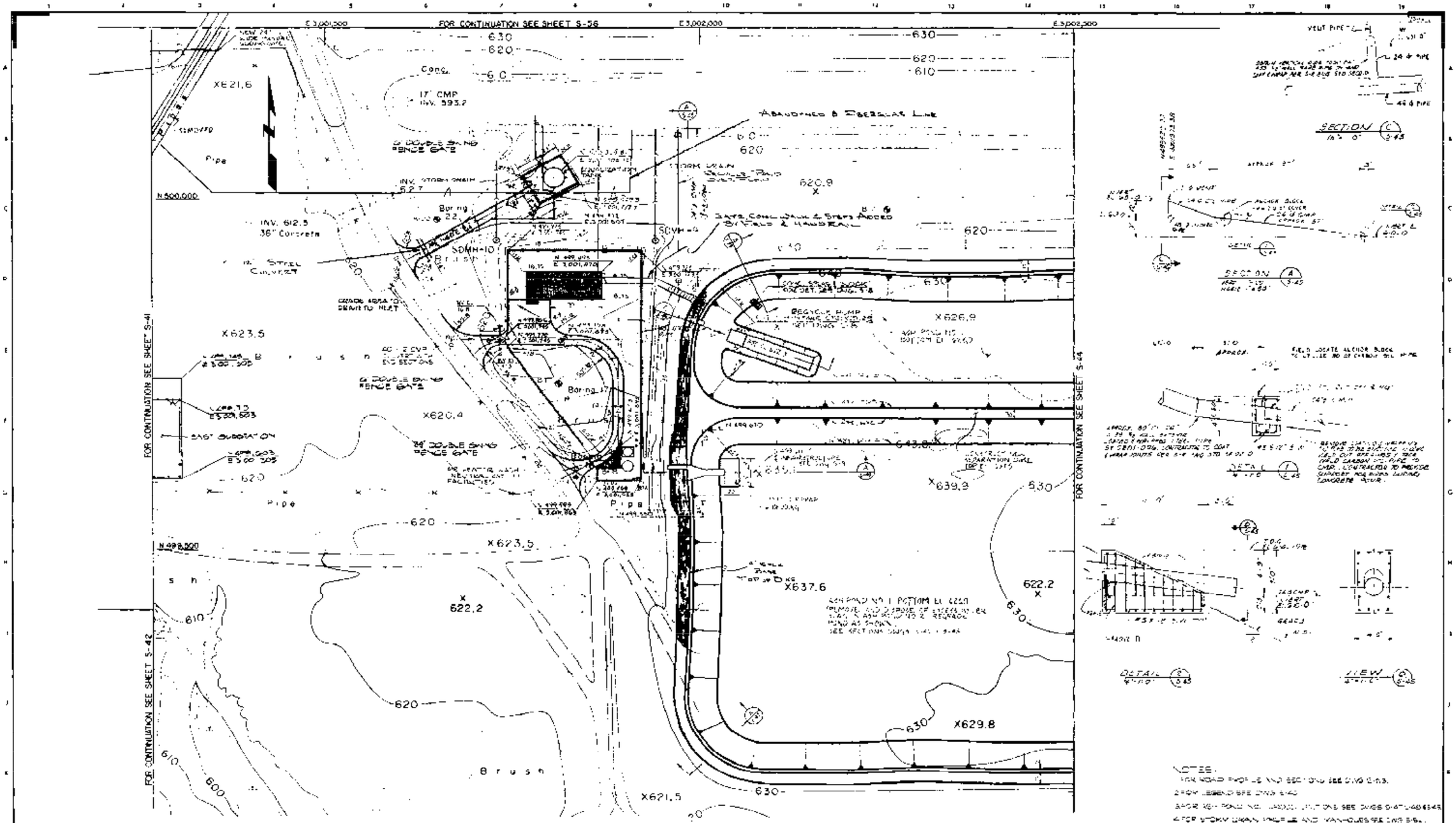
CIVIL

LAYOUT & GRADING PLAN SHEET 4

WASTEWATER MANAGEMENT FACILITIES
CENTRAL ILLINOIS PUBLIC SERVICE COMPANY
COFFEEN POWER STATION

Stearns-Roger

S-44



NOTES:
1. FOR ROAD PROFILE AND SECTIONS SEE DWG S-43.
2. FOR LEGEND SEE DWG S-40.
3. FOR ROAD NO. 1 PROFILE SECTIONS SEE DWGS S-47 THRU S-49.
4. FOR STORM DRAIN PROFILE AND MANHOLES SEE DWG S-51.
5. FOR SITE PLAN SEE DWG S-40.
6. FOR FENCE DETAILS SEE DWG S-51.

S.R. NO. Y2-5

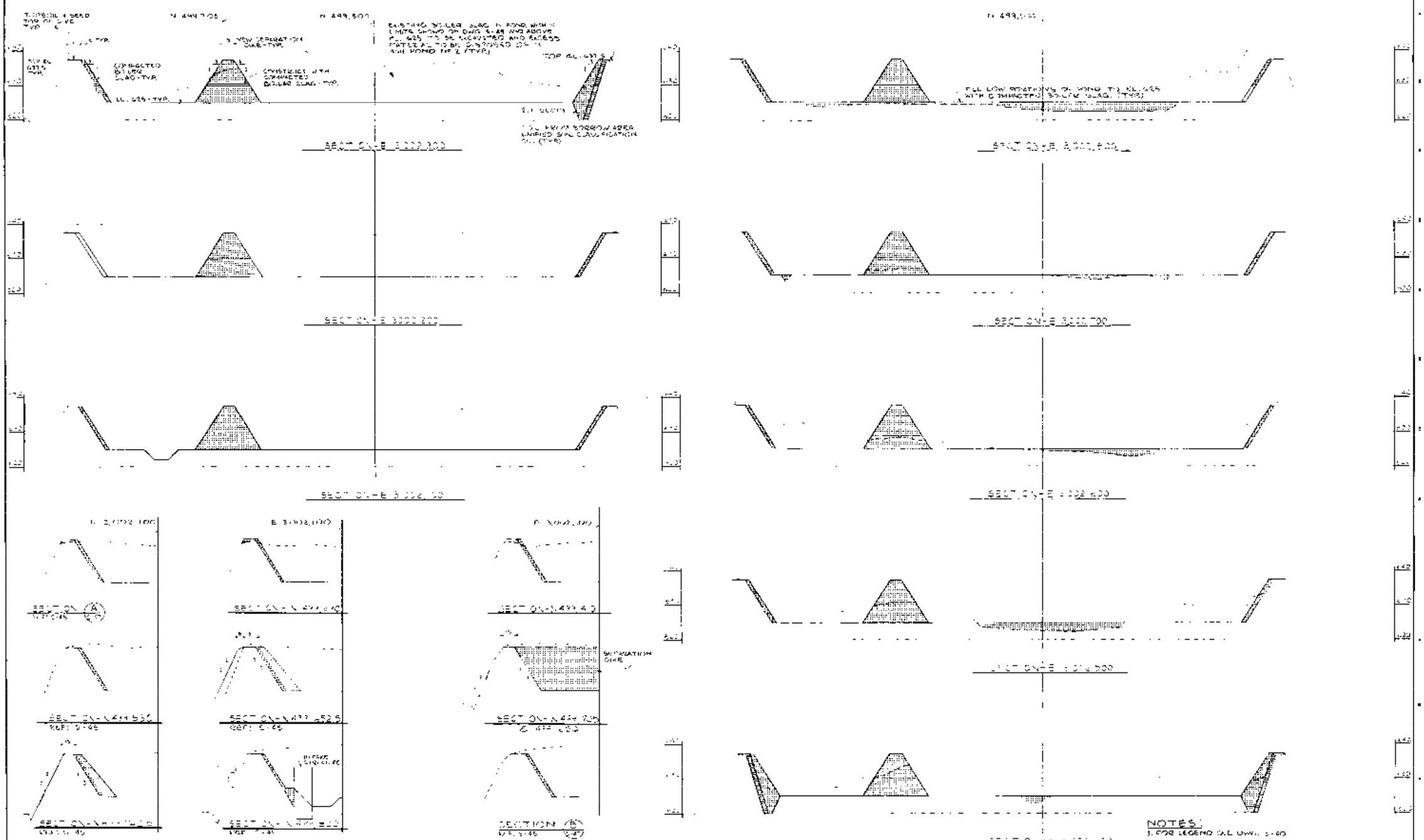
REVISIONS	REFERENCE DRAWINGS	PRINT RECORD	END RECORD	DRAWING STATUS
1. ADDED 11 28	M-51 ELEVATE PUMPHOUSE PIONS &	DATE RECEIVED	DESIGNED NDS	PRELIMINARY
2. ADD ELEVATION REV. DIMENSIONS ON CULVERT	M-54 PIPING PLAN & SECTIONS	REVISION NO. 0 1 2 3 4 5 6 7	CHECKED JET	SEE COMMENTS AND OR APPROVALS
3. ADDED SUBSTATION AND REVISED GATE & FENCE	S-51 CONCRETE RECYCLE PUMPHOUSE	FOR	PROJ. ENG.	APPROVED FOR CONSTRUCTION
4. REVISED CONTOURS TO AS BUILT	S-101 WASTEWATER FACILITIES	SYSTEMS	SYSTEMS	
5. FINAL GRADING		CIVIL	CIVIL	
6. ROUTE 4 POLE & TOWER DIMENSIONS, GATE, WALKWAY & STEPS		MECH. CO.	MECH. CO.	
		ELEC. CO.	ELEC. CO.	

STATE OF ILLINOIS
LEO W. VICTORA JR.
41-903
STRUCTURAL ENGINEER

CIVIL
LAYOUT & GRADING PLAN SHEET 5

WASTEWATER MANAGEMENT FACILITIES
CENTRAL ILLINOIS PUBLIC SERVICE COMPANY
COFFEEN POWER STATION

SCALE 1"=50'
Stearns-Roger
C-20000
S-45



NOTES:
1. FOR LEGEND SEE DWG. S-60
2. FOR ASH POND NO. 1 PLANS SEE DWGS. S-64 AND S-65
3. FOR SITE PLAN SEE DWG. S-40

SR NO Y2-7

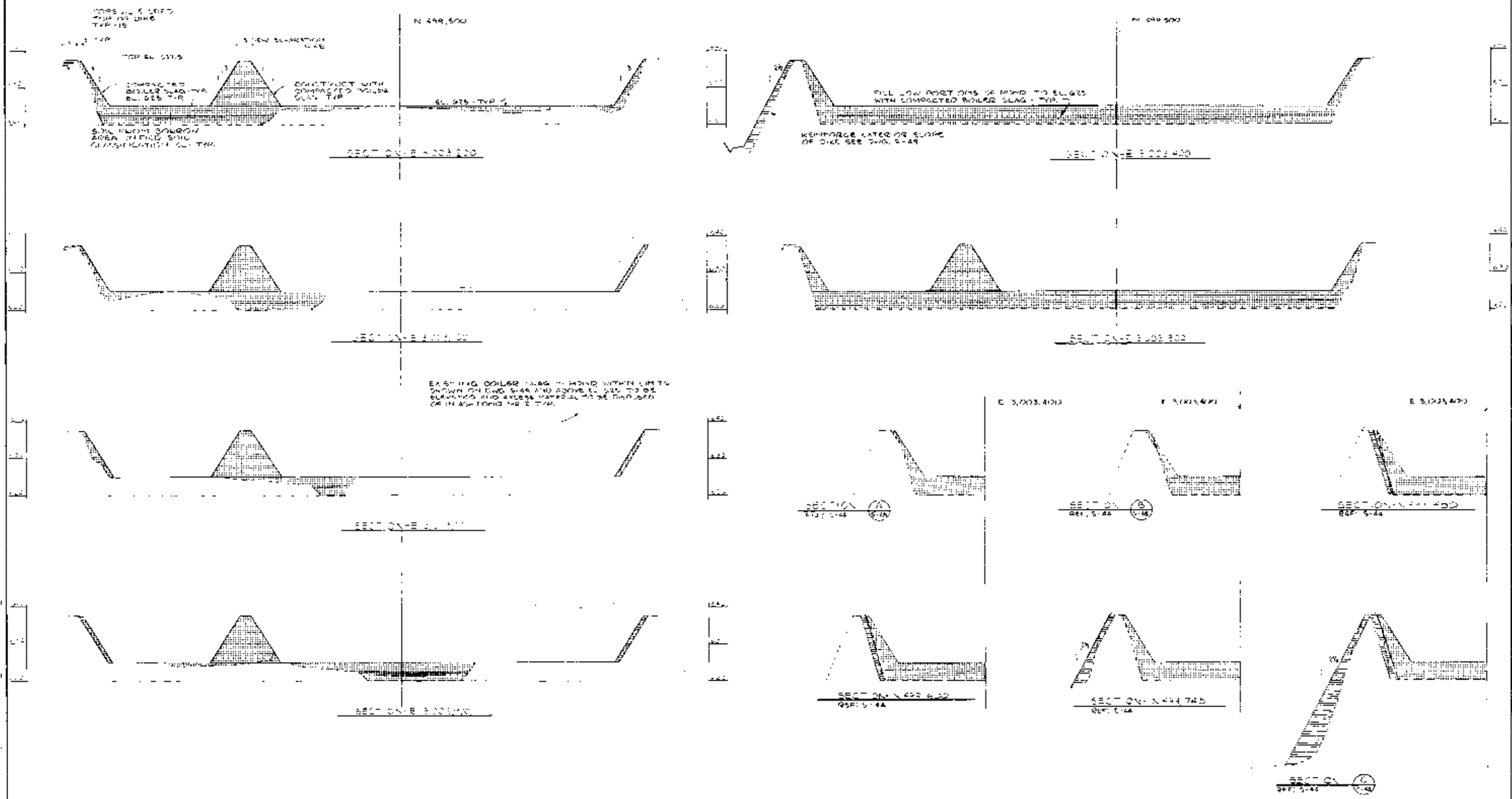
REVISIONS	REFERENCE DRAWINGS	PRINT RECORD	END RECORD	DRAWING STATUS
ALLOWED FOR CONSTRUCTION				

CIVIL
MISCELLANEOUS SECTIONS AND DETAILS
SHEET 2

WASTEWATER MANAGEMENT FACILITIES
CENTRAL ILLINOIS PUBLIC SERVICE COMPANY
DUFFERN POWER STATION

Stearns-Roger

S-47



NOTES.
1. FOR LEGEND SEE DWG. S-40
2. FOR ASH POND NO 1 PLANS SEE DWGS. S-44 AND S-45
3. FOR SITE PLAN SEE DWG. S-40

SR NO Y2-8

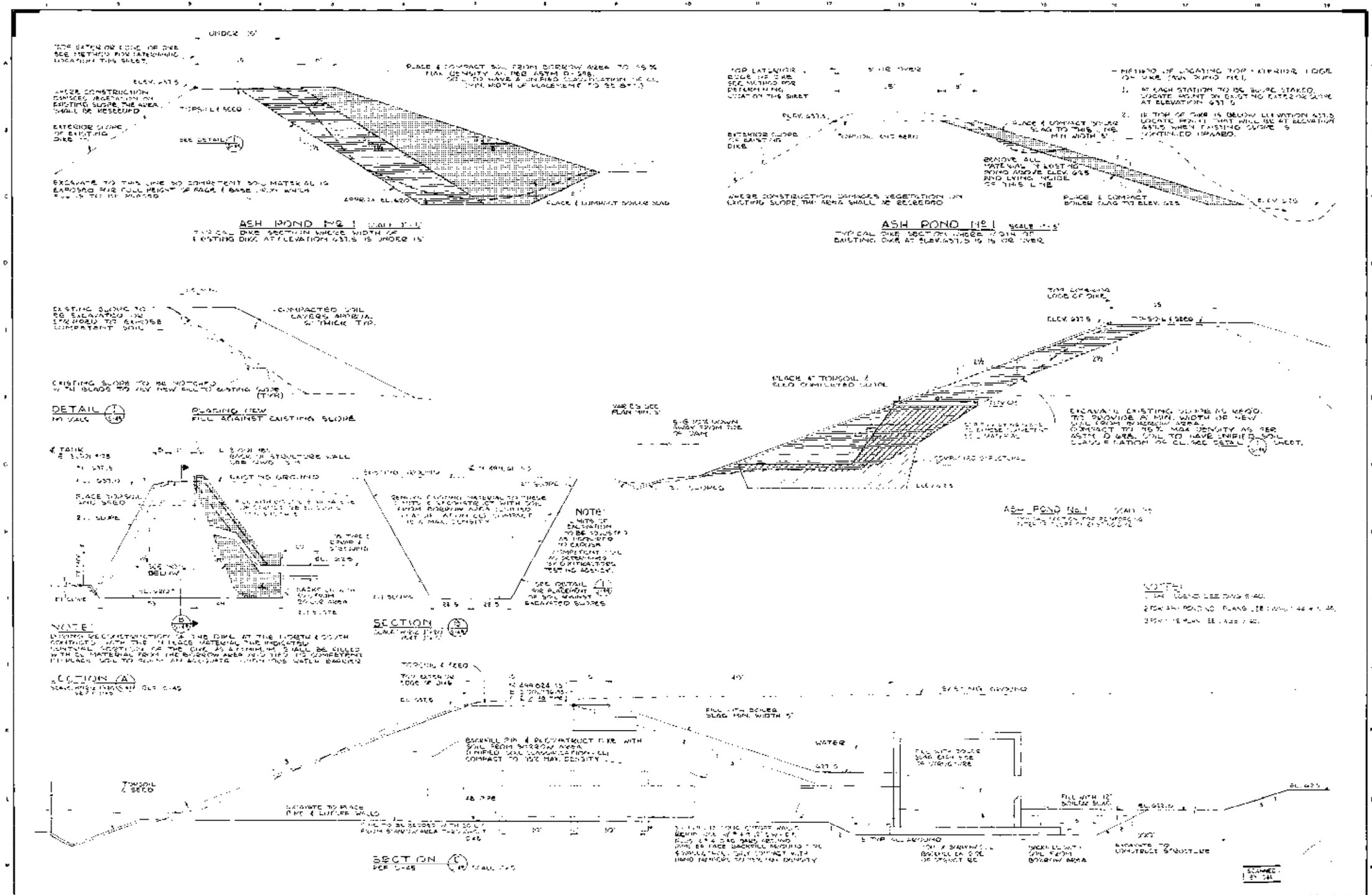
REVISIONS				REFERENCE DRAWINGS	PRINT RECORD	ENG RECORD	DRAWING STATUS
APPROVED FOR CONSTRUCTION							

CIVIL
ASH POND NO 1 SECTIONS AND DETAILS

WASTEWATER MANAGEMENT FACILITIES
CENTRAL ILLINOIS PUBLIC SERVICE COMPANY
COFFEEN POWER STATION

Stearns-Roger
INCORPORATED

S-48



SR NO Y2-9

REVISIONS	REFERENCE DRAWINGS	PRINT RECORD	ENG RECORD	DRAWING STATUS
GENERAL REVISIONS				

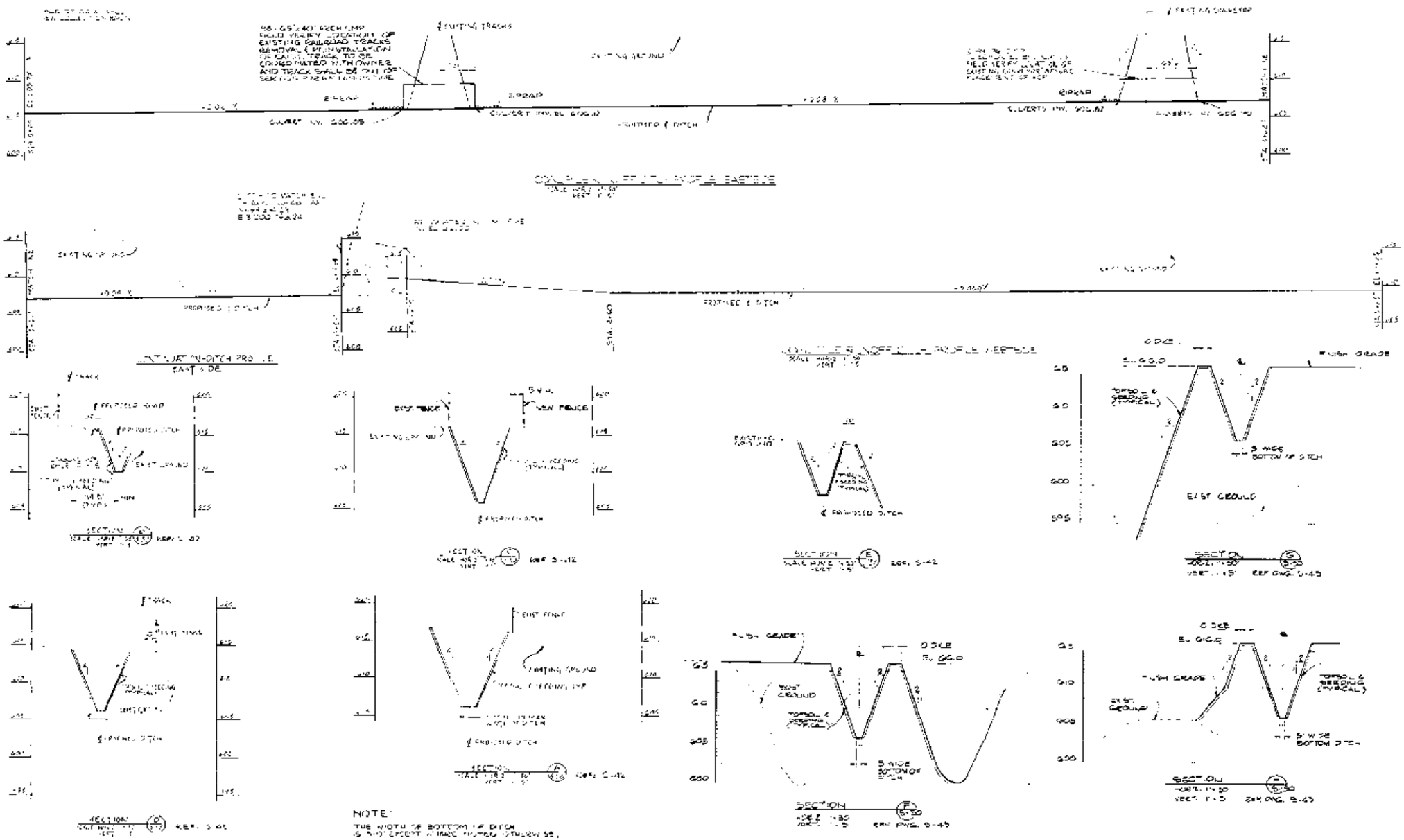
CIVIL
MISCELLANEOUS SECTIONS & DETAILS SHEET 4

WASTEWATER MANAGEMENT FACILITIES
CENTRAL ILLINOIS PUBLIC SERVICE COMPANY
COFFEEN POWER STATION

SCALE AS SHOWN

Stearns-Roger

S-49



REVISIONS	REFERENCE DRAWINGS	PLAT RECORD	ENG RECORD	DRAWING STATUS

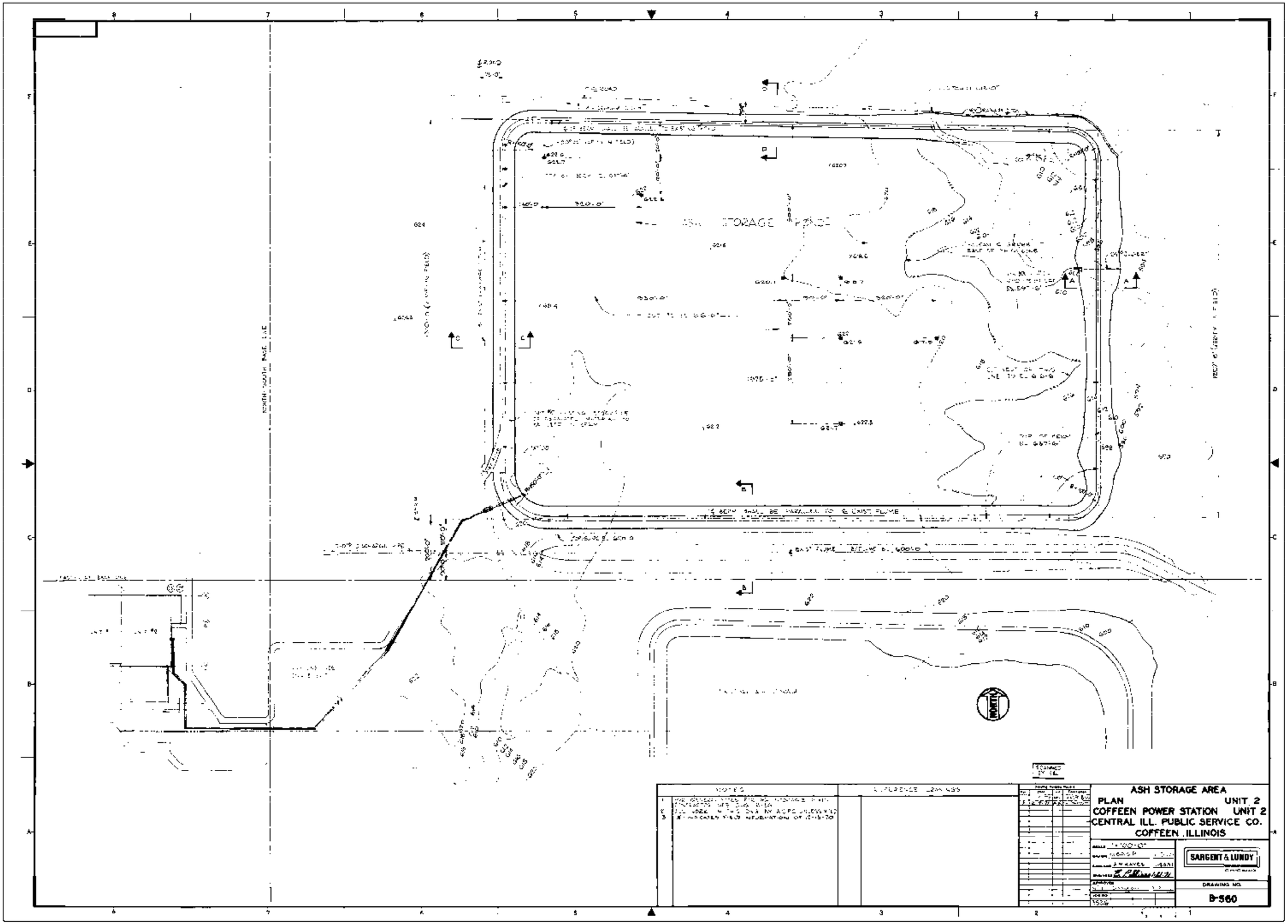
CIVIL
MISCELLANEOUS SECTIONS & DETAILS SHEET

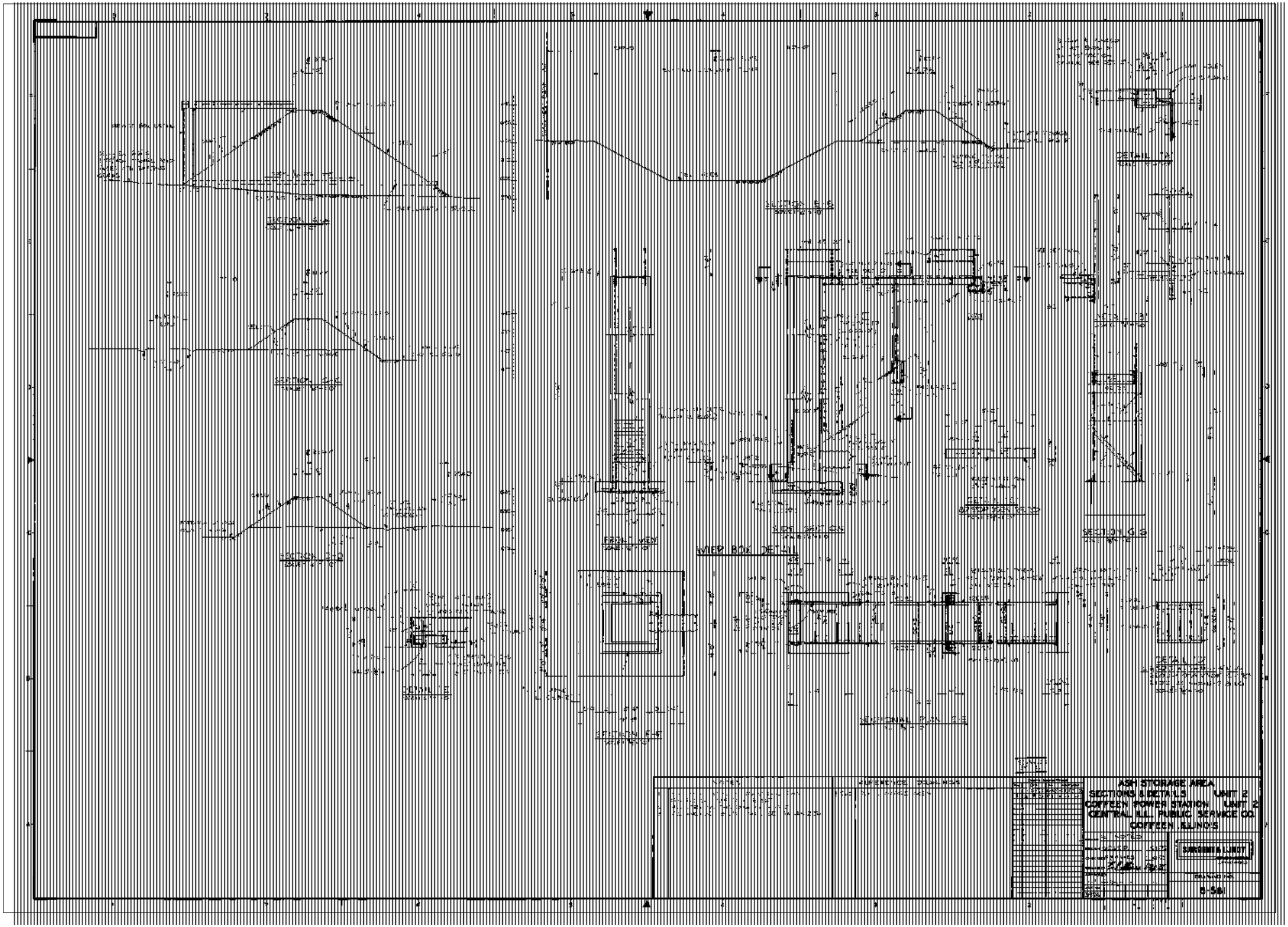
WASTEWATER MANAGEMENT FACILITIES
CENTRAL ILLINOIS PUBLIC SERVICE COMPANY
COFFEEN POWER STATION

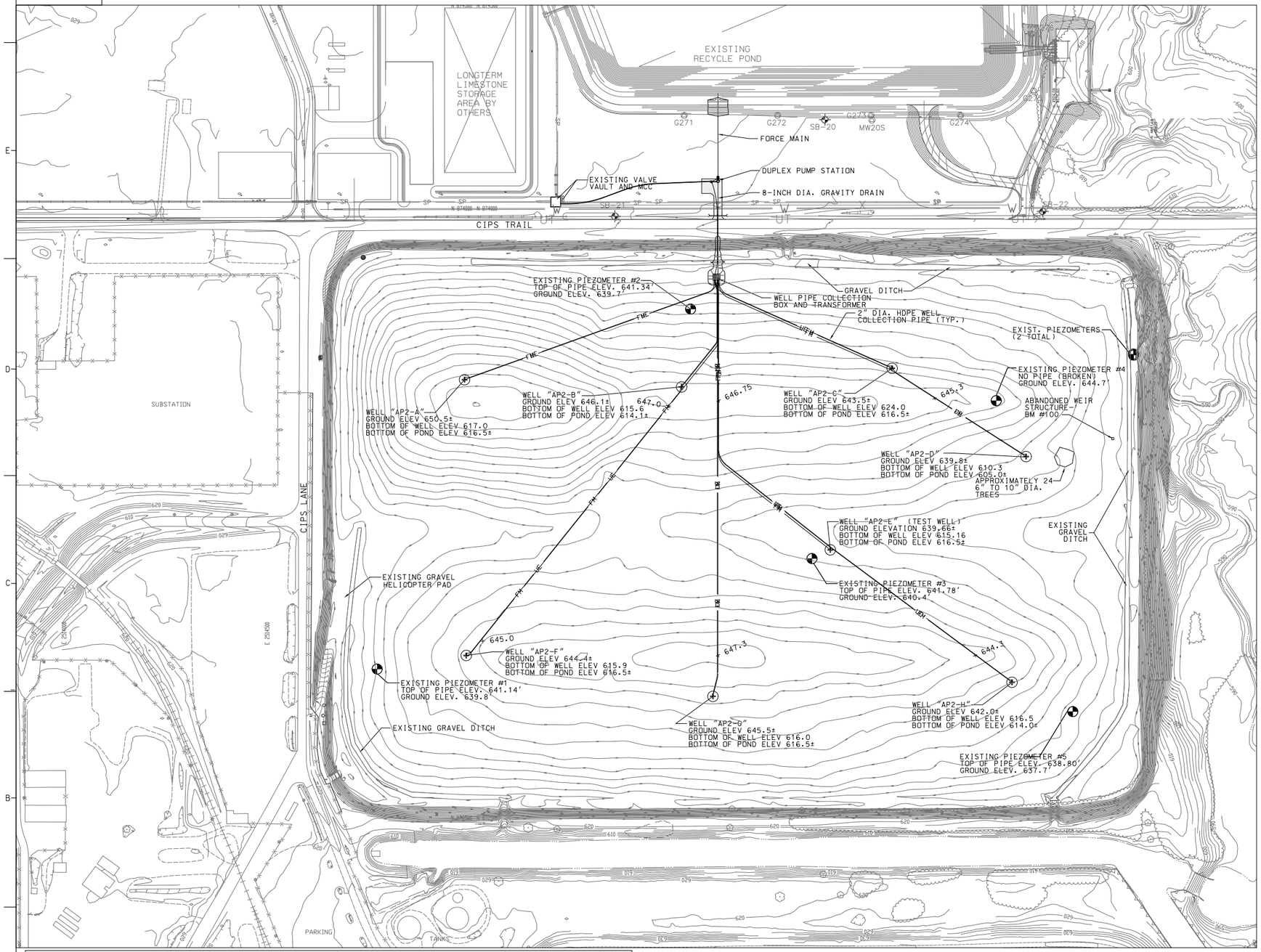
AS SHOWN | Stearns-Roger | C 20000

S.R. NO. Y2-10

S-50


ASH STORAGE AREA
NORTH
ASH STORAGE AREA
UNIT 2
COFFEEN POWER STATION UNIT 2
CENTRAL ILL. PUBLIC SERVICE CO.
COFFEEN, ILLINOIS
SARGENT & LUNDY
DRAWING NO.
B-560


SECTION A-A
SECTION B-B
SECTION C-C
SECTION D-D
SECTION E-E
SECTION F-F
SECTION G-G
DETAIL 1A
DETAIL 1B
DETAIL 1C
DETAIL 1D
DETAIL 1E
FRONT VIEW
SIDE SECTION
WIER BOX DETAIL
SECTIONAL PLAN C-C
NOTES
REFERENCE DRAWINGS
ASH STORAGE AREA
SECTIONS & DETAILS UNIT 2
COFFEEN POWER STATION UNIT 2
CENTRAL ILL. PUBLIC SERVICE CO.
COFFEEN, ILLINOIS
SARGENT & LUNDY
DRAWING NO.
B-561



NOTES:

1. THE LOCATION, SIZE AND/OR TYPE OF MATERIAL OF EXISTING UNDERGROUND OR OVERHEAD UTILITIES AS MAY BE INDICATED ON THESE CONSTRUCTION PLANS IS NOT REPRESENTED AS BEING ACCURATE, SUFFICIENT OR COMPLETE. THE OWNER AND THE PROJECT ENGINEER HAVE NOT INDEPENDENTLY VERIFIED THIS INFORMATION AND DO NOT ASSUME ANY RESPONSIBILITY WHATSOEVER IN RESPECT TO THE ACCURACY, SUFFICIENCY OR COMPLETENESS OF THE INFORMATION AND GIVE NO EXPRESSED OR IMPLIED GUARANTEE THAT ANY CONDITIONS INDICATED ARE REPRESENTATIVE OF ACTUAL CONDITIONS TO BE ENCOUNTERED.

2. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE ACTUAL LOCATION OF ALL SUCH FACILITIES, INCLUDING SERVICE CONNECTIONS TO UNDERGROUND UTILITIES. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL NOTIFY ALL UTILITY COMPANIES AND AGENCIES OF HIS CONSTRUCTION PLANS AND SHALL OBTAIN FROM EACH PARTY DETAILED INFORMATION AND ASSISTANCE RELATIVE TO THE LOCATION OF ALL UTILITIES AND THE SCHEDULE OF ANY REMOVALS AND ADJUSTMENTS REQUIRED OF THE UTILITY. THE CONTRACTOR SHALL CONTACT J.U.L.I.E. (1-800-892-0123 OR 811) TO ASSIST IN COMPLETING THIS RESPONSIBILITY.

3. THE CONTRACTOR SHALL PROTECT ANY FACILITIES TO THE SATISFACTION OF THE UTILITY OR OWNING-AGENCY WITH THE COST OF ANY REQUIRED PROTECTION TO BE INCIDENTAL TO THE CONTRACT. IN THE EVENT A UTILITY LINE OR SERVICE IS UNEXPECTEDLY ENCOUNTERED DURING CONSTRUCTION, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE OWNER AND THE UTILITY COMPANY OR AGENCY OF JURISDICTION. ANY SUCH UTILITIES DISTURBED BY THE CONTRACTOR'S OPERATIONS SHALL BE RESTORED TO SERVICE AT ONCE.

LEGEND

- ELECTRICAL SPLICE BOX
- TELEPHONE SPLICE BOX
- GUARDPOST
- EXISTING FENCE
- TREE AREA
- GRAVEL EDGE
- PAVED OUTLET EDGE
- FM — FORCE MAIN
- SS — SANITARY SEWER
- UE — UNDERGROUND ELECTRIC
- GRAVEL SURFACING
- PIEZOMETER
- IRON PIN

N

100' 50' 0 50' 100'
SCALE IN FEET

COORDINATE TABLE							
STATE PLANE COORDINATES				DESCRIPTION	PLANT COORDINATES		
POINT	NORTH	EAST	ELEV.		NORTH	EAST	ELEV.
100	873,444.5	2,516,566.2	636.78'	BENCHMK: CHISELED "□" IN N.E. COR. OF WEIR BOX	3610.958	1357.406	616.31'
1	872,940.7900	2,513,222.5010	615.74'	CONTROL PT #1 BRASS MONUMENT NEAR N.W. ENTRANCE	3610.440	2430.490	623.44'
2	872,942.4450	2,514,295.5440	622.92'	CONTROL PT #2 BRASS MONUMENT NEAR EAST PKG AREA	4561.951	2430.945	N/A
3	873,893.9360	2,514,294.3340	624.63'	CONTROL PT #3 BRASS MONUMENT NEAR MAIN ENTRANCE			
5001	873,587.59	2,514,969.63	.	WELL AP2-A			
5002	873,569.87	2,515,503.76	.	WELL AP2-B			
5003	873,615.67	2,516,021.68	.	WELL AP2-C			
5004	873,398.41	2,516,351.29	.	WELL AP2-D			
5005	873,168.81	2,515,869.61	.	WELL AP2-E			
5006	872,908.89	2,514,973.83	.	WELL AP2-F			
5007	872,808.37	2,515,580.73	.	WELL AP2-G			
5008	872,842.91	2,516,316.70	.	WELL AP2-H			

NOTES

REFERENCE DRAWINGS

DRAWING RECORD									
REV.	DATE	PROJECT NO.	AMEREN SUPV ENGR	DRAFTING DRFTR	DRAFTING CHK'D	DRAFTING SUPV	ENGR APPROVAL AMEREN	ENGR APPROVAL OTHER	DESCRIPTION
A	10-12-09	W1314	SUB	MJW	SDB	SDB	MJW	–	-

NOTICE OF LIMITED RESPONSIBILITY

THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT DRAWINGS AND DOCUMENTS BEARING HIS/HER SEAL, SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE. THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

AS BUILT

SCALE –

OVERALL SITE PLAN
DEWATERING SYSTEM
ASH POND #2
AMEREN COFFEEN POWER STATION

SITE: ASH POND #2

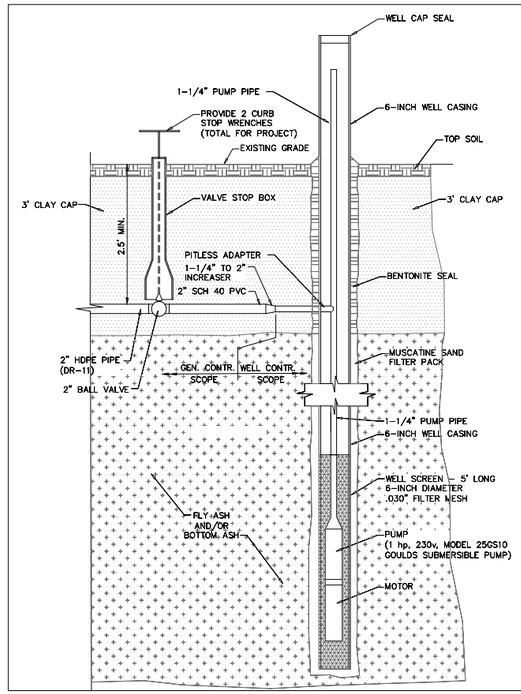
LOC. NO.

CLASS –

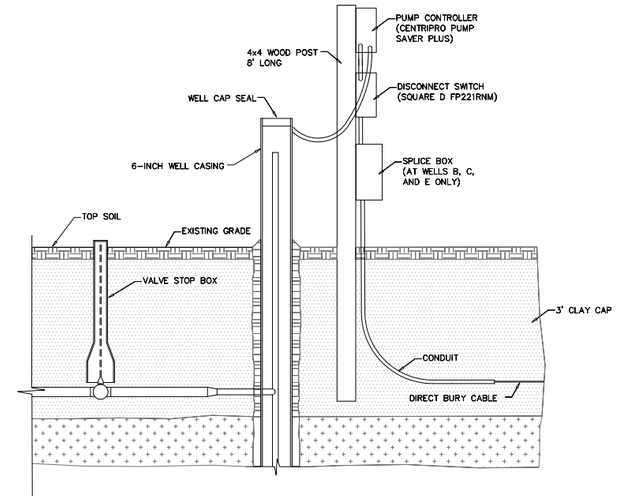
Ameren Energy. Resources Generating

DRAWING NO.	REV.
A1000	0

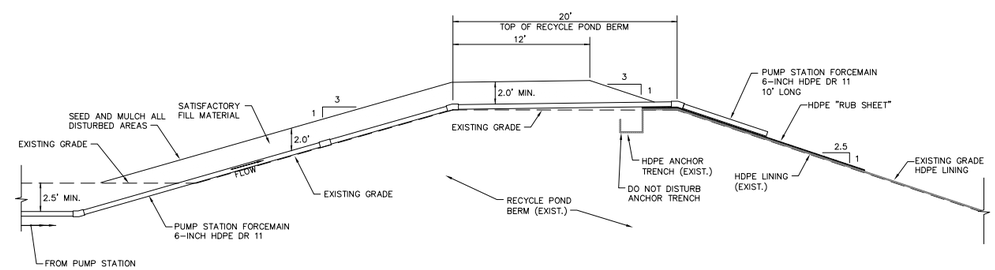
SHEET NO. 1 OF 5



1 WELL PUMP PIPING DETAIL
NOT TO SCALE



2 WELL PUMP CONTROLLER/DISCONNECT DETAIL
NOT TO SCALE



3 FORCE MAIN OUTLET DETAIL
NOT TO SCALE

N

10' 5' 0 5' 10'
SCALE IN FEET

NOTICE OF LIMITED RESPONSIBILITY
THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT DRAWINGS AND DOCUMENTS BEARING HIS/HER SEAL, SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE. HIS/HER RESPONSIBILITY FOR THE PROJECT DESIGN DOES NOT COME UNDER SUBSEQUENT REVISIONS AND AUTHORIZATIONS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

AS BUILT

SITE DETAILS
DEWATERING SYSTEM
ASH POND #2
AMEREN COFFEEN POWER STATION

SITE: ASH POND #2

SCALE: –
LOC. NO.:
CLASS: –

Ameren Energy. Resources Generating

DRAWING NO.	REV.
A1000	0

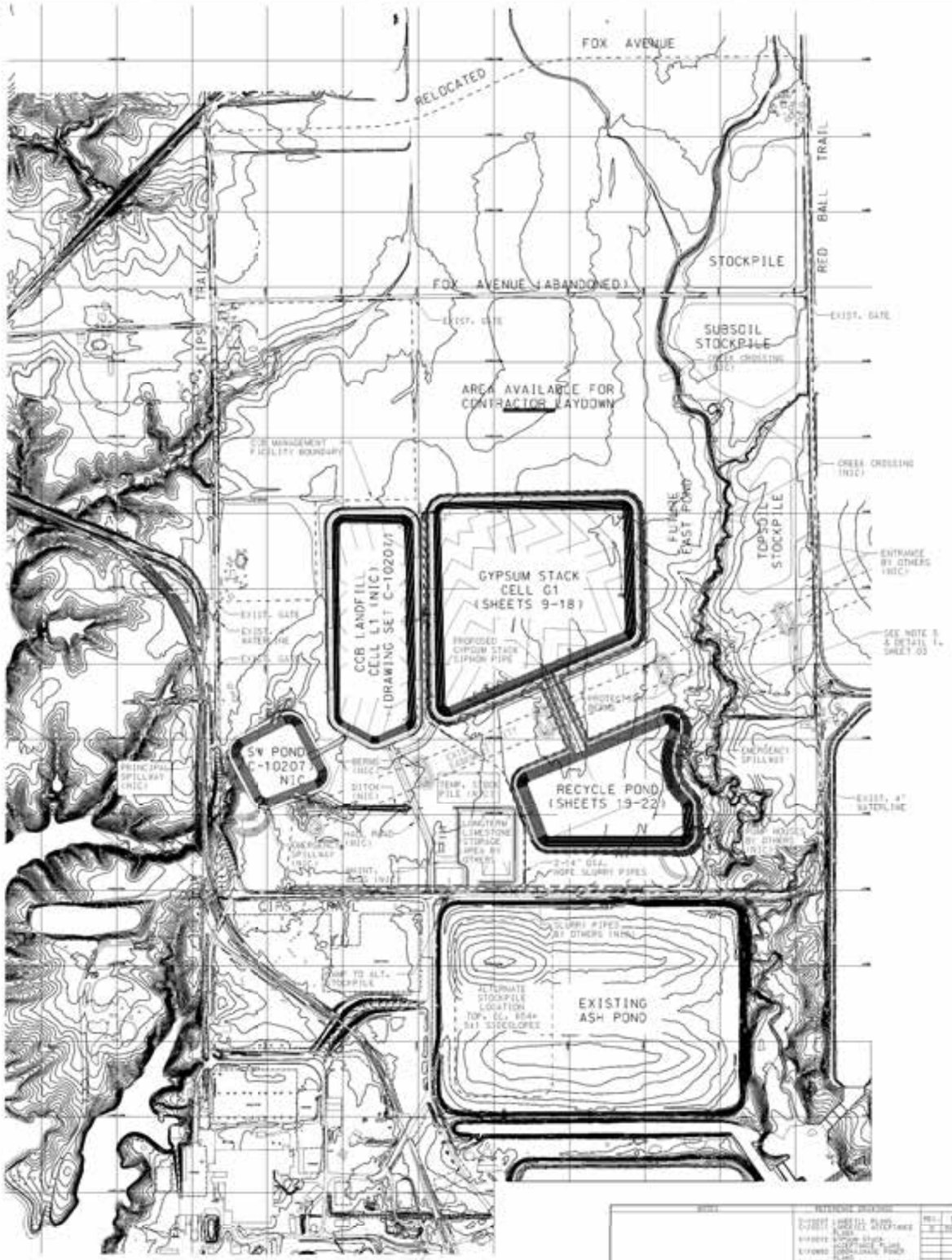
SHEET NO. 4 OF 5

NOTES

REFERENCE DRAWINGS

DRAWING RECORD

REV.	DATE	PROJECT NO.	AMEREN SUPV ENGR	DRAFTING DRF'R	DRAFTING CHK'D	DRAFTING SUPV	ENGR APPROVAL AMEREN	ENGR APPROVAL OTHER	DESCRIPTION
A	10-12-09	#1314	SDB	MJW	SDB	SDB	MJW	–	-



STANDARD LEGEND

(ALL SYMBOLS MAY NOT BE USED ON EACH PLAN)

- 650 — ORIGINAL CONTOURS
- FENCELINE
- TRANSMISSION TOWERS
- OVERHEAD ELECTRIC
- WATER MAIN
- TELEPHONE LINE
- LIMITS OF VEGETATION
- GRAVEL ROAD
- RAILROAD
- CP-1000 — CONTROL POINT - HORIZ. & VERT.
- A — A' — GEOLOGICAL CROSS SECTION LINE
- 850 — LANDFILL CONTOURS
- SB-55 — BORING
- GXXX — PREVIOUSLY INSTALLED GROUNDWATER MONITORING WELL
- GXXX — GROUNDWATER MONITORING WELL
- MW135 — WELLS - NOT PART OF MONITORING PLAN

NOTES:

1. SEE NOTES ON SHEET 2 REGARDING THE RESPONSIBILITY FOR EXISTING UTILITIES.
2. (NIC) INDICATES SITE FEATURES WHICH ARE NOT PART OF THIS CONTRACT. THEY ARE SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. HORIZONTAL AND VERTICAL CONTROL ARE BASED ON NAD 83, ILLINOIS STATE PLANE COORDINATE SYSTEM WEST ZONE, NAVD 88, US SURVEY FEET AND THE FOLLOWING PROJECT CONTROL POINTS WERE ESTABLISHED BY HANSON PROFESSIONAL SERVICES:

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-1000	873398.37	2515334.17	620.81	#8 REBAR IN 6" DIA. CONCRETE MONUMENT
CP-1001	873985.17	2513180.64	621.96	#8 REBAR IN 6" DIA. CONCRETE MONUMENT
CP-1002	877937.14	2514555.34	623.15	#8 REBAR IN 6" DIA. CONCRETE MONUMENT
CP-1003	877949.62	2516989.49	622.10	#8 REBAR IN 6" DIA. CONCRETE MONUMENT

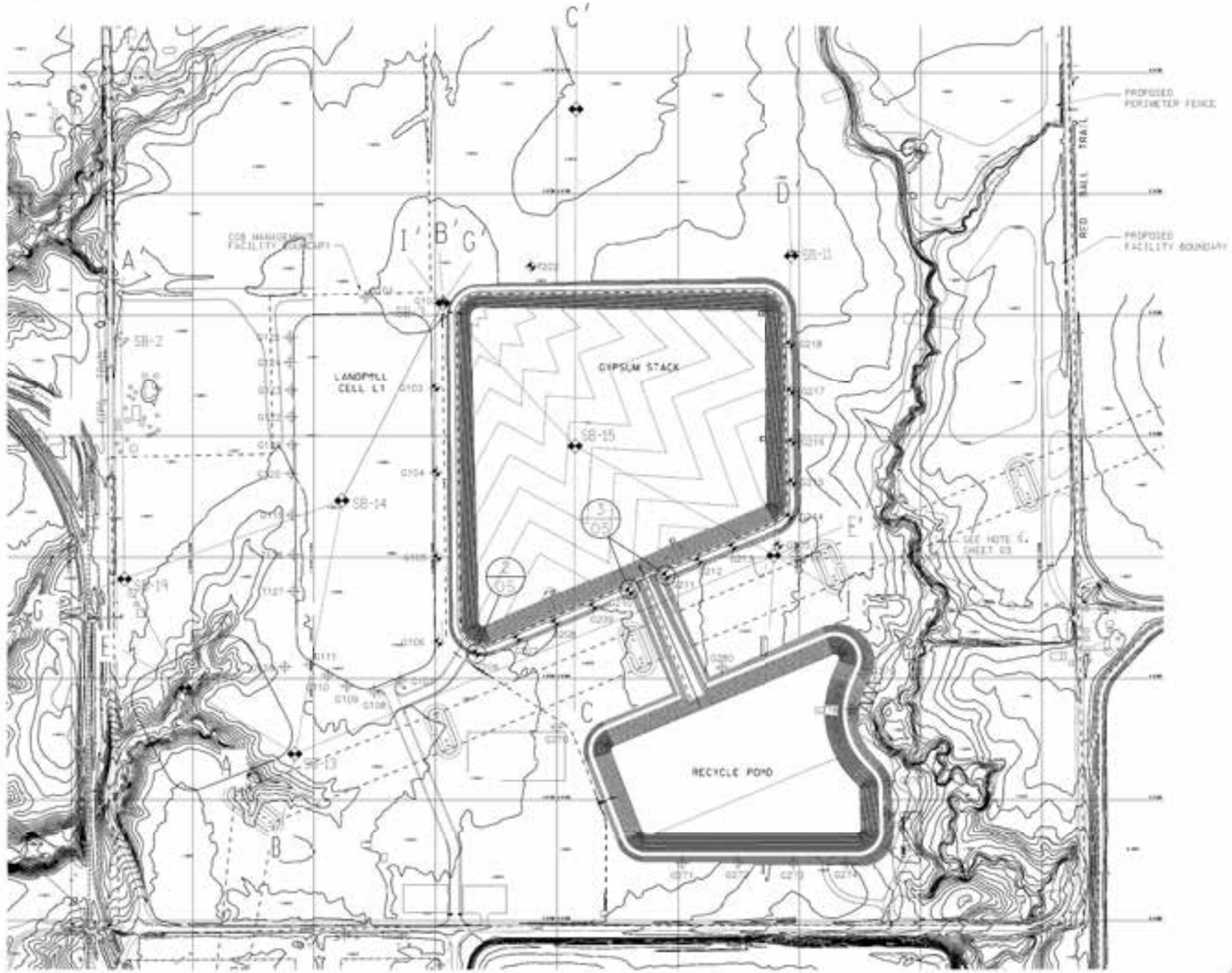
0' 300' 600'
SCALE: 1" = 300'

PROPOSED SITE PLAN

CCB MANAGEMENT FACILITY

Ameren Energy Generating

C-10206 | 0



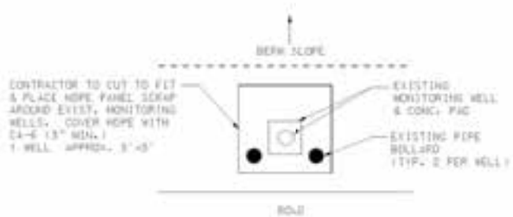
STANDARD LEGEND

(ALL SYMBOLS MAY NOT BE USED ON EACH PLAN)

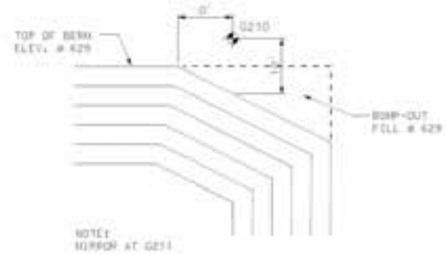
- ORIGINAL CONTOURS
- FENCELINE
- TRANSMISSION TOWERS
- OVERHEAD ELECTRIC
- WATER MAIN
- TELEPHONE LINE
- LIMITS OF VEGETATION
- GRAVEL ROAD
- RAILROAD
- CP-1000 — CONTROL POINT - HORIZ. & VERT.
- A — A' — GEOLOGICAL CROSS SECTION LINE
- LANDFILL CONTOURS
- SB-55 — BORING
- GYXX — GYPSUM STACK GROUNDWATER MONITORING WELL
- GXXX — OTHER MONITORING WELL

NOTES:

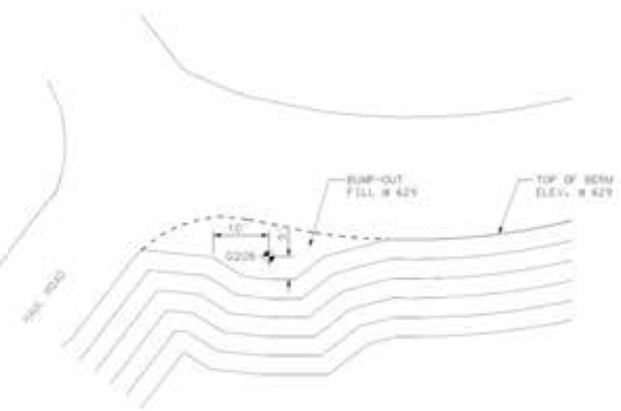
1. CONTOURS SHOWN IN GYPSUM STACK ARE TOP OF CLAY LINER.(NOTE: THE UPPER PORTION OF THE PROCESS WATER RECOVERY SYSTEM LINER WAS ELIMINATED AS PART OF THE CLEAN CLOSURE REVISION)
2. THE PROPERTY IS LOCATED IN SECTIONS 10 & 11, TOWNSHIP 7 NORTH, RANGE 3 WEST, 3RD P.M., MONTGOMERY COUNTY, ILLINOIS
3. THE DESIGN ELEMENTS INCLUDED IN THESE DRAWINGS WERE BASED UPON EXISTING AERIAL MAPPING AS OBTAINED FROM AMEREN.
4. ALL DISTURBED AREAS, INCLUDING THE CREST AND EXTERIOR FACE OF BOTH DAMS, WILL BE SEEDED AND MULCHED WITH TOOT CLASS 1A SEED MIXTURE.
5. FILL MATERIAL FOR DAM EMBANKMENT WILL BE PLACED IN MAXIMUM UNCOMPACTED LIFTS OF 8-INCHES AND COMPACTED TO 95% OF THE STANDARD PROCTOR DENSITY.
6. SUPERFICIAL CONTOURS WERE DEVELOPED USING AERIAL PHOTOGRAMMETRIC METHODS WITH PHOTOGRAPHS TAKEN BY SURDEX.
7. CURRENT SURFACE TOPOGRAPHY MAY DIFFER FROM THAT SHOWN DUE TO ON GOING OPERATIONS AT THE SITE.
8. FOR CLARITY, NOT ALL EXISTING SITE FEATURES ARE SHOWN ON THIS DRAWING.



1/05 WEED CONTROL AT EXIST. SINGLE MONITORING WELLS



3/05 MONITORING WELL BUMP-OUT NEAR TRANSFER CHANNEL



2/05 MONITORING WELL BUMP-OUT AT HAUL ROAD

SCALE: 1" = 200'

REVISIONS																		
NO.	DATE	PROJECT NO.	DRAWN	CHECKED	DESIGNED	APPROVED	DESCRIPTION
0	10-28-11						ISSUE FOR BIDDING

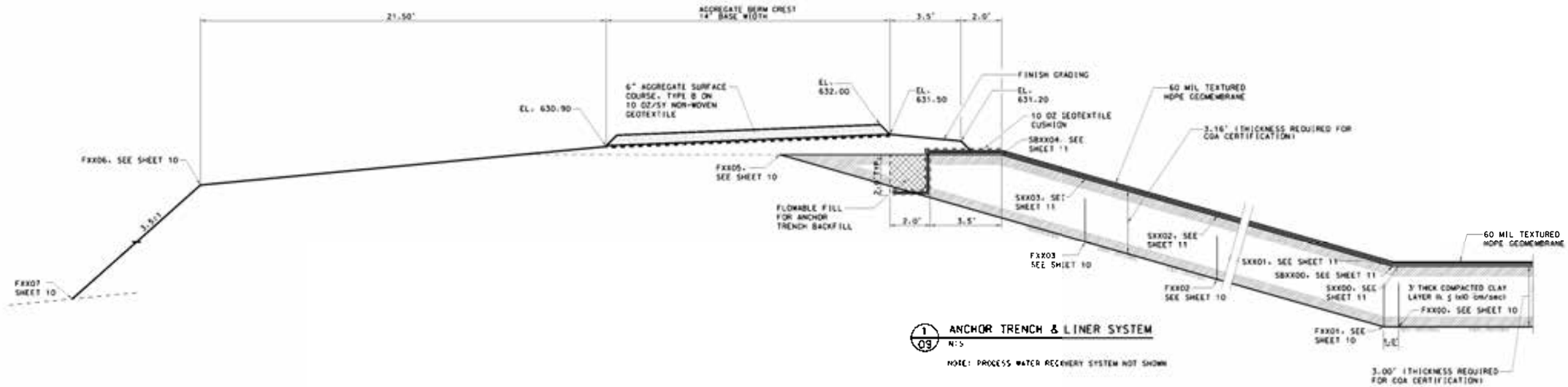
GROUNDWATER MONITORING & BORING PLAN

CCR MANAGEMENT FACILITY

UTILITY COMPANY

Ameren Energy Generating

DRAWING NO. C-10206 REV. 0



1/09 ANCHOR TRENCH & LINER SYSTEM

N:S

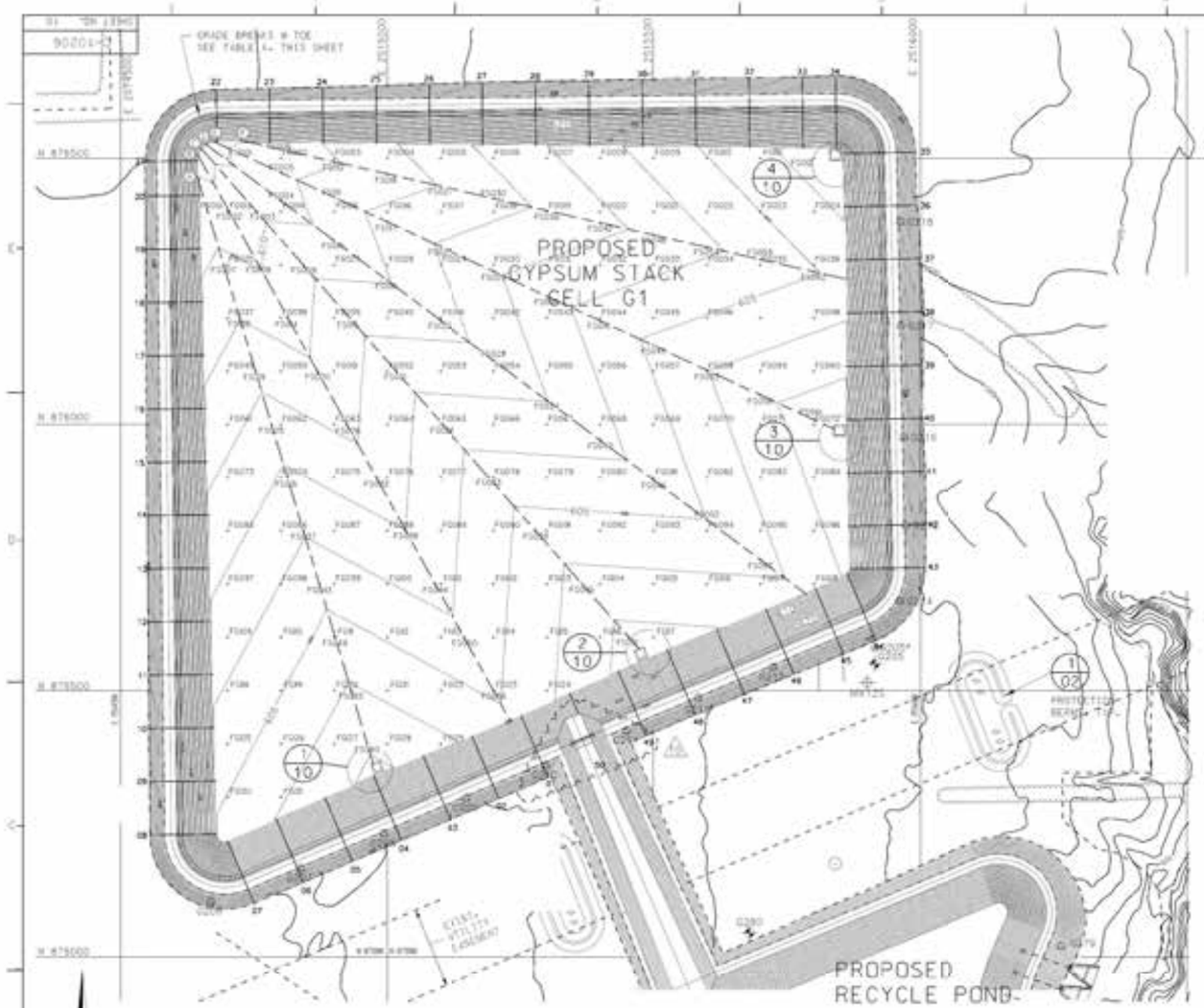
NOTE: PROCESS WATER RECOVERY SYSTEM NOT SHOWN

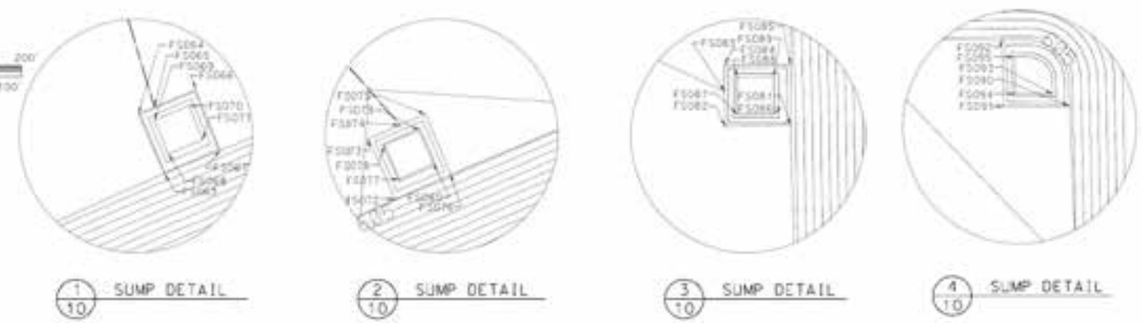
ANCHOR TRENCH AND LINER SYSTEM

COA MANAGEMENT FACILITY

AMERICAN ENERGY Generating

C-10206 0





NOTE: SEE OTHER PLAN SHEETS FOR LEGEND

TYPICAL POINT NUMBER LOCATION

FB 00 — GRID POINT NUMBER — FOUNDATION GRADE (BREAK POINT)

FS 00 — GRID POINT NUMBER — FOUNDATION GRADE (SUMP GRADING)

FO 00 — GRID POINT NUMBER — FOUNDATION GRADE

F 00 00 — POINT NUMBER (SEE POINT NUMBERING DETAIL) — CONTROL LINE NUMBER — FOUNDATION GRADE

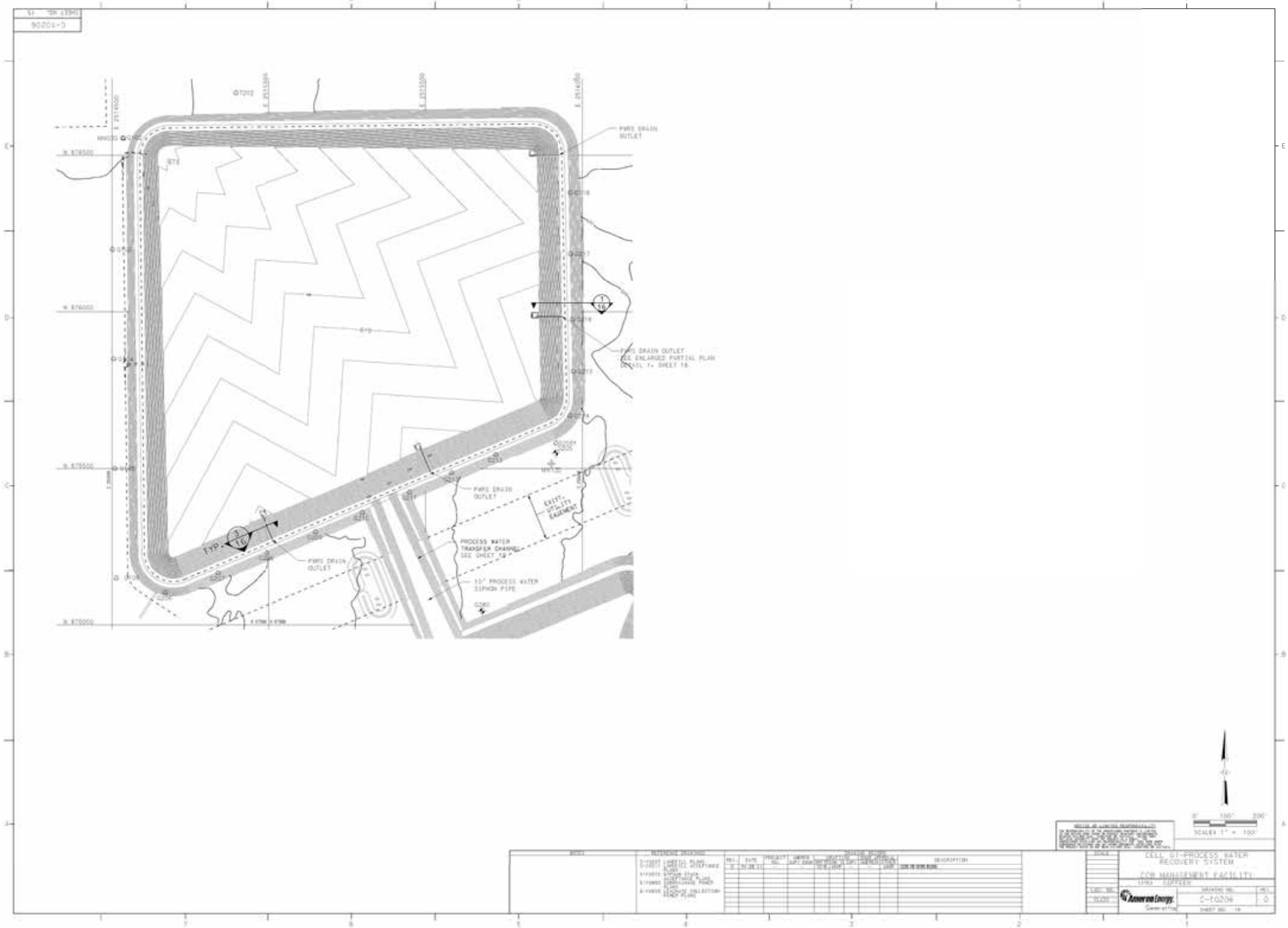
CELL G1-FOUNDATION GRADE & CONTROL DATA

CCR MANAGEMENT FACILITY

CITRUS COFFEEN

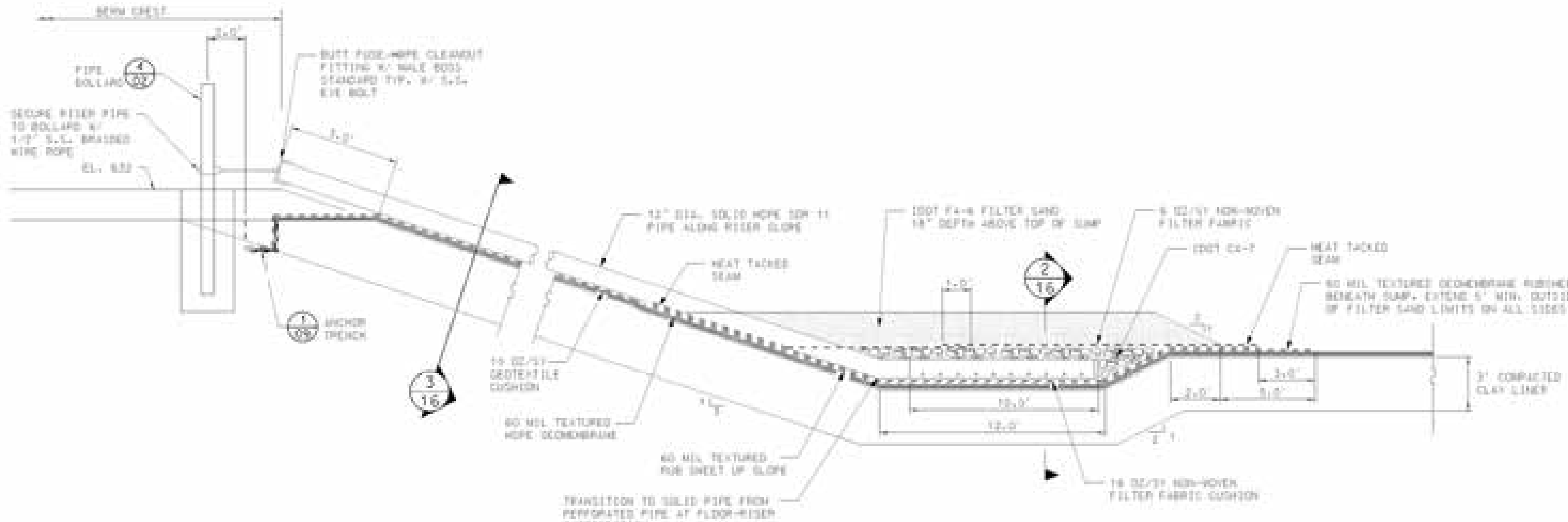
Ameren Energy Generating

C-10206 | 0

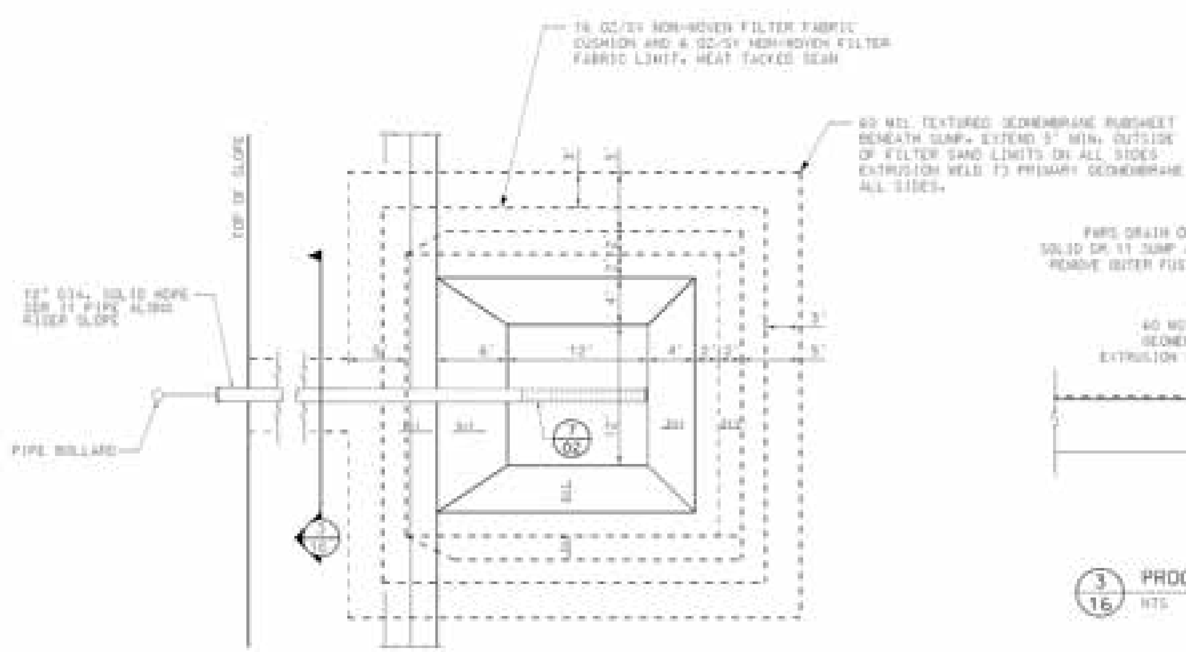


PWRS DRAIN OUTLET
PWRS DRAIN OUTLET
SEE ENLARGED PARTIAL PLAN
DETAIL 1, SHEET 16
PWRS DRAIN OUTLET
EXIST. UTILITY EASEMENT
PROCESS WATER TRANSFER CHANNEL
SEE SHEET 19
10' PROCESS WATER SIPHON PIPE
PWRS DRAIN OUTLET
TYP.
SCALE: 1" = 100'
CELL 01-PROCESS WATER RECOVERY SYSTEM
CCR MANAGEMENT FACILITY
CAPFEEN
Ameren Energy
C-10206
0

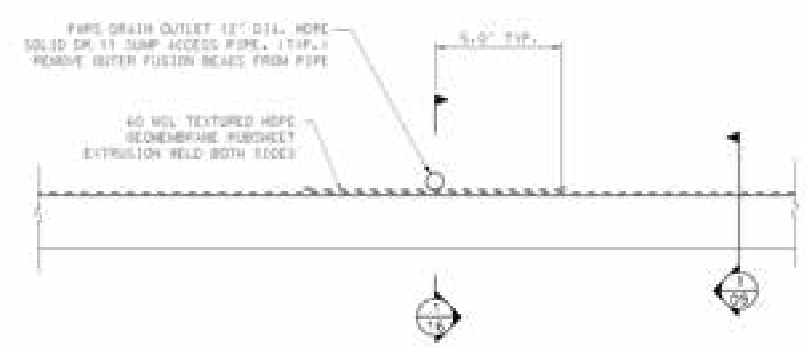
SHEET NO. 16
C-10206



1/16 TYPICAL PROCESS WATER SUMP SECTION
NTS



2/16 PWRS SUMP PLAN
NTS

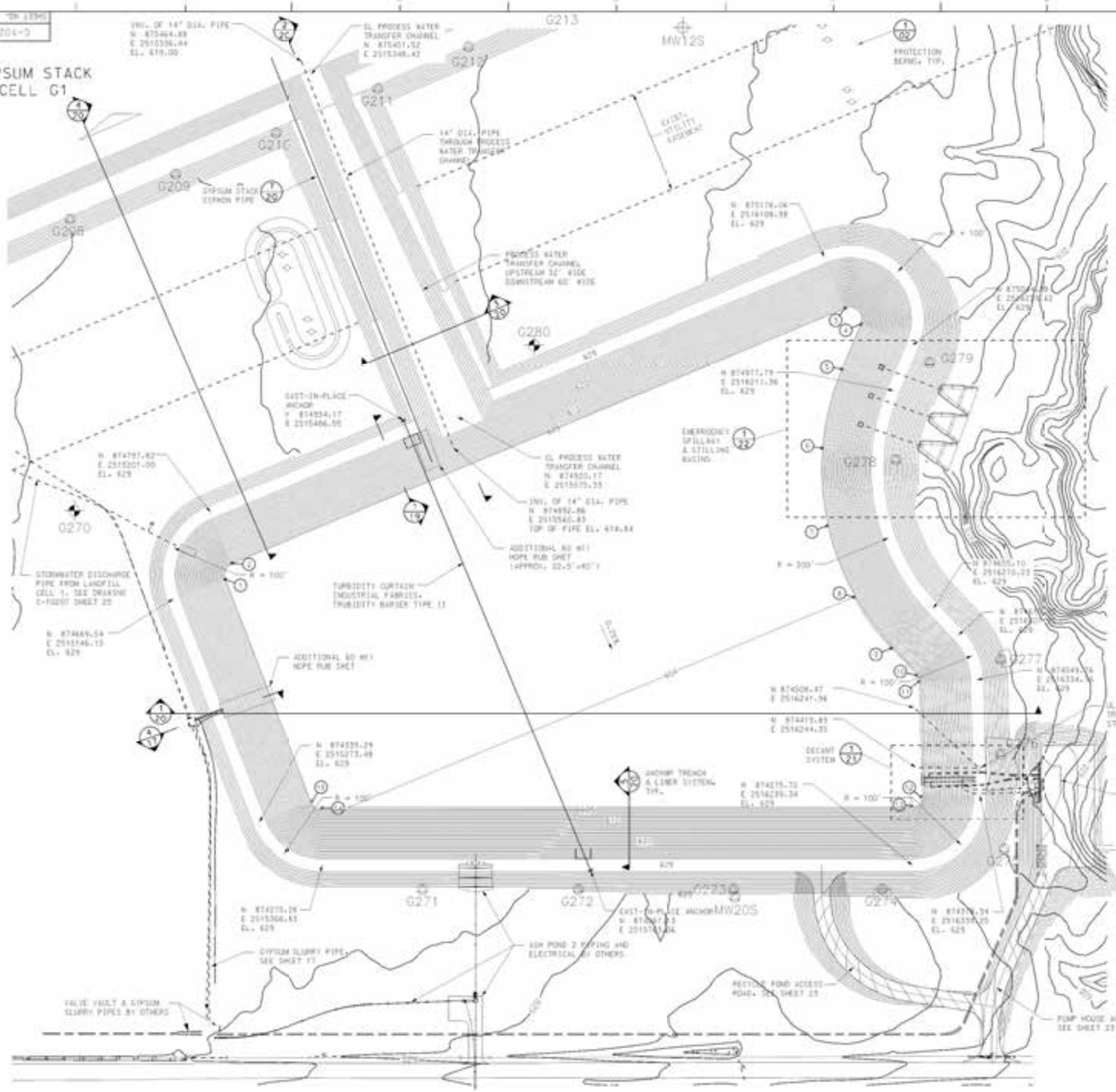


3/16 PROCESS WATER RECOVERY PIPE UP SIDESLOPE
NTS

NOTE:
ALL SIDE SLOPE PIPES TO BE SOLID WALL

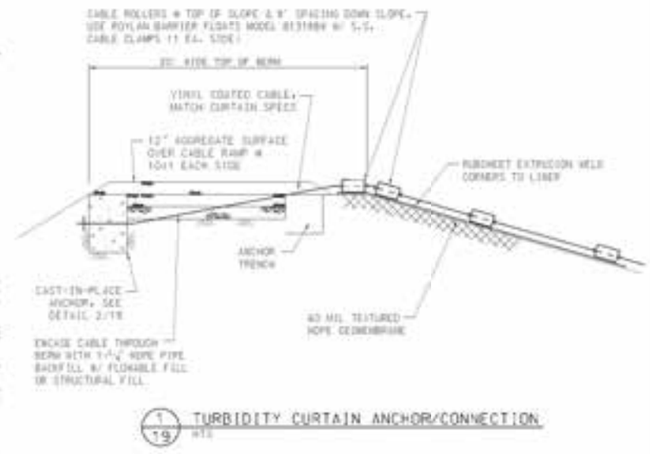
CELL G1-PWRS DRAIN DETAILS
CCR MANAGEMENT FACILITY
Ameren Energy Generating
DRAWING NO. C-10206 REV. 0
SHEET NO. 16

GYPSUM STACK
CELL G1



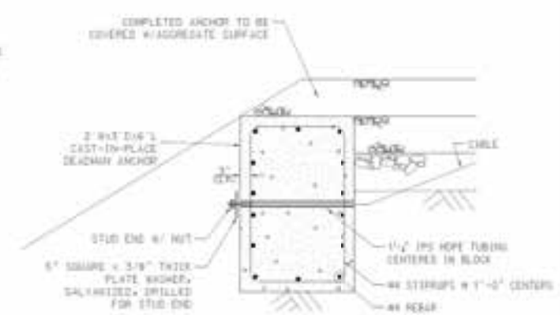
RECYCLE POND - INTERIOR TOE			
POINT	N	E	ELEV.
1	874706.91	2515227.14	605.24
2	874723.71	2515241.70	605.02
3	875095.89	2516132.29	605.05
4	875089.35	2516155.88	604.53
5	875005.91	2516132.91	604.93
6	874909.21	2516107.54	604.97
7	874811.81	2516106.37	604.93
8	874717.51	2516125.35	604.29
9	874633.41	2516173.61	604.17
10	874555.24	2516246.12	604.22
11	874546.61	2516249.01	604.07
12	874577.99	2516248.77	602.44
13	874583.11	2516237.06	604.00
14	874589.91	2515566.65	604.25
15	874572.61	2515551.72	604.49

SCALE 1" = 60'



1/19 TURBIDITY CURTAIN ANCHOR/CONNECTION
NTS

NOTE:
ALL CABLE CONNECTIONS SHALL BE 316 S.S. WITH A STRENGTH RATING GREATER THAN CABLE.



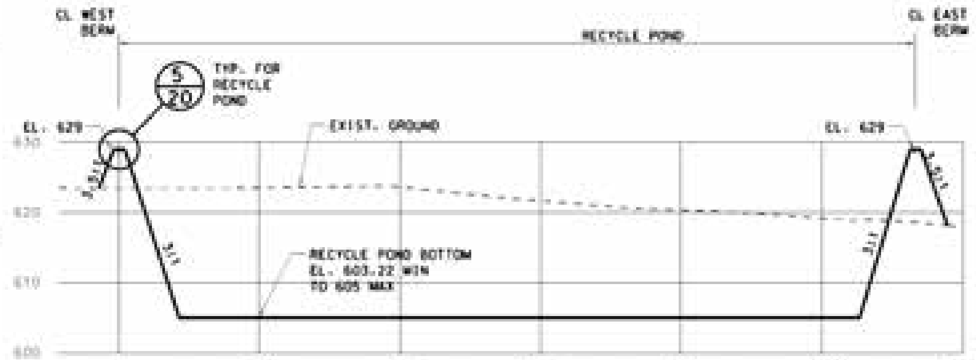
2/19 CAST-IN-PLACE ANCHOR
NTS

RECYCLE POND PLAN & CONTROL DATA
CCR MANAGEMENT FACILITY
GYPSUM SUPPLIER

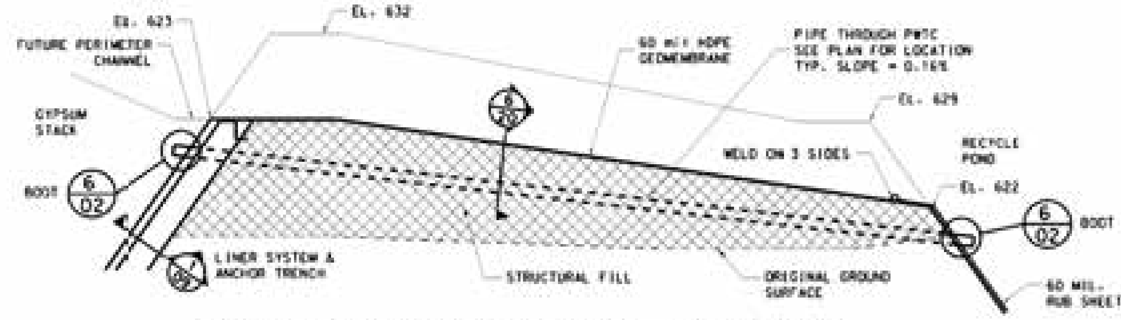
Ameren Energy Generating

DRAWING NO. C-10206 REV. 0

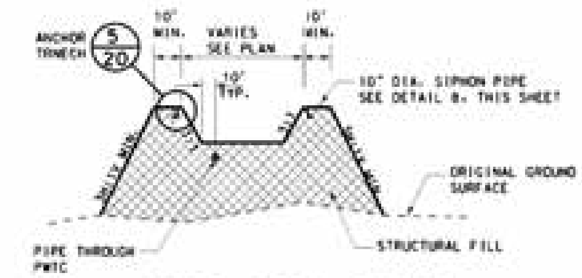
C-10206



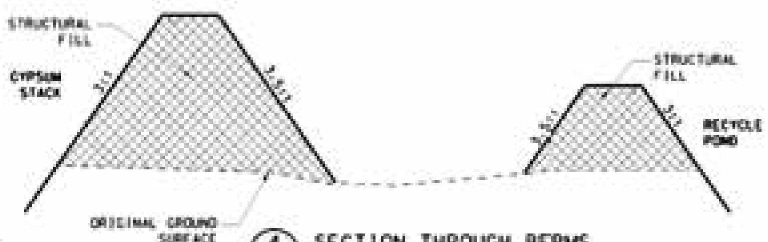
1/20 TYPICAL SECTION THROUGH RECYCLE POND
NTS



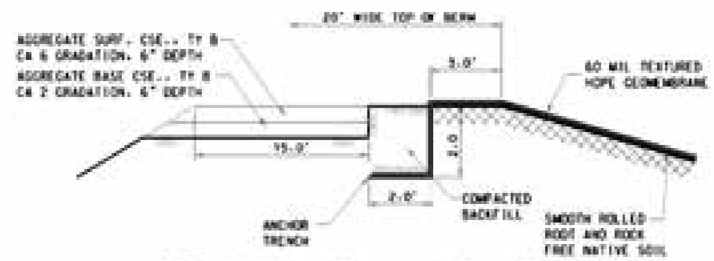
2/20 SECTION THROUGH PROCESS WATER TRANSFER CHANNEL
NTS



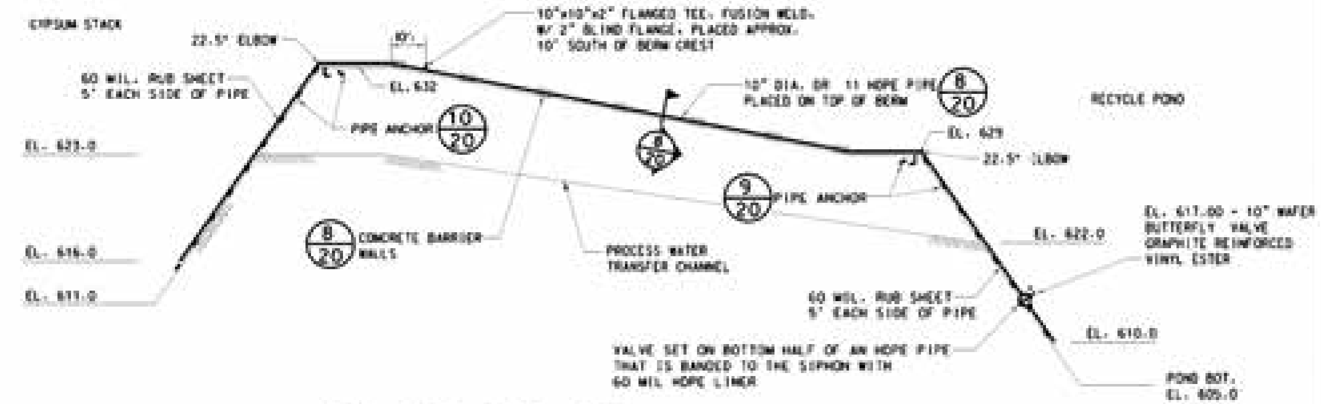
3/20 SECTION THROUGH PROCESS WATER TRANSFER CHANNEL
NTS



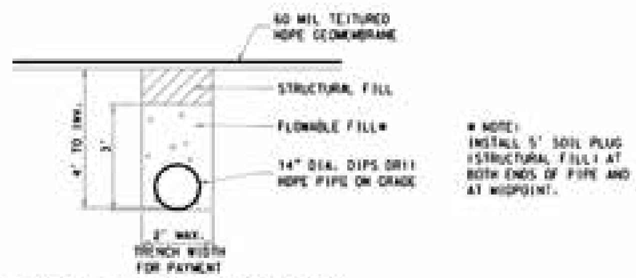
4/20 SECTION THROUGH BERMS
NTS



5/20 RECYCLE POND - LINER SYSTEM
NTS

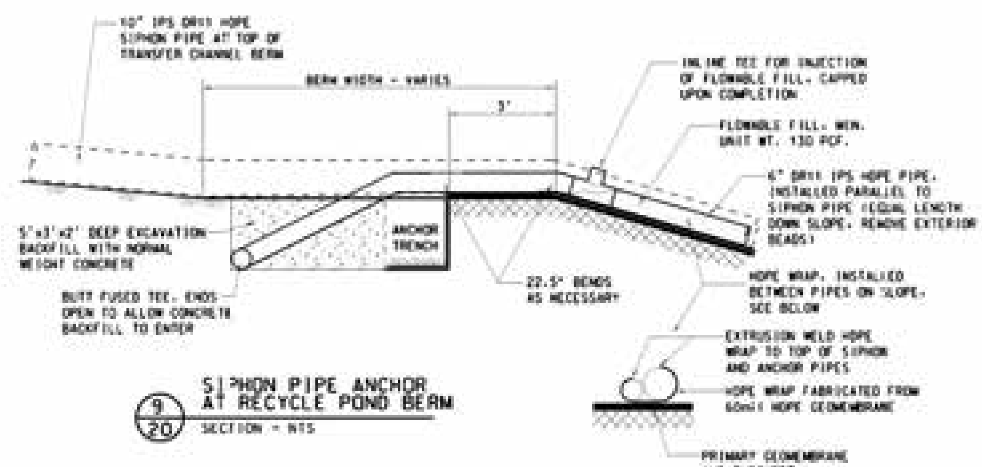


7/20 GYPSUM STACK SIPHON SYSTEM
SECTION THROUGH PROCESS WATER TRANSFER CHANNEL
NTS

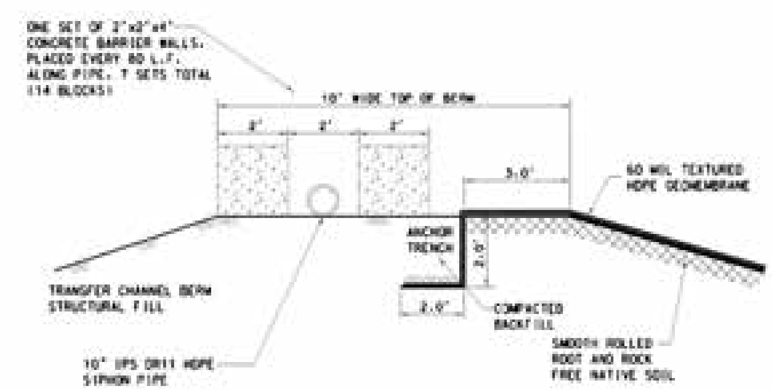


* NOTE:
INSTALL 5' SOIL PLUG (STRUCTURAL FILL) AT BOTH ENDS OF PIPE AND AT MIDPOINT.

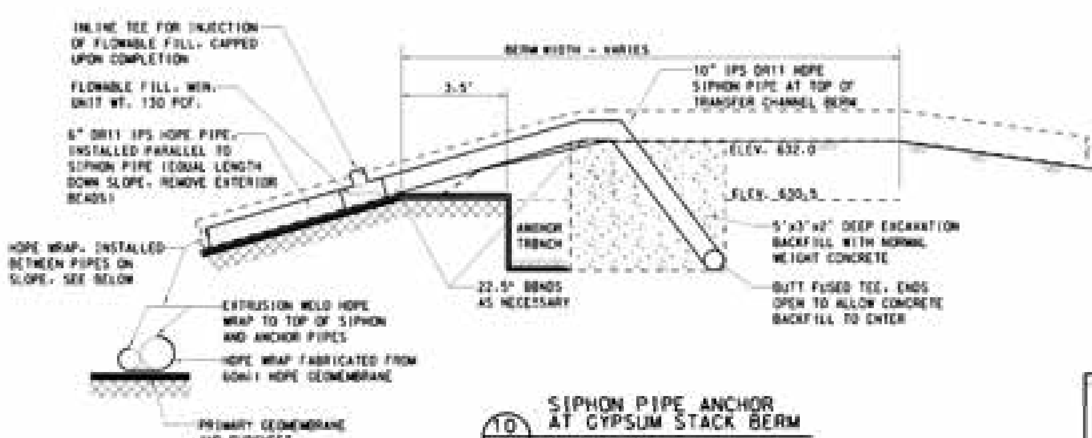
6/20 TYPICAL TRENCH SECTION
NTS



9/20 SIPHON PIPE ANCHOR AT RECYCLE POND BERM
SECTION - NTS



8/20 SIPHON PIPE INSTALLATION
SECTION - NTS



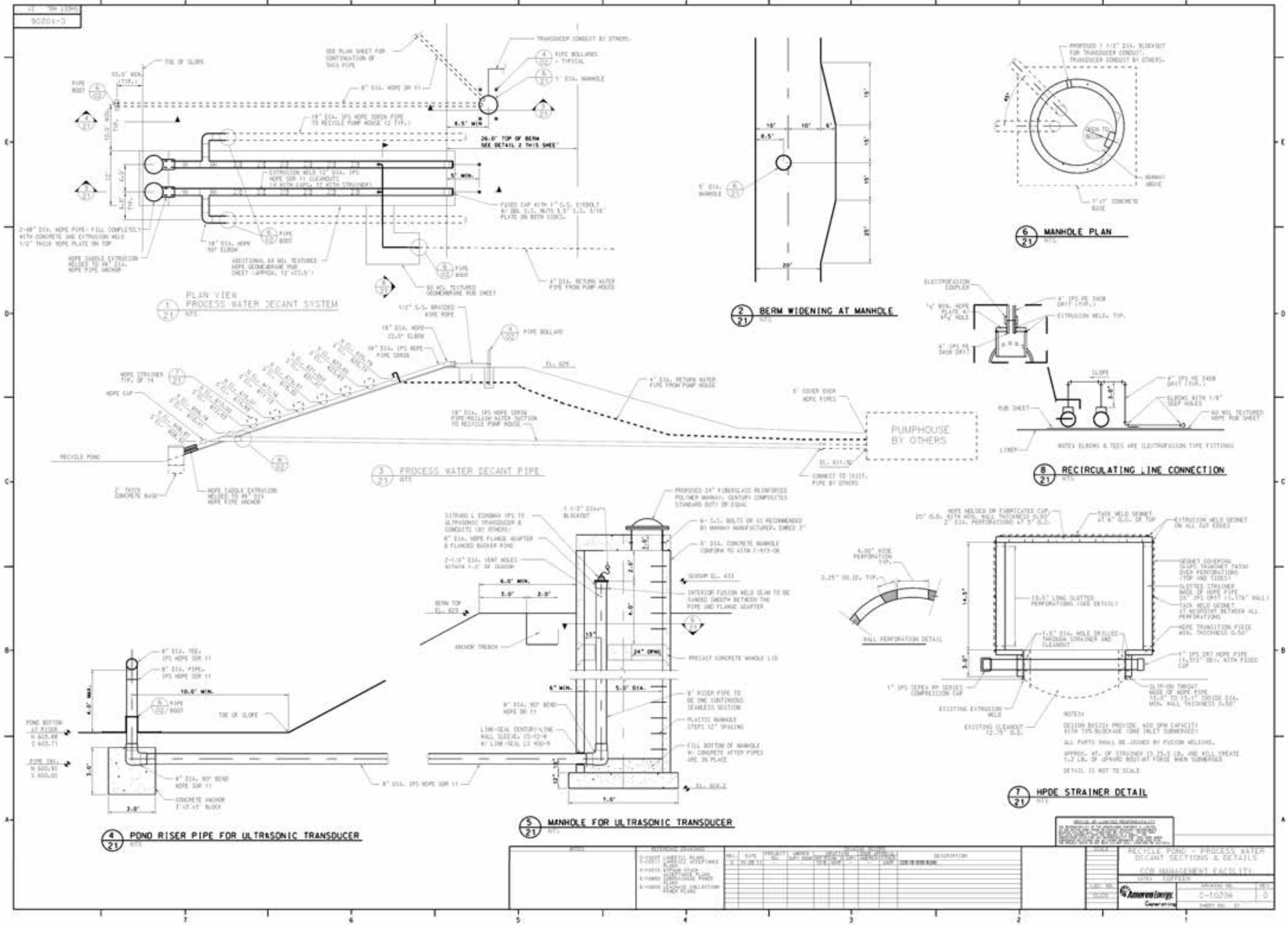
10/20 SIPHON PIPE ANCHOR AT GYPSUM STACK BERM
SECTION - NTS

NOTES | REFERENCE DRAWINGS | REV. | DATE | PROJECT NO. | DESCRIPTION

RECYCLE POND - PROCESS WATER TRANSFER CHANNEL DETAILS
CCR MANAGEMENT FACILITY

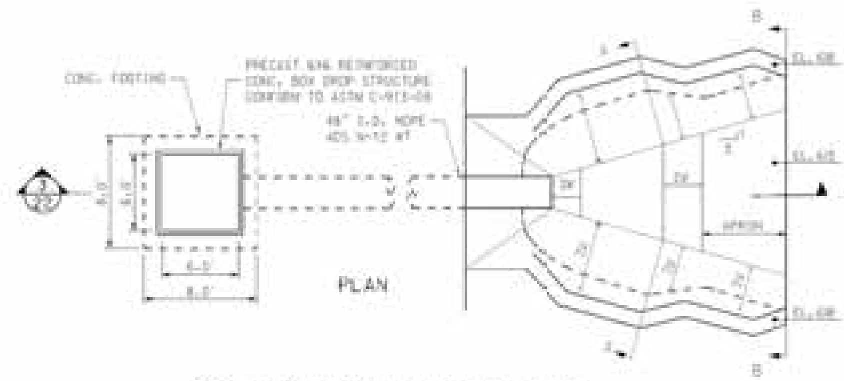
Ameren Energy Generating

DRAWING NO. C-10206 REV. 0


PLAN VIEW
PROCESS WATER DECANT SYSTEM
BERM WIDENING AT MANHOLE
MANHOLE PLAN
PROCESS WATER DECANT PIPE
PUMPHOUSE BY OTHERS
RECIRCULATING LINE CONNECTION
HPDE STRAINER DETAIL
POND RISER PIPE FOR ULTRASONIC TRANSDUCER
MANHOLE FOR ULTRASONIC TRANSDUCER
RECYCLE POND - PROCESS WATER DECANT SECTIONS & DETAILS
FOR MANAGEMENT FACILITY
C-10206

C-10206
SHEET NO. 22

1/22 STILLING BASIN PLAN AT EMERGENCY SPILLWAY
NTS



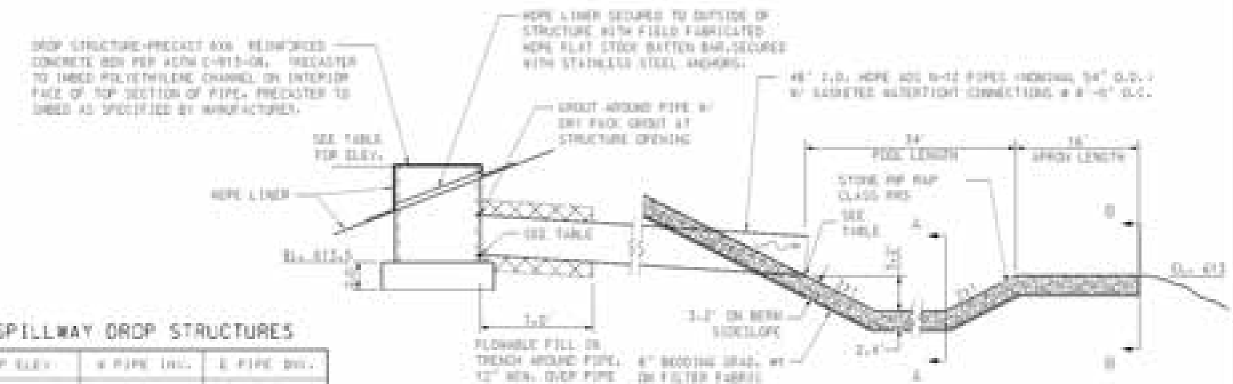
2/22 RIPRAP STILLING BASIN PLAN
NTS

SECTION A-A

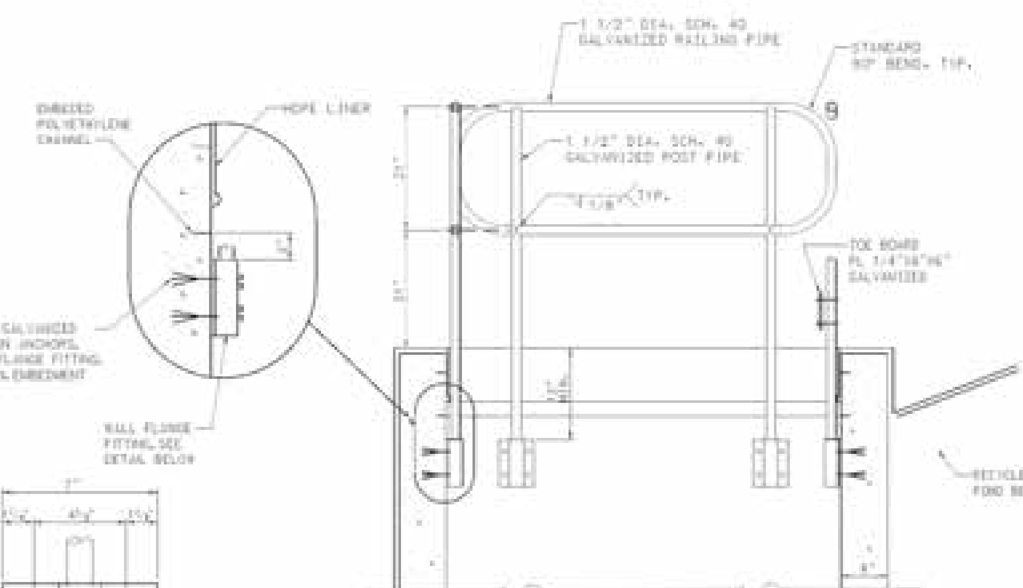
SECTION B-B

EMERGENCY SPILLWAY DROP STRUCTURES

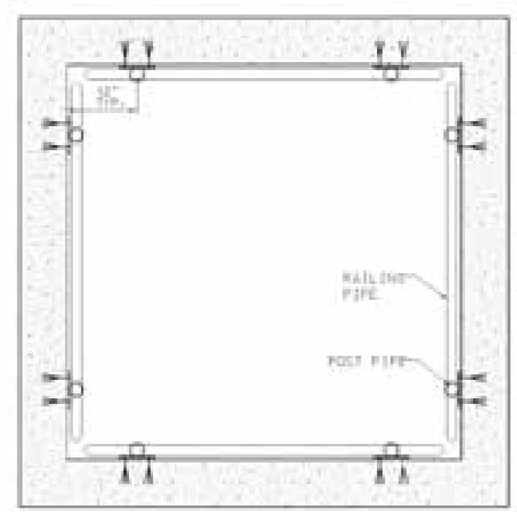
STRUCTURE	TOP ELEV.	W PIPE INV.	E PIPE INV.
NORTH	624.13	614.93	612.94
MIDDLE	624.15	614.95	613.00
SOUTH	624.11	614.03	613.06



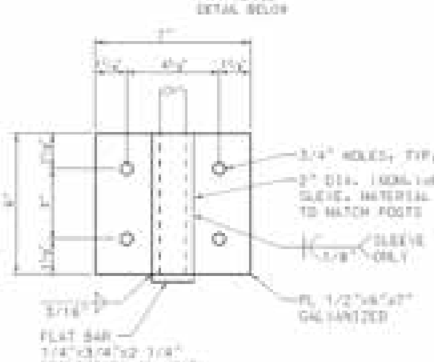
3/22 RIPRAP STILLING BASIN SECTION
NTS



4/22 DROP INLET HANDRAIL DETAIL
NTS



5/22 DROP INLET HANDRAIL PLAN
NTS



WALL FLANGE FITTING
NTS

HANDRAIL NOTES

GT-1 COPE ALL INTERSECTIONS OF RAILS AND POSTS, WELD JOINTS, AND GRIND SMOOTH TO A PLEASING APPEARANCE, TAKING CARE TO NOT REMOVE EXCESSIVE AMOUNT OF WELDED MATERIALS.

GT-2 BUTT WELD END-TO-END JOINTS, OR USE WELDING CONNECTIONS.

GT-3 CLEAN WELDED AREAS USING A WIRE BRUSH TO REMOVE SLAG AND LOOSE PARTICULATE. WIPE AWAY DUST WITH A CLEAN DRY RAG AND CLEAN THE WELDED SUFACE IN ACCORDANCE WITH SSPC-SP 1.

GT-4 TREAT ALL WELD ZONES WITH TWO COATS OF COLD GALVANIZING COMPOUND.

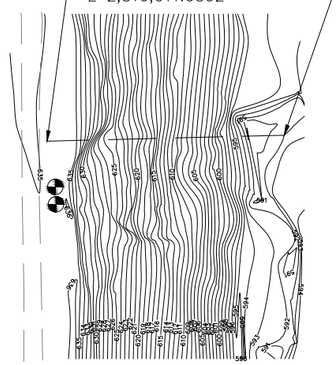
GT-5 COAT THE WELDED HANDRAIL ASSEMBLY PER THE FOLLOWING:
1 - 4 MIL COAT OF KRYLON INDUSTRIAL GALVANIZED METAL PRIMER
2 - 3 MIL COATS OF KRYLON INDUSTRIAL RUST TOUGH DTM ALKYD ENAMEL - COLOR: OHSA SAFETY YELLOW

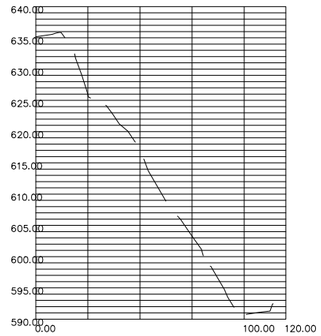
NOTICE OF LIMITED RESPONSIBILITY

NOTES | REFERENCE DRAWINGS | REV. | DATE | DESCRIPTION

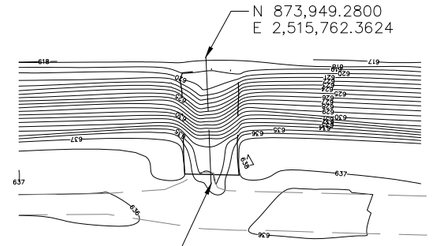
RECYCLE POND - EMERGENCY SPILLWAY SECTIONS & DETAILS
CCR MANAGEMENT FACILITY
Ameren Energy Generating
DRAWING NO. C-10206 REV. 0
SHEET NO. 22

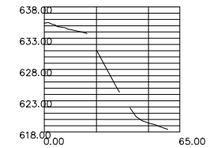
COFFEEN POWER STATION CLOSED ASH POND TOPO SURVEY



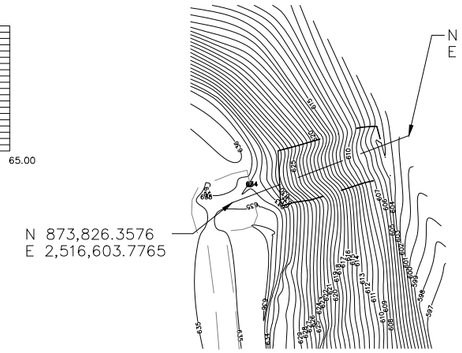


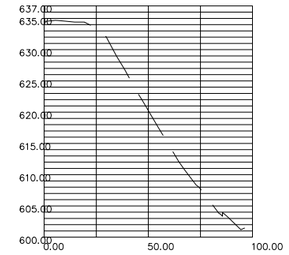
DETAIL G
EAST ERODED SLIDE AREA



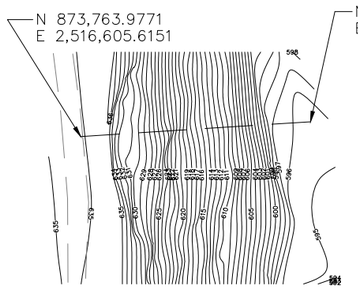


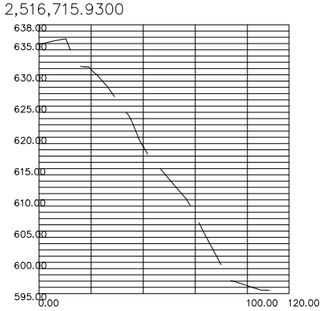
DETAIL A
NORTH PAVED OUTLET



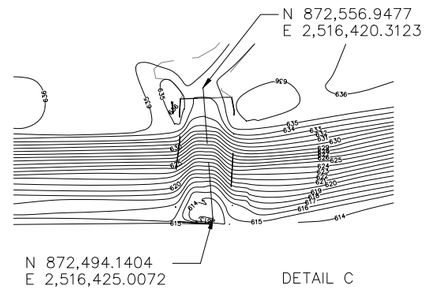


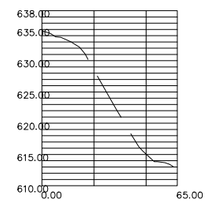
DETAIL B
NORTHEAST PAVED OUTLET



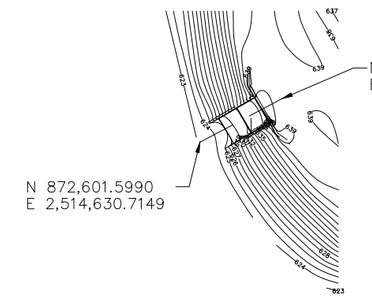


DETAIL H
NEW ERODED SLIDE AREA

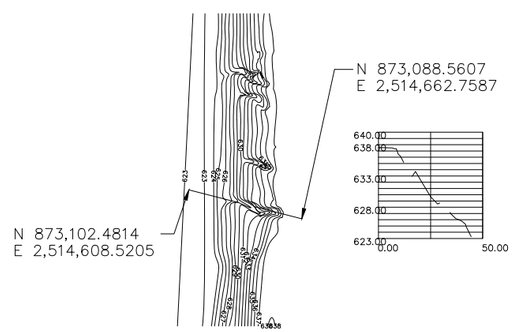


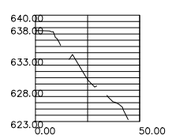


DETAIL C
SOUTHEAST PAVED OUTLET

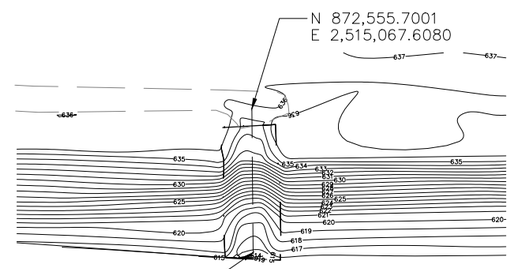


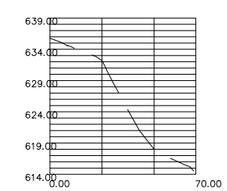
DETAIL E
CONCRETE DAM





DETAIL F
WEST ERODED SLIDE AREA





DETAIL D
SOUTHWEST PAVED OUTLET

LEGEND

- GRAVEL DITCH EDGE
- PAVED OUTLET EDGE
- CROSS SECTION LINE
- PIEZOMETER

N

30' 15' 0 15' 30'
SCALE IN FEET

BASIS OF BEARINGS –
BEARINGS ARE BASED ON THE IL. STATE PLANE COORDINATE SYSTEM. NAD 1983 WEST ZONE.

McDonough–Whitlow, P.C.
Consulting Engineers & Land Surveyors
138 East Wood Street
Hillsboro, IL 62049
Phone: 217.532.9233
Fax: 217.532.6300
PROFESSIONAL DESIGN No. 184-002754

TONY HARD 2953 PROFESSIONAL LAND SURVEYOR STATE OF ILLINOIS HILLSBORO, ILLINOIS

(License Expires: 11/30/06)

THIS IS TO CERTIFY TO AMEREN ENERGEY THAT A TOPOGRAPHIC SURVEY SHOWN HEREON HAS BEEN PERFORMED BY ME OR UNDER MY SUPERVISION AND THIS PLAT IS A REPRESENTATION OF MY PROFESSIONAL OPINION OF SAID SURVEY.

ILLINOIS PROFESSIONAL LAND SURVEYOR NO. 035-2953 DATE

FIELD WORK FOR THIS SURVEY WAS COMPLETED ON MAY 28, 2009

NOTES

REFERENCE DRAWINGS

DRAWING RECORD

REV.	DATE	PROJECT NO.	AMEREN SUPV ENGR	DRAFTING DRF'TR	DRAFTING CHK'D	DRAFTING SUPV	ENGR APPROVAL AMEREN	ENGR APPROVAL OTHER	DESCRIPTION
--	--	--	--	--	--	--	--	--	-

NOTICE OF LIMITED RESPONSIBILITY
THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT DRAWINGS AND DOCUMENTS BEARING HIS/HER SEAL, SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE. THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

AS BUILT

SCALE 1" = 30'

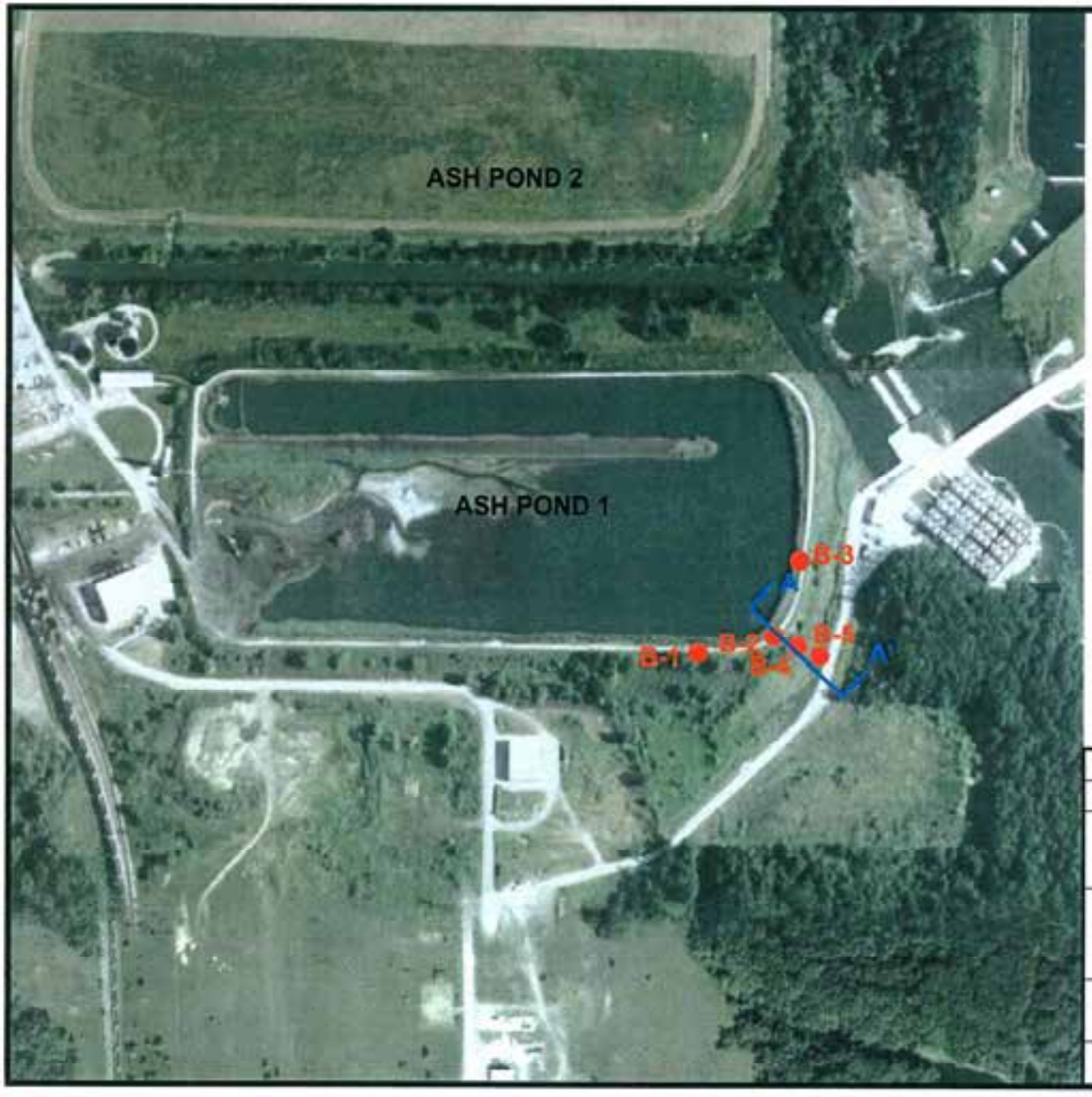
COFFEEN POWER STATION
ASH POND #2
DRAINAGE MODIFICATIONS
SITE: AMEREN CLOSED ASH POND

LOC. NO. --
CLASS --

AMERICAN ENERGY Generating

DRAWING NO. W1008
REV. --
SHEET NO. 2 OF 2

Appendix C: Coffeen Power Station Boring and Piezometer Locations



NOTES

1. Plan adapted from an aerial photograph courtesy of Google Earth.

LEGEND

● Boring Location

— Slope Stability Cross Section

N

0 200 400 800

SCALE IN FEET

Drawn By: SLC	Ck'd By: SEE	App'vd By: BM
Date: 11-04-10	Date: 12/21/10	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Coffeen Power Station
Coffeen, Illinois

AERIAL PHOTOGRAPH OF SITE AND BORING LOCATIONS

Project Number J017150.01	PLATE 2

EXPLORATION METHOD (B=BORING, C=CPT, P=PIEZOMETER)

XXX-X###

ID NUMBER

STATION ABBREVIATION

SOURCE:
MAP PROVIDED BY GOOGLE EARTH PRO 2015

LEGEND

PIEZOMETER LOCATION

CCR UNIT BERM ALIGNMENT

0 200

APPROXIMATE SCALE FEET

N

Illinois Power Generating Company	PROJECT NO. 60440742
AECOM	
DRN. BY: djd October 2015 DSGN. BY: eg CHKD. BY: eg	Coffeen Ash Pond No.1 Piezometer Locations
	FIG. NO. 2A

File: P:\PROJECTS\GEOTECH\60428794_DYNEGYCCR\04TASKS\00 PROGRAM TASKS\1.0 TASK 1 INITIAL UNIT ASSESSMENT\CCR FACT SHEETS\SITE MAPS\FIGURE 2A PIEZOMETER LOCATION PLAN (COFFEEN).DWG Last edited: NOV. 04, 15 @ 3:03 p.m. by: david_deguire

LEGEND

- AECOM PIEZOMETER LOCATION
- HISTORICAL PIEZOMETER LOCATION
- CCR UNIT BERM ALIGNMENT

0 200
APPROXIMATE SCALE FEET

N

SOURCE:
MAP PROVIDED BY GOOGLE EARTH PRO 2015

Illinois Power Generating Company	PROJECT NO. 60440742
AECOM	
DRN. BY: djd October 2015 DSGN. BY: eg CHKD. BY: eg	Coffeen Ash Pond No.2 Piezometer Locations
FIG. NO. 2B	

File: P:\PROJECTS\GEOTECH\60428794_DYNEGYCCR\04TASKS\00 PROGRAM TASKS\1.0 TASK 1 INITIAL UNIT ASSESSMENT\CCR FACT SHEETS\SITE MAPS\FIGURE 2A PIEZOMETER LOCATION PLAN (COFFEEN).DWG Last edited: NOV. 04, 15 @ 3:03 p.m. by: david_deguire

Appendix D: Project Specifications, Gypsum Stack and Recycle Pond Construction (Hanson 2008)

PROJECT SPECIFICATIONS
GYPSUM STACK AND RECYCLE POND CONSTRUCTION
GYPSUM MANAGEMENT FACILITY
COFFEEN POWER STATION
MONTGOMERY COUNTY, ILLINOIS

Prepared For:

AMEREN ENERGY GENERATING COMPANY

Prepared By:

HANSON PROFESSIONAL SERVICES INC.
1525 South Sixth Street
Springfield, Illinois 62703

January 2008

GYPSUM STACK AND RECYCLE POND CONSTRUCTION
GYPSUM MANAGEMENT FACILITY
COFFEEN POWER STATION
MONTGOMERY COUNTY, ILLINOIS

TABLE OF CONTENTS

	Sheet No.
Division 1 – General Requirements	
01356 - Storm Water Pollution Prevention Measures	01356-1 to 01356-3
Division 2 – Site Work	
02100 - Site Preparation	02100-2
02200 - Earthwork	02200-1 to 02200-12
02275 - Riprap	02275-1 to 02275-2
02315 - Granular Drainage Materials	02315-1 to 02315-8
02373 - Geotextiles	02373-1 to 02373-8
02376 - Geosynthetic Clay Liner	02376-1 to 02376-9
Attachment 1 – Bentomat® Certified Properties	End of Section
02640 - HDPE Piping	02640-1 to 02640-4
02800 - HDPE Geomembrane	02800-1 to 02800-12
02936 – Topsoil Seeding and Mulching	02936-1 to 02936-3
03100 – Concrete Formwork	03100-1 to 03100-5
03200 – Concrete Reinforcement	03200-1 to 03200-3
03300 – Cast-In-Place Concrete	03300-1 to 03300-6
03400 – Concrete Embedment Liner	03400-1 to 03400-4

PART 1. GENERAL

1.01 DESCRIPTION

A. This section pertains to the construction and maintenance of temporary erosion control systems to control erosion and sediment damage to adjacent properties and water resources, and the removal of erosion control devices when they are no longer required.

1.02 RELATED SECTIONS

The following sections contain items which are related to the work in this section:

02936 - Topsoil, Seeding, and Mulching.

1.03 REFERENCES

The following reference, or cited portions thereof, governs the work:

Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.

1.04 SUBMITTALS

A. Submittals shall follow the provisions of Section 01010.

B. Preconstruction Submittals: A storm water best management practices (BMP) plan shall be submitted that includes the following items:

1. Site drawing showing anticipated locations of structural erosion controls, areas of disturbed soils, and drainage patterns;
2. Inspection and record-keeping procedures; and
3. Maintenance procedures for erosion controls.

PART 2. PRODUCTS

2.01 EROSION CONTROL SYSTEMS

Materials for erosion control systems shall be in accordance with Article 280.02 of the IDOT Standard Specifications.

PART 3. EXECUTION

3.01 EXAMINATION

The site shall be examined to determine the extent of work required.

3.02 PRECONSTRUCTION JOBSITE INSPECTION

A. The person who shall be at the jobsite during construction and who shall be responsible for insuring that erosion control work is completed in a timely manner shall be identified at the preconstruction meeting.

B. A jobsite inspection shall be conducted with the Owner's Representative to review and designate the locations and types of erosion protection to be placed. The inspection shall be scheduled at the preconstruction conference and carried out on the job site before beginning any work that will disturb existing drainage or potentially create erodible conditions.

3.03 CONSTRUCTION

A. Temporary erosion control systems shall be constructed in accordance with IDOT Standard 280001 and Article 280.04 of the Standard Specifications and as directed by the Owner's Representative. Erosion control devices shall be in place and approved by the Owner's Representative prior to beginning other work.

B. Incorporate permanent erosion control features into the project at the earliest practicable time to minimize the need for temporary erosion controls.

3.04 MAINTENANCE

A. Temporary erosion control systems shall be maintained in accordance with Article 280.05 of the Standard Specifications, except that measurement and payment provisions shall not apply.

B. Temporary erosion control systems for unprotected disturbed areas shall be cleaned of trapped sediment and repaired immediately prior to project close out.

C. Temporary seeding shall be applied to all disturbed areas except the gypsum stack excavation and the future fill and topsoil stockpiles.

3.05 REMOVAL AND DISPOSAL

When the Owner's Representative deems that temporary erosion control systems are no longer needed, they shall be removed and properly disposed, and silt deposits shall be removed or regarded as directed by the Owner's Representative, and the area seeded. Non-biodegradable temporary erosion control materials shall be disposed of off site. Biodegradable erosion control devices may be disposed of in spoil areas designated by the Owner's Representative. All laws and regulations in disposing of the materials shall be obeyed.

END OF SECTION 01356

I:\05jobs\05s3004A\Gypsum Stacking\IDNR Dam Safety Permit Application\Specs\S01356_Storm Water Pollution Prevention Measures.doc

PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to stripping of topsoil and vegetation from areas of the site that are to be excavated.

1.02 RELATED SECTIONS

No related sections.

PART 2. PRODUCTS

No products used.

PART 3. EXECUTION

3.01 EXAMINATION

The Contractor shall examine the site to determine the extent of work required.

3.02 SITE PREPARATION - STRIPPING

A. All vegetation and topsoil encountered within the Gypsum Stack grading limits shall be stripped. Topsoil shall be kept clean and free of all foreign material, and stored in separate stockpiles from vegetation and common excavations. Stockpiles shall be located as indicated on the drawings or as directed by the Owner's Representative.

B. Payment for stripping shall be based upon removal of 24 inches of topsoil in areas that require stripping.

3.03 DISPOSAL

All materials resulting from site preparation operations shall be stockpiled in the designated spoil area. Contractor shall obey all laws and regulations when disposing of the materials.

END OF SECTION 02100

PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to excavation, fill, and backfill required for foundation preparation, construction of low-permeability soil layer, anchor trench construction, miscellaneous site grading and berm construction.

1.02 RELATED SECTIONS

A. The following sections contain items which are related to the work in this section:

1. 01356 – Storm Water Pollution Prevention Measures
2. 02100 - Site Preparation
3. 02373 – Geotextiles
4. 02936 - Topsoil, Seeding, and Mulching

1.03 REFERENCES

The following references, or cited portions thereof, govern the work:

1. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007
2. Department of Sustainable Natural Resources, Soil Survey Standard Test Method, Unified Soil Classification System: Field Method (USCS).

1.04 MEASUREMENT AND PAYMENT

A. The Contractor shall be responsible for estimating the extent of excavation and fill required to complete the work, including, but not limited to, excavation to required elevations; loading, transporting, placing, and compacting low permeability soil; excavation and backfill of anchor trench; and miscellaneous site grading and berm construction. The Contractor shall include the dollar amount associated with all earthwork in his Lump Sum Bid amount.

B. Removal and replacement of unsuitable foundation material and subgrade stabilization measures directed by the Owner's Representative will be paid for on a time and material basis.

1.06 COORDINATION

Existing utilities or other plant facilities shall not be interrupted, except when permitted in writing by the Owner's Representative and then only after acceptable

temporary services have been provided. A minimum 48-hour notice shall be provided prior to proceeding with an approved temporary interruption.

1.08 SUBMITTALS

A. Materials Handling Plan.

A materials handling plan shall be submitted for construction and protection of the low permeability soil liner. The plan shall describe the following:

1. Processing and placement of the low permeability soil type, model number, weight, and critical dimensions of equipment to be used for soil processing, compaction, scarification, and smooth rolling;
2. Method of protecting low permeability soil from changes in moisture content and freezing after placement.

B. Construction Access Ramp Layout.

Layout drawings shall be submitted showing alignment, profile, and typical section of the construction access ramps from the haul road into the bottom of the Gypsum Management Facility excavation. The minimum width of the ramp shall be 50 ft., and the longitudinal grade shall not exceed 8 percent.

PART 2. PRODUCTS

2.01 MATERIALS

A. Earth Fill Material

Earth Fill Material shall consist of a mixture of clay, silt, sand, and gravel-sized particles obtained from previously constructed subsoil stockpiles. These materials can be used separately or mixed as required for best results. When placed, Embankment Material shall have a USCS classification of SM, ML, or CL and shall be uniform. This material shall be free of ice, snow, organic matter, rubbish, and debris. Coarse-grained particles shall be well dispersed to prevent the development of segregated pockets or zones with insufficient fine material to fill the interstices.

B. Soil Liners

The Soil Liner for the Gypsum Management Facility is considered a Clay Liner, and shall be soil classification CL, CL-ML, or CH. The material shall be free of roots, debris, organic or frozen material, and shall have a maximum clod size no greater than the length of the compactor foot for the compaction equipment proposed by the Contractor. When compacted, the material shall have a hydraulic conductivity of less than 1×10^{-4} cm/sec.

C. Soil Stabilizers and Moisture Conditioning Agents

Additives to accelerate drying or to improve stability and workability of soil shall not be permitted unless approved in writing by the Owner's Representative.

2.02 EQUIPMENT

A. Compaction Equipment

1. Tamping foot rollers

Compaction equipment shall consist of tamping foot rollers which have a minimum weight of 40,000 pounds. At least one tamping foot shall be provided for each 110 square in. of drum surface. The length of each tamping foot, measured from the outside surface of the drum, shall be at least 1 in. longer than the loose lift thickness.

2. Steel-Wheeled Rollers

Equipment used to produce a smooth compacted surface shall be a smooth, non-vibratory steel wheeled roller weighing not less than 1,000 lb. per lineal ft.

B. Scarification Equipment

Discs, rotor tillers, or other equipment used to scarify the surface shall be capable of uniformly disturbing the upper 6 in. of surface to provide good bonding between lifts.

C. Mixing and Spreading Equipment

Discs, harrows, and motor graders or other similar equipment shall be available at the site for use in spreading, mixing, and drying Compacted Subsoil Stockpile Material.

PART 3. EXECUTION

3.01 PREPARATION

A. Control of Work

Benchmarks, monuments, and other reference points shall be maintained throughout the work area.

B. Utility Location

Before starting excavation, the location and extent of underground utilities in the work area shall be established.

3.02 EXCAVATION

A. General

Excavation consists of removal and redistribution of material encountered when establishing required grade and subgrade elevations. The Contractor shall be responsible for dewatering, protection, shoring, and disposal of excavated materials as necessary to complete the excavation.

B. Procedures

Excavation may be accomplished by any method and by use of any equipment that is suitable to the work, except that blasting will not be permitted. Based on previous construction experience at the site, it is recommended that excavation to the foundation grade be completed as far in advance of low permeability soil placement as possible to allow the foundation surface to dry and form a "crust" capable of sustaining compactive effort.

C. Overexcavation

All excavation shall be performed to the lines and grades indicated on the plans. Any overexcavation or excess excavation not requested by the Owner's Representative shall be at the expense of the Contractor.

D. Disposal of Excavated Materials

Contractor shall utilize excavated material as stockpile materials for future use as specified in paragraph E.

E. Stockpile Requirements

1. Excavated clay and silty clay materials are to be stockpiled in the short-term subsoil stockpile area.
2. Excess excavated materials are to be stockpile in the areas designated on the drawings.
3. Materials not suitable for use as fill or backfill shall be disposed of onsite in the locations specified by the Owner's Representative.
4. Spread fill material for use by others, topsoil, and low permeability soil are to be stockpiled in layers not to exceed 1 ft loose thickness.
5. Tops of stockpiles are to be graded to ensure positive drainage. Side slopes for stockpiles shall be no steeper than 3H:1V.
6. Perimeter ditches are to be excavated to intercept runoff flowing toward stockpile areas and to route it to outlet locations approved by the Owner's Representative.

3.03 SUBGRADE PREPARATION

A. Areas to receive fill shall be proof rolled under the observation of the Owner's Representative. Soft, loose, weak, or wet materials shall be removed and replaced with compacted fill or stabilized with geotechnical fabric or geogrid as directed by the Owner's Representative. Joints, fractures, and moisture seeps shall be repaired, and local sand deposits, if present at foundation grade, shall be removed and backfilled with compacted fill material as directed by the Owner's Representative.

B. The Owner's Representative may recommend additional drying time for soft, wet subgrade that has not been exposed long enough to permit "crust" formation. If approved by the Owner's Representative, the Contractor may install, at his own expense, geotechnical fabric or geogrid to stabilize the wet subgrade and expedite construction.

C. No fill shall be placed until the subgrade has been examined and approved.

3.04 GENERAL FILL

A. Placement

1. Unless otherwise indicated on the plans, all fill shall be composed of Earth Fill Material.
2. Fill materials used in embankment construction shall normally be placed in lanes parallel to the embankment axis and shall be placed in conformance with the lines, grades, and slopes as indicated on the plans. Placement of fill materials in lanes which are not parallel to the embankment will be allowed only where working room is too restricted for normal placement as determined by the Owner's Representative.
3. Fill shall be spread in approximately flat layers in such a manner as to obtain lifts of relatively uniform thickness without spaces between successively deposited loads. Segregation shall be prevented during placing and spreading. Hauling equipment shall be routed across the fill in such a way as to promote uniform compaction and to prevent the formation of ruts.
4. The maximum compacted thickness of each lift shall not exceed 8 in. where heavy compaction equipment will be used. The maximum compacted thickness shall not exceed 3 in. where power tampers or similar smaller equipment will be used. It may be necessary to reduce the thickness of lifts in order to obtain the required minimum density.
5. Where compacted earth fill is to be placed against existing slopes, each lift shall be keyed into existing slope by removing existing slope material in steps as each new lift is placed.
6. The surface of the fill shall be kept reasonably smooth. The fill surface shall be sloped transverse to the axis of the embankments to allow drainage. If the compacted surface is, in the opinion of the Owner's Representative, too smooth or too dry to bond properly with the

succeeding lift, it shall be roughened by scarifying, light discing, or other acceptable means, and it shall be sprinkled before the succeeding lift is placed thereon. If the surface becomes rutted or uneven subsequent to compaction, it shall be flattened and leveled before placing the next lift. This extra work shall be at the Contractor's expense.

7. Fill operations shall be suspended during periods of extended wet weather. Upon resuming operations, all fill materials that are excessively wet or soft shall be reprocessed in place or removed and stockpiled for reprocessing. The removal of soft material shall be carried to such depth as is necessary to expose firm materials. Fill shall not be placed on frozen surfaces.
8. When filling operations at any section will be suspended for any period in excess of 12 hours or in wet weather, the surface of the fill shall be rolled smooth to seal it against excessive absorption of moisture and to facilitate runoff. Prior to resuming fill placement and compaction, the fill surface shall be scarified and/or disced and moisture conditioned as required.
9. The Contractor will receive no additional compensation for any removal, reprocessing, stockpiling, recompaction, wasting, or similar operation related to suspensions or conditions due to weather or other causes unless caused by the Owner.
10. Earth fill access ramps shall not be constructed within the limits of the compacted embankments without prior approval. When such ramps are approved, they shall be constructed of low permeability soil (in-board of the perimeter berm) or compacted fill (out-board of the perimeter berm).

B. Compaction -

1. Fill materials shall be compacted to a dry density equal to or greater than the following:

   a. The Gypsum Management Facility: 95 percent of the maximum dry density obtained from the Standard Proctor Test, ASTM D698.

   In order to insure uniform coverage and to facilitate construction inspection and control, the compaction of each layer shall proceed in a systematic, orderly, and continuous manner. Rolling shall be parallel to the embankment axis, except where there is insufficient working room for such operations.

2. The moisture content of all earth fill materials shall be as uniform as practicable throughout each lift. Fill shall be compacted at a moisture content that is no more than 2 percent below and no more than 2 percent above optimum moisture content.
3. Moisture conditioning of fill materials shall be performed by discing, harrowing, plowing, blading, or other suitable means prior to excavation. Moisture conditioning where the fill is placed shall be limited to minor adjustments prior to compaction. Addition of moisture shall be by using a

pressure spray bar mounted in front of or to one side of a water tanker so that water will not collect in the tracks of the truck.

4. Compaction of fill materials shall not commence if the moisture content is not within the specified limits. Any materials that are placed but not compacted prior to drying out or becoming too wet shall be removed and replaced or reprocessed at the Contractor's expense.
5. No admixtures as drying agents or to improve the workability of the soil will be allowed.

3.05 SOIL LINERS

A. Sources

The Soil Liners for the Gypsum Management Facility shall be constructed from Soil Liner Material as described in paragraph 2.01(B) above.

B. Test Liner

A compacted low permeability soil test liner of the actual full scale liner shall be constructed in accordance with the following requirements:

1. Test liner will be constructed from the same soil material sources, to the same design specifications, and with similar equipment and procedures as are proposed for the full scale liner.
2. Test liner will be at least four times the width of the widest piece of equipment to be used.
3. Test liner will be no less than 100 ft long to allow equipment to reach normal operating speed before reaching a central 40-ft test area.
4. Test liner will be constructed with maximum 8-in. compacted lifts for a total liner thickness of 3 ft.
5. Test liner will be tested by the Owner's Testing Consultant as described below for each of the following physical properties:

    a. Multiple two-stage Boutwell permeameter tests will be used on the test liner to determine the hydraulic conductivity. The two-stage field hydraulic conductivity test is a falling head infiltration test conducted in a cased borehole, typically 4 in. in diameter. The test is cited in the U.S. EPA Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities, September 1993 (EPA/600/R-93/182).
    b. Undisturbed samples (Shelby tubes) will be tested in the laboratory for hydraulic conductivity to determine if there is a statistical correlation to the field testing results.
    c. Other engineering parameters including, but not limited to, particle size analysis, liquid limits, plasticity, water content, and in-place density that are needed to evaluate the full scale liner will be determined.

6. Additional test fills will be constructed for each new soil type or for each change in equipment or procedures.

C. Full Scale Liner Construction:

1. Full scale liner construction shall not be commenced until the results of the in-place compaction testing and Boutwell permeameter tests on the test liner confirm that the construction procedures and specified compaction requirements produce a in-situ hydraulic conductivities as specified in Section 2.01(B) above.
2. The liner shall be constructed according to the placement and compaction requirements for general fill, except the material shall be compacted to a density of no less than 95 percent of maximum dry density at a moisture content between 100 percent and 105 percent of optimum. The same compaction procedures, such as number of passes, speed, and compaction equipment used on construction of the test liner shall be used. Grade stakes shall not be driven into the clay liner.
3. The completed liner shall be smooth rolled to limit moisture loss and promote run-off of surface water. Moisture content shall be maintained within the specified range and erosion or other damage that occurs in the soil liner shall be repaired as directed by the Owner's Representative until the geosynthetic liner is placed.
4. Repair of any rutting or other damage caused by the installation of the geosynthetic liner will be paid for on a time and material basis.
5. Voids created in the clay barrier layer during construction (including, but not limited to, penetrations for test samples, and other penetrations necessary for construction) shall be repaired by removing material that does not meet the requirements for low permeability soil, placing low permeability soil backfill, granular or pelletized bentonite, or a mixture of bentonite and low permeability soil in lifts no thicker than 2 in. and tamping each lift with a steel rod. Each lift shall be tamped a minimum of 25 times altering the location of the rod within the void for each blow. Other ruts and depressions in the surface of the lifts shall be scarified, filled, and then compacted to grade.

3.06 CUSHION DIRT

Cushion Dirt to be placed beneath the upper High Density Polyethylene (HDPE) Geomembrane is to be placed to the specifications for General Fill in Section 3.04 above, except fill materials for Cushion Dirt shall be compacted to a dry density equal to or greater than 90 percent of the maximum dry density obtained from the Standard Proctor Test, ASTM D698.

3.07 ANCHOR TRENCH CONSTRUCTION

A. Gypsum Management Facility

1. A ledge at the bottom of the anchor trench elevation shall be excavated. Low permeability soil shall be placed and compacted on the ledge as shown on the anchor trench details in the plans.

2. The anchor trench shall be excavated to the depth and width shown on the anchor trench details. The front edge of the trench shall be rounded to eliminate any sharp corners that could cause excessive stress to the geosynthetic liners. Loose soil shall be removed or compacted into the floor of the trench.

3. Subsequent to Geosynthetic Clay Liner (GCL), Bottom HDPE Geomembrane and Geotextile Cushion installation, it shall be verified that the liners cover the entire trench floor, but do not extend up the back of the trench wall. After the liner installation in the trench has been inspected and approved by the Owner's Representative, the trench shall be backfilled with 1 ft. of low permeability soil. The backfill shall be deposited and compacted according to the requirements for general fill in such a manner as to prevent damage to the GCL and liner materials.

4. Subsequent to installation of separation geotextile on top of drainage layer, it shall be verified that the fabric extends across the top of the initial 1 ft layer of trench backfill, but does not extend up the back of the trench wall. After the fabric installation in the trench has been inspected and approved by the Owner's Representative, the trench shall be backfilled with 1 ft of low permeability soil. The backfill shall be deposited and compacted according to the requirements for general fill in such a manner as to prevent damage to the geotextile fabric.

5. Subsequent to installation of the upper HDPE Geomembrane, verify that the liner extends across the top of the initial 1 ft layer of trench backfill, but does not extend up the back of the trench wall. After the liner installation in the trench has been inspected and approved by the Owner's Representative, backfill the remainder of the trench to the top of the low permeability soil layer. Deposit and compact the backfill according to the requirements for general fill in such a manner as to prevent damage to the HDPE Geomembrane.

3.08 TESTING

A. Construction Quality Assurance (CQA) compaction and permeability tests will be made by the Owner's Testing Consultant during the progress of the work as indicated in Appendix 2. The Contractor shall cooperate with the Testing Consultant and allow such tests to be performed.

B. If tests indicate that an area of fill or low permeability soil liner does not meet the specified requirements, additional tests shall be performed to determine the extent of non-compliance. The Contractor shall moisture condition and recompact that area until a passing test result is obtained.

3.08 FINISH GRADING

All excavated and filled areas shall be fine graded and leveled to provide a smooth finish free of debris, foreign matter, objectionable stones, clods, lumps, pockets, or high spots, properly drained and true to indicated elevations. Finish grading shall be only near completion of work or when requested. Any portions of the berm damaged by construction shall be restored. The berm ditch shall be finished to design grade, and the ditch side slopes shaped and trimmed to provide a uniform ditch cross section.

3.09 CONSTRUCTION TOLERANCES

A. The foundation grade and finished earthwork grades shall be no more than 0.4 ft below and not above plan grade.

B. The minimum thickness of low permeability soil layer shall be 3 ft.

END OF SECTION 02200

I:\05jobs\05s3004A\Gypsum Stacking\IDNR Dam Safety Permit Application\Specs\S02200_Earthwork.doc

PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to the placement of riprap for erosion control.

1.02 RELATED SECTIONS

The following section contains items which are related to the work in this section:

02200 - Earthwork

1.03 REFERENCES

Specified references or cited portions thereof, current at date of bidding documents unless otherwise specified, govern the work.

A. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.

1.04 SUBMITTALS

Product Data: Provide quarry name and material type prior to delivery.

PART 2. PRODUCTS

2.01 MATERIALS

A. Stone Riprap and Bedding materials according to Article 1005.01 of the Illinois Standard Specifications for Road and Bridge Construction.

B. Filter Fabric material for Stone Riprap according to Article 1080.03, with an AOS (Apparent Opening Size) as indicated on the plans.

C. Supplier shall be listed on the current IDOT Approved Aggregate Source List.

D. Gradation as indicated in the drawings. Quality shall be Class A.

PART 3. EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Stone Riprap and Bedding shall be installed in accordance with Section 281 of the Illinois Standard Specifications for Road and Bridge Construction for the placement of Stone Riprap. Measurement and payment provisions of Section 281 shall not apply.

B. Filter Fabric for Stone Riprap shall be installed in accordance with Section 282 of the Illinois Standard Specifications for Road and Bridge Construction.

C. The Owner's Representative shall be allowed to visually inspect Riprap for compliance with specifications prior to placement.

END OF SECTION 02275

PART 1. GENERAL

1.01 DESCRIPTION

A. Gypsum Management Facility

This section pertains to the following:

1. Furnishing and placing granular drainage materials for the drainage layer and leachate collection system.
2. Furnishing and placing coarse aggregate for encasement of the ring drain collection piping.
3. Furnishing and installing materials for roadbed construction related to the Gypsum Management Facility access roads and the McKinley Road relocation.
4. Recycle Pond Drain.

1.02 RELATED SECTIONS

The following sections contain items which are related to the work in this section:

1. 02300 - Earthwork
2. 02373 – Geotextiles
3. 02640 - HDPE Piping

1.03 REFERENCES

The following references, or cited portions thereof, govern the work:

1. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.
2. American Society for Testing and Materials (ASTM):

    a. ASTM D 75 (2003) Practice for Sampling Aggregates.
    b. ASTM D 422 (1963; R 2002) Test Method for Particle-Size Analysis of Soils.
    c. ASTM D 2434 (1968, R 2000) Test Method for Permeability of Granular Soils (Constant Head).
    d. ASTM D 3042 (2003) Test Method for Insoluble Residue in Carbonate Aggregates.
    e. ASTM C 1260 (2005) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).

3. American Geological Institute (AGI). Geoscience Handbook AGI Data Sheets, 4th Edition.

1.04 MEASUREMENT AND PAYMENT

The Contractor shall be responsible for estimating the extent of granular materials required to complete the work including, but not limited to, construction of drainage layer, encasement of leachate collection piping, and road-bed construction. The Contractor shall include the dollar amount associated with furnishing and placing all granular materials in his Lump Sum Bid amount.

1.05 COORDINATION

A. The geosynthetic liner shall be covered with granular materials as soon as practicable after a section of liner has been approved by the Owner's Representative.

1.06 SUBMITTALS

A. Product Data:

1. Aggregate source list: Submit a list of proposed aggregate sources.

2. Shipping Tickets: Submit shipping tickets for the granular materials delivered to the site. Shipping tickets shall be according to paragraph 1004.01f of the IDOT Standard Specifications.

B. Test Reports.

1. Submit results of grain size analysis (ASTM D422) and hydraulic conductivity testing (ASTM D2434) for gradations established by the Contractor that provide the specified hydraulic conductivity. Test results are required for each proposed source and gradation. Submit test results for each source demonstrating compliance with reactivity, soundness, and abrasion requirements specified herein.

C. Samples:

1. Submit one sample per source for each gradation proposed for use on the project. Samples shall be at least one pound and shall be obtained and shipped according to ASTM D75. Submit samples at least 15 days prior to starting construction of the drainage layer and coarse aggregate encasement for leachate piping.

1.07 STORAGE AND HANDLING

A. Storage and handling of granular materials shall be according to paragraph 1004.01e of the IDOT Standard Specifications.

1.01
PART 2. PRODUCTS

2.01 MATERIALS

A. General

1. Unless otherwise approved by the Owner's Representative, granular materials shall be obtained from sources listed on the current IDOT Approved Aggregate Source List (www.dot.il.gov\materials\approvedaggregatesources.pdf).
2. Coarse Granular materials shall be meet the Description of Gravel, as described in Section 1004.01(a)(1) of the IDOT Standard Specifications, and shwll be spherical to sub-discoidal, sub-rounded to well rounded particles as defined by AGI Data Sheet, 4th Edition, Sheet 8.4 – Comparison Charts for Estimating Roundness and Sphericity.
3. Granular materials shall experience no more than 15 percent carbonate loss per ASTM D3042.
4. Granular materials shall be free of deleterious material, and shall meet the Na_2SO_4 soundness and Los Angeles Abrasion Specifications for Class B quality aggregate per paragraph 1004.01 of the IDOT Standard Specifications.
5. All material shall pass the 2 in. sieve, and no greater than 5 percent shall be retained on the No. 200 sieve.
6. Granular materials shall be innocuous to alkali-silica reactivity, and shall exhibit internal expansions of less than 0.10 percent at 16 days after casting as determined by ASTM C 1260.

B. Gypsum Management Facility Granular Materials

1. Granular Materials for Drainage Layer

Gradation for granular material for drainage layer shall be as required to provide a minimum hydraulic conductivity (ASTM D2434) of 1×10^{-3} cm/sec.

2. Coarse Aggregate around Ring Drain Collection Piping

Coarse Aggregate used to encase the ring drain collection piping shall be IDOT Gradation CA 7 material as outlined in Article 1004.01 of the IDOT Standard Specifications for Road and Bridge Construction.

3. Filter Sand

Filter Sand used for protective cover over the ring drain collection system shall be IDOT Gradation FA 1, Class B or better according to Article 1003 of the IDOT Standard Specifications for Road and Bridge Construction.

4. Aggregate Base Course, Type B

Aggregate Base Course, Type B used for base material for all new access roads and shall be IDOT Gradation CA 2, in accordance with Section 1004.04 of the IDOT Standard Specifications for Road and Bridge Construction. The material shall originate from an IDOT approved source. The Na_2SO_4 soundness and Los Angeles Abrasion Specifications for Class B quality aggregate per paragraph 1004.01 of the IDOT Standard Specifications shall not apply.

5. Aggregate Surface Course, Type B

Aggregate Surface Course, Type B used for surface material for all new access roads and the McKinley Road relocation shall be IDOT Gradation CA 6, in accordance with Section 1004.04 of the IDOT Standard Specifications for Road and Bridge Construction. The material shall originate from an IDOT approved source. The Na_2SO_4 soundness and Los Angeles Abrasion Specifications for Class B quality aggregate per paragraph 1004.01 of the IDOT Standard Specifications shall not apply.

2.02 EQUIPMENT

Equipment for spreading and compacting granular materials shall be low ground pressure equipment to prevent damage to the underlying geosynthetic liners.

PART 3. EXECUTION

3.01 PROTECTION OF GEOSYNTHETICS

A. Protection of the geosynthetic liners is critically important. Approved geosynthetic liner shall be covered by granular material as soon as practicable. Granular material shall be placed to a minimum thickness of 1 ft before any heavy equipment or loaded trucks are allowed on the lined area.

B. No equipment will be permitted directly on the geosynthetic liner.

C. Any damage to the geosynthetic liner system shall be repaired, as directed by the Owner's Representative, at the expense of the Contractor.

3.02 GRANULAR DRAINAGE LAYER (GYPSUM MANAGEMENT FACILITY)

A. Placement on Cell Floor

1. The granular material shall be back-dumped on the geotextile cushion fabric in a sequence of operations beginning at the perimeter of the liner on the cell floor.
2. Placement of material on the fabric shall be accomplished by spreading dumped material off of previously placed material with a bulldozer blade or endloader, in such a manner as to prevent tearing or shoving of the cloth. Dumping of material directly on the fabric will only be permitted to establish an initial working platform. No vehicles or construction equipment shall be allowed on the fabric prior to placement of the granular blanket to a minimum thickness of 1 ft.

B. Placement on Cell Side Slopes

1. Placement of granular material on cell side slopes shall be accomplished using methods and equipment similar to that specified for placement of material on cell floor.
2. The Contractor may place gypsum underlain with separation geotextile fabric to buttress the granular material on the slope:

    a. The Construction Quality Assurance (CQA) survey to certify thickness of drainage material shall be completed within the footprint of the gypsum stack before gypsum placement.

b. Separation geotextile fabric shall extend beyond the toe of gypsum buttress a sufficient distance to prevent contamination of the granular drainage layer. See Sections 02373 and 02320 for construction of separation geotextile fabric and gypsum, respectively.

3.04 COARSE AGGREGATE FOR ENCASEMENT OF RING DRAIN COLLECTION PIPING (GYPSUM MANAGEMENT FACILITY)

A. The geotextile filter fabric for encasement of leachate collection piping shall be placed on the approved cushion geotextile fabric according to Section 02373 – Geotextiles.

B. The coarse aggregate shall be placed on the encasement fabric to the width shown on the plans to the level of the bottom of the ring drain collection piping.

C. Course aggregate shall be placed and tamped along the pipe during pipe installation. The coarse aggregate shall be placed longitudinally along the pipe in lifts not to exceed 8 in. thick to a height of at least the center of the pipe. The aggregate shall be maintained at equal elevation on each side of the pipe, and the first lift of material shall be mechanically tamped to ensure that the space under the pipe is completely filled. The top of pipe shall not be covered until the CQA survey certifies leachate piping grade has been completed.

C. After the CQA survey has been completed, coarse aggregate material shall continue to be placed in lifts not to exceed 8 in. thick, as specified in the previous paragraph until the minimum cover height shown in the plans is attained.

D. The running of trucks or heavy equipment over leachate piping shall be avoided until there is at least a 12 in. cover of Filter Sand over the completed geotextile envelop. Temporary ramps no steeper than 10H:1V transverse to the piping shall be provided for temporary equipment crossings until the first lift of gypsum is placed.

3.03 ROADWAY CONSTRUCTION

A. Prepare the roadway subgrade as shown on the plans, in accordance with Section 02200 – Earthwork.

B. Furnish Geotechnical Fabric for Ground Stabilization in accordance with Section 02373 – Geotextiles.

C. Furnish Aggregate Base Course, Type B in accordance with Article 351 of the IDOT Standard Specifications for Road and Bridge Construction.

D. Furnish Aggregate Surface Course, Type B in accordance with Article 402 of the IDOT Standard Specifications for Road and Bridge Construction.

3.04 TESTING

A. CQA gradation and permeability tests will be made by the Owner's Testing Consultant during the progress of the work as indicated in Appendix 2. The Contractor shall cooperate with the Testing Consultant and allow such tests to be performed.

B. If tests indicate that an area of granular material or coarse aggregate does not meet the specified requirements, then the Contractor shall remove the material and replace it with suitable material.

3.05 FINISH GRADING

The granular drainage layer shall be fine graded to provide a smooth finish before a CQA survey of the completed portion of the drainage layer is requested. Ruts or erosion damage shall be repaired before placement of the separation geotextile fabric.

3.06 CONSTRUCTION TOLERANCES

The minimum thickness of drainage layer shall be 1 ft.

END OF SECTION 02315

PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to furnishing and installing geotextile fabrics on prepared surfaces.

1.02 RELATED SECTIONS

The following sections contain items which are related to the work in this section:

1. 02300 - Earthwork
2. 02315 - Granular Materials
3. 02800 – HDPE Geomembrane

1.03 REFERENCES

The following references, or cited portions thereof, govern the work:

1. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.
2. American Society for Testing and Materials (ASTM):

    a. ASTM 3776 (1996; R 2002) Standard Test Method for Mass per Unit Area (Weight) of Fabric;
    b. ASTM D 3786 (2001) Test Method for Hydraulic Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method;
    c. ASTM D 4533 (2004) Test Method for Trapezoid Tearing Strength of Geotextiles;
    d. ASTM D 4632 (1991; R 2003) Test Method for Grab Breaking Load and Elongation of Geotextiles;
    e. ASTM D 4751 (2004) Test Method for Determining Apparent Opening Size of Geotextile;
    f. ASTM D 4833 (2000) Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products;
    g. ASTM D 4873 (2002) Guide for Identification, Storage, and Handling of Geosynthetic Rolls;
    h. ASTM D 4884 (1996; R 2003) Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles;
    i. ASTM D5261-92(2003) Standard Test Method for Measuring Mass per Unit Area of Geotextiles

j. ASTM D6241-04 Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

1.04 MEASUREMENT AND PAYMENT

A. The Contractor shall be responsible for estimating the extent of geotextile fabric required to complete the work including fabric for laps, anchorage, repairs, and samples for Construction Quality Assurance (CQA) testing. The Contractor shall include the dollar amount associated with all geotextile construction in his Lump Sum Bid amount, except as specified in paragraph B.

B. Geotextile fabric for ground stabilization, when directed by the Owner's Representative, will be paid for on a time and materials basis.

C. No additional payment will be made for geotextile fabric for ground stabilization installed at the Contractor's discretion.

1.05 SUBMITTALS

A. Product Data

1. The manufacturer's list of guaranteed properties for each geotextile fabric or geogrid proposed for use on the project shall be submitted.
2. The manufacturer's installation guidelines shall be submitted.

B. Samples

Samples of geotextile fabrics shall be submitted for CQA prequalification testing. Sample size and sampling frequency are specified in Appendix 2.

C. Inventory

A copy of the roll inventory that identifies, as a minimum, manufacturer or supplier, product or style number, roll number, width, and length of roll as identified on the roll label shall be submitted.

1.06 STORAGE AND HANDLING

Geotextiles shall be stored and handled according to ASTM D4873.

PART 2. PRODUCTS

2.01 MATERIALS

A. Geotextile Fabric for Liner System

Geotextile fabrics for use in the cell liner system shall consist of non-woven filaments of polypropylene, polyester, or polyethylene. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Non-woven fabric may be needle-punched, heat-bonded, or a combination thereof. The filaments shall be dimensionally stable (i.e., filaments shall maintain their relative position with respect to each other) and resistant to delamination. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile. The filaments shall be free from any chemical treatment or coating that might significantly reduce porosity and permeability.

Fabric shall have the following physical properties:

Physical Properties[1]	**4 oz. (Separation)**	**6 oz. (PWRS)**	**16 oz. (CA Envelope)**
Mass/Unit Area (oz./yd^2) ASTM D5261	4.0	6.0	16.0
Grab Tensile Strength (lb.) ASTM D4632	115	160	380
Grab Elongation (%) ASTM D4632	50	50	50
Puncture Strength (lb.) ASTM D4833	65	85	240
Puncture (CBR) Strength (lb.) ASTM D6241	310	410	1025
Mullen Burst Strength (psi) ASTM D3786	210	280	750
Trapezoidal Tear Strength (lb.) ASTM D4533	50	60	150
Width (ft.)	15	15	15
Apparent Opening Size (AOS) Max. US Std. Sieve No. ASTM D4751	70	70	100
UV Resistance[2] (%) ASTM D4355	70	70	70
Roll Width (ft.)	15	15	15

Notes:

(1) All Values listed are Minimum Average Roll Values (MARV) unless otherwise noted, calculated as the typical minus two standard deviations..

(2) UV Resistance is a minimum value and not a MARV. Evaluation to be on 2.0 inch strip tensile specimens after 500 hours exposure.

A. Cushion Geotextile Fabric.

Cushion geotextile fabric shall consist of non-woven filaments of polypropylene, polyester, or polyethylene. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Non-woven fabric may be needle-punched, heat-bonded, or a combination thereof. The filaments shall be dimensionally stable (i.e., filaments shall maintain their relative position with respect to each other) and resistant to delamination. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile. The filaments shall be free from any chemical treatment or coating that might significantly reduce porosity and permeability.

Fabric shall have the following physical properties:

Physical Properties[1]	**10 oz. (Cushion)**
Mass per unit area (oz/yd^2) ASTM D5261	10
Grab Tensile Strength (lb.) ASTM D4632	230
Grab Tensile Elongation (%) ASTM D4632	50
Trapezoidal Tear Strength (lb.) ASTM D4533	95
Puncture (CBR) Strength (lb.) ASTM D6241	700
Puncture (CBR) Elongation (in.) ASTM D6241	1.5
UV Resistance[2] (%) ASTM D4355	70
Apparent Opening Size (Max.) (AOS) Sieve No. - ASTM D4751	---
Roll Width (ft.)	15

Notes:

(1) All Values listed are Minimum Average Roll Values (MARV) unless otherwise noted, calculated as the typical minus two standard deviations..

(2) UV Resistance is a minimum value and not a MARV. Evaluation to be on 2.0 inch strip tensile specimens after 500 hours exposure.

B. Geotechnical Fabric for Ground Stabilization

Geotechnical fabric for ground stabilization shall conform to Article 1080.02 of the IDOT Standard Specifications for Road and Bridge Construction.

C. Thread for Seams

High strength thread should be used such that seam test should conform to ASTM D4884. The thread shall meet the chemical, ultraviolet, and physical requirements of the geotextile, and the color shall be different from that of the geotextile.

D. Securing Devices

Pins, staples, and other devices that project through the geotextile fabric are not permitted for fabrics installed above the geomembrane. Sandbags, stone, or other appropriate means approved by the Owner's Representative shall be used to prevent movement of the geotextile.

2.02 EQUIPMENT

A. Equipment for spreading and compacting granular materials shall be low ground pressure equipment to prevent damage to the underlying geosynthetic liners.

PART 3. EXECUTION

3.01 SAMPLES FOR CQA TESTING

A. Geotextile fabric samples shall be obtained, identified and packaged from rolls designated by the Owner's Representative according to ASTM D4873.

B. Samples shall be 3 ft. wide by the full roll width.

3.02 BASE PREPARATION

A. Surface on which the geotextile will be placed shall be prepared to a relatively smooth surface condition, and shall be free from obstruction, debris, depressions, erosion features, or any irregularities that would prevent continuous, intimate contact of the geotextile with the entire surface. Rills, gullies, and ruts must be graded out of the surface before geotextile placement. Areas on which geotextile are to be placed shall be graded and/or dressed in accordance with Section 02200 – Earthwork and Section 02315 – Granular Drainage Materials. Immediately prior to placing the geotextile, the prepared base will be inspected by the Owner's Representative, and no material shall be placed thereon until that area has been approved.

B. Geotextile cushion fabric will be installed directly on the geosynthetic liner. Jointly inspect the liner with the Owner's Representative before commencing fabric installation each day. Notify the Owner's Representative promptly of any damage or defects observed in the liner as fabric installation progresses. Do not place fabric in the damaged or defective area until the liner has been repaired and

approved by the Owner's Representative. Submit a daily inspection report identifying the area of fabric placement and certifying that there were no visible defects in the area of fabric placement.

C. Do not run heavy vehicle traffic directly on the geosynthetic liner or cushion geotextile. Use vehicles and equipment as specified in paragraph 2.02 to transport and deploy fabric on the liner. Operate the equipment with care, and place protective cover over the geomembrane, if necessary, to avoid damaging the liner. Route traffic and personnel over installed cushion fabric and use the installed fabric as a working platform to the greatest extent possible.

3.03 INSTALLATION

A. General Requirements:

1. Geotextile fabric shall be unrolled and laid out following these requirements to the greatest extent practical:

   a. Orient panels with the longest dimension parallel to the slope.
   b. Minimize the number of seams in corners and odd-shaped areas.
   c. Extend panels on slopes a minimum of 5 ft onto a horizontal surface.

   Geotextile panels shall be unrolled using methods that will not damage the fabric and will protect underlying surface from damage. While unrolling, the geotextile fabric shall be visually inspected for imperfections and faulty or suspect areas marked. Ballast shall be placed on fabric to prevent wind uplift. Expansion and contraction should be allowed for by leaving slack.

   Heavy vehicle traffic shall not be run directly on geotextile fabric. Fabric in areas of heavy traffic shall be protected with protective cover over the fabric.

2. Laps

   Individual panels of geotextile fabric shall be lapped according to manufacturer's instructions and as specified herein. Provide a minimum overlap of 3 in. unless otherwise specified herein or in the plans. Shingle overlaps so that water or other material cannot run down the slope between the two layers of fabric.

3. Field Seams

Continuously sew all laps on slopes steeper than 10H:1V. This requirement does not apply to the heavy geotextile fabric for envelopment of coarse aggregate around leachate piping.

4. Defects and Repairs

Examine the installed geotextile fabric for defects, holes discontinuous seams, puckered or separated laps, etc. Repair defective laps and seams. Patch holes and defects according to manufacturer's recommendations and as directed by the Owner's Representative. Do not cover suspect or patched areas until they have been inspected and approved by the Owner's Representative.

B. Geotextile Fabric for Separation

1. Use low ground pressure equipment to avoid rutting the granular material.
2. Horizontal seams (parallel to top of slope) will be permitted on cell side slopes to facilitate staged construction of the drainage layer on the side slope.
3. Extend separation geotextile fabric into and across the bottom of the anchor trench and complete backfill of the trench according to Section 02200.

C. Geotextile Fabric for Coarse Aggregate Envelope

1. Geotextile for coarse aggregate envelope will be installed directly on the cushion fabric. Remove any foreign materials from the cushion fabric within the footprint of the coarse aggregate leachate piping encasement before installing the geotextile envelope. Place sufficient width to completely envelop the coarse aggregate and provide a longitudinal lap of at least 6 in.
2. After the coarse aggregate encasement has been completed, according to Section 02315, wrap the geotextile around the mounded aggregate, and cover the lap with at least 6 in. of material before permitting vehicle or equipment on the fabric.
3. Any ballast material other than coarse aggregate, according to Section 02315, that is placed within the envelope will require removal during coarse aggregate construction.

D. Geotechnical Fabric for Ground Stabilization

1. Install Geotechnical Fabric for Ground Stabilization in accordance with Section 210 of the IDOT Standard Specifications for Road and Bridge Construction.

2. If approved by the Owner's Representative, the Contractor may, at his own expense, install geotextile or geogrid for ground stabilization outside the limits designated by the Owner's Representative.
3. Submit as-built drawings that clearly delineate limits and type of ground stabilization.

3.04 PROTECTION

A. Protect installed fabric until it is covered by at least 1 ft. of overlying material.

B. Any damage to the geotextile during its installation or during placement of overlying materials shall be replaced by the Contractor at no cost to the Owner. Unless otherwise noted, the work shall be scheduled so that the covering of the geotextile with a layer of the specified material is accomplished within 14 calendar days after placement of the geotextile. Failure to comply shall require replacement of geotextile. The geotextile shall be protected from damage prior to and during the placement of overlying materials. Before placement of overlying materials, the Contractor shall demonstrate that the placement technique will not cause damage to the geotextile.

3.05 TESTING AND INSPECTION

A. Prequalification Testing

Geotextiles are subject to CQA testing by the Owner's Testing Consultant to verify conformance with the manufacturer's list of guaranteed properties according to Appendix 2. The Contractor shall provide samples as specified herein. If tests indicate nonconformance to the list of guaranteed properties, provide additional samples as directed by the Owner's Representative to determine the extent of the non-conformance. Any fabric that does not conform to the list of guaranteed properties shall be removed from the site.

B. Installed fabric shall be inspected by the Owner's Representative. No material shall be placed on the fabric, other than ballast, until the installation has been approved by the Owner's Representative. Ballast shall not obscure seams or significant length of unseamed laps. The Owner's Representative may require removal of ballast to inspect suspect areas.

C. If the Owner's Representative suspects that completed work has been damaged by construction methods that do not conform to the specifications, he may require removal of completed work to verify the integrity of the underlying materials. The Contractor shall bear the cost of removal and subsequent repair as directed by the Owner's Representative.

END OF SECTION 02373

PART 1. GENERAL

1.01 DESCRIPTION

A. This section covers furnishing and installation of a reinforced needlepunched Geosynthetic Clay Liner (GCL) at the Gypsum Management Facility and the CCB Management Facility.

B. The work includes furnishing all equipment and materials, providing all labor, supervision, administration and management necessary to perform the work as specified herein and as shown on the plans.

1.02 RELATED SECTIONS

None.

1.03 REFERENCES

The following references, or cited portions thereof, govern the work

1. American Society for Testing and Materials (ASTM):

   a. ASTM D 4632 (1991; R 2003), Standard Test Method for Grab Breaking Load and Elongation of Geotextiles;
   b. ASTM D 4643 (2000), Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method;
   c. ASTM D 5084 (2003), Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter;
   d. ASTM D 5261 (1992; R 2003), Test Method for Measuring Mass Per Unit Area of Geotextiles;
   e. ASTM D 5321 (2002), Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method;
   f. ASTM D 5887 (2004), Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter;
   g. ASTM D 5888 (1995; R 2002), Practice for Storage and Handling of Geosynthetic Clay Liners;
   h. ASTM D 5889 (1997; R 2003), Practice for Quality Control of Geosynthetic Clay Liners;

i. ASTM D 5890 (2002), Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners;

j. ASTM D 5891 (2002), Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners.

1.04 SUBMITTALS

A. With the bid, the Contractor shall furnish the following information:

1. Conceptual description of the proposed plan for placement of the GCL panels over the areas of installation.
2. GCL Manufacturer's Quality Control (MQC) Plan for documenting compliance with Sections 2.01 and 2.02 of these specifications.
3. GCL manufacturer's historical data for reinforced GCL of a) 10,000-hour creep shear testing per Section 2.01 D, and b) seam flow data at 2 psi confining pressure per Section 2.01 E.
4. A copy of GCL manufacturer's International Standards Organization (ISO) Quality Certificate of Registration.
5. Statement of experience from the proposed GCL supplier.
6. Statement of experience from the proposed GCL installer.

B. At the Owner Representative's or Owner's request, the Contractor shall furnish:

1. A representative sample of the GCLs.
2. A project reference list for the GCL(s) consisting of the principal details of at least ten projects totaling at least 10 million sq. ft (100,000 sq. meters) in size.

C. Upon shipment, the Contractor shall furnish:

1. The GCL manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the project are in accordance with the requirements of this specification.
2. Inventory of materials received.

D. As installation proceeds, the Contractor shall submit certificates of subgrade acceptance, signed by the Contractor and Construction Quality Assurance (CQA) Inspector (see Sections 1.06 and 3.03) for each area that is covered by the GCL.

E. Warranty

After construction, the contractor shall submit material and installation warranty certificates.

1.05 QUALIFICATIONS

A. GCL Manufacturer must have produced at least 10 million sq. ft. (1 million sq. meters) of GCL, with at least 8 million sq. ft. (800,000 sq. meters) installed.

B. The GCL Installer must either have installed at least 1 million sq. ft. (100,000 sq. meters) of GCL, **or** must provide to the Engineer satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the GCL will be installed in a competent, professional manner.

1.06 CONSTRUCTION QUALITY ASSURANCE (CQA)

A. The Owner shall provide a third-party inspector for CQA of the GCL installation. The inspector shall be an individual or company who is independent from the manufacturer and installer and who shall be responsible for monitoring and documenting activities, related to the CQA of the GCL throughout installation.

B. Testing of the GCL as necessary to support the CQA effort shall be performed by a third party laboratory retained by the Owner and independent from the GCL manufacturer and installer.

WARRANTY

The geomembrane material shall be warranted, on a pro-rata basis against manufacturer's defects for a period of five (5) years from the date of liner installation. The installation shall be warranted against defects in workmanship for a period of (1) year from the date of liner completion.

PART 2. PRODUCTS

2.01 MATERIALS

A. Acceptable products for the GCL are GCL Bentomat® SDN, as manufactured by CETCO, 1350 West Shure Drive, Arlington Heights, Illinois 60004 USA (847-392-5800), or an engineer-approved reinforced needlepunched GCL material equal to Bentomat SDN.

B. The delineation of areas to receive GCL shall be agreed by the Installer and the Engineer prior to installation.

C. The GCL and its components shall have the properties shown in the GCL Certified Properties table at the end of this section.

D. The reinforced GCL shall have 10,000 hour test data for large-scale constant-load (creep) shear testing for related products under hydrated conditions. The

displacement shall be 0.13 in. (3.3 mm) or less at a constant shear load of 250 psf (12 kPa) and a normal load of 500 psf (24 kPa).

E. The reinforced GCL shall have seam test data from an independent laboratory showing that the seam flow with a grooved cut in one of the nonwoven geotextiles is less than 1×10^{-8} $m^3/m^2/s$ at 2 psi hydraulic pressure.

F. The minimum acceptable dimensions of full-size GCL panels shall be 150 ft. (45.7 m) in length. Short rolls [(those manufactured to a length greater than 70 ft. (21 meters) but less than a full-length roll)] may be supplied at a rate no greater than three (3) per truckload or three (3) rolls every 36,000 sq. ft. (3,500 sq. meters) of GCL, whichever is less.

G. A 6-inch (150 mm) overlap guideline shall be imprinted on both edges of the upper geotextile component of the GCL as a means for providing quality assurance of the overlap dimension. Lines shall be printed in easily visible, non-toxic ink.

2.02 PRODUCT QUALITY DOCUMENTATION

The GCL manufacturer shall provide the Contractor or other designated party with manufacturing QA/QC certifications for each shipment of GCL. The certifications shall be signed by a responsible party employed by the GCL manufacturer and shall include:

A. Certificates of analysis for the bentonite clay used in GCL production demonstrating compliance with the swell index and fluid loss parameters shown in the GCL Certified Properties tables.

B. Manufacturer's test data for finished GCL product(s) of bentonite mass/area, GCL tensile strength and GCL peel strength (reinforced only) demonstrating compliance with the index parameters shown in the GCL Certified Properties tables.

C. GCL lot and roll numbers supplied for the project (with corresponding shipping information).

2.03 PRODUCT LABELING

A. Prior to shipment, the GCL manufacturer shall label each roll, identifying:

1. Product identification information (Manufacturer's name and address, brand product code).
2. Lot number and roll number.
3. Roll length, width and weight.

2.04 PACKAGING

A. The GCL shall be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

B. All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet (UV) light.

2.05 ACCESSORY BENTONITE

A. The granular bentonite sealing clay used for overlap seaming, penetration sealing and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL manufacturer. Seaming of GCLs shall be conducted in accordance with the manufacturer's guidelines for each particular GCL. Please refer to the installation guidelines for Bentomat /Claymax GCLs.

PART 3. EXECUTION

3.01 SHIPPING AND HANDLING

A. The rolls of GCL shall be packaged and shipped by appropriate means to prevent damage to the material and to facilitate off-loading.

B. The Installation Supervisor shall be present during delivery and unloading of the GCL. A visual inspection of each roll should be made during unloading to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage. The Installation Supervisor shall prepare and submit an inventory that includes lot and roll number for materials received.

C. The Installer is responsible for unloading the GCL. The Owner will make available equipment and operators employed at the site to assist with unloading. The Installer shall coordinate with the Owner to determine equipment availability and should contact the Manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

3.02 STORAGE

A. Storage of the GCL rolls shall be the responsibility of the Installer. A dedicated storage area shall be provided by the Owner at the job site. Submit storage area requirements (size and preferred location) with bid documents.

B. Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four).

C. All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.

D. The integrity and legibility of the labels shall be preserved during storage.

3.03 EARTHWORK

A. The low permeability soil layer upon which the GCL is installed shall be prepared and compacted prior to installation. The surface shall be smooth, firm, and unyielding, and free of:

1. Vegetation.
2. Construction debris.
3. Sticks.
4. Sharp rocks.
5. Void spaces.
6. Ice.
7. Abrupt elevation changes.
8. Standing water.
9. Cracks larger than 0.25 in. (6 mm) in width.
10. Any other foreign matter that could contact the GCL.

B. Immediately prior to GCL deployment, the low permeability soil layer shall be final-graded by the contractor to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. At completion of this activity, no wheel ruts, footprints or other irregularities shall exist in the subgrade. Furthermore, all protrusions extending more than 0.5 in. (12 mm) from the surface shall either be removed, crushed or pushed into the surface with a smooth-drum compactor.

C. On a continuing basis, the project CQA inspector shall certify acceptance of the subgrade before GCL placement.

D. It shall be the Installer's responsibility thereafter to indicate to the Owner's Representative any change in the condition of the low permeability soil layer that could cause the subgrade to be out of compliance with any of the requirements listed in this Section. The Installation Supervisor shall certify in the daily report that no GCL was placed over visibly defective low permeability soil surface.

E. At the top of sloped areas of the job site, an anchor trench for the GCL shall be excavated by the contractor in accordance with the project plans. The trench shall

be excavated and approved by the CQA Inspector prior to GCL placement. No loose soil shall be allowed at the bottom of the trench and no sharp corners or protrusions shall exist anywhere within the trench.

3.04 GCL PLACEMENT

A. GCL rolls shall be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging shall be carefully removed without damaging the GCL. The orientation of the GCL (i.e., which side faces up) shall be in accordance with the Owner Representative's recommendations.

B. Equipment which could damage the GCL, shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

C. Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. A temporary geosynthetic subgrade covering commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.

D. The GCL panels shall be placed parallel to the direction of the slope.

E. All GCL panels shall lie flat on the underlying surface, with no wrinkles or folds, especially at the exposed edges of the panels.

F. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, the Installer shall remove and replace the hydrated material as directed by the Owner Representative.

3.05 ANCHORAGE

A. As directed by the project drawings and specifications, the end of the GCL roll shall be placed in an anchor trench at the top of the slope. The front edge of the trench shall be rounded so as to eliminate any sharp corners. Loose soil shall be removed from the floor of the trench. The GCL shall cover the entire trench floor, but shall not extend up the rear trench wall.

3.06 SEAMING

A. The GCL seams shall be constructed by overlapping their adjacent edges according to the manufacturer's recommendations. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris.

B. The minimum dimension of the longitudinal overlap should be 6 in. (150 mm) for Bentomat SDN. If the GCL is manufactured with a grooved cut in the nonwoven geotextile that allows bentonite to freely extrude into the longitudinal overlap then no bentonite-enhanced seam is required for this overlap. If the GCL does not have a grooved cut in one of the nonwoven geotextiles in the longitudinal overlap, then bentonite-enhanced seams are required as described below.

C. End-of-roll overlapped seams shall be constructed with a minimum overlap of 24 in. (600 mm) for Bentomat SDN. Seams at the ends of the panels should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone. End-of-roll overlapped seams for all reinforced GCL seams require bentonite-enhanced seams as described below.

D. Bentonite-enhanced seams shall be constructed between the overlapping adjacent panels as follows. The underlying edge of the longitudinal overlap is exposed and then a continuous bead of granular sodium bentonite is applied along a zone defined by the edge of the underlying panel and the 6-inch (150 mm) line. The granular bentonite shall be applied at a minimum application rate of one quarter pound per lineal ft. (0.4 kg/m). A similar bead of granular sodium bentonite is applied at the end-of-roll overlap.

3.07 DETAIL WORK

A. There shall be no penetrations through the GCL.

B. Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes are recommended to avoid damage to the geotextile components of the GCL during the cutting process.

3.08 DAMAGE REPAIR

A. If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible, if approved by the Owner's Representative, to repair it by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of 12 in. (300 mm) is achieved around all of the damaged area. Granular bentonite or bentonite mastic shall be applied around the damaged area prior to placement of the patch. It may be desirable to use an adhesive to affix the patch in place so that it is not displaced during cover placement. Patching shall be observed and approved by the Owner's Representative.

GCL CERTIFIED PROPERTIES

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY $ft^2(m^2)$	REQUIRED VALUES
Bentonite Swell Index[1]	ASTM D 5890	1 per 50 tonnes	24 mL/2g min.
Bentonite Fluid Loss[1]	ASTM D 5891	1 per 50 tonnes	18 mL max.
Bentonite Mass/Area[2]	ASTM D 5993	40,000 ft^2 (4,000 m^2)	0.75 lb/ft^2 (3.6 kg/m^2) min
GCL Grab Strength[3]	ASTM D 6768	200,000 ft^2 (20,000 m^2)	30 lbs/in (53 N/cm) MARV
GCL Peel Strength[3]	ASTM D 6496	40,000 ft^2 (4,000 m^2)	2.5 lbs/in (4.4 N/cm) min
GCL Index Flux[4]	ASTM D 5887	Weekly	1×10^{-8} $m^3/m^2/sec$ max
GCL Hydraulic Conductivity[4]	ASTM D 5887	Weekly	5×10^{-9} cm/sec max
GCL Hydrated Internal Shear Strength[5]	ASTM D 5321 ASTM D 6243	Periodic	500 psf (24 kPa) typ @ 200 psf

Notes

[1] Bentonite property tests performed at a bentonite processing facility before shipment the manufacturer's production facilities.

[2] Bentonite mass/area reported at 0 percent moisture content.

[3] All tensile strength testing is performed in the machine direction using ASTM D 6768. All peel strength testing is performed using ASTM D 6496. Upon request, tensile and peel results can be reported per modified ASTM D 4632 using 4 inch grips.

[4] Index flux and permeability testing with deaired distilled/deionized water at 80 psi (551kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 925 gal/acre/day. This flux value is equivalent to a permeability of 5×10^{-9} cm/sec for typical GCL thickness. Actual flux values vary with field condition pressures. The last 20 weekly values prior the end of the production date of the supplied GCL may be provided.

[5] Peak values measured at 200 psf (10 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

END OF SECTION 02376

PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to construction of the HDPE (High Density Polyethylene) Piping at the Gypsum Management Facility and the CCB Management Facility.

1.02 RELATED SECTIONS

None.

1.03 REFERENCES

The following references, or cited portions thereof, govern the work

A. American Society of Testing and Materials:

1. ASTM D 2683 (2004); Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
2. ASTM D 3261 (2003); Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
3. ASTM D 3350 (2005); Specification for Polyethylene Plastics Pipe and Fittings Materials.
4. ASTM F 412 (2001a); Terminology Relating to Plastic Piping System.
5. ASTM F 1055 (1998); Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
6. ASTM F 1056 (2004); Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings.

1.04 SUBMITTALS

A. Qualifications

Submit qualifications of the Welding Supervisor who will be responsible for construction quality control of the pipe joining process.

B. Material Certifications

Submit manufacturer certifications that the pipe provided complies with the requirements herein.

C. Product Data

1. Submit product data and operating instructions for pipe joining equipment.
2. Submit pipe manufacturer's recommended procedures for storing, handling, and installing pipe and fittings.

1.05 QUALIFICATIONS

A. The Contractor or Subcontractor performing the work under this section shall have in his employ a Welding Supervisor who has completed a minimum of 1,000 ft of pipe joining work using the type of equipment proposed for use in this work. The Welding Supervisor shall be on site at all times during pipe line installation, and shall provide direct supervision over other employees.

1.06 WARRANTY

A. The pipe and fittings shall be warranted, on a pro-rata basis, against manufacturer's defects for a period of five (5) years from the date of pipe installation. The installation shall be warranted against defects in workmanship for a period of one (1) year from the date of completion of the leachate collection piping system.

PART 2. PRODUCTS

2.01 MATERIALS

A. Pipe

1. Pipe material shall be High Density Polyethylene (HDPE) PE 3408, according to ASTM F412, with a cell class designation of 345464C, according to ASTM D3350. Iron pipe size (IPS) and standard dimension ratio (SDR) shall be as indicated in the plans.
2. Size and spacing of holes in perforated pipe shall be as indicated in the plans.

B. Fittings

1. Fittings shall be made of the same material, and shall have a pressure rating no less than 160 psi. Butt fusion, socket, or electrofusion fittings, according to ASTM D3261, ASTM D2683, and ASTM F1055, respectively, are acceptable.

2.02 EQUIPMENT

A. Butt Fusion Machine

The butt fusion machine shall include the following features:

1. Facer with rotating planer block design.
2. Heater faces coated by the manufacturer to prevent molten plastic from adhering to the heater face.
3. Hydraulic-operated jaws suitable for use with the pipe sizes indicated in the plans.

B. Socket Fusion Equipment

Socket fusion heating tools and depth gauges shall be of the same manufacturer, unless they are all marked F1056, indicating compliance with ASTM F1056.

C. All equipment shall conform to any requirements specified in the pipe and socket manufacturer's installation instructions, and shall be approved by the Owner's Representative.

PART 3. EXECUTION

3.01 MATERIAL DELIVERY, STORAGE, AND HANDLING

A. HDPE pipe and fittings shall be packaged and shipped by appropriate means to prevent damage to the material and to facilitate off-loading. The Owner will provide an on-site storage site. Storage site requirements (size and preferred location) shall be submitted with the bid documents.

B. Storage and handling shall be according to manufacturer's recommendations.

3.02 BASE PREPARATION

All HDPE piping shall be installed on a layer of coarse aggregate placed by the Contractor in accordance with the plans. The grade of the coarse aggregate base shall be verified before installing the piping.

3.03 INSTALLATION

All pipe and fittings shall be installed according to the manufacturer's recommendations. Removal of weld beads is not required. Contractor shall place coarse aggregate along the pipe to provide lateral stability. Welds shall not be obscured until they have been approved by the Owner's Representative, the top of pipe shall not be covered until the Construction Quality Assurance (CQA) survey has been completed to verify conformance with specified tolerances.

3.04 INSPECTIONS

A. The Owner's Representative shall shall be visually inspect pipe materials to verify that each pipe material is properly stamped (by the manufacturer) for ASTM acceptance before installation. Defective or damaged materials shall be removed from the site.

B. Each weld and connection shall be visually inspected by the Owner's Representative. Defective welds shall be repaired as directed by the Owner's Representative and according to manufacturer's recommendations. Welds and connections shall not be covered until they have been approved by the Owner's Representative.

3.05 TOLERANCES

A. HDPE piping shall be located within 0.5 ft. of plan location, and elevation shall be within 0.1 ft. of plan elevation with no adverse slopes.

END OF SECTION 02936

PART 1. GENERAL

1.01 DESCRIPTION

A. This section includes manufacturing, furnishing, and installing High Density Polyethylene (HDPE) Geomembranes for the Gypsum Management Facility and the Gypsum Management Facility Recycle Pond.

B. The work includes furnishing all equipment and materials and providing all labor, supervision, administration and management necessary to perform the work as shown on the plans.

1.02 RELATED SECTIONS

A. The following sections contain items which are related to the work in this section:

1. 02373 – Geotextiles
2. 02376 – Geosynthetic Clay Liner

1.03 REFERENCES

A. The following references, or cited portions thereof, govern the work:

1. American Society for Testing and Materials (ASTM):

a. D 638, Standard Test Method for Tensile Properties of Plastics.
b. D 751, Standard Test Methods for Coated Fabrics.
c. D 792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
d. D 1004, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
e. D 1204, Standard Test Method for Linear Dimensional Changes of Non Rigid Thermoplastic Sheeting or Film at Elevated Temperature.
f. D 1238, Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
g. D 1505, Standard Test Method for Density of Plastics by Density-Gradient Technique.
h. D 1603, Standard Test Method for Carbon Black in Olefin Plastics.
i. D 3895, Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.
j. D 4218, Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.

k. D 4437, Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
l. D 4833, Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.
m. D 5199, Standard Test Method for Measuring Nominal Thickness of Smooth Geomembranes.
n. D 5397, Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefins using Notched Constant Tensile Load Test.
o. D 5596, Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds.
p. D 5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
q. D 5721, Practice for Air-Oven Aging of Polyolefin Geomembranes.
r. D 5820, Test Method for Air Testing.
s. D 5885, Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.
t. D 5994, Standard Test Method for Measuring Nominal Thickness of Textured Geomembranes
u. D 6365, Standard Practice for the Nondestructive Testing of Geomembrane Seams using The Spark Test

2. Geosynthetic Research Institute (GRI):

a. GRI GM 6, Pressurized Air Channel Test for Dual Seamed Geomembranes
b. GRI GM 9, Cold Weather Seaming of Geomembranes
c. GRI GM 10, Specification for Stress Crack Resistance of HDPE Geomembrane Sheet
d. GRI GM 13, Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
e. GRI GM 14, Test Frequencies for Destructive SeamTesting

1.04 SUBMITTALS

A. Submit the following to the Engineer or Owner, for review and approval, within a reasonable time so as to expedite shipment or installation of the Geomembrane:

1. Documentation of manufacturer's qualifications as specified in subsection 1.05A of this Section.
2. Manufacturer's Quality Control program manual or descriptive documentation.
3. A material properties sheet, including at a minimum all properties specified in GRI GM 13, including test methods used.
4. Sample of the material.

5. Documentation of Installer's qualifications, as specified below and in subsection 1.05B of this Section.
   a. Submit a list of at least ten completed facilities. For each name and type of facility; its location; the date of installation; number of contact at the facility; type and thickness of geomembrane and; surface area of the installed geomembrane.
   b. Submit resumes or qualifications of the Installation Supervisor, Master Seamer and Technicians to be assigned to this project.
   c. Quality Control Program.
6. Example Material Warranty and Liner Installation Warranty complying with subsections 1.07 and 1.08 of this Section.
7. Resin Supplier's name, resin production plant identification, resin brand name and number, production date of the resin, resin Manufacturer's quality control certificates, and certification that the properties of the resin meet the requirements

B. Shop Drawings

1. Submit copies of shop drawings for engineer's approval within a reasonable time so as not to delay the start of geomembrane installation. Shop drawings shall show the proposed panel layout identifying seams and details. Seams should generally follow direction of the slope. Butt seams or roll-end seams should not occur on a slope unless approved by the Owner's Representative. Butt seams on a slope, if allowed, should be staggered.
2. Placement of geomembrane will not be allowed to proceed until Owner's Representative has received and approved the shop drawings.

C. Additional Submittals (In-Progress and at Completion)

1. Manufacturer's warranty (refer to subsection 1.08).
2. Geomembrane installation warranty (refer to subsection 1.09).
3. Daily written acceptance of subgrade surface (refer to subsection 3.01.C).
4. Low-temperature seaming procedures if applicable (refer to subsection 3.03.A)
5. Prequalification test seam samples (refer to subsection 3.05.A.6).
6. Field seam non-destructive test results (refer to subsection 3.05.B.1).
7. Field seam destructive test results (refer to subsection 3.05.C.6).
8. Daily field installation reports (refer to subsection 3.05.G).
9. Installation record drawing, as discussed in subsection 3.05.G).

1.05 QUALITY CONTOL

A. Manufacturer's Qualifications:

The manufacturer of geomembrane of the type specified or similar product shall have at least five years experience in the manufacture of such geomembrane. In addition, the geomembrane manufacturer shall have manufactured at least

10,000,000 sq. ft. of the specified type of geomembrane or similar product during the last five years.

B. Installer's Qualifications:

1 The Geomembrane Installer shall be the Manufacturer, approved Manufacturer's Installer or a contractor approved by the Owner's Representative to install the geomembrane.

2 The Geomembrane Installer shall have at least three years experience in the installation of the specified geomembrane or similar. The Geomembrane Installer shall have installed at least 10 projects involving a total of 5,000,000 sq. ft. of the specified type of geomembrane or similar during the last three years.

3 Installation shall be performed under the direction of a field Installation Supervisor who shall be responsible throughout the geomembrane installation, for geomembrane panel layout, seaming, patching, testing, repairs, and all other activities of the Geomembrane Installer. The Field Installation Supervisor shall have installed or supervised the installation and seaming of a minimum of 10 projects involving a total of 5,000,000 sq. ft. of geomembrane of the type specified or similar product.

4 Seaming shall be performed under the direction of a Master Seamer (who may also be the Field Installation Supervisor or Crew Foreman) who has seamed a minimum of 3,000,000 sq. ft. of geomembrane of the type specified or similar product, using the same type of seaming apparatus to be used in the current project. The Field Installation Supervisor and/or Master Seamer shall be present whenever seaming, patching, other welding operations, and testing is performed.

5 All seaming, patching, other welding operations, and testing shall be performed by qualified technicians employed by the Geomembrane Installer.

1.06 DELIVERY, STORAGE AND HANDLING

A. Each roll of geomembrane delivered to the site shall be labeled by the manufacturer. The label shall be firmly affixed and shall clearly state the manufacturer's name, product identification, material thickness, roll number, roll dimensions and roll weight.

B. Geomembrane shall be protected from mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

C. Rolls shall be stored away from high traffic areas. Continuously and uniformly support rolls on a smooth, level prepared surface.

D. Rolls shall not be stacked more than three high.

1.07 PROJECT CONDITIONS

Geomembrane shall not be installed in the presence of standing water, while precipitation is occurring, during excessive winds, or when material temperatures are outside the limits specified in Section 3.03.

1.08 MATERIAL WARRANTY

As required by specification, or as required in GRI GM 13 (attachment A)

1.09 GEOMEMBRANE INSTALLATION WARRANTY

The Geomembrane Installer shall guarantee the geomembrane installation against defects in the installation and workmanship for 1 year commencing with the date of final acceptance.

1.10 GEOMEMBRANE PRE-CONSTRUCTION MEETING

A. Geomembrane Pre-Construction Meeting shall be held at the site prior to installation of the geomembrane. At a minimum, the meeting shall be attended by the Geomembrane Installer, Owner, Owner's representative (Engineer and/or CQA Firm), and the General Contractor.

B. Topics for this meeting shall include:
   1. Responsibilities of each party.
   2. Lines of authority and communication. Resolution of any project document ambiguity.
   3. Methods for documenting, reporting and distributing documents and reports.
   4. Procedures for packaging and storing archive samples.
   5. Review of time schedule for all installation and testing.
   6. Review of panel layout and numbering systems for panels and seams including details for marking on geomembrane.
   7. Procedures and responsibilities for preparation and submission of as-built panel and seam drawings.
   8. Temperature and weather limitations. Installation procedures for adverse weather conditions. Defining acceptable subgrade, geomembrane, or ambient moisture and temperature conditions for working during liner installation.
   9. Subgrade conditions, dewatering responsibilities and subgrade maintenance plan.
   10. Deployment techniques including allowable subgrade for the geomembrane.
   11. Plan for controlling expansion/contraction and wrinkling of the geomembrane.
   12. Covering of the geomembrane and cover soil placement.
   13. Measurement and payment schedules.
   14. Health and safety.

C. The meeting shall be documented by the Owner's Representative and minutes shall be transmitted to all parties.

PART 2. PRODUCTS

2.01 SOURCE QUALITY CONTROL

Manufacturing Quality Control

A. The test methods and frequencies used by the manufacturer for quality control/quality assurance of the above geomembrane prior to delivery, shall be in accordance with GRI GM 13, or modified as required for project specific conditions.

B. The manufacturer's geomembrane quality control certifications, including results of quality control testing of the products, as specified in subsection 2.01.C of this Section, must be supplied to the Owner's Representative. The certification shall be signed by a responsible party employed by the manufacturer, such as the QA/QC Manager, Production Manager, or Technical Services Manager. Certifications shall include lot and roll numbers and corresponding shipping information.

C. The Manufacturer will provide Certification that the geomembrane and welding rod supplied for the project have the same base resin and material properties.

2.02 GEOMEMBRANE

A. The geomembrane shall consist of new, first quality products designed and manufactured specifically for the purpose of this work which shall have been satisfactorily demonstrated by prior testing to be suitable and durable for such purposes. The geomembrane rolls shall be seamless, high density polyethylene (HDPE- Density >0.94g/cm) containing no plasticizers, fillers or extenders and shall be free of holes, blisters or contaminants, and leak free verified by 100% in line spark or equivalent testing. The geomembrane shall be supplied as a continuous sheet with no factory seams in rolls. The geomembrane will meet the property requirements as shown in Table A. (GRI GM 13)

B. Material shall be reviewed for conformance to the project specifications by the Owner's Representative

C. The geomembrane seams shall meet the property requirements as shown in Table 2, (Attachment B).

PART 3. EXECUTION

3.01 SUBGRADE PREPARATION

A. Geomembrane installed over geosynthetic clay liner (GCL).

The area of GCL to be covered with geomembrane shall be jointly inspected daily with the Owner's Representative before commencing geomembrane installation for the day, and the condition of the GCL shall be continuously observed as geomembrane installation progresses. Rocks, stones, sticks, sharp objects and debris of any kind shall be removed from the surface of the GCL. The Owner's Representative shall be notified of any discontinuities, premature hydration, or

otherwise defective GCL. Geomembrane shall not be placed over suspect areas until they have been repaired to the satisfaction of the Owner's Representative. The Installation Supervisor shall certify daily in writing that the GCL surface was acceptable at the time of geomembrane installation.

B. Geomembrane installed over cushion dirt.

The area of cushion dirt to be covered with geomembrane shall be prepared in accordance with the Section 02200 – Earthwork. The surface shall be smooth and free of ruts and holes, rocks, stones, sticks, sharp objects and debris of any kind.

C. The Geomembrane installer shall provide daily written acceptance for the surface to be covered by the geomembrane in that day's operations. The surface shall be maintained in a manner, during geomembrane installation, to ensure subgrade suitability.

D. All subgrade damaged by construction equipment and deemed unsuitable by the Owner's Representative for geomembrane deployment shall be repaired prior to placement of the geomembrane. All repairs shall be reviewed by the Owner's Representative and approved by the Geomembrane Installer. This damage, repair, and the responsibilities of the contractor and Geomembrane Installer shall be defined in the preconstruction meeting.

3.02 GEOMEMBRANE PLACEMENT

A. No geomembrane shall be deployed until the applicable certifications and quality control certificates listed in subsection 1.04 of this Section are submitted to and approved by the Owner's Representative. Should geomembrane material be deployed prior to approval by the Owner's Representative it will be at the sole risk of the Geomembrane Installer and/or Contractor. If the material does not meet project specifications it shall be removed from the work area at no cost to the owner.

B. The geomembrane shall be installed to the limits shown on the project drawings and essentially as shown on approved panel layout drawings.

C. No geomembrane material shall be unrolled and deployed if the material temperatures are lower than 0 degrees C (32 degrees F). Temperature limitations should be defined in the preconstruction meeting. Typically, only the quantity of geomembrane that will be anchored and seamed together in one day should be deployed.

D. No vehicular traffic shall travel on the geomembrane other than an approved low ground pressure All Terrain Vehicle or equivalent.

E. Sand bags or equivalent ballast shall be used as necessary to temporarily hold the geomembrane material in position under the foreseeable and reasonably - expected wind conditions. Sand bag material shall be sufficiently close- knit to prevent soil fines from working through the bags and discharging on the geomembrane.

F. Geomembrane placement shall not be done if moisture prevents proper subgrade preparation, panel placement, or panel seaming. Moisture limitations

should be defined in the preconstruction meeting.

G. Damaged panels or portions of the damaged panels which have been rejected shall be marked and their removal from the work area recorded.

H. The geomembrane shall not be allowed to "bridge over" voids or low areas in the subgrade. In these areas, the subgrade shall be prepared to allow the geomembrane to rest in intimate contact with the subgrade.

I. Wrinkles caused by panel placement or thermal expansion should be minimized in accordance with section 1.10 B. 11.

J. Considerations on Site Geometry: In general, seams shall be oriented parallel to the line of the maximum slope. In corners and odd shaped geometric locations, the total length of field seams shall be minimized. Seams shall not be located at low points in the subgrade.

K. Overlapping: The panels shall be overlapped prior to seaming to whatever extent is necessary to effect a good weld and allow for proper testing. In no case shall this overlap be less than 75mm (3 in.).

3.03 SEAMING PROCEDURES

A. Cold weather installations should follow guidelines as outlined in GRI GM9.

B. No geomembrane material shall be seamed when liner temperatures are less than 0 degrees C (32 degrees F).

C. No geomembrane material shall be seamed when the sheet temperature is above 75 degrees C (170 degrees F) as measured by an infrared thermometer or surface thermocouple.

D. Seaming shall primarily be performed using automatic fusion welding equipment and techniques. Extrusion welding shall be used where fusion welding is not possible such as at pipe penetrations, patches, repairs and short (less than a roll width) runs of seams.

E. Fishmouths or excessive wrinkles at the seam overlaps, shall be minimized and when necessary cut along the ridge of the wrinkles back into the panel so as to effect a flat overlap. The cut shall be terminated with a keyhole cut (nominal 10 mm (1/2 in) diameter hole) so as to minimize crack/tear propagation. The overlay shall subsequently be seamed. The key hole cut shall be patched with an oval or round patch of the same base geomembrane material extending a minimum of 150 mm (6 in.) beyond the cut in all directions.

3.04 PIPE AND STRUCTURE PENETRATION SEALING SYSTEM

A. Provide penetration sealing system as shown in the Project Drawings.

B. Penetrations shall be constructed from the base geomembrane material, flat stock, prefabricated boots and accessories as shown on the Project Drawings. The pre-fabricated or field fabricated assembly shall be field welded to the geomembrane as shown on the Project Drawings so as to prevent leakage. This assembly shall be tested as outlined in section 3.05.B. Alternatively, where field non destructive testing can not be performed, attachments will be field spark tested by standard holiday leak detectors in accordance with ASTM 6365 Spark testing should be done in areas where both air pressure testing and vacuum testing are not possible.

1. Equipment for Spark testing shall be comprised of but not limited to: A

hand held holiday spark tester and conductive wand that generates a high voltage.

2. The testing activities shall be performed by the Geomembrane Installer by placing an electrically conductive tape or wire beneath the seam prior to welding. A trial seam containing a non welded segment shall be subject to a calibration test to ensure that such a defect (non welded segment) will be identified under the planned machine settings and procedures. Upon completion of the weld, enable the spark tester and hold approximately 25mm (1 in) above the weld moving slowly over the entire length of the weld in accordance with ASTM 6365. If there is no spark the weld is considered to be leak free.
3. A spark indicates a hole in the seam. The faulty area shall be located, repaired and retested by the Geomembrane Installer.
4. Care should be taken if flammable gases are present in the area to be tested.

3.05 FIELD QUALITY CONTROL

The Owner's Representative shall be notified prior to all pre qualification and production welding and testing, or as agreed upon in the pre construction meeting.

A. Prequalification Test Seams

1. Test seams shall be prepared and tested by the Geomembrane Installer to verify that seaming parameters (speed, temperature and pressure of welding equipment) are adequate.
2. Test seams shall be made by each welding technician and tested in accordance with ASTM D 4437 at the beginning of each seaming period. Test seaming shall be performed under the same conditions and with the same equipment and operator combination as production seaming. The test seam shall be approximately 3.3 meters (10 feet) long for fusion welding and 1 meter (3 feet) long for extrusion welding with the seam centered lengthwise. At a minimum, tests seams should be made by each technician 1 time every 4–6 hours; additional tests may be required with changes in environmental conditions.
3. Two 25 mm (1 in) wide specimens shall be die-cut by the Geomembrane Installer from each end of the test seam. These specimens shall be tested by the Geomembrane Installer using a field tensiometer testing both tracks for peel strength and also for shear strength. Each specimen shall fail in the parent material and not in the weld, "Film Tear Bond"(F.T.D. failure). Seam separation equal to or greater than 10% of the track width shall be considered a failing test.
4. The minimum acceptable seam strength values to be obtained for all specimens tested are listed in Subsection 3.05.C.4 of this Section. All four specimens shall pass for the test seam to be a passing seam.
5. If a test seam fails, an additional test seam shall be immediately conducted. If the additional test seam fails, the seaming apparatus shall be rejected and not used for production seaming until the deficiencies are

corrected and a successful test seam can be produced.

6. A sample from each test seam shall be labeled. The label shall indicate the date, geomembrane temperature, number of the seaming unit, technician performing the test seam and pass or fail description. The sample shall then be given to the Owner's Representative for archiving.

B. Field Seam Non-destructive Testing

1. All field seams shall be non-destructively tested by the Geomembrane Installer over the full seam length before the seams are covered. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of tester and outcome of all non-destructive testing shall be recorded and submitted to the Owner's Representative.
2. Testing should be done as the seaming work progresses, not at the completion of all field seaming. All defects found during testing shall be numbered and marked immediately after detection. All defects found should be repaired, retested and remarked to indicate acceptable completion of the repair.
3. Non-destructive testing shall be performed using vacuum box, air pressure or spark testing equipment.
4. Non-destructive tests shall be performed by experienced technicians familiar with the specified test methods. The Geomembrane Installer shall demonstrate to the Owner's Representative all test methods to verify the test procedures are valid.
5. Extrusion seams shall be vacuum box tested by the Geomembrane Installer in accordance with ASTM D 4437 and ASTM D 5641 with the following equipment and procedures:
   a. Equipment for testing extrusion seams shall be comprised of but not limited to: a vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the base, port hole or valve assembly and a vacuum gauge; a vacuum pump assembly equipped with a pressure controller and pipe connections; a rubber pressure/vacuum hose with fittings and connections; a plastic bucket; wide paint brush or mop; and a soapy solution.
   b. The vacuum pump shall be charged and the tank pressure adjusted to approximately 35 kPa (5 psig).
   c. The Geomembrane Installer shall create a leak tight seal between the gasket and geomembrane interface by wetting a strip of geomembrane approximately 0.3m (12 in) by 1.2m (48 in) (length and width of box) with a soapy solution, placing the box over the wetted area, and then compressing the box against the geomembrane. The Geomembrane Installer shall then close the bleed valve, open the vacuum valve, maintain initial pressure of approximately 35 kPa (5 psig) for approximately 5 seconds. The geomembrane should be continuously examined through the viewing window for the presence of soap bubbles, indicating a leak. If no bubbles appear after 5 seconds, the area shall be

considered leak free. The box shall be depressurized and moved over the next adjoining area with an appropriate overlap and the process repeated.

d. All areas where soap bubbles appear shall be marked, repaired and then retested.

e. At locations where seams cannot be non destructively tested, such as pipe penetrations, alternate nondestructive spark testing (as outlined in section 3.04.B) or equivalent should be substituted.

f. All seams that are vacuum tested shall be marked with the date tested, the name of the technician performing the test and the results of the test.

6. Double Fusion seams with an enclosed channel shall be air pressure tested by the Geomembrane Installer in accordance with ASTM D 5820 and ASTM D 4437 and the following equipment and procedures:

a. Equipment for testing double fusion seams shall be comprised of but not limited to: an air pump equipped with a pressure gauge capable of generating and sustaining a pressure of 210 kPa (30 psig), mounted on a cushion to protect the geomembrane; and a manometer equipped with a sharp hollow needle or other approved pressure feed device.

b. The Testing activities shall be performed by the Geomembrane Installer. Both ends of the seam to be tested shall be sealed and a needle or other approved pressure feed device inserted into the tunnel created by the double wedge fusion weld. The air pump shall be adjusted to a pressure of 210 kPa (30 psig), and the valve closed,. Allow 2 minutes for the injected air to come to equilibrium in the channel, and sustain pressure for 5 minutes. If pressure loss does not exceed 28 kPa (4 psig) after this five minute period the seam shall be considered leak tight. Release pressure from the opposite end verifying pressure drop on needle to ensure testing of the entire seam. The needle or other approved pressure feed device shall be removed and the feed hole sealed.

c. If loss of pressure exceeds 28 kPa (4 psig) during the testing period or pressure does not stabilize, the faulty area shall be located, repaired and retested by the Geomembrane Installer.

d. Results of the pressure testing shall be recorded on the liner at the seam tested and on a pressure testing record.

C. Destructive Field Seam Testing

1. One destructive test sample per 150 linear m (500 linear ft) seam length or another predetermined length in accordance with GRI GM 14 shall be taken by the Geomembrane Installer from a location specified by the Owner's Representative. The Geomembrane Installer shall not be informed in advance of the sample location. In order to obtain test results prior to completion of geomembrane installation, samples shall be cut by the Geomembrane Installer as directed by the Owner's Representative as seaming progresses.

2. All field samples shall be marked with their sample number and seam number. The sample number, date, time, location, and seam number shall be recorded. The Geomembrane Installer shall repair all holes in the geomembrane resulting from obtaining the seam samples. All patches shall be vacuum box tested or spark tested. If a patch cannot be permanently installed over the test location the same day of sample collection, a temporary patch shall be tack welded or hot air welded over the opening until a permanent patch can be affixed.
3. The destructive sample size shall be 300 mm (12 in) wide by 1 m (36 in) long with the seam centered lengthwise. The sample shall be cut into three equal sections and distributed as follows: one section given to the Owner's Representative as an archive sample; one section given to the Owner's Representative for laboratory testing as specified in paragraph 5 below; and one section retained by the Geomembrane Installer for field testing as specified in paragraph 4 below.
4. For field testing, the Geomembrane Installer shall cut 10 identical 25 mm (1 in) wide replicate specimens from his sample. The Geomembrane Installer shall test five specimens for seam shear strength and five for peel strength. Peel tests will be performed on both inside and outside weld tracks. To be acceptable, 4 of 5 test specimens must pass the stated criteria in section 2.02 with less than 10% separation. If 4 of 5 specimens pass, the sample qualifies for testing by the testing laboratory if required.
5. If independent seam testing is required by the specifications it shall be conducted in accordance with ASTM 5820 or ASTM D4437 or GRI GM 6.
6. Reports of the results of examinations and testing shall be prepared and submitted to the Owner's Representative.
7. For field seams, if a laboratory test fails, that shall be considered as an indicator of the possible inadequacy of the entire seamed length corresponding to the test sample. Additional destructive test portions shall then be taken by the Geomembrane Installer at locations indicated by the Engineer, typically 3 m (10 ft) on either side of the failed sample and laboratory seem tests shall be performed. Passing tests shall be an indicator of adequate seams. Failing tests shall be an indicator of non-adequate seams and all seams represented by the destructive test location shall be repaired with a cap-strip extrusion welded to all sides of the capped area. All cap-strip seams shall be non-destructively vacuum box tested until adequacy of the seams is achieved. Cap strip seams exceeding 50 M in length (150 FT) shall be destructively tested.

D. Identification of Defects

1. Panels and seams shall be inspected by the Installer and Owner's Representative during and after panel deployment to identify all defects, including holes, blisters, undispersed raw materials and signs of contamination by foreign matter.

E. Evaluation of Defects: Each suspect location on the liner (both in geomembrane

seam and non-seam areas) shall be non-destructively tested using one of the methods described in Section 3.05.B. Each location which fails non-destructive testing shall be marked, numbered, measured and posted on the daily "installation" drawings and subsequently repaired.

1. If a destructive sample fails the field or laboratory test, the Geomembrane Installer shall repair the seam between the two nearest passed locations on both sides of the failed destructive sample location.
2. Defective seams, tears or holes shall be repaired by reseaming or applying a extrusion welded cap strip.
3. Reseaming may consist of either:
   a. Removing the defective weld area and rewelding the parent material using the original welding equipment; or
   b. Reseaming by extrusion welding along the overlap at the outside seam edge left by the fusion welding process.
4. Blisters, larger holes, and contamination by foreign matter shall be repaired by patches and/or extrusion weld beads as required. Each patch shall extend a minimum of 150 mm (6 in) beyond all edges of the defects.
5. All repairs shall be measured, located and recorded.

F. Verification of Repairs on Seams: Each repair shall be non-destructively tested using either vacuum box or spark testing methods. Tests which pass the non-destructive test shall be taken as an indication of a successful repair. Failed tests shall be reseamed and retested until a passing test results. The number, date, location, technician and test outcome of each patch shall be recorded.

G. Daily Field Installation Reports: At the beginning of each day's work, the Installer shall provide the Engineer with daily reports for all work accomplished on the previous work day. Reports shall include the following:
   1. Total amount and location of geomembrane placed;
   2. Total length and location of seams completed, name of technicians doing seaming and welding unit numbers;
   3. Drawings of the previous day's installed geomembrane showing panel numbers, seam numbers and locations of non-destructive and destructive testing;
   4. Results of pre-qualification test seams;
   5. Results of non-destructive testing; and
   6. Results of vacuum testing of repairs.

H. Destructive test results shall be reported prior to covering of liner or within 48 hours.

3.06 LINER ACCEPTANCE

A. Geomembrane liner will be accepted by the Owner's Representative when:

1. The entire installation is finished or an agreed upon subsection of the installation is finished;

2. All Installer's QC documentation is completed and submitted to the owner
3. Verification of the adequacy of all field seams and repairs and associated geomembrane testing is complete.

3.07 ANCHOR TRENCH

A. Construct as specified on the project drawings.

3.08 DISPOSAL OF SCRAP MATERIALS

A. On completion of installation, the Geomembrane Installer shall dispose of all trash and scrap material in a location approved by the Owner, remove equipment used in connection with the work herein, and shall leave the premises in a neat acceptable manner. No scrap material shall be allowed to remain on the geomembrane surface.

PART 4. GRI GM13 SPECIFICATIONS

Geosynthetics Research Institute (GRI) Test Method GM13 – "Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes", Revision 8, Dated July 10, 2006.

ATTACHMENT A:

Minimum Average Weld Properties for Smooth and Textured HDPE Geomembranes (English units)								
Property	**Test Method**	**30 mil**	**40 mil**	**50 mil**	**60 mil**	**80 mil**	**100 mil**	**120 mil**
Peel strength (fusion & extrusion) lb/in.	ASTM 4437	39	52	65	78	104	130	156
Shear strength (fusion & extrusion) lb/in.	ASTM 4437	60	80	100	120	160	200	239

END OF SECTION 02800

PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to seeding and placing mulch or erosion control blanket over seeded areas.

1.02 RELATED SECTIONS

A. Specified elsewhere:

1. 02200 - Earthwork

1.03 REFERENCES

The following reference or cited portions thereof, current at date of bidding documents unless otherwise specified, governs the work.

A. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.

1.04 SPECIFICATIONS

A. Work shall conform to the applicable requirements of Sections 250 and 251 of Standard Specifications for Road and Bridge Construction and to the requirements hereinafter specified.

B. Exceptions: All references in the IDOT specifications to methods of measurement and payment shall not apply.

1.05 WARRANTY

A. Warranty for one (1) year plus one growing season from date of substantial completion shall be provided.

PART 2. PRODUCTS

2.01 MATERIALS

A. Seed: Seed shall conform to Article 1081.04 of the IDOT Standard Specifications. The composition of the Ameren Energy Resources Generating hay seeding mix shall

be as follows:

Seed Type	Pounds/Acre
Vernal Alfalfa	12
Wrangler Alfalfa	8
Medium Red Clover	6
Timothy	4

B. Mulch Material and Erosion Control Blanket: Mulch material shall conform to Article 1081.06 and the excelsior blanket/knitted straw mat shall conform to Article 1081.10 of the IDOT Standard Specifications.

C. Fertilizer and agricultural ground limestone will not be permitted.

PART 3. EXECUTION

3.01 CONSTRUCTION

A. Seed bed preparation and seeding methods shall conform to Section 250 of the IDOT Specifications. Seeding of areas disturbed by construction activities after September 30, 2008 may be deferred until Spring 2009.

B. Seed shall be applied to the perimeter berm ditch, to disturbed portions of the perimeter berm, and to all disturbed earth surfaces outside of the existing perimeter berm. IDOT seeding mixture 7 shall be used on stockpiles. IDOT seeding mixture 1A shall be used on the gypsum stack perimeter earthen berm, the recycle pond dam embankment and on slopes that are 4H:1V or steeper. The Ameren hay seed mix shall be used on slopes flatter that 4H:1V.

C. Application rates for IDOT seed mixtures shall be as specified in Section 250 of the IDOT Specifications. The application rate for the Ameren Energy Resources Generating's seed mix shall be as specified in the Ameren Energy Resources Generating's hay seeding mix.

D. Seeded areas shall be mulched in accordance with Article 251.03. The Contractor may use either Method 2 or Method 3.

3.02 MAINTENANCE OF COMPLETED WORK

A. All areas seeded by the Contractor shall be maintained by the Contractor during the period between completion of such work and final completion and acceptance of the Contractor's work by the Owner. This maintenance shall be such that the completed work, at time of acceptance, complies in all respects with the requirements herein specified.

B. The areas seeded will be required to germinate. If the seed does not germinate, the Contractor will be required to regrade and reseed at no additional cost.

END OF SECTION 02936

PART 1. GENERAL

1.01 WORK INCLUDES

A. The complete installation of the formwork for cast-in-place concrete, with shoring, bracing and anchorage, openings for other work, form accessories, form stripping.

1.02 RELATED SECTIONS

A. Section 03200 - Concrete Reinforcement.

B. Section 03300 - Cast-In-Place Concrete.

C. Section 03400 – Concrete Embedment Liner.

1.03 REFERENCES

A. ACI 347 - Recommended Practice For Concrete Formwork.

B. ACI 301 - Specifications For Structural Concrete For Buildings.

1.04 DESIGN REQUIREMENTS

A. Design, engineer and construct formwork, shoring and bracing to conform to design and code requirements; resultant concrete to conform to required shape, line and dimension.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 347 and 301.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code for design, fabrication, erection and removal of formwork.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.08 COORDINATION

A. Coordinate this Section with other Sections of work which require attachment of components of formwork.

B. If formwork is placed which results in insufficient concrete cover over reinforcement, request instructions from Owner's Representative before proceeding.

PART 2. PRODUCTS

2.01 WOOD FORM MATERIALS

A. Softwood Plywood: 3/4 in. PS 1-83 "B-B" (concrete form) plywood, Class I, exterior grade or better, mill-oiled and edge sealed with each piece bearing legible inspection trademark.

B. Architectural Plywood: 3/4 in. PS 1-83 "B-B" plyform, Class I, with High Density smooth overlay, 1 surface, edge sealed with each piece bearing legible inspection trademark.

2.02 MANUFACTURERS - PREFABRICATED FORMS

A. Weyerhauser Concrete Form.

B. Georgia Pacific, G-P Exterior Soft Wood Plywood Product.

C. Plywood and Door Corporation's Finn-Form.

2.03 PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

2.04 FORMWORK ACCESSORIES

A. Form Ties: Snap-off type, galvanized metal, adjustable length, 1 in. back break dimension, free of defects that could leave holes larger than 1 in. in concrete surface; Dayton-Sure Grip snap-in-form ties, as manufactured by Dayton Superior

Corp., Symons Ties as manufactured by Symons Corporation, Snap-Tys as manufactured by Richmond Corporation. Ties shall be removed after forms are removed, and holes filled with mortar that matches the adjacent surfaces.

B. Form Release Agent: Colorless mineral oil which will not stain concrete, or absorb moisture; by Magic Kote manufactured by Symons Manufacturing Co., Form Coat manufactured by Concrete Services Co., Formcel manufactured by Lambert Corp.

C. Corners: Chamfered, wood strip type; 3/4 x 3/4 in. size on all exterior corners, 3 x 3 in. size where shown on the drawings; maximum possible lengths.

D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

E. Concrete Embedment Liner, where required, shall be installed in accordance with Section 03400 – Concrete Embedment Liner.

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 EARTH FORMS

A. Earth forms are not permitted, except for footings.

3.03 ERECTION - FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301. Metal forms shall be installed in strict accordance with manufacturer's directions and specifications.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

D. Align joints and make watertight. Keep form joints to a minimum.

E. Obtain approval before framing openings in structural members which are not indicated on drawings.

3.04 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent.

3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in or passing through concrete work.

B. Locate and set in place items which will be cast directly into concrete.

C. Coordinate work of other Sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, bolts, anchors, and other inserts.

D. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.06 FORM CLEANING

A. Clean and remove foreign matter within forms as erection proceeds.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts or water to clean out forms. Use compressed air or other means to remove foreign matter.

3.07 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 301.

3.08 FIELD QUALITY CONTROL

A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

B. Do not reuse wood formwork more than three times for concrete surfaces to be exposed to view. Do no patch formwork.

3.09 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finished concrete surfaces scheduled for exposure to view.

C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

END OF SECTION 03100

PART 1. GENERAL

1.01 WORK INCLUDES

A. The complete installation of the reinforcing steel bars and accessories for cast-in-place concrete.

1.02 RELATED SECTIONS

A. Section 03100 - Concrete Formwork.

B. Section 03300 - Cast-in-Place Concrete.

1.03 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.

B. ACI 318 - Building Code Requirements For Reinforced Concrete.

C. ACI SP-66 - American Concrete Institute - Detailing Manual.

D. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

E. CRSI - Concrete Reinforcing Steel Institute Manual of Practice.

1.04 SUBMITTALS

A. Submit under provisions of Section 01010.

B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel, and bending and cutting schedules. Contract drawings shall not be reproduced as the basis for shop drawings.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI Manual of Standard Practice.

B. Submit certified copies of mill test report of reinforcement materials analysis.

1.06 COORDINATION

A. Coordinate with placement of formwork, formed openings and other work.

PART 2. PRODUCTS

2.01 REINFORCEMENT

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade; deformed billet steel bars.

2.02 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage, annealed steel wire, epoxy coated when used with epoxy-coated reinforcement.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions.

C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic coated steel type; size and shape as required.

2.03 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI Manual of Standard Practice and ACI SP-66.

B. Splice reinforcement on at locations indicated on drawings. Indicate location of splices on shop drawings.

PART 3. EXECUTION

3.01 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position. Clean reinforcement of foreign particles or coatings.

B. Accommodate placement of formed openings.

C. Conform to ACI 318 code for concrete cover over reinforcement.

3.02 FIELD QUALITY CONTROL

A. Contractor shall notify the Owner's Representative at least 24 hrs. in advance of concrete placement. Placement of reinforcing shall occur in such sequence that the Owner's Representative has sufficient time to inspect the correctness of the reinforcing within the placement area. The Owner's Representative retains the right to require necessary revisions be made before concrete is placed.

END OF SECTION 03200

PART 1. GENERAL

1.01 WORK INCLUDES

A. The complete installation of cast-in-place concrete structures, including joint sealants.

1.02 RELATED SECTIONS

A. Section 03100 - Concrete Formwork: Formwork and accessories.

B Section 03200 - Concrete Reinforcement.

C. Section 03400 – Concrete Embedment Liner

1.03 REFERENCES

A. ACI 301 – Structural Concrete for Buildings.

B. ACI 302 - Guide for Concrete Floor and Slab Construction.

C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

D. ACI 305R - Hot Weather Concreting.

E. ACI 306R - Cold Weather Concreting.

F. ACI 308 - Standard Practice for Curing Concrete.

G. ACI 318 - Building Code Requirements for Reinforced Concrete.

H. ASTM C31 - Concrete Test Specimens.

I. ASTM C33 - Concrete Aggregates.

J. ASTM C94 - Ready-Mixed Concrete.

K. ASTM C150 - Portland Cement.

L. ASTM C260 - Air Entraining Admixtures for Concrete.

M. ASTM C494 - Chemical Admixtures for Concrete.

1.04 SUBMITTALS

A. Product Data: Provide data on joint devices, attachment accessories, admixtures.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Acquire cement and aggregate from same source for all work.

C. Conform to ACI 305R when concreting during hot weather.

D. Conform to ACI 306R when concreting during cold weather.

1.06 COORDINATION

A. Coordinate this Section with other Sections which require embedment of components in cast-in-place concrete.

1.07 PRODUCT DATA

A. Submit proposed mix design to Owner's Representative for review prior to commencement of work. Identify source and provide material certificates for cement, fine and coarse aggregates. Provide recent laboratory gradation for fine and coarse aggregates and mix design information in accordance with ACI 301.

B. Submit Construction joint plan.

PART 2. PRODUCTS

2.01 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I - Normal Portland Type, Gray Color.

B. Fine and Coarse Aggregates: ASTM C33.

C. Water: Potable.

2.02 ADMIXTURES

A. Air Entrainment: ASTM C260.

B. Chemical: ASTM C494. Maximum 0.05% Chloride Ion Contents.

C. The use of calcium chloride in any concrete is not permitted.

2.03 ACCESSORIES

A. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

B. Curing Compound: Dress and Seal No. 18 by L&M Construction Chemicals, MB-429 by Master Builders, or Sikagard Cure/Hard by the Sika Corporation.

C. Epoxy Grouted Adhesive Anchors: Hilti, Red Head, Simpson, or Rawl.

2.04 CONCRETE MIX

A. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94.

B. Select proportions for normal weight concrete in accordance with ACI 301.

C. Provide normal weight concrete of the following characteristics:

1. Compressive strength at 28 days: 4,000 psi.

2. Slump: 4 in. - A tolerance of up to 1 in. above the maximum shall be allowed for one batch in any five consecutive batches tested.

3. Water/cement ratios: 0.4 (max).

D. Use accelerating admixtures in cold weather only when approved by Owner's Representative. Use of admixtures will not relax cold weather placement requirements.

E. Use set-retarding admixtures during hot weather only when approved by Owner's Representative.

F. Water-reducing admixtures may be used in all concrete except footings and in strict compliance with the manufacturer's directions.

G. Add air-entraining agent to concrete mix for air content of 6% (± 1%).

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify requirements for concrete cover over reinforcement.

B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.02 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Notify Owner's Representative minimum of 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, and embedded parts are not disturbed during concrete placement.

D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Place concrete continuously between predetermined expansion, control, and construction joints.

F. When air temperature is between 80°F and 90°F, reduce the mixing and delivery time specified in ASTM C94 from 1-1/2 hours to 75 minutes. When the air temperature is above 90°F, reduce the mixing and delivery time to 60 minutes.

G. Cold weather concreting. Comply with ACI 306 except as follows:

1. In freezing weather, provide suitable means for maintaining concrete temperature at a minimum of 70°F for three days, or 50°F for five days after placing.

2. Cooling of concrete to outside temperature: Not faster than 1° per hour for first day and 2° per hour thereafter until outside temperature is reached.

3. Maximum temperature of concrete produced with heated aggregated, heated water, or both, at any time during its production or transportation: 90°F.

4. Do not mix chemicals or other foreign materials in concrete to prevent freezing or to accelerate hardening of concrete, unless approved in writing by Owner's Representative.

H. Hot weather concreting. Comply with ACI 305R.

1. ACI recommendations shall be observed when any combination of high air temperature, low relative humidity and wind velocity tend to impair the quality of fresh or hardened concrete.

2. Retarding and water reducing admixtures shall be approved in writing for each concrete mix design prior to placement.

3.03 CONCRETE FINISHING

A. Provide exterior concrete formed surfaces to be left exposed with smooth rubbed finish in accord with ACI 301. All other formed surfaces shall have fins, projections and offsets removed.

B. Provide Class A tolerances to exterior concrete slabs according to ACI 301.

1. Broom finish all exterior slabs. Broom out all tool marks.

C. Pitch slabs to drain.

3.04 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for a period necessary for hydration of cement and hardening of concrete in accordance with ACI 308.

C. Cure and protect finished concrete slabs in accordance with ACI 308.

3.05 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01010, paragraph 8.0.

B. Testing firm will take cylinders, perform slump and air entrainment tests in accordance with ACI 301.

C. Provide free access to Work and cooperate with appointed firm.

D. Submit proposed concrete mix design to Owner's Representative firm for review 14 days prior to commencement of Work.

E. Testing frequency shall be as specified in Section 01010, paragraph 8, except that one additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.

3.06 PATCHING

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by Owner's Representative and performed by the Contractor at no additional cost to the project.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Owner's Representative for each individual area.

END OF SECTION 03300

PART 1. GENERAL

1.01 WORK INCLUDES

A. Specifications and guidelines for manufacturing and installing high-density polyethylene embedment liners.

1.02 RELATED SECTIONS

A. Section 03100 - Concrete Formwork.

B. Section 03300 - Cast-in-Place Concrete.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
2. D 1603 Test Method for Carbon Black in Olefin Plastics
3. D 5199 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
4. D 5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
5. D 6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
6. D 1204 Standard Test Method for Linear Dimensional Changes of Nongrid Thermoplastic Sheeting or Film at Elevated Temperature
7. D 696 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C With a Vitreous Silica Dilatometer
8. D 746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
9. D 570 Standard Test Method for Water Absorption of Plastics
10. E 96 Standard Test Method for Water Vapor Transmission of Material

1.04 SUBMITTALS

A. All work for and in connection with the installation of the lining, field seaming and welding joints shall be completed in strict conformity with all applicable instructions and recommendations of the liner manufacturer.

B. Included with the shipment of liner, submit certified test reports that the liner and material are manufactured in accordance with standards specified herein.

1.05 QUALIFICATIONS

A. The HDPE liner specified in this section shall be furnished by a manufacturer who is fully experienced, reputable and qualified in the manufacturing of the materials. The manufacturer must at least 10 years of manufacturing experience.

B. Locking devices must be extruded to the sheet as a one step process.

C. Liner shall be GSE StudLiner as manufactured by GSE Lining Technology, Inc.

D. Liner shall be 8 feet in width.

E. Liner shall demonstrate a minimum pull-out strength of 14,000 psf.

1.06 COORDINATION

A. Coordinate with placement of formwork, formed openings and other work.

PART 2. PRODUCTS

2.01 ROLL DIMENSIONS

A. Embedment sheets shall be produced in rolls that are 8.0 ft (2.4 m) in width and a thickness range of 80 mils (2.0 mm) to 200 mils (5.0 mm) in thickness. Roll lengths vary according to thickness.

B. Locking studs of the same material as that of the liner shall be integrally extruded with the sheet. Stud spacing shall be on approximate 1.25 in (30 mm) centers, such that there are approximately 110 studs per square foot (1200 per square meter).

2.02 MATERIAL PROPERTIES

A. The material used in the embedment liner and in all welding strips shall be made from 97-98% virgin high density polyethylene and 1.5-3% carbon black or pigmentation for the purpose of an otherwise specified color.

B. Plasticizer shall not be added to the resin formulation.

C. Embedment sheet and welding strips shall be free of holes, pinholes, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.

D. The HDPE cap strips shall be made from HDPE, have good impact resistance and have an elongation sufficient to bridge up to 1/4 inch settling cracks.

E. Cap strips shall be approximately 4 inches wide or greater and shall be equivalent to that of the liner.

F. Material shall maintain a repairable state through it's lifecycle by methods approved and recommended by the manufacturer.

G. Embedment sheets shall have the following physical properties when tested in accordance with Table 1.

H. Raw resin shall have the following properties when tested in accordance with Table 2.

Table 1: Material Properties

Property	Test Method	Nominal Value				Testing Frequency
Thickness, mm (mil)	ASTM D 5199	2.00 (80)	3.00 (120)	4.00 (160)	5.00 (200)	Every 5th roll
Density, g/cm^3	ASTM D 1505	0.94	0.94	0.94	0.94	1/100,000 ft^2
Tensile Properties Strength@Yield,lb/in^2 (MPa) Elongation @ Break, %	ASTM D 6693 Type IV, Dumbell G.L.= 2.0in.	2,200 (14.5) 500	2,200 (14.5) 500	2,200 (14.5) 500	2,200 (14.5) 500	1/100,000 ft^2
Stud Pull-Out Strength[1], lb/ft^2 (kN/m^2)		>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)	1/ product
Carbon Black Content/ Pigment Content, % Black Liner Gray Liner	ASTM D 1603, mod. ASTM D 5630, mod.	2-3 1.5 – 2.5	2-3 1.5 – 2.5	2-3 1.5 – 2.5	2-3 1.5 – 2.5	1/100,000 ft^2
Carbon Black Dispersion[2]	ASTM D 5596	Note 2	Note 2	Note 2	Note 2	1/100,000 ft^2
Notched Constant Tensile Load, hours	ASTM D 5397	400	400	400	400	1/ formulation
Coefficient of Linear Thermal Expansion, per °C	ASTM D 696	1.20E-04	1.20E-04	1.20E-04	1.20E-04	1/ product
Low Temperature Brittleness, °C	ASTM D 746	-77	-77	-77	-77	1/ product
Dimensional Stability, % (each direction)	ASTM D 1204	± 1.0	± 1.0	± 1.0	± 1.0	1/ product
Water Absorption, %	ASTM D 570	0.1	0.1	0.1	0.1	1/ product
Water Vapor Transmission, (g/m^2/day)	ASTM E 96	<0.01	<0.01	<0.01	<0.01	1/ product

[1]Note: Concrete must have a compressive strength of at least 5,000 lb/in^2 (34,500 kPa).
[2]Note: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view for category 3.

Table 2: Raw Material Properties

Property	Test Method	Value	Testing Frequency
Density, g/cm3	ASTM D 1505	0.932	1/ resin lot
Melt Flow, g/10 min	ASTM D 1238 (190/2.16)	≤ 1.0	1/ resin lot
OIT, minutes	ASTM D 3895 (1atm/200°C)	100	1/ formulation

2.03 MATERIAL SUPPLY

A. Embedment sheets shall be supplied in roll form, sheets, pre-fabricated tubes or panels.

B. Cap strips shall be supplied in 4 inch widths or greater.

PART 3. EXECUTION

3.01 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position. Clean reinforcement of foreign particles or coatings.

B. Accommodate placement of formed openings.

C. Conform to ACI 318 code for concrete cover over reinforcement.

3.02 FIELD QUALITY CONTROL

A. Contractor shall notify the Owner's Representative at least 24 hrs. in advance of concrete placement. Placement of the Concrete Embedment Liner shall occur in such sequence that the Owner's Representative has sufficient time to inspect the correctness of the placement within the concrete formwork area. The Owner's Representative retains the right to require necessary revisions be made before concrete is placed.

END OF SECTION 03200

Appendix E: Operation & Maintenance Manual for #1 Ash Pond

Coffeen Power Station

Operational Procedure

x-xxx-xxxx--xxx

Operation & Maintenance Manual for #1 Ash Pond

(Bottom Ash Recycle Pond)

Effective Date: xx/xx/xxxx

Reason for Change: New Procedure

Approved By: _____*x*_____ Date: xx/xx/xxxx

x
John Romang

Responsible Department: Coffeen Power Station, Technical Services Department

- ☐ This entire document shall be in the field during procedure performance.
- ☐ The following portions of this procedure shall be in the field during procedure performance: _____
- ☐ _____ from this procedure shall be in the field during procedure performance.
- ☐ No part of this procedure is required to be in the field during procedure performance.

Table of Contents

Section		Page Number
1.0	Purpose	1
2.0	Scope	1
3.0	Responsibilities	1
4.0	Historical Information	1
5.0	Water Supply	Error! Bookmark not defined.
6.0	Operations Requirements	2
7.0	Dam Safety Requirements	3
8.0	Maintenance Logs	4
9.0	Contact Numbers	4
10.0	References	4

1.0 Purpose

1.1 This procedure is intended to ensure the safe and environmentally responsible operation and use of the #1 Ash Pond (Bottom Ash Recycle Pond) at the Coffeen Power Station. The primary purpose of the #1 Ash Pond is for the removal of bottom ash by settling and the recirculation of slag tank water. The pond is used to supply water to the Unit 1 and Unit 2 ash handling systems via the recycle pumps.

2.0 Scope

2.1 This procedure applies to all onsite personnel and the Dam Safety Group staff.

3.0 Responsibilities

3.1 Outside Unit Operator – Checks the pond level and screens once a shift. Operates the facilities as described in this Operational Procedure. Reports any conditions noted during routine activities to the Shift Supervisor and Chemistry Department. Writes job requests if a problem is identified.

3.2 Shift Supervisor (SS) - Calls the Chemistry Department when structural concerns or overflow conditions are reported. Make entries into the shift electronic log book (e-log) indicating the concern and actions taken.

3.3 Dam Safety Inspector - Conducts weekly detailed dam safety inspections and provides a report with findings and recommendations. Make entries in e-log indicating the concern and actions taken.

4.0 Historical Information

4.1 The #1 Ash Pond was initially constructed to be a mixed ash deposition pond and was put in service in the mid-1960's. It is located east of the Main Building. It is a 23 acre pond with a maximum outer berm height of 41.5 feet above ground surface level (approximately elevation 637.5'). The pond overflow was located on the north east corner of the pond and discharged into the flume.

4.2 The #1 Ash Pond was converted to act as a closed loop system in the late 1970's when the dewatering bins were installed. The mixed ash was removed and deposited into the #2 ash pond during the closure of #2 pond. The #1 Ash Pond berms were modified and an inner berms was added to the pond to aid in dropping out bottom ash solids. Exterior berm elevation is approximately 637.5 feet.

4.3 The #1 Ash Pond was equipped with an emergency overflow at the outlet structure. When the pond level reaches approximately 6.5 feet from the top of the berm, it will overflow into the flume. Overflow will be reported to the EPA. In 2011 there was an assessment of the overflow pipe which showed no obstructions or damage.

4.4 In 2006, the bottom ash system was modified to directly sluice bottom ash into the pond, bypassing the retired dewatering bins. Bottom Ash is removed from the pond via an outside contractor on an as needed (typically daily) basis.

5.0 Water Supply

All water inlets to the pond are located on the west side of the pond.

The ash sluice lines (from the valve house) discharge to the pond. These lines are used to convey ash from the slag handling system to the #1 Ash Pond. These lines are the southern most of the pond inlets. HPSW system is routed to the pond (valve house sparger valves, floor drains at Unit 1 cyclone level).

The Slag Tank Overflow sump pumps discharge into the pond at the concrete culvert located directly east of the of the lime/soda ash silo. Also in this area, a small stainless line extends thru the concrete. This is the discharge of the sludge pumps at the Waste Treatment System in the Recycle Pump House building.

The recycle pump flow control valves discharge to the pond through a line located at the northwest corner of the pond. Also in the vicinity of this line is the discharge pipe of the recycle pump house sump pumps.

Water from the Unit 1 and Unit 2 oil water separators are typically routed to the pond via the Slag Tank Overflow Pump (STOP) House sumps. Water entering these sumps are floor and roof drains in the plant and the yard area immediately to the north of the main building.

6.0 Operations Requirements

Pond Level - Plant personnel shall monitor the level of the #1 Ash Pond on a daily basis. Pond level is maintained at approximately 1.0’ to 1.5’ at the water level staff gauge located on the pond side of the screens. The staff gauge has elevation 629.0’ as the 0 elevation.

At 2.0' water level (elevation 631.0 feet), the pond overflows resulting in a sampling and analysis requirement for Total Suspended Solids and Oil and Grease with reporting of the results to the IEPA. If the pond is found at or above 2.0' on the pump side staff gauge, contact Chemistry immediately.

Water can be added to the pond from either the Unit 1 or Unit 2 Low Pressure Service Water (LPSW) headers via piping that discharges to the slag tank overflow trench.

Water can be drained from the pond via the water supply pipe to the dewatering bins. Opening this valve drains water from the recycle header which will remove water from the #1 Ash Pond.

Recycle Pump Intake Structure – Suction to the recycle pumps is supplied from the intake structure located at the west end of the north leg of the pond. This is the only water discharge point from the pond. Water level staff gauges are located upstream and downstream of the trash screens for determination of the screen differential. At 0.5' differential, the screens should be cleaned. Level sensors are also installed upstream and downstream of the screens. Digital displays of the upstream and downstream levels are located along the north side of the catwalk leading out to the screen enclosure. These level sensors will generate a high screen differential alarm in the Control Room DCS. Check screen differential (should clean screens at 6 inches differential.) When the screens become plugged, suction to the recycle pumps is reduced. Call shift supervisor to report if screens needs to be cleaned.

Oil Boom – Plant personnel shall monitor the oil boom that is provided upstream of the intake structure. Check condition of oil booms across pond, at discharge, and across pond inlet. Booms should be replaced when they become oil saturated or damaged. Also check that booms have not come unattached from one another. Write JR to change out booms or to reconnect booms when required.

Emergency Conditions – If a condition arises where there is a possibility of an embankment failure, then the following procedures will be followed:

1. Notify the Supervising Engineer Dam Safety immediately.

7.0 Dam Safety Requirements

7.1 Dam Safety Inspections - The plant's impoundment and flood prevention structures shall be inspected and maintained in a manner to ensure safe and environmentally responsible operations. A regular maintenance program shall be performed and shall consist of the following inspection items:

1. Earth embankments: Walk the crest, side slopes, and downstream toe of the dam concentrating on surface erosion, seepage, cracks, settlement, slumps, slides, and animal burrows. Frequency of inspection: Weekly.
2. Vegetation: Grass should be a thick vigorous growth to stabilize the earth embankment soils and prevent erosion form occurring. There should be NO trees on the earth embankment and none within a minimum of 20 feet of the embankment toe or other structures. Mowing frequency: Semiannually.
3. Well Readings: Record level of wells on the crest and toe of the berm. Frequency: Quarterly.
4. Special Inspections – Special inspections of the levees and ash pond berms shall be performed after earthquakes, floods, water level exceedance in the ponds, or heavy rainfall events. Inspection and report shall be equal to an annual inspection level of detail. Water level in the pond should be noted after a heavy rainfall. Dam Safety staff shall accompany plant personnel on special inspections. Frequency: As required.

8.0 Maintenance Log

8.1 Dam & Berm Inspector shall enter on e-log under the Dam Safety tab all weekly inspections, any usual occurrences, and maintenance performed.

9.0 Contact Numbers

Plant Environmental Supervisor: John Romang / 217-534-7629
Plant Dam & Berm Inspector: Vito Passariello/ 217-534-7664
Plant Control Room: 217-534-7668 / 217-534-7669
Supervising Engineer Dam Safety: Steve Bluemner / 314-554-6298
Dam Safety Staff Contact: Mike Wagstaff / 314-554-6296

10.0 References

Appendix F: Operation and Maintenance Manual, Gypsum Management FacilityOperation (2015)

Operation and Maintenance Manual
Coffeen Energy Center
Gypsum Management Facility
Montgomery County, Illinois

IDNR Permit # DS2014019
Dam Permit # IL50578 & IL50579

Prepared For:

ILLINOIS POWER GENERATING COMPANY
Coffeen Energy Center
134 CIPS Lane
Coffeen, Illinois 62017

Prepared By:

HANSON PROFESSIONAL SERVICES INC.
1525 South Sixth Street
Springfield, Illinois 62703

Amended By:

DYNEGY OPERATING COMPANY
1500 Eastport Plaza Drive
Collinsville, Illinois 62234

Original: February 2008
Amended: March 2015

OPERATION AND MAINTENANCE MANUAL
COFFEEN ENERGY CENTER
GYPSUM MANAGEMENT FACILITY
MONTGOMERY COUNTY, ILLINOIS

TABLE OF CONTENTS

Section **Page**

SECTION 1.0 General 1
1.1 Reasons For Development And Dissemination Of The O&M Manual 1
1.2 General Responsibilities Concerning Dams 1
SECTION 2.0 Definitions 2
SECTION 3.0 Information About The Dams 4
3.1 Location 4
3.2 Description Of Dam And Appurtenances 4
3.3 Size and Hazard Classification 5
3.4 Purpose Of The Dams 5
3.5 Pertinent Data 6
SECTION 4.0 Operations Activities 8
4.1 Introduction 8
4.2 Site Operations and Personnel 8
4.2.1 Site Operations 8
4.2.2 Personnel 8
4.3 Gypsum Management Facility Startup 8
4.4 Water Balance 9
4.5 Gypsum Management Facility Operation 9
4.5.1 Routine Operations 9
4.5.2 Piezometer Installation and Monitoring 10
4.6 Dam Inspections 12
4.6.1 Operation and Maintenance Inspection 12
4.6.2 Engineering Inspection 15
4.6.3 Review of Emergency Action Plan 16
SECTION 5.0 Maintenance Activities 17

LIST OF TABLES

Table 3-1 Pertinent Data for the Gypsum Stack Earthen Dam 6
Table 3-2 Pertinent Data for the Recycle Pond Dam 7

LIST OF FIGURES

Figure 4-1 Anticipated Phreatic Surface in Gypsum Stack 11

LIST OF APPENDICES

APPENDIX A – Location Map
APPENDIX B – Operation and Maintenance Inspection Checklist
APPENDIX C – Engineering Inspection Form
APPENDIX D – Herbicides
APPENDIX E – Construction Drawings

SECTION 1.0
GENERAL

This operation and maintenance (O&M) manual outlines objectives, proposed policies, responsibilities, and procedures for Coffeen Energy Center personnel who are responsible for the management of the Coffeen Energy Center Gypsum Management Facility (GMF). The GMF incorporates two reservoirs, the Gypsum Pond and the Recycle Pond, for processing and storing gypsum.

1.1 REASONS FOR DEVELOPMENT AND DISSEMINATION OF THE O&M MANUAL

The State of Illinois Rivers, Lakes and Streams Act, (615 ILCS 5) Paragraph 23a includes the statement "The Department is authorized to carry out inspections of any dam within the State, and to establish standards and issue permits for the safe construction of new dams and the reconstruction, repair, operation and maintenance of all existing dams." (emphasis added).

Part 3702 of Section 17 of the Illinois Administrative Code, Chapter I entitled the "Construction and Maintenance of Dams" details the requirements to obtain a permit for the construction, operation, and maintenance of a dam. Section 3702.40 b) includes the following statements:

> "4) An applicant for a Class I or II dam shall submit an operational plan specifying the method and schedule for the operation of the dam and the routine operating procedures to keep the dam in good working order, including an emergency warning plan." and
>
> "5) As a condition of each permit, the dam owner shall submit a maintenance plan detailing the procedures and schedules to be followed to maintain the dam and its appurtenances in a reasonable state of repair."

Thus, it is a requirement of all dam owners who have dams which fall under the jurisdiction of the Illinois Department of Natural Resources Office of Water Resources (IDNR-OWR) to operate and maintain them safely.

As a dam owner, Illinois Power Generating Company (IPGC) Coffeen Energy Center is responsible for the safety of the public and for maintaining the structures at the facility for both safety and economy. The overall public interest is served by providing a document to serve as a basis for the safe and economical operation and maintenance of the dam during both emergency and day-to-day conditions.

1.2 GENERAL RESPONSIBILITIES CONCERNING DAMS

IPGC is responsible for the operation and maintenance of the Gypsum Pond Dam and the Recycle Pond Dam. These responsibilities include general maintenance (mowing, removing debris from decants, placing riprap where needed, etc.), operation, inspection and emergency action decisions.

SECTION 2.0
DEFINITIONS

Appurtenant Works - The structures or machinery auxiliary to dams which are built to operate and maintain dams; such as outlet works, spillways, gates, valves, channels, etc.

Boil - A stream of water discharging from the ground surface downstream of the dam carrying with it a volume of soil which is distributed around the hole formed by the discharging water.

Berm - A horizontal step or bench in the sloping profile of an embankment dam.

Breach - A break, gap, or opening (failure) in a dam which releases impoundment water.

Dam - A barrier built for impounding or diverting the flow of water.

Dike (Levee) - An embankment, usually applied to embankments or structures built to protect land from flooding.

Drain, Layer or Blanket - A layer of pervious material in a dam to facilitate the drainage of the embankment including such items as a toe drain, a weephole, and a chimney drain.

Drawdown - The resultant lowering of the water surface level due to the release of water from the impoundment.

Embankment - Fill material, usually rock or earth, placed with sloping sides.

Earthen Dam - Any dam constructed of excavated natural materials.

Emergency Action Plan - A predetermined plan of action to be taken to reduce the potential for property damage and loss of lives.

Failure - An incident resulting in the uncontrolled release of water from the dam.

Freeboard - The vertical distance between a stated water level and the top of the dam.

Gate or Valve - In general, a device in which a leaf or member is moved across the waterway to control or stop the flow.

Groin - The junction of the upstream or downstream face of the dam with the valley wall.

Maintenance - The upkeep, involving labor and materials, necessary for efficient operation of dams and their appurtenant works.

Operation - The administration, management, and performance needed to operate the dam and appurtenant works.

Operation and Maintenance Inspection - Inspections conducted by the dam operator. These inspections are frequent visual "Walk-around" inspections of the dam surface and appurtenant works.

Outlet - An opening through which water can freely discharge for a particular purpose from an impoundment.

Phreatic Surface - The upper surface of saturation in an embankment.

Piping - The progressive development of internal erosion by seepage, appearing downstream as a hole or seam, discharging water that contains soil particles.

Riprap - A layer of large stones, broken rock or precast blocks placed in a random fashion usually on the upstream slope of an embankment dam, on a reservoir shore, or on the sides of a channel as a protection against wave and ice action.

Silt/Sediment - Soil particles and debris in an impoundment.

Slump/Slide Area - A portion of earth embankment which moves downslope, sometimes suddenly, often with cracks developing.

Spillway System - A structure or structures over or through which flows are discharged. If the flow is controlled by gates, it is considered a controlled spillway. If the elevation of the spillway crest is the only control of the flows, it is considered an uncontrolled spillway.

Emergency Spillway - A spillway designed to operate very infrequently, only during exceptionally large floods, usually constructed of materials expected to erode slowly.

Principal Spillway - The main spillway which controls both normal and flood flows and is usually constructed of non-erodable materials.

Auxiliary Spillway - A spillway which works in conjunction with the principal spillway to control flood flows and is usually constructed of non-erodable materials.

Stilling Basin - A basin constructed to dissipate the energy of fast flowing water, such as from a spillway, and to protect the streambed from erosion.

Toe of Embankment - The junction of the face of the dam with the ground surface in the floodplain upstream or downstream of the dam.

SECTION 3.0
INFORMATION ABOUT THE DAMS

3.1 LOCATION

The Gypsum Pond Dam and Recycle Pond Dam are located in the NW 1/4 of Section 11, Township 7 North, Range 3 West of the Third Principal Meridian in Montgomery County, Illinois. More specifically, the dams are located approximately 1.5 miles south of Coffeen, Illinois. A map showing the location of the dams is included in Appendix A.

3.2 DESCRIPTION OF DAM AND APPURTENANCES

The gypsum pond perimeter earthen dam, the gypsum pond "gypsum" dam, and the recycle pond dam will all be regulated in accordance with 17 Illinois Administrative Code (IAC) Part 3702, Construction and Maintenance of Dams. The gypsum pond perimeter earthen dam, which will be lined with a dual high density polyethylene (HDPE) geomembrane system, will have a maximum embankment height of 13 ft and a maximum impounding capacity of 442 acre-ft (measured at the top of earthen dam elevation 632 ft). There will be an additional 123 acre-ft of incised storage. The total volume of gypsum stored within the completed gypsum pond dams will be approximately 2,478 acre-ft.

The dam for the recycle pond, which will be lined with a 60 mil HDPE geomembrane, will have a maximum embankment height of 16 ft and a maximum impounding capacity of 243 acre-ft (measured at the top of dam elevation 629 ft). There will be an additional 99 acre-ft of incised storage.

The gypsum pond will be divided into two sub-cells for the containment of scrubber sludge (gypsum). Discharges to the site will switch back and forth between the two sub-cells so that one sub-cell can be dewatered and raised while the other is in use. There will be two fixed decant pipes constructed in the gypsum stack – one for each sub-cell - which will discharge to stilling wells located adjacent to the perimeter ditches. The control elevation on the decant pipes will be maintained 5.0 ft below the lowest point on the stack cell crest. The decant pipes will enable the cells to be dewatered after storm events so that a minimum of 5.0 ft of freeboard will be maintained in each cell. A minimum of 4.7 ft of freeboard is required above the decant inlet to contain the Probable Maximum Flood (PMF) storm event in addition to peak wind generated waves.

The gypsum pond dam perimeter ditches will be located on the interior sides of the earthen dam. Runoff from the stack will be conveyed through the ditches to a transfer channel which will discharge into the recycle pond. The ditches will be trapezoidal in shape with a 15 ft bottom width, a maximum depth of 9 ft and a longitudinal slope of 0.0005 ft/ft. Side slopes will be 3H:1V. During operation, the ditches will be monitored for erosion. If erosion of the designed ditch geometry occurs, a geogrid will be used for stabilization.

The transfer channel between the gypsum pond dam and the recycle pond have a trapezoidal cross-section with 3H:1V side slopes will be lined with HDPE. The 500 ft long transfer channel will transition from a 32-ft bottom width at an invert elevation of 623.0 ft at the upstream end to a 60-ft bottom width at an invert elevation of 622.0 ft at the downstream end. The transfer channel will be fitted with stop logs capable of raising the discharge control elevation to 625.0 ft. To prevent degradation of the HDPE liner due to flow velocities, the transfer channel and a portion of the recycle pond dam will incorporate an additional sacrificial layer of HDPE.

The emergency spillway for the recycle pond will consist of three 6 ft by 6 ft precast reinforced concrete risers (drop inlets) with a top elevation of 624 ft (5 ft below the top of the dam). The recycle pond's HDPE liner will attach to the exterior sides of each riser. A 4-ft diameter HDPE outlet conduit will be constructed at each riser with an upstream invert of 615.0 ft and a downstream invert of 613.0 ft. Assuming a normal pool elevation of 624 ft (control elevation of the risers), the emergency spillway has been designed to pass the 24-hour PMF storm event with adequate freeboard to prevent overtopping of the recycle pond crest by wind generated waves. The emergency spillway has been provided in the event of accident or catastrophic rainfall only. It is not expected to be activated during the life of the facility. As designed, all discharges from the system will be through the pump house located on the southeast corner of the recycle pond.

3.3 SIZE AND HAZARD CLASSIFICATION

If a worst case failure of the gypsum pond dam were to occur, and the entire volume of the stack is released easterly into Coffeen Lake, the Coffeen Lake reservoir has adequate freeboard to accept this additional volume without overtopping the dam during flood events up to and including the 60 percent PMF. However, the power plant and several residences could potentially be impacted if the gypsum stack dam were to fail in a westerly direction. Considering the regulatory criteria established in Part 3702, the gypsum stack perimeter earthen dam and the gypsum stack "gypsum" dam are classified as intermediate-size Class I (high hazard potential) dams.

A failure of the recycle pond dam would discharge water to Coffeen Lake but it is not anticipated to result in loss of life or any significant economic damage. Breach analyses indicate that a failure of the recycle pond dam during a PMF event would be expected to result in an increase in the Coffeen Lake water surface elevation of not more than ½ inch. Accordingly, the recycle pond dam is classified as a small-size Class III (low hazard potential) dam.

3.4 PURPOSE OF THE DAMS

The dams will be used to dewater, store and dispose of flue gas desulphurization sludge (gypsum) from the Coffeen Power Station (the Plant). Gypsum will be transported to the Gypsum Pond Dam in slurry form (approximately 20 percent solids) and allowed to settle. Clarified process water will then be decanted to the recycle pond and returned to the Plant for reuse via a pipeline.

3.5 PERTINENT DATA

Pertinent data about the dams, appurtenant works, and reservoirs are presented in Table 3-1 and Table 3-2.

Table 3-1 Pertinent Data for the Gypsum Pond Earthen Dam
(Based on the Construction of 2 Gypsum Cells)

Perimeter Ditches		
Bottom Width	15.00	feet
Top Width	73.50	feet
Depth	9.00	feet
Outer Side Slope	3:1	H:V
Inner Side Slope	3:1	H:V
Upstream Invert	624.85	feet
Downstream Invert	623.00	feet
Ditch slope	0.00050	ft/ft
Bank Full Cross-sectional Area	378.00	sf
Length of Each Ditch (Centerline)	3710.00	feet
Bank Full Volume of Each Ditch	32.19	acre-ft
Total Ditch length (Centerline)	7420.00	feet
Total Ditch Bank Full Volume	64.39	acre-ft

Transfer Channel		
Bottom Width	32.00	feet
Top Width	86.00	feet
Depth	9.00	feet
Upstream Invert	623.00	feet
Downstream Invert	622.00	feet
Weir Elevation	625.00	feet
Weir Length (at 2 ft height)	44.00	feet

Dam		
Top of Dam Elevation	632	feet
Reservoir Surface Area	77.29	acres
Total Watershed Area	77.29	acres
Dam Length	7720	feet
Dam Height	13	feet

1.0 PMF Storm Event		
Storm Duration	24	hours
Peak Outflow Discharge	1100.7	cfs
Total Discharge Volume	228.83	acre-ft
Peak WSEL in Perimeter Ditches	629.89	feet
Freeboard over Max WSEL	2.11	feet
Wave Runup/Wind Setup	2.06	feet
Adequate Freeboard?	**YES**	

0.5 PMF Storm Event		
Storm Duration	24	hours
Peak Outflow Discharge	541.1	cfs
Total Discharge Volume	122.41	acre-ft
Peak WSEL in Perimeter Ditches	628.23	feet
Freeboard over Max WSEL	3.77	feet
Wave Runup/Wind Setup	2.06	feet
Adequate Freeboard?	**YES**	

100-yr Storm Event - Critical Duration		
Storm Duration	12	hours
Peak Outflow Discharge	92.6	cfs
Total Discharge Volume	50.91	acre-ft
Peak WSEL in Perimeter Ditches	626.07	feet
Freeboard over Max WSEL	5.93	feet
Wave Runup/Wind Setup	2.06	feet
Adequate Freeboard?	**YES**	

100-yr Storm Event - 24 Hour Duration		
Storm Duration	24	hours
Peak Outflow Discharge	62.9	cfs
Total Discharge Volume	57.01	acre-ft
Peak WSEL in Perimeter Ditches	625.84	feet
Freeboard over Max WSEL	6.16	feet
Wave Runup/Wind Setup	2.06	feet
Adequate Freeboard?	**YES**	

Note: The Critical Storm Duration is the duration of the rainfall event which produces the highest reservoir water surface elevation in the Gypsum Stack Perimeter Ditches for the given storm frequency. In each case, the starting normal pool elevation of the Recycle Pond is considered to be at elevation 624 ft.

Table 3-2 Pertinent Data for the Recycle Pond Dam
(Based on the Construction of 2 Gypsum Cells)

Dam		
Top of Dam Elevation	629	feet
Invert of Reservoir Elevation	605	feet
Reservoir Area at Invert	11.55	acres
Reservoir Area at Top of Dam	17.07	acres
Total Reservoir Volume	341.91	acre-ft
Volume at Elevation 624 ft	259.60	acre-ft
Total Watershed Area	94.36	acres
Dam Length	3600	feet
Dam Height	16	feet

3 Spillways- 6ft x 6ft inlet w/ 4ft dia outlet pipe		
Weir Length	22	feet
Weir Elevation	624.00	feet
Outlet Conduit Length	120	feet
Outlet Conduit Diameter (Inside)	48	inch
Upstream Invert	615	feet
Downstream Invert	614	feet
Outlet Conduit Slope	0.00833	

1.0 PMF Storm Event - Normal Pool at Elev. 624 ft		
Storm Duration	24	hours
Peak Inflow	1261.6	cfs
Peak Outflow	586.9	cfs
Peak Storage	315.47	acre-ft
Peak WSEL (HEC-HMS)	627.45	feet
Freeboard over Peak WSEL	1.55	feet
Wave Runup/Wind Setup	1.20	feet
Adequate Freeboard?	**YES**	

1.0 PMF Storm Event - Normal Pool at Elev. 609 ft		
Critical Storm Duration	24	hours
Peak Inflow	1261.6	cfs
Peak Outflow	289.7	cfs
Peak Storage	280.65	acre-ft
Peak WSEL (HEC-HMS)	625.34	feet
Freeboard over Peak WSEL	3.66	feet
Wave Runup/Wind Setup	1.20	feet
Water Released from Dam?	**YES**	

0.5 PMF Storm Event - Normal Pool at Elev. 624 ft		
Storm Duration	24	hours
Peak Inflow	608.4	cfs
Peak Outflow	413.6	cfs
Peak Storage	286.48	acre-ft
Peak WSEL (HEC-HMS)	625.69	feet
Freeboard over Peak WSEL	3.31	feet
Wave Runup/Wind Setup	1.20	feet
Adequate Freeboard?	**YES**	

0.5 PMF Storm Event - Normal Pool at Elev. 613 ft		
Critical Storm Duration	24	hours
Peak Inflow	608.4	cfs
Peak Outflow	0	cfs
Peak Storage	255.83	acre-ft
Peak WSEL (HEC-HMS)	623.75	feet
Freeboard over Peak WSEL	5.25	feet
Wave Runup/Wind Setup	1.20	feet
Water Released from Dam?	**NO**	

100-yr Storm Event - Normal Pool at Elev. 624 ft		
Critical Storm Duration	12	hours
Peak Inflow	113.2	cfs
Peak Outflow	95.8	cfs
Peak Storage	269.36	acre-ft
Peak WSEL (HEC-HMS)	624.63	feet
Freeboard over Peak WSEL	4.37	feet
Wave Runup/Wind Setup	1.20	feet
Adequate Freeboard?	**YES**	

100-yr Storm Event - Normal Pool at Elev. 619 ft		
Critical Storm Duration	24	hours
Peak Inflow	76.6	cfs
Peak Outflow	0	cfs
Peak Storage	258.48	acre-ft
Peak WSEL (HEC-HMS)	623.94	feet
Freeboard over Peak WSEL	5.06	feet
Wave Runup/Wind Setup	1.20	feet
Water Released from Dam?	**NO**	

Note: The above variation in normal pool elevations for the Recycle Pond is for the purpose of documenting the water surface elevation which must be maintained in the recycle pond in order to prevent the release of water from the GMF for the above described storm events.

SECTION 4.0
OPERATIONS ACTIVITIES

4.1 INTRODUCTION

The operations plan describes the proposed operation of the Coffeen Gypsum Management Facility (GMF) which includes the gypsum pond and the recycle pond.

4.2 SITE OPERATIONS AND PERSONNEL

4.2.1 Site Operations

The GMF will receive gypsum slurry 24 hours per day, seven days per week. Routine facility maintenance and construction activities will generally be conducted during day shift hours. The crest widths for both the gypsum stack earthen dam and the recycle pond dam are 20 ft. In addition, multi-directional ramps are being provided for both structures so that they are readily accessible by inspection, maintenance and gypsum recovery equipment.

The Plant is a restricted access location. Additional fencing around the perimeter of the active sedimentation cells of the gypsum stack and the recycle pond will be erected to prevent unauthorized access to the GMF, which is also under surveillance by security personnel.

4.2.2 Personnel

The proposed GMF will be owned and operated by Ameren Energy Generating Company (Ameren). Corporate offices are located in St. Louis, Missouri. Overall responsibility for the GMF operation lies with Ameren management personnel.

4.3 GYPSUM MANAGEMENT FACILITY STARTUP

The major components of the proposed GMF consist of:

- The gypsum stack dam/impoundment;
- The recycle pond;
- The earthen transfer channel that connects the two structures and through which process water will be decanted from the gypsum stack into the recycle pond; and
- The recycle pond decant and pumphouse through which process water will be returned to the Plant for reuse.

Both the recycle pond and the gypsum stack dam will be constructed before gypsum is placed within the gypsum stack dam/impoundment.

Upon startup, it is likely that the gypsum stack impoundment will have no more than a few feet of water in the bottom to prevent the high density polyethylene (HDPE) geomembrane from moving. The gypsum slurry (approximately 20 percent solids) will be pumped from the

Plant to the gypsum stack via piping. The piping will be HDPE with a suitable pressure rating for the intended hydraulic and static head. The HDPE pipe will discharge the slurry into the impoundment, and gypsum will settle by gravity.

It will take approximately 10 months before the gypsum stack impoundment is filled to elevation 623 ft, the point where process water may begin flowing into the recycle pond via the HDPE-lined earthen channel connecting the two structures. As soon as water begins to fill the recycle pond, it will be pumped back to the Plant for reuse.

4.4 WATER BALANCE

The capacity of the recycle pond has been designed to accommodate all precipitation runoff from the entire gypsum pond/recycle pond area during a 2-week complete maintenance outage at the Coffeen Power Station (the Plant) followed by a 12-week outage of one of the two units. The runoff and excess water accumulated during this time can be stored within the recycle pond without discharging. The design is based on the maximum 3.5 month precipitation that has occurred in the area since 1950. This occurred in April, May, June and half of July, 1957 and consisted of 28.83 inches of rainfall.

The water balance has been carried out for the expected life of the Site. During the first nine or ten months of operation, the water balance is positive, meaning that there is more water entering the gypsum stack/recycle pond system through process water and precipitation than is leaving the system through process water return and evaporation. However, there is 15 ft of freeboard between the pump discharge and the emergency spillway. With proper water-level management, the water surface will remain well below discharge elevation. After this initial startup period, the water balance is negative, meaning that other water sources will need to be continually added to the process water makeup stream to maintain the volume necessary for transport of the gypsum slurry.

The water balance is of particular concern since the entire system is designed to be a closed loop with no discharges. *(As previously noted, the recycle pond has been designed with an emergency spillway, but this is only to protect the structures in the event of an unforeseen accident or catastrophic rainfall event.)* Table 3.5-2 lists the maximum water surface elevation allowed in the recycle pond in order to prevent the discharge of water for the 100-year storm event and the 0.5 PMF storm event.

4.5 GYPSUM MANAGEMENT FACILITY OPERATION

4.5.1 Routine Operations

Gypsum slurry will initially be discharged at the southwestern corner of the gypsum pond impoundment. Settled gypsum will gradually create a plane of material sloping gently towards the north end of the impoundment. Depending on the slope of the settled gypsum, the discharge pipe may be moved to other corners of the impoundment to evenly distribute the material. Care must be taken during the initial filling period so to ensure that the sand layer covering the ring drains is not disturbed. If necessary, the sand may be armored with larger washed aggregate or

the impoundment may be gradually filled with water to cover the sand prior to the discharge of gypsum slurry into the impoundment.

Once the gypsum plane reaches approximately elevation 627 ft (5 ft below the earthen dam crest), a track excavator or similar piece of equipment will be used to create the first gypsum berm and to form the perimeter ditch. Each gypsum berm will be approximately 10 ft in height and will effectively create a two-compartment impoundment within its perimeter. Gypsum for construction of the gypsum berm will be obtained from the settled material on the inside of the berm, creating an inner ditch. Gypsum slurry will then be discharged alternately into the inner ditch of each compartment. Gypsum will settle out into the inner ditch and clarified process water will flood the compartment to a depth of several feet. This water will be decanted to the perimeter ditch by way of an HDPE decant pipe which will discharge to a stilling well located at the toe of the gypsum stack.

As each compartment fills with settled gypsum, the discharge piping will be moved to the alternate compartment. The compartment, or sub-cell, that is not in service will be allowed to dewater and another gypsum berm will be constructed on top of the previous gypsum berm, effectively raising the gypsum stack another 10 ft. This alternating cycle of gypsum discharge, compartment dewatering and berm construction will continue. Gypsum will be deposited in the stack with an average dry density of approximately 74 $lb/ft^{3.}$ Drawing No. C-10201-25 provides a visual description of this process.

4.5.2 Piezometer Installation and Monitoring

The side slopes of the gypsum pond will be constructed with 3:1 side slopes. After consolidation of the settled gypsum over time, the final slopes should approach 3.75:1. The stability of each gypsum pond slope is critically dependent on the location of the phreatic surface which is anticipated to develop within the stack. Ring drains are intended to lower the phreatic surface so that it is located an adequate distance from the surface of the slope in order to maintain slope stability. In order to monitor the phreatic surface within the stack, piezometers will be installed on each side of the gypsum pond. The piezometers will be installed every 15 vertical feet up the slope (45 horizontal feet based on 3:1 side slopes) and will extend to a depth of at least 15 feet below the anticipated phreatic water surface elevation as shown in Figure 4-1. At the time of installation, each piezometer will be labeled with the “critical elevation” corresponding to the anticipated phreatic surface elevation at that location. The anticipated phreatic surface elevation is the water surface elevation which was used in the slope stability analysis of the gypsum pond. The water level in each piezometer will be read and recorded on a monthly basis. If at any time a reading is recorded higher than “critical elevation” for that specific peizometer, the design engineer must be contacted immediately for evaluation of the reading. Any readings above the “critical elevation” may be indicative of improper ring drain function and/or slope instability which could lead to a failure of the gypsum stack. Therefore, it is critical that the piezometers are installed in accordance with the construction plans and specifications and monitored in accordance with this manual. It may be necessary to install additional subdrainage to maintain the phreatic surface at the desired level within the gypsum stack.

Figure 4-1 Anticipated Phreatic Surface in Gypsum Pond

Refer to figure at the end of the report text.

4.6 DAM INSPECTIONS

The inspection program includes two types of dam inspections. The first is regularly conducted by the dam operator and is referred to as an Operation and Maintenance Inspection. The second type of inspection, referred to as the Engineering Inspection, is conducted by a qualified engineer approved by IPGC. All engineering inspection reports must be signed and sealed by an Illinois Registered Professional Engineer.

The dam operator will perform monthly Operation and Maintenance Inspections of the gypsum pond perimeter earthen dam and the gypsum berms and side slopes during the operating life of the structure. During these inspections, the gypsum stack ditches and the transfer channel will also be examined for signs of erosion and liner degradation. The "operating life of the structure" will be considered to cease upon covering of the gypsum with an HDPE/soil cover. Engineering Inspections will be conducted on an annual basis during the operating life of the structure and will continue after covering of the gypsum pond until authorization to abandon the structure is received from IDNR/OWR.

4.6.1 Operation and Maintenance Inspection

Occasional "walk-around" inspections of the dams and appurtenant works are to be made by the dam operator. During these inspections, a checklist of items to be maintained and items to be observed should be recorded. Appendix A provides an example of the Operation and Maintenance Inspection Checklist to be utilized for these inspections. **If any of the following items are found to be unusual or are cause for concern, the Shift Supervisor should be notified and the Emergency Action Plan should be immediately consulted for guidance on an appropriate course of action.**

Frequency: Operation and maintenance inspections will be performed by the dam operator on a monthly basis and also during and after unusual events such as heavy rainfall or an earthquake.

Inspection Items: During each inspection the following items should be noted in particular.

1. Water Level - Maximum reservoir levels as a result of heavy rainfall should be recorded.

2. Earth Embankment - Walk the crest, side slopes and downstream toe of the dam concentrating on surface erosion, seepage, cracks, settlement, slumps, slides, and animal burrows. These are described as follows:

   - Surface Erosion - Removal of vegetative cover by water action or pedestrian or vehicle usage forming deep ruts or gullies.

   - Seepage - The passage of water through and/or underneath the earth embankment abutment and natural groundline or at the contact between the embankment and

outlet works. It can be indicated by cattails or other wet environmental vegetation, erosion, channelization, or slumping on the embankment face.

- Cracks - Deep cracks usually indicate the movement of the dam and/or the foundation and can be in either the longitudinal (along the length of the dam) or transverse (across the dam) directions. Cracking can be an indicator of the beginning of slumps. Shallow cracks may develop during the summer when the surface soils of the embankment become severely dried and are usually of no concern in regard to the safety of the dam.

- Settlement - Settlement is indicated by depressions or low spots and can be signs of consolidation of the dam or foundation or the loss of material beneath the settlement area.

- Slumps/Slides - A slow or sudden movement of the earth embankment slope on either face toward the toe of the dam.

- If seepage indicates the presence of soil particles, or if deep cracks, settlement, slumps, or slides are noticed, a qualified engineer should be contacted immediately for consultation.

- Animal Burrows - Animal burrows result in a loss of earth embankment material and can provide seepage paths for water through the embankment.

3. Gypsum Embankment - Walk the crest, side slopes and downstream toe of the dam concentrating on surface erosion, seepage, cracks, settlement, slumps, slides and animal burrows. The descriptions for these are the same as for earth embankment.

4. Vegetation - Grass should be a thick vigorous growth to stabilize the earth embankment soils and prevent erosion from occurring. Note the height of the grass; if greater than 1 foot a mowing of the area should be scheduled before the next inspection. There should be NO trees on the earth embankment and NONE within a minimum of 20 feet of the embankment toes or other structures. The gypsum embankment will not be seeded and is not expected to have any vegetation.

5. Gypsum Stack piezometers should be inspected for any damage or loss of function. Damaged piezometers must be promptly repaired or replaced since their function is critical to ensuring stability of the gypsum stack.

6. The water level in each Gypsum Stack piezometer must be measured and recorded during each monthly inspection. If the water level in any piezometer is above the "critical elevation" as discussed in Section 4.5.2 of this plan, the Ameren Technical Services Superintendent should be notified and the **Emergency Action Plan should be immediately consulted for guidance on an appropriate course of action**.

7. Gypsum Pond LD/LCRS Drains - The change in location or amount of flows discharging from the Leak Detection/Leachate Collection Recovery System (LD/LCRS) should be recorded. If a significant change has occurred, a qualified engineer should be contacted for consultation.

8. Gypsum Stack Ring Drains - The change in location or amount of flows discharging from the Ring Drains should be recorded. If a significant change has occurred, a qualified engineer should be contacted for consultation.

9. Gypsum Stack Fixed Decant – Check the alignment and supports for the pipe. Record the amount of flows discharging from the pipe and any erosion or scour around the discharge point.

10. Gypsum Stack Perimeter Ditch – The perimeter ditch should have a consistent prismatic shape for the entire length. Inspect the perimeter ditch for evidence of erosion, sediment deposition and irregularity in channel geometry, especially in the vicinity of siphon, decant or ring drain outfall structures. If irregularities are noted, repairs should be scheduled and completed.

11. Drawdown Facilities - Check to make sure that the drawdown stop logs in the transfer ditch are undamaged, operating well and allowing for the free flow of water over them. Confirm during inspections the valves are opened and closed at least quarterly.

12. Transfer Channel - Check for any debris or other obstructions which may block or restrict the free flow of water. Check for any pools or undulation of the floor of the channel.

13. Recycle Pond Decant - Check for any debris or other obstructions around the Recycle Pond decant which may block or restrict the free flow of water. The emergency dewatering valve should be lubricated. If there is no return water in the pipe, the emergency dewatering valve should be exercised. Record the physical and operating conditions of the system.

14. Recycle Pond Drop Inlet Spillways - Check for any debris or other obstructions around the inlet crest and at the bottom of the drop inlet which may block or restrict the free flow of water. Check for the development of any rusty areas on the concrete, and seepage, cracking, breaking, or spalling of the concrete. Check for settlement or cracking of the crest. Check for any debris in the pipes which may restrict the flow of water. Check for any tears or leaks in the HDPE liner covering the concrete.

15. Recycle Pond Rip Rap Basin - Check for any debris or other obstructions in the riprap basin which may block or restrict the free flow of water. Check to make sure that the rip rap is remaining in a uniform position. Freeze/thaw action or flow over the rip rap may tend to lift or fracture, thus requiring replacement or leveling to maintain the necessary level of protection. NO trees or woody vegetation should be growing through the rip rap.

16. Fences - Check for damage, accumulated debris, operation of gates and locks, and adequacy of locations (this may change with time as people access the area or development occurs in the area).

17. Perimeter - Check the perimeter of the dams for a distance of at least 100 feet beyond the toe for signs of seepage or boils.

18. HDPE Liner – Wherever exposed, the HDPE Liner should be inspected for tears, gouges, protrusions under the liner and abrasion.

Records: A log book of activities occurring at the dam is to be kept current by the dam operator. The log book should be reviewed during the Engineering Inspection. This book should contain at the least the following documentation:

1. Completed operation and maintenance inspection checklists
2. Readings from all piezometers on the Gypsum Stack
3. Additional visual observations
4. A list of maintenance performed
5. A list of any unusual occurrences at the dam
6. Copies of the engineering inspection reports

4.6.2 Engineering Inspection

The engineering inspection is to be conducted by a qualified engineer approved by Ameren. The inspection will provide a thorough evaluation of the dam condition and appurtenances. Appendix B is an example of the inspection report form which is to be utilized for these inspections.

Frequency: The Gypsum Pond Dam is a Class I, High Hazard Potential dam and is to be inspected by an Illinois Registered Professional Engineer at least once per year. The Recycle Pond Dam is classified as a Class III, Low Hazard Potential dams and is to be inspected by an Illinois Registered Professional Engineer at least once every five years.

Inspection Items: The engineer will thoroughly inspect all of the items noted in Section 4.6.1 Operation and Maintenance Inspection.

Records: The Dam Inspection Report form from IDNR-OWR "Guidelines and Forms for Inspection of Illinois Dams" (a copy of which is included in Appendix B), will be completed by the inspecting engineer and will be signed and sealed by an Illinois Registered Professional Engineer. This report will document problem areas and deficiencies; recommend remedial actions for problem areas; and establish time requirements for dealing with the problems. The original report will be retained in Dynegy Operating Company (DOC) files, and a copy of the report will be submitted to the Illinois Department of Natural Resources, Office of Water Resources.

4.6.3 Review of Emergency Action Plan

The emergency action plan should be reviewed annually to assure that all contacts, addresses and telephone numbers are current. Changes in the adjacent land use should also be noted and may dictate the need for revisions to the plan. Changes to the plan should be made as appropriate but only with the concurrence of the Montgomery County Emergency Services and Disaster Agency and of the Illinois Department of Natural Resources, Office of Water Resources. Copies of any revisions should also be forwarded to all personnel and known emergency responders that possess previous versions the plan.

SECTION 5.0
MAINTENANCE ACTIVITIES

Timely repairs are a must after problem areas have been identified. The dam operator is to perform the work required to correct items noted in the operation and maintenance inspections and engineering inspections. Such items include repairing erosion of the gypsum slopes, mowing, seeding, tree and brush removal, replacing rip rap, repairing fences and locks, clearing debris, etc. The maintenance activities specified in the following sections are minimum requirements. NOTE: NO alterations or repairs to structural elements should be made without the assistance of the Ameren Chief Dam Safety Engineer and the concurrence of the Illinois Department of Natural Resources, Office of Water Resources.

Debris: Remove all trash, logs and other debris which may obstruct flow into the principal spillway pipes and drop inlets, or block passage from their discharge channels.

Rip Rap: Replenish rip rap as needed to provide adequate protection against erosion.

Vegetation Control

1. Maintain a good grass cover on the embankment by seeding, fertilizing and mulching areas which are refilled, barren, or thinly vegetated. Seeding mixtures used for maintenance reseeding shall result in a cover compatible with adjacent cover. The seeding mixture specified at the time of the dam's construction was IDOT Standard Specifications Class 1A (Salt Tolerant Lawn Mixture) as follows:

   IDOT Class 1A Salt Tolerant Lawn Mixture
   Bluegrass .....60 lb/acre
   Perennial Ryegrass.....20 lb/acre
   Dawsons Red Fescue.....20 lb/acre
   Scaldis Hard Fescue .....20 lb/acre
   Fults Salt Grass .....60 lb/acre

2. Grassed areas such as the embankment and the areas beyond the embankment toes for a distance of at least 20 feet should be mowed at least twice annually or at any time the height of the grass exceeds 1 foot.

3. All erosion areas will be filled and compacted, reseeded, fertilized and mulched to establish a thick erosion resistant cover.

4. Remove all trees and brush growing on the dam embankment to prevent development of a root system which could provide seepage paths. Herbicides utilized for tree and brush control are discussed in Appendix D.

5. Keep the riprap basin clear of weeds, brush, and trees.

6. Clear all brush and trees for a distance of approximately 20 feet beyond the toe of each dam.

Animal Damage: Fill rodent holes and other animal burrows with compacted clayey soil and reseed. If rodents become a nuisance, an effective rodent control program as approved by the Illinois Department of Natural Resources District Wildlife Biologist should be implemented.

Signs: All warning signs shall be maintained (repaired, painted, or replaced) as needed.

Gypsum Slopes: Erosion of the gypsum slopes will be evident with the presence of erosion rills. Erosion rills should be filled with additional gypsum material and graded to conform with the design slope.

Piezometers: All piezometers on the gypsum stack shall be inspected for signs of damage or displacement. Non-functioning piezometers shall immediately be replaced.

APPENDIX A
LOCATION MAP

APPENDIX B
OPERATION AND MAINTENANCE INSPECTION CHECKLIST

OPERATION AND MAINTENANCE INSPECTION CHECKLIST

Dam Name (circle one): Gypsum Pond Dam Recycle Pond Dam

Date: _____ Time: _____

Name of Inspector: _____

Reservoir Elevation: _____ feet

ITEM	NO	YES	IF YES
Record Piezometer Readings for Gypsum Stack. Are any readings above the critical level? (see section 4.5.2 of O&M Manual)			Contact Manager, Environment & Chemistry and notify Hanson Professional Services
Note the condition of the Piezometers on the Gypsum Stack. Any damage?			Contact Manager, Environment & Chemistry
Deep Surface Cracks			Contact Manager, Environment & Chemistry
Slump or Slide on the upstream or downstream face			Contact Manager, Environment & Chemistry
Erosion from runoff, wave action or traffic			Repair and stabilize
Embankment, abutment or spillway seepage			Contact Manager, Environment & Chemistry
Seepage or flows of muddy water			Contact Manager, Environment & Chemistry
Uneven settlement			Contact Manager, Environment & Chemistry
Trees, brush or burrow holes on the embankment or in the riprap basin			Remove trees and brush, fill holes
Transfer channel or Spillway pipes blocked			Clear immediately
Damage to stop logs			Repair or replace
Damage to HDPE Liner			Repair and schedule engineer inspection
Settlement or displacement of Gypsum Pond fixed decant pipes or outlets			Schedule engineer inspection
Discharge from Gypsum Pond LD/LCRS Drains?			Record discharge rate for each outlet (time to fill bucket)
Discharge from Gypsum Pond Ring Drains?			Record discharge rate for each outlet (time to fill bucket)
Gypsum Stack Perimeter Ditch erosion			Schedule repair
Problems with Recycle Pond spillways			Contact Manager, Environment & Chemistry
Problems with Recycle Pond decant			Contact Manager, Environment & Chemistry
Height of grass (inches)		inches	If more than 1 foot, schedule mowing
Damage to fencing, gates and locks or other access restriction measures			Contact Manager, Environment & Chemistry
Confirm drawdown facilities are opened and closed at least quarterly.			Contact Manager, Environment & Chemistry

Comments: _____

_____

APPENDIX C
ENGINEERING INSPECTION FORMS

Dam Inspection Report

Name of Dam _____ Dam Identification Number _____

Permit Number _____ Class of Dam _____

Location NW 1/4 Section 11 Township 7N Range 3W 3rd P.M.

Owner _____ _____
Name Telephone Number (Day)

_____ _____
Street Telephone Number (Night)

_____ County Montgomery
City Zip Code

Type of Dam _____

Type of Spillway _____

Date(s) Inspected _____

Weather When Inspected _____

Temperature When Inspected _____

Pool Elevation When Inspected _____

Tailwater Elevation When Inspected _____

Inspection Personnel:

_____
Name Title

_____
Name Title

_____
Name Title

_____
Name Title

Professional Engineer's Seal

The Department of Natural Resources is requesting information that is necessary to accomplish the statutory purpose as outlined under the River, Lakes and Streams Act, 615 ILCS 5 (1994 State Bar Edition). Submittal of this information is REQUIRED. Failure to provide the required information could result in the initiation of non-compliance procedures as outlined in Section 702.160 of the "Rules for Construction and Maintenance of Dams". This form has been approved by the State Forms Management Center.

CONDITION CODES

EC	**-**	**Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; such as, pool draw down, work stoppage, plant stoppage.**
NE	**-**	**No evidence of a problem**
GC	**-**	**Good condition**
MM	**-**	**Item needing minor maintenance and/or repairs within the year, the safety or integrity of the item is not yet imperiled**
IM	**-**	**Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.**
EC	**-**	**Emergency condition which if not immediately repaired or other appropriate measures taken could lead to failure of the dam**
OB	**-**	**Condition requires regular observation to ensure that the condition does not become worse**
NA	**-**	**Not applicable to this dam**
NI	**-**	**Not inspected - list the reason for non-inspection under deficiencies**
EC	**-**	**Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; such as, pool draw down, work stoppage, plant stoppage.**

GYPSUM STACK - EARTH EMBANKMENT

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Surface Cracks			
Vertical and Horizontal Alignment of Crest			
Unusual movement or Cracking at or Beyond Toe			
Sloughing or Erosion of Outer Embankment Slopes			
Upstream Face Slope Protection (HDPE Liner)			
Seepage			
Animal Damage			

GYPSUM STACK - EARTH EMBANKMENT

(Continued)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Vegetative Cover			

GYPSUM STACK - GYPSUM EMBANKMENT

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Surface Cracks			
Vertical and Horizontal Alignment of Crest			
Unusual movement or Cracking at or Beyond Toe			
Sloughing or Erosion of **Outside** Embankment Slopes			
Sloughing or Erosion of **Inside** Embankment Slopes			
Seepage			
Animal Damage			

GYPSUM STACK - GYPSUM EMBANKMENT

(Continued)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Condition of Piezometers on Gypsum Stack			
Piezometer Readings on Gypsum Stack Above Critical Level?			

GYPSUM STACK – PERIMETER DITCH

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Ditch Geometry (15 ft bottom width, 3:1 slopes, 8-9 ft depth)			
Concrete Apron at ring drain outlets			
Ring Drain Discharge Pipes			
Stilling Wells for Fixed Decants			

TRANSFER CHANNEL - (between gypsum stack and recycle pond)

[ ] Drop Inlet Structure [X] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Debris			
Side Slope Stability			
HPDE Liner			
HDPE Liner Welds			
Stop Logs			
Differential Settlement			

RECYCLE POND - EMBANKMENT

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Surface Cracks			
Vertical and Horizontal Alignment of Crest			
Unusual movement or Cracking at or Beyond Toe			
Sloughing or Erosion of Outer Embankment Slopes			
Upstream Face Slope Protection (HDPE Liner)			
Seepage			
Animal Damage			

RECYCLE POND - EMBANKMENT

(Continued)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Vegetative Cover			

RECYCLE POND - PRINCIPAL SPILLWAY (Left, Looking Downstream)

[X] Drop Inlet Structure [ ] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Alignment of Structure Walls			
Construction Joints			
Differential Settlement			
Erosion, Spalling, Cavitation			
Joint Separation			
Seepage Around or into Conduit			
Surface Cracks			

RECYCLE POND - PRINCIPAL SPILLWAY (Left, Looking Downstream)

(Continued)

[X] Drop Inlet Structure [ ] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Structural Cracks			

RECYCLE POND - PRINCIPAL SPILLWAY (Center)

[X] Drop Inlet Structure [ ] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Alignment of Structure Walls			
Construction Joints			
Differential Settlement			
Erosion, Spalling, Cavitation			
Joint Separation			
Seepage Around or into Conduit			
Surface Cracks			

RECYCLE POND - PRINCIPAL SPILLWAY (Center)

(Continued)

[X] Drop Inlet Structure [ ] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Structural Cracks			

RECYCLE POND - PRINCIPAL SPILLWAY (Right, Looking Downstream)

[X] Drop Inlet Structure [ ] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Alignment of Structure Walls			
Construction Joints			
Differential Settlement			
Erosion, Spalling, Cavitation			
Joint Separation			
Seepage Around or into Conduit			
Surface Cracks			

RECYCLE POND - PRINCIPAL SPILLWAY (Right, Looking Downstream)

(Continued)

[X] Drop Inlet Structure [ ] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Structural Cracks			

RECYCLE POND - ENERGY DISSIPATOR

[X] Principal Spillway [ ] Outlet Works Type: FHWA HEC-14, Riprap Basin

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Riprap			
Outlet Channel			
Debris			

RECYCLE POND - DECANT STRUCTURE

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Alignment			
Connection to Bollard			
Debris in Inlets			
Condition of Pipe			
Condition of Liner Beneath Pipe			
Connection to Ballast			
Connection of Pipe Boot to Liner			

RECYCLE POND - DECANT STRUCTURE

(continued)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Seepage Around or into Conduit			

RECYCLE POND – WATER LEVEL GAGE STRUCTURE

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE

APPENDIX D
HERBICIDES

HERBICIDES

Site personnel should check with the Illinois Department of Natural Resources, Regional Fisheries Biologist and the Regional Wildlife Biologist before using any herbicide. Read the product label prior to use and follow the use directions and precautions accordingly.

On March 1, 1979 the U.S. Environmental Protection Agency (U.S.E.P.A.) halted the use of the herbicide 2, 4, 5-T in parks and recreation areas. The use of silvex (2, 4, 5-TP) around water has also been banned.

The Agronomy Department at the University of Illinois and the Aquatic Biology Section of the Department of Natural Resources, Office of Scientific Research and Analysis indicate that the herbicides containing the 2, 4-D or 2, 4-DP are legal for use in parks and recreation areas and effective for controlling brush and woody growth. Some examples of approved herbicides are:

1. Tordon RTU by DOW Chemical. (Can be obtained with blue dye.)
2. WEEDONE 170 by Union Carbide
3. WEEDONE, 2, 4-DP by Union Carbide
4. A 1% to 2% solution of ROUNDUP
5. Garlon by DOW Chemical
6. Banvel by Sandoz

Your distributor may carry brand name herbicides other than those listed above. Be certain that the product does not contain the ingredients 2, 4, 5-T or 2, 4, 5-TP. An example of an unacceptable product is ESTERON 2, 4, 5 by DOW Chemical.

APPENDIX E
CONSTRUCTION DRAWINGS

Appendix G: Photos of 2015 Sloughing Repairs

Figure G.1. Photo of 2015 sloughing prior to repairs.

Figure G.2. Photo of 2015 sloughing prior to repairs.

Figure G.3. Photo of 2015 sloughing area after repairs.

Figure G.4. Photo of 2015 sloughing area after repairs.

Geosyntec consultants

1 McBride and Son Center Drive, Suite 202
Chesterfield, MO 63005
PH 636-812-0800
www.geosyntec.com

October 11, 2021

Illinois Power Generating Company
134 Cips Lane
Coffeen, Illinois 62017

Subject: Periodic History of Construction Report Update Letter
USEPA Final CCR Rule, 40 CFR §257.73(c)
Coffeen Power Plant
Coffeen Illinois

At the request of Illinois Power Resources Generation Company (IPRG), Geosyntec Consultants (Geosyntec) has prepared this Letter to documents updates to the Initial History of Construction (HoC) report for the Coffeen Power Plant (CPP), also known as the Coffeen Power Station (COF). The Initial HoC report was prepared by AECOM in October of 2016 [1] in accordance with 40 Code of Federal Regulations (CFR) §257.73(c) of the United States Environmental Protection Agency (USEPA) Coal Combustion Residuals Rule, known as the CCR Rule [2]. This letter also includes information required by Section 845.220(a)(1)(B) (Design and Construction Plans) of the state-specific Illinois Environmental Protection Agency (IEPA) Part 845 CCR Rule [3] that is not expressly required by §257.73(c).

Coffeen

BACKGROUND

The CCR Rule required that, by October 17, 2016, Initial HoC reports to be compiled for existing CCR surface impoundments with: (1) a height of five feet or more and a storage volume of 20 acre-feet or more, or (2) a height of 20 feet or more. The Initial HoC report was required to contain, to the extent feasible, the information specified in 40 CFR §257.73(c)(1)(i)-(xii). The Initial HoC report for CPP, which included four existing CCR surface impoundments, Ash Pond No. 1 (AP1), Ash Pond No. 2 (AP2), the GMF Gypsum Stack Pond (GMF GSP, also known as the GMF Pond), and the GMF Recycle Pond (GMF RP), was prepared and subsequently posted to IPGC's CCR Website prior to October 17, 2016.

The CCR Rule requires that Initial HoC to be updated if there is a significant change to any information complied in the Initial HoC report, as listed below:

engineers | scientists | innovators

§ 257.73(c)(2): If there is a significant change to any information complied under paragraph (c)(1) of this section, the owner or operator of the CCR unit must update the relevant information and place it in the facility's operating record as required by § 257.105(f)(9).

IPRG retained Geosyntec to review the Initial HoC report, review reasonably and readily available information for AP1, AP2, the GMF GSP, and the GMF RP generated since the Initial HoC report was prepared, and perform a site visit to CPP to evaluate if significant changes may have occurred since the Initial HoC report was prepared. This Letter contains the results of Geosyntec's evaluation and documents significant changes that have occurred at AP1, AP2, the GMF GSP, and the GMF RP, as they pertain the requirements of §257.73(c)(1)(i)-(xii).

UPDATES TO HISTORY OF CONSTRUCTION REPORT

Geosyntec's evaluation for the CPP AP1, AP2, GMF GSP, and GMF RP determined that no known significant changes requiring updates to the information in the Initial HoC report pertaining to §257.73(c)(1)(ii), (iv), (v), (vi), (vii), (xi), and (xii) of the CCR Rule had occurred since the Initial HoC report was developed.

However, Geosyntec's evaluation determined that significant changes at the CPP AP1, AP2, GMF GSP, and GMF RP, pertaining to §257.73(c)(1)(i), (iii), (viii), (ix), and (x) of the CCR Rule had occurred since the Initial HoC report had been developed. Additionally, information how long the CCR surface impoundments have been operating and the types of CCR in the surface impoundments, as required by Section 845.220(a)(1)(B) of the Part 845 Rule were not included in the Initial HoC report, as this information is not required by the CCR Rule. Each change and the subsequent updates to the Initial HoC report is described within this section.

Coffeen

Section 845.220(a)(1)(B): A statement of ... how long the CCR surface impoundment has been in operation, and the types of CCR that have been placed in the surface impoundment.

Ash Pond No. 1

The AP1 was in operation from 1964 until CPP was retired in 2019 and received CCR for approximately 55 years. As of the date of this report, the AP1 has been present for approximately 57 years [4].

CCR placed in the AP1 included bottom ash [4].

Ash Pond No. 2

The AP2 was in operation from 1971 to 1984, for a total of approximately 13 years. The AP2 was closed in 1984-1985 by installing a clay cover and has not since been active or

received CCR. As of the date of this report, AP2 has been present for approximately 50 years. [4].

CCR placed in the AP2 was used to store and dispose of fly ash and bottom ash [4].

GMF Gypsum Pond

The GMF GSP was in operation from 2010 until CPP was retired in 2019 and received CCR for approximately 9 years. As of the date of this report, the GMF GSP has been present for a total of approximately 11 years [4].

CCR placed in GMF GSP included gypsum [4].

GMF Recycle Pond

The GMF RP was in operation from 2010 until CPP was retired in 2019, for a total of 9 years [4]. As of the date of this report, the GMF RP has been present for approximately 11 years.

§ 257.73(c)(1)(i): The name and address of the person(s) owning or operating the CCR unit; the name associated with the CCR unit; and the identification number of the CCR unit if one has been assigned by the state.

State identification numbers (IDs) for AP1, AP2, the GMF GSP, and the GMF RP have been assigned by the Illinois Environmental Protection Agency (IEPA). Each ID is listed in **Table 1**.

Table 1 – IEPA ID Numbers

CCR Surface Impoundment	State ID
Ash Pond No. 1 (AP1)	W1350150004-01
Ash Pond No. 2 (AP2)	W1350150004-02
GMF Gypsum Stack Pond (GMF GSP)	W1350150004-03
GMF Recycle Pond (GMF RP)	W1350150004-04

§ 257.73(c)(1)(iii): A statement of the purpose for which the CCR unit is being used.

AP2 was closed in 2020, in substantial compliance with the written closure plan posted to IPRG's CCR Website [5], and as documented by a certified Notification of Completion of Closures posted to DMG's CCR Website [6].

The CPP was retired in December of 2019, with the generation of electricity ceased at that time. Therefore, AP1, the GMF GSP, and the GMF RP are no longer being used to store and dispose of new CCR that is actively generated by CPP, as CCR generation as ceased. All three impoundments still contain CCR and liquids that was present at the time of plant

Coffeen

retirement. The GMF RP also previously received dewatering discharge from AP2; this inflow was ceased after AP2 was closed in 202.

§ 257.73(c)(1)(viii): A description of the type, purpose, and location of existing instrumentation.

Instrumentation monitoring at AP2 is no longer required as the CCR surface impoundment was closed in accordance with §257.102 [6], and the instrumentation network was modified at that time. Therefore, the instrumentation locations shown in Appendix C of the Initial HoC report are no longer applicable to AP2.

§ 257.73(c)(1)(ix): Area-capacity curves for the CCR unit.

Updated area-capacity curves were prepared for AP1, the GMF GSP, and the GMF RP in 2021 and are provided in **Figures 1**, **2**, and **3**, respectively.

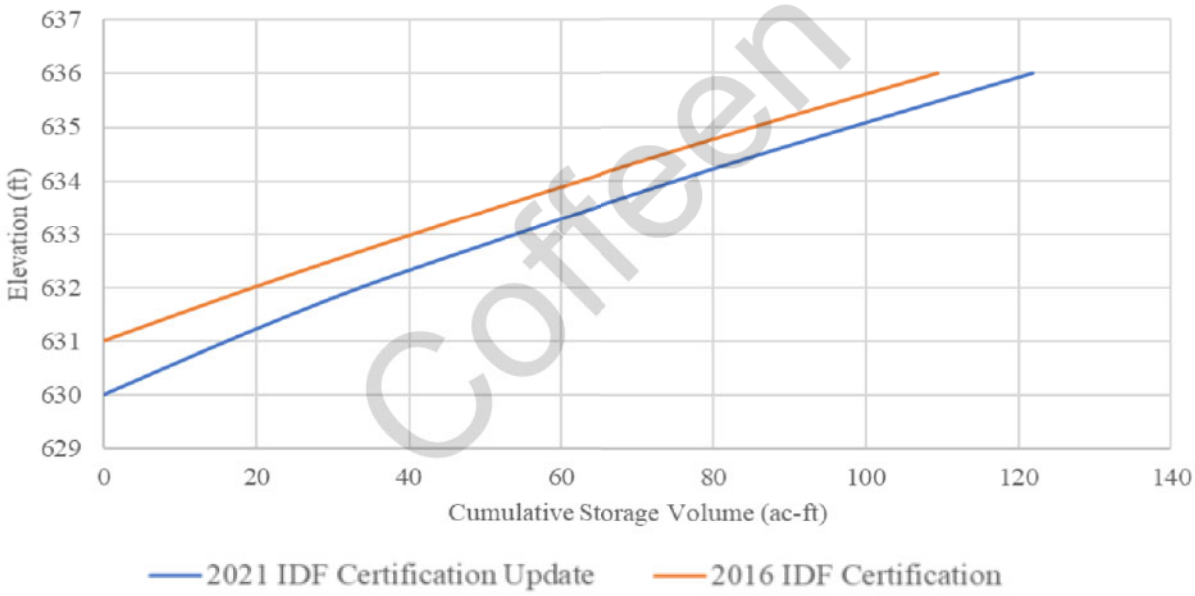


Figure 1 – Area-Capacity Curve for AP1

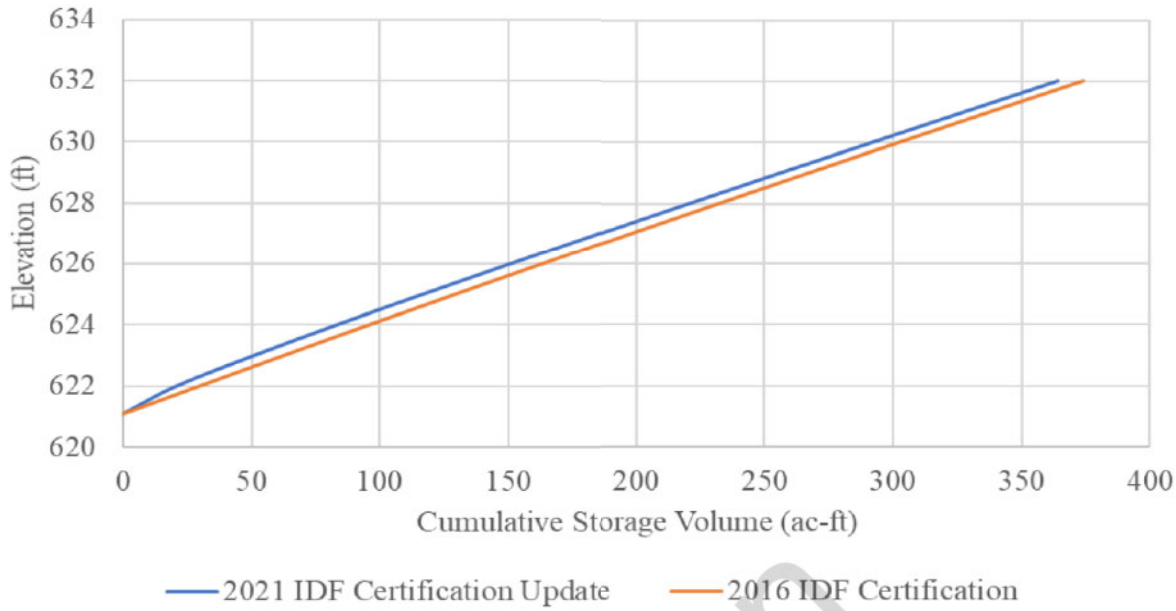
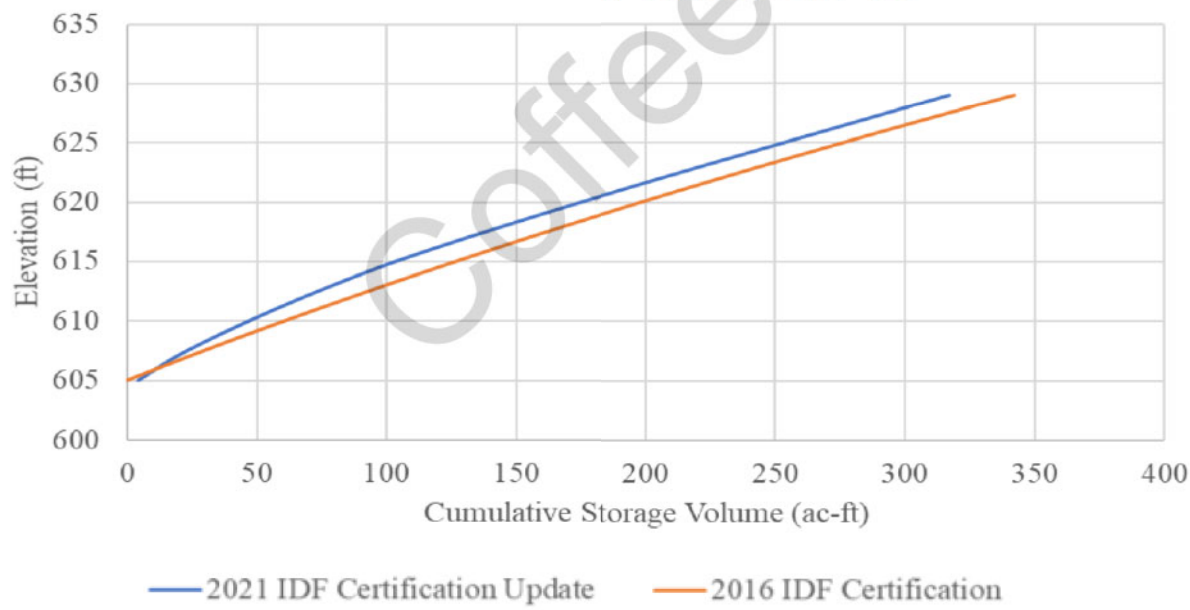


Figure 2 – Area-Capacity Curve for GMF GSP



Coffeen

Figure 3 – Area-Capacity Curve for GMF RP

§ 257.73(c)(1)(x): A description of each spillway and diversion design features and capacities and calculations used in their determination.

The primary spillway structure for AP1 was modified in 2020 by constructing a berm of bottom ash around the entrance to the spillway, to reduce the potential for freezing around the spillway during post-CPP closure conditions, with a berm crest elevation of

approximately 630 ft. Design drawings for the bottom ash berm are not reasonably or readily available.

The transfer channel between the GMF GSP and the GMF RP was modified in 2020 by constructing a geomembrane-lined berm, in order to allow the normal pool level of the GMF GSP to be increased. Design drawings for the berm are not reasonably or readily available. However, survey data [3] indicates the berm has an elevation of approximately 628 ft, a top width (perpendicular to the flow direction) of approximately 75 ft, a total length (parallel to the flow direction) of 25 ft, and side slopes of approximately 4 horizontal to 1 vertical.

Valves were installed on the intake pipes for the GMF RP after the CPP was closed and plant process water intake pumping was ceased. Design drawings for these valves are not reasonably or readily available.

Updated discharge capacity calculations for the existing spillways of AP1, the GMF GSP, and the GMF RP were prepared in 2021 using HydroCAD 10 modeling software. The calculations indicate that the AP1 and the GMF RP have sufficient storage capacity and will not overtop the embankments during the 1,000-year, 24-hour, storm event. The calculations also indicate that the GMF GSP has sufficient storage capacity and will not overtop the embankments during the Probable Maximum Precipitation (PMP), 24-hour storm event. The results of the calculations are provided in **Table 2**.

Coffeen

Table 2 – Results of Updated Discharge Capacity Calculations

	AP1	GMF GSP	GMF RP
Approximate Berm Minimum Elevation[1], ft	636.0	632.0	629.0
Approximate Emergency Spillway Elevation[1], ft	Not Present	Not Present	624.0
Starting Water Surface Elevation[1] (SWSE), ft	630.2	625.2	622.1
Peak Water Surface Elevation[1] (PWSE), ft	631.4	626.7	623.9
Time to Peak, hr	No Discharge	10.6	No Discharge
Surface Area[2], ac	18.1	34.8	16.1
Storage[3], ac-ft	19.5	52.9	29.0

Notes:
[1]Elevations are based on the NAVD88 datum
[2]Surface area is defined as the water surface area at the PWSE
[3]Storage is defined as the volume between the SWSE and PWSE

AP2 no longer retains free water as the CCR surface impoundments was closed in 2020 [6]. Therefore, the spillways are no longer present and the information regarding these structures, as presented in the Initial HoC report, is no longer applicable to AP2.

CLOSING

This letter has been prepared to document Geosyntec's evaluation of changes that have occurred at AP1, AP2, the GMF GSP, and the GMF RP since the Initial HoC was developed, based on reasonably and readily available information provided by IPRG, observed by Geosyntec during the site visit, or generated by Geosyntec as part of subsequent calculations.

Sincerely,

Lucas P. Carr, P.E.
Senior Engineer

John Seymour, P.E.
Senior Principal

Coffeen

REFERENCES

[1] AECOM, "History of Construction, USEPA Final CCR Rule, 40 CFR § 257.73(c), Coffeen Power Station, Coffeen, Illinois," October 2016.

[2] United Stated Environmental Protection Agency, "40 CFR Parts 257 and 261, Hazardous and Solid Waste Management System, Disposal of Coal Combustion Residuals from Electric Utilities, Final Rule, 2015," 2015.

[3] Illinois Environmental Protection Agency, "35 Ill. Adm. Code Part 845, Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments," Springfield, IL, 2021.

[4] AECOM, "History of Construction, USEPA Final CCR Rule, 40 CFR § 257.73(c), Hennepin Power Station, Hennepin, Illinois," October 2016.

[5] V. Modeer, "Closure Plan for Existing CCR Surface Impoundment, Coffeen Power Station, Illinois Power Generating Company, Ash Pond No. 2," October 17, 2016.

[6] D. Tickner, "Coffeen Power Station; Ash Pond No. 2; Notification of Completion of Closure," December 17, 2020.

Coffeen

APPENDIX D
TYPES OF CCR AND CHEMICAL CONSTITUENTS
(845.220(a)(2)(A)

Coffeen Power Plant - Ash Pond 2's Chemical Constituents

In accordance with 35 I.A.C. 845.220(a)(2)(A), IPGC is submitting an available/existing description of "the types of CCR expected in the CCR surface impoundment, including a chemical analysis of each type of expected CCR" in the closed CCR impoundment, Ash Pond 2.

A list of the chemical constituents' analyses contained in the IPGC surface impoundment can be found in Appendix A. Appendix A contains chemical constituents found in the subsurface free liquids as determined through antidegradation studies (per these studies, surface free liquids were not present in Ash Pond 2). IPGC is also including Safety Data Sheets for materials contains in Ash Pond 2 in Appendix B.

Appendix A: Chemical Constituents Contained in Ash Pond 2

Parameter	Units	Subsurface Free Liquids Average Concentration
Ammonia	mg/L	0.83
Arsenic	mg/L	0.022
Barium	mg/L	0.02
Boron	mg/L	5.2
Cadmium	mg/L	0.0
Chloride	mg/L	2.3
Chromium	mg/L	<0.004
Chromium (hexavalent)	mg/L	<0.005
Copper	mg/L	<0.003
Cyanide	mg/L	<0.005
Fluoride	mg/L	0.389
Iron	mg/L	276
Lead	mg/L	<0.001
Manganese	mg/L	1.9
Mercury	mg/L	<0.0002
Nickel	mg/L	<0.005
Nitrate	mg/L	<0.10
Nitrite	mg/L	<0.15
Total K Nitrogen	mg/L	1.06
Oil and Grease	mg/L	<6.0
pH	SU	6.4
Phenols	mg/L	<0.005
Phosphorus	mg/L	0.35
Selenium	mg/L	<0.001
Silver	mg/L	<0.005
Sulfate	mg/L	1485
Total Dissolved Solids (TDS)	mg/L	1838
Total Suspended Solids (TSS)	mg/L	105
Zinc	mg/L	0.012

DYNEGY

Safety Data Sheet

Section 1
Identification of the Substance and of the Supplier

1.1 Product Identifier

Product Name/Identification:	ASTM Class C Fly Ash
Synonyms:	Coal Fly Ash, Pozzolan
Formula:	UVCB Substance

1.2 Relevant Identified Uses of the Substance or Mixture and Uses Advices Against

Relevant Identified Uses:	Component of wallboard, concrete, roofing material, bricks, cement kiln feed.
Uses Advised Against:	None known.

1.3 Details of the Supplier of the SDS

Manufacturer/Supplier:	Dynegy, Inc.
Street Address:	601 Travis Street, Suite 1400
City, State and Zip Code:	Houston, TX 77002
Customer Service Telephone:	800-633-4704

Section 2
Hazards Identification

2.1 Classification of the Substance

GHS Classification(s) according to OSHA Hazard Communication Standard (29 CFR 1910.1200):

- Eye Irritant, Category 2A
- STOT-SE, Category 3 (Respiratory Irritation)
- Carcinogen, Category 1A
- STOT-RE, Category 1 (Lungs)
- Toxic to Reproduction, Category 2

2.2 Label Elements

Labelling according to 29 CFR 1910.1200 Appendices A, B and C*	
Hazard Pictogram(s):	
Signal word:	**DANGER**
Hazard Statement(s):	*Causes serious eye irritation.* *May cause damage to lungs after repeated/prolonged exposure via inhalation.* *May cause respiratory irritation.* *May cause cancer of the lung.* *Suspected of damaging fertility or the unborn child.*
Precautionary Statement(s):	*Obtain special instructions before use.* *Do not handle until all safety precautions have been read and understood.* *Avoid breathing dust.* *Wear protective gloves/protective clothing/eye protection/face protection.* *Wash thoroughly after handling.* *Do not eat drink or smoke when using this product.* *Use outdoors or in a well-ventilated area.* *If exposed or concerned: Get medical advice/attention.* *Store in a secure area.* *Dispose of product in accordance with local/national regulations.*

** Fly ash and other coal combustion products (CCPs) are UVCB substances (unknown or variable composition or biological). Various CCPs, noted as ashes/ash residuals; Ashes, residues, bottom; Bottom ash; Bottom ash residues; Waste solids, ashes under TSCA are defined as: "The residuum from the burning of a combination of carbonaceous materials. The following elements may be present as oxides: aluminum, calcium, iron, magnesium, nickel, phosphorus, potassium, silicon, sulfur, titanium, and vanadium." Ashes including fly ash and fluidized bed combustion ash are identified by CAS number 68131-74-8. The exact composition of the ash is dependent on the fuel source and flue additives composed of many constituents. The*

classification of the final substance is dependent on the presence of specific identified oxides as well as other trace elements.

2.3 Other Hazards

Listed Carcinogens:

-Respirable Crystalline Silica

IARC: [Yes] **NTP:** [Yes] **OSHA:** [Yes] **Other:** **(ACGIH)** [Yes]

Section 3
Composition/Information on Ingredients

Substance	***CAS No.***	***Percentage (%)***	***GHS Classification***
Crystalline Silica	*14808-60-7*	*30 - 60%*	*Repeat Dose STOT, Category 1* *Carcinogen, Category 1A*
Silica, crystalline respirable (RCS)	*14808-60-7*	***See Footnote 1***	*Repeat Dose STOT, Category 1* *Carcinogen, Category 1A*
Aluminosilicates	*71243-67-9* *1327-36-2*	*30 - 60%*	*Single Exposure STOT, Category 3*
Iron oxide	*1309-37-1*	*1 - 10%*	*Not Classified*
Calcium oxide (CaO)	*1305-78-8*	*20 - 30%*	*Skin Irritant, Category 2* *Eye Irritant, Category 1* *Single Exposure STOT, Category 3*
Magnesium oxide	*1309-48-4*	*2 - 10%*	*Not Classified*
Phosphorus pentoxide (P_2O_5)	*1314-56-3*	*≤2%*	*Skin Irritant, Category 2* *Eye Irritant, Category 2B*
Sodium oxide	*1313-59-3*	*1-8%*	*Not Classified*
Potassium oxide (K_2O)	*12136-45-7*	*≤1%*	*Skin Irritant, Category 2* *Eye Irritant, Category 2B*
Titanium dioxide (TiO_2)	*13463-67-7*	*<3%*	*Not Classified*
Bromide salt (calcium)	*7789-41-5*	*See Footnote 2*	*Toxic to Reproduction, Category 2*

Footnote 1: *The percentage of respirable crystalline silica has not been determined. Therefore, a GHS classification of Carcinogen, Category 1A has been assigned.*

Footnote 2: *Analytical data are not available to demonstrate that the concentration of bromide salt is <0.1%; therefore, a GHS classification of Toxic to Reproduction, Category 2 has been assigned.*

Section 4
First Aid Measures

4.1 Description of First Aid Measures

Inhalation:	If product is inhaled and irritation of the nose or coughing occurs, remove person to fresh air. Get medical advice/attention if respiratory symptoms persist.
Skin Contact:	If skin exposure occurs, wash with soap and water.
Eye Contact:	If product gets into the eye, rinse copiously with water for several minutes. Remove contact lenses, if present and easy to do. Seek medical attention/advice if irritation occurs or persists.
Ingestion:	No specific first aid measures are required.

4.2 Most Important Health Effects, Both Acute and Delayed

Acute Effects: Direct exposure may cause respiratory irritation, eye irritation and skin irritation. The product dust can dry and irritate the skin and cause dermatitis and can irritate eyes and skin through mechanical abrasion.

Chronic Effects: Chronic exposure may cause lung damage from repeated exposure. Prolonged inhalation of respirable crystalline silica above certain concentrations may cause lung diseases, including silicosis and lung cancer. Repeated exposure to dusts containing inorganic bromide salts may affect fertility and/or result in effects to the unborn child.

4.3 Indication of Any Immediate Medical Attention and Special Treatment Needed

Seek first aid or call a doctor or Poison Control Center if contact with eyes occurs and irritation remains after rinsing. Get medical advice if inhalation occurs and respiratory symptoms persist.

Section 5
Firefighting Measures

5.1 Extinguishing Media

Suitable Extinguishing Media:	Product is not flammable. Use extinguishing media appropriate for surrounding fire.
Unsuitable Extinguishing Media:	Not applicable, the product is not flammable.

5.2 Special Hazards Arising from the Substance or Mixture

Hazardous Combustion Products:	None known.

5.3 Advice for Firefighters

Special Protective Equipment and Precautions for Firefighters:	As with any fire, wear self-contained breathing apparatus (NIOSH approved or equivalent) and full protective gear.

Section 6
Accidental Release Measures

6.1 Personal Precautions, Protective Equipment and Emergency Procedures

Personal precautions/Protective Equipment:	See Section 8.2.2 Individual Protective Measures. For concentrations exceeding Occupational Exposure Levels (OELs), use a self-contained breathing apparatus (SCBA).
Emergency procedures:	Use scooping, water spraying/flushing/misting or ventilated vacuum cleaning systems to clean up spills. Do not use pressurized air.

6.2 Environmental Precautions

Environmental precautions:	Prevent contamination of drains or waterways and dispose according to local and national regulations.

6.3 Methods and Material for Containment and Cleaning Up

Methods and materials for containment and cleaning up:	Do not use brooms or compressed air to clean surfaces. Use dust collection vacuum and extraction systems. Large spills of dry product should be removed by a vacuum system. Dampened material should be removed by mechanical means and recycled or disposed of according to local and national regulations.

See Sections 8 and 13 for additional information on exposure controls and disposal.

Section 7
Handling and Storage

7.1 Precautions for Safe Handling

Practice good housekeeping. Use adequate exhaust ventilation, dust collection and/or water mist to maintain airborne dust concentrations below permissible exposure limits (note: respirable crystalline silica dust may be in the air without a visible dust cloud).

Do not permit dust to collect on walls, floors, sills, ledges, machinery, or equipment. Maintain and test ventilation and dust collection equipment. In cases of insufficient ventilation, wear a NIOSH approved respirator for silica dust when handling or disposing dust from this product. Avoid contact with skin and eyes. Wash or vacuum clothing that has become dusty. Avoid eating, smoking, or drinking while handling the material.

7.2 Conditions for Safe Storage, Including any Incompatibilities

Minimize dust produced during loading and unloading.

Section 8
Exposure Controls/Personal Protection

8.1 Control Parameters

OCCUPATIONAL EXPOSURE LIMITS					
SUBSTANCE		**OSHA PEL TWA (mg/m^3)**	**NIOSH REL TWA (mg/m^3)**	**ACGIH TLV TWA (mg/m^3)**	**CA - OSHA PEL (mg/m^3)**
Calcium oxide		5	2	2	2
Particulates Not Otherwise Regulated	Total	15	15	10	10
	Respirable	5	5	3	5
Respirable Crystalline Silica	Respirable Crystalline Silica	0.05	0.05	0.025	0.05
Titanium dioxide	Total	15	2.4 (fine) 0.3 (ultrafine)	10	10
Manganese dioxide (as manganese compounds)	Total	5 (Ceiling)	1 3 (STEL)	0.1	0.2
	Respirable	-	-	0.02	-

8.2 Exposure Controls

8.2.1 Engineering Controls

Provide ventilation to maintain the ambient workplace atmosphere below the occupational exposure limit(s). Use general and local exhaust ventilation and dust collection systems as necessary to minimize exposure.

8.2.2 Personal Protective Equipment (PPE)

Respiratory protection:	Wear a NIOSH approved particulate respirator if exposure to airborne particulates is unavoidable and where occupational exposure limits may be exceeded. If airborne exposures are anticipated to exceed applicable PELs or TLVs, a self-contained breathing apparatus or airline respirator is recommended.
Eye and face protection:	If eye contact is possible, wear protective glasses with side shields. Avoid contact lenses.
Hand and skin protection:	Wear gloves and protective clothing. Wash hands with soap and water after contact with material.

Section 9
Physical and Chemical Properties

9.1 Information on Basic Physical and Chemical Properties

Property: Value	Property: Value
Appearance (physical state, color, etc.): Fine tan/ gray particulate	**Upper/lower flammability or explosive limits:** Not applicable
Odor: Odorless[1]	**Vapor Pressure (Pa):** Not applicable
Odor threshold: Not applicable	**Vapor Density:** Not applicable
pH (25 °C) (in water): Not Determined	**Specific gravity or relative density:** 2.2 – 2.9
Melting point/freezing point (°C): Not applicable	**Water Solubility:** Slight
Initial boiling point/boiling range (°C): NA	**Partition coefficient: n-octane/water:** NA
Flash point (°C): Not determined	**Auto ignition temperature (°C):** Not applicable
Evaporation rate: Not applicable	**Decomposition temperature (°C):** Not determined
Flammability (solid, gas): Not combustible	**Viscosity:** Not applicable

[1] The use of urea or aqueous ammonia injected into the flue gas to reduce nitrogen oxides (NOx) emissions may result in the presence of ammonium sulfate or ammonium bisulfate in the ash at less than 0.1%. When ash containing these substances becomes wet under high pH (>9), free ammonia gas may be released resulting in objectionable/nuisance ammonia odor and potential exposure to ammonia gas especially in confined spaces.

Section 10
Stability and Reactivity

10.1 Reactivity:	The material is an inert, inorganic material primarily composed of elemental oxides.
10.2 Chemical stability:	The material is stable under normal use conditions.
10.3 Possibility of hazardous reactions:	The material is a relatively stable, inert material; however, when ash containing ammonia becomes wet under high pH (>9), free ammonia gas may be released resulting in an objectionable/nuisance ammonia odor and potential exposure to ammonia gas especially in confined spaces. Polymerization will not occur.
10.4 Conditions to avoid:	Product can become airborne in moderate winds. Dry material should be stored in silos. Materials stored out of doors should be covered or maintained in a damp condition.
10.5 Incompatible materials:	None known.
10. 6 Hazardous decomposition products:	None known.

Section 11
Toxicological Information

11.1 Information on Toxicological Effects

Endpoint	Data
Acute oral toxicity	LD50 > 2000 mg/kg
Acute dermal toxicity	LD50 > 2000 mg/kg
Acute inhalation toxicity	LD50 > 5.0 mg/L
Skin corrosion/irritation	Does not meet the classification criteria but may cause slight skin irritation. Product dust can dry the skin which can result in irritation.
Eye damage/irritation	Causes serious eye irritation. Positive scores for conjunctiva irritation and chemosis in 2/3 animals based on average of 24, 48 and 72-hour scores with irritation clearing within 21 days; No corneal or iritis effects observed.
Respiratory/skin sensitization	Not a respiratory or dermal sensitizer.
Germ cell mutagenicity	Not mutagenic in in-vitro and in-vivo assays with or without metabolic activation.
Carcinogenicity	Not available. Respirable crystalline silica has been identified as a carcinogen by OSHA, NTP, ACGIH and IARC.
Reproductive toxicity	No developmental toxicity was observed in available animal studies. Reproductive studies on CCPs showed either no reproductive effects, or some effects on male and female reproductive organs and parameters but without a clear dose response. Inorganic bromide salts have been shown to have adverse effects on reproductive parameters in some animal studies.
STOT-SE	CCPs when present as a nuisance dust may result in respiratory irritation.
STOT-RE	In a 180-day inhalation study with fly ash dust, no effects were observed at the highest dose tested. NOEC = 4.2 mg/m^3; it is not possible to assess the level at which toxicologically significant effects may occur. Repeated inhalation exposures to high levels of respirable crystalline silica may result in lung damage (i.e., silicosis).
Aspiration Hazard	Not applicable based product form.

Section 12
Ecological Information

12.1 Toxicity

Fly Ash C (CAS# 68131-74-8)	
Toxicity to Fish	LC50 > 100 mg/L
Toxicity to Aquatic Invertebrates	Data indicates that the test substance is not toxic to *Daphnia magna* (EC50 undetermined).
Toxicity to Aquatic Algae and Plants	EC50 = 10 mg/L

Calcium oxide CAS# 1305-78-8	
Toxicity to Fish	LC50 = 50.6 mg/L The findings were closely related to the pH of the test solutions; therefore, pH is considered to be the main reason for the effects.
Toxicity to Aquatic Invertebrates	EC50 = 49.1 mg/L The findings were closely related to the pH of the test solutions; therefore, pH is considered to be the main reason for the effects.
Toxicity to Aquatic Algae and Plants	NOEC =48 mg/L @ 72 hours based on $Ca(OH)_2$ The initial pH of the test medium was not directly related to the biologically relevant effects. The formation of precipitates is likely the result of the reaction between CO_2 dissolved in the medium.

12.2 Persistence and Degradability

Not relevant for inorganic materials.

12.3 Bioaccumulative Potential

This material does not contain any compounds that would bioaccumulate up the food chain.

12.4 Mobility in Soil

No data available.

12.5 Results of PBT and vPvB Assessment

This material does not contain any compounds classified as “persistent, bioaccumulative or toxic” nor as “very persistent/very bioaccumulative”.

12.6 Other Adverse Effects

None known.

Section 13

Disposal Considerations

See Sections 7 and 8 above for safe handling and use, including appropriate industrial hygiene practices.

Dispose of all waste product and containers in accordance with federal, state and local regulations.

Section 14
Transport Information

Regulatory entity: U.S. DOT	Shipping Name:	Not Regulated
	Hazard Class:	Not Regulated
	ID Number:	Not Regulated
	Packing Group:	Not Regulated

Section 15
Regulatory Information

15.1 Safety, Health and Environmental Regulations/Legislation Specific for the Mixture

- TSCA Inventory Status

  All components are listed on the TSCA Inventory.

- California Proposition 65.

  The following substances are known to the State of California to be carcinogens and/or reproductive toxicants:

  - Respirable crystalline silica

- State Right-to-Know (RTK)

Component	CAS	MA[1,2]	NJ[3,4]	PA[5]	RI[6]
Ammonium bisulfate	7803-63-6	No	Yes	No	No
Ammonium sulfate	7783-20-2	Yes	No	Yes	No
Calcium oxide	1305-78-8	Yes	Yes	Yes	No
Iron oxide	1309-37-1	Yes	Yes	Yes	No
Magnesium oxide	1309-48-4	No	Yes	No	No
Manganese oxide-as manganese compounds	1313-13-9; Various	No	No	Yes	Yes
Phosphorus pentoxide (or phosphorus oxide)	1314-56-3	Yes	Yes	Yes	No
Potassium oxide	12136-45-7	No	Yes	No	No
Silica-crystalline (SiO2), quartz	14808-60-7	Yes	Yes	Yes	No
Sodium oxide	1313-59-3	No	Yes	No	No
Titanium dioxide	13463-67-7	Yes	Yes	Yes	Yes

[1] Massachusetts Department of Public Health, no date
[2] 189th General Court of The Commonwealth of Massachusetts, no date
[3] New Jersey Department of Health and Senior Services, 2010a
[4] New Jersey Department of Health, 2010b
[5] Pennsylvania Code, 1986
[6] Rhode Island Department of Labor and Training, no date

Section 16
Other Information, Including Date of Preparation or Last Revision

16.1 Indication of Changes

Date of preparation or last revision: February 23, 2018

16.2 Abbreviations and Acronyms

- ACGIH: American Conference of Industrial Hygienists
- CA: California
- CAS: Chemical Abstract Services
- CCP: Coal Combustion Product
- CFR: Code of Federal Regulations
- EPA: Environmental Protection Agency

- GHS: Globally Harmonized System of Classification and Labelling
- IARC: International Agency for Research on Cancer
- LC50: Concentration resulting in the mortality of 50 % of an animal population
- LD50: Dose resulting in the mortality of 50 % of an animal population
- MA: Massachusetts
- NA: Not Applicable
- NJ: New Jersey
- NOEC: No observed effect concentration
- NIOSH: National Institute of Occupational Safety and Health
- NOx: Nitrogen oxides
- NTP: US National Toxicology Program
- OEL: Occupational Exposure Limit
- OSHA: Occupational Safety and Health Administration
- PA: Pennsylvania
- PBT: Persistent, Toxic and Bioaccumulative
- PEL: Permissible exposure limit
- PPE: Personal Protective Equipment
- REL: Recommended exposure limit
- RI: Rhode Island
- RCS: Respirable Crystalline Silica
- RTK: Right-to-Know
- SCBA: Self-contained breathing apparatus
- SDS: Safety Data Sheet
- STEL: Short-term exposure limit
- STOT-RE: Specific target organ toxicity-repeated exposure
- STOT-SE: Specific target organ toxicity-single exposure
- TLV: Threshold limit value
- TSCA: Toxic Substances Control Act
- TWA: Time-weighted average
- UEL: Upper explosive limit
- UVCB: Unknown or Variable Composition/Biological
- U.S.: United States
- U.S. DOT: United States of Department of Transportation

16.3 Other Hazards

Hazardous Materials Identification System (HMIS) Degree of hazard (0= low, 4 = extreme)							
Health:	2*	**Flammability:**	0	**Physical Hazards:**	0	**Personal protection:****	

** Chronic Health Effects*
*** Appropriate personal protection is defined by the activity to be performed.*
See Section 8 for additional information.

DISCLAIMER:

This SDS has been prepared in accordance with the Hazard Communication Rule 29 CFR 1910.1200. Information herein is based on data considered to be accurate as of date prepared. No warranty or representation, express or implied, is made as to the accuracy or completeness of this data and safety information. No responsibility can be assumed for any damage or injury resulting from abnormal use, failure to adhere to recommended practices, or from any hazards inherent in the nature of the product.

Safety Data Sheet

Section 1
Identification of the Substance and of the Supplier

1.1 Product Identifier

Product Name/Identification:	ASTM Bottom Ash
Synonyms:	Ash; Ashes; Ash residues; Ashes, residues, bottom; Bottom ash; Bottom ash residues; Coal Fly Ash; Pozzolan; Waste solids.
Formula:	UVCB Substance

1.2 Relevant Identified Uses of the Substance or Mixture and Uses Advices Against

Relevant Identified Uses:	Component of wallboard, concrete, roofing material, bricks, cement kiln feed.
Uses Advised Against:	None known.

1.3 Details of the Supplier of the SDS

Manufacturer/Supplier:	Dynegy, Inc.
Street Address:	601 Travis Street, Suite 1400
City, State and Zip Code:	Houston, TX 77002
Customer Service Telephone:	800-633-4704

Section 2
Hazards Identification

2.1 Classification of the Substance

GHS Classification(s) according to OSHA Hazard Communication Standard (29 CFR 1910.1200):

- Eye Irritant, Category 2A
- STOT-SE, Category 3 (Respiratory Irritation)
- Carcinogen, Category 1A
- STOT-RE, Category 1 (Lungs)
- Toxic to Reproduction, Category 2

2.2 Label Elements

Labelling according to 29 CFR 1910.1200 Appendices A, B and C*	
Hazard Pictogram(s):	
Signal word:	**DANGER**
Hazard Statement(s):	*Causes serious eye irritation.* *May cause respiratory irritation.* *May cause damage to lungs after repeated/prolonged exposure via inhalation.* *May cause cancer of the lung.* *Suspected of damaging fertility or the unborn child.*
Precautionary Statement(s):	*Obtain special instructions before use.* *Do not handle until all safety precautions have been read and understood.* *Avoid breathing dust.* *Wash thoroughly after handling.* *Do not eat drink or smoke when using this product.* *Wear protective gloves/protective clothing/eye protection/face protection.* *Use outdoors or in a well-ventilated area.* *If exposed or concerned: Get medical advice/attention.* *Store in a secure area.* *Dispose of product in accordance with local/national regulations.*

** Fly ash and other coal combustion products (CCPs) are UVCB substances (unknown or variable composition or biological). Various CCPs, noted as ashes/ash residuals; Ashes, residues, bottom; Bottom ash; Bottom ash residues; Waste solids, ashes under TSCA are defined as: "The residuum from the burning of a combination of carbonaceous materials. The following elements may be present as oxides: aluminum, calcium, iron, magnesium, nickel, phosphorus, potassium, silicon, sulfur, titanium, and vanadium." Ashes including fly ash and fluidized bed combustion ash are identified by CAS number 68131-74-8. The exact composition of the ash is dependent on the fuel source and flue additives composed of many constituents. The classification of the final substance is dependent on the presence of specific identified oxides as well as other trace elements.*

2.3 Other Hazards

Listed Carcinogens:

-Respirable Crystalline Silica

IARC: [Yes] **NTP:** [Yes] **OSHA:** [Yes] **Other:** **(ACGIH)** [Yes]

Section 3
Composition/Information on Ingredients

Substance	CAS No.	Percentage (%)	GHS Classification
Crystalline Silica	14808-60-7	20 - 40%	Repeat Dose STOT, Category 1 Carcinogen, Category 1A
Silica, crystalline respirable (RCS)	14808-60-7	See Footnote 1	Repeat Dose STOT, Category 1 Carcinogen. Category 1A
Aluminosilicates[2]	Various, see Footnote 2	10 - 60%	Single Exposure STOT, Category 3
Calcium oxide (CaO)	1305-78-8	10 - 30%	Skin Irritant, Category 2 Eye Irritant, Category 1 Single Exposure STOT, Category 3
Iron oxide	1309-37-1	1 - 10%	Not Classified
Manganese dioxide (MnO_2)	1313-13-9	<2%	Skin Irritant, Category 2 Eye Irritant, Category 2B
Magnesium oxide	1309-48-4	2 - 10%	Not Classified
Phosphorus pentoxide (P_2O_5)	1314-56-3	≤2%	Skin Irritant, Category 2 Eye Irritant, Category 2B
Sodium oxide	1313-59-3	1 - 10%	Not Classified
Potassium oxide (K_2O)	12136-45-7	≤1%	Skin Irritant Category 2 Eye Irritant Category 2B
Titanium dioxide (TiO_2)	13463-67-7	<3%	Not Classified

[1]The percentage of respirable crystalline silica has not been determined. Therefore, a GHS classification of Carcinogen 1A has been assigned.

[2]Aluminosilicates (CAS# 1327-36-2) may be in the form of mullite (CAS# 1302-93-8); aluminosilicate glass; pozzolans (CAS# 71243-67-9); or calcium aluminosilicates such as tricalcium aluminate (C3A), or calcium sulfoaluminate (C4A3S). The form is dependent on the source of the coal and or the process used to create the CCP. Pulverized coal combustion would be more likely to create high levels of pozzolans. Aluminosilicates may have inclusions of calcium, titanium, iron, potassium, phosphorus, magnesium and other metal oxides.

Section 4
First Aid Measures

4.1 Description of First Aid Measures

Inhalation:	If product is inhaled and irritation of the nose or coughing occurs, remove person to fresh air. Get medical advice/attention if respiratory symptoms persist.
Skin Contact:	If skin exposure occurs, wash with soap and water.
Eye Contact:	If product gets into the eye, rinse copiously with water for several minutes. Remove contact lenses, if present and easy to do. Seek medical attention/advice if irritation occurs or persists.
Ingestion:	No specific first aid measures are required.

4.2 Most Important Health Effects, Both Acute and Delayed

Acute Effects: Direct exposure may cause respiratory irritation, eye irritation and skin irritation. The product dust can dry and irritate the skin and cause dermatitis and can irritate eyes and skin through mechanical abrasion.

Chronic Effects: Chronic exposure may cause lung damage from repeated exposure. Prolonged inhalation of respirable crystalline silica above certain concentrations may cause lung diseases, including silicosis and lung cancer.

4.3 Indication of Any Immediate Medical Attention and Special Treatment Needed

Seek first aid or call a doctor or Poison Control Center if contact with eyes occurs and irritation remains after rinsing. Get medical advice if inhalation occurs and respiratory symptoms persist.

Section 5
Firefighting Measures

5.1 Extinguishing Media

Suitable Extinguishing Media:	Product is not flammable. Use extinguishing media appropriate for surrounding fire.
Unsuitable Extinguishing Media:	Not applicable, the product is not flammable.

5.2 Special Hazards Arising from the Substance or Mixture

Hazardous Combustion Products:	None known.

5.3 Advice for Firefighters

Special Protective Equipment and Precautions for Firefighters:	As with any fire, wear self-contained breathing apparatus (NIOSH approved or equivalent) and full protective gear.

Section 6
Accidental Release Measures

6.1 Personal Precautions, Protective Equipment and Emergency Procedures

Personal precautions/Protective Equipment:	See Section 8.2.2 Individual Protective Measures. For concentrations exceeding Occupational Exposure Levels (OELs), use a self-contained breathing apparatus (SCBA).
Emergency procedures:	Use scooping, water spraying/flushing/misting or ventilated vacuum cleaning systems to clean up spills. Do not use pressurized air.

6.2 Environmental Precautions

Environmental precautions:	Prevent contamination of drains or waterways and dispose according to local and national regulations.

6.3 Methods and Material for Containment and Cleaning Up

Methods and materials for containment and cleaning up:	Do not use brooms or compressed air to clean surfaces. Use dust collection vacuum and extraction systems. Large spills of dry product should be removed by a vacuum system. Dampened material should be removed by mechanical means and recycled or disposed of according to local and national regulations.

See Sections 8 and 13 for additional information on exposure controls and disposal.

Section 7
Handling and Storage

7.1 Precautions for Safe Handling

Practice good housekeeping. Use adequate exhaust ventilation, dust collection and/or water mist to maintain airborne dust concentrations below permissible exposure limits (note: respirable crystalline silica dust may be in the air without a visible dust cloud).

Do not permit dust to collect on walls, floors, sills, ledges, machinery, or equipment. Maintain and test ventilation and dust collection equipment. In cases of insufficient ventilation, wear a NIOSH approved respirator for silica dust when handling or disposing dust from this product. Avoid contact with skin and eyes. Wash or vacuum clothing that has become dusty. Avoid eating, smoking, or drinking while handling the material.

7.2 Conditions for Safe Storage, Including any Incompatibilities

Minimize dust produced during loading and unloading.

Section 8
Exposure Controls/Personal Protection

8.1 Control Parameters

OCCUPATIONAL EXPOSURE LIMITS					
SUBSTANCE		**OSHA PEL TWA (mg/m^3)**	**NIOSH REL TWA (mg/m^3)**	**ACGIH TLV TWA (mg/m^3)**	**CA - OSHA PEL (mg/m^3)**
Calcium oxide		5	2	2	2
Particulates Not Otherwise Regulated	Total	15	15	10	10
	Respirable	5	5	3	5
Respirable Crystalline Silica	Respirable	0.05	0.05	0.025	0.05
Manganese dioxide (as manganese compounds)	Total	5 (Ceiling)	1 3 (STEL)	0.1	0.2
	Respirable	-	-	0.02	-

8.2 Exposure Controls

8.2.1 Engineering Controls

Provide ventilation to maintain the ambient workplace atmosphere below the occupational exposure limit(s). Use general and local exhaust ventilation and dust collection systems as necessary to minimize exposure.

8.2.2 Personal Protective Equipment (PPE)

Respiratory protection:	Wear a NIOSH approved particulate respirator if exposure to airborne particulates is unavoidable and where occupational exposure limits may be exceeded. If airborne exposures are anticipated to exceed applicable PELs or TLVs, a self-contained breathing apparatus or airline respirator is recommended.
Eye and face protection:	If eye contact is possible, wear protective glasses with side shields. Avoid contact lenses.
Hand and skin protection:	Wear gloves and protective clothing. Wash hands with soap and water after contact with material.

Section 9
Physical and Chemical Properties

9.1 Information on Basic Physical and Chemical Properties

Property: Value	Property: Value
Appearance (physical state, color, etc.): Fine tan/ gray particulate	**Upper/lower flammability or explosive limits:** Not applicable
Odor: Odorless[1]	**Vapor Pressure (Pa):** Not applicable
Odor threshold: Not applicable	**Vapor Density:** Not applicable
pH (25 °C) (in water): 8 - 11	**Specific gravity or relative density:** 2.2 – 2.9
Melting point/freezing point (°C): Not applicable	**Water Solubility:** Slight
Initial boiling point and boiling range (°C): Not applicable	**Partition coefficient: n-octane/water:** Not determined
Flash point (°C): Not determined	**Auto ignition temperature (°C):** Not applicable
Evaporation rate: Not applicable	**Decomposition temperature (°C):** Not determined
Flammability (solid, gas): Not combustible	**Viscosity:** Not applicable

[1] The use of urea or aqueous ammonia injected into the flue gas to reduce nitrogen oxides (NOx) emissions may result in the presence of ammonium sulfate or ammonium bisulfate in the ash at less than 0.1%. When ash containing these substances becomes wet under high pH (>9), free ammonia gas may be released resulting in objectionable/nuisance ammonia odor and potential exposure to ammonia gas especially in confined spaces.

Section 10
Stability and Reactivity

10.1 Reactivity:	The material is an inert, inorganic material primarily composed of elemental oxides.
10.2 Chemical stability:	The material is stable under normal use conditions.
10.3 Possibility of hazardous reactions:	The material is a relatively stable, inert material; however, when ash containing ammonia becomes wet under high pH (>9), free ammonia gas may be released resulting in an objectionable/nuisance ammonia odor and potential exposure to ammonia gas especially in confined spaces. Polymerization will not occur.
10.4 Conditions to avoid:	Product can become airborne in moderate winds. Dry material should be stored in silos. Materials stored out of doors should be covered or maintained in a damp condition.
10.5 Incompatible materials:	None known.
10. 6 Hazardous decomposition products:	None known.

Section 11
Toxicological Information

11.1 Information on Toxicological Effects

Endpoint	Data
Acute oral toxicity	LD50 > 2000 mg/kg
Acute dermal toxicity	LD50 > 2000 mg/kg
Acute inhalation toxicity	LD50 > 5.0 mg/L
Skin corrosion/irritation	Does not meet the classification criteria but may cause slight skin irritation. Product dust can dry the skin which can result in irritation.
Eye damage/irritation	Causes serious eye irritation. Positive scores for conjunctiva irritation and chemosis in 2/3 animals based on average of 24, 48 and 72-hour scores with irritation clearing within 21 days; no corneal or iritis effects observed.
Respiratory/skin sensitization	Not a respiratory or dermal sensitizer.
Germ cell mutagenicity	Not mutagenic in in-vitro and in-vivo assays with or without metabolic activation.
Carcinogenicity	Not available. Respirable crystalline silica has been identified as a carcinogen by OSHA, NTP, ACGIH and IARC.
Reproductive toxicity	No developmental toxicity was observed in available animal studies. Reproductive studies on CCPs showed either no reproductive effects, or some effects on male and female reproductive organs and parameters but without a clear dose response.
STOT-SE	CCPs when present as a nuisance dust may result in respiratory irritation.
STOT-RE	In a 180-day inhalation study with fly ash dust, no effects were observed at the highest dose tested. NOEC = 4.2 mg/m^3; it is not possible to assess the level at which toxicologically significant effects may occur. Repeated inhalation exposures to high levels of respirable crystalline silica may result in lung damage (i.e., silicosis).
Aspiration Hazard	Not applicable based product form.

Section 12
Ecological Information

12.1 Toxicity

Fly Ash (CAS# 68131-74-8)	
Toxicity to Fish	LC50 > 100 mg/L
Toxicity to Aquatic Invertebrates	Data indicates that the test substance is not toxic to *Daphnia magna* (EC50 undetermined)
Toxicity to Aquatic Algae and Plants	EC50 = 10 mg/L
Calcium oxide CAS# 1305-78-8	
Toxicity to Fish	LC50 = 50.6 mg/L The findings were closely related to the pH of the test solutions; therefore, pH is considered to be the main reason for the effects.
Toxicity to Aquatic Invertebrates	EC50 = 49.1 mg/L The findings were closely related to the pH of the test solutions; therefore, pH is considered to be the main reason for the effects.
Toxicity to Aquatic Algae and Plants	NOEC =48 mg/L @ 72 hours based on $Ca(OH)_2$ The initial pH of the test medium was not directly related to the biologically relevant effects. The formation of precipitates is likely the result of the reaction between CO_2 dissolved in the medium.

12.2 Persistence and Degradability

Not relevant for inorganic materials.

12.3 Bioaccumulative Potential

This material does not contain any compounds that would bioaccumulate up the food chain.

12.4 Mobility in Soil

No data available.

12.5 Results of PBT and vPvB Assessment

This material does not contain any compounds classified as “persistent, bioaccumulative or toxic” nor as “very persistent/very bioaccumulative”.

12.6 Other Adverse Effects

None known.

Section 13
Disposal Considerations

See Sections 7 and 8 above for safe handling and use, including appropriate industrial hygiene practices.

Dispose of all waste product and containers in accordance with federal, state and local regulations.

Section 14
Transport Information

Regulatory entity: U.S. DOT	Shipping Name:	Not Regulated
	Hazard Class:	Not Regulated
	ID Number:	Not Regulated
	Packing Group:	Not Regulated

Section 15
Regulatory Information

15.1 Safety, Health and Environmental Regulations/Legislation Specific for the Mixture

- TSCA Inventory Status

  All components are listed on the TSCA Inventory.

- California Proposition 65

  The following substances are known to the State of California to be carcinogens and/or reproductive toxicants:

  - Respirable crystalline silica
  - Titanium dioxide

- State Right-to-Know (RTK)

Component	CAS	MA[1,2]	NJ[3,4]	PA[5]	RI[6]
Ammonium bisulfate	7803-63-6	No	Yes	No	No
Ammonium sulfate	7783-20-2	Yes	No	Yes	No
Calcium oxide	1305-78-8	Yes	Yes	Yes	No
Iron oxide	1309-37-1	Yes	Yes	Yes	No
Magnesium oxide	1309-48-4	No	Yes	No	No
Phosphorus pentoxide (or phosphorus oxide)	1314-56-3	Yes	Yes	Yes	No
Potassium oxide	12136-45-7	No	Yes	No	No
Silica-crystalline (SiO_2), quartz	14808-60-7	Yes	Yes	Yes	No
Sodium oxide	1313-59-3	No	Yes	No	No
Titanium dioxide	13463-67-7	Yes	Yes	Yes	Yes

[1] Massachusetts Department of Public Health, no date
[2] 189th General Court of The Commonwealth of Massachusetts, no date
[3] New Jersey Department of Health and Senior Services, 2010a
[4] New Jersey Department of Health, 2010b
[5] Pennsylvania Code, 1986
[6] Rhode Island Department of Labor and Training, no date

Section 16
Other Information, Including Date of Preparation or Last Revision

16.1 Indication of Changes

Date of preparation or last revision: February 23, 2018

16.2 Abbreviations and Acronyms

- ACGIH: American Conference of Industrial Hygienists
- CA: California
- CAS: Chemical Abstract Services
- CCP: Coal Combustion Product
- CFR: Code of Federal Regulations
- EPA: Environmental Protection Agency
- GHS: Globally Harmonized System of Classification and Labelling
- IARC: International Agency for Research on Cancer
- LC50: Concentration resulting in the mortality of 50 % of an animal population
- LD50: Dose resulting in the mortality of 50 % of an animal population
- MA: Massachusetts
- NA: Not Applicable
- NJ: New Jersey
- NOEC: No observed effect concentration
- NIOSH: National Institute of Occupational Safety and Health
- NOx: Nitrogen oxides
- NTP: US National Toxicology Program
- OEL: Occupational Exposure Limit
- OSHA: Occupational Safety and Health Administration
- PA: Pennsylvania
- PBT: Persistent, Toxic and Bioaccumulative
- PEL: Permissible exposure limit
- PPE: Personal Protective Equipment
- REL: Recommended exposure limit
- RI: Rhode Island
- RCS: Respirable Crystalline Silica
- RTK: Right-to-Know
- SCBA: Self-contained breathing apparatus
- SDS: Safety Data Sheet
- STEL: Short-term exposure limit
- STOT-RE: Specific target organ toxicity-repeated exposure
- STOT-SE: Specific target organ toxicity-single exposure
- TLV: Threshold limit value
- TSCA: Toxic Substances Control Act
- TWA: Time-weighted average
- UEL: Upper explosive limit
- UVCB: Unknown or Variable Composition/Biological
- U.S.: United States
- U.S. DOT: United States of Department of Transportation

16.3 Other Hazards

Hazardous Materials Identification System (HMIS) Degree of hazard (0= low, 4 = extreme)							
Health:	2*	**Flammability:**	0	**Physical Hazards:**	0	**Personal protection:****	

** Chronic Health Effects*
******* Appropriate personal protection is defined by the activity to be performed.*
See Section 8 for additional information.

DISCLAIMER:

This SDS has been prepared in accordance with the Hazard Communication Rule 29 CFR 1910.1200. Information herein is based on data considered to be accurate as of date prepared. No warranty or representation, express or implied, is made as to the accuracy or completeness of this data and safety information. No responsibility can be assumed for any damage or injury resulting from abnormal use, failure to adhere to recommended practices, or from any hazards inherent in the nature of the product.

APPENDIX E
SITE PLAN MAP AND ON-SITE TRANSPORTATION PLAN (845.220(a)(4) AND 845.220(a)(2)(E))

MONITORING WELL
PORE WATER WELL
ONSITE TRANSPORTATION ROUTE
HIGH VOLTAGE OVERHEAD ELECTRIC
HAZARDOUS LIQUID PIPELINES
CCR UNIT BOUNDARY
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

0 325 650 Feet

NOTES:
THE PROPERTY LINES ARE APPROXIMATE. ALL PRIVATE AND PUBLIC SITE UTILITIES INCLUDING, BUT NOT LIMITED TO, SERVICE ELECTRIC LINES, GAS LINES, HAZARDOUS LIQUID LINES, WATER AND SEWER LINES, TELECOMMUNICATION LINES, PLANT UTILITIES, AND/OR PRIVATE UTILITIES ARE NOT SHOWN ON THIS FIGURE AND SHALL BE VERIFIED IN THE FIELD PRIOR TO ANY SITE WORK.

SITE PLAN MAP AND TRANSPORTATION PLAN

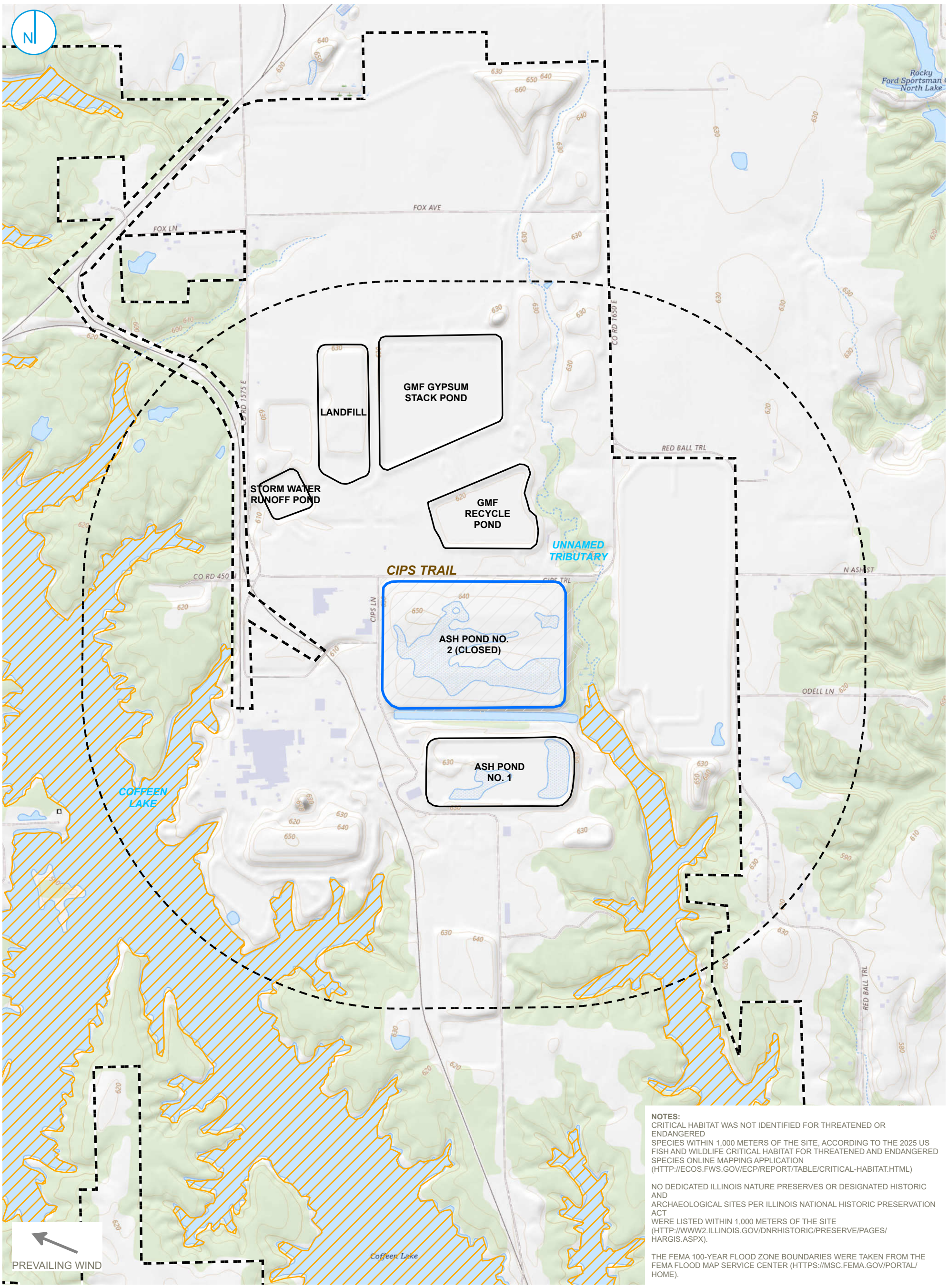
APPENDIX E

CONSTRUCTION PERMIT APPLICATION
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

APPENDIX F
SITE LOCATION MAPS (845.220(a)(3))



NOTES:
CRITICAL HABITAT WAS NOT IDENTIFIED FOR THREATENED OR ENDANGERED
SPECIES WITHIN 1,000 METERS OF THE SITE, ACCORDING TO THE 2025 US FISH AND WILDLIFE CRITICAL HABITAT FOR THREATENED AND ENDANGERED SPECIES ONLINE MAPPING APPLICATION (HTTP://ECOS.FWS.GOV/ECP/REPORT/TABLE/CRITICAL-HABITAT.HTML)

NO DEDICATED ILLINOIS NATURE PRESERVES OR DESIGNATED HISTORIC AND
ARCHAEOLOGICAL SITES PER ILLINOIS NATIONAL HISTORIC PRESERVATION ACT
WERE LISTED WITHIN 1,000 METERS OF THE SITE (HTTP://WWW2.ILLINOIS.GOV/DNRHISTORIC/PRESERVE/PAGES/HARGIS.ASPX).

THE FEMA 100-YEAR FLOOD ZONE BOUNDARIES WERE TAKEN FROM THE FEMA FLOOD MAP SERVICE CENTER (HTTPS://MSC.FEMA.GOV/PORTAL/HOME).

CCR UNIT BOUNDARY
SITE FEATURE
LIMITS OF FINAL COVER
1000 METER UNIT BUFFER
PROPERTY BOUNDARY
FEMA 100-YEAR FLOOD ZONE

0 500 1,000 Feet

SITE LOCATION MAP

APPENDIX F

CONSTRUCTION PERMIT APPLICATION
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL

APPENDIX G
CORRECTIVE ACTION PLAN AND PROPOSED SCHEDULE (845.670), INCLUDING THE CORRECTIVE ACTION ALTERNATIVES ANALYSIS (845.670(e))

Intended for
Illinois Power Generating Company
134 Cips Lane
Coffeen, Illinois 62017

Date
June 10, 2025

Project No.
1940110241-001

CORRECTIVE ACTION PLAN

ILLINOIS POWER GENERATING COMPANY, COFFEEN POWER PLANT, ASH POND NO. 2, IEPA ID NO. W1350150004-02

RAMBOLL Bright ideas. Sustainable change.

CORRECTIVE ACTION PLAN
ILLINOIS POWER GENERATING COMPANY, COFFEEN POWER PLANT, ASH POND NO. 2, IEPA ID NO. W1350150004-02

Project name	**Coffeen Power Plant Ash Pond No. 2**
Project no.	**1940110241-001**
Recipient	**Illinois Power Generating Company**
Document type	**Corrective Action Plan**
Revision	**FINAL**
Date	**June 10, 2025**
Prepared by	**Katlyn Nohr, Sarah Slagle-Garrett**
Checked by	**J. Austin Bond, PE**
Approved by	**Brian G. Hennings, PG**
Description	**Corrective Action Plan for 35 I.A.C. § 845**

Ramboll
234 W. Florida Street
Fifth Floor
Milwaukee, WI 53204
USA

T 414-837-3607
F 414-837-3608
https://ramboll.com

J. Austin Bond, PE
Qualified Professional Engineer

Brian G. Hennings, PG
Project Officer, Hydrogeology

CONTENTS

1.	**Introduction**	**3**
1.1	Plant and Site Information	3
1.2	Organization of the Corrective Action Plan	3
1.3	Permit Status	3
1.4	Closure and Source Control Status	3
1.5	Selected Corrective Action Remedy	4
1.5.1	Narrative Description of Selected Corrective Action Remedy	4
1.5.1.1	Narrative Discussion of Remedy Design and Function	5
1.5.2	Narrative Description of Proposed Remedy Operations	5
1.5.3	Narrative Description of Proposed Groundwater Monitoring	6
2.	**Corrective Action Overview**	**8**
2.1	Corrective Measures Assessment	8
2.2	Analysis of Corrective Action Alternatives	8
2.2.1	Corrective Action Alternatives Analysis Supporting Information Report	8
2.2.2	Corrective Action Alternatives Analysis	9
3.	**Corrective Action Plan**	**10**
3.1	General Requirements	10
3.2	Remedy Selection	10
3.3	Schedule for Implementation	11
3.3.1	Other Relevant Factors	16
3.4	Necessity of Interim Measures	16
4.	**References**	**18**

TABLES (WITHIN TEXT)

Table A Estimated Timeframes to Attain GWPS in Groundwater Monitoring Wells

TABLES

Table 1 Proposed Milestone Schedule for Implementing Corrective Action Remedy

APPENDICES

Appendix A Corrective Action Alternatives Analysis (845.670(e)), including Corrective Measures Assessment (845.660)

Appendix B Drawings and Material Specifications for Selected Remedy

ACRONYMS AND ABBREVIATIONS

%	percent
35 I.A.C.	Title 35 of the Illinois Administrative Code
40 C.F.R.	Title 40 of the Code of Federal Regulations
AP1	Ash Pond No. 1
AP2	Ash Pond No. 2 ("the site")
CA GMP	Corrective Action Groundwater Monitoring Plan
CAAA	Corrective Action Alternatives Analysis
CAAA-SIR	Corrective Action Alternatives Analysis Supporting Information Report
CAP	Corrective Action Plan
CCR	coal combustion residuals
CIP	closure-in-place
CMA	Corrective Measures Assessment
cm/s	centimeters per second
COC	constituent of concern
COI	contaminant of interest
CP	Construction Permit
CPP	Coffeen Power Plant
DA	deep aquifer
DCU	deep confining unit
Gradient	Gradient Corporation
GWE	groundwater extraction
GWP	groundwater polishing
GWPS	groundwater protection standard(s)
HCR	Hydrogeologic Site Characterization Report
HDPE	high-density polyethylene
ID	identification
IEPA	Illinois Environmental Protection Agency
in/yr	inches per year
ILWATER	Illinois Water and Related Wells (ILWATER)
IPGC	Illinois Power Generating Company
ISGS	Illinois State Geological Survey
kV	kilovolt
LCU	lower confining unit
NAVD88	North American Vertical Datum of 1988
No.	number
NPDES	National Pollutant Discharge Elimination System
OMM	Operation, Maintenance, and Monitoring
OP	Operating Permit
PMP	potential migration pathway
Ramboll	Ramboll Americas Engineering Solutions, Inc.
UA	uppermost aquifer
UCU	upper confining unit
USEPA	United States Environmental Protection Agency
VAC	volt alternating current

1. INTRODUCTION

1.1 Plant and Site Information

Illinois Power Generating Company (IPGC) is the owner of the inactive coal-fired Coffeen Power Plant (CPP), also referred to as the Coffeen Power Station, in Coffeen, Montgomery County, Illinois. This Corrective Action Plan (CAP) has been prepared for Ash Pond number (No.) 2 (AP2) at the CPP (site). Groundwater corrective action for AP2 will be performed under the requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845, Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments [1] and the requirements of Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257, herein referred to as the Federal coal combustion residuals (CCR) Rule [2]. AP2 is identified by Illinois Environmental Protection Agency (IEPA) identification (ID) No. W1350150004-02, CCR Unit ID No. 102, and National Inventory of Dams No. IL50723.

1.2 Organization of the Corrective Action Plan

This CAP is organized in the following manner:

- **Section 1** includes an introduction to AP2, lists the status of other 35 I.A.C. § 845 permit applications submitted to IEPA, identifies the selected remedy, and provides a narrative of remedy construction;
- **Section 2** includes an overview of the Corrective Action process, including the results of the Corrective Measures Assessment (CMA) and Corrective Action Alternatives Analysis (CAAA);
- **Section 3** provides the CAP requirements, the selected remedy, an evaluation of effectiveness, and an implementation schedule, as required by 35 I.A.C. § 845.670; and
- **Section 4** includes reference documents used in the development of this CAP.

This CAP was prepared as an attachment to a Corrective Action Construction Permit Application, as required by 35 I.A.C. § 845.220(a) and (c).

1.3 Permit Status

An Operating Permit (OP) application, as required by 35 I.A.C. § 845.230, was submitted on to IEPA by IPGC on October 25, 2021 [3]. As of the date of this CAP, IPGC's OP for AP2 is pending with IEPA.

1.4 Closure and Source Control Status

IPGC completed significant source control in 2020 as part of final closure of AP2 [4]. The final closure was performed in accordance with the Closure and Post-Closure Care Plan [5] that was developed in accordance with 40 C.F.R. § 257 and approved by IEPA on January 30, 2018 [6].

The AP2 closure construction included closure-in-place (CIP) of the entire AP2 and installation of an alternative geomembrane cover system. This was accomplished by constructing a final cover system that complies with 40 C.F.R. § 257.102 to minimize water infiltration into the closed AP2 and improve surface water drainage off the cover system, thus reducing generation of potentially impacted water and ultimately reducing the extent of CCR impacts to groundwater. The source control was predicted to lower water levels and decrease the potential transport of CCR constituents away from AP2 [7]. These completed source control activities will serve as the

primary groundwater corrective measure at AP2. The remedy presented within this CAP is intended to be supplementary to the primary remedy, which is the completed source control.

1.5 Selected Corrective Action Remedy

A horizontal groundwater extraction (GWE) well, combined with the source control completed in 2020 [4] as presented within the Final Closure Plan [5], has been identified as the most appropriate remedy for AP2, based on the CAAA provided in **Appendix A**. Potential remedies evaluated in the CAAA included source control with groundwater polishing (GWP), source control with upgradient barrier wall and GWE trench, and source control with horizontal GWE well.

The CAAA, which was prepared by Gradient Corporation (Gradient), was based on a CAAA Supporting Information Report (CAAA-SIR) that was prepared by Ramboll Americas Engineering Solutions, Inc. (Ramboll) and is attached to the CAAA. The CAAA-SIR includes the results of groundwater modeling and feasibility-level design information for each remedy.

A Groundwater Polishing Evaluation Report [8] is also attached to the CAAA. This report presents results from geochemical modeling of exceedance[1] parameters addressed at AP2 by the CAP. Geochemical modeling supports the assessment of GWP as a component of the proposed corrective action by evaluating the potential for chemical attenuation of constituents of concern (COCs) before and after source control as a means of contextualizing the times to meet groundwater protection standards (GWPS) estimated in the flow and transport model.

1.5.1 Narrative Description of Selected Corrective Action Remedy

Corrective action will consist of the completed source control (see **Section 1.4**) and the construction and operation of a horizontal GWE well beneath the eastern portion of AP2, which will serve to collect CCR-impacted groundwater. This will reduce, to the maximum extent feasible, further releases of constituents listed in 845.600 in accordance with 845.670(d)(3).

The horizontal GWE well will be continuously operated during the corrective action period, outside of routine shutdowns for maintenance and/or power outages. Groundwater corrective action performance will be monitored in accordance with the Corrective Action Groundwater Monitoring Plan (CA GMP). Estimated timelines for horizontal GWE well system operation and times to reach GWPS will be periodically reviewed and updated based on observed corrective action performance via an adaptive site management strategy. These periodic, updated estimates will be communicated to IEPA and the public within Annual Groundwater Monitoring and Corrective Action Report, in accordance with the Corrective Action Groundwater Monitoring Plan (CA GMP). The horizontal GWE well will be operated continuously until monitoring wells attain the GWPS and a determination has been made that COCs will not rebound above the GWPS after the system is removed from operation. Monitoring, groundwater modeling, and adaptive site management practices presented in the corrective action groundwater monitoring plan describe how stability in groundwater data will be evaluated before assessing if compliance with the GWPS has been

[1] Throughout this document, "exceedance" or "exceedances" is intended to refer only to potential exceedances of proposed applicable background statistics or GWPSs as described in the proposed groundwater monitoring program, which was submitted to the IEPA on October 25, 2021 as part of IPGC's operating permit application for COF AP2. That operating permit application, including the proposed groundwater monitoring program, remains under review by the IEPA and, therefore, IPGC has not identified any actual exceedances

attained to allow any transient effects of treatment on the groundwater (*e.g.,* rebounding concentrations) to dissipate.

Corrective action will be considered complete when a demonstration that GWPS compliance beyond the waste boundary has been achieved for at least three years after remedy operations have ceased and a Corrective Action Completion Report and certification have been submitted to IEPA in accordance with 35 I.A.C. § 845.680(e).

1.5.1.1 Narrative Discussion of Remedy Design and Function

The horizontal GWE design includes one horizontal well installed along an approximately 1,300-foot alignment which will be initiated from the south end of the AP2 at the base of the existing berm and run north under AP2 (*i.e.,* intersecting or perpendicular to the existing groundwater flow direction) at an approximate depth which coincides with the expected base of the CCR/native soil interface. Permit-level engineering drawings depicting the proposed remedy are provided in **Appendix B** and a list of key design components includes the following:

- The well will extend from the south end of AP2 at the base of the existing berm. The target elevation for the well is the bottom of CCR/top of the uppermost aquifer (UA) interface, which his expected to range from 600 to 606 feet[2] along the well alignment.
- The well casing will consist of slotted well screen over two targeted collection areas (expected to be around 400 feet total in length), with solid sections for areas where collection of liquids is not required.
- Following installation, the well will be developed to remove remaining drilling mud/solids. Water will be managed and discharged in accordance with applicable permits.
- The entry point will be sealed with grout to reduce surface water infiltration into the well, and a concrete pad will be constructed at the ground surface at the entry point.

Electrical and piping infrastructure to support the horizontal GWE well system will be installed. The infrastructure is expected to include:

- A shed structure to be constructed at the extraction well vault pad. The structure will house: a well vault; an air compressor to power a submersible pneumatic pump; and a shut-off valve, sample port, and flow totalizer to measure the extracted water.
- Piping will be used to convey groundwater from the extraction well sump for treatment, as needed, prior to discharge in accordance with applicable permits. This will include the installation of miscellaneous electrical controls to support data collection and system operation.

1.5.2 Narrative Description of Proposed Remedy Operations

Operations, Monitoring, and Maintenance (OMM) will be conducted on the horizontal GWE well system on a routine basis. OMM will consist of tracking the totalized flow to evaluate the flow/extraction rates from the horizontal well, and routine maintenance on system components. Waste streams associated with the horizontal GWE well system and its management may include:

[2] All elevations in this report are referenced to North American Vertical Datum of 1988 (NAVD88), unless otherwise noted.

- Conveyance piping will be flushed periodically as solids accumulation is observed as part of routine OMM inspections.
- If needed, the horizontal well will be re-developed as part of OMM inspections, likely using flushing or another technique to remove solids.

Routine equipment maintenance will be conducted per recommendations provided by the horizontal well and associated infrastructure components' manufacturers. Equipment will be replaced as needed to keep the horizontal GWE well system operating within design specifications. Equipment maintenance and/or replacement may require temporary shutdown of the horizontal GWE well system.

1.5.3 Narrative Description of Proposed Groundwater Monitoring

Corrective action groundwater monitoring will be conducted in accordance with the CA GMP during remedy operation to evaluate the effectiveness of the corrective action remedy and whether groundwater concentrations are achieving the GWPS as predicted by the groundwater model. Groundwater data collected as part of the monitoring program will be analyzed to determine if the remedy is on track to meet GWPS and inform adaptive management decisions if performance metrics are not achieved. Information associated with each of these activities is described below.

- Regular groundwater monitoring will be conducted utilizing a corrective action groundwater monitoring network designed in accordance with 35 I.A.C. § 845.680(a)(1).
- Samples will be collected on a quarterly basis initially and potentially reduced to a semiannual basis once five years of monitoring have occurred, in accordance with 35 I.A.C. § 845.650(b)(4). Monitoring results will be submitted to IEPA for each monitoring event, in addition to an Annual Groundwater Monitoring and Corrective Action Report, in accordance with 35 I.A.C. § 845.610(e).
- Routine maintenance of the monitoring well network will include inspecting the wells, making repairs to the wells (as needed) and rehabilitating and/or replacing wells to improve performance (as needed).
- Adaptive site management strategies will be employed as an integral part of ongoing CA. The adaptive site management approach will allow timely incorporation of new site information to ensure the achievement of the GWPS. The effectiveness of the remedy at each phase is evaluated using performance metrics designed to assess the goals of that phase. Performance metrics answer questions designed to evaluate multiple aspects of remedy effectiveness with the ultimate goal of holistically guiding management decisions [7]. The goals and performance metrics of each phase of remedy evaluation are presented in Section 3 of the CA GMP included in the CP application.
- Documentation of remedy progress metrics will be provided in the Annual Groundwater Monitoring and CA Report beginning after the second year of data collection: a minimum of eight data points is required to complete meaningful statistical analysis required for evaluation of the remedy progress metrics, which will be available after two years of quarterly sampling. Per USEPA guidance [9], a thorough review of CA progress and remedy effectiveness will be conducted every five years. A Five-Year Annual Groundwater Monitoring and CA Report will evaluate the comprehensive data set and, if triggered by the results of the remedy progress evaluation metrics, evaluate whether adaptive management actions are needed. The five-year

time frame allows adaptive management decisions to be based on a robust data sufficient to complete meaningful statistical analysis while remaining responsive to changing site conditions [9].

- Corrective Action Confirmation Monitoring and Completion
  - Per 35 I.A.C. § 845.680(c), corrective action is considered complete when compliance with the GWPS has been demonstrated "at all points within the plume of contamination that lies beyond the waste boundary […] for a period of three consecutive years." At that time, an attainment evaluation will be implemented. This will include monitoring each well for three additional years to confirm that GWPS have been achieved, in accordance 35 I.A.C. § 845.680(c).
  - After completion of the corrective action confirmation monitoring period, a Corrective Action Completion Report and Certification will be prepared and submitted to IEPA, in accordance with 35 I.A.C. § 845.680(e).

2. CORRECTIVE ACTION OVERVIEW

This CAP is based on the tiered assessment and analysis of alternative remedial technologies and remedies that were completed via the CMA and CAAA (**Appendix A**). The objective of these assessments was to determine the most appropriate alternative for AP2 that, when coupled with the source control previously completed as proposed in the Final Closure Plan [5], would remediate groundwater and provide compliance with the GWPS specified under 35 I.A.C. § 845.600.

2.1 Corrective Measures Assessment

The CMA [10] was performed for AP2 and submitted to the IEPA on June 12, 2024, after the exceedances of the GWPS were identified. The CMA considered four corrective measures for AP2, including:

- Source control with GWP;
- Source control with GWE;
- Source control with groundwater cutoff wall; and
- Source control with in-situ chemical treatment

Based on the CMA, three corrective measures, including source control with GWP, source control with GWE, and source control with groundwater cutoff wall were identified as potentially viable corrective measures for AP2. Of these measures, source control with GWP, source control with GWE, and source control with groundwater cutoff wall were included for further evaluation, design advancement, and comparative assessment within the CAAA. The source control with groundwater cutoff wall was expanded to also include GWE. Additionally, the source control with GWE remedy was further defined as the horizontal GWE well remedy as presented in this CAP. Additional information on these refinements are discussed in the CAAA provided in **Appendix A**.

2.2 Analysis of Corrective Action Alternatives

2.2.1 Corrective Action Alternatives Analysis Supporting Information Report

The CAAA for AP2 was prepared by Gradient based on the CAAA-SIR prepared by Ramboll. The CAAA-SIR, which is included as Attachment B of the CAAA provided in **Appendix A**, included additional evaluation, design advancement, and comparative assessment of the source control with GWP, source control with upgradient barrier wall and GWE trench, and source control with horizontal GWE well corrective measures identified as potentially viable for AP2 by the CMA. The evaluation included the completion of feasibility-level design activities for each alternative and incorporated the following tasks:

- Performing predictive groundwater modeling to evaluate the scope (*i.e.,* location and extents) of each alternative and the corresponding estimated time to achieve GWPS;
- Developing feasibility-level design drawings showing the extents in plan and elevation view of each engineered remedy;
- Estimating the time required to design, construct, and implement each remedy, in addition to ongoing operational and maintenance requirements;

- Developing conceptual plans for the storage, treatment, and discharge of extracted groundwater for applicable remedies;
- Identifying future tasks required to implement each alternative, including permitting, investigation, and design efforts; and
- Estimating relevant material quantities, labor hours, delivery miles, equipment miles, and daily commuting miles associated with constructing each remedy.

2.2.2 Corrective Action Alternatives Analysis

The CAAA (**Appendix A**) included a detailed analysis of each of the corrective action alternatives presented in the CAAA-SIR, including an evaluation of:

- Long- and short-term effectiveness and protectiveness;
- Ease or difficulty of implementation;
- Degree to which community concerns are addressed; and,
- Relative amount of contamination removed from the environment.

Based on the CAAA, source control with horizontal GWE well was identified as the most appropriate corrective action for AP2 and was selected for further design development as part of this CAP.

It should be noted that the permit-level engineering assessments, groundwater modeling, and other information contained within this CAP were developed to a higher level of design and detail than those assessments performed in the CAAA; therefore, information on items such as permitting, remedy scope, estimated time to reach GWPS, implementation schedule, etc. may differ between this CAP and the information included in the CAAA-SIR and CAAA. Information for the source control with horizontal GWE well contained within the CAP should be considered to supersede information contained within the CAAA and CAAA-SIR.

3. CORRECTIVE ACTION PLAN

The 35 I.A.C. § 845 requirements for the CAP and corresponding demonstrations that the proposed corrective measures meet these requirements are discussed individually in this section. Many of the CAP requirements are discussed within the CMA and CAAA documents that have been prepared to support the CAP. Therefore, the demonstrations will also refer to those documents.

3.1 General Requirements

35 I.A.C. § 845.670(c): The corrective action plan must meet the following requirements:

(1) Be based on the results of the corrective measures assessment conducted under 35 I.A.C. § 845.660;

(2) Identify a selected remedy that at a minimum, meets the standards listed in subsection (d);

(3) Contain the corrective action alternatives analysis specified in subsection (e); and

(4) Contain proposed schedules for implementation, including an analysis of the factors in subsection (f).

This CAP is based on the results of the CMA and CAAA, which are included within **Appendix A**. The proposed schedule for implementing source control with horizontal GWE well is provided in **Table 1**.

3.2 Remedy Selection

35 I.A.C. § 845.670(d): The selected remedy in the corrective action plan must:

(1) Be protective of human health and the environment;

Current conditions at AP2 pose no risk to human health or the environment [11]. Concentrations of CCR-derived constituents are anticipated to decline once the horizontal GWE well active remedy is in place as presented in the CAAA (**Appendix A**). The horizontal well would drain water from beneath AP2 reducing hydraulic head beneath AP2, which would accelerate achieving GWPS.

(2) Attain the groundwater protection standards specified in 35 I.A.C. § 845.600;

Groundwater modeling indicates a horizontal GWE well (Appendix B of the CAAA-SIR, which is attached in **Appendix A**), which is selected as the remedy of this CAP, will result in attainment of the GWPS in the current monitoring system within 14 years.

(3) Control the sources of releases to reduce or eliminate, to the maximum extent feasible, further releases of constituents listed in 35 I.A.C. § 845.600 into the environment;

AP2 was closed using a closure-in-place approach, which is currently acting as the main control mechanism to prevent further releases of CCR-derived constituents. The horizontal GWE well will, to the maximum extent feasible, prevent further releases of CCR-derived constituents in groundwater until the GWPS are achieved.

The main source of CCR-derived constituent release occurred as a result of surface water infiltration and precipitation coming into contact with AP2 CCR prior to completion of the final closure. Surface water infiltration has been controlled, minimized, or eliminated as much as feasible with the final closure completed in 2020 [4]. The horizontal GWE well is designed to provide continuous hydraulic control and capture of groundwater to reduce the time to attain the GWPS. If the remedy is found to be unsuccessful in meeting remediation goals, adaptive site management actions will be taken as described within the CA GMP (Appendix B).

(4) Remove from the environment as much of the contaminated material that was released from the CCR surface impoundment as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems; and

No known releases of CCR due to a structural integrity issue have occurred at AP2.

(5) Comply with standards for management of wastes as specified in 35 I.A.C. § 845.680(d).

The CCR managed as part of the corrective action (source control with horizontal GWE well) will be done in accordance with all 35 I.A.C. § 845 requirements and the submitted closure plan [5].

3.3 Schedule for Implementation

GWE via horizontal well is effective as an engineering control as it provides hydraulic control at the eastern boundary. GWE has been demonstrated as a reliable and applicable ex-situ remedial technology by the United States Environmental Protection Agency (USEPA) [12]. GWE via horizontal wells (or "directional wells") for remediation is accepted by the USEPA as an effective technology for extraction beneath landfills, interception of vertical features, and/or providing hydraulic control along the leading edge of a plume [12]**.** The horizontal GWE will continue to operate as the CA following source control until (1) GWPS have been met and (2) it has been determined that potential rebound above GWPS is not expected after operation of the GWE is ceased. Monitoring and adaptive site management practices presented in the corrective action groundwater monitoring plan will be used to determine when operations of the GWE will cease after the GWPS has been met. The corrective action groundwater monitoring plan describes how stability in groundwater data will be evaluated before assessing if compliance with the GWPS has been attained to allow any transient effects of treatment on the groundwater (*e.g.,* rebounding concentrations) to dissipate.

The horizontal GWE well remedy will successfully attain GWPS in a reasonable time as discussed in the following subsections. Timeframes to attain GWPS in the groundwater monitoring wells summarized in Table A indicate that 40% of progress is expected to occur within the first 5 years after remedy construction.

Table A. Estimated Timeframes to Attain GWPS Groundwater Monitoring Wells

Description	5 years**	10 years**	14 years**
Percentage of Wells predicted to attain GWPS*	40%	60%	100%

*: 5 wells were used in the 2025 Groundwater Modeling Technical Memorandum.

** Years counted starting from completion of corrective action.

<u>35 I.A.C. § 845.670(f)</u>: The owner or operator must specify, as part of the corrective action plan, a schedule for implementing, of and completing, remedial activities. The schedule must require the completion of remedial activities within a reasonable time, taking into consideration the

factors in this subsection (f). The owner or operator of the CCR surface impoundment must consider the following factors in determining the schedule of remedial activities:

The schedule for implementing and completing the source control with horizontal GWE well remedy at AP2 is included in **Table 1**. The schedule was developed considering the factors required by 35 I.A.C. §§ 845.670(f)(1) through (5), as summarized below.

35 I.A.C. § 845.670(f)(1): Extent and nature of contamination, as determined by the characterization required under 35 I.A.C. § 845.650(d);

The Nature and Extent Report [13], which was submitted to the IEPA on June 12, 2024 and is included as an attachment to the CAAA (**Appendix A**), details exceedances of GWPS. Groundwater modeling and geochemical analysis were performed by Ramboll as part of the CAAA-SIR to design the remedy, and the modeling considered the nature and extent of contamination.

35 I.A.C. § 845.670(f)(2): Reasonable probabilities of remedial technologies achieving compliance with the GWPS established by 35 I.A.C. § 845.600 and other objectives of the remedy;

Several remedies were evaluated in the CAAA (**Appendix A**), and it was determined that the selected remedy (source control with horizontal GWE well) is expected to achieve compliance with 35 I.A.C. § 845.600 in a reasonable timeframe. The potential for remedial technologies to achieve compliance with the GWPS were evaluated using groundwater modeling [14]. The results of the modeling indicates that the groundwater in the UA groundwater unit will attain the GWPS for all constituents within approximately 14 years after remedy construction.

As discussed in the CMA, source control and GWE are proven methods for addressing groundwater contamination [10]. The previously completed closure-in-place approach (*e.g.,* source control) is consistent with the requirements of 40 C.F.R. § 257.

35 I.A.C. § 845.670(f)(3): Availability of treatment or disposal capacity for CCR managed during implementation of the remedy;

The selected remedy includes CIP and GWE. The horizontal GWE well system is expected to result in the generation and management of a small volume of drill cuttings, which would contain CCR. CCR waste generated during implementation of the remedy would be placed into off-road dump trucks and hauled to the on-site landfill for disposal. The on-site landfill is expected to have sufficient capacity to dispose of the small volume of waste.

35 I.A.C. § 845.670(f)(4): Potential risks to human health and the environment from exposure to contamination before completion of the remedy;

A Human Health and Ecological Risk Assessment was completed and included as an attachment to the CAAA (**Appendix A**). The overall conclusion is that groundwater from the AP2 impoundment and potential groundwater contributions to surface water pose no unacceptable risks to human health or the environment. This conclusion is based on modeled and detected maximum concentrations of all COCs in surface water at the NPDES permitted discharge that were below conservative risk-based screening benchmarks. This conclusion was reached using methodology consistent with applicable USEPA risk assessment principles. The assessment relied

on conservative assumptions meant to overestimate possible exposures and risks and provide an additional level of certainty in the conclusions.

35 I.A.C. § 845.670(f)(5): Resource value of the aquifer, including:

The resource value of the aquifer is discussed in the Hydrogeologic Site Characterization Report (HCR), which is included as Appendix A in the Final Closure Plan [15]. The UA includes the sands, silty sands, and clays at the base of the Hagarstown Member and, in some locations, the uppermost weathered sandy clay portion of the Vandalia Member. This unit is absent in some locations at the CPP due to weathering and in others due to excavation during construction of the CCR units. The underlying lower confining unit (LCU) has been identified as a potential migration pathway (PMP) because downward vertical gradients indicate that there is the potential for impacts to migrate within this unit. Groundwater flows southeasterly below AP2 toward a historic process flume and an unnamed tributary leading to Coffeen Lake.

As set forth in 35 I.A.C. § 620.210, groundwater within the UA at AP2 meets the definition of Class I – Potable Resource Groundwater, as geologic material with a hydraulic conductivity of $1x10^{-4}$ centimeters per second (cm/s) or greater and located 10 feet or more below the land surface. This information was also considered in the CAAA as part of the Human Health and Ecological Risk Assessment, which concluded that groundwater from the AP2 impoundment and potential groundwater contributions to surface water pose no unacceptable risks to human health or the environment.

The source control with horizontal GWE well remedy will result in decline of concentrations of CCR-derived constituents in the UA and PMPs. No off-site migration of CCR-derived constituents is expected to occur. Groundwater polishing and adaptive site management following source control will function until the GWPS is achieved in accordance with the CA GMP. Paragraphs (A) through (F) from 35 I.A.C. § 845.670(f)(5) are further addressed, as summarized below.

35 I.A.C. § 845.670(f)(5)(A): Current and future uses, including potential residential, agricultural, commercial industrial and ecological uses; and

Current uses and users of the groundwater are discussed in HCR Section 2.5 [15] and attachments and were considered in the CAAA as part of the Human Health and Ecological Risk Assessment which concluded that groundwater from the AP2 impoundment and potential groundwater contributions to surface water pose no unacceptable risks to human health or the environment. No changes in future residential, commercial, or ecological use are expected. In the absence of changes to current and future uses there is no applicable scheduling consideration.

35 I.A.C. § 845.670(f)(5)(B): Proximity and withdrawal rate of users;

A water well inventory was completed in 2017 for AP2 and in 2021 for Ash Pond No. 1 (AP1), which is located 350 feet south of AP2 [16]. In 2024, Gradient updated the 2017 well survey as part of the HHERA [11].

A search of the Illinois State Geological Survey (ISGS) Illinois Water and Related Wells (ILWATER) Map identified 19 wells located within 1,000 meters of AP2. The wells that were identified included 13 monitoring wells and six farm/domestic wells. There is one farm/domestic well (121352283200) located north of and side-gradient to AP2, and on the west side of the unnamed tributary to Coffeen Lake. The well, which was installed in 1981, is located near the former location of several prior residences. The well was removed during the construction of the

Gypsum Management Facility Recycle Pond (GMF RP) in 2010. Additionally, the property in this area has been purchased by IPGC and no residents are currently living or using groundwater in the area. While there is no information available on the current use of the remaining five farm/domestic wells, they are located on the east/southeast side of Coffeen Lake's eastern branch and the unnamed tributary, *i.e.*, the opposite side of the lake from AP2. These surface water bodies are hydraulic boundaries that prevent shallow groundwater from flowing past or underneath them.

The assessment concluded there are no existing off-site water wells, potable or non-potable, that could potentially be impacted by groundwater from AP2. This information was also considered in the CAAA as part of the Human Health and Ecological Risk Assessment, which concluded that groundwater from the AP2 impoundment and potential groundwater contributions to surface water pose no unacceptable risks to human health or the environment. In the absence of changes in current and future uses, there is no applicable scheduling consideration for proximity and withdrawal rates of users.

35 I.A.C. § 845.670(f)(5)(C): Groundwater quantity and quality;

Per 35 I.A.C. § 620.210, groundwater within the UA at AP2 meets the definition of Class I – Potable Resource Groundwater [15]. The Human Health and Ecological Risk Assessment (Appendix A in CAAA Report) concluded that groundwater from the AP2 impoundment and potential groundwater contributions to surface water pose no unacceptable risks to human health or the environment.

35 I.A.C. § 845.670(f)(5)(D): The potential impact to the subsurface ecosystem, wildlife, other natural resources, crops, vegetation, and physical structures caused by exposure to CCR constituents;

A comprehensive search of the IDNR Natural Heritage Database and Historic Preservation Division database was performed to identify nature preserves, endangered/threatened species and historic sites in the vicinity of AP2 was completed to address comments received from the IEPA on the Operating Permit [17]. The results of the survey indicated that no nature preserves, protected areas, or historic sites are present within 1,000 meters of the site.

A search of Section 3.5 of the Human Health and Ecological Risk Assessment included as Appendix A of the CAAA and CMA/CAAA Report discusses the ecological risk evaluation.

- Ecological receptors exposed to surface water include aquatic and marsh plants, amphibians, reptiles, and fish. The risk evaluation showed that none of the contaminants of interest (COIs) in surface water exceeded protective screening benchmarks.
- Ecological receptors exposed to sediment include benthic invertebrates. The modeled sediment COIs did not exceed the conservative screening benchmarks, therefore, none of the COIs evaluated in sediment are expected to pose an unacceptable risk to ecological receptors.
- Ecological receptors were also evaluated for exposure to bioaccumulative COIs. This evaluation considered higher trophic-level wildlife with direct exposure to surface water and sediment and secondary exposure through the consumption of dietary items (*e.g.*, plants, invertebrates, small mammals, fish). Based on US EPA Region 4 Ecological Risk Assessment Supplemental Guidance (March 2018 Update) [18], mercury and selenium were identified as bioaccumulative COIs. However, the maximum detected concentration for mercury and the maximum detection limit for selenium (which was undetected) in surface water were below

benchmarks protective of bioaccumulative effects. In addition, modeled sediment concentrations were also below benchmarks protective of bioaccumulative exposures.

Overall, this evaluation demonstrated that none of the COIs evaluated are expected to pose an unacceptable risk to ecological receptors.

35 I.A.C. § 845.670(f)(5)(E): The hydrogeologic characteristic of the facility and surrounding land; and

In addition to the CCR present at AP2, there are five principal layers of unlithified material present above the bedrock, which are categorized into the hydrostratigraphic units described below (from surface downward) based on stratigraphic relationships and common hydrogeologic characteristics:

- **Upper Confining Unit (UCU):** Composed of the Roxana and Peoria Silts (Loess Unit) and the upper clayey portion of the Hagarstown member which are classified as silts to clayey silts and gravelly clay below the surficial soil. Loess Unit thickness ranges from 0 feet (absent) to 16 feet and the clayey portion of the Hagarstown member is up to 6 feet thick. The UCU has been eroded east of AP2, near the unnamed tributary.
- **Uppermost Aquifer (UA)**: The UA is the Hagarstown Member which is classified as primarily sandy to gravelly silts and clays with thin beds of sands. Where present, the sandy portion of the Hagarstown is generally 2 to 4 feet thick. Similar to the Loess Unit, the Hagarstown is absent in some locations near the unnamed tributary. Hydraulic conductivity in the UA is moderate.
- **Lower Confining Unit (LCU):** Comprised of the Vandalia Member, Mulberry Grove Member, and Smithboro Member. These units include a sandy to silty till with thin, discontinuous sand lenses, a discontinuous and limited extent sandy silt which has infilled prior erosional features, and silty to clayey diamicton, respectively. The unit was encountered in all borings on the CPP. This LCU has been identified as a PMP because downward vertical gradients indicate that there is the potential for impacts to migrate within this unit despite very low permeability.
- **Deep Aquifer (DA):** Sand and sandy silt/clay units of the Yarmouth Soil, which include accretionary deposits of fine sediment and organic materials, typically less than 5 feet thick and discontinuous across the CPP. Where present, the DA has been identified as a potential PMP due to presence of downward gradients in the overlying LCU and the relatively greater hydraulic conductivities measured in the DA. Hydraulic conductivity in the DA is moderate.
- **Deep Confining Unit (DCU):** Comprised of the Banner Formation, and generally consists of clays, silts, and sands. The Lierle Clay Member is the upper layer of the Banner Formation which was encountered at the Site. No boring locations penetrated the full thickness of the Lierle Clay.

The effects of these hydrostratigraphic units on schedule were considered by incorporating the geometry, hydraulic, and geochemical properties of these units into the groundwater modeling report and Groundwater Polishing Evaluation Report, attached to the CAAA-SIR and CAAA, respectively, included in **Appendix A**, which estimate the time to reach the GWPS for remedial alternatives.

The horizontal GWE well remedy will drain water from beneath AP2, reducing hydraulic head beneath AP2, which will accelerate achieving GWPS. The horizontal GWE well will be operated

continuously until monitoring wells attain the GWPS and a determination has been made that COCs will not rebound above the GWPS after the system is removed from operation.

35 I.A.C. § 845.670(f)(5)(F): The availability of alternative water supplies.

As discussed in subsection 670(f)(5)(B), there are 19 water wells within 1,000 meters of AP2 [16]. There is currently no need for an alternative water supply well as there are no current unacceptable risks to human or ecological receptors at the site. There are no applicable schedule concerns regarding the availability of alternative water supplies.

3.3.1 Other Relevant Factors

35 I.A.C. § 845.670(f)(6): Other relevant factors.

No additional factors were identified for consideration.

3.4 Necessity of Interim Measures

Source control using the closure-in-place approach was completed in 2020 [4]. Completion of the horizontal GWE well remedy is projected to be complete within four to six years after approval of the CAP. 35 I.A.C § 845.680(a)(3) states the owner or operator must take any interim measures necessary to reduce the contaminants leaching from the CCR surface impoundment, and/or potential exposures to human or ecological receptors. Because source control has already been completed and current conditions at AP2 pose no risk to human health or the environment, no interim measures are required. Further, all subsections of this requirement are discussed as follows.

35 I.A.C. § 845.680(a)(3)(A): Time required to develop and implement a final remedy.

Completion of the horizontal GWE well remedy is projected to be complete within four to six years after approval of the CAP.

35 I.A.C. § 845.680(a)(3)(B): Actual or potential exposure of nearby populations or environmental receptors to any of the constituents listed in 35 I.A.C. § 845.600.

There are no current unacceptable risks to human or ecological receptors at the site (**Appendix A**). It was concluded that shallow groundwater and surface water are not a source of drinking water [11].

35 I.A.C. § 845.680(a)(3)(C): Actual or potential contamination of sensitive ecosystems or current or potential drinking water supplies.

The nature and extent of exceedances have been evaluated in the Nature and Extent Report [13]. Although there are exceedances of GWPS, there are no impacts to current or potential drinking water supplies. As stated above, there are no current unacceptable risks to human or ecological receptors at the site. Additionally, an ecological risk assessment was completed, and no unacceptable risks were identified for ecological receptors exposed to surface water and sediment [11]. No potential groundwater receptors are in the vicinity of AP2 [11].

35 I.A.C. § 845.680(a)(3)(D): Further degradation of the groundwater that may occur if remedial action is not initiated expeditiously.

Source control, which consisted of the closure-in-place approach, was completed [4] and no unacceptable risks to human health or the environment have been identified. No interim measure is expected to prevent further degradation of the groundwater more expeditiously than implementation of the selected remedy.

35 I.A.C. § 845.680(a)(3)(E): Weather conditions that may cause any of the constituents listed in 35 I.A.C. § 845.600 to migrate or be released.

As stated above, source control which consisted of the closure-in-place approach was completed in 2020 [4], which isolate CCR contained within AP2 from weather-related impacts that could cause CCR-related constituents to migrate or be released. There are no unacceptable risks presented by AP2 under current conditions from weather-related phenomena.

35 I.A.C. § 845.680(a)(3)(F): Potential for exposure to any of the constituents listed in 35 I.A.C. § 845.600 as a result of accident or failure of a container or handling system.

There are no container or handling systems that pose a risk to receptors in the interim.

35 I.A.C. § 845.680(a)(3)(G): *Other situations that may pose threats to human health and the environment.*

No other situations have been identified where AP2 CCR leachate poses threats to human health and the environment.

4. REFERENCES

[1] "Illinois Administrative Code, Title 35, Subtitle G, Chapter I, Subchapter J, Part 845: Standards for The Disposal Of Coal Combustion Residuals In Surface Impoundments," effective April 21, 2021.

[2] Code of Federal Regulations, "Title 40, Chapter I, Subchapter I, Part 257, Subpart D, Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments," April 17, 2015.

[3] Burns & McDonnell Engineering Company, Inc., "Initial Operating Permit," Coffeen, IL, October 25, 2021.

[4] Luminant, "Coffeen Power Station; Ash Pond No. 2, Notification of Completion of Closure," 2020.

[5] AECOM, "Closure and Post-Closure Care Plan for the Coffeen Ash Pond No. 2 at Illinois Power Generating Company Coffeen Power Station," 2017.

[6] Illinois Environmental Protection Agency, "Re: Coffeen Power Station W1350150004 Montgomery County, Illinois," Coffeen, IL, January 30, 2018.

[7] Natural Resource Technology, "Groundwater Modeling Report, Ash Pond 2, Coffeen Power Station, Coffeen, Illinois," 2017.

[8] Geosyntec Consultants, Inc., "Groundwater Polishing Evaluation Report Coffeen Power Station - Ash Pond No. 2 (EPA ID No. 102)," Coffeen, IL, 2025.

[9] United States Environmental Protection Agency, "Groundwater Remedy Completion Strategy: Moving Forward with the End in Mind," Office of Solid Waste and Emergency Response, 2014.

[10] Ramboll Americas Engineering Solutions, "35 I.A.C § 845 Corrective Measures Assessment, Coffeen Power Plant, Ash Pond No. 2, IEPA ID No. W135015004-02," Coffeen, IL, June 12, 2024.

[11] Gradient Corp, Human Health and Ecological Risk Assessment, Ash Pond No. 2, Coffeen Power Plant, Coffeen, IL, June 14, 2024.

[12] USEPA, "Federal Remediation Technologies Roundtable, Technology Screening Matrix - Directional Wells," [Online]. Available: https://www.frtr.gov/matrix/Directional-Wells/. [Accessed 9 January 2025].

[13] Ramboll Americas Engineering Solutions, Inc., "Nature and Extent Report, Coffeen Power Plant, Ash Pond No. 2, IEPA ID No. W1350150004-02," Coffeen, IL, June 12, 2024.

[14] Ramboll Americas Engineering Solutions, Inc., Groundwater Modeling Technical Memorandum, Coffeen Power Plant, Ash Pond No. 2, Coffeen, IL, 2025.

[15] Natural Resource Technology, "Hydrogeologic Site Characterization Report, Ash Pond 2, Coffeen Power Station," Coffeen, IL, January 24, 2017.

[16] Ramboll Americas Engineering Solutions, "Hydrogeologic Site Characterization Report, Coffeen Power Plant, Ash Pond No. 1," Coffeen, IL, October 25, 2021.

[17] Illinois Power Generating Company, Initial Review Letter - Part 845 Construction/ Operating Permit Application(s)- Second Submittal, 2025.

[18] USEPA, "Region 4 Ecological Risk Assessment Supplemental Guidance," 2018.

TABLES

Table 1. Proposed Milestone Schedule for Implementing Corrective Action Remedy (Source Control with Horizontal GWE Well)

Implementation Phase	Implementation Task	Timeframe (Preliminary Estimates)
1: Pre-Construction Activities	Agency Coordination, Approvals, and Permitting	12 to 18 months
	Final Design and Bid Process	24 to 36 months
	Timeframe to Complete Corrective Pre-Construction Activities	36 to 54 months after CAP Approval
2: Corrective Action Construction	Corrective Action Construction	6 to 12 months
	Timeframe to Complete Corrective Action Construction	6 to 12 months
3: Corrective Action O&M and Closeout	Corrective Action O&M	168 months (14 years)
	Corrective Action Confirmation Monitoring	36 months
	Corrective Action Completion	6 months
	Timeframe to Complete Corrective Action O&M and Closeout	210 months (18 years)
Total Timeline to Complete Corrective Action (after approval of Corrective Action Plan)		252 to 276 months (21 to 23 years)

APPENDIX A
CORRECTIVE ACTION ALTERNATIVES ANALYSIS (845.670(E)), INCLUDING CORRECTIVE MEASURES ASSESSMENT (845.660)

Corrective Action Alternatives Analysis for Ash Pond No. 2 at the Coffeen Power Plant, Coffeen, Illinois

June 10, 2025

GRADIENT

www.gradientcorp.com
One Beacon Street, 17th Floor
Boston, MA 02108
617-395-5000

Table of Contents

Page

Summary of Findings S-1

1 Introduction 1
- 1.1 Site Description and History 1
  - 1.1.1 Site Location and History 1
  - 1.1.2 CCR Impoundment 1
  - 1.1.3 Surface Water Hydrology 2
  - 1.1.4 Hydrogeology 3
  - 1.1.5 Site Vicinity 4
- 1.2 Part 845 Regulatory Review and Requirements 4

2 Corrective Action Alternatives Analysis 5
- 2.1 Corrective Action Alternatives Descriptions 6
  - 2.1.1 Alternative 1: Source Control-GWP 7
  - 2.1.2 Alternative 2: Source Control-Upgradient Barrier Wall and GWE Trench 8
  - 2.1.3 Alternative 3: Source Control-Horizontal GWE Well 10
- 2.2 Long- and Short-Term Effectiveness and Protectiveness of Corrective Action Alternative (IAC Section 845.670(e)(1)) 13
  - 2.2.1 Magnitude of Reduction of Existing Risks (IAC Section 845.670(e)(1)(A)) 13
  - 2.2.2 Effectiveness of the Remedy in Controlling the Source (IAC Section 845.670(e)(2)/IAC Section 845.670(d)(3)) 14
  - 2.2.3 Likelihood of Future Releases of CCR (IAC Section 845.670(e)(1)(B)) 15
  - 2.2.4 Type and Degree of Long-Term Management, Including Monitoring, Operation, and Maintenance (IAC Section 845.670(e)(1)(C)) 15
  - 2.2.5 Short-Term Risks to the Community or the Environment During Implementation of Remedy (IAC Section 845.670(e)(1)(D)) 16
    - 2.2.5.1 Safety Impacts 16
    - 2.2.5.2 Cross-Media Impacts to Air 19
    - 2.2.5.3 Cross-Media Impacts to Surface Water and Sediments 20
    - 2.2.5.4 Control of Exposure to Any Residual Contamination During Implementation of the Remedy 20
    - 2.2.5.5 Other Identified Impacts 21
  - 2.2.6 Time Until Groundwater Protection Standards Are Achieved/Attain the Groundwater Protection Standards Specified in Section 845.600 (IAC Section 845.670(e)(1)(E)/IAC Section 845.680(d)(2)) 22

2.2.7 Potential for Exposure of Humans and Environmental Receptors to Remaining Wastes, Considering the Potential Threat to Human Health and the Environment Associated with Excavation, Transportation, Re-disposal, Containment, or Changes in Groundwater Flow (IAC Section 845.670(e)(1)(F)) 25
2.2.8 Long-Term Reliability of the Engineering and Institutional Controls (IAC Section 845.670(e)(1)(G)) 25
2.2.9 Potential Need for Replacement of the Remedy (IAC Section 845.670(e)(1)(H)) 26
2.3 The Ease or Difficulty of Implementing a Remedy (IAC Section 845.670 (e)(3)) .. 27
2.3.1 Degree of Difficulty Associated with Constructing the Remedy (IAC Section 845.670(e)(3)(A)) 27
2.3.2 Expected Operational Reliability of the Remedy (IAC Section 845.670(e)(3)(B)) 28
2.3.3 Need to Coordinate with and Obtain Necessary Approvals and Permits from Other Agencies (IAC Section 845.670(e)(3)(C)) 28
2.3.4 Availability of Necessary Equipment and Specialists (IAC Sections 845.670(e)(3)(D) and 845.660(c)(1), "Ease of Implementation") 29
2.3.5 Available Capacity and Location of Needed Treatment, Storage, and Disposal Services/Comply with Standards for Management of Wastes as Specified in Section 845.680(d) (IAC Section 845.670(e)(3)(E)/IAC Section 845.670(d)(5)) 30
2.4 The Degree to Which Community Concerns Are Addressed by the Remedy (IAC Section 845.670(e)(4)) 31
2.5 Remove from the Environment as Much of the Contaminated Material that Was Released from the CCR Surface Impoundment as Is Feasible, Taking into Account Factors such as Avoiding Inappropriate Disturbance of Sensitive Ecosystems (IAC Section 845.670(d)(4)) 31
2.6 Summary 33

References 34

Appendix A Human Health and Ecological Risk Assessment
Appendix B Corrective Action Alternative Analysis – Supporting Information Report
Appendix C Corrective Measures Assessment
Appendix D Nature and Extent Report
Appendix E Groundwater Polishing Evaluation Report

List of Tables

Table S.1 Comparison of Proposed Corrective Action Alternatives with Respect to Factors Specified in IAC Section 845.670(d) and IAC Section 845.670(e)

Table 2.1 Key Parameters for the Source Control-Upgradient Barrier Wall and GWE Trench Corrective Action Alternative

Table 2.2 Key Parameters for the Source Control-Horizontal GWE Well Corrective Action Alternative

Table 2.3 Expected Number of On-Site Worker Accidents Under Each Corrective Action Alternative

Table 2.4 Expected Number of Off-Site Worker Accidents Related to Off-Site Car and Truck Use Under Each Corrective Action Alternative

Table 2.5 Expected Number of Community Accidents Under Each Corrective Action Alternative

Table 2.6 Estimated Timeline and Implementation Schedule Under Each Corrective Action Alternative

List of Figures

Figure 1.1 Site Location Map

Abbreviations

amsl	Above Mean Sea Level
AP1	Ash Pond No. 1
AP2	Ash Pond No. 2
bgs	Below Ground Surface
BMP	Best Management Practice
CAAA	Corrective Action Alternatives Analysis
CCR	Coal Combustion Residual
CIP	Closure-in-Place
CMA	Corrective Measures Assessment
CPP	Coffeen Power Plant
GHG	Greenhouse Gas
GMP	Groundwater Monitoring Plan
GWE	Groundwater Extraction
GWP	Groundwater Polishing
GWPS	Groundwater Protection Standard
HUC	Hydrologic Unit Code
IAC	Illinois Administrative Code
ID	Identification
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
IPGC	Illinois Power Generating Company
ISGS	Illinois State Geological Survey
LCU	Lower Confining Unit
LLDPE	Linear Low-Density Polyethylene
NID	National Inventory of Dams
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
SFWA	State Fish and Wildlife Area
Source Control-GWP	Source Control with Groundwater Polishing
Source Control-Horizontal GWE Well	Source Control with a Horizontal Groundwater Extraction Well
Source Control-Upgradient Barrier Wall and GWE Trench	Source Control with Upgradient Barrier Wall and Groundwater Extraction Trench
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
UA	Uppermost Aquifer
UCU	Upper Confining Unit
US DOT	United States Department of Transportation
US EPA	United States Environmental Protection Agency

Summary of Findings

Title 35, Part 845 of the Illinois Administrative Code (IAC) (IEPA, 2021) requires that a Corrective Action Alternatives Analysis (CAAA) be performed as part of the remedy selection, prior to undertaking any corrective actions at certain coal combustion residual (CCR)-containing impoundments, where exceedances of groundwater protection standards (GWPSs) have been identified. This report presents a CAAA for Ash Pond No. 2 (AP2) at the Coffeen Power Plant (CPP) pursuant to the requirements under IAC Section 845.670. The goal of performing a CAAA is to holistically evaluate the potentially viable corrective actions identified in the Corrective Measures Assessment (CMA; Appendix C; Ramboll, 2024a) in order to remediate groundwater and achieve compliance with the GWPSs specified under IAC Section 845.600 (IEPA, 2021). These analyses assess potentially viable corrective action alternatives based on a wide range of factors, including the efficiency, reliability, and ease of implementation of a corrective action, its potential positive and negative short- and long-term impacts on human health and the environment, and its ability to address concerns raised by the community (IEPA, 2021).

It is important to note that many CCR sites are complex groundwater environments where remedial actions will inherently take many years to complete. While no formal definition of a complex groundwater environment exists, most would agree that there are a number of common characteristics at complex groundwater sites, including the following (National Research Council, 2013):

- Highly heterogeneous subsurface environments;
- Large source zones;
- Multiple, recalcitrant constituents; and
- Long timeframes over which releases occurred.

Each of these characteristics are common at CCR sites. Surface impoundments are often tens to hundreds of acres in size and many have operated for decades, leading to large source zones and prolonged releases. Furthermore, CCR impoundments are often located in alluvial geologic settings where sands are interbedded with silts and clays. This results in a heterogeneous environment where constituent mass may persist for many years in low-permeability deposits. Finally, the constituents that are most common at CCR sites include metals and inorganics that do not naturally biodegrade. The combination of these factors results in a complex groundwater environment where remediation, even under the best of circumstances, may take many years to achieve GWPSs. It is for these reasons that the United States Environmental Protection Agency (US EPA) refused to specify what is a reasonable *versus* an unreasonable timeframe for groundwater corrective actions at CCR sites, stating that it "was truly unable to establish an outer limit on the necessary timeframes—including even a presumptive outer bound" (US EPA, 2015a).

In this CAAA, all corrective actions that have been evaluated consist of source control and residual plume management. Source control is generally considered to be one of the more effective remedial action approaches. Source control involves removing the hydraulic head from an impoundment (*i.e.*, unwatering and dewatering) and preventing further downward migration of constituents. US EPA has found that "releases from surface impoundments [to groundwater] drop dramatically after closure" (US EPA, 2014). US EPA has also stated that source control is the most effective means of ensuring the timely attainment of remediation objectives (US EPA, 2015b). As a result, the implementation of source control often has a substantial and immediate effect on groundwater quality improvements.

The specific source control method that is the central component of all the corrective active alternatives evaluated in this CAAA is closure-in-place (CIP), which was approved of by Illinois Environmental Protection Agency (IEPA) in 2018 (Buscher, 2018) and completed in 2020 (Appendix B; Ramboll, 2025a). Specifically, this approach includes the removal of impounded water, the installation of a low-permeability final geomembrane cover system designed to limit the infiltration of precipitation into the impounded CCR, and the establishment of the stormwater management system. These activities were designed to control, minimize, or eliminate, post closure infiltration of liquids into the impounded CCR. As demonstrated by the groundwater modeling in support of the Closure and Post-Closure Care Plan (AECOM, 2017; NRT, 2017a), this source control approach would result in a reduction of CCR leachate generation and contraction of the groundwater contaminant plume, demonstrating that source control controls, minimizes, or eliminates post-closure releases of leachate.

Three potential corrective actions are evaluated in this CAAA: Source Control with Groundwater Polishing (Source Control-GWP), Source Control with Upgradient Barrier Wall and Groundwater Extraction Trench (Source Control-Upgradient Barrier Wall and GWE Trench) and Source Control with a Horizontal Groundwater Extraction Well (Source Control-Horizontal GWE Well). Each corrective action was identified as a viable approach in the CMA (Appendix C; Ramboll, 2024a). The residual plume management portions of these corrective action alternatives include groundwater polishing, an upgradient barrier wall in combination with groundwater extraction trenches, and a horizontal groundwater extraction well. It should be noted that Source Control-GWP, Source Control with GWE (Source Control-GWE), and Source Control with Groundwater Cutoff Wall (Source Control-Cutoff Wall) were originally identified in the CMA as viable remedial approaches (Appendix C; Ramboll, 2024a). However, during subsequent evaluations, the remedial approaches were modified. Remedy modifications include the following:

- The Source Control-Cutoff Wall alternative was determined to be infeasible for attaining GWPS in a reasonable amount of time without a supplementary hydraulic control method. The cutoff wall was expanded into the upgradient barrier wall with GWE trench remedy (*i.e.*, Source Control-Upgradient Barrier Wall and GWE Trench alternative).
- The Source Control-GWE alternative was further refined into the Source Control-Horizontal GWE Well remedy, which includes an alternate method of GWE well installation *via* horizontal directional drilling to reduce disturbance of the completed final cover system while allowing for targeted installation near the CCR/native soil interface beneath AP2.

Under the Source Control-GWP alternative, constituent concentrations in groundwater would attenuate naturally over time due to physical and geochemical mechanisms. Site-specific evaluations demonstrated that GWP is appropriate at AP2 because Site conditions are favorable for natural attenuation of inorganic contaminants *via* adsorption (Appendix E; Geosyntec Consultants, Inc., 2025). Under the Source Control-Upgradient Barrier Wall and GWE Trench alternative, a barrier wall would be constructed located adjacent to the northern and western sides of AP2, with an extraction trench running parallel and hydraulically downgradient of the barrier wall, in order to prevent groundwater flowing towards AP2 and to collect impacted groundwater beneath AP2, respectively. Both structures would be constructed from the ground surface to a depth of 8 feet (ft) below ground surface (bgs) and would penetrate the Uppermost Aquifer (UA). The barrier wall and the GWE trench would approximately 2 to 3 ft wide, with 1 to 2 ft of separation between them. Horizontal collection pipes would be installed in the trench, which would be backfilled with clean granular fill and capped with compacted clay to reduce surface water infiltration. The collection pipes would drain to sumps spaced throughout the trenches to extract groundwater. Extracted groundwater would be collected and sent to a new on-Site lined pond and discharged from either a new or existing outfall managed under the National Pollutant Discharge Elimination System (NPDES) permit for the Site. The barrier wall would be constructed using *in-situ* soils with a low-permeability mixture down to the target elevation. The barrier wall would be located upgradient of the extraction trench to limit groundwater from

flowing towards AP2 and to reduce the amount of groundwater that needs to be extracted from the trench. Under the Source Control-Horizontal GWE Well alternative, a 1,325 ft long horizontal groundwater extraction well would be constructed within the eastern portion of AP2 at elevations between 600 ft-above mean sea level (amsl) at the southern bank to 606 ft-amsl near the northern bank of AP2, to collect impacted groundwater beneath AP2 (Appendix B; Ramboll, 2025a). The horizontal well would direct extracted water to a freely draining culvert or pump it to a settling pond before discharge.

Table S.1 evaluates the three potentially viable corrective actions evaluated in this CAAA (Source Control-GWP, Source Control-Upgradient Barrier Wall and GWE Trench, and Source Control-Horizontal GWE Well) with regard to each of the factors specified under IAC Section 845.670(d) and IAC Section 845.670(e) (IEPA, 2021). Based on this evaluation and the details provided in Section 2 of this report, the most appropriate corrective action for this Site is the Source Control-Horizontal GWE Well alternative. The timeframe for achieving GWPSs under the Source Control-Horizontal GWE Well alternative (approximately 17.5 to 19.5 years after approval of the Construction Permit Application) is shorter than under Source Control-GWP alternative (over 100 years after approval of Corrective Action Plan) and Source Control-Upgradient Barrier Wall and GWE Trench (approximately 63 to 65 years after approval of the Construction Permit Application). Additionally, risks to worker safety and the community under the Source Control-Horizontal GWE Well alternative are lower compared to the Source Control-Upgradient Barrier Wall and GWE Trench alternative. Thus, Source Control-Horizontal GWE Well is the most appropriate corrective action alternative for AP2.

Table S.1 Comparison of Proposed Corrective Action Alternatives with Respect to Factors Specified in IAC Section 845.670(d) and IAC Section 845.670(e)

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
Magnitude of Reduction of Existing Risks/Be Protective of Human Health and the Environment (Section 2.2.1; IAC Section 845.670(e)(1)(A)/ IAC Section 845.670(d)(1))	Because current conditions do not present a risk to human health or the environment at AP2, there will be no unacceptable risk to human health or the environment for future conditions since the unit was closed and source control was implemented. Concentrations of CCR-related constituents will decline over time, and consequently potential exposures to CCR-related constituents in the environment will also decline. The magnitude of the reduction of existing risks is the same for the three potential corrective action alternatives, and all corrective action alternatives are equally protective of human health and the environment.	Because current conditions do not present a risk to human health or the environment at AP2, there will be no unacceptable risk to human health or the environment for future conditions since the unit was closed and source control was implemented. Concentrations of CCR-related constituents will decline over time, and consequently potential exposures to CCR-related constituents in the environment will also decline. The magnitude of the reduction of existing risks is the same for the three potential corrective action alternatives, and all corrective action alternatives are equally protective of human health and the environment.	Because current conditions do not present a risk to human health or the environment at AP2, there will be no unacceptable risk to human health or the environment for future conditions since the unit was closed and source control was implemented. Concentrations of CCR-related constituents will decline over time, and consequently potential exposures to CCR-related constituents in the environment will also decline. The magnitude of the reduction of existing risks is the same for the three potential corrective action alternatives, and all corrective action alternatives are equally protective of human health and the environment.
Effectiveness of the Remedy in Controlling the Source (Section 2.2.2; IAC Section 845.670(e)(2))			
Extent to Which Containment Practices Will Reduce Further Releases/Control the Sources of Releases to Reduce or Eliminate, to the Maximum Extent Feasible (IAC Section 845.670(e)(2)(A)/ IAC Section 845.670(d)(3))	All three alternatives include source control using CIP (which is the primary remedial measure) and residual plume management. Modeling results (NRT, 2017a) indicate that the source control approach implemented in 2020 would result in a reduction of CCR leachate generation and contraction of the groundwater contaminant plume. Source control is thus effective at	All three alternatives include source control using CIP (which is the primary remedial measure) and residual plume management. Modeling results (NRT, 2017a) indicate that the source control approach implemented in 2020 would result in a reduction of CCR leachate generation and contraction of the groundwater contaminant plume. Source control is thus effective at	All three alternatives include source control using CIP (which is the primary remedial measure) and residual plume management. Modeling results (NRT, 2017a) indicate that the source control approach implemented in 2020 would result in a reduction of CCR leachate generation and contraction of the groundwater contaminant plume. Source control is thus effective at

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
	controlling the source. Under the residual plume management for this alternative, physical and geochemical attenuation mechanisms would mitigate impacts to downgradient groundwater. However, it should be noted that some boron re-mobilization may occur as groundwater returns to background conditions, which may affect the time required to achieve GWPS (Appendix E; Geosyntec Consultants, Inc., 2025). If necessary, remedy optimizations would be implemented under the adaptive site management program.	controlling the source. Under the residual plume management for this alternative, a barrier wall would be constructed to prevent groundwater flowing towards AP2 and by installation of an extraction trench running parallel and hydraulically downgradient of the barrier wall to collect impacted groundwater beneath AP2. If necessary, remedy optimizations would be implemented under the adaptive site management program.	controlling the source. Under the residual plume management for this alternative, a horizontal groundwater extraction well would be installed to collect and drain CCR-impacted groundwater beneath AP2. If necessary, remedy optimizations would be implemented under the adaptive site management program.
Extent to Which Treatment Technologies May Be Used (IAC Section 845.670(e)(2)(B))	Source Control-GWP would rely on physical and geochemical attenuation processes. If necessary, remedy optimizations would be implemented under the adaptive site management program.	For the Source Control-Upgradient Barrier Wall and GWE Trench alternative, it would require construction of a new on-Site settling pond to remove solids from extracted groundwater, prior to discharge *via* an NPDES permitted outfall. If necessary, remedy optimizations would be implemented under the adaptive site management program.	For the Source Control-Horizontal GWE Well alternative, it would require construction of a new on-Site settling pond to settle solids from extracted groundwater from the GWE wells, prior to discharge *via* an NPDES permitted outfall. Other treatment and management technologies may be evaluated at later phases of the design. If necessary, remedy optimizations would be implemented under the adaptive site management program.
Likelihood of Future Releases of CCR (Section 2.2.3; IAC Section 845.670(e)(1)(B))	All three corrective action alternatives include source control using CIP; the CIP source control was completed in 2020. A geosynthetic cover system was installed in 2020, which included a 40-mil linear low-density polyethylene (LLDPE) geomembrane liner, 18 inches	All three corrective action alternatives include source control using CIP; the CIP source control was completed in 2020. A geosynthetic cover system was installed in 2020, which included a 40-mil LLDPE geomembrane liner, 18 in of soil cover and 6 in of erosion soil layer	All three corrective action alternatives include source control using CIP; the CIP source control was completed in 2020. A geosynthetic cover system was installed in 2020, which included a 40-mil LLDPE geomembrane liner, 18 in of soil cover and 6 in of erosion soil layer

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
	(in) of soil cover and 6 in of erosion soil layer for vegetative growth, as well as new stormwater control structures. This cover system provides increased protection against berm and surface erosion, precipitation infiltration, and other adverse effects that could potentially trigger a release of CCR. There would be minimal risk of accidental CCR releases occurring post-closure under any of the alternatives.	for vegetative growth, as well as new stormwater control structures. This cover system provides increased protection against berm and surface erosion, precipitation infiltration, and other adverse effects that could potentially trigger a release of CCR. There would be minimal risk of accidental CCR releases occurring post-closure under any of the alternatives. Any CCR-contact stormwater generated during the construction phase would be managed through a contact stormwater management system. There would be minimal risk of accidental CCR releases occurring post-closure under any of the alternatives.	for vegetative growth, as well as new stormwater control structures. This cover system provides increased protection against berm and surface erosion, precipitation infiltration, and other adverse effects that could potentially trigger a release of CCR. There would be minimal risk of accidental CCR releases occurring post-closure under any of the alternatives. Any CCR-contact stormwater generated during the construction phase would be managed through a contact stormwater management system. There would be minimal risk of accidental CCR releases occurring post-closure under any of the alternatives.
Type and Degree of Long-Term Management, Including Monitoring, Operation, and Maintenance (Section 2.2.4; IAC Section 845.670(e)(1)(C))	Minimal long-term O&M efforts would be required under Source Control-GWP alternative because it would not require the installation, operation, or maintenance of any engineered systems or structures other than maintenance of the monitoring well network. Post-closure care groundwater monitoring would continue for a minimum of 30 years as required by IAC Section 845.780(c). Corrective action groundwater monitoring would continue for 3 years after GWPSs have been achieved. Based on the adaptive site management approach, remedy	Long-term O&M efforts required under Source Control-Upgradient Barrier Wall and GWE Trench alternative would include the maintenance of the groundwater collection trench system and discharge of extracted groundwater. Non-routine maintenance may include tasks such as repair or replacement of the extraction and/or transfer pumps, repair or replacement of the system air compressor, and flushing or jetting of water conveyance lines in the event organic or inorganic solids accumulate on the interior walls. Extracted groundwater would be managed and treated by a newly-constructed on-Site	Long-term O&M efforts required under Source Control-Horizontal GWE Well would include inspection and maintenance of the horizontal well ensure the continued operation. These activities would include routine inspections of the horizontal well extraction system along with non-routine maintenance such as flushing or jetting of water conveyance lines. Extracted groundwater would be managed to ensure compliance with the Site's NPDES permit for treatment and discharge. Post-closure care groundwater monitoring would continue for a

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
	optimizations may be implemented to ensure achievement of the GWPSs.	settling pond before discharge *via* an NPDES permitted Outfall. Post-closure care groundwater monitoring would continue for a minimum of 30 years as required by IAC Section 845.780(c). Additionally, corrective action groundwater monitoring would continue for 3 years after GWPS have been achieved. Based on the adaptive site management approach, remedy optimizations may be implemented to ensure achievement of the GWPSs.	minimum of 30 years as required by IAC Section 845.780(c). Additionally, corrective action groundwater sampling would continue for 3 years after GWPSs have been achieved. Based on the adaptive site management approach, remedy optimizations may be implemented to ensure achievement of the GWPSs.
Short-Term Risks to the Community or the Environment During Implementation of Remedy (Section 2.2.5; IAC Section 845.670(e)(1)(D))			
Safety Impacts	Source control (*i.e.*, CIP) was implemented in 2020. Thus, there is no further risk of accidents and injuries occurring during the implementation of the source control remedy. Overall, no worker accidents or injuries would be expected under the Source Control-GWP alternative because no installation, operation, and maintenance of engineered systems or structures would be required. Similarly, no off-Site impacts on nearby residents would be expected under the	Source control (*i.e.*, CIP) was implemented in 2020. Thus, there is no further risk of accidents and injuries occurring during the implementation of the source control remedy. Overall, considering worker accidents occurring during residual plume management both on- and off-Site, 0.28 worker injuries and 3.8×10^{-3} worker fatalities would be expected to occur under the Source Control-Upgradient Barrier Wall and GWE Trench alternative, which is the highest among the three alternatives.	Source control (*i.e.*, CIP) was implemented in 2020. Thus, there is no further risk of accidents and injuries occurring during the implementation of the source control remedy. Overall, considering worker accidents occurring during residual plume management both on- and off-Site, 0.21 worker injuries and 2.8×10^{-3} worker fatalities would be expected to occur under the Source Control-Horizontal GWE Well alternative. In total, an estimated 0.038 injuries and

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
	Source Control-GWP alternative.	In total, an estimated 0.051 injuries and 6.9×10^{-4} fatalities would be expected to occur among community members due to off-Site activities under this alternative, which is also the highest among the three alternatives.	5.2×10^{-4} fatalities would be expected to occur among community members due to off-Site activities under this alternative.
Cross-Media Impacts to Air	Source control (*i.e.*, CIP) was implemented in 2020. No further air impacts associated with the implementation of the source control remedy are expected. Cross-media impacts to air can include air pollutants and GHG emissions, which are proportional to the potential impact of each alternative on other emissions from construction vehicles and equipment. Residual plume management for the Source Control-GWP alternative would be expected to have minimal air impacts because it would not require the construction of any engineered systems or structures.	Source control (*i.e.*, CIP) was implemented in 2020. No further air impacts associated with the implementation of the source control remedy are expected. Cross-media impacts to air can include air pollutants and GHG emissions, which are proportional to the potential impact of each alternative on other emissions from construction vehicles and equipment. Residual plume management for the Source Control-Upgradient Barrier Wall and GWE Trench alternative would have the highest air impacts, due to the greatest amount of vehicle travel miles required for construction, operation, and maintenance under this alternative.	Source control (*i.e.*, CIP) was implemented in 2020. No further air impacts associated with the implementation of the source control remedy are expected. Cross-media impacts to air can include air pollutants and GHG emissions, which are proportional to the potential impact of each alternative on other emissions from construction vehicles and equipment. Residual plume management for the Source Control-Horizontal GWE Well alternative would have greater air impacts than the Source Control-GWP, due to the horizontal GWE well installation activities and operation of the extraction system.
Cross-Media Impacts to Surface Water and Sediments	Source control was implemented in 2020 for all three corrective action alternatives, and constituent mass flux from groundwater into surface water will decline over time (AECOM, 2017). The source control approach minimizes the amount of water retained within the impoundment, which reduces the hydraulic flux through the CCR. Due to the reduction in the hydraulic flux out	Source control was implemented in 2020 for all three corrective action alternatives, and constituent mass flux from groundwater into surface water will decline over time (AECOM, 2017). The source control approach minimizes the amount of water retained within the impoundment, which reduces the hydraulic flux through the CCR. Due to the reduction in the hydraulic flux out	Source control was implemented in 2020 for all three corrective action alternatives, and constituent mass flux from groundwater into surface water will decline over time (AECOM, 2017). The source control approach minimizes the amount of water retained within the impoundment, which reduces the hydraulic flux through the CCR. Due to the reduction in the hydraulic flux out

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
	of AP2, the mass flux out of AP2 will also be controlled or minimized. As demonstrated by the groundwater modeling in support of the Closure Plan, source control would result in a significant reduction in groundwater concentrations and, overtime, reduce the extent of groundwater impacts to within the footprint of the impoundment (NRT, 2017a). Under residual plume management for the Source Control-GWP alternative, minimal surface water and sediment impacts would be expected, because it would not require the construction of any engineered systems or structures.	of AP2, the mass flux out of AP2 will also be controlled or minimized. As demonstrated by the groundwater modeling in support of the Closure Plan, source control would result in a significant reduction in groundwater concentrations and, overtime, reduce the extent of groundwater impacts to within the footprint of the impoundment (NRT, 2017a). Under residual plume management for the Source Control-Upgradient Barrier Wall and GWE Trench alternative, surface water and sediment impacts would be higher than the Source Control-GWP alternative due to the construction of the extraction trench system and barrier wall. Construction can have short-term negative impacts on surface water and sediment quality immediately adjacent to a site due to potential erosion and sediment runoff.	of AP2, the mass flux out of AP2 will also be controlled or minimized. As demonstrated by the groundwater modeling in support of the Closure Plan, source control would result in a significant reduction in groundwater concentrations and, overtime, reduce the extent of groundwater impacts to within the footprint of the impoundment (NRT, 2017a). Under residual plume management for the Source Control-Horizontal GWE Well alternative, surface water and sediment impacts would be higher than the Source Control-GWP alternative due to the construction of horizontal GWE well. Construction can have short-term negative impacts on surface water and sediment quality immediately adjacent to a site due to potential erosion and sediment runoff.
Control of Exposure to Any Residual Contamination During Implementation of the Remedy	Source control (*i.e.*, CIP) was implemented in 2020. Thus, there are no further risks of CCR exposure associated with source control implementation. Risks to workers arising from potential contact with residual contamination during construction activities associated with residual plume management would be minimal under the Source Control-GWP alternative,	Source control (*i.e.*, CIP) was implemented in 2020. Thus, there are no further risks of CCR exposure associated with source control implementation. Risks to workers arising from potential contact with residual contamination during construction, operation, and maintenance activities associated with residual plume management would be higher for the Source Control-	Source control (*i.e.*, CIP) was implemented in 2020. Thus, there are no further risks of CCR exposure associated with source control implementation. Risks to workers arising from potential contact with residual contamination during construction, operation, and maintenance activities associated with residual plume management would be higher for the Source Control-

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
	which would not involve exposure to soil or groundwater waste streams.	Upgradient Barrier Wall and GWE Trench alternative than for the Source Control-GWP alternative, because Source Control-Upgradient Barrier Wall and GWE Trench would involve the production, management, and treatment of extracted groundwater, as well as on-Site disposal of excavated spoils generated during extraction trench and barrier wall construction.	Horizontal GWE Well alternative than for the Source Control-GWP alternative, because Source Control-Horizontal GWE Well would involve on-Site disposal of the excavated spoils generated during the horizontal GWE well installation and the production, management, and treatment of extracted groundwater.
Other Identified Impacts	Source control (*i.e.*, CIP) was implemented in 2020. Thus, there are no further impacts associated with the implementation of source control. The energy demands of construction equipment and vehicles associated with residual plume management would be the lowest under the Source Control-GWP alternative because this alternative would not require any significant construction activity. Similarly, traffic and noise impacts associated with residual plume management would be lowest under the Source Control-GWP alternative because this alternative would not require any significant construction activity. There would be no impacts to natural resources and habitats under the Source Control-GWP alternative because no additional construction activities would be required.	Source control (*i.e.*, CIP) was implemented in 2020. Thus, there are no further impacts associated with the implementation of source control. The energy demands of construction equipment and vehicles associated with residual plume management would be greater under the Source Control-Upgradient Barrier Wall and GWE Trench than the Source Control-GWP alternative, due to the activities that would be required to construct the GWE Trench and barrier wall, as well as additional energy required to operate the extraction system. Similarly, traffic and noise impacts associated with residual plume management would be greater under the Source Control-Upgradient Barrier Wall and GWE Trench than the Source Control-GWP alternative, due to the activities that would be required to construct the GWE Trench system and	Source control (*i.e.*, CIP) was implemented in 2020. Thus, there are no further impacts associated with the implementation of source control. The energy demands of construction equipment and vehicles associated with residual plume management would be greater under the Source Control-Horizontal GWE Well than the Source Control-GWP alternative, due to the construction activities related to installation of the horizontal well. Additional energy would be required to operate the extraction system. Similarly, traffic and noise impacts associated with residual plume management would also be greater under the Source Control-Horizontal GWE Well alternative than the Source Control-GWP alternative, due to the construction activities required to install the horizontal GWE wells and construct the settling pond.

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
		barrier wall system. Under the Source Control-Upgradient Barrier Wall and GWE Trench alternative, there would be some negative impacts to natural resources and habitats, including disturbances of some existing habitats atop portions of the construction areas, and potential impacts to aquatic and wetland species in Coffeen Lake and other wetlands due to sediment runoff during construction.	Under the Source Control-Horizontal GWE Well alternative, there would be some negative impacts to natural resources and habitats, including disturbances of some existing habitats atop portions of the construction areas, and potential impacts to aquatic and wetland species in Coffeen Lake and other wetlands due to sediment runoff during construction.
Time Until Groundwater Protection Standards Are Achieved (Section 2.2.6; IAC Section 845.670(e)(1)(E))	Groundwater modeling was performed in support of the Closure Plan (AECOM, 2017). The modeling predicted that source control would result in a reduction of CCR leachate generation and contraction of the groundwater contaminant plume, which was predicted to begin after the completion of the source control (NRT, 2017a). Additional modeling was conducted for each of the corrective action alternatives to evaluate future groundwater quality in the vicinity of AP2 as a result of residual plume management (Appendix B; Ramboll, 2025b). The results of the modeling indicate that groundwater would meet the GWPSs for all constituents identified as having potential groundwater exceedances in the monitoring network within	Groundwater modeling was performed in support of the Closure Plan (AECOM, 2017). The modeling predicted that source control would result in a reduction of CCR leachate generation and contraction of the groundwater contaminant plume, which was predicted to begin after the completion of the source control (NRT, 2017a). Additional modeling was conducted for each of the corrective action alternatives to evaluate future groundwater quality in the vicinity of AP2 as a result of residual plume management (Appendix B; Ramboll, 2025b). The results of the modeling indicate that groundwater would attain the GWPSs for all constituents identified as having potential exceedances within approximately 63 to 65 years (4 to 6 years of pre-	Groundwater modeling was performed in support of the Closure Plan (AECOM, 2017). The modeling predicted that source control would result in a reduction of CCR leachate generation and contraction of the groundwater contaminant plume, which was predicted to begin after the completion of the source control (NRT, 2017a). Additional modeling was conducted for each of the corrective action alternatives to evaluate future groundwater quality in the vicinity of AP2 as a result of residual plume management (Appendix B; Ramboll, 2025b). The results of the modeling indicate that groundwater would attain the GWPSs for all constituents identified as having potential exceedances within approximately 17.5 to 19.5 years (3.5 to 5.5 years of pre-

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
	approximately 135 years (Appendix B; Ramboll, 2025a).	construction and construction activities followed by approximately 59 years of post-construction O&M) under the Source Control-Upgradient Barrier Wall and GWE Trench alternative (Appendix B; Ramboll, 2025a).	construction and construction activities followed by approximately 14 years of system operation until the GWPSs are achieved). Current modeling indicates that an additional 25 years of system operation may be required to prevent concentrations from rebounding above the GWPSs (Appendix B; Ramboll, 2025a); however, additional modeling would be performed and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to determine the exact required duration of additional system operation.
Potential for Exposure of Humans and Environmental Receptors to Remaining Wastes, Considering the Potential Threat to Human Health and the Environment Associated with Excavation, Transportation, Re-disposal, Containment, or Changes in Groundwater Flow (Section 2.2.7; IAC Section 845.670(e)(1)(F))	Source control (CIP) was implemented in 2020. As a result of the source control, there would be no risk of CCR releases post-closure, and all three corrective action alternatives are equally and fully protective with regard to exposure to residual CCR.	Source control (CIP) was implemented in 2020. As a result of the source control, there would be no risk of CCR releases post-closure and all three corrective action alternatives are equally and fully protective with regard to exposure to residual CCR. Potential risks to workers that come in contact with residual contamination of CCR-related constituents during groundwater extraction and treatment would be managed through the use of rigorous safety protocols and personal protective equipment. Some changes in groundwater flow (*i.e.*, controlled discharge into Coffeen Lake and blocking of natural groundwater flow) may occur under	Source control (CIP) was implemented in 2020. As a result of the source control, there would be no risk of CCR releases post-closure and all three corrective action alternatives are equally and fully protective with regard to exposure to residual CCR. Potential risks to workers that come in contact with residual contamination of CCR-related constituents during groundwater extraction and treatment from the GWE wells would be managed through the use of rigorous safety protocols and personal protective equipment. Under the residual plume management for Source Control-Horizontal GWE Well alternative, a horizontal GWE well

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
		the Source Control-Upgradient Barrier Wall and GWE Trench alternative, due to the operation of the GWE trench system and installation of subsurface groundwater barrier wall. However, changes to groundwater flow would not be expected to have an effect on the potential for the exposure of humans and environmental receptors to remaining wastes.	would be installed. This remedy would reduce the hydraulic head beneath AP2 and alter the hydraulic gradient and corresponding groundwater patterns. However, changes to groundwater flow would not be expected to have an effect on the potential for the exposure of humans and environmental receptors to remaining wastes.
Long-Term Reliability of the Engineering and Institutional Controls (Section 2.2.8; IAC Section 845.670(e)(1)(G))	Source control (CIP) was implemented in 2020. Thus, long-term reliability of source control would be same for all three corrective action alternatives. Residual plume management under the Source Control-GWP alternative would be reliable because it would rely on physical and geochemical attenuation processes and active monitoring. If necessary, remedy optimizations would be implemented under the adaptive site management program.	Source control (CIP) was implemented in 2020. Thus, long-term reliability of source control would be same for all three corrective action alternatives. GWE Trench and subsurface barrier wall technologies are proven remedies that have been implemented at many sites. Thus, residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench alternative would be reliable, provided that the barrier wall and extraction trench are constructed in accordance with standard design and specifications. Routine and non-routine maintenance of the GWE trench is required to ensure reliable operation of the extraction trench and pumps, as well as other mechanical components. The barrier wall component provides an inert, continuous, low-permeability barrier to groundwater flow and is not expected to need maintenance. If necessary,	Source control (CIP) was implemented in 2020. Thus, long-term reliability of source control would be same for all three corrective action alternatives. Horizontal GWE well is a proven remedy that has been implemented at many sites. Thus, residual plume management under the Source Control-Horizontal GWE Well alternative would be reliable, provided the horizontal well is constructed in accordance with standard design and specifications. The horizontal well system is a passive drain system; however, conveyance of extracted groundwater would require operation and maintenance of a mechanical system. If necessary, remedy optimizations would be implemented under the adaptive site management program.

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
		remedy optimizations would be implemented under the adaptive site management program.	
Potential Need for Replacement of the Remedy (Section 2.2.9; IAC Section 845.670(e)(1)(H))	Replacement of the residual plume management remedy under the Source Control-GWP alternative would likely be unnecessary, because it would not require the installation, operation, and maintenance of engineered systems or structures. Adaptive site management strategies would be used to implement remedy optimizations, if necessary, to ensure that remedial goals are achieved.	Replacement of the residual plume management remedy under the Source Control-Upgradient Barrier Wall and GWE Trench alternative would likely be unnecessary, as long as the extraction trench system and barrier wall are constructed, maintained, and serviced appropriately. The GWE Trench system would need ongoing maintenance and potential replacement of system components to ensure its effectiveness. Adaptive site management strategies would be used to implement remedy optimizations, if necessary, to ensure that remedial goals are achieved.	Replacement of the residual plume management remedy under the Source Control-Horizontal GWE Well alternative would likely be unnecessary, as long the horizontal well is constructed, maintained, and serviced appropriately. The conveyance of extracted groundwater to the settling pond would constitute a mechanical system which may require routine maintenance to reliably operate. Adaptive site management strategies would be used to implement remedy optimizations, if necessary, to ensure that remedial goals are achieved.
Degree of Difficulty Associated with Constructing the Remedy (Section 2.3.1; IAC Section 845.670 (e)(3)(A))	Source control (CIP) was implemented in 2020. Thus, there would be no further construction difficulties associated with the implementation of source control. Residual plume management under the Source Control-GWP alternative would rely on physical and geochemical attenuation processes and therefore would not be difficult.	Source control (CIP) was implemented in 2020. Thus, there would be no further construction difficulties associated with the implementation of source control. Residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench alternative would involve the construction of a barrier wall, an extraction trench, settling pond, and conveyance system to extract and treat impacted groundwater to address downgradient groundwater quality impacts. The construction of the shallow	Source control (CIP) was implemented in 2020. Thus, there would be no further construction difficulties associated with the implementation of source control. Residual plume management under the Source Control-Horizontal GWE Well alternative would involve the installation of a horizontal well to drain water from AP2 to address downgradient groundwater quality impacts. This alternative would require the use of specialty equipment such as horizontal directional drill rigs and other supporting equipment such as

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
		groundwater trench and barrier wall required by this alternative are commonly constructed at similar depths and can be performed using specialized (*i.e.*, one-pass trenching) and conventional construction equipment. Therefore, while some construction is necessary, the degree of difficulty for this remedy is expected to be low.	excavating and grading equipment that would need to be mobilized to the site. Horizontal wells are routinely constructed in similar environments, however there may be difficulty due to heterogeneity encountered in the subsurface at the bottom of the CCR and top of the UA interface, and would require specialized techniques/ equipment to address the issue. Therefore, the degree of difficulty is expected to be moderate for the horizontal well component.
Expected Operational Reliability of the Remedy (Section 2.3.2; IAC Section 845.670 (e)(3)(B))	Source control (CIP) was implemented in 2020. The operational reliability of the source control would be the same for all three corrective action alternatives. Residual plume management under the Source Control-GWP alternative would have high operational reliability because this alternative would rely on natural processes and active monitoring. However, it should be noted that some boron re-mobilization may occur as groundwater returns to background conditions at AP2, which may affect the time to achieve GWPS (Appendix E; Geosyntec Consultants, Inc., 2025). Adaptive site management strategies would be used to implement remedy optimizations, if necessary.	Source control (CIP) was implemented in 2020. The operational reliability of the source control would be the same for all three corrective action alternatives. Residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench alternative would have high operational reliability because it is an established and commonly used technology, as long as the barrier wall and the extraction trench system are constructed in accordance with standard design and specifications. The barrier wall is an inert, continuous, low-permeability subsurface structure and is not expected to require maintenance after construction. The GWE trench system operates as a mechanical system and would require routine and non-routine	Source control (CIP) was implemented in 2020. The operational reliability of the source control would be the same for all three corrective action alternatives. Residual plume management under the Source Control-Horizontal GWE Well alternative would have high operational reliability if the horizontal GWE well and conveyance system are constructed in accordance with standard design and specifications. The horizontal well system is a passive drain system; however, conveyance of extracted groundwater would require operation and maintenance of a mechanical system. Adaptive site management strategies would be used to implement remedy optimizations, if necessary.

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
		maintenance to ensure reliable operation. Adaptive site management strategies would be used to implement remedy optimizations, if necessary.	
Need to Coordinate with and Obtain Necessary Approvals and Permits from Other Agencies (Section 2.3.3; IAC Section 845.670 (e)(3)(C))	Specific permits and approvals associated with source control were the same for all corrective action alternatives and were discussed in the Closure Plan (AECOM, 2017). Residual plume management under the Source Control-GWP alternative would not need additional permits from other agencies, other than the approval of the eventual Corrective Action Plan.	Specific permits and approvals associated with source control were the same for all corrective action alternatives and were discussed in the Closure Plan (AECOM, 2017). Residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench alternative would require regulatory approval and permits. Groundwater extracted from the extraction trench would require a modified NPDES permit, which would likely require renewals depending on the timeline of corrective action implementation. Permits from IEPA for construction stormwater controls, BMPs, and operating would be required. An IDNR Dam Safety modification permit would be obtained for modifications of the embankment.	Specific permits and approvals associated with source control were the same for all corrective action alternatives and were discussed in the Closure Plan (AECOM, 2017). The Source Control-Horizontal GWE Well alternative would require regulatory approval and permits. Modifications would be necessary to the Site's NPDES permit to allow for discharge of groundwater from the horizontal well. Permits from IEPA for construction stormwater controls and BMPs would be required.
Availability of Necessary Equipment and Specialists (Section 2.3.4; IAC Section 845.670 (e)(3)(D))	Source control (CIP) was implemented in 2020. Thus, there are no further equipment and specialist needs associated with the implementation of the source control remedy. Residual plume management under the Source Control-GWP alternative would require standard environmental monitoring equipment and	Source control (CIP) was implemented in 2020. Thus, there are no further equipment and specialist needs associated with the implementation of the source control remedy. Residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench alternative would require specialists to construct the	Source control (CIP) was implemented in 2020. Thus, there are no further equipment and specialist needs associated with the implementation of the source control remedy. Residual plume management under the Source Control-Horizontal GWE Well alternative would require specialists for horizontal well installation and O&M:

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
	groundwater professionals. Specialists such as geologists, hydrogeologists, statisticians (*i.e.*, statistical analysis), and geochemists would be available to collect and evaluate the data.	barrier wall and the GWE trench system and to manage the GWE Trench system throughout its operational period: ▪ Construction of the groundwater extraction system and the barrier wall on the Site is expected to require a specialized contractor, who would most likely need specialized and often custom-built equipment including one-pass construction equipment. The availability of contractors with such equipment may be limited. ▪ Specialists including design engineers, geotechnical experts, construction managers and contractor staff experienced in trench construction and similar geologic environments would be required. ▪ Geotechnical specialists would be required to design the working platform and oversee the AP2 embankment, monitoring for any signs of distress during the one-pass trench installation. ▪ In addition, specialists and equipment may have backlogs due to high demand in similar specialty ground improvement projects in the area, which could delay the project schedule. ▪ After the construction phase,	▪ Construction of the horizontal well would require design engineers, geologists, construction managers, and contractor staff experienced with horizontal well construction and specialized equipment operation. ▪ Contractors would be required during the operation of the system including replacement of components and periodic well re-development (*i.e.*, flushing or jetting of conveyance lines). Specialists and equipment needed for O&M are generally available within close proximity to the Site with the exception of more complex system components, such as transfer pumps and transfer pump controller. ▪ As with the other two alternatives, this alternative would necessitate the use of equipment and the expertise of specialists for tasks such as field data collection, groundwater sampling, analysis, and periodic corrective action groundwater monitoring and reporting. These activities are already being conducted as part of routine groundwater monitoring.

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
		specialists and equipment would be required during the operation of the GWE system for routine and non-routine maintenance. ▪ Specialists and replacement equipment needed to operate the system would generally be available, although some of the more complex equipment (*i.e.*, transfer pumps and transfer pump controller) may have extended lead times for servicing. ▪ This alternative would also necessitate the use of equipment and the expertise of specialists for tasks such as field data collection, groundwater sampling, analysis, and periodic corrective action groundwater monitoring and reporting. Similar to those in the GWP alternative, these activities are already being conducted as part of routine groundwater monitoring.	
Available Capacity and Location of Needed Treatment, Storage, and Disposal Services/Comply with Standards for Management of Wastes as Specified in Section 845.680(d) (Section 2.3.5; IAC Section 845.670 (e)(3)(E)/ IAC section 845.670(d)(5))	No treatment, storage, or disposal services would be required with the residual plume management under the Source Control-GWP alternative, as GWP would not generate any significant volume of waste or wastewater.	Residual plume management for the Source Control-Upgradient Barrier Wall and GWE Trench alternative would require the construction of the barrier wall, extraction trench, and a new settling pond. Spoils would be generated and would be disposed of in the on-Site landfill. Extracted groundwater would be sent to an on-Site settling pond, which collects solids	Residual plume management for the Source Control-Horizontal GWE Well would send extracted groundwater to a newly constructed on-Site settling pond to settle solids extracted during groundwater recovery. The settling pond would need to be sited, designed, constructed, and maintained properly. The siting of the settling pond would need to consider limiting impacts to

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
		removed during groundwater recovery *via* the pneumatic extraction pumps and transfer piping. Discharge from the settling pond would be conveyed to an NPDES permitted outfall.	existing and future Site infrastructure and other surface impoundments at the Coffeen Power Plant (CPP). Flows from the horizontal GWE wells would be discharged through an NPDES permitted outfall.
The Degree to Which Community Concerns Are Addressed by the Remedy (Section 2.4; IAC Section 845.670(e)(4))	Some communities have expressed concerns over groundwater quality at CCR surface impoundments. The combination of source control (*i.e.*, CIP) and residual plume management would cause groundwater concentrations to decline over time under all of the corrective action alternatives, as suggested by the groundwater modeling (Appendix B; Ramboll, 2025b). A public meeting was held on May 1, 2025, pursuant to requirements under IAC Section 845.710(e). Questions raised by attendees were addressed at the meeting; a written summary of the questions and responses were prepared.	Some communities have expressed concerns over groundwater quality at CCR surface impoundments. The combination of source control (*i.e.*, CIP) and residual plume management would cause groundwater concentrations to decline over time under all of the corrective action alternatives, as suggested by the groundwater modeling (Appendix B; Ramboll, 2025b). A public meeting was held on May 1, 2025, pursuant to requirements under IAC Section 845.710(e). Questions raised by attendees were addressed at the meeting; a written summary of the questions and responses were prepared.	Some communities have expressed concerns over groundwater quality at CCR surface impoundments. The combination of source control (*i.e.*, CIP) and residual plume management would cause groundwater concentrations to decline over time under all of the corrective action alternatives, as suggested by the groundwater modeling (Appendix B; Ramboll, 2025b). A public meeting was held on May 1, 2025, pursuant to requirements under IAC Section 845.710(e). Questions raised by attendees were addressed at the meeting; a written summary of the questions and responses were prepared.
Remove from the Environment as Much of the Contaminated Material That Was Released from the CCR Surface Impoundment as Is Feasible, Taking into Account Factors Such as Avoiding Inappropriate Disturbance of Sensitive Ecosystems (Section 2.5;	There have been no known releases of CCR at the AP2. All three potential corrective action alternatives include source control and residual plume management efforts. The source control included removal of impounded water and the installation of a low-permeability final geomembrane cover system designed to limit the infiltration of precipitation into the impounded	There have been no known releases of CCR at the AP2. All three potential corrective action alternatives include source control and residual plume management efforts. The source control included removal of impounded water and the installation of a low-permeability final geomembrane cover system designed to limit the infiltration of precipitation into the impounded	There have been no known releases of CCR at the AP2. All three potential corrective action alternatives include source control and residual plume management efforts. The source control included removal of impounded water and the installation of a low-permeability final geomembrane cover system designed to limit the infiltration of precipitation into the impounded

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
IAC Section 845.670(d)(4))	CCR. Groundwater modeling performed in support of the Closure Plan predicted that source control would result in a reduction of CCR leachate production, a decrease in CCR leachate constituent concentrations, and a contraction of the groundwater contaminant plume (NRT, 2017a). Additionally, residual plume management under the Source Control-GWP alternative would address impacted groundwater by relying on physical and geochemical attenuation processes to reduce the residual concentrations of CCR-related constituents in groundwater. Attenuation *via* sorption onto mineral surfaces should remain stable under post-closure conditions, and remobilization is unlikely to impact the time to achieve GWPS for sulfate. It should be noted that remobilization of boron may occur at some locations and affect the time to achieve GWPS compared to sulfate (Appendix E; Geosyntec Consultants, Inc., 2025). No ecosystems would be disturbed because no construction activities are expected under the Source Control-GWP alternative.	CCR. Groundwater modeling performed in support of the Closure Plan predicted that source control would result in a reduction of CCR leachate production, a decrease in CCR leachate constituent concentrations, and a contraction of the groundwater contaminant plume (NRT, 2017a). Additionally, residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench alternative would rely on the barrier wall to limit groundwater from flowing towards AP2 and to reduce the amount of groundwater that needs to be extracted from the trench. The GWE trench would collect impacted groundwater and reduce the hydraulic head beneath AP2 which would reduce of prevent migration of impacted groundwater. The construction activities would likely result in some negative impacts to the ecosystem, including disturbances of some existing habitats atop portions of the construction areas, and habitats in the immediate vicinity of these locations by causing alarm and escape behavior in nearby wildlife (*e.g.*, due to noise disturbances). Short-term impacts could also occur to sensitive aquatic and wetland species in Coffeen Lake and other wetlands or surface	CCR. Groundwater modeling performed in support of the Closure Plan predicted that source control would result in a reduction of CCR leachate production, a decrease in CCR leachate constituent concentrations, and a contraction of the groundwater contaminant plume (NRT, 2017a). Additionally, residual plume management under the Source Control-Horizontal GWE Well alternative would rely on installation of a horizontal extraction well to drain water from beneath AP2, thus reducing the hydraulic head beneath AP2 and accelerating the time to achieve GWPS. The horizontal well would drain water from AP2 which would reduce or prevent migration of impacted groundwater. The construction activities would likely result in some negative impacts to the ecosystem, including disturbances of some existing habitats atop portions of the construction areas, and habitats in the immediate vicinity of these locations by causing alarm and escape behavior in nearby wildlife (*e.g.*, due to noise disturbances). Short-term impacts could also occur to sensitive aquatic and wetland species in Coffeen Lake and other wetlands or surface water bodies located within the SFWA

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-Upgradient Barrier Wall and GWE Trench	Source Control-Horizontal GWE Well
		water bodies located within the SFWA near AP2 (see Section 1.1.3) due to potential sediment runoff during construction at the Site.	near AP2 (see Section 1.1.3) due to potential sediment runoff during construction at the Site.

Notes:
AP2 = Ash Pond No. 2; BMP = Best Management Practice; CCR = Coal Combustion Residual; CIP = Closure-in-Place; GHG = Greenhouse Gas; GWE = Groundwater Extraction; GWE Trench = Groundwater Extraction Trench; GWP = Groundwater Polishing; GWPS = Groundwater Protection Standard; IAC = Illinois Administrative Code; IDNR = Illinois Department of Natural Resources; IEPA = Illinois Environmental Protection Agency; LLDPE = Linear Low-Density Polyethylene; NPDES = National Pollutant Discharge Elimination System; O&M = Operations and Maintenance; SFWA = State Fish and Wildlife Area; Source Control-GWP = Source Control with Groundwater Polishing; Source Control-Horizontal GWE Well = Source Control with a Horizontal Groundwater Extraction Well; Source Control-Upgradient Barrier Wall and GWE Trench = Source Control with Upgradient Barrier Wall and Groundwater Extraction Trench.

1 Introduction

1.1 Site Description and History

1.1.1 Site Location and History

Coffeen Power Plant (CPP) is an electric power generating facility with coal-fired units and is operated by Illinois Power Generating Company (IPGC). The Site is located about 2 miles south of the City of Coffeen, Illinois, and situated approximately between two lobes of Coffeen Lake. Historically, three room and pillar coal mines operated within the boundaries of the Site. From south to north, they are the Hillsboro Mine, which operated from 1964 to 1983; the Clover Leaf No. 1 Mine, which operated from 1889 to 1901; and the Clover Leaf No. 4 Mine, which operated from 1906 to 1924 (Ramboll, 2021a; ISGS and University of Illinois at Urbana-Champaign, 2011). The Coffeen Power Plant operated from 1964 to November 2019 when it was retired (Ramboll, 2021a).

1.1.2 CCR Impoundment

The Coffeen Power Plant produced and stored coal combustion residuals (CCRs) as a part of its historical operations. Ash Pond No. 2 (AP2; Vistra identification [ID] No. CCR Unit 102, Illinois Environmental Protection Agency [IEPA] ID No. W1350150004-02, and National Inventory of Dams [NID] ID No. IL50723) is the subject of this report.

AP2 (Figure 1.1) is an inactive and unlined 60-acre bermed CCR Unit that started operation in the early 1970s. AP2 was removed from service and capped in the mid-1980s with a 2-ft clay and soil layer (AECOM, 2017). Four additional CCR units exist on the Site, including Ash Pond No. 1 (AP1) (operated from 1964 to 2019), the Gypsum Management Facility Gypsum Stack Pond (operated from 2010 to 2021), the Gypsum Management Facility Recycling Pond (operated from 2010 to 2021), and the lined Landfill that managed fly ash beginning in 2010 (Ramboll, 2021a).

Source control by removal of impounded water and installation of a geomembrane cover system for AP2 was completed in 2020 in accordance with the closure plan (Ramboll, 2021a); the closure was supported by groundwater modeling approved by IEPA in 2018 (Buscher, 2018), which is discussed in detail in Section 2.1.

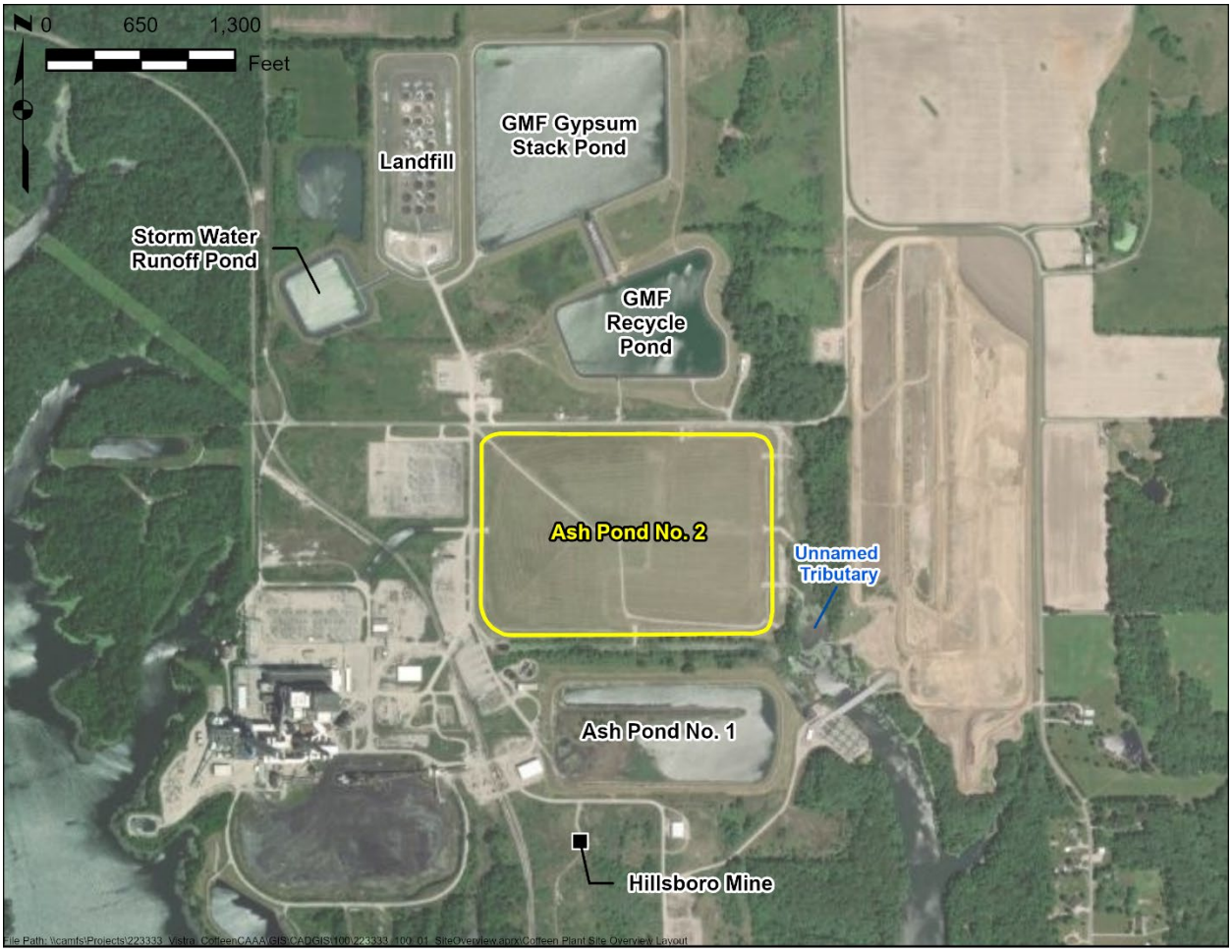


Figure 1.1 Site Location Map. GMF = Gypsum Management Facility. Adapted from NRT (2017b).

1.1.3 Surface Water Hydrology

The CPP is bordered by Coffeen Lake to the west, south, and east. Additionally, to the east, the CPP is also bordered by the Unnamed Tributary. East of the Site, the Unnamed Tributary flows south into the eastern lobe of Coffeen Lake. The facility is permitted to discharge to Coffeen Lake under National Pollutant Discharge Elimination System (NPDES) Permit No. IL 0000108 (IEPA, 2023; Ramboll, 2021a). The northeast corner of AP2 is located approximately several hundred ft west of Coffeen Lake within the Shoal Creek Watershed (Hydrologic Unit Code [HUC] 07140203; Ramboll, 2021a). The Unnamed Tributary flows south into Coffeen Lake approximately 200 ft northeast of AP2, and the East Fork of Shoal Creek is located approximately 4,300 ft east of AP2. Within 1,000 meters (m) of AP2, there are several unnamed freshwater ponds and two freshwater emergent wetlands (Ramboll, 2021a). The ponds range in size from 0.2 acres to 4.8 acres. Emergent wetlands are 0.4 acre in size, located south of AP2, and 1.6 acres, located east and northeast of AP2 where the Unnamed Tributary enters Coffeen Lake.

The 1,100-acre Coffeen Lake was constructed by damming the McDavid Branch of the East Fork of Shoal Creek to aid with cooling for the facility (Ramboll, 2021a). The IEPA classifies Coffeen Lake as a General Use Water (IEPA, 2007): it is designated for aquatic life and use in primary contact recreation; however, it is not designated for use in food processing or as a public water supply. Coffeen Lake (Assessment Unit ID IL_ROG) is listed on the 2018 Illinois Section 303(d) List as being impaired for fish consumption due to mercury (IEPA, 2019; US EPA, 2022). In addition, US EPA approved in 2007 a Total Maximum Daily

Load (TMDL) for phosphorus to address aesthetic quality impairments in Coffeen Lake due to excess algae and total suspended solids (IEPA, 2007).

1.1.4 Hydrogeology

The geology underlying the Site in the vicinity of AP2 consists of several distinct hydrostratigraphic units (Appendix C; Ramboll, 2024a; NRT, 2017b; Ramboll, 2020):

- **Upper Confining Unit (UCU):** The UCU underlies AP2. It consists of the Roxana and Peoria Silts (Loess Unit) and the upper portion of the Hagarstown Member, which has low permeability clays and silts. The Loess Unit in the area of AP2 is relatively thin, with less than 1 ft of thickness and was likely removed during AP2 construction. The upper clayey till portion of the Hagarstown Member has varying thicknesses from 1.9 ft to over 12 ft to the south and west of AP2.
- **Uppermost Aquifer (UA):** The UA comprises moderately permeable sands, silty sand, and clayey gravel of the Hagarstown Member and, in some portions of the Site, the Vandalia Member. The UA unit is thin (generally less than 3 ft), discontinuous, and variable throughout AP2 due deposition and weathering.
- **Lower Confining Unit (LCU):** The LCU underlies the UA. It consists of three low hydraulic conductivity soil layers: the sandy clay till of the Vandalia Member, the silt of the Mulberry Grove Formation, and the compacted clay till of the Smithboro Member. The thickness of LCU ranges approximately 7 to 18 ft thick near AP2. The LCU has been identified as a potential migration pathway (PMP) because downward vertical gradients indicate that there is the potential for impacts to migrate through this unit.
- **Deep Aquifer (DA):** The DA consists of sand and sandy silt/clay units of the Yarmouth Soil, which is discontinuous and, where present, generally less than 5 ft thick. This unit is also identified as a PMP.
- **Deep Confining Unit (DCU):** The DCU is comprised of the Banner Formation, with a mixture of clays, silts, and sands. The Lierle Clay Member is the upper portion of the Banner Formation.

There is a groundwater flow divide within the UA in the center of the CPP property between the two lobes of Coffeen Lake. Groundwater in the UA flows from the center of the CPP property west toward Coffeen Lake and east toward the Unnamed Tributary. Groundwater near AP2 flows east and south toward a former surface water discharge flume and the Unnamed Tributary (NRT, 2017b). There is limited groundwater flow from AP2 toward the west due to a thinning or lower hydraulic conductivity of the Hagarstown Beds (NRT, 2017b). Both the discharge flume and the Unnamed Tributary intersect and cut off the Hagarstown Member in the UA, which blocks any further migration of potentially impacted groundwater (NRT, 2017a). Groundwater flow within the UA is predominantly horizontal due to the underlying low-permeability LCU (NRT, 2017b). Groundwater flow directions in the vicinity of AP2 are typically stable and do not have significant seasonal change. Groundwater elevations are controlled by the water level along the shoreline of Coffeen Lake (NRT, 2017a).

During groundwater interaction with surface water, CCR-related constituents may partition between sediments and the surface water column. It should be noted that many CCR-related constituents occur naturally in sediments and surface water (and can also arise from other industrial sources). As a result, their presence in the sediments and/or surface water of the Coffeen Lake and the Unnamed Tributary does not necessarily signify contributions from AP2.

1.1.5 Site Vicinity

The CPP property is bordered by Coffeen Lake to the west and south, by the Unnamed Tributary and Coffeen Lake to the east, and by agricultural land to the north (Ramboll, 2021a, Figure 1.1). Coal mining operations occurred in the vicinity of AP2 from 1906 until 1983. The former Hillsboro Mine (Illinois State Geological Survey [ISGS] Mine No. 871), which operated from 1964 until 1983, is located to the south of AP2. The Clover Leaf No. 4 Mine (ISGS Mine No. 442) was located north to northwest of AP2 and operated from 1906 until 1924 (Ramboll, 2021a).

Although the area surrounding the CPP is predominantly agricultural, Coffeen Lake and the surrounding land are used for recreational activities. Since 1986, Coffeen Lake State Fish and Wildlife Area (SFWA) has been open to the public under a lease and management agreement between the Illinois Department of Natural Resources (IDNR) and Ameren Energy Generating Company (IDNR, 2014). To the north of the Coffeen Power Plant, there are walking and hiking trails and bank fishing. Coffeen Lake also entertains fishing and picnicking on the western shore. Based on a review of the IDNR Historic Preservation Division database and the Illinois State Archaeological Survey database, there are no historic sites located within 1,000 m of AP2 (Ramboll, 2021a).

1.2 Part 845 Regulatory Review and Requirements

Title 35, Part 845 of the Illinois Administrative Code (IAC) (IEPA, 2021) requires that a Corrective Action Alternatives Analysis (CAAA) be performed as part of the remedy selection, prior to undertaking any corrective actions at certain CCR-containing impoundments where exceedances of GWPSs have been identified. Because exceedances[1] of GWPSs in groundwater associated with AP2 have been identified for boron, cobalt, pH, sulfate, and total dissolved solids (TDS) (Appendix D; Ramboll, 2024b), this report presents a CAAA for AP2 pursuant to the requirements under IAC Section 845.670. The goal of a CAAA is to holistically evaluate a range of factors for the various corrective actions being considered at an impoundment, including the efficiency, reliability, and ease of implementation of the corrective action; its potential positive and negative short- and long-term impacts on human health and the environment; and its ability to address concerns raised by the community (IEPA, 2021). A CAAA is a decision-making tool that is designed to aid in the selection of a corrective action alternative.

[1] Throughout this document, "exceedance" or "exceedances" is intended to refer only to potential exceedances of proposed applicable background statistics or Groundwater Protection Standards (GWPS) as described in the proposed groundwater monitoring program (Burns & McDonnell, 2021). That operating permit application, including the proposed groundwater monitoring program, remains under review by IEPA and therefore IPRG has not identified any actual exceedances.

2 Corrective Action Alternatives Analysis

This section presents the CAAA pursuant to requirements under IAC Section 845.670 (IEPA, 2021). The goal of a CAAA is to fully evaluate proposed viable corrective measures that were identified in the CMA (Appendix C; Ramboll, 2024a). The CAAA evaluates potential corrective actions with respect to a wide range of factors, including the performance, reliability, and ease of implementation of the corrective action; its potential impacts on human health and the environment; and its ability to address concerns raised by the community (IEPA, 2021).

Per IAC Section 845.670(d) (IEPA, 2021), any corrective actions selected under a Corrective Action Plan must:

1. Be protective of human health and the environment;
2. Attain the groundwater protection standards specified in Section 845.600;
3. Control the sources of releases to reduce or eliminate, to the maximum extent feasible, further releases of constituents listed in Section 845.600 into the environment;
4. Remove from the environment as much of the contaminated material that was released from the CCR surface impoundment as is feasible, considering factors such as avoiding inappropriate disturbance of sensitive ecosystems; and
5. Comply with standards for management of wastes as specified in Section 845.680(d).

At AP2, a CAAA is required because groundwater monitoring associated with AP2 identified exceedances of the GWPSs. Groundwater monitoring was conducted in accordance with the proposed groundwater monitoring plan (GMP) between 2015 and 2023 (Appendix D; Ramboll, 2024b) samples collected from groundwater compliance monitoring wells were used to monitor groundwater quality and evaluate compliance with the groundwater quality standards listed in IAC Section 845.600(a). As of the date of this report, boron, cobalt, pH, sulfate, and TDS were identified as a constituent detected in groundwater at a concentration in excess of its GWPS (Appendix D; Ramboll, 2024b).

Three potentially viable corrective actions for AP2 were selected in the CMA for further consideration in this CAAA. Each of these corrective action alternatives includes source control by closure-in-place (CIP). The corrective actions that are considered in this CAAA are Source Control with Groundwater Polishing (Source Control-GWP), Source Control with an Upgradient Barrier Wall and Groundwater Extraction Trench (Source Control-Upgradient Barrier Wall and GWE Trench) and Source Control with a Horizontal Groundwater Extraction Well (Source Control-Horizontal GWE Well). The corrective actions are described below in Section 2.1.

It should be noted that Source Control-GWP, Source Control with GWE (Source Control-GWE), and Source Control with Groundwater Cutoff Wall (Source Control-Cutoff Wall) were initially identified in the CMA as viable remedial approaches (Appendix C; Ramboll, 2024a). However, during subsequent evaluations, the remedial approaches were modified. Remedy modifications include the following:

- The Source Control-Cutoff Wall alternative was determined to be infeasible for attaining GWPS in a reasonable amount of time without a supplementary hydraulic control method. The cutoff wall

was expanded into the upgradient barrier wall with GWE trench (*i.e.*, Source Control-Upgradient Barrier Wall and GWE Trench alternative).

- The Source Control-GWE alternative was further refined into the Source Control-Horizontal GWE well remedy, which includes an alternate method of GWE well installation *via* horizontal directional drilling to reduce disturbance of the completed final cover system while allowing for targeted installation near the CCR/native soil interface beneath AP2.

2.1 Corrective Action Alternatives Descriptions

For all three corrective actions evaluated in this CAAA, source control is the primary remedy. US EPA has stated that source control is the most effective means of ensuring the timely attainment of remediation objectives (US EPA, 2015b). The source control for AP2 consisted of closure-in-place (CIP). Specific elements of this approach completed in 2020 included (AECOM, 2017):

- Removal of impounded water prior to the grading of CCR and fill materials;
- Removing and abandoning existing dewatering wells and piezometers within the previous cover system;
- Installation of a geomembrane cover system consisting of a 40-mil linear low-density polyethylene (LLDPE) geomembrane layer, a geocomposite drainage layer, 18 inches (in) of protective soil cover and at least 6 in of earthen material suitable for supporting vegetative growth; and
- Construction of a stormwater management system to convey stormwater runoff to perimeter drainage channels and to letdown structures.

These source control activities included the removal of impounded water and the installation of a low-permeability final geomembrane over system designed to limit the infiltration of precipitation into the impounded CCR, and the establishment of the stormwater management system. These activities were designed to control, minimize, or eliminate, post closure infiltration of liquids into the impounded CCR. As demonstrated by the groundwater modeling in support in support of the Closure and Post-Closure Care Plan (AECOM, 2017; NRT, 2017a), this source control approach would result in a reduction of CCR leachate generation and contraction of the groundwater contaminant plume, which was predicted to begin after the completion of the source control, demonstrating that source control controls, minimizes, or eliminates post-closure releases of leachate.

In addition to source control, the corrective actions evaluated in this CAAA include residual plume management. Three potential corrective actions, identified as viable in the CMA, are evaluated in this CAAA for AP2:

- **Alternative 1:** Source Control with Groundwater Polishing (Source Control-GWP)
- **Alternative 2:** Source Control with Upgradient Barrier Wall and Groundwater Extraction Trench (Source Control-Upgradient Barrier Wall and GWE Trench)
- **Alternative 3:** Source Control with a Horizontal Groundwater Extraction Well (Source Control-Horizontal GWE Well)

For all three potential corrective action alternatives, adaptive site management strategies would be integrated into residual plume management. This approach ensures the timely incorporation of new Site information throughout the corrective action process in order to optimize the remediation and expedite achievement of the GWPSs. As part of the adaptive site management approach, system performance and residual plume conditions would be monitored throughout the implementation of the selected corrective action. If groundwater concentrations do not respond as expected to the corrective action, the adaptive site management approach would enable prompt adjustments, optimizations, or replacement of the remedy to ensure overall effectiveness.

2.1.1 Alternative 1: Source Control-GWP

The first corrective action alternative is Source Control-GWP. This remedy includes source control (*i.e.*, CIP) combined with residual plume management based on natural physical and geochemical processes that would reduce groundwater concentrations downgradient of AP2. GWP mechanisms were evaluated using geochemical speciation and reaction models. The primary objective of the geochemical model was to support the evaluation of GWP as a potential remedy for the Site. The model focused on evaluating the dominant geochemical reactions that may occur at time scales relevant to groundwater flow, including adsorption and mineral dissolution/precipitation reactions (*i.e.*, iron and aluminum hydroxides, carbonates, and some sulfates) (Appendix E; Geosyntec Consultants, Inc., 2025). Model inputs included geochemically reactive solid mineral phases, downgradient groundwater composition, and background groundwater composition derived from Site-specific data. Speciation models analyzed the distribution of chemical constituents between solid and aqueous phases, while reaction models assessed how these distributions may shift in response to changing Site conditions (US EPA, 2015b).

Components of residual plume management for this Source Control-GWP alternative include:

- Groundwater concentrations would be reduced in the downgradient plume as a result of physical and geochemical attenuation processes. Site-specific evaluations have shown that GWP would reduce the groundwater concentrations and mobility of inorganic contaminants under post-closure conditions. Specifically, chemical attenuation of contaminants is feasible *via* sorption to aquifer solids, particularly iron and aluminum oxides under current conditions. Attenuation *via* sorption onto mineral surfaces should remain stable under future conditions, and remobilization is unlikely to impact the time to achieve GWPS as groundwater returns to background conditions for sulfate. Remobilization of boron may occur at some locations and affect the time to achieve GWPS compared to sulfate (Appendix E; Geosyntec Consultants, Inc., 2025).
- Corrective action groundwater monitoring using a groundwater monitoring system designed in accordance with IAC Section 845.680(c), which would be installed within the plume that lies beyond the facility boundary;
- Adaptive site management strategies for this alternative would include geochemical modeling. Groundwater monitoring results would be evaluated and compared to the model-predicted concentrations. In situations in which observed groundwater concentrations deviate significantly from modeled conditions, alternative methods or techniques would be evaluated, and if viable, incorporated as per IAC Section 845.680(b);
- Corrective action confirmation groundwater sampling would be performed for 3 years after GWPSs have been achieved; and
- Following the completion of the corrective action confirmation monitoring period, a report and certification for Corrective Action Completion would be prepared and submitted to IEPA as per IAC Section 845.680(e).

The overall corrective action implementation duration for this alternative is over 100 years after approval of the corrective action plan (Appendix B; Ramboll, 2025a), including:

- Approximately 135 years (1,620 months) of corrective action monitoring (*i.e.*, time to meet GWPSs);
- At least 3 years (36 months) of corrective action confirmation monitoring;[2] and
- Approximately 6 months associated with post-closure reporting.

Although source control (*i.e.*, closure-in-place [CIP]) is a primary component of the corrective action, source control was completed in the 2020 and is not evaluated in this report. Moreover, there is no labor and mileage incurred with the residual plume management under the Source Control-GWP alternative, because no construction would be required under this alternative. Mileage and labor associated with corrective action monitoring was not included in this analysis (Appendix B; Ramboll, 2025a).

2.1.2 Alternative 2: Source Control-Upgradient Barrier Wall and GWE Trench

The second corrective action alternative is Source Control-Upgradient Barrier Wall and GWE Trench. This remedy includes source control (*i.e.*, CIP) with a barrier wall and groundwater extraction trench as the residual plume management approach. The residual plume management would include the construction of a barrier wall located adjacent to the northern and western sides of AP2, with an extraction trench running parallel and hydraulically downgradient of the barrier wall. The combined extraction trench and barrier wall would prevent groundwater flowing towards AP2 from the northwest, to collect impacted groundwater and reduce the hydraulic head beneath AP2. Both structures would be constructed from the ground surface to a depth of 8 ft bgs penetrating the UA. The barrier wall and the GWE trench would be approximately 2 to 3 ft wide, with 1 to 2 ft of separation between them. Horizontal collection pipes would be installed in the trench which would be backfilled with clean granular fill and capped with compacted clay to reduce surface water infiltration. The collection pipes would drain to sumps spaced throughout the trenches to extract groundwater. Extracted groundwater would be collected and sent to a new on-Site lined pond and discharged from either a new or existing outfall managed under the National Pollutant Discharge Elimination System (NPDES) permit for the Site (IEPA, 2023). The barrier wall would be approximately 3,300 ft long and constructed using *in-situ* soils with a low-permeability mixture down to the target elevation. The barrier wall would be located on the outer side (hydraulically upgradient) of the extraction trench to limit groundwater from flowing towards AP2 and to reduce the amount of groundwater that needs to be extracted from the trench (Appendix B; Ramboll, 2025a).

Implementation of the Source Control-Upgradient Barrier Wall and GWE Trench is expected to include various tasks across three major phases: pre-construction activities (Phase 1), corrective action construction (Phase 2), and corrective action operations, maintenance, and closeout (Phase 3). The activities associated with each of these phases are summarized below:

- **Phase 1:** Pre-construction activities including obtaining permits from agencies, and completing Site investigations and engineering designs;
- **Phase 2:** Construction of the extraction trench, settling pond, and minor Site restoration of disturbed areas;

[2] It should be noted that post-closure care groundwater monitoring would continue for a minimum of 30 years as required by IAC Section 845.780(c).

- Mobilization of equipment and materials to the Site, and preparation for Site construction including stormwater best management practices (BMPs), modification for Site utilities, and specialty geotechnical techniques for trenching activities;
- The GWE trench would be constructed using one-pass trenching methods by excavating subgrade soils, placing collection piping and pumps, and backfilling/capping the trench to reduce surface water infiltration; other installation methods may be evaluated at a later phase of design;
- The barrier wall would be constructed using one-pass technology, although other installation approaches may be evaluated during a later phase of design; a temporary on-Site batch plant or material handling system would be established to generate the low permeability backfill for the wall;
- Excavated soils from the GWE trench and barrier wall would be hauled and disposed of at an on-Site landfill;
- The 1-acre, geomembrane-lined settling pond would be constructed to manage extracted groundwater using conventional construction equipment; although other groundwater treatment and management technologies may be evaluated during a later phase of design. Piping and installation of electrical, mechanical, and pneumatic infrastructure would be used to convey water from the settling pond to an appropriate NPDES outfall;
- Site restoration would be completed following the construction of the GWE trench and settling pond.

▪ **Phase 3:** Operations, Maintenance (O&M), and Closeout of the barrier wall and GWE trench system. Details pertaining to each of these activities are outlined below.

- Continuous operation of the GWE trench and barrier wall system;
- Corrective Action O&M would involve routine and non-routine maintenance of extraction pumps, transfer pumps, air compressor, totalizer data collection, filter system, and other system components, as well as flushing or jetting of water conveyance lines to remove accumulated organic or inorganic solids from the interior walls;
- Monitoring of extracted groundwater under the NPDES permit;
- Adaptive site management strategies would be employed to track remediation progress and incorporate new Site information to assure the achievement of the GWPSs;
- Corrective action monitoring would be performed using a new corrective action groundwater monitoring network designed in accordance with IAC Section 845.680(c), which would be installed within the plume that lies beyond the facility boundary;
- Following the completion of the corrective action confirmation monitoring period, a report and certification for Corrective Action Completion would be prepared and submitted to IEPA as per IAC Section 845.680(e).

The overall corrective action implementation duration is approximately 67 to 69 years after approval of the Construction Permit Application (Appendix B; Ramboll, 2025a), including:

▪ Approximately 3.5 to 5 years (42 to 60 months) of pre-construction activities (Phase 1),

▪ Approximately 6 to 12 months of corrective action construction (Phase 2), and

- Approximately 63 years (750 months) of O&M and closeout (Phase 3):
  - It is estimated to include 59 years (708 months) of corrective action monitoring (*i.e.*, time to meet GWPSs), at least 3 years (36 months) of corrective action confirmation monitoring,[3] and 6 months associated with post-closure reporting.

Key parameters for the Source Control-Upgradient Barrier Wall and GWE Trench corrective action alternative are shown in Table 2.1, below.

Table 2.1 Key Parameters for the Source Control-Upgradient Barrier Wall and GWE Trench Corrective Action Alternative[a]

Parameter[b]	Value[c]
Labor Hours	
Total On-Site Labor	16,900 hours
Total Off-Site Labor	0 hours
40% Contingency	6,760 hours
Total Labor Hours:	23,600 hours
Vehicle and Equipment Travel Miles	
Vehicles On-Site	23,300 miles
On-Site Haul Trucks (Unloaded + Loaded)	4,200 miles
Labor Mobilization	152,000 miles
Equipment Mobilization (Unloaded + Loaded)	26,300 miles
Off-Site Haul Trucks (Unloaded + Loaded)	17,400 miles
Material Deliveries (Unloaded + Loaded)	9,000 miles
Total On-Site Vehicle and Equipment Travel Miles:	27,500 miles
Total Off-Site Vehicle and Equipment Travel Miles:	205,000 miles
Total Vehicle and Equipment Travel Miles:	233,000 miles

Notes:
GWE Trench = Groundwater Extraction Trench.
(a) Although source control (*i.e.*, closure-in-place [CIP]) is a primary component of the corrective action, the source control was completed in 2020 and the associated labor time, equipment usage, and mileage are not discussed in this analysis.
(b) Site activities are expected to occur during the corrective action construction and operation and maintenance phases for this alternative.
(c) Values reported in this table were rounded to reflect 3 significant figures.
Source: Appendix B.

2.1.3 Alternative 3: Source Control-Horizontal GWE Well

The third corrective action alternative is Source Control-Horizontal GWE Well. This remedy includes source control (*i.e.*, CIP) with a horizontal extraction well as the residual plume management approach. This residual plume management would include constructing a horizontal extraction well running in the north south direction within the eastern portion of AP2 at the CCR/native soil interface. The GWE well would extract and drain water from beneath the AP2, reduce the hydraulic head, and accelerate the time to achieve the GWPSs (Appendix B; Ramboll, 2025a). The horizontal well would begin at the southern bank of AP2 at an elevation of 600 ft-amsl and extend 1,325 ft to the north at an elevation of 606 ft-amsl. Extracted water would be directed through a culvert or be pumped to a settling pond before discharge to an NPDES permitted outfall.

[3] It should be noted that post-closure care groundwater monitoring would continue for a minimum of 30 years or until such time as GWPSs are achieved, whichever is longer, as required by IAC Section 845.780(c).

Implementation of the Source Control-Horizontal GWE Well is expected to include various tasks across three major phases: pre-construction activities (Phase 1); corrective action construction (Phase 2); and corrective action operations, maintenance, and closeout (Phase 3). The activities associated with each of these phases are summarized below:

- **Phase 1:** Pre-construction activities, including obtaining permits from agencies, and completing Site investigations and engineering designs;
- **Phase 2:** Construction activities related to installation of the horizontal well, and minor Site restoration of disturbed areas;
  - Mobilization of equipment and materials to the Site and preparation for Site construction, which would include implementing stormwater BMPs around the construction area, modification of Site utilities, and the construction of a work platform;
  - The horizontal well would be installed in a south-north direction at the targeted elevation of the bottom of CCR/top of the UA between 600 and 606 ft-amsl with a length of about 1,300 ft; the well casing would contain a slotted well screen for collection of groundwater;
  - After well installation, the well would be developed by flushing or jetting the system as needed and the entry point would be grout sealed to reduce surface infiltration and any drill cuttings and spoils would be hauled to an on-Site landfill for disposal;
  - The geomembrane-lined settling pond would be constructed to manage extracted groundwater using conventional construction equipment; the settling pond would be approximately 1 acre in size and 2-ft deep; and
  - Site restoration would be completed following the construction of the horizontal well and settling pond.
- **Phase 3:** Operations, maintenance, and closeout. Details pertaining to each of these activities are outlined below.
  - Corrective Action O&M would involve routine inspection of the horizontal well extraction system such as transfer pumps and other system components; non-routine maintenance such as flushing or jetting of water conveyance lines may also occur;
  - Adaptive site management strategies would be employed to track remediation progress and incorporate new Site information to assure the achievement of the GWPSs;
  - Corrective action monitoring would be performed using a new corrective action groundwater monitoring network designed in accordance with IAC Section 845.680(c), which would be installed within the plume that lies beyond the facility boundary;
  - GWPSs are expected to be achieved in approximately 14 years after corrective action operation starts. Current modeling indicates that operation of the horizontal well system may be required for an additional 25 years to prevent concentrations from rebounding above the GWPSs; however, additional modeling would be performed and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation. Therefore, the total operational time period for the horizontal GWE system may be about 39 years. Corrective action monitoring would continue during this time and would include an additional 3 years of corrective action confirmation sampling after the correction action operation has ceased; and

- Following the completion of the corrective action confirmation monitoring period, a report and certification for Corrective Action Completion would be prepared and submitted to IEPA as per IAC Section 845.680(e).

The overall corrective action implementation duration is approximately 46 to 48 years (552 to 576 months) after approval of the Construction Permit Application (Appendix B; Ramboll, 2025a), including:

- Approximately 3 to 4.5 years (36 to 54 months) of pre-construction activities (Phase 1);
- Approximately 6 to12 months of corrective action construction (Phase 2); and
- Approximately 46 years (546 months) of corrective action O&M, and closeout (Phase 3).
  - It is estimated to include 14 years (168 months) of corrective action monitoring (*i.e.*, time to meet GWPSs), 25 years (300 months) of additional operation to prevent concentrations from rebounding above the GWPSs,[4] at least 3 years (36 months) of corrective action confirmation monitoring,[5] and 6 months associated with post-closure reporting.

[4] Current modeling indicates that an additional 25 years of system operation may be required to prevent concentrations from rebounding above the GWPSs; however, additional modeling would be performed and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation.

[5] It should be noted that post-closure care groundwater monitoring would continue for a minimum of 30 years as required by IAC Section 845.780(c).

Key parameters for the Source Control-Horizontal GWE Well corrective action alternative are shown in Table 2.2, below.

Table 2.2 Key Parameters for the Source Control-Horizontal GWE Well Corrective Action Alternative[a]

Parameter[b]	Value[c]
Labor Hours	
Total On-Site Labor	12,600 hours
Total Off-Site Labor	0 hours
40% Contingency	5,020 hours
Total Labor Hours:	17,600 hours
Vehicle and Equipment Travel Miles	
Vehicles On-Site	16,800 miles
On-Site Haul Trucks (Unloaded + Loaded)	98 miles
Labor Mobilization	116,000 miles
Equipment Mobilization (Unloaded + Loaded)	18,900 miles
Off-Site Haul Trucks (Unloaded + Loaded)	9,950 miles
Material Deliveries (Unloaded + Loaded)	7,570 miles
Total On-Site Vehicle and Equipment Travel Miles:	16,900 miles
Total Off-Site Vehicle and Equipment Travel Miles:	153,000 miles
Total Vehicle and Equipment Travel Miles:	170,000 miles

Notes:
Source Control-Horizontal GWE Well = Source Control with a Horizontal Groundwater Extraction Well.
(a) Although source control (*i.e.*, closure-in-place [CIP]) is a primary component of the corrective action, the source control was completed in 2020 and the associated labor time, equipment usage, and mileage are not discussed in this analysis.
(b) Site activities are expected to occur during the corrective action construction and O&M phases for this alternative.
(c) Values reported in this table were rounded to reflect 3 significant figures.
Source: Appendix B; Ramboll, 2025a.

2.2 Long- and Short-Term Effectiveness and Protectiveness of Corrective Action Alternative (IAC Section 845.670(e)(1))

2.2.1 Magnitude of Reduction of Existing Risks (IAC Section 845.670(e)(1)(A))

There are no current unacceptable risks to human or ecological receptors at this Site associated with AP2 (Appendix A; Gradient, 2025). Because current conditions do not present a risk to human health or the environment at AP2, there will be no unacceptable risk to human health or the environment for future conditions since the unit was already closed and source control was implemented. Concentrations of CCR-related constituents will decline over time and, consequently, potential exposures to CCR-related constituents in the environment will also decline. As a result of this, the magnitude of the reduction of existing risks is the same for the three potential corrective action alternatives (IAC Section 845.670(e)(1)(A)), and each corrective action alternative are equally protective of human health and the environment (IAC Section 84.670(d)(1)).

2.2.2 Effectiveness of the Remedy in Controlling the Source (IAC Section 845.670(e)(2)/IAC Section 845.670(d)(3))

Extent to Which Containment Practices Will Reduce Further Releases/Control the Sources of Releases to Reduce or Eliminate, to the Maximum Extent Feasible (IAC Section 845.670(e)(2)(A)/IAC Section 845.670(d)(3))

Source control was implemented for all three corrective action alternatives. Source control (*i.e.*, CIP) included removal of impounded water, and the installation of a low-permeability final geomembrane cover system to limit the infiltration into the impounded CCR, and the establishment of the stormwater management system. As demonstrated by the groundwater modeling in support of the Closure and Post-Closure Care Plan (NRT, 2017a), this source control approach would result in a reduction of CCR leachate generation and contraction of the groundwater contaminant plume, which was predicted to begin after the completion of the source control. Because source control was already completed at the Site, all three corrective action alternatives would remove the potential for CCR within the impoundment to impact groundwater. All three corrective action alternatives would be equally and fully protective with regard to source control. The effectiveness of residual plume management for each of the corrective action alternatives with respect to residual source control is summarized below.

- Under the Source Control-GWP alternative, the attenuation of dissolved constituent concentrations remaining after source control would be achieved through natural physical and geochemical processes. Site-specific evaluations have shown that GWP would reduce the groundwater concentrations and mobility of inorganic contaminants under post-closure conditions. Specifically, chemical attenuation of contaminants is feasible *via* sorption to aquifer solids, particularly iron and aluminum oxides under current conditions. Attenuation *via* sorption onto mineral surfaces should remain stable as groundwater returns to background conditions, and remobilization is unlikely to impact the time to achieve GWPS for sulfate. Remobilization of boron may occur at some locations and affect the time to achieve GWPS compared to sulfate (Appendix E; Geosyntec Consultants, Inc., 2025). In cases in which observed groundwater concentrations deviate significantly from modeled conditions, alternative methods or techniques would be evaluated under the adaptive site management, and if viable, incorporated as per IAC Section 845.680(b).
- Under the Source Control-Upgradient Barrier Wall and GWE Trench alternative, residual contamination control would be achieved by the construction of a barrier wall to prevent groundwater flowing towards AP2 and by installation of an extraction trench running parallel and hydraulically downgradient of the barrier wall to reduce the hydraulic head and collect impacted groundwater beneath AP2. GWE trench and a subsurface barrier wall are widely used corrective measures that have been effectively implemented at many sites to contain and capture and dissolved-phase groundwater plumes, and their combined implementation increases their efficacy to control the residual contamination. In cases in which observed groundwater concentrations deviate significantly from modeled conditions, alternative methods or techniques would be evaluated under the adaptive site management plan, and if viable, incorporated as per IAC Section 845.680(b).
- Under the Source Control-Horizontal GWE Well alternative, residual contamination control would be achieved by installing a horizontal GWE well to collect and drain CCR-impacted groundwater beneath AP2. Horizontal GWE wells are commonly used corrective measures that have been effectively implemented at many sites to control the residual contamination. In cases in which observed groundwater concentrations deviate significantly from modeled conditions, alternative methods or techniques would be evaluated under the adaptive site management plan, and if viable, incorporated as per IAC Section 845.680(b).

All three corrective action alternatives include source control and residual plume management. Thus, all three potential corrective action alternatives would be effective at reducing releases from both primary and residual sources (IAC Section 845.670(e)(2)(A)/IAC Section 845.670(d)(3)).

Extent to Which Treatment Technologies May Be Used (IAC Section 845.670(e)(2)(B))

Because Source Control-GWP would rely on physical and geochemical processes, no additional treatment technologies would be required. The Source Control-Upgradient Barrier Wall and GWE Trench alternative would require construction of a new on-Site settling pond to remove solids from extracted groundwater, prior to discharge *via* an NPDES permitted outfall. For the Source Control-Horizontal GWE Well alternative, extracted water would be managed and treated by a newly constructed on-Site settling pond, although other treatment and management technologies may be evaluated at later phases of the design (Appendix B; Ramboll, 2025a). For all corrective action alternatives, remedy optimizations would be implemented, if necessary, under the adaptive site management program.

2.2.3 Likelihood of Future Releases of CCR (IAC Section 845.670(e)(1)(B))

All three corrective action alternatives include source control (CIP), which was implemented in 2020. A geosynthetic cover system was previously installed over AP2, which included a 40-mil LLDPE geomembrane liner, 18 in of soil cover and 6 in of erosion soil layer for vegetative growth. A new stormwater control system was also installed. This cover system provides increased protection against berm and surface erosion, precipitation infiltration, and other adverse effects that could potentially trigger a release of CCR. None of the alternatives would disturb the previously installed cover system. Thus, there would be minimal risk of accidental CCR releases occurring post-closure under any of the corrective action alternatives.

2.2.4 Type and Degree of Long-Term Management, Including Monitoring, Operation, and Maintenance (IAC Section 845.670(e)(1)(C))

The type and degree of long-term residual groundwater plume management associated for all corrective action alternatives are summarized as follows:

- The Source Control-GWP alternative would not require the installation, operation, or maintenance of any engineered systems or structures, other than maintenance of the monitoring well network. The only long-term management activity required under this alternative would be regular corrective action groundwater monitoring and routine maintenance of the monitoring wells, which would continue at least 3 years after GWPSs have been achieved for all wells, in accordance with IAC Section 845.680(c)(2). Post-closure care groundwater monitoring would continue for a minimum of 30 years as required by IAC Section 845.780(c). Based on the adaptive site management approach, remedy optimization (additional methods or techniques) may be implemented to ensure the achievement of the GWPSs.
- The Source Control-Upgradient Barrier Wall and GWE Trench would require the construction of an extraction trench and barrier wall. Multiple tasks would be completed over three phases: pre-construction activities (Phase 1), corrective action construction (Phase 2), and corrective action O&M, and closeout (Phase 3). Once pre-construction activities are completed, construction of the extraction trench and barrier wall would occur. Corrective action O&M would require regular inspection and maintenance of the extraction trench system, such as extraction pumps, filter system, and other system components. Non-routine maintenance may include tasks such as repair or replacement of the extraction and/or transfer pumps, repair or replacement of the system air

compressor, and flushing or jetting of water conveyance lines in the event organic or inorganic solids accumulate on the interior walls. Extracted groundwater would be managed and treated by a newly-constructed on-Site settling pond before discharge *via* an NPDES Outfall. Additionally, corrective action groundwater sampling and routine maintenance of the monitoring well network would continue for at least 3 years after GWPSs have been achieved at all wells, in accordance with IAC Section 845.680(c)(2). Post-closure care groundwater monitoring would continue for a minimum of 30 years as required by IAC Section 845.780(c). Based on the adaptive site management approach, remedy optimization (additional methods or techniques) may be implemented to ensure the achievement of the GWPSs.

- The Source Control-Horizontal GWE Well would require the construction of a horizontal groundwater well. Multiple tasks would be completed over three phases: pre-construction activities (Phase 1), corrective action construction (Phase 2), corrective action O&M, and closeout (Phase 3). Once pre-construction activities are completed, installation of the horizontal GWE well and construction of the settling pond would occur. Corrective action O&M would require inspection and maintenance of the horizontal well to ensure continued operation. These activities would include routine inspection of the horizontal well extraction system along with non-routine maintenance such as flushing or jetting of water conveyance lines. Extracted groundwater would be managed to ensure compliance with the Site's NPDES permit for treatment and discharge. As with the other alternatives, corrective action sampling and routine maintenance of the monitoring well network would continue during the system operation. Once the GWPSs have been reached (approximately 14 years), corrective action monitoring may continue for additional 25 years to prevent groundwater concentrations from rebounding above the GWPSs.[6] Corrective action confirmation monitoring would continue after GWPSs have been achieved for all compliance wells for a period of 3 years after extraction from the horizontal well has been ceased, in accordance with IAC Section 845.680(c)(2). Post-closure care groundwater monitoring would continue for a minimum of 30 years as required by IAC Section 845.780(c). Based on the adaptive site management approach, remedy optimization (additional methods or techniques) may be implemented to ensure the achievement of the GWPSs.

2.2.5 Short-Term Risks to the Community or the Environment During Implementation of Remedy (IAC Section 845.670(e)(1)(D))

2.2.5.1 Safety Impacts

Best practices would be employed during construction in order to ensure worker safety and comply with all relevant regulations, permit requirements, and safety plans. However, it is impossible to completely eliminate risks to workers during construction and/or other corrective action activities. For example, injuries and fatalities can occur due to truck accidents or equipment malfunctions. Truck accidents that occur off-Site can also result in injuries or fatalities to community members. Because the source control was implemented in 2020, there is no further risk of accidents and injuries occurring during the implementation of the source control remedy. The safety impacts associated with residual plume management (*i.e.*, construction and O&M) for each corrective action alternative are described below.

- The Source Control-GWP alternative would not require the construction and maintenance of any engineered systems or structures, and therefore no safety impacts are expected.

[6] The exact duration of additional system operation would be determined as part of Corrective Action Groundwater Monitoring based on additional modeling and data collection.

- The Source Control-Upgradient Barrier Wall and GWE Trench alternative would include the construction of a barrier wall in order to prevent groundwater flowing towards AP2; a groundwater extraction trench system and settling pond to collect, extract, and treat CCR-impacted groundwater. Potential safety concerns would be related to the construction and O&M of the barrier wall, the extraction trench and settling pond.
- The Source Control-Horizontal GWE Well alternative would include construction of a horizontal well to collect CCR-impacted groundwater beneath AP2. Potential safety concerns would be related to the construction activities associated with installation of the horizontal well, as well as activities related to subsequent O&M.

Worker Risks

On-Site accidents include injuries and deaths arising from the use of heavy equipment and/or earthmoving operations during Site activities. Off-Site accidents include injuries and deaths due to vehicle accidents during labor and equipment mobilization/demobilization, as well as materials/supplies hauling and deliveries.

As discussed in section 2.1.1, there are no construction activities or operational requirements associated with residual plume management for the Source Control-GWP alternative. As shown in Tables 2.1-2.2, Ramboll estimates that residual plume management for the Source Control-Upgradient Barrier Wall and GWE Trench corrective action alternative would require 16,900 hours on-Site labor hours and residual plume management for the Source Control-Horizontal GWE Well corrective action alternative would require 12,600 hours on-Site labor hours (Appendix B; Ramboll, 2025). The US Bureau of Labor Statistics (US DOL, 2020a,b) provides an estimate of the hourly fatality and injury rates for construction workers. Based on the accident rates reported by the US Bureau of Labor Statistics and the on-Site labor hours reported in Appendix B, we estimate that approximately 0.17 worker injuries and 1.5×10^{-3} worker fatalities would occur on-Site under the Source Control-Source Control-Upgradient Barrier Wall and GWE Trench corrective action alternative; and approximately 0.13 worker injuries and 1.1×10^{-3} worker fatalities would occur on-Site under the Source Control-Horizontal GWE Well corrective action alternative (Table 2.3). No worker accidents would be expected under the Source Control-GWP alternative. The number of on-Site worker accidents is therefore expected to be highest under the Source Control- Source Control-Upgradient Barrier Wall and GWE Trench alternative.

Table 2.3 Expected Number of On-Site Worker Accidents Under Each Corrective Action Alternative[a,b]

Corrective Action Alternative	Injuries	Fatalities
Source Control-GWP	0	0
Source Control-Upgradient Barrier Wall and GWE Trench	0.17	1.5×10^{-3}
Source Control-Horizontal GWE Well	0.13	1.1×10^{-3}

Notes:
Source Control-GWP = Source Control with Groundwater Polishing; Source Control-Horizontal GWE Well = Source Control with a Horizontal Extraction Well; Source Control-Upgradient Barrier Wall and GWE Trench = Source Control with an Upgradient Barrier Wall and Groundwater Extraction Trench.
(a) Although source control (*i.e.*, closure-in-place [CIP]) is a primary component of the corrective action, it was complete in 2020, and the worker accidents associated with source control are not included in this analysis.
(b) Worker accidents associated with groundwater sampling and monitoring are not included in this analysis for any of the alternatives.

Off-Site, a greater number of haul truck miles, labor and equipment mobilization/demobilization miles, and material delivery miles would be required under the Source Control-Upgradient Barrier Wall and GWE Trench compared to the Source Control-Horizontal GWE Well alternative (Tables 2.1-2.2). For residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench and Source Control-Horizontal GWE Well corrective action alternatives, 205,000 and 153,000 total off-Site vehicle and equipment travel miles would be required, respectively. No off-Site travel miles would be expected under the Source Control-GWP alternative (Appendix B; Ramboll, 2025a). The United States Department of Transportation (US DOT) provides estimates of the expected number of fatalities and injuries "per vehicle mile driven" for drivers and passengers of large trucks and passenger vehicles (US DOT, 2023). Table 2.4 shows the expected number of off-Site accidents under each corrective action alternative due to all categories of off-Site vehicle usage. For these calculations, it was assumed that labor mobilization/ demobilization would rely upon passenger vehicles (cars or light trucks, including pickups, vans, and sport utility vehicles) and that hauling, equipment mobilization/demobilization, and material deliveries would rely upon large trucks. Based on US DOT's accident statistics and the mileage estimates in Appendix B, an estimated 0.10 worker injuries and 2.3×10^{-3} worker fatalities would be expected to occur due to off-Site activities under the Source Control-Upgradient Barrier Wall and GWE Trench alternative; and an estimated 0.077 worker injuries and 1.7×10^{-3} worker fatalities would be expected to occur due to off-Site activities under the Source Control-Horizontal GWE Well alternative. No worker accidents would be expected under the Source Control-GWP alternative.

Table 2.4 Expected Number of Off-Site Worker Accidents Related to Off-Site Car and Truck Use Under Each Corrective Action Alternative[a]

Off-Site Vehicle Use Category	Source Control-GWP		Source Control-Upgradient Barrier Wall and GWE Trench		Source Control-Horizontal GWE Well	
	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Hauling	0	0	3.7×10^{-3}	2.7×10^{-4}	2.1×10^{-3}	1.6×10^{-4}
Labor Mobilization/Demobilization	0	0	0.09	1.4×10^{-3}	0.069	1.1×10^{-3}
Equipment Mobilization/Demobilization	0	0	5.5×10^{-3}	4.1×10^{-4}	4.0×10^{-3}	3.0×10^{-4}
Material Deliveries	0	0	1.9×10^{-3}	1.4×10^{-4}	9.6×10^{-4}	1.2×10^{-4}
Total:	0	0	0.10	2.3×10^{-3}	0.077	1.7×10^{-3}

Notes:
GWE = Groundwater Extraction; GWE Trench = Groundwater Extraction Trench; Source Control-GWP = Source Control with Groundwater Polishing; Source Control-Horizontal GWE Well = Source Control with a Horizontal Groundwater Extraction Well; Source Control-Upgradient Barrier Wall and GWE Trench = Source Control with Upgradient Barrier Wall and Groundwater Extraction Trench.
(a) Although source control (*i.e.*, closure-in-place [CIP]) is a primary component of the corrective action, it was complete in 2020, and the worker accidents associated with source control are not included in this analysis.

Overall, considering accidents occurring both on- and off-Site, 0.28 worker injuries and 3.8×10^{-3} worker fatalities would be expected to occur for residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench alternative; and 0.21 worker injuries and 2.8×10^{-3} worker fatalities would be expected to occur for residual plume management under the Source Control-Horizontal GWE Well alternative. Thus, overall risks to workers would be highest under the Source Control-Upgradient Barrier Wall and GWE Trench alternative.

Community Risks

Vehicle accidents that occur off-Site can result in injuries or fatalities among community members as well as workers. Based on the accident statistics reported by US DOT (2023) and the off-Site travel mileages reported in Appendix B (and summarized in Tables 2.1-2.2), off-Site vehicle accidents could result in an

estimated 0.051 injuries and 6.9×10^{-4} fatalities among community members (*e.g.*, people involved in haul truck accidents that are neither haul truck drivers nor passengers, including pedestrians, drivers of other vehicles) for residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench alternative (Table 2.5). For residual plume management under the Source Control-Horizontal GWE Well alternative, off-Site vehicle accidents could result in an estimated 0.038 community injuries and 5.2×10^{-4} community fatalities. No community risks are expected under the Source Control-GWP alternative. Therefore, off-Site impacts on nearby residents, including injuries or fatalities, would be the highest under the Source Control-Upgradient Barrier Wall and GWE Trench alternative.

Table 2.5 Expected Number of Community Accidents Under Each Corrective Action Alternative[a]

Off-Site Vehicle Use Category	Source Control-GWP		Source Control-Upgradient Barrier Wall and GWE Trench		Source Control-Horizontal GWE Well	
	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Hauling	0	0	4.6×10^{-3}	3.4×10^{-5}	2.6×10^{-3}	1.9×10^{-5}
Labor Mobilization/Demobilization	0	0	3.7×10^{-2}	5.9×10^{-4}	2.8×10^{-2}	4.5×10^{-4}
Equipment Mobilization/Demobilization	0	0	6.9×10^{-3}	5.1×10^{-5}	5.0×10^{-3}	3.7×10^{-5}
Material Deliveries	0	0	2.4×10^{-3}	1.7×10^{-5}	2.0×10^{-3}	1.5×10^{-5}
Total:	0	0	0.051	6.9×10^{-4}	0.038	5.2×10^{-4}

Notes:
GWE = Groundwater Extraction; GWE Trench = Groundwater Extraction Trench; Source Control-GWP = Source Control with Groundwater Polishing; Source Control-Horizontal GWE Well = Source Control with a Horizontal Groundwater Extraction Well; Source Control-Upgradient Barrier Wall and GWE Trench = Source Control with Upgradient Barrier Wall and Groundwater Extraction Trench.
(a) Although source control (*i.e.*, closure-in-place [CIP]) is a primary component of the corrective action, the worker accidents associated with source control were previously performed and are not repeated in this analysis.

2.2.5.2 Cross-Media Impacts to Air

Air pollution can occur both on-Site (*e.g.*, construction activities) and off-Site (*e.g.*, along transportation routes), potentially impacting workers as well as community members. Diesel emissions are a major source of air pollutants and greenhouse has (GHG) emissions at construction sites. Diesel exhaust contains air pollutants, including nitrogen oxides (NO_x), particulate matter (PM), carbon monoxide (CO), and volatile organic compounds (VOCs) (Hesterberg *et al*., 2009; Mauderly and Garshick, 2009). Construction equipment also emits GHGs, including carbon dioxide (CO_2) and possibly nitrous oxide (N_2O). The potential impact of each corrective action alternative on GHG emissions is proportional to the potential impact of each alternative on other emissions from construction vehicles and equipment.

Source control (CIP) was implemented for all three potential corrective action alternatives and there are no further air impacts associated with source control. On-Site emissions would be highest for residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench alternative due to the greatest amount of on-Site vehicle travel miles required under this corrective action alternative (27,500 total on-Site travel miles under the Source Control-Upgradient Barrier Wall and GWE Trench alternative *versus* 16,900 total on-Site travel miles under the Source Control-Horizontal GWE Well alternative and no off-Site travel miles under the Source Control-GWP alternative; Section 2.1.1; Tables 2.1-2.2). Off-Site emissions would be highest for residual plume management under the Source Control- Upgradient Barrier Wall and GWE Trench alternative due to the greatest amount of off-Site vehicle and equipment travel miles required under this alternative (205,000 total off-Site travel miles under the Source Control-Upgradient Barrier Wall and GWE Trench alternative *versus* 153,000 total off-Site travel miles under the Source Control-Horizontal GWE Well alternative and no off-Site travel miles under the Source Control-GWP alternative). In summary, air impacts would be highest for the Source Control-Upgradient Barrier Wall and

GWE Trench alternative due to greatest vehicle travel miles, and lowest for the Source Control-GWP alternative, because no construction activities would be expected under this alternative.

2.2.5.3 Cross-Media Impacts to Surface Water and Sediments

Under all three corrective action alternatives, source control was implemented in 2020 (CIP), and, consequently, constituent mass flux from groundwater into surface water is declining over time. The source control approach removes the amount of water retained within the impoundment, which further reduces the hydraulic flux through the CCR. Due to the reduction in the hydraulic flux out of AP2, the mass flux out of AP2 would also be controlled or minimized. As demonstrated by the groundwater modeling in support in support of the Closure and Post-Closure Care Plan (NRT, 2017a), this source control approach would result in a reduction of CCR leachate parameters and thereby contraction of CCR constituents into the groundwater plume.

Under residual plume management for the Source Control-GWP alternative, minimal surface water and sediment impacts would be expected associated with residual plume management because it would not require the construction of any engineered systems or structures (other than utilizing groundwater monitoring wells).

Under residual plume management for the Source Control-Upgradient Barrier Wall and GWE Trench alternative, surface water and sediment impacts would be higher than the Source Control-GWP alternative due to the construction of the extraction trench system and the barrier wall. Construction can have short-term negative impacts on surface water and sediment quality immediately adjacent to a site due to erosion and sediment runoff. Extracted groundwater would be discharged *via* an NPDES permitted outfall. Any associated impacts would be addressed through BMPs in accordance with Site land disturbance permits.

Similarly, under residual plume management for the Source Control-Horizontal GWE Well alternative, surface water and sediment impacts would be higher than the Source Control-GWP alternative due to the construction of a horizontal GWE well (Appendix B; Ramboll, 2025a). Construction can have short-term negative impacts on surface water and sediment quality immediately adjacent to a site due to potential erosion and sediment runoff. Extracted groundwater would be discharged *via* an NPDES permitted outfall. Any associated impacts would be addressed through BMPs in accordance with Site land disturbance permits.

2.2.5.4 Control of Exposure to Any Residual Contamination During Implementation of the Remedy

Source control (CIP) was implemented for all three potential corrective action alternatives. Thus, there are no further risks of CCR exposure associated with source control implementation. However, impacted soils and groundwater can be a source of CCR-related constituent exposure for workers. Risks to workers arising from potential contact with residual contamination during construction, operation, and maintenance activities associated with residual plume management would be higher for the Source Control-Upgradient Barrier Wall and GWE Trench and Source Control-Horizontal GWE Well than for the Source Control-GWP alternative. The Source Control-Upgradient Barrier Wall and GWE Trench alternative would involve the production, management, and treatment of extracted groundwater, as well as on-Site disposal of excavated spoils generated during extraction trench and barrier wall construction. The Source Control-Horizontal GWE Well alternative would involve the production, management, and treatment of extracted groundwater, as well as on-Site disposal of excavated spoils generated during GWE well installation. The

Source Control-GWP alternative would not involve exposure to either of these soil or groundwater waste streams. Any potential CCR-exposures during the Source Control-Upgradient Barrier Wall and GWE Trench or Source Control-Horizontal GWE Well alternative would be managed through the use of rigorous safety protocols and personal protective equipment.

2.2.5.5 Other Identified Impacts

Source control (CIP) was implemented for all three potential corrective action alternatives (AECOM, 2017). Thus, there are no further risks associated with source control implementation.

In addition to safety impacts, cross-media impacts, and the potential for workers to be exposed to residual contamination, construction activities and remedial operations can have significant energy demands and can cause nuisance impacts such as traffic and noise. Energy consumption at a construction site is synonymous with fossil fuel consumption because the energy to power construction vehicles and equipment comes from the burning of fossil fuels. Fossil fuel demands considered here include the burning of diesel fuel during construction equipment and vehicle travel miles. Because GHG emission impacts and energy consumption impacts both arise from the same sources at construction sites, the trends discussed in Section 2.2.5.2 with respect to GHG emissions also apply to the evaluation of energy demands. Specifically, the energy demands of construction equipment and vehicles associated with residual plume management would be greater under the Source Control-Upgradient Barrier Wall and GWE Trench Source and Control-Horizontal GWE Well alternatives, while the energy demands under the Source Control-GWP alternative associated with residual plume management are expected to be lower because Source Control-GWP would not require any significant construction activity. Additionally, energy would be required for the operation of the extraction systems and transfer pumps under the Source Control-Upgradient Barrier Wall and GWE Trench Source and Control-Horizontal GWE Well alternatives; there is no operational energy required under the Source Control-GWP because it would rely only on natural physical and geochemical processes.

Traffic and noise impacts associated with residual plume management are expected to be higher under the Source Control-Upgradient Barrier Wall and GWE Trench Source and Control-Horizontal GWE Well alternatives than the Source Control-GWP alternative, due to the construction activities required to construct the barrier wall and the extraction trench system under the Source Control-Upgradient Barrier Wall alternative, and construction activities related to installation of the horizontal well under the Source Control-Horizontal GWE Well alternative, respectively. Traffic may increase temporarily around the Site under the Source Control-Upgradient Barrier Wall and GWE Trench and Source Control-Horizontal GWE Well alternatives due to the daily arrival and departure of the workforce, equipment mobilization/ demobilization, and material deliveries. However, these impacts would be expected to largely occur at the beginning or end of each workday (for the arrival/departure of the work force), at the beginning or end of the construction period (for equipment mobilization/demobilization), and at specific times throughout the construction period (for material deliveries). Traffic and noise impacts associated with residual plume management from the Source Control-GWP alternative is expected to be significantly less than those associated with the Source Control-Upgradient Barrier Wall and GWE Trench Source and Control-Horizontal GWE Well alternative.

Construction activities can negatively impact natural resources and habitats near the Site, as well as scenic, historical, and recreational value. Based on a review of the IDNR Historic Preservation Division database and the Illinois State Archaeological Survey database, there are no historic sites located within 1,000 m of AP2 (Ramboll, 2021a). There would be no impacts under the Source Control-GWP alternative because no additional construction activities would occur after implementation of source control. However, the Source Control-Upgradient Barrier Wall and GWE Trench Source alternative would require construction of a

barrier wall, an extraction trench, and an on-Site settling pond. The Source Control-Horizontal GWE Well alternative would require installation of a horizontal well and an on-Site settling pond. These impacts would include disturbance of some existing habitats atop portions of the construction areas, and habitat in the immediate vicinity of these locations by causing alarm and escape behavior in nearby wildlife (*e.g.*, due to noise disturbances). It is also possible that limited negative short-term impacts could occur to sensitive aquatic and wetland species in Coffeen Lake and other wetlands or surface water bodies located within the SFWA near AP2 (see Section 1.1.3) due to sediment runoff during construction required in any residual plume management.

2.2.6 Time Until Groundwater Protection Standards Are Achieved/Attain the Groundwater Protection Standards Specified in Section 845.600 (IAC Section 845.670(e)(1)(E)/IAC Section 845.680(d)(2))

This section of the report evaluates the time required to achieve GWPSs, pursuant to requirements under IAC Section 845.670(e)(1)(E) (IEPA, 2021) and under IAC Section 845.680(d)(2).

AP2 is underlain by the UCU beneath the majority of the impoundment footprint. There is a groundwater flow divide within the UA in the center of the CPP property between the two lobes of Coffeen Lake. Groundwater in the UA flows from the center of the CPP property west toward Coffeen Lake and east toward the Unnamed Tributary. Groundwater near AP2 flows east and south toward a former surface water discharge flume and the Unnamed Tributary (NRT, 2017b). There is limited groundwater flow from AP2 toward the west due to a thinning or lower hydraulic conductivity of the Hagarstown Beds (NRT, 2017b). Both the discharge flume and the Unnamed Tributary intersect and cut off the Hagarstown Member in the UA, which blocks any further migration of potentially impacted groundwater (NRT, 2017a). Groundwater flow within the UA is predominantly horizontal due to the underlying low-permeability LCU (NRT, 2017b). Groundwater flow directions in the vicinity of AP2 are typically stable and do not have significant seasonal change. Groundwater elevations are controlled by the water level along the shoreline of Coffeen Lake (NRT, 2017a).

Groundwater modeling was performed in support of the Closure Plan (AECOM, 2017). The model predicted that source control would result in a reduction of CCR leachate generation and contraction of the groundwater contaminant plume, which was predicted to begin after the completion of the source control (NRT, 2017a). Additional modeling was conducted for each of the corrective action alternatives to evaluate future groundwater quality in the vicinity of AP2 as a result of residual plume management (Appendix B; Ramboll, 2025b). The results of modeling indicate that groundwater concentrations would meet the GWPSs for all of the constituents[7] identified as having potential groundwater exceedances in approximately 135 years under the Source Control-GWP alternative after approval of the corrective action plan. Under the Source Control-Upgradient Barrier Wall and GWE Trench alternative, the time to achieve GWPSs in all monitoring wells would be approximately 63 to 65 years (4 to 6 years of pre-construction and construction activities followed by approximately 59 years of post-construction O&M) after approval of the Construction Permit Application. Under the Source Control-Horizontal GWE Well alternative, the time to achieve GWPSs would be approximately 17.5 to 19.5 years after approval of the Construction Permit Application (3.5 to 5.5 years of pre-construction and construction activities followed by approximately 14 years of system operation until the GWPSs are achieved). For the Source Control-Horizontal GWE Well

[7] Sulfate was selected as a surrogate for the contaminant fate and transport simulations to evaluate the effectiveness of each of the corrective action alternative. Sulfate was detected in AP2 groundwater at the highest concentrations relative to its GWPS and it is expected to take the longest time to achieve GWPS. Sulfate has also been detected above the GWPS at more well locations adjacent to AP1 and AP2 than any other IAC Section 845.600 parameter which contributed to its selection for modeling at both units. Modeling all constituents that exceed GWPS or have been detected at lower concentrations relative to their GWPSs is unnecessary, as these constituents will likely more quickly achieve their GWPSs (Ramboll, 2025b).

alternative, current modeling indicates that an additional 25 years of system operation may be required to prevent concentrations from rebounding above the GWPSs (Appendix B; Ramboll, 2025a); however, additional modeling would be performed and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation. The timeframe for achieving GWPS under the Source Control-Horizontal GWE Well is, thus, predicted to be shorter than the timeframe for the other two alternatives (Table 2.6).

Table 2.6 Estimated Timeline and Implementation Schedule Under Each Corrective Action Alternative

Implementation Phase	Implementation Task	Timeframe		
		Source Control-GWP[a]	Source Control-Upgradient Barrier Wall and GWE Trench[b]	Source Control-Horizontal GWE Well[b]
1: Pre-Construction Activities	Agency Coordination, Approvals, and Permitting	NA	18 to 24 months	12 to 18 months
	Final Design and Bid Process		24 to 36 months	24 to 36 months
	Total Timeframe to Complete Pre-Construction Activities		42 to 60 months (3.5 to 5 years)	36 to 54 months (3 to 4.5 years)
2: Corrective Action Construction	Corrective Action Construction	NA	6 to 12 months	6 to 12 months
	Total Timeframe to Complete Corrective Action Construction		6 to 12 months	6 to 12 months
3: Corrective Action O&M and Closeout	Corrective Action Operation (Time to Meet GWPS)	1,620 months (135 years)	708 months (59 years)	168 months (14 years)
	Potential Additional Corrective Action Operation (After GWPS have been Achiever)	NA	NA	300 months (25 years)[c]
	Corrective Action Confirmation Monitoring	36 months	36 months	36 months
	Corrective Action Completion Reporting	6 months	6 months	6 months
	Total Timeframe to Complete Corrective Action O&M and Closeout	Over 100 years	750 months (63 years)	510 months (43 years)
Total Timeline to Complete Corrective Action (all phases)		Over 100 years	798 to 822 months (67 to 69 years)	552 to 576 months (46 to 48 years)

Notes:
Source Control-GWP = Source Control with Groundwater Polishing; Source Control-Horizontal GWE Well = Source Control with a Horizontal Groundwater Extraction Well; Source Control-Upgradient Barrer Wall and GWE Trench = Source Control with an Upgradient Barrier Wall and Groundwater Extraction Trench.
(a) All timelines are assumed to occur after approval of the Corrective Action Plan.
(b) All timelines are assumed to occur after approval of the Construction Permit Application.
Source: Appendix B; Ramboll, 2025a.(c) For the Source Control-Horizontal GWE Well alternative, current modeling indicates that an additional 25 years of system operation may be required to prevent concentrations from rebounding above the GWPSs (Appendix B; Ramboll, 2025a); however, additional modeling would be performed and data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation.

2.2.7 Potential for Exposure of Humans and Environmental Receptors to Remaining Wastes, Considering the Potential Threat to Human Health and the Environment Associated with Excavation, Transportation, Re-disposal, Containment, or Changes in Groundwater Flow (IAC Section 845.670(e)(1)(F))

Section 2.2.1 describes the magnitude of reduction of existing risks under each corrective action alternative. Section 2.2.2 describes the effectiveness of the remedy in controlling the source, including the extent to which containment practices would reduce further releases. Section 2.2.3 describes the likelihood of future releases of CCR occurring under each corrective action alternative, and Section 2.2.5 describes the short-term risks to workers, the community, and the environment during implementation of the remedy, including safety impacts and control of exposure to any residual contamination. In summary, source control measures (CIP) were implemented at the Site in 2020. Thus, all corrective action alternatives would essentially eliminate the potential for a sudden CCR release to occur post-closure (*e.g.*, a dike failure or flooding event) due to the absence of impounded water within the unit and all corrective action alternatives are equally and fully protective with regard to exposure to residual CCR. There are no current or future risks to any human or ecological receptors at the Site, and there would be no risk of CCR releases post-closure.

For construction workers, risks arising from potential contact with residual contamination during construction, operation, and maintenance activities associated with residual plume management would be higher for the Source Control-Upgradient Barrier Wall and GWE Trench and Source Control-Horizontal GWE Well alternatives than for the Source Control-GWP alternative. The Source Control-Upgradient Barrier Wall and GWE Trench would involve the production, management, and treatment of extracted groundwater, as well as on-Site disposal of excavated spoils generated during extraction trench construction. The Source Control-Horizontal GWE Well would involve the construction of the horizontal GWE well and production, management and treatment of extracted groundwater. The Source Control-GWP alternative would not involve exposure to any soils, surface waters or groundwater waste streams. Any potential CCR exposures occurring under Source Control-Upgradient Barrier Wall and GWE Trench and Source Control-Horizontal GWE Well during groundwater extraction and treatment would be managed through the use of rigorous safety protocols, personal protective equipment, and appropriate disposal practices.

Some changes in groundwater flow (*i.e.*, potential controlled discharge of extracted groundwater) may occur under the residual plume management for Source Control-Upgradient Barrier Wall and GWE Trench alternative, due to the operation of the GWE trench system and installation of a subsurface barrier wall in the UA. Hydrogeological changes as a result of this alternative would be lowering the groundwater table in the vicinity of the extraction trench and creating a subsurface barrier wall perpendicular to groundwater flow which would both alter flow patterns in the UA and cause changes in hydraulic gradients. Under the residual plume management for Source Control-Horizontal GWE Well alternative, a horizontal GWE well would be installed. This remedy would reduce hydraulic head beneath AP2, alter the hydraulic gradient and corresponding groundwater flow pattern. However, changes to groundwater flow would not be expected to have an effect on the potential for the exposure of humans and environmental receptors to remaining wastes for either of these alternatives.

2.2.8 Long-Term Reliability of the Engineering and Institutional Controls (IAC Section 845.670(e)(1)(G))

Source control (CIP) was implemented in 2020. Thus, long-term reliability during source control would be the same for all three corrective action alternatives (AECOM, 2017). The long-term reliability of the

engineering and institutional controls associated with residual plume management of each corrective action alternative are summarized below.

- Residual plume management under the Source Control-GWP alternative would be reliable, because it would rely on physical and geochemical processes, rather than the installation, operation, and maintenance of engineered systems or structures. Site specific evaluations have shown that chemical attenuation is feasible, and remobilization is unlikely to impact the time to achieve GWPS as groundwater returns to background conditions for sulfate. Remobilization of boron may occur at some locations and affect the time to achieve GWPS compared to sulfate (Appendix E; Geosyntec Consultants, Inc., 2025). Under this alternative, engineering failure would not occur, and no O&M activities would be required to ensure the success of the alternative (other than those required for groundwater monitoring). Active groundwater monitoring would be in place to track the remediation progress. Should the predicted decrease in groundwater concentrations not occur, the adaptive site management approach would enable prompt adjustments or enhancements to the corrective action in accordance with IAC Section 845.680(b). This strategy would allow continuous improvement of AP2 groundwater remediation in response to new Site information and/or the performance of the corrective action alternative.
- GWE trench and barrier wall are proven remedies that have been implemented at many sites. Thus, residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench alternative would be expected to be reliable provided that the barrier wall and the extraction trench are constructed in accordance with standard design and specifications. Under this alternative, the extraction trench system and settling pond would require engineering design and implementation of the barrier wall, and groundwater extraction and treatment. Routine and non-routine maintenance of the GWE trench are required to ensure reliable operation of the extraction trench and pumps, as well as other mechanical components. The barrier wall component provides an inert, continuous, low-permeability barrier to groundwater flow and is not expected to need maintenance (Appendix B; Ramboll, 2025a). Active groundwater monitoring would be in place, similar to those required under the Source Control-GWP alternative.
- Horizontal GWE well is a proven remedy that has been implemented at many sites. Thus, residual plume management under the Source Control-Horizontal GWE Well alternative would be reliable provided that the horizontal well is constructed in accordance with standard design and specifications. The horizontal well system is a passive drain system; however, conveyance of extracted groundwater to the settling pond operates as a mechanical system and would require routine and non-routine operation and maintenance. Active groundwater monitoring would be in place, similar to the Source Control-GWP alternative.
- For all corrective action alternatives, remedy optimizations would be implemented if necessary under the adaptive site management program.

2.2.9 Potential Need for Replacement of the Remedy (IAC Section 845.670(e)(1)(H))

The potential need for the eventual replacement of the residual plume management remedy under each corrective action alternative is summarized as follows:

- Source Control-GWP would rely on physical and geochemical processes to achieve reductions in groundwater concentrations to below the GWPSs. Because no installation, operation, and maintenance of engineered systems or structures would be required, it would be unlikely that the residual plume management remedy under the Source Control-GWP alternative would need to be replaced. Adaptive site management strategies would be used to implement remedy optimizations

or replacement, as necessary based on data that are collected, to ensure that remedial goals are achieved.

- Source Control-Upgradient Barrier Wall and GWE Trench alternative would utilize a subsurface low-permeability barrier wall to prevent flow towards AP2; as well as an extraction trench and settling pond to extract and treat impacted groundwater to achieve reductions in groundwater concentrations to below GWPSs. The barrier wall is a robust, engineered, and maintenance-free subsurface structure and therefore physical replacement is unlikely; while the GWE Trench system would need ongoing maintenance and potential replacement of system components to ensure its effectiveness. It is unlikely that the remedy would need to be replaced, if implemented as designed. Adaptive site management strategies would be used to implement remedy optimizations or replacement, as necessary based on data that are collected, to ensure that remedial goals are achieved.
- Source Control-Horizontal GWE Well alternative would consist of installing a horizontal GWE well conveyance system to drain and convey groundwater beneath AP2. Physical replacements for this remedy are not likely. The conveyance of extracted groundwater to the settling pond would constitute a mechanical system which may require routine maintenance to reliably operate. Ongoing monitoring and maintenance of the horizontal well would be needed to retain its effectiveness. Similar to other alternatives, adaptive site management strategies would be used to implement remedy optimizations or replacement, as necessary based on data that are collected, to ensure that remedial goals are achieved.

2.3 The Ease or Difficulty of Implementing a Remedy (IAC Section 845.670 (e)(3))

2.3.1 Degree of Difficulty Associated with Constructing the Remedy (IAC Section 845.670(e)(3)(A))

Source control (CIP) was previously implemented in 2020. Thus, there would be no further construction difficulties associated with source control. The expected degree of difficulty associated with residual plume management for each of the corrective action alternatives is summarized below.

- Residual plume management under the Source Control-GWP alternative would rely on physical and geochemical attenuation processes and therefore would not pose any significant construction challenges. Therefore, there would be minimal difficulty in constructing the Source Control-GWP remedy.
- Residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench would involve the construction of a barrier wall, an extraction trench, settling pond and conveyance system to extract and treat impacted groundwater to address downgradient groundwater quality impacts. The construction of the shallow groundwater trench and barrier wall required by this alternative are commonly constructed at similar depths and can be performed using specialized (*i.e.*, one-pass trenching) and conventional construction equipment (Appendix B; Ramboll, 2025a). Therefore, while some construction is necessary, the degree of difficulty is expected to be low. Groundwater monitoring would be conducted using a groundwater monitoring network designed in accordance with IAC Section 845.680(c).
- Residual plume management under the Source Control-Horizontal GWE Well would involve the installation of a horizontal well to drain water beneath AP2 to address downgradient groundwater

quality impacts. This alternative would require the use of specialty equipment such as horizontal directional drill rigs and other supporting equipment such as excavating and grading equipment that would need to be mobilized to the site. Horizontal wells are routinely constructed in similar environments, however there may be difficulties due to potential heterogeneities encountered in the subsurface at the bottom of the CCR and top of the UA interface, and would require specialized techniques/equipment to address the issue. Therefore, the degree of difficulty is expected to be moderate for the horizontal well component (Appendix B; Ramboll, 2025a). Groundwater monitoring would be conducted using a groundwater monitoring network designed in accordance with IAC Section 845.680(c).

2.3.2 Expected Operational Reliability of the Remedy (IAC Section 845.670(e)(3)(B))

Source control (CIP) was implemented in 2020. Thus, the operational reliability of the remedy would be the same for all three corrective action alternatives. All three corrective action alternatives would likely be highly reliable with respect to operational controls associated with residual plume management; specific details for each corrective action alternative are discussed below.

- Residual plume management under the Source Control-GWP alternative would have high operational reliability because it would rely on physical and geochemical processes and active monitoring, rather than the installation, operation, and maintenance of engineered systems or structures (other than monitoring wells). Under the Source Control-GWP alternative, engineering failure would not occur, and no O&M activities would be required to ensure the success of the alternative. However, it should be noted that some boron re-mobilization may occur as groundwater returns to background conditions at AP2, which may affect the time to achieve GWPSs (Appendix E; Geosyntec Consultants, Inc., 2025).
- Residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench alternative would also have high operational reliability because it is an established and commonly used remedial technique, as long as the barrier wall and the extraction trench system are constructed in accordance with standard design and specifications. The barrier wall is an inert, continuous, low-permeability subsurface structure and is not expected to require maintenance after construction. The GWE trench system operates as a mechanical system and would require routine and non-routine maintenance ensure reliable operation.
- Residual plume management under the Source Control-Horizontal GWE Well alternative would also have high operational reliability if the horizontal well and conveyance system are constructed in accordance with standard design and specifications. The horizontal well system is a passive drain system; however, conveyance of extracted groundwater to the settling pond would operate as a mechanical system and require operation and routine/non-routine maintenance to ensure reliable operation.

2.3.3 Need to Coordinate with and Obtain Necessary Approvals and Permits from Other Agencies (IAC Section 845.670(e)(3)(C))

All three corrective action alternatives would require regulatory approvals. Specific permits and approvals associated with source control were the same for all corrective action alternatives and were discussed in the Closure Plan (AECOM, 2017). The specific approvals and permits associated with residual plume management for each corrective action alternatives are discussed below.

- Residual plume management under the Source Control-GWP alternative would not need additional permits from other agencies, other than the approval of the eventual Corrective Action Plan.
- Residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench alternative would require approvals and permits. Groundwater discharge from the extraction trench would require a modified NPDES permit, which would likely require renewals depending on the timeline of corrective action implementation. In addition, permits from IEPA for construction stormwater controls, BMPs, and operating would be required. An IDNR Dam Safety modification permit would be obtained for modifications of the embankment. These permits and plans typically take 18-24 months to obtain (Appendix B; Ramboll, 2025a).
- Residual plume management under the Source Control-Horizontal GWE Well alternative would require approvals and permits. Modifications would be necessary to the Site's NPDES permit to allow for discharge of groundwater from the horizontal well. In addition, permits from IEPA for construction stormwater controls and BMPs would be required. These permits and plans typically take 18 to 24 months to obtain (Appendix B; Ramboll, 2025a).

2.3.4 Availability of Necessary Equipment and Specialists (IAC Sections 845.670(e)(3)(D) and 845.660(c)(1), "Ease of Implementation")

Source control (CIP) was implemented in 2020. Thus, there are no further equipment and specialist needs associated with the implementation of the source control remedy. Specialized equipment and personnel are essential for field data collection and groundwater sampling for residual plume management under all three potential corrective action alternatives. Additionally, the assessment of groundwater concentrations for Site constituents would necessitate laboratory equipment and specialists for all three alternatives. The availability of equipment and specialists associated with residual plume management for each corrective action alternative is summarized below.

- Residual plume management under the Source Control-GWP alternative would require groundwater professionals, such as geologists, hydrogeologists, statisticians (*i.e.*, statistical analysis), and geochemists to evaluate all monitoring data, ensuring that physical and geochemical processes function as anticipated for this alternative. The equipment and specialists needed for Site groundwater monitoring and analysis are currently engaged in these tasks as part of the routine groundwater monitoring program outlined in accordance with IAC Section 845.220(c)(4).
- Residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench alternative would require specialists to construct the barrier wall and the GWE trench system and to manage the GWE Trench system throughout its operational period.
    - Construction of the groundwater extraction system and the barrier wall on the Site is expected to require a specialized contractor. The contractor would most likely need specialized and often custom-built equipment including one-pass construction equipment. The availability of contractors with such equipment may be limited.
    - Specialists including design engineers, geotechnical experts, construction managers and contractor staff experienced in trench construction and similar geologic environments would be required as well.
    - Geotechnical specialists would be required to design the working platform and oversee the AP2 embankment, monitoring for any signs of distress during the one-pass trench installation.
    - In addition, specialists and equipment may have backlogs due to high demand in similar specialty ground improvement projects in the area, which could delay the project schedule.

- After the construction phase, specialists and equipment would be required during the operation of the GWE system. Routine maintenance would include inspection of system components such as totalizers, instrumentation, and the extraction and transfer pumps. Non-routine maintenance such as flushing or jetting of the conveyance lines, replacement of faulty system components, replacement of pumps or pump controllers, and replacement of faulty system instrumentation would also be necessary. Specialists and replacement equipment needed to operate the system would be generally available to the Site, although some of the more complex equipment (*i.e.*, transfer pumps and transfer pump controller) may have extended lead times for servicing.
- This alternative would also necessitate the use of equipment and the expertise of specialists for tasks such as field data collection, groundwater sampling, analysis, and periodic corrective action groundwater monitoring and reporting. Similar to those in the GWP alternative, these activities are already being conducted as part of routine groundwater monitoring in accordance with IAC Section 845.220(c)(4).

- Residual plume management under the Source Control-Horizontal GWE Well alternative would require specialists for horizontal well installation and maintenance.
  - Construction of the horizontal well would require design engineers, geologists, construction managers, and contractor staff experienced with horizontal well construction and specialized equipment operation.
  - Contractors would be required during the operation of the system including replacement of components and periodic well re-development (*i.e.*, flushing or jetting of conveyance lines). Specialists and equipment needed for O&M are generally available within close proximity to the Site with the exception of more complex system components, such as transfer pumps and transfer pump controller.
  - As with the other two alternatives, this alternative would necessitate the use of equipment and the expertise of specialists for tasks such as field data collection, groundwater sampling, analysis, and periodic corrective action groundwater monitoring and reporting. These activities are already being conducted as part of routine groundwater monitoring in accordance with IAC Section 845.220(c)(4).

2.3.5 Available Capacity and Location of Needed Treatment, Storage, and Disposal Services/Comply with Standards for Management of Wastes as Specified in Section 845.680(d) (IAC Section 845.670(e)(3)(E)/IAC Section 845.670(d)(5))

The available capacity and location of needed treatment, storage, and disposal services associated with residual plume management under each corrective action alternative is summarized below. All the practices employed in each alternative would comply with standards for the management of wastes as specified in IAC Section 845.670(e)(3)(E) and IAC Section 845.680(d)(5).

- Residual plume management for the Source Control-GWP remedy would not require any treatment, storage, or disposal services, because GWP is not anticipated to produce a substantial amount of waste or wastewater, aside from minor purge water volumes generated during routine groundwater sampling activities for residual plume management. This could be managed by a standard waste management contractor.

- Residual plume management for the Source Control-Upgradient Barrier Wall and GWE Trench alternative would require the construction of the extraction of the barrier wall, the extraction trench system, and a new settling pond on-Site:
  - The waste materials (*i.e.*, spoils) generated from barrier wall and extraction trench would be disposed of in the on-Site landfill.
  - The extraction trench system would send extracted groundwater to the newly constructed settling pond, which would settle solids removed during groundwater recovery *via* the pneumatic extraction pumps and transfer piping. The settling pond would need to be sited, designed, constructed, and maintained properly. The siting of the settling pond would need to consider limiting impacts to existing and future Site infrastructure and other surface impoundments at CPP.
  - Discharge from the settling pond would be conveyed to an NPDES permitted outfall. Renewal of the NPDES permits may be necessary to continue operations, depending on the timeline of the corrective action implementation in relation to the source control completion.
- Residual plume management for the Source Control-Horizontal GWE Well alternative would require installation of a horizontal well and extracted groundwater conveyance system.
  - The horizontal well system would send extracted groundwater to a newly constructed on-Site settling pond to settle solids extracted during groundwater recovery. The settling pond would need to be sited, designed, constructed, and maintained properly. The siting of the settling pond would need to consider limiting impacts to existing and future Site infrastructure and other surface impoundments at CPP. Flows from the horizontal GWE wells would be discharged through an NPDES permitted outfall. Depending on the timeline of the corrective action, NPDES permit renewals may be required.

2.4 The Degree to Which Community Concerns Are Addressed by the Remedy (IAC Section 845.670(e)(4))

Several nonprofits raised concerns regarding the potential impacts of coal ash impoundments on groundwater and surface water quality including Earthjustice, the Prairie Rivers Network, and the Sierra Club (Earthjustice *et al*., 2018; Lydersen, 2017; Sierra Club and CIHCA, 2014). The combination of source control (*i.e.*, CIP) and residual plume management would cause groundwater concentrations to decline over time under all of the corrective action alternatives, as suggested by the groundwater modeling (NRT, 2017a).

A public meeting was held on May 1, 2025, pursuant to requirements under IAC Section 845.710(e). Questions raised by attendees were addressed at the meeting; a written summary of the questions and responses were prepared.

2.5 Remove from the Environment as Much of the Contaminated Material that Was Released from the CCR Surface Impoundment as Is Feasible, Taking into Account Factors such as Avoiding Inappropriate Disturbance of Sensitive Ecosystems (IAC Section 845.670(d)(4))

There have been no documented releases of CCR from the unit (Ramboll, 2025). All three potential corrective action alternatives include source control and would have residual plume management efforts.

Source Control for AP2 included CIP with the installation of a low-permeability final geomembrane cover system designed to limit the infiltration of precipitation into the impounded CCR. Groundwater modeling was performed in support of the Closure Plan (AECOM, 2017), and concluded that this source control approach would result in a reduction of CCR leachate production, a decrease in CCR leachate constituent concentrations, and a contraction of the groundwater contaminant plume (NRT, 2017a). Therefore, source control will prevent further releases from AP2 into the environment and remove from the environment as much CCR and impacted material as is feasible.

Moreover, residual plume management under each corrective action alternative will further result in the removal of contaminated material from the environment and/or the improvement of downgradient groundwater quality. Groundwater modeling has predicted that GWPSs would be achieved in all monitoring wells after remedy implementation in approximately 135 years under the Source Control-GWP alternative, approximately 63 to 65 years (4 to 6 years of pre-construction and construction activities followed by 59 years of post-construction) under the Source Control-Upgradient Barrier Wall and GWE Trench alternative, and approximately 17.5 to 19.5 years (3.5 to 5.5 years of pre-construction and construction activities followed by approximately 14 years of system operation until the GWPSs are achieved) under the Source Control-Horizontal GWE Well alternative. Under the Source Control-Horizontal GWE Well alternative, current modeling indicates that an additional 25 years of system operation may be required to prevent concentrations from rebounding above the GWPSs (see Section 2.2.6; Appendix B; Ramboll, 2025b); however, additional modeling would be performed and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation. Specific considerations for residual plume management for each alternative are provided below.

- Residual plume management under the Source Control-GWP alternative would address impacted groundwater by relying on natural physical and geochemical attenuation processes to reduce the residual concentrations of CCR. Site-specific evaluation demonstrated conditions are favorable for the attenuation of inorganic contaminants *via* adsorption. Attenuation *via* sorption onto mineral surfaces should remain stable under post-closure conditions, and remobilization is unlikely to impact the time to achieve GWPS for sulfate. Remobilization of boron may occur at some locations and affect the time to achieve GWPS compared to sulfate (Appendix E; Geosyntec Consultants, Inc., 2025). In cases in which observed groundwater concentrations deviate significantly from modeled conditions, alternative methods or techniques would be evaluated under the adaptive site management, and if viable, incorporated as per IAC Section 845.680(b). No ecosystems would be disturbed, because no construction activities would be expected under the Source Control-GWP alternative.
- Residual plume management under the Source Control-Upgradient Barrier Wall and GWE Trench alternative would rely on the barrier wall to limit groundwater from flowing towards AP2 and to reduce the amount of groundwater that needs to be extracted from the trench. The GWE trench would collect impacted groundwater and reduce hydraulic head beneath AP2, to reduce or prevent migration of impacted groundwater. Groundwater quality would also be improved as a result of physical and geochemical attenuation processes. This approach would reduce groundwater flow toward AP2 by the barrier wall and remove constituent mass in groundwater through operation of the extraction trench. The construction activities would likely result in some negative impacts to the ecosystem, including disturbances of some existing habitats atop portions of the construction areas, and habitats in the immediate vicinity of these locations by causing alarm and escape behavior in nearby wildlife (*e.g.*, due to noise disturbances). Short-term impacts could also occur to sensitive aquatic and wetland species in Coffeen Lake and other wetlands or surface water bodies located within the SFWA near AP2 (see Section 1.1.3) due to potential sediment runoff during construction at the Site.

- Residual plume management under the Source Control-Horizontal GWE Well alternative would rely on installation of a horizontal extraction well to drain water from beneath AP2, thus reducing the hydraulic head beneath AP2 and accelerating the time to achieve the GWPSs. The horizontal well would drain water from AP2 to reduce or prevent migration of impacted groundwater. Groundwater quality would also be improved as a result of physical and geochemical attenuation processes. The construction activities would likely result in some negative impacts to the ecosystem, and habitats in the immediate vicinity of these locations by causing alarm and escape behavior in nearby wildlife (*e.g.*, due to noise disturbances). Short-term impacts could also occur to sensitive aquatic and wetland species in Coffeen Lake and other wetlands or surface water bodies located within the SFWA near AP2 (see Section 1.1.3) due to sediment runoff during construction at the Site. Stormwater BMPs and turbidity curtains downstream of the weir would be installed to mitigate potential effects on Coffeen Lake.

2.6 Summary

This CAAA evaluates three corrective action alternatives identified as potentially viable in the CMA with regard to each of the factors specified in IAC Section 845.670(d) and 845.670(e) (IEPA, 2021). Based on this evaluation, the most appropriate corrective action for this Site is the Source Control-Horizontal GWE Well alternative. The timeframe for achieving GWPSs is expected to be shorter under the Source Control-Horizontal GWE Well alternative (approximately 17.5 to 19.5 years after approval of the Construction Permit Application) than under the Source Control-GWP alternative (over 100 years after approval of the Corrective Action Plan) and Source Control-Upgradient Barrier Wall and GWE Trench (approximately 63 to 65 years after approval of the Construction Permit Application). Additionally, risks to worker safety and the community under the Source Control-Horizontal GWE Well alternative are lower compared to the Source Control-Upgradient Barrier Wall and GWE Trench alternative. Thus, Source Control-Horizontal GWE Well is the most appropriate corrective action alternative for AP2.

References

AECOM. 2017. "Closure and Post-Closure Care Plan for Ash Pond No. 2 at Illinois Power Generating Company, Coffeen Power Station, 1134 Cips Lane, Coffeen, IL 62107 (Final)." Report to Illinois Power Generating Co., Coffeen, IL. 1173p., January.

Burns & McDonnell. 2021. "Initial Operating Permit, Coffeen Ash Pond 2." Report to Illinois Power Generating Co., Collinsville, IL. Submitted to Illinois Environmental Protection Agency (IEPA). 1301p., October 25.

Buscher, WE. [Illinois Environmental Protection Agency (IEPA)]. 2018. "Letter to R. Diericx (Illinois Power Generating Co.) [re: Approval of Closure and Post-Closure Care Plan for the Coffeen Ash Pond No. 2 and GMZ plan application]." 1p., January 30.

Earthjustice; Prairie Rivers Network; Environmental Integrity Project (EIP); Sierra Club. 2018. "Cap and Run: Toxic Coal Ash Left Behind by Big Polluters Threatens Illinois Water." 45p.

Geosyntec Consultants, Inc. 2025. "Groundwater Polishing Evaluation Report, Coffeen Power Plant - Ash Pond No. 2 Unit (IEPA ID No. W1350150004-02 (Final)." Report to Illinois Power Generating Co. (Collinsville, IL).

Gradient. 2025. "Human Health and Ecological Risk Assessment, Ash Pond 2, Coffeen Power Plant, Coffeen, Illinois." 43p.

Hesterberg, TW; Valberg, PA; Long, CM; Bunn, WB III; Lapin, C. 2009. "Laboratory studies of diesel exhaust health effects: Implications for near-roadway exposures." *EM Mag.* (August):12-16. Accessed at http://pubs.awma.org/gsearch/em/2009/8/hesterberg.pdf.

Illinois Dept. of Natural Resources (IDNR). 2014. "Coffeen Lake State Fish & Wildlife Area." 2p.

Illinois Environmental Protection Agency (IEPA). 2007. "Greenville Old Lake and Coffeen Lake Watersheds." IEPA/BOW/07-014, 155p., August.

Illinois Environmental Protection Agency (IEPA). 2019. "Appendix A-1. Illinois' 2018 303(d) List and Prioritization." In "Illinois Integrated Water Quality Report and Section 303(d) List, 2018 (Final as submitted to US EPA Region V on February 22, 2021)." 40p., May 20. Accessed at https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Documents/Appendix%20A-1_303d_by_priority_FINAL_5-20-19.pdf.

Illinois Environmental Protection Agency (IEPA). 2021. "Standards for the disposal of coal combustion residuals in surface impoundments." Accessed at https://www.ilga.gov/commission/jcar/admincode/035/03500845sections.html.

Illinois Environmental Protection Agency (IEPA). 2023. "Draft Reissued NPDES Permit to Discharge into Waters of the State, Coffeen Power Station, Coffeen, Illinois." Submitted to Coffeen Power Station, Coffeen, IL. NPDES Permit No. IL0000108. 23p., September 14.

Illinois State Geological Survey (ISGS); University of Illinois at Urbana-Champaign. 2011. "Directory of Coal Mines in Illinois 7.5-Minute Quadrangle Series, Coffeen Quadrangle, Montgomery & Bond Counties." Report to Illinois Mine Subsidence Insurance Fund. 20p.

Lydersen, K. 2017. "Citizens fill void in oversight of potentially hazardous Illinois coal ash impoundments." *Energy News Network.* January 20. Accessed at https://energynews.us/2017/01/20/citizens-fill-void-in-oversight-of-potentially-hazardous-illinois-coal-ash-impoundments/.

Mauderly, JL; Garshick, E. 2009. "Diesel exhaust." In *Environmental Toxicants: Human Exposures and Their Health Effects (Third Edition)*. (Ed.: Lippmann, M), John Wiley & Sons, Inc., Hoboken, NJ. p551-631.

National Research Council. 2013. "Alternatives for Managing the Nation's Complex Contaminated Groundwater Sites." Division of Earth and Life Sciences, Water Science and Technology Board, Committee on Future Options for Management in the Nation's Subsurface Remediation Effort. National Academies Press, Washington, DC. Accessed at http://www.nap.edu/catalog.php?record_id=14668.

Natural Resource Technology, Inc (NRT). 2017a. "Groundwater Modeling Report, Ash Pond 2, Coffeen Power Station, Coffeen, Illinois (Final)." Report to Illinois Power Generating Co., Coffeen, IL. 63p., January 24.

Natural Resource Technology, Inc (NRT). 2017b. Letter to R. Diericx (Dynegy Operating Co.) re: Responses to IEPA comments - Coffeen Station Inactive Ash Pond No. 2, Closure and Post-Closure Care Plan for the Coffeen Ash Pond No. 2, NRT Project No. 2380. 24p., November 21.

Ramboll. 2020. "Corrective Measures Assessment, Revision 1, Coffeen Ash Pond No. 2, Cofeen [*sic*] Power Station, 134 Cips Lane, Coffeen, Illinois." Report to Illinois Power Generating Co. 82p., November 30.

Ramboll. 2021a. "Hydrogeologic Site Characterization Report, Ash Pond No. 1, Coffeen Power Plant, Coffeen, Illinois (Final)." Report to Illinois Power Generating Co. 700p., October 25.

Ramboll. 2021b. "Groundwater Monitoring Plan Addendum for Ash Pond No. 2, Coffeen Power Plant, Coffeen, IL." Report to Illinois Power Generating Co., Coffeen, IL. 219p., October 25.

Ramboll. 2024a. "35 I.A.C. § 845 Corrective Measures Assessment, Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois, IEPA ID: W135015004-02 (Final)." Report to Illinois Power Generating Co.. 28p.

Ramboll. 2024b. "Nature and Extent Report, Coffeen Power Plant, Ash Pond No. 2, IEPA ID No. W1350150004-02." Report to Illinois Power Generating Co., Coffeen, IL. 386p., June 12.

Ramboll. 2025a. "Corrective Action Alternatives Analysis Supporting Information Report: Ash Pond No. 2, Coffeen Power Plant, IEPA ID No. W1350150004-02 (Final)." Report to Illinois Power Generating Co. (Coffeen, IL).

Ramboll. 2025b. "Groundwater Modeling Technical Memorandum, Coffeen Power Plant, Ash Pond No. 2, IEPA ID No. W1350150004-02 (Final)." Report to Illinois Power Generating Co., Coffeen, IL.

Sierra Club. 2021. "Sierra Club statement on Joppa closure and settlement agreement with Vistra Energy." April 7. Accessed at https://www.sierraclub.org/press-releases/2021/09/sierra-club-statement-joppa-closure-and-settlement-agreement-vistra-energy.

Sierra Club; Central Illinois Healthy Community Alliance (CIHCA). 2014. "Dynegy's Toxic Assets: Legacy Coal Pollution in the Heartland." 17p.

US Dept. of Labor (US DOL). 2020a. "Fatal occupational injuries, total hours worked, and rates of fatal occupational injuries by selected worker characteristics, occupations, and industries, civilian workers, 2019." Bureau of Labor Statistics, December. Accessed at https://www.bls.gov/iif/oshwc/cfoi/cfoi_rates_2019hb.xlsx.

US Dept. of Labor (US DOL). 2020b. "Table R100. Incidence rates for nonfatal occupational injuries and illnesses involving days away from work per 10,000 full-time workers by occupation and selected events or exposures leading to injury or illness, private industry, 2019." Bureau of Labor Statistics, October. Accessed at https://www.bls.gov/iif/oshwc/osh/case/cd_r100_2019.xlsx.

US Dept. of Transportation (US DOT). 2023. "Large Truck and Bus Crash Facts 2021." Federal Motor Carrier Safety Administration, Analysis Division, FMCSA-RRA-23-002, 118p., November.

US EPA. 2014. "Human and Ecological Risk Assessment of Coal Combustion Residuals (Final)." Office of Solid Waste and Emergency Response (OSWER), Office of Resource Conservation and Recovery. Submitted to US EPA Docket. EPA-HQ-OLEM-2020-0107-0885. 1237p., December. Accessed at http://www.regulations.gov/#!documentDetail;D=EPA-HQ-RCRA-2009-0640-11993.

US EPA. 2015a. "Hazardous and solid waste management system; Disposal of coal combustion residuals from electric utilities (Final rule)." *Fed. Reg.* 80(74):21302-21501. 40 CFR 257, 40 CFR 261, April 17.

US EPA. 2015b. "Use of Monitored Natural Attenuation for Inorganic Contaminants in Groundwater at Superfund Sites." Office of Solid Waste and Emergency Response (OSWER). OSWER Directive 9283.1-36, 83p., August.

US EPA. 2022. "Coffeen, Illinois, Watershed: Rocky Fork Lakes-East Fork Shoal Creek (071402030305)." Accessed at https://mywaterway.epa.gov/community/coffeen/overview.

Appendix A

Human Health and Ecological Risk Assessment

Human Health and Ecological Risk Assessment
Ash Pond 2
Coffeen Power Plant
Coffeen, Illinois

June 10, 2025

GRADIENT

www.gradientcorp.com
One Beacon Street, 17th Floor
Boston, MA 02108
617-395-5000

Table of Contents

Page

1 Introduction 1

2 Site Overview 3
- 2.1 Site Description 3
- 2.2 Geology/Hydrogeology 4
- 2.3 Conceptual Site Model 4
- 2.4 Groundwater Monitoring 5
- 2.5 Surface Water Monitoring 8

3 Risk Evaluation 9
- 3.1 Risk Evaluation Process 9
- 3.2 Human and Ecological Conceptual Exposure Models 10
  - 3.2.1 Human Conceptual Exposure Model 10
    - 3.2.1.1 Groundwater or Surface Water as a Drinking Water/Irrigation Source 11
    - 3.2.1.2 Recreational Exposures 16
  - 3.2.2 Ecological Conceptual Exposure Model 16
- 3.3 Identification of Constituents of Interest 17
  - 3.3.1 Human Health Constituents of Interest 17
  - 3.3.2 Ecological Constituents of Interest 19
  - 3.3.3 Surface Water and Sediment Modeling 21
- 3.4 Human Health Risk Evaluation 23
  - 3.4.1 Recreators Exposed to Surface Water 23
  - 3.4.2 Recreators Exposed to Sediment 26
- 3.5 Ecological Risk Evaluation 27
  - 3.5.1 Ecological Receptors Exposed to Surface Water 27
  - 3.5.2 Ecological Receptors Exposed to Sediment 28
  - 3.5.3 Ecological Receptors Exposed to Bioaccumulative Constituents of Interest 29
- 3.6 Uncertainties and Conservatisms 29

4 Summary and Conclusions 32

References 34

Appendix A Surface Water and Sediment Modeling
Appendix B Screening Benchmarks

List of Tables

Table 2.1 Groundwater Monitoring Wells Related to Coffeen Ash Pond 2

Table 2.2 Groundwater Data Summary (2018-2023)

Table 2.3 Surface Water Data Summary

Table 3.1 Human Health Constituents of Interest

Table 3.2 Ecological Constituents of Interest

Table 3.3 Groundwater and Surface Water Properties Used in Modeling

Table 3.4 Sediment Properties Used in Modeling

Table 3.5 Surface Water and Sediment Modeling Results

Table 3.6 Risk Evaluation for Recreators Exposed to Surface Water

Table 3.7 Risk Evaluation for Recreators Exposed to Sediment

Table 3.8 Risk Evaluation for Ecological Receptors Exposed to Surface Water

Table 3.9 Risk Evaluation for Ecological Receptors Exposed to Sediment

List of Figures

Figure 2.1 Site Location Map

Figure 2.2 Monitoring Well Locations

Figure 2.3 Surface Water Sampling Locations

Figure 3.1 Overview of Risk Evaluation Methodology

Figure 3.2 Human Conceptual Exposure Model

Figure 3.3 Water Wells Within 1,000 Meters of AP2

Figure 3.4 Historic Property Use in the Vicinity of Well 32

Figure 3.5 Ecological Conceptual Exposure Model

Abbreviations

ADI	Acceptable Daily Intake
AP2	Ash Pond 2
BCF	Bioconcentration Factor
BCG	Biota Concentration Guide
CAAA	Corrective Action Alternatives Analysis
CPP	Coffeen Power Plant
CCR	Coal Combustion Residuals
CEM	Conceptual Exposure Model
COI	Constituent of Interest
COPC	Constituent of Potential Concern
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
ESV	Ecological Screening Value
GMF	Gypsum Management Facility
GWPS	Groundwater Protection Standard
GWQS	Groundwater Quality Standards
HTC	Human Threshold Criteria
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
ILWATER	Illinois Water and Related Wells
IPGC	Illinois Power Generating Company
ISGS	Illinois State Geological Survey
LCU	Lower Confining Unit
MCL	Maximum Contaminant Level
NRT	Natural Resource Technology
NRWQC	National Recommended Water Quality Criteria
ORNL RAIS	Oak Ridge National Laboratory Risk Assessment Information System
pCi/L	PicoCuries Per Liter
PRG	Preliminary Remediation Goal
RfD	Reference Dose
RME	Reasonable Maximum Exposure
RSL	Regional Screening Level
SI	Surface Impoundment
SWQC	Surface Water Quality Criteria
UA	Uppermost Aquifer
UCU	Upper Confining Unit
USDA	United States Department of Agriculture
US DOE	United States Department of Energy
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey

1 Introduction

Illinois Power Generating Company's (IPGC) Coffeen Power Plant (CPP, or "the Site") is an electric power generating facility with coal-fired units located approximately two miles south of the City of Coffeen, Illinois. The CPP operated as a coal-fired power plant from 1964 until November 2019 and has five coal combustion residuals (CCR) management units (Ramboll, 2021). The CCR unit that is the subject of this report is Ash Pond 2 (AP2), (Illinois Environmental Protection Agency [IEPA] ID No. W1350150004-02), a 60-acre, unlined surface impoundment (SI) that was used to manage CCR and non-CCR waste streams at the CPP (Ramboll, 2021).

This report presents the results of an evaluation that characterizes potential risk to human and ecological receptors that may be exposed to CCR constituents in environmental media originating from AP2. This risk evaluation was performed to support the Corrective Action Alternative Analysis (CAAA) for AP2 in accordance with requirements in Title 35 Part 845 of the Illinois Administrative Code (IEPA, 2021a). Human and ecological risks were evaluated for Site-specific constituents of interest (COIs). The conceptual site model (CSM) assumed that Site-related COIs in groundwater may migrate to the adjacent Coffeen Lake and affect surface water and sediment in the vicinity of the Site.

Consistent with United States Environmental Protection Agency (US EPA) guidance (US EPA, 1989), this report used a tiered approach to evaluate potential risks, which included the following steps:

1. Identify complete exposure pathways and develop a conceptual exposure model (CEM).
2. Identify Site-related COIs: Constituents detected in groundwater were considered COIs if their maximum detected concentration over the period from 2015 to 2021 exceeded a groundwater protection standard (GWPS) identified in Part 845.600 (IEPA, 2021a), or a relevant surface water quality standard (IEPA, 2019; US EPA Region IV, 2018).
3. Perform screening-level risk analysis: Compare maximum measured or modeled COI concentrations in surface water and sediment to conservative, health-protective benchmarks to determine constituents of potential concern (COPCs).
4. Perform refined risk analysis: If COPCs are identified, perform a refined analysis to evaluate potential risks associated with the COPCs.
5. Formulate risk conclusions and discuss any associated uncertainties.

This assessment relies on a conservative (*i.e.*, health-protective) approach and is consistent with the risk approaches outlined in US EPA guidance. Specifically, we considered evaluation criteria detailed in IEPA guidance documents (*e.g.*, IEPA, 2013, 2019), incorporating principles and assumptions consistent with the Federal CCR Rule (US EPA, 2015a) and US EPA's "Human and Ecological Risk Assessment of Coal Combustion Residuals" (US EPA, 2014).

US EPA has established acceptable risk metrics. Risks above these US EPA-defined metrics are termed potentially "unacceptable risks." Based on the evaluation presented in this report, no unacceptable risks to human or ecological receptors resulting from CCR exposures associated with AP2 were identified. This means that the risks from the site are likely indistinguishable from normal background risks. Specific risk assessment results include the following:

- No completed exposure pathways were identified for any groundwater receptors; consequently, no risks were identified relating to the use of groundwater.
- No unacceptable risks were identified for recreators boating in Coffeen Lake adjacent to the Site.
- No unacceptable risks were identified for recreators exposed to sediment in Coffeen Lake adjacent to the Site.
- No unacceptable risks were identified for anglers consuming locally caught fish.
- No unacceptable risks were identified for ecological receptors exposed to surface water or sediment.
- No bioaccumulative ecological risks were identified.

It should be noted that this evaluation incorporates a number of conservative assumptions that tend to overestimate exposure and risk. Moreover, it should be noted that because current conditions do not present a risk to human health or the environment, there will also be no unacceptable risk to human health or the environment for future conditions because AP2 was already closed in 2020. For all future closure scenarios, potential releases of CCR-related constituents will decline over time and, consequently, potential exposures to CCR-related constituents in the environment will also decline.

2 Site Overview

2.1 Site Description

The CPP is located in Montgomery County, Illinois, approximately 2 miles south of the City of Coffeen and about 8 miles southeast of the City of Hillsboro, Illinois. Five CCR units are present on the CPP property, including Ash Pond 1, AP2, Gypsum Management Facility (GMF) Recycle Pond, GMF Gypsum Stack Pond, and the Landfill (Ramboll, 2021). AP2, the subject of this report, is an unlined SI that covers an area of approximately 60 acres (NRT, 2017). AP2 started operation in the early 1970s, and was removed from service and capped in the mid-1980s with a 2-foot clay and soil cap (NRT, 2017). The CPP is bordered by Coffeen Lake to the west, east, and south, and is bordered by agricultural land to the north. An unnamed tributary, located east of AP2, flows south into Coffeen Lake (Figure 2.1) (Ramboll, 2021). Coffeen Lake (approximately 1,100-acres) was formed in 1963 for use as an artificial cooling lake for the CPP, by damming the McDavid Branch of the East Fork of Shoal Creek (Ramboll, 2021).

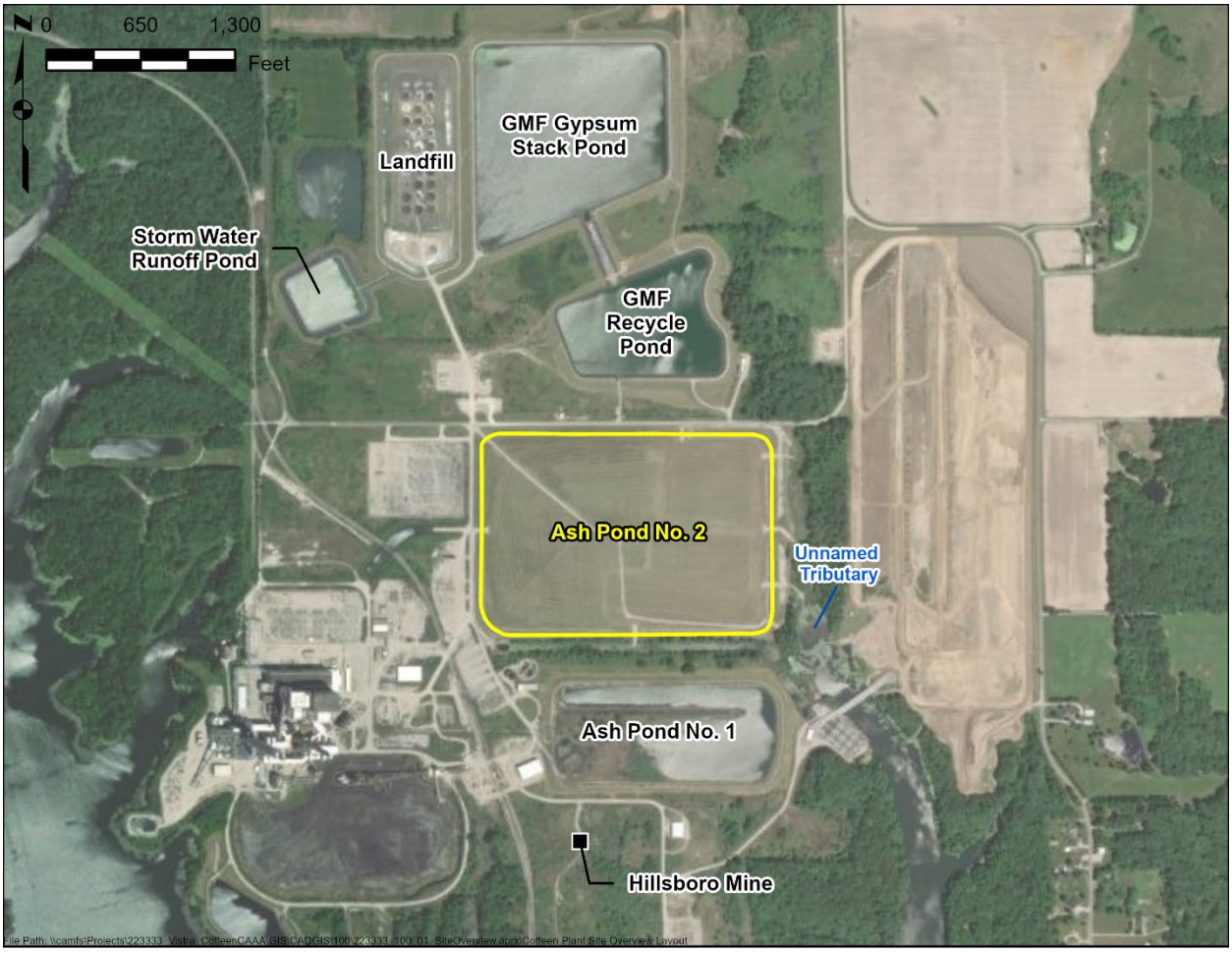


Figure 2.1 Site Location Map. Adapted from NRT (2017).

2.2 Geology/Hydrogeology

The geology underlying the CPP Site in the vicinity of AP2 primarily consists of unlithified deposits (NRT, 2017; Ramboll, 2021). These unlithified deposits were categorized into the following hydrostratigraphic units (moving downward from the ground surface):

- **Upper Confining Unit (UCU):** The UCU underlies AP2. It consists of a Loess Unit and the upper portion of the Hagarstown Member, which has low permeability clays and silts. The Loess Unit in the area of AP2 is relatively thin with less than 1 foot of thickness and was likely removed during AP2 construction. The upper clayey till portion of the Hagarstown Member has varying thicknesses from 1.9 ft to over 12 ft to the south and west of AP2.
- **Uppermost Aquifer (UA):** The UA is comprised of moderately permeable sands, silty sand, and clayey gravel of the Hagarstown Member and, in some portions of the Site, the Vandalia Member. The UA unit is thin (generally less than 3 feet), discontinuous, and variable throughout AP2 due deposition and weathering.
- **Lower Confining Unit (LCU):** The LCU underlies the UA. It consists of three low hydraulic conductivity soils: the sandy clay till of the Vandalia Member, the silt of the Mulberry Grove Formation, and the compacted clay till of the Smithboro Member. The layer has been observed to be generally greater than 15 ft thick.
- **Deep Aquifer (DA):** The DA consists of sand and sandy silt/clay units of the Yarmouth Soil, which is discontinuous and less than 5 ft thick across the Site. This unit is also identified as a PMP.
- **Deep Confining Unit (DCU):** The DCU is comprised of the Banner Formation, with a mixture of clays, silts, and sands. The Lierle Clay Member, which was encountered at the Site, is the upper portion of the Banner Formation.

There is a groundwater flow divide within the UA in the center of the CPP property between the two lobes of Coffeen Lake. Groundwater in the UA flows from the center of the CPP property west toward Coffeen Lake and east toward the Unnamed Tributary. Groundwater near AP2 flows east and south toward a former surface water discharge flume and the Unnamed Tributary which discharges into the Coffeen Lake, respectively (NRT, 2017). There is limited groundwater flow from AP2 toward the west due to a thinning or lower hydraulic conductivity of the Hagarstown Beds (NRT, 2017). Both the discharge flume and the Unnamed Tributary intersect and cut off the Hagarstown Member in the UA, which blocks any further migration of potentially impacted groundwater (NRT 2017). Groundwater flow within the UA is predominantly horizontal due to the underlying low-permeability LCU, and the average horizontal hydraulic gradient calculated for the UA across AP2 is approximately 0.007 ft/ft (NRT, 2017; NRT, 2017). Groundwater flow directions in the vicinity of AP2 are typically stable and do not have significant seasonal change. Groundwater elevations are controlled by the water level along the shoreline of Coffeen Lake (NRT 2017).

2.3 Conceptual Site Model

A CSM describes sources of contamination, the hydrogeological units, and the physical processes that control the transport of water and solutes. In this case, the CSM describes how groundwater underlying AP2 migrates and interacts with surface water and sediment in the adjacent Coffeen Lake. The CSM was developed using available hydrogeologic data specific to AP2, including information on groundwater flow and surface water characteristics (NRT, 2017; Ramboll, 2020, 2021).

CCR-related constituents may migrate vertically downward through the UCU from AP2 into the underlying groundwater of the UA. Once in groundwater, CCR-related constituents may migrate to the south to the discharge flume and to the east to the Unnamed Tributary and the eastern branch of Coffeen Lake (NRT, 2017; Ramboll, 2020). Groundwater flow within the UA is mostly in the horizontal direction because the UA is underlain by the LCU, which is a low-permeability till unit inhibiting vertical flow of groundwater.

Groundwater near AP2 may mix with surface water in the Unnamed Tributary and eastern branch of Coffeen Lake, and dissolved constituents in groundwater may partition between the sediments and surface water.

2.4 Groundwater Monitoring

A total of 12 wells have been used to monitor the groundwater quality near and downgradient of AP2 (Figure 2.2). Of these, 11 wells are screened in the UA, 1 well is screened in the LCU (Table 2.1). The analyses presented in this report relied on the recent data from 11 of these wells collected between 2018 and 2023 (G1003 was not used due to lack of data, as the well was dry during the 2021-2023 sampling). Groundwater samples were analyzed for a suite of total metals, specified in Illinois CCR Rule Part 845.600 (IEPA, 2021a).[1] A summary of the groundwater data used in this risk evaluation is presented in Table 2.2. The AP2 well locations used in this risk evaluation are shown in Figure 2.2. The use of groundwater data in this risk evaluation does not imply that detected constituents are associated with AP2 or that they have been identified as potential groundwater exceedances.

Figure 2.2 Monitoring Well Locations. Source: Ramboll (2025).

[1] Samples were analyzed for a longer list of inorganic constituents and general water quality parameters (including, but not limited to, fluoride, sulfate, pH, and total dissolved solids); however, these constituents were not evaluated in the risk assessment because toxicological criteria have not been developed. Given that these parameters are not likely to pose a human health or ecological risk concern even in the event of exposure, they are not typically evaluated in risk assessments.

Table 2.1 Groundwater Monitoring Wells Related to Coffeen Ash Pond 2

Well	Date Constructed	Screen Top Depth (ft bgs)	Screen Bottom Depth (ft bgs)	Well Depth from Ground Surface (ft bgs)	Hydrogeologic Unit
G270	2/26/2008	13.1	17.9	18.3	UA
G280	02/26/2008	12.8	17.6	18.0	UA
G281	09/08/2015	15.5	20.2	20.3	UA
G401	09/14/2015	14.4	18.8	19.3	UA
G402	08/27/2010	10.0	20.0	20.4	UA
G403	09/11/2015	13.1	17.8	18.2	UA
G404	05/01/2007	6.4	11.2	11.6	UA
G405	05/01/2007	9.0	13.8	14.2	UA
G406	08/19/2016	13.6	18.4	18.8	UA
G407	08/16/2016	13.8	18.6	19.0	UA
G1001	04/05/2021	6.0	11.0	12.0	LCU
G1003	05/25/2021	8.0	12.0	12.0	UA

Notes:
Source: Ramboll (2021).
bgs = Below Ground Surface; DA = Deep Aquifer; ft = Feet; LCU = Lower Confining Unit; UA = Uppermost Aquifer.

Table 2.2 Groundwater Data Summary (2018-2023)

Constituent	Samples with Constituent Detected	Samples Analyzed	Minimum Detected Value	Maximum Detected Value	Maximum Laboratory Detection Limit
Total Metals (mg/L)					
Antimony	11	179	0.00052	0.0049	0.0019
Arsenic	79	203	0.00040	0.13	0.016
Barium	203	203	0.0092	1.5	0.0043
Beryllium	3	193	0.0015	0.0030	0.00078
Boron	162	204	0.0090	21	0.16
Cadmium	9	200	0.00020	0.018	0.0040
Chromium	30	202	0.00080	0.44	0.0076
Cobalt	80	203	0.00020	0.42	0.0030
Lead	40	198	0.00033	0.043	0.00060
Lithium	89	206	0.0029	0.32	0.0099
Mercury	4	191	0.00016	0.00029	0.00019
Molybdenum	80	203	0.00060	0.016	0.0012
Selenium	18	201	0.00076	0.021	0.016
Thallium	2	181	0.00051	0.0010	0.0010
Dissolved Metals (mg/L)					
Antimony	2	47	0.00050	0.0066	0.00040
Arsenic	30	226	0.00024	0.019	0.00040
Barium	47	47	0.020	0.060	0.00070
Beryllium	1	47	0.031	0.031	0.00023
Boron	190	235	0.0076	17	0.15
Cadmium	1	47	0.028	0.028	0.00020
Chromium	9	47	0.00013	0.031	0.00070
Cobalt	5	48	0.000080	0.028	0.00010
Lead	6	227	0.0010	0.010	0.00060
Lithium	NT	NT	NT	NT	NT
Molybdenum	21	47	0.00032	0.020	0.00060
Selenium	21	47	0.00026	0.022	0.00060
Thallium	1	47	0.0040	0.0040	0.0010
Radionuclides (pCi/L)					
Radium 226 + 228	201	202	0.0063	8.7	4.6
Other (mg/L or SU)					
pH	204	204	5.6	7.7	NA
Chloride	198	204	1.1	710	96
Fluoride	165	203	0.067	0.79	0.19
Sulfate	204	204	15	4600	307
Total Dissolved Solids	203	203	270	6600	40

Notes:
Source: Ramboll (2024).
NA = Not Applicable; NT = Not Tested; pCi/L = PicoCuries Per Liter.

2.5 Surface Water Monitoring

Geosyntec collected a total of six surface water samples from Coffeen Lake in the vicinity of AP2 in August 2021 (Geosyntec, 2021). The sample locations are shown in Figure 2.3, and the sampling results are summarized in Table 2.3.

Figure 2.3 Surface Water Sampling Locations. Source: Geosyntec (2021).

Table 2.3 Surface Water Data Summary

Constituent	Samples with Constituent Detected	Samples Analyzed	Minimum Detected Value	Maximum Detected Value	Maximum Laboratory Detection Limit
Total Metals (mg/L)					
Boron	5	5	0.086	0.33	0.05
Calcium	5	5	21	53	0.2
Cobalt	0	5	0	0	0.005
Iron	5	5	0.23	0.38	0.2
Lithium	0	5	0	0	0.01
Magnesium	5	5	10	16	0.1
Manganese	5	5	0.03	0.2	0.01
Potassium	5	5	2.5	4.9	0.5
Sodium	5	5	11	19	1
Other (mg/L)					
Chloride	5	5	7.2	11	0.4
Phosphorus	5	5	0.095	0.24	0.15
Sulfate	5	5	31	110	2
Total Dissolved Solids	5	5	120	240	10

Notes:
Source: Geosyntec (2021).
Surface water was analyzed for both total and dissolved metals; only the total metals are reported here because they generally have higher concentrations than dissolved metals. The only exception was iron, which had a maximum dissolved concentration 1.8 times higher than the maximum total concentration. However, iron was not measured in groundwater and, therefore, was not identified as a constituent of interest (COI).

3 Risk Evaluation

3.1 Risk Evaluation Process

A risk evaluation was conducted to determine whether constituents present in groundwater underlying and downgradient of AP2 have the potential to pose adverse health effects to human and ecological receptors. The risk evaluation is consistent with the principles of risk assessment established by US EPA and has considered evaluation criteria detailed in Illinois guidance documents (*e.g.*, IEPA, 2013, 2019).

The general risk evaluation approach is summarized in Figure 3.1 and discussed below.

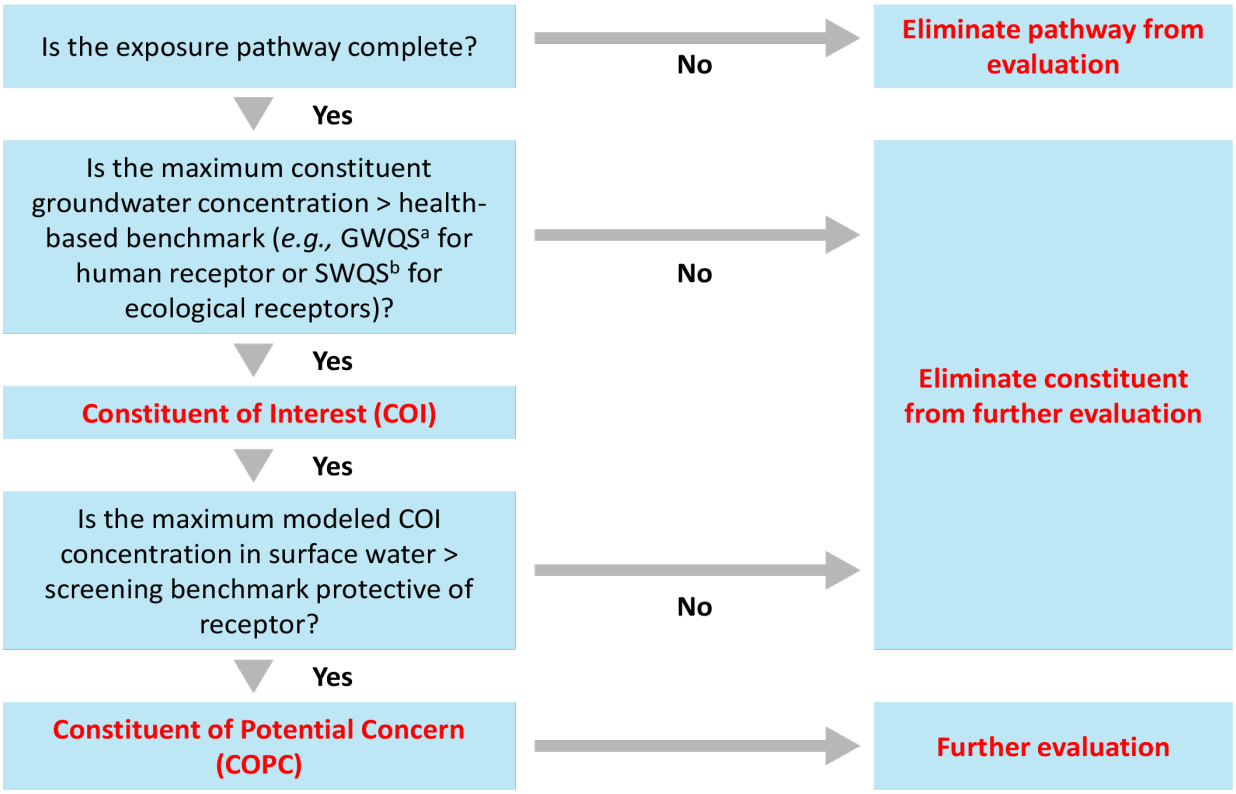


Figure 3.1 Overview of Risk Evaluation Methodology. GWQS = Groundwater Quality Standard; IEPA = Illinois Environmental Protection Agency; SWQS = Surface Water Quality Standard. (a) The IEPA Part 845 GWPS were used to identify COIs. (b) IEPA SWQS protective of chronic exposures to aquatic organisms were used to identify ecological COIs. In the absence of a SWQS, US EPA Region IV ecological screening values were used.

The first step in the risk evaluation was to develop the CEMs and identify complete exposure pathways. All potential receptors and exposure pathways based on groundwater use and surface water use in the vicinity of the Site were considered. Exposure pathways that are incomplete were excluded from the evaluation.

Groundwater data were used to identify COIs. COIs were identified as constituents with maximum concentrations in groundwater in excess of groundwater quality standards (GWQS)[2] for human receptors and surface water quality standards (SWQS) for ecological receptors. Based on the CSM (Section 2.3), some groundwater underlying AP2 has the potential to interact with surface water in Coffeen Lake. Therefore, potential AP2-related constituents in groundwater may potentially flow toward and flow into surface water in Coffeen Lake.

Surface water samples have been collected from Coffeen Lake adjacent to the Site; however, sediment samples have not been collected from the lake. Gradient modeled the potential migration of COIs from groundwater to surface water and sediment to evaluate potential risks to receptors (see Section 3.3.3).

Gradient modeled the COI concentrations in surface water and sediment based on the groundwater data from the AP2-related wells. The measured and modeled COI concentrations in surface water and sediment were compared to conservative, generic risk-based screening benchmarks for human health and ecological receptors. These generic screening benchmarks rely on default assumptions with limited consideration of site-specific characteristics. Human health benchmarks are receptor-specific values calculated for each pathway and environmental medium that are designed to be protective of human health. Ecological benchmarks are medium-specific values designed to be protective of all potential ecological receptors exposed to surface water. Ecological and human health screening benchmarks are inherently conservative because they are intended to screen out chemicals that are of no concern with a high level of confidence. Therefore, a measured or modeled COI concentration exceeding a screening benchmark does not indicate an unacceptable risk, but only that further risk evaluation is warranted. COIs with maximum concentrations exceeding a conservative screening benchmark are identified as COPCs requiring further evaluation.

As described in more detail below, this evaluation relied on the screening assessment to demonstrate that constituents present in groundwater underlying AP2 do not pose an unacceptable human health or ecological risk. That is, after the screening step, no COPCs were identified and further assessment was not warranted.

3.2 Human and Ecological Conceptual Exposure Models

A CEM provides an overview of the receptors and exposure pathways requiring risk evaluation. The CEM describes the source of the contamination, the mechanism that may lead to a release of contamination, the environmental media to which a receptor may be exposed, the route of exposure (exposure pathway), and the types of receptors that may be exposed to these environmental media.

3.2.1 Human Conceptual Exposure Model

The human CEM for the Site depicts the relationships between the off-Site environmental media potentially impacted by constituents in groundwater and human receptors that could be exposed to these media. Figure 3.2 presents a human CEM for the Site. It considers a human receptor who could be exposed to COIs hypothetically released from AP2 into groundwater, surface water, sediment, and fish. The following human receptors and exposure pathways were evaluated for inclusion in the Site-specific CEM.

[2] As discussed further in Section 3.3.2, GWQS are protective of human health and not necessarily of ecological receptors. While ecological receptors are not exposed to groundwater, groundwater can potentially enter into the adjacent surface water and impact ecological receptors. Therefore, two sets of COIs were identified: one for humans and another for ecological receptors.

- Residents – exposure to groundwater/surface water as drinking water;
- Residents – exposure to groundwater/surface water used for irrigation;
- Recreators in the lake adjacent to the Site:
  - Boaters – exposure to surface water and sediment while boating;
  - Swimmers – exposure to surface water and sediment while swimming;
  - Anglers – exposure to surface water and sediment and consumption of locally caught fish.

All of these exposure pathways were considered to be complete, except for residential exposure to groundwater or surface water used for drinking water or irrigation, and swimming. Section 3.2.1.1 explains why the residential drinking water and irrigation pathways are incomplete, and Section 3.2.1.2 provides additional description of the recreational exposures. While a recreator's potential exposure to surface water in Coffeen Lake was evaluated, swimming is prohibited in Coffeen Lake and thus was not evaluated (IDNR, 2014).

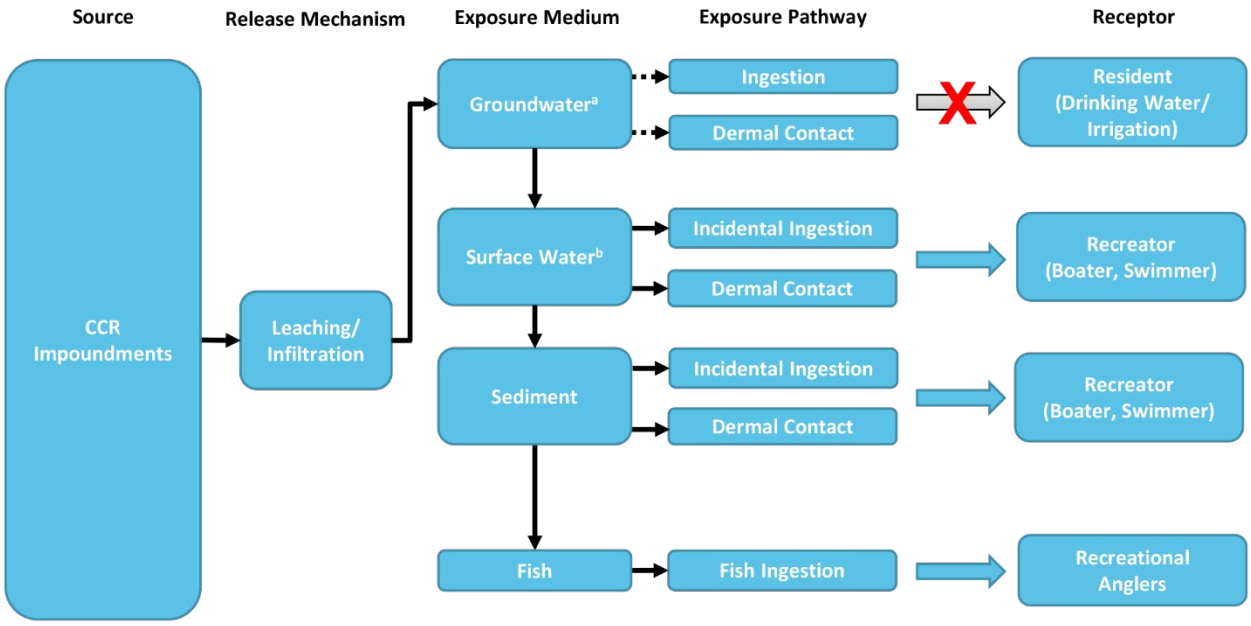


Figure 3.2 Human Conceptual Exposure Model. CCR = Coal Combustion Residuals. Dashed line/Red X = Incomplete or insignificant exposure pathway. (a) Groundwater in the vicinity of the Site is not used as a drinking water or irrigation source. (b) Surface water is not used as a drinking water source.

3.2.1.1 Groundwater or Surface Water as a Drinking Water/Irrigation Source

Using groundwater as a source of drinking water and/or irrigation water is not a complete exposure pathway for CCR-related constituents originating from AP2. Specifically, there are no users of shallow groundwater from the UA in the vicinity of AP2; thus, no receptors can be exposed to any CCR-related constituents in groundwater originating from AP2.

Natural Resource Technology (NRT) completed a water well survey for AP2 in 2017 (NRT, 2017), Ramboll completed a water well survey for AP1 in 2021 (Ramboll, 2021), and Gradient updated the well survey in 2024. A total of 19 water wells were identified within a 1,000-meter radius of the AP2 boundary during a

comprehensive search of the Illinois State Geological Survey's (ISGS) Illinois Water and Related Wells (ILWATER) Map (ISGS, 2024b) (Table 3.1). These included 13 monitoring wells and 6 farm/domestic wells (Figure 3.3). There is no information available about the current use of these wells. However, site-specific groundwater flow conditions support the conclusion that none of the six farm/domestic wells are or can ever be affected by potential CCR-related constituents originating from AP2.

- **There is no off-Site migration of CCR-related constituents in groundwater**. Groundwater from the UA flows north/east before flowing into the Unnamed Tributary and the eastern branch of Coffeen Lake (Ramboll, 2021). Five of the six farm/domestic wells within a 1,000 m radius of AP2 are located on the east/southeast side of Coffeen Lake's eastern branch and the unnamed tributary, *i.e.*, the opposite side of the lake from AP2 (Figure 3.3). These surface water bodies are hydraulic boundaries which limits any further migration of potentially impacted groundwater (NRT 2017). Furthermore, the surface waters are regional "sinks", meaning that groundwater flows into the surface water bodies both from the east and the west, but cannot flow past. Thus, because the eastern branch of Coffeen Lake and the unnamed tributary separate the farm/domestic wells from AP2 (Figure 3.3), there is no plausible mechanism by which the wells could be impacted by any potential constituents in groundwater associated with the AP2.
- There is one domestic/farm well located near the northeast corner of AP2 (Well ID 5 on Figure 3.3), side-gradient to AP2 and on the west side of the unnamed tributary. This well, which was installed in 1981, is located near the former location of several prior residents (Figure 3.4). The well was removed during the construction of the Recycle Pond in 2010 (Ramboll, 2021b; NRT, 2017). However, the property in this area has been purchased by IPGC and no residents are currently living or using groundwater in the area.
- **Coffeen Lake is not used as a public water supply.** Coffeen Lake is a cooling water pond owned and maintained by IPGC, and IPGC restricts the use of the lake as a source of drinking water. Therefore, the human exposure pathway of surface water ingestion (as potable water) adjacent to AP2 is not a complete pathway and was not evaluated further.
- **AP2 has a limited hydraulic connection to underlying groundwater.** The LCU underlying the UA forms a hydraulic barrier between AP2 and deeper groundwater resources. Due to the very low hydraulic conductivity of the LCU, downward migration of shallow groundwater is expected to be limited. Therefore, the likelihood of AP2-related impacts to deep groundwater is minimal.

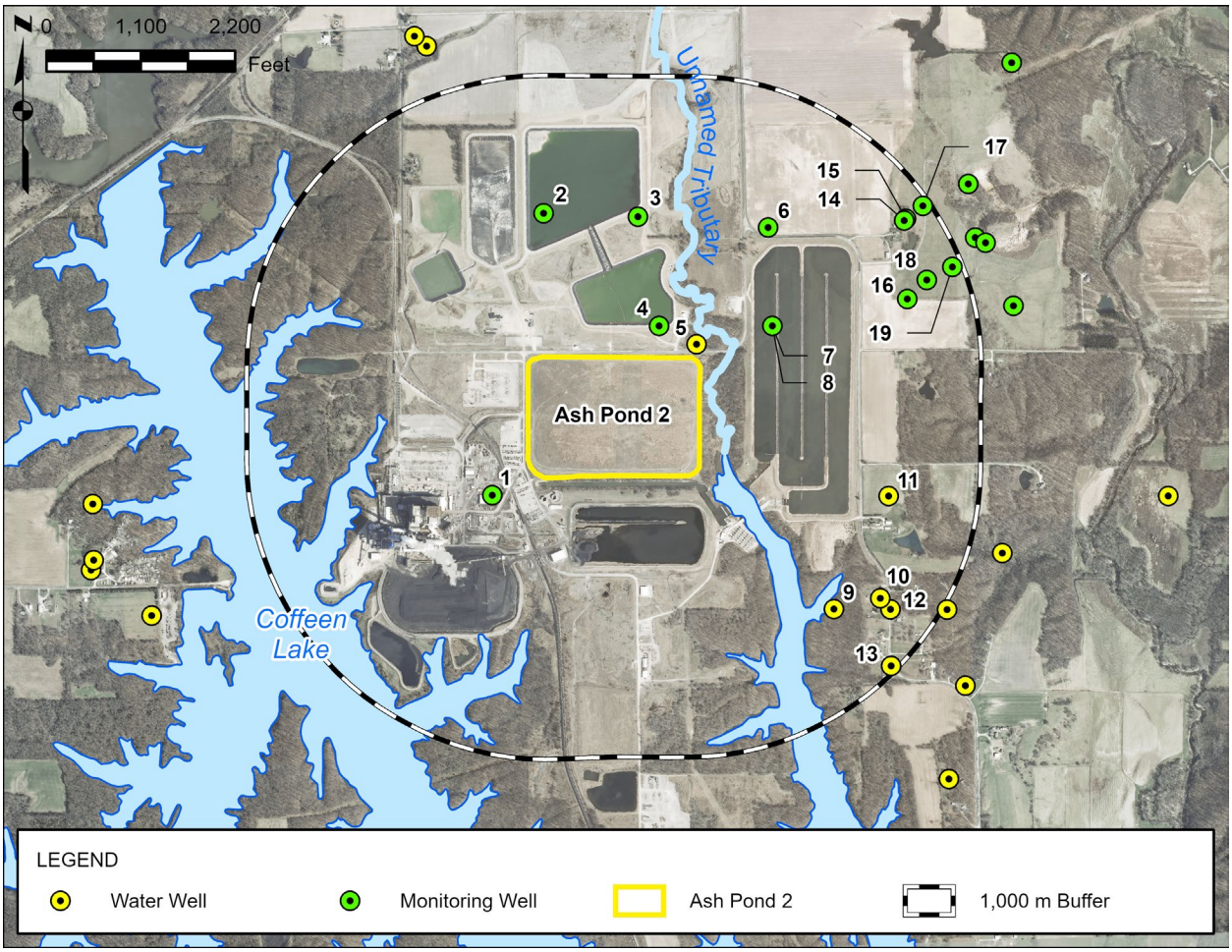


Figure 3.3 Water Wells Within 1,000 Meters of AP2

Table 3.1 Water Wells Within 1,000 Meters of AP2

Map ID #	ISGS API #	Well Depth (ft)	Year Drilled	Owner	Well Use
1	121352423200	20	2015	Illinois Power Holdings, LLC	Monitoring
2	121352423600	18	2015	Illinois Power Holdings, LLC	Monitoring
3	121352425400	16	2017	Coffeen Power Station	Monitoring
4	121352423400	18	2015	Illinois Power Holdings, LLC	Monitoring
6	121352361500	35	1993	White & Brewer	Monitoring
7	121352423300	16	2015	Illinois Power Holdings, LLC	Monitoring
8	121352423500	19	2015	Illinois Power Holdings, LLC	Monitoring
14	121352362000	20	–	White & Brewer	Monitoring
15	121352361900	40	–	White & Brewer	Monitoring
16	121352362100	33	–	White & Brewer	Monitoring
17	121352361800	23	–	White & Brewer	Monitoring
18	121352361700	25	–	White & Brewer	Monitoring
19	121352361600	17	–	White & Brewer	Monitoring
5	121352283200	39	1981	Wibel, William	Private Water Well
9	121350171700	29	1970	Marfield, Mac	Private Water Well
10	121352221400	151	1977	Warfield, William	Private Water Well
11	121352380200	363	1996	O'Dell, Kenneth & Chong	Private Water Well
12	121350172600	32	1971	Schuler, Paul	Private Water Well
13	121352380300	401	1996	Childers, Joe	Private Water Well

Notes:
– = Unknown; LLC = Limited Liability Company.

Figure 3.4 Historic Property Use in the Vicinity of Well 32. (a) 1998; (b) 2005; (c) 2009. Sources: USGS (1998a,b, 2005a,b); USDA (2009a,b).

3.2.1.2 Recreational Exposures

Coffeen Lake is located adjacent to the Site and is owned by IPGC. Property along the lake has been leased to the Illinois Department of Natural Resources (IDNR) for use as a State Fish and Wildlife Area (Ramboll, 2021), and the lake is used for recreational fishing (IDNR, 2022). Recreational exposure to surface water and sediment may occur during activities such as boating or fishing in the lake. Recreational anglers may also consume locally caught fish from Coffeen Lake. Swimming does not occur in Coffeen Lake because it is owned by IPGC and used as a cooling reservoir (IDNR, 2022).

3.2.2 Ecological Conceptual Exposure Model

The ecological CEM for the Site depicts the relationships between off-Site environmental media (surface water and sediment) potentially impacted by COIs in groundwater and ecological receptors that may be exposed to these media. The ecological risk evaluation considered both direct toxicity and secondary toxicity *via* bioaccumulation. Figure 3.5 presents the ecological CEM for the Site. The following ecological receptor groups and exposure pathways were considered:

- **Ecological Receptors Exposed to Surface Water:**
  - Aquatic plants, amphibians, reptiles, and fish.
- **Ecological Receptors Exposed to Sediment:**
  - Benthic invertebrates (*e.g.*, insects, crayfish, and mussels).
- **Ecological Receptors Exposed to Bioaccumulative COIs:**
  - Higher trophic-level wildlife (avian and mammalian) *via* direct exposures (surface water and sediment exposure) and secondary exposures through the consumption of prey (*e.g.*, plants, invertebrates, small mammals, and fish).

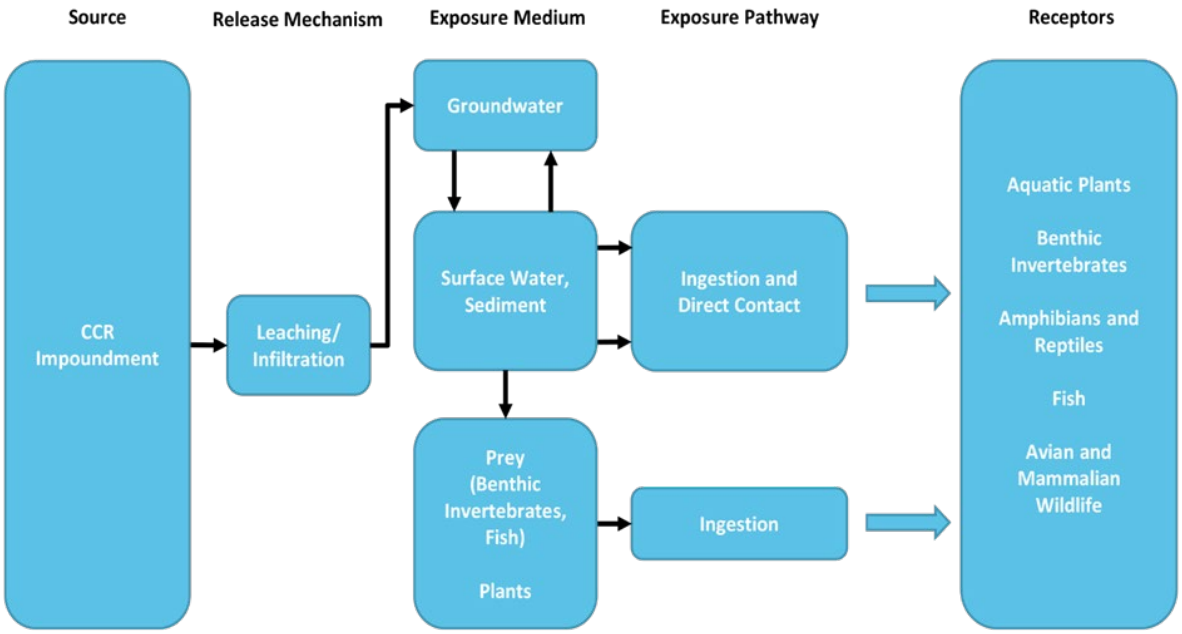


Figure 3.5 Ecological Conceptual Exposure Model. CCR = Coal Combustion Residuals.

3.3 Identification of Constituents of Interest

Risks were evaluated for COIs. A constituent was considered a COI if the maximum detected constituent concentration in groundwater exceeded a health-based benchmark. According to US EPA risk assessment guidance (US EPA, 1989), this screening step is designed to reduce the number of constituents carried through the risk evaluation that are anticipated to have a minimal contribution to the overall risk. Identified COIs are the constituents that are most likely to pose a risk concern in the surface water adjacent to the Site.

3.3.1 Human Health Constituents of Interest

For the human health risk evaluation, COIs were conservatively identified as constituents with maximum concentrations in groundwater above the GWPS listed in the Illinois CCR Rule Part 845.600 (IEPA, 2021a). Gradient used the maximum detected concentrations from groundwater samples collected from all of the AP2-associated wells, regardless of hydrostratigraphic unit. The use of groundwater data in this risk evaluation does not imply that detected constituents are associated with AP2 or that they have been identified as potential groundwater exceedances. Using this approach, 12 COIs (antimony, arsenic, beryllium, boron, cadmium, chromium, cobalt, lead, lithium, thallium, radium-226+228, and chloride) were identified for the human health risk evaluation *via* the surface water pathway (Table 3.1).

The water quality parameters that exceeded the GWPS included sulfate and total dissolved solids; however, these constituents were not included in the risk evaluation because the GWPS are based on aesthetic quality. US EPA set secondary maximum contaminant levels (MCLs) for sulfate and TDS based on aesthetic quality. The secondary MCL for sulfate (250 mg/L) is based on salty taste (US EPA, 2021a). The secondary MCL for total dissolved solids (500 mg/L) is based on hardness, deposits, colored water, staining, and salty taste (US EPA, 2021a). Given that these parameters are not likely to pose a human health risk concern in the event of exposure, they were not considered to be human health COIs.

Table 3.1 Human Health Constituents of Interest

Constituent[a]	Maximum Concentration[b]	GWPS[c]	Human Health COI[d]
Total Metals (mg/L)			
Antimony	0.0049	0.0060	No
Arsenic	0.13	0.010	Yes
Barium	1.5	2.0	No
Beryllium	0.0030	0.0040	No
Boron	21	2.0	Yes
Cadmium	0.018	0.0050	Yes
Chromium	0.44	0.10	Yes
Cobalt	0.42	0.0060	Yes
Lead	0.043	0.0075	Yes
Lithium	0.32	0.040	Yes
Mercury	0.00029	0.0020	No
Molybdenum	0.016	0.10	No
Selenium	0.021	0.050	No
Thallium	0.0010	0.0020	No
Dissolved Metals (mg/L)			
Antimony	0.0066	0.0060	Yes
Arsenic	0.019	0.010	Yes
Barium	0.060	2.0	No
Beryllium	0.031	0.0040	Yes
Boron	17	2.0	Yes
Cadmium	0.028	0.0050	Yes
Chromium	0.031	0.10	No
Cobalt	0.028	0.0060	Yes
Lead	0.010	0.0075	Yes
Molybdenum	0.02	0.1	No
Selenium	0.022	0.05	No
Thallium	0.004	0.002	Yes
Radionuclides (pCi/L)			
Radium 226 + Radium 228	8.66	5	Yes
Other (mg/L, unless otherwise noted)			
pH	7.7	6.5-9.0	No
Chloride	710	200	Yes
Fluoride	0.79	4.0	No
Sulfate	4600	400	No[e]
Total Dissolved Solids	6600	1200	No[e]

Notes:
COI = Constituent of Interest; GWPS = Groundwater Protection Standard; pCi/L = PicoCuries Per Liter.
Shaded = Compound identified as a COI.
(a) The constituents are those listed in the Illinois Part 845.600 GWPS (IEPA, 2021a).
(b) The maximum detected groundwater concentration was used to identify COIs.
(c) The Illinois Part 845.600 GWPS (IEPA, 2021a) were used to identify COIs.
(d) COIs are constituents for which the maximum concentration exceeds the groundwater standard.
(e) This constituent is not likely to pose a human health risk concern due to the absence of studies regarding toxicity to human health. Therefore, this constituent is not considered a COI.

3.3.2 Ecological Constituents of Interest

The Illinois GWPS, as defined in IEPA's guidance, were developed to protect human health, but not necessarily ecological receptors. While ecological receptors are not exposed to groundwater, groundwater can potentially migrate into the adjacent surface water and impact ecological receptors. Therefore, to identify ecological COIs, the maximum concentrations of constituents detected in groundwater were compared to ecological surface water benchmarks protective of aquatic life.

The surface water screening benchmarks for freshwater organisms were obtained from the following hierarchy of sources:

- IEPA (2019) Surface Water Quality Criteria (SWQC). IEPA SWQC are health-protective benchmarks for aquatic life exposed to surface water on a long-term basis (*i.e.*, chronic exposure). The SWQC for several metals are hardness-dependent (cadmium, chromium, copper, lead, manganese, nickel, and zinc). Screening benchmarks for these constituents were calculated assuming US EPA's default hardness of 100 mg/L (US EPA, 2022).[3]
- US EPA Region IV (2018) surface water Ecological Screening Values (ESVs) for hazardous waste sites.

Benchmarks from the United States Department of Energy's (US DOE) guidance document ("A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota") were used for radium (US DOE, 2019). US DOE (2019) presents benchmarks for radium-226 and radium-228 (4 and 3 picoCuries per liter [pCi/L], respectively). Given that radium concentrations are expressed as total radium (radium-226+228, *i.e.*, the sum of radium-226 and radium-228), Gradient used the lower of the two benchmarks (3 pCi/L for radium-228) to evaluate total radium concentrations.

Consistent with the human health risk evaluation, Gradient used the maximum detected concentrations from groundwater samples collected from all of the AP2-associated wells (regardless of hydrostratigraphic unit) without considering spatial or temporal representativeness for ecological receptor exposures. The use of the maximum constituent concentrations in this evaluation is designed to conservatively identify COIs that warrant further investigation. Boron, cadmium, chromium, cobalt, lead, radium-226+228, and chloride were identified as COIs for ecological receptors (Table 3.2).

[3] Hardness data are not available for Coffeen Lake adjacent to the Site; therefore, the US EPA (2022) default hardness of 100 mg/L was used. Use of a higher hardness value would result in less stringent screening values; thus, use of the US EPA default hardness is conservative.

Table 3.2 Ecological Constituents of Interest

Constituent[a]	Maximum Groundwater Concentration	Ecological Benchmark[b]	Basis	Ecological COI[c]
Total Metals (mg/L)				
Antimony	0.0049	0.19	EPA R4 ESV	No
Arsenic	0.13	0.19	IEPA SWQC	No
Barium	1.5	5.0	IEPA SWQC	No
Beryllium	0.0030	0.064	EPA R4 ESV	No
Boron	21	7.6	IEPA SWQC	Yes
Cadmium	0.018	0.0011	IEPA SWQC	Yes
Chromium	0.44	0.21	IEPA SWQC	Yes
Cobalt	0.42	0.019	EPA R4 ESV	Yes
Lead	0.043	0.020	IEPA SWQC	Yes
Lithium	0.32	0.44	EPA R4 ESV	No
Mercury	0.00029	0.0011	IEPA SWQC	No
Molybdenum	0.016	7.2	EPA R4 ESV	No
Selenium	0.021	1.0	IEPA SWQC	No
Thallium	0.0010	0.0060	EPA R4 ESV	No
Dissolved Metals (mg/L)				
Antimony	0.0066	0.19	EPA R4 ESV	No
Arsenic	0.019	0.19	IEPA SWQC	No
Barium	0.060	5.0	IEPA SWQC	No
Beryllium	0.031	0.064	EPA R4 ESV	No
Boron	17	7.6	IEPA SWQC	Yes
Cadmium	0.028	0.0011	IEPA SWQC	Yes
Chromium	0.031	0.21	IEPA SWQC	No
Cobalt	0.028	0.019	EPA R4 ESV	Yes
Lead	0.010	0.020	IEPA SWQC	No
Molybdenum	0.020	7.2	EPA R4 ESV	No
Selenium	0.022	1.0	IEPA SWQC	No
Thallium	0.0040	0.0060	EPA R4 ESV	No
Radionuclides (pCi/L)				
Radium 226 + 228	8.7	3.0	US DOE	Yes
Other (mg/L, unless otherwise noted)				
pH	7.7	6.5-9.0	IEPA SWQC	No
Chloride	710	500	IEPA SWQC	Yes
Fluoride	0.79	4.0	IEPA SWQC	No
Sulfate	4600	NA	NA	No
Total Dissolved Solids	6600	NA	NA	No

Notes:
AP2 = Ash Pond 2; COI = Constituent of Interest; ESV = Ecological Screening Value; IEPA = Illinois Environmental Protection Agency; NA = Not Available; pCi/L = picoCuries Per Liter; SWQC = Surface Water Quality Criteria; US DOE = United States Department of Energy; US EPA R4 = US Environmental Protection Agency Region IV.
Shaded = Compound identified as a COI.
(a) The constituents are those listed in the Illinois Part 845.600 GWPS (IEPA, 2021a).
(b) Ecological benchmarks are from the hierarchy of sources discussed in Section 3.3.2: IEPA SWQC (IEPA, 2019); US EPA Region IV "Ecological Risk Assessment Supplemental Guidance" (US EPA Region IV, 2018); and US DOE's guidance document, "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" (US DOE, 2019).
(c) Constituents with maximum detected concentrations exceeding a benchmark protective of surface water exposure are considered ecological COIs.

3.3.3 Surface Water and Sediment Modeling

Surface water sampling has been conducted in Coffeen Lake adjacent to the Site. To estimate the potential contribution to surface water (and sediment) from groundwater specifically associated with AP2, Gradient modeled concentrations in Coffeen Lake surface water and sediment from groundwater flow into the lake for the detected human and ecological COIs. This is because the constituents detected in groundwater above an ecological- or health-based benchmark are most likely to pose a risk concern in the adjacent surface water. Gradient modeled human health and ecological COI concentrations in the surface water and sediment using a mass balance calculation based on the surface water and groundwater mixing. The model assumes a well-mixed groundwater-surface water location. The maximum detected concentrations in groundwater (regardless of well location or hydrogeologic unit) from 2018 to 2023 were conservatively used to model COI concentrations in surface water and sediment. In cases where the maximum groundwater concentration was from the "total metals" analysis, use of the total metals concentration for these COIs may overestimate surface water concentrations because dissolved concentrations, which are lower than total concentrations, represent the mobile fractions of constituents that could likely flow into and mix with surface water.

This modeling approach does not account for geochemical transformations that may occur during groundwater mixing with surface water. Gradient assumed that predicted surface water concentrations were influenced only by the physical mixing of groundwater as it enters the surface water, and were not further influenced by the geochemical reactions in the water and sediment, such as precipitation. In addition, the model only predicts surface water and sediment concentrations as a result of the potential migration of COI concentrations in AP2-related groundwater and does not account for background concentrations in surface water or sediment.

For this evaluation, Gradient adapted a simplified and conservative form of US EPA's indirect exposure assessment methodology (US EPA, 1998) that was used in US EPA's coal combustion waste risk assessment (US EPA, 2014). The model is a mass balance calculation based on surface water and groundwater mixing and the concept that the dissolved and sorbed concentrations can be related through an equilibrium partitioning coefficient (K_d). The model assumes a well-mixed groundwater-surface water location, with partitioning among total suspended solids, dissolved water column, sediment pore water, and solid sediments.

Sorption to soil and sediment is highly dependent on the surrounding geochemical conditions. To be conservative, we ignored the natural attenuation capacity of soil and sediment and estimated the surface water concentration based only on the physical mixing of groundwater and surface water (*i.e.*, dilution) at the point of entry of groundwater to the surface water.

The aquifer and surface water properties used to estimate the volume of groundwater flowing into Coffeen Lake and surface water concentrations are presented in Table 3.3. The COI concentrations in sediment were modeled using the COI-specific sediment-to-water partitioning coefficients and the sediment properties presented in Table 3.4. In the absence of Site-specific information for Coffeen Lake, Gradient used default assumptions (*e.g.*, depth of the upper benthic layer and bed sediment porosity) to model sediment concentrations. The modeled surface water and sediment concentrations are presented in Table 3.5. These modeled concentrations reflect conservative contributions from groundwater flow. A description of the modeling and the detailed results are presented in Appendix A.

Table 3.3 Groundwater and Surface Water Properties Used in Modeling

Parameter	Unit	Values	Notes/Source
Groundwater			
COI Concentration	mg/L	Constituent-specific	Maximum detected concentration in groundwater
Cross Section Area for the UA[a]	m^2	960	The average thickness of the UA (*i.e.*, 3 ft or 0.9144 m) multiplied by the length of AP2 affected groundwater intersecting Coffeen Lake (*i.e.*, sum of the eastern and southern sides of AP2, about 1050 m) (Ramboll, 2021)
Hydraulic Gradient	m/m	0.007	The average hydraulic gradient for the UA (Ramboll, 2021)
Hydraulic Conductivity of the UA	cm/s	0.002	The geometric mean horizontal hydraulic conductivity measured for the UA (Ramboll, 2021)
Surface Water			
Surface Water Flow Rate in the Eastern Branch of Coffeen Lake	L/yr	8.0×10^{10}	There are no flow records available for the eastern branch of Coffeen Lake. The flow rate was assumed to be the same (*i.e.*, 90 cfs) as estimated for the unnamed tributary that flows from north to south into the eastern branch of Coffeen Lake (Golder Associates Inc., 2020).
Total Suspended Solids	mg/L	3.2	Average Coffeen Lake concentration (Hanson Professional Services, Inc., 2020)
Depth of the Water Column	m	5.7	Mean depth of Coffeen Lake (Austen *et al*., 1993)
Suspended Sediment to Water Partition Coefficient	mg/L	Constituent-specific	Values based on US EPA (2014)

Notes:
AP2 = Ash Pond 2; cfs = Cubic Feet Per Second; COI = Constituent of Interest; ft = Feet; L/yr = Liter Per Year; UA = Uppermost Aquifer; US EPA = United States Environmental Protection Agency.
(a) Cross-sectional area represents the area through which groundwater flows from the UA into Coffeen Lake (*i.e.*, the groundwater flow area that intersects with Coffeen Lake).

Table 3.4 Sediment Properties Used in Modeling

Parameter	Unit	Value	Notes/Source
Sediment			
Depth of Upper Benthic Layer	m	0.03	Default (US EPA, 2014)
Depth of Water Body	m	5.73	Sum of depth of water column (5.7 m, depth of Coffeen Lake) (Austen *et al*., 1993) and depth of upper benthic layer (0.03 m) (US EPA, 2014)
Bed Sediment Particle Concentration	g/cm^3	1	Default (US EPA, 2014)
Bed Sediment Porosity	-	0.6	Default (US EPA, 2014)
TSS Mass Per Unit Area	kg/m^2	0.018	Depth of water column × TSS × conversion factors (10^{-6} kg/mg and 1,000 L/m^3)
Sediment Mass Per Unit Area	kg/m^2	30	Depth of upper benthic layer × bed sediment particulate concentration × conversion factors (0.001 kg/g, 10^6 cm^3/m^3)
Sediment to Water Partition Coefficients	mg/L	Constituent-specific	Values based on US EPA (2014)

Notes:
TSS = Total Suspended Solids; US EPA = United States Environmental Protection Agency.

Table 3.5 Surface Water and Sediment Modeling Results

COI	Groundwater Concentration (mg/L or pCi/L)	Mass Discharge Rate (mg/yr or pCi/yr)	Total Water Column Concentration (mg/L or pCi/L)	Concentration Sorbed to Bottom Sediments (mg/kg or pCi/kg)
Metals				
Antimony[b]	6.6E-03	2.8E+04	3.5E-07	1.2E-03
Arsenic	1.3E-01	5.5E+05	6.9E-06	1.7E-03
Beryllium[b]	3.1E-02	1.3E+05	1.6E-06	9.9E-04
Boron[b]	2.1E+01	9.0E+07	1.1E-03	6.9E-03
Cadmium	2.8E-02	1.2E+05	1.5E-06	2.4E-03
Chromium	4.4E-01	1.9E+06	2.3E-05	1.3E+00
Cobalt	4.2E-01	1.8E+06	2.2E-05	2.3E-02
Lead	4.3E-02	1.8E+05	2.3E-06	3.5E-02
Lithium	3.2E-01	1.4E+06	1.7E-05	NA[a]
Thallium[b]	4.0E-03	1.7E+04	2.1E-07	4.1E-06
Radionuclides				
Radium 226 + 228	8.7E+00	3.7E+07	4.6E-04	3.3E+00

Notes:
COI = Constituent of Concern; K_d = Equilibrium Partition Coefficient; NA = Not Applicable; pCi/L = PicoCuries Per Liter; pCi/kg = PicoCuries Per Kilogram.
(a) Lithium does not readily sorb to soil or sediment particles; a K_d value of 0 was used for the modeling.
(b) Maximum groundwater concentration was for dissolved metals.

3.4 Human Health Risk Evaluation

The section below presents the results of the human health risk evaluation for recreators (boaters and anglers) in Coffeen Lake adjacent to the Site. Risks were assessed using the maximum measured or modeled COIs in surface water.

3.4.1 Recreators Exposed to Surface Water

Screening Exposures: Recreators could be exposed to surface water *via* incidental ingestion and dermal contact while boating. In addition, anglers could consume fish caught in Coffeen Lake. The maximum measured or modeled COI concentrations in surface water were used as conservative upper-end estimates of the COI concentrations to which a recreator might be exposed directly (incidental ingestion of COIs in surface water while boating) and indirectly (consumption of locally caught fish exposed to COIs in surface water).

Screening Benchmarks: Illinois surface water criteria (IEPA, 2019), known as human threshold criteria (HTC), are based on incidental exposure through contact or ingestion of small volumes of water while swimming or during other recreational activities, as well as the consumption of fish. The HTC values were calculated from the following equation (IEPA, 2019):

$$\mathrm{HTC} = \frac{\mathrm{ADI}}{\mathrm{W} + (\mathrm{F} \times \mathrm{BCF})}$$

where:

HTC = Human health protection criterion in milligrams per liter (mg/L)
ADI = Acceptable daily intake (mg/day)

W = Water consumption rate (L/day)
F = Fish consumption rate (kg/day)
BCF = Bioconcentration factor (L/kg-tissue)

Illinois defines the acceptable daily intake (ADI) as the "maximum amount of a substance which, if ingested daily for a lifetime, results in no adverse effects to humans" (IEPA, 2019). US EPA defines its chronic reference dose (RfD) as an "estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure for a chronic duration (up to a lifetime) to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime" (US EPA, 2011a). Illinois lists methods to derive an ADI from the primary literature (IEPA, 2019). In accordance with Illinois guidance, Gradient derived an ADI by multiplying the MCL by the default water ingestion rate of 2 L/day (IEPA, 2019). In the absence of an MCL, Gradient applied the RfD used by US EPA to derive its Regional Screening Levels (RSLs) (US EPA, 2021b) as a conservative estimate of the ADI. The RfDs are given in mg/kg-day, while the ADIs are given in mg/day; thus, Gradient multiplied the RfD by a standard body weight of 70 kg to obtain the ADI in mg/day. The calculation of the HTC values is shown in Appendix B, Table B.1.

Gradient used bioconcentration factors (BCFs) from a hierarchy of sources. The primary BCFs were those that US EPA used to calculate the National Recommended Water Quality Criteria (NRWQC) for human health (US EPA, 2002). Other sources included BCFs used in the US EPA coal combustion ash risk assessment (US EPA, 2014) and BCFs reported by Oak Ridge National Laboratory's Risk Assessment Information System (ORNL RAIS) (ORNL, 2023).[4] Lithium did not have a BCF value available from any authoritative source; therefore, the water quality criterion for lithium was calculated assuming a BCF of 1. This is a conservative assumption, as lithium does not readily bioaccumulate in the aquatic environment (ECHA, 2020).

Illinois recommends a fish consumption rate of 0.020 kg/day (20 g/day) for an adult weighing 70 kg (IEPA, 2019). Illinois recommends a water consumption rate of 0.01 L/day for "incidental exposure through contact or ingestion of small volumes of water while swimming or during other recreational activities" (IEPA, 2019). Appendix B, Table B.1 presents the calculated HTC for fish consumption and water ingestion, and for fish consumption only.

The HTC for fish consumption for radium-226+228 was calculated as follows:

$$\mathrm{HTC} = \frac{\mathrm{TCR}}{(\mathrm{SF} \times \mathrm{BAF} \times \mathrm{F})}$$

where:

HTC = Human health protection criterion in picoCuries per liter (pCi/L)
TCR = Target cancer risk (1×10^{-5})
SF = Food ingestion slope factor (risk/pCi)
BAF = Bioaccumulation factor (L/kg-tissue)
F = Fish consumption rate (kg/day)

The food ingestion slope factor (lifetime excess total cancer risk per unit exposure, in risk/pCi) used to calculate the HTC was the highest value of those for radium-226 (Ra-226), radium-228 (Ra-228), and "Ra-228+D" (US EPA, 2001). According to US EPA (2001), "+D" indicates that "the risks from associated

[4] Although recommended by US EPA (2015b), US EPA EpiSuite 4.1 (US EPA, 2019) was not used as a source of BCFs because inorganic compounds are outside the estimation domain of the program.

short-lived radioactive decay products (*i.e.,* those decay products with radioactive half-lives less than or equal to 6 months) are also included."

Screening Risk Evaluation: The maximum modeled and measured COI concentrations in surface water were compared to the calculated Illinois HTC values (Table 3.6). All surface water concentrations were below their respective benchmarks. The HTC values are protective of recreational exposure *via* water and/or fish ingestion and do not account for dermal exposures to COIs in surface water while boating. However, given that the measured and modeled COI surface water concentrations are orders of magnitude below an HTC protective of water and/or fish ingestion, dermal exposures to COIs are not expected to be a risk concern. Moreover, the dermal uptake of metals is considered to be minimal and only a small proportion of ingestion exposures. Thus, none of the COIs evaluated would be expected to pose an unacceptable risk to recreators exposed to surface water while boating or anglers consuming fish caught in Coffeen Lake.

Table 3.6 Risk Evaluation for Recreators Exposed to Surface Water

COI	Maximum Surface Water Concentration		HTC for Water and Fish	HTC for Water Only	HTC for Fish Only	COPC	
	Modeled	Measured[a]				Based on Modeled Concentrations	Based on Measured Concentrations
Total Metals (mg/L)							
Arsenic	6.9E-06	NA	2.2E-02	2.0E+00	2.3E-02	No	NA
Boron	1.1E-03	3.3E-01	4.7E+02	1.4E+03	7.0E+02	No	No
Chromium	2.3E-05	NA	6.1E-01	2.0E+01	6.3E-01	No	NA
Cobalt	2.2E-05	ND	3.5E-03	2.1E+00	3.5E-03	No	No
Lead	2.3E-06	NA	1.5E-02	1.5E-02	1.5E-02	No	NA
Lithium	1.7E-05	ND	4.7E+00	1.4E+01	7.0E+00	No	No
Dissolved Metals (mg/L)							
Antimony	3.5E-07	NA	4.0E-01	1.2E+00	6.0E-01	No	NA
Beryllium	1.6E-06	NA	2.1E-02	8.0E-01	2.1E-02	No	NA
Cadmium	1.5E-06	NA	1.8E-03	1.0E+00	1.9E-03	No	NA
Thallium	2.1E-07	NA	1.7E-03	4.0E-01	1.7E-03	No	NA
Radionuclides (pCi/L)							
Radium 226 + 228	4.6E-04	NA	1.0E+03	1.0E+03	8.7E+04	No	NA

Notes:
COI = Constituent of Interest; COPC = Constituent of Potential Concern; HTC = Human Threshold Criteria; NA = Not Applicable; ND = Not Detected; pCi/L = PicoCuries Per Liter.
(a) Measured concentrations are listed only for the constituents identified as COIs. Measured surface water concentrations may be different from modeled concentrations because measured data include the effects of background and other industrial sources. Modeled concentrations only represent the potential effect on surface water quality resulting from the measured groundwater concentrations. COIs with no measured surface water data were listed as NA.

3.4.2 Recreators Exposed to Sediment

Recreational exposure to sediment may occur during boating activity in Coffeen Lake; exposure to sediment may occur through incidental ingestion and dermal contact.
Screening Exposures: COIs in impacted groundwater flowing into the river can sorb to sediments. In the absence of sediment data, sediment concentrations were modeled using maximum detected groundwater concentrations.

Screening Benchmarks: There are no established recreator RSLs that are protective of recreational exposures to sediment (US EPA, 2021c). Therefore, benchmarks that are protective of recreational exposures to sediment *via* incidental ingestion and dermal contact were calculated using US EPA's RSL guidance (US EPA, 2021c). These benchmarks were calculated using the recommended assumptions (*i.e.*, oral bioavailability, body weights, and averaging time) and toxicity reference values (*i.e.*, RfD and cancer slope factor [CSF]), with the following changes: Recreators were assumed to be exposed to sediment while recreating 60 days per year (or two weekend days per week for 30 weeks per year, from April to October). The exposure duration was assumed for a child 6 years of age and an adult 20 years of age, per US EPA guidance (Stalcup, 2014). The daily recommended residential soil ingestion rates of 200 mg/day for a child and 100 mg/day for an adult are based on an all-day exposure to residential soils (Stalcup, 2014; US EPA, 2011b). Since recreational exposures to sediment are assumed to occur for less than 4 hours per day, one-third of the daily residential soil ingestion (67 mg/day for a child and 33 mg/day for an adult) was used as a conservative assumption. For dermal exposures, recreators were assumed to be exposed to sediment on their lower legs and feet (1,026 cm^2 for the child and 3,026 cm^2 for the adult, based on the age-weighted surface areas reported in US EPA, 2011b). While other body parts may be exposed to sediment, the contact time will likely be very short, as the sediment would wash off in the surface water. Gradient used US EPA's recommended adherence factor of 0.2 mg/cm^2 based on child exposure to wet soil (US EPA, 2004; Stalcup, 2014), which was used in the US EPA RSL User's Guide for a child recreator exposed to soil or sediment (US EPA, 2021c). The sediment screening benchmarks were calculated based on a target hazard quotient of 1, or a target cancer risk of 1×10^{-5}. Appendix B, Table B.2 presents the calculation of screening benchmarks protective of recreational exposures to sediment. A recreator sediment screening benchmark for radium-226+228 was based on soil Preliminary Remediation Goals (PRGs) calculated for radium-226 and radium-228 using US EPA's PRG calculator (US EPA, 2020). The lower of the two values (7,900) was used as the recreator sediment screening benchmark for radium-226+228 (Appendix B, Table B.3).

Screening Risk Evaluation: The modeled sediment concentrations were well below the recreational sediment screening benchmarks (Table 3.7). Therefore, exposure to sediment is not expected to pose an unacceptable risk to recreators while boating.

Table 3.7 Risk Evaluation for Recreators Exposed to Sediment

COI	Modeled Sediment Concentration	Recreator RSL	COPC
Total Metals (mg/kg)			
Arsenic	1.7E-03	6.8E+01	No
Boron	6.9E-03	2.7E+05	No
Chromium	1.3E+00	2.1E+06	No
Cobalt	2.3E-02	4.1E+02	No
Lead	3.5E-02	2.0E+02	No
Lithium	NA[a]	2.7E+03	NA
Dissolved Metals (mg/kg)			
Antimony	1.2E-03	5.5E+02	No
Beryllium	9.9E-04	2.7E+03	No
Cadmium	2.4E-03	1.2E+02	No
Thallium	4.1E-06	1.4E+01	No
Radionuclides (pCi/kg)			
Radium 226 + 228	3.3E+00	7.9E+03	No

Notes:
COI = Constituent of Interest; COPC = Constituent of Potential Concern; K_d = Equilibrium Partition Coefficient; mg/kg = Milligram Per Kilogram; NA = Not Applicable; pCi/kg = PicoCuries Per Kilogram; RSL = Regional Screening Level.
(a) Lithium does not readily sorb to soil or sediment particles; a K_d value of 0 was used for the modeling.

3.5 Ecological Risk Evaluation

Based on the ecological CEM (Figure 3.4), ecological receptors could be exposed to surface water and dietary items (*i.e.*, prey and plants) potentially impacted by identified COIs (*i.e.*, boron, cadmium, chromium, cobalt, lead, radium-226+228, and chloride).

3.5.1 Ecological Receptors Exposed to Surface Water

Screening Exposures: The ecological evaluation considered aquatic communities in Coffeen Lake potentially impacted by identified ecological COIs. Measured and modeled surface water concentrations were compared to risk-based ecological screening benchmarks.

Screening Benchmarks: Surface water screening benchmarks protective of aquatic life were obtained from the following hierarchy of sources:

- IEPA SWQC (IEPA, 2019), regulatory standards that are intended to protect aquatic life exposed to surface water on a long-term basis (*i.e.*, chronic exposure). For cadmium, the surface water benchmark is hardness-dependent and calculated using a default hardness of 100 mg/L (US EPA, 2022)[5];
- US EPA Region IV (2018) surface water ESVs for hazardous waste sites; and

[5] Conservatisms associated with using a default hardness value are discussed in Section 3.6.

- US DOE benchmarks from the guidance document, "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" (US DOE, 2019).

Risk Evaluation: The maximum measured and modeled COI concentrations in surface water were compared to the benchmarks protective of aquatic life (Table 3.8). The measured and modeled surface water concentrations for the COIs were below their respective benchmarks. Thus, none of the COIs evaluated are expected to pose an unacceptable risk to aquatic life in Coffeen Lake.

Table 3.8 Risk Evaluation for Ecological Receptors Exposed to Surface Water

COI	Maximum Surface Water Concentration		Ecological Freshwater Benchmark	Basis	COPC	
	Modeled	Measured[a]			Based on Modeled Concentrations	Based on Measured Concentrations
Total Metals (mg/L)						
Boron	1.1E-03	3.3E-01	7.6E+00	IEPA SWQC	No	No
Chromium	2.3E-05	NA	2.1E-01	IEPA SWQC	No	NA
Cobalt	2.2E-05	ND	1.9E-02	EPA R4 ESV	No	No
Lead	2.3E-06	NA	2.0E-02	IEPA SWQC	No	NA
Dissolved Metals (mg/L)						
Cadmium	1.5E-06	NA	1.1E-03	IEPA SWQC	No	NA
Radionuclides (pCi/L)						
Radium 226 + 228	4.6E-04	NA	3.0E+00	US DOE	No	NA
Other (mg/L)						
Chloride	3.8E-02	1.1E+01	5.0E+02	IEPA SWQC	No	No

Notes:
COI = Constituent of Interest; COPC = Constituent of Potential Concern; ESV = Ecological Screening Value; IEPA = Illinois Environmental Protection Agency; NA = Not Applicable; ND = Not Detected; pCi/L = PicoCuries Per Liter; SWQC = Surface Water Quality Criteria; US DOE = United States Department of Energy; US EPA = United States Environmental Protection Agency.
(a) COIs with no measured surface water data were listed as NA.

3.5.2 Ecological Receptors Exposed to Sediment

Screening Exposures: COIs in impacted groundwater discharging into Coffeen Lake can sorb to sediments *via* chemical partitioning. In the absence of sediment data, sediment concentrations were modeled using maximum detected groundwater concentrations. Therefore, the modeled COI sediment concentrations reflect the potential maximum Site-related sediment concentration from groundwater discharge.

Screening Benchmarks: Sediment screening benchmarks were obtained from US EPA Region IV (2018). The majority of the sediment ESVs are based on threshold effect concentrations from MacDonald *et al.* (2000), which provide consensus values that identify concentrations below which harmful effects on sediment-dwelling organisms are unlikely to be observed. In the absence of an ESV for radium-226+228, a sediment screening value of 90,000 pCi/kg was used, based on the biota concentration guide (BCG) for radium-228 (US DOE, 2019).[6] Chloride is not expected to sorb to sediment; therefore, risk to ecological receptors exposed to sediment was not evaluated for chloride. The benchmarks used in this evaluation are listed in Table 3.9.

[6] US DOE (2019) reported the BCG for sediment as 90 pCi/g for Ra-228 and 100 pCi/g for Ra-226; the lower of the two values was used for Ra-226+228, and converted to pCi/kg.

Screening Risk Results: The maximum modeled COI sediment concentrations were below their respective sediment screening benchmarks (Table 3.9). The modeled sediment concentrations attributed to potential contributions from Site groundwater for all COIs were less than or equal to 3% of the sediment screening benchmark. Therefore, the modeled sediment concentrations attributed to potential contributions from Site groundwater are not expected to significantly contribute to ecological exposures in Coffeen Lake adjacent to the Site.

Table 3.9 Risk Evaluation for Ecological Receptors Exposed to Sediment

COI[a]	Modeled Sediment Concentration	ESV[a]	COPC	% of Benchmark
Metals (mg/kg)				
Boron	6.9E-03	38[b]	No	0.02%
Cadmium[d]	2.4E-03	0.99	No	0.2%
Chromium	1.3E+00	43	No	3%
Cobalt	2.3E-02	50	No	0.05%
Lead	3.5E-02	35.8	No	0.1%
Radionuclides (pCi/kg)				
Radium 226 + Radium 228	3.3E+00	90,000[c]	No	0.004%
Other (mg/kg)				
Chloride	NA	NA	NA	NA

Notes:
COI = Constituent of Interest; COPC = Constituent of Potential Concern; ESV = Ecological Screening Value; NA = Not Applicable; NOEC = No Observed Effect Concentration; pCi/kg = PicoCuries Per Kilogram; US DOE = United States Department of Energy; US EPA = United States Environmental Protection Agency.
(a) ESV from US EPA Region IV (2018).
(b) Boron NOEC of 38 mg/kg was used as a conservative benchmark for boron in the absence of an ESV (ECHA, 2019).
(c) ESV from US DOE (2019); value converted from 90 pCi/g to 90,000 pCi/kg.
(d) Modeled sediment was based on maximum dissolved concentration in groundwater.

3.5.3 Ecological Receptors Exposed to Bioaccumulative Constituents of Interest

Screening Exposures: COIs with bioaccumulative properties can impact higher-trophic-level wildlife exposed to these COIs *via* direct exposures (surface water and sediment exposure) and secondary exposures through the consumption of dietary items (*e.g.*, plants, invertebrates, small mammals, and fish).

Screening Benchmark: US EPA Region IV (2018) and IEPA SWQC (IEPA, 2019) guidance were used to identify constituents with potential bioaccumulative effects.

Risk Evaluation: The ecological COIs were not identified as having potential bioaccumulative effects. Therefore, these COIs are not considered to pose an ecological risk *via* bioaccumulation.

3.6 Uncertainties and Conservatisms

A number of uncertainties and their potential impact on the risk evaluation are discussed below. Wherever possible, conservative assumptions were used in an effort to minimize uncertainties and overestimate rather than underestimate risks.

Exposure Estimates:

- The risk evaluation included the Illinois Part 845.600 constituents detected in groundwater samples (above GWPS) collected from wells associated with AP2. However, it is possible that not all of the detected constituents are related specifically to AP2.
- The human health and ecological risk characterizations were based on the maximum measured or modeled COI concentrations, rather than on averages. Thus, the variability in exposure concentrations was not considered. Assuming continuous exposure to the maximum concentration overestimates human and ecological exposures, given that receptors are mobile and concentrations change over time. For example, US EPA guidance states that risks should be estimated using average exposure concentrations as represented by the 95% upper confidence limit on the mean (US EPA, 1992). Given that exposure estimates based on the maximum concentrations did not exceed risk benchmarks, Gradient has greater confidence that there is no risk concern.
- Only constituents detected in groundwater were used to identify COIs and model COI concentrations in surface water and sediment. For the constituents that were not detected in AP2 groundwater, the detection limits were below the Illinois Part 845.600 GWPS and thus do not require further evaluation.
- COI concentrations in surface water were modeled using the maximum detected total concentrations in groundwater for four of the COIs. Modeling surface water concentrations using total metal concentrations may overestimate surface water concentrations because dissolved concentrations, which are lower than total concentrations, represent the mobile fractions of constituents that could likely flow into and mix with surface water.
- The COIs identified in this evaluation also occur naturally in the environment. Contributions to exposure from natural or other non-AP2-related sources were not considered in the evaluation of modeled concentrations; only exposure contributions potentially attributable to Site groundwater mixing with surface water were evaluated. While not quantified, exposures from potential AP2-related groundwater contributions are likely to represent only a small fraction of the overall human and ecological exposure to COIs that also have natural or non-AP2-related sources.
- Screening benchmarks for human health were developed using exposure inputs based on US EPA's recommended values for reasonable maximum exposure (RME) assessments (Stalcup, 2014). RME is defined as "the highest exposure that is reasonably expected to occur at a site but that is still within the range of possible exposures" (US EPA, 2004). US EPA states the "intent of the RME is to estimate a conservative exposure case (*i.e.*, well above the average case) that is still within the range of possible exposures" (US EPA, 1989). US EPA also notes this high-end exposure "is the highest dose estimated to be experienced by some individuals, commonly stated as approximately equal to the 90th percentile exposure category for individuals" (US EPA, 2015c). Thus, most individuals will have lower exposures than those presented in this risk assessment.

Toxicity Benchmarks:

- Screening-level ecological benchmarks were compiled from IEPA and US EPA guidance and designed to be protective of the majority of Site conditions, leaving the option for Site-specific refinement. In some cases, these benchmarks may not be representative of the Site-specific conditions or receptors found at the Site, or may not accurately reflect concentration-response relationships encountered at the Site. For example, the ecological benchmark for cadmium is hardness-dependent. However, hardness data are not available for Coffeen Lake; therefore, Gradient relied on US EPA's default hardness of 100 mg/L. Use of a higher hardness value would increase the cadmium SWQC because benchmarks become less stringent with higher levels of

hardness. Regardless of the hardness, the maximum modeled cadmium concentration is orders of magnitude below the SWQC.

- In addition, for the ecological evaluation, Gradient conservatively assumed all constituents to be 100% bioavailable. Modeled COI concentrations in surface water are considered total COI concentrations. In addition, the measured surface water data used in this report represent total concentrations. US EPA recommends using dissolved metals as a measure of exposure to ecological receptors because it represents the bioavailable fraction of metal in water (US EPA, 1993). Therefore, the modeled surface water COI concentrations may be an overestimation of exposure concentrations to ecological receptors.
- In general, it is important to appreciate that the human health toxicity factors used in this risk evaluation are developed to account for uncertainties, such that safe exposure levels used as benchmarks are often many times lower (even orders of magnitude lower) than the levels that cause effects which have been observed in human or animal studies. For example, toxicity factors incorporate a 10-fold safety factor to protect sensitive subpopulations. This means that a risk exceedance does not necessarily equate to actual harm.

4 Summary and Conclusions

A screening-level risk evaluation was performed for potential Site-related constituents in groundwater at the CPP in Coffeen, Illinois. The CSM developed for the Site indicates that groundwater beneath AP2 flows into Coffeen Lake adjacent to the Site and may potentially impact surface water and sediment.

CEMs were developed for human and ecological receptors. The complete exposure pathways for humans include recreators (boaters) in Coffeen Lake who are exposed to surface water and sediment, and anglers who consume locally caught fish. Based on the local hydrogeology, residential exposure to groundwater used for drinking water or irrigation is not a complete pathway and was not evaluated. The complete exposure pathways for ecological receptors include aquatic life (including aquatic and marsh plants, amphibians, reptiles, and fish) exposed to surface water; benthic invertebrates exposed to sediment; and avian and mammalian wildlife exposed to bioaccumulative COIs in surface water, sediment, and dietary items.

Groundwater data collected from 2018 to 2023 were used to estimate exposures. Surface water data collected from Coffeen Lake in 2021 were also evaluated. For groundwater constituents retained as COIs, surface water and sediment concentrations were modeled using the maximum detected groundwater concentration. Surface water and sediment exposure estimates were screened against benchmarks protective of human health and ecological receptors for this risk evaluation.

US EPA has established acceptable risk metrics. Risks above these US EPA-defined metrics are termed potentially "unacceptable risks." Based on the evaluation presented in this report, no unacceptable risks to human or ecological receptors resulting from CCR exposures associated with AP2 were identified. This means that the risks from the site are likely indistinguishable from normal background risks. Specific risk assessment results include the following:

- For recreators exposed to surface water, all COIs were below the conservative risk-based screening benchmarks. Therefore, none of the COIs evaluated in surface water are expected to pose an unacceptable risk to recreators in Coffeen Lake adjacent to the Site.
- For recreators exposed to sediment *via* incidental ingestion and dermal contact, the modeled sediment concentrations were below health-protective sediment benchmarks. Therefore, the modeled sediment concentrations are not expected to pose an unacceptable risk to recreators exposed to sediment in Coffeen Lake adjacent to the Site.
- For anglers consuming locally caught fish, the modeled concentrations of all COIs in surface water (as well as the measured data) were below conservative benchmarks protective of fish consumption. Therefore, none of the COIs evaluated are expected to pose an unacceptable risk to recreators consuming fish caught in Coffeen Lake.
- Ecological receptors exposed to surface water include aquatic and marsh plants, amphibians, reptiles, and fish. The risk evaluation showed that none of the modeled or measured COIs in surface water exceeded protective screening benchmarks. Ecological receptors exposed to sediment include benthic invertebrates. The modeled sediment COIs did not exceed the conservative screening benchmarks; therefore, none of the COIs evaluated in sediment are expected to pose an unacceptable risk to ecological receptors.

- Ecological receptors were also evaluated for exposure to bioaccumulative COIs. However, none of the ecological COIs were identified as having potential bioaccumulative effects. Therefore, these COIs are not considered to pose an ecological risk *via* bioaccumulation. Overall, this evaluation demonstrated that none of the COIs evaluated are expected to pose an unacceptable risk to ecological receptors.

It should be noted that this evaluation incorporates a number of conservative assumptions that tend to overestimate exposure and risk. The risk evaluation was based on the maximum detected COI concentration for each constituent; however, US EPA guidance states that risks should be based on a representative average concentration such as the 95% upper confidence limit on the mean. Thus, using the maximum concentration tends to overestimate exposure. Although the COIs identified in this evaluation also occur naturally in the environment, the contributions to exposure from natural background sources and nearby industry were not considered; thus, CCR-related exposures were likely overestimated. In addition, exposure estimates assumed 100% metal bioavailability, which likely results in overestimates of exposure and risks. Further, exposure estimates were based on inputs to evaluate the "reasonable maximum exposure"; thus, most individuals will have lower exposures than those estimated in this risk assessment.

Finally, it should be noted that because current conditions do not present a risk to human health or the environment, there will also be no unacceptable risk to human health or the environment for future conditions because AP2 was already closed in 2020. For all future closure scenarios, potential releases of CCR-related constituents will decline over time and, consequently, potential exposures to CCR-related constituents in the environment will also decline.

References

Austen, DJ; Peterson, JT; Newman, B; Sobaski, ST; Bayley, PB. [Illinois Natural History Survey]. 1993. "Compendium of 143 Illinois Lakes: Bathymetry, Physico-chemical Features, and Habitats. Volume 2 - Lakes in Regions 4 and 5 (Final)." Report to Illinois Dept. of Conservation, Division of Fisheries, Center for Aquatic Ecology. Aquatic Ecology Technical Report 93/9 (2); F-69-R(4-6) 273p., June.

European Chemicals Agency (ECHA). 2019. "Ecotoxicological information: Sediment toxicity: 001 Weight of evidence." In REACH dossier for Boron (CAS No. 7740-42-8). Accessed at https://echa.europa.eu/registration-dossier/-/registered-dossier/14776/6/3

European Chemicals Agency (ECHA). 2020. "REACH dossier for lithium (CAS No. 7439-93-2)." Accessed at https://echa.europa.eu/registration-dossier/-/registered-dossier/14178.

Geosyntec Consultants. 2021. "Draft Surface Water Analytical Results, Coffeen Site." August 3. 2p.

Golder Associates Inc. 2020. "Construction Completion Report, Unnamed Tributary Relocation at the Illinois Power Generating Company Coffeen Site." Report to Illinois Power Generating Co., 161p., November.

Hanson Professional Services Inc. 2020. "Antidegradation Assessment for Discharge of Gypsum Management Facility Waters to Coffeen Lake, Coffeen Power Plant, Illinois Power Generating Company, NPDES Permit No. IL000108." Report to Illinois Power Generating Co., Collinsville, IL. 37p., July 20.

Illinois Dept. of Natural Resources (IDNR). 2014. Coffeen Lake State Fish and Wildlife Area.

Illinois Dept. of Natural Resources (IDNR). 2022. "Coffeen Lake profile." Accessed at https://www.ifishillinois.org/profiles/waterbody.php?waternum=00600.

Illinois Environmental Protection Agency (IEPA). 2013. "Title 35: Environmental Protection, Subtitle F: Public Water Supplies, Chapter I: Pollution Control Board, Part 620: Ground Water Quality." Accessed at https://www.ilga.gov/commission/jcar/admincode/035/035006200D04200R.html.

Illinois Environmental Protection Agency (IEPA). 2019. "Title 35: Environmental Protection, Subtitle C: Water Pollution, Chapter I: Pollution Control Board, Part 302: Water Quality Standards." Accessed at https://www.epa.gov/sites/production/files/2019-11/documents/ilwqs-title35-part302.pdf.

Illinois Environmental Protection Agency (IEPA). 2021. "Standards for the disposal of coal combustion residuals in surface impoundments." Accessed at https://www.ilga.gov/commission/jcar/admincode/035/03500845sections.html.

Illinois State Geological Survey. 2024. "Illinois Water Well (ILWATER) Interactive Map." Accessed at https://prairie-research.maps.arcgis.com/apps/webappviewer/index.html?id=e06b64ae0c814ef3a4e43a191cb57f87

MacDonald, DD; Ingersoll, CG; Berger, TA. 2000. "Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems." *Arch. Environ. Contam. Toxicol.* 39:20-31. doi: 10.1007/s002440010075.

Natural Resource Technology, Inc. (NRT). 2017. "Hydrogeologic Site Characterization Report, Ash Pond 2, Coffeen Power Station, Coffeen, Illinois." Report to Illinois Power Generating Co. (Coffeen, IL). 2380 Hydrogeologic Characterization Report 170124. 811p., January 24.

Oak Ridge National Laboratory (ORNL). 2023. "Risk Assessment Information System (RAIS) Toxicity Values and Physical Parameters Search: Chemical Toxicity Values." Report to US Department of Energy (DOE), Office of Environmental Management, Oak Ridge Operations Office. Accessed at https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chemtox.

Ramboll. 2020. "Corrective Measures Assessment, Revision 1, Coffeen Ash Pond No. 2, Coffeen Power Station, 134 Cips Lane, Coffeen, Illinois." Report to Illinois Power Generating Co.. 82p., November 30.

Ramboll. 2021. "Hydrogeologic Site Characterization Report, Ash Pond No. 1, Coffeen Power Plant, Coffeen, Illinois (Final)." Report to Illinois Power Generating Co. 700p., October 25.

Ramboll. 2024. "Groundwater and surface water data for Ash Pond 2, Coffeen Power Plant, 2008-2023."

Ramboll. 2025. "Corrective Action Alternatives Analysis Supporting Information Report: Ash Pond No. 2, Coffeen Power Plant, IEPA ID No. W1350150004-02 (Final)." Report to Illinois Power Generating Co. (Coffeen, IL).

Stalcup, D. 2014. Memorandum to Superfund National Policy Managers, Regions 1-10 re: Human Health Evaluation Manual, Supplemental Guidance: Update of standard default exposure factors. US EPA, Office of Solid Waste and Emergency Response (OSWER), OSWER Directive 9200.1-120, February 6. Accessed at https://www.epa.gov/sites/production/files/2015-11/documents/oswer_directive_9200.1-120_exposurefactors_corrected2.pdf.

US Dept. of Agriculture (USDA). 2009a. "Aerial imagery of the Coffeen, IL area [Northeast]." National Agricultural Imagery Program. Accessed at https://earthexplorer.usgs.gov/.

US Dept. of Agriculture (USDA). 2009b. "Aerial imagery of the Coffeen, IL area [Southeast]." National Agricultural Imagery Program. Accessed at https://earthexplorer.usgs.gov/.

US Dept. of Energy (US DOE). 2019. "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota." DOE-STD-1153-2019. Accessed at https://www.standards.doe.gov/standards-documents/1100/1153-astd-2019/@@images/file.

US EPA. 1989. "Risk Assessment Guidance for Superfund (RAGS). Volume I: Human Health Evaluation Manual (Part A) (Interim final)." Office of Emergency and Remedial Response, NTIS PB90-155581, EPA-540/1-89-002, December.

US EPA. 1992. "Risk Assessment Guidance for Superfund: Supplemental Guidance to RAGS: Calculating the Concentration Term." Office of Emergency and Remedial Response, OSWER Directive 9285.7-08I, NTIS PB92-963373, May.

US EPA. 1993. Memorandum to US EPA Directors and Regions re: Office of Water policy and technical guidance on interpretation and implementation of aquatic life metals criteria. Office of Water, EPA-822-F93-009, October 1.

US EPA. 1998. "Methodology for assessing health risks associated with multiple pathways of exposure to combustor emissions." National Center for Environmental Assessment (NCEA), EPA 600/R-98/137, December. Accessed at http://www.epa.gov/nceawww1/combust.htm.

US EPA. 2001. "Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors (Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries)." Health Effects Assessment Summary Tables (HEAST) 72p. Accessed at https://www.epa.gov/radiation/radionuclide-table-radionuclide-carcinogenicity-slope-factors.

US EPA. 2002. "National Recommended Water Quality Criteria [NRWQC]: 2002. Human Health Criteria Calculation Matrix." Office of Water, EPA-822-R-02-012, November.

US EPA. 2004. "Risk Assessment Guidance for Superfund (RAGS). Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) (Final)." Office of Superfund Remediation and Technology Innovation, EPA/540/R/99/005, OSWER 9285.7-02EP; PB99-963312, July. Accessed at http://www.epa.gov/oswer/riskassessment/ragse/pdf/part_e_final_revision_10-03-07.pdf.

US EPA. 2011a. "IRIS Glossary." August 31. Accessed at https://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=IRIS%20Glossary#formTop.

US EPA. 2011b. "Exposure Factors Handbook: 2011 Edition." Office of Research and Development, US EPA, National Center for Environmental Assessment (NCEA) EPA/600/R-090/052F. September. Accessed at https://www.epa.gov/expobox/about-exposure-factors-handbook.

US EPA. 2014. "Human and Ecological Risk Assessment of Coal Combustion Residuals (Final)." Office of Solid Waste and Emergency Response (OSWER), Office of Resource Conservation and Recovery, December. Accessed at http://www.regulations.gov/#!documentDetail;D=EPA-HQ-RCRA-2009-0640-11993.

US EPA. 2015a. "Hazardous and solid waste management system; Disposal of coal combustion residuals from electric utilities (Final rule)." *Fed. Reg.* 80(74):21302-21501, 40 CFR 257, 40 CFR 261, April 17.

US EPA. 2015b. "Human Health Ambient Water Quality Criteria: 2015 Update." Office of Water, EPA 820-F-15-001. June.

US EPA. 2015c. "Conducting a Human Health Risk Assessment." October 14. Accessed at http://www2.epa.gov/risk/conducting-human-health-risk-assessment#tab-4.

US EPA. 2019. "EPI Suite™ - Estimation Program Interface." March 12. Accessed at https://www.epa.gov/tsca-screening-tools/epi-suitetm-estimation-program-interface.

US EPA. 2020. "Preliminary Remediation Goals for Radionuclides (PRG): PRG Calculator." Accessed at https://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search. July 24.

US EPA. 2021a. "Secondary drinking water standards: Guidance for nuisance chemicals." January 7. Accessed at https://www.epa.gov/sdwa/secondary-drinking-water-standards-guidance-nuisance-chemicals.

US EPA. 2021b. Regional Screening Level (RSL) Summary Table (TR=1E-06, HQ=1). November. 11p. Accessed at https://semspub.epa.gov/work/HQ/401635.pdf.

US EPA. 2021c. "Regional Screening Levels (RSLs) - User's Guide." 82p. Accessed at https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide. November.

US EPA. 2022. "National Recommended Water Quality Criteria - Aquatic Life Criteria Table." Accessed at https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table. January 6.

US EPA Region IV. 2018. "Region 4 Ecological Risk Assessment Supplemental Guidance (March 2018 Update)." Superfund Division, Scientific Support Section. March. Accessed at https://www.epa.gov/sites/production/files/2018-03/documents/era_regional_supplemental_guidance_report-march-2018_update.pdf.

US Geological Survey (USGS). 1998a. "Aerial imagery of the Coffeen, IL area [Northeast]." Accessed at https://earthexplorer.usgs.gov/.

US Geological Survey (USGS). 1998b. "Aerial imagery of the Coffeen, IL area [Southeast]." Accessed at https://earthexplorer.usgs.gov/.

US Geological Survey (USGS). 2005a. "Aerial imagery of the Coffeen, IL area [Northeast]." Accessed at https://earthexplorer.usgs.gov/.

US Geological Survey (USGS). 2005b. "Aerial imagery of the Coffeen, IL area [Southeast]." Accessed at https://earthexplorer.usgs.gov/.

Appendix A

Surface Water and Sediment Modeling

Gradient modeled concentrations in eastern Coffeen Lake surface water and sediment based on available groundwater data. First, Gradient estimated the flow rate of constituents of interest (COIs) that may flow into the eastern branch Coffeen Lake *via* groundwater. Then, Gradient adapted United States Environmental Protection Agency's (US EPA's) indirect exposure assessment methodology (US EPA, 1998) in order to model surface water and sediment water concentrations in Coffeen Lake.

Model Overview

Groundwater flow into Coffeen Lake is represented by a one-dimensional steady-state model. In this model, the groundwater plume migrates horizontally in the Uppermost Aquifer (UA) before flowing into the eastern branch of Coffeen Lake. The groundwater flow entering the lake is the flow going through a cross-sectional area with a length equal to the length of the lake adjacent to Ash Pond 2 (AP2) with potential CCR-related impacts and a height equal to the average saturated thickness of the UA. It was assumed that all the groundwater in the UA flowing through this cross-section flows into the eastern branch of Coffeen Lake.

Groundwater flow into Coffeen Lake mixes with the surface water in the lake. The COIs entering the lake *via* groundwater can dissolve into the water column, sorb to suspended sediments, or sorb to benthic sediments. Using US EPA's indirect exposure assessment methodology (US EPA, 1998), the model evaluates the surface water and sediment concentrations at a location downstream of the groundwater discharge, assuming a well-mixed water column.

Groundwater Discharge Rate

The groundwater discharge rate was evaluated using conservative assumptions. Gradient conservatively assumed that the groundwater concentrations were uniformly equal to the maximum detected concentration for each individual COI. Gradient ignored adsorption by subsurface soil and assumed that all the groundwater flowing through the uppermost aquifer flows into the lake.

For each groundwater unit, the groundwater flow rate into the lake was derived using Darcy's Law:

$$Q = K \times i \times A$$

where:

Q = Groundwater flow rate (m^3/s)
K = Hydraulic conductivity (m/s)
i = Hydraulic gradient (m/m)
A = Cross-sectional area (m^2)

For each COI, the mass discharge rate into the lake was then calculated by:

$$m_c = C_c \times Q \times CF$$

where:

m_c = Mass discharge rate of the COI (mg/year)
C_c = Maximum groundwater concentration of the COI (mg/L)
CF = Conversion factors: 1,000 L/m^3; 31,557,600 s/year

The values of the aquifer parameters used for these calculations are provided in Table A.1. The calculated mass discharge rates were then used as inputs for the surface water and sediment partitioning model.

Surface Water and Sediment Concentration

Groundwater flowing into the lake gets diluted in the surface water flow. Constituents transported by groundwater into the surface water migrate into the water column and the bed sediments. The surface water model Gradient used to estimate the surface water and sediment concentrations is a steady-state model described in US EPA's indirect exposure assessment methodology (US EPA, 1998), and also used in US EPA's "Human and Ecological Risk Assessment of Coal Combustion Residuals" (US EPA, 2014). This model describes the partitioning of constituents between surface water, suspended sediments, and benthic sediments based on equilibrium partition coefficients. It estimates the concentrations of constituents in surface water, suspended sediments, and benthic sediments at steady-state equilibrium at a theoretical location downstream of the discharge point after complete mixing of the water column. In the analysis, Gradient used the partitioning coefficients given in Table J-1 of the US EPA CCR Risk Assessment for all COIs (US EPA, 2014). These coefficients are presented in Table A.2.

To be conservative, Gradient assumed that the constituents were not affected by dissipation or degradation once they entered the water body. The total water body concentration of the COI was calculated as (US EPA, 1998):

$$C_{wtot} = \frac{m_c}{V_f \times f_{water}}$$

where:

C_{wtot}	=	Total water body concentration of the constituent (mg/L)
m_c	=	Mass discharge rate of the COI (mg/year)
V_f	=	Water body annual flow (L/year)
f_{water}	=	Fraction of COI in the water column (unitless)

There are no flow records available for the eastern branch of Coffeen Lake. The flow rate was assumed to be the same as that estimated for the unnamed tributary (*i.e.*, 90 cfs) (Golder Associates Inc., 2020), which flows from north to south into the eastern branch of the lake. The surface water parameters are presented in Table A.3.

The fraction of COI in the water column was calculated for each COI using the sediment/water and suspended solids/water partition coefficients (US EPA, 2014, Table J-1). The fraction of COI in the water column is defined as (US EPA, 2014):

$$f_{water} = \frac{(1 + [K_{dsw} \times TSS \times 0.000001]) \times \frac{d_w}{d_z}}{\left([1 + (K_{dsw} \times TSS \times 0.000001)] \times \frac{d_w}{d_z}\right) + ([bsp + K_{dbs} \times bsc] \times \frac{d_b}{d_z})}$$

where:

K_{dsw}	=	Suspended sediment-water partition coefficient (mL/g)
K_{dbs}	=	Sediment-water partition coefficient (mL/g)
TSS	=	Total suspended solids in the surface water body (mg/L)
0.000001	=	Units conversion factor
d_w	=	Depth of the water column (m)
d_b	=	Depth of the upper benthic layer (m), set equal to 0.03 m (US EPA, 2014)
$d_z = d_w + d_b$	=	Depth of the water body (m)

bsp	=	Bed sediment porosity (unitless), set equal to 0.6 (US EPA, 2014)
bsc	=	Bed sediment particle concentration (g/cm^3), set equal to 1.0 g/cm^3 (US EPA, 2014)

The fraction of COIs dissolved in the water column (f_d) is calculated as (US EPA 2014):

$$f_d = \frac{1}{1 + K_{dsw} \times TSS \times 0.000001}$$

The values of the fraction of COIs in the water column and other calculated parameters are presented in Table A.4.

The total water column concentration (C_{wcTot}) of the COIs, comprising both the dissolved and suspended sediment phases, is then calculated as (US EPA, 2014):

$$C_{wcTot} = C_{wtot} \times f_{water} \times \frac{d_z}{d_w}$$

Finally, the dissolved water column concentration (C_{dw}) for the COIs is calculated as (US EPA, 2014):

$$C_{dw} = f_d \times C_{wcTot}$$

The dissolved water column concentration was then used to calculate the concentration of COIs sorbed to suspended solids in the water column (US EPA, 1998):

$$C_{sw} = C_{dw} \times K_{dsw}$$

where:

C_{sw}	=	Concentration sorbed to suspended solids (mg/kg)
C_{dw}	=	Concentration dissolved in the water column (mg/L)
K_{dsw}	=	Suspended solids/water partition coefficient (mL/g)

In the same way, using the total water body concentration and the fraction of COIs in the benthic sediments, the model derives the total concentration in benthic sediments (US EPA, 2014, Table J-1-12):

$$C_{bstot} = f_{benth} \times C_{wtot} \times \frac{d_z}{d_b}$$

where:

C_{bstot}	=	Total concentration in bed sediment (mg/L or g/m^3)
C_{wtot}	=	Total water body concentration of the constituent (mg/L)
f_{benth}	=	Fraction of constituent in benthic sediments (unitless)
d_b	=	Depth of the upper benthic layer (m)
$d_z = d_w + d_b$	=	Depth of the water body (m)

This value can be used to calculate dry weight sediment concentration as follows:

$$C_{sed-dw} = \frac{C_{bstot}}{bsc}$$

where:

C_{sed-dw}	=	Dry weight sediment concentration (mg/kg)
C_{bstot}	=	Total sediment concentration (mg/L)
bsc	=	Bed sediment bulk density (default value of 1 g/cm^3 from US EPA, 2014)

The total sediment concentration is composed of the concentration dissolved in the bed sediment pore water (equal to the concentration dissolved in the water column) and the concentration sorbed to benthic sediments (US EPA, 1998).

The concentration sorbed to benthic sediments was calculated from (US EPA, 1998):

$$C_{sb} = C_{dbs} \times K_{dbs}$$

where:

C_{sb}	=	Concentration sorbed to bottom sediments (mg/kg)
C_{dbs}	=	Concentration dissolved in the sediment pore water (mg/L)
K_{dbs}	=	Sediments/water partition coefficient (mL/kg)

For each COI, the modeled total water column concentration, the modeled dry weight sediment concentration, and the modeled concentration sorbed to sediment are presented in Table A.5.

Table A.1 Parameters Used to Estimate Groundwater Discharge to Surface Water

Groundwater Unit	Parameter	Name	Value	Unit
Uppermost Aquifer	A	Cross-Sectional Area	960	m^2
Uppermost Aquifer	i	Hydraulic Gradient	0.007	m/m
Uppermost Aquifer	K	Hydraulic Conductivity	0.002	cm/s

Notes:
Cross-sectional area calculated by multiplying the average thickness of the UA (i.e., 3 ft or 0.91 m) by the length of AP2 intersecting Coffeen Lake (conservatively assumed to be the sum of the eastern and southern sides of AP2; about 1,050 m).
Source: Hydraulic gradient from Dynegy (2017) and hydraulic conductivity values from Ramboll (2021).

Table A.2 Partition Coefficients

Constituent	Sediment-Water, Mean, K_{dbs}		Suspended Sediment-Water, Mean, K_{dsw}	
	Value (log_{10}) (mL/g)	Value (mL/g)	Value (log_{10}) (mL/g)	Value (mL/g)
Metals				
Antimony	3.6	3.98E+03	4.8	6.31E+04
Arsenic	2.4	2.51E+02	3.9	7.94E+03
Beryllium	2.8	6.31E+02	4.2	1.58E+04
Boron	0.8	6.31E+00	3.9	7.94E+03
Cadmium	3.3	2.00E+03	4.9	7.94E+04
Chromium	4.9	7.94E+04	5.1	1.26E+05
Cobalt	3.1	1.26E+03	4.8	6.31E+04
Lead	4.6	3.98E+04	5.7	5.01E+05
Lithium	-	-	-	-
Thallium	1.3	2.00E+01	4.1	1.26E+04
Radionuclides				
Radium-226+228	-	7.40E+03	-	7.40E+03
Other				
Chloride	-	-	-	-
Sulfate	-	-	-	-

Notes:
Source: US EPA (2014).
Lithium, chloride and sulfate do not readily sorb to soils and sediments. Consequently, sediment concentrations were not modeled for these constituents (K_d was assumed to be 0).

Table A.3 Surface Water Parameters

Parameter	Name	Value	Unit
TSS	Total Suspended Solids	3.2	mg/L
V_{fx}	Surface Water Flow Rate	8.04×10^{10}	L/yr
d_b	Depth of Upper Benthic Layer (default)	0.03	m
d_w	Depth of Water Column	5.70	m
d_z	Depth of Water Body	5.73	m
bsc	Bed Sediment Bulk Density (default)	1	g/cm^3
bsp	Bed Sediment Porosity (default)	0.6	-
M_{TSS}	TSS Mass Per Unit Area[a]	0.0182	kg/m^2
M_S	Sediment Mass Per Unit Area[b]	30	kg/m^2

Notes:
Source of default values: US EPA (2014).
Other sources: total suspended solids from Hanson Professional Services, Inc. (2020), surface water flow rate from Golder (2020), and depth of water column from Austen *et al*. (1993).
(a) Determined by multiplying total suspended solids, TSS by the depth of water column, d_w.
(b) Determined by multiplying depth of upper benthic layer, d_b, with sediment bed particle concentration of 1 g/cc.

Table A.4 Calculated Parameters

COI	Fraction of Constituent in the Water Column f_{water}	Fraction of Constituent in the Benthic Sediments $f_{benthic}$	Fraction of Constituent Dissolved in the Water Column $f_{dissolved}$
Antimony	0.0542	0.9458	0.8320
Arsenic	0.436	0.564	0.975
Beryllium	0.2402	0.7598	0.9517
Boron	0.9657	0.0343	0.9752
Cadmium	0.1067	0.8933	0.7973
Chromium	0.0033	0.9967	0.7128
Cobalt	0.153	0.847	0.832
Lead	0.012	0.988	0.384
Lithium	0.997	0.003	
Thallium	0.906	0.094	0.961
Radionuclides			
Radium-226+228	0.026	0.974	0.977

Note:
COI = Constituent of Interest.

Table A.5 Surface Water and Sediment Modeling Results

COI	Groundwater Concentration (mg/L or pCi/L)	Mass Discharge Rate (mg/year or pCi/year)	Total Water Column Concentration (mg/L or pCi/L)	Concentration Sorbed to Bottom Sediments (mg/kg or pCi/kg)
Total Metals				
Antimony	6.60E-03	2.80E+04	3.50E-07	1.16E-03
Arsenic	1.30E-01	5.51E+05	6.89E-06	1.69E-03
Boron	3.10E-02	1.31E+05	1.64E-06	9.87E-04
Beryllium	2.12E+01	8.99E+07	1.12E-03	6.92E-03
Cadmium	2.80E-02	1.19E+05	1.48E-06	2.36E-03
Chromium	4.40E-01	1.87E+06	2.33E-05	1.32E+00
Cobalt	4.20E-01	1.78E+06	2.23E-05	2.33E-02
Lead	4.30E-02	1.82E+05	2.28E-06	3.49E-02
Lithium	3.20E-01	1.36E+06	1.70E-05	(a)
Thallium	4.00E-03	1.70E+04	2.12E-07	4.07E-06
Radionuclides				
Radium-226+228	8.66E+00	3.67E+07	4.59E-04	3.32E+00
Other				
Chloride	7.10E+02	3.01E+09	3.76E-02	(a)
Sulfate	4.60E+03	1.95E+10	2.44E-01	(a)

Notes:
pCi/kg = PicoCuries Per Kilogram; pCi/L = PicoCuries Per Liter.
(a) Lithium, chloride, and sulfate do not readily sorb to soil or sediment particles; a K_d value of 0 was used for the modeling.

Appendix A References

Austen, DJ; Peterson, JT; Newman, B; Sobaski, ST; Bayley, PB. [Illinois Natural History Survey]. 1993. "Compendium of 143 Illinois Lakes: Bathymetry, Physico-chemical Features, and Habitats. Volume 2 - Lakes in Regions 4 and 5 (Final)." Report to Illinois Dept. of Conservation, Division of Fisheries, Center for Aquatic Ecology. Aquatic Ecology Technical Report 93/9 (2); F-69-R(4-6) 273p., June.

Dynegy Operating Co. 2017. "Letter to W. Buscher (Illinois EPA) re: Responses to IEPA's October 27, 2017 Comments on IPGC's February 1, 2017 Closure and Post-Closure Care Plans, Inactive Ash Pond No. 2, Coffeen Power Station." Report to Illinois Power Generating Co. 24p., November 21.

Golder Associates Inc. 2020. "Construction Completion Report, Unnamed Tributary Relocation at the Illinois Power Generating Company Coffeen Site." Report to Illinois Power Generating Co., 161p., November.

Hanson Professional Services Inc. 2020. "Antidegradation Assessment for Discharge of Gypsum Management Facility Waters to Coffeen Lake, Coffeen Power Plant, Illinois Power Generating Company, NPDES Permit No. IL000108." Report to Illinois Power Generating Co., Collinsville, IL. 37p., July 20.

Ramboll. 2021. "Hydrogeologic Site Characterization Report, Ash Pond No. 1, Coffeen Power Plant, Coffeen, Illinois (Final)." Report to Illinois Power Generating Co. 700p., October 25.

US EPA. 1998. "Methodology for assessing health risks associated with multiple pathways of exposure to combustor emissions." National Center for Environmental Assessment (NCEA), EPA 600/R-98/137, December. Accessed at http://www.epa.gov/nceawww1/combust.htm.

US EPA. 2014. "Human and Ecological Risk Assessment of Coal Combustion Residuals (Final)." Office of Solid Waste and Emergency Response (OSWER), Office of Resource Conservation and Recovery, December. Accessed at http://www.regulations.gov/#!documentDetail;D=EPA-HQ-RCRA-2009-0640-11993.

Appendix B

Screening Benchmarks

Table B.3.1 Recreator PRGs for Soil, input values

Variable	Recreator Soil Default Value	Form-input Value
A (PEF Dispersion Constant)	16.2302	16.8653
B (PEF Dispersion Constant)	18.7762	18.7848
City (Climate Zone)	Default	Chicago, IL (7)
C (PEF Dispersion Constant)	216.108	215.0624
Cover layer thickness for GSF (gamma shielding factor) cm	0 cm	0 cm
$CF_{rec\text{-}fowl}$ (fowl contaminated fraction) unitless	1	1
$CF_{rec\text{-}game}$ (game contaminated fraction) unitless	1	1
ED_{rec} (exposure duration - recreator) yr		26
EF_{rec} (exposure frequency - recreator) day/yr		60
$f_{p\text{-}fowl}$ (fowl on-site fraction) unitless	1	1
$f_{p\text{-}game}$ (land game on-site fraction) unitless	1	1
$f_{s\text{-}fowl}$ (fraction of year fowl is on site) unitless	1	1
$f_{s\text{-}game}$ (fraction of year land game is on site) unitless	1	1
$MLF_{pasture}$ (pasture plant mass loading factor) unitless	0.25	0.25
t_{rec} (time - recreator) yr		26
TR (target risk) unitless	0.000001	0.000001
F(x) (function dependent on U_m/U_t) unitless	0.194	0.182
PEF (particulate emission factor) m^3/kg	1,359,344,438	1,560,521,177
Q/C_{wind} (g/m^2-s per kg/m^3)	93.77	98.431
A_s (acres)	0.5	0.5
Site area for ACF (area correction factor) m^2	1,000,000 m^2	1,000 m^2
ED_{rec} (exposure duration - recreator) yr		26
$ED_{rec\text{-}a}$ (exposure duration - recreator adult) yr		20
$ED_{resc\text{-}c}$ (exposure duration - recreator child) yr		6
EF_{rec} (exposure frequency - recreator) day/yr		60
$EF_{rec\text{-}a}$ (exposure frequency - recreator adult) day/yr		60
$EF_{rec\text{-}c}$ (exposure frequency - recreator child) day/yr		60
ET_{rec} (exposure time - recreator) hr/day		8
$ET_{rec\text{-}a}$ (exposure time - recreator) hr/day		8
$ET_{rec\text{-}c}$ (exposure time - recreator) hr/day		8
$IFA_{rec\text{-}adj}$ (age-adjusted inhalation rate - recreator) m^3		9,200
$IFS_{rec\text{-}adj}$ (age-adjusted soil intake rate - recreator) mg		63,720
$IRA_{rec\text{-}a}$ (inhalation rate - recreator adult) m^3/day	20	20
$IRA_{rec\text{-}c}$ (inhalation rate - recreator child) m^3/day	10	10
$IRS_{rec\text{-}a}$ (soil intake rate - recreator adult) mg/day	100	33
$IRS_{rec\text{-}c}$ (soil intake rate - recreator child) mg/day	200	67
t_{rec} (time - recreator) yr		26
TR (target risk) unitless	0.000001	0.000001
U_m (mean annual wind speed) m/s	4.69	4.65
U_t (equivalent threshold value)	11.32	11.32
V (fraction of vegetative cover) unitless	0.5	0.5

Notes:

IL = Illinois; PRG = Preliminary Remediation Goal; yr = year.

Table B.3.2 Recreator PRGs for Soil, Ra-226 and Ra-228

Isotope	ICRP Lung Absorption Type	Soil Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)	1,000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Particulate Emission Factor (m^3/kg)	Dry Soil-to-plant transfer factor (pCi/g-fresh plant per pCi/g	Beef Transfer Factor (pCi/kg per pCi/d)	Poultry Transfer Factor (pCi/kg per pCi/d)	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (mg/kg)	Total PRG TR=1.0E-06 (pCi/kg)
Ra-226	S	6.77E-10	2.82E-08	2.50E-08	5.14E-10	4.33E-04	1.60E+03	6.85E-01	1.00E+00	1.56E+09	1.95E-02	1.70E-03	-	2.32E+01	6.02E+03	4.10E+01	1.48E+01	1.50E-05	1.48E+04
Ra-228	S	1.98E-09	4.37E-08	3.43E-11	1.42E-09	1.21E-01	5.75E+00	1.00E+00	1.00E+00	1.56E+09	1.95E-02	1.70E-03	-	7.93E+00	3.89E+03	2.04E+04	7.91E+00	2.90E-08	7.91E+03

Notes:

d = Day; ICRP = International Commission on Radiological Protection; Ra = Radium; S = Slow; pCi = Picocurie; PRG = Preliminary Remediation Goal; TR = Target Risk; yr = Year.

Appendix B

Corrective Action Alternative Analysis – Supporting Information Report

Intended for
Illinois Power Generating Company
134 Cips Lane
Coffeen, Illinois 62017

Date
June 10, 2025

Project No.
1940110241-001

CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT

ASH POND NO. 2
COFFEEN POWER PLANT
IEPA ID NO. W1350150004-02

RAMBOLL Bright ideas. Sustainable change.

CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT IEPA ID NO. W1350150004-02

Project name	**Coffeen Power Plant Ash Pond No. 2**
Project no.	**1940110241-001**
Recipient	**Illinois Power Generating Company**
Document type	**Corrective Action Plan**
Revision	**FINAL**
Date	**June 10, 2025**
Prepared by	**Katlyn Nohr, Sarah Slagle-Garrett**
Checked by	**J. Austin Bond, PE**
Approved by	**Brian G. Hennings, PG**
Description	**Corrective Action Alternatives Analysis Supporting Information Report**

Ramboll
234 W. Florida Street
Fifth Floor
Milwaukee, WI 53204
USA

T 414-837-3607
F 414-837-3608
https://ramboll.com

J. Austin Bond, PE
Qualified Professional Engineer

Brian G. Hennings, PG
Project Officer Hydrogeology

CONTENTS

1.	**Introduction and Background**	**4**
1.1	Plant and Site Information	4
1.2	CAAA-SIR Background and Scope	4
1.2.1	Identified Corrective Action Alternatives	4
1.2.2	Scope of CAAA-SIR	5
1.2.3	Criterion for Estimating Time to Achieve GWPS	6
1.3	Report Contents	6
2.	**Alternative 1 Remedy: Source Control with Groundwater Polishing**	**7**
2.1	Supporting Groundwater Modeling and Time to Reach GWPS	7
2.2	Remedy Implementation	7
2.2.1	Remedy Implementation Schedule	8
2.2.2	Management of Extracted Groundwater	9
2.2.3	35 I.A.C. § 845.670(e)(1)(H) and 35 I.A.C. § 845.670(e)(3) Information	9
3.	**Alternative 2 Remedy: Source Control with Upgradient Barrier Wall and GWE Trench**	**11**
3.1	Remedy Scoping and Groundwater Modeling Results	11
3.2	Remedy Implementation	12
3.2.1	Phase 1: Pre-Construction Activities	12
3.2.2	Phase 2: Corrective Action Construction	13
3.2.3	Phase 3: Corrective Action Operations, Maintenance, and Closeout	15
3.2.4	Remedy Implementation Schedule	16
3.2.5	Management of Extracted Groundwater	16
3.2.6	35 I.A.C. § 845.670(e)(1)(H) and 35 I.A.C. § 845.670(e)(3) Information	17
4.	**Alternative 3 Remedy: Source Control with Horizontal GWE Well**	**20**
4.1	Remedy Scoping and Groundwater Modeling Results	20
4.2	Remedy Implementation	21
4.2.1	Phase 1: Pre-Construction Activities	21
4.2.2	Phase 2: Corrective Action Construction	21
4.2.3	Phase 3: Corrective Action Operations, Maintenance, and Closeout	23
4.2.4	Remedy Implementation Schedule	24
4.2.5	Management of Extracted Groundwater	24
4.2.6	35 I.A.C. § 845.670(e)(1)(H) and 35 I.A.C. § 845.670(e)(3) Information	25
5.	**Material Quantity, Labor, and Mileage Estimates**	**27**
6.	**References**	**28**

TABLES (WITHIN TEXT)

Table A Feasibility-Level Implementation Schedule – Alternative 1 Source Control with GWP
Table B Feasibility-Level Implementation Schedule – Alternative 2 Source Control with Upgradient Barrier Wall and GWE Trench
Table C Feasibility-Level Implementation Schedule – Alternative 3 Source Control with Horizontal GWE Well

APPENDICES

Appendix A Feasibility-Level Design Drawings for Alternative 2 and Alternative 3 Remedies
Appendix B.1 Groundwater Modeling Technical Memorandum
Appendix B.2 Groundwater Modeling Report (2022)
Appendix C Material Quantity, Labor, and Mileage Estimates for Alternative 2 and Alternative 3 Remedies

ACRONYMS AND ABBREVIATIONS

35 I.A.C.	Title 35 of the Illinois Administrative Code
40 C.F.R.	Title 40 of the Code of Federal Regulations
AP1	Ash Pond No. 1
AP2	Ash Pond No. 2 ("the site")
bgs	below ground surface
BMP	best management practices
CAAA	Corrective Action Alternatives Analysis
CAAA-SIR	Corrective Action Alternatives Analysis Supporting Information Report
CAP	Corrective Action Plan
CCR	coal combustion residuals
CCR Rule	40 C.F.R. § 257 Subpart D
CIP	closure-in-place
CMA	Corrective Measures Assessment
COC	constituent of concern
COF	Coffeen Power Station
CPP	Coffeen Power Plant
GMF	Gypsum Management Facility (GMF)
Gradient	Gradient Corporation
GSP	Gypsum Stack Pond
GWE	groundwater extraction
GWP	groundwater polishing
GWPS	groundwater protection standard(s)
HDPE	high-density polyethylene
ID	identification
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
IGPC	Illinois Power Generating Company
Kd	soil adsorption coefficient
LCU	lower confining unit
mL/g	milliliters per gram
NAVD88	North American Vertical Datum of 1988
NID	National Inventory of Dams
No.	number
NPDES	National Pollutant Discharge Elimination System
NRT	Natural Resource Technology, Inc.
O&M	operations and maintenance
Ramboll	Ramboll Americas Engineering Solutions, Inc.
RP	Recycle Pond
RS Means	RS Means Heavy Construction Cost Data
SI	surface impoundment
TDS	total dissolved solids
UA	uppermost aquifer
USEPA	United States Environmental Protection Agency

1. INTRODUCTION AND BACKGROUND

1.1 Plant and Site Information

Illinois Power Generating Company (IPGC) is the owner of the inactive coal-fired Coffeen Power Plant (CPP), also referred to as the Coffeen Power Station (COF), in Coffeen, Montgomery County, Illinois. IPGC intends to complete groundwater corrective action at the coal combustion residuals (CCR) surface impoundment (SI) Ash Pond number (No.) 2 (AP2), which is identified by Illinois Environmental Protection Agency (IEPA) identification (ID) No. W1350150004-02, CCR Unit ID 102, and National Inventory of Dams (NID) No. IL50723. Groundwater corrective action for COF AP2 will be performed under the requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845, Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments [1] and the requirements of Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257, herein referred to as the Federal CCR Rule [2].

1.2 CAAA-SIR Background and Scope

35 I.A.C. § 845 requires a Corrective Action Alternatives Analysis (CAAA) to be completed as part of remedy selection, pursuant to the requirements of 35 I.A.C. § 845.670(e). The CAAA for COF AP2 was prepared by Gradient Corporation (Gradient). Ramboll Americas Engineering Solutions, Inc. (Ramboll) has prepared this Corrective Action Alternatives Analysis Supporting Information Report (CAAA-SIR) to provide information requested by Gradient to support the CAAA for COF AP2.

This CAAA-SIR was prepared to address specific constituents of concern (COCs) where exceedances[1] of the 35 I.A.C. § 845.600 groundwater protection standards (GWPS) have been detected in the COF AP2's groundwater compliance monitoring wells.

This CAAA-SIR is a feasibility-level assessment utilized to evaluate multiple groundwater corrective action alternatives. The remedy that is ultimately selected within the CAAA, to which this CAAA-SIR is attached, was then further developed into a permit-level remedy within the Corrective Action Plan (CAP), to which the CAAA is attached. Therefore, there may be minor differences in information presented for the selected remedy between this CAAA-SIR and the CAP. Information that may be different includes, but is not limited to, groundwater quality data, groundwater modeling inputs and results, implementation schedules, time to reach GWPS, the physical dimensions and scope of the remedy, and engineering design parameters. These differences are due to the further remedy refinement that is inherent with advancing the selected alternative into the permit-level remedy that is included within the CAP.

1.2.1 Identified Corrective Action Alternatives

Corrective action remedies selected for evaluation within this CAAA-SIR include:

- Alternative 1: Source control with groundwater polishing (GWP);

[1] Throughout this document, "exceedance" or "exceedances" is intended to refer only to potential exceedances of proposed applicable background statistics or GWPSs as described in the proposed groundwater monitoring program, which was submitted to the IEPA on October 25, 2021 as part of IPGC's operating permit application for COF AP2. That operating permit application, including the proposed groundwater monitoring program, remains under review by the IEPA and, therefore, IPGC has not identified any actual exceedances.

- Alternative 2: Source control with upgradient barrier wall with groundwater extraction (GWE) trench; and
- Alternative 3: Source control with horizontal GWE well.

Multiple remedies were evaluated in the Corrective Measures Assessment (CMA) prepared by Ramboll and attached to the CAAA prepared by Gradient, including source control with GWP, source control with GWE, source control with groundwater cutoff wall, and source control with in-situ chemical treatment.

Out of these remedies, source control with GWP, source control with GWE, and source control with groundwater cutoff wall were identified for further assessment, while the remaining remedy was determined to be infeasible. As part of the further assessment performed during this CAAA-SIR modeling and development, the following adjustments were made to the remedies identified by the CMA:

- Following groundwater modeling, the source control with groundwater cutoff wall remedy was determined to be infeasible for attaining GWPS in a reasonable amount of time without a supplementary hydraulic control method. The source control with groundwater cutoff wall remedy expanded into the upgradient barrier wall with GWE trench remedy.
- The source control with GWE remedy was further refined into the source control with horizontal GWE well remedy. The remedy includes an alternate method of GWE well installation via horizontal directional drilling, which would significantly reduce disturbance of the completed final cover system while allowing for targeted installation near the CCR/native soil interface beneath AP2. Additional information on the modified remedy is provided in **Section 4**.

Other remedies, including source control with in-situ treatment (permeable reactive barrier or chemical treatment), were determined to be infeasible for the site during the CMA process.

1.2.2 Scope of CAAA-SIR

Ramboll completed the following tasks and documented the tasks within this CAAA-SIR, for each of the corrective action alternative remedies listed in **Section 1.2.1**:

- Feasibility-level design drawings (**Appendix A**) were developed to show the approximate extents and typical sections/details of the Alternative 2 remedy (source control with upgradient barrier wall and GWE trench) and the Alternative 3 remedy (source control with horizontal GWE well). Drawings were not prepared for the Alternative 1 remedy as it does not involve construction at the site.
- Narratives describing the implementation of each remedy were developed, including the pre-design, design, construction, operations and maintenance (O&M), and closeout phases.
- Feasibility-level schedules providing the estimated time to implement the remedy were developed, including design, permitting, construction, and post-construction O&M.
- Feasibility-level plans for the management of extracted groundwater were developed for alternatives that include the generation of extracted groundwater.
- Information required to evaluate specific portions of 35 I.A.C. § 845.670(e) requirements were prepared, as requested by Gradient, including 35 I.A.C. § 845.670(e)(1)(H) and 35 I.A.C. § 845.670(e)(3).

- Estimates of implementation-based equipment mileage, vehicle delivery mileage, labor hour, and labor commuting mileage, were developed for each remedy alternative where physical construction and/or O&M activities are expected to occur.

All remedies presented in this CAAA-SIR are in conjunction with source control for the AP2, which was completed in 2020 [3] in accordance with the closure plan and supporting groundwater modeling that was submitted to and approved by IEPA in 2018 [4, 5]. Source control was the primary corrective action completed for AP2 and utilized a closure-in-place (CIP) approach. The CIP approach included capping AP2 with a geosynthetic and soil final cover system [6].

1.2.3 Criterion for Estimating Time to Achieve GWPS

Times to achieve GWPS for each of the remedial alternative remedies were estimated using monitoring wells within the existing AP2 compliance monitoring system. This approach was utilized to provide a consistent comparison of the estimated time to reach GWPS for each remedy, as required by 35 I.A.C. § 845.670(e)(f).

Closure for AP2 serves as the primary corrective action for the unit and was completed in 2020, as discussed in **Section 1.2.2**. Supplemental remedial alternatives for AP2 will need to be integrated with the completed closure. This affects the time to reach GWPS for each remedy, as the timeframe for each remedial alternative to become functional varies significantly based on the required level of remedy permitting, design, and construction, or lack thereof. To provide a simplified comparative framework for the remedial alternatives, the groundwater modeling provided in **Appendix B.1** used a remedial action start date of 2024, in order to provide a normalized estimate of time to reach GWPS between the various remedies.

1.3 Report Contents

The following information is included within this report:

- **Section 1** includes the introduction and background;
- **Section 2** includes information for the Alternative 1 remedy: source control with GWP;
- **Section 3** includes information for the Alternative 2 remedy: source control with upgradient barrier wall and GWE trench;
- **Section 4** includes information for the Alternative 3 remedy: source control with horizontal GWE well;
- **Section 5** includes information used to develop estimates of material quantities, labor hours, and mileage; and
- **Section 6** includes reference documents used in the development of this CAAA-SIR.

2. ALTERNATIVE 1 REMEDY: SOURCE CONTROL WITH GROUNDWATER POLISHING

The Alternative 1 remedy, source control with GWP, includes the completed source control and GWP. GWP is a remedial alternative that relies on natural geochemical processes and can be an appropriate remedy as recognized by the United States Environmental Protection Agency (USEPA) in a final policy directive for groundwater remediation [7]. GWP has been naturally occurring at AP2 since source control was completed in 2020. For the purposes of this CAAA-SIR, the Alternative 1 remedy would involve formalizing the ongoing natural GWP processes with adaptive management as the corrective action remedy for the AP2.

2.1 Supporting Groundwater Modeling and Time to Reach GWPS

The COCs exceeding the GWPS at compliance groundwater monitoring wells as of the 2024 Annual Report [8] are boron, cobalt, pH, sulfate, and TDS. In 2017, groundwater modeling conducted by Natural Resource Technology, Inc. (NRT) simulated the fate and transport of boron to support the closure of AP2 [9]. In 2024, Ramboll updated this model, using sulfate as the constituent to evaluate the effectiveness of both the completed closure scenario and corrective action alternatives (**Appendix B.2**). Sulfate has been detected in AP2 groundwater at the highest concentrations relative to its GWPS and will likely take the longest time to meet the GWPS (**Appendix B.1**). Sulfate was therefore identified as a surrogate for the exceedances of boron, cobalt, pH, and TDS, as described in the Groundwater Modeling Technical Memorandum. For modeling purposes, it was assumed that sulfate would not significantly sorb or chemically react with aquifer solids (soil adsorption coefficient [Kd] was set to 0 milliliters per gram [mL/g]) which is a conservative estimate for predicting contaminant transport times in the model. Sulfate transport is likely to be affected by both chemical and physical attenuation mechanisms (i.e., adsorption and/or precipitation reactions as well as dilution and dispersion) (**Appendix B.1**). Physical attenuation (dilution and dispersion) of contaminants in groundwater is simulated in the groundwater computer models. Chemical attenuation mechanisms and their effect on modeled times for exceedances to reach the GWPS are discussed in the Groundwater Polishing Evaluation Report [10] and discussed herein.

Groundwater modeling for the Alternative 1 remedy performed to support the closure plan for AP2 was updated to included additional data collected since the 2017 modeling was completed (**Appendix B.1**). Modeling results estimated that GWPS will be met in approximately 135 years for all wells within the existing AP2 monitoring well network.

2.2 Remedy Implementation

Implementation of the source control portions of this remedy (*e.g.,* final closure of AP2) was completed in 2020. Although a formal groundwater polishing remedy has not yet been initiated and approved by IEPA, natural geochemical attenuation processes have been ongoing since the closure was completed. Implementation of GWP would include performing corrective action groundwater monitoring, enacting an adaptive management strategy, and, after GWPS have been met, performing corrective action closure and completion activities. Information associated with each of these activities is described below.

- Corrective Action Groundwater Monitoring

  - Regular corrective action groundwater monitoring would be conducted utilizing a corrective action groundwater monitoring well network designed in accordance with 35 I.A.C. § 845.680(c), which specifies that wells must be installed in the plume of contamination that lies beyond the waste boundary.
    - Samples would be collected for major ions for evaluating groundwater chemistry and COCs. Samples would be collected on a quarterly basis initially and potentially reduced to a semiannual basis once five years of monitoring have occurred, in accordance with 35 I.A.C. § 845.650(b)(4).
    - Monitoring results would be submitted to IEPA for each monitoring event, in addition to an annual groundwater monitoring and corrective action report, in accordance with 35 I.A.C. § 845.610(e).
    - Routine maintenance of the monitoring well network would occur during the monitoring period. This would include inspecting the wells, making repairs to the wells (as and if needed), and rehabilitating and/or replacing wells to improve performance (as and if needed).
- Adaptive Management during Monitoring
  - Groundwater monitoring results would be evaluated and documented in in the monitoring reports submitted to IEPA, in accordance with 35 I.A.C. § 845.610(e).
  - Remedy progress evaluation as part of adaptive site management may include additional investigation to inform updates to the conceptual site, groundwater, and geochemical models.
  - If remedy progress does not correspond with expectations, additional methods or techniques to achieve compliance with GWPS would be evaluated and, if feasible, implemented in accordance with 35 I.A.C. § 845.680(b).
- Corrective Action Confirmation Monitoring and Completion
  - After GWPS have been met for all corrective action monitoring wells, corrective action confirmation groundwater monitoring would be implemented. This would include monitoring each well for three additional years to confirm that GWPS have been achieved, in accordance 35 I.A.C. § 845.680(c).
  - After completion of the corrective action confirmation monitoring period, a Corrective Action Completion Report and Certification would be prepared and submitted to IEPA, in accordance with 35 I.A.C. § 845.680(e).

2.2.1 Remedy Implementation Schedule

A feasibility-level implementation schedule for the Alternative 1 source control with GWP remedy is provided in **Table A** below.

Table A. Feasibility-Level Implementation Schedule – Alternative 1: Source Control with GWP

Implementation Phase	Implementation Task	Timeframe (Preliminary Estimates)
Corrective Action Implementation	Corrective Action Monitoring (Time to Meet GWPS)	1,620 months (135 years)
	Corrective Action Confirmation Monitoring	36 months
	Corrective Action Completion	6 months
	Timeframe to Complete Corrective Action Implementation	1,662 months (139 years)
	Total Timeline to Complete Corrective Action (after approval of Corrective Action Plan)	1,662 months (139 years)

2.2.2 Management of Extracted Groundwater

No groundwater extraction would occur under this remedy.

2.2.3 35 I.A.C. § 845.670(e)(1)(H) and 35 I.A.C. § 845.670(e)(3) Information

As requested by Gradient, the following information required by 35 I.A.C. § 845.670(e)(1)(H) and 35 I.A.C. § 845.670(e)(3) has been developed for the remedy. The information was developed based on preliminary-level information contained within the CMA for AP2 and then refined based on additional feasibility-level design activities performed as part of the development of this CAAA-SIR.

- Potential Need for Replacement of the Remedy – 35 I.A.C. § 845.670(e)(1)(H)
  - No replacement of the remedy would be required for source control with GWP, as a physical remedy would not be constructed.
- Degree of Difficulty Associated with Constructing the Remedy – 35 I.A.C. § 845.670(e)(3)(A)
  - No construction would be required with the source control with GWP remedy; therefore, there is no difficulty in construction of the remedy.
- Expected Operational Reliability of the Remedy - 35 I.A.C. § 845.670(e)(3)(B)
  - As documented in the Groundwater Polishing Evaluation Report [10], groundwater geochemical processes anticipated to occur as downgradient groundwater approaches ambient background conditions are not expected to delay the modeled time to achieve GWPS compliance.
  - GWP would begin once source control has been completed without delays and continuously function during the corrective action period.
- Need to Coordinate with and Obtain Necessary Approvals and Permits from Other Agencies - 35 I.A.C. § 845.670(e)(3)(C)
  - No permits from other agencies would be required.
- Availability of Necessary Equipment and Specialists - 35 I.A.C. § 845.670(e)(3)(D)
  - Equipment and specialists for field data collection and groundwater sampling are required for the GWP alternative. Laboratory equipment and specialists will also be required to assess groundwater concentrations of site constituents. Groundwater professionals

(*i.e.,* geologists, hydrogeologists, statisticians, geochemists) would be required to perform statistical analysis and other assessments to confirm that GWP is functioning as intended and prepare corrective-action related groundwater monitoring and progress reports.

  - The equipment and specialists required for site groundwater monitoring and analysis are currently performing this work as part of the routine groundwater monitoring program in accordance with 35 I.A.C. § 845.220(c)(4). Therefore, no new equipment or specialists are required for groundwater monitoring for this alternative.

- Available Capacity and Location of Needed Treatment, Storage, and Disposal Services – 35 I.A.C. § 845.670(e)(3)(E)
  - No treatment, storage, or disposal services would be required with the source control with GWP remedy, as GWP would not generate any appreciable volume of waste or wastewater.

3. ALTERNATIVE 2 REMEDY: SOURCE CONTROL WITH UPGRADIENT BARRIER WALL AND GWE TRENCH

The Alternative 2 remedy, source control with upgradient barrier wall and GWE trench, would include the construction of a barrier wall that would be located adjacent to the northern and western sides of AP2 with a GWE trench running parallel to and hydraulically downgradient of the barrier wall. The barrier wall and extraction trench would be constructed from grade surface down to approximately 8 feet below ground surface (bgs) (approximate elevation 615 feet[2]), in order to penetrate the uppermost aquifer (UA). The extraction trench and barrier wall are both expected to be on the order of 2 to 3 feet thick, with approximately 1 to 2 feet of separation between them. The purpose of the combined extraction trench and barrier wall is to prevent the flow of groundwater towards AP2 from the northwest, while providing a means to capture groundwater and reduce hydraulic head beneath AP2, which would accelerate achieving GWPS.

The GWE trench portion of the remedy would be constructed by excavating existing subgrade soils, installing a horizontal collection pipe in the trench, backfilling with clean granular fill, and placing a compacted clay cap over the trench to reduce surface water infiltration. The collection pipe will drain to sumps spaced throughout the trench with an extraction pump within each sump. Extracted groundwater would be routed via conveyance piping to a new on-site lined settling pond and discharged through either a new or existing outfall, where it would be managed in accordance with site National Pollutant Discharge Elimination System (NPDES) permits.

The barrier wall portion of the remedy would be constructed adjacent to the extraction trench by mixing in-situ soils with a low-permeability mixture down to the target elevation. The upgradient barrier wall is intended to reduce the flow of groundwater towards AP2 and reduce the volume of groundwater that needs to be extracted from the trench.

A feasibility-level drawing of the source control with upgradient barrier wall and GWE trench remedy is provided as **Figure 1** in **Appendix A.**

3.1 Remedy Scoping and Groundwater Modeling Results

The location of the barrier wall and GWE trench were selected by reviewing physical constraints around AP2 and designating locations on IPGC property where the barrier wall and extraction trench could feasibly be constructed with limited impacts to other site features. The location was additionally selected to avoid sensitive areas such as wetlands and floodplains [11, 12] and avoid areas with steep slopes and/or limited access which could increase construction complexity and risk. This assessment identified that the barrier wall and GWE trench could not be constructed south of AP2 because of the limited space between the toe of the dike and the former CPP cooling water discharge flume. Construction in this area could not be performed without major dike modifications and geotechnical considerations.

Assessment of physical constraints resulted in the barrier wall and GWE trench alignments being located within the open area along the access road to the north of AP2 and between the access road and the dikes west of AP2. These areas provide a generally straight and level alignment for

[2] All elevations in this report are referenced to North American Vertical Datum of 1988 (NAVD88), unless otherwise noted.

construction of the barrier wall and GWE trench. The location of the barrier wall and GWE trench is generally perpendicular to existing groundwater flow patterns between the Gypsum Management Facility (GMF) Recycle Pond (RP) and AP2.

The depth of the barrier wall and GWE trench was selected based on interception with the existing groundwater table and the base of the UA. The surface elevation at the base of the northern AP2 CIP berm (approximate elevation 623 feet) results in an extraction trench and cutoff wall depth of approximately 8 feet bgs to terminate at the bottom of the UA (approximate elevation 615 feet) in order to reduce the flow of off-site groundwater into the AP2 footprint from the north/west and to direct groundwater from beneath the AP2 footprint into the trench.

Groundwater modeling for the Alternative 2 remedy (**Appendix B.1**) estimated that GWPS will be met approximately 59 years after remedy construction for all wells within the existing AP2 monitoring well network.

3.2 Remedy Implementation

Implementation of the Alternative 2 source control with upgradient barrier wall and GWE trench remedy is expected to include multiple tasks spread out over three phases, including pre-construction activities (Phase 1), corrective action construction (Phase 2), and corrective action operations, maintenance, and closeout (Phase 3). Information for each phase is described in this section.

3.2.1 Phase 1: Pre-Construction Activities

Pre-construction activities would include further pre-design investigation, obtaining permits from other agencies, completing the final design of the remedy, and selecting a remedy implementation contractor via a bidding process. Information associated with each of these activities is described below.

- Completing pre-design investigation, final design and bid activities, including:
  - Completion of final pre-design subsurface investigations, laboratory soil testing, cutoff wall backfill mix design bench testing, engineering calculations, design drawings, specifications, and a construction quality assurance plan.
  - Bidding and selection of a GWE trench and barrier wall construction contractor.
- Obtaining permits from other agencies including:
  - A general stormwater permit for construction site activities through IEPA, including construction stormwater controls and other best management practices (BMPs) such as silt fences and other measures.
  - An Illinois Department of Natural Resources (IDNR) Office of Water Resources, Dam Safety modification permit may need to be obtained, for construction of the GWE trench and barrier wall in the vicinity of the embankment.
  - A modification to the site's NPDES permit would be obtained to accept discharge of extracted groundwater for the operational lifetime of the GWE trench.

3.2.2 Phase 2: Corrective Action Construction

Corrective action construction would be initiated after pre-construction activities are complete. It will include mobilizing construction equipment to the site, preparing the site for construction activities, construction of the GWE trench (the trench and associated mechanical elements and piping installation), construction of the barrier wall, construction of a settling pond, and performing post-construction and site restoration activities.

Information associated with each of these activities is described below.

- The contractor would mobilize equipment and materials to the site, install stormwater BMPs around the construction area, construct a staging and laydown area, and construct a level working platform and/or temporary construction access roads along the GWE trench/barrier wall alignment.
- Construction of the working platform would include removing, relocating, or modifying existing site infrastructure that may conflict with the construction of the GWE trench/barrier wall, grading to ensure a level working platform, and placing a granular fill working pad to support trench installation equipment. The existing road surfaces along the wall alignment would be saw-cut where necessary for GWE trench/barrier wall construction.
- The approximately 3,300-foot long GWE trench would be installed along the northern and western perimeter of AP2. For the purposes of this CAAA-SIR, the GWE trench was assumed to be installed using one-pass technology, although other installation methods may be evaluated during a later phase of design.
  - The GWE trench would be excavated to an approximate depth of 8 feet bgs (elevation 615 feet), terminating at the bottom of the UA. The trench would be on the order of 2 to 3 feet wide.
  - Sump locations would be installed along the trench, spaced approximately 500 feet apart. Sumps would consist of a vertical pit to collect water, a discharge line, a pneumatic pump to pump water to the conveyance line, and a common air compressor to drive the pumps.
  - Perforated 6-inch-diameter high-density polyethylene (HDPE) collection pipe would be installed approximately 8 inches from the bottom of the trench at a very slight grade (approximately 0.5 to 2 percent) towards the sump locations.
  - Simultaneously with pipe installation, in-situ soils would be removed, and the trench would be backfilled with granular material consisting of premixed sand and gravel.
  - The trench would be backfilled with clean granular material and capped to reduce surface water infiltration into the trench.
    - Where the trench is located within a site access road, the cap would include asphalt or concrete.
    - Where the trench is located outside of a site access road, the cap would include low-permeability clay and topsoil at the surface or a more erosion-resistant material (*i.e.,* a turf-reinforced mat or gravel).
- Following the installation of the GWE trench, an approximately 3,300-foot adjacent barrier wall would be installed on the outer (hydraulically upgradient) side of the trench. For the purposes of this CAAA-SIR, the barrier wall was assumed to be installed using one-pass

technology, although other installation methods may be evaluated during a later phase of design.

  - A temporary on-site batch plant and/or material handling system would be established for the purpose of generating low permeability backfill for the barrier wall. This would include either mixing bentonite with the subgrade soils or producing a cement-bentonite slurry to place into the wall.
  - In-situ soils would be either mixed with bentonite or removed and backfilled with a cement-bentonite or soil-bentonite mixture.
  - The wall would likely be constructed in one continuous unit along the western side of AP2, and one continuous unit along the northern side. The wall would be on the order of 2 to 2.5 feet thick and 8 feet deep in order to tie into the lower confining unit (LCU).

- Excavated soils (*e.g.,* spoils) from the GWE trench and barrier wall installations would be placed into off-road dump trucks and hauled to the on-site landfill for disposal.
- An approximately 1-acre settling pond for management of extracted groundwater was assumed to be constructed using conventional construction equipment. However, other groundwater treatment and management technologies may be evaluated during a later phase of design. A temporary wastewater treatment plant that is being constructed on-site to treat existing CCR-contact water within the GMF Gypsum Stack Pond (GSP) and adjacent GMF RP is not expected to operate post-closure, and therefore was assumed to be unavailable for treating extracted groundwater from the GWE trench.
  - The location of the settling pond would be selected to limit adverse impacts or conflicts with future solar redevelopment and other existing and future site infrastructure. The precise location of the pond will be evaluated during later phases of design.
  - The settling pond would be approximately 1 acre in size and 2 feet deep. Soils would be mechanically excavated from the settling pond and used to create 10-foot-wide berms around the perimeter of the settling pond to contain extracted groundwater. All excavated soils from the settling pond would be managed within the settling pond footprint.
  - A geomembrane liner system would be installed in the settling pond to reduce the potential for releases of extracted groundwater.
  - Fused HDPE piping would be used to convey groundwater from the GWE trench to the settling pond and from the settling pond to the appropriate NPDES outfall. This would include the installation of electrical, mechanical, and pneumatic infrastructure to operate the conveyance piping system.
- Site restoration would be completed following the installation of the barrier wall and GWE trench. This would include repairing site infrastructure that was relocated or damaged during construction, restoration of the road surfaces, and minor regrading and seeding of disturbed areas.
  - Temporary BMPs would be installed during the site restoration period, if required in accordance with site land disturbance permits. The BMPs would be removed once vegetation is established.

3.2.3 Phase 3: Corrective Action Operations, Maintenance, and Closeout

Corrective action operations, maintenance, and closure would be initiated after corrective action construction is completed. It would include performing corrective action groundwater monitoring, and, after GWPS have been met, performing corrective action closeout and completion activities. Information associated with each of these activities is described below.

- Corrective Action O&M
  - Continued operation of the GWE trench and barrier wall system would require routine scheduled inspections and associated maintenance including, but not limited to, totalizer data collection, filter system maintenance (if needed), and maintenance of extraction pumps, as well as other system components.
  - Non-routine maintenance that may occur during extended operation of the GWE trench may include tasks such as repair or replacement of the extraction and/or transfer pumps, repair or replacement of the system air compressor, and flushing or jetting of water conveyance lines in the event organic or inorganic solids accumulate on the interior walls.
  - Routine monitoring and compliance activities associated with the treatment and discharge of extracted water via the site's NPDES permit.
- Corrective Action Monitoring
  - Regular corrective action groundwater monitoring would be conducted using a corrective action groundwater monitoring well network designed in accordance with 35 I.A.C. § 845.680(c), which specifies that wells must be installed within the plume of contamination that lies beyond the waste boundary.
    - Samples would be collected for major ions for evaluating groundwater chemistry and COCs. Samples will be collected on a quarterly basis initially and potentially reduced to a semiannual basis once five years of monitoring have occurred, in accordance with 35 I.A.C. § 845.650(b)(4).
    - Monitoring results would be submitted to IEPA after each monitoring event, in addition to an annual groundwater monitoring and corrective action report, in accordance with 35 I.A.C. § 845.640(e). The annual corrective action report would include an evaluation of the actual performance of the remedy relative to the remedy's expected performance.
    - Routine maintenance of the monitoring well network would be conducted during the monitoring period. This would include inspecting the wells, making repairs to the wells (as and if needed), and rehabilitation and/or replacing the wells to improve performance (as and if needed).
  - If the remedy does not achieve its expected performance, additional methods or techniques to achieve compliance with GWPS would be evaluated and, if feasible, implemented in accordance with 35 I.A.C. § 845.680(b).
- Adaptive Management during Monitoring
  - Groundwater monitoring results would be evaluated and documented in in the monitoring reports submitted to IEPA, in accordance with 35 I.A.C. § 845.610(e).

  - Remedy progress evaluation as part of adaptive site management may include additional investigation to inform updates to the conceptual site, groundwater, and geochemical models.
  - If remedy progress does not correspond with expectations, additional methods or techniques to achieve compliance with GWPS would be evaluated and, if feasible, implemented in accordance with 35 I.A.C. § 845.680(b).
- Corrective Action Completion
  - After GWPS have been met for all compliance wells for a period of three years, corrective action would be considered complete, per 35 I.A.C. § 845.680(c).
  - After completion of the corrective action confirmation monitoring period, a Corrective Action Completion Report and Certification would then be submitted to IEPA, in accordance with 35 I.A.C. § 845.680(e).

3.2.4 Remedy Implementation Schedule

A feasibility-level implementation schedule for the Alternative 2 source control with upgradient barrier wall and GWE trench remedy is provided in **Table B** below.

Table B. Feasibility-Level Implementation Schedule – Alternative 2: Source Control with Upgradient Barrier Wall and GWE Trench

Implementation Phase	Implementation Task	Timeframe (Preliminary Estimates)
1: Pre-Construction Activities	Agency Coordination, Approvals, and Permitting	18 to 24 months
	Final Design and Bid Process	24 to 36 months
	Timeframe to Complete Corrective Pre-Construction Activities	42 to 60 months after CAP Approval
2: Corrective Action Construction	Corrective Action Construction	6 to 12 months
	Timeframe to Complete Corrective Action Construction	6 to 12 months after completion of pre-construction activities.
3: Corrective Action O&M and Closeout	Corrective Action Monitoring (Time to Meet GWPS)	708 months (59 years)
	Corrective Action Confirmation Monitoring	36 months
	Corrective Action Completion	6 months
	Timeframe to Complete Corrective Action O&M and Closeout	750 months (63 years)
Total Timeline to Complete Corrective Action (after approval of Construction Permit Application)		798 to 822 months (67 to 69 years)

3.2.5 Management of Extracted Groundwater

Extracted groundwater from the trench was assumed to be managed and treated by a newly constructed on-site settling pond, although other treatment technologies may be evaluated at a later phase of design. The settling pond would need to be sited to avoid conflict with planned

solar redevelopment, other site infrastructure, and closure activities related to AP1 and other SIs at CPP. A settling pond of approximately 1 acre in size was assumed to be sufficient to allow sediments to settle from extracted groundwater prior to discharge. Groundwater collected from the extraction well network would be sent to the settling pond via the pneumatic extraction pumps and transfer piping. Treated water would be discharged via a NDPES outfall, in accordance with site-specific NPDES permit requirements [13].

3.2.6 35 I.A.C. § 845.670(e)(1)(H) and 35 I.A.C. § 845.670(e)(3) Information

As requested by Gradient, the following information required by 35 I.A.C. § 845.670(e)(1)(H) and 35 I.A.C. § 845.670(e)(3) has been developed for the remedy. The information was developed based on preliminary-level information contained within the CMA for COF AP2 and then refined based on additional feasibility-level design activities performed as part of the development of this CAAA-SIR.

- Potential Need for Replacement of the Remedy – 35 I.A.C. § 845.670(e)(1)(H)
  - The upgradient barrier wall and GWE trench would be unlikely to require replacement of the remedy, as the barrier wall would be a robust, engineered, and maintenance-free subsurface structure.
  - No replacement of the GWE trench is expected to be required, although the trench would require ongoing monitoring and maintenance to retain its effectiveness.
- Degree of Difficulty Associated with Constructing the Remedy – 35 I.A.C. § 845.670(e)(3)(A)
  - The remedy would require use of specialized contractors and equipment (*i.e.,* one-pass trenching/barrier wall contractor and equipment) for the installation of the trench and barrier wall, in addition to general construction equipment (*i.e.,* excavation and grading equipment).
- Expected Operational Reliability of the Remedy - 35 I.A.C. § 845.670(e)(3)(B)
  - The GWE trench and barrier wall system is expected to have a high operational reliability if it is constructed in accordance with the design and specifications.
  - The barrier wall provides an inert, continuous, low-permeability barrier to groundwater flow which is not expected to need maintenance.
  - The GWE trench system is a mechanical system that would require routine maintenance to reliably operate, as outlined in **Section 3.2.3**.
- Need to Coordinate with and Obtain Necessary Approvals and Permits from Other Agencies - 35 I.A.C. § 845.670(e)(3)(C)
  - Agency permits would need to be obtained from IEPA for discharge of extracted groundwater, construction of stormwater controls and BMPs, and potentially an IDNR Dam Safety modification permit. These permits typically take 18 to 24 months to obtain, with the NPDES permit modification taking longer to obtain than the other permits.
- Availability of Necessary Equipment and Specialists - 35 I.A.C. § 845.670(e)(3)(D)
  - Construction of the barrier wall and GWE trench would require a specialized contractor experienced with constructing similar types of trenches and barrier walls in similar geologic environments. Relatively few construction contractors with this experience, particularly

using one-pass equipment, are available. The contractor would likely need specialized and often custom-built equipment.

- Specialists in one-pass trenching and barrier wall methods would also need to be utilized during the design and construction phase. The specialists would include design engineers, construction managers, and contractor staff experienced with trench construction and equipment operation.
- Geotechnical specialists would be needed to design the working platform and monitor the AP2 embankment for signs of distress during one-pass trench installation.
- These types of equipment and specialists have been utilized in the past for other similar types of barrier wall and GWE trench design and construction projects. However, there may be backlogs associated with the equipment and specialists, due to high existing backlog for specialty ground improvement contractors and design specialists who are supporting similar types of projects in the electric utility, dam/levee, and other market sectors. These backlogs could delay the project schedule beyond current assumptions.
- Specialists would be needed to maintain the GWE system during the operational timeframe and are currently being utilized as part of GWE O&M. System components that require maintenance include totalizers, instrumentation, and the extraction and transfer pumps.
  - Additionally, specialists are occasionally needed for non-routine O&M which may include flushing or jetting of the conveyance lines, replacement of faulty system components, replacement of pumps or pump controllers, and replacement of faulty system instrumentation.
  - Specialists and replacement equipment are generally available in proximity (*i.e.*, 100 to 300 miles) of the site but some of the more complex equipment, including the transfer pumps and transfer pump controller, may have extended lead times for replacement or servicing.
- Equipment and specialists for field data collection and groundwater sampling are required for the remedy. Laboratory equipment and specialists would also be required to assess groundwater concentrations of site COCs. Groundwater professionals (*i.e.,* geologists, hydrogeologists, statisticians, geochemists) would be required to perform statistical analysis and other assessments to confirm that the remedy is functioning as intended and prepare corrective action-related groundwater monitoring and progress reports.
  - The equipment and specialists required for site groundwater monitoring and analysis are currently performing this work in accordance with 35 I.A.C. § 845.220(c)(4). Therefore, no new equipment or specialists are required for groundwater monitoring for this alternative.

- Available Capacity and Location of Needed Treatment, Storage, and Disposal Services – 35 I.A.C. § 845.670(e)(3)(E)
  - Wastes generated during barrier wall and GWE trench construction would be limited to spoils; these would be disposed of in the on-site landfill.
  - The GWE trench system would send extracted groundwater to an on-site settling pond to settle solids extracted during groundwater recovery via the pneumatic pumps and transfer

piping. This settling pond would be new construction that would need to be sited, designed, constructed, and maintained.

  - The settling pond would need to be sited to not conflict with planned solar redevelopment, wetlands, floodplains, or other site infrastructure.

- Continued NPDES permit renewals may be required, depending on the timeline of corrective action implementation relative to completion of source control activities.

4. ALTERNATIVE 3 REMEDY: SOURCE CONTROL WITH HORIZONTAL GWE WELL

The Alternative 3 remedy, source control with horizontal GWE well, would include construction of one horizontal well within the eastern portion of AP2 to collect groundwater from beneath AP2. The horizontal well would be single ended, initiating from the southern bank of AP2 at an elevation of approximately 600 feet and terminating approximately 1,325 feet to the north at an elevation of approximately 606 feet. The horizontal well would drain water from beneath AP2 reducing hydraulic head beneath AP2, which would accelerate achieving GWPS. Extracted water would be directed through a freely draining culvert or be pumped to a settling pond prior to discharge.

The discharge flume is was part of CPP operations and was utilized to route plant process water towards Coffeen Lake. Since the CPP is closed, the flume no longer receives any plant process flows and only receives site stormwater. The water level in the flume is currently at an elevation of 598 to 599.3 feet.

A feasibility-level design drawing of the Alternative 3: source control with horizontal GWE well remedy is provided as **Figure 2** in **Appendix A.**

4.1 Remedy Scoping and Groundwater Modeling Results

In the updated groundwater modeling the discharge flume was simulated as a drain located within the upper portion of the lower confining unit clays beneath the sands of the uppermost aquifer, with a drain stage set to 598.7 feet. This elevation was based on typical water level data obtained from the staff gage on the eastern side of the flume and a review of available survey data, which indicated a current bottom elevation of approximately 598 feet in the flume. Therefore, it was assumed that this elevation could be readily obtained without requiring extensive modifications to the flume or the existing weir structure. Further, if slightly higher water levels are present in the flume, up to 600 feet, there is minimal to no change in the time to reach GWPS.

One horizontal GWE well would be installed running north/south along the eastern portion of AP2. The location of the horizontal well was selected by reviewing physical constraints around AP2 and designating locations on the IPGC property where the well could feasibly be constructed with limited impacts to other site features. Sensitive areas, such as wetlands and floodplains were considered, which prevented the placement of the well east of AP2 and resulted in the horizontal extraction well located in a north-south orientation within the CIP footprint of AP2 [11, 12]. The horizontal drilling entry point would be located at the southern perimeter of AP2. While the entry point is not within regulatory flood plains or known wetlands, construction of a working platform would be required to span the flume. The location of the horizontal well would be at the CCR/native soil interface and would generally intersect (*i.e.*, be perpendicular to) the existing groundwater flow directions beneath AP2. The depth of the horizontal well was selected to coincide with the bottom of CCR based on as-built construction information for the bottom of AP2 [14]. The elevation of this base surface results in horizontal well depths at an approximate north to south elevation of 606 to 600 feet.

Groundwater modeling for the Alternative 3 remedy (**Appendix B.1**) estimated that GWPS would be met approximately 14 years after remedy construction for all wells within the existing AP2 monitoring well network. The horizontal well may require that extraction continue for a total of 39 years (*i.e.*, 25 years after GWPS have been met) to prevent concentrations from rebounding above the GWPS.

4.2 Remedy Implementation

Implementation of the Alternative 3 remedy, source control with horizontal GWE well, is expected to include multiple tasks spread out over three phases, including pre-construction activities (Phase 1), corrective action construction (Phase 2), and corrective action operations, maintenance, and closeout (Phase 3). Information for each phase is described in this section.

4.2.1 Phase 1: Pre-Construction Activities

Pre-construction activities would include further pre-design investigation, obtaining permits from other agencies, completing the final design of the remedy, and selecting a remedy implementation contractor via a bidding process. Information associated with each of these activities is described below.

- Completing pre-design investigation, final design, and bid activities, including:
  - Completion of final pre-design subsurface investigations, laboratory soil testing, engineering calculations, design drawings, specifications, and a construction quality assurance plan.
  - Bidding and selection of a construction general contractor.
- Obtaining permits from other agencies including:
  - A general stormwater permit for construction site activities through IEPA, including construction stormwater controls and other BMPs such as silt fences and other measures.
  - A modification to the site's NPDES permit to allow for the discharge of groundwater from the horizontal well.

4.2.2 Phase 2: Corrective Action Construction

Corrective action construction would be initiated after pre-construction activities are complete. It would include mobilizing construction equipment to the site, preparing the site for construction activities, installation of the horizontal well (and associated piping and mechanical elements), and performing post-construction and site restoration activities.

Information associated with each of these activities is described below.

- The contractor would mobilize equipment and materials to the site, install stormwater BMPs around the construction area, construct a staging and laydown area, and construct a level working pad and/or temporary construction access roads to navigate to the southern perimeter of AP2, to allow the horizontal well to be installed.
- Horizontal well installation would be implemented, including the following tasks:
  - A work pad would be constructed within the flume to allow drilling equipment to install the well from the south side of AP2 and drill towards the north. This would include installing

culverts in an approximately 50-foot-long portion of the flume and backfilling the flume up to surrounding grades with free-draining gravel backfill.

- Drilling would be initiated from the south end of AP2 at the base of the existing berm. The target elevation of the bottom of CCR/top of the UA is approximately 600 to 606 feet along the CCR/native soil interface. A pilot hole would be drilled from the entry point north, terminating at a length of approximately 1,300 feet.
    - Drill cuttings and drilling fluids (*e.g.,* spoils) generated during drilling would be placed into off-road dump trucks and hauled to the on-site landfill for disposal.
- The well casing would consist of slotted well screen for targeted collection areas and solid sections for areas where collection is not required. The casing would be assembled at the surface and installed through the pilot borehole.
- Following installation, the well would be developed, consisting of flushing or jetting the system as needed to fully remove any remaining drilling mud/solids.
- The entry point would be sealed with grout to reduce surface water infiltration into the well and a concrete bulkhead would be constructed at the exit points of the well.

- An approximately 1-acre settling pond for management of extracted groundwater was assumed to be constructed using conventional construction equipment. However, other groundwater treatment and management technologies may be evaluated during a later phase of design. A temporary wastewater treatment plant that is being constructed on-site to treat existing CCR-contact water within the GMF GSP and adjacent GMF RP is not expected to operate post-closure, and therefore was assumed to be unavailable for treating extracted groundwater.
    - The location of the settling pond would be selected to limit adverse impacts or conflicts with future solar redevelopment and other existing and future site infrastructure. The precise location of the pond would be evaluated during later phases of design.
    - The settling pond would be approximately 1 acre in size and 2 feet deep. Soils would be mechanically excavated from the settling pond and used to create 10-foot-wide berms around the perimeter of the settling pond to contain extracted groundwater. All excavated soils from the settling pond would be managed within the settling pond footprint.
    - A geomembrane liner system would be installed in the settling pond to reduce the potential for releases of extracted groundwater.
    - Fused HDPE piping would be used to convey groundwater from the horizontal well to the settling pond and from the settling pond to the appropriate NPDES outfall. This would include the installation of electrical, mechanical, and pneumatic infrastructure to operate the conveyance piping system.
- Site restoration would be completed following the horizontal well installation. This would include repairing site infrastructure that was relocated or damaged during construction and minor regrading and seeding of disturbed areas, including the work pad and temporary access roads.
    - Temporary BMPs would also be installed during the site restoration period, if required in accordance with site land disturbance permits. The BMPs would be removed once vegetation is established.

4.2.3 Phase 3: Corrective Action Operations, Maintenance, and Closeout

Corrective action operations, maintenance, and closure would be initiated after corrective action construction is completed. It would include performing corrective action groundwater monitoring, and, after GWPS have been met, performing corrective action closeout and completion activities. Information associated with each of these activities is described below.

- Corrective Action O&M
  - Continued operation of the horizontal well would require routine scheduled inspections and associated maintenance including maintenance of extraction and transfer pumps as well as other system components.
  - Non-routine maintenance that may occur during extended operation of the horizontal well system may include flushing or jetting of water conveyance lines in the event organic or inorganic solids accumulate on the conveyance pipe interior walls.
  - Routine monitoring and compliance activities associated with the treatment and discharge of extracted water via the site's NPDES permit would also be completed during this phase.
- Corrective Action Monitoring
  - Regular corrective action groundwater monitoring would be conducted using a corrective action groundwater monitoring well network designed in accordance with 35 I.A.C. § 845.680(c), which specified that wells must be installed within the plume of contamination that lies beyond the waste boundary.
    - Samples would be collected for major ions for evaluating groundwater chemistry and COCs. Samples would be collected on a quarterly basis initially and potentially reduced to a semiannual basis once five years of monitoring have occurred, in accordance with 35 I.A.C. § 845.650(b)(4).
    - Monitoring results would be submitted to IEPA after each monitoring event, in addition to an annual groundwater monitoring and corrective action report, in accordance with 35 I.A.C. § 845.640(e). The annual corrective action report would include an evaluation of the actual performance of the remedy relative to the remedy's expected performance.
    - Routine maintenance of the monitoring well network would be conducted during the monitoring period. This would include inspecting the wells, making repairs to the wells (as and if needed), and rehabilitation and/or replacing the wells to improve performance (as and if needed).
  - If the remedy does not achieve its expected performance, additional methods or techniques to achieve compliance with GWPS would be evaluated and, if feasible, implemented in accordance with 35 I.A.C. § 845.680(b).
- Adaptive Management during Monitoring
  - Groundwater monitoring results would be evaluated and documented in in the monitoring reports submitted to IEPA, in accordance with 35 I.A.C. § 845.610(e).
  - Remedy progress evaluation as part of adaptive site management may include additional investigation to inform updates to the conceptual site, groundwater, and geochemical models.

  - If remedy progress does not correspond with expectations, additional methods or techniques to achieve compliance with GWPS would be evaluated and, if feasible, implemented in accordance with 35 I.A.C. § 845.680(b).

- Corrective Action Completion
  - After GWPS have been met for all compliance wells for a period of three years, corrective action would be considered complete, per 35 I.A.C. § 845.680(c).
  - After completion of the corrective action confirmation monitoring period, a Corrective Action Completion Report and Certification would then be submitted to IEPA, in accordance with 35 I.A.C. § 845.680(e).

4.2.4 Remedy Implementation Schedule

A feasibility-level implementation schedule for the Alternative 3 remedy, source control with horizontal GWE well, is provided in **Table C**.

Table C. Feasibility-Level Implementation Schedule – Alternative 3: Source Control with Horizontal GWE Well

Implementation Phase	Implementation Task	Timeframe (Preliminary Estimates)
1: Pre-Construction Activities	Agency Coordination, Approvals, and Permitting	12 to 18 months
	Final Design and Bid Process	24 to 36 months
	Timeframe to Complete Corrective Pre-Construction Activities	36 to 54 months after CAP Approval
2: Corrective Action Construction	Corrective Action Construction	6 to 12 months
	Timeframe to Complete Corrective Action Construction	6 to 12 months
3: Corrective Action O&M and Closeout	Corrective Action Monitoring (Time to Meet GWPS)	168 months (14 years)
	Corrective Action Monitoring (Post-GWPS Operations)	300 months (25 years)
	Corrective Action Confirmation Monitoring	36 months
	Corrective Action Completion	6 months
	Timeframe to Complete Corrective Action O&M and Closeout	510 months (43 years)
Total Timeline to Complete Corrective Action (after approval of Construction Permit Application)		552 to 576 months (46 to 48 years)

4.2.5 Management of Extracted Groundwater

Extracted groundwater from the horizontal well was assumed to be managed and treated by a newly constructed on-site settling pond, although other treatment technologies may be evaluated at a later phase of design. The settling pond would need to be sited to avoid conflict with planned solar redevelopment, other site infrastructure, and closure activities related to AP1 and other surface impoundments at CPP. A settling pond approximately 1 acre in size was assumed to be sufficient to allow sediments to settle from extracted groundwater prior to discharge.

Groundwater collected from the extraction well network would be sent to the settling pond via the pneumatic extraction pumps and transfer piping. Treated water would be discharged via a NDPES outfall, in accordance with site-specific NPDES permit requirements [13].

4.2.6 35 I.A.C. § 845.670(e)(1)(H) and 35 I.A.C. § 845.670(e)(3) Information

As requested by Gradient, the following information required by 35 I.A.C. § 845.670(e)(1)(H) and 35 I.A.C. § 845.670(e)(3) has been developed for the remedy. The information was developed based on preliminary-level information contained within the CMA for the COF AP2 and then refined based on additional feasibility-level design activities performed as part of the development of this CAAA-SIR.

- Potential Need for Replacement of the Remedy – 35 I.A.C. § 845.670(e)(1)(H)
  - No replacement of the remedy is expected to be required, although the horizontal well would require ongoing monitoring and maintenance to retain its effectiveness.
- Degree of Difficulty Associated with Constructing the Remedy – 35 I.A.C. § 845.670(e)(3)(A)
  - The remedy would require mobilizing specialty equipment to the site (*i.e.,* horizontal directional drill rigs) in addition to other supporting equipment (*i.e.,* excavation and grading equipment).
  - While horizontal wells are routinely constructed to similar depths and profiles in similar geologic environments, they may encounter difficulties during construction. The difficulties could include heterogeneity in the surface of the bottom of the CCR/top of UA interface or encountering obstructions that require specialized techniques and/or equipment to advance past. Therefore, the degree of construction difficulty is expected to be moderate.
- Expected Operational Reliability of the Remedy - 35 I.A.C. § 845.670(e)(3)(B)
  - The horizontal well is expected to have high operational reliability if constructed in accordance with the design and specifications.
  - While the horizontal well system is a passive drain system, the conveyance of extracted groundwater to the settling pond would constitute a mechanical system which would require routine maintenance to reliably operate, as outlined in **Section 4.2.3**.
- Need to Coordinate with and Obtain Necessary Approvals and Permits from Other Agencies - 35 I.A.C. § 845.670(e)(3)(C)
  - Agency permits would need to be obtained from IEPA for construction stormwater controls and BMPs, in addition to modifications to the site's NDPES permit. These permits typically take 18 to 24 months to obtain.

- Availability of Necessary Equipment and Specialists - 35 I.A.C. § 845.670(e)(3)(D)
  - Construction of the horizontal well would require a specialized contractor. The contractor would utilize specialized equipment along with conventional construction support equipment (*i.e.,* excavators, telehandlers).
  - Specialists in horizontal well design and construction would also need to be utilized during the design and construction phase of the horizontal well installation. The specialists would include design engineers, geologists, construction managers, and contractor staff experienced with horizontal well construction and equipment operation.
  - Additionally, specialists are occasionally needed for non-routine O&M which may include periodic re-development of the well (*i.e.*, flushing or jetting of conveyance lines), replacement of faulty system components, replacement of pumps or pump controllers, and replacement of faulty system instrumentation.
  - Specialists and replacement equipment are generally available in proximity (*i.e.,* 100 to 300 miles) of the site but some of the more complex and/or equipment, including the transfer pumps and transfer pump controller, may have extended lead times for replacement or servicing.
- Available Capacity and Location of Needed Treatment, Storage, and Disposal Services – 35 I.A.C. § 845.670(e)(3)(E)
  - The horizontal well system would send extracted groundwater to an on-site settling pond to settle solids extracted during groundwater recovery. This settling pond would be new construction that would need to be sited, designed, constructed, and maintained.
  - Settling pond design and construction would need to consider and limit impacts to existing site infrastructure and other SI limitations at CPP.
  - Continued NPDES permit renewals may be required, depending on the timeline of corrective action implementation relative to completion of source control activities.

5. MATERIAL QUANTITY, LABOR, AND MILEAGE ESTIMATES

Estimates of material quantities, total labor hours, and mileage were prepared for Alternative 2 source control with upgradient barrier wall and GWE trench and Alternative 3 source control with horizontal GWE well, to support Gradient in preparing a CAAA. Estimates were prepared for the construction and O&M of each remedy. Estimates were not prepared for Alternative 1 source control with GWP as the alternative does not require remedial construction or O&M of a physical remedy.

Both estimates were prepared utilizing the following approach:

- Major implementation (*e.g.,* construction) components and line items were identified, in accordance with the remedy implementation narratives contained within this CAAA-SIR.
- Construction quantities were estimated based on quantity estimates for volumes, areas, and units, as obtained from the feasibility-level engineering drawings and schedules included within this CAAA-SIR.
- RS Means Heavy Construction Cost Data (RS Means) [15] was utilized to estimate the crew size, equipment description, and daily output associated with each line item.
- For line items where RS Means data was not available, the crew size, equipment description, and daily output were estimated based on Ramboll's experience, information from contractors, and/or information from material suppliers.
- For the Alternative 2 source control with upgradient barrier wall and GWE trench and Alternative 3 source control with horizontal GWE well active remedies, daily construction and O&M labor mobilization miles were estimated assuming a weekly mobilization/demobilization from Chicago (500 miles round trip) and a local commute of 40 miles round trip per day. The number of working days and hours per week were estimated from the construction schedule developed for each remedy.
- Estimates of material delivery miles were prepared based on Ramboll's experience.

The detailed material quantity, labor, and mileage estimates are provided in **Appendix C** for each alternative.

6. REFERENCES

[1] "Illinois Administrative Code, Title 35, Subtitle G, Chapter I, Subchapter J, Part 845: Standards for The Disposal Of Coal Combustion Residuals In Surface Impoundments," effective April 21, 2021.

[2] Code of Federal Regulations, "Title 40, Chapter I, Subchapter I, Part 257, Subpart D, Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments," April 17, 2015.

[3] Luminant, "Coffeen Power Station; Ash Pond No. 2, Notification of Completion of Closure," 2020.

[4] AECOM, "Closure and Post-Closure Care Plan for the Coffeen Ash Pond No. 2 at Illinois Powering Generating Company Coffeeen Power Station," 2017.

[5] Illinois Environmental Protection Agency, "Coffeen Power Station W1350150004, Montgomery County, Illinois," 2018.

[6] Golder Associates, Inc., "Construction Completion and Construction Quality Assurance Report, Coffeen Power Station Ash Pond #2 Closure," 2001.

[7] United States Environmental Protection Agency, "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites," OSWER Directive Number 9200.4-17P, April 21, 1999.

[8] Ramboll Americas Engineering Solutions, "2024 35 I.A.C. S 845 Annual Groundwater Monitoring and Corrective Action Report, Ash Pond No. 2, Coffeen Power Plant, IEPA ID No. W1350150004-02," Coffeen, IL, January 2025.

[9] Natural Resource Technology, Inc., "Groundwater Modeling Report, Ash Pond 2, Coffeen Power Station, Coffeen, Illinois," 2017.

[10] Geosyntec Consultants, Inc., "Groundwater Polishing Evaluation Report, Coffeen Power Plant - Ash Pond No. 2 Unit (IEPA ID No. 102)," Coffeen, IL, February 2025.

[11] U.S. Fish and Wildlife Service, "National Wetlands Inventory, Surface Waters and Wetlands," [Online]. Available: https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/.

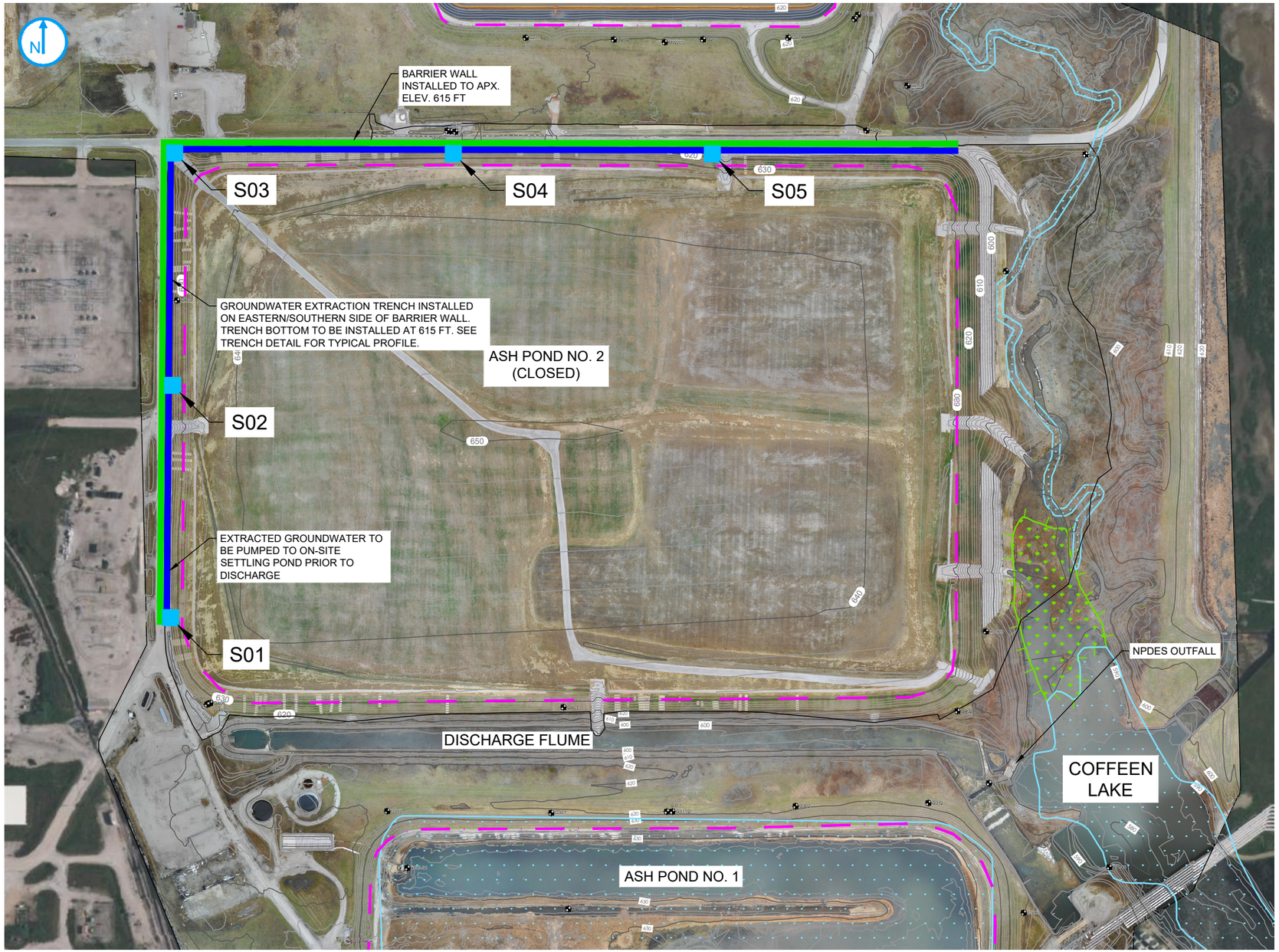
[12] National Flood Insurance Program, *Flood Hazard Boundary Map, Montgomery County, Illinois, Unincorporated Areas,* Federal Emergency Management Agency, 1981.

[13] Illinois Environmental Protection Agency, "NPDES Permit No. IL0000108," Illinois Environmental Protection Agency, Coffeen, Illinois, 2023.

[14] AECOM, "History of Construction, USEPA Final CCR Rule, 40 CFR § 257.73 (c), Coffeen Power Station, Coffeen, Illinois," 2016.

[15] Gordian, RS Means Data version 8.7, Springfield, IL: Gordian, 2023.

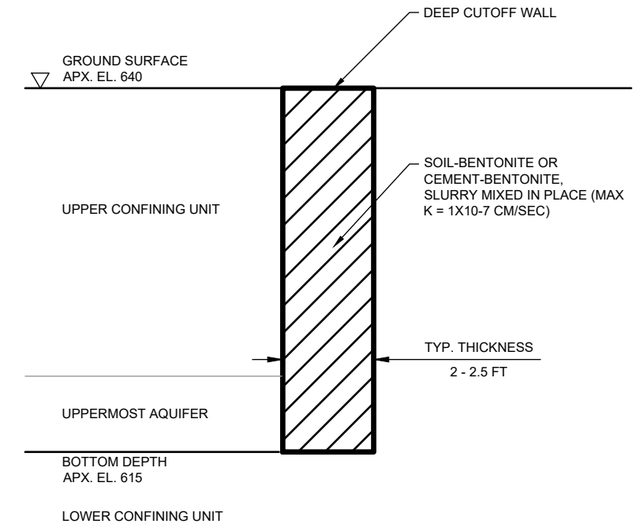
APPENDIX A
FEASIBILITY-LEVEL DESIGN DRAWINGS FOR ALTERNATIVE 2 AND ALTERNATIVE 3 REMEDIES



SITE PLAN

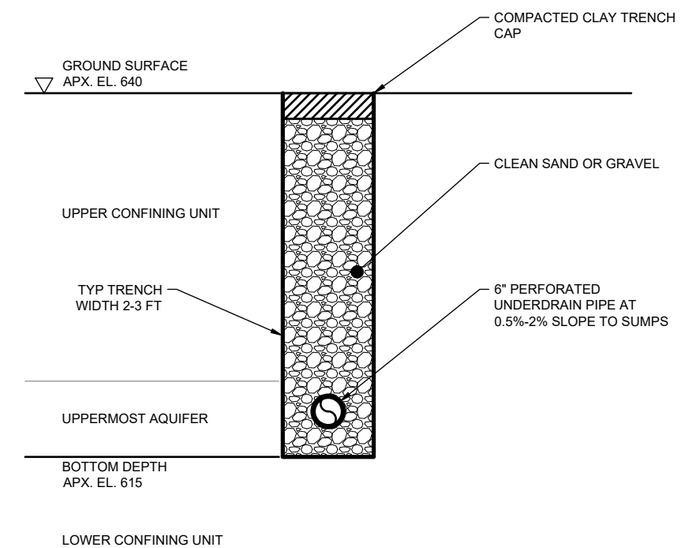
0 300 Feet

NOTE:
1. EXISTING AND POST-CLOSURE GRADING REPRESENTED PER COFFEEN POWER PLANT ASH POND NO. 2 CLOSURE AS-BUILT DRAWINGS COMPLETED BY GOLDER, NOVEMBER 2020.
2. WETLANDS REPRESENTED AS PER ILLINOIS NATIONAL WETLANDS INVENTORY.



BARRIER WALL DETAIL

NOT TO SCALE



TRENCH DETAIL

NOT TO SCALE

PROJECT: 1940075591 DATED: 12/9/2024 DESIGNER: LEMMONEN C:\DC\ACCDocs\Ramboll Gruppen AS\RUS-1940103584-002 Vistra Energy COF\Project Files\4 Delivery\40 WIP\401 Civil\Drawings\03_CAAA-SIR\COF-AP2 CAAA-SIR.dwg

EXISTING

- 360 — MAJOR CONTOUR
- 358 — MINOR CONTOUR
- LIMITS OF CCR
- WETLANDS BOUNDARY (SEE NOTE 2)
- BODY OF WATER

PROPOSED

- BARRIER WALL
- GROUNDWATER EXTRACTION TRENCH
- SUMP PUMP

UPGRADIENT BARRIER WALL AND GROUNDWATER EXTRACTION TRENCH

FEASABILITY-LEVEL DESIGN

ASH POND NO. 2

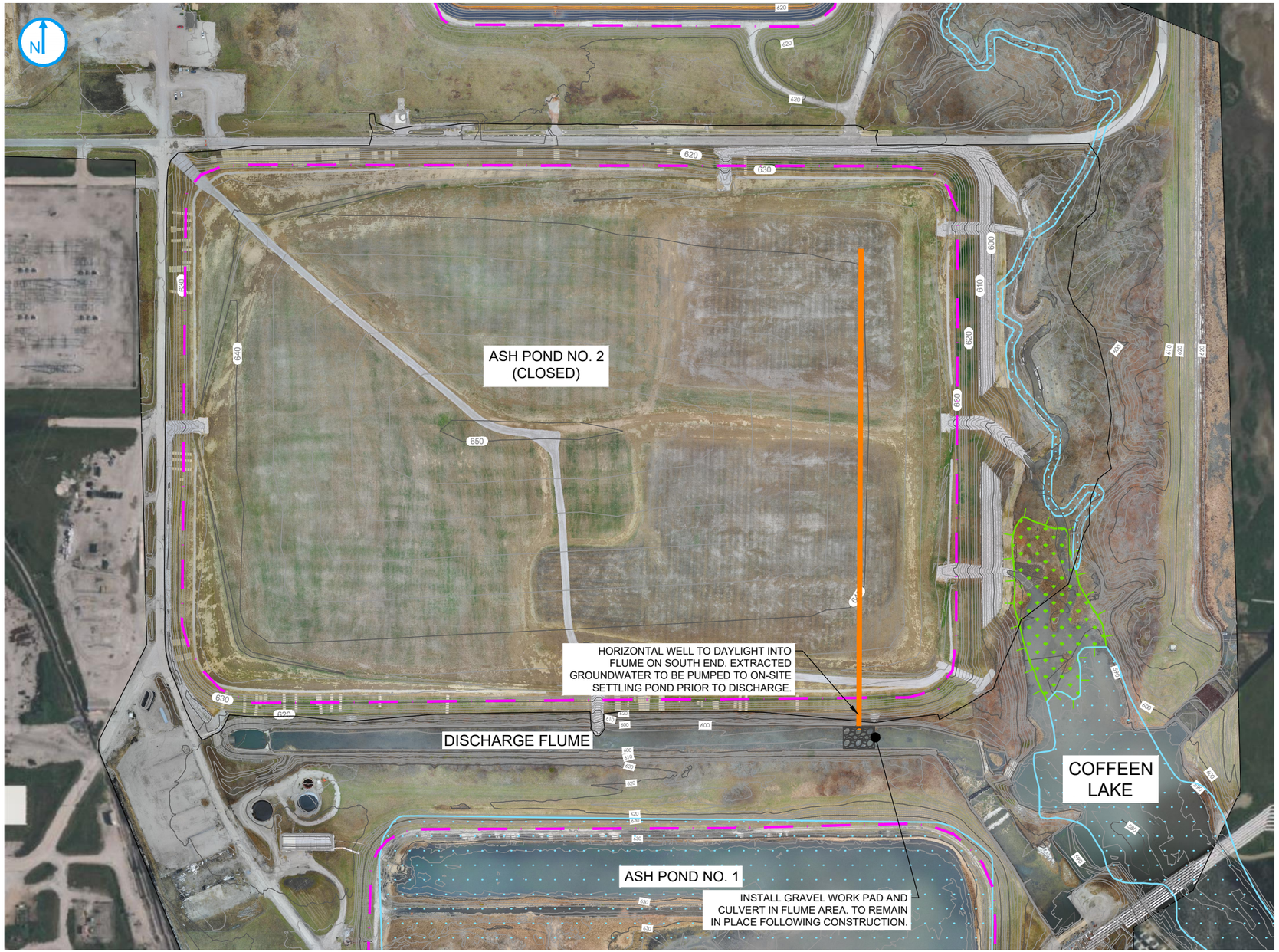
Coffeen Power Plant 134 CIPS Lane Coffeen, IL 62017

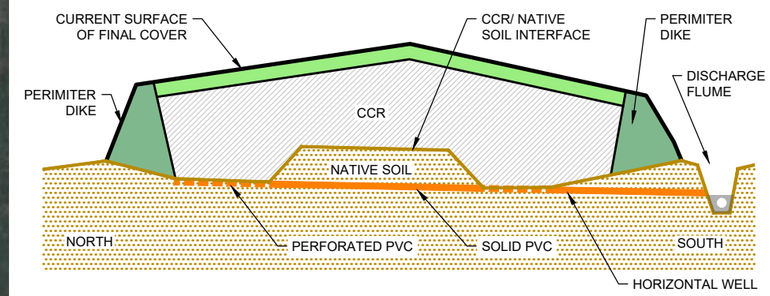
FIGURE 1

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL

PROJECT: 1940075591 DATED: 12/9/2024 DESIGNER: LEMMONBK:\DC\ACCDocs\ramboll gruppen as\rus-1940103584-002 vistra energy co\project files\4 delivery\40 WIP\401 civil\Drawings\03_CAAA-SIR\COF-AP2 CAAA-SIR.dwg





ASH POND NO. 2
HORIZONTAL WELL CROSS SECTION

NOT TO SCALE - LOOKING EAST

SITE PLAN

0 300 Feet

NOTE:
1. EXISTING GRADING REPRESENTED PER COFFEEN POWER PLANT ASH POND NO. 2 CLOSURE AS-BUILT DRAWINGS COMPLETED BY GOLDER, NOVEMBER 2020.
2. WETLANDS REPRESENTED AS PER ILLINOIS NATIONAL WETLANDS INVENTORY.

EXISTING

- 360 — MAJOR CONTOUR
- 358 — MINOR CONTOUR
- LIMITS OF CCR
- WETLANDS BOUNDARY (SEE NOTE 2)
- BODY OF WATER

PROPOSED

- HORIZONTAL WELL
- GRAVEL WORK PAD WITH CULVERT

HORIZONTAL GROUNDWATER EXTRACTION WELL

FEASABILITY-LEVEL DESIGN

ASH POND NO. 2

Coffeen Power Plant 134 CIPS Lane Coffeen, IL 62017

FIGURE 2

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL

APPENDIX B1
GROUNDWATER MODELING TECHNICAL MEMORANDUM

Intended for
Illinois Power Generating Company
134 Cips Lane
Coffeen, Illinois 62017

Date
June 10, 2025

Project No.
1940110241-001

GROUNDWATER MODELING TECHNICAL MEMORANDUM

COFFEEN POWER PLANT, ASH POND NO. 2, IEPA ID NO. W1350150004-02

RAMBOLL Bright ideas. Sustainable change.

GROUNDWATER MODELING TECHNICAL MEMORANDUM COFFEEN POWER PLANT, ASH POND NO. 2, IEPA ID NO. W1350150004-02

Project name	**Coffeen Power Plant Ash Pond No. 2**
Project no.	**1940103584-002**
Recipient	**Illinois Power Generating Company**
Document type	**Technical Memorandum**
Revision	**FINAL**
Date	**June 10, 2025**
Prepared by	**Jinjun Wang, PhD**
Checked by	**Katie Moran**
Approved by	**Brian G. Hennings, PG**

Ramboll
234 W. Florida Street
Fifth Floor
Milwaukee, WI 53204
USA

T 414-837-3607
F 414-837-3608
https://ramboll.com

Jinjun Wang, PhD
Senior Managing Consultant

Brian G. Hennings, PG
Project Officer, Hydrogeology

CONTENTS

Executive Summary **3**
1. Introduction **5**
1.1 Background 5
1.2 Previous Groundwater Modeling Reports 5
2. Alternative 1 Simulation **6**
2.1 NRT (2017) Model Description 6
2.2 Ramboll (2022) Model Description 6
2.3 Groundwater Model Update 7
2.4 Simulation Results of Updated Model 8
3. Alternative 2 and Alternative 3 Simulations **9**
3.1 Alternative 2 Remedy – Source Control with Upgradient Barrier Wall and GWE Trench 9
3.1.1 Overview 9
3.1.2 Model Approach 9
3.1.3 Simulation Results 9
3.2 Alternative 3 Remedy – Source Control with Horizontal GWE Well 10
3.2.1 Overview 10
3.2.2 Model Approach 10
3.2.3 Simulation Results 10
4. Assessment of Geochemical Processes **11**
5. Conclusions **12**
6. References **13**

TABLES (ATTACHED)

Table 1 Summary of Surface Water Elevations in Discharge Flume
Table 2 Simulated Time to Achieve Sulfate GWPS in AP2 Monitoring Wells

TABLES (IN TEXT)

Table A Estimated Timeframes to Attain GWPS in Groundwater Monitoring Wells

FIGURES

Figure 1 Monitoring Well Location Map
Figure 2 Simulated Sulfate Concentrations in AP2 Monitoring Wells – Alternative 1 Remedy
Figure 3 Proposed Upgradient Barrier Wall and Groundwater Extraction Trench Location – Alternative 2 Remedy
Figure 4 Simulated Sulfate Concentrations in AP2 Monitoring Wells – Alternative 2 Remedy
Figure 5 Simulated Extraction Rate from the Extraction Trench – Alternative 2 Remedy
Figure 6 Proposed Horizontal Groundwater Extraction Well Location – Alternative 3 Remedy
Figure 7 Simulated Sulfate Concentrations in AP2 Monitoring Wells – Alternative 3 Remedy
Figure 8 Simulated Discharge Rate from Horizontal Groundwater Extraction Well – Alternative 3 Remedy

APPENDICES

Appendix A MODFLOW and MT3DMS Model Files (Electronic Only)

ACRONYMS AND ABBREVIATIONS

35 I.A.C.	Title 35 of the Illinois Administrative Code
AP1	Ash Pond No. 1
AP2	Ash Pond No. 2
CAAA	Corrective Action Alternatives Analysis
CAP	Corrective Action Plan
CCR	coal combustion residual(s)
CIP	closure-in-place
COC	constituent of concern
CPP	Coffeen Power Plant
ft	foot/feet
Geosyntec	Geosyntec Consultants, Inc.
gpm	gallons per minute
GPR	Groundwater Polishing Evaluation Report
GMF GSP	Gypsum Management Facility Gypsum Stack Pond
GMF RP	Gypsum Management Facility Recycle Pond
Golder	Golder Associates USA, Inc.
GWE	groundwater extraction
GWPS	groundwater protection standard(s)
ID	identification
IEPA	Illinois Environmental Protection Agency
LCU	lower confining unit
mg/L	milligrams per liter
mL/g	milliliters per gram
NAVD88	North American Vertical Datum of 1988
NID	National Inventory of Dams
No.	number
NRT	Natural Resource Technology, Inc.
Ramboll	Ramboll Americas Engineering Solutions, Inc.
SI	surface impoundment
UA	uppermost aquifer
UCU	upper confining unit

EXECUTIVE SUMMARY

Ramboll Americas Engineering Solutions, Inc. (Ramboll) has prepared this Groundwater Modeling Technical Memorandum on behalf of the Coffeen Power Plant (CPP), operated by Illinois Power Generating Company, in accordance with requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845. This document presents the results of predictive groundwater modeling simulations in support of potential Corrective Action Plan (CAP) remedial alternatives identified in the Corrective Action Alternatives Analysis (CAAA) required by 35 I.A.C. § 845,670(e), for Ash Pond No. 2 (AP2) in Coffeen, Illinois, identified by Illinois Environmental Protection Agency (IEPA) identification (ID) number (No.) W1350150004-02 and National Inventory of Dams (NID) No. 50723. A total of three potential remedial alternatives were evaluated, including (1) Alternative 1 remedy: source control with groundwater polishing, (2) Alternative 2 remedy: source control with upgradient barrier wall and groundwater extraction (GWE) trench, and (3) Alternative 3 remedy: source control with horizontal groundwater extraction (GWE) well. Alternative 1 remedy is the closure-in-place (CIP) scenario that was modeled in the Groundwater Modeling Report (Natural Resource Technology, Inc. [NRT], 2017), and was implemented at AP2 in 2020 (Luminant, 2020). Alternative 2 and Alternative 3 remedies were assumed to be implemented in addition to the CIP scenario.

The groundwater modeling efforts described in this Groundwater Modeling Technical Memorandum include groundwater flow modeling using MODFLOW-NWT (Niswonger et al., 2011) and contaminant fate and transport modeling using MT3DMS (Zheng and Wang, 1999) to evaluate how each corrective action will achieve compliance with the applicable groundwater protection standards (GWPSs); and describe fate and transport of contaminants in accordance with 35 I.A.C. § 845.220 (c)(2). The effectiveness of each corrective action was assessed based on the time for simulated sulfate concentrations to decrease below GWPS in twelve groundwater monitoring wells[1] in the vicinity of AP2 (**Figure 1**). Considering the potential need to coordinate groundwater corrective action at AP2 with groundwater corrective actions at adjacent coal combustion residual (CCR) surface impoundment (SI) units, including Ash Pond No. 1 (AP1), Gypsum Management Facility Gypsum Stack Pond (GMF GSP), and Gypsum Management Facility Recycle Pond (GMF RP), corrective action construction for AP2 was assumed to be implemented upon the completion of the closures of the adjacent CCR SI units, as the corrective actions at these SI units are anticipated to occur concurrently with their closures. All timeframes are assumed to start concurrent with final closures of AP1, GMF GSP, and GMF RP.

The Alternative 1 remedy includes a closure in place approach for source control, after which groundwater polishing is implemented. The closure was re-simulated using sulfate as the surrogate for any CCR impacts in groundwater to be consistent with the modeling of AP1 closure, which is an adjacent CCR SI that will be closed in the future via a 35 I.A.C. § 845 closure plan. Using sulfate for both units allows the models to incorporate the potential impact of AP1 closure on fate and transport at AP2. According to the simulation results, sulfate concentrations in all monitoring wells will decrease below the 400 milligrams per liter (mg/L) GWPS for sulfate in 135 years under Alternative 1 remedy.

[1] There are 12 groundwater monitoring wells associated with AP2 available for evaluation. Simulated concentrations at G1003 are not presented since this well is typically dry and no groundwater samples have been obtained from this location.

The Alternative 2 remedy consists of source control with installation and operation of upgradient barrier wall and GWE trench. Groundwater modeling results for the remedy indicate that sulfate concentrations in all the groundwater monitoring wells will decrease below the applicable GWPS of 400 mg/L in 59 years. No operation of the GWE trench is required after that, as no rebounding of sulfate concentrations is expected according to the simulation results.

The Alternative 3 remedy consists of source control with installation of a horizontal GWE well at the interface of CCR and underlying soil in the eastern portion of AP2. Groundwater modeling results indicate that sulfate concentrations in AP2's groundwater monitoring wells would achieve the GWPS of 400 mg/L within 14 years. The simulation results also indicate that operating the horizontal well for 39 years (*i.e.*, 25 additional years after attaining the GWPS) may be necessary to effectively prevent the sulfate concentrations from rebounding above GWPS.

1. INTRODUCTION

1.1 Background

This Groundwater Modeling Technical Memorandum is prepared to evaluate how potential CAP remedial alternatives would achieve compliance with the applicable GWPSs and to describe fate and transport of contaminants in accordance with 35 I.A.C. § 845.220 (c)(2). The groundwater modeling efforts consist of predictive groundwater modeling to assess the long-term effectiveness and time to achieve GWPS for sulfate for the following remedial alternatives: (1) Alternative 1 remedy: source control with groundwater polishing; (2) Alternative 2 remedy: source control with upgradient barrier wall and GWE trench; and (3) Alternative 3 remedy: source control with horizontal GWE well. Alternative 1 remedy is the CIP scenario that was modeled in the Groundwater Modeling Report (NRT, 2017), and was implemented at AP2 in 2020 (Luminant, 2020). Alternative 2 and Alternative 3 remedies were assumed to be implemented in addition to the Alternative 1 CIP scenario.

1.2 Previous Groundwater Modeling Reports

NRT developed groundwater flow and transport models for AP2 in 2017 to evaluate AP2 closure scenarios. The groundwater flow model was built using MODFLOW-2005 (Harbaugh, 2005), and the contaminant fate and transport model was built using MT3DMS. The modeling exercises and results were summarized in the Groundwater Modeling Report (NRT, 2017).

Based upon the NRT (2017) models for AP2, Ramboll developed groundwater flow and transport models in 2022 to evaluate closure scenarios for the adjacent CCR SI unit AP1, and the footprint of AP2 falls within the model domain of the AP1 model. The modeling results were summarized in the Groundwater Modeling Report (Ramboll, 2022).

The groundwater modeling efforts presented in this Groundwater Modeling Technical Memorandum are based on the NRT (2017) and Ramboll (2022) groundwater modeling exercises, as detailed in **Section 2**.

2. ALTERNATIVE 1 SIMULATION

The CIP closure of AP2 (*i.e.*, Alternative 1 remedy) was originally simulated as documented in the Groundwater Modeling Report (NRT, 2017). The AP2 closure was implemented in 2020, consisting of a CIP approach for source control with groundwater polishing. In this Groundwater Modeling Technical Memorandum, the CIP closure of AP2 was re-simulated to incorporate the potential influence of closure activities at the adjacent CCR SI units AP1, GMF GSP, and GMF RP, which will also be closed in the future (Golder Associates USA, Inc. [Golder], 2022a,2022b, and 2022c). The updated simulation of CIP closure at AP2 served as the baseline scenario for the additional CAP scenario simulations presented in **Section 3**.

Considering the potential need to coordinate groundwater corrective action at AP2 with groundwater corrective action and closure construction activities at adjacent SI units (*i.e.,* AP1, GMF GSP, and GMF RP), corrective action construction for AP2 was assumed to be implemented upon the completion of closures of adjacent SI units, as AP2 corrective action construction would also occur concurrently with closures of these SI units. Therefore, all timeframes are assumed to start concurrent with final closures of AP1, GMF GSP, and GMF RP.

2.1 NRT (2017) Model Description

The NRT (2017) groundwater modeling simulated groundwater flow and transport of boron to support closure of AP2. The groundwater modeling consisted of the following:

- A steady state groundwater flow was developed using MODFLOW-2005 to represent site conditions for 2016.
- The hydrogeologic properties from the steady state model were used in the calibration of transient MODFLOW-2005 and MT3DMS models which simulated groundwater flow and transport at AP2 from 1970 to 2017. Boron concentrations collected in August 2016 were used to calibrate the transport model.
- Predictive simulations were conducted to evaluate the CIP scenario at AP2.

2.2 Ramboll (2022) Model Description

The NRT (2017) flow and transport models were retained and revised as appropriate to evaluate closure scenarios for AP1 (Ramboll, 2022) and consisted of the following:

- A steady state groundwater flow model was constructed using MODFLOW-2005 and calibrated to match mean groundwater elevations observed between 2015 to 2021. The calibrated flow model was used to simulate the mean groundwater flow conditions at the site.
- Transient flow and transport models were constructed based off of the calibrated steady state model using MODFLOW-2005 and MT3DMS, respectively. These models simulate groundwater flow and transport for 42 years with changes in site conditions through time and match observed sulfate concentrations in groundwater.
- Prediction simulations began with a 2-year dewatering period for AP1 where heads were reduced within the CCR unit and concentrations were removed from CCR removal areas.
- Prediction simulations resumed for CIP following the 2-year dewatering period.

2.3 Groundwater Model Update

The updated simulation of CIP closure at AP2 was based on the Ramboll (2022) models so that the potential influence of the closure activities at adjacent SI units could be incorporated. The input and output files, as well as the model executables, are provided in **Appendix A**. For the contaminant fate and transport simulation, sulfate was selected as the constituent to evaluate the effectiveness of the closure scenario. Of the analytes which exceed GWPS in site groundwater, sulfate has been detected in AP2 groundwater at the highest concentrations relative to its GWPS and it will likely take the longest time to meet the GWPS. Sulfate has also been detected above the GWPS at more well locations adjacent to AP1 and AP2 than any other 845.600 parameter which contributed to its selection for modeling at both units. It is not necessary to model all constituents that have GWPS exceedances[2] or have been detected at lower concentrations relative to their GWPSs, because those constituents will likely achieve their GWPSs more quickly (Gradient, 2024).

For the purpose of evaluating the potential groundwater remedial alternatives, the groundwater flow modeling program associated with the prediction simulations, including the 2-year dewatering simulation and the 1,000-year CIP simulation, was updated from MODFLOW-2005 to MODFLOW-NWT. MODFLOW-NWT is a modeling program designed to solve nonlinear groundwater flow problems due to unconfined aquifer conditions and is superior in solving problems involving drying and rewetting of unconfined aquifers (Niswonger et al., 2011), which were expected for the selected remedial alternatives. In addition, the layer types associated with model Layers 2 through 4 in the prediction models were updated from "confined" to "unconfined (T Varies)" to accommodate the drying and rewetting conditions. MT3DMS remained as the fate and transport modeling program.

A stream gauge was installed within the discharge flume, located to the south of AP2 and formerly utilized as part of the CPP to route plant process water towards Coffeen Lake, to monitor the surface water elevation in the flume. Historical surface water elevations collected at the stream gauge are summarized in **Table 1**. As shown in the table, the surface water elevation varied from 598.34 ft[3] to 599.36 ft between March 2021 and July 2024, with an average of 598.67 ft. Accordingly, in the 1,000-year CIP prediction model, the discharge flume was simulated as a drain, with a drain stage set to 598.7 ft to represent the average surface water elevation within the flume.

In addition, the drain boundaries simulating the GMF GSP and GMF RP in the 1,000-year CIP prediction model were updated to reflect the final closure design associated with these two SI units (Golder, 2022b and 2022c).

The updated simulation results for Alternative 1 remedy are discussed in **Section 2.4**. The simulated groundwater elevations and sulfate concentrations at the end of the 2-year AP1

[2] Throughout this document, "exceedance" or "exceedances" is intended to refer only to potential exceedances of proposed applicable background statistics or GWPSs as described in the proposed groundwater monitoring program, which was submitted to the IEPA on October 25, 2021 as part of IPGC's operating permit application for COF AP2. That operating permit application, including the proposed groundwater monitoring program, remains under review by the IEPA and, therefore, IPGC has not identified any actual exceedances.

[3] All elevations in this report are referenced to North American Vertical Datum of 1988 (NAVD88) unless otherwise noted.

dewatering period also served as the initial conditions for the following remedial alternative simulations[4] described in **Section 3**.

2.4 Simulation Results of Updated Model

The simulated sulfate concentrations for the Alternative 1 remedy: source control with groundwater polishing in AP2's groundwater monitoring wells versus time are shown in **Figure 2**. The simulated time to achieve sulfate GWPS in the monitoring wells is summarized in **Table 2**. With the exception of G1001, sulfate concentrations are expected to achieve the GWPS within approximately 25 years. As shown in **Figure 2**, the simulated sulfate concentration in monitoring well G1001 decreases below the 400 mg/L GWPS after about 70 years, increases above the GWPS around 123 years, and eventually decreases and remains below the GWPS after 135 years until the end of the 1,000-year simulation.

Review of the simulation results also indicates the updated groundwater model is likely to overpredict the amount of time to attain the GWPS at monitoring well G1001. As presented in the Nature and Extent Report (Ramboll, 2024a), monitoring wells G1001 and G1003 were installed in 2021 between the eastern edge of AP2 and the Unnamed Tributary. The borings did not identify the presence of either the upper confining unit or uppermost aquifer materials, indicating that the uppermost aquifer is absent east of AP2. Wells G1001 and G1003 were screened in the LCU to evaluate shallow groundwater quality east of AP2. Only G1001 contains measurable amounts of groundwater that can be collected and analyzed; G1003 is routinely dry. As of December of 2024, eight groundwater samples have been collected from G1001 with total sulfate concentrations ranging from 107 mg/L to 630 mg/L with an average concentration of 249 mg/L. The simulated sulfate concentration at G1001 at the beginning of prediction simulation is approximately 1,600 mg/L, which is consistent with the source concentrations used for AP2 in the 2022 model (Ramboll, 2022) present just west of G1001. The simulated concentration at the beginning of the prediction simulation is approximately 2.5 times higher than maximum observed concentration at G1001. Further, total sulfate has not been reported as an exceedance of the GWPS at well G1001 (Ramboll, 2024b and 2025a). Therefore, model simulated time to reach the GWPS at well G1001 is likely to be overpredicted.

[4] The remedial alternative simulations assume the remedial alternatives at AP2 will be implemented following the 2-year dewatering at AP1.

3. ALTERNATIVE 2 AND ALTERNATIVE 3 SIMULATIONS

The Alternative 2 and Alternative 3 remedies were simulated to evaluate their impacts, in addition to the Alternative 1 remedy, on sulfate concentrations at Coffeen AP2. Alternative 1 remedy simulation described in **Section 2** provides a baseline scenario for comparison to the two alternative remedies. As discussed in **Section 2**, all timeframes described herein are assumed to start concurrent with closure of the adjacent SI units (*i.e.,* AP1, GMF GSP, and GMF RP).

3.1 Alternative 2 Remedy – Source Control with Upgradient Barrier Wall and GWE Trench

3.1.1 Overview

The Alternative 2 remedy consists of the installation and operation of a GWE trench and barrier wall upgradient of AP2 (**Figure 3**). The barrier wall is assumed to be installed to 616 feet in the simulation. The extraction trench is proposed to be installed between the barrier wall and AP2 to an elevation of 615 feet. According to the simulated groundwater flow pattern for the CIP, the groundwater flow direction within AP2 is to the southeast in general. The goal of Alternative 2 remedy is to prevent the flow of groundwater towards AP2 from the northwest, while providing a means to capture groundwater and reduce hydraulic head beneath AP2. Increasing the rate at which groundwater elevations decrease beneath AP2 also more rapidly decreases the amount of CCR that may come into contact with groundwater, thereby reducing the amount of sulfate potentially released to groundwater and accelerating attainment of GWPS.

3.1.2 Model Approach

The 1,000-year CIP prediction model described in **Section 2** was modified to simulate the Alternative 2 remedy. The input and output files, as well as the model executables, are provided in **Appendix A**. The proposed barrier wall was simulated as a horizontal flow barrier (Hsieh and Freckleton, 1993) installed within the Upper Confining Unit (UCU) in model Layer 1. The barrier wall was assumed to be 3-foot thick and constructed of cement-bentonite with a permeability of 2.8×10^{-4} ft/day. The GWE trench was simulated as a drain with stage set to 615 feet. The drain was included in model Layer 2, which simulates the lower portion of UCU at the site. The GWE trench was assumed to be 3-foot thick, and the backfill material for the trench was assumed to be sand with a hydraulic conductivity of 62.4 ft/day. Therefore, the hydraulic conductivities in model cells within and above the drain were adjusted to 10 ft/day, both vertically and horizontally, to match the permeability of fill material in the extraction trench.

3.1.3 Simulation Results

The simulated sulfate concentrations in AP2's groundwater monitoring wells versus time for Alternative 2 remedy are shown in **Figure 4**. The simulated time to attain the sulfate GWPS in the monitoring wells is summarized in **Table 2**. According to the results, monitoring well G1001 is the last to attain GWPS compliance, in 59 years under the Alternative 2 remedy followed by well G404 which attains the GWPS at 20 years. As discussed in **Section 2.4**, the model likely overpredicts the time to attain the GWPS at well G1001. According to the simulation results, operation of the GWE trench can be terminated after 59 years, after which no rebounding of sulfate concentrations is expected to occur.

The simulated extraction rate from the GWE trench versus time is plotted in **Figure 5**. As shown in the figure, the extraction rate is higher at the beginning of the operation (about 50 gallons per

minute [gpm] on day 24 of the operation) due to the higher initial groundwater elevations near the trench. The groundwater levels near the GWE trench and the extraction rate decrease over time with continued trench operation. The extraction rate decreases to about 2 gpm at the end of the 59-year operation.

3.2 Alternative 3 Remedy – Source Control with Horizontal GWE Well

3.2.1 Overview

The Alternative 3 remedy consists of groundwater removal through a horizontal well (**Figure 6**). The proposed horizontal GWE well will be installed penetrating the estimated bottom of CCR (about 602 feet) located within the historical drainage features. Groundwater removal through the horizontal GWE well will collect CCR-impacted groundwater and thereby reduce the sulfate mass potentially released to groundwater. Groundwater removal from the horizontal well will also induce groundwater flow towards the slotted portions of the well and capture the CCR-impacted groundwater plume in their vicinity.

3.2.2 Model Approach

The 1,000-year CIP prediction model described in **Section 2** was updated to simulate the groundwater removal from the horizontal well. The input and output files, as well as the model executables, are provided in **Appendix A**. The updated model incorporated one horizontal well as shown in **Figure 6**, with its perforated portions simulated as drains located at the bottom of the UA in model Layer 3, with drain stages set to 602 feet.

3.2.3 Simulation Results

Simulation of Alternative 3 remedy assumed operation of the horizontal well for 39 years. The simulated sulfate concentrations in AP2's groundwater monitoring wells versus time for Alternative 3 remedy are shown in **Figure 7**. The simulated time to achieve sulfate GWPS in the monitoring wells is summarized in **Table 2**. As shown, monitoring wells G1001 (screened within the LCU) and G404 are the last monitoring wells to achieve GWPS compliance. Under Alternative 3 remedy, the time for sulfate concentration in wells G1001 and G404 to decrease below the GWPS is 14 years. The simulation results also indicate that operating the horizontal well for 39 years will effectively prevent the sulfate concentrations from rebounding above GWPS.

As discussed in **Section 2.4**, the model likely overpredicts the sulfate concentrations at well G1001. Groundwater sampling results indicate there are no current exceedances at this well (Ramboll, 2024b and 2025a); therefore, the model result is very conservative. If sulfate concentration at G1001 continues to remain below the GWPS then this period of additional operation may not be necessary. Monitoring and adaptive site management practices presented in the Corrective Action Groundwater Monitoring Plan (Ramboll, 2025b) describe how stability in groundwater data will be evaluated before assessing if compliance with the GWPS has been attained to allow any transient effects of treatment on the groundwater (e.g., rebounding concentrations) to dissipate.

The simulated groundwater removal rate from the horizontal GWE well versus time is plotted on **Figure 8**. As shown in the figure, the discharge rate is higher at the beginning of the operation (about 30 gpm on day 10 of the operation). Groundwater elevations in AP2 decrease over time due to the operation of the horizontal well, and the discharge rate from the horizontal well decreases gradually to approximately 2 gpm towards the end of the 39-year operation.

4. ASSESSMENT OF GEOCHEMICAL PROCESSES

This groundwater flow and transport model estimates the time for sulfate to reach the GWPS under different potential corrective actions based on physical components of groundwater polishing. As described in the Groundwater Modeling Report submitted with the construction permit, it was assumed that sulfate would not significantly sorb or chemically react with aquifer solids (distribution coefficient [K_d] was set to 0 milliliters per gram [mL/g]), which is a conservative estimate for estimating contaminant transport times.

A Groundwater Polishing Evaluation Report (GPR) (Geosyntec Consultants, Inc. [Geosyntec], 2025) was attached to the Corrective Actions Alternative Analysis (CAAA). The geochemical modeling effort presented in the GPR supports the assessment of groundwater polishing as a component of the proposed corrective action by evaluating the potential for chemical attenuation of constituents of concern (COCs) before and after source control as a means of contextualizing the times estimated in the flow and transport model. The GPR also provides an initial foundation for understanding groundwater chemistry to inform adaptive site management as a key component of the Corrective Action Groundwater Monitoring Program.

In their report, Geosyntec evaluated the potential for natural groundwater polishing processes, which involve both physical and chemical mechanisms, to attenuate sulfate and boron and evaluate the potential for previously attenuated sulfate and boron to be remobilized into groundwater as concentrations return to background levels. The groundwater polishing evaluation determined that geochemical conditions demonstrate chemical attenuation of boron and sulfate via sorption to aquifer solids, particularly iron and aluminum oxides and (applicable to sulfate only) precipitation of barite. Mobilization of currently attenuated sulfate is unlikely to affect the modeled time to reach the GWPS, and that mobilization of previously attenuated boron may result in a longer observed time to reach the GWPS compared to sulfate. In other words, the impact of groundwater polishing through chemical attenuation mechanisms has only a minimal effect on the estimated time it takes for sulfate concentrations to reach the GWPS of 400 mg/L, as simulated by the flow and transport model.

5. CONCLUSIONS

The groundwater modeling efforts in this Groundwater Modeling Technical Memorandum consist of flow and transport modeling using MODFLOW-NWT and MT3DMS to assess the time to achieve GWPS for sulfate for three CAP remedy alternatives: Alternative 1 remedy (source control with groundwater polishing), Alternative 2 remedy (source control with upgradient barrier wall and GWE trench), and Alternative 3 remedy (source control with horizontal GWE well).

A summary of predicted time for sulfate concentrations to meet the GWPS at the compliance monitoring wells is provided in **Table 2**. Percentage of compliance monitoring wells predicted to attain GWPS over time is summarized below in **Table A**. According to the simulation results, under both Alternative 1 remedy and Alternative 2 remedy options, monitoring well G1001 (screened within the LCU) is the last monitoring location to achieve GWPS compliance. For Alternative 1 remedy, the time to achieve GWPS compliance is 135 years. For Alternative 2 remedy, the time to achieve GWPS compliance is 59 years. Operation of the GWE trench can be terminated once the GWPS compliance is achieved. Under Alternative 3 remedy, the time to attain the GWPS in compliance wells is 14 years, driven by sulfate concentrations in monitoring wells G1001 and G404. Operating the horizontal well for 39 years may be necessary to mitigate the potential for sulfate concentrations from rebounding above GWPS after remedy operations have ceased.

Table A. Estimated Timeframes to Attain GWPS in Groundwater Monitoring Wells

Alternative	Impacted Wells	Percentage of Wells Predicted to Attain GWPS†						
		5 Years‡	10 Years‡	14 Years‡	20 Years‡	40 Years‡	59 Years‡	135 Years‡
1	5	40%	60%	60%	60%	80%	80%	100%
2	4	50%	50%	50%	50%	75%	100%	100%
3	5	40%	60%	100%	100%	100%	100%	100%

†: Estimated timeframes per the number of impacted wells (wells with estimated times to achieve the GWPS) shown in Table 2

‡: Years counted starting from completion of corrective action

6. REFERENCES

Geosyntec Consultants, Inc., 2025. Groundwater Polishing Evaluation Report, Coffeen Power Plant - Ash Pond No. 2 Unit. June.

Golder Associates USA, Inc., 2022a. Part 845 Construction Permit Application for Ash Pond No. 1, Coffeen Power Plant.

Golder Associates USA, Inc., 2022b. Part 845 Construction Permit Application for Gypsum Management Facility Gypsum Stack Pond, Coffeen Power Plant. July 28.

Golder Associates USA, Inc., 2022c. Part 845 Construction Permit Application for Gypsum Management Facility Recycle Pond, Coffeen Power Plant. July 28.

Gradient, 2024. Closure Alternatives Analysis Groundwater Modeling Review at the Coffeen Power Plant, Edwards Power Plant, Newton Power Plant, and Hennepin Power Plant, Expert Report of Andrew Bittner, P.E.

Harbaugh, A.W., 2005, MODFLOW-2005, The U.S. Geological Survey modular ground-water model—the Ground-Water Flow Process: U.S. Geological Survey Techniques and Methods 6-A16, variously p.

Hsieh, P. and J.R. Freckleton, 1993, Documentation of a Computer Program to Simulate Horizontal-Flow Barriers Using the U.S. Geological Survey's Modular Three-Dimensional Finite-Difference Ground-Water Flow Model. U.S. Geological Survey Open-File Report 92-477.

Illinois Administrative Code, Title 35, Subtitle G, Chapter I, Subchapter J, Part 845: Standards for The Disposal of Coal Combustion Residuals In Surface Impoundments, effective April 21, 2021.

Luminant, 2020, Coffeen Power Station; Ash Pond No. 2 Notification of Completion of Closure.

Natural Resource Technology, Inc., 2017, Groundwater Modeling Report, Ash Pond 2, Coffeen Power Plant, Coffeen, Illinois. January 24, 2017.

Niswonger, R.G., Panday, Sorab, and Ibaraki, Motomu, 2011, MODFLOW-NWT, A Newton formulation for MODFLOW-2005: U.S. Geological Survey Techniques and Methods 6–A37, 44 p.

Ramboll Americas Engineering Solutions, Inc (Ramboll), 2022. Groundwater Modeling Report, Ash Pond No. 1, Coffeen Power Plant, Coffeen, Illinois.

Ramboll Americas Engineering Solutions, Inc (Ramboll), 2024a. Nature and Extent Report, Coffeen Power Plant, Ash Pond No. 2.

Ramboll Americas Engineering Solutions, Inc (Ramboll), 2024b. 2023 35 I.A.C. § 845 Annual Groundwater Monitoring and Corrective Action Report, Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois.

Ramboll Americas Engineering Solutions, Inc (Ramboll), 2025a. 2024 35 I.A.C. § 845 Annual Groundwater Monitoring and Corrective Action Report, Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois.

Ramboll Americas Engineering Solutions, Inc (Ramboll), 2025b. Corrective Action Groundwater Monitoring Plan, Coffeen Power Plant, Ash Pond No. 2, IEPA ID No W1350150004-02.

Zheng C., and P. Wang, 1999. MT3DMS: A Modular Three-Dimensional Multispecies Transport Model for Simulation of Advection, Dispersion, and Chemical Reactions of Contaminants in Groundwater Systems: Documentation and User's Guide.

TABLES

TABLE 1. SUMMARY OF SURFACE WATER ELEVATIONS IN DISCHARGE FLUME

GROUNDWATER MODELING TECHNICAL MEMORANDUM

COFFEEN POWER PLANT

ASH POND NO. 2

COFFEEN, ILLINOIS

Date	Surface Water Elevation[1] (ft amsl)
03/29/2021	598.75
04/20/2021	598.56
05/03/2021	598.74
05/17/2021	598.56
06/09/2021	598.37
06/23/2021	598.34
07/12/2021	598.75
07/26/2021	598.44
08/16/2021	598.39
10/25/2021	598.59
02/07/2022	598.52
05/09/2022	598.52
08/23/2022	598.42
02/13/2023	598.62
05/30/2023	598.40
10/24/2023	598.38
11/13/2023	598.51
12/18/2023	598.56
01/12/2024	599.17
02/12/2024	598.82
03/29/2024	599.00
04/29/2024	599.36
05/29/2024	599.18
06/29/2024	598.84
07/30/2024	598.91
Minimum	598.34
Maximum	599.36
Average	598.67

1. All surface water elevations are referenced to North American Vertical Datum of 1988 (NAVD88).

RAMBOLL

TABLE 2. SIMULATED TIME TO ACHIEVE SULFATE GWPS IN AP2 MONITORING WELLS

GROUNDWATER MODELING TECHNICAL MEMORANDUM

COFFEEN POWER PLANT

ASH POND NO. 2

COFFEEN, ILLINOIS

Monitoring Well	Time to Achieve GWPS* in Monitoring Well (Year)		
	Alternative 1 Remedy (Source Control with Groundwater Polishing)	Alternative 2 Remedy (Source Control with Upgradient Barrier Wall and Groundwater Extraction Trench)	Alternative 3 Remedy (Source Control with Horizontal Groundwater Extraction Well)
G1001	135	59	14
G1003**	-	-	-
G270	0	0	0
G280	0	0	0
G281	0	0	0
G401	3	2	2
G402	1	1	1
G403	0	0	0
G404	25	20	14
G405	8	0	8
G406	0	0	0
G407	0	0	0
Minimum	0	0	0
Maximum	135	59	14
Average	16	7	3

* GWPS - groundwater protection standard

** Simulation results at G1003 are not presented since the well is typically dry.

RAMBOLL

FIGURES

C:\Projects\Coffeen\GIS\COFFEEN_TechMemo_202402.aprx\AP2_Figure01_SiteMap

PROJECT: 19401103584-002 | DATED: 3/17/2024 | DESIGNER: JWANG

UA Monitoring Well
LCU (Vandalia Member) Monitoring Well
SI Unit

0 250 500 Feet

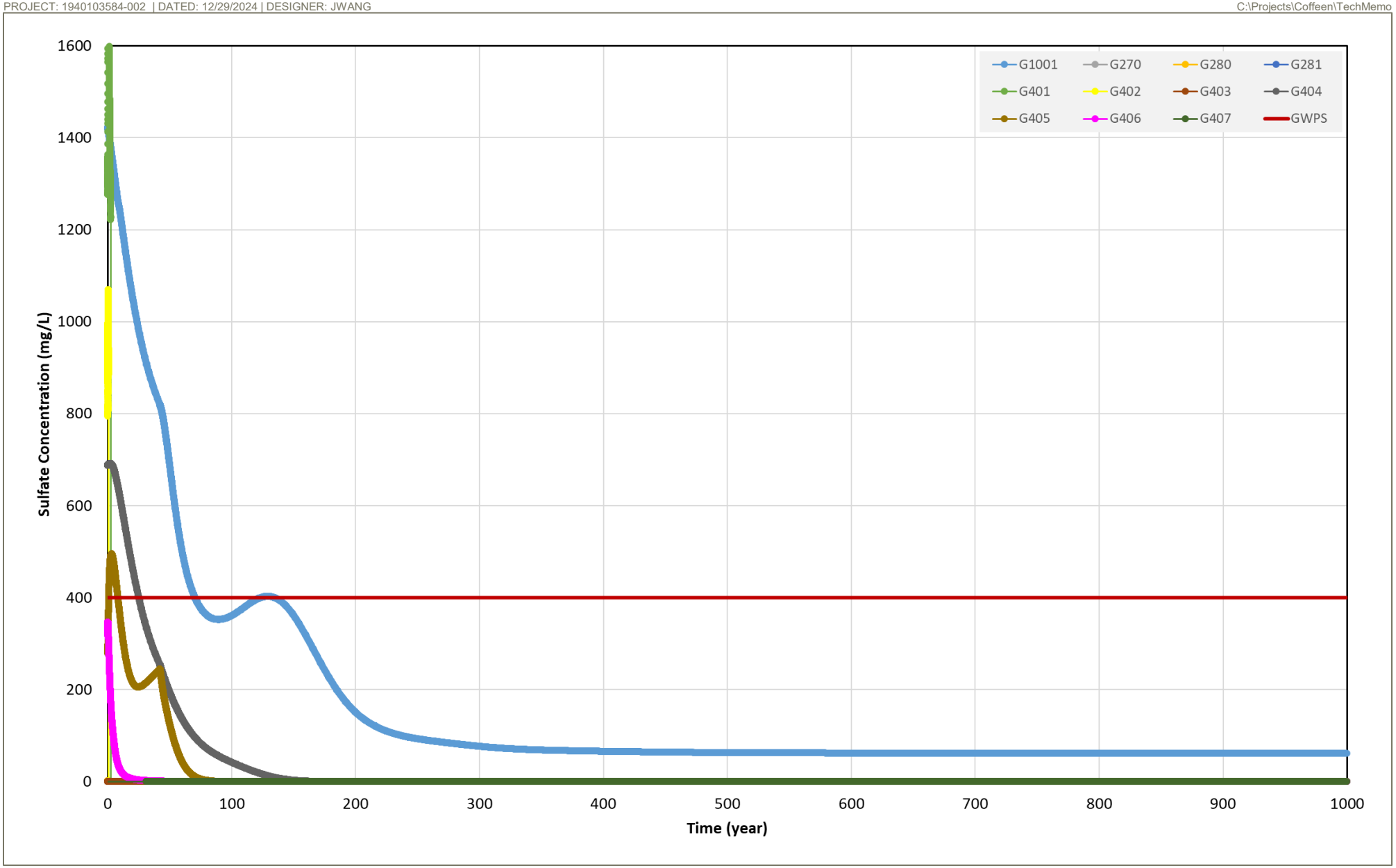
MONITORING WELL LOCATION MAP

ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL



SIMULATED SULFATE CONCENTRATIONS IN AP2 MONITORING WELLS - ALTERNATIVE 1 REMEDY

ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 2

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL

UA Monitoring Well
LCU (Vandalia Member) Monitoring Well
SI Unit
Proposed Extraction Trench Location
Proposed Barrier Wall Location

0 300 600 Feet

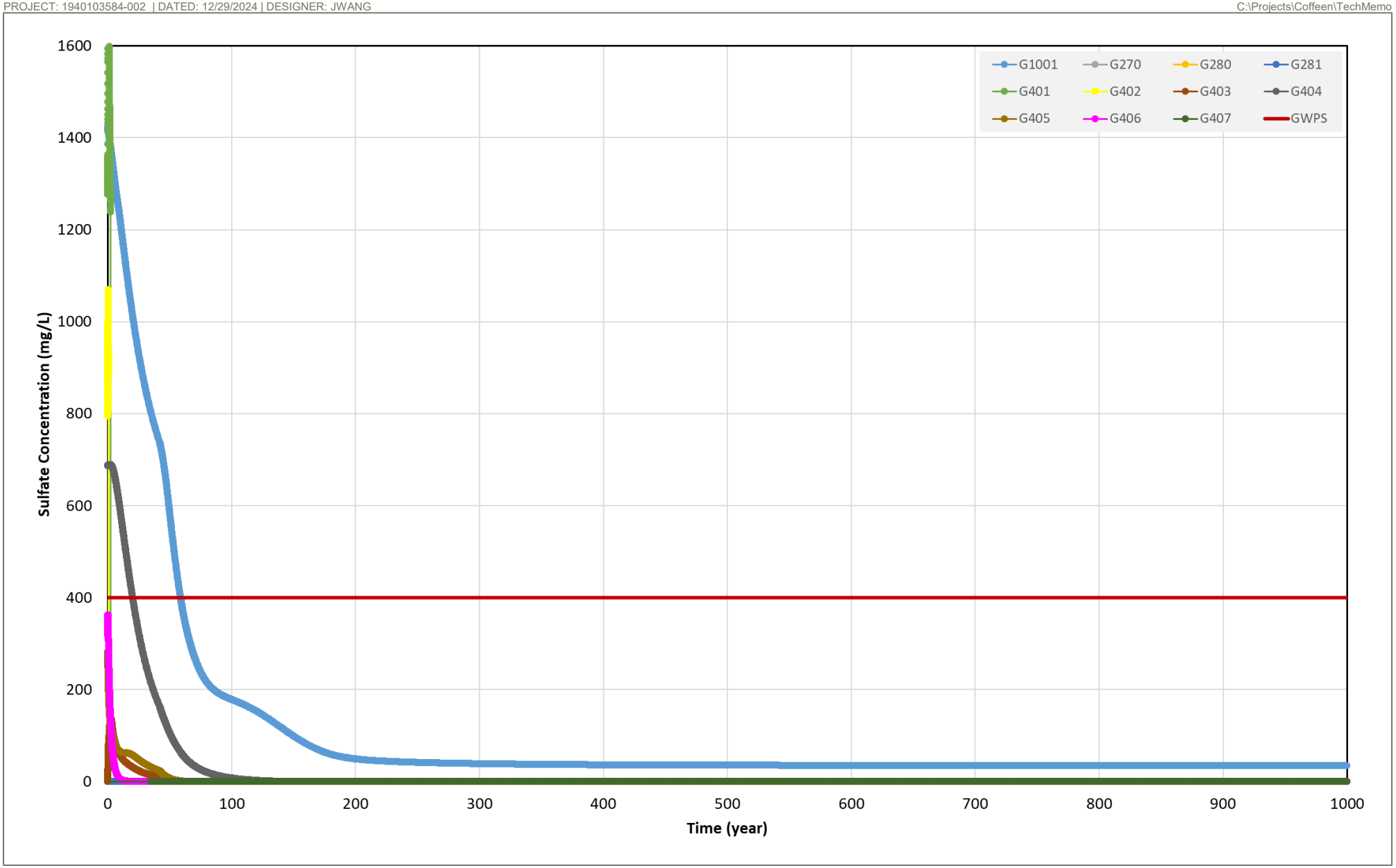
PROPOSED UPGRADIENT BARRIER WALL AND GROUNDWATER EXTRACTION TRENCH LOCATION - ALTERNATIVE 2 REMEDY

ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 3

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL



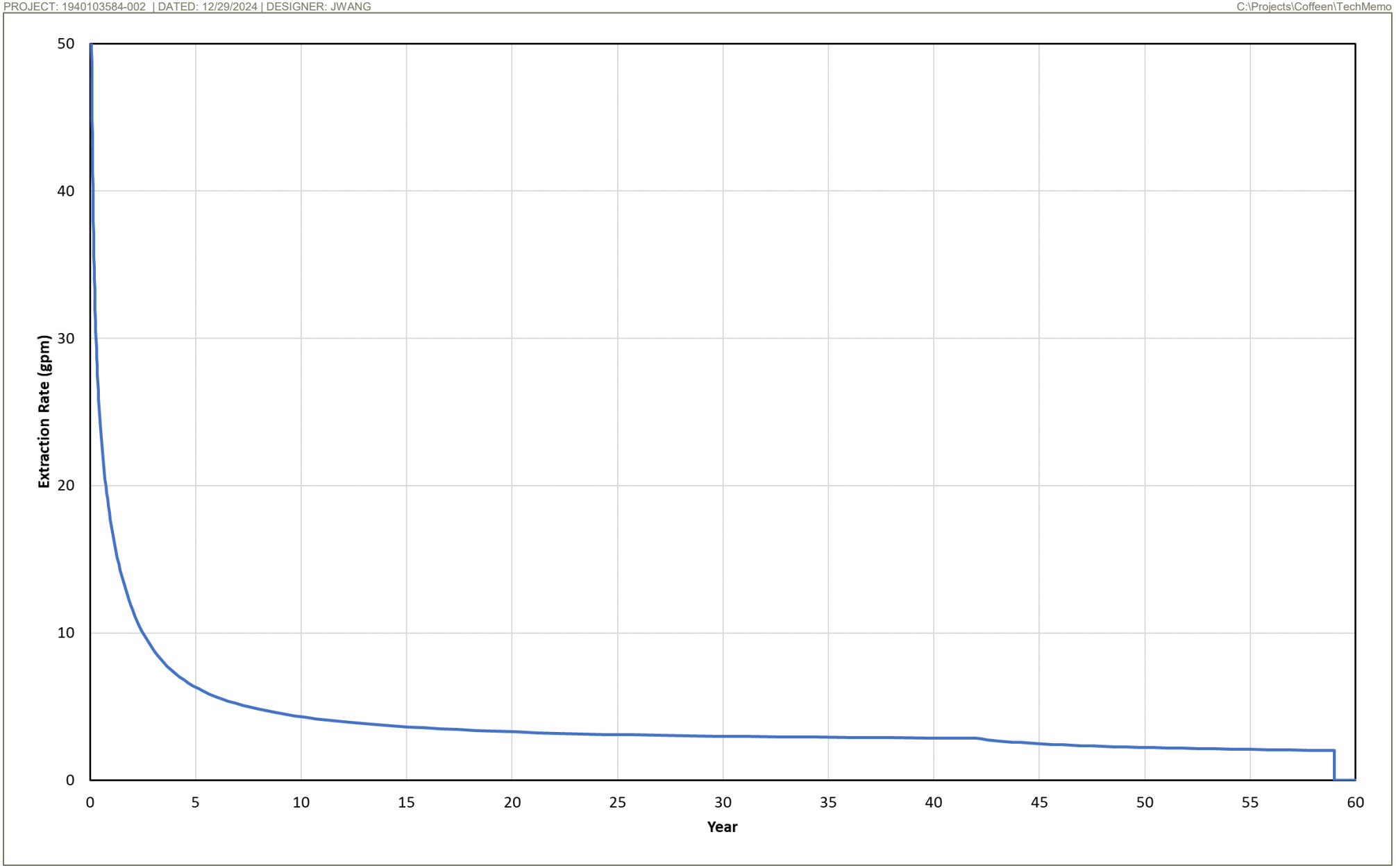
SIMULATED SULFATE CONCENTRATIONS IN AP2 MONITORING WELLS - ALTERNATIVE 2 REMEDY

FIGURE 4

ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL



SIMULATED EXTRACTION RATE FROM THE EXTRACTION TRENCH - ALTERNATIVE 2 REMEDY

ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 5

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL

- UA Monitoring Well
- LCU (Vandalia Member) Monitoring Well
- SI Unit
- Horizontal Well (Perforated)
- Horizontal Well (Non-Perforated)

0 300 600 Feet

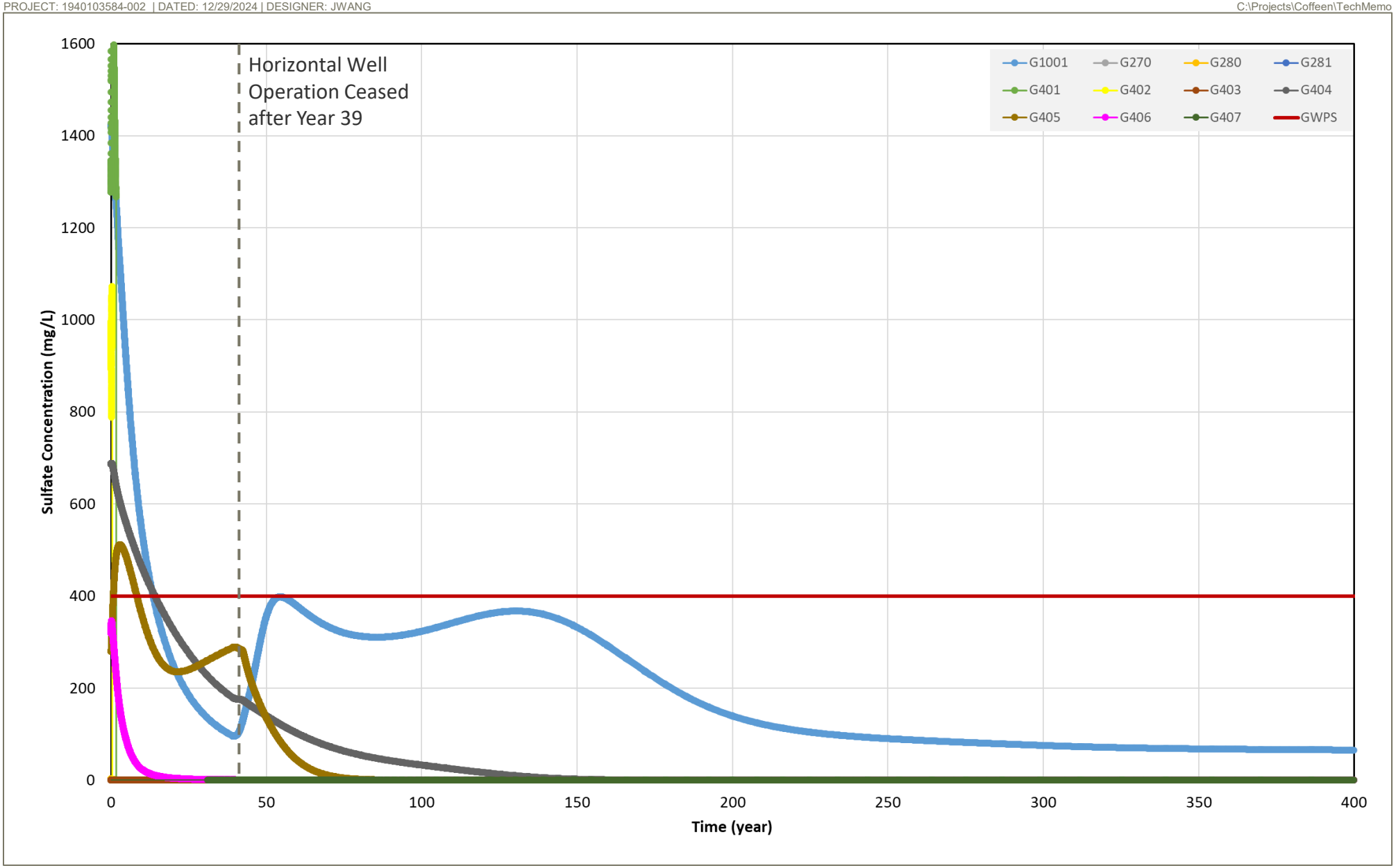
PROPOSED HORIZONTAL GROUNDWATER EXTRACTION WELL LOCATION - ALTERNATIVE 3 REMEDY

ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 6

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL



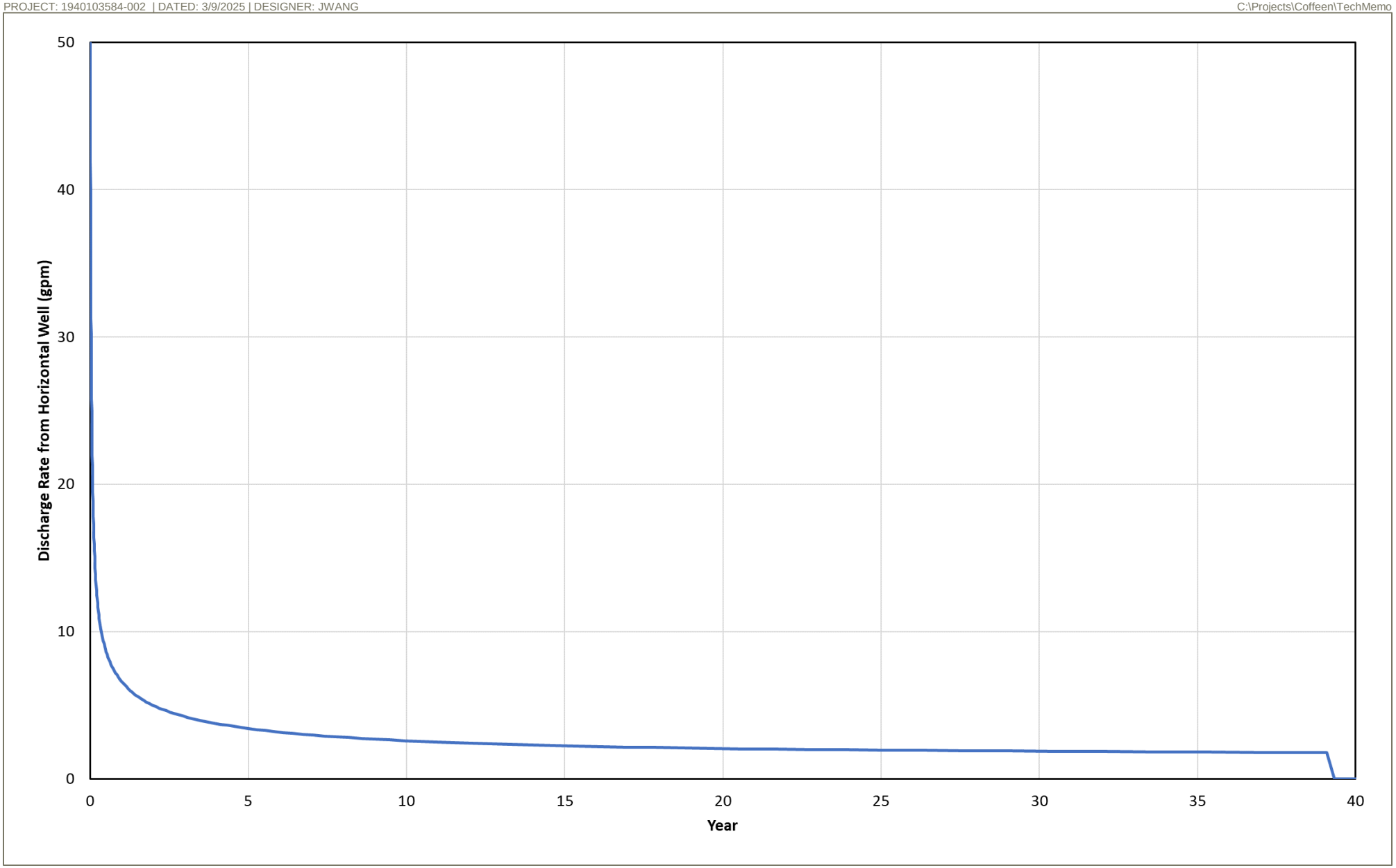
SIMULATED SULFATE CONCENTRATIONS IN AP2 MONITORING WELLS - ALTERNATIVE 3 REMEDY

FIGURE 7

ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL



SIMULATED DISCHARGE RATE FROM HORIZONTAL GROUNDWATER EXTRACTION WELL - ALTERNATIVE 3 REMEDY

ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 8

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL

APPENDIX A
MODFLOW AND MT3DMS MODELING FILES

(ELECTRONIC ONLY)

APPENDIX B2
GROUNDWATER MODELING REPORT (2022)

Intended for
Illinois Power Generating Company

Date
July 28, 2022

Project No.
1940101010-008

GROUNDWATER MODELING REPORT

ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL Bright ideas. Sustainable change.

GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT ASH POND NO. 1

Project name	**Coffeen Power Plant Ash Pond No. 1**
Project no.	**1940101010-008**
Recipient	**Illinois Power Generating Company**
Document type	**Groundwater Model Report**
Revision	**FINAL**
Date	**July 28, 2022**

Ramboll
234 W. Florida Street
Fifth Floor
Milwaukee, WI 53204
USA

T 414-837-3607
F 414-837-3608
https://ramboll.com

Saskia Noorduijn, PhD
Consultant

Brian G. Hennings, PG
Senior Managing Hydrogeologist

CONTENTS

Executive Summary **7**
1. Introduction **10**
1.1 Overview 10
1.2 Previous Groundwater Modeling Reports 10
1.3 Site Location and Background 10
1.4 Site History and CCR Units 11
2. Site Geology and Hydrogeology **13**
2.1 Stratigraphy 13
2.2 Hydrogeology 14
2.2.1 Groundwater Flow 14
2.2.2 Hydraulic Properties 15
2.2.3 Groundwater Elevation Data 15
2.2.4 Mining Activity 16
3. Groundwater Quality **17**
3.1 Groundwater Classification 17
3.2 Potential Groundwater Exceedances 17
4. Groundwater Model **19**
4.1 Overview 19
4.2 Description of Existing Model 19
4.3 Conceptual Model 19
4.3.1 Hydrogeology 19
4.3.2 Extent and Boundaries 20
4.3.3 Ash Pond No. 1 20
4.5 Model Approach 21
4.5.1 Potential Groundwater Exceedances 21
4.5.2 Summary of Modeling Activities 22
5. Model Setup and Calibration **23**
5.1 Model Descriptions 23
5.2 Flow and Transport Model Setup 24
5.2.1 Grid and Boundary Conditions 24
5.2.2 Flow Model Input Values and Sensitivity 25
5.2.2.1 Layer Top/Bottom 25
5.2.2.2 Hydraulic Conductivity 26
5.2.2.3 Recharge 26
5.2.2.1 Storage and Specific Yield 27
5.2.2.2 River Parameters 27
5.2.2.3 Drain Parameters 28
5.2.2.4 GMF Unit Parameters 28
5.2.2.5 General Head Boundary 29
5.2.3 Transport Model 30
5.2.3.1 Time Discretization and Stress Periods 30
5.2.3.2 GMF Units 31
5.2.3.3 Initial Concentration 32
5.2.3.4 Source Concentration 32
5.2.3.5 Effective Porosity 32

5.2.3.6	Storage and Specific Yield	33
5.2.3.7	Dispersivity and Diffusion	33
5.2.3.8	Retardation and Decay	33
5.3	Flow and Transport Model Assumptions and Limitations	34
5.4	Calibration Flow Model	34
5.5	Calibration Flow and Transport Model Results	35
6.	**Predictive Simulations**	**37**
6.1	Overview and Prediction Model Development	37
6.2	HELP Model Setup and Results	38
6.3	Simulation of Closure Scenarios	38
6.3.1	Closure in Place Model Results	39
6.3.2	Closure by Removal Model Results	40
7.	**Conclusions**	**42**
8.	**References**	**43**

TABLES (IN TEXT)

Table A Flow Model Layer Description
Table B River and Drain Information
Table C Liner System Properties From Top to Bottom for the GMF GSP, RP, and LF
Table D Transient Model Setup and Time Discretization

TABLES (ATTACHED)

Table 2-1 Monitoring Well Locations and Construction Details
Table 4-1 Flow and Transport Model Calibration Targets
Table 5-1 Flow Model Input and Sensitivity Analysis Results
Table 5-2 Transport Model Input Values (Calibration)
Table 5-3 Transport Model Input Sensitivity (Calibration)
Table 6-1 HELP Model Input and Output Values
Table 6-2 Prediction Model Input Values

FIGURES (IN TEXT)

Figure A Sulfate Correlation with TDS in UA Wells
Figure B Liner Modification Zones

FIGURES (ATTACHED)

Figure 1-1 Site Location Map
Figure 1-2 Site Map
Figure 2-1 Monitoring Well Location Map
Figure 2-2 Uppermost Aquifer Potentiometric Surface Map, April 20, 2021
Figure 2-3 Uppermost Aquifer Potentiometric Surface Map, July 26, 2021
Figure 4-1 Calibration and Predictive Timeline
Figure 5-1 Model Area Map
Figure 5-2 Boundary Conditions for Layer 1
Figure 5-3 Boundary Conditions for Layer 2
Figure 5-4 Boundary Conditions for Layer 3
Figure 5-5 Boundary Conditions for Layer 4
Figure 5-6 Boundary Conditions for Layer 5
Figure 5-7 Base of Model Layer 1
Figure 5-8 Base of Model Layer 2
Figure 5-9 Base of Model Layer 3
Figure 5-10 Base of Model Layer 4
Figure 5-11 Base of Model Layer 5
Figure 5-12 Hydraulic Conductivity Zones for Layer 1
Figure 5-13 Hydraulic Conductivity Zones for Layer 2
Figure 5-14 Hydraulic Conductivity Zones for Layer 3
Figure 5-15 Hydraulic Conductivity Zones for Layer 4
Figure 5-16 Hydraulic Conductivity Zones for Layer 5
Figure 5-17 Model Recharge Distribution Steady State (SS) Model
Figure 5-18 Model Recharge Distribution for the Transient (TR) Model TR-1 Stress Period 1
Figure 5-19 Model Recharge Distribution for the Transient (TR) Model TR-1 Stress Period 2
Figure 5-20 Model Recharge Distribution for the Transient (TR) Model TR-2 Stress Period 1
Figure 5-21 Model Recharge Distribution for the Transient (TR) Model TR-3 Stress Period 1

Figure 5-22 Observed Versus Simulated Steady State Groundwater Levels from the Calibrated Model
Figure 5-23 Simulated Groundwater Level Residuals from the Calibrated Model
Figure 5-24 Simulated Steady State Groundwater Level Contours from UA (Layer 3) from the Calibrated Model
Figure 5-25 Simulated Steady State Groundwater Level Contours in Proximity to AP1 from UA (Layer 3) from the Calibrated Model
Figure 5-26 Observed Versus Simulated Sulfate Concentrations (mg/L)
Figure 5-27 Simulated Sulfate Plume in the UA from the Transient Model
Figure 6-1 CIP Recharge and Stormwater Pond Modifications
Figure 6-2 CBR Recharge and Stormwater Pond Modifications
Figure 6-3 Simulated Sulfate Plume of the UA for the CIP and CBR Scenarios After 14.8 Years
Figure 6-4 Simulated Maximum Extent of the Sulfate Plume for the CIP and CBR Scenarios After 14.8 Years
Figure 6-5 Simulated Sulfate Plume of the UA for the CIP and CBR Scenarios After 58.8 Years
Figure 6-6 Simulated Maximum Extent of the Sulfate Plume for the CIP and CBR Scenarios After 58.8 Years
Figure 6-7 Scenario 1 (CIP) – Hydraulic Steady State Reductions in Total Flux In and Out of the Fill Unit (CCR)
Figure 6-8 Scenario 1 (CIP) – Reduction in Total Flux In and Out of the Fill Unit (CCR)
Figure 6-9 Potential Ash Saturation in Simulated Scenario 1 (CIP)

APPENDICES

Appendix A Evaluation of Potential GWPS Exceedances (Geosyntec Consultants, Inc., 2022a)
Appendix B MODFLOW, MT3DMS, and HELP Model Files (Electronic only)
Appendix C Evaluation of Partition Coefficient Results (Geosyntec Consultants, Inc., 2022b)
Appendix D HELP Model Output Files
Appendix E Flux Evaluation Data

ACRONYMS AND ABBREVIATIONS

§	Section
35 I.A.C.	Title 35 of the Illinois Administrative Code
AP1	Ash Pond No. 1
AP2	Ash Pond No. 2
bgs	below ground surface
CBR	closure by removal
CCR	coal combustion residual(s)
CIP	closure in place
cm/s	centimeter per second
CPP	Coffeen Power Plant
CSM	conceptual site model
DA	deep aquifer
DCU	deep confining unit
DEM	Digital Elevation Model
ft^2	square feet
ft/d	feet per day
ft/ft	feet per foot
Geosyntec	Geosyntec Consultants, Inc.
GHB	general head boundary conditions
GMF GSP	Gypsum Management Facility Gypsum Stack Pond
GMF RP	Gypsum Management Facility Recycle Pond
GMP	Groundwater Monitoring Plan
GMR	Groundwater Modeling Report
GWPS	groundwater protection standard(s)
Hanson	Hanson Professional Services, Inc.
HCR	Hydrogeologic Site Characterization Report
HDPE	high density polyethylene
HELP	Hydrologic Evaluation of Landfill Performance
HFB	horizontal flow barrier
HUC	Hydrologic Unit Code
ID	identification
IEPA	Illinois Environmental Protection Agency
IPGC	Illinois Power Generating Company - IPGC
ISGS	Illinois State Geological Survey
K_D	linear isotherm
K_{eff}	effective hydraulic conductivity
K_F	Freundlich isotherm
K_L	Langmuir isotherm
Kd	distribution coefficient
Kh/Kv	anisotropy ratio
LCU	lower confining unit
LF	Landfill
L/kg	liters per kilogram
m	meter
mg/L	milligrams per liter

mil	one thousandth of an inch
mL/g	milliliters per gram
NAVD88	North American Vertical Datum of 1988
NID	National Inventory of Dams
No.	number
NPDES	National Pollutant Discharge Elimination System
NRT	Natural Resources Technology, Inc.
Part 845	35 I.A.C. § 845: Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments
R2	correlation coefficient
Ramboll	Ramboll Americas Engineering Solutions, Inc.
SI	surface impoundment(s)
SSR	sum of squared residuals
TDS	total dissolved solids
TR	transient model
TVD	total-variation-diminishing
UA	uppermost aquifer
UCU	upper confining unit
USDA/NRCS	United States Department of Agriculture/Natural Resources Conservation Service
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

EXECUTIVE SUMMARY

Ramboll Americas Engineering Solutions, Inc. (Ramboll) has prepared this Groundwater Modeling Report (GMR) on behalf of the Coffeen Power Plant (CPP), operated by Illinois Power Generating Company - IPGC (IPGC), in accordance with requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) Section (§) 845: Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments (Part 845) (Illinois Environmental Protection Agency [IEPA], 2021). This document presents the results of predictive groundwater modeling simulations for proposed closure scenarios for the coal combustion residuals (CCR) management unit Ash Pond Number (No.) 1 (AP1 [(Vistra Identification [ID] No. 101, IEPA ID No. W1350150004-01, and National Inventory of Dams [NID] No. IL50722]). AP1 is a 23-acre, unlined surface impoundment (SI) used to manage CCR and non-CCR waste streams at the CPP. Its total storage capacity is approximately 300 acre-feet.

The CPP is located in Montgomery County, in central Illinois between the two lobes of Coffeen Lake (**Figure 1-1**), which was formed in 1963 by damming the McDavid Branch of the East Fork of Shoal Creek. Coffeen Lake encompasses approximately 1,100 acres and was created to provide a source of cooling water for the CPP. Coffeen Lake borders the CPP to the west, east, and south, and agricultural land is located to the north. Historically coal mines were operated at depth below the site. Mine shafts, processing facilities, and historic coal storage were located on the southern extent of the CPP, south of AP1. The CPP operated as a coal-fired power plant from 1964 until November 2019 and has five CCR management units, with AP1 being the subject of this GMR. Unlithified material present above the bedrock in the vicinity of the CPP was categorized into hydrostratigraphic units as part of the 2021 Hydrogeologic Site Characterization Reports (HCR; Ramboll, 2021a). In addition to the CCR, the hydrostratigraphic units occur in the following order (from ground surface downward) and include:

- **Upper Confining Unit (UCU):** Consists of the Loess Unit and the upper clayey portion of the Hagarstown Member which has generally lower vertical permeability. The UCU has been eroded east of AP1, near the Unnamed Tributary.
- **Uppermost Aquifer (UA):** The UA is the sandy portion of the Hagarstown Member which is classified as primarily sandy to gravelly silts and clays with thin beds of sands. Similar to the Loess Unit, the Hagarstown is absent in some locations near the Unnamed Tributary.
- **Lower Confining Unit (LCU):** Comprised of the Vandalia Member, Mulberry Grove Member, and Smithboro Member. These units include a sandy to silty till with thin, discontinuous sand lenses, a discontinuous and limited extent sandy silt which has infilled prior erosional features, and silty to clayey diamicton, respectively.
- **Deep Aquifer (DA):** Sand and sandy silt/clay units of the Yarmouth Soil, which include accretionary deposits of fine sediment and organic materials, typically less than five feet thick and discontinuous across the CPP.
- **Deep Confining Unit (DCU):** Comprised of the Banner Formation and generally clays, silts, and sands. The Lierle Clay Member is the upper layer of the Banner Formation which was encountered at the CPP.

Flow of groundwater from central portions of the CPP to Coffeen Lake or the Unnamed Tributary through the UA are the primary pathways for contaminant migration. Groundwater elevations are

primarily controlled by surface topography, geologic unit topography, and water levels within Coffeen Lake and the Unnamed Tributary. A groundwater divide trending north-south is observed running through the approximate center of the CPP. Phreatic surfaces or water elevations within the SI are generally consistent and have not been observed to fluctuate with groundwater elevations, indicating limited hydraulic connection with the SI.

The conceptual site model (CSM) for modeling the groundwater at the CPP is as follows:

- Most hydrostratigraphic layers are laterally continuous across the area. The flat to gently rolling uplands are dissected by deeply incised streams (into the materials of the UCU, UA, and LCU) that are tributaries to river systems in the area. Coffeen Lake was created by damming one of these tributary streams for use by the CPP.
- The UA is separated from the bottom of the AP1 by a minimum of 10 feet of low-permeability glacial till that comprises the UCU. Erosion caused by incised streams has occurred along the northeast corner of AP1 which likely results in ash being in contact with the UA.
- Surface recharge and groundwater migrate vertically through the low permeability sediments of the UCU. Groundwater migrates horizontally through the higher permeability sediments of the UA.
- Groundwater elevations and lake elevations indicates groundwater flows into Coffeen Lake from the UA.
- AP1 is constructed such that the earthen berm and base are in contact with the UCU with exception of limited areas in the northeast of the SI where the UCU and UA have been eroded and the berm and base are in contact with the LCU.
- The stage within AP1 is managed with minimal (less than 3 feet) variability throughout the year.

A review and summary of data collected from 2015 through 2021 for parameters with groundwater protection standards (GWPS) listed in 35 I.A.C. § 845.600 is provided in the HCR (Ramboll, 2021a). Concentration results presented in the HCR and summarized in the History of Potential Exceedances (Ramboll, 2021b) are considered potential exceedances because the methodology used to determine them is proposed in the Statistical Analysis Plan (Appendix A to the Groundwater Monitoring Plant [GMP], Ramboll 2021c), which has not been reviewed or approved by IEPA at the time of submittal of the Part 845 operating permit application. The following constituents with potential exceedances of the GWPS listed in 35 I.A.C. § 845.600 were identified: boron, cobalt, pH, sulfate, and total dissolved solids (TDS) (Ramboll, 2021b) at AP1.

A Technical Memorandum (**Attachment A**) was prepared by Geosyntec Consultants, Inc. (Geosyntec, 2022a), *Evaluation of Potential Groundwater Protection Standard Exceedances, Coffeen Ash Pond No.1, Coffeen Illinois*, to further evaluate potential GWPS exceedances. The results of the evaluation demonstrated that the potential GWPS exceedances of cobalt in well G314 and pH in well G312 are not related to AP1 based on several lines of evidence presented in the Technical Memorandum.

Statistically significant correlations between sulfate concentrations and concentrations of TDS identified as potential exceedances of the GWPS indicate sulfate is an acceptable surrogate for TDS in the groundwater model. Concentrations of TDS are expected to change along with model predicted sulfate concentrations. A potential exceedance of boron was observed at one

monitoring well, G313, which also has potential exceedances of both sulfate and TDS. Similar source and behavior in the groundwater system would be expected among boron, sulfate, and TDS at UA monitoring well G313, and boron concentrations are expected to change along with model predicted sulfate concentrations.

It was assumed that sulfate would not significantly sorb or chemically react with aquifer solids (distribution coefficient [Kd] was set to 0 milliliters per gram [mL/g]) which is a conservative estimate for predicting contaminant transport times in the model. Boron, sulfate, and TDS transport is likely to be affected by both chemical and physical attenuation mechanisms (*i.e.,* adsorption and/or precipitation reactions as well as dilution and dispersion).

All available hydrological information were used to construct a CSM and numerical model of the CPP. A steady state, 5-layer numerical model, based on a previous groundwater model of the area, was constructed to characterize the long-term groundwater flow conditions at the site. The hydrostratigraphic units included in the model were the UCU, UA, and LCU. The DA and DCU were not included in the model. Calibration of the model focused on simulating mean groundwater elevations for 95 wells at the site by modifying hydraulic parameters for the different hydrostratigraphic units, alongside river and general head boundary conductance. The calibrated model represents a reasonable match to the observed head and sulfate concentration data.

The calibrated model was used to predict the sulfate concentration for two closure scenarios using information provided in the Final Closure Plan for AP1 (Golder Associates [Golder], 2022a) including:

- **Scenario 1:** closure in place (CIP) including removal of CCR from the eastern portion of AP1, consolidation into the western portion of AP1, and construction of a cover system over the remaining CCR, and;
- **Scenario 2:** closure by removal (CBR) including removal of all CCR and regrading of the removal area.

Prior to the simulation of these scenarios, a dewatering simulation was included, which simulated the removal of free liquids from AP1 prior to the implementation of the two closure scenarios.

Scenario 1 (CIP) was predicted to reduce total flux in and out of the Fill Unit (CCR) by approximately 99.9%, when simulated post-construction heads in the groundwater monitoring wells are predicted to stabilize. Additionally, the base of consolidated CCR was compared to the simulated steady-state groundwater elevations which indicate between 3.2 and 10 feet of separation will be present between the base of CCR and groundwater.

Differences exist in the timeframes to reach the GWPS for most monitoring wells between CIP and CBR. In general, the simulated groundwater concentrations in the monitoring wells within the UA will achieve the GWPS in 15 years and 18 years respectively for the CIP and CBR closure scenarios, with the exception of well G301 in the CIP scenario. The predicted delayed reduction in concentration at well G301, 59 years to reach the GWPS, is a result of the well being located along the flow path of the residual sulfate concentrations released into native geologic materials prior to closure. Reduced percolation rates through the consolidation area at the northwest corner of AP1 in the CIP scenario means that the residual sulfate concentrations in this limited area require a longer time period to migrate through native geologic materials.

1. INTRODUCTION

1.1 Overview

In accordance with the requirements of Part 845 (IEPA, 2021), Ramboll has prepared this GMR on behalf of the CPP, operated by IPGC. This report will apply specifically to the CCR unit referred to as AP1 (**Figure 1-1**). However, information gathered to evaluate other CCR units at the CPP regarding geology, hydrogeology, and groundwater quality is included, where appropriate. AP1 is a 23-acre, unlined SI used to manage CCR and non-CCR waste streams at the CPP. Its total storage capacity is approximately 300 acre-feet. This GMR presents and evaluates the results of predictive groundwater modeling simulations for two proposed closure scenarios, including CCR consolidation and CIP, and CBR scenarios summarized below.

- **Scenario 1:** CIP including removal of CCR from the eastern portion of AP1, consolidation into the western portion of AP1, and construction of a cover system over the remaining CCR.
- **Scenario 2:** CBR including removal of all CCR and regrading of the removal area.

1.2 Previous Groundwater Modeling Reports

Several reports containing groundwater modeling have been completed at the CPP. The information presented in this GMR includes data collected in support of the previous groundwater models as well as data collected as part of a 2021 field investigation to support development of a HCR (Ramboll, 2021a). The HCR was provided as an attachment to the initial operating permit application required by 35 I.A.C. § 845.230. Previous groundwater modeling reports completed for the various CCR units located at the CPP include, but are not limited to, the following (recent to oldest):

- ***Natural Resources Technology, Inc. (NRT), January 24, 2017. Hydrostatic Modeling Report. Coffeen Power Station, Coffeen, Illinois.***
  Utilized the Hydrologic Evaluation of Landfill Performance (HELP) model to predict percolation from Ash Pond No. 2 (AP2) and evaluate AP2 hydrostatic conditions in response to the proposed cover system as described in the Revised 30% Closure Design Package.
- ***NRT, January 24, 2017. Groundwater Modeling Report. Coffeen Power Station, Coffeen, Illinois.***
  Included simulations of the site hydrology, the extent of CCR leachate impacts on groundwater, and the effect of pond closure on groundwater quality.

1.3 Site Location and Background

The CPP is located in Montgomery County, in central Illinois, within Section 11 Township 7 North and Range 7 East (**Figure 1-1**). The CPP is approximately two miles south of the city of Coffeen and about eight miles southeast of the city of Hillsboro, Illinois. AP1 is located between the two lobes of Coffeen Lake (identified as "Coffeen Lake" and "Unnamed Tributary" on **Figure 1-1** and **Figure 1-2**) to the west, east, and south, and is bordered by agricultural land to the north. The approximately 1,100-acre Coffeen Lake was built by damming the McDavid Branch of the East Fork of Shoal Creek in 1963 for use as an artificial cooling lake for the CPP. Historically, several coal mines were operated at depth in the vicinity of the CPP as well as the US Minerals processing facility located to the north. **Figure 1-2** is a site map showing the location of AP1 (Part 845 regulated CCR unit and subject of this GMR), AP2, Gypsum Management Facility Recycle Pond

(GMF RP), Gypsum Management Facility Gypsum Stack Pond (GMF GSP), and Landfill (LF). A surface water pond southwest of the LF collects overflow from the LF, this feature does not contain CCR. The area near AP1 will hereinafter be referred to as the Site.

1.4 Site History and CCR Units

The CPP was a coal-fired electrical generating plant that began operation in 1964. The plant initially burned bituminous coal from Illinois and CCR from the coal fired units was disposed of in AP1. AP2 was also utilized in the early 1970's and AP1 was reconstructed in 1978. Both of these units were used until the mid-1980's. Beginning in 2010, CCR material was placed in the LF and GMF units (*i.e.,* GMF RP and GMF GSP). All approximate dates of construction of each successive stage of the CCR units at the CPP are included in the groundwater model and described here.

AP1: This SI (also known as the Bottom Ash/Recycle Pond) is a reclaimed ash pond that was reconstructed utilizing the existing earthen berms with reinforcement, as provided by Water Pollution Control Permit 1978-EA-389 issued by the IEPA on May 26, 1978. AP1 (existing unlined SI) covers an area of approximately 23 acres, has berms up to 41 feet above the surrounding land surface, and a volume of 300 acre-feet. It primarily received bottom ash and low volume wastes from floor drains in the main power block building. Several years ago, air heater wash and boiler chemical cleaning wastes were directed to AP1, but this practice was discontinued. The bottom ash was periodically removed for beneficial uses by a third-party contractor. Sluicing of waste to AP1 ceased prior to November 4, 2019.

AP2: AP2 is a closed (IEPA approved) SI with a surface area of approximately 60 acres and berms 47 feet higher than the surrounding land surface. AP2 was originally removed from service and capped in the mid 1980's. A clay and soil cap was placed on the surface of the pond with contouring and drainage provided to direct storm water to four engineered revetment down drain structures. Prior to capping, this pond was identified as Outfall 004 in the facility National Pollutant Discharge Elimination System (NPDES) operating permit, IL0000108. Additional closure activities include the construction of a geomembrane cover system that began in July 2019 and was completed on November 17, 2020. The construction was completed in accordance with the Closure and Post Closure Care Plan approved by the IEPA on January 30, 2018.

GMF GSP: The 77-acre GMF GSP received blowdown from the air emission scrubbers and was put into operation in 2010. Construction of the GMF GSP was in accordance with Water Pollution Control Permit 2008-EA-4661 and features a composite 60- one thousandth of an inch (mil) high-density polyethylene (HDPE) liner with 3 feet of recompacted soil with a hydraulic conductivity of 1×10^{-7} centimeters per second (cm/s) with internal piping and drains to collect contact water. Construction of the unit required excavation to approximately 603 feet North American Vertical Datum of 1988 (NAVD88), removal of the sands and silts of the UA prior to construction of the liner, and installation of a groundwater underdrain system to eliminate inward pressure on the liner prior to placement of CCR. The GMF GSP underdrain was actively pumped during construction but is no longer actively pumped. IPGC ceased receipt of waste to the GMF GSP prior to April 11, 2021.

GMF RP: The 17-acre GMF RP received blowdown from the air emission scrubbers and was put into operation in 2010. Construction of the GMF RP was in accordance with Water Pollution Control Permit 2008-EA-4661 and features a composite 60-mil HDPE liner with 3 feet of recompacted soil with a hydraulic conductivity of 1×10^{-7} cm/s with internal piping and drains to collect contact water. Construction of the unit required excavation to approximately 601 feet

NAVD88, removal of the sands and silts of the UA prior to construction of the liner, and installation of a groundwater underdrain system to eliminate inward pressure on the liner prior to placement of CCR. The GMF RP underdrain is a passive, gravity drained system. IPGC ceased receipt of waste to the GMF RP prior to April 11, 2021.

LF: Fly ash was managed in a permitted composite lined landfill constructed in 2010. The LF has an active groundwater underdrain system that is currently being pumped. Additionally, the ash landfill leachate collection system is restricted by rule to no more than one foot of leachate on the composite liner. An IEPA groundwater monitoring program is in effect for the GMF GSP and GMF RP (under Bureau of Water), and LF (under Bureau of Land).

2. SITE GEOLOGY AND HYDROGEOLOGY

2.1 Stratigraphy

The geology and hydrogeology of AP1 are described in detail in the HCR (Ramboll, 2021a) and summarized below.

The unlithified stratigraphy within and immediately surrounding AP1 consists of the following in descending order: fill material and CCR; clays and silts (Loess Unit); gravelly clay till and sandy materials, absent in some locations (Hagarstown Member); a weathered till zone and sandy, silt, or clay till (Vandalia Member); silt and sandy silt/clay unit (Mulberry Grove Member); silty clay diamicton (Smithboro Member); sand and sandy silt/clay, absent in some locations (Yarmouth Soil); and clay and silt with some sand (Lierle Clay Member). The unlithified units overlay Pennsylvanian-age limestone, sandstone, and minor coal beds (Bond Formation). The Bond Formation bedrock was not encountered in any borings advanced at the CPP, so site-specific information is not available.

CCR consisting of bottom ash and other non-CCR waste is present within AP1 at a thickness of up to 18 feet, as estimated from borings advanced within AP1, and an average thickness of 10 feet. However, CCR materials may be thicker near former drainage features in localized areas eroded through the loess and clay (Ramboll, 2021a). One such former drainage feature is located in the northeast corner of AP1 and ash fill may be in contact with the sandy portion of the Hagarstown Member similar to features observed at AP2. Non-CCR fill material consisting of silty clay, sandy lean clay, or lean clay with sand, with trace amounts of fine gravel comprises the berms surrounding AP1.

The Loess Unit is the uppermost unlithified unit identified at the CPP. This unit is comprised of the combined Roxana and Peoria Silt and extends from beneath the topsoil, derived from the loess, to the top of the Hagarstown Member. The loess has been classified as silt or clayey silt, with minor amounts of sand. The Loess Unit ranges in thickness from 0 feet (absent) to 16 feet, and was generally 8 to 14 feet thick, where present near AP1. The Loess Unit is generally considered unsaturated, and the UA is recharged by precipitation that percolates through this unit.

The Hagarstown Member (also referred to as Hagarstown Beds) exhibits two units: the first unit consisting of the gravelly clay till and the second consisting of sandy material overlying the Vandalia Member. The clay till portion had varying thicknesses ranging from approximately 2 to 6 feet as observed adjacent to AP1 (Ramboll, 2021a). The sandy portion of the Hagarstown, where present, was typically encountered between 9 and 34 feet below ground surface (bgs) near AP1, and is generally 1 to 5 feet thick, although thicknesses up to 7 feet have been observed north of the LF (Ramboll, 2021d; Ramboll, 2021e). The composition of the sandy portion of the Hagarstown unit varies across the CPP and has been classified as gravelly till, poorly sorted gravel, well sorted gravel, sand, and silty sand. Based on historic topography, the Hagarstown Member is not present in former drainage features present along the banks of Coffeen Lake and the Unnamed Tributary. During construction of the LF, GMF GSP, and the GMF RP, the Loess Unit and portions of the Hagarstown Member were excavated to facilitate construction.

The Vandalia (*i.e.,* till) Member is a sandy/silty till with thin, discontinuous lenses of silt, sand, and gravel. The Vandalia Member was encountered between 1.5 and 34 feet bgs in all borings

advanced at the CPP. The Vandalia Member typically ranged in thickness from 11.7 feet in the northern portion of the CPP, to 31.0 feet between the GMF GSP and the GMF RP. Similar to the observed top elevation of the Hagarstown Member, the top of the Vandalia Member declines in elevation near Coffeen Lake and topographic drainage features. This unit is relatively thick throughout the CPP, with an average thickness of over 15 feet (Hanson Professional Services, Inc. [Hanson], 2009).

The Mulberry Grove (*i.e.,* silt) Member typically consists of a thin, lenticular unit of gray sandy silt (Willman et al., 1975). It represents the interval between the retreat of the glacier that deposited the Smithboro Member and the advance of the glacier that deposited the Vandalia Member. At the CPP, the Mulberry Grove Member is represented by gray sandy silt layers deposited in depressions found in the surface of the underlying Smithboro Member. This unit was absent in many borings through the central portion of the CPP from south to north, and is generally less than 2 feet thick, but was measured at up to 4.9 feet thick near the GMF GSP (Hanson, 2009).

The Smithboro (*i.e.,* till) Member is described as a gray, compact, silty, clayey diamicton that ranges in thickness from 6.7 to 21.2 feet northwest of the LF.

The Yarmouth Soil is described as the weathered zone on the Kansan drift, but in some places, it consists of accretionary deposits of fine sediment and organic material that accumulated in poorly drained areas on the surface of the Kansan deposits. Historical borings in the northern portion of the CPP which encountered the Yarmouth were summarized previously by Hanson (2009) as ranging in thickness from 0 feet (absent) to 5.1 feet.

The Lierle Clay Member is the uppermost member of the Kansan Stage Banner Formation. It is described as an accretion gley with clay, silt, and some sand. It was encountered by Hanson (2009) in all but a few borings on site. During the 2021 investigation, the top of the Lierle Clay was observed between 54 and 57 feet bgs. No borings advanced at the CPP penetrated the full thickness of the Banner Formation.

Pennsylvanian-age Bond Formation bedrock was not encountered in any borings advanced at the CPP, so site-specific information is not available.

2.2 Hydrogeology

Regionally, the water table conforms to the topographic features of the land surface. Recharge occurs in the uplands and flows towards drainage features. Moderate thicknesses of unconsolidated materials fill shallow valleys or are present on the uplands bordering the main valleys. These materials contain thin and discontinuous deposits of sand and gravel.

2.2.1 Groundwater Flow

Monitoring well locations are illustrated in **Figure 2-1**. Monitoring well locations and construction details are summarized in **Table 2-1**. Overall groundwater flow within the UA is divided towards the two lobes of Coffeen Lake. Groundwater generally flows from the center of the CPP west towards Coffeen Lake, and east towards the Unnamed Tributary, the eastern lobe of Coffeen Lake, and the discharge flume, resulting in a groundwater divide (high) running through the middle of the CPP (**Figure 2-2** and **Figure 2-3**). Groundwater flows north to northeast across AP1 toward the former discharge structure and Unnamed Tributary. Although elevations vary

seasonally, the groundwater flow direction in the UA is consistent and likely controlled by the proximity and hydraulic connection to Coffeen Lake.

2.2.2 Hydraulic Properties

Over 100 monitoring wells have been installed since 2006 to monitor groundwater conditions around the five CCR units at the CPP for both State and Federal groundwater compliance programs. Six hydrostratigraphic units were described in detail in the HCR (Ramboll, 2021a) and are summarized as follows:

- **CCR**: This unit is composed of CCR, consisting primarily of bottom ash. This also includes earthen fill deposits of predominantly silt and clay materials from on-site excavations that were used to construct berms and roads surrounding the various impoundments across the CPP. Laboratory testing of one CCR (ash) sample from AP1 had a vertical hydraulic conductivity of 8.8×10^{-5} cm/s.
- **UCU**: Consists of the Loess Unit and the upper clayey portion of the Hagarstown Member which has generally lower vertical permeability and generally greater than 60 percent fines (Ramboll, 2021a). This unit was encountered across most of the CPP, with the exception of the eastern edges of AP1 near the Unnamed Tributary where the unit was eroded following deposition or locations where it has been excavated for construction. Vertical hydraulic conductivities based on laboratory testing ranged from 1.3×10^{-8} to 5.0×10^{-7} cm/s.
- **UA** This unit consists primarily of sand and sandy silts and clays at the base of the Hagarstown Member and, in some locations, the uppermost weathered sandy clay portion of the Vandalia Member. This unit is absent in several locations due to weathering and in others due to excavation during construction of CCR Units. Field hydraulic conductivity tests indicated hydraulic conductivities ranged from 1.7×10^{-5} to 9.1×10^{-3} cm/s near AP1. Laboratory testing of one UA sample, collected near the GMF RP, had a vertical hydraulic conductivity of 1.6×10^{-4} cm/s (Ramboll, 2021a).
- **LCU**: This unit is composed of the sandy clay till of the Vandalia Member, the silt of the Mulberry Grove Formation, and the compacted clay till of the Smithboro Member. The unit underlies the UA and was encountered in all boring locations on the CPP. Results from laboratory tests completed for vertical hydraulic conductivity indicate the Vandalia Member has a very low vertical hydraulic conductivity. Field hydraulic conductivity tests indicated hydraulic conductivities from 4.0×10^{-8} to 3.4×10^{-5} cm/s; however, these likely reflect the isolated and discontinuous sandy lenses. Vertical hydraulic conductivities based on laboratory testing were from 1.3×10^{-8} to 5.0×10^{-7} cm/s.
- **DA**: This unit consists primarily of sandy silt and sands of the Yarmouth Soil, which are thin (less than 5 feet) and discontinuous across the CPP. Field hydraulic conductivity tests indicated hydraulic conductivities from 8.7×10^{-5} to 1.7×10^{-3} cm/s within the DA.
- **DCU**: This unit underlies the DA and is composed of the Banner Formation, of which the thick Lierle Clay is the first encountered unit. No boring penetrated the full thickness of this formation.

2.2.3 Groundwater Elevation Data

During the 2021 Part 845 investigation, groundwater elevations in the UA ranged from approximately 591 to 625 feet NAVD88 across the CPP. Groundwater elevations were typically

highest towards the northern extent of the CPP, near the GMF GSP and GMF RP, except monitoring well G307 south of AP1, which consistently had the highest groundwater elevation. Groundwater elevations were lowest near the Unnamed Tributary and east of AP1 towards Coffeen Lake. Groundwater elevations in the vicinity of AP1 were typically from 591 to 621 feet NAVD88, with the exception of G307 as noted above, which was typically around 624 feet NAVD88 (**Figure 2-2** and **Figure 2-3**).

No seasonal variation has been observed in the UA monitoring wells, and any seasonal responses may be muted by the proximity and hydraulic connection to Coffeen Lake.

2.2.4 Mining Activity

Several coal mines, both strip and underground types, previously operated in Montgomery County, Illinois. Three mines - the Hillsboro Mine (Illinois State Geological Survey [ISGS] Mine No. 871), the Clover Leaf No. 4 Mine (ISGS Mine No. 442), and the Clover Leaf No. 1 Mine (ISGS Mine No. 3001) – were operated as room and pillar mines in the vicinity of the site beginning as early as 1889. The mines extracted coal from the Herrin (No. 6) Coal at depths of approximately 500 to 535 feet bgs (ISGS, 2019). All nearby mining operations ceased in 1983.

The Hillsboro Mine showed indications of small-scale faulting, roof stability issues, and floor heaving. Mine shafts, processing facilities, and some historic coal storage associated with these historic mines were located south of AP1. AP1 directly overlies the Hillsboro Mine. AP1 is outside of the buffer zone of the Clover Leaf No. 4 and Clover Leaf No. 1 mines (Ramboll, 2021a).

3. GROUNDWATER QUALITY

3.1 Groundwater Classification

Per 35 I.A.C. § 620.210, groundwater within the UA at AP1 meets the definition of Class I - Potable Resource Groundwater based on the following criteria:

- Groundwater in the UA is located 10 feet or more below the land surface and
- Within a geologic material which is capable of a hydraulic conductivity of 1 x 10^{-4} cm/s or greater using a slug test.

Field hydraulic conductivity tests performed in the UA near AP1 in 2021 had a geometric mean of 2.0 x 10^{-3} cm/s (Ramboll, 2021a). Based on this information, groundwater is classified as Class I – Potable Resource Groundwater.

However, background (upgradient) groundwater originates from areas southwest of AP1 that have historically been used for coal storage and present a potential alternate source for groundwater impacts.

3.2 Potential Groundwater Exceedances

A review and summary of data collected from 2015 through 2021 for parameters with GWPSs listed in 35 I.A.C. § 845.600 is provided in the HCR (Ramboll, 2021a). Concentration results presented in the HCR were compared directly to 35 I.A.C. § 845.600 GWPSs to determine potential exceedances. The results are considered potential exceedances because the results were compared directly to the standard and did not include an evaluation of background groundwater quality or utilize the statistical methodologies proposed in the GMP (Ramboll, 2021c) attached to the operating permit application.

Groundwater concentrations from 2015 to 2021 are summarized in the History of Potential Exceedances (Ramboll, 2021b) (attached to the operating permit application) and are considered potential exceedances because the methodology used to determine them is proposed in the Statistical Analysis Plan (Appendix A to the GMP, Ramboll 2021c), which has not been reviewed or approved by IEPA at the time of submittal of the Part 845 operating permit application.

The History of Potential Exceedances attached to the operating permit application summarizes all potential groundwater exceedances following the proposed Statistical Analysis Plan. The following potential exceedances were identified:

- Boron – determined at well G313.
- Cobalt - determined at well G314.
- pH (lower limit) - determined at well G312.
- Sulfate - determined at wells G301, G303, G304/G307, G305, G307D, G308, G309, G310, G311, G312, G313, G314, G314D, G315, and G317.
- TDS - determined at wells G303, G304/G307, G305, G307D, G308, G309, G310, G311, G312, G313, G314, G315, and G317.

A Technical Memorandum (**Attachment A**) was prepared by Geosyntec Consultants, Inc. (Geosyntec, 2022a), *Evaluation of Potential Groundwater Protection Standard Exceedances, Coffeen Ash Pond No.1, Coffeen Illinois*, to further evaluate potential GWPS exceedances. The

results of the evaluation demonstrated that the potential GWPS exceedances of cobalt in well G314 and pH in well G312 are not related to AP1 based on several lines of evidence presented in the Technical Memorandum. Since potential GWPS exceedances for cobalt and pH are not related to AP1, these parameters will not be discussed further in this GMR.

4. GROUNDWATER MODEL

4.1 Overview

Data collected at the Site from 2015 to the 2021 field investigation were used to update an existing groundwater model of the CPP (NRT, 2017b). The updated model was then used to evaluate the results of predictive groundwater modeling simulations for two proposed closure scenarios, including CCR consolidation and CIP, and CBR. The modeling results are summarized and evaluated in this GMR. The associated model files are included as **Appendix B**.

4.2 Description of Existing Model

The NRT (2017b) contaminant fate and transport model simulated boron and was performed to support closure of AP2 using MODFLOW and MT3DMS. AP1, GMF GSP, GMF RP, and LF were present within the previous model domain.

The NRT (2017b) modeling consisted of the following:

- Steady-state MODFLOW model was developed to represent site conditions for 2016. This model was calibrated to a set of groundwater elevation data collected during November 2016.
- The hydraulic properties from the steady-state model were used in the calibration of the transient MODFLOW and MT3DMS models which simulated groundwater flow and transport at the AP2 from 1970 to 2017. Boron concentrations collected in August 2016 were used to calibrate the transport model.
- Predictive simulations to estimate future boron concentrations for a baseline (no action) and capping closure scenario for AP2 were completed. Closure action was modeled over a period of 1,500 years, beginning in January 2018.
- Predicted boron concentrations were simulated to reach compliance for CIP at AP2 after 101 years (NRT, 2017b). These modeling results were part of the closure plan approved by IEPA on January 30, 2018.

4.3 Conceptual Model

The HCR (Ramboll, 2021a) forms the foundation of the AP1 hydrogeological setting. The AP1 overlies the recharge area for the underlying transmissive geologic media, which are composed of unlithified deposits.

4.3.1 Hydrogeology

As discussed in **Section 2.2**, groundwater flow in the UA at the CPP is divided towards the two lobes of Coffeen Lake. The loess of the UCU and sands of the UA are hydraulically connected. The groundwater flow in the silts and clays of the UCU and LCU are expected to be primarily vertical. The Hagarstown member is where the majority of the horizontal migration is expected to occur. The hydrogeological CSM consists of the following layers:

- Hagarstown Loess Unit (*i.e.,* UCU) – Loess Unit and the upper clayey portion of the Hagarstown Member.
- Hagarstown Member (*i.e.,* UA) – sand and sandy silts and clays at the base of the Hagarstown Member and, in some locations, the uppermost weathered sandy clay portion of the Vandalia Member.

- Vandalia Member/Mulberry Grove Member (*i.e.,* LCU) – unweathered sandy clay till and discontinuous silts.
- Smithboro Till (*i.e.,* LCU) – compacted clay till of the Smithboro Member.

The hydrostratigraphic units included in the model were the UCU, UA, and LCU. The DA and DCU were not included in the model, which includes consistency with the original model (NRT, 2017b). No potential GWPS exceedances have been observed in the DA. This, coupled with the limited groundwater data available for the DA and DCU, meant that these layers were not included in the model. Therefore, the Smithboro Till (*i.e.,* LCU) represents the lower boundary of the CSM.

Surfaces for each of the three major geological units (Loess Unit, Hagarstown Member, Vandalia/Mulberry Grove Member and Smithboro Till Member) were taken from the NRT model (2017b). The NRT model (2017b) used available information from well logs to interpolate the top and base of the UA.

4.3.2 Extent and Boundaries

The United States Geological Survey (USGS) National Map places the CPP within the East Fork Shoal Creek watershed subbasin (Hydrologic Unit Code [HUC] 071402030303).

The CPP CSM extent is bounded by a hydrological catchment (watershed) divide to the east based on watershed data from USGS. Along the north, south, and east, the model boundary has been placed along known waterbodies as much as possible. As such, it is assumed groundwater inflow from adjacent watersheds is negligible through both the UA and LCU.

The Coffeen Lake water levels are managed an average elevation 591.0 feet NAVD88. Coffeen Lake and Unnamed Tributary are the receiving body of water for surface water in the area encompassed by the CSM.

Infiltration of precipitation to the groundwater table is applied as recharge at the site. Groundwater in the UCU migrates downward into the Hagarstown Formation. As discussed in **Section 2.2.1**, the Hagarstown Formation is considered the UA for groundwater adjacent to AP1.

4.3.3 Ash Pond No. 1

AP1 is constructed such that the earthen berm and base are in contact with the UCU with exception of limited areas in the northeast of the SI where the UCU and UA have been eroded and the berm and base of CCR are in contact with the LCU. Findings from the HCR (Ramboll, 2021a) indicate that AP1 does influence the UA flow system, where there is a component of radial flow from AP1. However, this radial flow system appears to be centered around the southwest corner of AP1 resulting in a northerly and easterly component of groundwater flow within the UA.

Sulfate was selected for transport modeling. Sulfate is commonly used as an indicator parameter for contaminant transport modeling for CCR because: (i) it is commonly present in coal ash leachate; and (ii) it is mobile and typically not very reactive but conservative (*i.e.*, low rates of sorption or degradation) in groundwater.

4.5 Model Approach

4.5.1 Potential Groundwater Exceedances

A comparison of observed TDS concentrations to sulfate (**Figure A** below) indicates a statistically significant correlation between these parameters in UA wells where these potential exceedances were observed. Observed concentrations were transformed into Log10 concentrations for evaluation. The correlation coefficient (R^2) and p values (indicator of statistical significance) are also provided on **Figure A**. Higher R^2 values (*i.e.,* closer to 1) indicate stronger correlation between parameters. A correlation is considered statistically significant when the p value is lower than 0.05. The correlation has a p value less than the target of 0.05, indicating the correlation is statistically significant. The statistically significant correlation associated with sulfate concentrations indicate sulfate is an acceptable surrogate for TDS in the groundwater model, and concentrations of this parameter are expected to change along with model predicted sulfate concentrations.

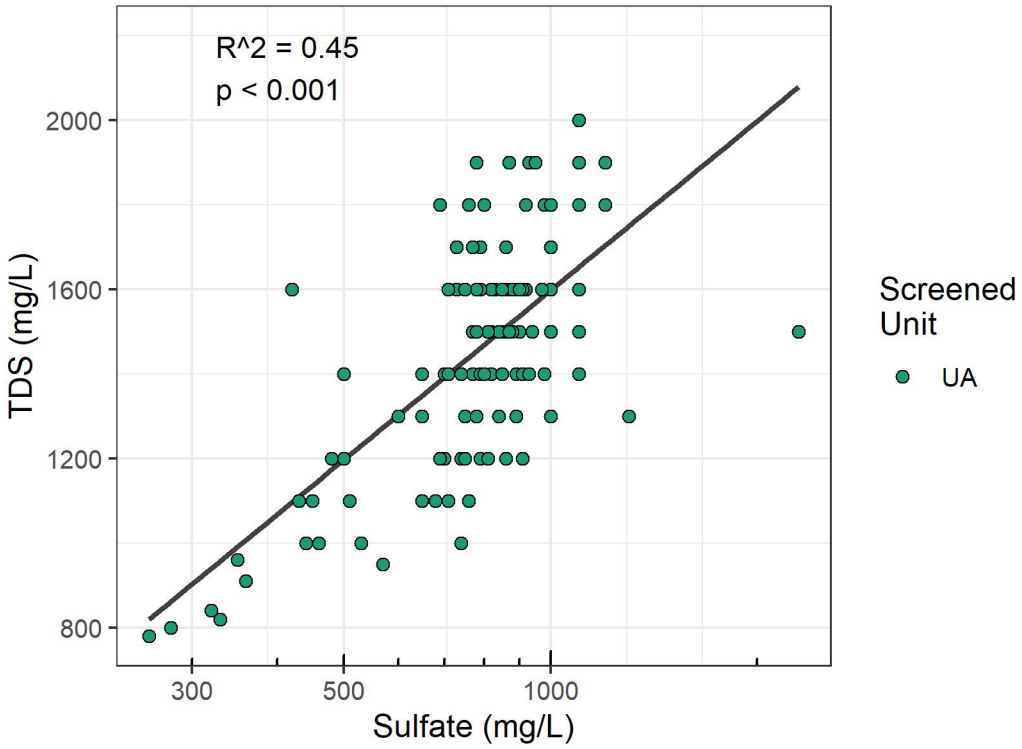


Figure A. Sulfate Correlation with TDS in UA Wells

A potential exceedance of boron was also observed at one monitoring well, G313, in the vicinity of AP1, based on the History of Potential Exceedances (Ramboll, 2021b). Correlations between sulfate and boron for the same AP1 UA wells did not indicate a statistically significant correlation between these constituents. However, UA monitoring well G313 has potential exceedances of both sulfate and TDS along with the potential exceedance of boron (**Section 3.2**). Boron, like sulfate, is a common indicator parameter used for contaminant transport modeling of CCR; and boron is less likely than other constituents to be present in background groundwater from natural or other anthropogenic sources. The only significant source of boron is AP1. With potential

exceedances of boron, sulfate, and TDS present in the same well (G313) and having the same source (AP1), boron concentrations are expected to change along with model predicted sulfate concentrations.

4.5.2 Summary of Modeling Activities

A three-dimensional groundwater flow model was calibrated to represent the conceptual flow system described above. Prediction simulations were performed to evaluate the effects of closure (source control) measures (CCR consolidation and CIP and CBR scenarios) for the CCR units on groundwater quality following initial corrective action measures, which includes removal of free liquids (dewatering). **Figure 4-1** illustrates the calibration and predictive modeling timelines.

Three model codes were used to simulate groundwater flow and contaminant transport:

- Groundwater flow was modeled in three dimensions using MODFLOW 2005.
- Contaminant transport was modeled in three dimensions using MT3DMS.
- Percolation (recharge) was modeled using the results of HELP model.

Modeling steps are a summarized below:

- A steady state model was created in MODFLOW 2005 and used to simulate the mean groundwater flow conditions at the site. The model was calibrated to match mean groundwater elevations observed between 2015 to 2021 (**Table 4-1**).
- Transient flow models based off of the calibrated steady state model were used to simulate groundwater flow and transport for 42 years using MODFLOW 2005 and MT3DMS to simulate changes in site conditions through time and match currently observed concentrations of sulfate in groundwater (**Table 4-1**).
- Prediction simulations began with a 2-year dewatering period simulated in MODFLOW 2005 and MT3DMS where heads were reduced within the CCR unit and concentrations were removed from CCR removal areas.
- Prediction simulations resumed for CIP and CBR following the 2-year dewatering period using the results of HELP modeling as input values for recharge rates in the construction areas.
- The prediction simulations were run using MODFLOW 2005 and MT3DMS to estimate the time for sulfate concentrations to meet the GWPS in the compliance wells and to evaluate the differences between the two closure scenarios.

5. MODEL SETUP AND CALIBRATION

5.1 Model Descriptions

For the construction and calibration of the numerical groundwater flow model for the site, Ramboll selected the model code MODFLOW, a publicly-available groundwater flow simulation program developed by the USGS (McDonald and Harbaugh, 1988). MODFLOW is thoroughly documented, widely used by consultants, government agencies and researchers, and is consistently accepted in regulatory and litigation proceedings. MODFLOW uses a finite difference approximation to solve a three-dimensional head distribution in a transient, multi-layer, heterogeneous, anisotropic, variable-gradient, variable-thickness, confined or unconfined flow system—given user-supplied inputs of hydraulic conductivity, aquifer/layer thickness, recharge, wells, and boundary conditions. The program also calculates water balance at wells, rivers, and drains.

MODFLOW was developed by USGS (McDonald and Harbaugh, 1988) and has been updated several times since. Major assumptions of the code are: (i) groundwater flow is governed by Darcy's law; (ii) the formation behaves as a continuous porous medium; (iii) flow is not affected by chemical, temperature, or density gradients; and (iv) hydraulic properties are constant within a grid cell. Other assumptions concerning the finite difference equation can be found in McDonald and Harbaugh (1988). MODFLOW 2005 was used for these simulations with Groundwater Vistas 7 software for model pre- and post- processing tasks (Environmental Simulations, Inc., 2017).

MT3DMS (Zheng and Wang, 1998) is an update of MT3D. It calculates concentration distribution for a single dissolved solute as a function of time and space. Concentration is distributed over a three-dimensional, non-uniform, transient flow field. Solute mass may be input at discrete points (wells, drains, river nodes, constant head cells), or distributed evenly or unevenly over the land surface (recharge).

MT3DMS accounts for advection, dispersion, diffusion, first-order decay, and sorption. Sorption can be calculated using linear, Freundlich, or Langmuir isotherms. First-order decay terms may be differentiated for the adsorbed and dissolved phases.

The program uses the standard finite difference method, the particle-tracking-based Eulerian-Lagrangian methods and the higher-order finite-volume total-variation-diminishing (TVD) method for the solution schemes. The finite difference solution has numerical dispersion for low-dispersivity transport scenarios but conserves good mass balance. The particle-tracking method avoids numerical dispersion but was not accurate in conserving mass. The TVD solution is not subject to significant numerical distribution and adequately conserves mass, but is numerically intensive, particularly for long-term models such as developed for this model. The finite difference solution was used for this simulation.

Major assumptions of MT3DMS are: (i) changes in the concentration field do not affect the flow field; (ii) changes in the concentration of one solute do not affect the concentration of another solute; (iii) chemical and hydraulic properties are constant within a grid cell; and (iv) sorption is instantaneous and fully reversible, while decay is not reversible.

The HELP model was developed by the United States Environmental Protection Agency (USEPA). HELP is a one-dimensional hydrologic model of water movement across, into, through, and out of

a landfill or soil column based on precipitation, evapotranspiration, runoff, and the geometry and hydrogeologic properties of a layered soil and waste profile. For this modeling, results of the HELP model, HELP Version 4.0 (Tolaymat and Krause, 2020) completed for the groundwater model were used to estimate the hydraulic flux from closure construction.

5.2 Flow and Transport Model Setup

The 2017 flow and transport models were retained and revised as appropriate to perform simulations for the AP1.

The modeled area was approximately 10,000 feet by 15,025 feet (150,250,000 square feet [ft^2]) centered on the CPP (**Figure 5-1**). The model boundaries along the northern and eastern edges of the model were selected to maintain sufficient distance from the CPP to reduce boundary interference with model calculations, while not extending too far past the extent of available calibration data. The eastern edge of the model also approximates topographic highs, surface water divides, and watershed boundaries.

The steady state MODFLOW model was calibrated to mean groundwater elevation collected from 2015 to 2021 as presented in **Table 4-1**. MT3DMS was run on the transient flow model and model-simulated concentrations were calibrated to observed sulfate concentration values at the monitoring wells from January 2015 to July 2021 as presented in **Table 4-1**. Multiple iterations of MODFLOW and MT3DMS calibration were performed to achieve an acceptable match to observed flow and transport data. For AP1, the calibrated flow and transport models were used in predictive modeling to evaluate the CIP and CBR closure scenarios. Prior to simulation of CIP and CBR, a dewatering phase, which simulated the removal of free liquid from the CCR material in the AP1 was completed. Closure scenarios were simulated by removing saturated ash cells from removal areas and using HELP modeled recharge values to simulate changes proposed in the closure scenarios.

5.2.1 Grid and Boundary Conditions

A five-layer, 326 x 211 node grid was established with a variable grid spacing between 25 and 100 feet (**Figures 5-2 through 5-6**), with a total number of 284,575 active cells.

The main body of Coffeen Lake is immediately adjacent to CPP on the west and south and the Unnamed Tributary borders CPP to the east. These surface water features form the southern, eastern, and western boundaries of the model. The northern boundary of the model domain is a general head boundary. Vertically, the model domain extends from the top of the saturated zone to the base of the Smithboro Member. The thick clays of the Banner Formation are relatively impermeable compared to the overlying unconsolidated sediments and provides a base for the model.

The northern boundaries for layers 3, 4, and 5 are general head boundaries placed to simulate flow in the sandier soils of the Hagarstown Member, Vandalia/Mulberry Grove Member and Smithboro Till composing the UA (layer 3), and LCU (layer 4 and 5). The northern boundary represents the regional flow conditions within these units. The eastern edge is no-flow boundary in all model layers.

Coffeen Lake is represented as a constant head boundary based on an average surface water elevation of 591.0 feet NAVD88. The constant head boundary was simulated with an elevation equal to 591.0 feet. The lake is in hydraulic connection with multiple layers within the model.

The bottom of the model was also a no-flow boundary. The top of the model was a time-dependent specified flux boundary, with specified flux rates equal to the recharge rate. A specified mass flux boundary was used to simulate downward percolation of solute mass from the AP1. This boundary condition assigns a specified concentration to recharge water entering the cells within AP1, and the resulting concentration in the AP1 cells is a function of the relative rate and concentration of recharge water (water percolating from the impoundment) compared to the rate and concentration of other water entering the node.

5.2.2 Flow Model Input Values and Sensitivity

Evaluation of monitoring well data for the CPP has not identified statistically significant seasonal trends in groundwater flow or quality which could affect model applicability for prediction of transport. The MODFLOW model was calibrated to mean groundwater elevations from 2015 to 2021. Multiple iterations of MODFLOW calibration were performed to achieve an acceptable match to observed flow data.

Sensitivity analysis was conducted by changing input values and observing changes in the sum of squared residuals (SSR). Horizontal conductivity, vertical conductivity, and river and general head conductance terms were all varied by one order of magnitude (*i.e.*, between one-tenth and ten times) of the calibrated values. Recharge terms were varied between one-half and two times calibrated values. River stage was obtained from the 10 meter (m) Digital Elevation Model (DEM) from the United States Department of Agriculture/Natural Resources Conservation Service (USDA/NRCS) National Geospatial Center of Excellence (USDA/NRCS, 2022). The vertical error of the 10 m DEM is 0.82 m (2.7 feet); therefore, the stream stage was varied by adding and subtracting 2.7 feet. Where appropriate, drain stage was modified based on the DEM error. Where this was inappropriate, drain stage increased and decreased by 2 feet. General head boundary head terms were varied between 90 and 110 percent of calibrated values. The HFB was varied by increasing the hydraulic conductivity by a factor of 100 and 1,000. When the calibrated model was tested, the SSR was 351. Sensitivity test results were categorized into negligible, low, moderate, moderately high, and high sensitivity based on the change in the SSR as summarized in the notes in **Table 5-1**.

5.2.2.1 Layer Top/Bottom

The top of the saturated zone was used as the top of the model. The elevations for the base of each hydrostratigraphic layer were obtained from the NRT model (2017b) and were imported as grid data into MODFLOW. The upper Loess Unit of the Hagarstown Member (UCU) was divided into two layers to accommodate the explicit inclusion of the CCR in AP1 and AP2. The sand and silts of the Hagarstown Member which form the UA were represented using a single layer. The LCU was represented by two layers, the upper LCU (layer 4) represents the unweathered Vandalia/Mulberry Grove Member and the lower LCU (layer 5) represents the Smithboro Member.

The UCU layer was split into two layers (layers 1 and 2) to simulate the construction of AP1 and AP2. Within AP1 and AP2, layer 1 represents ash fill and layer 2 represents the UCU present below the ash and above the UA. Outside of AP1 and AP2, both layers 1 and 2 represent the UCU. Layer 3 represents the UA and the LCU is present in layers 4 and 5. **Figures 5-7 through 5-11** show the bottom elevations of the five model layers. The resulting model layers represent the distribution and change in thickness of each water-bearing unit across the model domain. **Table A** below provides elevation and thickness information for the model layers and hydrostratigraphic units used in the model.

Table A. Flow Model Layer Descriptions

Layer	Hydrostratigraphic Unit Name	Hydrostratigraphic Unit Used to Determine Layer Thickness	Top Elevation [1]	Bottom Elevation [1]	Thickness (feet)
			Mean (Minimum – Maximum)		
1&2	UCU and CCR	Loess Unit of Hagarstown Member and CCR	640 (-)	607.73 (604.0-614.15)	27.1 (26.0-29.85)
3	UA	Hagarstown Member	607.73 (604.0-614.15)	600.9 (580.0-612.0)	5.2 (2.0-34.0)
4	LCU	Vandalia/Mulberry Grove Member	600.9 (580.0-612.0)	588.5 (578.0-594.0)	18.83 (2.0-30.0)
5	LCU	Base of Coffeen Lake	588.5 (578.0-594.0)	540.0 (-)	48.4 (38.0-51.1)

Notes:
[1] Elevation is measured in feet, referenced to NAVD88.

5.2.2.2 Hydraulic Conductivity

Hydraulic conductivity values and sensitivity results are summarized in **Table 5-1.** The spatial distribution of the hydraulic conductivities within the UCU, UA and LCU were considered homogenous. **Figures 5-12 through 5-16** show the spatial distribution of the hydraulic conductivity zones, AP1 and other units on site for each of the five model layers. Construction of the GMF units removed the sands and silts of the UA prior to construction of the liner, therefore the UA is absent beneath these units and liner hydraulic properties are assigned. Conductivity zones that did not have representative site data (*i.e.,* zones 19 and 21, representing the cells above the river cells and the disturbed sediments between the LF and GMF GSP, respectively) were determined through model calibration.

Where available, hydraulic conductivity values were derived from field measured or laboratory tested values reported in the HCR (Ramboll, 2021a) (**Section 2.2.2**). No horizontal anisotropy was assumed. Vertical anisotropy was applied to conductivity zones to simulate preferential flow in the horizontal direction in these materials, and are presented as anisotropy ratio (Kh/Kv) in **Table 5-1**.

The model was highly sensitive to changes in horizontal and vertical hydraulic conductivity in zones 1 (UCU), 2 (UA), and 3 (LCU - unweathered Vandalia), and moderately sensitive to changes in horizontal and vertical hydraulic conductivity in zones 10 (CCR fill-AP1) and 19 (UCU-fill). The model exhibited a negligible to low sensitivity in the remaining zones for both horizontal and vertical conductivity.

5.2.2.3 Recharge

Recharge rates were determined through calibration of the model to observed groundwater elevations. For the calibration model, recharge was applied to the uppermost active layer and the rates varied based on different units, namely the AP1, AP2, GMF GSP, GMF RP, LF, Surface Water Pond, and Cooling Pond. Model inputs are summarized in **Table 5-1**. The distribution of recharge is shown in **Figure 5-17**. Changes in operational history, such as the addition of AP1 to the site in 1977 and the GMF units in 2010 as illustrated in **Figures 5-18 through 5-21,** have been

incorporated into the transient model simulation (**Table 5-2**). See **Section 5.2.3.1** for additional discussion of time discretization.

The model had a high sensitivity to changes in recharge in zones 1 (UCU) and 7 (CCR fill - AP1). The model had negligible to low sensitivity to changes in recharge in the remaining zones, with the exception of zone 6 (CCR fill - AP2), where the sensitivity was moderate.

5.2.2.1 Storage and Specific Yield

The flow calibration model did not use these terms because it was run at steady state. For the transport model, which was run as a transient simulation, no field data defining these terms were available so published values were used consistent with Fetter (1988). Specific yield was set to equal effective porosity values described in **Section 5.2.3.5**. The spatial distribution of the storage and specific yield zones were consistent with those of the hydraulic conductivity zones. The sensitivity of these parameters was tested by evaluating their effect on the transport model as described in **Section 5.2.3.6**.

5.2.2.2 River Parameters

Five river reaches were included in the model as head dependent flux boundaries that required inputs for elevation of the surface water, bottom of the stream, width, bed thickness, and bed hydraulic conductivity (**Table 5-1**). The five river reaches were the Unnamed Tributary east of the CPP (reach 0 and reach 5), the Unnamed Tributary west of the CPP (reach 1), ponded surface water west of the LF (reach 2), and the condenser cooling water discharge flume (reach 3). The river and drain information is summarized in **Table B** below.

Table B. River and Drain Information

Name	Boundary Type	Length (feet)	Slope (ft/ft)
Unnamed Tributary East	River	8959.0	-0.0031
Unnamed Tributary East – downstream reach	River	1438.3	-0.0026
Unnamed Tributary West	River	3436.5	-0.0098
Ponded Surface Water West	River	-	-
Condenser Cooling Flume	River	-	-
Active Landfill Underdrain	Drain	2147.0	-
Gravity Drain Recycle Pond	Drain	2181.8	-
North Drain	Drain	3032.0	-

Notes:
ft/ft = feet per foot

In the absence of river geometry information, the DEM was used to estimate stream stage at the upstream and downstream limits of the Unnamed Tributary east of the CPP and the Unnamed Tributary west of the CPP. The surface water stages for the ponded surface water west of the LF and the Condenser Cooling Flume were constant (not sloped) and were also obtained from the DEM. For both Unnamed Tributaries (east and west), the slope of the river was then linearly interpolated along the reaches, providing an estimation of stream stage along the length of each reach for each model grid cell though which the river flows. Bed thickness was set at 2 foot and river width was set at 10 feet. The river bottom is set 3 feet below the stage for both the

Unnamed Tributaries. The downstream reach (reach 5) of the Unnamed Tributary is located in layer 5 of the model adjacent to the SI unit AP2, this layer represents the LCU-Smithboro till and has a low hydraulic conductivity. To increase connectivity of the tributary to the overlying layers, the hydraulic conductivity of the streambed was modified during calibration.

The Condenser Cooling flume stage is maintained at 604.0 feet and the ponded surface water west of the LF was maintained at 617.5 feet, and bed thicknesses for these reaches were set to 1 foot. The width of the Cooling Flume (approximately 52 feet) and ponded surface water west of the LF are larger than the grid cell dimensions (25 feet by 25 feet); therefore, the conductance term for both were based on the area of the cells which coincide with the flume and ponded water.

The model had low to moderate sensitivity to changes in river stage. The model had low to moderately high sensitivity to changes in river conductance, with the exceptions of reach 0 (Unnamed Tributary East) and reach 3 (Condenser Cooling Flume) which had high sensitivity.

5.2.2.3 Drain Parameters

The LF has an active underdrain, which is actively pumped to prevent more than 1-foot of groundwater head above the liner. This was estimated to be 603.5 feet. The GMF RP has a passive drain beneath the liner which discharges water towards the Unnamed Tributary east of the unit. This was estimated to be 600.5 feet. Both the active LF drain and passive GMF RP drain were placed in layer 4 (LCU) below the low hydraulic conductivity zones which represent the base of the lined units. A surface water drain in the north of the model was also included; the placement of this northern drain was determined using google earth imagery. The Northern drain appears to be a man-made feature and no hydrological data are available as to its flow conditions. Therefore, its implementation in the model as a drain makes the fewest assumptions of its interaction with the aquifer. This surface water drain is located in layer 1 and has an elevation of 622.0 feet.

The model had low sensitivity to changes in drain stage. The model had negligible to moderate sensitivity to changes in drain conductance, with the exception of reach 0 (Active LF Underdrain) where the model had moderately high sensitivity to changes in drain conductance.

5.2.2.4 GMF Unit Parameters

All GMF units (GMF GSP, GMF RP, and LF) have a similar liner construction (**Table C** below); they were all implemented into the model using horizontal flow barrier (HFB) package to represent the liner system on the sides of the units. The bottom of the liner is implemented by assigning the liner system hydraulic conductance to model layer 3 within the footprint of the pond. The base elevation of layer 3 within the footprint of the GMF units simulates the base elevation of the liner. The thickness of model layer 3 within the footprint of the pond was set to three feet. Removal of the sands and silts below the GMF units (as described in **Sections 1.4** and **2.1**) means that the liner is in direct contact with the Vandalia Member. The groundwater flow dynamics beneath/around the Ash Landfill and GMF Units is affected by several factors, including: removal of the Hagarstown Member from beneath the Units; presence of the construction dewatering systems around the units; and the lateral variability of lithology within the Hagarstown Member (Hanson, 2016). Drains discussed above were used to represent the underdrains associated with the GMF units. The hydraulic properties within the GMF units were set to represent the CCR.

Estimates of the hydraulic properties of each of the components within the liner system were derived using values from the HELP model; see **Section 5-1** for more information about HELP. For flow perpendicular to the layer orientation, as is the case in the liner where the hydraulic gradient is vertical for the base and horizontal for the sides of the pond, the harmonic mean was used to obtain the effective hydraulic conductivity (K_{eff}) (Fetter, 1988). The harmonic mean was determined by:

$$K_{eff} = \frac{\sum b}{\sum \frac{b}{K}}$$

where b is the layer thickness and K is the horizontal hydraulic conductivity.

HFB input parameters are presented in **Table 5-1**. The model had low to moderate sensitivity to changes in the hydraulic conductivity in the HFB.

Table C. Liner System Properties From Top to Bottom for the GMF GSP, GMF RP, and LF

Liner Component	Thickness (feet)	Hydraulic Conductivity (cm/s)	Hydraulic Conductivity (ft/d)
HDPE geomembrane (60 mil)	0.06	2.0×10^{-13}	5.7×10^{-10}
Recompacted Soil	3.0	1.0×10^{-7}	2.8×10^{-4}
Vertical Harmonic Mean of liner system	**NA**	**NA**	***2.89×10^{-8}***

* Estimated based on available information
ft/d = feet per day
NA = not applicable

5.2.2.5 General Head Boundary

General head boundary conditions (GHB) were used along the northern boundary of the model for layer 3 through 5 (**Figures 5-4 through 5-6**). The GHB at the northern limit of the model represents groundwater entering the model domain from upgradient areas. The GHB is present in layers 3 through 5 and was used to simulate groundwater flow into the model via the UA and LCU. The groundwater levels used for the northern boundary of the model in layers 3 through 5 were estimated using the Dupuit equation for steady state flow in an unconfined aquifer with recharge.

The DEM of the site provided estimates of the surface water levels for Coffeen Lake on the west of the model (591 feet), and Rocky Ford Sportsman Club North Lake (604 feet) on the east of the model domain (refer to **Figure 5-1**). The calibrated ambient recharge to the UCU was used in the calculation of the groundwater level distribution at the northern boundary. The hydraulic conductivity value used in the Dupuit equation was estimated during model calibration.

This GHB was only applied to cells along the northern boundary where the base of the cell was below the calculated groundwater head for a given distance from the constant head boundaries, the head was determined by the Dupuit equation. Cell conductance was then calculated using the cells' saturated thickness and cell width, and hydraulic conductivity were based on cell hydraulic conductivities and adjusted if appropriate during calibration.

The GHB elevation for northern boundary in the UA was established during calibration (**Table 5-1**). The distance to the GHB head was set to 1, and the GHB conductivity was

calculated using the cell width, cell thickness, and calibrated hydraulic conductivity from the model.

The sensitivity to changes in specified head was low to moderate, with the exception of reach 3 (Northern Model Boundary in LCU Layer 4) where the model sensitivity was high. The flow calibration model had a negligible sensitivity to changes in conductance.

5.2.3 Transport Model

MT3DMS input values are listed in **Table 5-2** and described below. Sensitivity of the transport model is summarized in **Table 5-3**.

Groundwater transport was calibrated to groundwater sulfate concentration ranges at each well as measured from the monitoring wells between 2015 (where available) and 2021. The transport model calibration targets are summarized in **Table 4-1**.

Sensitivity analysis was conducted by changing input values and observing percent change in sulfate concentration at each well from the calibrated model sulfate concentration. Effective porosity was varied by decreasing and increasing calibrated model values by 0.05. Storage values were multiplied and divided by a factor of 10, and specific yield by a factor of 2. The dispersivity values in the calibrated model were increased by a factor of 5 and 10. The sensitivity of the transport model to changes in the liner conductance was also investigated by increasing and decreasing the hydraulic conductivity of the liner by one order of magnitude (*i.e.*, between one-tenth and ten times).

The transport model had a negligible to moderate sensitivity to changes in storage and specific yield (**Table 5-3**) as discussed in **Section 5.2.3.6**. The transport model ranged from negligible to moderate sensitivity to effective porosity and dispersivity as discussed in **Sections 5.2.3.5** and **5.2.3.7**, respectively. The sensitivity to the liner conductivity was negligible to low as discussed in **Section 5.2.3.2**.

5.2.3.1 Time Discretization and Stress Periods

The evolution of the CPP required changes to the hydraulic properties within the model; this is not possible in a single model where hydraulic properties as assumed to remain constant. As a result, the changes in the site (*e.g.,* inclusion of the GMF units) are simulated in three consecutive numerical models, as summarized in **Table D** below. The simulation length was revised from the existing model to extend to the current time (2022).

Table D. Transient Model Setup and Time Discretization

Date	Model	Stress Period	Operational Change	Previous model
Pre-1970	Steady-State	NA	No CCR units present	Not applicable
1970-2010	Transient (TR-1)	1:1970-1985	AP2 only	Steady State Pre-1970 flow
		2:1985-2010	AP2 and AP1 in operation	
2010-2018	Transient (TR-2)	1:2010-2018.	AP1, GMF GSP and GMF RP in operation.	TR-1 as initial flow and concentrations

2018-2022	Transient (TR-3)	1:2018-2022	Modification to lined units GMF GSP and GMF RP, AP2 capped	TR-2 as initial flow and concentrations

Notes:
TR = transient model

5.2.3.2 GMF Units

Groundwater chemistry data from wells G215 (located adjacent to the GMF GSP), and wells G275 and G279 (located adjacent to the GMF RP), indicate an increase in sulfate concentrations post 2018 when compared with sulfate concentrations in adjacent wells. Sulfate concentrations in G215 have experienced further increases since 2021. Sulfate concentrations around the GMF RP tend to be higher than those around the GMF GSP, with elevated sulfate concentrations observed since 2015 (the earliest sampling date). Elevated sulfate concentrations along the southern boundary of the GMF RP are associated with historic groundwater impacts from AP2. However, wells G275 and G279 are located along the eastern boundary of the pond and have elevated sulfate concentrations. To simulate observed sulfate concentrations at these isolated wells (GMF GSP well G215, and GMF RP wells G275 and G279), the hydraulic conductivity of the liner (simulated using HFB) was increased to allow sulfate migration from the CCR unit in the transient model TR-3, as shown in **Figure B** below and **Table D** above.

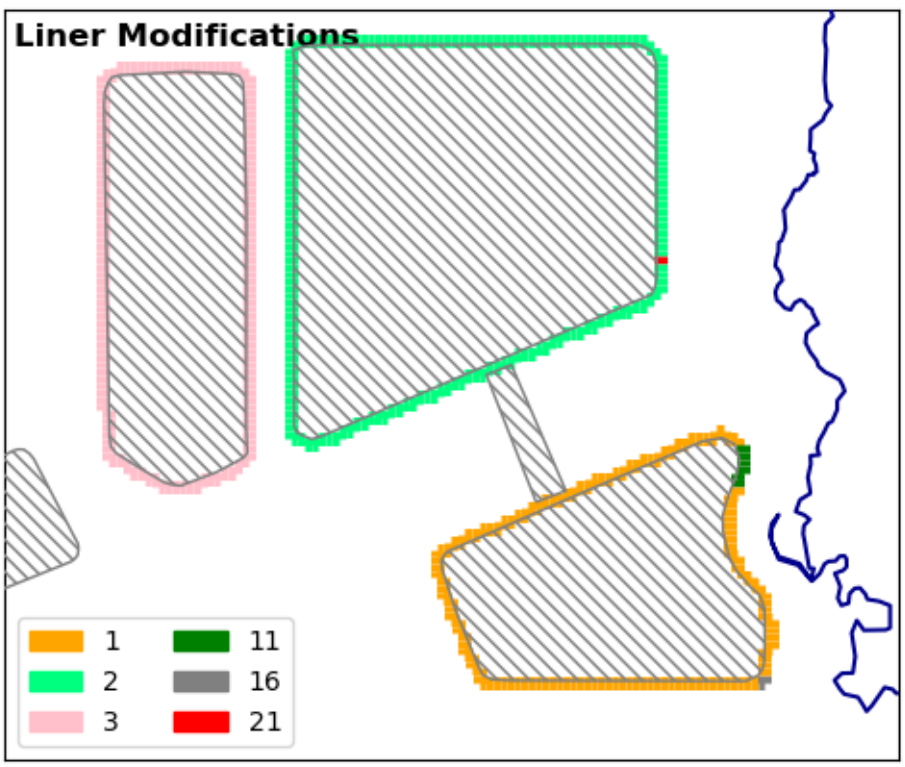


Figure B. Liner Modification Zones

As part of the transport calibration process, the hydraulic conductivity of HFB reaches 11, 16, and 21 were modified to simulate the observed rises in sulfate. The changes are summarized in **Table 5-2**. Model sensitivity near the GMF ponds is discussed in the Groundwater Modeling

Report, *GMF Gypsum Stack Pond and GMF Recycle Pond, Coffeen Power Plant, Coffeen Illinois* (Ramboll, 2022).

The monitoring wells associated with AP1 show negligible to low sensitivity to changes in the GMF liner conductivity (**Table 5-3**). AP1 Is located approximately 2,500 foot south of the GMF SIs, any changes in groundwater flow and transport will be minimal in proximity to AP1.

5.2.3.3 Initial Concentration

No initial concentrations were placed in the steady state flow calibration model. The flow model was run as transient and concentration was added to the model through recharge starting at the same time as the transient flow simulation. Modeling was performed for a sufficient period (42 years) to allow modeled concentrations in the primary transport layer (*i.e.,* UA) to reach recently observed levels.

Modeling was performed over three numerical models which mirror the operational developments at the CPP. **Table 5-2** provides an overview of how the source concentrations and recharge rates change through time.

5.2.3.4 Source Concentration

Five sources in the form of vertical percolation (recharge) and constant concentration cells were simulated in the CCR material for calibration (**Table 5-2**) (in chronological order): (i) percolation through CCR in AP2 (1970-2022), (ii) percolation through CCR in AP1 (1978-2022), (iii) percolation through CCR in GMF RP (2010-2022), (iv) percolation through CCR in GMF GSP (2010-2022), and (v) percolation through CCR in GMF LF (2010-2022). All five sources were simulated by assigning concentration to the recharge input. The CCR sources were also simulated with constant concentration cells placed where CCR was present (**Figures 5-18 through 5-21**) to simulate saturated CCR conditions. From the model perspective, this means that when the simulated water level is above the base of these cells, water that passes through the cell will take on the assigned concentration. All source concentrations were calibrated in the transport model to the sulfate concentration data collected from November 2015 to August 2021. The source concentrations applied to the recharge zones and saturated ash cells immediately below the recharge zones have the same concentration values. **Table 4-1** indicates that the background sulfate concentrations (identified with a "B" for background in the "CCR unit" column) at CPP show considerable variability across the site, from 11 mg/L (G286) to 770.0 mg/L (G288). No background sulfate concentration was applied to recharge beyond the source areas in the model.

Because these are the sources of concentration in the model, the model will be highly sensitive to changes in the input values. For that reason, sensitivity testing was not completed for the source values.

5.2.3.5 Effective Porosity

Effective porosity for each modeled hydraulic conductivity zones were based on the NRT model (2017b), data from the HCR (Ramboll, 2021a), and literature values (Fetter, 2001) and are presented in **Table 5-2**.

The model had a negligible to moderate sensitivity to changes in porosity values (**Table 5-3**). The greatest sensitivity for porosity was moderate for the high porosity sensitivity test at

monitoring locations G305, G306, and G317. Moderate sensitivity at monitoring well G317 was also observed for the low porosity sensitivity test.

5.2.3.6 Storage and Specific Yield

The transport model had a negligible to low sensitivity to changes in storage and specific yield, with the exception of sensitivity at monitoring wells G306, G307, and G317, where sensitivity was moderate (**Table 5-3**).

5.2.3.7 Dispersivity and Diffusion

Physical attenuation (dilution and dispersion) of contaminants is simulated in MT3DMS. Dispersion in porous media refers to the spreading of contaminants over a greater region than would be predicted solely from the average groundwater velocity vectors (Anderson, 1979; Anderson, 1984). Dispersion is caused by both mechanical dispersion, a result of deviations of actual velocity at a microscale from the average groundwater velocity, and molecular diffusion driven by concentration gradients. Molecular diffusion is generally secondary and negligible compared to the effects of mechanical dispersion and only becomes important when groundwater velocity is very low. The sum of mechanical dispersion and molecular diffusion is termed hydrodynamic dispersion, or simply dispersion (Zheng and Wang, 1998).

Longitudinal dispersivity was 10 feet in the UA and 1 foot in the UCU and LCU, with transverse and vertical dispersion coefficients assuming a ratio of 1/10 and 1/100.

The model had a negligible to moderate sensitivity to changes in dispersivity values (**Table 5-3**). The greatest sensitivity for dispersivity was moderate for the highest dispersivity sensitivity test at monitoring well locations G313, G314, G316, and G317. Sensitivity was also moderate for the lower dispersivity sensitivity test at monitoring well locations G313 and G317.

5.2.3.8 Retardation and Decay

It was assumed that sulfate would not significantly sorb or chemically react with aquifer solids (Kd was set to 0 mL/g) which is a conservative estimate for estimating contaminant transport times. Boron, sulfate, and TDS transport is likely to be affected by both chemical and physical attenuation mechanisms (*i.e.,* adsorption and/or precipitation reactions as well as dilution and dispersion). Batch adsorption testing was conducted to generate site specific partition coefficient results for boron and sulfate (Geosyntec, 2022b; **Appendix C**) for locations G311 and G313. Results of the testing are summarized below:

- Boron: The Freundlich isotherm (K_F) fit the data best for G313/SB306 and G313/SB313, yielding K_F values of 0.65 liters per kilogram (L/kg) and 2.03 L/kg, respectively. Though slightly higher at G313/SB313, these values are comparable to boron partition coefficients reported in literature, which range from 0.19 to 1.3 L/kg depending on pH conditions and the amount of sorbent present (EPRI, 2005; Strenge & Peterson, 1989). No partition coefficient was calculated for G311.
- Sulfate: The G311 partition coefficient for sulfate ranged from -624 L/kg for the Langmuir isotherm (K_L) to 10.11 L/kg for the linear isotherm (K_D), but the best-fitting Freundlich isotherm yielded a low K_F value of 9.2×10^{-12} L/kg. None of the isotherms showed a high goodness-of-fit (*i.e.,* R^2) for either G313/SB306 or G313/SB313, with the highest correlation being 0.05, and were associated with erroneously high (1,700 L/kg) and low (-690 L/kg) partition coefficients. An accurate sulfate partition coefficient could therefore not be calculated from any of the data. These results are consistent with the findings of Strenge and Peterson

(1989), who found that partition coefficients for sulfate are 0.0 L/kg, regardless of pH conditions and the amount of sorbent present.

The results from site samples are variable with poor goodness of fit which supports modeling sulfate without retardation. The potential exceedances identified in groundwater (boron, sulfate, and TDS) are affected by natural attenuation processes in multiple ways and to varying degrees. Further assessment of these processes and how they may be applied as a potential groundwater remedy will be completed as part of future remedy selection evaluations, as necessary. For the purposes of this GMR, and as mentioned at the beginning of this section, no retardation was applied to sulfate transport in the model (*i.e.*, Kd was set to 0 mL/g). Sensitivity tests were not run for retardation.

5.3 Flow and Transport Model Assumptions and Limitations

Simplifying assumptions were made while developing this model:

- Leading up to 2022, the groundwater flow system cannot be simulated as steady state.
- Natural recharge is constant over the long term.
- Fluctuations in lake stage do not affect groundwater flow and transport over the long term.
- Hydraulic conductivity is consistent within hydrostratigraphic units.
- The approximate base of ash surface in the AP1, GMF GSP, GMF RP, and LF were developed with Golder using soil borings and historic topographic maps.
- Source concentrations are assumed to remain constant over time.
- Sulfate is not adsorbed and does not decay and mixing and dispersion are the only attenuation mechanisms.

The model is limited by the data used for calibration, which adequately define the local groundwater flow system and the source and extent of the plume. Since data used for calibration are located near the units on site, model predictions of transport distant spatially and temporally from the calibrated conditions at the CCR units will not be as reliable as predictions closer to the CCR units and concentrations observed in 2021.

5.4 Calibration Flow Model

The groundwater model was manually calibrated to best approximate the mean groundwater elevations in 95 wells at the site. The mean elevations used for calibration and locations of wells within the flow model are summarized in **Table 4-1** Well locations are shown in **Figure 2-1**. This involved modifying the hydraulic conductivities of the different hydrostratigraphic units, recharge rate, and conductance of the drains, rivers, and general head boundaries within the model to minimize the difference between the mean observed groundwater elevation and simulated groundwater elevation. Where possible, the range of the parameter values used during calibration were based on observed values (*i.e.,* for the range in hydraulic conductivity estimates from the HCR). Where this was not possible, such as for the drain and general head boundary conductance, the range of parameter values were based on other site information or inferred from knowledge from similar sites. Where data were limited, the parameter values were less constrained during calibration (*e.g.,* parameter values had wider ranges). The SSR was used as a metric to identify the optimal values for the different parameters.

5.5 Calibration Flow and Transport Model Results

Results of the MODFLOW modeling are presented below. The model files accompany this report (**Appendix B**). **Table 5-1** shows the calibrated hydraulic conductivity for the different units shown in **Figures 5-12 through 5-16**.

Groundwater model calibration results are presented in **Figure 5-22** and **Figure 5-23**, which shows the observed and simulated groundwater elevations and the observed groundwater elevations versus residuals. The near-linear relationship between observed and simulated values presented on **Figure 5-22** indicates that the model adequately represents the calibration dataset. The root mean squared error of the groundwater elevation across all wells was 1.92 feet. The mass balance error for the flow model was 0.00 percent and the ratio of the residual standard deviation to the range of heads was 9.0 percent, which is below the desired target value of 10 percent. Another flow model calibration goal is that residuals are evenly distributed such that there is no bias affecting modeled flow. The observed heads are plotted versus the simulated heads in **Figure 5-23** and simulated values are evenly distributed above and below observed values. The residual mean was also near zero with a value of 0.10 feet, indicating a small bias towards underestimating the groundwater elevations in the calibrated model; this is also illustrated in the observed versus residuals plot in **Figure 5-23**.

The simulated groundwater elevations within the UA (layer 3) for the entire site are shown in **Figure 5-24**. **Figure 5-25** shows the simulated groundwater elevations in proximity to AP1. In general, the model is able to simulate the groundwater flow patterns for the UA (**Figure 2-2** and **Figure 2-3**) at AP1 as interpreted from the site well data for April and July 2021, respectively. The simulated groundwater flow pattern also captures the radial flow pattern centered on the southwest area of AP1. Fourteen wells provided calibration targets for the simulated groundwater level around AP1. The simulated groundwater levels for five of these wells are within 1 foot; six wells are within 2 feet. G303 and G312 are underestimated by 2.14 feet and 3.06 feet respectively, and G309 is overestimated by 2.24 feet.

The range of observed sulfate concentrations for transport calibration locations are summarized in **Table 4-1**. The goals of the transport model calibration were to have predicted concentrations fall within the range of observed concentrations, and to have predicted concentrations above and below the GWPS for sulfate (400 mg/L) match observed concentrations above or below the standard at each well. One or both of these goals were achieved at all of the transport calibration location wells, except G317, where concentrations were underpredicted (**Figure 5-26**). Deviations from the observed ranges are discussed below.

The model underpredicts concentrations at G305 and G317. The observed sulfate concentrations range from 710 to 930 mg/L and 780 to 1100 mg/L for G305 and G317, respectively. The predicted concentrations are 424.8 mg/L and 146.8 mg/L for G305 and G317, respectively. G305 is located south of AP1 (**Figure 2-1**) in close proximity to the mine entrance discussed in **Section 2.2.4** and shown in **Figure 1-2**. The disturbance associated with the former mining activity may be associated with the elevated sulfate concentrations in this well. G317 is located southeast of AP1, downgradient of G303 (whose predicted sulfate concentration is within the observed range). Groundwater flow in this area is predominantly towards Coffeen Lake (west to east). There is aerial and topographic evidence supporting the presence of a soil pile related to the mining activities in the area west (upgradient) of G317 (see **Section 2.2.4**). One soil boring completed through the soil pile documents the presence of coal in the boring log, indicating the

soil pile may be another source of sulfate. This soil pile may potentially leach sulfate into the groundwater thereby increasing the sulfate concentration at G317 above that which would be attributed to AP1 alone.

The remaining calibration locations had predicted concentrations that fall within the range of observed concentrations and/or have predicted concentrations above and below the GWPS for sulfate (400 mg/L) matching observed concentrations above or below the standard at each well. In other words, there was a very good match between predicted and observed sulfate concentrations relative to wells with concentrations above and below the GWPS. The transport model has achieved a very good calibration using a sulfate source concentration of 1,000 mg/L, even though some wells have observed concentrations that are greater than the source concentration used. The distribution of sulfate concentrations in the calibrated model are presented on **Figure 5-27**.

6. PREDICTIVE SIMULATIONS

6.1 Overview and Prediction Model Development

Prediction simulations were performed to evaluate the effects of closure (source control measures) for AP1 on groundwater quality. The prediction simulations evaluated changes in groundwater sulfate concentrations from Scenario 1: CIP (removal of CCR from the eastern portion of AP1 and consolidation into the western portion of the AP1) and Scenario 2: CBR (removal of all CCR material from AP1). As discussed in **Section 5.2.3.7** physical attenuation (dilution and dispersion) of contaminants in groundwater is simulated in MT3DMS, which captures the physical process of natural attenuation as part of corrective actions for both closure scenarios simulated. No retardation was applied to sulfate transport in the model (*i.e.,* Kd was set to 0 mL/g) as discussed in **Section 5.2.3.8**.

Closure scenarios were simulated by initially removing free liquids from the CCR material over the course of 2 years by placing drain cells within AP1 with an elevation of 618 feet and applying zero recharge to simulate dewatering of the CCR units.

HELP-calculated percolation rates, based on removal and final soil backfill grading designs provided in the Final Closure Plans for AP1 (Golder, 2022a), GMF GSP (Golder, 2022b), and GMF RP (Golder, 2022c), were applied for the different closure scenarios. HELP modeling input and output values are summarized in **Table 6-1** and described in detail below.

The CIP and CBR scenarios were simulated for a 100-year period. The following simplifying assumptions were made during the simulations:

- Removal of free liquids from CCR takes place prior to the CIP and CBR closure scenarios. Drain cells were placed within the units to simulate the removal of free water within the ponds; and recharge was set to zero.
- In the CIP and CBR closure scenarios, HELP-calculated average annual percolation rates were developed from a 30-year HELP model run. This 30-year HELP-calculated percolation rate remained constant over duration of the closure scenario prediction model runs following CCR dewatering period.
- Changes in recharge resulting from removal of free liquids (decrease calibration model recharge rates to zero) and CCR fill removal/final soil backfill grading (recharge rates are based on HELP-calculated average annual percolation rates) have an instantaneous effect on recharge and percolation through surface materials.
- Sulfate source concentrations were assumed to be negligible (0 mg/L) in CCR removal areas in both the CIP and CBR scenarios. The spatial distribution of CCR concentrations within the consolidation area for the CIP scenario were maintained from the initial transport simulation.
- Cap construction in CIP scenario was assumed to be completed with a cover system consisting of the following (listed from ground surface down): a vegetative cover (6 inches thick), rooting zone (18 inches thick), a 200-mil geocomposite drainage layer and a 40-mil linear HDPE geomembrane.
- The start of each closure prediction simulation was initiated at the end of the calibration model period of 42 years plus 2 years to complete removal of free liquids. For example, the

simulation of Scenario 1: CIP begins at 44 years (42 years for calibration plus 2 years). The prediction modeling timeline for each scenario is illustrated in **Figure 4-1**.

- CCR consolidation/removal areas were assumed to be graded and include proper drainage controls to remove excess water from the surface using the design drawings provided (Golder, 2022a).
- The CIP scenario includes the placement of a stormwater pond within the removal area. The outflow elevation of this stormwater pond is 625 feet, which will discharge into Coffeen Lake adjacent to the AP2. This is represented as a drain in the model whose elevation is equal to the stormwater pond outflow elevation.
- Local fill materials applied to the prediction models have similar hydraulic properties as the UCU materials used in the transport calibration models. However, the local fill materials were assumed to have reduced vertical anisotropy ratios, approaching isotropic, due to reworking of the material as it is placed as backfill (Kh/Kv decreased from measured values of 10 to 1 for reworked material).

6.2 HELP Model Setup and Results

HELP (Version 4.0; Tolaymat and Krause, 2020) was used to estimate percolation through AP1 in areas of CCR removal with soil backfill, and areas of CCR consolidation with final cover system. HELP input and output files are included electronically and attached to this report.

HELP input data and results are provided in **Table 6-1**. All scenarios were modeled for a period of 30 years. Climatic inputs were synthetically generated using default equations developed for Belleville Scott Air Force Base in Belleville, Illinois (the closest weather station included in the HELP database). Precipitation, temperature, and solar radiation was simulated based on the latitude of CPP. Thickness of soil backfill and soil runoff input parameters were developed for the ash fill removal scenarios using data provided in the Final Closure Plans for AP1 (Golder, 2022a), GMF GSP (Golder, 2022b), and GMF RP (Golder, 2022c).

HELP model results (**Table 6-1**) indicated 7.85 inches of percolation per year for AP1 CCR removal and soil backfill area in the CIP scenario and 0.00027 inches of percolation per year through the CCR and final cover system for the CIP scenario. Results indicated 7.85 inches and 6.28 inches of percolation per year for AP1 eastern and western CCR removal and soil backfill area in the CBR scenario, respectively. The differences in HELP model runs for each area included the following parameters: area, soil backfill thickness, slopes, and soil runoff slope length; all other HELP model input parameters were the same for each simulated area. HELP input data and results are provided in **Appendix B.**

Two additional HELP model simulations were completed to support the *Proposed Alternative Final Protective Layer Equivalency Demonstration*, (Geosyntec, 2022c) which is an appendix to the Construction Permit Application to which this report is also attached. Results of these two HELP simulations were not incorporated in the MODFLOW simulations for closure. Simulation inputs and output results are presented in **Appendix D**.

6.3 Simulation of Closure Scenarios

The calibrated model was used to evaluate the effectiveness of the two closure scenarios by defining CCR removal and consolidation areas, reducing head to simulate removal of free liquids, removing source concentrations from the removal areas, adding drain cells and removing

recharge to simulate stormwater management within the removal areas, and applying reduced recharge in the CCR consolidation areas to simulate the effects of the cover system on flow and transport. Removal of source inputs from the ash removal areas was simulated by reducing the sulfate concentrations associated with recharge in the areas to 0 mg/L and removing constant concentration cells.

Each prediction scenario was simulated as a continuation of the AP1 dewatering simulation which followed the transient calibrated model. The prediction model input values are summarized in **Table 6-2,** and the modifications to the recharge zones and drain placement for the CIP scenario are illustrated in **Figure 6-1**. **Figure 6-2** illustrates the CCR removal area for the CBR at the AP1. The two closure scenarios are discussed in this report based on predicted changes in sulfate concentrations as described below and results are presented in **Figure 6-3 to Figure 6-6**.

6.3.1 Closure in Place Model Results

The design for Scenario 1: CIP includes an initial 2-year dewatering period to remove free liquids followed by CCR removal from AP1, consolidation in the western area of AP1, and construction of a cover system over the remaining CCR (**Figure 6-1**). Stormwater drainage will be present within the eastern area of AP1 with an outflow elevation of 625 feet.

Predicted concentrations start to decline at all monitoring wells with observations above the GWPS for sulfate (400 mg/L) once closure actions are initiated within the prediction model. These declines occur first in the eastern area where CCR is removed and saturated ash cells (constant concentration cells) are reduced in the area of the highest modeled source concentrations. Following removal of CCR in the eastern area, sulfate concentrations are no longer entering the model domain from recharge or from saturated ash cells (constant concentration cells). Dewatering also reduces the head within AP1. These low heads are maintained following completion of closure by the drain cells that simulate storm water management designs within the removal area to the east, and by the greatly reduced infiltration rates (recharge) that result from placement of the cover system over the consolidated CCR in the western end of AP1. As a result of the reduced heads and recharge, downward percolation of solute mass from AP1 is reduced, which decreases the sulfate concentration entering the model domain.

The predictive model indicates that most wells will reach the GWPS (400 mg/L) in under 14.8 years following closure, with one exception. **Figure 6-3** and **Figure 6-4** show the extent of the plume in the UA after 14.8 years and the maximum extent of the plume in the model after 14.8 years, respectively. The predicted delayed reduction in concentration at well G301, 58.8 years, is a result of the well's location along the flow path of the residual sulfate concentrations released into native geologic materials prior to closure. All UA groundwater monitoring wells are below the GWPS within 58.8 years (**Figure 6-5** and **Figure 6-6**). The residual sulfate plume in the UA from the calibrated model remains in close proximity to AP1 as it recedes over time. The predicted footprint of the sulfate plume in the UA after 58.8 years shown in **Figure 6-5** is considerably reduced from that at the end of the transient model simulation (**Figure 5-27**).

The predicted delayed reduction in concentration at well G301 is a result of the well's location along the flow path of the residual sulfate concentrations released into native geologic materials prior to closure. Reduced percolation rates through the consolidation area within AP1 in the CIP scenario means that the residual sulfate concentrations require a longer time period to migrate through native geologic materials.

Evaluations of post-construction water flux through the consolidated and covered Fill Unit (CCR) were completed using data obtained from the Scenario 1 (CIP) prediction model when simulated post-construction heads in the groundwater monitoring wells are predicted to stabilize (once heads stabilized in the model, the post-construction movement of water in and out of the Fill Unit [CCR] were compared to pre-construction conditions). The pre-construction (calibration model) and post-construction Scenario 1 (CIP) prediction model simulated water flux values are summarized in **Appendix E** and discussed below. Data export files used for flux evaluations are found along with model files in **Appendix B**.

Scenario 1 (CIP) was predicted to reduce total flux in and out of the Fill Unit (CCR) by approximately 99.9%, when simulated post-construction heads in the groundwater monitoring wells are predicted to stabilize (approximate hydraulic steady state) as illustrated in **Figure 6-7**. **Figure 6-8** is a plot showing the changes in flux reduction (shown as negative percentage) over time starting from implementation of Scenario 1 (CIP) through approximate hydraulic steady state conditions. Following implementation of Scenario 1 (CIP), influx into the CCR unit decreases rapidly as illustrated in **Figure 6-8**. Following removal of free-liquids, the consolidated CCR is no longer in contact with groundwater. Thus, the modeling indicates consolidation and closure with the proposed cover system result in 99.9% reduction in outflux after 10 days (**Figure 6-8**). The outflux from the CCR unit remains relatively constant throughout the CIP simulation.

Further, the base of consolidated CCR was compared to the simulated steady-state groundwater elevations which indicate between 3.2 and 10 feet of separation will be present between the base of CCR and groundwater (**Figure 6-9**).

6.3.2 Closure by Removal Model Results

The design for Scenario 2: CBR includes an initial 2-year dewatering period followed by CCR removal from AP1 (**Figure 6-2**). Stormwater drainage is present within AP1 with an outflow elevation of 625 feet.

For most wells, predicted concentrations for CBR start to decline at monitoring wells with observations above the standard GWPS for sulfate (400 mg/L) once the closure actions are initiated within the prediction model. The concentration of sulfate in some wells (most notably G315, G307 and G308) show short term fluctuations (less than 5 years) following the removal of concentration during the dewatering phase, such that sulfate concentrations decline and are followed by a short rise before the impacts of the CBR are clearly observed. The general decline in sulfate concentration occur as the CCR is removed from AP1 and saturated ash cells (constant concentration cells) are removed. Following removal of CCR, sulfate concentrations are no longer entering the model domain from recharge or from saturated ash cells (constant concentration cells); all source concentrations are removed. Dewatering through removal of free liquids also reduces the head within AP1. These low heads are maintained following completion of closure by the drain cells that simulate storm water management designs within AP1. The removal of the CCR sources leads to the gradual reduction the residual sulfate concentrations released into native geologic materials prior to closure. All monitoring wells with observations above the standard GWPS for sulfate (400 mg/L) are predicted to be below the GWPS 18.1 years after closure implementation (**Figure 6-3**).

The sulfate plume in the CBR prediction model differs from that in the CIP prediction model. Higher recharge rates are present in the western portion of the pond because there is no cover

system. The relatively higher recharge rates maintain components of the radial flow pattern described in **Section 2.2** at AP1. However, the stormwater drainage within the pond does constrain the groundwater elevation beneath AP1. As a result of the radial flow pattern, the prediction model indicates that a portion of the historic plume will remain along the western edge of AP1 as the plume recedes over time. The maximum extent of the plume at 14.8 years is illustrated in **Figure 6-4**. The maximum extent of the plume remains in close proximity to AP1 and is no longer present above the GWPS (400 mg/L) at 58.8 years as illustrated in **Figure 6-6**.

7. CONCLUSIONS

This GMR has been prepared to evaluate how proposed CIP and CBR scenarios will achieve compliance with the applicable groundwater standards at the CPP for AP1. An existing groundwater model was updated to include data collected from the recent 2021 field investigations and used to predict the impacts of the closure scenarios on groundwater quality at the CPP. Statistically significant correlations between sulfate concentrations and concentrations of TDS identified as potential exceedances of the GWPS indicate sulfate is an acceptable surrogate for TDS in the groundwater model. Concentrations of TDS are expected to change along with model predicted sulfate concentrations. A potential exceedance of boron was observed at one monitoring well, G313, which also has potential exceedances of both sulfate and TDS. Similar source and behavior in the groundwater system would be expected among boron, sulfate, and TDS at UA monitoring well G313, and boron concentrations are expected to change along with model predicted sulfate concentrations. It was assumed that sulfate would not significantly sorb or chemically react with aquifer solids (Kd was set to 0 mL/g) which is a conservative estimate for predicting contaminant transport times in the model. The MODFLOW and MT3DMS models were used to evaluate two scenarios using information provided in the Final Closure Plan for AP1 (Golder, 2022a):

- **Scenario 1:** CIP including removal of CCR from the eastern portion of AP1, consolidation into the western portion of AP1, and construction of a cover system over the remaining CCR.
- **Scenario 2:** CBR including removal of all CCR and regrading of the removal area.

Scenario 1 (CIP) was predicted to reduce total flux in and out of the Fill Unit (CCR) by approximately 99.9%, when simulated post-construction heads in the groundwater monitoring wells are predicted to stabilize. Additionally, the base of consolidated CCR was compared to the simulated steady-state groundwater elevations which indicate between 3.2 and 10 feet of separation will be present between the base of CCR and groundwater.

Differences exist in the timeframes to reach the GWPS for most monitoring wells between CIP and CBR. In general, the simulated groundwater concentrations in the monitoring wells within the UA will achieve the GWPS in 15 years and 18 years respectively for the CIP and CBR closure scenarios, with the exception of well G301 in the CIP scenario. The predicted delayed reduction in concentration at well G301, 59 years to reach the GWPS, is a result of the well's location along the flow path of the residual sulfate concentrations released into native geologic materials prior to closure. Reduced percolation rates through the consolidation area at the northwest corner of AP1 in the CIP scenario means that the residual sulfate concentrations in this limited area require a longer time period to migrate through native geologic materials.

8. REFERENCES

Anderson, M.P. 1979. *Using models to simulate the movement of contaminants through groundwater flow systems*. CRC Critical Rev. Environ. Control., 9(2), p. 97-156.

Anderson, M.P. 1984. *Movement of contaminants in groundwater: groundwater transport -- advection and dispersion*. Groundwater Contamination. National Academy Press, Washington, D.C. p. 37-45.

Environmental Simulations, Inc., 2017. *Groundwater Vistas 7 Software*.

Electric Power Research Institute (EPRI), 2005. *Chemical constituents in coal combustion product leachate: boron. Final Report 1005258.*

EPRI, 2005. *Chemical constituents in coal combustion product leachate: boron*. Final Report 1005258.

Fetter, C.W., 1988. *Applied Hydrogeology*. Merrill Publishing Company, Columbus, Ohio.

Fetter, C.W., 2001. *Applied Hydrogeology*. 4th Edition, Prentice Hall, Upper Saddle River, p. 79.

Geosyntec Consultants, Inc. (Geosyntec), 2022a. *Technical Memorandum: Evaluation of Potential GWPS Exceedances, Coffeen Ash Pond 1, Coffeen Power Plant*.

Geosyntec Consultants, Inc. (Geosyntec), 2022b. *Technical Memorandum: Evaluation of Partition Coefficient Results, Coffeen Ash Pond No. 1, CCR Unit 101, Coffeen Power Plant, Coffeen Illinois*.

Geosyntec Consultants, Inc. (Geosyntec), 2022c. *Technical Memorandum: Proposed Alternative Final Protective Layer Equivalency Demonstration, Ash Pond No. 1, Coffeen Power Plant, Coffeen, Illinois*.

Golder Associates (Golder), 2022a. *Final Closure Plan for Ash Pond No. 1*, attached to the Construction Permit Application to which this report is also attached, July 2022.

Golder Associates (Golder), 2022b. *Final Closure Plan for the Gypsum Management Facility Gypsum Stack Pond, Coffeen Power Plant, Coffeen, Illinois*, July 2022.

Golder Associates (Golder), 2022c. *Final Closure Plan for the Gypsum Management Facility Recycle Pond, Coffeen Power Plant, Coffeen*, July 2022.

Haley & Aldrich, Inc., October 1, 2018. *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities*.

Hanson Professional Services, Inc. (Hanson), 2009. *Section 3: Hydrogeologic Investigation. Initial Facility Report*. Hanson Professional Services, Inc. August 2009.

Hanson Professional Services, Inc. (Hanson), 2016. 40 CFR 257.60 *Uppermost Aquifer Considerations, Gypsum Pond*, Illinois Power Holdings LLC, Coffeen Energy Center, Montgomery County, Illinois, April 2016.

Illinois Environmental Protection Agency (IEPA), 2021. *In the Matter of: Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments: Title 35 Illinois Administration Code 845, Addendum*. April 15, 2021.

Illinois State Geological Survey (ISGS), 2019. *Directory of Coal Mines in Illinois, Christian County*. Accessed from URL: https://wikiimage.isgs.illinois.edu/ilmines/webfiles/mines-series/mines-directories/pdf-files/mines-directory-christian.pdf. August 2019.

McDonald, M.G., and A.W. Harbaugh, 1988. *A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model: Techniques of Water-Resources Investigations, Techniques of Water-Resources of the United States Geological Survey*. Book 6, Chapter A1.

Natural Resource Technology, Inc. (NRT), 2017a. *Hydrogeologic Site Characterization Report. Ash Pond 2, Coffeen Power Station, Coffeen, Illinois*. Illinois Power Generating Company. January 24, 2017.

Natural Resource Technology, Inc. (NRT), 2017b. *Groundwater Model Report. Ash Pond 2, Coffeen Power Station, Coffeen, Illinois*. Illinois Power Generating Company. January 24, 2017.

Nelson, W. John, 1995. *Structural Features in Illinois*. Illinois State Geological Survey, Bulletin 100, 144 p.

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2021a. *Hydrogeologic Site Characterization Report, Ash Pond No. 1, Coffeen, Illinois*. Illinois Power Generating Company. October 25, 2021.

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2021b. *History of Potential Exceedances, Ash Pond No. 1, Coffeen, Illinois*. Illinois Power Generating Company. October 25, 2021.

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2021c. *Groundwater Monitoring Plan. Coffeen Power Plant, Ash Pond No. 1, Coffeen, Illinois*. Illinois Power Generating Company. October 25, 2021.

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2021d. *Hydrogeologic Site Characterization Report, GMF Recycle Pond, Coffeen, Illinois*. Illinois Power Generating Company. October 25, 2021.

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2021e. *Hydrogeologic Site Characterization Report, GMF Gypsum Stack Pond, Coffeen, Illinois*. Illinois Power Generating Company. October 25, 2021.

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2022. *Groundwater Modeling Report, GMF Gypsum Stack Pond and GMF Recycle Pond, Coffeen Power Plant, Coffeen Illinois*.

Strenge, D. and Peterson, S. 1989. *Chemical Data Bases for the Multimedia Environmental Pollutant Assessment System (MEPAS) (No. PNL-7145)*. Pacific Northwest Lab., Richland, WA (USA).

Tolaymat, T. and Krause, M, 2020. *Hydrologic Evaluation of Landfill Performance: HELP 4.0 User Manual*. United States Environmental Protection Agency, Washington, DC, EPA/600/B 20/219.

United States Department of Agriculture/Natural Resources Conservation Service (USDA/NRCS), 2022. National Geospatial Center of Excellence, Digital Elevation Model.

United States Geological Survey (USGS), 2021. *National Map*. Accessed from URL: https://apps.nationalmap.gov/viewer/

Willman, H.B., E. Atherton, T.C. Buschbach, C. Collinson, J.C. Frye, M.E. Hopkins, J.A. Lineback, and J.A. Simon, 1975. *Handbook of Illinois Stratigraphy.* Illinois State Geological Survey, Bulletin 95, 261 p.

Zheng, Z., and P.P. Wang, 1998. MT3DMS, a Modular Three-Dimensional Multispecies Transport Model, Model documentation and user's guide prepared by the University of Alabama Hydrogeology Group for the US Army Corps of Engineers.

TABLES

TABLE 2-1. MONITORING WELL LOCATIONS AND CONSTRUCTION DETAILS
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

Well Number	HSU	Date Constructed	Top of PVC Elevation (feet)	Measuring Point Elevation (feet)	Measuring Point Description	Ground Elevation (feet)	Screen Top Depth (feet bgs)	Screen Bottom Depth (feet bgs)	Screen Top Elevation (feet)	Screen Bottom Elevation (feet)	Well Depth (feet bgs)	Bottom of Boring Elevation (feet)	Screen Length (feet)	Screen Diameter (inches)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
G045D	LCU	08/17/2016	623.81	623.81	Top of PVC	620.94	31.88	41.52	589.06	579.42	41.92	578.90	9.6	2	39.064349	-89.396281
G046D	LCU	08/19/2017	625.24	625.24	Top of PVC	621.91	41.61	51.26	580.30	570.65	51.65	569.90	9.7	2	39.060305	-89.398524
G101	UA	02/02/2010	--	627.60	Top of Disk	625.27	15.68	20.32	609.59	604.95	20.89	603.40	4.6	2	39.071386	-89.400107
G102	UA	04/28/2006	--	629.04	Top of Disk	626.18	12.02	16.78	614.16	609.40	17.15	609.00	4.8	2	39.071387	-89.398991
G103	UA	02/15/2010	--	633.80	Top of Disk	627.94	15.88	20.67	612.06	607.27	21.09	606.90	4.8	2	39.070412	-89.399107
G104	UA	02/15/2010	--	632.94	Top of Disk	627.96	14.91	19.61	613.05	608.35	20.08	605.80	4.7	2	39.069451	-89.399104
G105	UA	02/16/2010	--	632.08	Top of Disk	626.86	16.11	20.90	610.75	605.96	21.37	604.40	4.8	2	39.068491	-89.3991
G106	UA	02/16/2010	--	631.15	Top of Disk	625.96	14.37	18.96	611.59	607.00	19.44	605.50	4.6	2	39.06753	-89.399097
G107	UA	02/17/2010	630.22	630.22	Top of Disk	628.20	13.87	18.50	614.33	609.70	19.00	607.50	4.6	2	39.067106	-89.399646
G108	UA	02/12/2010	--	630.22	Top of Disk	625.58	16.82	21.50	608.76	604.08	22.00	603.60	4.7	2	39.066984	-89.400035
G109	UA	02/11/2010	--	629.76	Top of Disk	624.79	15.39	19.93	609.40	604.86	20.50	604.30	4.5	2	39.067045	-89.400423
G110	UA	02/11/2010	--	629.65	Top of Disk	624.81	15.05	19.59	609.76	605.22	20.16	604.70	4.5	2	39.067172	-89.400704
G111	UA	02/11/2010	--	629.90	Top of Disk	625.28	14.61	19.15	610.67	606.13	19.72	605.60	4.5	2	39.067292	-89.40097
G119	UA	02/09/2010	--	631.55	Top of Disk	626.57	17.29	21.83	609.28	604.74	22.38	604.20	4.5	2	39.068986	-89.401213
G120	UA	02/08/2010	--	631.87	Top of Disk	627.21	15.10	19.62	612.11	607.59	20.21	605.10	4.5	2	39.069479	-89.401214
G121	UA	02/04/2010	--	632.83	Top of Disk	627.94	16.79	21.47	611.15	606.47	21.95	603.80	4.7	2	39.069781	-89.401216
G122	UA	02/04/2010	--	632.69	Top of Disk	628.05	16.51	21.05	611.54	607.00	21.66	606.20	4.5	2	39.070098	-89.401218
G123	UA	02/04/2010	--	632.96	Top of Disk	628.12	20.94	25.46	607.18	602.66	26.07	602.10	4.5	2	39.070399	-89.401219
G124	UA	02/03/2010	--	633.39	Top of Disk	628.70	15.98	20.51	612.72	608.19	21.06	606.70	4.5	2	39.070715	-89.40122
G125	UA	02/03/2010	--	633.51	Top of Disk	628.85	17.03	21.56	611.82	607.29	22.04	606.80	4.5	2	39.071003	-89.401221
G126	UA	02/10/2010	--	625.39	Top of Disk	622.96	12.89	17.43	610.07	605.53	18.00	605.00	4.5	2	39.067304	-89.401274
G151	UA	12/19/2011	--	625.93	Top of Disk	622.82	15.34	19.84	607.48	602.98	20.46	602.40	4.5	2	39.0672	-89.40159
G152	UA	12/20/2011	--	626.52	Top of Disk	623.06	13.59	18.09	609.47	604.97	18.57	604.50	4.5	2	39.066275	-89.401289
G153	UA	12/15/2011	626.35	626.40	Top of Disk	623.23	15.90	20.34	607.33	602.89	20.80	602.50	4.4	2	39.065857	-89.402567
G154	UA	12/16/2011	--	626.35	Top of Disk	623.52	14.26	18.76	609.26	604.76	19.10	603.50	4.5	2	39.067089	-89.403574
G155	UA	12/19/2011	--	625.86	Top of Disk	622.89	15.09	19.58	607.80	603.31	23.23	599.70	4.5	2	39.067493	-89.402659
G200	UA	02/25/2008	--	625.94	Top of Disk	623.27	12.19	16.98	611.08	606.29	17.36	605.30	4.8	2	39.075139	-89.395009
G201	UA	02/25/2008	627.15	627.15	Top of Riser	624.19	13.01	17.80	611.18	606.39	18.15	606.00	4.8	2	39.075141	-89.397829
G205	UA	02/21/2008	--	624.34	Top of Disk	622.10	10.04	14.53	612.06	607.57	15.07	606.10	4.5	2	39.068596	-89.394147
G206	UA	10/14/2010	--	632.82	Top of Disk	630.53	17.51	21.92	613.02	608.61	22.42	606.50	4.4	2	39.067399	-89.398548
G206D	DA	01/25/2021	634.14	634.14	Top of PVC	631.41	49.20	59.00	582.21	572.41	59.39	571.41	9.8	2	39.067428	-89.398493
G207	UA	10/08/2010	--	633.21	Top of Disk	630.61	18.24	22.77	612.37	607.84	23.30	606.60	4.5	2	39.067568	-89.397952
G208	UA	10/07/2010	--	633.16	Top of Disk	630.57	17.53	22.06	613.04	608.51	22.60	606.60	4.5	2	39.067743	-89.397402
G209	UA	10/07/2010	--	632.91	Top of Disk	630.57	17.74	22.28	612.83	608.29	22.81	606.60	4.5	2	39.067923	-89.39685
G210	UA	10/06/2010	--	632.99	Top of Disk	630.48	19.39	23.93	611.09	606.55	24.46	605.50	4.5	2	39.068088	-89.396322
G211	UA	10/11/2010	--	632.64	Top of Disk	630.31	17.34	21.88	612.97	608.43	22.41	606.30	4.5	2	39.068263	-89.395792
G212	UA	10/11/2010	--	632.89	Top of Disk	630.59	16.74	21.29	613.85	609.30	21.81	606.60	4.6	2	39.06843	-89.395318
G213	UA	10/12/2010	--	632.81	Top of Disk	630.34	16.75	21.29	613.59	609.05	21.82	606.30	4.5	2	39.068585	-89.394822
G214	UA	10/14/2010	--	632.85	Top of Disk	630.39	17.75	22.14	612.64	608.25	22.65	606.40	4.4	2	39.068919	-89.393982
G215	UA	10/13/2010	--	633.06	Top of Disk	630.48	19.41	23.80	611.07	606.68	24.31	606.20	4.4	2	39.069309	-89.39394

TABLE 2-1. MONITORING WELL LOCATIONS AND CONSTRUCTION DETAILS

GROUNDWATER MODELING REPORT

COFFEEN POWER PLANT

ASH POND NO. 1

COFFEEN, ILLINOIS

Well Number	HSU	Date Constructed	Top of PVC Elevation (feet)	Measuring Point Elevation (feet)	Measuring Point Description	Ground Elevation (feet)	Screen Top Depth (feet bgs)	Screen Bottom Depth (feet bgs)	Screen Top Elevation (feet)	Screen Bottom Elevation (feet)	Well Depth (feet bgs)	Bottom of Boring Elevation (feet)	Screen Length (feet)	Screen Diameter (inches)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
G216	UA	10/13/2010	--	632.76	Top of Disk	630.28	20.04	24.42	610.24	605.86	24.93	604.30	4.4	2	39.069765	-89.393946
G217	UA	10/12/2010	--	633.10	Top of Disk	630.67	20.49	24.88	610.18	605.79	25.38	604.70	4.4	2	39.07034	-89.393959
G218	UA	10/12/2010	--	633.11	Top of Disk	630.64	20.33	24.77	610.31	605.87	25.27	604.60	4.4	2	39.070876	-89.393956
G270	UA	02/26/2008	--	625.86	Top of Disk	623.73	13.13	17.92	610.60	605.81	18.27	605.50	4.8	2	39.066564	-89.397403
G271	UA	09/10/2009	--	625.57	Top of Disk	622.89	9.96	14.31	612.93	608.58	14.79	606.90	4.4	2	39.065007	-89.395587
G272	UA	09/10/2009	--	623.81	Top of Disk	620.72	9.11	13.98	611.61	606.74	14.32	606.40	4.9	2	39.064989	-89.394785
G273	UA	09/10/2009	--	623.02	Top of Disk	620.17	9.08	14.56	611.09	605.61	15.10	604.20	5.5	2	39.064985	-89.393973
G274	UA	09/16/2009	--	624.04	Top of Disk	621.67	12.90	17.67	608.77	604.00	18.06	603.60	4.8	2	39.064991	-89.393198
G275	UA	09/16/2009	--	618.26	Top of Disk	616.14	8.22	12.62	607.92	603.52	13.19	603.00	4.4	2	39.065151	-89.392561
G275D	DA	01/14/2021	620.31	620.31	Top of PVC	617.52	49.76	59.55	567.76	557.97	59.89	517.80	9.8	2	39.065121	-89.392595
G276	UA	09/16/2009	--	632.00	Top of Disk	629.14	22.41	27.22	606.73	601.92	27.65	601.10	4.8	2	39.065534	-89.392617
G277	UA	09/14/2009	--	623.08	Top of Disk	620.79	14.29	18.77	606.50	602.02	19.24	600.80	4.5	2	39.065927	-89.392572
G278	UA	09/11/2009	631.19	631.17	Top of Disk	628.85	18.93	23.70	609.92	605.15	24.06	604.80	4.8	2	39.066737	-89.393161
G279	UA	09/10/2009	--	632.04	Top of Disk	629.19	22.40	26.79	606.79	602.40	27.30	601.20	4.4	2	39.067156	-89.392998
G280	UA	02/26/2008	625.35	625.35	Top of Riser	623.11	12.79	17.63	610.32	605.48	17.98	605.10	4.8	2	39.067216	-89.394992
G281	UA	09/08/2015	--	626.36	Top of Disk	623.82	15.51	20.16	608.31	603.66	20.30	603.50	4.7	2	39.065405	-89.399322
G283	LCU	01/14/2021	610.75	610.75	Top of PVC	608.30	8.39	18.17	599.91	590.13	18.36	589.90	9.8	2	39.064645	-89.392119
G284	UA	02/03/2021	618.42	618.42	Top of PVC	615.33	8.08	12.85	607.25	602.48	13.23	601.30	4.8	2	39.065487	-89.390631
G285	LCU	01/25/2021	613.52	613.52	Top of PVC	610.54	13.68	23.45	596.86	587.09	23.83	584.50	9.8	2	39.066513	-89.391474
G286	UA	01/18/2021	613.13	613.13	Top of PVC	609.97	3.37	8.16	606.60	601.81	8.50	600.00	4.8	2	39.067277	-89.391883
G287	UA	01/20/2021	617.45	617.45	Top of PVC	614.34	5.43	10.25	608.91	604.09	10.59	602.50	4.8	2	39.068297	-89.392388
G288	UA	01/19/2021	620.07	620.07	Top of PVC	617.08	7.59	12.26	609.49	604.82	12.75	603.10	4.7	2	39.067834	-89.390082
G301	UA	09/04/2015	--	622.65	Top of Disk	620.88	11.31	15.96	608.96	604.31	16.21	604.10	4.7	2	39.05951	-89.395415
G302	UA	09/04/2015	--	620.04	Top of Disk	618.52	13.21	17.86	604.74	600.09	18.39	599.60	4.7	2	39.059544	-89.393192
G303	UA	08/26/2010	--	622.02	Top of Disk	619.33	10.00	20.00	609.07	599.07	20.40	598.70	10	2	39.057144	-89.391721
G304	UA	08/26/2010	--	626.72	Top of Disk	623.32	10.00	20.00	613.32	603.32	20.40	602.90	10	2	39.057205	-89.395663
G305	UA	05/03/2016	625.67	625.67	Top of PVC	623.23	13.44	18.27	609.10	604.27	18.50	604.10	4.8	2	39.056558	-89.396798
G306	UA	05/03/2016	625.91	625.91	Top of PVC	623.57	13.07	17.68	609.77	605.16	17.90	604.80	4.6	2	39.056494	-89.393556
G307	UA	07/27/2016	624.60	624.60	Top of PVC	624.73	12.96	17.80	609.12	604.28	18.22	603.90	4.8	2	39.057214	-89.395545
G307D	LCU	01/19/2021	624.88	624.88	Top of PVC	622.51	48.98	58.75	573.53	563.76	59.60	562.50	9.8	2	39.05721	-89.39552
G308	UA	01/18/2021	624.59	624.59	Top of PVC	621.59	10.10	14.89	611.49	606.70	15.24	605.80	4.8	2	39.057379	-89.397134
G309	UA	01/21/2021	625.88	625.88	Top of PVC	622.77	12.97	17.75	609.80	605.02	18.10	604.70	4.8	2	39.058508	-89.397243
G310	UA	02/09/2021	622.87	622.87	Top of PVC	619.89	10.24	15.03	609.65	604.86	15.38	604.00	4.8	2	39.059532	-89.396907
G311	UA	01/13/2021	621.04	621.04	Top of PVC	618.32	9.27	14.04	609.05	604.28	14.40	603.90	4.8	2	39.059513	-89.394363
G311D	LCU	01/12/2021	621.24	621.24	Top of PVC	618.39	50.16	60.10	568.23	558.29	60.58	557.80	9.9	2	39.059513	-89.394312
G312	UA	01/15/2021	619.78	619.78	Top of PVC	616.92	9.79	14.58	607.13	602.34	14.93	601.70	4.8	2	39.059558	-89.391983
G313	UA	02/05/2021	614.30	614.30	Top of PVC	611.51	6.30	11.11	605.21	600.40	11.46	599.50	4.8	2	39.058773	-89.391124
G314	LCU	02/05/2021	613.88	613.88	Top of PVC	611.11	14.56	19.58	596.55	591.53	20.02	591.10	5	2	39.05782	-89.390964
G314D	DA	02/04/2021	613.70	613.70	Top of PVC	610.87	39.34	49.11	571.53	561.76	49.47	510.60	9.8	2	39.057852	-89.390958
G315	UA	01/14/2021	623.52	623.52	Top of PVC	620.94	9.69	14.48	611.25	606.46	14.85	605.00	4.8	2	39.057165	-89.393667

TABLE 2-1. MONITORING WELL LOCATIONS AND CONSTRUCTION DETAILS

GROUNDWATER MODELING REPORT

COFFEEN POWER PLANT

ASH POND NO. 1

COFFEEN, ILLINOIS

Well Number	HSU	Date Constructed	Top of PVC Elevation (feet)	Measuring Point Elevation (feet)	Measuring Point Description	Ground Elevation (feet)	Screen Top Depth (feet bgs)	Screen Bottom Depth (feet bgs)	Screen Top Elevation (feet)	Screen Bottom Elevation (feet)	Well Depth (feet bgs)	Bottom of Boring Elevation (feet)	Screen Length (feet)	Screen Diameter (inches)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
G316	LCU	02/26/2021	602.59	602.59	Top of PVC	599.64	10.02	14.82	589.62	584.82	15.16	583.90	4.8	2	39.057847	-89.389698
G317	UA	02/12/2021	641.93	641.93	Top of PVC	638.85	30.14	34.93	608.71	603.92	35.28	602.90	4.8	2	39.056727	-89.390148
G401	UA	09/14/2015	--	625.57	Top of Disk	623.03	14.36	18.79	608.67	604.24	19.29	603.70	4.4	2	39.060259	-89.395295
G402	UA	08/27/2010	--	613.37	Top of Disk	610.36	10.00	20.00	600.36	590.36	20.40	590.00	10	2	39.060207	-89.391712
G403	UA	09/11/2015	--	626.47	Top of Disk	623.81	13.11	17.78	610.70	606.03	18.15	605.70	4.7	2	39.063167	-89.398779
G404	UA	05/01/2007	--	615.67	Top of Disk	613.57	6.42	11.17	607.15	602.40	11.62	601.60	4.8	2	39.064329	-89.392493
G405	UA	05/01/2007	--	623.63	Top of Disk	621.40	9.01	13.76	612.39	607.64	14.21	607.20	4.8	2	39.064345	-89.396234
G406	UA	08/19/2016	625.36	625.36	Top of PVC	621.86	13.56	18.37	608.30	603.49	18.75	603.10	4.8	2	39.060309	-89.398508
G407	UA	08/16/2016	621.32	621.32	Top of PVC	618.35	13.78	18.61	604.57	599.74	19.04	598.40	4.8	2	39.061574	-89.402004
G410	UA	02/23/2018	--	619.79	Top of Disk	617.21	8.89	13.68	608.32	603.53	14.09	603.10	4.8	2	39.061572	-89.403763
G411	UA	02/22/2018	--	623.25	Top of Disk	620.49	11.21	16.07	609.28	604.42	16.47	604.00	4.9	2	39.063979	-89.404033
MW01D	DA	05/03/2006	609.02	609.02	Top of PVC	607.08	33.29	38.05	573.79	569.03	38.41	567.10	4.8	2	39.067068	-89.402747
MW02S	UA	05/05/2006	627.12	627.12	Top of PVC	624.16	10.34	15.12	613.82	609.04	15.51	608.70	4.8	2	39.071017	-89.403648
MW02D	LCU	05/05/2006	626.99	626.99	Top of PVC	624.14	22.03	26.83	602.11	597.31	27.22	596.90	4.8	2	39.071031	-89.403649
MW03D	DA	04/27/2006	629.01	629.01	Top of PVC	625.86	52.29	57.06	573.57	568.80	57.40	567.90	4.8	2	39.071386	-89.398976
MW04S	UA	05/11/2006	625.89	625.89	Top of PVC	622.63	9.83	14.26	612.80	608.37	14.77	607.90	4.4	2	39.075356	-89.399232
MW05S	UA	05/17/2006	625.95	625.95	Top of PVC	622.65	12.66	17.41	609.99	605.24	17.71	604.90	4.8	2	39.075866	-89.40333
MW05D	DA	05/17/2006	625.91	625.91	Top of PVC	622.65	45.57	50.33	577.08	572.32	50.72	568.70	4.8	2	39.075863	-89.403313
MW06S	UA	05/04/2006	626.15	626.15	Top of PVC	623.37	11.04	15.62	612.33	607.75	16.08	607.30	4.6	2	39.078189	-89.403644
MW07S	UA	05/09/2006	627.60	627.60	Top of PVC	624.90	9.91	13.79	614.99	611.11	14.39	610.50	3.9	2	39.0786	-89.399383
MW08S	UA	05/10/2006	628.01	628.01	Top of PVC	625.09	11.51	16.00	613.58	609.09	16.60	608.00	4.5	2	39.080234	-89.399079
MW09S	UA	05/03/2006	627.62	627.62	Top of PVC	624.70	11.21	15.62	613.49	609.08	16.20	608.50	4.4	2	39.079954	-89.394899
MW09D	LCU	05/03/2006	627.61	627.61	Top of PVC	624.68	45.81	50.57	578.87	574.11	51.00	570.70	4.8	2	39.07994	-89.394899
MW10S	UA	05/02/2006	624.45	624.45	Top of PVC	621.43	11.28	15.76	610.15	605.67	16.30	605.10	4.5	2	39.07601	-89.394068
MW10D	LCU	05/01/2006	624.47	624.47	Top of PVC	621.33	41.74	46.57	579.59	574.76	47.02	572.60	4.8	2	39.075995	-89.39407
MW11S	UA	04/28/2006	625.27	625.27	Top of PVC	622.04	8.89	13.63	613.15	608.41	14.08	608.00	4.7	2	39.071888	-89.393913
MW11D	LCU	04/28/2006	625.52	625.52	Top of PVC	622.19	28.31	33.04	593.88	589.15	33.50	585.90	4.7	2	39.071888	-89.393894
MW12S	UA	05/10/2006	625.31	625.31	Top of PVC	622.24	10.61	15.18	611.63	607.06	15.61	606.60	4.6	2	39.068514	-89.394199
MW12D	DA	05/10/2006	625.21	625.21	Top of PVC	622.24	42.46	46.99	579.78	575.25	47.47	572.20	4.5	2	39.068501	-89.394199
MW13S	UA	05/09/2006	625.96	625.96	Top of PVC	622.80	11.43	16.23	611.37	606.57	16.62	606.20	4.8	2	39.066297	-89.40118
MW13D	DA	05/09/2006	625.86	625.86	Top of PVC	622.85	49.81	54.60	573.04	568.25	55.00	567.90	4.8	2	39.066293	-89.401163
MW14S	UA	05/02/2006	626.88	626.88	Top of PVC	624.62	12.26	17.02	612.36	607.60	17.38	607.20	4.8	2	39.069153	-89.400442
MW15S	UA	04/25/2006	626.66	626.66	Top of PVC	623.83	14.41	19.16	609.42	604.67	19.62	604.20	4.8	2	39.069772	-89.397088
MW15D	LCU	04/25/2006	626.44	626.44	Top of PVC	623.83	33.68	38.45	590.15	585.38	38.80	585.00	4.8	2	39.06977	-89.397073
MW16S	UA	04/25/2006	629.47	629.47	Top of PVC	626.32	14.59	19.41	611.73	606.91	19.76	606.40	4.8	2	39.073571	-89.397006
MW16D	DA	04/25/2006	629.38	629.38	Top of PVC	626.37	45.90	50.34	580.47	576.03	50.78	575.40	4.4	2	39.073571	-89.397036
MW17S	UA	05/04/2006	630.56	630.56	Top of PVC	627.28	14.02	23.56	613.26	603.72	24.11	603.20	9.5	2	39.07715	-89.396978
MW17D	DA	05/04/2006	630.29	630.29	Top of PVC	627.47	48.82	53.32	578.65	574.15	53.87	573.60	4.5	2	39.077151	-89.396958
MW18S	UA	05/11/2006	628.66	628.66	Top of PVC	625.69	11.31	15.79	614.38	609.90	16.40	609.30	4.5	2	39.077033	-89.401698
MW20S	UA	05/01/2007	622.90	622.90	Top of PVC	620.26	8.41	13.22	611.85	607.04	13.67	604.30	4.8	2	39.064968	-89.394322

TABLE 2-1. MONITORING WELL LOCATIONS AND CONSTRUCTION DETAILS
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

Well Number	HSU	Date Constructed	Top of PVC Elevation (feet)	Measuring Point Elevation (feet)	Measuring Point Description	Ground Elevation (feet)	Screen Top Depth (feet bgs)	Screen Bottom Depth (feet bgs)	Screen Top Elevation (feet)	Screen Bottom Elevation (feet)	Well Depth (feet bgs)	Bottom of Boring Elevation (feet)	Screen Length (feet)	Screen Diameter (inches)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
R104	UA	10/08/2010	--	632.84	Top of Disk	629.03	14.59	19.32	614.44	609.71	19.85	609.20	4.7	2	39.069474	-89.399109
R201	UA	10/08/2010	--	626.34	Top of Disk	624.02	14.59	19.32	609.43	604.70	19.85	604.20	4.7	2	39.075142	-89.397855
R205	UA	03/20/2017	--	624.52	Top of Disk	621.91	11.32	16.01	610.59	605.90	16.42	605.50	4.7	2	39.068593	-89.394164
T127	UA	02/10/2010	--	630.96	Top of Disk	625.53	17.53	22.07	608.00	603.46	22.64	602.90	4.5	2	39.068119	-89.40121
T128	UA	02/09/2010	631.03	630.93	Top of Disk	626.27	16.53	21.04	609.74	605.23	21.64	602.20	4.5	2	39.068532	-89.401211
T202	UA	10/15/2010	--	628.63	Top of Disk	626.22	12.27	16.65	613.95	609.57	17.21	608.20	4.4	2	39.071776	-89.397705
T408	LCU	08/17/2016	624.08	624.08	Top of PVC	621.09	20.66	25.49	600.43	595.60	25.92	595.20	4.8	2	39.064353	-89.396307
T409	LCU	08/19/2016	625.01	625.01	Top of PVC	621.85	21.79	26.59	600.06	595.26	26.99	594.90	4.8	2	39.0603	-89.398538
TA31	UA	10/28/2014	626.55	626.55	Top of PVC	623.89	15.09	19.57	608.80	604.32	20.19	603.70	4.5	2	39.071368	-89.401366
TA32	UA	10/27/2014	621.42	621.42	Top of PVC	618.93	11.31	15.68	607.62	603.25	16.47	602.50	4.4	2	39.074093	-89.402223
TA33	UA	06/02/2015	625.27	625.27	Top of PVC	622.51	12.23	16.89	610.28	605.62	17.44	605.10	4.7	2	39.071556	-89.403506
TA34	UA	06/03/2015	626.52	626.52	Top of PVC	624.10	10.92	15.41	613.18	608.69	16.10	608.00	4.5	2	39.069631	-89.402759
TR32	UA	07/02/2021	621.68	621.68	Top of PVC	619.28	11.00	15.68	608.28	603.60	16.17	603.11	4.68	2	39.074064	-89.397758
X201	S	--	--	618.47	--	--	--	--	--	--	--	--	--	--	39.065278	-89.3925
SG-02	SW	--	--	605.87	Top of Prot Casing	605.87	--	--	--	--	--	--	--	--	39.059695	-89.391429
SG-03	SW	--	--	594.94	Top of Prot Casing	594.94	--	--	--	--	--	--	--	--	39.059092	-89.390342
SG-04	SW	--	--	599.52	Top of Prot Casing	599.52	--	--	--	--	--	--	--	--	39.064146	-89.390504

Notes:
All elevation data are presented relative to the North American Vertical Datum 1988 (NAVD88), GEOID 12A
-- = data not available
bgs = below ground surface
DA = deep aquifer
ft = foot or feet
HSU = hydrostratigraphic Unit
LCU = lower confining unit
PVC = polyvinyl chloride
S = source water
SW = surface water
UA = uppermost aquifer
generated 10/05/2021, 2:15:37 PM CDT

TABLE 4-1. FLOW AND TRANSPORT MODEL CALIBRATION TARGETS
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

					Flow Targets								Transport Targets							
Well Name	Easting	Northing	HSU	CCR Unit	Number of Samples	mean GWL[1] (feet)	std GWL[1] (feet)	min GWL[1] (feet)	max GWL[1] (feet)	Earliest Sample Date	Latest Sample Date	Flow Calibration Wells	Number of Samples	mean Sulfate (mg/L)	std Sulfate (mg/L)	min Sulfate (mg/L)	max Sulfate (mg/L)	Earliest Sample Date	Latest Sample Date	Transport Calibraiton Well
G101	2514214.26	876551.76	UA	LF	20	617.989	2.504194166	612.95	623.65	15/01/2019	16/11/2015	Yes	-	-	-	-	-	-	-	-
G102	2514531.1	876554.8	UA	GSP	25	622.8612	1.751842649	618.96	627.12	15/01/2019	16/11/2015	Yes	19	90.6	29.7	49	140	04/08/2015	01/26/2021	Yes
G103	2514501.17	876199.41	UA	GSP	19	622.0884211	1.754825927	617.95	624.93	15/01/2019	11/12/2016	Yes	3	66.3	11.2	54	76	04/08/2015	10/06/2015	Yes
G105	2514509.06	875499.78	UA	GSP	19	622.0884211	2.178504235	613.96	624	15/01/2019	11/12/2016	Yes	3	116.7	11.5	110	130	04/08/2015	10/06/2015	Yes
G106	2514512.87	875149.77	UA	GSP	20	620.763	1.194844628	617.46	622.6	15/01/2019	16/11/2015	Yes	19	66.1	23.3	36	140	04/08/2015	01/26/2021	Yes
G107	2514358.3	874994.03	UA	LF	19	619.1036842	1.658802147	615.46	622.33	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G108	2514248.22	874948.67	UA	LF	19	619.4994737	1.31911786	616.24	622.22	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G109	2514137.87	874969.96	UA	LF	19	618.7294737	1.25543031	615.7	620.84	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G110	2514057.7	875015.54	UA	LF	20	618.104	1.590105591	613.27	620.65	15/01/2019	16/11/2015	Yes	-	-	-	-	-	-	-	-
G111	2513981.81	875058.61	UA	LF	19	616.9310526	1.267626368	613.16	618.53	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G119	2513907.62	875675	UA	LF	19	615.9689474	1.16332328	612.24	617.45	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G120	2513905.82	875854.56	UA	LF	19	614.3242105	1.834418817	612.13	617.69	15/01/2019	16/11/2015	Yes	-	-	-	-	-	-	-	-
G121	2513904.33	875964.54	UA	LF	18	614.6861111	2.034979806	611.93	618.73	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G122	2513902.79	876080	UA	LF	18	615.3283333	2.095957594	612.94	620.41	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G123	2513901.58	876189.62	UA	LF	18	614.5494444	3.842648401	610.31	622.79	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G124	2513900.33	876304.71	UA	LF	19	617.8857895	2.128430083	615.09	622.86	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G125	2513899.16	876409.6	UA	LF	20	619.676	2.365809976	614.6	622.96	15/01/2019	16/11/2015	Yes	-	-	-	-	-	-	-	-
G126	2513895.46	875062.25	UA	LF	19	614.87	1.340053896	612.28	616.87	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G151	2513806.06	875023.62	UA	LF	16	614.468125	0.894980214	612.13	615.49	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G152	2513894.35	874687.44	UA	SW	16	615.421875	1.122949799	612.77	617.44	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G153	2513532.77	874532.15	UA	SW	16	614.5425	1.204416871	612.37	616.3	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G154	2513243.08	874978.46	UA	SW	16	614.16	1.731546515	610.33	618.28	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G155	2513501.64	875127.78	UA	SW	16	613.686875	1.278998143	609.91	615.99	15/01/2019	11/12/2016	Yes	-	-	-	-	-	-	-	-
G200	2515650.03	877930.9	UA	B	26	621.4965385	1.461968378	618.16	623.29	15/01/2019	16/11/2015	Yes	25	101.2	8.3	87	120	01/20/2015	07/28/2021	-
G205	2515915	875549.93	UA	GSP	8	619.71	1.482912193	616.33	621.45	02/04/2017	11/12/2016	Yes	-	-	-	-	-	-	-	-
G206	2514669.15	875103.38	UA	GSP	25	621.286	1.444036588	616.61	622.76	15/01/2019	16/11/2015	Yes	20	119.4	24.7	32	150	01/21/2015	01/27/2021	Yes
G207	2514837.85	875166.36	UA	GSP	19	621.9526316	1.135658605	619.41	623.39	15/01/2019	11/12/2016	Yes	4	44.5	30.1	16	72	01/21/2015	10/07/2015	Yes
G208	2514993.46	875231.42	UA	GSP	19	622.0989474	1.175154339	618.97	624.07	15/01/2019	11/12/2016	Yes	4	53.5	37.7	33	110	01/21/2015	10/07/2015	Yes
G209	2515149.64	875298.3	UA	GSP	25	621.6212	1.211081885	617.76	623.18	15/01/2019	16/11/2015	Yes	20	248.8	51.6	95	310	01/21/2015	01/27/2021	Yes
G210	2515299.04	875359.67	UA	GSP	19	620.8747368	1.372254303	616.82	622.5	15/01/2019	11/12/2016	Yes	4	90.3	6.5	84	99	01/21/2015	10/07/2015	Yes
G211	2515448.98	875424.68	UA	GSP	19	621.1094737	1.148145721	618.14	622.45	15/01/2019	11/12/2016	Yes	4	79.8	5.4	74	87	01/21/2015	10/07/2015	Yes
G212	2515583.04	875486.65	UA	GSP	25	620.7644	1.197814259	617.19	622.12	15/01/2019	16/11/2015	Yes	20	55.9	4.2	49	66	01/21/2015	01/26/2021	Yes
G213	2515723.38	875544.3	UA	GSP	19	620.6210526	0.889262458	618.62	621.72	15/01/2019	11/12/2016	Yes	4	53.3	3.3	50	57	01/21/2015	10/07/2015	Yes
G214	2515960.85	875667.97	UA	GSP	19	617.8473684	1.193332598	614.52	619.39	15/01/2019	11/12/2016	Yes	4	71.3	3.9	68	76	01/21/2015	10/07/2015	Yes
G215	2515971.56	875810.11	UA	GSP	25	617.9504	1.033285537	615.48	619.51	15/01/2019	16/11/2015	Yes	21	167.1	109.9	100	490	01/21/2015	06/29/2021	Yes
G216	2515968.45	875976.18	UA	GSP	19	617.8368421	1.365349172	614.37	619.86	15/01/2019	11/12/2016	Yes	4	217.5	9.6	210	230	01/21/2015	10/07/2015	Yes
G217	2515962.98	876185.57	UA	GSP	19	617.5063158	1.127668246	614.32	619.13	15/01/2019	11/12/2016	Yes	4	132.5	5.0	130	140	01/21/2015	10/07/2015	Yes
G218	2515962.17	876380.8	UA	GSP	25	618.3172	1.25211328	614.46	620.1	01/15/2019	11/16/2015	Yes	20	135.8	34.0	94	220	01/21/2015	01/26/2021	Yes
G270	2514996.81	874802.01	UA	RP	26	620.3503846	2.547542315	614.45	623.38	01/15/2019	11/16/2015	Yes	21	69.8	25.8	49	140	01/20/2015	03/30/2021	Yes
G271	2515517.24	874239.3	UA	RP	25	615.7952	1.212807075	613.31	617.95	01/15/2019	11/16/2015	Yes	6	455.0	89.6	340	610	08/10/2018	02/01/2021	Yes
G272	2515745.01	874234.68	UA	RP	19	614.3836842	1.271854335	611.45	616.88	01/15/2019	12/11/2016	Yes	4	332.5	45.7	270	380	01/21/2015	10/08/2015	Yes

TABLE 4-1. FLOW AND TRANSPORT MODEL CALIBRATION TARGETS

GROUNDWATER MODELING REPORT

COFFEEN POWER PLANT

ASH POND NO. 1

COFFEEN, ILLINOIS

					Flow Targets								Transport Targets							
Well Name	Easting	Northing	HSU	CCR Unit	Number of Samples	mean GWL[1] (feet)	std GWL[1] (feet)	min GWL[1] (feet)	max GWL[1] (feet)	Earliest Sample Date	Latest Sample Date	Flow Calibration Wells	Number of Samples	mean Sulfate (mg/L)	std Sulfate (mg/L)	min Sulfate (mg/L)	max Sulfate (mg/L)	Earliest Sample Date	Latest Sample Date	Transport Calibraiton Well
G273	2515975.58	874235.18	UA	RP	25	611.5884	1.339299195	608.82	614.2	01/15/2019	11/16/2015	Yes	20	475.0	89.5	360	690	01/21/2015	02/01/2021	Yes
G274	2516195.61	874239.23	UA	RP	19	610.4968421	1.009549144	607.79	612	01/15/2019	12/11/2016	Yes	4	322.5	53.2	260	390	01/21/2015	10/08/2015	Yes
G275	2516375.98	874299.05	UA	RP	19	604.7021053	0.833210517	602.97	605.97	01/15/2019	12/11/2016	Yes	3	780.0	147.3	650	940	01/21/2015	07/23/2015	Yes
G276	2516358.89	874438.41	UA	RP	24	604.3108333	0.781508667	603.11	606.6	01/15/2019	11/16/2015	Yes	19	223.6	59.6	19	310	01/21/2015	06/28/2021	Yes
G277	2516370.45	874581.65	UA	RP	15	602.6546667	0.949126415	601.23	603.79	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
G278	2516200.7	874875.24	UA	RP	19	605.7357895	1.268819731	604.29	608.15	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
G279	2516245.69	875028.24	UA	RP	24	607.4420833	2.205378759	599.69	611.08	01/15/2019	11/16/2015	Yes	20	569.0	336.3	170	1600	01/21/2015	01/28/2021	Yes
G280	2515679.35	875045.28	UA	RP	26	618.8873077	1.884508546	614.47	622.33	01/15/2019	11/16/2015	Yes	27	78.1	12.2	52	94	01/21/2015	07/27/2021	Yes
G281	2514455.52	874375.28	UA	B	27	619.6537037	1.162395233	616.41	621.68	01/15/2019	11/16/2015	Yes	24	296.3	34.2	250	380	11/20/2015	07/27/2021	-
G283	2516503.05	874115.82	LCU	AP2	9	605.86	1.027898341	604.56	607.8	03/29/2021	08/16/2021	Yes	8	242.5	7.1	230	250	03/31/2021	07/27/2021	Yes
G284	2516922.93	874426.1	UA	B	9	607.9777778	1.492646792	606.17	611.14	03/29/2021	08/16/2021	Yes	8	69.5	10.8	60	95	03/30/2021	07/27/2021	-
G285	2516680.39	874797.74	LCU	B	9	606.5866667	1.509014579	604.33	608.62	03/29/2021	08/16/2021	Yes	8	570.0	40.0	490	620	03/30/2021	07/27/2021	-
G286	2516561.89	875075	UA	B	6	606.6166667	1.448346183	604.68	609.08	03/29/2021	12/07/2021	Yes	8	13.5	2.1	11	16	03/31/2021	07/27/2021	-
G287	2516415.34	875445.28	UA	B	7	608.9657143	1.217249045	607.59	610.83	03/29/2021	08/16/2021	Yes	8	44.4	2.7	41	50	03/29/2021	07/27/2021	-
G288	2517071.51	875282.23	UA	B	9	613.6466667	1.259801572	611.9	616.32	03/29/2021	08/16/2021	Yes	8	200.5	302.5	29	770	03/30/2021	07/27/2021	-
G301	2515583.06	872237.64	UA	AP1	25	615.0272	1.602722995	610.39	618.07	01/15/2019	11/16/2015	Yes	16	742.5	79.8	570	860	11/20/2015	01/27/2021	Yes
G302	2516214.19	872255.38	UA	AP1	25	609.8508	2.621329052	604.64	615.41	01/15/2019	11/16/2015	Yes	16	414.4	86.0	260	530	11/20/2015	01/27/2021	Yes
G303	2516639.34	871384.83	UA	AP1	25	615.7748	1.750197894	611.18	618.05	01/15/2019	11/16/2015	Yes	16	770.0	76.2	600	870	11/20/2015	01/26/2021	Yes
G304	2515519.76	871397.53	UA	AP1	2	623.99	0.113137085	623.91	624.07	08/02/2016	09/05/2016	Yes	3	1033.3	57.7	1000	1100	11/20/2015	05/20/2016	-
G305	2515199.45	871159.15	UA	AP1	23	618.0413043	1.084004798	615.3	620.49	01/15/2019	12/11/2016	Yes	5	864.0	87.6	710	930	05/19/2016	11/17/2016	Yes
G306	2516120.28	871143.66	UA	AP1	26	618.9373077	1.290400117	616.12	621.73	01/15/2019	12/11/2016	Yes	24	284.0	113.3	5.9	700	05/19/2016	07/27/2021	Yes
G307	2515553.24	871401.09	UA	AP1	17	624.0317647	1.239890294	619.33	624.6	01/15/2019	12/11/2016	Yes	13	1029.2	113.1	850	1300	08/16/2016	01/27/2021	Yes
G308	2515101.51	871457.36	UA	AP1	11	619.7218182	0.671190259	618.54	621.03	03/29/2021	08/16/2021	Yes	8	1125.0	46.3	1100	1200	03/29/2021	07/27/2021	Yes
G309	2515067.07	871868.3	UA	AP1	11	618.9445455	0.814350829	617.89	621.09	03/29/2021	08/16/2021	Yes	8	787.5	38.8	740	840	03/29/2021	07/27/2021	Yes
G310	2515159.33	872242.06	UA	AP1	11	614.4509091	1.049528032	613.2	617.27	03/29/2021	08/16/2021	Yes	8	990.0	552.5	420	2300	03/29/2021	07/28/2021	Yes
G311	2515881.77	872241.27	UA	AP1	11	613.6636364	1.07212194	612.45	616.54	03/29/2021	08/16/2021	Yes	8	811.3	35.6	750	860	03/30/2021	07/27/2021	Yes
G312	2516557.45	872263.4	UA	AP1	11	608.9363636	1.307511168	606.99	612.19	03/29/2021	08/16/2021	Yes	8	838.8	143.6	600	1000	03/30/2021	07/27/2021	Yes
G314	2516852.2	871632.87	UA	AP1	10	605.13	3.49532386	596.4	608.6	03/29/2021	08/16/2021	Yes	8	1953.8	473.9	830	2400	03/30/2021	07/27/2021	Yes
G315	2516086.68	871387.77	UA	AP1	10	620.529	0.69468538	619.17	621.24	03/29/2021	08/16/2021	Yes	8	908.8	81.1	850	1100	03/30/2021	07/28/2021	Yes
G316	2517211.619	871645.77	UA	AP1	10	590.022	3.016792999	581.54	591.63	03/29/2021	08/16/2021	-	8	691.3	156.1	330	840	03/30/2021	07/27/2021	Yes
G317	2517087.319	871236.76	UA	AP1	10	609.619	1.740890258	606.57	611.75	03/29/2021	08/16/2021	-	8	952.5	93.6	780	1100	03/30/2021	07/28/2021	Yes
G401	2515614.82	872510.72	UA	AP2	18	607.6811111	1.846264556	603.94	609.8	01/15/2019	11/16/2015	Yes	-	-	-	-	-	-	-	-
G402	2516632.39	872500.43	UA	AP2	20	603.743	1.213286533	600.77	605.36	01/15/2019	11/16/2015	Yes	-	-	-	-	-	-	-	-
G403	2514616.58	873561.48	UA	AP2	20	621.055	1.263622612	618.36	622.45	01/15/2019	11/16/2015	Yes	-	-	-	-	-	-	-	-
G404	2516397.84	873999.83	UA	AP2	20	610.838	1.183783408	607.58	612.14	01/15/2019	11/16/2015	Yes	-	-	-	-	-	-	-	-
G405	2515335.58	873996.63	UA	AP2	20	617.8585	1.158348529	614.47	619.28	01/15/2019	11/16/2015	Yes	-	-	-	-	-	-	-	-
G406	2514702.32	872521.21	UA	AP2	16	615.141875	1.675395351	611.27	617.52	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
G407	2513705.74	872973.57	UA	B	16	613.60625	0.84114109	612.11	614.86	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
MW04S	2514450.47	877999.78	UA	B	19	618.2110526	2.142835335	613.88	621.62	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
MW05S	2513285.52	878175.73	UA	B	19	617.8810526	1.843543975	613.32	620.92	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
MW10S	2515914.48	878250.4	UA	B	18	617.255	1.690963004	614.36	620.43	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-

RAMBOLL

TABLE 4-1. FLOW AND TRANSPORT MODEL CALIBRATION TARGETS
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

					Flow Targets								Transport Targets							
Well Name	**Easting**	**Northing**	**HSU**	**CCR Unit**	**Number of Samples**	**mean GWL[1] (feet)**	**std GWL[1] (feet)**	**min GWL[1] (feet)**	**max GWL[1] (feet)**	**Earliest Sample Date**	**Latest Sample Date**	**Flow Calibration Wells**	**Number of Samples**	**mean Sulfate (mg/L)**	**std Sulfate (mg/L)**	**min Sulfate (mg/L)**	**max Sulfate (mg/L)**	**Earliest Sample Date**	**Latest Sample Date**	**Transport Calibraiton Well**
MW11S	2515971.24	876749.49	UA	GSP	24	620.7020833	1.218373753	617.19	622.19	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
MW12S	2515900.49	875519.94	UA	GSP	24	617.9708333	2.049907562	611.42	620.48	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
MW16S	2515087.93	877355.01	UA	B	24	622.0208333	2.003932908	618.34	625.59	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
MW20S	2515876.54	874228.14	UA	B	19	612.0194737	1.76501959	607.74	615.4	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
R104	2514503.48	875857.78	UA	B	20	623.479	1.640654234	619.38	625.92	01/15/2019	11/16/2015	Yes	7	74.4	2.2	72	77	04/08/2015	08/03/2016	-
R201	2514842.05	877925.14	UA	B	26	621.8242308	1.348306117	618.3	623.52	01/15/2019	11/16/2015	Yes	28	211.0	55.8	89	370	01/20/2015	07/28/2021	-
T127	2513911.13	875359.24	UA	B	20	615.954	1.042297058	612.33	617.05	01/15/2019	11/16/2015	Yes	-	-	-	-	-	-	-	-
T128	2513909.58	875509.65	UA	B	19	615.1989474	1.45420805	611.33	617.25	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
T202	2514895.01	876699.56	UA	GSP	19	620.5410526	2.211231167	615.31	624.22	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
T408	2515314.82	873999.37	UA	B	16	617.25875	1.507615667	614.45	619.46	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
T409	2514693.83	872517.86	UA	B	16	615.403125	1.232908316	612.16	617.16	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
TA31	2513856.87	876542.19	UA	B	19	619.7289474	2.10867756	614.89	622.93	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
TA32	2513605.22	877532.63	UA	B	10	615.309	1.097172629	612.42	616.3	01/20/2020	12/11/2016	Yes	-	-	-	-	-	-	-	-
TA33	2513248.73	876605.56	UA	B	19	617.2257895	1.90237663	612.91	620.35	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-
TA34	2513466.7	875906.23	UA	B	19	617.0926316	1.535020239	613.48	619.58	01/15/2019	12/11/2016	Yes	-	-	-	-	-	-	-	-

Notes:

[O: SLN 04/20/22; C: EGP 4/29/22]

[1] GWL = Groundwater Elevation
AP1 = Ash Pond No. 1
AP2 = Ash Pond No. 2
B = Background
GSP = Gypsum Management Facility Gypsum Stack Pond
LF = Landfill
max=maximum
mg/l = milligrams per liter
min=minimum
RP = Gypsum Management Facility Recycle Pond
std=standard deviation from the mean

HSU = Hydrostratigraphic Unit
CCR = coal combustion residuals
UA = uppermost aquifer
LCU = lower confining unit

TABLE 5-1. FLOW MODEL INPUT AND SENSITIVITY ANALYSIS RESULTS
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

Zone	Hydrostratigraphic Unit	Materials	ft/d	cm/s	Kh/Kv	Value Source	Sensitivity[1]
Horizontal Hydraulic Conductivity			**Calibration Model**				
1	UCU	loess and clay	0.51	1.80E-04	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	High
2	UA	sand and sandy silt	4.04	1.43E-03	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	High
3	LCU (unweathered Vandalia)	sand clay till	0.83	2.93E-04	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	High
4	LCU (Smithboro Formation)	sand clay till	0.0014	4.94E-07	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Low
5	SW Pond	NA	2.89E-09	1.02E-12	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
6	LF-CCR	CCR	13.6	4.80E-03	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
7	GSP-CCR	CCR	13.6	4.80E-03	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
8	RP-CCR	CCR	13.6	4.80E-03	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
9	AP2	CCR	13.6	4.80E-03	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
10	AP1	CCR	13.6	4.80E-03	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Moderate
11	Cooling Pond	clay and silt	0.51	1.80E-04	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Low
12	GSP-RP connector	lined channel within UCU	0.51	1.80E-04	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
13	AP2 -berm	loess and clay	0.51	1.80E-04	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
14	AP1-berm	loess and clay	0.51	1.80E-04	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
15	Pond (west)	loess and clay	0.51	1.80E-04	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
16	GSP-liner	liner	2.89E-08	1.02E-11	NA	Harmonic mean of liner layers	Negligible
17	RP-liner	liner	2.89E-08	1.02E-11	NA	Harmonic mean of liner layers	Negligible
18	LF-liner	liner	2.89E-08	1.02E-11	NA	Harmonic mean of liner layers	Negligible
19	UCU- fill (drain/river)	NA	10	3.53E-03	NA	Calibrated - Conductivity Value to Allow Groundwater Flow from UCU to River and Drain Boundary Conditions	Moderate
21	LF-GSP shared embankment	reworked silts and clays	0.01	3.53E-06	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
Vertical Hydraulic Conductivity			**Calibration Model**				
1	UCU	loess and clay	0.0510	1.80E-05	10	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	High
2	UA	sand and sandy silt	0.4040	1.43E-04	10	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	High
3	LCU (unweathered Vandalia)	sand clay till	0.0830	2.93E-05	10	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	High
4	LCU (Smithboro Formation)	sand clay till	0.0001	4.94E-08	10	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Low
5	SW Pond	lined	2.89E-09	1.02E-12	1	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
6	LF-CCR	CCR	0.2500	8.82E-05	54	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
7	GSP-CCR	CCR	0.2500	8.82E-05	54	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
8	RP-CCR	CCR	0.2500	8.82E-05	54	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
9	AP2	CCR	0.2500	8.82E-05	54	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
10	AP1	CCR	0.2500	8.82E-05	54	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Moderate
11	Cooling Pond	clay and silt	0.0510	1.80E-05	10	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Low
12	GSP-RP connector	lined channel within UCU	0.0510	1.80E-05	10	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
13	AP2 -berm	loess and clay	0.0510	1.80E-05	10	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
14	AP1-berm	loess and clay	0.0510	1.80E-05	10	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
15	Pond (west)	loess and clay	0.0510	1.80E-05	10	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
16	GSP-liner	liner	2.89E-08	1.02E-11	1	Harmonic mean of liner layers	Negligible
17	RP-liner	liner	2.89E-08	1.02E-11	1	Harmonic mean of liner layers	Negligible
18	LF-liner	liner	2.89E-08	1.02E-11	1	Harmonic mean of liner layers	Negligible
19	UCU- fill (drain/river)	NA	10.0000	3.53E-03	1	Calibrated - Conductivity Value to Allow Groundwater Flow from UCU to River and Drain Boundary Conditions	Moderate

TABLE 5-1. FLOW MODEL INPUT AND SENSITIVITY ANALYSIS RESULTS
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

Zone	Hydrostratigraphic Unit	Materials	ft/d	cm/s	Kh/Kv	Value Source	Sensitivity[1]
Vertical Hydraulic Conductivity (Continued)			**Calibration Model**				
21	LF-GSP shared embankment	reworked silts and clays	0.0100	3.53E-06	1	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	Negligible
Zone	**Hydrostratigraphic Unit**	**Materials**	**ft/d**	**in/yr**	**Kh/Kv**	**Value Source**	**Sensitivity[1]**
Recharge			**Calibration Model**				
1	UCU	clay and silt	0.00055	2.41	NA	Calibrated	High
2	SW Pond	clay and silt	1.50E-08	6.57E-05	NA	Calibrated	Negligible
3	LF	CCR	8.00E-08	3.50E-04	NA	Calibrated	Negligible
4	GSP	CCR	8.00E-08	3.50E-04	NA	Calibrated	Negligible
5	RP	CCR	8.00E-08	3.50E-04	NA	Calibrated	Negligible
6	AP2	CCR	0.0005	2.19	NA	Calibrated	Moderate
7	AP1	CCR	0.0024	10.51	NA	Calibrated	High
8	Cooling pond	clay and silt	1.40E-05	0.06	NA	Calibrated	Negligible
9	GSP-RP connector	clay and silt	0.00055	2.41	NA	Calibrated	Low
10	AP2-Berm	clay and silt	0.00055	2.41	NA	Calibrated	Negligible
11	AP1-Berm	clay and silt	0.00055	2.41	NA	Calibrated	Negligible
12	Pond (west)	clay and silt	5.50E-04	2.41	NA	Calibrated	Negligible
Storage							
1	UCU	loess and clay	*Not used in steady-state calibration model*				
2	UA	sand and sandy silt					
3	LCU (unweathered Vandalia)	sand clay till					
4	LCU (Smithboro Formation)	sand clay till					
5	SW Pond	lined					
6	LF-CCR	CCR					
7	GSP-CCR	CCR					
8	RP-CCR	CCR					
9	AP2	CCR					
10	AP1	CCR					
11	Cooling Pond	clay and silt					
12	GSP-RP connector	lined channel within UCU					
13	AP2 -berm	loess and clay					
14	AP1-berm	loess and clay					
15	Pond (west)	loess and clay					
16	GSP-liner	liner					
17	RP-liner	liner					
18	LF-liner	liner					
19	UCU- fill (drain/river)	NA					
21	LF-GSP shared embankment	reworked silts and clays					

TABLE 5-1. FLOW MODEL INPUT AND SENSITIVITY ANALYSIS RESULTS
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

River Parameters							
	Relative Location	**River Width (feet)**	**River depth (feet)**	**Bed Thickness (feet)**	**Hydraulic Conductivity (ft/d)**	**Head (feet)**	**River Boundary Conductance (ft^2/d)**
Reach 0	Unnamed Tributary East Coffeen Lake	10	3	2	4.00E-02	594.7-621.84	0.08-20.4
Sensitivity[1]	NA	- - -	- - -	- - -	- - -	Moderate	High
Reach 5	Unnamed Tributary East Coffeen Lake - downstream in layer 5	10	3	2	4.00E-01	591.0-594.7	1.5-109.2
Sensitivity[1]	NA	- - -	- - -	- - -	- - -	Moderate	Low
Reach 1	Unnamed Tributary West Coffeen Lake	10	3	2	4.80E-02	591.0-622.45	0.04-12.3
Sensitivity[1]	NA	- - -	- - -	- - -	- - -	Low	Moderately High
Reach 2	Pond (west)	cell dimensions	3	1	3.20E-03	617.50	4.0
Sensitivity[1]	NA	- - -		- - -		Low	Low
Reach 3	Condenser Cooling Flume	cell dimensions	4	1	5.00	604.00	5.00
Sensitivity[1]	NA	- - -	- - -	- - -	- - -	Moderate	High
Value Source	NA	Calibrated	Calibrated	Calibrated	Calibrated	Estimated based on DEM	Calibrated
Drain Parameters							
	Name	**Drain Width (feet)**	**Drain depth (feet)**	**Bed Thickness (feet)**	**Hydraulic Conductivity (ft/d)**	**Stage (feet)**	**Drain Conductance (ft^2/d)**
Reach 0	Active LF Underdrain	2	2	1.5	2.40E-02	603.5	6.6e-5-0.47
Sensitivity[1]	NA	- - -	- - -	- - -	- - -	Low	Moderately High
Reach 1	Gravity Driven GRP Drain	cell dimensions	2	1.5	2.50E-02	600.5	9.7e-5-0.51
Sensitivity[1]		- - -	- - -	- - -	- - -	Low	Moderate
Reach 2	Northern Drain	cell dimensions	2	1.5	2.00E+00	622	5.1-135.46
Sensitivity[1]		- - -	- - -	- - -	- - -	Low	Negligible
Value Source	NA	Calibrated	Calibrated	Calibrated	Calibrated	Estimated based on DEM	Calibrated
General Head Parameters							
	Relative Location	**Width of General Head Boundary Cell (feet)**	**Distance to General Head Boundary Head (feet)**	**Saturated Thickness of Cell (feet)**	**Hydraulic Conductivity (ft/d)**	**Head (feet)**	**General Head Boundary Conductance (ft^2/d)**
Reach 2	Northern Model Boundary in UA	*variable*	1	variable	4.54	591-610.66	1.4-7032.9
Sensitivity[1]	NA	- - -	- - -	- - -	- - -	Moderate	Negligible
Reach 3	Northern Model Boundary in LCU ayer 4	*variable*	1	variable	0.83	591-610.66	166-1812.6
Sensitivity[1]	NA	- - -	- - -	- - -	- - -	High	Negligible
Reach 4	Northern Model Boundary in LCU ayer 5	*variable*	1	variable	0.0014	591-610.66	1.61-6.0
Sensitivity[1]	NA	- - -	- - -	- - -	- - -	Low	Negligible
Value Source	NA	Calibrated	Calibrated	Calibrated	Calibrated	Estimated based on Groundwater Elevation Targets in UA around the GSP/GRP/LF	Calibrated

TABLE 5-1. FLOW MODEL INPUT AND SENSITIVITY ANALYSIS RESULTS
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

Hydraulic Flow Boundary Parameters					
	Relative Location	**Width of HFB (feet)[2]**	**Hydraulic Conductivity (feet)**		
Reach 1	GSP	1	2.89E-08		
Sensitivity[1]	NA	- - -	Low		
Reach 2	RP	1	2.89E-08		
Sensitivity[1]	NA	- - -	Moderate		
Reach 3	LF	1	2.89E-08		
Sensitivity[1]	NA	- - -	Low		
Value Source	NA	Calibrated	Harmonic mean of construction material		

Notes:

[O: SLN 04/01/22; C: EGP 4/29/22]

[1] Sensitivity Explanation:
Negligible - SSR changed by less than 1%
Low - SSR change between 1% and 10%
Moderate - SSR change between 10% and 50%
Moderately High - SSR change between 50% and 100%
High - SSR change greater than 100%
[2] Liner thickness accounted for in harmonic mean calculation
SSR = sum of squared residuals
- - - = not tested
AP1 = Ash Pond No. 1
AP2 = Ash Pond No. 2
CCR = coal combustion residuals
cm/s = centimeters per second
ft/d = feet per day
ft^2/day = feet squared per day
GSP = Gypsum Management Facility Gypsum Stack Pond
in/yr = inches per year
Kh/Kv = anisotropy ratio
LF = Landfill
NA = not applicable
RP = Gypsum Management Facility Recycle Pond
SW = Surface Water

Hydrostratigraphic Unit
UCU = upper confining unit
UA = uppermost aquifer
LCU = lower confining unit

TABLE 5-2. TRANSPORT MODEL INPUT VALUES (CALIBRATION)
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

Zone	Hydrostratigraphic Unit	Materials	Calibration Model									
			Recharge (ft/d)				Sulfate Concentration (mg/L)				Value Source	Sensitivity
Initial Concentration												
Entire Domain	NA	NA	0.00055				0				NA	- - -
Source Concentration (recharge and constant concentration cells)												
			Pre-GMF		**Post-GMF**		**Pre-GMF**		**Post-GMF**			
	Model Name and Stress Period		**TR1 - STP 1**	**TR1 - STP 2**	**TR2 - STP 1**	**TR3 - STP 1**	**TR1 - STP 1**	**TR1 - STP 2**	**TR2 - STP 1**	**TR3 - STP 1**		
	Time Period		**1970-1984**	**1985-2009**	**2010-2017**	**2018-2022**	**1970-1984**	**1985-2009**	**2010-2017**	**2018-2022**		
6	AP2	CCR	0.0005	0.0005	0.0005	0.00027	1,600	1,600	1,600	0	Leachate sulfate concentrations	- - -
13	AP2 Northwest seep area	-	0.002	0.002	0.002	0.00055	1,600	1,600	1,600	0	Based on previous model	- - -
14	AP2 East and Southwest seep area	-	0.01	0.01	0.01	0.00055	300	300	300	0	Based on previous model	- - -
13	AP2 closure structures	-									Based on previous model	- - -
7	AP1	CCR	0.00055	0.00240	0.00240	0.00240	0	1,000	1,000	1,000	Calibrated	- - -
5	RP	CCR	NA	NA	8.00E-08	8.00E-08	NA	NA	15,000	15,000	Leachate sulfate concentrations	- - -
4	GSP	CCR	NA	NA	8.00E-08	8.00E-08	NA	NA	11,000	11,000	Leachate sulfate concentrations	- - -
3	LF	CCR	NA	NA	8.00E-08	8.00E-08	NA	NA	7,500	7,500	Leachate sulfate concentrations	- - -
GMF Units liner modification (HFB)												
		Well Data	**Hydraulic Conductivity (ft/d)**									
			Pre-GMF		**Post-GMF**							
	Model Name and Stress Period		**TR1 - STP 1**	**TR1 - STP 2**	**TR2 - STP 1**	**TR3 - STP 1**						
	Time Period		**1970-1984**	**1985-2009**	**2010-2017**	**2018-2022**						
1	RP		NA	NA	2.89E-08	2.89E-08					Harmonic Mean	see Table 5-3
11	RP-northeast	G279	NA	NA	2.89E-08	3.00E-04					Calibrated	see Table 5-3
16	RP-southeast	G275	NA	NA	2.89E-08	6.54E-04					Calibrated	see Table 5-3
2	GSP		NA	NA	2.89E-08	2.89E-08					Harmonic Mean	see Table 5-3
21	GSP-east	G215	NA	NA	2.89E-08	6.00E-04					Calibrated	see Table 5-3
3	LF		NA	NA	2.89E-08	2.89E-08					Harmonic Mean	see Table 5-3
Storage, Specific Yield and Effective Porosity				**Calibration Model**								
Zone	**Hydrostratigraphic Unit**	**Materials**	**Storage**	**Specific Yield**	**Effective Porosity**						**Value Source**	**Sensitivity**
1	UCU	loess and clay	0.0034	0.35	0.35						Ramboll (2021a) HCR	see Table 5-3
2	UA	sand and sany silt	0.0034	0.16	0.16						Ramboll (2021a) HCR	see Table 5-3
3	LCU (unweathered Vandalia)	sand clay till	0.0034	0.19	0.19						Ramboll (2021a) HCR	see Table 5-3
4	LCU (Smithboro Formation)	sand clay till	0.0034	0.28	0.28						Ramboll (2021a) HCR	see Table 5-3
5	SW Pond	NA	0.0034	0.35	0.35						Ramboll (2021a) HCR	see Table 5-3
6	LF-CCR	CCR	0.0034	0.19	0.19			NA			Ramboll (2021a) HCR	see Table 5-3
7	GSP-CCR	CCR	0.0034	0.19	0.19						Ramboll (2021a) HCR	see Table 5-3
8	RP-CCR	CCR	0.0034	0.19	0.19						Ramboll (2021a) HCR	see Table 5-3
9	AP2	CCR	0.0034	0.19	0.19						Ramboll (2021a) HCR	see Table 5-3
10	AP1	CCR	0.0034	0.19	0.19						Ramboll (2021a) HCR	see Table 5-3
11	Cooling Pond	clay and silt	0.0034	0.35	0.35						Ramboll (2021a) HCR	see Table 5-3
12	GSP-RP connector	lined channel within UCU	0.0034	0.35	0.35						Ramboll (2021a) HCR	see Table 5-3
13	AP2 -berm	loess and clay	0.0034	0.35	0.35						Ramboll (2021a) HCR	see Table 5-3

TABLE 5-2. TRANSPORT MODEL INPUT VALUES (CALIBRATION)
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

Storage, Specific Yield and Effective Porosity				**Calibration Model**				
Zone	**Hydrostratigraphic Unit**	**Materials**	**Storage**	**Specific Yield**	**Effective Porosity**		**Value Source**	**Sensitivity**
14	AP1-berm	loess and clay	0.0034	0.35	0.35	NA	Ramboll (2021a) HCR	see Table 5-3
15	Pond (west)	loess and clay	0.0034	0.35	0.35		Ramboll (2021a) HCR	see Table 5-3
16	GSP-liner	liner	0.0034	0.16	0.16		Ramboll (2021a) HCR	see Table 5-3
17	RP-liner	liner	0.0034	0.16	0.16		Ramboll (2021a) HCR	see Table 5-3
18	LF-liner	liner	0.0034	0.16	0.16		Ramboll (2021a) HCR	see Table 5-3
19	UCU- fill (drain/river)	NA	0.0034	0.5	0.5		Calibrated	see Table 5-3
21	LF-GSP shared embankment	reworked silts and clays	0.0034	0.16	0.16		Calibrated	see Table 5-3
Dispersivity								
Applicable Region	**Hydrostratigraphic Unit**	**Materials**	**Longitudinal (feet)**	**Transverse (feet)**	**Vertical (feet)**		**Value Source**	**Sensitivity**
1	UCU	loess and clay	1	0.1	0.01	NA	calibrated	see Table 5-3
2	UA	sand and sany silt	10	1	0.1		calibrated	see Table 5-3
3	LCU (unweathered Vandalia)	sand clay till	1	0.1	0.01		calibrated	see Table 5-3
4	LCU (Smithboro Formation)	sand clay till	1	0.1	0.01		calibrated	see Table 5-3

[O: SLN 04/01/22; C: EGP 04/29/22]

Notes:
- - - = not tested
AP1 = Ash Pond No. 1
AP2 = Ash Pond No. 2
CCR = coal combustion residuals
ft/d = feet per day
GMF = Gypsum Management Facility
GSP = Gypsum Management Facility Gypsum Stack Pond
LF = Landfill
mg/L = milligrams per liter
NA = not applicable
RP = Gypsum Management Facility Recycle Pond
SS = Steady State model
STP = Stress Period
SW = Surface Water
TR = Transient model

Hydrostratigraphic Unit
UCU = upper confining unit
UA = uppermost aquifer
LCU = lower confining unit

TABLE 5-3. TRANSPORT MODEL INPUT SENSITIVITY (CALIBRATION)
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

			Storage and Specific Yield				Effective Porosity			
Well ID	**SI**	**Calibration on Sulfate Concentration (mg/L)**	**Sulfate Concentration (mg/L)**	**Sensitivity [1]**	**Sulfate Concentration (mg/L)**	**Sensitivity [1]**	**Sulfate Concentration (mg/L)**	**Sensitivity [1]**	**Sulfate Concentration (mg/L)**	**Sensitivity [1]**
G301	AP1	961.2	961.3	Negligible	958.1	Negligible	964.1	Negligible	954.2	Negligible
G302	AP1	954.3	951.2	Negligible	937.3	Low	954.8	Negligible	950.7	Negligible
G303	AP1	626.7	613.2	Low	572.0	Low	643.3	Low	598.3	Low
G305	AP1	426.0	408.8	Low	442.1	Low	451.3	Low	379.3	Moderate
G306	AP1	427.0	371.0	Moderate	400.9	Low	463.5	Low	375.8	Moderate
G307	AP1	779.7	762.4	Low	911.7	Moderate	786.0	Negligible	768.6	Low
G308	AP1	880.0	868.7	Low	813.0	Low	883.2	Negligible	872.2	Negligible
G309	AP1	922.0	901.3	Low	867.1	Low	924.2	Negligible	916.0	Negligible
G310	AP1	921.9	925.6	Negligible	916.5	Negligible	926.7	Negligible	915.6	Negligible
G311	AP1	966.6	965.5	Negligible	956.7	Low	967.0	Negligible	964.8	Negligible
G312	AP1	934.7	940.5	Negligible	924.4	Low	936.7	Negligible	933.5	Negligible
G313	AP1	908.8	908.3	Negligible	903.2	Negligible	909.3	Negligible	907.0	Negligible
G314	AP1	848.0	845.7	Negligible	838.1	Low	850.8	Negligible	841.8	Negligible
G315	AP1	786.7	737.7	Low	791.7	Negligible	789.6	Negligible	776.3	Low
G316	AP1	507.5	509.6	Negligible	494.8	Low	532.8	Low	469.7	Low
G317	AP1	146.9	149.8	Low	116.4	Moderate	202.9	Moderate	93.4	Moderate
			S*0.1 Sy*0.5		S*10 Sy*2		Porosity-0.05		Porosity+0.05	

TABLE 5-3. TRANSPORT MODEL INPUT SENSITIVITY (CALIBRATION)
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

		Dispersivity				HFB (GMF GSP and GMF RP Liner)			
Well ID	**SI**	**Sulfate Concentration (mg/L)**	**Sensitivity [1]**	**Sulfate Concentration (mg/L)**	**Sensitivity [1]**	**Sulfate Concentration (mg/L)**	**Sensitivity [1]**	**Sulfate Concentration (mg/L)**	**Sensitivity [1]**
G301	AP1	931.7	Low	909.6	Low	959.2	Negligible	937.3	Low
G302	AP1	914.3	Low	887.2	Low	953.4	Negligible	956.9	Negligible
G303	AP1	620.4	Negligible	589.4	Low	626.1	Negligible	622.1	Negligible
G305	AP1	415.1	Low	387.9	Low	425.8	Negligible	425.0	Negligible
G306	AP1	420.1	Low	390.5	Low	426.9	Negligible	426.2	Negligible
G307	AP1	756.7	Low	720.4	Low	779.6	Negligible	779.1	Negligible
G308	AP1	843.3	Low	800.4	Low	879.4	Negligible	879.2	Negligible
G309	AP1	892.9	Low	858.2	Low	922.8	Negligible	916.7	Negligible
G310	AP1	882.3	Low	853.6	Low	922.3	Negligible	915.6	Negligible
G311	AP1	943.7	Low	926.1	Low	965.1	Negligible	963.6	Negligible
G312	AP1	900.6	Low	869.2	Low	934.9	Negligible	933.7	Negligible
G313	AP1	774.1	Moderate	693.3	Moderate	908.4	Negligible	908.6	Negligible
G314	AP1	799.7	Low	756.2	Moderate	848.5	Negligible	848.5	Negligible
G315	AP1	764.9	Low	722.5	Low	785.7	Negligible	786.4	Negligible
G316	AP1	461.4	Low	426.2	Moderate	507.4	Negligible	507.5	Negligible
G317	AP1	123.6	Moderate	124.2	Moderate	146.9	Negligible	146.9	Negligible
		Disp*5		Disp*10		HFB*0.1		HFB*10	

[O: SLN 04/10/22; C: EGP 5/5/22]

Notes:

[1] Sensitivity Explanation:
Negligible = concentration changed by less than 1%
Low = concentration change between 1% and 10%
Moderate = concentration change between 10% and 50%
Moderately High = concentration change between 50% and 100%
High = concentration change greater than 100%

[2] sensitivity test used transient transport

AP1 = Ash Pond No. 1
AP2 = Ash Pond No. 2
Disp = dispersivity
GSP = Gypsum Management Facility Gypsum Stack Pond
HFB = Horizontal Flow Boundary
ID = identification
mg/L = milligrams per liter
RP = Gypsum Management Facility Recycle Pond
S = storativity
Sy = specific yield

TABLE 6-1. HELP MODEL INPUT AND OUTPUT VALUES
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

Closure Scenario Number (Drainage Length)	Ash Pond 1 - CIP Consolidation and Cover System Area	Ash Pond 1 - CIP Removal Area (1 foot) - CBR East Side (1 foot)	Ash Pond 1 - CBR West Side (3 feet)	Notes
Input Parameter				
Climate-General				
City	Coffeen, Illinois	Coffeen, Illinois	Coffeen, Illinois	Nearby city to the Site within HELP database
Latitude	39.06	39.06	39.06	Site latitude
Evaporative Zone Depth	18	12	18	Estimated based on geographic location (Illinois) and uppermost soil type (Tolaymat, T. and Krause, M., 2020)
Maximum Leaf Area Index	4.5	4.5	4.5	Maximum for geographic location (Illinois) (Tolaymat, T. and Krause, M., 2020)
Growing Season Period, Average Wind Speed, and Quarterly Relative Humidity	Belleville Scott Air Force Base Belleville, Illinois	Belleville Scott Air Force Base Belleville, Illinois	Belleville Scott Air Force Base Belleville, Illinois	Nearby city to the Coffeen Power Plant within HELP database
Number of Years for Synthetic Data Generation	30	30	30	
Temperature, Evapotranspiration, and Precipitation	Precipitation, temperature, and solar radiation was simulated based on HELP V4 weather simulation for: Lat/Long: 39.06/-89.39	Precipitation, temperature, and solar radiation was simulated based on HELP V4 weather simulation for: Lat/Long: 39.06/-89.39	Precipitation, temperature, and solar radiation was simulated based on HELP V4 weather simulation for: Lat/Long: 39.06/-89.39	
Soils-General				
% where runoff possible	100	100	100	
Area (acres)	10	13	10	CBR - Removal Area based on HCR (Ramboll, 2021); CIP - Consolidation and Cover System Area based on construction drawing for Ash Pond No. 1; CIP -Removal Area equals the difference
Specify Initial Moisture Content	No	No	No	
Surface Water/Snow	Model Calculated	Model Calculated	Model Calculated	
Soils-Layers				
1	Vegetative Soil Layer (HELP Final Cover Soil [topmost layer])	Protective Cover Layer (HELP Final Cover Soil [topmost layer])	Protective Cover Layer (HELP Final Cover Soil [topmost layer])	Layers details for CBR, CIP, and Landfill areas based on grading plans, construction drawings, and cover system design for Ash Pond No. 1
2	Protective Soil Layer (HELP Vertical Percolation Layer)	--	--	
3	Nonwoven Geotextile (HELP Custom Layer)	--	--	
4	Geomembrane Liner	--	--	
5	Unsaturated CCR Material (HELP Waste)	--	--	
6	HELP Vertical Percolation Layer	--	--	
7	--	--	--	

TABLE 6-1. HELP MODEL INPUT AND OUTPUT VALUES
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

Closure Scenario Number (Drainage Length)	Ash Pond 1 - CIP Consolidation and Cover System Area	Ash Pond 1 - CIP Removal Area (1 foot) - CBR East Side (1 foot)	Ash Pond 1 - CBR West Side (3 feet)	Notes
Soil Parameters--Layer 1				
Type	1	1	1	Vertical Percolation Layer (Cover Soil)
Thickness (in)	6	12	36	For CBR and CIP removal areas, layer 1 thickness is the average thickness of unsaturated backfill material placed after removal
Texture	12	14	14	Defaults used
Description	Silty Clay Loam	Silty Clay	Silty Clay	
Saturated Hydraulic Conductivity (cm/s)	4.20E-05	2.50E-05	2.50E-05	Defaults used
Soil Parameters--Layer 2				
Type	1	--	--	Vertical Percolation Layer
Thickness (in)	18	--	--	design thickness
Texture	14	--	--	Defaults used
Description	Silty Clay	--	--	
Saturated Hydraulic Conductivity (cm/s)	2.50E-05	--	--	Defaults used
Soil Parameters--Layer 3				
Type	2	--	--	Lateral Drainage Layer
Thickness (in)	0.11	--	--	design thickness
Texture	123	--	--	Defaults used
Description	10 oz Nonwoven Geotextile	--	--	
Saturated Hydraulic Conductivity (cm/s)	3.00E-01	--	--	Defaults used
Soil Parameters--Layer 4				
Type	4	--	--	Flexible Membrane Liner
Thickness (in)	0.04	--	--	design thickness
Texture	36	--	--	Defaults used
Description	LDPE Membrane	--	--	
Saturated Hydraulic Conductivity (cm/s)	4.00E -13	--	--	Defaults used
Soil Parameters--Layer 5				
Type	1	--	--	Vertical Percolation Layer (Waste)
Thickness (in)	360	--	--	design thickness
Texture	84	--	--	Defaults used
Description	High-Density Electric Plant Coal Bottom Ash	--	--	
Saturated Hydraulic Conductivity (cm/s)	8.80E-05	--	--	defaults used

TABLE 6-1. HELP MODEL INPUT AND OUTPUT VALUES
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

Closure Scenario Number (Drainage Length)	Ash Pond 1 - CIP Consolidation and Cover System Area	Ash Pond 1 - CIP Removal Area (1 foot) - CBR East Side (1 foot)	Ash Pond 1 - CBR West Side (3 feet)	Notes
Soil Parameters--Layer 6				
Type	1	--	--	Background Silty Clay (Ash Pond No. 1)
Thickness (in)	60	--	--	Background clay thickness (Ash Pond No. 1)
Texture	43	--	--	Custom (Ash Pond No. 1) Defaults used (GSP and Landfill)
Description	Loess Unit Silty Clay	--	--	
Saturated Hydraulic Conductivity (cm/s)	3.85E-06	--	--	Average for Loess Unit (Ash Pond No. 1)
Soil Parameters--Layer 7				
Type	--	--	--	Drainage Liner
Thickness (in)	--	--	--	design thickness
Texture	--	--	--	Defaults used
Description	--	--	--	
Saturated Hydraulic Conductivity (cm/s)	--	--	--	Defaults used
Soils--Runoff				
Runoff Curve Number	85.9	88.6	89.2	HELP-computed curve number
Slope	5.00%	0.50%	0.50%	Estimated from construction design drawings
Length (ft)	350	1,000	350	estimated maximum flow path
Vegetation	fair	fair	fair	fair indicating fair stand of grass on surface of soil backfill
Execution Parameters				
Years	30	30	30	
Report Daily	No	No	No	
Report Monthly	No	No	No	
Report Annual	Yes	Yes	Yes	
Output Parameter				
Unsaturated Percolation Rate (in/yr)	**0.00090**	**7.85**	**6.28**	

Notes:
% = percent
CBR = closure by removal
CIP = closure in place
cm/s = centimeters per second
ft = feet
HCR = Hydrogeologic Site Characterization Report
HELP = Hydrologic Evaluation of Landfill Performance
in = inches
in/yr = inches per year
Lat = latitude
Long = longitude

References:
Tolaymat, T. and Krause, M, 2020. Hydrologic Evaluation of Landfill Performance: HELP 4.0 User Manual . United States Environmental Protection Agency, Washington, DC, EPA/600/B 20/219
Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2021. Hydrogeologic Site Characterization Report. AP1, GMF GSP, Coffeen Power Plant. Coffeen, Illinois.

TABLE 6-2. PREDICTION MODEL INPUT VALUES
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

Hydrostratigraphic Unit/Recharge Area	Notes	Recharge Zone	Sulfate Concentration (mg/L)	Recharge (ft/day)	Recharge (inches/yr)	Constant Concentration Layer	Constant Concentration (mg/L)
Scenario 1: CIP							
AP1 - removal area east	FILL	7	0	1.8E-03	7.85	2&3	130.0
AP1 - consolidation area west	CCR	16	1,000	6.26E-08	2.74E-04	- - -	- - -
Scenario 2: CBR							
AP1 - removal area east	FILL	7	0	1.8E-03	7.85	- - -	- - -
AP1 - removal area west	FILL	16	0	1.4E-03	6.28	- - -	- - -

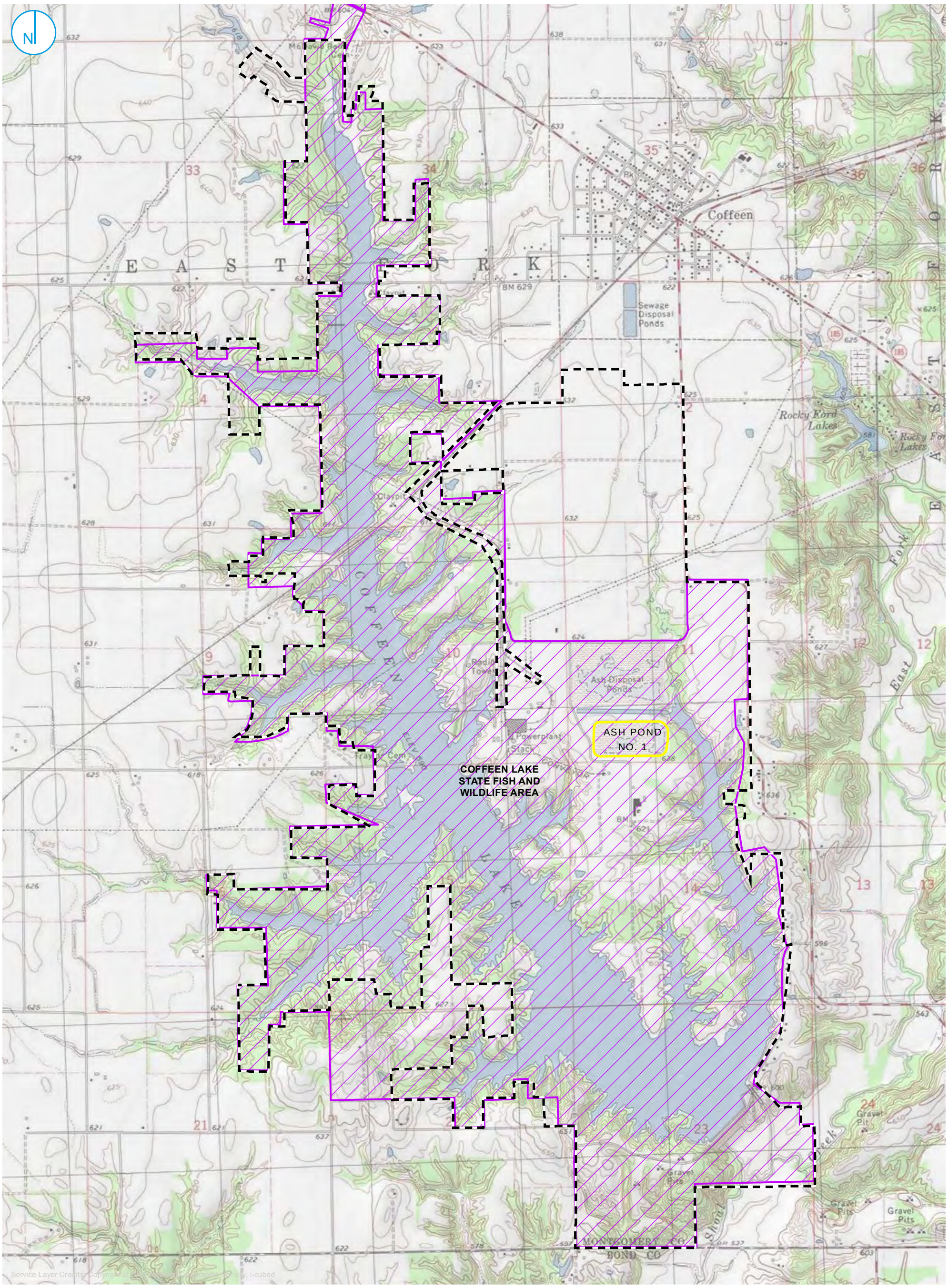
[O: SLN 04/01/22; C: EGP 04/29/22]

Notes:

- - - = not included
AP1 = Ash Pond No. 1
CCR = coal combustion residuals
ft/day = feet per day
inches/yr = inches per year
mg/L = milligrams per liter

RAMBOLL

FIGURES



PART 845 REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY
COFFEEN LAKE STATE FISH AND WILDLIFE AREA

0 1,000 2,000 Feet

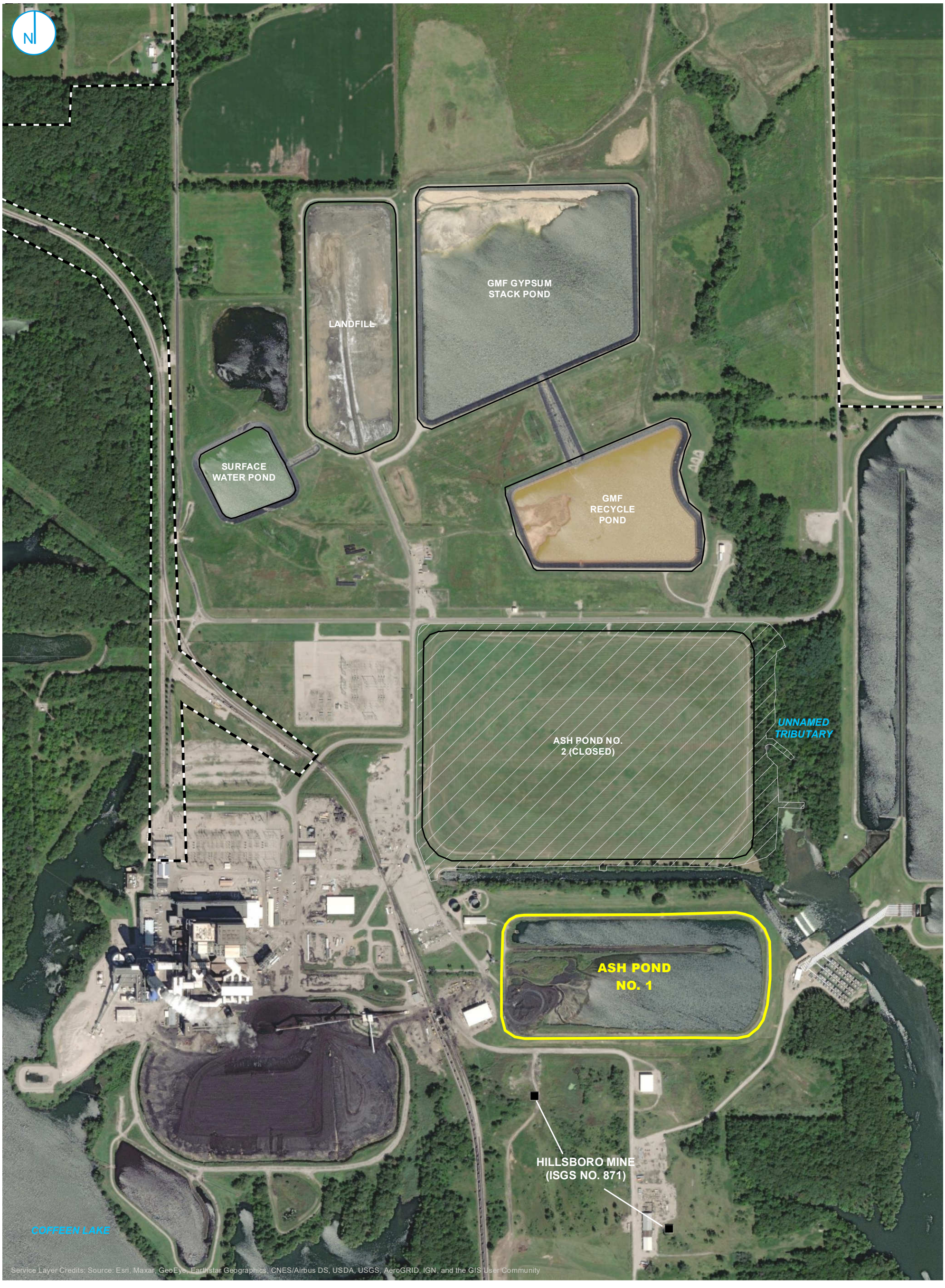
SITE LOCATION MAP

FIGURE 1-1

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



- COAL MINE SHAFT
- PART 845 REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- LIMITS OF FINAL COVER
- PROPERTY BOUNDARY

0 275 550 Feet

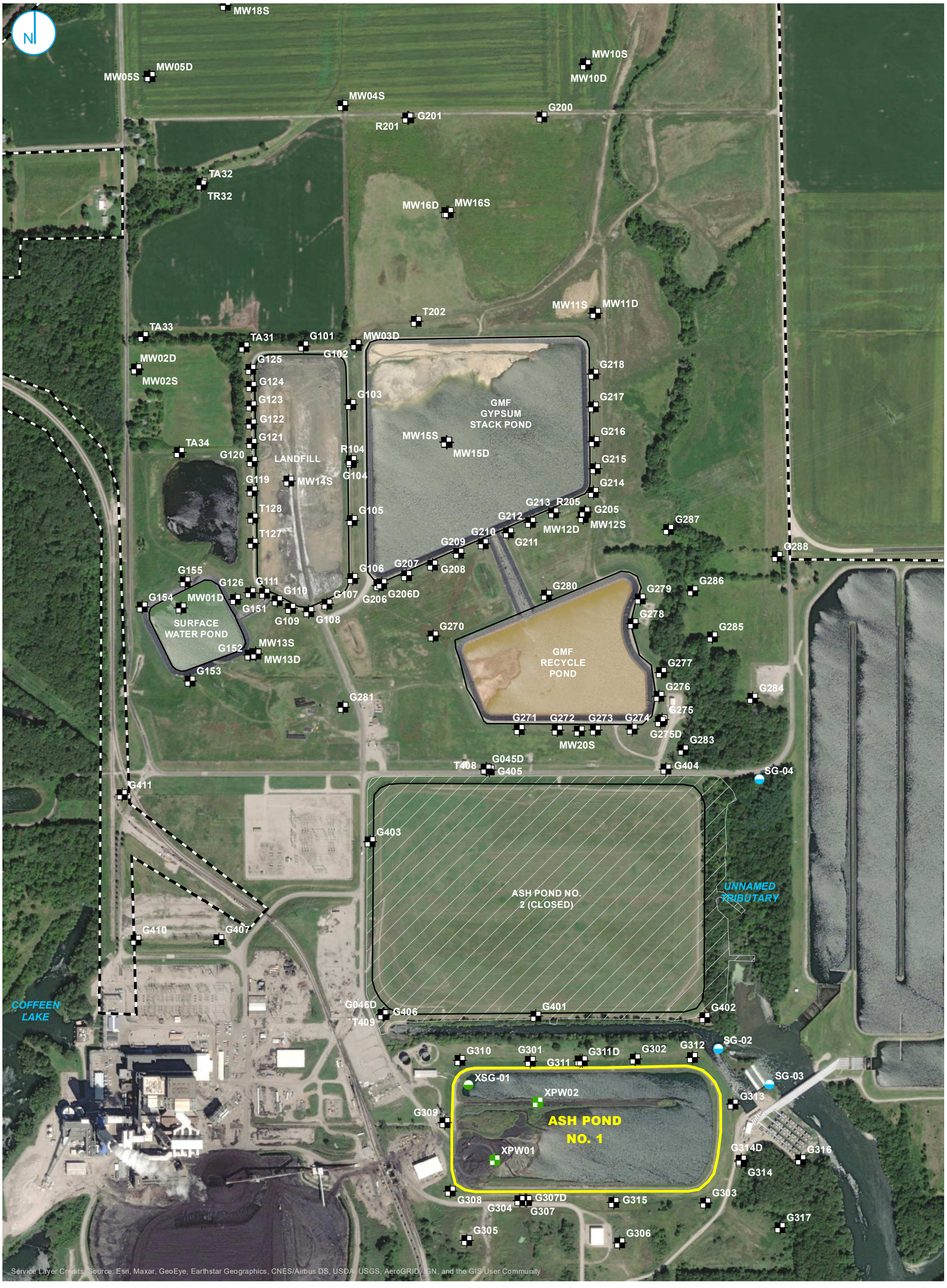
SITE MAP

FIGURE 1-2

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



MONITORING WELL
PORE WATER WELL
STAFF GAGE, RIVER
STAFF GAGE, CCR UNIT
PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

0 275 550 Feet

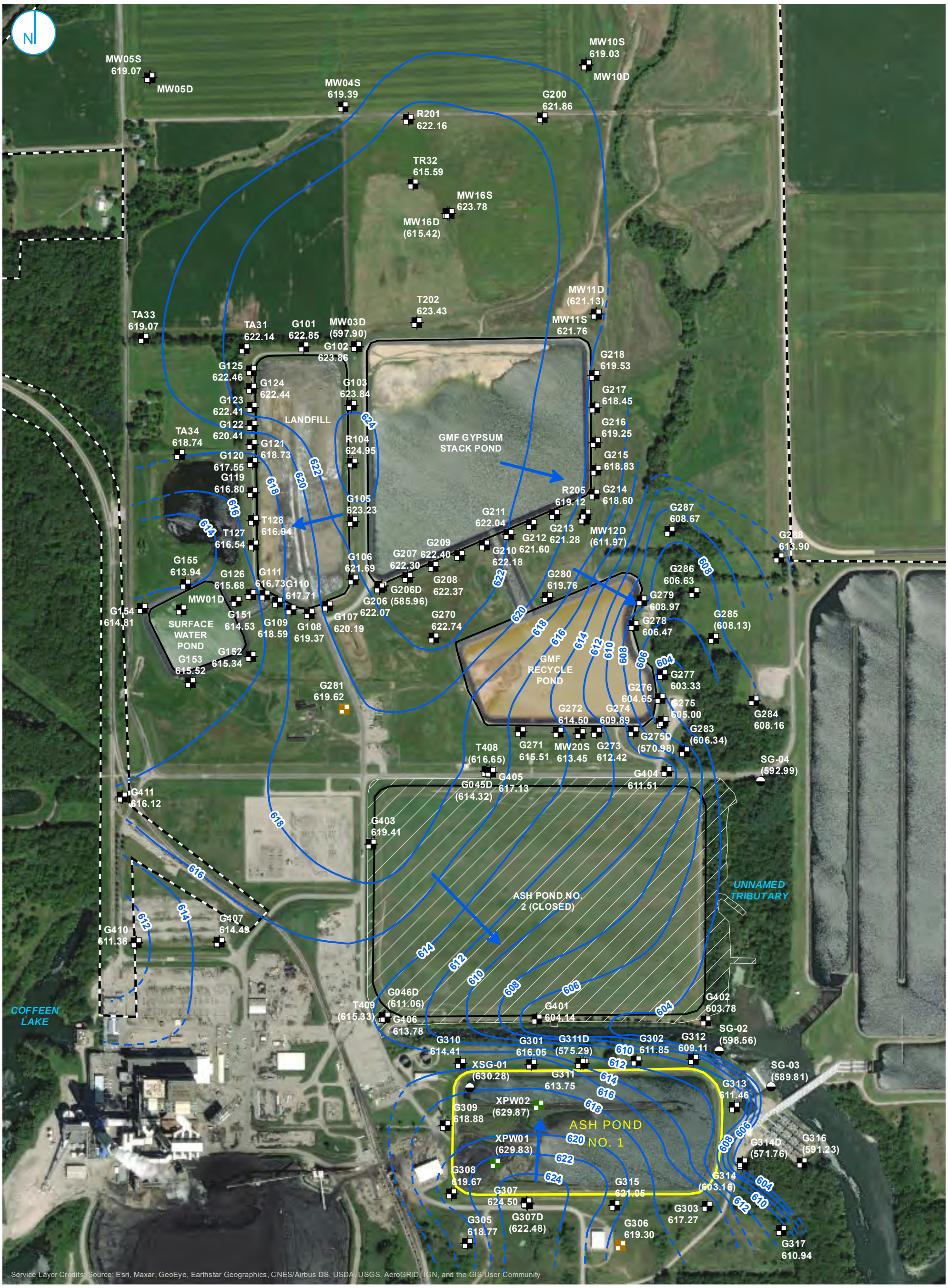
MONITORING WELL LOCATION MAP

FIGURE 2-1

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



BACKGROUND WELL
MONITORING WELL
SOURCE SAMPLE LOCATION
STAFF GAGE
GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
INFERRED GROUNDWATER ELEVATION CONTOUR
GROUNDWATER FLOW DIRECTION

0 275 550 Feet

PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

NOTE:
ELEVATIONS IN PARENTHESES WERE NOT USED FOR CONTOURING.

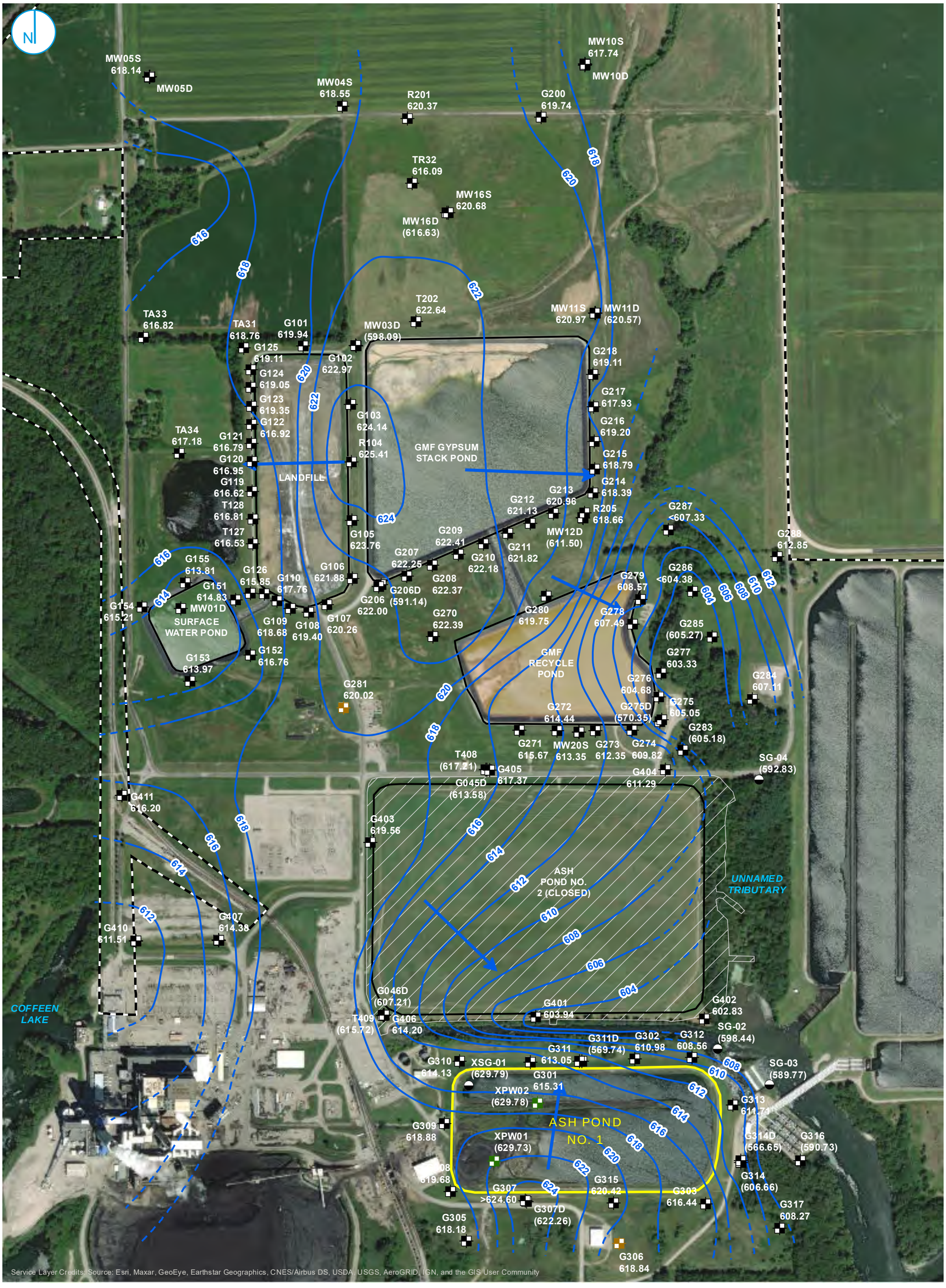
UPPERMOST AQUIFER POTENTIOMETRIC SURFACE MAP APRIL 20, 2021

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 2-2

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL



- BACKGROUND WELL
- MONITORING WELL
- SOURCE SAMPLE LOCATION
- STAFF GAGE
- GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
- INFERRED GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION

0 275 550 Feet

- PART 845 REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- LIMITS OF FINAL COVER
- PROPERTY BOUNDARY

NOTE:
ELEVATIONS IN PARENTHESES WERE NOT USED FOR CONTOURING.

UPPERMOST AQUIFER POTENTIOMETRIC SURFACE MAP JULY 26, 2021

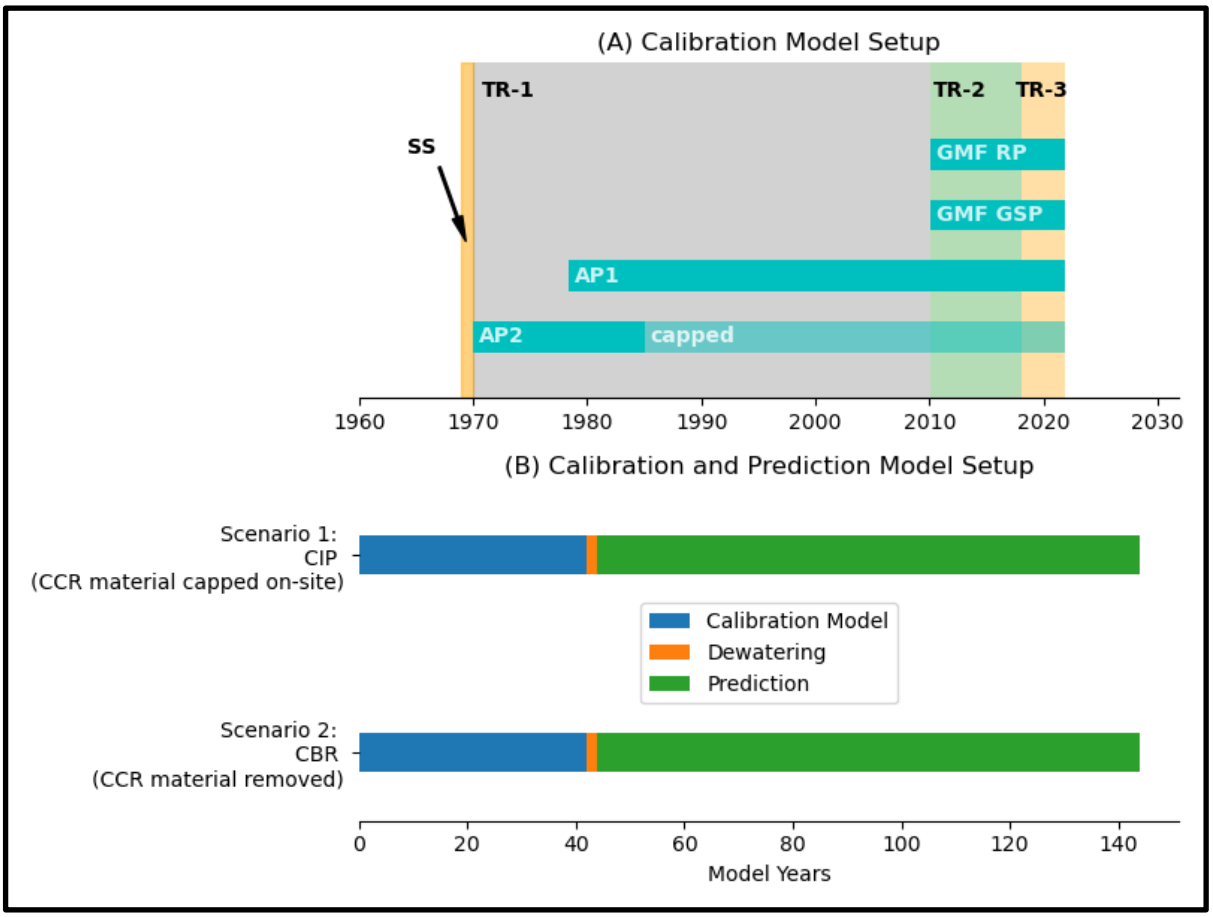
GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 2-3

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL

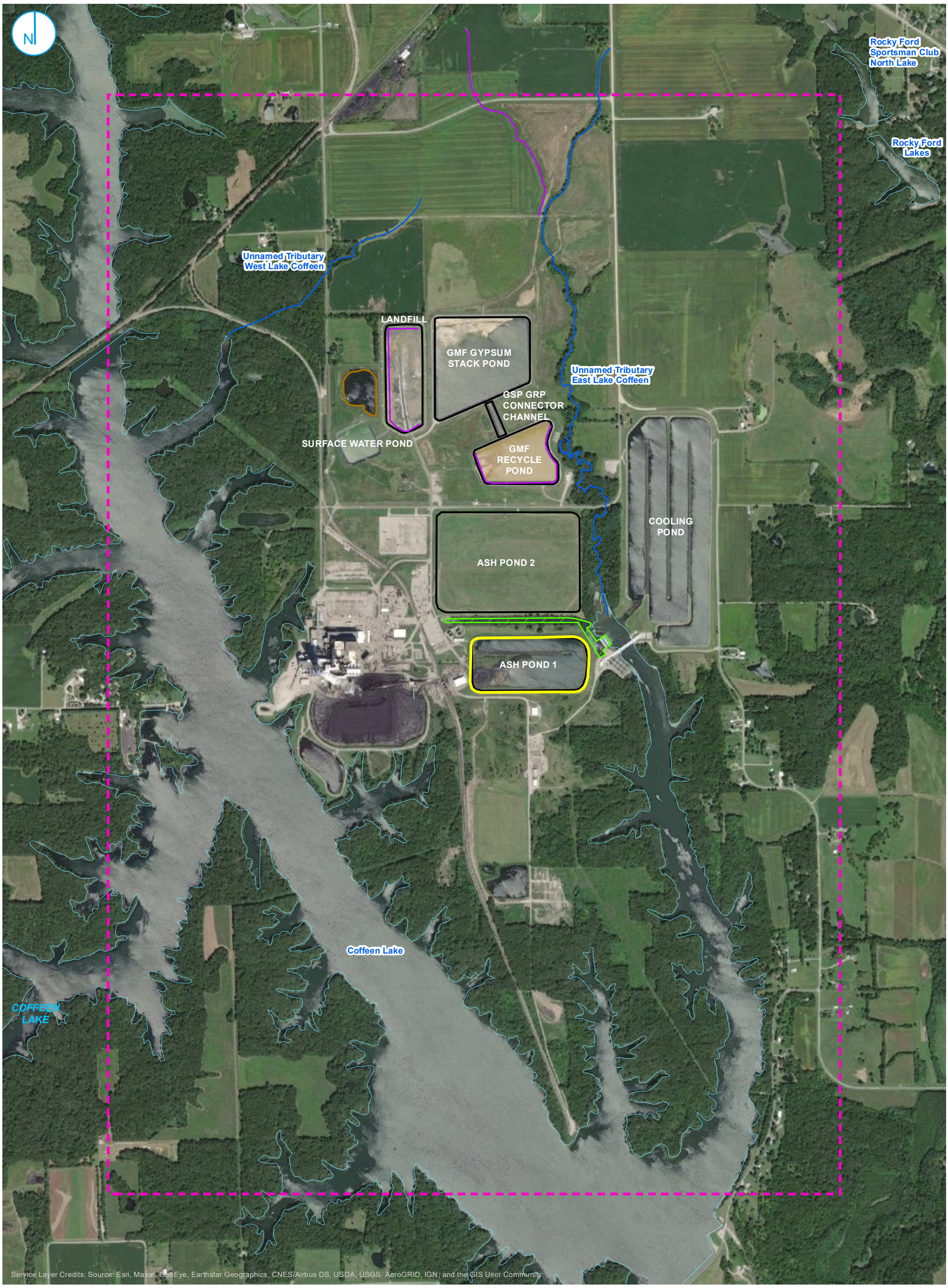
FIGURE 4-1



CALIBRATION AND PREDICTIVE TIMELINE
(SS = STEADY STATE MODEL AND TR = TRANSIENT MODEL)

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL



DRAIN
STREAM
LAKE
COOLING CONDENSER FLUME
SI UNIT
POND
MODEL GRID
PART 845 REGULATED UNIT (SUBJECT UNIT)

0 625 1,250 Feet

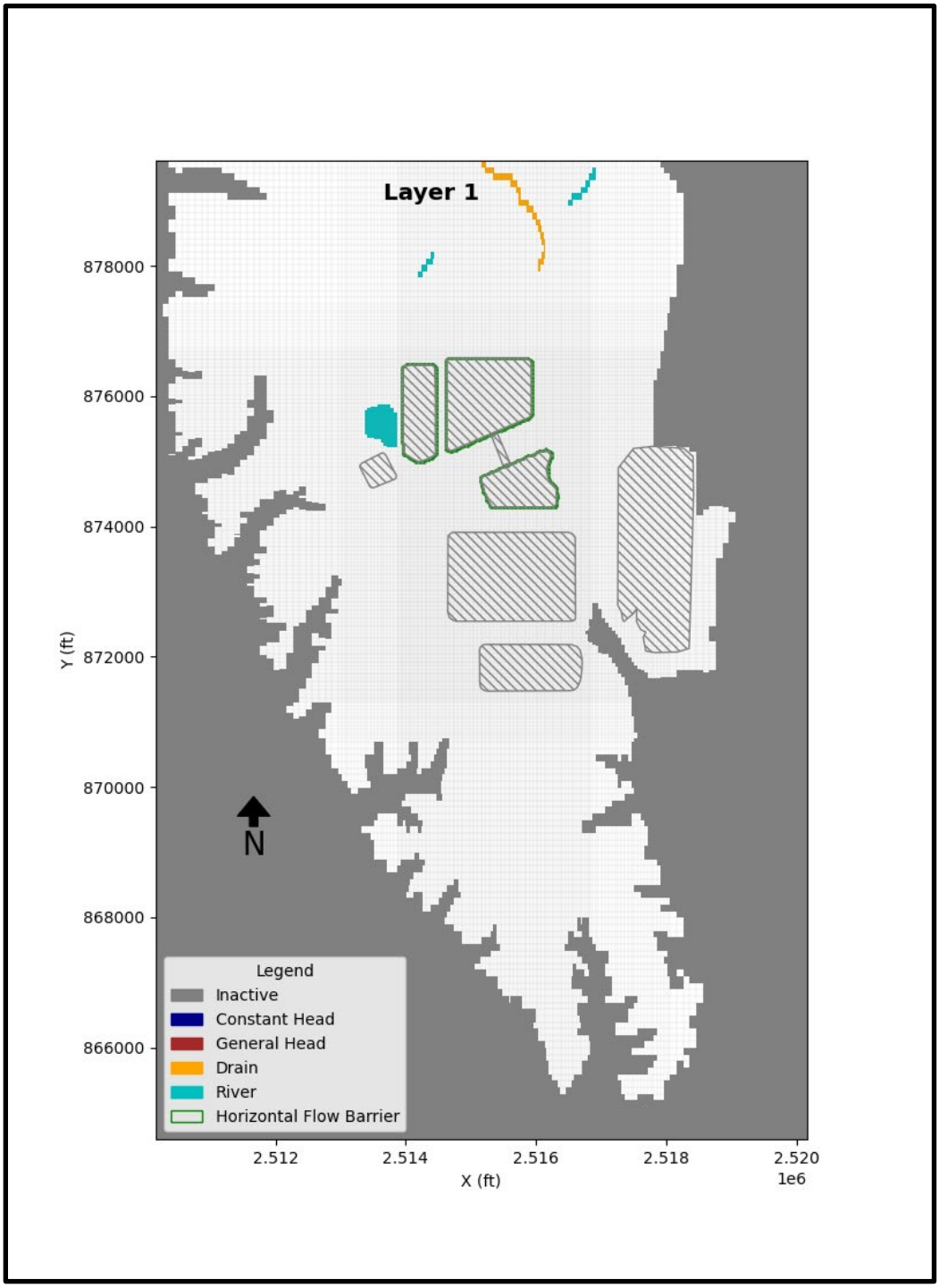
MODEL AREA MAP

FIGURE 5-1

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

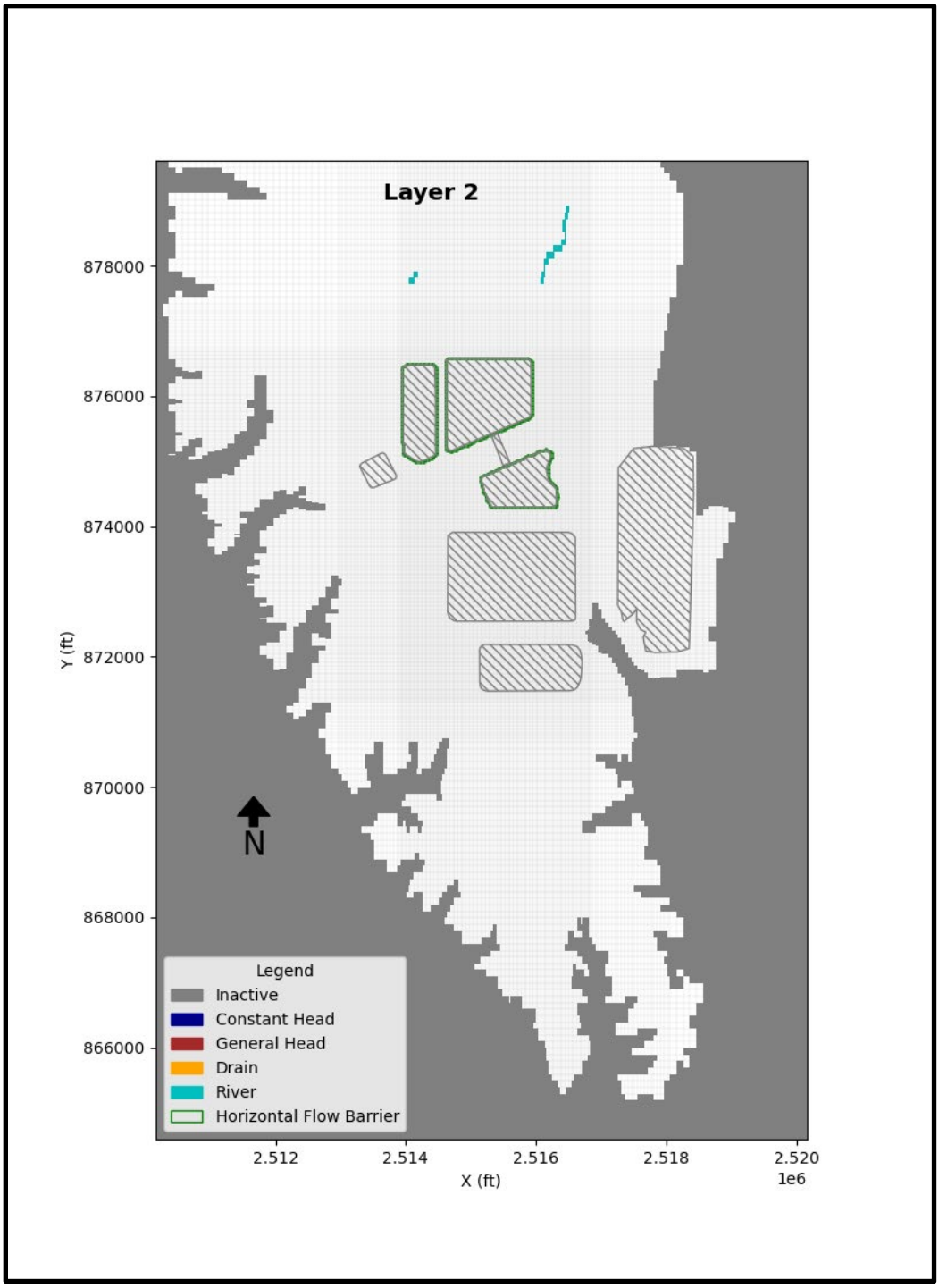
RAMBOLL



BOUNDARY CONDITIONS FOR LAYER 1

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

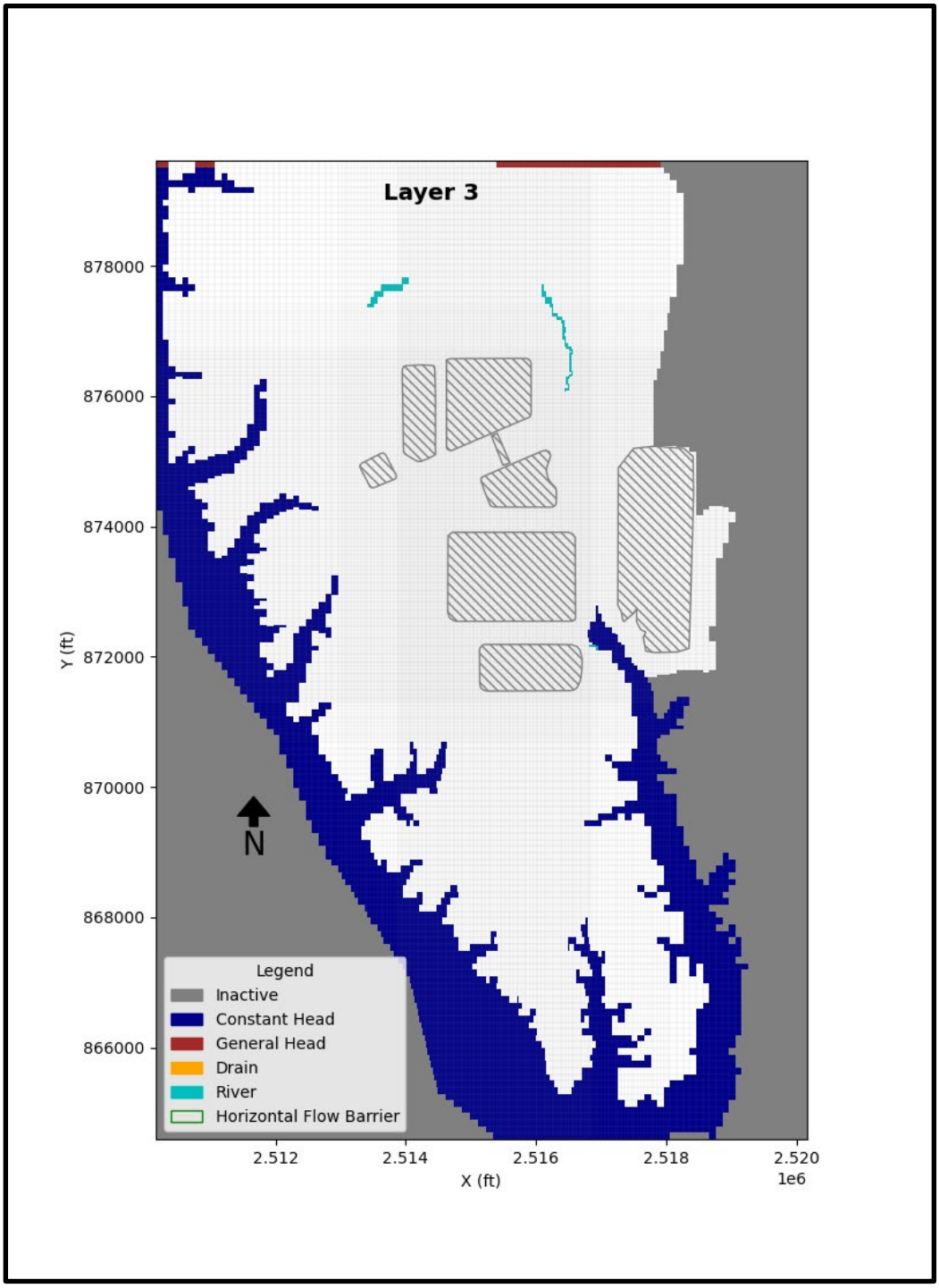
RAMBOLL



BOUNDARY CONDITIONS FOR LAYER 2

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

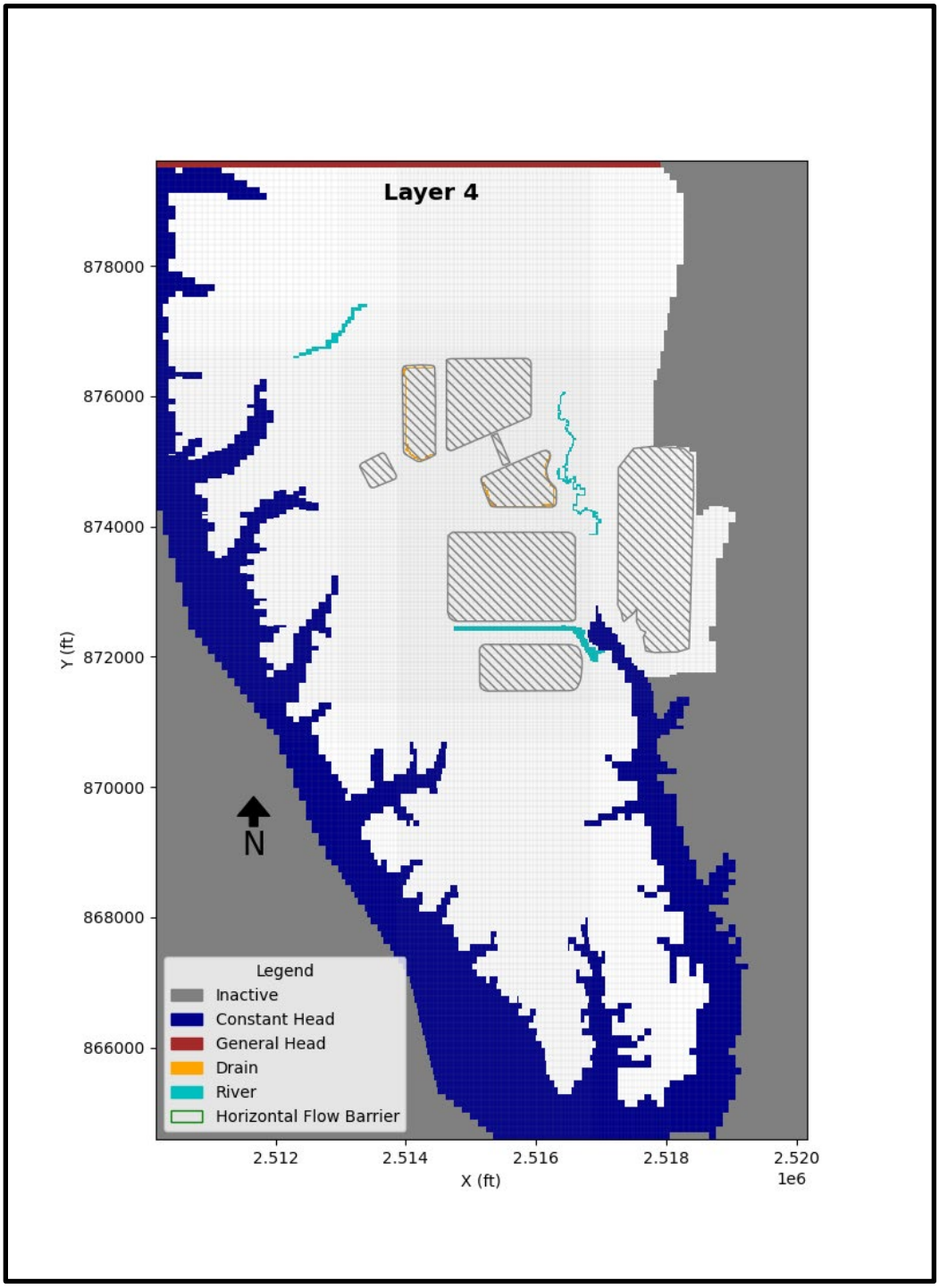
RAMBOLL



BOUNDARY CONDITIONS FOR LAYER 3

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

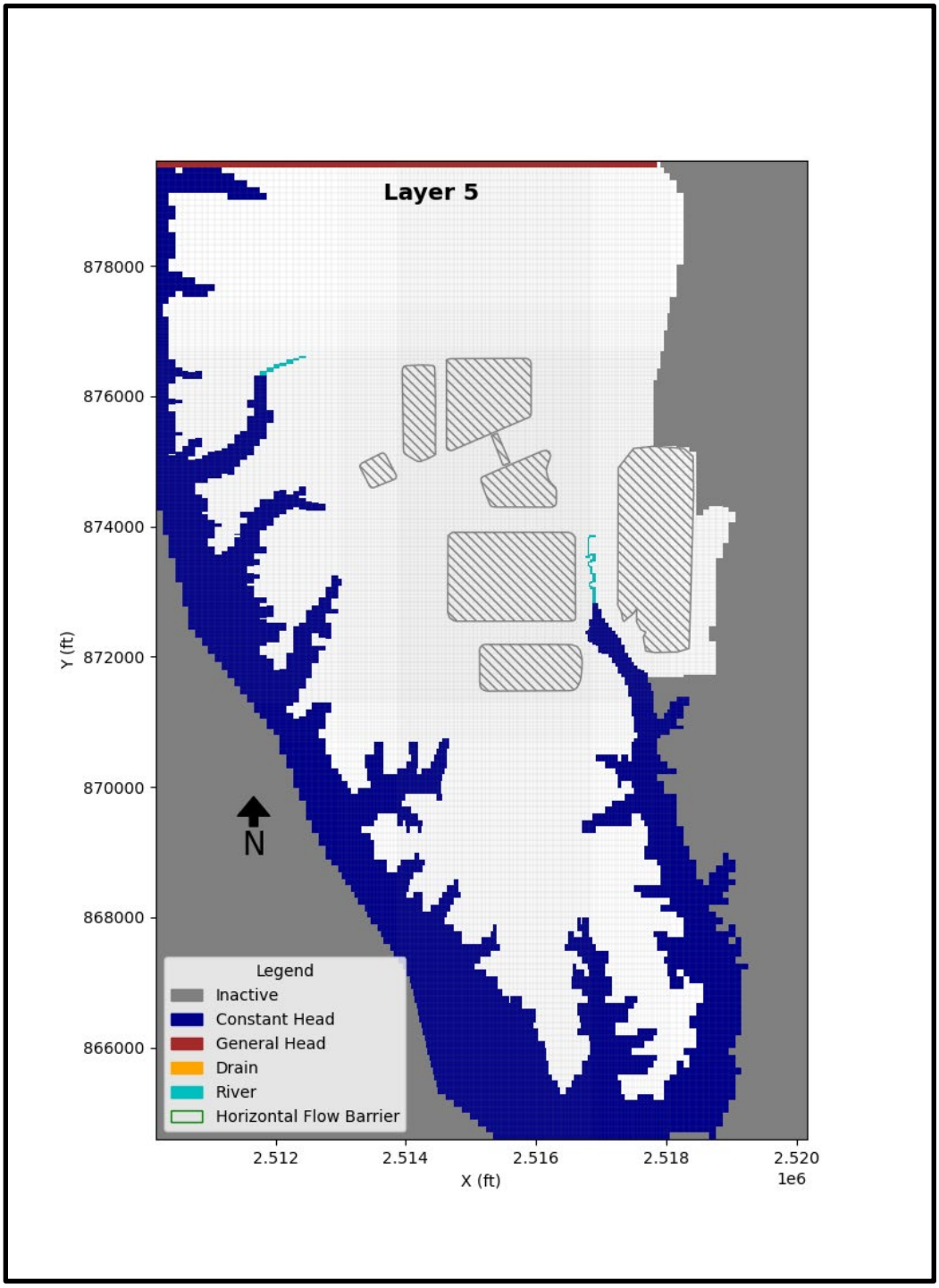
RAMBOLL



BOUNDARY CONDITIONS FOR LAYER 4

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

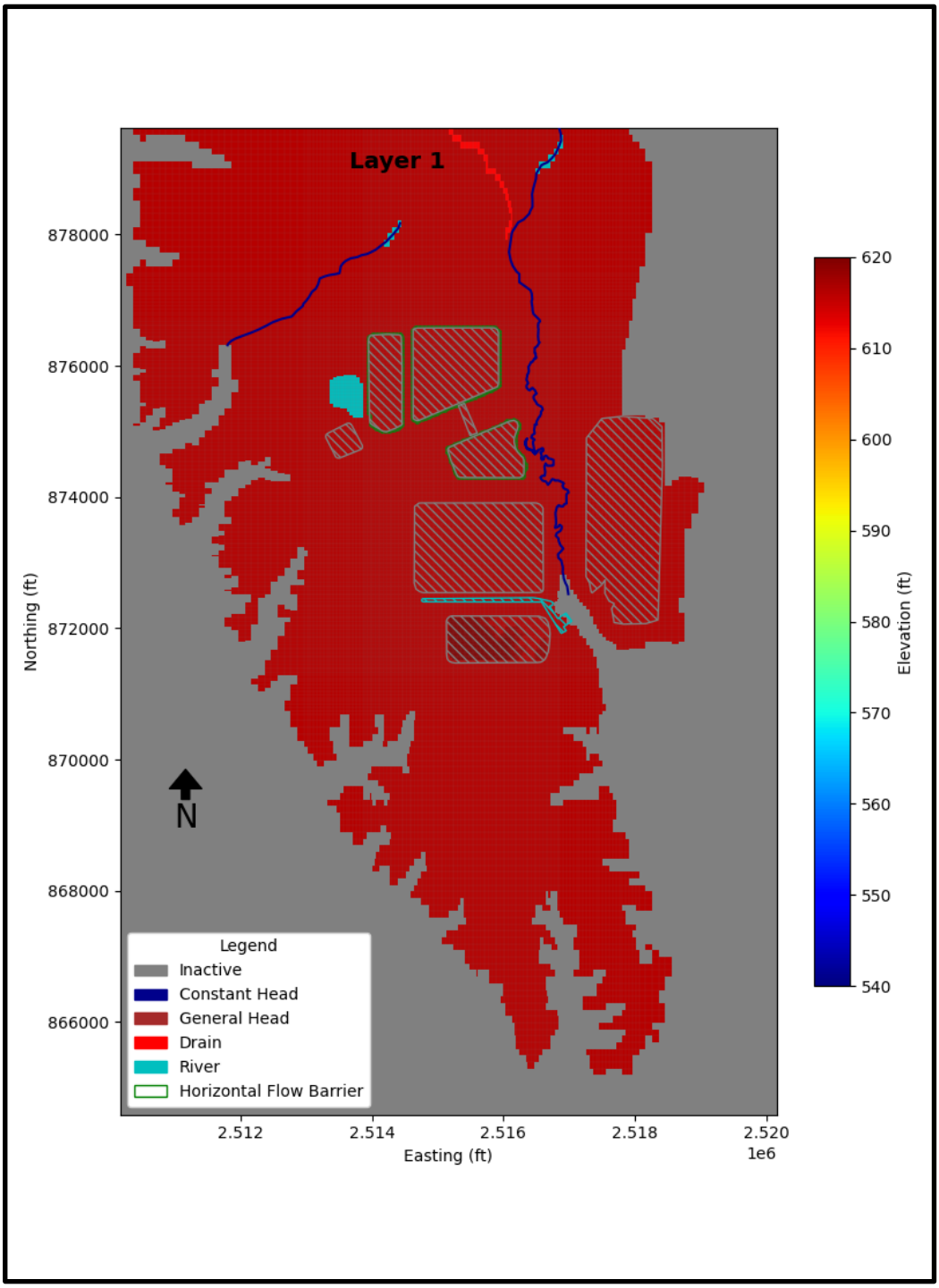
RAMBOLL



BOUNDARY CONDITIONS FOR LAYER 5

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

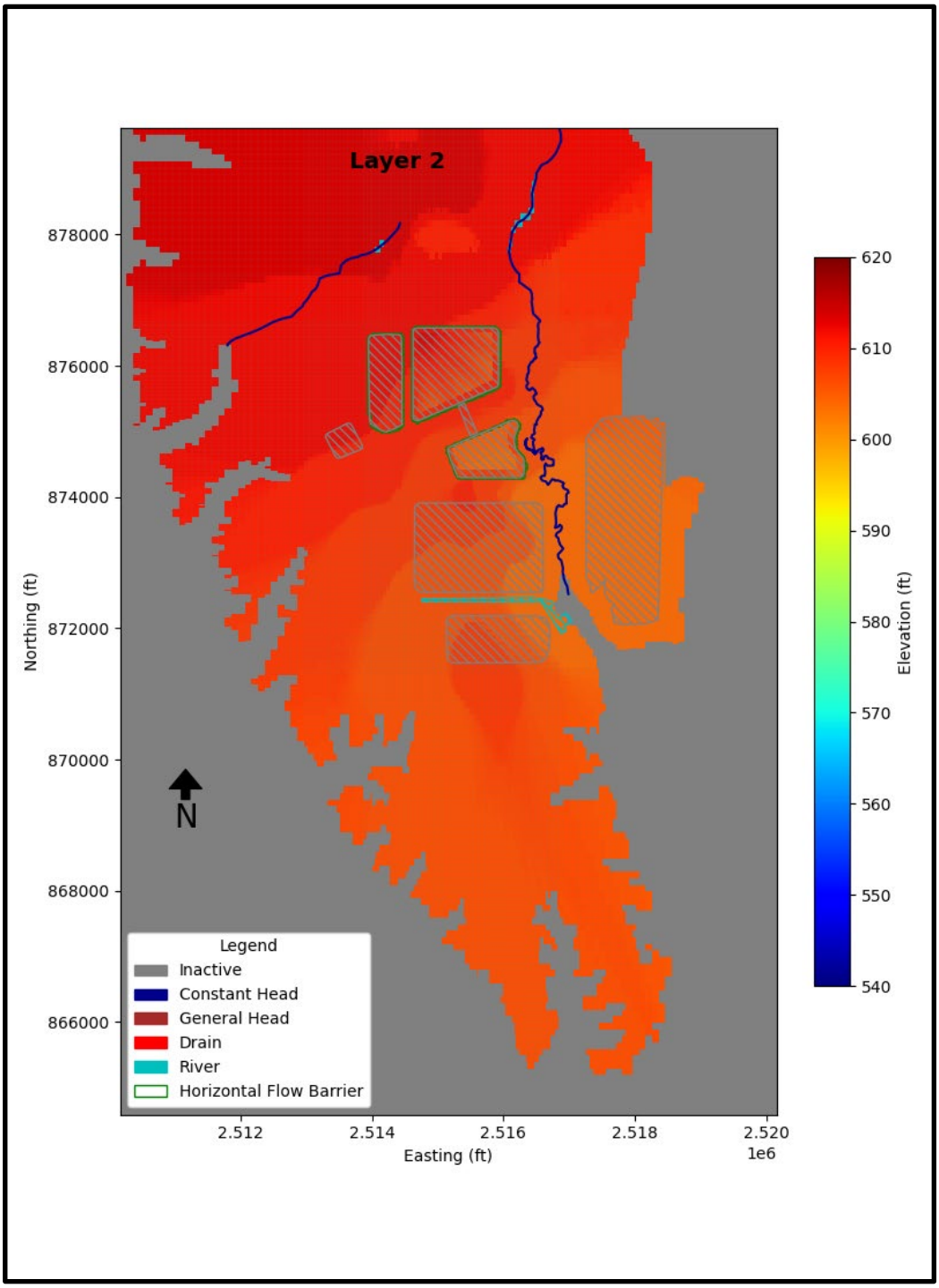
RAMBOLL



BASE OF MODEL FOR LAYER 1

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

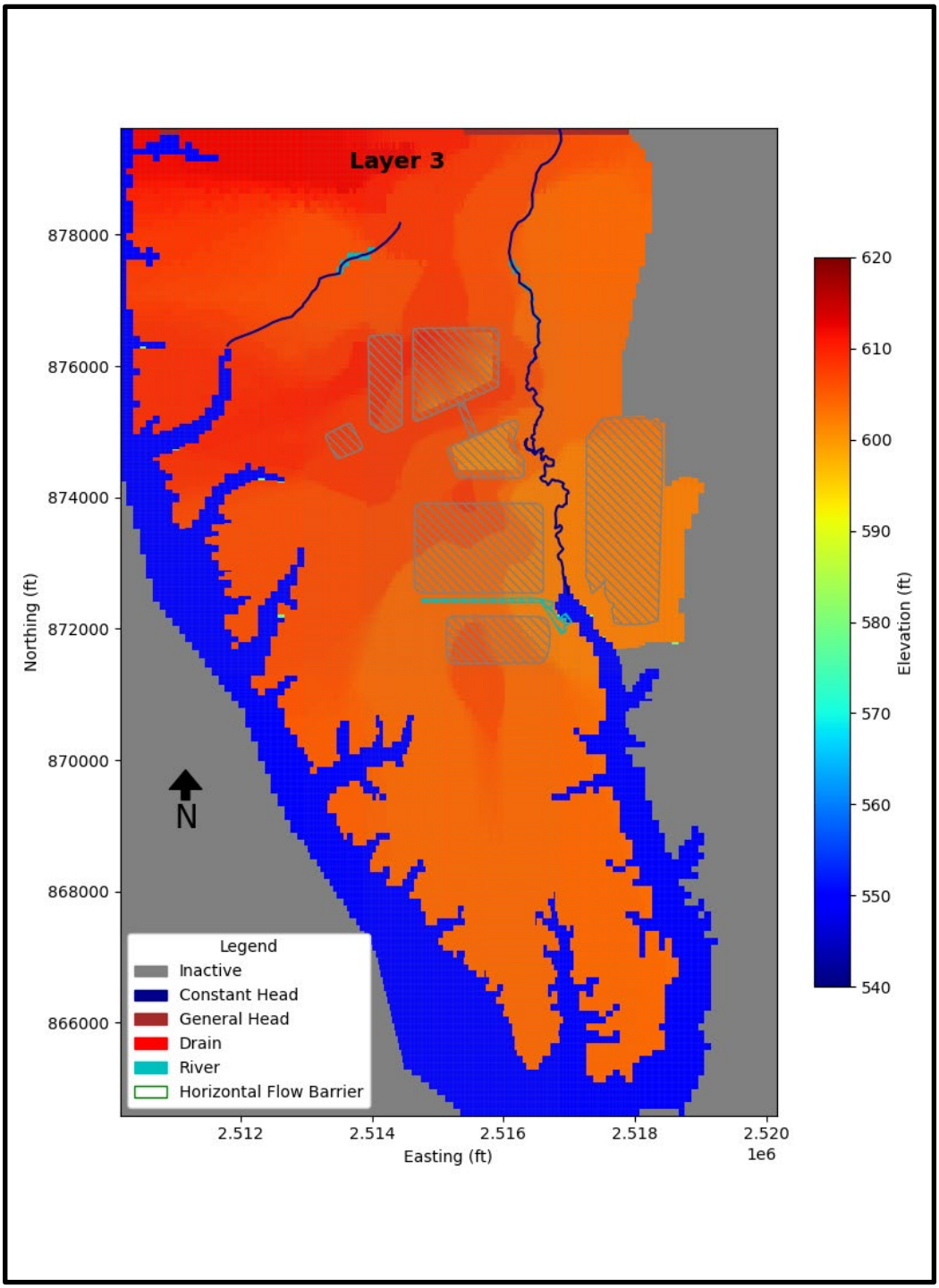
RAMBOLL



BASE OF MODEL FOR LAYER 2

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

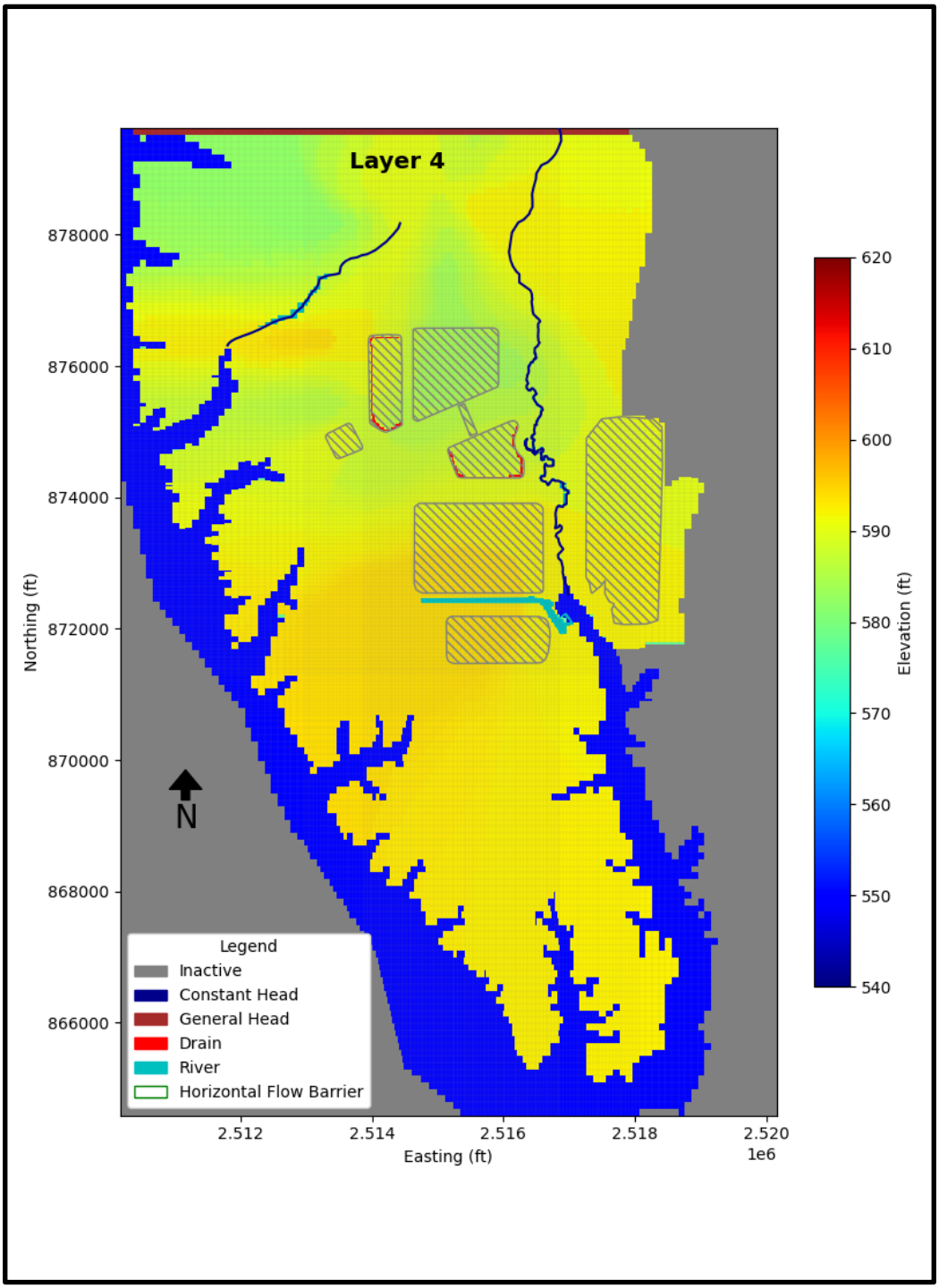
RAMBOLL



BASE OF MODEL FOR LAYER 3

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

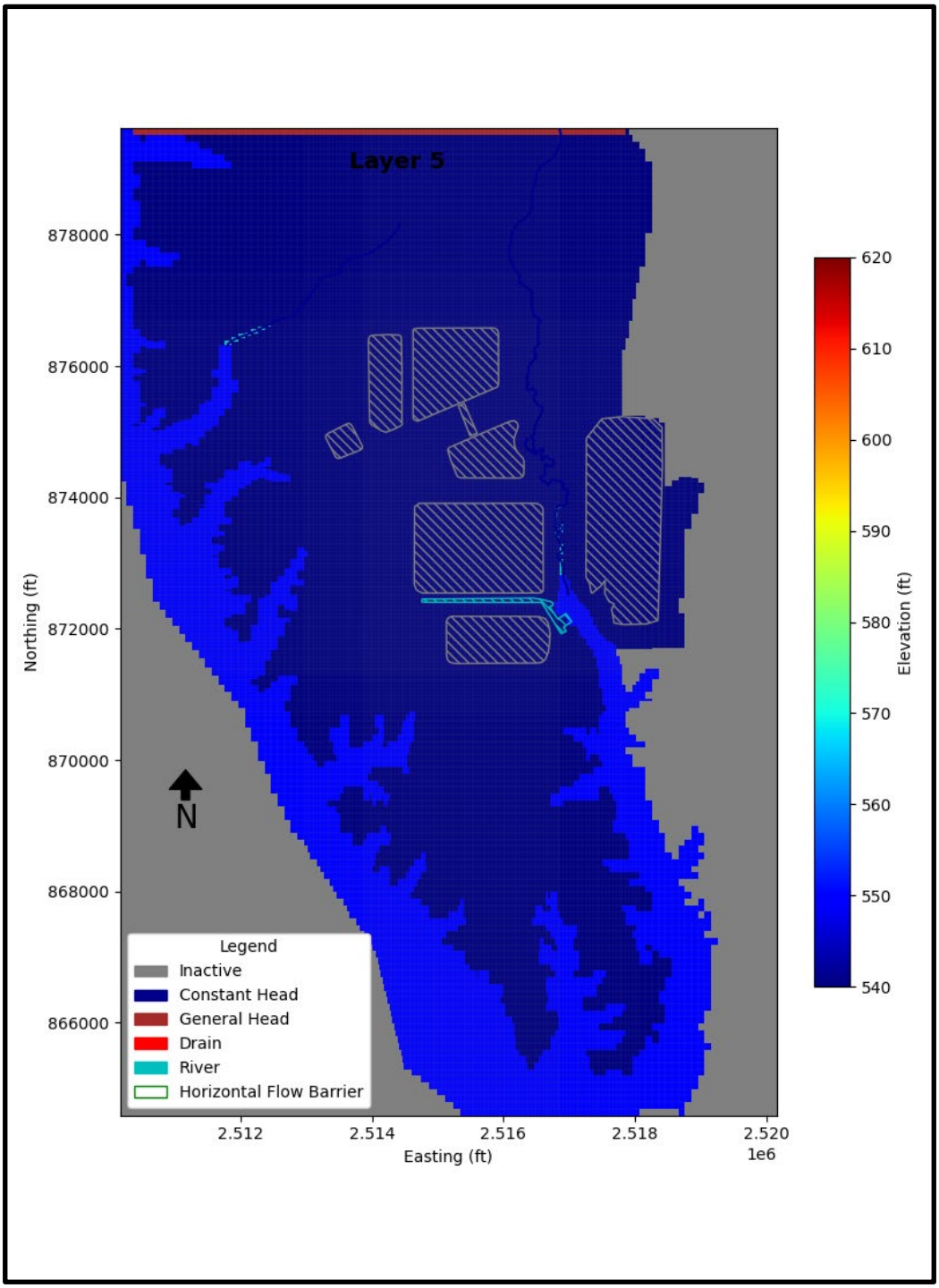
RAMBOLL



BASE OF MODEL FOR LAYER 4

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

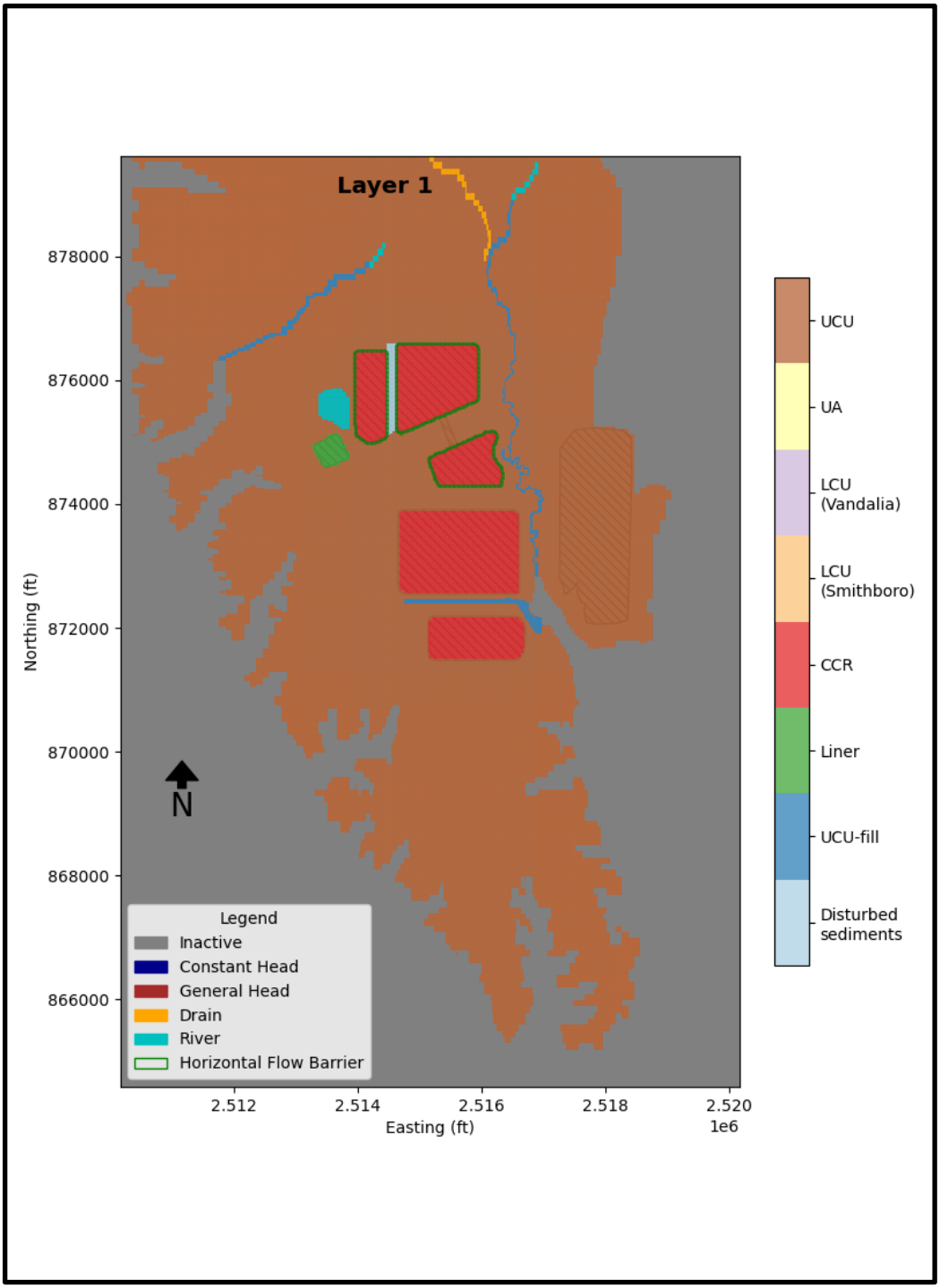
RAMBOLL



BASE OF MODEL FOR LAYER 5

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

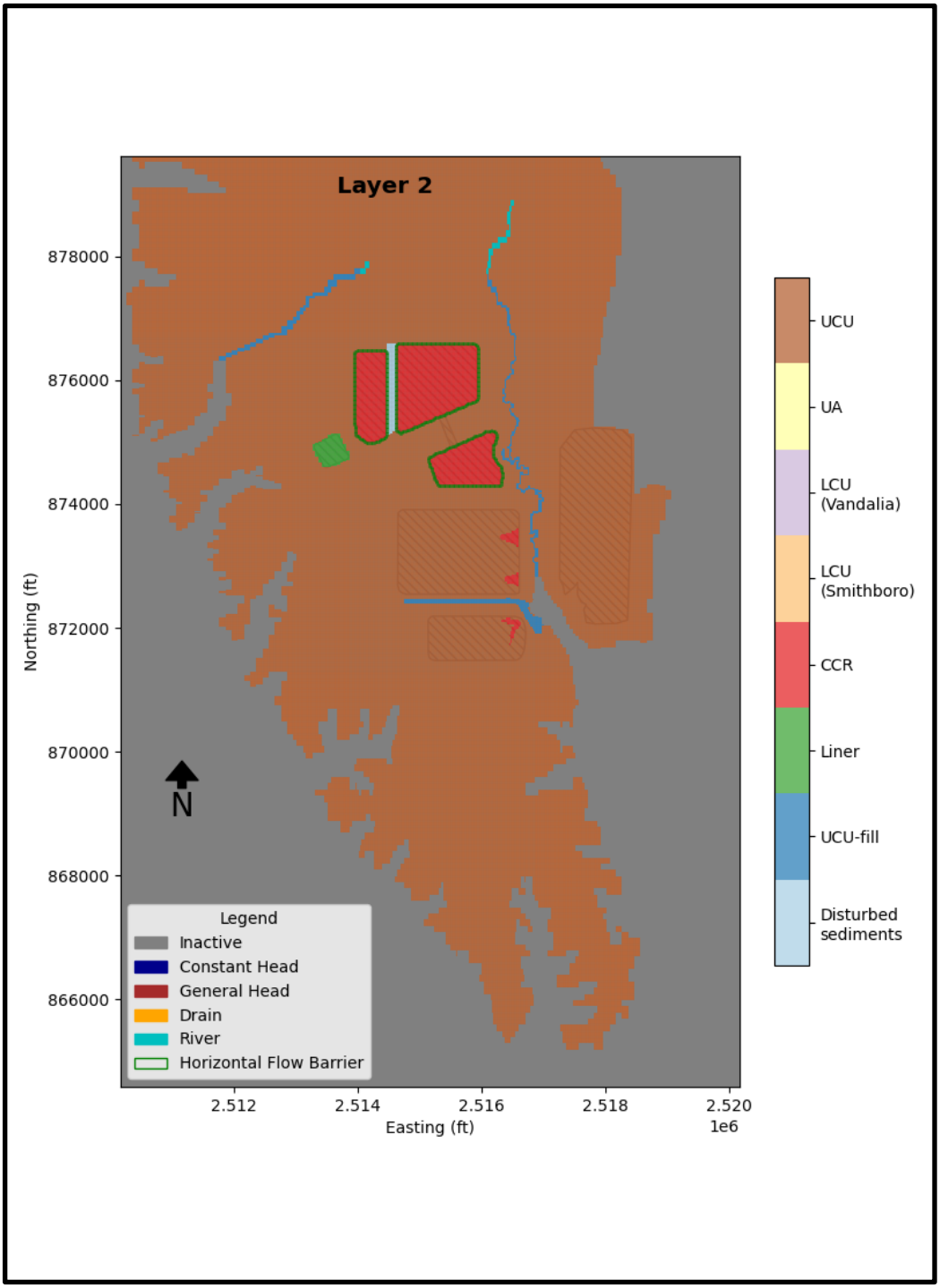
RAMBOLL



HYDRAULIC CONDUCTIVITY ZONES FOR LAYER 1

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

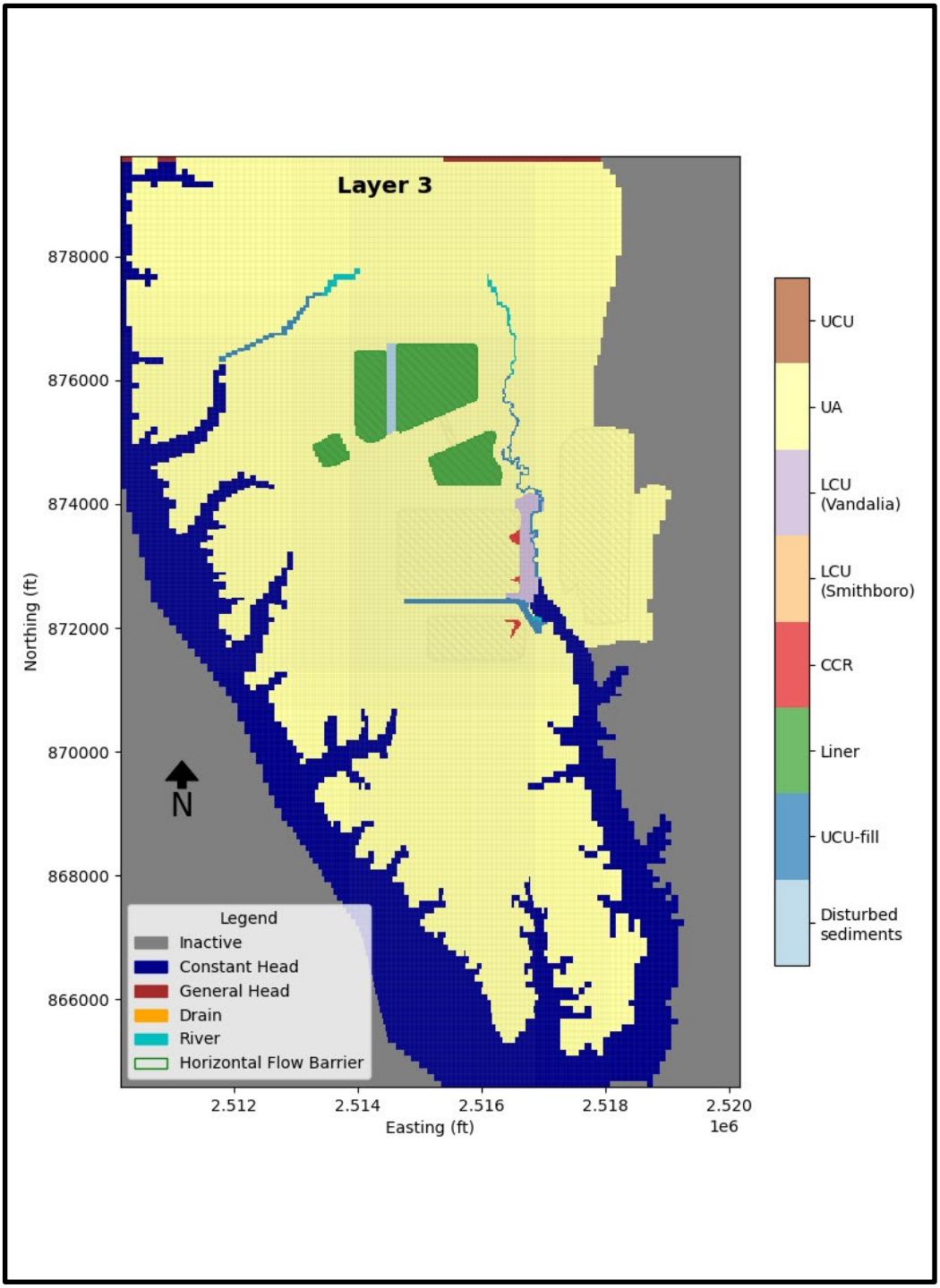
RAMBOLL



HYDRAULIC CONDUCTIVITY ZONES FOR LAYER 2

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

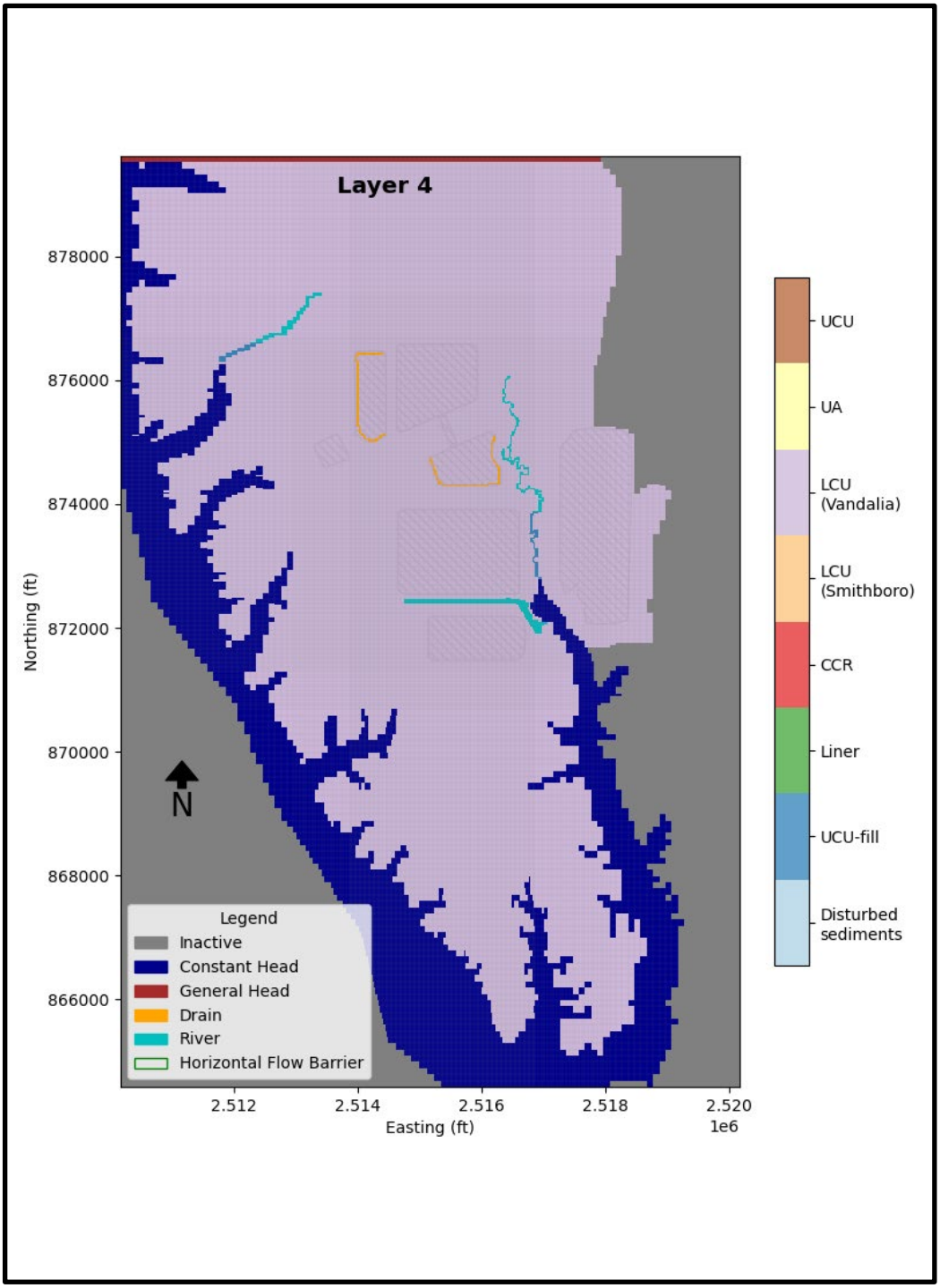
RAMBOLL



HYDRAULIC CONDUCTIVITY ZONES FOR LAYER 3

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

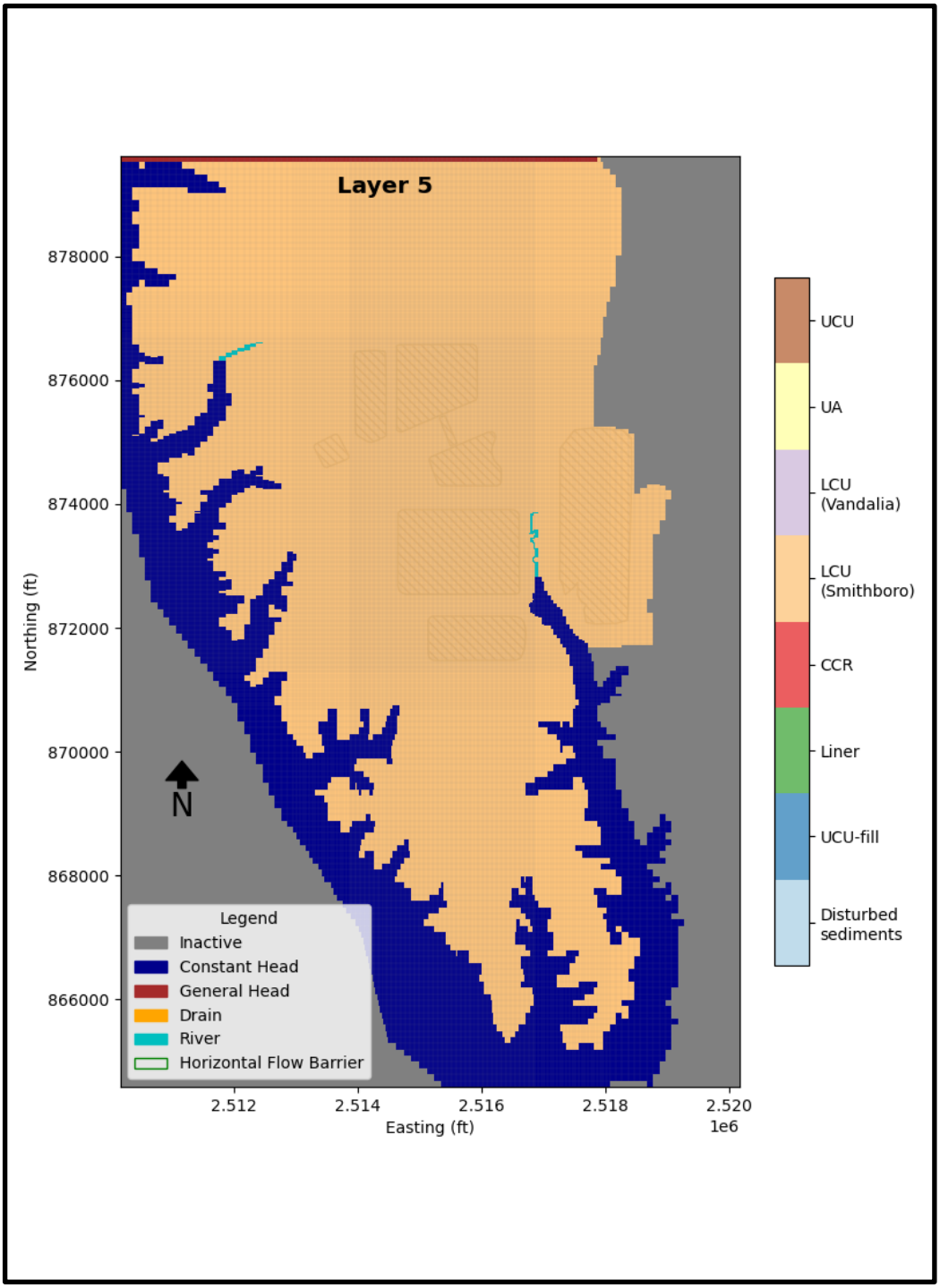
RAMBOLL



HYDRAULIC CONDUCTIVITY ZONES FOR LAYER 4

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

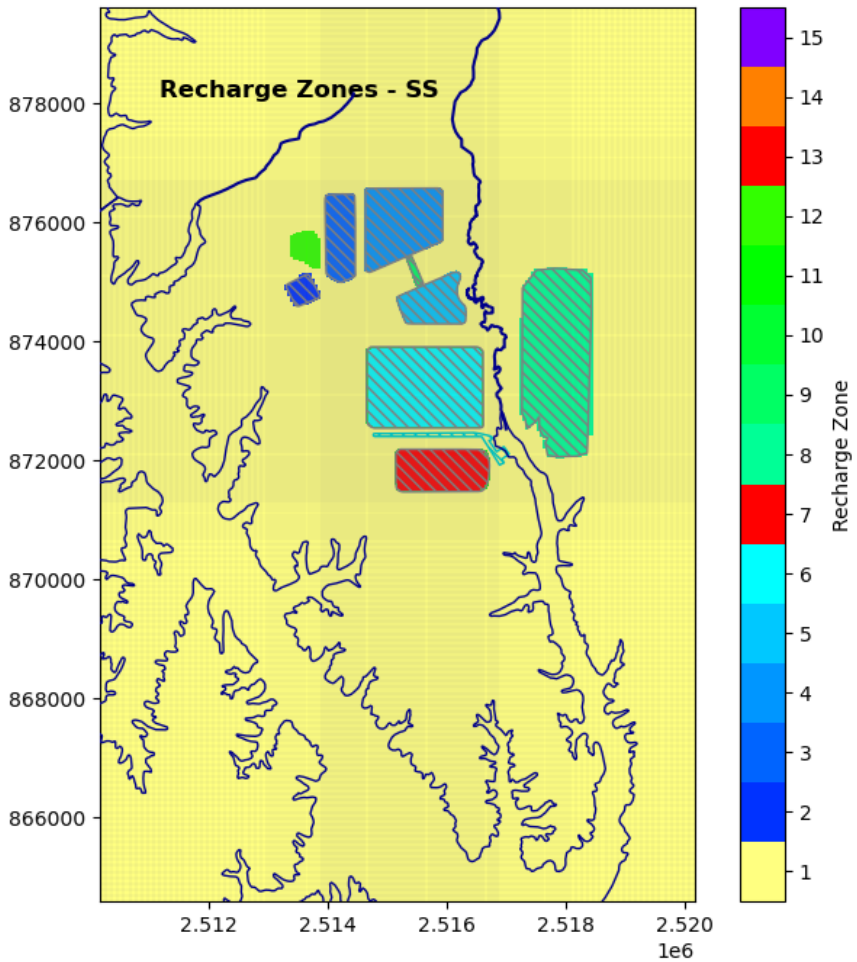
RAMBOLL



HYDRAULIC CONDUCTIVITY ZONES FOR LAYER 5

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

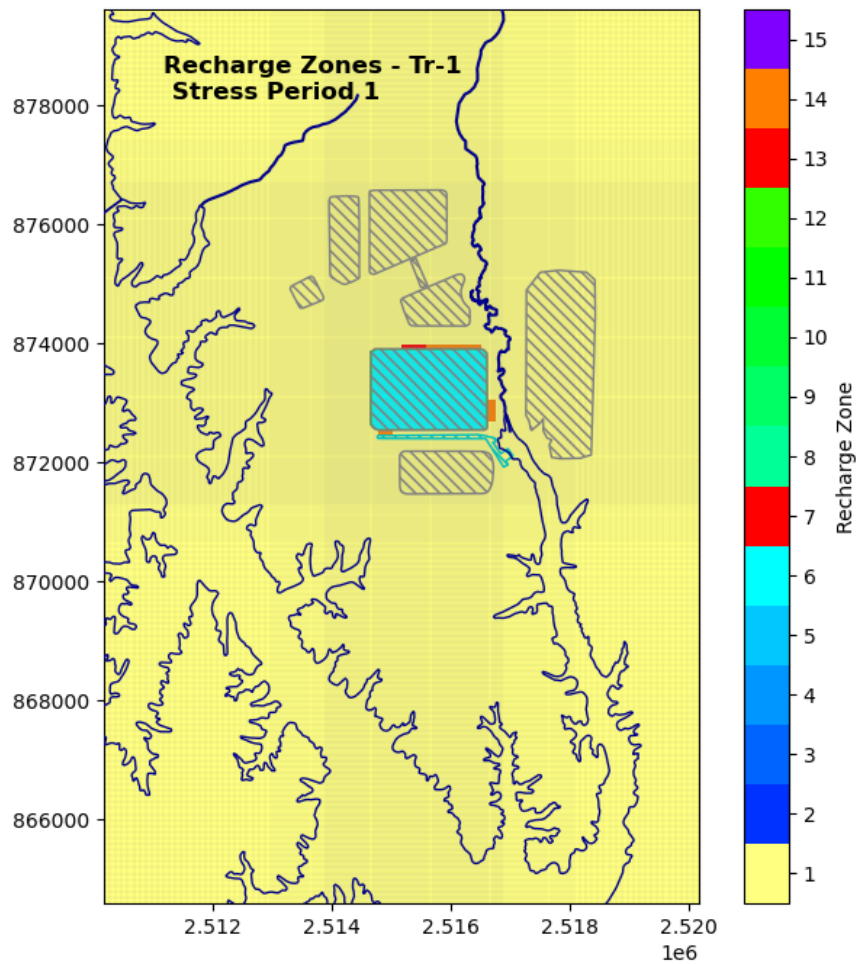
RAMBOLL



MODEL RECHARGE DISTRIBUTION STEADY STATE (SS) MODEL

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

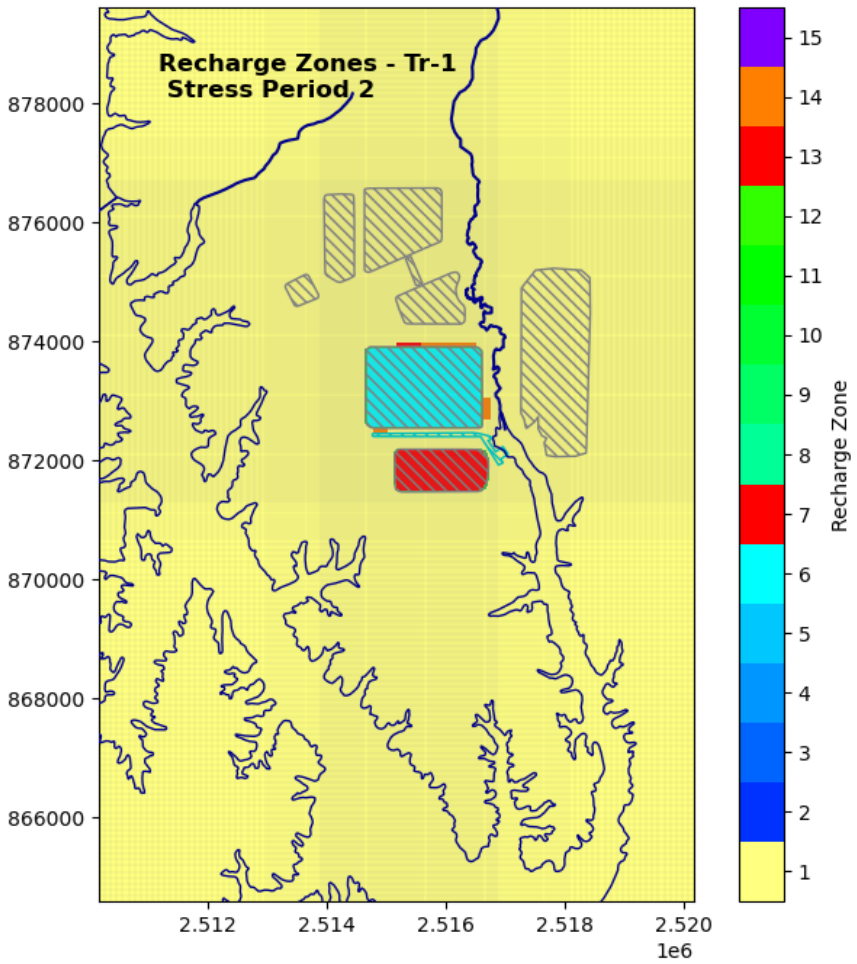
RAMBOLL



MODEL RECHARGE DISTRIBUTION FOR THE TRANSIENT (TR) MODEL TR-1
STRESS PERIOD 1

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

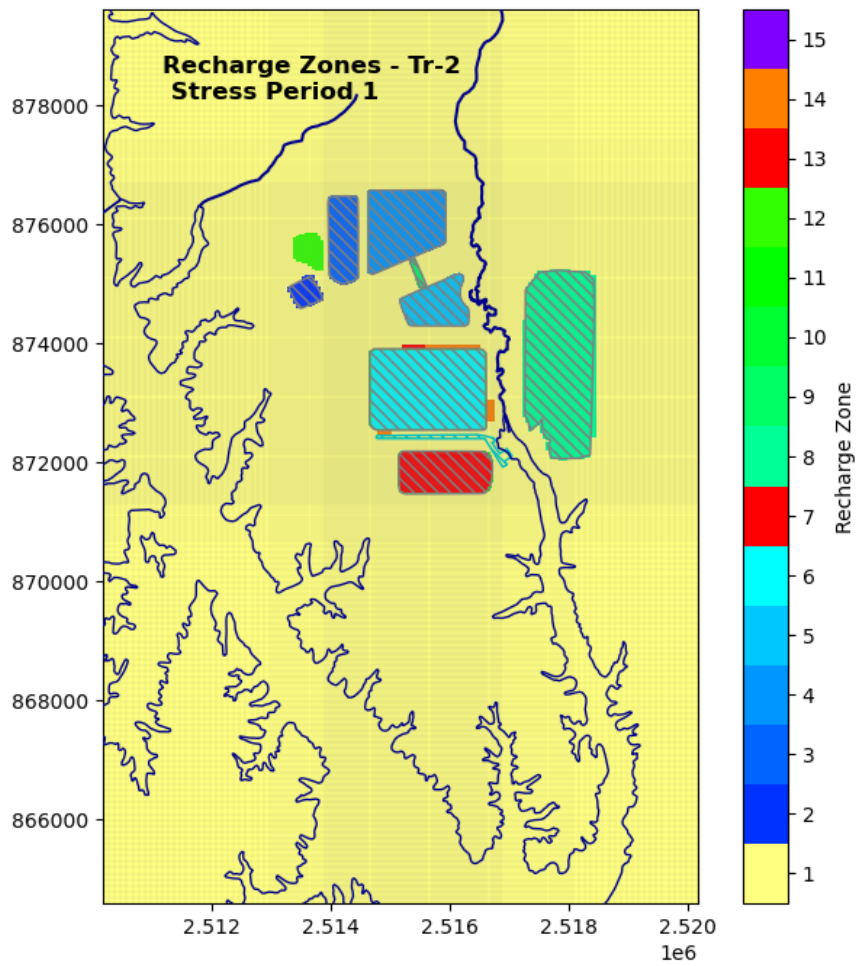
RAMBOLL



MODEL RECHARGE DISTRIBUTION FOR THE TRANSIENT (TR) MODEL TR-1
STRESS PERIOD 2

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

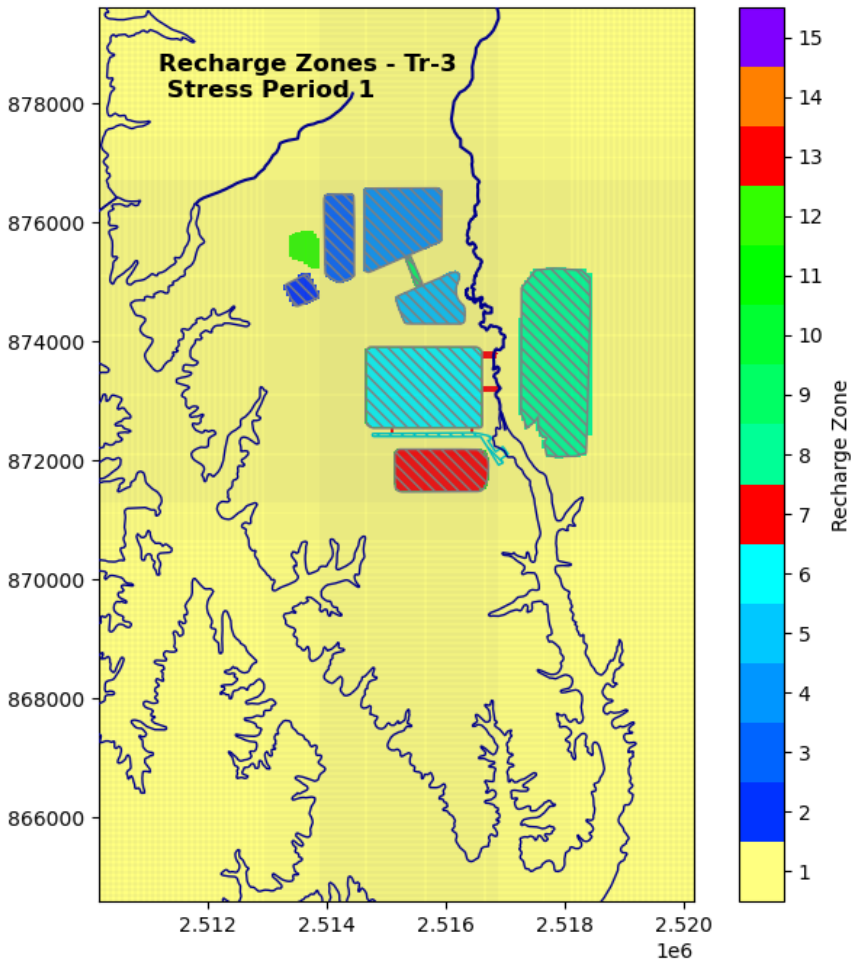
RAMBOLL



MODEL RECHARGE DISTRIBUTION FOR THE TRANSIENT (TR) MODEL TR-2
STRESS PERIOD 1

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL

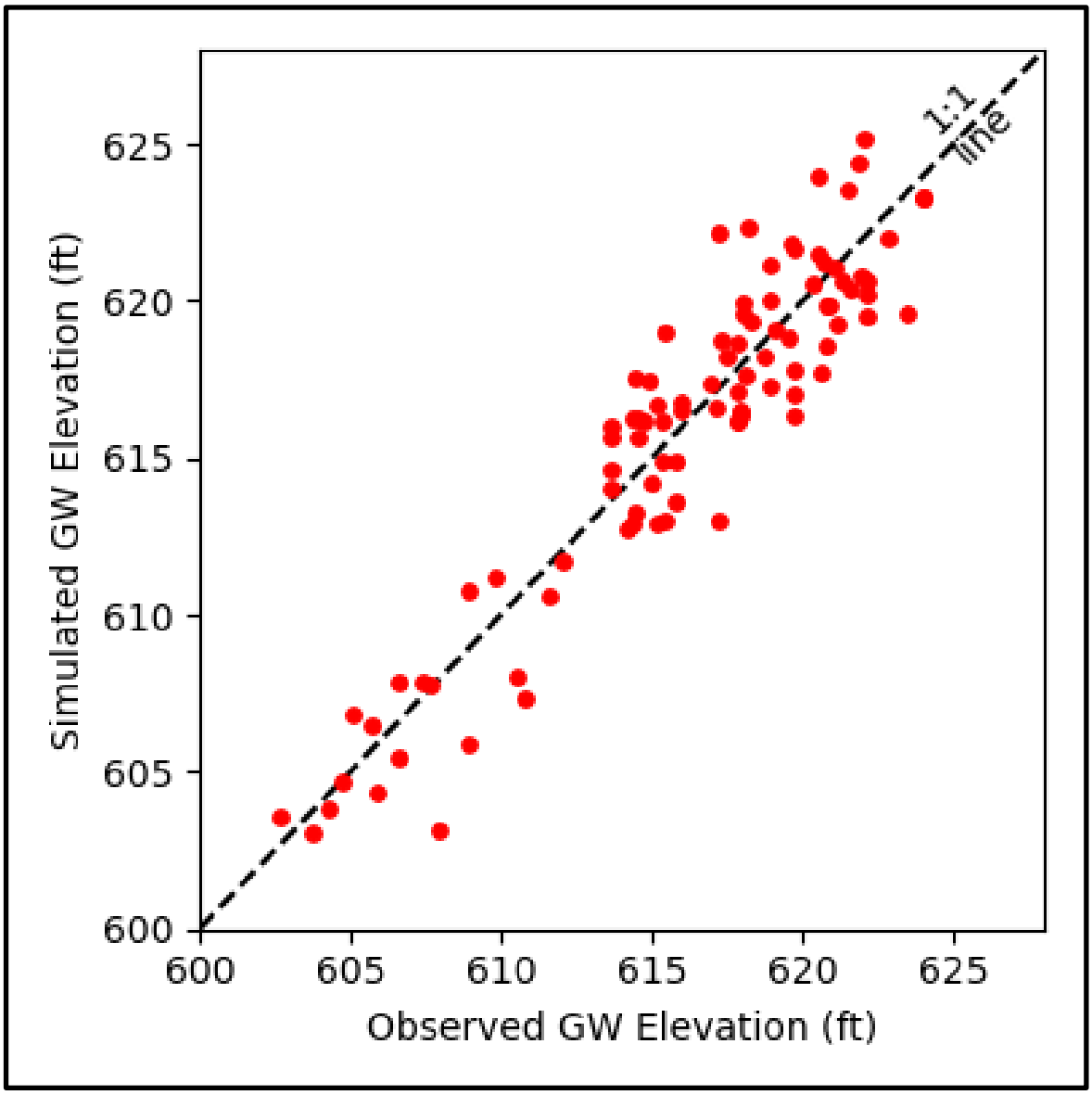


MODEL RECHARGE DISTRIBUTION FOR THE TRANSIENT (TR) MODEL TR-3
STRESS PERIOD 1

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL

FIGURE 5-22

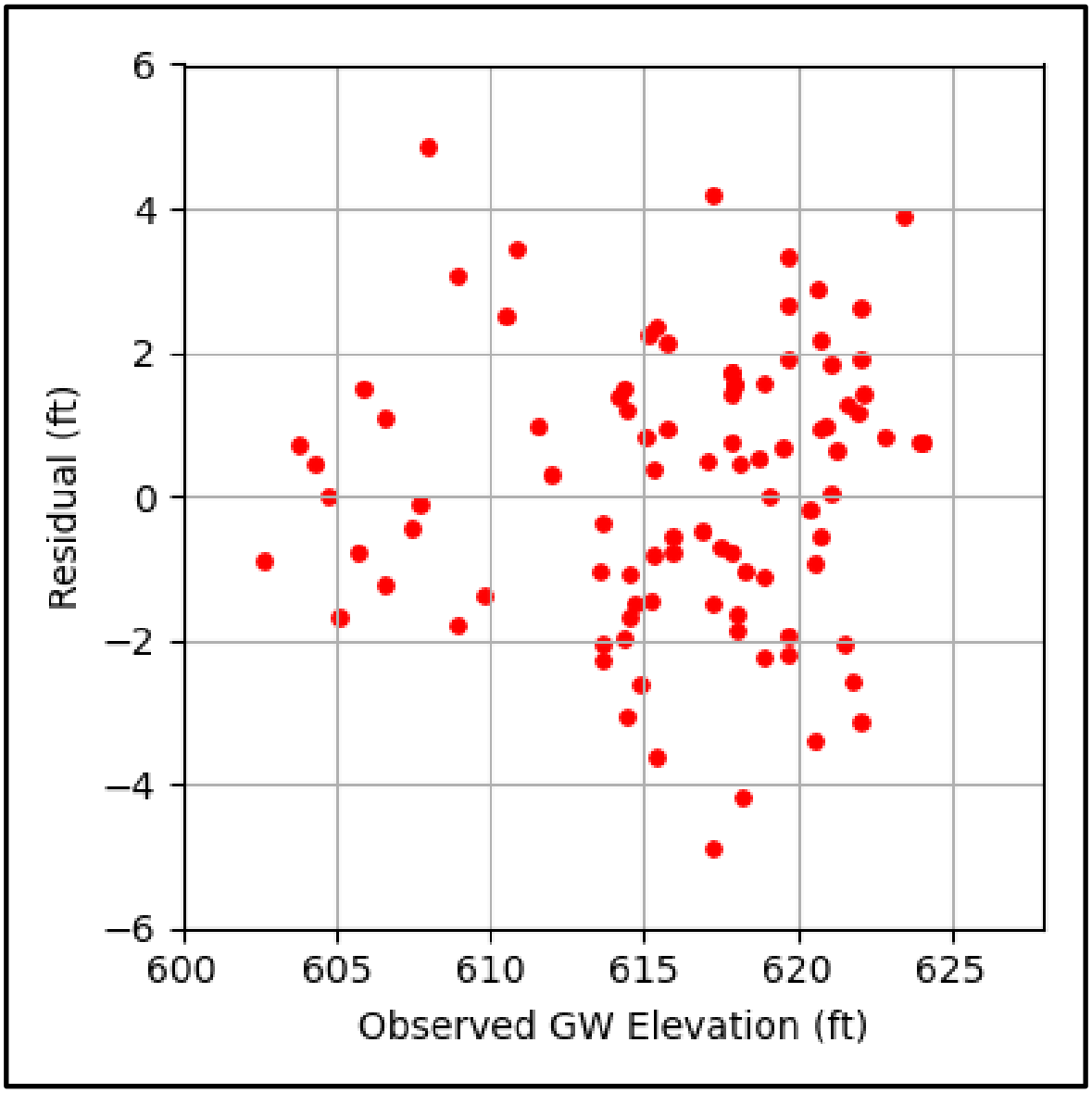


OBSERVED VERSUS SIMULATED STEADY STATE GROUNDWATER LEVELS FROM THE CALIBRATED MODEL

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL

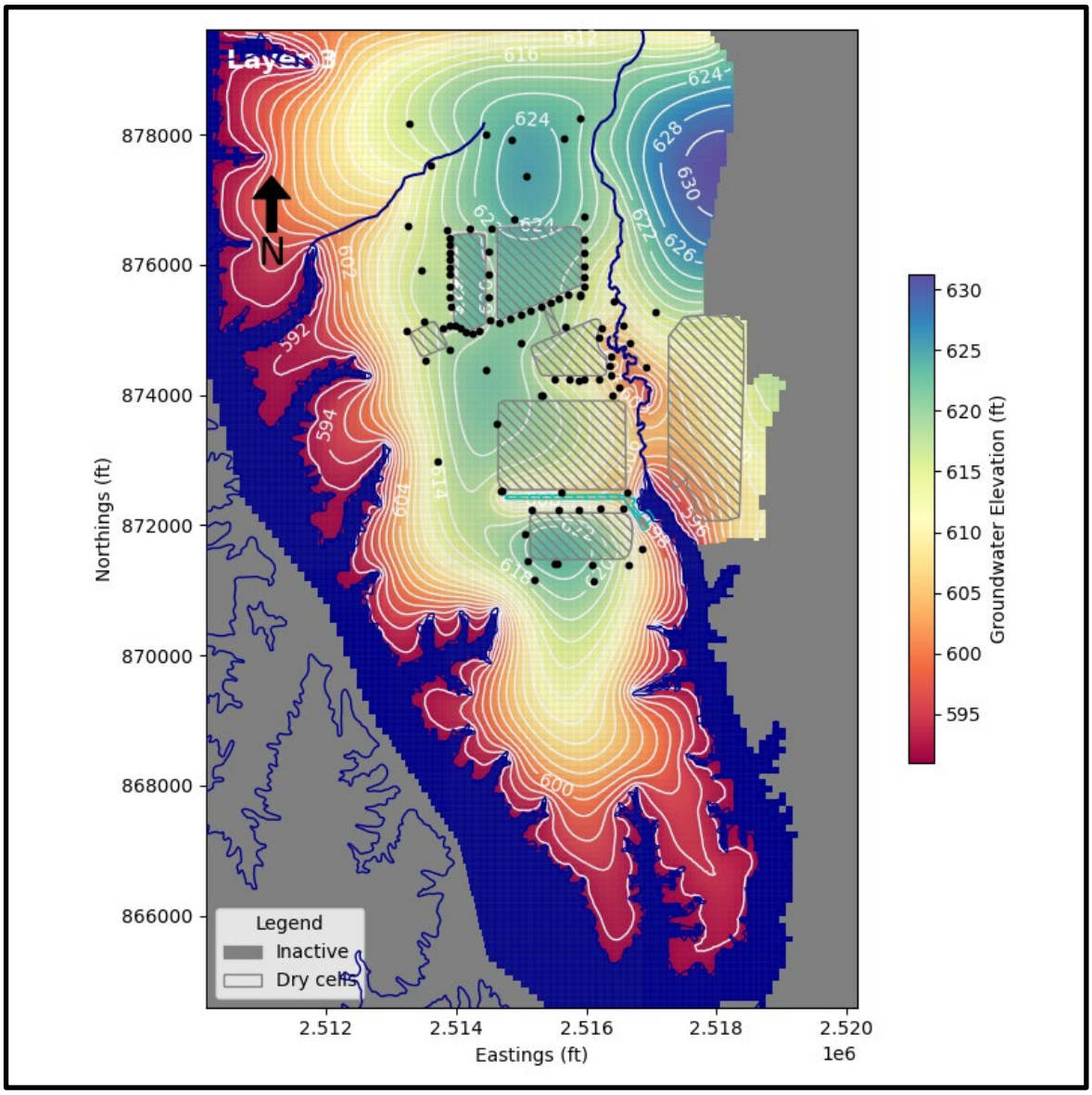
FIGURE 5-23



SIMULATED GROUNDWATER LEVEL RESIDUALS FROM THE CALIBRATED MODEL

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

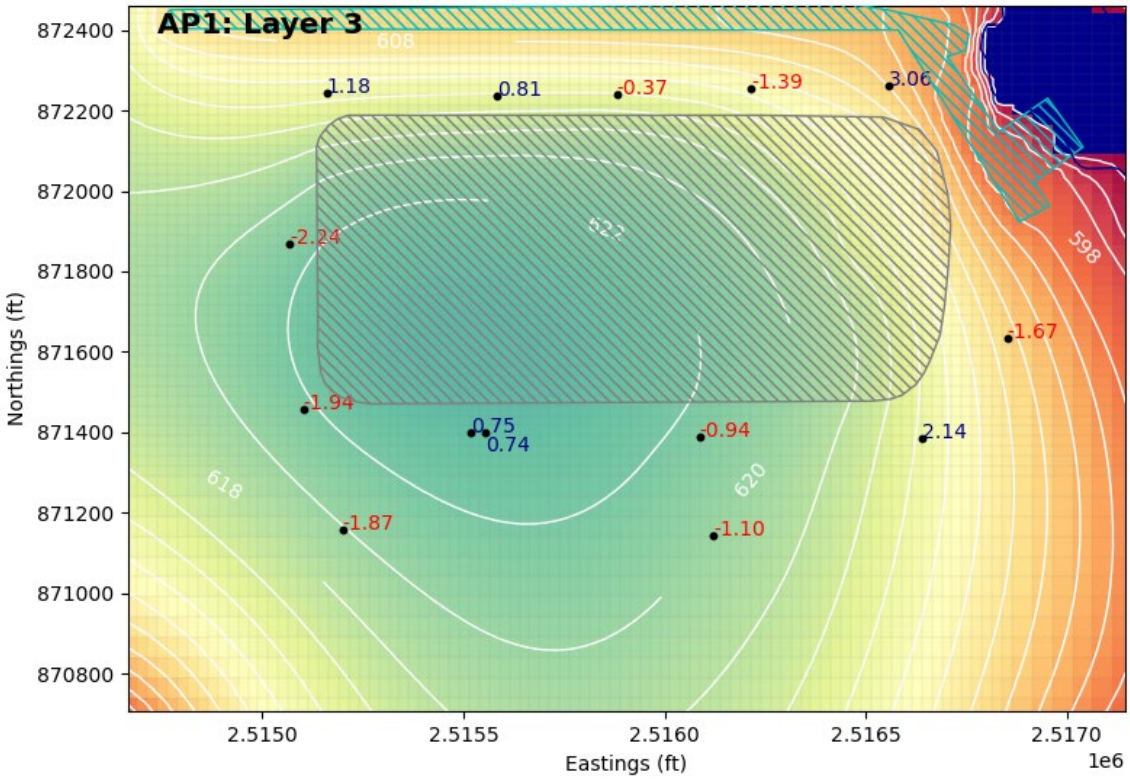
RAMBOLL



SIMULATED STEADY STATE GROUNDWATER LEVEL CONTOURS FROM UA (LAYER 3) FROM THE CALIBRATED MODEL

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

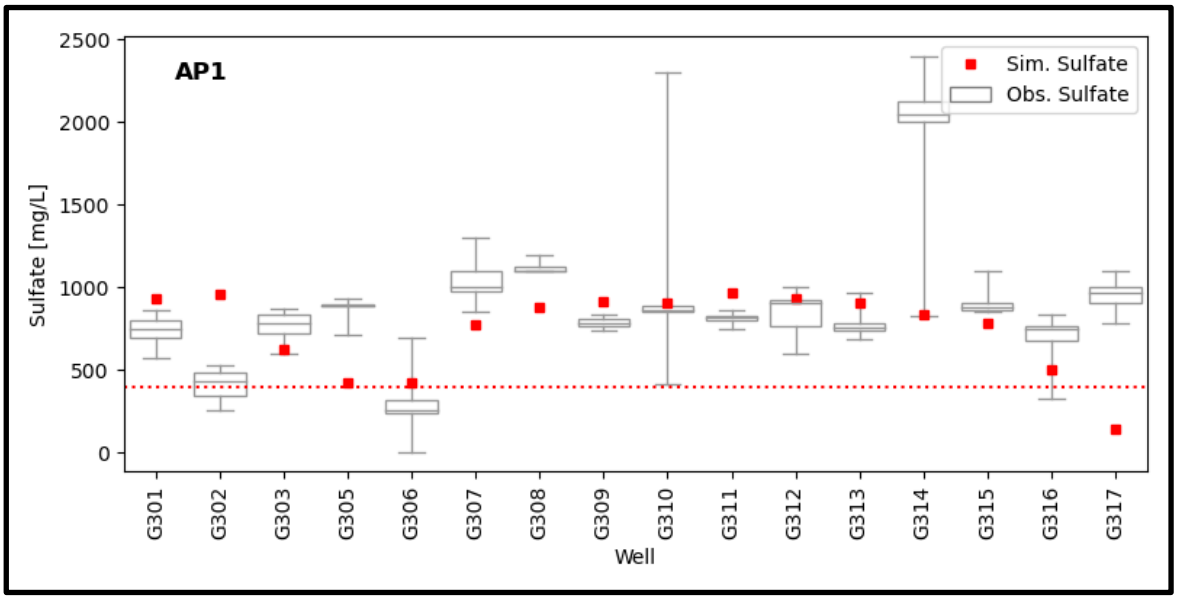
RAMBOLL



SIMULATED STEADY STATE GROUNDWATER LEVEL CONTOURS IN PROXIMITY TO AP1 FROM UA (LAYER 3) FROM THE CALIBRATED MODEL

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

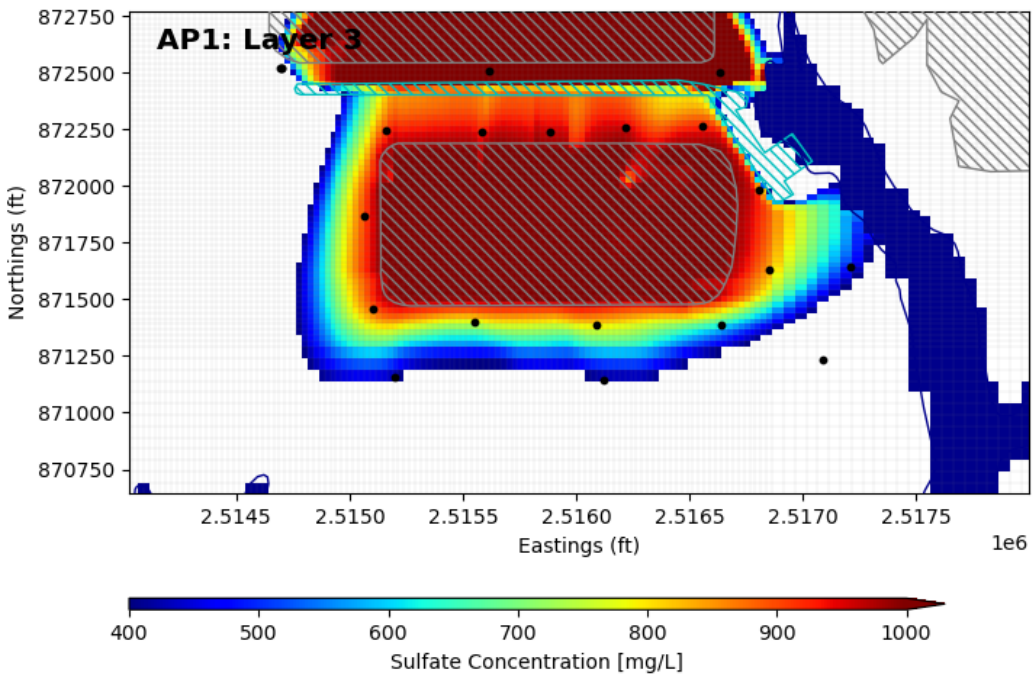
RAMBOLL



OBSERVED VERSUS SIMULATED SULFATE CONCENTRATIONS (mg/L)

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL

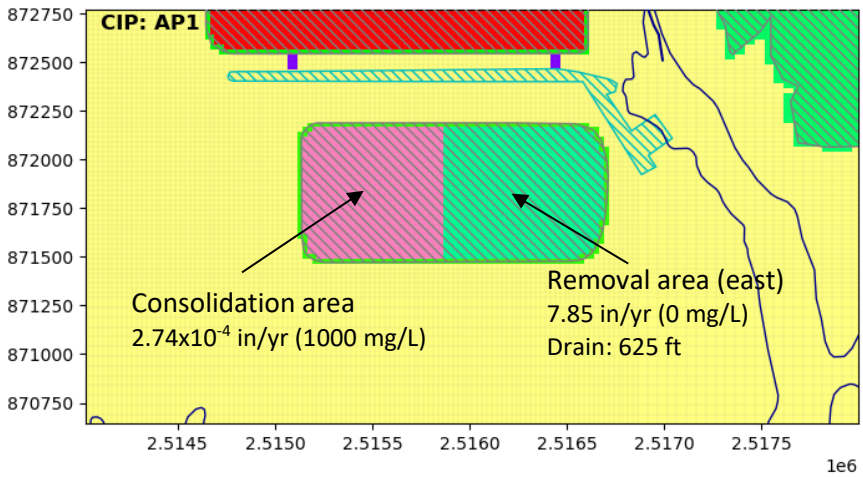


SIMULATED SULFATE PLUME IN THE UA FROM THE TRANSIENT MODEL

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL

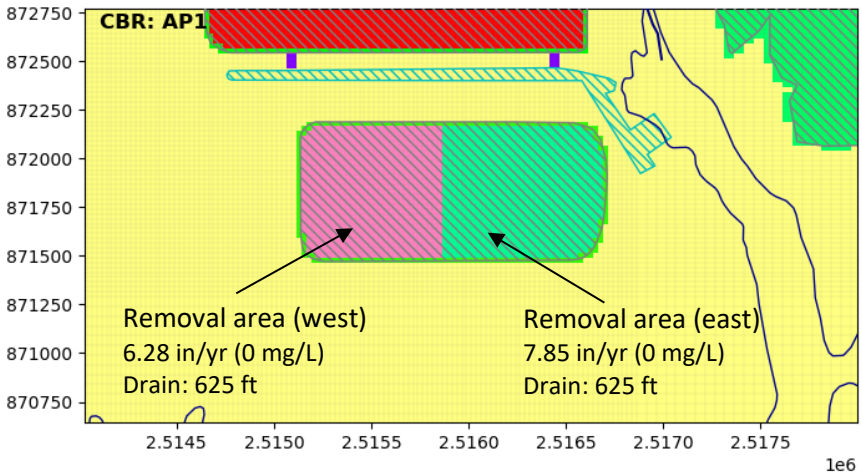
FIGURE 6-1



CIP RECHARGE AND STORMWATER POND MODIFICATIONS

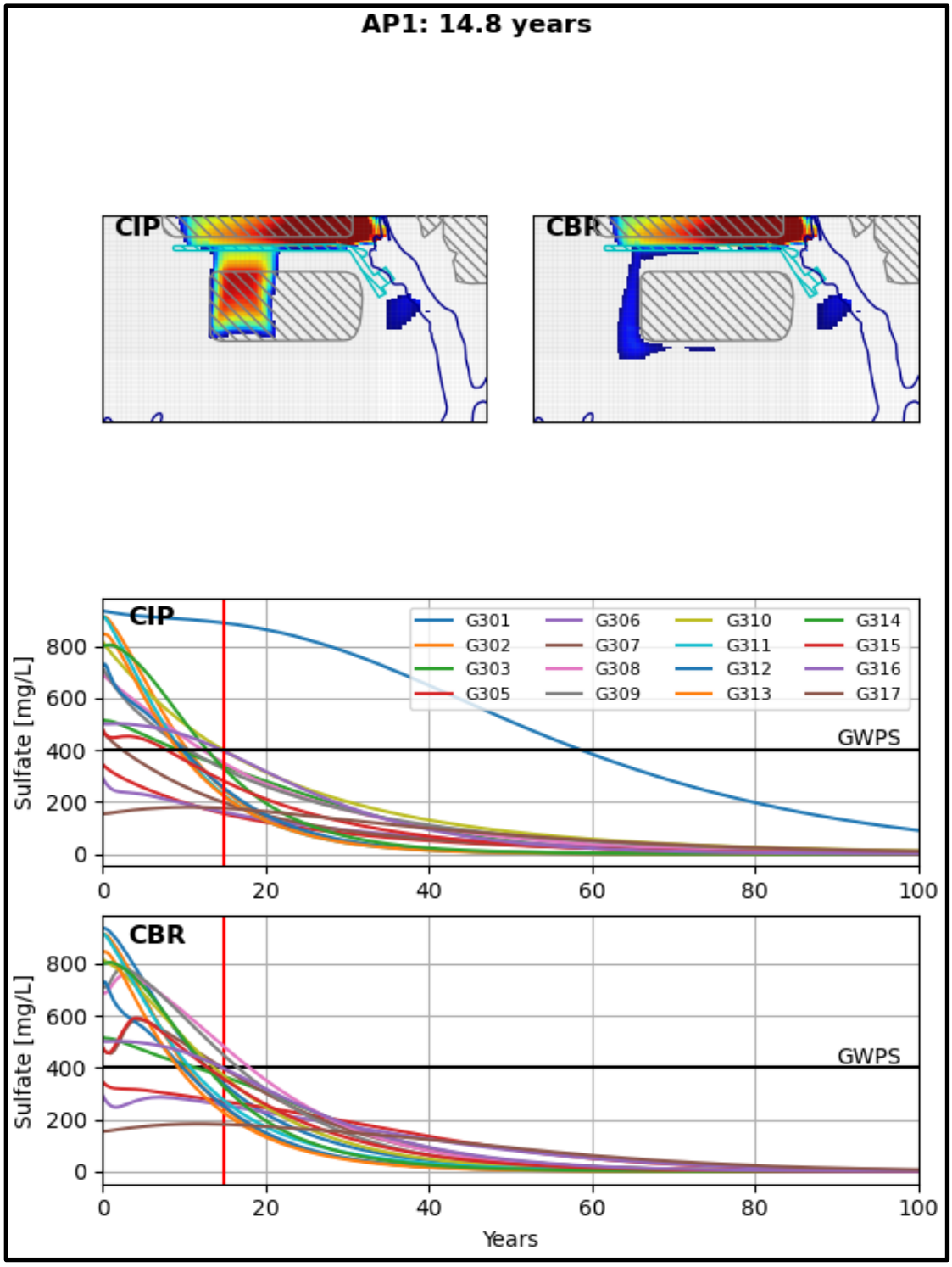
GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL



CBR RECHARGE AND STORMWATER POND MODIFICATIONS

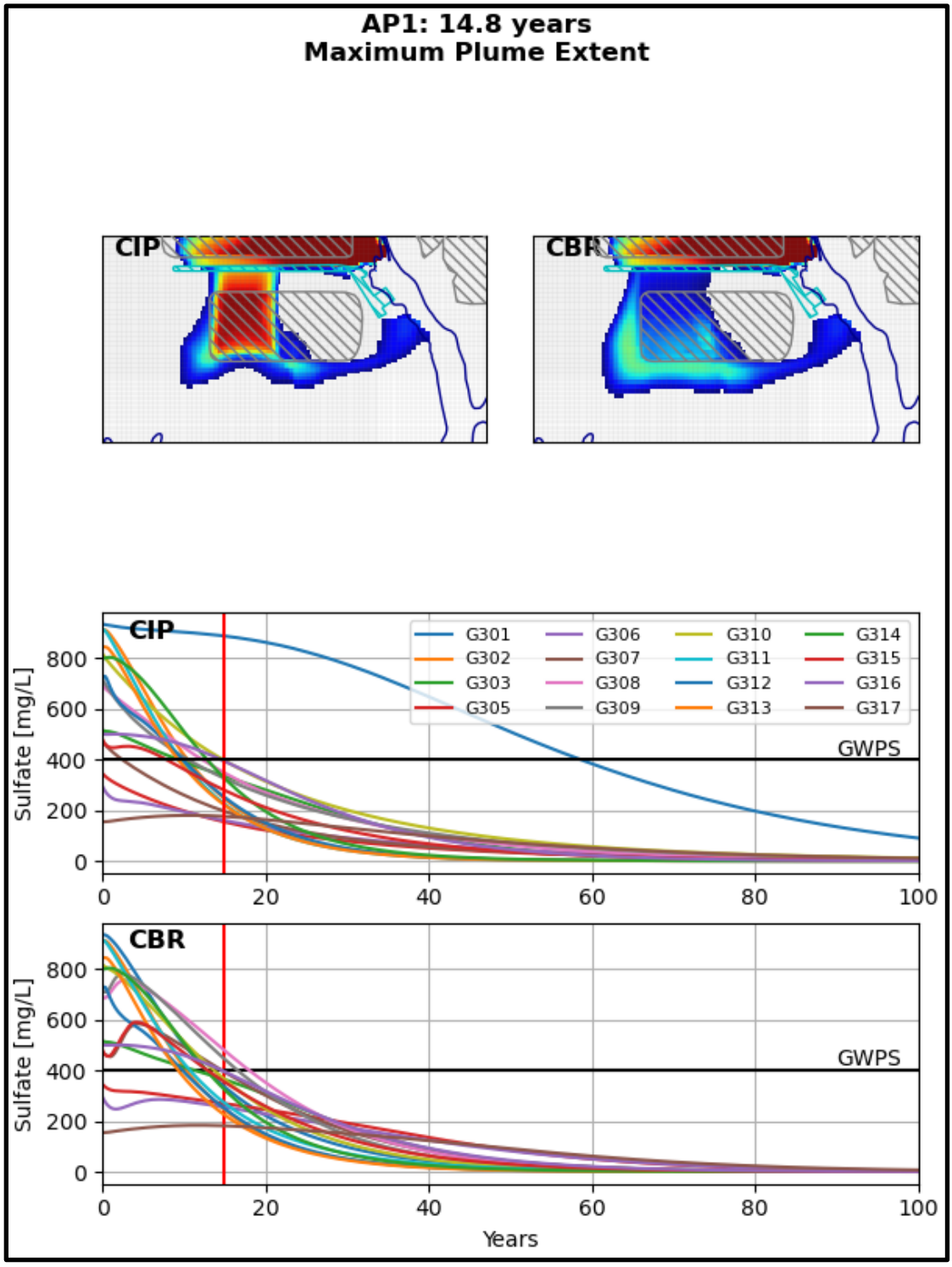
GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS



SIMULATED SULFATE PLUME OF THE UA FOR THE CIP AND CBR SCENARIOS AFTER 14.8 YEARS

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

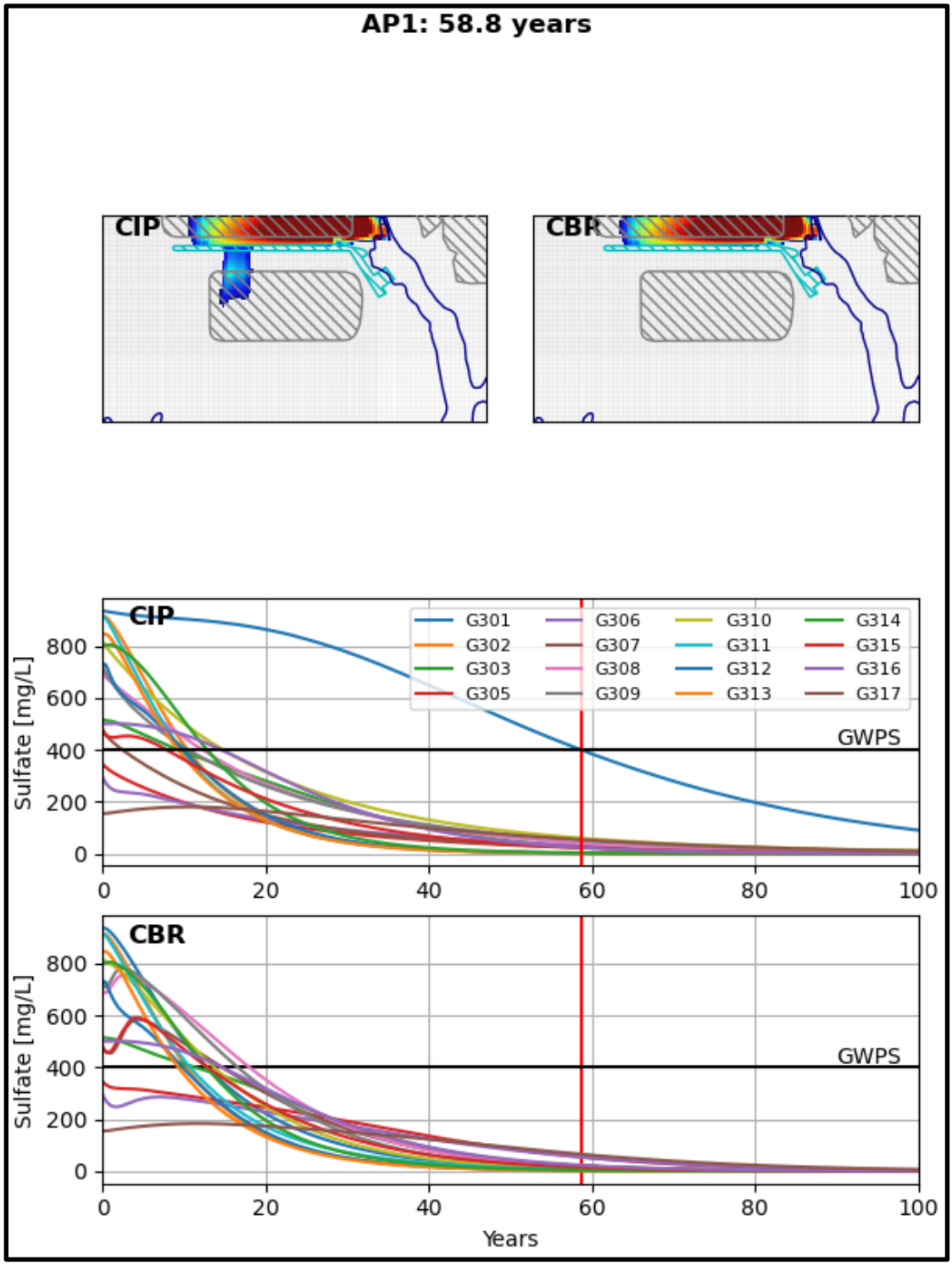
RAMBOLL



SIMULATED MAXIMUM EXTENT OF THE SULFATE PLUME FOR THE CIP AND CBR SCENARIOS AFTER 14.8 YEARS

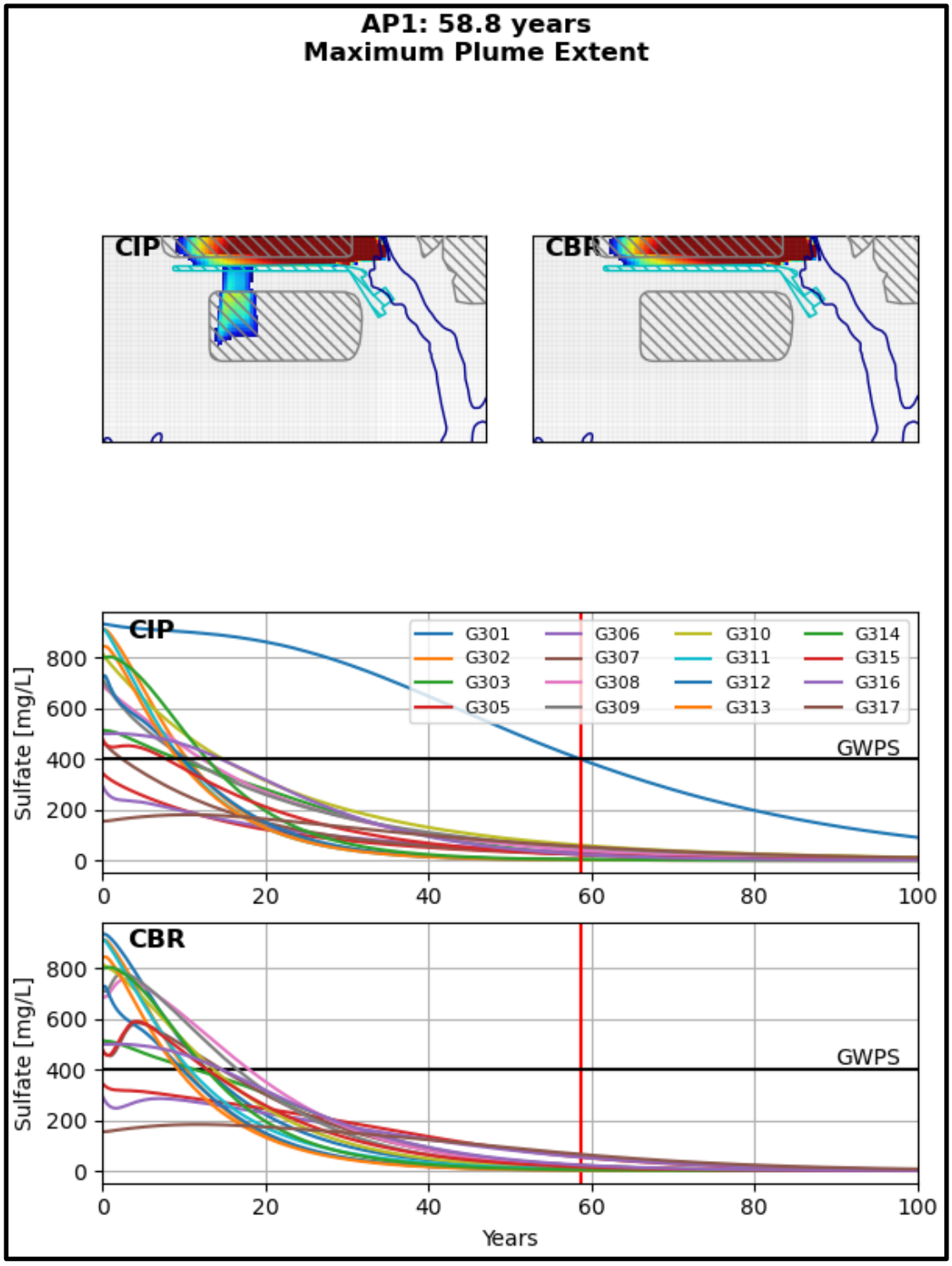
GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL



SIMULATED SULFATE PLUME OF THE UA FOR THE CIP AND CBR SCENARIOS AFTER 58.8 YEARS

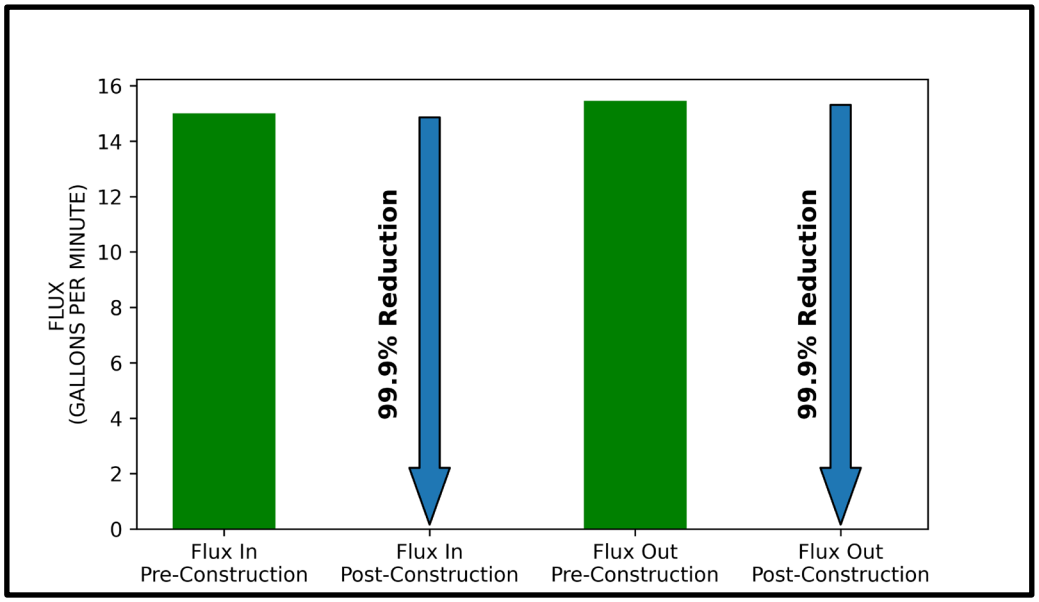
RAMBOLL



SIMULATED MAXIMUM EXTENT OF THE SULFATE PLUME FOR THE CIP AND CBR SCENARIOS AFTER 58.8 YEARS

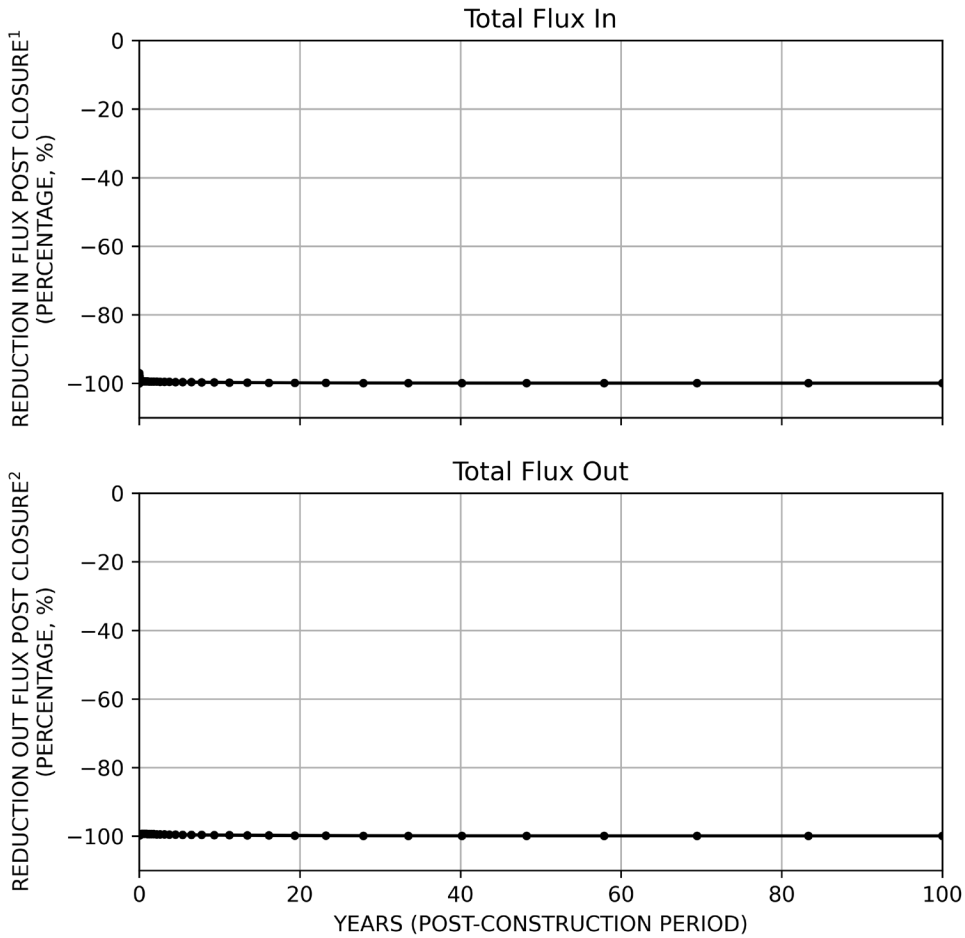
GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL



SCENARIO 1 (CIP) –
HYDRAULIC STEADY STATE REDUCTIONS IN TOTAL FLUX IN AND OUT OF FILL UNIT (CCR)

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS



[1] Reduction in flux in compared to flux in at the end of the calibration model (model period of 42 years). Reduction in flux in are expressed as negative percentages to illustrate decreases in flux over time.

[2] Reduction in flux out compared to flux out at the end of the calibration model (model period of 42 years). Reduction in flux out are expressed as negative percentages to illustrate decreases in flux over time.

SCENARIO 1 (CIP) –
REDUCTIONS IN TOTAL FLUX IN AND OUT OF FILL UNIT (CCR)

GROUNDWATER MODELING REPORT
ASH POND NO. 1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL

SITE FEATURE

LIMITS OF FINAL COVER

DIFFERENCE BETWEEN BOTTOM OF CCR AND SIMULATED GROUNDWATER SURFACE*
(FEET, POSITIVE VALUES INDICATE SEPARATION)

0 - 5
5.1 - 10
10.1 - 15
15.1 - 20
20.1 - 25
25.1 - 30

0 87.5 175 Feet

*GROUNDWATER SURFACE BASED ON SIMULATED CLOSURE IN PLACE SCENARIO AT HYDRAULIC STABILIZATION.

POTENTIAL ASH SATURATION SIMULATED CLOSURE IN PLACE GROUNDWATER SURFACE

COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 6-9

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

APPENDICES

APPENDIX A
EVALUATION OF POTENTIAL GWPS EXCEEDANCES

EVALUATION OF POTENTIAL GROUNDWATER PROTECTION STANDARD EXCEEDANCES

Coffeen Ash Pond No. 1
Coffeen, Illinois

Prepared for

Illinois Power Generating Company

Submitted by

Geosyntec consultants

engineers | scientists | innovators

1 McBride and Son Center Dr Suite 202
Chesterfield, Missouri 63005

July 5, 2022

GLP8029

TABLE OF CONTENTS

SECTION 1 Introduction 1-1
SECTION 2 Background 2-2
2.1 Site Location and Description 2-2
2.2 Ash Pond 1 Design 2-2
2.3 Geology and Hydrogeology 2-2
2.4 Groundwater and AP1 Monitoring 2-4
SECTION 3 Potential Groundwater Protection Standard Exceedance Review 3-1
SECTION 4 Lines of Evidence 4-1
4.1 LOE #1: AP1 porewater samples do not contain detectable concentrations of cobalt 4-1
4.2 LOE #2: Cobalt concentrations in ash samples collected from AP1 are comparable to or lower than cobalt concentrations in soil samples near AP1 4-2
4.3 LOE #3: Monitoring well G314 has experienced significant changes in oxidation-reduction (redox) conditions since well installation occurred, which may impact cobalt behavior in groundwater 4-2
4.4 LOE #4: AP1 porewater is slightly basic and would not result in low pH measurements at monitoring well G312 4-3
4.5 LOE #5: pH values within the proposed monitoring well network are strongly correlated with saturation indices of carbonate minerals in soil near AP14-4
SECTION 5 Conclusions 5-1
SECTION 6 References 6-2

LIST OF TABLES

Table 1 Cobalt Concentrations in Soil and Ash
Table 2 Summary of X-ray Diffraction Results

LIST OF FIGURES

Figure 1 Aqueous Cobalt Time Series
Figure 2 Oxidation-Reduction Potential (ORP) Time Series – Recently Installed Wells
Figure 3 G314 Eh-pH Diagram – Iron
Figure 4 pH Time Series
Figure 5 pH vs. Carbonate Saturation Indices

LIST OF APPENDICES

Appendix A Figure 2-1: Proposed 845 Groundwater Monitoring Well Network. From Groundwater Monitoring Plan, Ash Pond No. 1, Coffeen Power Plant Report.

Appendix B Figure 1-3: Uppermost Aquifer Groundwater Elevation Contours, April 20, 2021. From Groundwater Monitoring Plan, Ash Pond No. 1, Coffeen Power Plant Report.

LIST OF ACRONYMS AND ABBREVIATIONS

AP1	Ash Pond No. 1
AP2	Ash Pond No. 2
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
CPP	Coffeen Power Plant
DA	Deep Aquifer
DCU	Deep Confining Unit
IPGC	Illinois Power Generation Company
LCU	Lower Confining Unit
mg/L	Milligram per Liter
NID	National Inventory of Dams
ORP	Oxidation-Reduction Potential
QC	Quality Control
SI	Saturation Index
SU	Standard Units
TDS	Total Dissolved Solids
UA	Uppermost Aquifer
UCU	Upper Confining Unit
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

SECTION 1

INTRODUCTION

The Illinois Power Generation Company (IPGC) currently operates the Coffeen Power Plant (CPP) and its associated ash ponds. In October 2021, the IPGC submitted an Operating Permit application for the coal combustion residual (CCR) Unit referred to as the Ash Pond Number (No.) 1 (AP1), Vistra identification (ID) No. 101, IEPA ID No. W1350150004-01, and National Inventory of Dams (NID) No. IL50722 (Burns & McDonnell, 2021). The Operating Permit was prepared to comply with Part 845 "Standards of the Disposal of Coal Combustion Residuals in Surface Impoundments (Part 845), which was promulgated by the Illinois Pollution Control Board on April 21, 2021. Ramboll Americas Engineer Solutions, Inc. (Ramboll) identified potential groundwater protection standard (GWPS) exceedances for multiple constituents in groundwater samples collected from monitoring wells in the vicinity of AP1, as presented in the Operating Permit Application. This report was developed to further evaluate the potential GWPS exceedances identified.

SECTION 2

BACKGROUND

A brief description of the site location, AP1 design, geology, and groundwater assessment activities to date are described below.

2.1 Site Location and Description

The CPP, operated by the IPGC is located in Montgomery County, Illinois approximately two miles south of the City of Coffeen in Section 11, Township 7 North, and Range 7 East. The CPP is located between the two lobes of Coffeen Lake to the west, east, and south, and is bordered by agricultural land to the north. The CPP operated as a coal-fired power plant from 1964 to November 2019 and has five CCR management units. The approximately 1,100-acre Coffeen Lake was built by damming the McDavid Branch of the East Fork of Shoal Creek in 1963 for use as an artificial cooling lake for the CPP. Historically, coal mines were operated at depth in the vicinity of the CPP as well as a US Minerals processing facility located to the north. Mine shafts, processing facilities, and coal storage associated with these historical operations were located south of AP1.

2.2 Ash Pond 1 Design

Coffeen AP1 is a 23-acre, unlined surface impoundment used to manage CCR and non-CCR waste streams at the CPP. The location of AP1 relative to the proposed monitoring well network is displayed on Figure 2-1 of the Groundwater Monitoring Plan Report (Ramboll, 2021a) and is provided herein as **Appendix A**. AP1 (also known as the Bottom Ash/Recycle Pond) is a reclaimed ash pond that was constructed utilizing the existing earthen berms with reinforcement. AP1 is an unlined surface impoundment which covers an area of approximately 23 acres, has berms up to 41 feet above the surrounding land surface, and a capacity of 300 acre-feet. It primarily received bottom ash and low volume wastes from floor drains in the main power block building. Several years ago, air heater wash and boiler chemical cleaning wastes were directed to AP1, but this practice was discontinued. The bottom ash is periodically removed from AP1 for beneficial uses by a third-party contractor. Sluicing of waste to AP1 ceased prior to November 4, 2019.

2.3 Geology and Hydrogeology

The AP1 geologic and hydrogeologic setting summarized below is excerpted from the Hydrogeologic Site Characterization Report (HCR) for AP1 (Ramboll, 2021b).

There are five principal layers of unlithified material present below AP1 and above bedrock which are categorized into hydrostratigraphic units listed below (from the surface downward) based on stratigraphic relationships and hydrogeologic characteristics:

- **Upper Confining Unit (UCU):** Composed of the Roxana and Peoria Silts (Loess Unit) and the upper clayey portion of the Hagarstown member which are classified as silts-clayey silts and gravelly clay below the surficial soil. The UCU has been eroded east of AP1, near the Unnamed Tributary.

- **Uppermost Aquifer (UA):** The uppermost aquifer is the Hagarstown Member which is classified as primarily sandy-gravelly silts and clays with thin beds of sands. Similar to the Loess Unit, the Hagarstown is absent in some locations near the Unnamed Tributary.

- **Lower Confining Unit (LCU):** Comprised of the Vandalia Member, Mulberry Grove Member, and Smithboro Member. These units include a sandy-silty till with thin, discontinuous sand lenses, a discontinuous and limited extent sandy silt which has infilled prior erosional features, and silty-clayey diamicton, respectively. This unit has been identified as a potential migration pathway (PMP) because downward vertical gradients indicate that there is the potential for impacts to migrate within this unit.

- **Deep Aquifer (DA):** Comprised of sand and sandy silt/clay units of the Yarmouth Soil, which include accretionary deposits of fine sediment and organic materials, typically less than five feet thick and discontinuous across the CPP. This unit is also identified as a PMP, because it is the first permeable unit below the uppermost aquifer.

- **Deep Confining Unit (DCU):** Comprised of the Banner Formation, generally consisting of clays, silts, and sands. The Lierle Clay Member is the upper layer of the Banner Formation which was encountered at the Site.

Bedrock is comprised of the Bond Formation, which consists of limestone and calcareous clays and shale. Bedrock was not encountered in the borings advanced to date at CPP.

Flow of groundwater from central portions of the CPP to Coffeen Lake or the Unnamed Tributary through the UA are the primary pathways for contaminant migration. The LCU and DA underlying the UA have been identified as PMPs. Groundwater elevations are primarily controlled by surface topography, geologic unit topography, and water levels within Coffeen Lake and the Unnamed Tributary. A groundwater divide trending north-south is observed running through the approximate center of the CPP (Figure 1-3 of Ramboll [2021a], provided as **Appendix B**). Phreatic surfaces or water elevations within the surface impoundments are generally consistent and have

not been observed to fluctuate with groundwater elevations, indicating limited hydraulic connection with the surface impoundments.

2.4 Groundwater and AP1 Monitoring

The proposed Part 845 monitoring well network for AP1 was established in the Groundwater Monitoring Plan (Ramboll, 2021a). The proposed monitoring well network consists of sixteen (16) monitoring wells, which are installed in the UA, LCU, DA, and temporary water-level only surface water staff gages. Two of the installed wells are background monitoring wells (G281 and G306) and the remaining fourteen are compliance monitoring wells. Both background wells and most compliance wells are screened within the UA. G307D, G314, and G316 are screened within the LCU, and G314D is screened within the DA. Well locations are shown on **Appendix A**.

SECTION 3
POTENTIAL GROUNDWATER PROTECTION STANDARD EXCEEDANCE REVIEW

An evaluation of the history of potential GWPS exceedances was completed for the Operating Permit application in October 2021 (Burns & McDonnell, 2021). Groundwater concentrations from 2015 to 2021 were evaluated for potential exceedances in accordance with the Statistical Analysis Plan proposed in the Operating Permit application. Potential exceedances are summarized below:

- Boron at monitoring well G313: The boron statistical result at G313 is 3.5 milligrams per liter (mg/L), which exceeds the Part 845 GWPS (3.2 mg/L).

- Cobalt at monitoring well G314: The cobalt statistical result at G314 is 0.00959 mg/L which exceeds the Part 845 GWPS (0.006 mg/L).

- pH (field) at monitoring well G312: The pH statistical result at G312 is 6.4 standard units (SU), which is below the lower limit of the Part 845 GWPS (6.5/9.0 SU).

- Sulfate at monitoring wells G301, G303, G304, G305, G307, G307D, G308, G309, G310, G311, G312, G313, G314, G314D, G315, and G317: The sulfate statistical results ranged from 464 to 1100 mg/L and individually exceed their relevant Part 845 GWPS (400 to 700 mg/L) for the identified wells.

- Total dissolved solids (TDS) at monitoring wells G303, G304, G305, G307, G307D, G308, G309, G310, G311, G312, G313, G314, G315, and G317: The TDS statistical results ranged from 1210 to 1900 mg/L which exceed the Part 845 GWPS (1200 mg/L).

A review of groundwater, porewater, soil, and ash data indicates that the potential exceedances of cobalt at G314 and pH at G312 are not related to AP1, as documented in Section 4. An evaluation of alternative sources of the boron, sulfate, and TDS potential exceedances was not completed at this time.

SECTION 4
LINES OF EVIDENCE

A review of groundwater, porewater, soil, and ash data indicates that the potential GWPS exceedances of cobalt at G314 and the pH value at G312 are not related to AP1, as supported by the lines of evidence (LOE) below:

1. AP1 porewater samples do not contain detectable concentrations of cobalt.
2. Cobalt concentrations in ash samples collected from AP1 are comparable to or lower than cobalt concentrations in soil samples near AP1.
3. Monitoring well G314 has experienced significant changes in oxidation-reduction (redox) conditions since well installation occurred, which may impact cobalt behavior in groundwater.
4. AP1 porewater is slightly basic and would not result in low pH measurements at monitoring well G312.
5. pH values within the proposed monitoring well network are strongly correlated with saturation indices of carbonate minerals in soil near AP1.

4.1 LOE #1: AP1 porewater samples do not contain detectable concentrations of cobalt

Of the three AP1 porewater sampling locations analyzed for cobalt (AP1d, XPW01, and XPW02), none have ever contained cobalt concentrations above the method detection limit of 0.002 mg/L; therefore, cobalt concentrations detected at G314 cannot be derived from a mixing scenario between groundwater and AP1 porewater. In contrast, both background monitoring wells have at times contained cobalt concentrations within the range observed at G314. This indicates that aqueous cobalt is naturally present in groundwater at CPP at variable concentrations.

Figure 1 displays cobalt concentrations over time for G314, background wells G306 and G281, and porewater samples from AP1. Cobalt concentrations at G314 display an increasing trend, but this trend is punctuated by a concentration decrease in the most recent sampling event. The highest values at G314 are comparable to or lower than select results observed at background well G306, suggesting there is variability within the aquifer.

4.2 LOE #2: Cobalt concentrations in ash samples collected from AP1 are comparable to or lower than cobalt concentrations in soil samples near AP1

Soil samples were collected in May 2021 and September 2021 adjacent to select existing monitoring wells and analyzed for total metals. Cobalt concentrations in soil are displayed in **Table 1** along with total cobalt concentrations in ash material collected from AP1. Cobalt concentrations in ash from AP1 (4.3 – 4.8 mg/kg) fall within the range of cobalt concentrations observed in CPP soil (4.0 – 10 mg/kg). Cobalt concentrations in soil are highest at Ash Pond No.2 (AP2) background monitoring well G270, which is in a background location relative to AP1 (**Appendix B**). **Table 1** indicates variability in cobalt concentrations detected in soil across the CPP. Three sample locations (two background locations and one compliance location) contained greater cobalt concentrations than ash samples, indicating that naturally occurring cobalt exists in solid phase across the CPP at equivalent or greater concentrations than within AP1 itself.

4.3 LOE #3: Monitoring well G314 has experienced significant changes in oxidation-reduction (redox) conditions since well installation occurred, which may impact cobalt behavior in groundwater

Groundwater oxidation-reduction potential (ORP) was measured as a field parameter during the sample collection process at monitoring wells in the proposed network. ORP is a measure of the redox conditions of water which, along with other parameters like pH, temperature, and chemical composition, govern the stability of minerals comprising groundwater aquifer solids. ORP values over time at recently installed compliance monitoring wells are displayed on **Figure 2**. ORP values for recently installed wells display a decreasing trend, indicating a shift from highly oxic to near reducing conditions. This decreasing trend is hypothesized to be attributable to stabilization of the new wells following the potential introduction of drilling water involved in the well installation process. Such a change in geochemical conditions can influence the stability of redox-sensitive mineral phases such as iron and manganese oxides. Significantly, decreases in ORP are commonly correlated with dissolution of iron and manganese bearing minerals, leading to the release of ions associated with these mineral phases.

Cobalt is known to undergo isomorphic substitution for iron in crystalline iron minerals such as iron oxides, iron sulfides, and iron carbonates due to the similar ionic radii of approximately 1.56 angstroms (Å) for iron vs. 1.52 Å for cobalt (Clementi and Raimondi, 1963; Krupka and Serne, 2002; Hitzman et al., 2017). Soil samples around AP1 were collected and submitted for mineralogical analysis via X-ray diffraction (XRD) to determine the mineralogical composition of the natural aquifer material. XRD results are shown in **Table 2**. **Table 2** indicates that the majority component of site soils consists of geochemically inert minerals quartz and feldspar (microcline and albite). No iron oxides or iron sulfides were detected in XRD analysis, but iron-bearing carbonate mineral ankerite ($Ca,Fe(CO_3)_2$) was detected at a maximum abundance of 7.7 wt.%.

An Eh-pH diagram displaying the thermodynamic stability of iron phases was generated using the average composition of G314 groundwater (**Figure 3**). Geochemical conditions during initial sampling events favored thermodynamic stability of the ferric (Fe^{3+}) iron hydroxide mineral $Fe(OH)_3$; however, no iron hydroxide or oxide minerals were present in XRD results above the detection limit of 0.5%. **Figure 3** indicates G314 groundwater conditions have shifted in recent sampling events, favoring the formation of ferrous (Fe^{2+}) carbonate mineral siderite ($FeCO_3$). The modeled shift of thermodynamic stability away from iron hydroxide and oxide minerals and towards iron carbonates would result in the release of iron and isomorphically substituted cobalt into groundwater through mineral dissolution reactions.

While siderite was not detected in the XRD results, iron-bearing carbonate mineral ankerite was detected at abundances of up to 7.7 wt.%. Ankerite exists in nature as a solid-solution mineral without a fixed mineral formula. As a result, accurate thermodynamic information is not available for modeling purposes and ankerite was consequently not included in the thermodynamic database used to generate **Figure 3**. It is likely that ankerite thermodynamic stability is favored over siderite stability at G314 and the ankerite detected in XRD analyses is a product of the formation of carbonate minerals in an iron-rich environment.

Naturally occurring cobalt is known to substitute for iron in iron-bearing minerals. Thermodynamic modeling indicates that a recent trend in redox conditions has resulted in a mineral stability shift from iron hydroxides and oxides towards iron carbonates. The presence of ankerite, an iron-bearing carbonate mineral, has been confirmed across the site. The modeled dissolution of iron hydroxide and oxide minerals may have resulted in isomorphically substituted cobalt being released from the crystal structure of these minerals and entering groundwater. The presence of observed iron carbonate minerals in soil samples supports the occurrence of this mineralogical shift.

4.4 LOE #4: AP1 porewater is slightly basic and would not result in low pH measurements at monitoring well G312

Groundwater pH conditions were measured as a field parameter during the sample collection process at monitoring wells within the proposed monitoring well network. A time series plot of field pH measurements at G312, background wells G281 and G306, and AP1 porewater monitoring locations XPW-01 and XPW-02 is provided as **Figure 4**. Groundwater at monitoring well G312 contains pH levels below the calculated lower GWPS for pH of 6.5 SU. Low pH values at G312 cannot be attributed to AP1, because AP1 porewater samples are consistently slightly basic (pH values range from 7.78-8.08). Physical mixing of AP1 porewater with G312 groundwater would result in an increase in pH at G312. In contrast, pH values at background well G306 were occasionally measured at 6.5 SU, which is within the range of measurements observed

at G312. Therefore, low pH conditions at G312 are attributable to natural variability within the aquifer.

4.5 LOE #5: pH values within the proposed monitoring well network are strongly correlated with saturation indices of carbonate minerals in soil near AP1

As mentioned in Section 4.3, composite soil samples from various locations surrounding AP1 were collected and submitted for mineral identification analysis via XRD (**Table 2**). Soil surrounding AP1 contains variable abundances of carbonate minerals such as calcite, dolomite, and ankerite, with the total abundance of carbonates at each location ranging an order of magnitude from 2.7-27.5 wt.%. Carbonate minerals in nature function as pH buffers, capable of neutralizing acidity through reaction with carbonate (CO_3) (Drever, 1988). pH levels at individual wells may be significantly influenced by the presence and abundance of carbonate minerals comprising localized sections of the aquifer unit. Although soil samples were not collected for all wells of interest, carbonate saturation indices (SIs) provide a method to assess the role of carbonate minerals in soil buffering capacity in the absence of XRD results.

United States Geologic Survey (USGS) software package PHREEQC was used to calculate SIs of carbonate minerals at G312 and background wells G281 and G306 based on groundwater compositions. A mineral's SI is an expression of its thermodynamic equilibrium state relative to a liquid (groundwater). If the calculated SI for a mineral is negative, then that mineral is undersaturated relative to groundwater and is thermodynamically favored to dissolve. If the calculated SI for a mineral is positive, then that mineral is supersaturated relative to groundwater and is thermodynamically favored to precipitate. If a mineral's SI is approximately 0 (+\- 0.2), then the mineral is in thermodynamic equilibrium with groundwater. SIs for calcite ($CaCO_3$) and dolomite ($Ca,Mg(CO_3)_2$) were plotted against pH for individual samples (**Figure 5**). **Figure 5** demonstrates a strong positive correlation between pH and carbonate SI. pH values tend to be lower in groundwater that is undersaturated with respect to carbonate minerals. This relationship is expected – monitoring wells which favor carbonate dissolution are likely to contain less carbonate in the solid phase. Absence of carbonate in localized portions of the aquifer results in the inability of these locations to buffer low pH groundwater. According to **Figure 5**, background wells G281 and G306 are near equilibrium or supersaturated with respect to carbonate minerals and are likely to have these minerals present and stable. These wells would then have greater capability to buffer acidic water and retain near-neutral pH values. G312 was not sampled for mineralogy, although **Figure 5** demonstrates that groundwater from this well is undersaturated with respect to carbonate minerals, suggesting that large abundances of carbonate are not likely to be present in aquifer solids at this location.

XRD analyses indicate carbonate mineral abundances around AP1 vary up to an order of magnitude (**Table 2**). Evaluation of carbonate SIs reveals that a strong correlation exists between

carbonate SIs and pH. G312 is undersaturated with respect to calcite and dolomite; therefore, these minerals are likely not present as pH buffers, resulting in lower groundwater pH values where acid neutralizing minerals are not available.

SECTION 5

CONCLUSIONS

Based on these five LOEs, it has been demonstrated that AP1 is not the source of the potential cobalt and pH exceedances identified.

1. AP1 porewater samples do not contain detectable concentrations of cobalt, whereas cobalt concentrations in background well G306 occasionally exceed the relevant GWPS.

2. Cobalt concentrations in ash samples collected from AP1 are comparable to or lower than cobalt concentrations in soil samples from downgradient and background monitoring wells.

3. Monitoring well G314 has experienced significant changes in oxidation-reduction (redox) conditions since well installation occurred, which may cause destabilization of iron-bearing minerals capable of hosting cobalt ions in their crystal structure.

4. AP1 porewater is slightly basic and would not result in low pH measurements at monitoring well G312.

5. pH values within the proposed monitoring well network are strongly correlated with saturation indices of carbonate minerals which are detected at variable abundances across soil near AP1.

SECTION 6

REFERENCES

Burns & McDonnell. 2021. Initial Operating Permit – Coffeen Ash Pond No. 1. October.

Clementi, E., and Raimdoni, D. L. 1963. Atomic screening constants from SCF functions. *J. Chem. Phys.,* 38, 2686.

Drever, J. 1988. *The Geochemistry of Natural Waters*. Englewood Cliffs, N.J: Prentice Hall.

Hitzman, M.W., Bookstrom, A.A., Slack, J.F., and Zientek, M.L., 2017. Cobalt – Styles of Deposits and the Search for Primary Deposits. USGS Open File Report 2017-1155.

Krupka, K.M. and Serne, R.J., 2002. Geochemical Factors Affecting the Behavior of Antimony, Cobalt, Europium, Technetium, and Uranium in Vadose Sediments. Pacific Northwest National Lab, PNNL-14126. December.

Ramboll. 2021a. Groundwater Monitoring Plan, Ash Pond No.1, Coffeen Power Plant, Coffeen, Illinois. October.

Ramboll. 2021b. Hydrogeologic Site Characterization Report, Ash Pond No. 1, Coffeen Power Plant, Coffeen, Illinois. October.

TABLES

Table 1: Cobalt Concentrations in Soil and Ash
Coffeen Power Plant - Ash Pond No. 1

Sample Location	Description	Sample Depth (feet)	Cobalt (mg/kg)
G270	Background	16-20	10
G306	Background	14-16	6.0
G311	Compliance	14-15	4.0
G313	Compliance	8-9	7.0
G316	Compliance	13-16	4.0
XPW01	Ash Pond 1	NA	4.8
XPW02	Ash Pond 1	NA	4.3

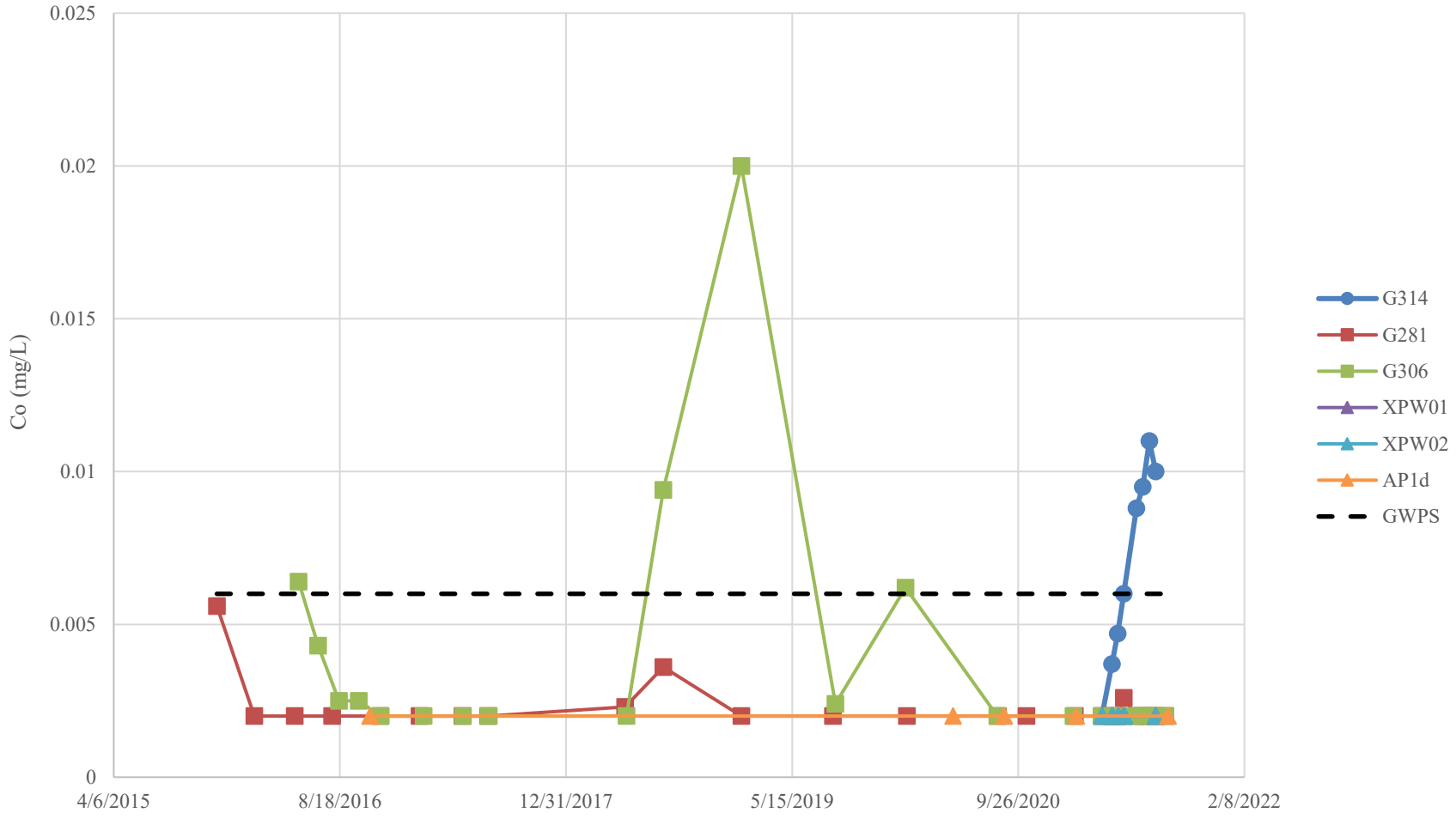
Notes:
Soil samples were composite samples collected over the indicated depth range

Table 2: Summary of X-ray Diffraction Results *Geosyntec Consultants, Inc.*
Coffeen Power Plant - Ash Pond No. 1

Sample ID	**SB-306**	**SB-311**	**SB-313**	**SB-316**
Sample Depth (ft.) / **Mineral**	14-16	14-15	8-9	13-16
Quartz	70.9	58.9	51.3	67.6
Microcline	8.5	7.4	7.6	9.8
Albite	9.6	8.6	7.9	9.6
Chlorite	1.8	1.7	1.1	1.7
Diopside	3.1	3.8	4.6	1.3
Muscovite	-	-	-	7.3
Carbonate Minerals				
Calcite	0.5	2.5	4.1	-
Dolomite	3.5	12.1	15.7	1.9
Ankerite	2.1	5	7.7	0.8
Carbonate Total	*6.1*	*19.6*	*27.5*	*2.7*

Notes:
Results presented in units of weight %
- : Mineral was not detected in sample
Weight % quantities have been normalized to a sum of 100% to remove reporting of amorphous material
Carbonate total consists of calcite, dolomite, and ankerite

FIGURES



Notes: Data displayed for compliance well G314, background wells G281 and G306, and pore water samples XPW01, XPW02, and AP1d. The calculated Groundwater Protection Standard (GWPS) is indicated by the dashed line. Samples which did not contain cobalt concentrations above the method detection limit of 0.002 mg/L are displayed on the figure as having a detected concentration of 0.002 mg/L.

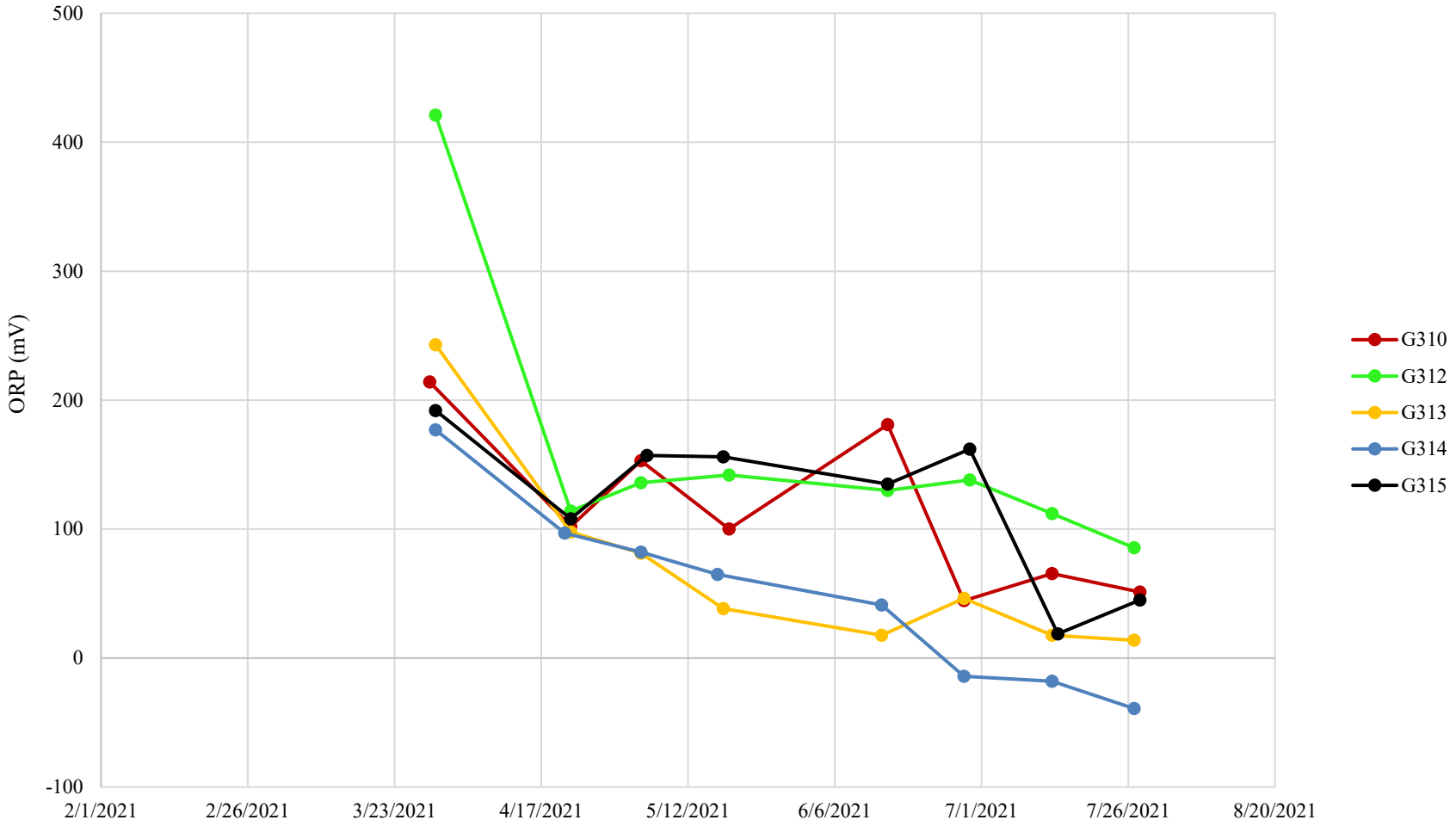
Aqueous Cobalt Time Series

Coffeen Power Plant

Geosyntec consultants

Columbus, OH | April 2022

Figure 1



Notes: Groundwater monitoring began at all wells displayed in March 2021. Positive ORP values are considered indicative of oxic environments, and negative ORP values are considered indicative of anoxic environments.

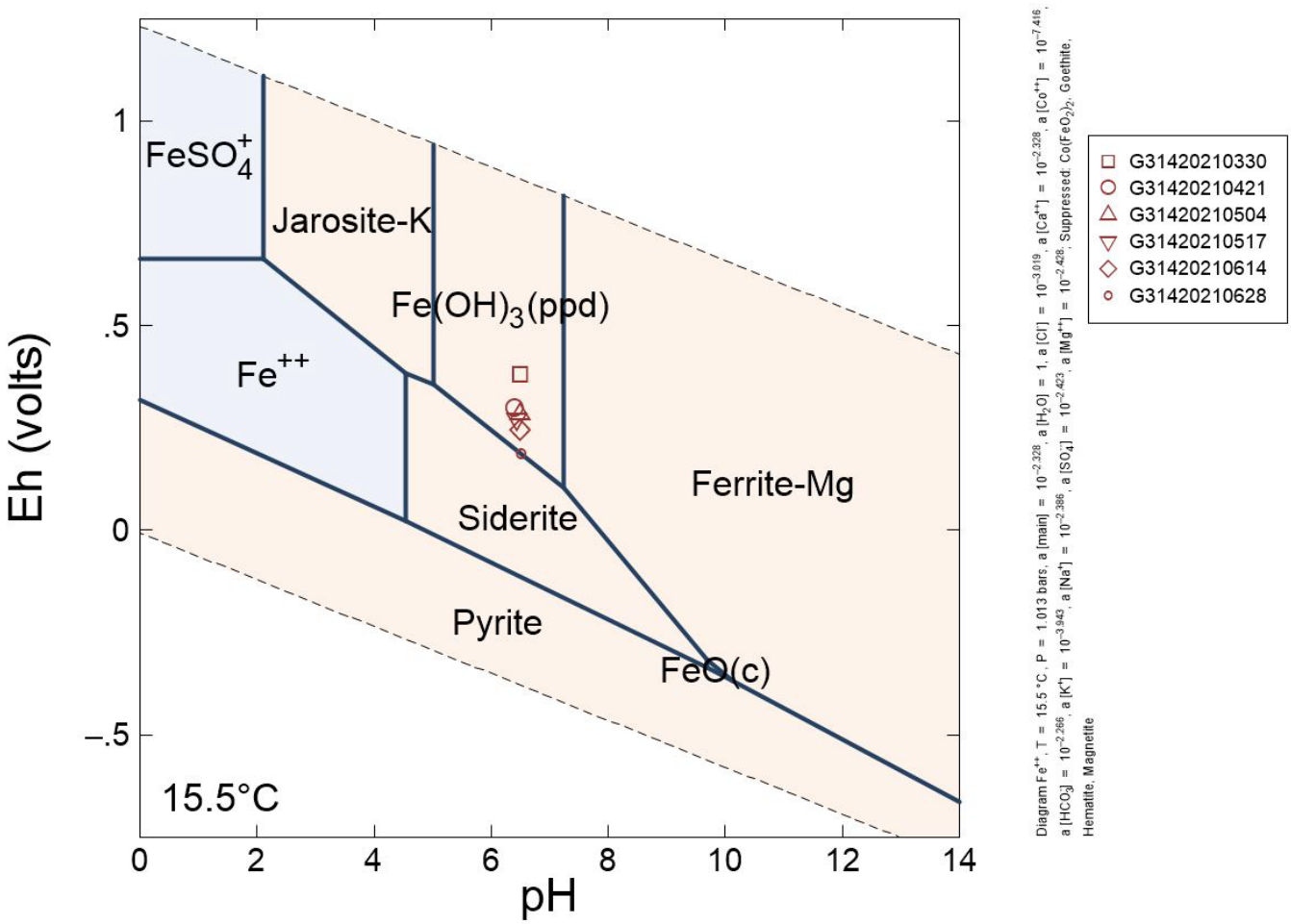
Oxidation-Reduction Potential (ORP) Time Series – Recently Installed Wells

Coffeen Power Plant

Geosyntec consultants

Columbus, OH | April 2022

Figure **2**



Notes: The average groundwater composition of compliance monitoring well G314 was used to establish baseline conditions for the diagram. Eh and pH values for sampling dates at G314 are shown on the diagram. Fe-oxide phases hematite, goethite, and magnetite were suppressed to reflect detected mineralogy from XRD analysis.

G314 Eh-pH Diagram - Iron

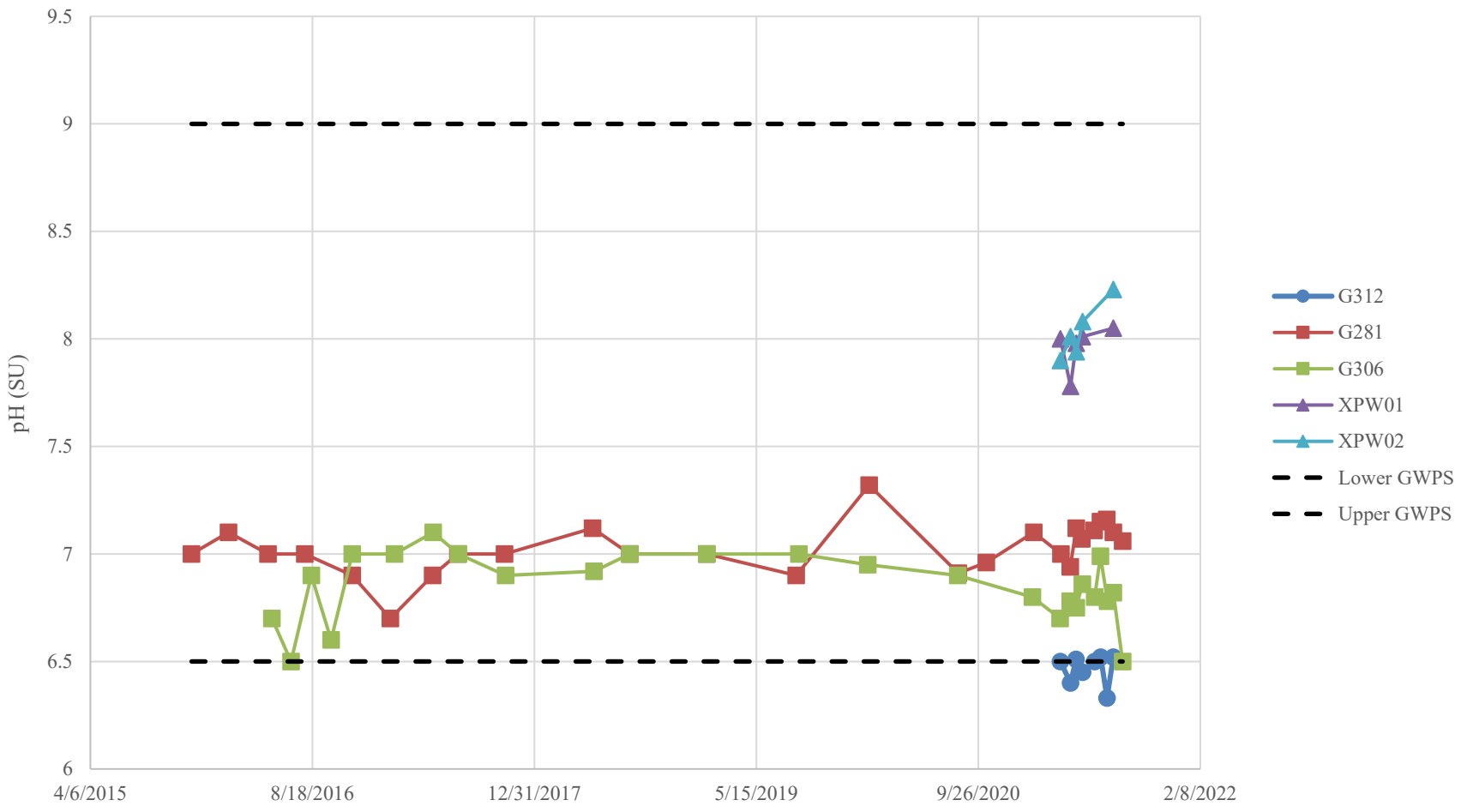
Coffeen Power Plant

Geosyntec consultants

Columbus, Ohio | April 2022

Figure 3

internal info: path, date revised, author



Notes: Data displayed for compliance well G312, background wells G281 and G306, and pore water samples XPW01 and XPW02. The calculated GWPS for the upper and lower pH values are indicated by dashed lines.

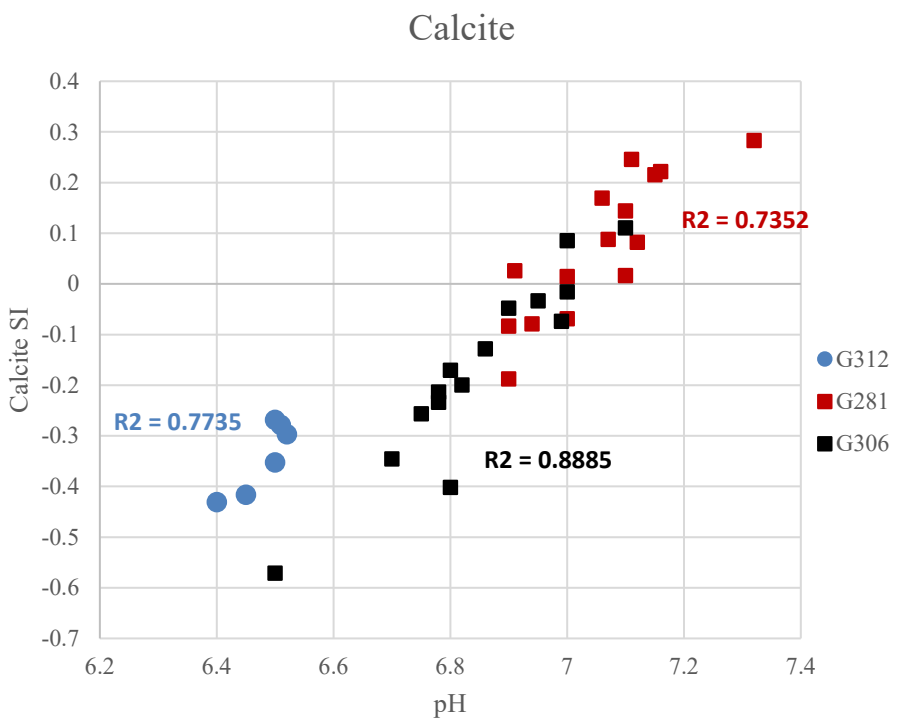
pH Time Series

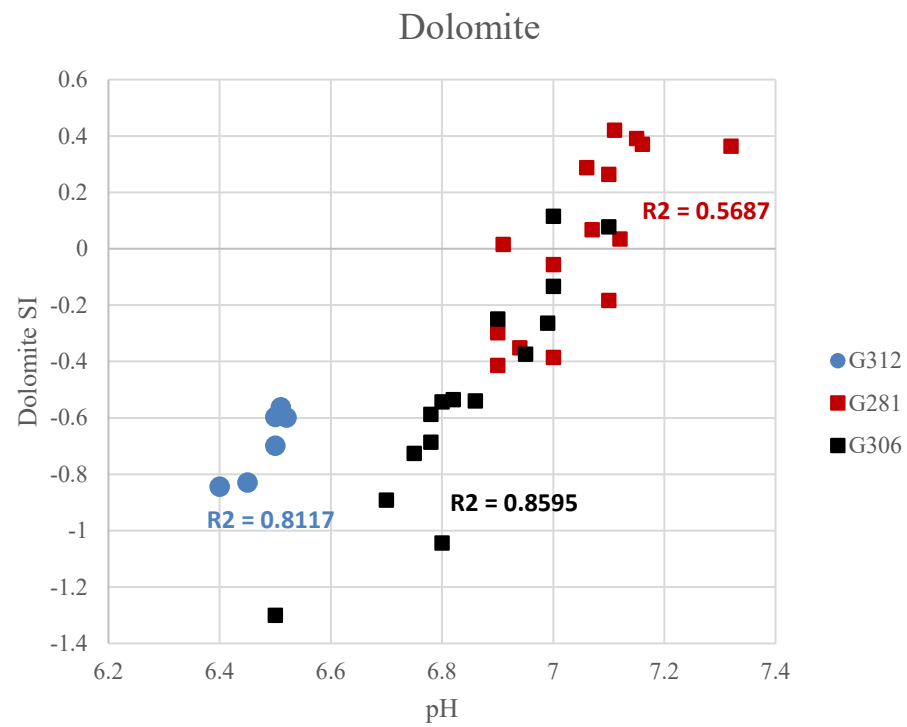
Coffeen Power Plant

Geosyntec consultants

Columbus, OH | April 2022

Figure **4**





Notes: Saturation indices (SIs) were calculated using PHREEQC based on groundwater composition and geochemical characteristics. R^2 values for linear trendlines for each individual well are displayed.

pH vs. Carbonate Saturation Indices

Coffeen Power Plant

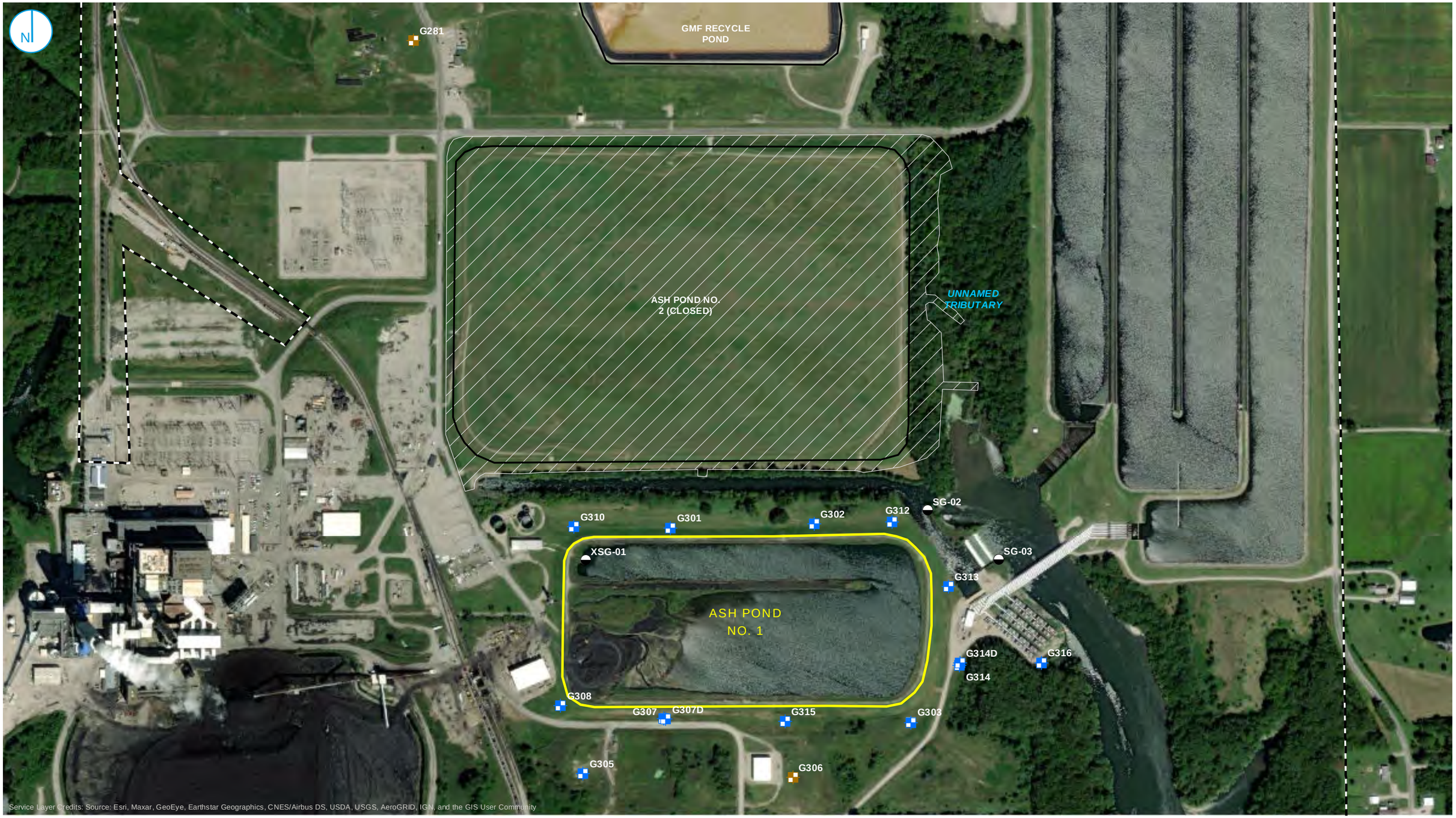
Geosyntec consultants

Columbus, OH | April 2022

Figure 5

APPENDIX A

Figure 2-1: Proposed 845 Groundwater Monitoring Well Network. From Groundwater Monitoring Plan, Ash Pond No. 1, Coffeen Power Plant



Y:\Mapping\Projects\22\2285\MXD\845_Operating_PermitCoffeen\AP1\GMP\Figure 2-1_Proposed Monitoring Well Network.mxd

PROJECT: 169000XXXX | DATED: 10/12/2021 | DESIGNER: HOTCALD

COMPLIANCE WELL
BACKGROUND WELL
STAFF GAGE

PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

0 200 400 Feet

PROPOSED 845 GROUNDWATER MONITORING WELL NETWORK

GROUNDWATER MONITORING PLAN
ASH POND NO.1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

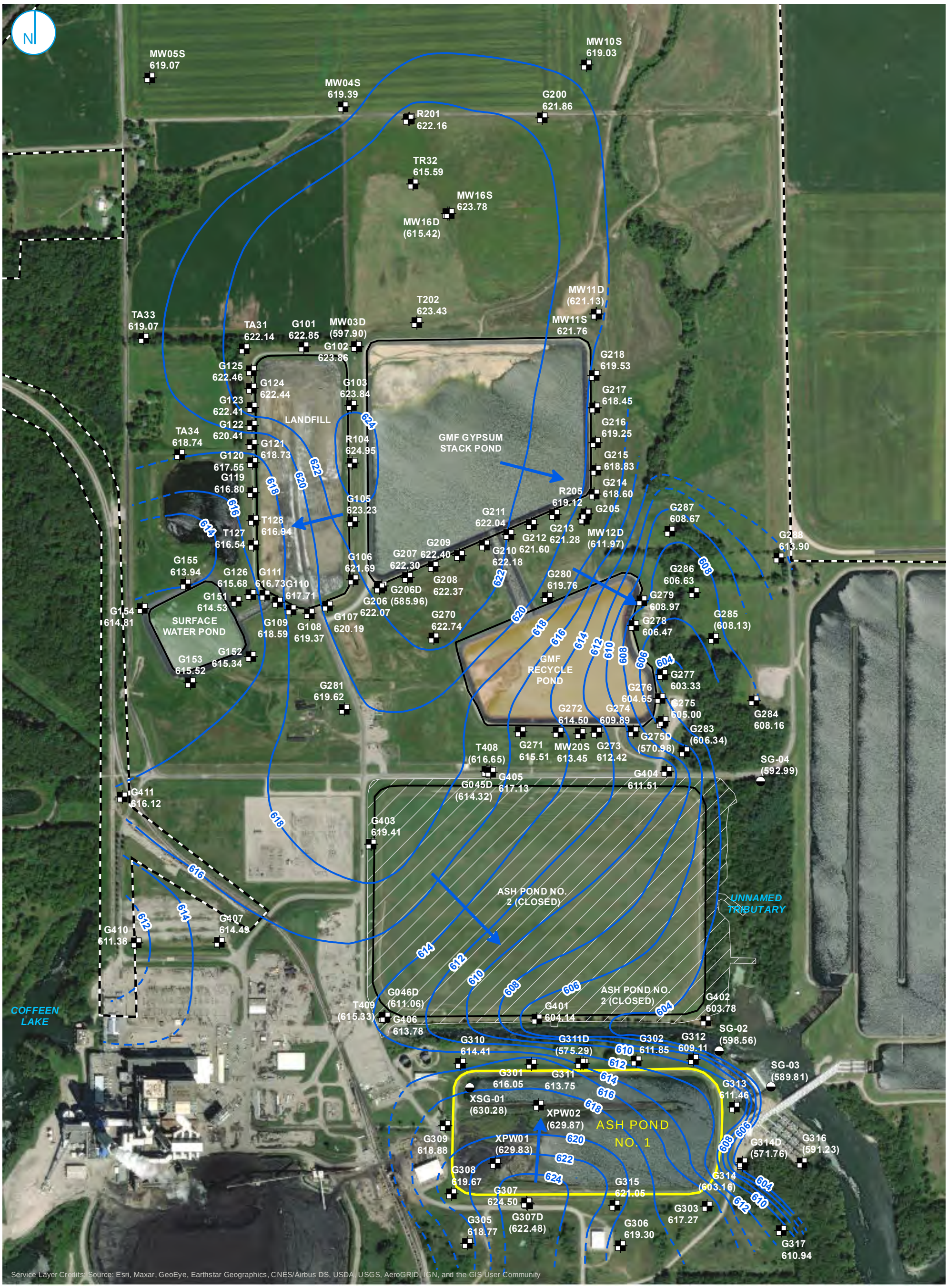
FIGURE 2-1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

APPENDIX B

Figure 1-3: Uppermost Aquifer Groundwater Elevation Contours, April 20, 2021. From Groundwater Monitoring Plan, Ash Pond No. 1, Coffeen Power Plant



MONITORING WELL
STAFF GAGE
PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
INFERRED GROUNDWATER ELEVATION CONTOUR
GROUNDWATER FLOW DIRECTION

0 275 550 Feet

NOTE:
ELEVATIONS IN PARENTHESES WERE NOT USED FOR CONTOURING.

UPPERMOST AQUIFER GROUNDWATER ELEVATION CONTOURS APRIL 20, 2021

GROUNDWATER MONITORING PLAN
ASH POND NO.1
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 1-3

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL

APPENDIX B
MODFLOW, MT3DMS, HELP MODEL, AND FLUX EVALUATION DATA EXPORT FILES (ELECTRONIC ONLY)

APPENDIX C
EVALUATION OF PARTITION COEFFICIENT RESULTS

Geosyntec consultants

1 McBride and Son Center Drive, Suite 202
Chesterfield, MO 63005
www.geosyntec.com

Memorandum

Date:	July 5, 2022
To:	David Mitchell, Stu Cravens, Vic Modeer Illinois Power Generating Company
Copies to:	Brian Hennings - Ramboll
From:	Allison Kreinberg, Ryan Fimmen – Geosyntec Consultants, Inc.
Subject:	Evaluation of Partition Coefficient Results – Coffeen Ash Pond No. 1 CCR Unit 101, Coffeen Power Plant, Coffeen, Illinois

INTRODUCTION

The Illinois Power Generation Company (IPGC) currently operates the Coffeen Power Plant (CPP) and its associated ash ponds located in Coffeen, Illinois. Ash Pond Number (No.) 1 (AP1) (Vistra identification (ID) No. 101; Illinois Environmental Protection Agency [IEPA] ID No. W1350150004-01; National Inventory of Dams [NID] No. IL50722) is a 23-acre, unlined SI used to manage CCR (bottom ash) and non-CCR waste streams at the CPP in accordance with the plant's Water Pollution Control Permit 1978-EA-389 issued by the Agency on May 26, 1978. Geosyntec Consultants (Geosyntec) is assisting IPGC with Part 845 compliance at the Site.

IPGC is currently preparing a Construction Permit application for AP1 as required under Section 845.220. As part of the Construction Permit application, groundwater modeling is being completed for known potential exceedances of groundwater protection standards (GWPS) identified in the Operating Permit (Burns & McDonnell, 2021). In the Operating Permit (October 2021), Burns & McDonnell identified potential GWPS exceedances for several compounds potentially associated with AP1, including boron, cobalt, pH (field), sulfate, and total dissolved solids (TDS). An evaluation of potential exceedances of applicable GWPS found that both cobalt and pH potential exceedances are not related to AP1 (Geosyntec, 2022). Batch adsorption testing was conducted for boron and sulfate to generate site-specific partition coefficients. This technical memorandum summarizes the results of the batch adsorption testing and calculation of partition coefficients.

BATCH ATTENUATION TESTING

In 2021, Geosyntec conducted a field investigation at AP1 which included completion of four (4) soil/rock borings ranging in depth from 13 to 18 feet below ground surface. As part of that investigation, soil and groundwater samples were submitted to SiREM Laboratories (Guelph, ON) for batch solid/liquid partitioning testing. A summary of the soil samples used for the batch testing is provided in **Table 1**.

Two groundwater samples (G311 and G313) and three soil samples (SB-306, SB-311, and SB-313) were used for batch attenuation testing at five (5) soil:solution ratios (**Table 1**), each ran in duplicate. For each treatment, 0.1 L of groundwater was brought into contact with varying amounts of soil (0.004 to 0.2 kg, depending on the ratio) and equilibrated over a seven-day period. Each microcosm was amended (i.e., spiked) with sodium sulfate (Na_2SO_4), and the microcosms with G313 groundwater were also amended with boric acid (H_3BO_3), to achieve a target concentration of sulfate and boron, respectively (**Table 2**). The G311 microcosm was not amended with boric acid because potential boron exceedances were not identified in the vicinity of G311. G313 groundwater was combined with aquifer solids both adjacent to downgradient location G311 and background location G306 to understand how partitioning behavior may be affected by position relative to AP1.

An initial sample of the stock solution for each experimental design was collected on Day 0, and a control sample (i.e., only amended G311 or G313 groundwater with no aquifer solids) was collected on Day 7 after tumbling in polypropylene bottleware to evaluate any loss to interactions with the bottleware or ambient conditions. Duplicates were constructed for each microcosm, including the control samples. After seven days of contact time, an aliquot of the free liquid was collected and filtered through a 0.45 micron (µm) filter prior to analysis for dissolved concentrations of sulfate and/or boron. The oxidation/reduction potential (redox) and pH were measured for each batch test at the beginning and end of the contact period and in the control samples.

Data obtained from the tests (**Tables 3** and **4**) were used to construct isotherms for boron and sulfate; 5-point isotherms were constructed by averaging duplicate results for each soil:solution ratio. Mathematical fitting was used to calculate the attenuation distribution coefficients (K_d), assuming linear adsorption. The linear adsorption equation was used:

$$q_e = K_d \times C_e \qquad \text{Eq. 1}$$

where q_e is the mass of constituent adsorbed to the solid phase at equilibrium, C_e is the remaining aqueous constituent concentration at equilibrium, and K_d is the linear sorption coefficient (reported in liters per kilogram [L/kg]). Some of the data showed a deviation from a linear trend, and so were also fitted using non-linear isotherms. The non-linear Langmuir isotherm was used:

$$q_e = \frac{q_m K_L C_e}{1 + K_L C_e} \qquad \text{Eq. 2}$$

where q_m is the inverse of the slope and K_L is the Langmuir distribution coefficient. The adsorption data were linearized according to:

$$\frac{C_e}{q_e} = \frac{1}{(K_L \times q_m)} + \frac{C_e}{q_m} \qquad \text{Eq. 3}$$

A common non-linear Freundlich equation was also used:

$$q_e = K_F (C_e)^{1/n} \qquad \text{Eq. 4}$$

where q_e is the mass of constituent adsorbed to the solid phase at equilibrium, C_e is the remaining aqueous constituent concentration at equilibrium, K_F is the Freundlich distribution coefficient, and $1/n$ is a non-linearity constant. The adsorption data were plotted as log-transformed values to perform the non-linear isotherm fitting using the linearized Freundlich equation:

$$log(q_e) = \log(K_F) + (1/n)\log(C_e) \qquad \text{Eq. 5}$$

The calculated linear, Langmuir, and Freundlich distribution coefficients (K_d, K_L, and K_F, respectively) and $1/n$ values are shown in **Tables 5** and **6**.

SUMMARY OF RESULTS

The partition coefficient values for G311 and G313 (denoted below as G313/SB-306 when combined with SB-306 geologic material and G313/SB-313 when combined with the SB-313 geologic material) are presented in **Tables 5** and **6**, respectively. Figures which show the linear, Langmuir, and Freundlich isotherms for boron and sulfate are provided in **Appendix A**.

A boron partition coefficient was not calculated for G311, since the microcosm was not amended with boric acid because potential boron exceedances were not identified in the vicinity. The Freundlich isotherm fit the data best for G313/SB-306 and G313/SB-313, yielding K_F values of 0.65 L/kg and 2.03 L/kg, respectively. Though slightly higher at G313/SB-313, these values are comparable to boron partition coefficients reported in the literature, which range from 0.19 to 1.3 L/kg depending on pH conditions and the amount of sorbent present (EPRI, 2005; Strenge & Peterson, 1989).

The G311 partition coefficient for sulfate ranged from -624 L/kg for the Langmuir isotherm to 10.11 L/kg for the linear isotherm, but the best-fitting Freundlich isotherm yielded a low K_F value of 9.2×10^{-12} L/kg. None of the isotherms showed a high goodness-of-fit (i.e., R^2) for either G313/SB-306 or G313/SB-313, with the highest correlation being 0.51, and were associated with erroneously high (1700 L/kg) and low (-690 L/kg) partition coefficients. An accurate sulfate

partition coefficient could therefore not be calculated from any of the data. These results are consistent with the findings of Strenge and Peterson (1989), who found that partition coefficients for sulfate are 0.0 L/kg, regardless of pH conditions and the amount of sorbent present.

REFERENCES

EPRI, 2005. *Chemical constituents in coal combustion product leachate: boron. Final Report 1005258.*

Burns & McDonnell. 2021. Initial Operating Permit Coffeen GMF Recycle Pond. October

Strenge, D. and Peterson, S. 1989. Chemical Data Bases for the Multimedia Environmental Pollutant Assessment System (MEPAS) (No. PNL-7145). Pacific Northwest National Laboratory, Richland, WA (USA).

Geosyntec. 2022. Evaluation of Potential Groundwater Protection Standard Exceedances. Coffeen Ash Pond No. 1. Coffeen, Illinois. May

TABLES

Table 1 - Batch Attenuation Testing Data Summary
Coffeen AP1

Geosyntec Consultants

Groundwater Sample ID	Soil Sample ID	Soil: Water Ratio
G311	SB-311 (14-15 ft bgs)	2:1.4
		1:1.3
		1:5.7
		1:11.3
		1:27.8
G313	SB-306 (14-16 ft bgs)	2:1.5
		1:1.3
		1:6.0
		1:11.7
		1:28.8
G313	SB-313 (8-9 ft bgs)	2:1.5
		1:1.3
		1:6.0
		1:11.7
		1:28.8

Notes:

ft bgs = feet below ground surface

Table 2 - Microcosm Amendment and Target Concentrations
Coffeen AP1

Groundwater Sample ID	Soil Sample ID	Compound	Amendment	Target Concentration (mg/L)
G311	SB-311 (14-15 ft bgs)	Boron	--	--
		Sulfate	2.76 g of Na_2SO_4	1500
G313	SB-306 (14-16 ft bgs)	Boron	19.73 mL of a 2 g/L H_3BO_3	5
		Sulfate	1.98 g of Na_2SO_4	1500
G313	SB-313 (8-9 ft bgs)	Boron	19.73 mL of a 2 g/L H_3BO_3	5
		Sulfate	1.98 g of Na_2SO_4	1500

Notes:
ft bgs - feet below ground surface
mg/L - milligrams per liter
Na_2SO_4 - sodium sulfate
H_3BO_3 - boric acid

Table 3 - Batch Attenuation Testing Results, G311
Coffeen AP1

Groundwater Sample ID	Geologic Material Sample ID	Treatment	Date	Day	Replicate	Dissolved Sulfate	pH	ORP
						mg/L	SU	mV
G311	--	Groundwater Only Control	25-Jan-22	0	G311-1a	1,589	6.83	-62
					G311-2a	1,826	6.88	-66
					Average Concentration (mg/L)	**1,708**	**6.86**	**-64**
			1-Feb-22	7	G311-1	1,617	6.85	42
					G311-2	1,478	6.85	38
					Average Concentration (mg/L)	**1,548**	**6.85**	**40**
	G311 SB-311 Geologic Material	2:1 Soil:Water Ratio	25-Jan-22	0				
			1-Feb-22	7	SB-311:G311 2:1-1	1,321	6.92	50
					SB-311:G311 2:1-2	1,302	6.86	100
					Average Concentration (mg/L)	**1,311**	**6.89**	**75**
		1:1 Soil:Water Ratio	25-Jan-22	0				
			1-Feb-22	7	SB-311:G311 1:1-1	1,727	6.92	51
					SB-311:G311 1:1-2	860	6.88	24
					Average Concentration (mg/L)	**1,294**	**6.90**	**38**
		1:5 Soil:Water Ratio	25-Jan-22	0				
			1-Feb-22	7	SB-311:G311 1:5-1	1,326	6.87	93
					SB-311:G311 1:5-2	1,516	6.88	56
					Average Concentration (mg/L)	**1,421**	**6.88**	**75**
		1:10 Soil:Water Ratio	25-Jan-22	0				
			1-Feb-22	7	SB-311:G311 1:10-1	1,570	6.89	27
					SB-311:G311 1:10-2	1,551	6.86	133
					Average Concentration (mg/L)	**1,560**	**6.88**	**80**
		1:20 Soil:Water Ratio	25-Jan-22	0				
			1-Feb-22	7	SB-311:G311 1:20-1	1,511	6.88	88
					SB-311:G311 1:20-2	1,588	6.86	39
					Average Concentration (mg/L)	**1,550**	**6.87**	**64**

Notes:
mg/L - milligrams per liter
mV - millivolts
SU - Standard Units
ORP - oxidation/reduction potential

Table 4 - Batch Attenuation Testing Results, G313
Coffeen AP1

Groundwater Sample ID	Geologic Material Sample ID	Treatment	Date	Day	Replicate	Dissolved Boron	Dissolved Sulfate	pH	ORP
						mg/L	mg/L	SU	mV
G313	--	Groundwater Only Control	25-Jan-22	0	G313-1a	6.5	1,372	6.98	-60
					G313-2a	6.7	1,473	6.98	-21
					Average Concentration (mg/L)	**6.6**	**1,423**	**6.98**	**-41**
			1-Feb-22	7	G313-1	6.3	1,158	6.98	113
					G313-2	6.2	1,058	6.97	40
					Average Concentration (mg/L)	**6.2**	**1,108**	**6.98**	**77**
	G313 SB-306 Geologic Material	2:1 Soil:Water Ratio	25-Jan-22	0					
			1-Feb-22	7	SB-306:G313 2:1-1	4.5	884	6.95	46
					SB-306:G313 2:1-2	4.7	779	6.95	44
					Average Concentration (mg/L)	**4.6**	**831**	**6.95**	**45**
		1:1 Soil:Water Ratio	25-Jan-22	0					
			1-Feb-22	7	SB-306:G313 1:1-1	5.3	1,049	6.94	75
					SB-306:G313 1:1-2	5.3	976	6.93	44
					Average Concentration (mg/L)	**5.3**	**1,012**	**6.94**	**60**
		1:5 Soil:Water Ratio	25-Jan-22	0					
			1-Feb-22	7	SB-306:G313 1:5-1	5.8	243	6.95	80
					SB-306:G313 1:5-2	6.1	1,005	6.96	-5
					Average Concentration (mg/L)	**5.9**	**624**	**6.96**	**38**
		1:10 Soil:Water Ratio	25-Jan-22	0					
			1-Feb-22	7	SB-306:G313 1:10-1	6.1	958	6.96	203
					SB-306:G313 1:10-2	6.1	832	6.97	90
					Average Concentration (mg/L)	**6.1**	**895**	**6.97**	**147**
		1:20 Soil:Water Ratio	25-Jan-22	0					
			1-Feb-22	7	SB-306:G313 1:20-1	6.0	881	6.96	39
					SB-306:G313 1:20-2	6.0	1,409	6.94	81
					Average Concentration (mg/L)	**6.0**	**1,145**	**6.95**	**60**
	G313 SB-313 Geologic Material	2:1 Soil:Water Ratio	25-Jan-22	0					
			1-Feb-22	7	SB-313:G313 2:1-1	4.3	852	6.96	164
					SB-313:G313 2:1-2	4.6	900	6.93	143
					Average Concentration (mg/L)	**4.5**	**876**	**6.95**	**154**
		1:1 Soil:Water Ratio	25-Jan-22	0					
			1-Feb-22	7	SB-313:G313 1:1-1	4.9	482	6.99	78
					SB-313:G313 1:1-2	5.0	1,000	6.95	39
					Average Concentration (mg/L)	**4.9**	**741**	**6.97**	**59**
		1:5 Soil:Water Ratio	25-Jan-22	0					
			1-Feb-22	7	SB-313:G313 1:5-1	6.0	1,227	6.96	23
					SB-313:G313 1:5-2	6.2	837	6.97	25
					Average Concentration (mg/L)	**6.1**	**1,032**	**6.97**	**24**
		1:10 Soil:Water Ratio	25-Jan-22	0					
			1-Feb-22	7	SB-313:G313 1:10-1	6.0	1,459	6.97	63
					SB-313:G313 1:10-2	5.8	2,105	6.98	85
					Average Concentration (mg/L)	**5.9**	**1,782**	**6.98**	**74**
		1:20 Soil:Water Ratio	25-Jan-22	0					
			1-Feb-22	7	SB-313:G313 1:20-1	5.8	1,000	6.96	125
					SB-313:G313 1:20-2	6.0	1,043	6.97	47
					Average Concentration (mg/L)	**5.9**	**1,022**	**6.97**	**86**

Notes:

mg/L - milligrams per liter
mV - millivolts
SU - Standard Units
ORP - oxidation/reduction potential

Table 5 - Partition Coefficient Results, G311
Coffeen AP1

Analyte	Isotherm	Variable	Value
Sulfate	Linear	R^2	0.61
		K_D (L/kg)	10.11
	Langmuir	R^2	0.65
		q_m (mg/g)	-0.10
		K_L (L/kg)	-6.24E+02
	Freundlich	R^2	0.78
		1/n	10.27
		K_F (L/kg)	9.20E-12

Notes:

K_D - linear partition coefficient

K_L - Langmuir partition coefficient

K_F - Freundlich partition coefficient

q_m - inverse of the slope of the linearized Langmuir isotherm

n - non-linearity constant of the Freundlich isotherm

Table 6 - Partition Coefficient Results, G313
Coffeen AP1

Materials	Analyte	Isotherm	Variable	Value
G313/SB-306	Boron	Linear	R^2	0.37
			K_D (L/kg)	6.13
		Langmuir	R^2	0.76
			q_m (mg/g)	0.00
			K_L (L/kg)	-1.51E+05
		Freundlich	R^2	0.64
			1/n	6.65
			K_F (L/kg)	6.50E-01
	Sulfate	Linear	R^2	0.05
			K_D (L/kg)	3.97
		Langmuir	R^2	0.01
			q_m (mg/g)	2.20
			K_L (L/kg)	1.19E+03
		Freundlich	R^2	0.00
			1/n	-0.06
			K_F (L/kg)	1.70E+03
G313/SB-313	Boron	Linear	R^2	0.24
			K_D (L/kg)	5.68
		Langmuir	R^2	0.50
			q_m (mg/g)	0.00
			K_L (L/kg)	-1.43E+05
		Freundlich	R^2	0.46
			1/n	5.25
			K_F (L/kg)	2.03E+00
	Sulfate	Linear	R^2	0.21
			K_D (L/kg)	-6.50
		Langmuir	R^2	0.51
			q_m (mg/g)	-0.66
			K_L (L/kg)	-6.91E+02
		Freundlich	R^2	--
			1/n	--
			K_F (L/kg)	--

Notes:

The Freundlich isotherm was not calculated for G313/SB-313 because the data were not conducive to log transformation

K_D - linear partition coefficient

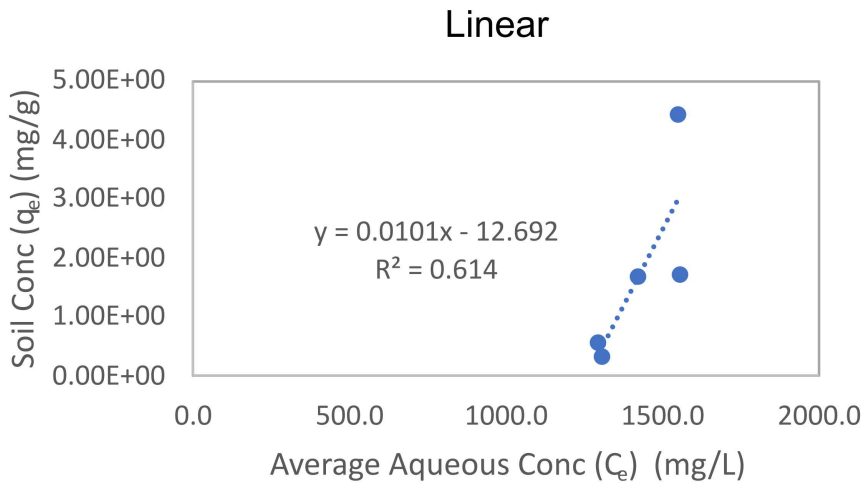
K_L - Langmuir partition coefficient

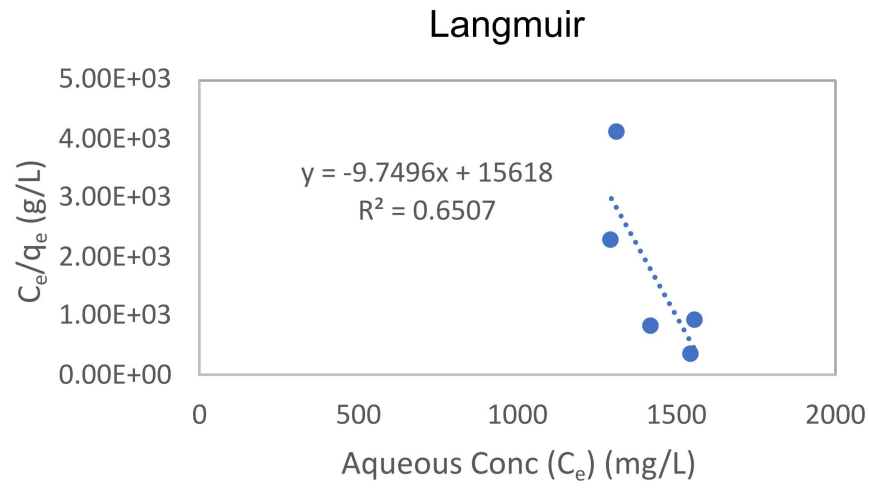
K_F - Freundlich partition coefficient

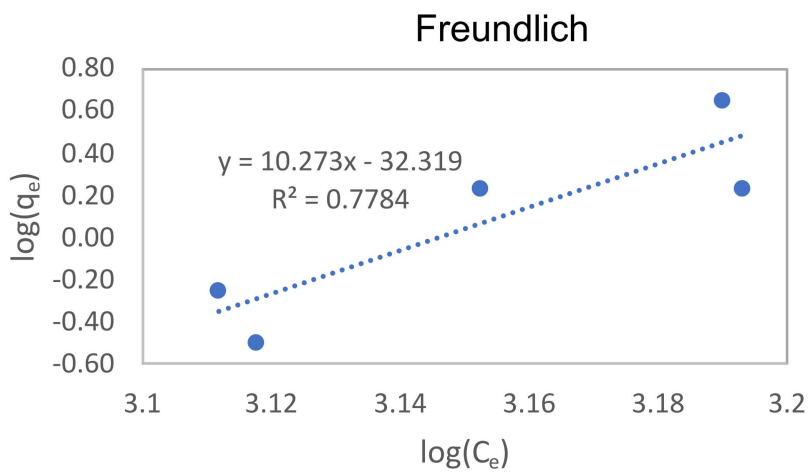
q_m - inverse of the slope of the linearized Langmuir isotherm

n - non-linearity constant of the Freundlich isotherm

APPENDIX A
BATCH TESTING ISOTHERM PLOTS







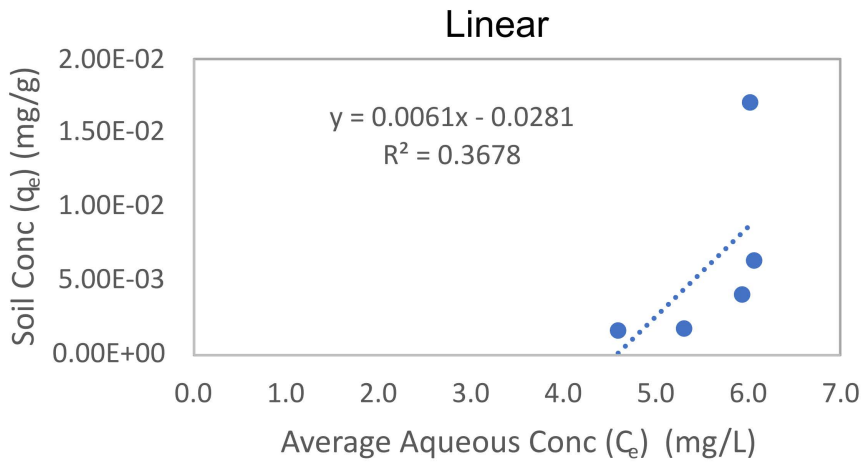
Notes:
q_e - mass of constituent adsorbed to the solid phase
C_e - remaining aqueous constituent concentration
mg/L - milligrams per liter
mg/g - milligrams per gram
g/L - grams per liter

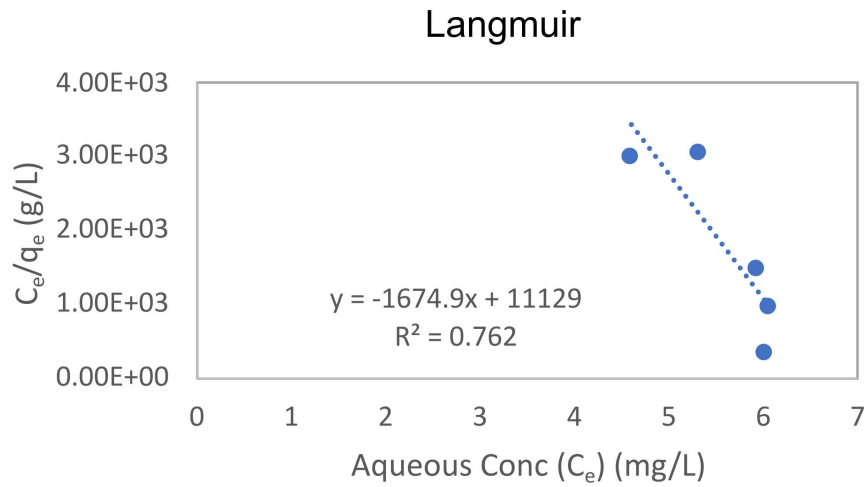
G311 Sulfate Partitioning Coefficients
Coffeen Power Plant AP-1
Coffeen, Illinois

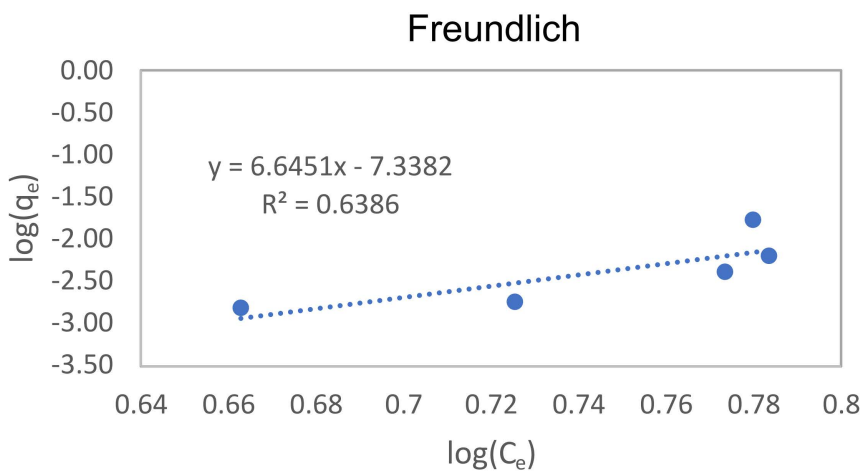
Geosyntec consultants

Columbus, OH | May 2022

Figure 1







Notes:

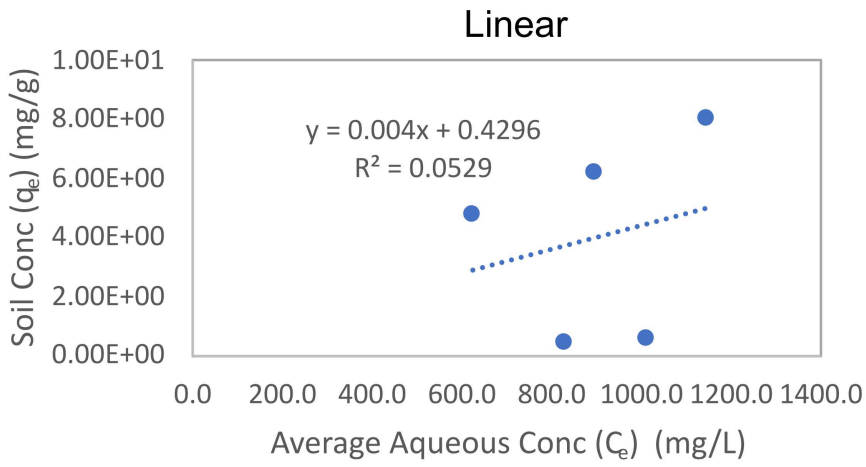
q_e - mass of constituent adsorbed to the solid phase
C_e - remaining aqueous constituent concentration
mg/L - milligrams per liter
mg/g - milligrams per gram
g/L - grams per liter

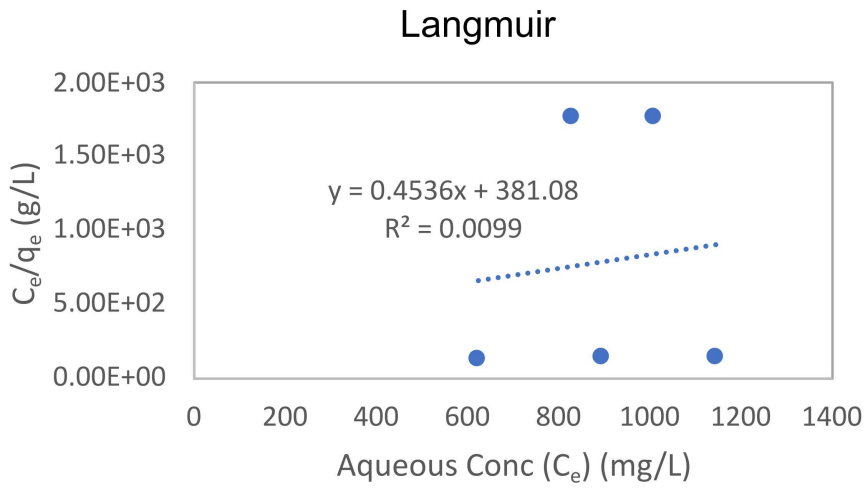
G313/SB-306 Boron Partitioning Coefficients
Coffeen Power Plant AP-1
Coffeen, Illinois

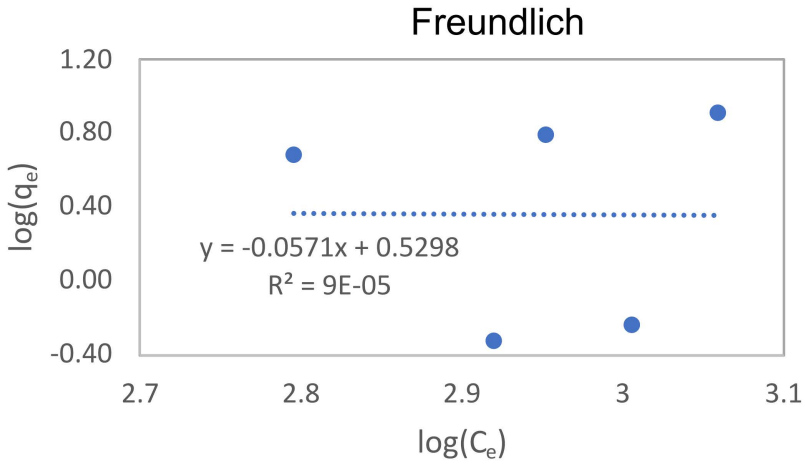
Geosyntec consultants

Columbus, OH | May 2022

Figure 2







Notes:

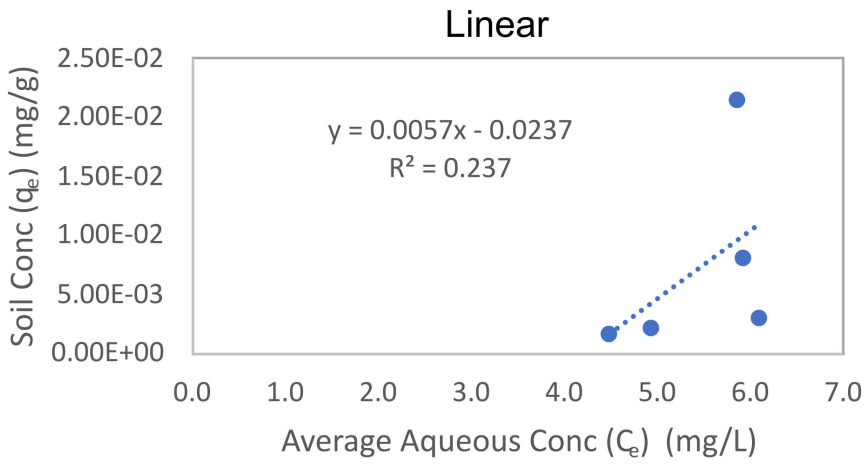
q_e - mass of constituent adsorbed to the solid phase
C_e - remaining aqueous constituent concentration
mg/L - milligrams per liter
mg/g - milligrams per gram
g/L - grams per liter

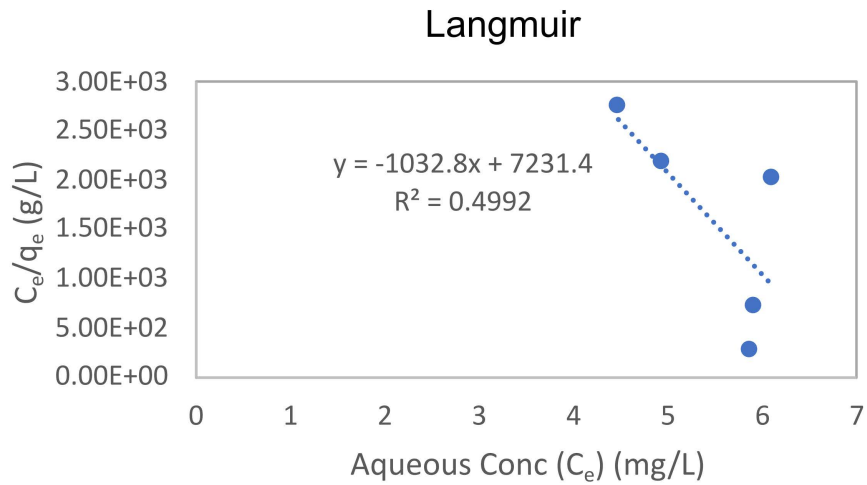
G313/SB-306 Sulfate Partitioning Coefficients
Coffeen Power Plant AP-1
Coffeen, Illinois

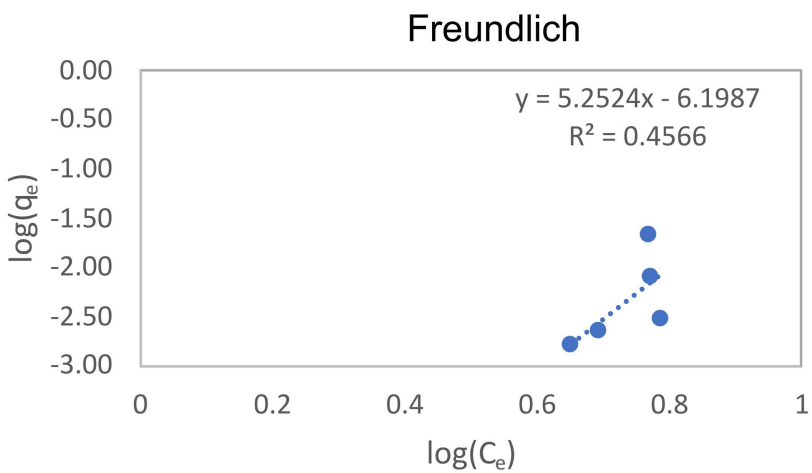
Geosyntec consultants

Columbus, OH | May 2022

Figure 3







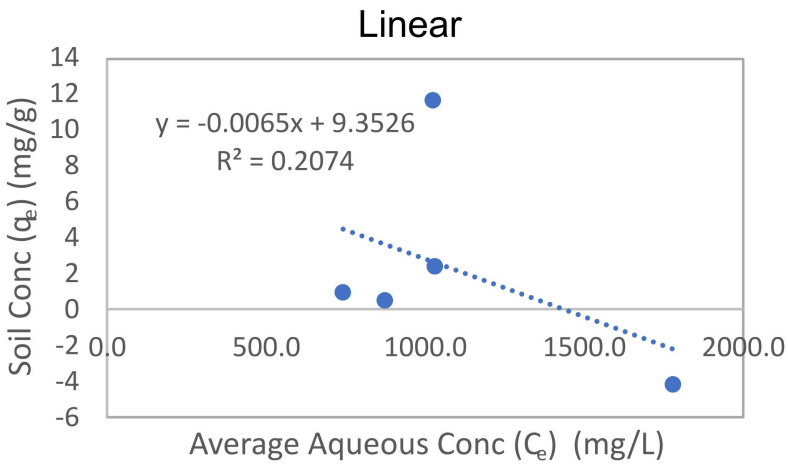
Notes:
q_e - mass of constituent adsorbed to the solid phase
C_e - remaining aqueous constituent concentration
mg/L - milligrams per liter
mg/g - milligrams per gram
g/L - grams per liter

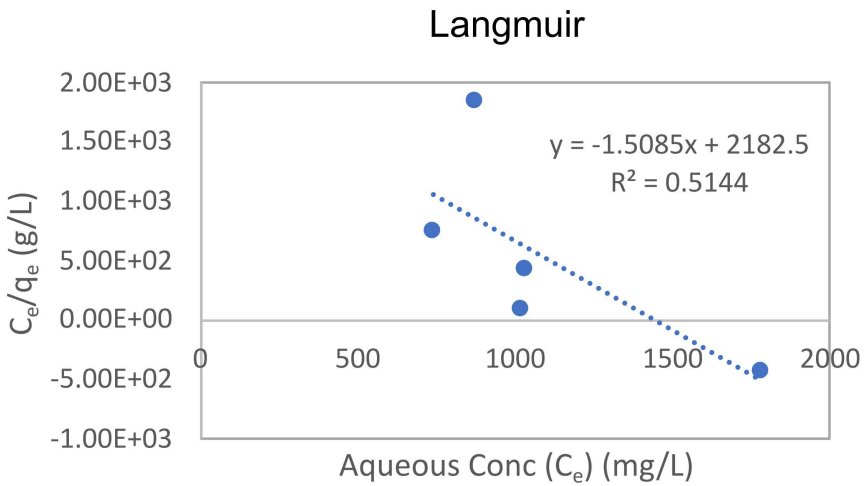
G313/SB-313 Boron Partitioning Coefficients
Coffeen Power Plant AP-1
Coffeen, Illinois

Geosyntec consultants

Columbus, OH | May 2022

Figure 4





Notes:

The Freundlich isotherm was not calculated because the data were not conducive to log transformation.

q_e - mass of constituent adsorbed to the solid phase
C_e - remaining aqueous constituent concentration
mg/L - milligrams per liter
mg/g - milligrams per gram
g/L - grams per liter

G313/SB-313 Sulfate Partitioning Coefficients
Coffeen Power Plant AP-1
Coffeen, Illinois

Geosyntec consultants

Columbus, OH | May 2022

Figure 5

APPENDIX D
HELP MODEL OUTPUT FILES

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: COF AP1 CIP **Simulated On:** 6/23/2022 13:38

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
SiCL - Silty Clay Loam
Material Texture Number 12

Thickness	=	6	inches
Porosity	=	0.471	vol/vol
Field Capacity	=	0.342	vol/vol
Wilting Point	=	0.21	vol/vol
Initial Soil Water Content	=	0.2544	vol/vol
Effective Sat. Hyd. Conductivity	=	4.20E-05	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer
SiC - Silty Clay
Material Texture Number 14

Thickness	=	18	inches
Porosity	=	0.479	vol/vol
Field Capacity	=	0.371	vol/vol
Wilting Point	=	0.251	vol/vol
Initial Soil Water Content	=	0.3554	vol/vol
Effective Sat. Hyd. Conductivity	=	2.50E-05	cm/sec

Layer 3

Type 2 - Lateral Drainage Layer
10 oz Nonwoven Geotextile
Material Texture Number 123

Thickness	=	0.11	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.5445	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-01	cm/sec
Slope	=	5	%
Drainage Length	=	350	ft

Layer 4

Type 4 - Flexible Membrane Liner
LDPE Membrane
Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	1	Holes/Acre
FML Installation Defects	=	1	Holes/Acre
FML Placement Quality	=	3	Good

Layer 5

Type 1 - Vertical Percolation Layer (Waste)
High Density Electric Plant Coal Bottom Ash
Material Texture Number 84

Thickness	=	360	inches
Porosity	=	0.578	vol/vol
Field Capacity	=	0.076	vol/vol
Wilting Point	=	0.025	vol/vol
Initial Soil Water Content	=	0.0762	vol/vol
Effective Sat. Hyd. Conductivity	=	8.80E-05	cm/sec

Layer 6

Type 2 - Lateral Drainage Layer
Loess Unit Silty Clay
Material Texture Number 43

Thickness	=	60	inches
Porosity	=	0.479	vol/vol
Field Capacity	=	0.371	vol/vol
Wilting Point	=	0.251	vol/vol
Initial Soil Water Content	=	0.371	vol/vol
Effective Sat. Hyd. Conductivity	=	3.85E-08	cm/sec
Slope	=	0	%
Drainage Length	=	0	ft

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	87.9	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	10.37	acres
Evaporative Zone Depth	=	18	inches
Initial Water in Evaporative Zone	=	5.654	inches
Upper Limit of Evaporative Storage	=	8.574	inches

Lower Limit of Evaporative Storage	=	4.272	inches
Initial Snow Water	=	0.088108	inches
Initial Water in Layer Materials	=	57.664	inches
Total Initial Water	=	57.752	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	39.06	Degrees
Maximum Leaf Area Index	=	4.5	
Start of Growing Season (Julian Date)	=	97	days
End of Growing Season (Julian Date)	=	302	days
Average Wind Speed	=	8	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	64	%
Average 3rd Quarter Relative Humidity	=	71	%
Average 4th Quarter Relative Humidity	=	72	%

Note: Evapotranspiration data was obtained for Coffeen, Illinois

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
2.353618	2.511085	2.81508	3.241374	3.956664	4.312863
4.375035	2.656228	3.284204	3.675466	3.677412	3.106835

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
37.3	37.1	50	61.9	69.7	80.6
84.2	81	72.2	62.4	48.1	38

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39

Average Annual Totals Summary

Title: COF AP1 CIP
Simulated on: 6/23/2022 13:40

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	39.97	[4.83]	1,504,439.0	100.00
Runoff	5.219	[2.734]	196,475.1	13.06
Evapotranspiration	30.032	[3.266]	1,130,503.8	75.14
Subprofile1				
Lateral drainage collected from Layer 3	4.5549	[1.2488]	171,460.7	11.40
Percolation/leakage through Layer 4	0.195970	[0.082153]	7,376.9	0.49
Average Head on Top of Layer 4	4.4608	[1.8873]	---	---
Subprofile2				
Percolation/leakage through Layer 6	0.000911	[0.001146]	34.3	0.00
Water storage				
Change in water storage	0.1585	[1.4776]	5,965.1	0.40

* Note: Average inches are converted to volume based on the user-specified area.

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: COF AP1 CBR E 1ft Simulated On: 18/04/2022 12:42

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
SiC - Silty Clay
Material Texture Number 14

Thickness	=	12	inches
Porosity	=	0.479	vol/vol
Field Capacity	=	0.371	vol/vol
Wilting Point	=	0.251	vol/vol
Initial Soil Water Content	=	0.2751	vol/vol
Effective Sat. Hyd. Conductivity	=	2.50E-05	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	88.6	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	14.28	acres
Evaporative Zone Depth	=	12	inches
Initial Water in Evaporative Zone	=	3.302	inches
Upper Limit of Evaporative Storage	=	5.748	inches
Lower Limit of Evaporative Storage	=	3.012	inches
Initial Snow Water	=	0.088108	inches
Initial Water in Layer Materials	=	3.302	inches
Total Initial Water	=	3.39	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	39.06	Degrees
Maximum Leaf Area Index	=	4.5	
Start of Growing Season (Julian Date)	=	97	days
End of Growing Season (Julian Date)	=	302	days

Average Wind Speed	=	8 mph
Average 1st Quarter Relative Humidity	=	72 %
Average 2nd Quarter Relative Humidity	=	64 %
Average 3rd Quarter Relative Humidity	=	71 %
Average 4th Quarter Relative Humidity	=	72 %

Note: Evapotranspiration data was obtained for Coffeen, Illinois

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
2.353618	2.511085	2.81508	3.241374	3.956664	4.312863
4.375035	2.656228	3.284204	3.675466	3.677412	3.106835

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
37.3	37.1	50	61.9	69.7	80.6
84.2	81	72.2	62.4	48.1	38

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39

Average Annual Totals Summary

Title: COF AP1 CBR E 1ft
Simulated on: 18/04/2022 12:43

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	39.97	[4.83]	2,071,686.5	100.00
Runoff	4.098	[2.566]	212,424.0	10.25
Evapotranspiration	28.031	[2.833]	1,453,011.5	70.14
Subprofile1				
Percolation/leakage through Layer 1	7.845754	[2.291827]	406,695.7	19.63
Water storage				
Change in water storage	-0.0086	[0.9272]	-444.6	-0.02

* Note: Average inches are converted to volume based on the user-specified area.

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: COF AP1 CBR W 3ft Simulated On: 18/04/2022 17:19

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
SiC - Silty Clay
Material Texture Number 14

Thickness	=	36	inches
Porosity	=	0.479	vol/vol
Field Capacity	=	0.371	vol/vol
Wilting Point	=	0.251	vol/vol
Initial Soil Water Content	=	0.3502	vol/vol
Effective Sat. Hyd. Conductivity	=	2.50E-05	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	89.2	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	10.38	acres
Evaporative Zone Depth	=	18	inches
Initial Water in Evaporative Zone	=	5.826	inches
Upper Limit of Evaporative Storage	=	8.622	inches
Lower Limit of Evaporative Storage	=	4.518	inches
Initial Snow Water	=	0.088108	inches
Initial Water in Layer Materials	=	12.606	inches
Total Initial Water	=	12.694	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	39.06	Degrees
Maximum Leaf Area Index	=	4.5	
Start of Growing Season (Julian Date)	=	97	days
End of Growing Season (Julian Date)	=	302	days

Average Wind Speed	=	8 mph
Average 1st Quarter Relative Humidity	=	72 %
Average 2nd Quarter Relative Humidity	=	64 %
Average 3rd Quarter Relative Humidity	=	71 %
Average 4th Quarter Relative Humidity	=	72 %

Note: Evapotranspiration data was obtained for Coffeen, Illinois

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
2.353618	2.511085	2.81508	3.241374	3.956664	4.312863
4.375035	2.656228	3.284204	3.675466	3.677412	3.106835

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
37.3	37.1	50	61.9	69.7	80.6
84.2	81	72.2	62.4	48.1	38

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39

Average Annual Totals Summary

Title: COF AP1 CBR W 3ft
Simulated on: 18/04/2022 17:20

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	39.97	[4.83]	1,505,889.7	100.00
Runoff	4.277	[2.541]	161,157.5	10.70
Evapotranspiration	29.447	[3.212]	1,109,534.9	73.68
Subprofile1				
Percolation/leakage through Layer 1	6.278209	[2.388206]	236,559.2	15.71
Water storage				
Change in water storage	-0.0361	[1.2459]	-1,361.9	-0.09

* Note: Average inches are converted to volume based on the user-specified area.

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: COF AP1 CIP Default **Simulated On:** 6/21/2022 16:04

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	6	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.154	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
SiC - Silty Clay
Material Texture Number 14

Thickness	=	30	inches
Porosity	=	0.479	vol/vol
Field Capacity	=	0.371	vol/vol
Wilting Point	=	0.251	vol/vol
Initial Soil Water Content	=	0.3698	vol/vol
Effective Sat. Hyd. Conductivity	=	2.50E-05	cm/sec

Layer 3
Type 2 - Lateral Drainage Layer
10 oz Nonwoven Geotextile
Material Texture Number 123

Thickness	=	0.11	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.6794	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-01	cm/sec
Slope	=	5	%
Drainage Length	=	350	ft

Layer 4

Type 4 - Flexible Membrane Liner
LDPE Membrane
Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	1	Holes/Acre
FML Installation Defects	=	1	Holes/Acre
FML Placement Quality	=	3	Good

Layer 5

Type 1 - Vertical Percolation Layer (Waste)
High Density Electric Plant Coal Bottom Ash
Material Texture Number 84

Thickness	=	360	inches
Porosity	=	0.578	vol/vol
Field Capacity	=	0.076	vol/vol
Wilting Point	=	0.025	vol/vol
Initial Soil Water Content	=	0.0762	vol/vol
Effective Sat. Hyd. Conductivity	=	8.80E-05	cm/sec

Layer 6

Type 2 - Lateral Drainage Layer
Loess Unit Silty Clay
Material Texture Number 43

Thickness	=	60	inches
Porosity	=	0.479	vol/vol
Field Capacity	=	0.371	vol/vol
Wilting Point	=	0.251	vol/vol
Initial Soil Water Content	=	0.371	vol/vol
Effective Sat. Hyd. Conductivity	=	3.85E-08	cm/sec
Slope	=	0	%
Drainage Length	=	0	ft

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	85.9	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	10.37	acres
Evaporative Zone Depth	=	18	inches
Initial Water in Evaporative Zone	=	5.059	inches
Upper Limit of Evaporative Storage	=	8.136	inches

Lower Limit of Evaporative Storage	=	3.828	inches
Initial Snow Water	=	0.088108	inches
Initial Water in Layer Materials	=	61.794	inches
Total Initial Water	=	61.882	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	39.06	Degrees
Maximum Leaf Area Index	=	4.5	
Start of Growing Season (Julian Date)	=	97	days
End of Growing Season (Julian Date)	=	302	days
Average Wind Speed	=	8	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	64	%
Average 3rd Quarter Relative Humidity	=	71	%
Average 4th Quarter Relative Humidity	=	72	%

Note: Evapotranspiration data was obtained for Coffeen, Illinois

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
2.353618	2.511085	2.81508	3.241374	3.956664	4.312863
4.375035	2.656228	3.284204	3.675466	3.677412	3.106835

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
37.3	37.1	50	61.9	69.7	80.6
84.2	81	72.2	62.4	48.1	38

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39

Average Annual Totals Summary

Title: COF AP1 CIP
Simulated on: 6/21/2022 16:05

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	39.97	[4.83]	1,504,439.0	100.00
Runoff	4.089	[2.542]	153,905.0	10.23
Evapotranspiration	30.058	[3.318]	1,131,459.1	75.21
Subprofile1				
Lateral drainage collected from Layer 3	5.5133	[1.5623]	207,537.5	13.80
Percolation/leakage through Layer 4	0.344465	[0.16843]	12,966.7	0.86
Average Head on Top of Layer 4	7.8378	[3.8306]	---	---
Subprofile2				
Percolation/leakage through Layer 6	0.049311	[0.128508]	1,856.2	0.12
Water storage				
Change in water storage	0.2572	[1.781]	9,681.1	0.64

* Note: Average inches are converted to volume based on the user-specified area.

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: COF AP1 Default Earth Simulated On: 27/06/2022 18:16

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	6	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.1542	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
SiC - Silty Clay
Material Texture Number 14

Thickness	=	30	inches
Porosity	=	0.479	vol/vol
Field Capacity	=	0.371	vol/vol
Wilting Point	=	0.251	vol/vol
Initial Soil Water Content	=	0.436	vol/vol
Effective Sat. Hyd. Conductivity	=	2.50E-05	cm/sec

Layer 3
Type 3 - Barrier Soil Liner
Liner Soil (High)
Material Texture Number 16

Thickness	=	36	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Layer 4
Type 1 - Vertical Percolation Layer (Waste)
High Density Electric Plant Coal Bottom Ash

Material Texture Number 84

Thickness	=	360	inches
Porosity	=	0.578	vol/vol
Field Capacity	=	0.076	vol/vol
Wilting Point	=	0.025	vol/vol
Initial Soil Water Content	=	0.0805	vol/vol
Effective Sat. Hyd. Conductivity	=	8.80E-05	cm/sec

Layer 5
Type 2 - Lateral Drainage Layer
Loess Unit Silty Clay
Material Texture Number 43

Thickness	=	60	inches
Porosity	=	0.479	vol/vol
Field Capacity	=	0.371	vol/vol
Wilting Point	=	0.251	vol/vol
Initial Soil Water Content	=	0.371	vol/vol
Effective Sat. Hyd. Conductivity	=	3.85E-08	cm/sec
Slope	=	0	%
Drainage Length	=	0	ft

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	85.9	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	10.37	acres
Evaporative Zone Depth	=	18	inches
Initial Water in Evaporative Zone	=	5.382	inches
Upper Limit of Evaporative Storage	=	8.136	inches
Lower Limit of Evaporative Storage	=	3.828	inches
Initial Snow Water	=	0.088108	inches
Initial Water in Layer Materials	=	80.625	inches
Total Initial Water	=	80.713	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	39.06	Degrees
Maximum Leaf Area Index	=	4.5	

Start of Growing Season (Julian Date)	=	97	days
End of Growing Season (Julian Date)	=	302	days
Average Wind Speed	=	8	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	64	%
Average 3rd Quarter Relative Humidity	=	71	%
Average 4th Quarter Relative Humidity	=	72	%

Note: Evapotranspiration data was obtained for Coffeen, Illinois

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
2.353618	2.511085	2.81508	3.241374	3.956664	4.312863
4.375035	2.656228	3.284204	3.675466	3.677412	3.106835

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
37.3	37.1	50	61.9	69.7	80.6
84.2	81	72.2	62.4	48.1	38

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 39.06/-89.39

Average Annual Totals Summary

Title: COF AP1 Default Earth
Simulated on: 27/06/2022 18:17

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	39.97	[4.83]	1,504,439.0	100.00
Runoff	6.862	[3.483]	258,316.2	17.17
Evapotranspiration	31.176	[3.425]	1,173,551.9	78.01
Subprofile1				
Percolation/leakage through Layer 3	1.992946	[0.073666]	75,020.7	4.99
Average Head on Top of Layer 3	21.7496	[2.1124]	---	---
Subprofile2				
Percolation/leakage through Layer 5	1.698973	[0.713508]	63,954.6	4.25
Water storage				
Change in water storage	0.2289	[1.8082]	8,616.3	0.57

* Note: Average inches are converted to volume based on the user-specified area.

APPENDIX E
FLUX EVALUATION DATA

Appendix E. Flux Evaluation Data
GROUNDWATER MODELING REPORT
COFFEEN POWER PLANT
ASH POND NO. 1
COFFEEN, ILLINOIS

Calibration Model					
Model	**Model Period (years)**	**HSU**	**Total Flux In[1] (ft^3/d)**	**Total Flux In (gpm)**	
Calibration Model	42	Fill Unit (CCR)	2888.39	15.00	
Model	**Model Period (years)**	**HSU**	**Total Flux Out[1] (ft^3/d)**	**Total Flux Out (gpm)**	
Calibration Model	42	Fill Unit (CCR)	-2975.75	-15.46	
Scenario 1: CIP (CCR removal from the northwest areas of the Ash Pond, consolidation to the northeast, central and southern areas of the Ash Pond, and construction of a cover system over the remaining CCR)					
Prediction Model	**Construction Period (years)**	**HSU**	**Total Flux In[1] (ft^3/d)**	**Total Flux In (gpm)**	**Reduction in Flux In Post Closure[2] (Percentage, %)**
CIP	56	Fill Unit (CCR)	2.20	0.01	99.92%
Prediction Model	**Construction Period (years)**	**HSU**	**Total Flux Out[1] (ft^3/d)**	**Total Flux Out (gpm)**	**Reduction in Flux Out Post Closure[2] (Percentage, %)**
CIP	56	Fill Unit (CCR)	-2.21	-0.01	99.93%

[O: SLN 6/25/22; C: BGH 6/29/22]

Notes:
1. Total flux in and out source data provided in flux calculation data files included in Appendix B.
2. Reduction in flux as compared to flux at the end of calibration model (model period of 42 years).

CCR = coal combustion residuals
CIP = Closure In Place
HSU = Hydrostratigraphic Unit
% = percentage
ft^3/d = cubic feet per day
gpm = gallons per minute

APPENDIX C
MATERIAL QUANTITY, LABOR, AND MILEAGE ESTIMATES FOR ALTERNATIVE 2 AND ALTERNATIVE 3 REMEDIES

ILLINOIS POWER GENERATING COMPANY - COFFEEN POWER PLANT - ASH POND 2
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 1 - MONITORED NATURAL ATTENUATION (MNA)[1]

ITEM NO.	Corrective Action Groundwater Monitoring	Units	Quantity	Labor Hours	Equipment Hours	Notes
1	Groundwater Compliance Monitoring	Event	76	-	-	Assumes quarterly monitoring for the first five (5) years and subsequent semi-annual monitoring until GWPSs are achieved, or a maximum of 30 years, followed by three (3) years of semi-annual confirmation monitoring. Total estimated duration of monitoring is 33 years (see Note 1) and total number of monitoring events is 76.
	Field Sampling	Event	76	-	-	Assumes a total of eleven (11) monitoring wells will be sampled per event as part of the Illinois Coal Combustion Waste Surface Impoundments section 845.650 Groundwater Monitoring Program requirement. Additionally, it is assumed it will take approximately 3 days to complete each sampling event. 70 events - Corrective Action Monitoring (30 years) 6 events - Corrective Action Confirmation Monitoring (3 years)
	Laboratory Analytical	Event	76	-	-	Assumes groundwater analysis eleven (11) monitoring wells will include the following analytes for samples collected at each monitoring well, plus two QA/QC samples: antimony, arsenic, barium, beryllium, boron, cadmium, chloride, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, pH, selenium, sulfate, thallium, total dissolved solids, and radium 226 and 228 combined. 70 events - Corrective Action Monitoring (30 years) 6 events - Corrective Action Confirmation Monitoring (3 years)
2	Groundwater Monitoring Reporting	Event	76	-	-	Assumes a groundwater monitoring report will be generated for each sampling event conducted throughout the life cycle of the alternative. Additionally, it is assumed the annual groundwater monitoring report will be submitted in lieu of a quarterly or semi-annual groundwater monitoring report at the end of each year during the life cycle of the alternative.
	Quarterly Monitoring Report	Event	15	-	-	Assumes a total of 3 quarterly groundwater monitoring reports will be submitted per year to the Illinois Environmental Protection Agency (IEPA) for the first 5 years of AP2 monitoring.
	Semi-annual Monitoring Report	Event	28	-	-	Assumes a total of one 1 semiannual groundwater monitoring report will be submitted per year to the IEPA following the first 5 years of monitoring until GWPS is achieved at all AP2 perimeter monitoring wells, or a maximum of 30 years, followed by three (3) years of semi-annual confirmation monitoring.
	Annual Monitoring Report	Event	33	-	-	Assumes a total of one 1 annual groundwater monitoring report will be submitted per year to the IEPA until GWPS is achieved at all AP2 perimeter monitoring wells, or a maximum of 30 years, followed by three (3) years of semi-annual confirmation monitoring.
3	Compliance Well Network Maintenance	Event	33	-	-	Assumes two persons completing maintenance of monitoring well infrastructure and one Ramboll personal as oversight over a two day period and the maintenance occurs on a yearly basis over the life cycle of the alternative
4	Corrective Action Completion Reporting	Event	1	-	-	Assumes one Corrective Action Completion Report will be generated following 3 consecutive years of GWPSs being achieved at all AP2 perimeter monitoring wells, or after a maximum of 30 years of corrective action monitoring.
	CORRECTIVE ACTION MAINTENANCE SUBTOTAL			**-**	**-**	

	Total Labor Hours	Total Equipment Hours
ENGINEERING AND CONSTRUCTION SUBTOTAL	**-**	**-**
CORRECTIVE ACTION OPERATION AND MAINTENANCE SUBTOTAL	**-**	**-**
CORRECTIVE ACTION GROUNDWATER MONITORING SUBTOTAL	**-**	**-**
ALTERNATIVE 1 SUBTOTAL	**-**	**-**
40%	**-**	**-**
ENGINEER'S ESTIMATE OF TOTAL CONSTRUCTION AND ENGINEERING HOURS	**-**	**-**

NOTES:
1. Alternative 1: Source Control with MNA is estimated to take greater than 30 years to achieve groundwater protection standards (GWPS-35 I.A.C Section 845.600) at all perimeter wells associated with the Ash Pond 2 (AP2). For the purposes of this estimate, a maximum of 30 years of compliance monitoring followed by 3 yea
2. RS Means refers to the 2023 Quarter 4 online edition of RS Means Commercial New Construction.

ACRONYMS:
AP2 = Ash Pond No. 2
GWPS = Groundwater Protection Standards
IEPA = Illinois Environmental Protection Agency
MNA = Monitored Natural Attenuation
QA/QC = Quality Assurance / Quality Control

RAMBOLL

ILLINOIS POWER GENERATING COMPANY - COFFEEN POWER PLANT - ASH POND 2
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 2 - UPGRADIENT BARRIER WALL AND GROUNDWATER EXTRACTION TRENCH[1]

ITEM NO.	ENGINEERING, PRE-CONSTRUCTION, AND CONSTRUCTION SUPPORT TASKS	Units	Quantity	Crew	Daily Output	Labor Hours	Equipment Hours	Notes
1	Engineering Support and CQA During Construction	LS	1	Eng	12	1,728	0	Assumed labor and equipment hours based on Ramboll project experience.
	PRE-CONSTRUCTION ESTIMATED SUBTOTAL					**1,728**	**0**	
ITEM NO.	**SITE PREPARATION**	**Units**	**Quantity**	**Crew**	**Daily Output**	**Labor Hours**	**Equipment Hours**	**Notes**
2	Staging Area & Temporary Roads Preparation	-	-	-	-	473	146	Assumes some work general preparation of temporary access roads along the trench alignment will be needed specific to extraction trench construction.
	Subsurface Stabilization Nonwoven Geotextile	SY	5,600	2 Clab	2500	36	0	313219161550: Geosynthetic soil stabilization, geotextile fabric, non-woven, 120 lb tensile strength includes scarifying and compaction. Assumes 0.5 acre staging area and approximately 2,500 ft of temporary access road.
	Construct Staging Area & Temporary Roads	SY	5,600	B14	615	437	146	015523500100: Temporary, roads, gravel fill, 8" gravel depth, excluding surfacing. Assumes 0.5 acre staging area and approximately 2,500 ft of temporary access road.
3	Construction Soil Erosion & Sediment Controls	-	-	-	-	241	80	Assumes soil erosion and sediment controls will be implemented only during the groundwater extraction trench construction.
	Silt Fence	LF	3,600	B62	650	133	44	312514161000: Synthetic erosion control, silt fence, install and remove, 3' high. Assumes silt fence is installed down both sides of the extraction trench alignment (3,600 ft total).
	Sediment Log, Filter Sock	LF	4,500	A2	1000	108	36	312514160705: Sediment Log, Filter Sock, 9". Assume sediment log is needed along alignment of extraction trench (3,600 LF total) and settling pond perimeter (~900 LF).
4	Temporary Electrical Installation	EA	1	R1B	-	144	0	Electrical installation based on Ramboll experience to install two power drops for low-voltage (120V) power for the pneumatic extraction pumps along the extraction trench, and for the pneumatic transfer pump at the settling pond for discharge of water to outfall.
5	Work Pad Construction	-	-	-	-	1,124	409	Working surface 45 ft wide needed for trench and barrier wall installation. Existing roads along northern and western perimeter of AP2 will be saw-cut as needed for trench and barrier wall installation.
	Remove Asphalt Roads Along Perimeter	SY	10,833	B38	690	628	251	024113175010: Demolish, remove pavement and curb, remove bituminous pavement, up to 3" thick, excludes hauling and disposal. Assumes saw cutting and removal asphalt roads along the entire perimeter of AP2 for trench and wall installation (30-ft wide road).
	Surface Grading	MSF	50	B11L	30	27	13	312216103600: Fine grading, work pad area. Assumes grading along banks of AP2 between the bottom of the berm and the road to complete the needed working surface.
	Subsurface Stabilization Nonwoven Geotextile	SY	5,555	2 Clab	2500	36	0	313219161550: Geosynthetic soil stabilization, geotextile fabric, non-woven, 120 lb tensile strength includes scarifying and compaction. Assume stabilization needed for 15-ft wide swath between berm and road.
	Install Crushed Gravel Work Pad (8" Thick)	SY	5,555	B14	615	434	145	015523500100: Temporary, roads, gravel fill, 8" gravel depth, excluding surfacing. Assume stabilization needed for 15-ft wide swath between berm and road.
6	Geotechnical Monitoring	LS	-	GM	-	600	0	Assumes installation of inclinometers, survey prisms, and settlement monitoring devices. Assumes a 4-person crew installs the monitoring system over a period of 3 weeks. Based on Ramboll experience.
	SITE PREPARATION ESTIMATED SUBTOTAL					**2,580**	**640**	
ITEM NO.	**BARRIER WALL & GROUNDWATER EXTRACTION TRENCH CONSTRUCTION**	**Units**	**Quantity**	**Crew**	**Daily Output**	**Labor Hours**	**Equipment Hours**	**Notes**
7	Materials Import	-	-	-	-	134	106	Includes materials associated with barrier wall and extraction trench and labor costs associated with hauling. Purchase of sand/granular material for backfilling the extraction trench.
	Sand/Granular Backfill	CY	725	B13D	376	31	15	Sand/granular backfill for extraction trenches. Assumes trench is 3,250 ft long, 8 ft deep, and 2.5 ft wide and ~30% of trench volume needs to be backfilled with granular material. Based on Ramboll and Specialty Contractor experience.
	Clay Trench Cap	CY	150	B13D	100	24	12	Clay material for extraction trench cap. Assumes trench is 3,250 ft long, 2.5 ft wide, and cap is approximately 0.5 feet thick. Based on Ramboll experience.
	Haul material to Site	LCY	875	B34C	99	71	71	312323203104: Cycle hauling (wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 16.5 C.Y. truck, cycle 50 miles, 45 mph, excludes loading equipment.
	Haul material to Trench Locations	CY	875	B34G	850	8	8	312323206170: Hauling; no loading equipment, including hauling, waiting, loading/dumping; 34 C.Y. off-road, 15 min wait/ld./uld., 15 MPH, cycle 1 mile. Daily output extrapolated down to 10 min wait. Assumes onsite stockpile locations average of 0.25 mile from trench dumping location.
8	Installation of Groundwater Extraction Trench	-	-	-	-	544	544	Assumes mobilization and demobilization, trench excavation, and construction of clay trench cap.
	Mobilization, Assembly, & Demobilization of Specialty Contractor	LS	1	-	-	-	-	Mobilization, assembly, and demobilization from One-Pass technology specialty contractor.
	Trench Excavation	LF	3,250	OP	300	542	542	OP crew determined from crew information provided by specialty contractor. Assumes total trench length 3,250 ft with an approximate average depth of 8 ft and 2 ft wide.
	Spread Lifts for Clay Trench Cap	CY - as excavated	120	B10B	1000	1	1	312323170020: Spread dumped material, no compaction, by dozer. Daily output edited to match excavation based on experience.
	Compaction of Clay Trench Cap	CY - in place	120	B10F	5200	1	1	312323235060: Compaction; Riding, vibrating roller, 6" lifts, 2 passes. RS Means Crew is B10Y; altered to B10F based on experience.
9	Installation of Barrier Wall	-	-	-	-	1,083	1,083	Assumes same mobilization and specialty contractor as extraction trench construction. Barrier wall to be installed immediately following trench installation.
	Installation of Barrier Wall	LF	3,250	OP	150	1,083	1,083	Assumes barrier wall construction and materials (bentonite and standard Portland cement) provided by specialty contractor. OP crew determined from crew information provided by specialty contractor. Assumes total wall length is 3,250 ft with approximate average depth of 7 ft and 2.5 ft wide.
	Barrier Wall Mix Design	LS	1	-	-	0	0	Specialty contractor for creating mix design to achieve specifications. Mix design will include 1 soil bore to obtain a representative soil sample.
10	Groundwater Extraction Trench Mechanical Installation	-	-	-	-	1,174	403	Includes installation of sumps, equalization tank, transfer pumps and controllers, and associated excavation and backfill.
	Install Sumps	EA	5	Q1	2	44	0	Sump installation from specialty contractor. 8-20" diameter Sch. 40-304 Stainless Steel. Daily output adjusted for scale.
	Install Equalization Tank	EA	2	B6	1	180	60	Installation of equalization tank at each trench and associated site preparation and instrumentation. Assumes 2 days each for installation.
	Install Transfer Pumps and Controllers	EA	2	R30	1	52	0	Installation of transfer pump and pump controller at each extraction trench to convey water from settling pond to discharge outfall based on Ramboll project experience. Assumes inclusion of housing structure and 2 days for installation.
	Excavate Utility Trench for Lines to Compressors and Extraction Pumps	LF	500	B54	860	5	5	312316142750: Utility trench excavating, chain trencher, 40 HP operator riding, 12" wide trench and backfill, 18" deep. Trench installed from power drop/compressor shed to extraction trench to supply compressed air and power to sump pits. Assumes 500 ft distance from compressor shed to trench.
	Install Mechanical Elements and Piping	EA	1	R30	-	260	0	Assumes furnishing all mechanical elements (air compressors, pneumatic extraction pumps, transfer pumps) and associated HDPE housing piping for distribution of power and housing of mechanical elements throughout the extraction trench system. Assumes approximately 10 days of work.
	Excavate Utility Trench for Conveyance to Settling Pond	LF	2,500	B10R	100	300	200	312316142750: Utility trench excavating, chain trencher, 40 HP operator riding, 12" wide trench and backfill, 18" deep. Trench installed from groundwater extraction trench to convey extracted water to the settling pond.
	Install 8" HDPE Conveyance Pipe to Settling Pond	LF	2,500	B22A	320	313	125	331413350300: Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 8" diameter, SDR 21. Includes labor, materials, and machine for installation and welding of HDPE pipe for conveying extracted water from trench to settling pond.
	Backfill with Granular Trench Backfill	LCY	166	B10R	100	20	13	312316133060: Backfill trench, F.E. loader, wheel mtd., 1 C.Y. bucket, 200' haul. Backfill with granular trench backfill. Quantity based on trench dimensions 12" wide, 18" deep, 3,000 ft (500 ft and 2,500 ft) long.
11	Construction of Compressor Shed	-	-	-	-	180	60	Based on Ramboll experience for construction of housing unit for air compressor shed.
	Construct Compressor Shed	EA	1	B6	-	180	60	Assumes pre-fabricated air compressor shelter, installed primarily by hand with light equipment assistance. Hours are based on Ramboll experience
12	Installation of Settling Pond	-	-	-	-	226	89	Quantity based on 1-acre pond, 2 feet deep. Assume all excavated material is reused for berm construction.
	Excavation and Loading of Settling Pond Material	BCY	3,300	B12D	2080	25	13	312316420300: Excavating, bulk bank measure, hydraulic, crawler mtd., 3 C.Y. cap (300 CY/hr). Assumes loading of material onto trucks.
	Hauling and Placement of Settling Pond Material	LCY	3,300	B34G	3287	8	8	312323206130: Hauling; no loading equipment, including hauling, waiting, loading/dumping; 34 C.Y. off-road, 15 min wait/ld./uld., 15 MPH, cycle 2,000 ft. Daily output extrapolated down to 600 ft cycle.
	Spreading/Drying Material in Berm	CY	3,300	B10B	1000	40	26	312323170020: Spread dumped material, no compaction, by dozer. Daily output edited to match excavation based on experience.
	Compaction of Material in Berm	BCY	3,300	B10F	2600	15	10	312323235060: Compaction; Riding, vibrating roller, 12" lifts, 2 passes. RS Means Crew is B10Y; altered to B10F based on experience.
	Fine Grading of Berm	MSF	36	B11L	30	19	10	312216103600: Fine grading, tops of lagoon banks for compaction. Assumes 10 ft-wide berm around perimeter of 1-acre settling pond.
	Subsurface Stabilization Nonwoven Geotextile	SY	5,000	2 Clab	2500	32	0	313219161550: Geosynthetic soil stabilization, geotextile fabric, non-woven, 120 lb tensile strength includes scarifying and compaction. Assumes 1 acre settling pond.
	Settling Pond Liner	SF	5,000	B63B	1850	86	22	310519531100: Reservoir liners, membrane lining, 40 mil, LLDPE.
13	Extracted Water Discharge Management	-	-	-	-	193	64	Based on approximate 1,000 ft distance from settling pond to discharge outfall.
	Install Transfer Pump and Controller	EA	1	R30	1	52	0	Installation of transfer pump and pump controller to convey water from settling pond to discharge outfall based on Ramboll project experience. Assumes inclusion of housing structure. Assume 2 days for installation.
	Excavate Utility Trench for Conveyance to Discharge	LF	1,000	B54	860	9	9	312316142750: Utility trench excavating, chain trencher, 40 HP operator riding, 12" wide trench and backfill, 18" deep. Trench installed from settling pond to convey settled water to outfall for discharge.
	Install 8" HDPE Conveyance Pipe to Discharge	LF	1,000	B22A	320	125	50	331413350300: Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 8" diameter, SDR 21. Includes labor, materials, and machine for installation and welding of HDPE pipe for conveying water from settling pond to discharge point.
	Backfill with Granular Trench Backfill	LCY	57	B10R	100	7	5	312316133060: Backfill trench, F.E. loader, wheel mtd., 1 C.Y. bucket, 200' haul. Backfill with granular trench backfill. Quantity based on trench dimensions 12" wide, 18" deep, 1,000 ft long.
14	Trench & Wall Spoils Management	-	-	-	-	24	18	Quantity based on average area of trench excavation 2.5 ft wide by 8 ft deep over 3,250 ft extraction trench alignment. Spoils assumed to be disposed of in on-site landfill.
	Loading	CY - as excavated	725	B14B	5000	2	1	312316435320: Excavating, large volume projects; excavation with truck loading; excavator, 6 C.Y. bucket, 100% fill factor (assume 10% fluff factor from ground to excavated). Spoils volume is 30% of total trench volume per Contractor experience.
	Hauling and Placement to On-site Landfill	CY - as excavated	725	B34G	850	7	7	312323206170: Hauling; no loading equipment, including hauling, waiting, loading/dumping; 34 C.Y. off-road, 15 min wait/ld./uld., 15 MPH, cycle 1 mile.
	Spreading/Drying Moisture Conditioning	CY - as excavated	375	B10B	1000	5	3	312323170020: Spread dumped material, no compaction, by dozer. Daily output edited to match excavation based on experience. Quantity assumes 50% of volume requires moisture conditioning.
	Spreading Lifts	CY - as excavated	650	B10B	1000	8	5	312323170020: Spread dumped material, no compaction, by dozer. Daily output edited to match excavation based on experience.
	Compaction of Material	CY - in place	650	B10F	2600	3	2	312323235060: Compaction; Riding, vibrating roller, 12" lifts, 2 passes. RS Means Crew is B10Y; altered to B10F based on experience.
	BARRIER WALL & GROUNDWATER EXTRACTION TRENCH CONSTRUCTION					**3,560**	**2,370**	

ITEM NO.	SITE RESTORATION	Units	Quantity	Crew	Daily Output	Labor Hours	Equipment Hours	Notes
15	Site Restoration	-	-	-	-	317	88	Assumes restoration of grade surface following extraction trench installation
	Erosion Control Blanket	SF	8,000	B1	2500	77	0	312514160100: Rolled erosion control mats and blankets, plastic netting stapled, 2" x 1" mesh, 20 mil. Assumes erosion control blanket installed over settling pond berm.
	Lime	MSF	100.0	B66	700	2	2	329113234250: Soil preparation, structural soil mixing, spread soil conditioners, ground limestone, 1#/S.Y., tractor spreader. Assumes soils possibly being void of nutrients. Quantity disturbed areas including staging area, temporary roads, and working surface (~2.3 acre total) excluding settling pond.
	Fertilizer	MSF	144.0	B66	700	2	2	329113234150: Soil preparation, structural soil mixing, spread soil conditioners, fertilizer, 0.2#/S.Y., tractor spreader. Assumes soils possibly being void of nutrients. Quantity all disturbed areas including staging area, temporary roads, and working surface (~2.3 acre total) and new settling pond (1 acre).
	Grassland Mix	MSF	144.0	B66	52	22	22	329219142300: Seeding athletic fields, seeding fescue, tall, 5.5 lb. per M.S.F., tractor spreader. Quantity all disturbed areas including staging area, temporary roads, and working surface (~2.3 acre total) and new settling pond (1 acre).
	Mulch	MSF	144.0	B65	530	4	4	329113160350: Mulching, Hay, 1" deep, power mulcher, large.
	Road Pavement Replacement	SY	10,833	B25	4545	210	57	321216130160: Plant-mixed asphalt paving, for highways and large paved areas, binder course, 3" thick, no hauling.
	SITE RESTORATION ESTIMATED SUBTOTAL					**317**	**88**	

ITEM NO.	Corrective Action Operation and Maintenance	Units	Quantity	Crew	Daily Output	Labor Hours	Equipment Hours	Notes
16	Groundwater Extraction Trench Operation & Maintenance	-	-	-	-	4800	-	Assumes routine maintenance required over the maximum 30 years of operation. Operation excludes the 3 years of confirmation monitoring.
	Field Maintenance	Event	120	TM	-	4800	0	Assumes quarterly maintenance on pneumatic pumps and air compressors over 30 years of operation. Each maintenance event assumes 2 staff for 3 days to check, clean, and service all mechanical parts.
	Electrical Distribution and Service Charges	MO	360	-	-	-	-	Assumes electrical distribution and usage for operating the extraction and transfer pumps.
17	Non-routine System O&M	-	-	-	-	3960	990	Assumes non-routine tasks including flushing of groundwater conveyance lines and periodic site visits (e.g., alarm responses or equipment troubleshooting) over 30 years of operation. Operation excludes the 3 years of confirmation monitoring.
	Groundwater Conveyance Line Flushing - Vacuum Truck	LF	105,000	VT	-	1,980	990	330130116140: Pipe, internal cleaning and inspection, cleaning, power rudder with header & cutts, 4"-12" diameter. Assumes one 3-day cleaning event of 3,500 LF of 8" HDPE pipe per year for a total of 30 years of operation.
	Non-Routine Site Visits/Alarm Responses	LS	180	OM	-	1,980	0	Assumes 6 non-routine site visits per year over 30 years of operation. Each non-routine event assumes 2 staff for 1 day.
	CORRECTIVE ACTION OPERATION AND MAINTENANCE SUBTOTAL					**8,760**	**990**	

	Total Labor Hours	Total Equipment Hours
ENGINEERING AND CONSTRUCTION SUBTOTAL	**8,200**	**3,100**
CORRECTIVE ACTION OPERATION AND MAINTENANCE SUBTOTAL	**8,760**	**990**
ENGINEER'S ESTIMATE OF TOTAL CONSTRUCTION AND ENGINEERING HOURS	**17,000**	**4,100**

NOTES:

1. Alternative 2: Source Control with groundwater extraction trench and barrier wall is estimated to take greater than 30 years to achieve groundwater protection standards (GWPS-35 I.A.C Section 845.600) at all perimeter wells associated with AP2. For the purposes of this estimate, a maximum of 30 years of operation & compliance monitoring followed by 3 years of confirmation monitoring was assumed.
2. RS Means refers to the 2023 Quarter 4 online edition of RS Means Commercial New Construction.
3. See crew tab (Alt 2 - Crews) for assumptions regarding crew size, total labor hours and required construction equipment, as needed, for each task.
4. See mileage tab (Alt 2 - Mileage) for assumptions regarding total mileage for tasks outlined in this alternative.

ACRONYMS:

AC = Acre
AP2 = Ash Pond No. 2
CY = Cubic Yard
Loose: Material swelled when removed from compacted state
EA = Each
GWPS = groundwater protection standards
LF = Linear Foot
LS = Lump Sum
MSF = square feet divided by 1000
MO = Month
O&M = Operation & Maintenance
SF = Square Feet
SY = Square Yard

CREW CODES
ILLINOIS POWER GENERATING COMPANY - COFFEEN POWER PLANT - ASH POND 2
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 2 - UPGRADIENT BARRIER WALL AND GROUNDWATER EXTRACTION TRENCH

Item No.	Crew Code	Labor	Daily Labor Hours	Equipment	Daily Equipment Hours	Crew Size	Onsite Labor Hours	Onsite Heavy Equipment Hours
Construction								
2,5,12	2 Clab	Laborer x2	16	None	0	2	103	0
3	A2	Laborer x2 Truck Driver x1	24	Flatbed Truck, Gas, 1.5 ton	8	3	108	36
15	B1	Labor Foremanx1 Laborer x2	24	None	0	3	77	0
10,11	B6	Laborer x 2 Operator (light) x 1	24	Backhoe Loader, 48 H.P.	8	3	360	120
8,12,14	B10B	Operator x1 Laborer x0.5	12	Dozer, 200 H.P.	8	1.5	53	36
8,12,14	B10F	Operator (med) x1 Laborer x0.5	12	Tandem Roller, 10, Ton	8	1.5	19	13
10,13	B10R	Operator (med) x 1 Laborer x 0.5	12	Frontend loader, W.M., 1 C.Y.	8	1.5	327	218
5,12	B11L	Operator (med) x 1 Laborer x 1	16	Grader, 30,000lb	8	2	46	23
12	B12D	Operator (crane) x 1 Laborer x 1	16	Hydraulic excavator, 3.5 C.Y.	8	2	25	13
7	B13D	Operator (crane) x 1 Laborer x 1	16	Hydraulic excavator, 1 C.Y. Trench Box	8	2	55	27
2,5	B14	Labor Foreman x 1 Operator (light) x1 Laborer x 4	48	Hyd. Excavator, 4.5 C.Y. Backhoe Loader, 48 H.P.	16	6	871	290
14	B14B	Operator (crane) x 1 Laborer x 0.5	12	Hydraulic excavator, 6. C.Y.	8	1.5	2	1
10,13	B22A	Labor Foreman x1 Skilled Worker x1 Laborer x2 Operator (crane) x1	40	S.P. Crane, 4x4, 5 ton Butt Fusion Machine, 4-12" diam.	16	5	438	175
15	B25	Labore Foreman x1 Laborer x7 Operator x3	88	Asphalt Paver, 130 H.P. Tandem Roller, 10 ton Roller, Pneum. Whl, 12 ton	24	11	210	57
7	B34C	Truck Driver x1	8	Truck Tractor, 6x4, 380 H.P. Dump Trailer, 16.5 C.Y.	8	1	71	71
7,12,14	B34G	Truck Driver x1	8	Dump Truck, Off Hwy., 50 ton	8	1	23	23
5	B38	Labor Foreman x1 Laborer x2 Operator (light) x1 Operator (med) x1	40	Backhoe Loader, 48 H.P. Hyd. Hammer (1200 lb) F.E. Loader, W.M., 4 C.Y. Pvmt. Rem. Bucket	16	5	628	251
10,13	B54	Operator (light) x1	8	Trencher, Chain, 40 H.P.	8	1	14	14
3	B62	Laborer x2 Operator x 1	24	Loader, Skid Steer, 30 H.P.	8	3	133	44
12	B63B	Labor Foreman x1 Laborer x2 Operator (light) x1	32	Loader, Skid Steer, 78 H.P.	8	4	86	22
15	B65	Laborer x1 Truck Driver (light) x1	16	Power Mulcher (large) Flatbed Truck, Gas, 1.5 ton	16	2	4	4
15	B66	Operator (light) x1	8	Loader-Backhoe, 40 H.P.	8	1	26	26
10	Q1	Plumber x1 Plumber Apprentice x1	16	None	0	2	44	0
4	R1B	Electrician x1 Electrician Apprentice x2	24	None	0	3	144	0
10,13	R30	Electrician Foreman x0.25 Electrician x1 Laborer (Semi-Skilled) x2	26	None	0	3.25	312	0
6	GM	Engineering Staff x4	40	Service Vehicle x 2	0	4	600	0
8,9	OP	Operator x3 Laborer x 2	50	CAT 950 Loader x 3, CAT 374 Excavator x 1 CAT 349 Excavator x 1 Manlift x 1, Telehandlers x 2	50	5	1,625	1,625
1	Eng	Engineering Staff x1.2	10	Rental Vehicle x1	0	1.2	1,728	0
				Construction Subtotals			8,200	3,100
Corrective Action Operation & Maintenance								
16	TM	Maintenance Crew x2	20	Service Truck x2 Hand Tools	0	2	4,800	0
17	VT	Laborer x1 Operator x1	20	Vacuum Truck with Flushing Capabilities	10	2	1,980	990
17	OM	Laborer x1	10	Service Truck x1	0	1	1,980	0
				O&M Subtotals			8,760	990
Note: Blue shaded crew codes were created by Ramboll based on experience (not pulled from RS Means).						**Totals**	**17,000**	**4,100**

CONSTRUCTION MILEAGE AND LABOR ESTIMATES
ILLINOIS POWER GENERATING COMPANY - COFFEEN POWER PLANT - ASH POND 2
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 2 - UPGRADIENT BARRIER WALL AND GROUNDWATER EXTRACTION TRENCH

Construction Mileage and Labor Estimates - Alternative 2: Upgradient Barrier Wall and Groundwater Extraction Trench

Item	Quantity	Assumptions
Labor Total Hours	8,132	Per projected Construction total in cost estimate (does not include contingency)
Duration of Onsite Construction Days	135	Total Days
Average Daily Crew Size	5.0	Assumes multiple crew sizes and a 10 hour work day Assumes 1 Ramboll personnel daily for construction oversight
Daily Labor Mobilization Miles	47,274	Includes light and medium commercial vehicles Average of 70 miles round trip per day
Vehicles Miles Onsite	10,130	Includes light and medium commercial vehicles 5 miles per day for onsite miles No contingency Included
Equipment Mobilization Miles - Unloaded	5,628	Average of 250 miles one-way for equipment hauling (from Chicago, IL) Average 1 load of equipment per working week
Equipment Mobilization Miles - Loaded	5,628	Average of 250 miles one-way for equipment hauling (from Chicago, IL) Average 1 load of equipment per working week
Onsite Haul Truck Miles - Unloaded	2,098	34 CY Off Road Dump Truck 1 mile round trip per load
Onsite Haul Truck Miles - Loaded	2,098	34 CY Off Road Dump Truck 1 mile round trip per load
Offsite Haul Truck Miles - Unloaded	8,697	Assumes 16 CY loads of fill materials (gravel/sand backfill and clay cap) are delivered to the site from a regional supplier located within 100 miles of the site
Offsite Haul Truck Miles - Loaded	8,697	Assumes truck is returning to the regional supplier located within 100 miles of the site
Material Delivery Miles - Unloaded	4,502	Misc. construction materials (erosion controls, piping, geotextile) Assumes 200 mile round trip, average 2 trips per working week
Material Delivery Miles - Loaded	4,502	Misc. construction materials (erosion controls, piping, geotextile) Assumes 200 mile round trip, average 2 trips per working week

Operation & Maintenance (O&M) Mileage and Labor Estimates - Alternative 2: Upgradient Barrier Wall and Groundwater Extraction Trench

Item	Quantity	Assumptions
Labor Total Hours	8,760	Per projected CM total in cost estimate (does not include contingency)
Duration of Onsite OMM Days	240	Total Days
Average Daily Crew Size	4	Assumes multiple crew sizes and a 10 hour work day
Daily Labor Mobilization Miles	105,120	Includes mob/demob from Chicago (260 miles round trip) and local daily commute mileage (40 round trip miles per day). Assumes 6 work days per week
Vehicles Miles Onsite	13,140	Includes light and medium commercial vehicles 15 miles per day for onsite miles No contingency Included
Equipment Mobilization Miles - Unloaded	7,500	Average of 250 miles one-way for equipment mobilization (from Chicago, IL) Average 1 mobilization/demobilization per year for jetting/flushing of conveyance lines over 30 years of operation
Equipment Mobilization Miles - Loaded	7,500	Average of 250 miles one-way for equipment mobilization (from Chicago, IL) Average 1 mobilization/demobilization per year for jetting/flushing of conveyance lines over 30 years of operation
Onsite Haul Truck Miles - Unloaded	0	-
Onsite Haul Truck Miles - Loaded	0	-
Offsite Haul Truck Miles - Unloaded	0	-
Offsite Haul Truck Miles - Loaded	0	-
Material Delivery Miles - Unloaded	0	-
Material Delivery Miles - Loaded	0	-

CAGM = Corrective Action Groundwater Monitoring

ILLINOIS POWER GENERATING COMPANY - COFFEEN POWER PLANT - ASH POND 2
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 3 - HORIZONTAL EXTRACTION WELL[1]

ITEM NO.	ENGINEERING, PRE-CONSTRUCTION, AND CONSTRUCTION SUPPORT TASKS	Units	Quantity	Crew	Daily Output	Labor Hours	Equipment Hours	Notes
1	Engineering Support and CQA During Construction	LS	1	Eng	12	1440	0	Assumed labor and equipment hours based on Ramboll project experience.
	ENGINEERING, PRE-CONSTRUCTION, AND CONSTRUCTION SUPPORT TASK ESTIMATED SUBTOTAL					**1,440**	**0**	
ITEM NO.	**SITE PREPARATION**	**Units**	**Quantity**	**Crew**	**Daily Output**	**Labor Hours**	**Equipment Hours**	**Notes**
2	Staging Area & Temporary Roads Preparation	-	-	-	-	524	161	Assumes some work general preparation of temporary access roads to access the horizontal well installation point
	Subsurface Stabilization Nonwoven Geotextile	SY	6,200	2 Clab	2500	40	0	313219161550: Geosynthetic soil stabilization, geotextile fabric, non-woven, 120 lb tensile strength includes scarifying and compaction. Assumes 0.25 acre staging area and approximately 1,500 ft of temporary access road along the southern edge of flume for access to the horizontal well installation point in southeast corner of AP2.
	Construct Staging Area & Temporary Roads	SY	6,200	B14	615	484	161	015523500100: Temporary, roads, gravel fill, 8" gravel depth, excluding surfacing. Assumes 0.25 acre staging area and approximately 1,500 ft of temporary access road along the southern edge of flume for access to the horizontal well installation point in southeast corner of AP2.
3	Construction Soil Erosion Controls	-	-	-	-	27	9	Assumes soil erosion controls will be implemented throughout horizontal well construction.
	Silt Fence	LF	450	B62	650	17	6	312514161000: Synthetic erosion control, silt fence, install and remove, 3' high. Assumes silt fence is installed around perimeter of work pad.
	Sediment Log, Filter Sock	LF	450	A2	1000	11	4	312514160705: Sediment Log, Filter Sock, 9". Assumes silt fence is installed around perimeter of work pad.
4	Temporary Electrical Installation	EA	1	R1B	-	72	0	Electrical installation based on Ramboll experience to install one power drop for low-voltage (120V) power for the pneumatic transfer pump at the settling pond for discharge of water to outfall.
5	Work Pad Construction for Horizontal Well Installation	-	-	-	-	134	48	Construction of work pad within the flume for access during horizontal well construction, approximately 50 feet long by 50 feet wide and 10 feet deep. Gravel in flume will be left in place after construction with a free-draining culvert.
	Clearing & Grubbing for Work Surface	Acre	0.35	B7	0.3	56	28	311110100020: Clearing & grubbing, cut & chip light trees to 6" diameter. Clearing of 100 ft by 150 ft total area salong northern bank of flume/southern side of AP2.
	Surface Grading	MSF	15	B11L	30	8	4	312216103600: Fine grading, work pad area. Assumes grading in cleared area 100 ft by 150 ft along northern bank of flume/southern side of AP2.
	Subsurface Stabilization Nonwoven Geotextile	SY	1,670	2 Clab	2500	11	0	313219161550: Geosynthetic soil stabilization, geotextile fabric, non-woven, 120 lb tensile strength includes scarifying and compacting. Assumes reinforcement for graded slope area on northern bank of flume/southern side of AP2, 100 ft by 150 ft.
	Install Crushed Gravel Work Pad in Flume	SY	926	B10R	800	14	9	312323155050: Borrow, select granular fill, 3/4 C.Y. bucket, loading and/or spreading, front end loader, wheel mounted. Work pad in flume for horizontal well installation assumed 10 ft deep (flume depth), 50 ft wide (flume width) and extending 300 ft long for placement of drill rig for horizontal well installation.
	Install Concrete Culverts	LY	50	B13	62	45	6	334211601594: Public storm utility drainage piping, reinforced concrete pipe (RCP), 36" diameter, class 2, excludes excavation and backfill, gaskets. Assumes culvert extends the length of the area of placed rip-rap and gravel work pad.
	SITE PREPARATION ESTIMATED SUBTOTAL					**760**	**220**	
ITEM NO.	**HORIZONTAL WELL CONSTRUCTION**	**Units**	**Quantity**	**Crew**	**Daily Output**	**Labor Hours**	**Equipment Hours**	**Notes**
6	Installation of Horizontal Well	-	-	-	-	1,640	1,204	Installation of one single-ended well in north-south alignment at the base of AP2, performed in one mobilization.
	Drill Pilot Bore for 4" Single-Ended Well	LF	1,325	OP	-	700	500	Quantities for labor of well assembly and installation in the pilot bore for one horizontal well per specialty contractor estimate. Assumes one well takes approximately 5 full days to bore.
	Assembly and Installation of 4" Well Materials	LF	1,325	OP	-	700	500	Quantities for labor of well assembly and installation in the pilot bore for one horizontal well per specialty contractor estimate. Assumes one well takes approximately 5 full days to assemble and install after drilling of the borehole.
	Install Entry Grout Seal	EA	1	SUP	-	40	40	Quantities for one horizontal well per specialty contractor estimate. Assume each seal takes approximately half a day to complete.
	Install Surface Pad	EA	1	SUP	-	40	4	Installation of concrete surface pad for 4" well per specialty contractor estimate. Assume one pad takes approximately half a day to install.
	Well Development	EA	1	SUP	-	160	160	Quantities for one horizontal well per specialty contractor estimate. Purge water to be managed by settling pond.
7	Horizontal Well Mechanical Installation	-	-	-	-	551	139	Includes installation of sumps, equalization tank, transfer pumps and controllers, and associated excavation and backfill.
	Install Equalization Tank	EA	1	B6	1	180	60	Installation of equalization tank at end of each horizontal well and associated site preparation and instrumentation. Assumes 2 days each for installation.
	Install Transfer Pumps and Controllers	EA	1	R30	1	26	0	Installation of transfer pump and pump controller at end of one horizontal well to convey water from settling pond to discharge outfall based on Ramboll project experience. Assumes inclusion of housing structure and 2 days for installation.
	Excavate Utility Trench for Lines to Compressors and Extraction Pumps	LF	1,200	B54	860	11	11	312316142750: Utility trench excavating, chain trencher, 40 HP operator riding, 12" wide trench and backfill, 18" deep. Trench installed from power drop/compressor shed to extraction trench to supply compressed air and power to sump pits. Assumes 1,200 ft distance from compressor shed to end of horizontal well.
	Install Mechanical Elements and Piping	EA	1	R30	-	208	0	Assumes furnishing all mechanical elements (air compressors, pneumatic extraction pumps, transfer pumps) and associated HDPE housing piping for distribution of power and housing of mechanical elements throughout the extraction trench system. Assumes approximately 8 days of work.
	Excavate Utility Trench for Conveyance to Settling Pond	LF	500	B10R	100	60	40	312316142750: Utility trench excavating, chain trencher, 40 HP operator riding, 12" wide trench and backfill, 18" deep. Trench installed from horizontal well to convey extracted water to the settling pond.
	Install 8" HDPE Conveyance Pipe to Settling Pond	LF	500	B22A	320	63	25	331413350300: Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 8" diameter, SDR 21. Includes labor, materials, and machine for installation and welding of HDPE pipe for conveying extracted water from horizontal well to settling pond.
	Backfill with Granular Trench Backfill	LCY	30	B10R	100	4	2	312316133060: Backfill trench, F.E. loader, wheel mtd., 1 C.Y. bucket, 200' haul. Backfill with granular trench backfill. Quantity based on trench dimensions 12" wide, 18" deep, 500 ft long.
8	Construction of Compressor Shed	-	-	-	-	180	60	Based on Ramboll experience for construction of housing unit for air compressor shed.
	Construct Compressor Shed	EA	1	B6	-	180	60	Assumes pre-fabricated air compressor shelter, installed primarily by hand with light equipment assistance. Hours are based on Ramboll experience
9	Installation of Settling Pond	-	-	-	-	226	89	Quantity based on 1-acre pond, 2 feet deep. Assume all excavated material is reused for berm construction.
	Excavation and Loading of Settling Pond Material	BCY	3,300	B12D	2080	25	12.7	312316420300: Excavating, bulk bank measure, hydraulic, crawler mtd., 3 C.Y. cap (300 CY/hr).
	Hauling and Placement of Settling Pond Material	LCY	3,300	B34G	3287	8	8.0	312323206130: Hauling; no loading equipment, including hauling, waiting, loading/dumping; 34 C.Y. off-road, 15 min wait/ld./uld., 15 MPH, cycle 2,000 ft. Daily output extrapolated down to 600 ft cycle.
	Spreading/Drying Material in Berm	CY	3,300	B10B	1000	40	26.4	312323170020: Spread dumped material, no compaction, by dozer. Daily output edited to match excavation based on experience.
	Compaction of Material in Berm	BCY	3,300	B10F	2600	15	10.2	312323235060: Compaction; Riding, vibrating roller, 12" lifts, 2 passes. RS Means Crew is B10Y; altered to B10F based on experience.
	Fine Grading of Berm	MSF	36	B11L	30	19	10	312216103600: Fine grading, tops of lagoon banks for compaction. Assumes 10 ft-wide berm around perimeter of 1-acre settling pond.
	Subsurface Stabilization Nonwoven Geotextile	SY	5,000	2 Clab	2500	32	0	313219161550: Geosynthetic soil stabilization, geotextile fabric, non-woven, 120 lb tensile strength includes scarifying and compaction. Assumes 1 acre settling pond.
	Settling Pond Liner	SF	5,000	B63B	1850	86	22	310519531100: Reservoir liners, membrane lining, 40 mil, LLDPE.
10	Extracted Water Discharge Management	-	-	-	-	123	32	Management of water extracted from the horizontal well to convey from settling pond to discharge. Based on approximate distance of 500 ft from settling pond to discharge outfall.
	Install Transfer Pump and Controller	EA	1	R30	1	52	0	Installation of transfer pump and pump controller to convey water from settling pond to discharge outfall based on Ramboll project experience. Assumes inclusion of housing structure. Assume 2 days for installation.
	Excavate Utility Trench for Conveyance to Discharge	LF	500	B54	860	5	5	312316142750: Utility trench excavating, chain trencher, 40 HP operator riding, 12" wide trench and backfill, 18" deep. Trench installed from settling pond to convey settled water to outfall for discharge.
	Install 8" HDPE Conveyance Pipe to Discharge	LF	500	B22A	320	63	25	331413350300: Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 8" diameter, SDR 21. Includes labor, materials, and machine for installation and welding of HDPE pipe for conveying water from settling pond to discharge point.
	Backfill with Granular Trench Backfill	LCY	30	B10R	100	4	2	312316133060: Backfill trench, F.E. loader, wheel mtd., 1 C.Y. bucket, 200' haul. Backfill with granular trench backfill. Quantity based on trench dimensions 12" wide, 18" deep, 500 ft long.
	HORIZONTAL WELL CONSTRUCTION					**2,720**	**1,530**	
ITEM NO.	**SITE RESTORATION**	**Units**	**Quantity**	**Crew**	**Daily Output**	**Labor Hours**	**Equipment Hours**	**Notes**
11	Site Restoration	-	-	-	-	126	6	Assumes restoration of grade surface following horizontal well installation for staging area (50x150 ft) and bank restoration (50x100 ft). Gravel backfill and culvert will remain in place in flume. Gravel access road will remain in place for O&M access.
	Erosion Control Blanket	SF	12,500	B1	2500	120	0	312514160100: Rolled erosion control mats and blankets, plastic netting stapled, 2" x 1" mesh, 20 mil. Assumes erosion control blanket installed on work pad (150x50 ft).
	Lime	MSF	13.8	B66	700	1	1	329113234250: Soil preparation, structural soil mixing, spread soil conditioners, ground limestone, 1#/S.Y., tractor spreader. Assumes soils possibly being void of nutrients. Quantity disturbed areas staging area and northern bank of flume.
	Fertilizer	MSF	13.8	B66	700	1	1	329113234150: Soil preparation, structural soil mixing, spread soil conditioners, fertilizer, 0.2#/S.Y., tractor spreader. Assumes soils possibly being void of nutrients. Quantity disturbed areas staging area and northern bank of flume.
	Grassland Mix	MSF	13.8	B66	52	3	3	329219142300: Seeding athletic fields, seeding fescue, tall, 5.5 lb. per M.S.F., tractor spreader. Quantity disturbed areas including staging area and northern tank of flume. Assume that gravel in flume and temporary roads are to remain in place.
	Mulch	MSF	13.8	B65	530	1	1	329113160350: Mulching, Hay, 1" deep, power mulcher, large.
	SITE RESTORATION ESTIMATED SUBTOTAL					**126**	**6**	

ALTERNATIVE 3 - HORIZONTAL EXTRACTION WELL[1]

ITEM NO.	Corrective Action Operation and Maintenance	Units	Quantity	Crew	Daily Output	Labor Hours	Equipment Hours	Notes
12	Horizontal Well Operation & Maintenance	-	-	-	-	4800	-	Assumes routine maintenance required over the maximum of 30 years of operation. Operation excludes the 3 years of confirmation monitoring.
	Field Maintenance	Event	120	TM	-	4800	0	Assumes quarterly maintenance on transfer pumps and air compressors over a maximum of 30 years of operation. Each maintenance event assumes 2 staff for 2 days to check, clean, and service all mechanical parts. Assumes all labor, equipment, mobilization over 2 days.
13	Non-routine System O&M	-	-	-	-	2,760	300	Assumes non-routine tasks including flushing of groundwater conveyance lines and periodic site visits (e.g., alarm responses or equipment troubleshooting) over a maximum of 30 years of operation. Operation excludes the 3 years of confirmation monitoring.
	Groundwater Conveyance Line Flushing - Vacuum Truck	LF	30,000	VT	-	600	300	33013011614O: Pipe, internal cleaning and inspection, cleaning, power rudder with header & cutts, 4"-12" diameter. Assumes one 2-day cleaning event of 1,000 LF of 8" HDPE pipe per year for a total of 15 years.
	Non-Routine Site Visits/Alarm Responses	LS	180	OM	-	1,800	-	Assumes 6 non-routine site visits per year over a maximum of 30 years of operation. Each non-routine event assumes 2 staff for 1 day.
	Extraction Well Development and Maintenance	LS	6	WD	-	360	-	Assumes extraction well will be developed once every 5 years to remove potential accumulation of organic or inorganic solids in the extraction well over 30 years of operation. Assumes re-development is completed with a two man crew over a 3 day period total for the one well.
	CORRECTIVE ACTION OPERATION AND MAINTENANCE SUBTOTAL					**7,560**	**300**	

			Total Labor Hours	Total Equipment Hours
ENGINEERING AND CONSTRUCTION SUBTOTAL			**5,100**	**1,800**
CORRECTIVE ACTION OPERATION AND MAINTENANCE SUBTOTAL			**7,560**	**300**
ENGINEER'S ESTIMATE OF TOTAL CONSTRUCTION AND ENGINEERING HOURS			**12,700**	**1,800**

NOTES:

1. Alternative 3: Source Control with horizontal extraction well is estimated to take greater than 30 years to achieve and maintain groundwater protection standards (GWPS-35 I.A.C Section 845.600) at all perimeter wells associated with AP2 following alternative implementation.
2. RS Means refers to the 2023 Quarter 4 online edition of RS Means Commercial New Construction.
3. See crew tab (Alt 3 - Crews) for assumptions regarding crew size, total labor hours and required construction equipment, as needed, for each task.
4. See mileage tab (Alt 3 - Mileage) for assumptions regarding total mileage for tasks outlined in this alternative.

ACRONYMS:

AC = Acre
AP2 = Ash Pond No. 2
CY = Cubic Yard
Loose: Material swelled when removed from compacted state
EA = Each
GWPS = groundwater protection standards
LCY = Loose Cubic Yards
LF = Linear Foot
LS = Lump Sum
MSF = square feet divided by 1000
MO = Month
OMM = Operation, Monitoring, Maintenance
SF = Square Feet
SY = Square Yard

CREW CODES
ILLINOIS POWER GENERATING COMPANY - COFFEEN POWER PLANT - ASH POND 2
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 3 - HORIZONTAL EXTRACTION WELL

Item No.	Crew Code	Labor	Daily Labor Hours	Equipment	Daily Equipment Hours	Crew Size	Onsite Labor Hours	Onsite Heavy Equipment Hours
Construction								
2,5,9	2 Clab	Laborer x2	16	None	0	2	82	0
3	A2	Laborer x2 Truck Driver x1	24	Flatbed Truck, Gas, 1.5 ton	8	3	11	4
11	B1	Labor Foremanx1 Laborer x2	24	None	0	3	120	0
7,8	B6	Laborer x 2 Operator (light) x 1	24	Backhoe Loader, 48 H.P.	8	3	360	120
5	B7	Labore Foreman (outside) x1 Laborer x4 Operator (medium) x1	48	Brush Chipper, 12", 130 H.P. Crawl Loader, 3 C.Y. Chain Saws, Gas, 36" Long x2	24	6	56	28
9	B10B	Operator x1 Laborer x0.5	12	Dozer, 200 H.P.	8	1.5	40	26
9	B10F	Operator (med) x1 Laborer x0.5	12	Tandem Roller, 10, Ton	8	1.5	15	10
5,7,10	B10R	Operator (med) x 1 Laborer x 0.5	12	Frontend loader, W.M., 1 C.Y.	8	1.5	81	54
5,9	B11L	Operator (med) x 1 Laborer x 1	16	Grader, 30,000lb	8	2	27	14
9	B12D	Operator (crane) x 1 Laborer x 1	16	Hydraulic excavator, 3.5 C.Y.	8	2	25	13
5	B13	Laborer Foreman x1 Laborer x4 Operator (crane) x1 Operator (oiler) x1	56	Hydraulic Crane, 25 ton	8	6	45	6
2	B14	Labor Foreman x 1 Operator (light) x1 Laborer x 4	48	Hyd. Excavator, 4.5 C.Y. Backhoe Loader, 48 H.P.	16	6	498	171
7,10	B22A	Labor Foreman x1 Skilled Worker x1 Laborer x2 Operator (crane) x1	40	S.P. Crane, 4x4, 5 ton Butt Fusion Machine, 4-12" diam.	16	5	125	50
9	B34G	Truck Driver x1	8	Dump Truck, Off Hwy., 50 ton	8	1	8	8
7,10	B54	Operator (light) x1	8	Trencher, Chain, 40 H.P.	8	1	16	16
3	B62	Laborer x2 Operator x 1	24	Loader, Skid Steer, 30 H.P.	8	3	17	6
9	B63B	Labor Foreman x1 Laborer x2 Operator (light) x1	32	Loader, Skid Steer, 78 H.P.	8	4	86	22
11	B65	Laborer x1 Truck Driver (light) x1	16	Power Mulcher (large) Flatbed Truck, Gas, 1.5 ton	16	2	1	1
11	B66	Operator (light) x1	8	Loader-Backhoe, 40 H.P.	8	1	5	5
4	R1B	Electrician x1 Electrician Apprentice x2	24	None	0	3	72	0
7,10	R30	Electrician Foreman x0.25 Electrician x1 Laborer (Semi-Skilled) x2	26	None	0	3.25	260	0
6	SUP	Operator x2 Laborer x2	40	CAT 950 Loader x 3, CAT 374 Excavator x 1 CAT 349 Excavator x 1 Manlift x 1, Telehandler x 1	40	4	200	200
6	OP	Operator x4 Laborer x3	70	Drill Rig x1 Drill Cab, Trailer-Mtd x1 CAT Excavator x 1 Mud Recycling System x1 Water Truck x1 Manlift x 1, Telehandlers x 2	50	7	1,400	1,000
1	Eng	Engineering Staff x1.2	10	Rental Vehicle x1	0	1.2	1,440	0
				Construction Subtotals			5,000	1,800
Corrective Action Operation & Maintenance								
12	TM	Maintenance Crew x2	20	Service Truck x2 Hand Tools	0	2	4,800	0
13	VT	Laborer x1 Operator x1	20	Vacuum Truck with Flushing Capabilities	10	2	600	300
13	WD	Laborer x1 Operator x1	20	Well Development Rig, Mounted Winch or Hoisting System	8	2	360	0
13	OM	Laborer x1	10	Service Truck x1	0	1	1,800	0
				O&M Subtotals			7,560	300
						Totals	**12,600**	**2,100**

Note: Blue shaded crew codes were created by Ramboll based on experience (not pulled from RS Means).

CONSTRUCTION MILEAGE AND LABOR ESTIMATES
ILLINOIS POWER GENERATING COMPANY - COFFEEN POWER PLANT - ASH POND 2
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 3 - HORIZONTAL EXTRACTION WELL

Construction Mileage and Labor Estimates - Alternative 3: Horizontal Extraction Wells

Item	Quantity	Assumptions
Labor Total Hours	5,000	Per projected Construction total in cost estimate (does not include contingency)
Duration of Onsite Construction Days	69	Total Days
Average Daily Crew Size	5.3	Assumes multiple crew sizes and a 10 hour work day Assumes 1 Ramboll personnel daily for construction oversight
Daily Labor Mobilization Miles	25,586	Includes light and medium commercial vehicles Average of 70 miles round trip per day
Vehicles Miles Onsite	5,483	Includes light and medium commercial vehicles 5 miles per day for onsite miles No contingency Included
Equipment Mobilization Miles - Unloaded	5,711	Average of 500 miles round trip for equipment hauling (from Chicago, IL) Average 1 load of equipment per working week
Equipment Mobilization Miles - Loaded	5,711	Average of 500 miles round trip for equipment hauling (from Chicago, IL) Average 1 load of equipment per working week
Onsite Haul Truck Miles - Unloaded	49	34 CY Off Road Dump Truck 1 mile round trip per load
Onsite Haul Truck Miles - Loaded	49	34 CY Off Road Dump Truck 1 mile round trip per load
Offsite Haul Truck Miles - Unloaded	4,973	Assumes 16 CY loads of fill materials (gravel/sand backfill and clay cap) are delivered to the site from a regional supplier and 16 CY loads of recyced concrete are hauled to a facility located within 50 miles of the site
Offsite Haul Truck Miles - Loaded	4,973	Assumes truck is returning to the regional supplier/recycling facility located within 50 miles of the site
Material Delivery Miles - Unloaded	2,284	Misc. construction materials (erosion controls, piping, geotextile) Assumes 200 mile round trip, average 2 trips per working week
Material Delivery Miles - Loaded	2,284	Misc. construction materials (erosion controls, piping, geotextile) Assumes 200 mile round trip, average 2 trips per working week

Operation & Maintenance (O&M) Mileage and Labor Estimates - Alternative 3: Horizontal Extraction Wells

Item	Quantity	Assumptions
Labor Total Hours	7,560	Per projected CM total in cost estimate (does not include contingency)
Duration of Onsite OMM Days	240	Total Days
Average Daily Crew Size	3	Assumes multiple crew sizes and a 10 hour work day
Daily Labor Mobilization Miles	90,720	Includes mob/demob from Chicago (260 miles round trip) and local daily commute mileage (40 round trip miles per day). Assumes 6 work days per week
Vehicles Miles Onsite	11,340	Includes light and medium commercial vehicles 15 miles per day for onsite miles No contingency Included
Equipment Mobilization Miles - Unloaded	3,750	Average of 250 miles one-way for equipment mobilization (from Chicago, IL) Average 1 mobilization/demobilization per year for jetting/flushing of conveyance lines over 30 years of operation
Equipment Mobilization Miles - Loaded	3,750	Average of 250 miles one-way for equipment mobilization (from Chicago, IL) Average 1 mobilization/demobilization per year for jetting/flushing of conveyance lines over 30 years of operation
Onsite Haul Truck Miles - Unloaded	0	No onsite hauling during this phase
Onsite Haul Truck Miles - Loaded	0	No onsite hauling during this phase
Offsite Haul Truck Miles - Unloaded	0	No spoil handling off-site will occur under this alternative
Offsite Haul Truck Miles - Loaded	0	No spoil handling off-site will occur under this alternative
Material Delivery Miles - Unloaded	1,500	Misc. vegetation maintenance materials (seeding, etc.) Assumes 200 mile round trip, 1 load per mobilization (once per year)
Material Delivery Miles - Loaded	1,500	Misc. vegetation maintenance materials (seeding, etc.) Assumes 200 mile round trip, 1 load per mobilization (once per year)

CAGM = Corrective Action Groundwater Monitoring

Appendix C

Corrective Measures Assessment

Intended for
Illinois Power Generating Company

Date
June 12, 2024

Project No.
1940103584-002

35 I.A.C. § 845 CORRECTIVE MEASURES ASSESSMENT

ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS
IEPA ID: W135015004-02

RAMBOLL Bright ideas. Sustainable change.

35 I.A.C. § 845 CORRECTIVE MEASURES ASSESSMENT COFFEEN POWER PLANT ASH POND NO. 2

Project name	**Coffeen Power Plant Ash Pond No. 2**
Project no.	**1940103584-002**
Recipient	**Illinois Power Generating Company**
Document type	**35 I.A.C. § 845 Corrective Measures Assessment**
Revision	**FINAL**
Date	**June 12, 2024**
Prepared by	**A. Frances Ackerman, RG, PE**
Checked by	**Lucas P. Carr, PE**
Approved by	**Brian G. Hennings, PG**

Frances Ackerman, RG, PE
Senior Managing Engineer

Brian Hennings, PG
Project Officer, Hydrogeology

CONTENTS

1.	**Introduction**	**3**
1.1	Source Control and Residual Plume Management	3
1.2	Adaptive Site Management	3
2.	**Site Information**	**5**
2.1	Conceptual Site Model	5
2.2	Groundwater Quality	6
3.	**Corrective Measures Assessment Methodology**	**8**
4.	**Description of Potential Corrective Measure Technologies**	**9**
4.1	Source Control with Groundwater Polishing	9
4.2	Source Control with Groundwater Extraction	10
4.3	Source Control with a Cutoff Wall	11
4.4	Source Control with In-Situ Chemical Treatment	11
5.	**Assessment of Corrective Measure Technologies**	**13**
5.1	Requirements	13
5.2	Groundwater Corrective Technology Assessment	13
5.2.1	Source Control with Groundwater Polishing	13
5.2.2	Source Control with Groundwater Extraction	14
5.2.3	Source Control with Groundwater Cutoff Wall	15
5.2.4	Source Control with In-Situ Chemical Treatment	16
5.3	Technologies Advanced to CAAA	17
6.	**References**	**18**

TABLES

Table 5-1 Corrective Measures Assessment Matrix

FIGURES

Figure 2-1 Site Location Map
Figure 2-2 Site Map
Figure 2-3 Potentiometric Surface Map - April 30, 2023
Figure 2-4 Monitoring Well Location Map

ACRONYMS AND ABBREVIATIONS

35 I.A.C.	Title 35 of the Illinois Administrative Code
AP1	Ash Pond No. 1
AP2	Ash Pond No. 2
ASD	alternative source demonstration
CAAA	Corrective Action Alternatives Analysis
CAP	Corrective Action Plan
CCR	coal combustion residuals
CIP	closure-in-place
CMA	Corrective Measures Assessment
cm/s	centimeters per second
CPP	Coffeen Power Plant
CSM	conceptual site model
DA	deep aquifer
DCU	deep confining unit
EPRI	Electric Power Research Institute
E001	Event 1; quarter 2, 2023
GMF	Gypsum Management Facility
GMF GSP	GMF Gypsum Stack Pond
GMF RP	GMF Recycle Pond
GMP	Groundwater Monitoring Plan
GWPS	groundwater protection standard(s)
ID	identification
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
IPGC	Illinois Power Generating Company
ITRC	National Research Council, Interstate Technology & Regulatory Council
LCU	lower confining unit
NID	National Inventory of Dams
No.	number
NPDES	National Pollutant Discharge Elimination System
NRT	Natural Resource Technology
PMP	potential migration pathway
PRB	Permeable Reactive Barrier
Ramboll	Ramboll Americas Engineering Solutions, Inc.
SI	surface impoundment
Site	Coffeen Power Plant
TDS	total dissolved solids
UA	uppermost aquifer
UCU	upper confining unit
USEPA	United States Environmental Protection Agency
ZVI	zero-valent iron

1. INTRODUCTION

Ramboll Americas Engineering Solutions, Inc. (Ramboll) has developed this assessment of groundwater corrective measures on behalf of Illinois Power Generating Company (IPGC) to assist in the compliance with the requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845 Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments. This assessment applies specifically to the coal combustion residuals (CCR) unit referred to as the Ash Pond Number (No.) 2 (AP2) at the Coffeen Power Plant (CPP), also referred to as CCR unit identification (ID) No. 102, Illinois Environmental Protection Agency (IEPA) ID No. W1350150004-02, and National Inventory of Dams (NID) No. IL50723. This report addresses content requirements specific to 35 I.A.C. § 845.660 (Assessment of Corrective Measures) for exceedances of boron, cobalt, pH, sulfate, and total dissolved solids (TDS) at AP2.

1.1 Source Control and Residual Plume Management

IPGC completed significant source control and residual plume management efforts in 2020 as part of final closure of AP2 (Golder Associates, Inc., 2021). The final closure was performed in accordance with the Closure and Post-Closure Care Plan (AECOM, 2017) that was developed in accordance with Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257 and approved by IEPA on January 30, 2018.

The AP2 closure construction included closure-in-place (CIP) of the entire AP2 and installation of an alternative geomembrane cover system. This was accomplished by constructing a final cover system that complies with 40 C.F.R. § 257.102 to minimize water infiltration into the closed AP2 and improve surface water drainage off the cover system, thus reducing generation of potentially impacted water and ultimately reducing the extent of CCR impacts to groundwater. The source control was predicted to lower water levels and decrease the potential transport of CCR constituents off-site (Natural Resource Technology [NRT], 2017a). These source control activities will serve as the primary groundwater corrective measure at AP2. The potentially feasible corrective measures presented herein are intended to be supplementary to the primary source control and are intended to serve as management measures to address any residual plume that may remain after completion of source control.

1.2 Adaptive Site Management

Adaptive site management strategies will be employed as an integral part of ongoing corrective action at AP2. The adaptive site management approach will allow timely incorporation of new site information over the closure and post-closure life cycle of AP2 to ensure the achievement of the groundwater protection standards (GWPS). The adaptive site management approach is proposed to expedite progress toward meeting the GWPS while acknowledging uncertainties, such as the persistence of current groundwater flow directions and flux quantities and potential related changes in geochemical conditions. A structured decision-making process and explicitly planned iterations between the implemented corrective measures and monitoring results will ensure that remediation is occurring. System performance and the condition of the residual plume will be monitored as the corrective measure(s) selected through the 35 I.A.C. § 845.710 Corrective Action Plan (CAP) process are implemented to supplement the source control measures described above. If the groundwater concentrations do not decrease consistent with the modeling predictions, the adaptive site management approach will facilitate timely modifications or enhancements to the corrective measure(s), as needed in accordance with 35 I.A.C. §

845.680(b). This approach will be employed in response to new site information and/or the performance of the selected corrective measure(s).

The planned adaptive site management strategies are generally consistent with National Research Council, Interstate Technology & Regulatory Council (ITRC) and United States Environmental Protection Agency (USEPA) methodologies developed to address sites with long remediation times and high levels of uncertainty regarding the remedial actions necessary to achieve final and protective remediation goals (USEPA, 2022). The elements of the proposed adaptive site management strategy at AP2 will be responsive to the changing conditions associated with pond closure and performance of the selected corrective measure(s) and will include the following:

1. Implementing the groundwater corrective measure(s) selected as part of the CAP for the current conditions at AP2. The selected corrective measures may include a combination of the technologies presented in this Corrective Measures Assessment (CMA).

2. Establishing both the absolute remedial objective and functional (interim) goals to monitor progress toward the remedial objective. Achieving the GWPS for 35 I.A.C. § 845.600 constituents at the downgradient waste boundary is the remedial objective for AP2. Specific functional goals will be developed as part of the CAP process. The functional goals will be measurable thresholds for future action and may include short-term or technology-specific objectives and triggers. Functional goals may vary for different locations, CCR constituents or other site-specific considerations (ITRC, 2017) and will serve as benchmarks for comparison to ongoing groundwater monitoring at AP2.

3. Ongoing groundwater monitoring at AP2 will continue throughout the implementation of source control and residual plume management activities. Post-closure monitoring will continue for a period of at least 30 years, in accordance with 35 I.A.C. § 845.780(c). A comprehensive groundwater monitoring plan (GMP) will be developed as part of the CAP process in accordance with 35 I.A.C. § 845.670 and 35 I.A.C. § 845.220(c)(4). The GMP will include the functional goals and proposed action levels.

4. Groundwater monitoring information will be used to guide decisions regarding whether progress toward the remedial goal is advancing as expected and/or whether additional actions may be needed to achieve the remedial objective, in conjunction with IEPA, as required by 35 I.A.C. § 845.680(b).

2. SITE INFORMATION

The CPP is located in Montgomery County in central Illinois, approximately two miles south of the city of Coffeen and about eight miles southeast of the city of Hillsboro. AP2 is a closed CCR surface impoundment (SI) located in Section 11, Township 7 North and Range 7 East. AP2 is located south of the power plant and situated in a predominantly agricultural area (**Figure 2-1**). AP2 is located between two lobes of Coffeen Lake (the western lobe is identified as "Coffeen Lake" and the upper reaches of the eastern lobe are fed by a stream labeled as "Unnamed Tributary" on Figures 2-1 and 2-2), which surround the SI to the west, east, and south. The southern edge of AP2 is adjacent to the former discharge flume for the closed generating plant. AP2 is bordered by other CCR units and agricultural land to the north. **Figure 2-2** is a site map showing the location of AP2 (35 I.A.C. § 845 regulated CCR Unit and subject of this CMA), Ash Pond No. 1 (AP1), the Gypsum Management Facility (GMF) Gypsum Stack Pond (GMF GSP), GMF Recycle Pond (GMF RP), and Landfill. The area near AP2 will hereinafter be referred to as the Site.

The CPP was a coal-fired electrical generating plant that began operation in 1964. The plant initially burned bituminous coal from Illinois and CCR from the coal fired units was disposed of in surface impoundments. AP2 was utilized in the early 1970's until the mid-1980's, beginning in 2010 CCR material was placed in the Landfill and GMF Units.

2.1 Conceptual Site Model

Significant site investigation has been completed at the CPP to characterize the geology, hydrogeology, and groundwater quality. Based on extensive investigation and monitoring, AP2 has been well characterized and detailed in the Hydrogeologic Characterization Report (NRT, 2017b). The conceptual site model (CSM) is presented below.

In addition to the CCR present at AP2, there are five principal layers of unlithified material present above the bedrock, which are categorized into hydrostratigraphic units below (from surface downward) based on stratigraphic relationships and common hydrogeologic characteristics.

- **Upper Confining Unit (UCU):** Composed of the Roxana and Peoria Silts (Loess Unit) and the upper clayey portion of the Hagarstown member which are classified as silts to clayey silts and gravelly clay below the surficial soil. Loess Unit thickness ranges from 0 feet (absent) to 16 feet and the clayey portion of the Hagarstown member is up to 6 feet thick. The UCU has been eroded east of AP2, near the Unnamed Tributary.
- **Uppermost Aquifer:** The uppermost aquifer is the Hagarstown Member which is classified as primarily sandy to gravelly silts and clays with thin beds of sands. Where present the sandy portion of the Hagarstown is generally 2 to 4 feet thick, and 1 to 2 feet thick near AP2. Similar to the Loess Unit and upper Hagarstown, the lower Hagarstown is absent in some locations near the Unnamed Tributary. Historical hydraulic conductivities near AP2 ranged from 4.3×10^{-5} to 9.8×10^{-4} centimeters per second (cm/s) (geometric mean of 2.7×10^{-4} cm/s).
- **Lower Confining Unit (LCU):** Comprised of the Vandalia Member, Mulberry Grove Member, and Smithboro Member. These units include a sandy to silty till with thin, discontinuous sand lenses, a discontinuous and limited extent sandy silt which has infilled prior erosional features, and silty to clayey diamicton, respectively. The Vandalia Member typically ranged in thickness

from 11.7 feet in the northern portion of the CPP, to 31.0 feet between the GMF GSP and the GMF RP; the Mulberry Grove Member is represented by pockets (generally less than 2 feet thick); and the Smithboro Member ranges in thickness from 6.7 to 21.2 feet northwest of the landfill. This LCU has been identified as a potential migration pathway (PMP) because downward vertical gradients indicate that there is the potential for impacts to migrate through this unit. The LCU is approximately 7 to 18 feet thick near AP2. Historical hydraulic conductivities ranged from 4.0×10^{-8} to 3.4×10^{-5} cm/s (geometric mean of 5.6×10^{-6} cm/s).

- **Deep Aquifer (DA):** Sand and sandy silt/clay units of the Yarmouth Soil, which include accretionary deposits of fine sediment and organic materials, typically less than five feet thick and discontinuous across the CPP. This unit is also identified as a PMP due to presence of downward gradients in the overlying LCU and the relatively greater hydraulic conductivities measured in the DA. Historical hydraulic conductivity in the DA ranged from 7.5×10^{-8} to 3.6×10^{-5} cm/s (geometric mean of 4.4×10^{-4} cm/s).
- **Deep Confining Unit (DCU):** Comprised of the Banner Formation, generally consists of clays, silts, and sands. The Lierle Clay Member is the upper layer of the Banner Formation which was encountered at the Site. No monitoring wells are screened only within the DCU, and no field hydraulic conductivity tests were conducted for the DCU.

In the UA, groundwater generally migrates from central portions of the CPP towards Coffeen Lake or the Unnamed Tributary. The LCU and DA underlying the UA have been identified as PMPs. Groundwater elevations are primarily controlled by surface topography, geologic unit topography, and water levels within Coffeen Lake and the Unnamed Tributary. Groundwater generally flows from the center of the CPP west towards Coffeen Lake, and east towards the Unnamed Tributary, the eastern lobe of Coffeen Lake, and the former discharge flume present along the southern perimeter of AP2 and northern perimeter of AP1, resulting in a groundwater divide (high) running through the middle of the CPP. Groundwater elevations and contours for the quarter 2, 2023 groundwater monitoring event (Event 1 [E001]) are presented in **Figure 2-3**.

2.2 Groundwater Quality

Groundwater monitoring in accordance with the proposed GMP and sampling methodologies provided in the operating permit application for AP2 began in the second quarter of 2023. The 35 I.A.C § 845 groundwater monitoring system is displayed on **Figure 2-4** and consists of 10 wells screened in the UA (three background and seven compliance), one compliance well screened in the LCU, and three temporary water level only surface water staff gages. The groundwater samples collected from the 11 wells are used to monitor and evaluate groundwater quality and demonstrate compliance with the groundwater quality standards listed in 35 I.A.C. § 845.600(a). The proposed monitoring wells yield groundwater samples that represent the quality of downgradient groundwater at the CCR boundary (as required in 35 I.A.C. § 845.630(a)(2)).

The E001 sampling event was completed on June 8, 2023. In accordance with 35 I.A.C. § 845.610(b)(3)(C), statistically derived values were compared with the GWPSs summarized in 35 I.A.C. § 845.600 to determine exceedances of the GWPS. The statistical determination identified the following GWPS exceedances at compliance groundwater monitoring wells (Ramboll, 2023):

- Boron in UA wells G401, G402, G404, and G405
- Cobalt in UA well G401
- pH in UA well G401

- Sulfate in UA wells G401, G402, G404, G405, G406, and G407
- TDS in UA wells G401, G402, G404, G405, and G407

Pursuant to 35 I.A.C. § 845.650(e), an alternative source demonstration (ASD) was prepared and submitted to IEPA that presented evidence demonstrating that sources other than AP2 were the cause of the cobalt GWPS exceedance in G401, and sulfate and TDS GWPS exceedances in G407 listed above (Geosyntec Consultants, Inc., 2023).

The IEPA did not concur with the cobalt ASD due to the following alleged data gaps:

1. Source characterization of the CCR at AP2 must include total solids sampling in accordance with SW846.
2. Research on porewater characterization of CCR does not come from an independent peer reviewed publication.

The IEPA did not concur with the G407 sulfate and TDS ASD due to the following alleged data gaps:

1. Characterization to include sample and analysis in accordance with 35 I.A.C. § 845.640 must be provided with the ASD.
2. Updated geologic cross sections must be provided and must include data surrounding the hydrogeologic divide and the exceedance well G407 in accordance with § 845.620(b)(9).

IPGC filed a petition asking the Illinois Pollution Control Board (IPCB) to review IEPA's ASD denial. The petition included a motion for a partial stay of the 35 I.A.C. § 845 requirements as they apply to the cobalt, sulfate, and TDS GWPS exceedances at AP2. The IEPA had no objection to the requested stay, which was granted by IPCB on April 18, 2024. Therefore, the CMA will address identified GWPS exceedances summarized above, exclusive of the cobalt exceedance at well G401, and the sulfate and TDS exceedances in G407, in accordance with 35 I.A.C. § 845.660 and the partial stay. The 35 I.A.C. § 845.650 groundwater monitoring requirements will continue to ensure that there will be timely detection of any additional changes in groundwater quality during the stay.

3. CORRECTIVE MEASURES ASSESSMENT METHODOLOGY

This section describes the CMA methodology initiated in response to the identification of exceedances of the GWPSs for 35 I.A.C. § 845.600 constituents at the downgradient waste boundary of AP2 during the E001 groundwater monitoring event (Ramboll, 2023). The CMA was initiated on January 14, 2024, within 90 days after the detection of exceedance(s) of GWPS. Under 35 I.A.C. § 845, owners and operators of existing CCR SIs must initiate the assessment of corrective measures in accordance with 35 I.A.C. § 845.660 if one or more constituents are detected, and confirmed by an immediate resample, to be in exceedance of a GWPS in 35 I.A.C. § 845.600, and the owner or operator has not demonstrated that: a source other than the CCR SI caused the exceedance, or; that the exceedance of the GWPS resulted from error in sampling, analysis, statistical evaluation, natural variation in groundwater quality or a change in the potentiometric surface and groundwater flow direction (*i.e.,* an ASD).

The CMA is the first step in developing a long-term CAP to address the GWPS exceedances at CCR SIs. The process provides a systematic, rational method for evaluating potential corrective measures by first identifying potentially viable technologies and assessing them using qualitative information to eliminate from consideration infeasible or otherwise unacceptable remedial technologies (*i.e.,* the 35 I.A.C. § 845.660). The remaining technologies will be evaluated individually, or assembled into combined alternatives, and further evaluated under the CAP process per 35 I.A.C. § 845.670.

This CMA identified applicable corrective measure technologies and evaluated them for viability, given the site-specific conditions and considerations at AP2, by addressing the following 35 I.A.C § 845.660 evaluation criteria:

- Performance, reliability, ease of implementation and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination;
- Time required to begin and complete the CAP; and
- Institutional requirements, such as State or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the CAP.

The evaluation included qualitative and/or semi-quantitative screening of the potential corrective measures (technologies) relative to their general performance, reliability, and ease of implementation characteristics and their potential impacts, timeframes, and institutional requirements to assess the viability of each technology to address the GWPS exceedances at AP2. This approach provided a reasoned set of corrective measures that could be used, either individually or in combination, to supplement the primary source control measures described in **Section 1.1**. This set of corrective measures will be further evaluated in the Corrective Action Alternatives Assessment (CAAA).

4. DESCRIPTION OF POTENTIAL CORRECTIVE MEASURE TECHNOLOGIES

The potential groundwater corrective measures summarized below are applicable to AP2 and were included in the CMA development and analysis. Site-specific considerations provided in **Section 2** were used to evaluate potential groundwater corrective measures. Each of the corrective measures evaluated may be capable of satisfying the requirements and objectives, listed in **Section 3**, to varying degrees of effectiveness. The corrective measure review process was intended to yield a set of applicable corrective measures that could be used to supplement the primary corrective actions, namely the completed source control activities described in **Section 1.1** (CIP with an alternative geomembrane cover system). The completed source control has significantly reduced infiltration rates relative to pre-closure conditions. Ongoing monitoring will be an integral part of all corrective measures to verify and document the remedial process. The corrective measures ultimately advanced to the CAAA and selected in the CAP will be used to enhance the effectiveness of the completed source control and may be used independently or combined into specific remedial alternatives to leverage the advantages of multiple corrective measures to attain GWPSs.

Source control measures were completed for AP2 in 2020, as described in **Section 1.1**; all of the evaluated additional corrective measure technologies are proposed to be supplemental and complementary to source control activities. The following potential corrective measures, commonly used to mitigate groundwater impacts, were considered as a part of the CMA process:

- Source Control with Groundwater Polishing;
- Source Control with Groundwater Extraction (groundwater pumping wells or collection trenches);
- Source Control with a Cutoff Wall; and
- Source Control with In-Situ Chemical Treatment.

4.1 Source Control with Groundwater Polishing

Both federal and state regulators have long recognized that natural geochemical processes can be an acceptable component of a remedial action when it can achieve remedial action objectives in a reasonable timeframe. In 1999, the United States Environmental Protection Agency (USEPA) published a final policy directive (USEPA, 1999) for groundwater remediation and described the process as follows:

- *"The reliance on natural attenuation processes (within the context of a carefully controlled and monitored site cleanup approach) to achieve site-specific remediation objectives within a time frame that is reasonable compared to that offered by other more active methods. The 'natural attenuation processes' that are at work in such a remediation approach include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These in-situ processes include biodegradation; dispersion; dilution; sorption; volatilization; radioactive decay; and chemical or biological stabilization, transformation, or destruction of contaminants."*

The USEPA has stated that source control is the most effective means of ensuring the timely attainment of remediation objectives (USEPA, 1999). Natural geochemical processes may be appropriate as a "finishing step" after effective source control implementation (*i.e.*, groundwater polishing), to reduce the residual mass remaining in the groundwater after closure, if there are no risks to receptors and/or the contaminant plume is not expanding. Thus, groundwater polishing would be used in conjunction with the completed source control activities at the site, which consisted of CIP with an alternative cover system described in **Section 1.1**.

In 2015, USEPA addressed remediation of inorganic compounds in groundwater and noted that the use of natural geochemical processes to address inorganic contaminants: (1) is not intended to constitute a treatment process for inorganic contaminants; (2) when appropriately implemented, can help to restore an aquifer to beneficial uses by immobilizing contaminants onto aquifer solids and providing the primary means for attenuation of contaminants in groundwater; and (3) is not intended to be a "do nothing" response (USEPA, 2015). Rather, documenting the applicability of natural geochemical processes for groundwater remediation should be thoroughly and adequately supported with site-specific characterization data and analysis (USEPA, 1999; USEPA, 2007; USEPA, 2015):

Both physical and chemical processes can contribute to the reduction of the small amount of residual mass remaining since closure of AP2, and the toxicity, mobility, volume, or concentration of contaminants in groundwater. Physical processes applicable to CCR constituents in groundwater include dilution, dispersion, and flushing. Chemical processes applicable to CCR constituents in groundwater include precipitation and coprecipitation (*e.g.,* incorporation into sulfide minerals), sorption (*e.g.,* to iron, manganese, aluminum; to other metal oxides or oxyhydroxides; or to sulfide minerals or organic matter), and ion exchange.

All inorganic compounds are subject to physical processes and under typical environmental conditions, physical mechanisms most often exert the dominant control on the CCR constituents of interest, such as sulfate and chloride, and lithium to a more variable degree. Chemical mechanisms are also likely to be active, though not often dominant, such as adsorption, ion exchange, and organic complexation. In combination with source control, these natural controls can provide an effective means to polish residual loading and achieve the GWPS in a reasonable timeframe. Additional data collection and analysis may be required to support the USEPA's evaluation framework (USEPA, 2015) and obtain regulatory approval.

4.2 Source Control with Groundwater Extraction

Groundwater extraction is one of the most widely used groundwater corrective technologies and has a long history of performance. This corrective measure includes installation of one or more groundwater pumping wells or trenches to control and extract impacted groundwater. Groundwater extraction captures and contains impacted groundwater and can limit plume expansion and/or off-site migration. Construction of a groundwater extraction system typically includes, but is not limited to, the following primary components:

- Designing and constructing a groundwater extraction system consisting of one or more extraction wells and operating at a rate to allow capture of CCR impacted groundwater within the UA and/or the LCU and DA.
- Management of extracted groundwater, which may include modification to the existing National Pollutant Discharge Elimination System (NPDES) permit.

- Ongoing inspection and maintenance of the groundwater extraction system.

Remediation of inorganics by groundwater extraction can be effective, but systems do not always perform as expected. A combination of factors, including geologic heterogeneities, difficulty in flushing low-permeability zones, and rates of contaminant desorption from aquifer solids can limit effectiveness. Groundwater extraction systems require ongoing operation and maintenance to address issues such as iron bacteria and well fouling and to ensure optimal performance. The extracted groundwater must be managed, either by ex-situ treatment or disposal.

4.3 Source Control with a Cutoff Wall

Since the late 1970s and early 1980s, vertical cutoff walls have been used to control and/or isolate impacted groundwater. Low-permeability cutoff walls can be used to prevent horizontal off-site migration of potentially impacted groundwater. Cutoff walls act as barriers to transport of impacted groundwater and can isolate soils that have been impacted by CCR to prevent contact with unimpacted groundwater. Cutoff walls are often used in conjunction with an interior pumping system to establish an inward gradient within the cutoff wall. The gradient imparted by the pumping system maintains an inward flow through the wall, keeping it from acting as a groundwater dam and controlling potential end-around or breakout flow of contaminated groundwater. Constructing the cutoff wall such that it intersects a low-permeability material at its base, referred to as "keying", greatly increases its effectiveness.

A commonly used cutoff wall construction technology is the slurry trench method, which consists of excavating a trench and backfilling it with a soil-bentonite mixture, often created with the excavated soils, or, for deeper walls, a cement-bentonite mixture that is produced at an onsite batch plant. The trench is temporarily supported with bentonite slurry pumped into the trench during excavation (D'Appolonia & Ryan, 1979). Cutoff wall excavation uses conventional hydraulic excavators, hydraulic excavators equipped with specialized booms to extend their reach (*i.e.,* long-stick excavators), clamshells, or more specialized equipment such as hydromills or secant-pile drill rigs, depending upon trench depth, material excavated, and type of material that the wall is keyed into.

Cutoff walls are a widely accepted technology for containing impacted groundwater. Combining a cutoff wall and groundwater extraction in specific areas may provide advantages over independent use of these potential corrective technologies. Cutoff walls can also be used in combination with groundwater extraction or as part of a PRB system (as the "funnel" in a funnel-and-gate system; **Section 3.4**).

4.4 Source Control with In-Situ Chemical Treatment

The use of in-situ treatment, either by injection or PRBs is a widely used technology for treating impacted groundwater. However, in-situ treatment techniques for boron and sulfate are not well established, therefore performance is unknown.

Chemical treatment could consist of injection of reactive materials into the subsurface to treat contaminants at specific, targeted locations. Alternately, treatment via PRB, where reactive materials are placed in the subsurface at locations designed to direct the contaminant plume along a flow path through the reactive media. In either system, the contaminants are transformed or otherwise rendered into environmentally acceptable forms to attain remediation concentration goals downgradient of the barrier (Electric Power Research Institute [EPRI], 2006).

As groundwater passes through the PRB under natural gradients, dissolved constituents in the groundwater react with the media and are transformed or immobilized. A variety of media have been used or proposed for use in PRBs. Zero-valent iron (ZVI) has been shown to effectively immobilize some CCR constituents, including arsenic, chromium, cobalt, molybdenum, selenium, and sulfate. Use of a combination media consisting of ZVI and a boron-selective ion exchange resin to treat boron has been documented in a pilot-scale test (EPRI, 2006).

System configurations include continuous PRBs, in which the reactive media extends across the entire path of the contaminant plume; and funnel-and-gate systems, where low-permeability barriers are installed to control groundwater flow through a permeable gate containing the reactive media. Continuous PRBs intersect the entire contaminant plume and do not materially impact the groundwater flow system. Design may or may not include keying the PRB into a low-permeability unit at depth. Funnel-and-gate systems utilize a system of barriers to groundwater flow (funnels) to direct the contaminant plume through the reactive gate. The barriers, typically some form of cutoff wall, are keyed into a low-permeability unit at depth to prevent short circuiting of the plume. Funnel-and-gate design must consider the residence time to allow chemical reactions to occur. Directing the contaminant plume through the reactive gate can significantly increase the flow velocity, thus reducing residence time.

Design of in-situ treatment systems requires rigorous site investigation to characterize the site hydrogeology and to delineate the contaminant plume. A thorough understanding of the geochemical and redox characteristics of the plume is critical to assess the feasibility of the process and select appropriate reactive media. Laboratory studies, including batch studies and column studies using samples of site groundwater, are needed to determine the effectiveness of the selected reactive media at the site (EPRI, 2006). The main considerations in selecting reactive media are as follows (Gavaskar et al., 1998 as cited by EPRI, 2006):

- Reactivity - The media should be of adequate reactivity to immobilize a contaminant within the residence time of the design.
- Hydraulic performance - The media should provide adequate flow through the PRB, meaning a greater particle size than the surrounding aquifer materials. Alternatively, gravel beds have been emplaced in front of barriers to direct flow through the barrier.
- Stability - The media should remain reactive for an amount of time that makes its use economically advantageous over other technologies.
- Environmentally compatible by-products - Any by-products of media reaction should be environmentally acceptable. For example, iron released by zero-valent iron corrosion should not occur at levels exceeding regulatory acceptance levels.
- Availability and price: The media should be easy to obtain in large quantities at a price that does not negate the economic feasibility of using a PRB.

5. ASSESSMENT OF CORRECTIVE MEASURE TECHNOLOGIES

This CMA was initiated to address exceedances of the 35 I.A.C. § 845.600 GWPS for boron, pH, sulfate, and TDS (exclusive of the sulfate and TDS exceedances in G407) at the downgradient waste boundary of AP2 identified during the E001 groundwater monitoring event (**Section 2.2**).

5.1 Requirements

The potential groundwater corrective technologies described in the previous section were evaluated relative to the requirements presented in **Section 3** and reiterated below:

- Performance, reliability, ease of implementation and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination:
- Time required to begin and complete the corrective action plan; and
- Institutional requirements, such as State or local permit requirement or other environmental or public health requirements that may substantially affect implementation of the corrective action plan.

Table 5-1 presents the qualitative CMA evaluation of each corrective technology relative to these requirements, as well as their ability to address boron, pH, sulfate, and TDS GWPS exceedances. The following sections provide a summary of these evaluations and a discussion of the potential groundwater corrective measure technologies that may be viable, either independently or in combination, to address GWPS exceedances. This section also provides a summary of corrective measure technologies that have been retained and advanced for evaluation as part of the 35 I.A.C. § 845.670 CAAA process for selecting the final remedy for AP2.

5.2 Groundwater Corrective Technology Assessment

Source control, consisting of CIP with an alternate geomembrane cover system, is the primary groundwater corrective measure for AP2 and was completed in 2020. Each of the potential groundwater corrective measure technologies would supplement the positive impact of the prior closure activities. The following sections evaluate groundwater corrective measure technologies that, when combined with site closure, may be viable to address the boron, pH, sulfate, and TDS GWPS exceedances (exclusive of the sulfate and TDS exceedances in G407). Technologies that are not viable for addressing the GWPS at AP2 will be eliminated from further evaluation and viable technologies will be advanced for further evaluation as part of the CAAA process per 35 I.A.C. § 845.600.

5.2.1 Source Control with Groundwater Polishing

Completed source control corrective measures (**Section 1.1**) have reduced the mass loading to the groundwater system. Performance of groundwater polishing, which is currently occurring at the site to some degree, could decrease the timeframe for attainment of GWPS for one or more parameters in the UA. The time estimated for plume contraction at AP2 is relatively long, based on previous groundwater modeling (NRT, 2017c). Groundwater polishing is dependent on site-specific conditions and may not significantly reduce the time to attain the GWPS for all parameters at AP2.

Groundwater polishing by natural geochemical processes is a widely accepted component of groundwater remediation and is routinely approved by the USEPA when paired with source control. The performance of groundwater polishing as a groundwater corrective measure varies based on site-specific conditions and additional data collection may be needed to support the design and regulatory approval. Site conditions are favorable for physical attenuation, while chemical attenuation may be limited under normal UA conditions.

Naturally occurring geochemical processes are currently ongoing at post-closure AP2 and will continue to affect post-closure groundwater constituent concentrations. Ongoing monitoring of groundwater conditions is needed to better understand the mechanisms and efficacy of the groundwater polishing process and to confirm the effectiveness over time. Thus, additional groundwater sample collection and analyses would be required to characterize potential mechanisms, as discussed above, and to provide long term monitoring of the remedial progress. Enhancements to the groundwater monitoring system may be required to ensure that groundwater polishing is occurring as predicted, consistent with the adaptive site management approach. The reliability of groundwater polishing as a groundwater corrective measure is high because operation and maintenance requirements are limited. However, the reliability can also vary based on site-specific hydrogeologic and geochemical conditions.

Following characterization and approval of the CAP, monitoring of the groundwater polishing processes and comparison to functional goals established to monitor progress toward the remedial objective could begin approximately 90 days after CAP permit approval.

No potential safety impacts or exposure to human health or environmental receptors are expected to result from implementing the groundwater polishing processes. Timeframes to achieve GWPS are dependent on site-specific conditions, which require detailed technical analysis which are ongoing and will be evaluated in connection with the CAAA. Selecting groundwater polishing as a corrective measure for AP2 will require approval of the CAP permit by the IEPA.

Monitoring the groundwater polishing to track progress toward achievement of the GWPS, in conjunction with source control at AP2, would require long-term maintenance and monitoring of the groundwater monitoring system to confirm source control and verify the effectiveness in reducing groundwater concentrations to levels below the GWPS. Monitoring activities could be initiated immediately after approval of the CAP permit.

Groundwater polishing processes will continue to occur naturally at AP2. It may be a viable corrective measure for the boron, pH, sulfate, and TDS exceedances at AP2. Therefore, it is being advanced to the CAAA for further evaluation.

5.2.2 Source Control with Groundwater Extraction

Source control is currently reducing mass loading to the AP2 groundwater system and implementing a downgradient groundwater extraction system may reduce the time required to attain the GWPS in the UA. However, the groundwater impacts already present in the low permeability PMP may limit the reduction in time to attain the GWPS that can be achieved by a groundwater extraction system.

Groundwater extraction is a widely accepted corrective measure with a long track record of performance and reliability. It is routinely approved by the IEPA. For a corrective measure using groundwater extraction to effectively control off-site flow and/or to remove potentially

contaminated groundwater, horizontal and vertical capture zone(s) must be created. Additionally, the groundwater flow direction and location of the existing former discharge flume may complicate design and may affect performance of a pumping well system. An alternative method for controlling groundwater flow and removing potentially contaminated groundwater could include constructing a discharge trench by lowering the normal water level in the former discharge flume (*i.e.,* dewatering). This approach could passively increase the hydraulic gradient and corresponding groundwater flow velocities between AP2 and the former discharge flume, without the need for groundwater collection or active pumping. More active methods, such as groundwater extraction trenches, collection sumps, or horizontal wells could also be utilized. Cutoff walls (**Section 4.3**) could also be used in conjunction with a pumping system to control potential groundwater movement from the flume.

Implementation of a groundwater extraction system presents design challenges due to heterogeneous, varied nature of the UA. An extraction system in the UA would have to consider the potential for extracting water from the former discharge flume. Extracted groundwater would require management, possibly including treatment, which may require specialized equipment and/or contractors. Construction of an extraction system to intercept the natural groundwater flow to the south and east would introduce challenges related to construction access and relocating compliance wells so that they are not affected by other site features.

There could be some impacts associated with constructing and operating a groundwater extraction system, including altering the groundwater flow system and some limited exposure to extracted groundwater. The construction of trenches could also cause stability impacts to the AP2 dikes and/or adjacent structures. Additional data collection and analyses would be required to design an extraction system. Construction could be completed within 1 year following completion of a final design. Time of implementation is approximately 3 to 4 years after approval of the CAP permit, including characterization, design, permitting, and construction. Timeframes to achieve GWPS are dependent on site-specific conditions. An extraction system may reduce the time to attain GWPS in the UA relative to the post-closure timeframe predicted by the groundwater modeling. However, accelerated attainment of the GWPS may be limited by the heterogeneity of the UA.

Implementing a groundwater extraction system at AP2 would require IEPA approval of the CAP permit, and extracted groundwater could likely be discharged under the NPDES permit. Additional permitting related to construction in wetlands and/or Waters of the United States may be required, if they are determined to be present at the site and in the vicinity of the extraction system. Depending upon the location of the extraction system, an Illinois Department of Natural Resources (IDNR) dam safety modification permit may also be required to construct an extraction system.

Groundwater extraction could be a viable corrective measure for the boron, pH, sulfate, and TDS exceedances at AP2. Implementation of groundwater extraction may require combining an extraction system with a cutoff wall to provide directional control of groundwater flow. Therefore, groundwater extraction is being advanced to the CAAA for further evaluation.

5.2.3 Source Control with Groundwater Cutoff Wall

Source control is reducing mass loading to the groundwater system and implementing additional groundwater corrective measures may reduce the time required to attain the GWPS in the UA. A

low permeability cutoff wall could be used in combination with a groundwater extraction system in the UA to reduce the water management and treatment requirements for an extraction system.

Groundwater cutoff walls are a widely accepted corrective measure used to control and/or isolate impacted groundwater and are routinely approved by the IEPA. Cutoff walls have a long history of reliable performance as hydraulic barriers, provided they are properly designed and constructed. However, if not coupled with a groundwater extraction system, a cutoff wall will provide directional groundwater control only and may result in redistribution of contaminants and potentially GWPS exceedances at new locations.

Cutoff walls are designed to act as hydraulic barriers; as a result, cutoff walls inherently alter the existing groundwater flow system. Changes to the existing groundwater flow system may need to be controlled to maximize the effectiveness of the remedy by, for example, combining a cutoff wall with groundwater extraction to control build-up of hydraulic head upgradient and around the cutoff walls. The effectiveness of a cutoff wall as a hydraulic barrier also relies on the contrast between the hydraulic conductivity of the aquifer and the cutoff wall. The most effective barriers have hydraulic conductivity values that are several orders of magnitude lower than the geologic materials they are in contact with. A cutoff wall designed with hydraulic conductivity of 1×10^{-7} cm/s would two to four orders of magnitude lower than the UA, which has hydraulic conductivities from 1.7×10^{-5} to 9.1×10^{-3} cm/s (NRT, 2017a), and would be an effective containment method in the UA and could improve the performance of a UA extraction system.

Constructing a cutoff wall could result in structural impacts to the AP1 and AP2 embankment dikes, depending on the location of the wall. Specialized construction contractor(s) may be required depending upon the required construction methodology and site access considerations, which could delay implementation.

Additional data collection and analyses would be required to design a cutoff wall. The time to implement a cutoff wall is approximately 4 to 5 years, including characterization, design, permitting and construction. To attain GWPS, cutoff walls require a separate groundwater corrective measure to operate in concert with the cutoff wall(s). Cutoff walls are commonly coupled with groundwater polishing and/or groundwater extraction as groundwater corrective measures. The time to attain GWPS is dependent on the selected groundwater corrective measure or measures that are coupled with the cutoff walls.

Constructing a cutoff wall at AP2 would require IEPA approval of the CAP permit and, depending on the location, an IDNR dam safety modification permit may be required. Construction of a cutoff wall may also require an evaluation and/or permits related to wetlands if they are determined to be present in the area of the proposed remedy.

A cutoff wall alone would not be a viable corrective measure for the boron, pH, sulfate, and TDS exceedances at AP2. However, a cutoff wall may provide directional control, which, when combined with other corrective measures, would reduce the time required to achieve and attain GWPS. Therefore, the cutoff wall is being advanced to the CAAA for further evaluation.

5.2.4 Source Control with In-Situ Chemical Treatment

Source control is reducing mass loading to the groundwater system and implementing additional groundwater corrective measures may reduce the time required to attain the GWPS in the UA.

Use of in-situ treatment, either through targeted injection of reactive media or in PRB systems, to transform contaminants into environmentally acceptable forms to attain the GWPS was considered.

In-situ treatment using ion exchange (IX) to address boron and sulfate exceedances in groundwater is not an established or widely accepted groundwater corrective measure; therefore, its performance and reliability are unknown. Regulatory acceptance of this innovative approach to achieving the GWPS is uncertain.

In-situ treatment presents design and construction challenges due to the heterogeneous and varied nature of the UA. Depending upon the location of a PRB system, construction may affect AP2 embankment and/or final cover system and periodic change-outs of ion exchange resin media may be required.

Additional data collection and analyses would be required to design an in-situ treatment system and bench scale and/or pilot scale testing may be required to demonstrate performance and reliability. Time of implementation is approximately 4 to 6 years after approval of the CAP permit, including characterization, design, permitting, and construction. Timeframes to achieve GWPS are dependent on demonstrations of performance and reliability along with regulatory acceptance. It is not known whether in-situ treatment would reduce the time to attain GWPS in the UA relative to the post-closure timeframe predicted by the groundwater modeling.

Due to the uncertain performance, reliability and potential for regulatory hurdles, in-situ chemical treatment is not a viable corrective measure for the boron and sulfate exceedances at AP2 and is not being advanced to the CAAA for further evaluation.

5.3 Technologies Advanced to CAAA

Based on the evaluations presented above, the following potential corrective technologies are being advanced to the CAAA, individually or in combination, for more detailed evaluations:

- Source control with groundwater polishing;
- Source control and with groundwater extraction; and
- Source control with a groundwater cutoff wall.

6. REFERENCES

AECOM, 201. *Closure and Post-Closure Care Plan for Coffeen Ash Pond No. 2 at Illinois Power Generating Company Coffeen Power Station. Coffeen, Illinois.* January 2017.

D'Appolonia, D.J., and Ryan, C.R., 1979. *Soil-Bentonite Slurry Trench Cut-Off Wall*s, Geotechnical Exhibition and Technical Conference, Chicago, Illinois.

Electric Power Research Institute (EPRI), 2006. *Groundwater Remediation of Inorganic Constituents at Coal Combustion Project Management Sites, Technical Report #1012584*, October 2006.

Gavaskar, A.R., N Gupta, B.M. Sass, R.J. Janosy and D. O'Sullivan, 1998. *Permeable Reactive Barriers for Groundwater Remediation: Design, Construction and Monitoring*. Battelle Press.

Geosyntec Consultants, 2023. *Alternative Source Demonstration, Coffeen Power Plant Ash Pond No. 2 (Unit ID #102), IEPA ID: W1350150004-02, 35 I.A.C. 845.650.* December, 2023.

Golder Associates, Inc., 2021. *Construction Completion and Construction Quality Assurance Report, Coffeen Power Station Ash Pond #2 Closure. March*, 2021.

Interstate Technology & Regulatory Council (ITRC), 2017. *Remediation Management of Complex Sites*. RMCS-1. Washington, D.C.: Interstate Technology & Regulatory Council, Remediation Management of Complex Sites Team. https://rmcs-1.itrcweb.org.

Natural Resource Technology, Inc. (NRT), 2017a. *Hydrogeologic Site Characterization Report, Ash Pond 2, Coffeen Power Station, Coffeen, Illinois.* January 24, 2017.

Natural Resource Technology, Inc. (NRT), 2017b. *Hydrostatic Modeling Report, Ash Pond 2, Coffeen Power Station, Coffeen, Illinois.* January 24, 2017.

Natural Resource Technology, Inc. (NRT), 2017c. *Groundwater Model Report, Ash Pond 2, Coffeen Power Station, Coffeen, Illinois.* January 24, 2017.

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2023. 35 I.A.C. § 845.610(b)(3)(D) Groundwater Monitoring Data and Detected Exceedances, Quarter 2, 2023, Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois. October 16, 2023.

United States Environmental Protection Agency (USEPA), 1999. *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. Directive No. 9200.U-17P*. Washington, D.C.: EPA, Office of Solid Waste and Emergency Response.

United States Environmental Protection Agency (USEPA), 2007*. Monitored Natural Attenuation of Inorganic Contaminants in Ground Water, Volume 1 – Technical Basis for Assessment. EPA/600/R-07/139*. National Risk Management Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio. October 2007.

United States Environmental Protection Agency (USEPA), 2015. *Use of Monitored Natural Attenuation for Inorganic Contaminants in Groundwater at Superfund Sites. Directive No.*

9283.1-36. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. August 2015.

United States Environmental Protection Agency (USEPA), 2022. *Adaptive Site Management – A Framework for Implementing Adaptive Management at Contaminated Sediment Superfund Sites. Directive No. 9200.1-166*. U.S. Environmental Protection Agency. June 2022.

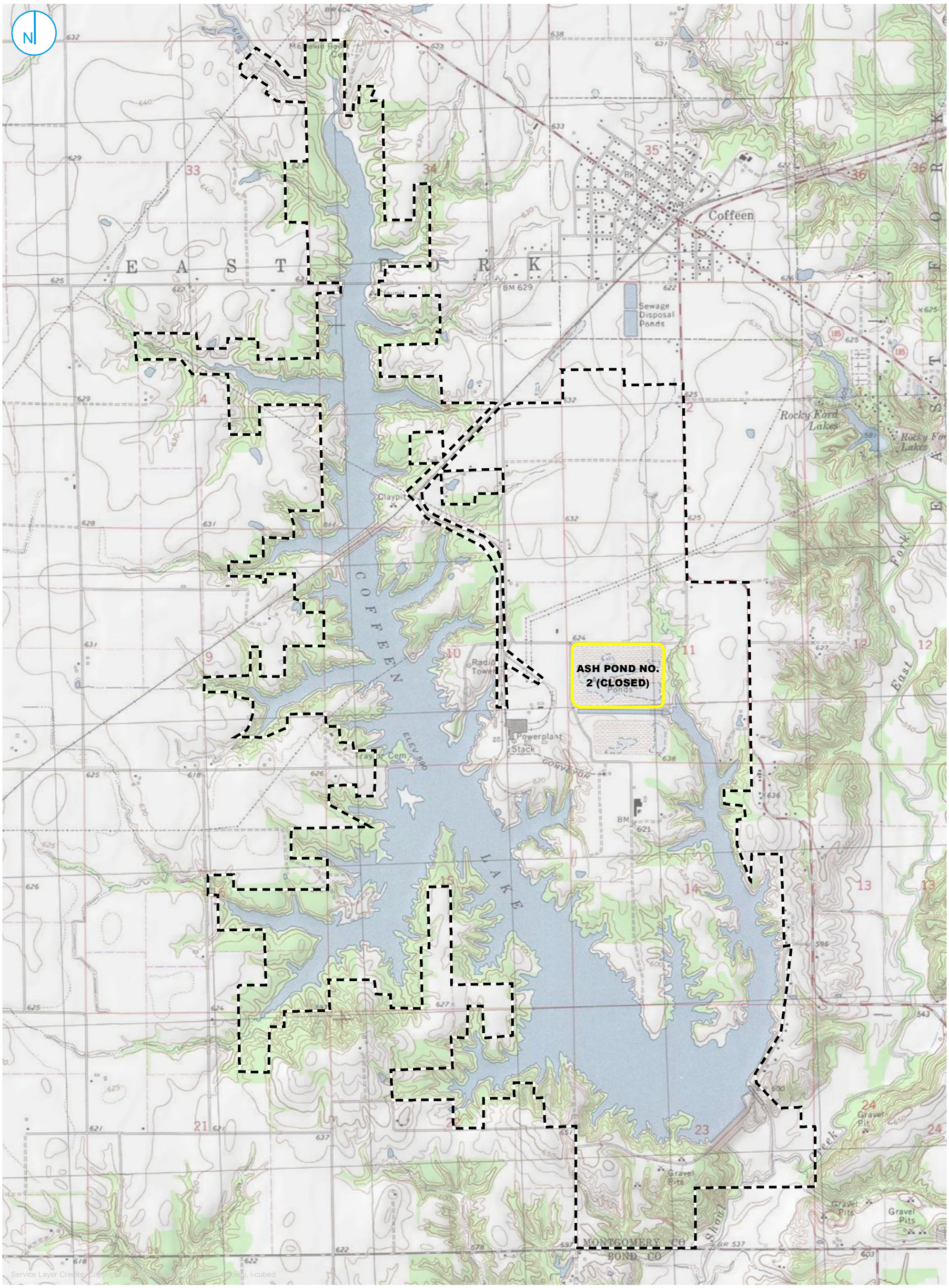
TABLES

TABLE 5-1. CORRECTIVE MEASURES ASSESSMENT MATRIX
ASH POND NO. 2
COFEEN POWER PLANT
COFFEEN, ILLINOIS
June 12, 2024

Remedy	Evaluation Factors						
	Performance	**Reliability**	**Ease of Implementation**	**Potential Impacts of Remedy (safety impacts, cross-media impacts, control of exposure to any residual contamination)**	**Time Required to Begin and Implement Remedy[1]**	**Time to Attain Groundwater Protection Standards**	**Institutional Requirements (state/local permit requirements, environmental/public health requirements that affect implementation of remedy)**
Source Control with Groundwater Polishing	Performs best paired with source control, which was completed by closure in place with an alternate cover system in 2020. Site conditions are favorable for physical processes, while attenuation processes may be limited under normal aquifer conditions.	Ongoing analysis will evaluate if the attenuation mechanism has low reversibility, the aquifer has sufficient capacity, and the hydrogeology is favorable for physical processes.	Evaluation is underway and is expected to be completed in 2024. Long-term monitoring would be required. Implementing would not require extensive specialized equipment or contractors.	None identified.	Approximately 90 days after CAP permit approval.	Dependent on site-specific conditions including source decay rate. Less than the post-closure timeframe predicted by the groundwater model.	IEPA approval of the CAP is required.
Source Control with Groundwater Extraction	Widely accepted and routinely approved technology; variable performance of a pumping system is anticipated in the heterogeneous uppermost aquifer and possibly due to proximity of CPP discharge flume (might capture water from the extraction system). A downgradient extraction trench, or alternately, deepening the discharge flume, combined with a groundwater pumping system, may be more effective that an independent groundwater pumping system.	Reliable if properly designed, constructed and maintained. Heterogeneous, varied nature of uppermost aquifer may present reliability challenges for pumping wells.	Design challenges due to heterogeneous, varied nature of uppermost aquifer. Specialized contractors may be necessary. Extracted groundwater would require management, possibly including treatment, which may require specialized equipment/contractors. Construction of an extraction system to intercept the natural groundwater flow to the south and east, would introduce challenges related to construction access and relocating compliance wells so that they are not affected by other site features.	Alters groundwater flow system. Potential for some limited exposure to extracted groundwater. Groundwater extraction may induce settlement, which could cause structural impacts to the AP1 or AP2 embankments and/or adjacent structures.	Design, permitting and construction is expected to take 3 to 4 years after CAP permit approval. Additional time may be required to permit a trench and a new compliance monitoring well network.	May be similar to the timeframe predicted by the groundwater model due to the low permeability Upper Confining Unit.	IEPA approval of the CAP permit is required. Extracted groundwater could likely be discharged under the NPDES permit. Approval from IEPA for modifications to the compliance monitoring well network proposed in the operating permit would be required. An IDNR dam safety modification permit might also be required, depending on location of wells and settlement. If an extraction trench is used, additional permitting related to construction in wetlands and/or Waters of the United States may be required, if they are determined to be present in the area of the proposed remedy.
Source Control with Groundwater Cutoff Wall	Widely accepted and routinely approved technology with good performance if properly designed and constructed. If not combined with groundwater extraction, a cutoff wall will provide directional control only, thus redirecting flow to other areas where GWPS may be exceeded.	Reliable for groundwater directional control if properly designed and constructed.	Widely used, established technology. May require specialized contractors depending upon the construction/implementation method.	Alters groundwater flow system but does not provide any treatment. Can result in unintended consequences resulting from redirecting contaminants to areas where they are not currently present. May cause structural impacts to the embankment, depending on the location of the wall.	Design, permitting and construction is expected to take 4 to 5 years after CAP approval. Implementation could potentially be accelerated by combining with closure construction activities.	Provides groundwater directional control only. Combination with other groundwater corrective measure(s), such as groundwater extraction or permeable reactive barrier, would reduce the time required to attain GWPS. Time required may be similar to the groundwater model prediction due to the low permeability Upper Confining Unit.	IEPA approval of the CAP permit is required. An IDNR dam safety permit may also be required depending on the location of the cutoff wall. May also require an evaluation and/or permits related to wetlands, if determined to be present in the area of the proposed remedy.
Source Control with In-Situ Treatment	In-situ treatment using IX resins not well established for sulfate or boron, therefore performance is unknown.	Unknown reliability for sulfate or boron.	Design challenges related to reactive material delivery and due to heterogenous, discontinuous nature of uppermost aquifer. Could require periodic change-outs of resin media.	A permeable reactive barrier may cause structural impacts to the embankment, depending on the location of the barrier.	May require bench scale and/or pilot scale testing as part of design. Design, permitting and construction is expected to take 4 to 6 years after CAP approval.	There is uncertainty regarding whether a in-situ treatment would reduce sulfate or boron concentrations to achieve the GWPS. Dependent on conditions specific to the reactive media used and the site. Treatment technology is not well understood.	IEPA approval of the CAP permit is required. IEPA approval of this innovative and relatively unproved solution may be challenging. An IDNR dam safety permit may also be required depending on the location of the barrier. May also require an evaluation and/or permits related to wetlands, if determined to be present in the area of the proposed remedy.

Notes:
[1] Time required to begin and implement remedy includes design, permitting, and construction.
AP1 - Ash Pond No. 1
AP2 - Ash Pond No. 2
CAP - Corrective Action Plan
CPS - Coffeen Power Station
GWPS - groundwater protection standard
IDNR - Illinois Department of Natural Resources
IEPA - Illinois Environmental Protection Agency
IX - Ion Exchange
NPDES - National Pollutant Discharge and Elimination System

FIGURES



REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY

0 1,000 2,000 Feet

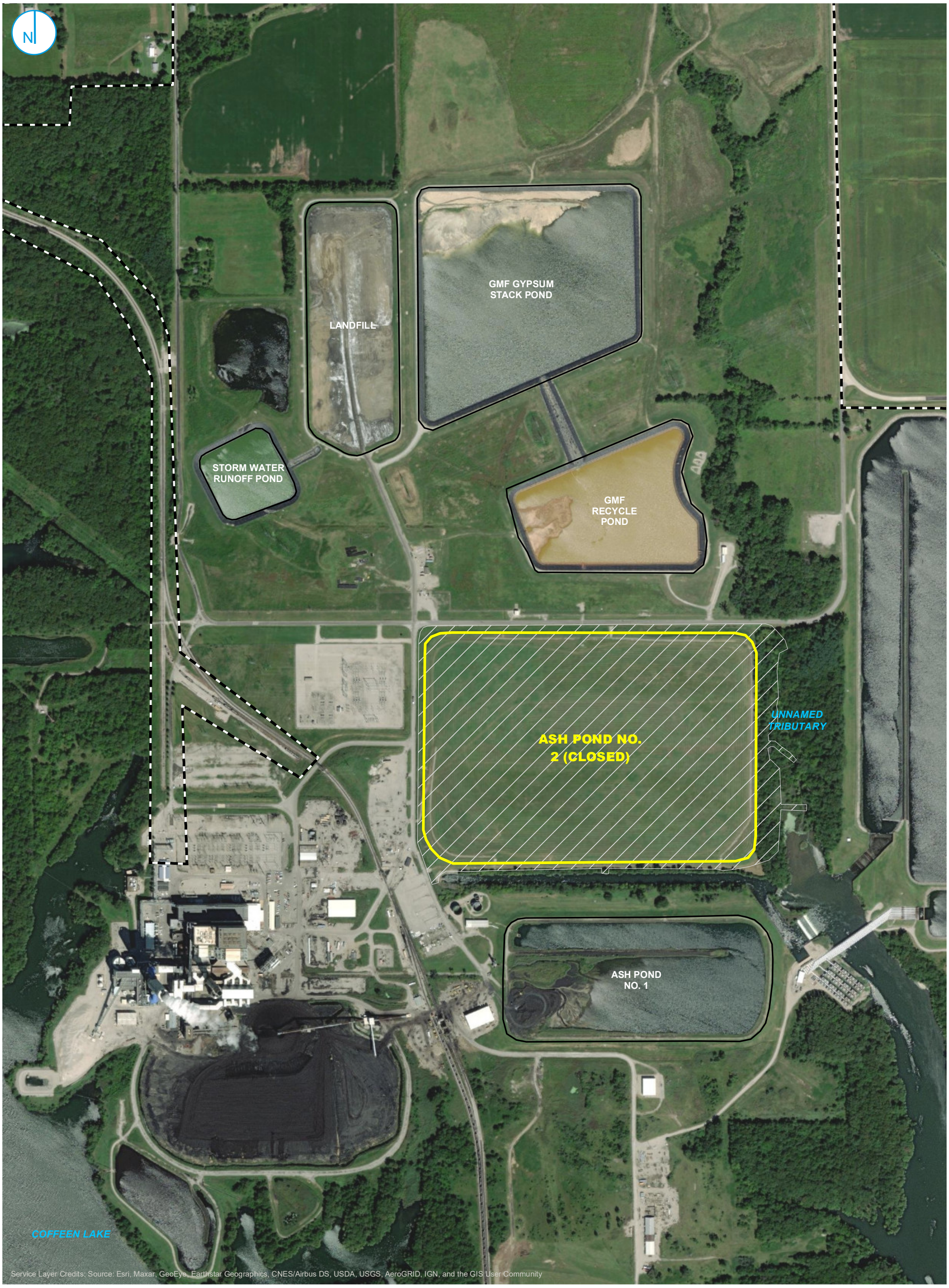
SITE LOCATION MAP

FIGURE 2-1

35 I.A.C. § 845 CORRECTIVE MEASURES ASSESSMENT
ASH POND NO.2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

0 275 550 Feet

SITE MAP

FIGURE 2-2

35 I.A.C. § 845 CORRECTIVE MEASURES ASSESSMENT
ASH POND NO.2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

- COMPLIANCE MONITORING WELL
- BACKGROUND MONITORING WELL
- MONITORING WELL
- SOURCE SAMPLE LOCATION
- LEACHATE WELL
- STAFF GAGE; RIVER
- STAFF GAGE, CCR UNIT
- GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
- INFERRED GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION
- REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- PROPERTY BOUNDARY

0 325 650 Feet

NOTES:
1. ELEVATIONS IN PARENTHESES WERE NOT USED FOR CONTOURING.
2. ELEVATION CONTOURS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

POTENTIOMETRIC SURFACE MAP APRIL 30, 2023

35 I.A.C. § 845 CORRECTIVE MEASURES ASSESSMENT
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 2-3

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Coffeen\AP2_GMP\Figure 2-1_Proposed Monitoring Well Network.mxd

PROJECT: 169000XXXX | DATED: 10/6/2021 | DESIGNER: STOLZSD

COMPLIANCE WELL
BACKGROUND WELL
MONITORING WELL
STAFF GAGE
REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

0 200 400 Feet

MONITORING WELL LOCATION MAP

35 I.A.C. § 845 CORRECTIVE MEASURES ASSESSMENT
ASH POND NO.2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 2-4

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

Appendix D

Nature and Extent Report

Intended for
Illinois Power Generating Company
134 CIPS Lane
Coffeen, IL 62017
Montgomery County

Date
June 12, 2024

Project No.
1940103584-002

NATURE AND EXTENT REPORT

COFFEEN POWER PLANT, ASH POND NO. 2, IEPA ID NO. W1350150004-02

RAMBOLL Bright ideas. Sustainable change.

NATURE AND EXTENT REPORT
COFFEEN POWER PLANT, ASH POND NO. 2, IEPA ID NO. W1350150004-02

Project name	**Coffeen Power Plant Ash Pond No. 2**
Project no.	**1940103584-002**
Recipient	**Illinois Power Generating Company**
Document type	**Nature and Extent Report**
Revision	**Final**
Date	**June 12, 2024**
Prepared by	**Alison O'Connor, PhD and Nathaniel Keller**
Checked by	**Melanie Conklin**
Approved by	**Brian G. Hennings, PG**

Ramboll
234 W. Florida Street
Fifth Floor
Milwaukee, WI 53204
USA

T 414-837-3607
F 414-837-3608
https://ramboll.com

Alison O'Connor, PhD
Geochemist

Nathaniel R. Keller
Senior Technical Manager

Brian G. Hennings, PG
Project Officer, Hydrogeology

CONTENTS

EXECUTIVE SUMMARY **4**
1. Introduction **6**
2. Unit Background **7**
2.1 Site Location and Description 7
2.2 Description of CCR Unit 7
2.3 Geology and Hydrogeology 8
2.3.1 Hydrostratigraphic Units 8
2.3.2 Uppermost Aquifer 9
2.3.3 Potential Migration Pathways 9
2.3.4 Regional Bedrock Geology 10
2.3.5 Water Table Elevation and Groundwater Flow Direction 10
2.3.5.1 Vertical Hydraulic Gradients 11
2.3.5.2 Impact of Surface Water Bodies on Groundwater Flow 12
2.3.6 Hydraulic Conductivities 12
2.3.6.1 Field Hydraulic Conductivities 12
2.3.6.2 Laboratory Hydraulic Conductivities 13
2.4 Groundwater Monitoring 14
2.5 Hydrogeologic Conceptual Site Model 14
3. Occurrence and Distribution of Groundwater Exceedances (Extent) **16**
3.1 Additional Investigation to Define Nature and Extent 16
3.2 Extent in the Uppermost Aquifer 16
3.2.1 Boron 17
3.2.2 pH 17
3.2.3 Sulfate 18
3.2.4 Total Dissolved Solids 19
4. Geochemical Conceptual Site Model (Nature) **20**
5. Combined Geochemical and Hydrogeologic Conceptual Site Models **21**
5.1 Boron 21
5.2 pH Conceptual Site Model 21
5.3 Sulfate and TDS Conceptual Site Model 21
6. Conclusions and Future Activities **23**
7. References **24**

TABLES (ATTACHED)

Table 2-1 Summary of Groundwater Elevations
Table 2-2 Vertical Hydraulic Gradients
Table 3-1 Monitoring Well Construction Details
Table 3-2 Exceedance Parameter Statistical Results
Table 3-3 Summary of Groundwater Data

FIGURES (ATTACHED)

Figure 2-1 Site Location Map
Figure 2-2 Monitoring Well Location Map
Figure 2-3 Base of CCR
Figure 2-4 Top of Uppermost Aquifer
Figure 2-5 Uppermost Aquifer Potentiometric Surface Map - May 30, 2023 (E001)
Figure 2-6 Deep Aquifer Potentiometric Surface Map – August 8, 2023 (E002)
Figure 3-1 GWPS Exceedance Map Uppermost Aquifer
Figure 3-2 GWPS Exceedance Map Lower Confining Unit

APPENDICES

Appendix A Hydrogeologic Characterization Report Cross-Sections
Appendix B Site-Wide Groundwater Elevations
Appendix C Supplemental Vertical Hydraulic Gradients
Appendix D Historical Field and Laboratory Hydraulic Conductivities
Appendix E Supplemental Field Hydraulic Conductivities
Appendix F Surface Water Sampling Locations and Laboratory Analytical Report
Appendix G Geochemical Conceptual Site Model

ACRONYMS AND ABBREVIATIONS

35 I.A.C.	Title 35 of the Illinois Administrative Code
AP1	Ash Pond No. 1
AP2	Ash Pond No. 2
bgs	below ground surface
CCR	coal combustion residuals
cm/s	centimeters per second
CPP	Coffeen Power Plant
CSM	conceptual site model
DA	deep aquifer
DCU	deep confining unit
E001	Event 1
E002	Event 2
E003	Event 3
ft/ft	feet per foot
GCSM	geochemical conceptual site model
GMF	Gypsum Management Facility
GSP	Gypsum Stack Pond
GWPS	groundwater protection standard
HCR	Hydrogeologic Site Characterization Report
HDPE	high-density polyethylene
IEPA	Illinois Environmental Protection Agency
IPGC	Illinois Power Generating Company
IPCB	Illinois Pollution Control Board
Kd	soil adsorption coefficient
LCL	lower confidence limit
LCU	lower confining unit
LF	Landfill
mg/L	milligrams per liter
NAVD88	North American Vertical Datum of 1988
No.	number
PMP	potential migration pathway
Ramboll	Ramboll Americas Engineering Solutions, Inc.
RP	Recycle Pond
SI	surface impoundment
TDS	total dissolved solids
UA	uppermost aquifer
UCU	upper confining unit
USGS	United States Geological Survey
WPCP	Water Pollution Control Permit

EXECUTIVE SUMMARY

Groundwater samples collected at the Coffeen Power Plant (CPP) Ash Pond Number (No.) 2 (AP2) during May and June 2023 for the Quarter 2, 2023 compliance sampling event (Event 1 [E001]) were evaluated for statistical exceedances of the groundwater protection standards (GWPS) described in Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845.600. Statistical exceedances were identified in the following hydrostratigraphic units and wells:

- Detected Uppermost aquifer (UA) Exceedances:
  - Boron at G401, G402, G404, and G405
  - Cobalt at G401
  - pH at G401
  - Sulfate at G401, G402, G404, G405, G406, and G407
  - Total dissolved solids (TDS) at G401, G402, G404, G405, and G407

As a result of the identified E001 statistical exceedances, a Corrective Measures Assessment (CMA) was initiated on January 14, 2024 in accordance with 35 I.A.C. § 845.660 and submitted on June 12, 2024 [1]. The subsequent compliance sampling events for the Quarter 3 and Quarter 4, 2023 sampling events (Event 2 [E002] and Event 3 [E003]) were completed in August and November 2023 and groundwater samples were evaluated for statistical exceedances of the GWPS as described in 35 I.A.C. § 845.600. Statistical exceedances identified during the E002 and E003 events were consistent with those listed above, with the notable exception of a sulfate statistical exceedance absent at G402 during E003.

In accordance with 35 I.A.C. § 845.650(e), Alternative Source Demonstrations (ASD) were completed on December 15, 2023 for sulfate and TDS statistical exceedances at well G407 and the cobalt statistical exceedance at well G401 [2, 3]. The Illinois Environmental Protection Agency (IEPA) provided a non-concurrence letter for both ASDs on January 11, 2024 [4, 5]. The non-concurrences were appealed, and the Illinois Pollution Control Board (IPCB) granted a partial stay on March 7, 2024 [6, 7]. As a result of the IPCB partial stay, GWPS statistical exceedances of cobalt (G401), and sulfate and TDS (G407) will not be discussed in this nature and extent report.

As required by 35 I.A.C. § 845.650(d)(1), this report characterizes the nature and extent of boron, pH, sulfate, and TDS, and relevant site conditions to determine how they may affect the corrective measures ultimately selected for AP2 and documents the additional measures taken in accordance with 35 I.A.C. § 845.650(d).

Statistical exceedances of boron greater than the GWPS were encountered within the UA at multiple monitoring well locations. The lateral extent of boron statistical exceedances are defined to the west by monitoring wells G403 and G406 (and additionally the groundwater divide running north-south across the CPP), to the east by the Unnamed Tributary and Coffeen Lake, and to the south by the former discharge flume. Due to erosion, the UA is absent east of monitoring wells G402 and G404 and boron statistical exceedances are ultimately defined by Coffeen Lake. The boron concentrations in the groundwater system may be attenuated via surface complexation reactions and via interactions with clay minerals, which are present in solids across the UA and lower confining unit (LCU).

The boron concentrations from monitoring wells around AP1, the discharge flume, and Coffeen Lake were used to evaluate risk to Human Health or ecological receptors and findings indicate they do not present unacceptable risk [8]. Comparison of boron concentrations from AP1 used in the analysis (7.5 mg/L) to the maximum measured in G401 and G402 at AP2 (8.1 mg/L) suggests that results for AP2 would also not present an unacceptable risk. At both AP1 and AP2 the vertical extent of boron greater than the GWPS is limited by the presence of low permeability tills.

Measurements of pH less than the lower GWPS were encountered only within the UA at G401. The lateral extent of pH statistical exceedances are defined to the west by G406, to the east by G402, and to the south by the former discharge flume. Vertically, the extent of pH less than the lower GWPS is limited by the presence of low permeability tills.

Statistical exceedances of sulfate and TDS greater than the GWPS were encountered within the UA at multiple monitoring well locations. The extent of sulfate and TDS statistical exceedances greater than the GWPS are laterally defined as follows: to the west of AP2 by the groundwater divide running north-south across the CPP; to the east by the Unnamed Tributary and Coffeen Lake; and to the south by the former discharge flume. Due to erosion, the UA is absent east of monitoring wells G402 and G404 and sulfate and TDS statistical exceedances are ultimately defined by Coffeen Lake. Sulfate and TDS statistical exceedances are not expected to extend a significant distance to the north or west due to observed groundwater flow direction in the vicinity of AP2. The sulfate concentrations in the groundwater system may be attenuated via surface complexation reactions. Attenuation of the constituents contributing to TDS, such as sulfate, will reduce TDS concentrations as well. Sulfate and TDS concentrations in Coffeen Lake and the former discharge flume were evaluated for AP1 and they do not present unacceptable risk [8]. Vertically, the extent of sulfate and TDS statistical exceedances greater than the GWPS is limited by the presence of low permeability tills.

1. INTRODUCTION

35 I.A.C. § 845.650(d)(1) requires the owner or operator of a coal combustion residuals (CCR) surface impoundment (SI) to characterize the nature and extent of a release and relevant site conditions that may affect the remedy ultimately selected for a CCR SI if any constituent regulated under 35 I.A.C. § 845 is found to exceed the GWPS. This report documents the nature and extent of constituents detected above the GWPS that are attributable to the CPP AP2.

The groundwater data and analysis in this report includes results from historical sampling (initiated in 2015) through E003, which was completed on November 21, 2023. Results of the E001, E002, and E003 events were submitted and placed in the facility's operating record by October 16, 2023; January 20, 2024; and March 10, 2024, respectively, as required by 35 I.A.C. § 845.800(d)(15), within 60 days of receiving final laboratory analytical data [9, 10, 11]. The statistical determination presented in the report identified the following statistical exceedances of the GWPS at compliance groundwater wells in the following hydrostratigraphic unit:

- Detected UA Exceedances:
  - Boron at G401, G402, G404, and G405
  - Cobalt at G401
  - pH at G401
  - Sulfate at G401, G402, G404, G405, G406, and G407
  - TDS at G401, G402, G404, G405, and G407

An ASD, as allowed by 35 I.A.C. § 845.650(e), was completed for the cobalt statistical exceedance at UA monitoring well G401 [2] and an ASD was completed for the sulfate and TDS statistical exceedances at UA monitoring well G407 [3]. The IEPA did not concur with the ASDs. The non-concurrences were appealed, and the IPCB granted partial stays on March 7, 2024 [6] [7]. Therefore, the nature and extent of cobalt at G401, and sulfate and TDS at G407, are not discussed in this document. Evaluations were not conclusive in demonstrating an alternative source for the other identified GWPS statistical exceedances. This Nature and Extent Report discusses in detail the extent of the boron, pH, sulfate, and TDS statistical exceedances as well as a geochemical conceptual site model (GCSM) describing the nature of these statistical exceedances.

2. UNIT BACKGROUND

2.1 Site Location and Description

The CPP is located in Montgomery County in central Illinois, approximately two miles south of the City of Coffeen and about eight miles southeast of the City of Hillsboro (**Figure 2-1**). The CPP was a coal-fired power plant with five CCR units present: AP2 (35 I.A.C. § 845 regulated CCR Unit and subject of this report), Ash Pond No. 1 (AP1), the Gypsum Management Facility (GMF) Gypsum Stack Pond (GSP), GMF Recycle Pond (RP), and Landfill (LF). AP2 is located in Section 11, Township 7 North and Range 3 West. AP2 is located south of the CPP and situated in a predominantly agricultural area (**Figure 2-2**). AP2 is located between two lobes of Coffeen Lake (the western lobe is identified as "Coffeen Lake" and the upper reaches of the eastern lobe are fed by a stream labeled as "Unnamed Tributary" on **Figures 2-1** and **2-2**), which surround the SI to the west, east, and south. The southern edge of AP2 is adjacent to the former discharge flume for the closed generating plant. AP2 is bordered by other CCR units and agricultural land to the north.

2.2 Description of CCR Unit

The CPP was a coal-fired electrical generating plant that began operation in 1964. The plant initially burned bituminous coal from Illinois and CCR from the coal fired units was disposed of in AP1. AP2 was utilized for CCR disposal beginning in the early 1970's and AP1 was reconstructed in 1978. Both of these units were used until the mid-1980's, beginning in 2010 CCR material was placed in the LF and GMF Units.

- **AP2:** AP2 is a closed (IEPA-approved) SI with a surface area of approximately 60 acres and berms 47 feet higher than the surrounding land surface. AP2 was originally removed from service and capped in the mid 1980's. A clay and soil cap was placed on the surface of the pond with contouring and drainage provided to direct storm water to four engineered revetment down drain structures. Prior to capping, this pond was identified as Outfall 004 in the facility National Pollutant Discharge Elimination System operating permit, IL0000108. Additional closure activities include the construction of a geomembrane cover system that began in July 2019 and was completed on November 17, 2020. Construction was completed in accordance with the Closure and Post Closure Care Plan approved by the IEPA on January 30, 2018 [12]. No CCR was sampled in 2021 because the pond was closed and capped [13]. The unit contains bottom ash and fly ash and the base of CCR at AP2 is shown in **Figure 2-3**.

  Water that may come into contact with CCR within the footprint of AP2 becomes CCR source water. Results from CCR source water samples collected from porewater wells and historically from porewater grab samples [13] are used to provide information for groundwater transport modeling[1].

- **AP1:** This SI (also known as the Bottom Ash/Recycle Pond) is a reclaimed ash pond that was reconstructed utilizing the existing earthen berms with reinforcement, as provided by Water

[1] Per Federal Register 80 (21302), which promulgated the final Title 40 of the Code of Federal Regulations. § 257 rule, porewater concentrations should be used to characterize potential leaching from impoundments. As discussed further in USEPA's risk assessment of CCR surface impoundments (USEPA 2014), porewater is "collected from the interstitial water between waste particles in surface impoundments as it occurs in the field," and concentrations within the porewater are "the most representative data available for impoundments because these data are field-measured concentrations of leachate." Therefore, CCR source water collected from porewater wells within the unit, represent the CCR source term.

Pollution Control Permit (WPCP) 1978-EA-389 issued by the IEPA on May 26, 1978. AP1 (existing unlined SI) covers an area of approximately 23 acres, has berms up to 41 feet above the surrounding land surface, and a volume of 300 acre-feet. It primarily received bottom ash and low volume wastes from floor drains in the main power block building. Several years ago, air heater wash and boiler chemical cleaning wastes were directed to AP1, but this practice was discontinued. The bottom ash was periodically removed for beneficial uses by a third-party contractor. Sluicing of waste to AP1 ceased prior to November 4, 2019.

- **GMF GSP:** The 37-acre GMF GSP received blowdown from the air emission scrubbers and was put into operation in 2010. Construction of the GMF GSP was in accordance with WPCP 2008-EA-4661 and features a composite 60-mil high-density polyethylene (HDPE) liner with 3 feet of recompacted soil with a hydraulic conductivity of 1×10^{-7} centimeters per second (cm/s) with internal piping and drains to collect contact water. Construction of the unit required excavation to an elevation of approximately 603 feet[2] and installation of a groundwater underdrain system to eliminate inward pressure on the liner prior to placement of CCR. The GMF GSP underdrain was actively pumped during construction but is no longer used. Illinois Power Generating Company (IPGC) ceased receipt of waste to the GMF GSP prior to April 11, 2021.
- **GMF RP:** The 17-acre GMF RP received blowdown from the air emission scrubbers and was put into operation in 2010. Construction of the GMF RP was in accordance with WPCP 2008-EA-4661 and features a composite 60-mil HDPE liner with 3 feet of recompacted soil with a hydraulic conductivity of 1×10^{-7} cm/s with internal piping and drains to collect contact water. Construction of the unit required excavation to an elevation of approximately 601 feet and installation of a groundwater underdrain system to eliminate inward pressure on the liner prior to placement of CCR. The GMF RP underdrain is a passive, gravity drained system. IPGC ceased receipt of waste to the GMF RP prior to April 11, 2021.
- **LF:** Fly ash was managed in a permitted composite lined landfill constructed in 2010. The LF has an active groundwater underdrain system that is currently being operated. Additionally, the ash landfill leachate collection system is restricted by rule to no more than one foot of leachate on the composite liner. An IEPA groundwater monitoring program is in effect for the GMF (under Bureau of Water) and Ash Landfill (under Bureau of Land).

2.3 Geology and Hydrogeology

Significant site investigation has been completed at the CPP to characterize the geology, hydrogeology, and groundwater quality. Based on extensive investigation and monitoring, AP2 has been well characterized and detailed in the Hydrogeologic Site Characterization Report (HCR) [13].

2.3.1 Hydrostratigraphic Units

In addition to the CCR, five hydrostratigraphic units have been identified at the CPP based on stratigraphic relationships and common hydrogeologic characteristics, and are summarized as follows:

- **Upper Confining Unit (UCU)**: Consists of the Loess Unit and the upper clayey portion of the Hagarstown Member which has generally lower vertical permeability and generally greater than 60 percent fines. This Unit was encountered across most of the CPP, with the exception

[2] All elevations in this report are referenced to North American Vertical Datum of 1988 (NAVD88) unless otherwise noted.

of the eastern edges of the SIs near the Unnamed Tributary where the unit was eroded following deposition or locations where it has been excavated for construction.

- **Uppermost Aquifer (UA)**: This unit consists primarily of sand and sandy silts and clays at the base of the Hagarstown Member and, in some locations, the uppermost weathered sandy clay portion of the Vandalia Member. This unit is absent in several locations due to weathering and in others due to excavation during construction of CCR Units. The hydraulic characteristics of the Hagarstown Member are variable due to the different material compositions, but generally indicate the unit has a moderate hydraulic conductivity.
- **Lower Confining Unit (LCU)**: This unit is composed of the sandy clay till of the Vandalia Member, the silt of the Mulberry Grove Formation, and the compacted clay till of the Smithboro Member. The unit underlies the UA and was encountered in all boring locations on the CPP. Results from laboratory tests completed for vertical hydraulic conductivity indicate the Vandalia Member has a very low vertical hydraulic conductivity.
- **Deep Aquifer (DA)**: This unit consists primarily of sandy silt and sands of the Yarmouth Soil, which are thin (less than 5 feet) and discontinuous across the CPP.
- **Deep Confining Unit (DCU)**: This unit underlies the DA and is composed of the Banner Formation, of which the thick Lierle Clay is the first encountered unit. No boring penetrated the full thickness of this formation.

2.3.2 Uppermost Aquifer

The UA has been identified as the base of the Hagarstown Member and, in some locations, the uppermost weathered sandy clay portion of the Vandalia Member. This unit is continuous across the site, but hydraulic characteristics are variable as a result of the unit composition. The UA is likely absent in several locations due to weathering. The UA exhibits a moderate hydraulic conductivity and is the most likely unit to indicate potential impacts from AP2. Based on the geologic information, the top of the aquifer is highest in elevation at the northern side of AP2, with an elevation of approximately 610 feet. Except in areas where the UCU and UA have been eroded (adjacent to the Unnamed Tributary), the top of the UA is typically separated from overlying CCR material by several feet of the low permeability UCU, which consists of the Loess Unit and the upper clayey portion of the Hagarstown Member (**Figure 2-4**, **Appendix A**). The base of the UA is the top of the LCU, which contains the low permeability Vandalia Member, Mulberry Grove Member, and Smithboro Till. In 2021, soil borings and monitoring wells (G1001 and G1003) were completed between the eastern edge of AP2 and the Unnamed Tributary. The borings did not identify the presence of either the UCU or UA, indicating that the UA is absent east of AP2. Wells G1001 and G1003 were screened in the LCU to evaluate shallow groundwater quality east of AP2. Only G1001 contains measurable amounts of groundwater that can be collected and analyzed; G1003 is routinely dry.

2.3.3 Potential Migration Pathways

Potential migration pathways (PMP) were interpreted using the lithologic composition and hydrogeologic properties (hydraulic conductivity, hydraulic position with respect to the unit) of the screened materials. In addition to the physical properties, the analytical results from the baseline groundwater monitoring performed in wells screened in the confining units and DA were used to identify PMPs. The UA is the first occurrence of groundwater and therefore the PMPs identified are in geologic units located below the UA. Monitoring wells G1001 and G1003 are

considered LCU PMP monitoring locations. Wells G1001 and G1003 are used to evaluate the potential for migration of impacts through the LCU where the UCU and UA are absent.

2.3.4 Regional Bedrock Geology

Bedrock has not been investigated at the site due to the depth to bedrock and presence of two low permeability confining units underlying the UA and above the bedrock, and the intermittent coal beds found within the bedrock. There are no known monitoring wells or production wells screened within the bedrock at the CPP. Bedrock has not been encountered at any borings on-site. A literature review was completed to supplement the site geology.

Detailed descriptions of the Pennsylvanian strata of Illinois were published by Willman et al. [14] and Kolata [15]. The Bond Formation includes all strata from the base of the Shoal Creek Limestone Member or the LaSalle Limestone Member to the top of the Millersville Limestone Member or the Livingstone Limestone Member. It is overlain by the Mattoon Formation and underlain by the Modesto Formation. It varies from less than 150 feet thick in eastern Illinois to over 300 feet thick in southeastern Illinois, averaging about 250 feet. The Bond Formation is characterized by a high percentage of limestone and calcareous clays and shales. The Bond and Modesto Formations of the McLeansboro Group also contain multiple thin (typically less than 2 feet) intermittent coal beds. The upper formation of the Kewanee Group is the Carbondale Formation which contains multiple coal beds, including the Herrin (No. 6) Coal, of varying thicknesses (up to 7 feet) [16]. It is bound by thick limestone members (up to 50 feet), the thickest and purest limestones in the Pennsylvanian System of Illinois. Gray shales constitute the greatest part of the formation, although thick channel sandstones are developed locally.

Two mines were operated historically in the vicinity of the site. The Hillsboro Mine located east/southeast of the GSP was operated by the Truax-Traer Coal Company from 1964-1970 and by the Consolidation Coal Company from 1971 through 1983. The mine targeted the Herrin Coal at a depth of 500 to 510 feet below ground surface (bgs), and geological reports included roof problems and slight floor heaving. The Clover Leaf No. 4 Mine located north of the GSP was operated by the Clover Leaf Coal Mining company and the Coffeen Coal Mining Company from 1906 through 1924. The mine targeted the Herrin Coal at a depth of 510 to 544 feet bgs. Geologic reports indicate a massive black shale roof, and unmined areas which could be related to water-bearing sandstones above the roof [17].

2.3.5 Water Table Elevation and Groundwater Flow Direction

Porewater (*i.e.,* CCR source water) elevations within AP2 (as observed in AP2-D) are greater than the surrounding areas. The phreatic surface within AP2 in 2023 averaged approximately 624.1 feet, ranging from 623.7 to 624.8 feet (**Appendix B**). As indicated in **Section 2.3.2**, UA groundwater is typically separated from overlying CCR material by several feet of the low permeability soils of the UCU, except along the eastern edge of AP2 where two incised stream gullies were backfilled to construct the eastern berm of AP2.

Overall groundwater flow within the UA is divided towards the two lobes of Coffeen Lake. The groundwater divide runs approximately through the center of the CPP, with groundwater east of the divide flowing east to southeast towards the Unnamed Tributary or the eastern lobe of Coffeen Lake and groundwater west of the divide flowing west to southwest towards the western lobe of Coffeen Lake. Groundwater flows southeast to east across AP2 (**Figure 2-5** and **Table 2-1**) toward the former discharge flume and Unnamed Tributary. Groundwater elevations are

lowest near the Unnamed Tributary and east of AP2 towards the eastern lobe of Coffeen Lake. Based on the elevations of the tributary and groundwater elevations measured east of the tributary (**Appendix B** and **Table 2-1)**, the Unnamed Tributary may be a local groundwater receiving body and prevent or reduce groundwater migration east of the Unnamed Tributary. During 2023, groundwater elevations in the UA in the vicinity of AP2 ranged from approximately 601 to 621 feet (**Figure 2-5**). Although elevations vary seasonally, the groundwater flow direction in the UA is consistent and likely controlled by the proximity and hydraulic connection to both the eastern and western lobes of Coffeen Lake.

LCU (PMP) groundwater elevations are slightly lower than those in the UA and exhibit similar variability in seasonal groundwater elevation as the UA. Groundwater elevation within the LCU ranged from about 590 to 623 feet in 2023 (**Figure 2-5** and **Table 2-1**). LCU monitoring wells G1001, G1003, T408, and T409 are nearest AP2 and typically have groundwater elevations ranging from approximately 591 to 618 feet. Monitoring well G1003 was dry for the entirety of 2023 and groundwater elevation could not be established at this location.

DA (PMP) groundwater elevations are generally lower than those in the UA and LCU (PMP) and ranged from about 576 to 618 feet in 2023 (**Figures 2-6** and **Table 2-1**). Monitoring well G275D (south of the GMF RP) is nearest AP2 and typically had groundwater elevations ranging from about 576 to 589 feet during 2023. A groundwater contour map was generated for the DA for the E002 event and groundwater flow within the DA generally follows subsurface topography for the unit (**Figure 2-6**).

No monitoring wells were installed in the UCU during 2021 investigation activities and no wells have historically been installed across solely the UCU because it is not present or is unsaturated where present at the CPP. Groundwater elevations within the DCU and bedrock unit are unknown because no wells are screened within these low hydraulic conductivity units.

2.3.5.1 Vertical Hydraulic Gradients

Vertical hydraulic gradients were calculated using available groundwater elevation data from February 2017 to November 2023 at nested well locations within the UA, LCU (upper and lower), and DA. Vertical hydraulic gradients for AP2 are presented in **Table 2-2** and well locations are shown on **Figure 2-5**. Vertical hydraulic gradients for other nested well locations at the CPP, discussed below, are presented in **Appendix C**. The results of the vertical hydraulic gradient calculations between hydrostratigraphic units are summarized below:

- UA to Upper LCU (Vandalia Member):
  - Vertical gradients at well nest G405/T408, located north of AP2, vary between upward and downward with an average (downward) vertical gradient of 0.02 feet per foot (ft/ft).
  - Vertical gradients at well nest G406/T409, located south of AP2/northwest of AP1, vary between upward and downward with an average (upward) vertical gradient of -0.06 ft/ft. Since 2021, the vertical gradient observed at this well nest has been consistently upward, with the exception of August 2022.
- Upper LCU (Vandalia Member) to Lower LCU (Smithboro Member)
  - Well nest T408/G45D, located north of AP2, has consistently downward vertical gradients, with an average vertical gradient of 0.98 ft/ft. Beginning in 2020, vertical gradients observed at this well nest have become less strongly downward.

  - Vertical gradients at well nest G406/T409, located south of AP2/northwest of AP1, are consistently downward, with the exception of August 2022, with an average vertical gradient of 0.64 ft/ft. Beginning in 2020, vertical gradients observed at this well nest have become less strongly downward.
- UA to Lower LCU (Smithboro Member)
  - Well nest G307/G307D, located south of AP1, has consistently downward vertical gradients with an average vertical gradient of 0.13 ft/ft.
  - In well nest G311/G311D gradients are consistently strongly downward, with an average vertical gradient of 0.71 ft/ft.
- LCU to DA
  - Vertical gradients at well nest G314/G314D, located east of AP1, are consistently downward, with an average vertical gradient of 0.69 ft/ft. Beginning in 2022, vertical gradients observed at this well nest have become progressively less strongly downward and the vertical gradient was observed to be upward (-0.01 ft/ft) during December 2023.

Vertical hydraulic gradients indicate there is consistently downward migration of groundwater in most areas of the CPP, with the exception being southwest of AP2, where consistent upward gradients were measured between the UA and upper LCU. However, there has been a decrease in magnitude of downward gradients since approximately 2020, which is likely a result of plant shutdown and placement of a geomembrane on AP2.

2.3.5.2 Impact of Surface Water Bodies on Groundwater Flow

Surface water elevations were measured from various locations along the Unnamed Tributary from March 2021 to December 2023 (**Figure 2-5**). Elevations at SG-04 (near CIPS Trail and determined to be destroyed in October 2023) ranged from 591.94 to 593.38 feet. Surface water elevations near the former discharge flume located between AP1 and AP2 were measured at SG-02 and ranged from 598.34 to 598.75 feet. Surface water elevations from Coffeen Lake at SG-03 (near the outfall east of AP1) ranged from 585.09 to 589.97 feet.

Groundwater contour maps prepared from elevation data measured in monitoring wells indicate groundwater elevations can be variable, but flow directions are generally consistent.

Groundwater near AP2 discharges locally to the former discharge flume to the south and the Unnamed Tributary to the east, which flows south into the eastern lobe of Coffeen Lake. The Unnamed Tributary is a local groundwater receiving body that may prevent or reduce groundwater migration east of the Unnamed Tributary.

Construction of the LF, GMF GSP, and GMF RP required removal of the Hagarstown Member, in effect removing the aquifer beneath the footprint of these units [18]. It is uncertain whether these constructed units significantly limit lateral groundwater flow, either by creating no flow zones, or by capturing groundwater via their dewatering [19].

2.3.6 Hydraulic Conductivities

2.3.6.1 Field Hydraulic Conductivities

Field hydraulic conductivity tests were performed historically by Hanson as part of initial characterization efforts for the CPP [13]. In 2021, additional field hydraulic conductivity tests

were completed by Hanson to support 35 I.A.C. § 845 requirements for AP1, the GMF GSP, and the GMF RP [20, 21, 22]. Historical field hydraulic conductivity test results are included in **Appendix D** and tests completed for other CCR units in 2021 are included in **Appendix E** [13].The results of the tests are summarized as follows:

- **UA:** Historical tests completed in UA monitoring wells (G401, G402, G403, G404, and G405) indicated hydraulic conductivities ranged from 4.3 x 10^{-5} to 9.8 x 10^{-4} cm/s, with a geometric mean of 2.7 x 10^{-4} cm/s.
- **LCU:** Historical tests completed in the LCU for monitoring wells and temporary piezometers (G45D, G46D, T408, and T409) indicated hydraulic conductivities ranged from 7.5 x 10^{-8} to 3.6 x 10^{-5} cm/s, with a geometric mean of 5.6 x 10^{-6} cm/s.
- **DA:** Geometric mean hydraulic conductivity at DA well G314D, near AP1, was 8.7 x 10^{-5} cm/s and was slightly lower than tests completed in the northern portion of the CPP in 2009 that estimated hydraulic conductivity values ranged from 1.3 x 10^{-4} to 1.7 x 10^{-3} cm/s, with a geometric mean of 4.4 x 10^{-4} cm/s.
- No monitoring wells are screened only within the DCU, and no field hydraulic conductivity tests have been conducted for the DCU.

2.3.6.2 Laboratory Hydraulic Conductivities

Falling head permeability tests (ASTM D5084 Method F) were performed in the laboratory on samples collected during the 2021 investigations at the CPP [22, 21, 20] and historically [13]. The results are summarized in **Appendix D** and discussed below.

- **CCR:** No laboratory vertical hydraulic conductivity tests were completed during 2021 on CCR materials in AP2.
- **UCU:**
  - The 2021 sitewide geometric mean of vertical hydraulic conductivities of three samples collected from the UCU is 2.5 x 10^{-8} cm/s, which is consistent with historically reported values.
  - Geotechnical tests conducted prior to 2017 indicated UCU vertical hydraulic conductivity values ranged from 1.3 x 10^{-8} to 5.0 x 10^{-7} cm/s, with a geometric mean of 1.0 x 10^{-7} cm/s.
- **UA:** One geotechnical sample of UA material was collected from G275D, near the GMF RP and immediately northeast of AP2, with a vertical hydraulic conductivity of 1.6 x 10^{-4} cm/s.
- **LCU:**
  - The 2021 sitewide geometric mean of vertical hydraulic conductivities of three samples collected from the LCU is 1.8 x 10^{-7} cm/s. Vertical hydraulic conductivities from 2021 are consistent with those observed historically.
  - Intermittently present within the LCU is the Mulberry Grove Member. Historical vertical hydraulic conductivities of the Mulberry Grove Member were measured as 1.6 x 10^{-6} and 1.9 x 10^{-6} cm/s.
  - Historical laboratory tests reported LCU vertical hydraulic conductivity values ranged from 6.8 x 10^{-9} to 4.5 x 10^{-6} cm/s, with a geometric mean of 3.0 x 10^{-8} cm/s.

- **DA:** No laboratory vertical hydraulic conductivity tests were completed during 2021 on DA materials.
- **DCU**: No laboratory vertical hydraulic conductivity tests were completed during 2021 on DCU materials. Historical vertical hydraulic conductivity tests were performed on samples collected north and west of the GMF GSP. Vertical hydraulic conductivities of 6.8×10^{-9} and 4.5×10^{-6} cm/s were reported.
- **Bedrock**: No bedrock samples were analyzed for vertical hydraulic conductivity.

2.4 Groundwater Monitoring

The monitoring system for AP2 is shown on **Figure 2-2** and consists of three background monitoring wells (G270, G280, and G281), eight compliance monitoring wells (G401, G402, G403, G404, G405, G406, G407, and G1001), one water level only monitoring well (G1003), and three temporary water level only surface water staff gages (SG-02, SG-03, and SG-04) to monitor potential impacts from AP2 [23]. The monitoring wells are screened within the UA (G270, G280, G281, G401, G402, G403, G404, G405, G406, and G407) and LCU (G1001 and G1003) along the perimeter of AP2. Porewater samples are not regularly collected as part of the groundwater monitoring plan for AP2 (**Figure 2-2**), but porewater samples were collected from dewatering locations in 2016 [13], and a leachate sample was collected from the C102 PumpQbox in 2020 to provide information on the source concentrations. Additional porewater samples are collected as needed from an existing porewater monitoring well (AP2D) (**Figure 2-2**).

2.5 Hydrogeologic Conceptual Site Model

The HCR [13] and information provided above forms the foundation of the AP2 hydrogeological setting. AP2 overlies a potential recharge area for the underlying transmissive geologic media, which are composed of unlithified deposits. Recharge migrates downward into and through the UCU, into the UA, where present.

Groundwater flow in the UA at the CPP is divided towards the two lobes of Coffeen Lake. The loess of the UCU and sands of the UA are hydraulically connected. Groundwater flow in the silts and clays of the UCU and LCU is expected to be primarily vertical. The majority of horizontal groundwater migration is expected to be within the lower Hagarstown Member (*i.e.,* UA). The geologic conceptual model for the site used for closure plan groundwater modeling [24] consists of the following layers:

- Hagarstown Loess Unit (*i.e.,* UCU) – Loess Unit and the upper clayey portion of the Hagarstown Member.
- Hagarstown Member (*i.e.,* UA) – sand and sandy silts and clays at the base of the Hagarstown Member and, in some locations, the uppermost weathered sandy clay portion of the Vandalia Member.
- Vandalia Member/Mulberry Grove Member (*i.e.,* LCU) – unweathered sandy clay till and discontinuous silts.
- Smithboro Till (*i.e.,* LCU) – compacted clay till of the Smithboro Member.
- The Deep Aquifer (*i.e.,* DA) and Deep Confining Unit (*i.e.,* DCU) were not included in the model, for consistency with the original model [25].

The United States Geological Survey (USGS) National Map places the CPP within the East Fork Shoal Creek watershed subbasin (Hydrologic Unit Code 071402030303). The CPP conceptual site model (CSM) extent is bounded by a hydrological catchment (watershed) divide to the east based on watershed data from USGS. Along the north, south, and east, the model boundary was placed along known waterbodies as much as possible. As such, it is assumed groundwater inflow from adjacent watersheds is negligible through both the UA and LCU. The Coffeen Lake water levels are managed at an average elevation of 591.0 feet. Coffeen Lake and Unnamed Tributary are the receiving surface water bodies in the area encompassed by the CSM.

Precipitation infiltrates and recharges the groundwater table throughout the site and upgradient of the site. Groundwater in the UCU migrates downward into the sandy material of the lower Hagarstown Formation, or weathered Vandalia Till, which is considered the UA. The sands of the UA are separated from the base of CCR in AP2 by the laterally continuous low permeability UCU. Erosion caused by incised streams has occurred along the eastern side of AP2 which likely results in ash being in contact with the UA. Water that percolates downward from layers overlying the UA is most likely to travel laterally from the site within the UA due to the relatively high permeability (as compared to the underlying LCU) and horizontal gradients present within the UA as described above. Groundwater and surface water elevations indicate groundwater flows towards Coffeen Lake, which is a local receiving body for the UA. Further downward migration is also limited by the relatively thick and low permeability LCU.

Based on the geology and hydrogeology, monitoring wells at AP2 can be separated into two distinct groupings that exhibit similar geologic and hydraulic characteristics. Monitoring well groupings are summarized as follows:

- UA wells: shallow wells (generally less than 20 feet bgs) screened in moderate permeability materials (generally about 10^{-3} cm/s) including G270, G280, G281, G401, G402, G403, G404, G405, G406, and G407.
- LCU wells: shallow wells (less than 15 feet bgs) east of AP2 where the UCU and UA have been eroded (G1001 and G1003). LCU wells are screened across moderate permeability (generally about 10^{-4} cm/s) sand lenses within the low permeability till.

3. OCCURRENCE AND DISTRIBUTION OF GROUNDWATER EXCEEDANCES (EXTENT)

Results from groundwater samples collected from AP2 during E001, E002, and E003 were received on August 17, 2023; November 21, 2023; and January 10, 2024, respectively. In accordance with 35 I.A.C. § 845.610(b)(3)(C), comparison of statistically derived values with the GWPSs described in 35 I.A.C. § 845.600 to determine statistical exceedances of the GWPS was completed [9, 10, 11]. Statistical exceedances for which an ASD was not completed include the following parameters and wells by hydrostratigraphic unit:

- UA (**Figure 3-1**):
  - Boron at G401, G402, G404, and G405
  - pH at G401
  - Sulfate at G401, G402, G404, G405, and G406
  - TDS at G401, G402, G404, and G405

The extents of statistical exceedances discussed below were defined using existing monitoring wells, including wells present on-site (**Table 3-1** and **Figure 3-2**) that may not be included in the 35 I.A.C. § 845 monitoring program.

3.1 Additional Investigation to Define Nature and Extent

Following initial sampling in 2021, potential statistical exceedances of the GWPS were identified for the parameters and locations identified above [9, 10, 11]. A total of three borings were advanced later in 2021 adjacent to locations with potential statistical exceedances (G401 and G1001), and background well (G270). Solids samples were collected and analyzed for the following:

- 6010B for 7-step sequential extraction (arsenic, boron, cobalt, lithium, and molybdenum);
- EPA 6010B for Total Metals (aluminum, arsenic, beryllium, calcium, chromium, cobalt, iron, lead, lithium, manganese, molybdenum, and selenium);
- Bulk Mineralogy by Reitveld x-ray diffraction analysis;
- Bulk elemental composition by X-ray fluorescence
- Cation Exchange Capacity Analysis; and,
- Total Organic Carbon Analysis and Loss on Ignition.

Six surface water samples were collected later in 2021 to characterize the water quality in Coffeen Lake and supplement previous samples collected in 2016 (**Appendix F**) [26]. Surface water samples were analyzed for 35 I.A.C. § 845.600 parameters (total and dissolved), ferrous and ferric iron, major ions, and monitored natural attenuation parameters. Data from surface water sampling has been incorporated into this report where applicable.

3.2 Extent in the Uppermost Aquifer

Groundwater samples are evaluated quarterly and statistical exceedances are identified following comparison of lower confidence limits (LCLs) to the GWPSs described in 35 I.A.C. § 845.600. The

LCLs vary as the dataset is updated to include additional quarterly events (**Table 3-2**). The discussion below includes ranges of concentrations measured in wells with statistical exceedances, because there is no single value for LCLs.

3.2.1 Boron

Boron GWPS (2 milligrams per liter [mg/L]) statistical exceedances were encountered within the UA at monitoring well locations (G401, G402, G404, and G405). Concentrations of boron from locations where the GWPS was exceeded range from 1.1 to 21.2 mg/L (**Table 3-3**) and generally exhibit stable to declining trends except for G404. Concentrations of boron at G404 have increased from approximately 2.8 mg/L in 2020, prior to completion of closure, to 21 mg/L in November 2023. Review of porewater elevations within AP2 (Appendix X) indicate an increase during closure activities that has since stabilized and started to decline after closure was completed. Modeling completed as part of the Closure Plan [27] indicated that water levels beneath the cover system would equilibrate in approximately 46 years, suggesting that concentrations in G404 may be a result of altered flow conditions following placement of the geomembrane and closure of AP2.

The extents of statistical exceedances above the GWPS are defined laterally in the UA to the west by monitoring wells G403 and G406 (and additionally the groundwater divide running north-south across the CPP), to the east by the Unnamed Tributary and Coffeen Lake, and to the south by the former discharge flume (**Figure 3-1**). The boring logs from G1001 and G1003, and historical topographic maps, indicate that the UA has been eroded east of AP2 and statistical exceedances are not expected to extend a significant distance in these directions due to the absence of UA materials. The eastern lobe of Coffeen Lake is located approximately 200 feet downgradient of G402. The former discharge flume is located approximately 60 feet downgradient of G401. Comparison of water elevations indicates that groundwater migrates toward Coffeen Lake and the former discharge flume from AP2. The eastern extent of boron is defined downgradient by surface water sample CL-1, collected east of G402 from the eastern lobe of Coffeen Lake, which had a boron concentration of 0.1 mg/L (**Appendix F**). The southern extent of boron is defined downgradient by surface water samples D-1 and D-2, collected south of G402 from the former discharge flume, which had boron concentrations of 0.33 and 0.3 mg/L, respectively (**Appendix F**). Concentrations of boron at CL-1, D-1, and D-2 are a similar magnitude to boron concentrations measured in a Coffeen Lake background sample (BKG-1; 0.086 mg/L).

Downward migration of boron in the UA is inhibited by the underlying Vandalia Till, Mulberry Grove Member, and Smithboro Till which are, on average, greater than 15 feet thick at the site. Vertical hydraulic conductivity tests completed on samples of the LCU beneath the UA indicate hydraulic conductivities from 5.5×10^{-8} to 3.7×10^{-7} cm/s. This is very low relative to the horizontal hydraulic conductivity measured within the UA (geometric mean of 2.7×10^{-4} cm/s). The significant contrast in permeability (greater than two orders of magnitude) indicates groundwater will preferentially migrate horizontally toward the Unnamed Tributary and ultimately Coffeen Lake and the elevated boron concentrations will not extend into the underlying hydrostratigraphic units.

3.2.2 pH

Lower limit pH GWPS (6.5 Standard Units [S.U.]) statistical exceedances in the UA are limited to G401. Monitoring well G401 is located south of the south berm between AP2 and the former

discharge flume. Measurements of pH in G401 range from 5.6 to 6.4 S.U. (**Table 3-3**). The extents of measurements less than the lower GWPS are defined laterally in the UA to the west by monitoring well G406, to the east by monitoring well G402, to the north by wells G404 and G405, and to the south by the former discharge flume (**Figure 3-1**). Measurements of pH from the former discharge flume (CLb in 2016) and Coffeen Lake (CL-1 and CL-2 in 2021) were 7.52, 8.90 and 8.13 S.U, respectively (**Appendix F**).

Downward migration of low pH conditions in the UA at G401 is inhibited by the underlying Vandalia Till, Mulberry Grove Member, and Smithboro Till which are, on average, greater than 15 feet thick at the site. Vertical hydraulic conductivity tests completed on samples of the LCU beneath the UA indicate hydraulic conductivities from 5.5×10^{-8} to 3.7×10^{-7} cm/s. This is very low relative to the horizontal hydraulic conductivity measured within the UA (geometric mean of 2.0×10^{-3} cm/s). The significant contrast in permeability (greater than two orders of magnitude) indicates groundwater will preferentially migrate horizontally toward and the former discharge flume and lower limit pH GWPS statistical exceedances will not extend into the underlying hydrostratigraphic units.

3.2.3 Sulfate

Sulfate statistical exceedances in the UA have been measured in monitoring wells G401, G402, G404, G405, and G406 for events E001, E002, and E003. Concentrations of sulfate in these wells ranged from 25 to 4,600 mg/L (**Table 3-3)**. The extents of the sulfate statistical exceedances are limited laterally to the west by the groundwater divide, running north-south across the CPP, to the east by the Unnamed Tributary and Coffeen Lake, and to the south by the former discharge flume. Erosion of the UA east of monitoring wells G402 and G404 limits migration of sulfate impacts horizontally as the LCU has a much lower hydraulic conductivity (See **Section 2.3.6**) than the materials in the UA. Migration of potentially impacted groundwater is expected to have a limited extent to the north and west as groundwater tends to flow south and east in the vicinity of AP2.

The eastern extent of sulfate is defined downgradient by surface water sample CL-1, collected east of G402 from the eastern lobe of Coffeen Lake, which had a sulfate concentration of 33 mg/L (**Appendix F**). The southern extent of sulfate is defined downgradient by surface water samples D-1 and D-2, collected south of G402 from the former discharge flume, which had sulfate concentrations of 110 and 69 mg/L, respectively (**Appendix F**). Concentrations of sulfate at CL-1, D-1, and D-2 are a similar magnitude as sulfate concentrations measured in a Coffeen Lake background sample (BKG-1; 36 mg/L).

Downward migration of sulfate in the UA is inhibited by the underlying Vandalia Till, Mulberry Grove Member, and Smithboro Till which are, on average, greater than 15 feet thick at the site. Vertical hydraulic conductivity tests completed on samples of the LCU beneath the UA indicate hydraulic conductivities from 7.5×10^{-8} to 3.6×10^{-5} cm/s. This is very low relative to the horizontal hydraulic conductivity measured within the UA (geometric mean of 2.7×10^{-4} cm/s). The significant contrast in permeability (up to four orders of magnitude) indicates groundwater will preferentially migrate horizontally toward Coffeen Lake and the elevated sulfate concentrations will not extend into the underlying hydrostratigraphic units.

3.2.4 Total Dissolved Solids

TDS results indicate the mass of dissolved material in groundwater and is a representation of multiple constituents present in the groundwater. Typically, major ions (such as sulfate) represent the primary contributors to TDS. TDS statistical exceedances in the UA are coincident with most of the sulfate statistical exceedances except for well G406, which has a sulfate statistical exceedance without a TDS statistical exceedance. TDS statistical exceedances in the UA have been measured in monitoring wells G401, G402, G404, and G405 for events E001, E002, and E003. Concentrations of TDS in these wells ranged from 1,250 to 2,800 mg/L during 2023 compliance sampling events (**Table 3-2)**. The extent of the TDS statistical exceedances, similar to sulfate, are limited laterally to the west by the groundwater divide running north-south across the CPP and to the east by the Unnamed Tributary and Coffeen Lake, to the south by the former discharge flume. Erosion of the UA east of monitoring wells G402 and G404 limits migration of sulfate impacts horizontally as the LCU has a much lower hydraulic conductivity (see **Section 2.3.6**) than the materials in the UA. Migration of potentially impacted groundwater is expected to have a limited extent to the north and west as groundwater in the vicinity of AP2 tends to flow south and east.

The eastern extent of TDS is defined downgradient by surface water sample CL-1 collected east of G402 from the eastern lobe of Coffeen Lake, which had a TDS concentration of 120 mg/L (**Appendix F**).The southern extent of sulfate is defined downgradient by surface water samples D-1 and D-2 collected south of G402 from the former discharge flume, which each had a TDS concentration of 240 mg/L (**Appendix F**). Concentrations of TDS at CL-1, D-1, and D-2 are a similar magnitude as TDS concentrations measured in a Coffeen Lake background sample (BKG-1; 72 mg/L).

Downward migration of TDS in the UA is inhibited by the underlying Vandalia Till, Mulberry Grove Member, and Smithboro Till which are, on average, greater than 15 feet thick at the site. Vertical hydraulic conductivity tests completed on samples of the LCU beneath the UA indicate hydraulic conductivities from 7.5×10^{-8} to 3.6×10^{-5} cm/s. This is very low relative to the horizontal hydraulic conductivity measured within the UA (geometric mean of 2.7×10^{-4} cm/s). The significant contrast in permeability (up to four orders of magnitude) indicates groundwater will preferentially migrate horizontally toward Coffeen Lake and the elevated TDS concentrations will not extend into the underlying hydrostratigraphic units.

4. GEOCHEMICAL CONCEPTUAL SITE MODEL (NATURE)

A GCSM was developed to describe the conditions of the groundwater in the vicinity of the CPP AP2 and is summarized here (full analysis presented in **Appendix G**). The GCSM describes the geochemical processes that contribute to the mobilization, distribution, and attenuation of chemicals in the environment. Only parameters that have exceeded the GWPS in AP2 groundwater and will be addressed in the Corrective Action Plan are included in the GCSM. As discussed in previous sections, the statistical exceedances observed at AP2 include boron, pH, sulfate, and TDS.

CCR porewater is water "collected from the interstitial water between waste particles in surface impoundments as it occurs in the field" [28] and represents the material potentially leached from impoundments. CCR materials are the primary source of constituent loading to CCR porewater (*i.e.*, CCR source water). Over an extended period (*e.g.*, months to years), CCR porewater (*i.e.*, water contained within the interstitial pore spaces of CCR that can be sampled by low-flow groundwater sampling methods) reaches equilibrium with the CCR materials. Porewater is therefore representative of the mobile phase constituents capable of migrating into the underlying materials and potentially downgradient in groundwater. AP2 CCR source water is therefore the primary indicator of constituents *available* to groundwater and is considered as the primary source term for environmental investigation and fate and transport modeling.

Conditions within UA groundwater are predicted to favor amorphous iron oxide stability at most locations, which indicates that a portion of the boron and sulfate in the groundwater system may be attenuated via surface complexation reactions. Attenuation of the constituents contributing to TDS, such as sulfate, will reduce TDS concentrations as well. Boron may be further attenuated via interactions with clay minerals, which are present in solids across the UA and LCU. Site-specific partition coefficients could not be calculated from the results of batch attenuation testing completed with solids from the site. These results indicate that chemical attenuation of boron and sulfate could be minimal. Low pH at one downgradient location is potentially caused by geochemical reactions driven by the mixing of porewater and groundwater, although the specific drivers are still under investigation.

5. COMBINED GEOCHEMICAL AND HYDROGEOLOGIC CONCEPTUAL SITE MODELS

5.1 Boron

The CSM describing current conditions at AP2 combining the hydrogeologic and geochemical CSMs for boron is as follows. Water that may come into contact with CCR in AP2 becomes porewater within the closed and geomembrane capped CCR unit. Porewater containing elevated concentrations of boron is capable of migrating into and mixing with groundwater of the UA. Groundwater within the higher hydraulic conductivity zones of the UA in the vicinity of AP2 travels horizontally south and southeast outward from AP2. The horizontal migration of groundwater outward from AP2 is influenced by groundwater flow gradients towards adjacent receiving water bodies, including the former discharge flume, Unnamed Tributary, and ultimately into the east lobe of Coffeen Lake.

Conditions within the UA are predicted to favor amorphous iron oxide stability at most locations and the presence of iron oxides in some site solids indicates a portion of the boron in the groundwater system may be attenuated via surface complexation reactions. Boron may be further attenuated via interactions with clay minerals, which are present in solids across the UA and LCU. However, batch attenuation testing results indicate that chemical attenuation of boron downgradient of AP2 could be minimal.

5.2 pH Conceptual Site Model

The CSM describing current conditions at AP2 combining the hydrogeologic and geochemical CSMs for pH is as follows. Water that may come into contact with CCR in AP2 becomes porewater within the closed and geomembrane capped CCR unit. Porewater with a geochemical signature distinct from groundwater is capable of migrating into and mixing with groundwater of the UA. Statistical exceedances of sulfate and TDS indicate that AP2 porewater is influencing groundwater at G401. AP2 porewater does not have sufficiently low pH to directly cause the pH values observed at G401, suggesting that geochemical reactions driven by interaction of porewater with the underlying UCU materials and/or mixing of porewater with groundwater may cause a low pH. These reactions may include iron oxidation and precipitation or carbonate mineral precipitation. Geochemical modeling to support evaluation of corrective actions may clarify the drivers of low pH at AP2.

5.3 Sulfate and TDS Conceptual Site Model

The CSM describing current conditions at AP2 combining the hydrogeologic and geochemical CSMs for sulfate and TDS is as follows. Water that may come into contact with CCR in AP2 becomes porewater within the closed and geomembrane capped CCR unit. Porewater containing elevated concentrations of sulfate and TDS is capable of migrating into and mixing with groundwater of the UA. Groundwater within the higher hydraulic conductivity zones of the UA in the vicinity of AP2 travels horizontally south and southeast outward from AP2. The horizontal migration of groundwater south and southeast outward from AP2 is influenced by groundwater flow gradients towards adjacent receiving water bodies, including the former discharge flume, Unnamed Tributary, and ultimately into the east lobe of Coffeen Lake.

Conditions within UA groundwater are predicted to favor amorphous iron oxide stability at most locations and the presence of iron oxides in some site solids indicates a portion of the sulfate in the groundwater system may be attenuated via surface complexation reactions. Attenuation of the constituents contributing to TDS, such as sulfate, will reduce TDS concentrations as well. However, batch attenuation testing results indicate that chemical attenuation of sulfate downgradient of AP2 could be minimal.

Surface water samples collected from the former discharge flume and Coffeen Lake indicate concentrations are below the GWPS. In addition, a screening level human health and ecological risk assessment [8] was performed to characterize potential risks to human and ecological receptors that may be exposed to CCR constituents present in Coffeen Lake that may have originated from AP1. Given the similar CCR constituents and concentrations in AP1 and AP2, and the same local groundwater receiving bodies for each SI, the constituents of concern that were identified in the AP1 risk assessment are appropriate for assessing human health and ecological risks that may be attributable to AP2. The risk assessment evaluation considered contaminants of interest if the maximum detected constituent concentration in groundwater exceeded a human health-based benchmark or a maximum detected constituent concentrations in groundwater exceeded an ecological surface water benchmark protective of aquatic life. Based on the evaluation presented in the risk assessment, no unacceptable risks to human or ecological receptors in Coffeen Lake resulting from CCR exposures associated with AP1 (which has concentrations similar to AP2) were identified. This means that the risks from the site, in particular the migration of constituents in groundwater to Coffeen Lake that are attributable to either AP1 or AP2, are likely indistinguishable from normal background risks.

6. CONCLUSIONS AND FUTURE ACTIVITIES

In accordance with 35 I.A.C. § 845.650(d)(1), the nature and extent of GWPS statistical exceedances of boron, pH, sulfate, and TDS have been described in sufficient detail to support a complete and accurate assessment of the corrective measures necessary to effectively clean up all releases from AP2.

The lateral extents of statistical exceedances in the UA are illustrated in **Figure 3-1**. As discussed in **Sections 3.2.1** through **3.2.4**, boron, pH, sulfate, and TDS statistical exceedances are defined downgradient by surface water samples collected from the former discharge flume to the south of AP2, and by surface water samples collected from the east lobe of Coffeen Lake to the southeast of AP2. GWPS statistical exceedances of boron, pH, sulfate, and TDS are not expected to extend a significant distance to the west due to the north-south groundwater divide or to the north due to groundwater flow directions surrounding AP2. Boron, pH, sulfate, and TDS statistical exceedances are constrained vertically by the underlying Vandalia Till.

Boron was selected for modeling source control as presented in the Closure Plan [12] and Groundwater Modeling Report [25]. For modeling purposes, it was assumed that boron would not significantly sorb or chemically react with aquifer solids in the UA (soil adsorption coefficient [Kd] was set to 0 milliliters per gram), which is a conservative estimate for predicting contaminant transport times in the model. A Kd value of 0.7 cubic centimeters per gram was used for the UCU and LCU.

7. REFERENCES

[1] Ramboll Americas Engineering Solutions, Inc. (Ramboll), "35 I.A.C. § 845 Corrective Measures Assessment, Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois, IEPA ID: W135015004-01," April 24, 2024.

[2] Geosyntec Consultants, Inc. (Geosyntec), "Alternative Source Demonstration, Coffeen Power Plant Ash Pond No. 2 (Unit ID #102), IEPA ID: W1350150004-02, 35 I.A.C. 845.650," December 15, 2023.

[3] Geosyntec, "Alternative Source Demonstration - G407 Sulfate and Total Dissolved Solids, Coffeen Power Plant Ash Pond No. 2 (Unit ID #102), IEPA ID: W1350150004-02, 35 I.A.C. 845.650," December 15, 2023.

[4] IEPA, Bureau of Water, Division of Water Pollution Control, "Re: Coffeen Power Plant Ash Pond No. 2; W1350150004-02, Alternative Source Demonstration Submittal," January 11, 2024.

[5] IEPA, Bureau of Water, Division of Water Pollution Control, "Re: Coffeen Power Plant Ash Pond No. 2; W1350150004-02, Alternative Source Demonstration Submittal," January 11, 2024.

[6] Illinois Pollution Control Board (IPCB), "PCB 24-55 (Petition for review - Alternative Source Demonstration)," April 18, 2024.

[7] IPCB, "PCB 24-56 (Petition for review - Alternative Source Demonstration)," April 18, 2024.

[8] Gradient, "Human Health and Ecological Risk Assessment, Primary Ash Pond Newton Power Plant, Newton Illinois," July 28, 2022.

[9] Ramboll, "35 I.A.C. § 845.610(b)(3)(D) Groundwater Monitoring Data and Detected Exceedances, 2023 Quarter 2, Ash Pond No. 2, Coffeen Power Plant, Coffeen, Illinois," October 16, 2023.

[10] Ramboll, "35 I.A.C. § 845.610(b)(3)(D) Groundwater Monitoring Data and Detected Exceedances, 2023 Quarter 3, Ash Pond No. 2, CoffeenPower Plant, Coffeen, Illinois," January 20, 2024.

[11] Ramboll, "35 I.A.C. § 845.610(b)(3)(D) Groundwater Monitoring Data and Detected Exceedances, 2023 Quarter 4, Ash Pond No. 2, CoffeenPower Plant, Coffeen, Illinois," March 10, 2024.

[12] AECOM, "Closure and Post-Closure Care Plan for the Coffeen Ash Pond No. 2 at Illinois Power Generating Company, Coffeen Power Station, 134 Cips Lane, Coffeen, IL 62107," July 28, 2022.

[13] Natural Resource Technology, Inc., "Hydrogeologic Site Characterization Report, Ash Pond 2, Coffeen Power Station, Coffeen, Illinois," January 24, 2017.

[14] H. Willman, E. Atherton, T. Buschbach, C. Collinson, J. Frye, M. Hopkins, J. Lineback and J. Simon, Handbook of Illinois Stratigraphy, vol. Bulletin 95, Illinois State Geological Survey, 1975, p. 261.

[15] D. Kolata, *Bedrock Geology of Illinois. Scale 1:500,000,* Illinois State Geological Survey Map, 2005.

[16] Illinois State Geological Survey (ISGS), "ILSTRAT: The Online Handbook of Illinois Stratigraphy," 2020. [Online]. Available: https://ilstratwiki.web.illinois.edu/wiki/Main_Page.

[17] Illinois State Geological Survey (ISGS), "Directory of Coal Mines in Illinois, Christian County," August 2019. [Online]. Available: https://wikiimage.isgs.illinois.edu/ilmines/webfiles/mines-series/mines-directory/pdf-files/mines-directory-christian.pdf. [Accessed August 2019].

[18] Hanson Professional Services, Inc. (Hanson), "40 CFR 257.60 Uppermost Aquifer Considerations, Gypsum Pond, Illinois Power Holdings LLC, Coffeen Energy Center, Montgomery County, Illinois," April 2016.

[19] Natural Resource Technology, Inc., an OBG Company (NRT/OBG), "Hydrogeologic Monitoring Plan," Coffeen Ash Pond No. 1 – CCR Unit ID 101, Coffeen Ash Pond No. 2 – CCR Unit ID 102, Coffeen GMF Gypsum Stack Pond – CCR Unit ID 103, Coffeen GMF Recycle Pond – CCR Unit ID 104, Coffeen Landfill – CCR Unit ID 105, Coffeen Power Plant, Coffeen, Illinois, October 17, 2017.

[20] Ramboll, "Hydrogeologic Site Characterization Report. Coffeen Power Plant, GMF Recycle Pond, Coffeen, Illinois. Illinois Power Generating Company," October 25, 2021.

[21] Ramboll, "Hydrogeologic Site Characterization Report. Coffeen Power Plant. GMF Gypsum Stack Pond, Coffeen, Illinois. Illinois Power Generating Company," October 25, 2021.

[22] Ramboll, "Hydrogeologic Site Characterization Report. Coffeen Power Plant. Ash Pond No. 1. Coffeen, Illinois. Illinois Power Generating Company," October 25, 2021.

[23] Ramboll, "Groundwater Monitoring Plan, Coffeen Power Plant, Ash Pond No. 2, Coffeen, Illinois, Illinois Power Generating Company," October 25, 2021.

[24] Ramboll Americas Engineering Solutions, Inc., "Groundwater Monitoring Report, Coffeen Power Plant, Ash Pond No. 2, Coffeen, Illinois. Illinois Power Generating Company.," July 28, 2022.

[25] NRT, "Groundwater Modeling Report, Ash Pond 2, Coffeen Power Station, Coffeen, Illinois," January 24, 2017.

[26] Gradient Corporation, "Human Health and Ecological Risk Assessment, Ash Pond 1, Coffeen Power Plant, Coffeen, Illinois," July 28, 2022.

[27] Natural Resource Technology, Inc., "Hydrostatic Modeling Report, Ash Pond 2, Coffeen Power Station, Coffeen, Illinois," January 24, 2017.

[28] United States Environmental Protection Agency, "Human and Ecological Risk Assessment of Coal Combustion Residuals (2050-AE81)," December 2014.

TABLES

Table 2-1. Summary of Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G1001	Compliance	05/30/2023	6.61	590.99
G1003	Water Level	05/30/2023	10.97	599.82
G270	Background	05/30/2023	5.06	620.79
G280	Background	05/30/2023	3.96	621.38
G281	Background	05/30/2023	6.64	619.71
G401	Compliance	05/30/2023	21.72	603.85
G402	Compliance	05/30/2023	10.56	602.80
G403	Compliance	05/30/2023	8.13	618.33
G404	Compliance	05/30/2023	5.42	610.24
G405	Compliance	05/30/2023	6.83	616.79
G406	Compliance	05/30/2023	13.06	612.29
G407	Compliance	05/30/2023	7.35	613.96
SG-02	Water Level	05/30/2023	7.47	598.40
SG-03	Water Level	05/30/2023	9.85	585.09
SG-04	Water Level	05/30/2023	6.41	593.11

Notes:
BMP = below measuring point
NAVD88 = North American Vertical Datum of 1988

Table 2-1. Summary of Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G1001	Compliance	08/08/2023	6.32	591.29
G1003	Water Level	08/08/2023	Dry	
G270	Background	08/14/2023	[8.52]	[617.34]
G280	Background	08/08/2023	5.80	619.55
G281	Background	08/08/2023	6.39	619.97
G401	Compliance	08/08/2023	21.75	603.82
G402	Compliance	08/08/2023	11.65	601.72
G403	Compliance	08/08/2023	7.45	619.02
G404	Compliance	08/14/2023	[5.62]	[610.05]
G405	Compliance	08/08/2023	6.85	616.78
G406	Compliance	08/08/2023	11.49	613.87
G407	Compliance	08/08/2023	8.79	612.53
SG-03	Water Level	08/08/2023	9.65	585.29

Notes:
Only wells with groundwater elevations measured are included.
BMP = below measuring point
Bracketing [ ] indicates that the measurement was obtained outside of the 24-hour period from initiation of depth to groundwater measurements.
NAVD88 = North American Vertical Datum of 1988

Table 2-1. Summary of Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G1001	Compliance	11/13/2023	6.49	591.12
G1003	Water Level	11/13/2023	Dry	
G270	Background	11/13/2023	10.90	614.96
G280	Background	11/13/2023	8.91	616.44
G281	Background	11/13/2023	8.59	617.77
G401	Compliance	11/13/2023	13.63	611.94
G402	Compliance	11/13/2023	11.71	601.66
G403	Compliance	11/13/2023	8.27	618.20
G404	Compliance	11/13/2023	6.48	609.19
G405	Compliance	11/13/2023	7.73	615.90
G406	Compliance	11/13/2023	13.83	611.53
G407	Compliance	11/13/2023	8.31	613.01
SG-02	Water Level	11/13/2023	7.36	598.51
SG-03	Water Level	11/13/2023	9.71	585.23
SG-04	Water Level	11/13/2023	Not Measured	

Notes:
Only wells with groundwater elevations measured are included.
BMP = below measuring point
NAVD88 = North American Vertical Datum of 1988

Table 2-2. Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen Power Plant

Ash Pond No. 2

Coffeen, IL

Date	G405 Groundwater Elevation (ft NAVD88)	T408 Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UA	LCU (upper)				
2/4/2017	618.47	619.46	-0.99	12.00	-0.08	up
5/13/2017	618.74	619.00	-0.26	12.00	-0.02	up
7/8/2017	618.54	619.12	-0.58	12.00	-0.05	up
10/21/2017	614.47	614.81	-0.34	12.00	-0.03	up
5/8/2018	618.94	615.82	3.12	12.00	0.26	down
8/2/2018	617.55	614.45	3.10	12.00	0.26	down
10/23/2018	616.40	616.30	0.10	12.00	0.01	down
1/15/2019	616.81	617.01	-0.20	12.00	-0.02	up
8/5/2019	617.72	617.15	0.57	12.00	0.05	down
1/20/2020	619.28	619.13	0.15	12.00	0.01	down
8/10/2020	617.62	617.38	0.24	12.00	0.02	down
1/20/2021	617.12	616.85	0.27	12.00	0.02	down
4/20/2021	617.13	616.65	0.48	12.00	0.04	down
7/26/2021	617.37	617.21	0.16	12.00	0.01	down
8/16/2021	617.28	617.22	0.06	12.00	0.00	down
10/25/2021	618.12	615.50	2.62	12.00	0.22	down
2/7/2022	617.28	616.88	0.40	12.00	0.03	down
5/9/2022	617.91	617.78	0.13	12.00	0.01	down
8/23/2022	616.85	616.99	-0.14	12.00	-0.01	up
2/13/2023	617.50	617.16	0.34	12.00	0.03	down
5/30/2023	616.79	616.66	0.13	12.00	0.01	down
8/8/2023	616.78	616.62	0.16	12.00	0.01	down
10/24/2023	615.79	615.97	-0.18	12.00	-0.02	up
11/13/2023	615.90	616.06	-0.16	12.00	-0.01	up
			Middle of screen elevation G405D			610.0
			Middle of screen elevation T408			598.0

Table 2-2. Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen Power Plant

Ash Pond No. 2

Coffeen, IL

Date	G406 Groundwater Elevation (ft NAVD88)	T409 Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UA	LCU (upper)				
2/4/2017	617.52	615.93	1.59	8.23	0.19	down
5/13/2017	616.20	616.75	-0.55	8.23	-0.07	up
7/8/2017	616.29	617.05	-0.76	8.23	-0.09	up
10/21/2017	611.27	612.16	-0.89	8.23	-0.11	up
5/8/2018	615.47	616.02	-0.55	8.23	-0.07	up
8/2/2018	615.75	615.25	0.50	8.23	0.06	down
10/23/2018	614.11	613.96	0.15	8.23	0.02	down
1/15/2019	615.36	614.78	0.58	8.23	0.07	down
8/5/2019	616.50	615.10	1.40	8.23	0.17	down
1/20/2020	617.48	617.16	0.32	8.23	0.04	down
8/10/2020	615.54	615.43	0.11	8.23	0.01	down
1/20/2021	612.97	614.41	-1.44	8.23	-0.17	up
4/20/2021	613.78	615.33	-1.55	8.23	-0.19	up
7/26/2021	614.20	615.72	-1.52	8.23	-0.18	up
8/16/2021	613.82	615.42	-1.60	8.23	-0.19	up
10/25/2021	614.93	616.43	-1.50	8.23	-0.18	up
2/7/2022	613.55	614.97	-1.42	8.23	-0.17	up
5/9/2022	615.36	616.81	-1.45	8.23	-0.18	up
8/23/2022	613.47	610.73	2.74	8.23	0.33	down
2/13/2023	614.11	615.65	-1.54	8.23	-0.19	up
5/30/2023	612.29	613.74	-1.45	8.23	-0.18	up
8/8/2023	613.87	615.02	-1.15	8.23	-0.14	up
10/24/2023	611.28	612.55	-1.27	8.23	-0.15	up
11/13/2023	611.53	613.01	-1.48	8.23	-0.18	up
			Middle of screen elevation G406			605.9
			Middle of screen elevation T409			597.7

Table 2-2. Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen Power Plant

Ash Pond No. 2

Coffeen, IL

Date	T408 Groundwater Elevation (ft NAVD88) LCU (upper)	G45D Groundwater Elevation (ft NAVD88) LCU (lower)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
2/4/2017	619.46	587.71	31.75	13.78	2.30	down
5/13/2017	619.00	586.19	32.81	13.78	2.38	down
7/8/2017	619.12	586.29	32.83	13.78	2.38	down
10/21/2017	614.81	584.69	30.12	13.78	2.19	down
5/8/2018	615.82	587.56	28.26	13.78	2.05	down
8/2/2018	614.45	585.81	28.64	13.78	2.08	down
10/23/2018	616.30	584.60	31.70	13.78	2.30	down
1/15/2019	617.01	586.96	30.05	13.78	2.18	down
8/5/2019	617.15	588.04	29.11	13.78	2.11	down
8/10/2020	617.38	614.21	3.17	13.78	0.23	down
1/20/2021	616.85	614.60	2.25	13.78	0.16	down
4/20/2021	616.65	614.32	2.33	13.78	0.17	down
7/26/2021	617.21	613.58	3.63	13.78	0.26	down
8/16/2021	617.22	613.83	3.39	13.78	0.25	down
10/25/2021	615.50	614.51	0.99	13.78	0.07	down
2/7/2022	616.88	615.01	1.87	13.78	0.14	down
5/9/2022	617.78	614.95	2.83	13.78	0.21	down
8/23/2022	616.99	614.58	2.41	13.78	0.17	down
2/13/2023	617.16	614.69	2.47	13.78	0.18	down
5/30/2023	616.66	613.99	2.67	13.78	0.19	down
8/8/2023	616.62	613.47	3.15	13.78	0.23	down
10/24/2023	615.97	613.40	2.57	13.78	0.19	down
11/13/2023	616.06	613.55	2.51	13.78	0.18	down
			Middle of screen elevation T408			598.0
			Middle of screen elevation G45D			584.2

Table 2-2. Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen Power Plant

Ash Pond No. 2

Coffeen, IL

Date	T409 Groundwater Elevation (ft NAVD88) LCU (upper)	G46D Groundwater Elevation (ft NAVD88) LCU (lower)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
2/4/2017	615.93	586.06	29.87	22.19	1.35	down
5/13/2017	616.75	584.87	31.88	22.19	1.44	down
7/8/2017	617.05	585.22	31.83	22.19	1.43	down
5/8/2018	616.02	585.86	30.16	22.19	1.36	down
8/2/2018	615.25	583.95	31.30	22.19	1.41	down
10/23/2018	613.96	582.05	31.91	22.19	1.44	down
1/15/2019	614.78	583.17	31.61	22.19	1.42	down
8/5/2019	615.10	583.68	31.42	22.19	1.42	down
8/10/2020	615.43	609.00	6.43	22.19	0.29	down
1/20/2021	614.41	610.49	3.92	22.19	0.18	down
4/20/2021	615.33	611.06	4.27	22.19	0.19	down
7/26/2021	615.72	607.21	8.51	22.19	0.38	down
8/16/2021	615.42	608.17	7.25	22.19	0.33	down
10/25/2021	616.43	609.87	6.56	22.19	0.30	down
2/7/2022	614.97	610.71	4.26	22.19	0.19	down
5/9/2022	616.81	611.34	5.47	22.19	0.25	down
8/23/2022	610.73	615.13	-4.40	22.19	-0.20	up
2/13/2023	615.65	610.39	5.26	22.19	0.24	down
5/30/2023	613.74	610.70	3.04	22.19	0.14	down
8/8/2023	615.02	610.14	4.88	22.19	0.22	down
10/24/2023	612.55	609.65	2.90	22.19	0.13	down
11/13/2023	613.01	609.70	3.31	22.19	0.15	down
			Middle of screen elevation T409			597.7
			Middle of screen elevation G46D			575.5

[O: KLT 6/4/21, C:YMD 6/7/21; U:KLT 8/25/21, C:EDP 8/31/21]
[KLT 5/3/24, C: 5/7/24]

Notes:

[1] Distance change was calculated using the midpoint of the piezometer screen and water table surface. If the water table surface was above the top of the monitoring well screen, then distance change was calculated using the midpoint of both screens.

[2] Vertical gradients between ±0.0015 are considered flat, and typically have less than 0.02 foot difference in groundwater elevation between wells.

- - = no data collected on date / no vertical gradient calculated
DA = deep aquifer
dh = head change
dl = distance change
ft = foot/feet
LCU (lower) = lower confining unit (Smithboro)
LCU (upper) = lower confining unit (Vandalia)
NAVD88 = North American Vertical Datum of 1988
PMP = potential migration pathway
UA = uppermost aquifer

Table 3-1. Monitoring Well Construction Details
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Location	HSU	Date Constructed	Top of PVC Elevation (ft)	Measuring Point Elevation (ft)	Measuring Point Description	Ground Elevation (ft)	Screen Top Depth (ft bgs)	Screen Bottom Depth (ft bgs)	Screen Top Elevation (ft)	Screen Bottom Elevation (ft)	Well Depth (ft bgs)	Bottom of Boring Elevation (ft)	Screen Length (ft)	Screen Diameter (inches)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
G270	UA	02/26/2008	--	625.43	Top of Disk	623.73	13.13	17.92	610.60	605.81	18.27	605.50	4.8	2	39.0665638	-89.3974031
G280	UA	02/26/2008	625.35	625.26	Top of Riser	623.11	12.79	17.63	610.32	605.48	17.98	605.10	4.8	2	39.0672155	-89.3949916
G281	UA	09/08/2015	--	626.43	Top of Disk	623.82	15.51	20.16	608.31	603.66	20.3	603.50	4.7	2	39.0654052	-89.3993221
G401	UA	09/14/2015	--	625.57	Top of Disk	623.03	14.36	18.79	608.67	604.24	19.29	603.70	4.4	2	39.0602586	-89.3952949
G402	UA	08/27/2010	--	613.06	Top of Disk	610.36	10	20	600.36	590.36	20.4	590.00	10	2	39.0602071	-89.3917118
G403	UA	09/11/2015	--	626.24	Top of Disk	623.81	13.11	17.78	610.70	606.03	18.15	605.70	4.7	2	39.0631666	-89.3987788
G404	UA	05/01/2007	--	615.67	Top of Disk	613.57	6.42	11.17	607.15	602.40	11.62	601.60	4.8	2	39.0643292	-89.3924931
G405	UA	05/01/2007	--	623.41	Top of Disk	621.40	9.01	13.76	612.39	607.64	14.21	607.20	4.8	2	39.064345	-89.3962337
G406	UA	08/19/2016	625.36	625.05	Top of PVC	621.86	13.56	18.37	608.30	603.49	18.75	603.10	4.8	2	39.0603094	-89.3985078
G407	UA	08/16/2016	621.32	620.95	Top of PVC	618.35	13.78	18.61	604.57	599.74	19.04	598.40	4.8	2	39.0615735	-89.4020036
G1001	LCU	04/05/2021	597.61	597.78	Top of PVC	594.82	6	11	588.82	583.82	11	562.82	5	4	39.0633242	-89.39123631
G1003	LCU	05/25/2021	610.791	610.791	Top of PVC	608.01	8	12	600.01	596.01	14.79	587.01	4	2	39.06077048	-89.3914461

Notes:
All elevation data are presented relative to the North American Vertical Datum 1988 (NAVD88), GEOID 12A
-- = not measured/recorded
bgs = below ground surface
ft = foot or feet
HSU = Hydrostratigraphic Unit
LCU = Lower Confining Unit
PVC = polyvinyl chloride
UA = Uppermost Aquifer

Table 3-2. Exceedance Parameter Statistical Results
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Location	Parameter	Unit	Groundwater Protection Standard	2023 Q2 LCL	2023 Q3 LCL	2023 Q4 LCL
G401	Boron, total	mg/L	2	3.50	3.50	3.50
G402	Boron, total	mg/L	2	4.43	4.50	5.44
G404	Boron, total	mg/L	2	5.52	6.35	7.42
G405	Boron, total	mg/L	2	9.19	9.25	9.42
G401	Cobalt, total	mg/L	0.006	0.0629	0.0656	0.0692
G401	Sulfate, total	mg/L	400	2,000	2,000	1,410
G402	Sulfate, total	mg/L	400	442	427	393
G404	Sulfate, total	mg/L	400	422	452	478
G405	Sulfate, total	mg/L	400	412	436	442
G406	Sulfate, total	mg/L	400	450	450	450
G407	Sulfate, total	mg/L	400	440	440	830
G401	Total Dissolved Solids	mg/L	1,200	2,800	2,800	2,800
G402	Total Dissolved Solids	mg/L	1,200	1,310	1,300	1,290
G404	Total Dissolved Solids	mg/L	1,200	1,250	1,300	1,320
G405	Total Dissolved Solids	mg/L	1,200	1,530	1,540	1,540
G407	Total Dissolved Solids	mg/L	1,200	1,920	1,910	1,920
G401	pH (field)	SU	6.5/9.0	5.9/6.1	5.9/6.1	5.9/6.1

Notes:
LCL = Lower Confidence Level
mg/L = milligrams per liter
SU = standard units

Table 3-3. Summary of Groundwater Data
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

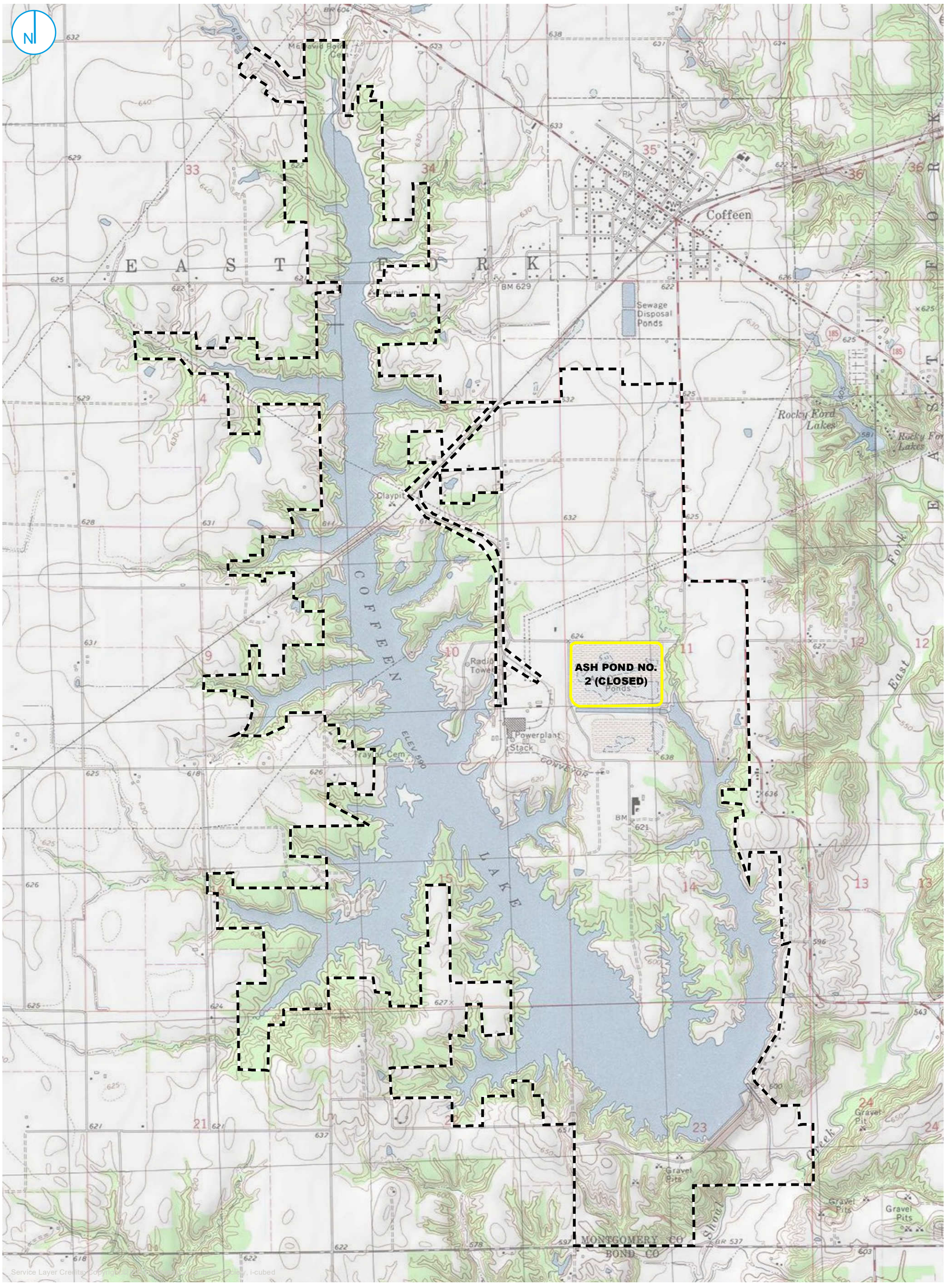
HSU	Location	Parameter	Unit	Sample Count	Non-Detect Result Count	Percent Non-Detect Results	First Sample	Last Sample	Minimum	Median	Mean	Maximum
LCU	G1001	Boron, total	mg/L	4	0	0	05/12/2021	11/14/2023	0.720	1.03	1.04	1.40
LCU	G1001	Cobalt, total	mg/L	4	1	25	05/12/2021	11/14/2023	0.000200	0.00119	0.0129	0.0490
LCU	G1001	Sulfate, total	mg/L	4	0	0	05/12/2021	11/14/2023	140	236	310	630
LCU	G1001	Total Dissolved Solids	mg/L	3	0	0	02/15/2023	11/14/2023	830	900	1,143	1,700
LCU	G1001	pH (field)	SU	3	0	0	02/15/2023	11/14/2023	6.8	6.97	6.92	7.0
UA	G270	Boron, total	mg/L	39	25	64	01/20/2015	11/17/2023	<0.0071	0.0100	0.0170	0.120
UA	G270	Cobalt, total	mg/L	37	34	92	04/13/2015	11/17/2023	0.000200	0.00200	0.00170	<0.002
UA	G270	Sulfate, total	mg/L	39	0	0	01/20/2015	11/17/2023	48.0	54.0	62.4	140
UA	G270	Total Dissolved Solids	mg/L	39	0	0	01/20/2015	11/17/2023	340	420	436	570
UA	G270	pH (field)	SU	39	0	0	01/20/2015	11/17/2023	6.6	7.10	7.09	7.5
UA	G280	Boron, total	mg/L	40	19	48	01/21/2015	11/20/2023	<0.0071	0.0105	0.0539	1.00
UA	G280	Cobalt, total	mg/L	37	32	86	04/13/2015	11/20/2023	0.000200	0.00200	0.00195	0.00600
UA	G280	Sulfate, total	mg/L	40	0	0	01/21/2015	11/20/2023	43.0	82.0	100	910
UA	G280	Total Dissolved Solids	mg/L	40	0	0	01/21/2015	11/20/2023	350	460	476	1,100
UA	G280	pH (field)	SU	39	0	0	01/21/2015	11/20/2023	6.0	7.26	7.24	7.7
UA	G281	Boron, total	mg/L	35	19	54	11/20/2015	11/20/2023	<0.0071	0.0100	0.0170	0.110
UA	G281	Cobalt, total	mg/L	34	26	76	11/20/2015	11/20/2023	0.000400	0.00200	0.00189	0.00560
UA	G281	Sulfate, total	mg/L	35	0	0	11/20/2015	11/20/2023	140	280	287	380
UA	G281	Total Dissolved Solids	mg/L	35	0	0	11/20/2015	11/20/2023	700	870	866	1,000
UA	G281	pH (field)	SU	35	0	0	11/20/2015	11/20/2023	6.7	7.00	7.0	7.3
UA	G401	Boron, total	mg/L	28	0	0	11/21/2015	11/21/2023	1.10	3.90	3.77	5.37
UA	G401	Cobalt, total	mg/L	27	0	0	11/21/2015	11/21/2023	0.0460	0.240	0.222	0.420
UA	G401	Sulfate, total	mg/L	28	0	0	11/21/2015	11/21/2023	870	2,100	2,345	4,600
UA	G401	Total Dissolved Solids	mg/L	28	0	0	11/21/2015	11/21/2023	1,200	2,920	3,028	6,600
UA	G401	pH (field)	SU	30	0	0	11/21/2015	11/21/2023	5.6	6.00	6.03	6.4
UA	G402	Boron, total	mg/L	28	0	0	11/21/2015	11/21/2023	4.60	5.70	5.84	8.13
UA	G402	Cobalt, total	mg/L	27	5	19	11/21/2015	11/21/2023	0.000930	0.00370	0.00587	0.0190
UA	G402	Sulfate, total	mg/L	28	0	0	11/21/2015	11/21/2023	78.0	840	790	1,200
UA	G402	Total Dissolved Solids	mg/L	28	0	0	11/21/2015	11/21/2023	1,300	1,600	1,554	1,800
UA	G402	pH (field)	SU	28	0	0	11/21/2015	11/21/2023	6.4	6.79	6.76	7.3
UA	G403	Boron, total	mg/L	28	5	18	11/23/2015	11/20/2023	<0.0023	0.0309	0.0393	0.110
UA	G403	Cobalt, total	mg/L	27	13	48	11/23/2015	11/20/2023	<0.00048	0.00200	0.00201	0.00340
UA	G403	Sulfate, total	mg/L	28	0	0	11/23/2015	11/20/2023	4.90	34.5	34.7	74.0
UA	G403	Total Dissolved Solids	mg/L	28	0	0	11/23/2015	11/20/2023	270	355	369	508
UA	G403	pH (field)	SU	28	0	0	11/23/2015	11/20/2023	6.5	6.92	6.92	7.3
UA	G404	Boron, total	mg/L	29	0	0	10/07/2015	11/21/2023	1.40	4.10	5.68	21.2
UA	G404	Cobalt, total	mg/L	28	25	89	10/07/2015	11/21/2023	<0.00048	0.00200	0.00176	0.00330
UA	G404	Sulfate, total	mg/L	29	0	0	10/07/2015	11/21/2023	140	310	375	840

Table 3-3. Summary of Groundwater Data
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

HSU	Location	Parameter	Unit	Sample Count	Non-Detect Result Count	Percent Non-Detect Results	First Sample	Last Sample	Minimum	Median	Mean	Maximum
UA	G404	Total Dissolved Solids	mg/L	29	0	0	10/07/2015	11/21/2023	460	950	1,037	1,900
UA	G404	pH (field)	SU	29	0	0	10/07/2015	11/21/2023	6.4	6.80	6.89	7.5
UA	G405	Boron, total	mg/L	29	0	0	10/07/2015	11/21/2023	4.00	10.8	11.3	20.0
UA	G405	Cobalt, total	mg/L	28	14	50	10/07/2015	11/21/2023	0.000790	0.00200	0.00211	0.00440
UA	G405	Sulfate, total	mg/L	29	0	0	10/07/2015	11/21/2023	340	1,000	1,095	1,900
UA	G405	Total Dissolved Solids	mg/L	29	0	0	10/07/2015	11/21/2023	720	1,700	1,763	2,900
UA	G405	pH (field)	SU	29	0	0	10/07/2015	11/21/2023	6.6	6.95	6.92	7.4
UA	G406	Boron, total	mg/L	13	0	0	10/14/2020	11/20/2023	0.170	1.50	1.44	2.29
UA	G406	Cobalt, total	mg/L	13	10	77	10/14/2020	11/20/2023	<0.00048	0.000800	0.00123	<0.002
UA	G406	Sulfate, total	mg/L	13	0	0	10/14/2020	11/20/2023	25.0	480	464	610
UA	G406	Total Dissolved Solids	mg/L	13	0	0	10/14/2020	11/20/2023	920	1,070	1,078	1,200
UA	G406	pH (field)	SU	13	0	0	10/14/2020	11/20/2023	6.4	6.56	6.60	7.0
UA	G407	Boron, total	mg/L	13	0	0	10/14/2020	11/20/2023	0.0614	0.0900	0.0970	0.150
UA	G407	Cobalt, total	mg/L	13	7	54	10/14/2020	11/20/2023	<0.00048	0.00200	0.00170	0.00620
UA	G407	Sulfate, total	mg/L	13	0	0	10/14/2020	11/20/2023	400	960	897	1,100
UA	G407	Total Dissolved Solids	mg/L	13	0	0	10/14/2020	11/20/2023	1,800	2,000	2,022	2,200
UA	G407	pH (field)	SU	13	0	0	10/14/2020	11/20/2023	6.4	6.66	6.65	6.9

Notes:
< = less than the method detection limit
HSU = Hydrostratigraphic Unit
LCU = Lower Confining Unit
mg/L = milligrams per liter
SU = standard units
UA = Uppermost Aquifer

FIGURES



REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY

0 1,000 2,000 Feet

SITE LOCATION MAP

FIGURE 2-1

NATURE AND EXTENT REPORT
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

- COMPLIANCE MONITORING WELL
- BACKGROUND MONITORING WELL
- MONITORING WELL
- STAFF GAGE, RIVER
- PORE WATER WELL
- REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- LIMITS OF FINAL COVER
- PROPERTY BOUNDARY

0 275 550 Feet

NOTE:
STAFF GAGE SG-04 WAS IDENTIFIED AS DESTROYED DURING OCTOBER 2023.

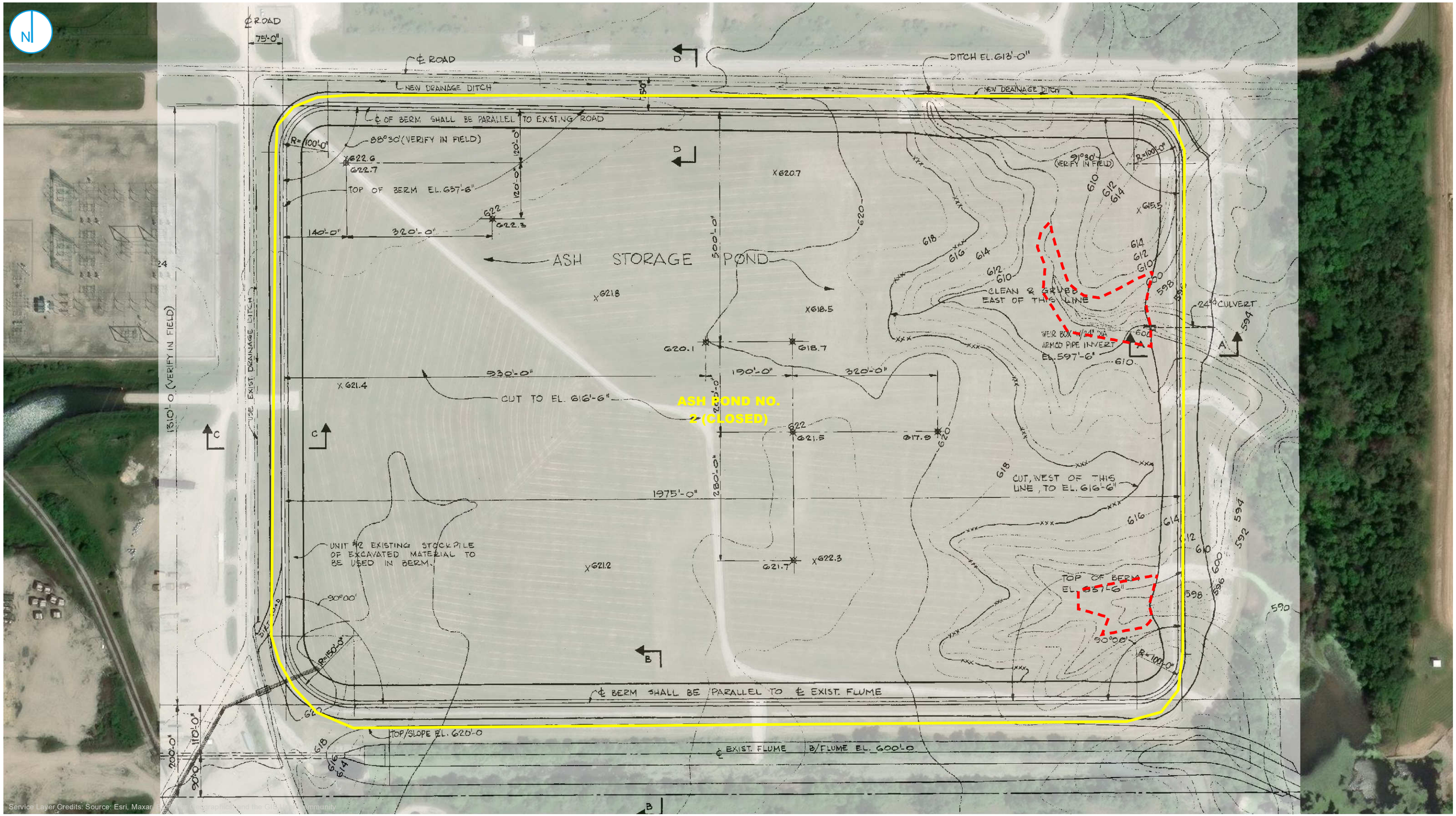
MONITORING WELL LOCATION MAP

NATURE AND EXTENT REPORT
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 2-2

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL



HAGARSTOWN BEDS POTENTIALLY IN CONTACT WITH ASH

REGULATED UNIT (SUBJECT UNIT)

0 100 200 Feet

NOTES:
BACKGROUND DRAWING SOURCE: SARGENT & LUNDY, 1/21/1971

BASE OF CCR

NATURE AND EXTENT REPORT
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

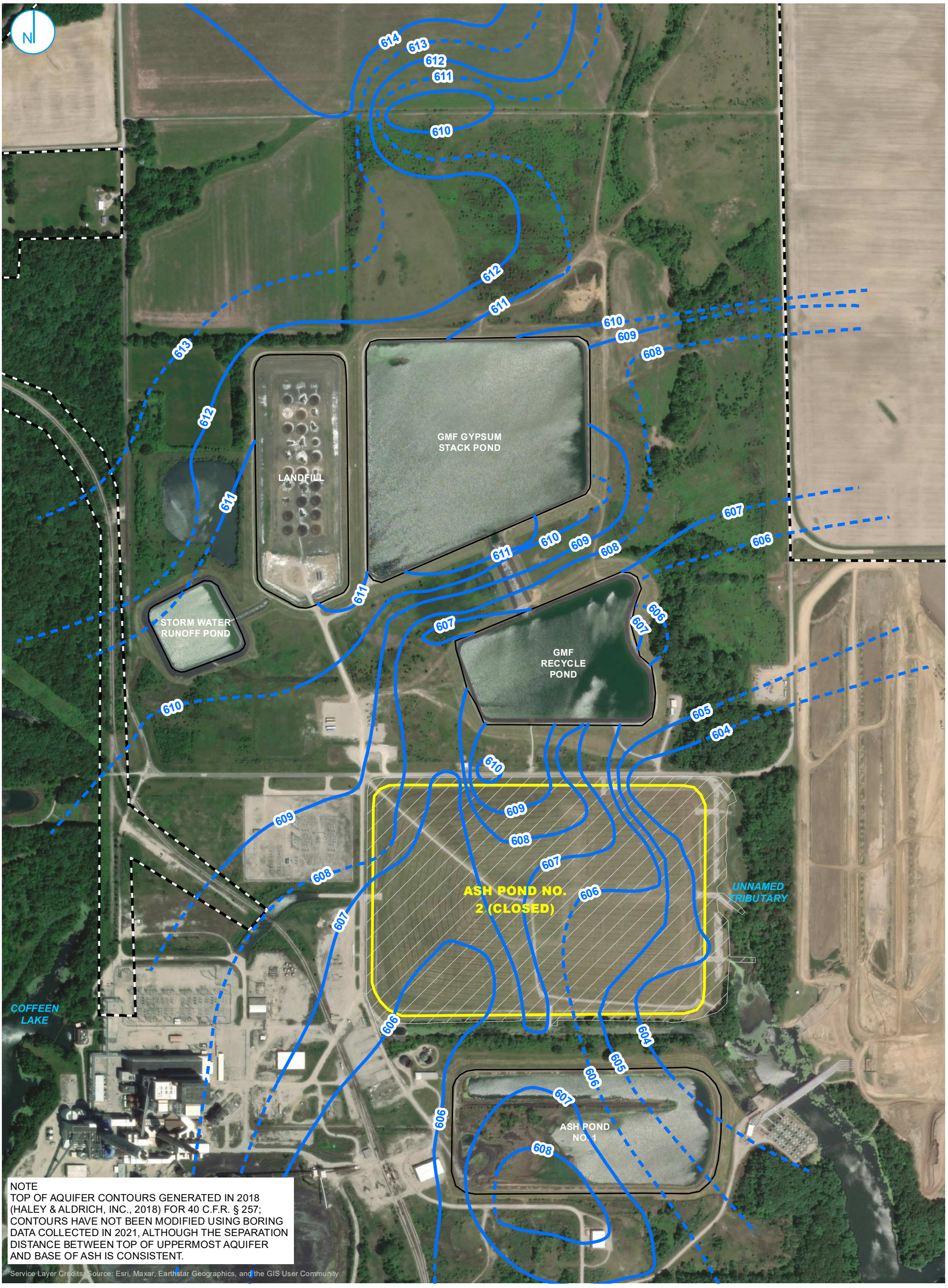
FIGURE 2-3

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

PROJECT: 169000XXXX | DATED: 6/6/2024 | DESIGNER: GALARNMC

Y:\Mapping\Projects\22\2285\MXD\Nature_and_Extent\COF\Nature_and_Extent_Report\102\Figure 2-4. Base of CCR.mxd



HAGARSTOWN MEMBER ELEVATION CONTOUR (1-FT INTERVAL, NAVD88)
INFERRED HAGARSTOWN MEMBER ELEVATION CONTOUR
REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

0 275 550 Feet

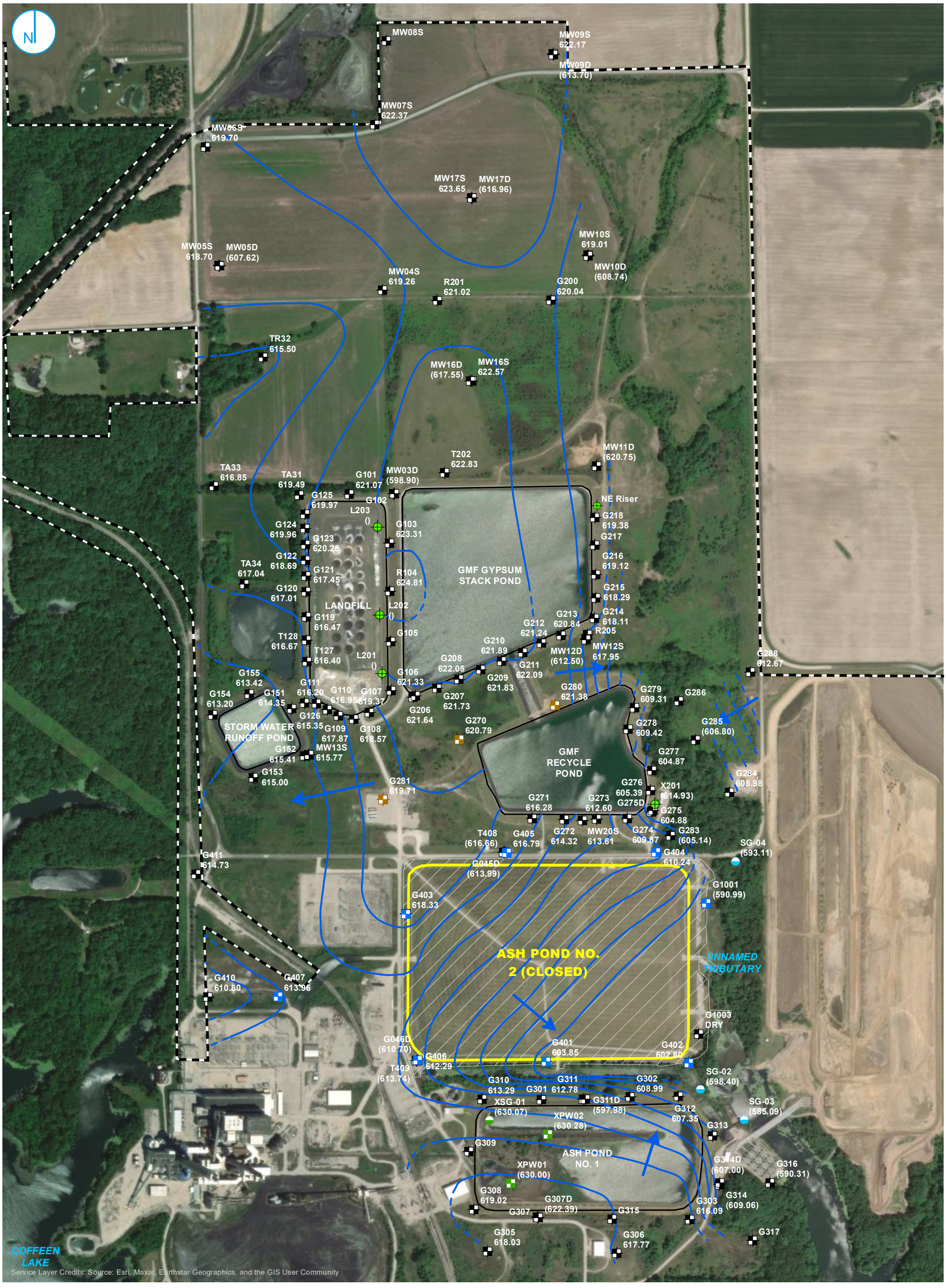
TOP OF UPPERMOST AQUIFER

FIGURE 2-4

NATURE AND EXTENT REPORT
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL



- COMPLIANCE MONITORING WELL
- BACKGROUND MONITORING WELL
- MONITORING WELL
- PORE WATER WELL
- LEACHATE WELL
- STAFF GAGE, CCR UNIT
- STAFF GAGE, RIVER
- GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
- INFERRED GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION
- REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- LIMITS OF FINAL COVER
- PROPERTY BOUNDARY

0 325 650 Feet

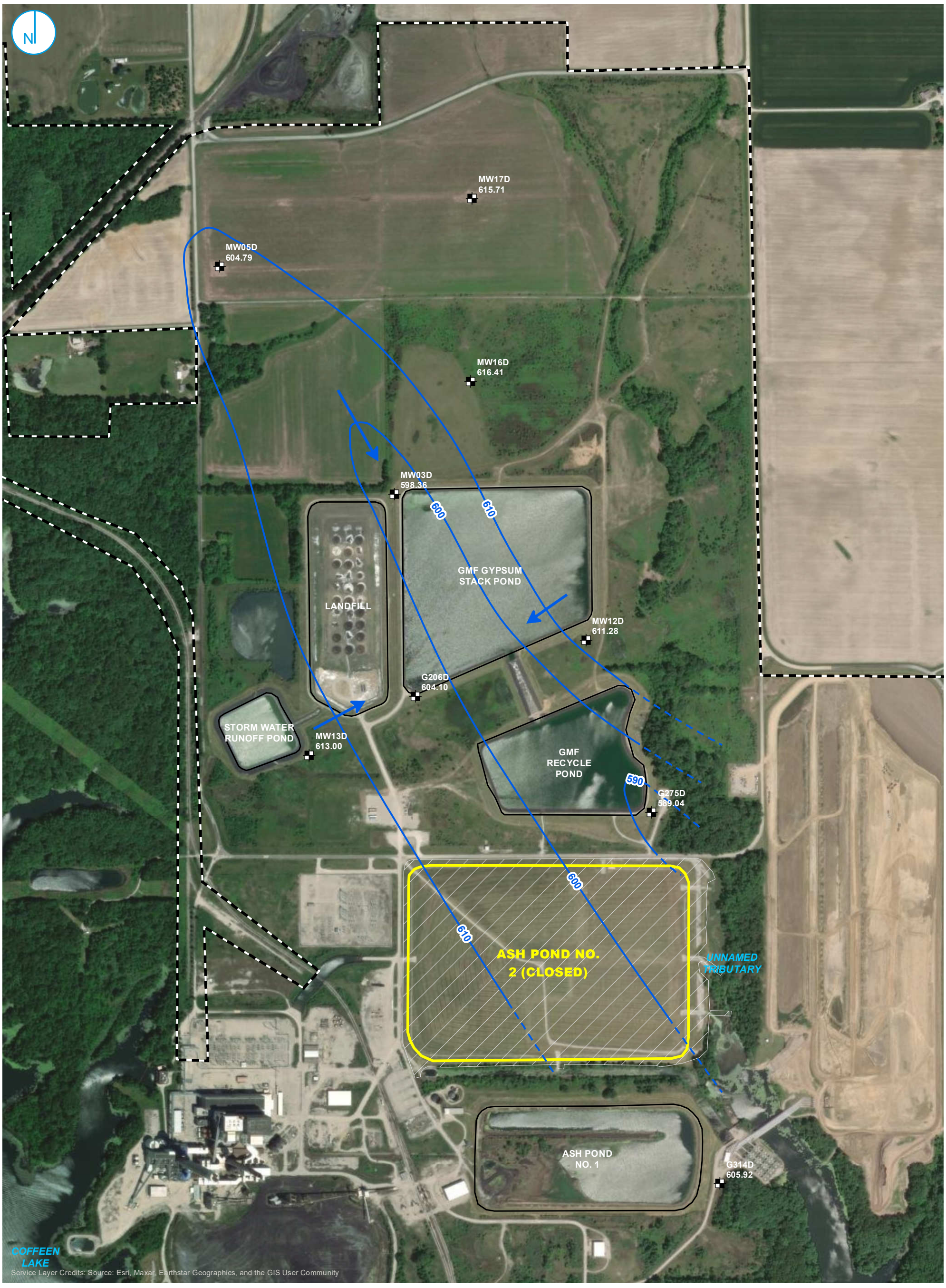
UPPERMOST AQUIFER POTENTIOMETRIC SURFACE MAP MAY 30, 2023 (E001)

FIGURE 2-5

NATURE AND EXTENT REPORT
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL



MONITORING WELL
GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
INFERRED GROUNDWATER ELEVATION CONTOUR
GROUNDWATER FLOW DIRECTION
REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

0 325 650 Feet

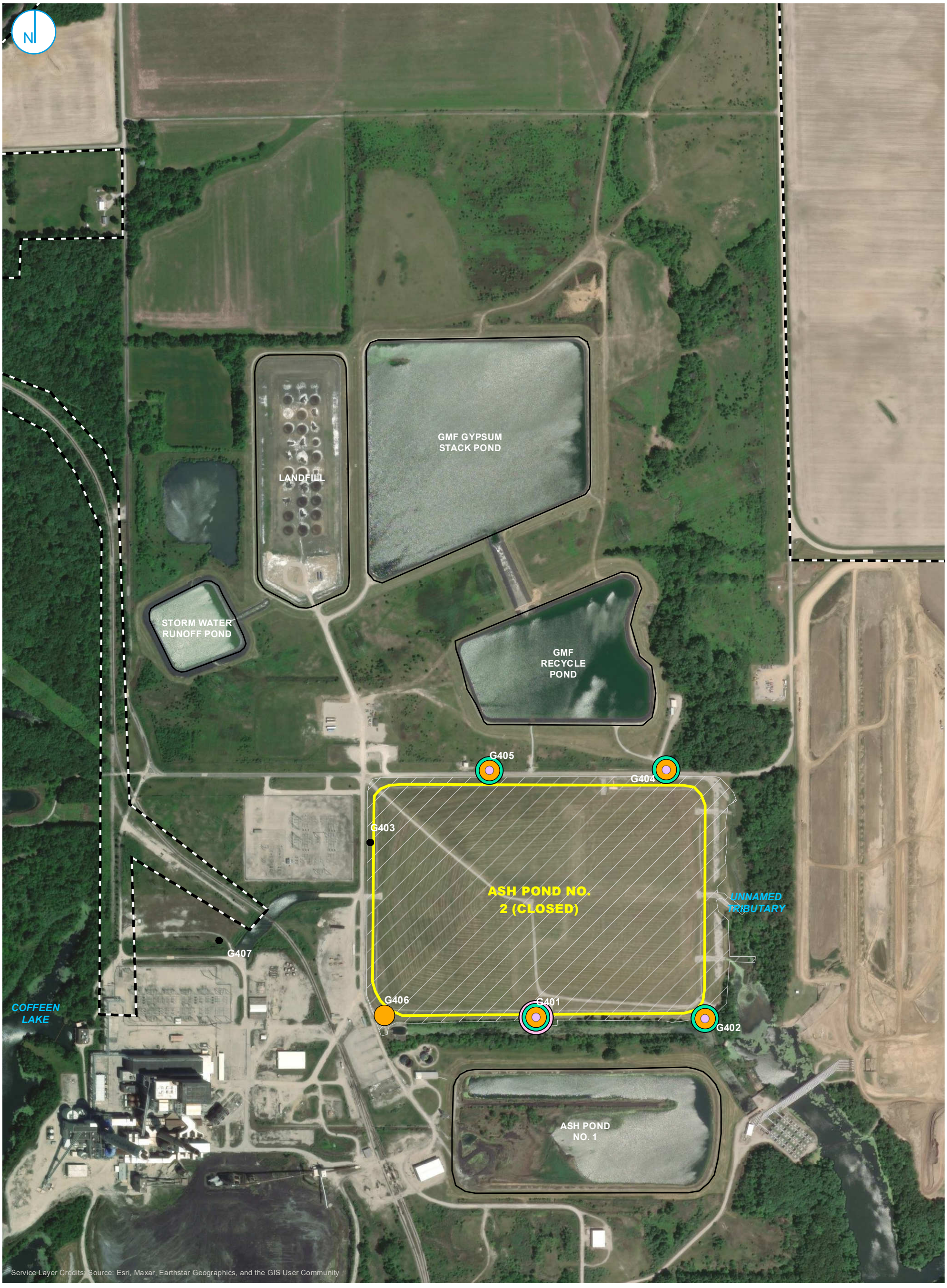
DEEP AQUIFER POTENTIOMETRIC SURFACE MAP AUGUST 8, 2023 (E002)

FIGURE 2-6

NATURE AND EXTENT REPORT
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL



TOTAL BORON EXCEEDANCE
TOTAL SULFATE EXCEEDANCE
TOTAL DISSOLVED SOLIDS EXCEEDANCE
pH EXCEEDANCE
COMPLIANCE WELL WITHOUT EXCEEDANCE
REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

0 275 550 Feet

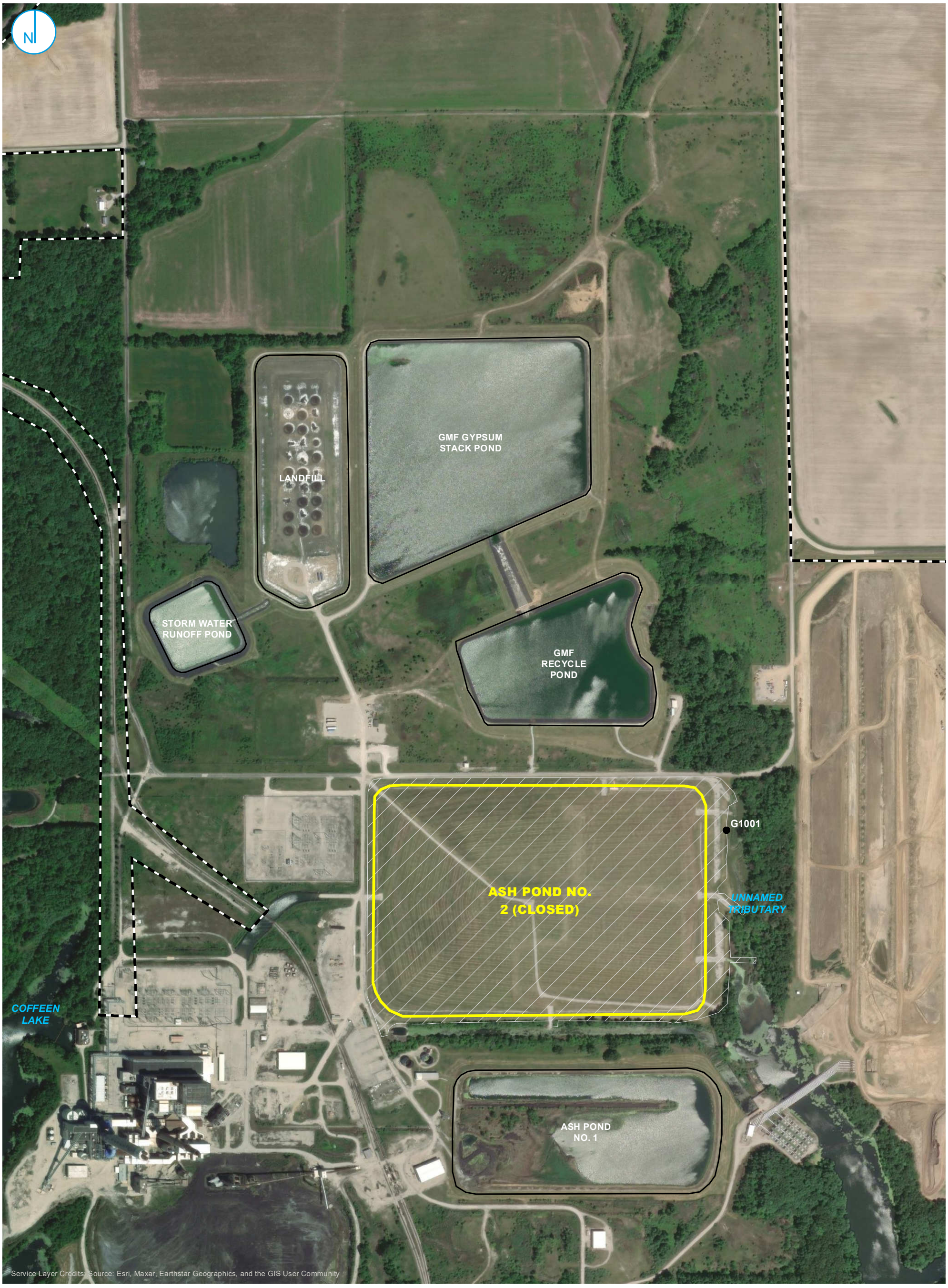
GWPS EXCEEDANCE MAP UPPERMOST AQUIFER

FIGURE 3-1

NATURE AND EXTENT REPORT
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL



● COMPLIANCE WELL WITHOUT EXCEEDANCE

REGULATED UNIT (SUBJECT UNIT)

SITE FEATURE

LIMITS OF FINAL COVER

PROPERTY BOUNDARY

0 275 550 Feet

GWPS EXCEEDANCE MAP LOWER CONFINING UNIT

FIGURE 3-2

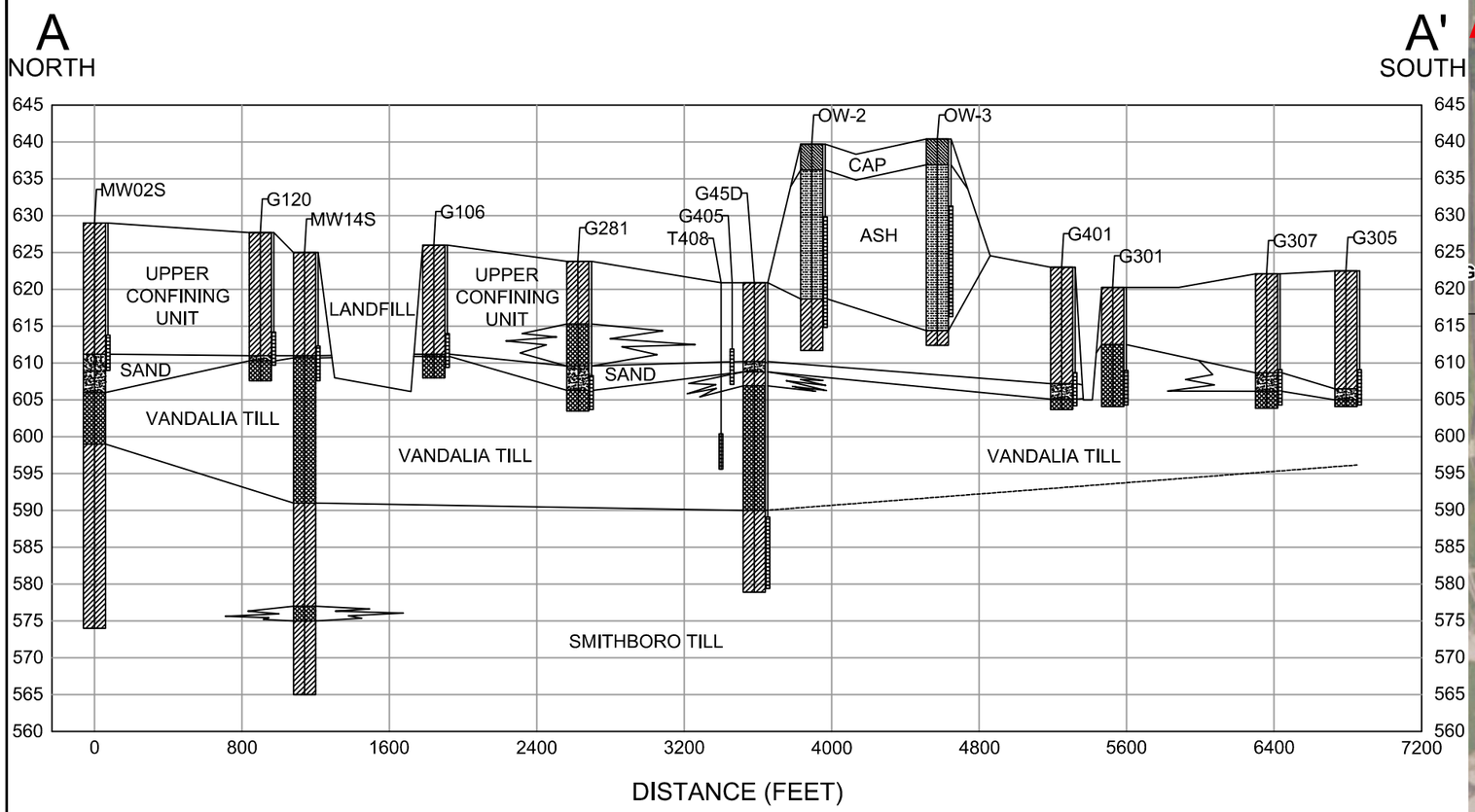
NATURE AND EXTENT REPORT
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

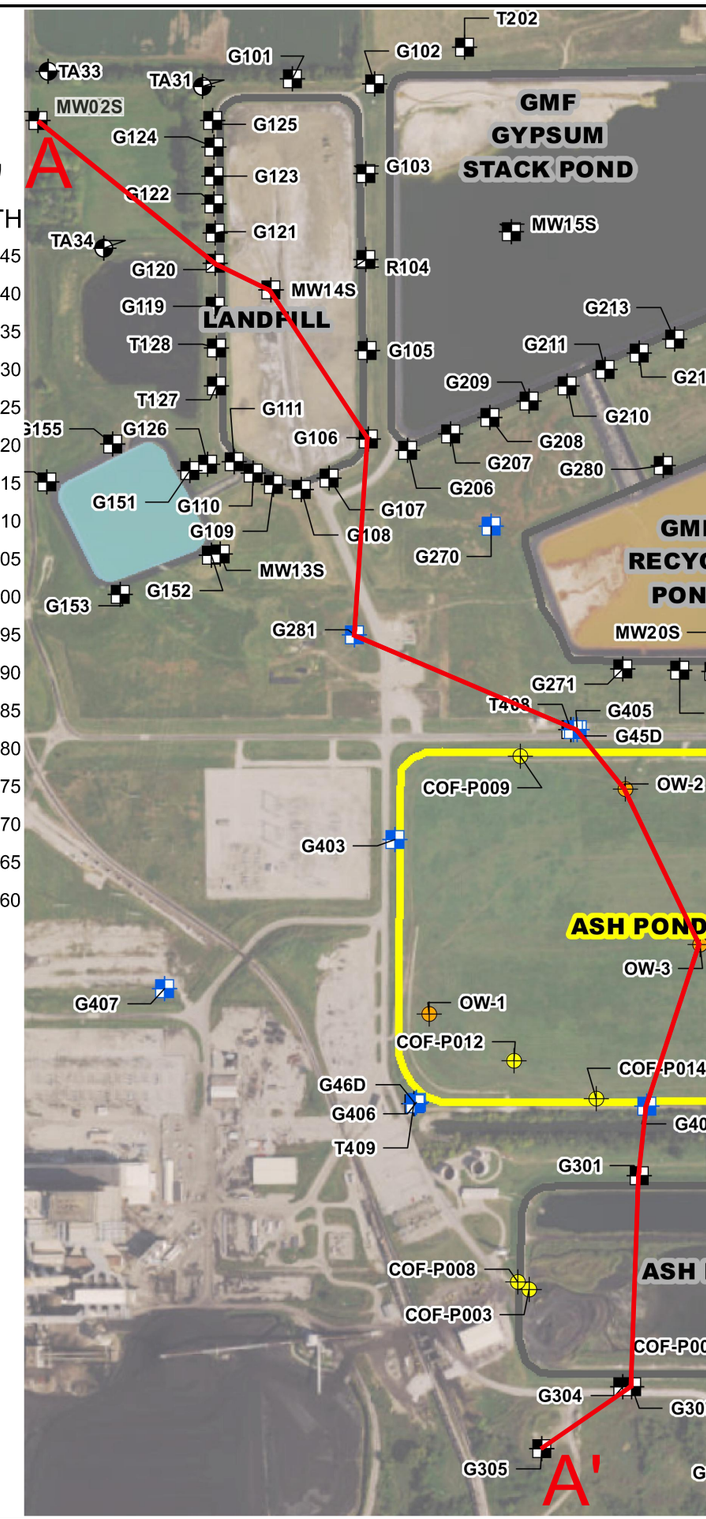
RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL

APPENDICES

APPENDIX A
Hydrogeologic Characterization Report
Cross-Sections





VERTICAL SCALE IN FEET: 20

HORIZONTAL SCALE IN FEET: 800

VERTICAL EXAGGERATION =40

B—B'	CROSS-SECTION TRANSECT
	CLAY
	SOIL
	SAND
	SILT
	ASH
	WELL SCREEN

DRAWN BY: AGC	DATE: 12/6/16	
CHECKED BY: NRK	DATE: 12/20/16	
APPROVED BY: SJC	DATE: 12/20/16	
DRAWING NO: Fig 9_Geologic Cross-Section A-A'	REFERENCE: SEE INFO BLOCK	

GEOLOGIC CROSS-SECTION A-A'

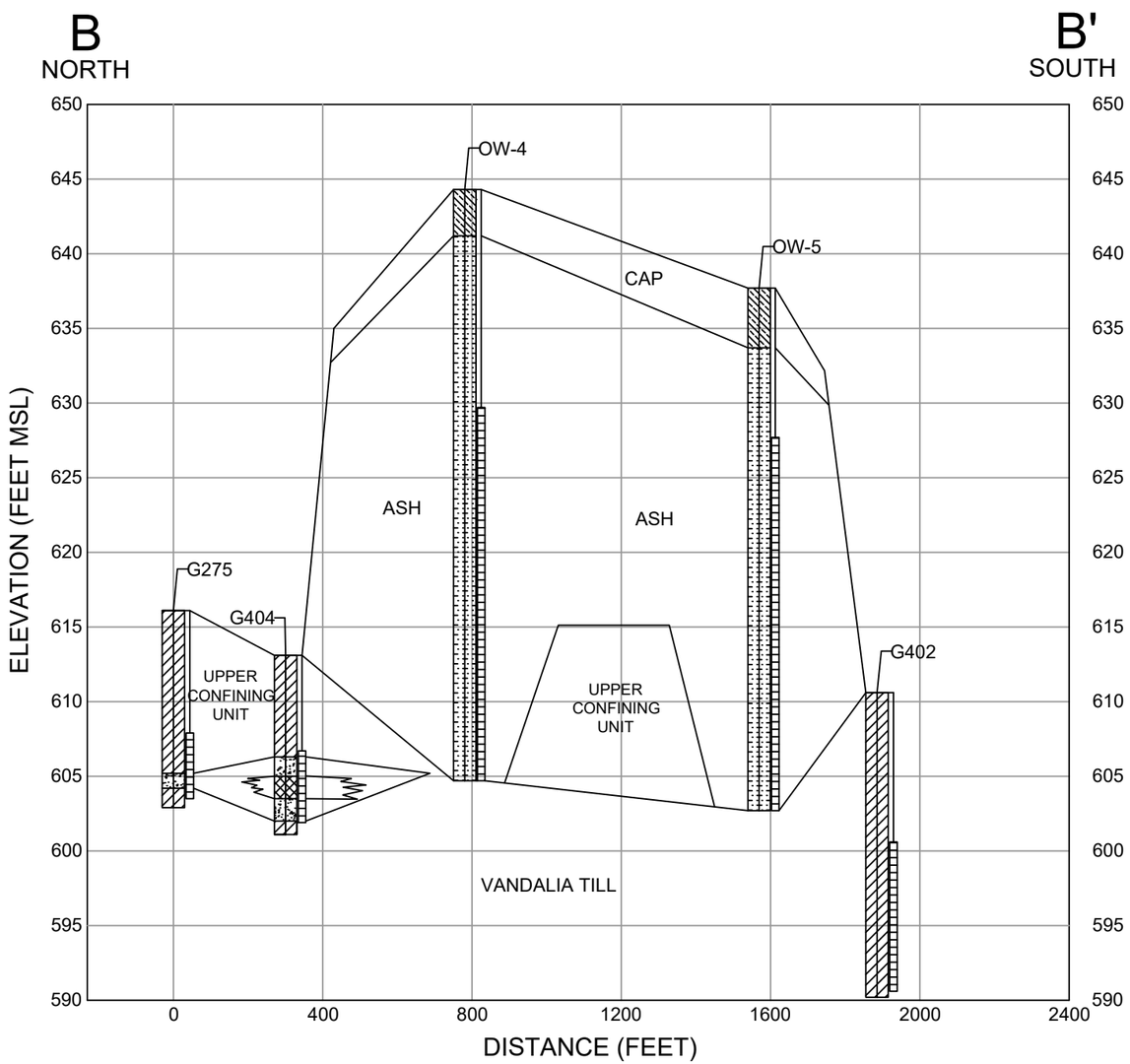
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

NATURAL RESOURCE TECHNOLOGY

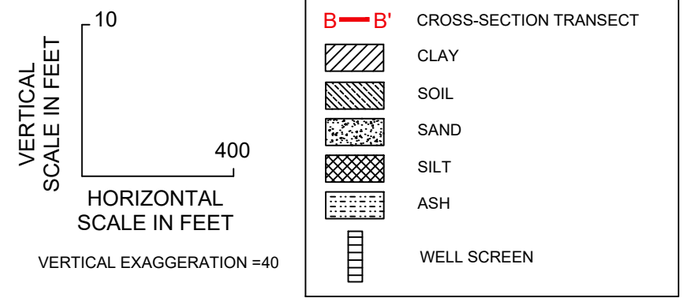
PROJECT NO.
2380/2.0

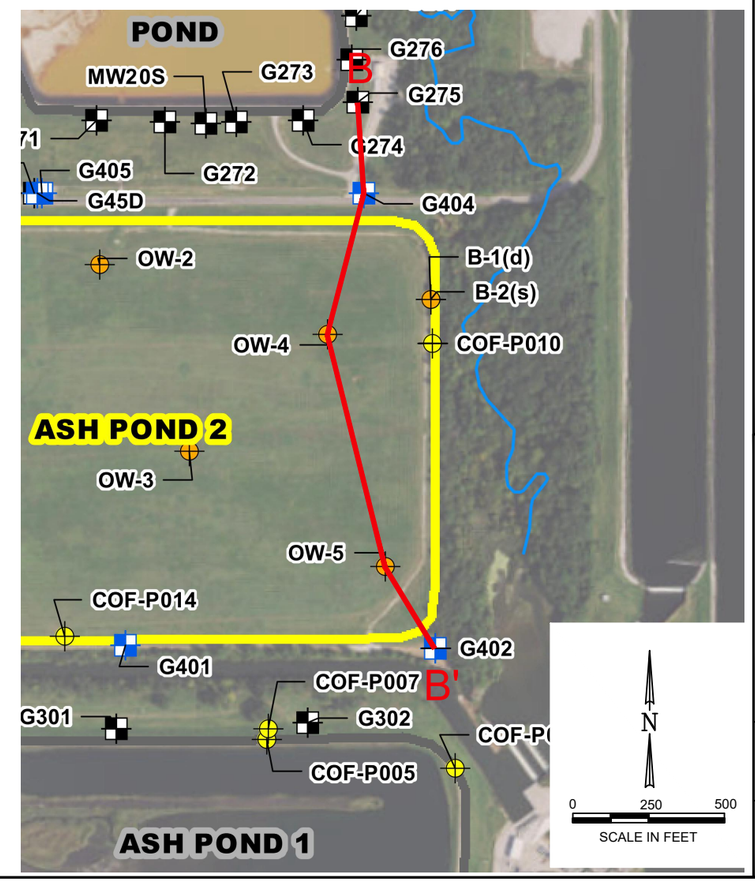
FIGURE NO.
9

Dec 21, 2016 12:07pm PLOTTED BY: amillspaugh SAVED BY: acawrse
Y:\Mapping\Projects\23\2380\CAD\2-0\Figure 9_Geologic Cross-Section A-A'.dwg Layout1
IMAGES: Y:\Mapping\Projects\23\2380\CAD\2-0\Reference\MW02S.JPG;
XREFS:



NOTE: FIGURE UPDATED IN 2024 TO MAINTAIN CONSISTENCY WITH CROSS-SECTION C-C'





DRAWN BY:	AGC	DATE: 11/30/16
CHECKED BY:	NRK	DATE: 12/20/16
APPROVED BY:	SJC	DATE: 12/20/16
DRAWING NO:	Fig 10_Geologic Cross-Section B-B'	
REFERENCE:	SEE INFO BLOCK	

GEOLOGIC CROSS-SECTION B-B'

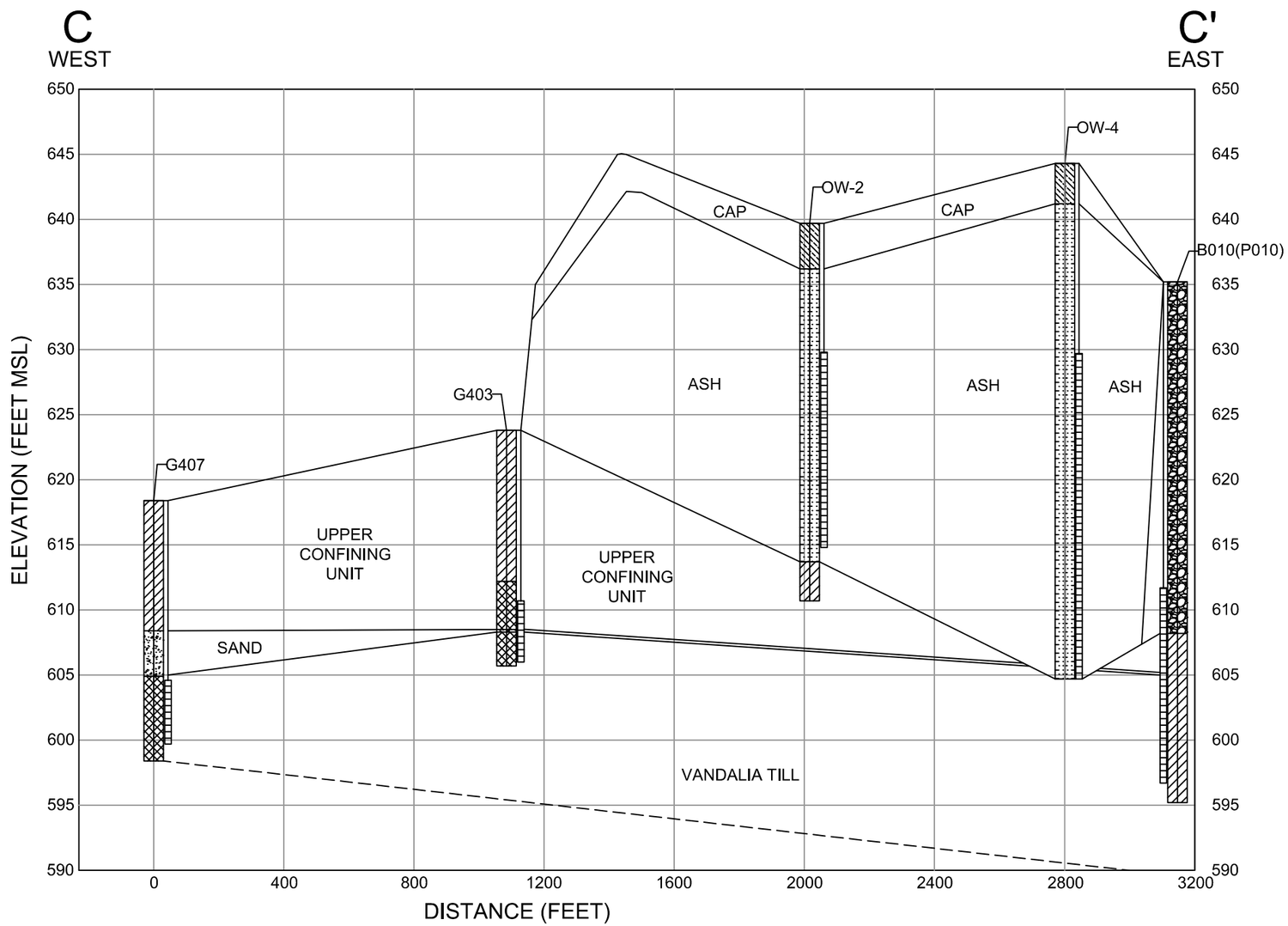
HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

NATURAL RESOURCE TECHNOLOGY

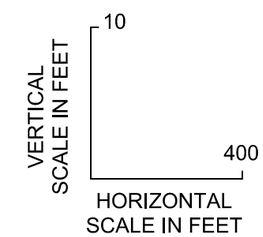
PROJECT NO.
2380/2.0

FIGURE NO.
10

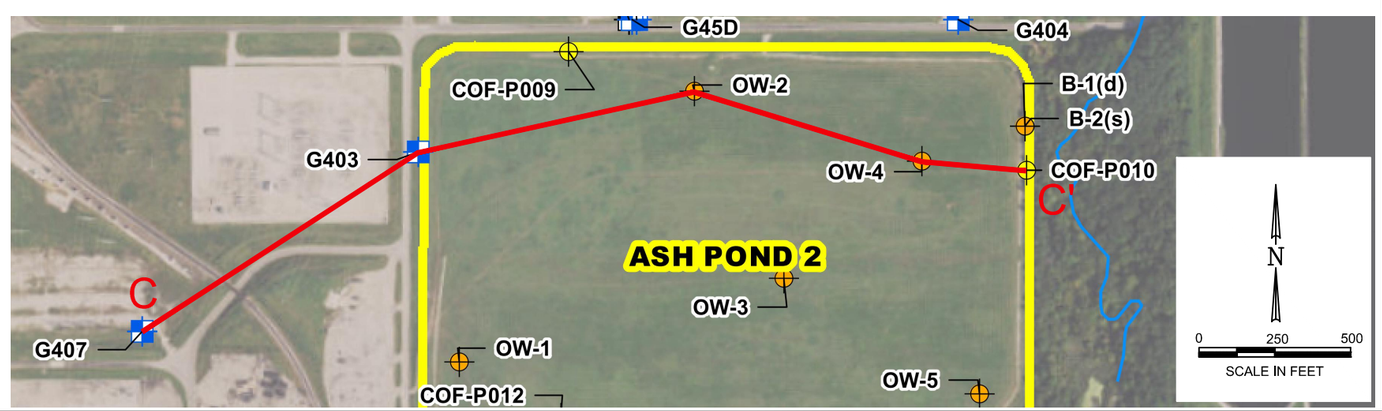
Jun 11, 2024 8:25am PLOTTED BY: CAWRSEAG SAVED BY: CAWRSEAG
X:\Mapping\Projects\23\2380\CAD\2-0\Figure 10_Geologic Cross-Section B-B' rev.dwg Layout1
IMAGES:
XREFS:



B — B' CROSS-SECTION TRANSECT
CLAY
SOIL
SAND
SILT
ASH
FILL
WELL SCREEN



VERTICAL EXAGGERATION =40



DRAWN BY: AGC DATE: 12/1/16
CHECKED BY: NRK DATE: 12/20/16
APPROVED BY: SJC DATE: 12/20/16
DRAWING NO: Fig 11_Geologic Cross-Section C-C'
REFERENCE: SEE INFO BLOCK

GEOLOGIC CROSS-SECTION C-C'

HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
2380/2.0

FIGURE NO.
11

Dec 21, 2016 12:13pm PLOTTED BY: amillspaugh SAVED BY: acowrse
Y:\Mapping\Projects\23\2380\CAD\2-0\Figure 11_Geologic Cross-Section C-C'.dwg Layout1
IMAGES:
XREFS:

APPENDIX B
Site-Wide Groundwater Elevations

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G045D	Water Level	LCU	02/13/2023	9.12	614.69
G045D	Water Level	LCU	05/30/2023	9.82	613.99
G045D	Water Level	LCU	08/08/2023	10.34	613.47
G045D	Water Level	LCU	10/24/2023	10.41	613.40
G045D	Water Level	LCU	11/13/2023	10.26	613.55
G046D	Water Level	LCU	02/13/2023	14.85	610.39
G046D	Water Level	LCU	05/30/2023	14.54	610.70
G046D	Water Level	LCU	08/08/2023	15.10	610.14
G046D	Water Level	LCU	10/24/2023	15.59	609.65
G046D	Water Level	LCU	11/13/2023	15.54	609.70
G1001	Water Level	LCU	02/13/2023	6.12	591.49
G1001	Water Level	LCU	03/30/2023	6.09	591.51
G1001	Water Level	LCU	04/30/2023	6.53	591.07
G1001	Water Level	LCU	05/30/2023	6.61	590.99
G1001	Water Level	LCU	08/08/2023	6.32	591.29
G1001	Water Level	LCU	09/25/2023	6.14	591.46
G1001	Water Level	LCU	10/24/2023	6.20	591.41
G1001	Water Level	LCU	11/13/2023	6.49	591.12
G1001	Water Level	LCU	12/18/2023	5.88	591.73
G1003	Water Level	LCU	02/13/2023	Dry	Dry
G1003	Water Level	LCU	05/30/2023	Dry	Dry
G1003	Water Level	LCU	08/08/2023	Dry	Dry
G1003	Water Level	LCU	10/24/2023	Dry	Dry
G1003	Water Level	LCU	11/13/2023	Dry	Dry
G101	Water Level	UA	02/13/2023	4.71	622.89
G101	Water Level	UA	05/30/2023	6.53	621.07
G101	Water Level	UA	08/08/2023	11.16	616.44
G101	Water Level	UA	10/25/2023	14.15	613.45
G101	Water Level	UA	11/13/2023	13.95	613.65
G102	Water Level	UA	02/13/2023	4.80	624.24
G102	Water Level	UA	08/08/2023	10.34	618.70
G102	Water Level	UA	10/24/2023	12.60	616.44
G102	Water Level	UA	11/13/2023	12.84	616.20
G102	Water Level	UA	12/18/2023	12.82	616.22

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G103	Water Level	UA	02/13/2023	9.59	624.21
G103	Water Level	UA	03/30/2023	7.94	625.85
G103	Water Level	UA	04/30/2023	9.58	624.21
G103	Water Level	UA	05/30/2023	10.49	623.31
G103	Water Level	UA	06/08/2023	11.00	622.80
G103	Water Level	UA	07/08/2023	12.05	621.74
G103	Water Level	UA	08/08/2023	13.53	620.27
G103	Water Level	UA	09/25/2023	14.74	619.06
G103	Water Level	UA	10/25/2023	15.66	618.14
G103	Water Level	UA	11/13/2023	16.00	617.80
G103	Water Level	UA	12/18/2023	16.24	617.56
G105	Water Level	UA	02/13/2023	8.24	623.84
G105	Water Level	UA	08/08/2023	10.84	621.24
G105	Water Level	UA	09/25/2023	15.74	616.34
G105	Water Level	UA	10/25/2023	12.90	619.18
G105	Water Level	UA	11/13/2023	13.46	618.62
G105	Water Level	UA	12/18/2023	13.63	618.45
G106	Water Level	UA	02/13/2023	8.44	622.71
G106	Water Level	UA	03/30/2023	7.82	623.32
G106	Water Level	UA	04/30/2023	9.16	621.98
G106	Water Level	UA	05/30/2023	9.81	621.33
G106	Water Level	UA	06/08/2023	10.39	620.76
G106	Water Level	UA	07/08/2023	10.50	620.65
G106	Water Level	UA	08/08/2023	12.17	618.98
G106	Water Level	UA	09/25/2023	12.97	618.18
G106	Water Level	UA	10/25/2023	14.01	617.14
G106	Water Level	UA	11/13/2023	14.21	616.94
G106	Water Level	UA	12/18/2023	13.87	617.28
G107	Water Level	UA	02/13/2023	9.07	621.15
G107	Water Level	UA	05/30/2023	10.85	619.37
G107	Water Level	UA	08/08/2023	12.76	617.46
G107	Water Level	UA	10/25/2023	14.31	615.91
G107	Water Level	UA	11/13/2023	14.40	615.82
G108	Water Level	UA	02/13/2023	9.67	620.55

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G108	Water Level	UA	05/30/2023	11.65	618.57
G108	Water Level	UA	08/08/2023	13.24	616.98
G108	Water Level	UA	10/25/2023	14.89	615.33
G108	Water Level	UA	11/13/2023	14.96	615.26
G109	Water Level	UA	02/13/2023	9.81	619.95
G109	Water Level	UA	05/30/2023	11.89	617.87
G109	Water Level	UA	08/08/2023	13.64	616.12
G109	Water Level	UA	10/25/2023	14.89	614.87
G109	Water Level	UA	11/13/2023	15.09	614.67
G110	Water Level	UA	02/13/2023	10.80	618.85
G110	Water Level	UA	05/30/2023	12.70	616.95
G110	Water Level	UA	08/08/2023	14.16	615.49
G110	Water Level	UA	10/25/2023	15.31	614.34
G110	Water Level	UA	11/13/2023	15.43	614.22
G111	Water Level	UA	02/13/2023	12.91	616.99
G111	Water Level	UA	05/30/2023	13.70	616.20
G111	Water Level	UA	08/08/2023	14.95	614.95
G111	Water Level	UA	10/25/2023	16.00	613.90
G111	Water Level	UA	11/13/2023	16.09	613.81
G119	Water Level	UA	02/13/2023	14.64	616.91
G119	Water Level	UA	05/30/2023	15.08	616.47
G119	Water Level	UA	08/08/2023	15.65	615.90
G119	Water Level	UA	10/25/2023	16.40	615.15
G119	Water Level	UA	11/13/2023	16.25	615.30
G120	Water Level	UA	02/13/2023	14.43	617.44
G120	Water Level	UA	05/30/2023	14.86	617.01
G120	Water Level	UA	08/08/2023	16.31	615.56
G120	Water Level	UA	10/25/2023	17.18	614.69
G120	Water Level	UA	11/13/2023	17.08	614.79
G121	Water Level	UA	02/13/2023	14.72	618.11
G121	Water Level	UA	05/30/2023	15.38	617.45
G121	Water Level	UA	08/08/2023	18.40	614.43
G121	Water Level	UA	10/25/2023	19.45	613.38
G121	Water Level	UA	11/13/2023	18.96	613.87

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G122	Water Level	UA	02/13/2023	13.89	618.80
G122	Water Level	UA	05/30/2023	14.00	618.69
G122	Water Level	UA	08/08/2023	19.54	613.15
G122	Water Level	UA	10/25/2023	21.21	611.48
G122	Water Level	UA	11/13/2023	20.40	612.29
G123	Water Level	UA	02/13/2023	11.80	621.16
G123	Water Level	UA	05/30/2023	12.68	620.28
G123	Water Level	UA	08/08/2023	18.57	614.39
G123	Water Level	UA	10/25/2023	20.09	612.87
G123	Water Level	UA	11/13/2023	19.94	613.02
G124	Water Level	UA	02/13/2023	12.14	621.25
G124	Water Level	UA	05/30/2023	13.43	619.96
G124	Water Level	UA	08/08/2023	18.49	614.90
G124	Water Level	UA	10/25/2023	21.05	612.34
G124	Water Level	UA	11/13/2023	Dry	Dry
G125	Water Level	UA	02/13/2023	11.99	621.52
G125	Water Level	UA	05/30/2023	13.54	619.97
G125	Water Level	UA	08/08/2023	18.53	614.98
G125	Water Level	UA	10/25/2023	21.21	612.30
G125	Water Level	UA	11/13/2023	Dry	Dry
G126	Water Level	UA	02/13/2023	8.92	616.47
G126	Water Level	UA	05/30/2023	10.04	615.35
G126	Water Level	UA	08/08/2023	10.93	614.46
G126	Water Level	UA	10/25/2023	11.85	613.54
G126	Water Level	UA	11/13/2023	11.91	613.48
G151	Water Level	UA	02/13/2023	10.88	615.05
G151	Water Level	UA	05/30/2023	11.58	614.35
G151	Water Level	UA	08/08/2023	12.22	613.71
G151	Water Level	UA	10/25/2023	12.99	612.94
G151	Water Level	UA	11/13/2023	12.97	612.96
G152	Water Level	UA	02/13/2023	10.25	616.27
G152	Water Level	UA	05/30/2023	11.11	615.41
G152	Water Level	UA	08/08/2023	12.40	614.12
G152	Water Level	UA	10/25/2023	13.42	613.10

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G152	Water Level	UA	11/13/2023	13.07	613.45
G153	Water Level	UA	02/13/2023	12.24	614.16
G153	Water Level	UA	05/30/2023	11.40	615.00
G153	Water Level	UA	08/08/2023	13.08	613.32
G153	Water Level	UA	10/25/2023	14.81	611.59
G153	Water Level	UA	11/13/2023	14.90	611.50
G154	Water Level	UA	02/13/2023	10.91	615.44
G154	Water Level	UA	05/30/2023	13.15	613.20
G154	Water Level	UA	08/08/2023	14.60	611.75
G154	Water Level	UA	10/25/2023	15.90	610.45
G154	Water Level	UA	11/13/2023	15.76	610.59
G155	Water Level	UA	02/13/2023	11.56	614.30
G155	Water Level	UA	05/30/2023	12.44	613.42
G155	Water Level	UA	08/08/2023	13.21	612.65
G155	Water Level	UA	10/25/2023	14.01	611.85
G155	Water Level	UA	11/13/2023	13.92	611.94
G200	Water Level	UA	02/13/2023	2.91	623.03
G200	Water Level	UA	03/30/2023	3.01	622.92
G200	Water Level	UA	04/30/2023	4.51	621.42
G200	Water Level	UA	05/30/2023	5.89	620.04
G200	Water Level	UA	06/08/2023	6.44	619.49
G200	Water Level	UA	08/08/2023	9.21	616.73
G200	Water Level	UA	09/25/2023	10.61	615.33
G200	Water Level	UA	10/25/2023	11.51	614.43
G200	Water Level	UA	11/13/2023	11.88	614.06
G200	Water Level	UA	12/18/2023	11.48	614.46
G206	Water Level	UA	02/13/2023	9.20	623.62
G206	Water Level	UA	03/30/2023	9.12	623.69
G206	Water Level	UA	04/30/2023	10.27	622.54
G206	Water Level	UA	05/30/2023	11.17	621.64
G206	Water Level	UA	07/08/2023	12.13	620.69
G206	Water Level	UA	08/08/2023	13.89	618.93
G206	Water Level	UA	09/25/2023	14.74	618.08
G206	Water Level	UA	10/25/2023	15.71	617.11

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G206	Water Level	UA	11/13/2023	16.16	616.66
G206	Water Level	UA	12/18/2023	15.85	616.97
G206D	Water Level	DA	02/13/2023	9.92	624.22
G206D	Water Level	DA	02/16/2023	[29.69]	[604.16]
G206D	Water Level	DA	03/30/2023	32.14	601.99
G206D	Water Level	DA	04/30/2023	30.53	603.60
G206D	Water Level	DA	05/30/2023	30.22	603.91
G206D	Water Level	DA	07/08/2023	30.10	604.04
G206D	Water Level	DA	08/08/2023	30.04	604.10
G206D	Water Level	DA	09/25/2023	30.08	604.06
G206D	Water Level	DA	10/25/2023	30.34	603.80
G206D	Water Level	DA	11/13/2023	30.40	603.74
G206D	Water Level	DA	12/18/2023	30.32	603.82
G207	Water Level	UA	02/13/2023	10.25	622.96
G207	Water Level	UA	03/30/2023	9.67	623.53
G207	Water Level	UA	04/30/2023	10.55	622.65
G207	Water Level	UA	05/30/2023	11.47	621.73
G207	Water Level	UA	07/08/2023	12.45	620.76
G207	Water Level	UA	08/08/2023	14.20	619.01
G207	Water Level	UA	09/25/2023	15.27	617.94
G207	Water Level	UA	10/25/2023	16.24	616.97
G207	Water Level	UA	11/13/2023	16.67	616.54
G207	Water Level	UA	12/18/2023	16.31	616.90
G208	Water Level	UA	02/13/2023	10.28	622.88
G208	Water Level	UA	03/30/2023	9.65	623.50
G208	Water Level	UA	04/30/2023	10.30	622.85
G208	Water Level	UA	05/30/2023	11.10	622.05
G208	Water Level	UA	06/08/2023	12.38	620.78
G208	Water Level	UA	07/08/2023	12.32	620.83
G208	Water Level	UA	08/08/2023	14.08	619.08
G208	Water Level	UA	09/25/2023	15.31	617.84
G208	Water Level	UA	10/25/2023	16.25	616.91
G208	Water Level	UA	11/13/2023	16.66	616.50
G208	Water Level	UA	12/18/2023	16.24	616.92

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G209	Water Level	UA	02/13/2023	10.01	622.90
G209	Water Level	UA	03/30/2023	9.63	623.27
G209	Water Level	UA	04/30/2023	10.25	622.65
G209	Water Level	UA	05/30/2023	11.07	621.83
G209	Water Level	UA	07/08/2023	11.82	621.08
G209	Water Level	UA	08/08/2023	13.79	619.12
G209	Water Level	UA	09/25/2023	14.78	618.13
G209	Water Level	UA	10/25/2023	15.60	617.31
G209	Water Level	UA	11/13/2023	16.24	616.67
G209	Water Level	UA	12/18/2023	16.04	616.87
G210	Water Level	UA	02/13/2023	10.49	622.50
G210	Water Level	UA	03/30/2023	9.73	623.25
G210	Water Level	UA	04/30/2023	10.36	622.62
G210	Water Level	UA	05/30/2023	11.09	621.89
G210	Water Level	UA	06/08/2023	11.76	621.23
G210	Water Level	UA	07/08/2023	12.29	620.70
G210	Water Level	UA	08/08/2023	13.75	619.24
G210	Water Level	UA	09/25/2023	14.67	618.32
G210	Water Level	UA	10/25/2023	15.52	617.47
G210	Water Level	UA	11/13/2023	15.82	617.17
G210	Water Level	UA	12/18/2023	15.99	617.00
G211	Water Level	UA	02/13/2023	9.90	622.74
G211	Water Level	UA	03/30/2023	9.18	623.45
G211	Water Level	UA	04/30/2023	9.99	622.64
G211	Water Level	UA	05/30/2023	10.54	622.09
G211	Water Level	UA	06/08/2023	11.76	620.88
G211	Water Level	UA	07/08/2023	12.43	620.21
G211	Water Level	UA	08/08/2023	13.44	619.20
G211	Water Level	UA	09/25/2023	14.74	617.90
G211	Water Level	UA	10/25/2023	15.15	617.49
G211	Water Level	UA	11/13/2023	15.61	617.03
G211	Water Level	UA	12/18/2023	15.93	616.71
G212	Water Level	UA	02/13/2023	10.38	622.51
G212	Water Level	UA	03/30/2023	9.77	623.11

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G212	Water Level	UA	04/30/2023	10.89	621.99
G212	Water Level	UA	05/30/2023	11.64	621.24
G212	Water Level	UA	06/08/2023	12.80	620.08
G212	Water Level	UA	07/08/2023	13.48	619.41
G212	Water Level	UA	08/08/2023	14.61	618.28
G212	Water Level	UA	09/25/2023	15.97	616.92
G212	Water Level	UA	10/25/2023	16.46	616.43
G212	Water Level	UA	11/13/2023	16.92	615.97
G212	Water Level	UA	12/18/2023	17.00	615.89
G213	Water Level	UA	02/13/2023	10.83	621.98
G213	Water Level	UA	03/30/2023	10.15	622.65
G213	Water Level	UA	04/30/2023	11.04	621.76
G213	Water Level	UA	05/30/2023	11.96	620.84
G213	Water Level	UA	06/08/2023	12.80	620.00
G213	Water Level	UA	07/08/2023	13.50	619.31
G213	Water Level	UA	08/08/2023	15.05	617.76
G213	Water Level	UA	09/25/2023	15.90	616.91
G213	Water Level	UA	10/25/2023	16.81	616.00
G213	Water Level	UA	11/13/2023	17.41	615.40
G213	Water Level	UA	12/18/2023	17.34	615.47
G214	Water Level	UA	02/13/2023	14.53	618.32
G214	Water Level	UA	03/30/2023	13.04	619.80
G214	Water Level	UA	04/30/2023	13.98	618.86
G214	Water Level	UA	05/30/2023	14.73	618.11
G214	Water Level	UA	06/08/2023	15.56	617.29
G214	Water Level	UA	07/08/2023	16.44	616.41
G214	Water Level	UA	08/08/2023	17.64	615.21
G214	Water Level	UA	09/25/2023	18.42	614.43
G214	Water Level	UA	10/25/2023	19.14	613.71
G214	Water Level	UA	11/13/2023	19.35	613.50
G214	Water Level	UA	12/18/2023	19.23	613.62
G215	Water Level	UA	02/13/2023	14.38	618.68
G215	Water Level	UA	03/30/2023	13.16	619.89
G215	Water Level	UA	04/30/2023	14.03	619.02

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G215	Water Level	UA	05/30/2023	14.76	618.29
G215	Water Level	UA	06/08/2023	15.46	617.59
G215	Water Level	UA	07/08/2023	16.06	616.99
G215	Water Level	UA	08/08/2023	17.22	615.84
G215	Water Level	UA	09/25/2023	18.06	614.99
G215	Water Level	UA	10/25/2023	18.41	614.65
G215	Water Level	UA	11/13/2023	19.03	614.03
G215	Water Level	UA	12/18/2023	18.75	614.31
G216	Water Level	UA	02/13/2023	13.54	619.22
G216	Water Level	UA	03/30/2023	12.27	620.48
G216	Water Level	UA	04/30/2023	12.94	619.81
G216	Water Level	UA	05/30/2023	13.63	619.12
G216	Water Level	UA	06/08/2023	14.99	617.77
G216	Water Level	UA	07/08/2023	15.42	617.33
G216	Water Level	UA	08/08/2023	16.51	616.25
G216	Water Level	UA	09/25/2023	17.38	615.38
G216	Water Level	UA	10/25/2023	17.86	614.90
G216	Water Level	UA	11/13/2023	18.21	614.55
G216	Water Level	UA	12/18/2023	18.00	614.76
G217	Water Level	UA	02/13/2023	14.72	618.38
G217	Water Level	UA	08/08/2023	18.29	614.81
G217	Water Level	UA	10/25/2023	19.51	613.59
G217	Water Level	UA	11/13/2023	19.68	613.42
G217	Water Level	UA	12/18/2023	19.33	613.77
G218	Water Level	UA	02/13/2023	13.71	619.40
G218	Water Level	UA	03/30/2023	12.50	620.60
G218	Water Level	UA	04/30/2023	12.98	620.12
G218	Water Level	UA	05/30/2023	13.72	619.38
G218	Water Level	UA	06/08/2023	15.11	618.00
G218	Water Level	UA	07/08/2023	15.80	617.31
G218	Water Level	UA	08/08/2023	16.98	616.13
G218	Water Level	UA	09/25/2023	17.95	615.16
G218	Water Level	UA	10/25/2023	18.48	614.63
G218	Water Level	UA	11/13/2023	18.67	614.44

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G218	Water Level	UA	12/18/2023	18.38	614.73
G270	Water Level	UA	02/13/2023	2.53	623.33
G270	Water Level	UA	03/30/2023	2.41	623.44
G270	Water Level	UA	04/30/2023	2.83	623.02
G270	Water Level	UA	05/30/2023	5.06	620.79
G270	Water Level	UA	08/14/2023	[8.52]	[617.34]
G270	Water Level	UA	10/25/2023	10.92	614.94
G270	Water Level	UA	11/13/2023	10.90	614.96
G270	Water Level	UA	12/18/2023	9.84	616.02
G271	Water Level	UA	02/13/2023	8.93	616.64
G271	Water Level	UA	03/30/2023	7.12	618.44
G271	Water Level	UA	04/30/2023	8.97	616.59
G271	Water Level	UA	05/30/2023	9.28	616.28
G271	Water Level	UA	06/08/2023	9.57	615.99
G271	Water Level	UA	07/08/2023	9.83	615.73
G271	Water Level	UA	08/08/2023	11.20	614.37
G271	Water Level	UA	09/25/2023	12.44	613.13
G271	Water Level	UA	10/25/2023	12.95	612.62
G271	Water Level	UA	11/13/2023	13.00	612.57
G271	Water Level	UA	12/18/2023	12.79	612.78
G272	Water Level	UA	02/13/2023	8.55	615.26
G272	Water Level	UA	03/30/2023	6.96	616.84
G272	Water Level	UA	04/30/2023	9.20	614.60
G272	Water Level	UA	05/30/2023	9.48	614.32
G272	Water Level	UA	08/08/2023	10.55	613.26
G272	Water Level	UA	09/25/2023	11.63	612.18
G272	Water Level	UA	10/25/2023	12.03	611.78
G272	Water Level	UA	11/13/2023	12.01	611.80
G272	Water Level	UA	12/18/2023	11.81	612.00
G273	Water Level	UA	02/13/2023	8.95	614.07
G273	Water Level	UA	03/30/2023	7.80	615.21
G273	Water Level	UA	04/30/2023	10.09	612.92
G273	Water Level	UA	05/30/2023	10.41	612.60
G273	Water Level	UA	08/08/2023	11.56	611.46

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G273	Water Level	UA	09/25/2023	12.39	610.63
G273	Water Level	UA	10/25/2023	12.78	610.24
G273	Water Level	UA	11/13/2023	12.71	610.31
G273	Water Level	UA	12/18/2023	12.40	610.62
G274	Water Level	UA	02/13/2023	13.22	610.82
G274	Water Level	UA	03/30/2023	11.96	612.07
G274	Water Level	UA	04/30/2023	13.85	610.18
G274	Water Level	UA	05/30/2023	14.16	609.87
G274	Water Level	UA	06/08/2023	14.41	609.63
G274	Water Level	UA	07/08/2023	14.33	609.70
G274	Water Level	UA	08/08/2023	14.99	609.05
G274	Water Level	UA	09/25/2023	15.46	608.57
G274	Water Level	UA	10/25/2023	Dry	Dry
G274	Water Level	UA	11/13/2023	15.77	608.27
G274	Water Level	UA	12/18/2023	15.53	608.51
G275	Water Level	UA	02/13/2023	13.02	605.24
G275	Water Level	UA	05/30/2023	13.38	604.88
G275	Water Level	UA	08/08/2023	Dry	Dry
G275	Water Level	UA	11/13/2023	Dry	Dry
G275D	Water Level	DA	02/13/2023	39.49	580.82
G275D	Water Level	DA	08/08/2023	31.27	589.04
G275D	Water Level	DA	09/25/2023	42.29	578.02
G275D	Water Level	DA	10/25/2023	39.74	580.57
G275D	Water Level	DA	12/18/2023	43.46	576.85
G276	Water Level	UA	02/13/2023	27.37	604.63
G276	Water Level	UA	03/30/2023	25.78	606.21
G276	Water Level	UA	04/30/2023	26.04	605.95
G276	Water Level	UA	05/30/2023	26.60	605.39
G276	Water Level	UA	06/08/2023	26.84	605.16
G276	Water Level	UA	07/08/2023	27.27	604.73
G276	Water Level	UA	08/08/2023	27.75	604.25
G276	Water Level	UA	10/25/2023	28.49	603.51
G276	Water Level	UA	11/13/2023	28.59	603.41
G276	Water Level	UA	12/18/2023	28.71	603.29

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G277	Water Level	UA	02/13/2023	19.67	603.41
G277	Water Level	UA	05/30/2023	18.21	604.87
G277	Water Level	UA	08/08/2023	19.76	603.32
G277	Water Level	UA	11/13/2023	Dry	Dry
G278	Water Level	UA	02/13/2023	19.95	611.22
G278	Water Level	UA	05/30/2023	21.75	609.42
G278	Water Level	UA	08/08/2023	20.98	610.19
G278	Water Level	UA	10/25/2023	23.48	607.69
G278	Water Level	UA	11/13/2023	24.23	606.94
G279	Water Level	UA	02/13/2023	20.83	611.21
G279	Water Level	UA	05/30/2023	22.73	609.31
G279	Water Level	UA	08/08/2023	23.69	608.35
G279	Water Level	UA	10/25/2023	24.56	607.48
G279	Water Level	UA	11/13/2023	23.39	608.65
G280	Water Level	UA	02/13/2023	3.01	622.34
G280	Water Level	UA	03/30/2023	2.74	622.60
G280	Water Level	UA	04/30/2023	3.52	621.82
G280	Water Level	UA	05/30/2023	3.96	621.38
G280	Water Level	UA	08/08/2023	5.80	619.55
G280	Water Level	UA	09/25/2023	7.42	617.92
G280	Water Level	UA	10/25/2023	8.56	616.79
G280	Water Level	UA	11/13/2023	8.91	616.44
G280	Water Level	UA	12/18/2023	9.04	616.31
G281	Water Level	UA	02/13/2023	4.63	621.73
G281	Water Level	UA	03/30/2023	3.94	622.41
G281	Water Level	UA	04/30/2023	6.44	619.91
G281	Water Level	UA	05/30/2023	6.64	619.71
G281	Water Level	UA	08/08/2023	6.39	619.97
G281	Water Level	UA	10/24/2023	8.64	617.72
G281	Water Level	UA	11/13/2023	8.59	617.77
G281	Water Level	UA	12/18/2023	6.83	619.53
G283	Water Level	LCU	02/13/2023	4.61	606.14
G283	Water Level	LCU	03/30/2023	3.55	607.19
G283	Water Level	LCU	04/30/2023	4.71	606.03

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G283	Water Level	LCU	05/30/2023	5.60	605.14
G283	Water Level	LCU	08/14/2023	[7.45]	[603.30]
G283	Water Level	LCU	10/24/2023	7.79	602.96
G283	Water Level	LCU	11/13/2023	7.22	603.53
G283	Water Level	LCU	12/18/2023	6.49	604.26
G284	Water Level	UA	02/13/2023	9.72	608.70
G284	Water Level	UA	03/30/2023	8.65	609.76
G284	Water Level	UA	04/30/2023	11.62	606.79
G284	Water Level	UA	05/30/2023	12.43	605.98
G284	Water Level	UA	08/14/2023	[12.28]	[606.14]
G284	Water Level	UA	10/24/2023	Dry	Dry
G284	Water Level	UA	11/13/2023	Dry	Dry
G284	Water Level	UA	12/18/2023	12.91	605.51
G285	Water Level	LCU	02/13/2023	6.12	607.40
G285	Water Level	LCU	03/30/2023	4.18	609.33
G285	Water Level	LCU	04/30/2023	5.80	607.71
G285	Water Level	LCU	05/30/2023	6.71	606.80
G285	Water Level	LCU	07/08/2023	8.14	605.37
G285	Water Level	LCU	08/08/2023	8.25	605.26
G285	Water Level	LCU	08/14/2023	[8.44]	[605.08]
G285	Water Level	LCU	09/25/2023	8.47	605.05
G285	Water Level	LCU	10/24/2023	8.96	604.56
G285	Water Level	LCU	11/13/2023	9.38	604.14
G285	Water Level	LCU	12/18/2023	8.03	605.49
G286	Water Level	UA	02/13/2023	6.18	606.95
G286	Water Level	UA	08/10/2023	[Dry]	[Dry]
G286	Water Level	UA	10/24/2023	Dry	Dry
G286	Water Level	UA	11/13/2023	Dry	Dry
G286	Water Level	UA	12/18/2023	Dry	Dry
G287	Water Level	UA	02/13/2023	5.75	611.70
G288	Water Level	UA	02/13/2023	9.78	610.29
G288	Water Level	UA	03/30/2023	4.70	615.37
G288	Water Level	UA	04/30/2023	6.66	613.41
G288	Water Level	UA	05/30/2023	7.40	612.67

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G288	Water Level	UA	06/08/2023	8.05	612.02
G288	Water Level	UA	07/08/2023	7.65	612.42
G288	Water Level	UA	08/08/2023	8.62	611.45
G288	Water Level	UA	08/11/2023	[8.70]	[611.37]
G288	Water Level	UA	09/25/2023	9.57	610.50
G288	Water Level	UA	10/24/2023	9.95	610.12
G288	Water Level	UA	11/13/2023	9.84	610.23
G288	Water Level	UA	12/18/2023	8.56	611.51
G301	Water Level	UA	02/13/2023	5.30	617.35
G301	Water Level	UA	06/08/2023	7.70	614.94
G301	Water Level	UA	07/08/2023	7.82	614.82
G301	Water Level	UA	08/08/2023	8.11	614.54
G301	Water Level	UA	10/24/2023	8.51	614.14
G301	Water Level	UA	11/13/2023	8.43	614.22
G301	Water Level	UA	12/18/2023	8.00	614.65
G302	Water Level	UA	02/13/2023	7.16	612.88
G302	Water Level	UA	03/30/2023	4.68	615.35
G302	Water Level	UA	04/30/2023	9.10	610.93
G302	Water Level	UA	05/30/2023	11.04	608.99
G302	Water Level	UA	06/08/2023	11.57	608.46
G302	Water Level	UA	07/08/2023	12.07	607.96
G302	Water Level	UA	08/08/2023	12.68	607.36
G302	Water Level	UA	09/25/2023	13.12	606.92
G302	Water Level	UA	11/13/2023	13.16	606.88
G302	Water Level	UA	12/18/2023	12.47	607.57
G303	Water Level	UA	02/13/2023	4.20	617.82
G303	Water Level	UA	03/30/2023	3.62	618.39
G303	Water Level	UA	04/30/2023	4.62	617.39
G303	Water Level	UA	05/30/2023	5.92	616.09
G303	Water Level	UA	08/08/2023	8.40	613.62
G303	Water Level	UA	09/25/2023	9.18	612.83
G303	Water Level	UA	10/24/2023	9.71	612.31
G303	Water Level	UA	11/13/2023	9.32	612.70
G303	Water Level	UA	12/18/2023	8.22	613.80

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G305	Water Level	UA	02/13/2023	6.08	619.59
G305	Water Level	UA	03/30/2023	5.81	619.85
G305	Water Level	UA	04/30/2023	6.59	619.07
G305	Water Level	UA	05/30/2023	7.63	618.03
G305	Water Level	UA	06/08/2023	8.35	617.31
G305	Water Level	UA	07/08/2023	8.23	617.43
G305	Water Level	UA	08/08/2023	9.19	616.48
G305	Water Level	UA	10/24/2023	9.95	615.72
G305	Water Level	UA	11/13/2023	8.50	617.17
G305	Water Level	UA	12/18/2023	8.24	617.43
G306	Water Level	UA	02/13/2023	5.80	620.11
G306	Water Level	UA	03/30/2023	5.41	620.49
G306	Water Level	UA	04/30/2023	6.64	619.26
G306	Water Level	UA	05/30/2023	8.13	617.77
G306	Water Level	UA	06/08/2023	9.18	616.72
G306	Water Level	UA	07/08/2023	8.60	617.30
G306	Water Level	UA	08/08/2023	9.70	616.21
G306	Water Level	UA	10/24/2023	10.81	615.10
G306	Water Level	UA	11/13/2023	10.13	615.78
G306	Water Level	UA	12/18/2023	7.56	618.35
G307	Water Level	UA	02/13/2023	Above Top of Casing	Above Top of Casing
G307	Water Level	UA	08/08/2023	0.70	623.90
G307	Water Level	UA	11/13/2023	1.96	622.64
G307D	Water Level	LCU	02/13/2023	2.75	622.13
G307D	Water Level	LCU	03/30/2023	2.32	622.55
G307D	Water Level	LCU	04/30/2023	2.41	622.46
G307D	Water Level	LCU	05/30/2023	2.48	622.39
G307D	Water Level	LCU	08/08/2023	7.89	616.99
G307D	Water Level	LCU	10/24/2023	11.33	613.55
G307D	Water Level	LCU	11/13/2023	12.36	612.52
G307D	Water Level	LCU	12/18/2023	7.55	617.33
G308	Water Level	UA	02/13/2023	3.88	620.71
G308	Water Level	UA	03/30/2023	3.79	620.79
G308	Water Level	UA	04/30/2023	4.84	619.74

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G308	Water Level	UA	05/30/2023	5.56	619.02
G308	Water Level	UA	06/08/2023	5.93	618.66
G308	Water Level	UA	07/08/2023	5.37	619.22
G308	Water Level	UA	08/08/2023	5.09	619.50
G308	Water Level	UA	09/25/2023	6.16	618.42
G308	Water Level	UA	10/24/2023	6.19	618.40
G308	Water Level	UA	11/13/2023	6.00	618.59
G308	Water Level	UA	12/18/2023	4.71	619.88
G309	Water Level	UA	02/13/2023	9.64	616.24
G309	Water Level	UA	08/08/2023	8.04	617.84
G309	Water Level	UA	09/25/2023	8.24	617.64
G309	Water Level	UA	10/24/2023	8.69	617.19
G309	Water Level	UA	11/13/2023	8.32	617.56
G309	Water Level	UA	12/18/2023	7.60	618.28
G310	Water Level	UA	02/13/2023	7.09	615.78
G310	Water Level	UA	03/30/2023	6.42	616.44
G310	Water Level	UA	04/30/2023	8.94	613.92
G310	Water Level	UA	05/30/2023	9.57	613.29
G310	Water Level	UA	06/08/2023	9.96	612.90
G310	Water Level	UA	08/08/2023	10.30	612.57
G310	Water Level	UA	09/25/2023	10.73	612.14
G310	Water Level	UA	10/24/2023	10.82	612.05
G310	Water Level	UA	11/13/2023	10.56	612.31
G310	Water Level	UA	12/18/2023	9.95	612.92
G311	Water Level	UA	05/30/2023	8.26	612.78
G311	Water Level	UA	08/08/2023	9.08	611.96
G311	Water Level	UA	10/24/2023	9.29	611.75
G311	Water Level	UA	11/13/2023	9.38	611.66
G311D	Water Level	LCU	02/13/2023	23.66	597.58
G311D	Water Level	LCU	05/30/2023	23.26	597.98
G311D	Water Level	LCU	08/08/2023	23.52	597.72
G311D	Water Level	LCU	10/24/2023	23.51	597.73
G311D	Water Level	LCU	11/13/2023	24.15	597.09
G312	Water Level	UA	03/30/2023	8.28	611.49

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G312	Water Level	UA	04/30/2023	10.81	608.96
G312	Water Level	UA	05/30/2023	12.42	607.35
G312	Water Level	UA	06/08/2023	12.87	606.91
G312	Water Level	UA	07/08/2023	13.42	606.36
G312	Water Level	UA	08/08/2023	14.00	605.78
G312	Water Level	UA	10/24/2023	Dry	Dry
G312	Water Level	UA	11/13/2023	Dry	Dry
G312	Water Level	UA	12/18/2023	14.45	605.33
G313	Water Level	UA	02/13/2023	3.24	611.06
G313	Water Level	UA	08/08/2023	3.01	611.29
G313	Water Level	UA	10/24/2023	3.08	611.22
G313	Water Level	UA	11/13/2023	3.36	610.94
G313	Water Level	UA	12/18/2023	3.48	610.82
G314	Water Level	LCU	02/13/2023	6.14	607.74
G314	Water Level	LCU	03/30/2023	8.96	604.91
G314	Water Level	LCU	04/30/2023	5.53	608.34
G314	Water Level	LCU	05/30/2023	4.81	609.06
G314	Water Level	LCU	06/08/2023	9.43	604.44
G314	Water Level	LCU	07/08/2023	5.67	608.20
G314	Water Level	LCU	08/08/2023	4.88	609.00
G314	Water Level	LCU	09/25/2023	4.96	608.92
G314	Water Level	LCU	10/24/2023	5.30	608.58
G314	Water Level	LCU	11/13/2023	5.67	608.21
G314	Water Level	LCU	12/18/2023	7.39	606.49
G314D	Water Level	DA	02/13/2023	16.40	597.30
G314D	Water Level	DA	03/30/2023	9.98	603.71
G314D	Water Level	DA	04/30/2023	7.48	606.21
G314D	Water Level	DA	05/30/2023	6.69	607.00
G314D	Water Level	DA	06/08/2023	11.80	601.90
G314D	Water Level	DA	07/08/2023	7.25	606.45
G314D	Water Level	DA	08/08/2023	7.78	605.92
G314D	Water Level	DA	09/25/2023	8.50	605.20
G314D	Water Level	DA	10/24/2023	8.56	605.14
G314D	Water Level	DA	11/13/2023	7.97	605.73

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G314D	Water Level	DA	12/18/2023	7.04	606.66
G315	Water Level	UA	02/13/2023	2.08	621.44
G315	Water Level	UA	08/08/2023	3.50	620.02
G315	Water Level	UA	10/24/2023	4.04	619.48
G315	Water Level	UA	11/13/2023	4.11	619.41
G315	Water Level	UA	12/18/2023	2.55	620.97
G316	Water Level	LCU	02/13/2023	11.53	591.06
G316	Water Level	LCU	05/30/2023	12.28	590.31
G316	Water Level	LCU	08/08/2023	11.70	590.89
G316	Water Level	LCU	10/24/2023	12.54	590.05
G316	Water Level	LCU	11/13/2023	12.46	590.13
G317	Water Level	UA	02/13/2023	34.52	607.41
G317	Water Level	UA	08/08/2023	Dry	Dry
G317	Water Level	UA	09/25/2023	37.42	604.51
G317	Water Level	UA	10/24/2023	Dry	Dry
G317	Water Level	UA	11/13/2023	Dry	Dry
G317	Water Level	UA	12/18/2023	38.02	603.91
G401	Water Level	UA	02/13/2023	21.17	604.40
G401	Water Level	UA	05/30/2023	21.72	603.85
G401	Water Level	UA	08/08/2023	21.75	603.82
G401	Water Level	UA	10/24/2023	21.66	603.91
G401	Water Level	UA	11/13/2023	13.63	611.94
G402	Water Level	UA	02/13/2023	8.83	604.54
G402	Water Level	UA	03/30/2023	8.23	605.13
G402	Water Level	UA	04/30/2023	9.59	603.77
G402	Water Level	UA	05/30/2023	10.56	602.80
G402	Water Level	UA	06/08/2023	10.94	602.43
G402	Water Level	UA	07/08/2023	11.08	602.29
G402	Water Level	UA	08/08/2023	11.65	601.72
G402	Water Level	UA	10/24/2023	12.01	601.36
G402	Water Level	UA	11/13/2023	11.71	601.66
G402	Water Level	UA	12/18/2023	11.48	601.89
G403	Water Level	UA	02/13/2023	6.05	620.42
G403	Water Level	UA	03/30/2023	5.81	620.65

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G403	Water Level	UA	04/30/2023	7.09	619.37
G403	Water Level	UA	05/30/2023	8.13	618.33
G403	Water Level	UA	06/08/2023	8.74	617.73
G403	Water Level	UA	07/08/2023	7.21	619.26
G403	Water Level	UA	08/08/2023	7.45	619.02
G403	Water Level	UA	09/25/2023	8.82	617.64
G403	Water Level	UA	10/24/2023	8.62	617.85
G403	Water Level	UA	11/13/2023	8.27	618.20
G403	Water Level	UA	12/18/2023	6.64	619.83
G404	Water Level	UA	02/13/2023	3.46	612.21
G404	Water Level	UA	03/30/2023	3.24	612.42
G404	Water Level	UA	04/30/2023	4.64	611.02
G404	Water Level	UA	05/30/2023	5.42	610.24
G404	Water Level	UA	08/14/2023	[5.62]	[610.05]
G404	Water Level	UA	10/24/2023	7.09	608.58
G404	Water Level	UA	11/13/2023	6.48	609.19
G404	Water Level	UA	12/18/2023	4.70	610.97
G405	Water Level	UA	02/13/2023	6.13	617.50
G405	Water Level	UA	03/30/2023	5.87	617.75
G405	Water Level	UA	04/30/2023	6.53	617.09
G405	Water Level	UA	05/30/2023	6.83	616.79
G405	Water Level	UA	06/08/2023	7.08	616.55
G405	Water Level	UA	07/08/2023	6.59	617.04
G405	Water Level	UA	08/08/2023	6.85	616.78
G405	Water Level	UA	09/25/2023	7.59	616.04
G405	Water Level	UA	10/24/2023	7.84	615.79
G405	Water Level	UA	11/13/2023	7.73	615.90
G405	Water Level	UA	12/18/2023	6.55	617.08
G406	Water Level	UA	02/13/2023	11.25	614.11
G406	Water Level	UA	03/30/2023	9.94	615.41
G406	Water Level	UA	04/30/2023	12.48	612.87
G406	Water Level	UA	05/30/2023	13.06	612.29
G406	Water Level	UA	06/08/2023	13.75	611.61
G406	Water Level	UA	07/08/2023	11.92	613.44

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G406	Water Level	UA	08/08/2023	11.49	613.87
G406	Water Level	UA	09/25/2023	13.95	611.41
G406	Water Level	UA	10/24/2023	14.08	611.28
G406	Water Level	UA	11/13/2023	13.83	611.53
G406	Water Level	UA	12/18/2023	12.03	613.33
G407	Water Level	UA	02/13/2023	5.60	615.72
G407	Water Level	UA	03/30/2023	5.49	615.82
G407	Water Level	UA	04/30/2023	6.91	614.40
G407	Water Level	UA	05/30/2023	7.35	613.96
G407	Water Level	UA	06/08/2023	8.75	612.57
G407	Water Level	UA	07/08/2023	8.22	613.10
G407	Water Level	UA	08/08/2023	8.79	612.53
G407	Water Level	UA	10/24/2023	8.39	612.93
G407	Water Level	UA	11/13/2023	8.31	613.01
G407	Water Level	UA	12/18/2023	6.76	614.56
G410	Water Level	UA	02/13/2023	7.44	612.35
G410	Water Level	UA	05/30/2023	8.99	610.80
G410	Water Level	UA	08/08/2023	9.66	610.13
G410	Water Level	UA	10/24/2023	10.88	608.91
G410	Water Level	UA	11/13/2023	10.68	609.11
G411	Water Level	UA	02/13/2023	6.15	617.10
G411	Water Level	UA	05/30/2023	8.52	614.73
G411	Water Level	UA	08/08/2023	8.69	614.56
G411	Water Level	UA	10/24/2023	11.33	611.92
G411	Water Level	UA	11/13/2023	11.20	612.05
MW03D	Water Level	DA	02/13/2023	30.75	598.26
MW03D	Water Level	DA	03/30/2023	30.43	598.57
MW03D	Water Level	DA	04/30/2023	30.00	599.01
MW03D	Water Level	DA	05/30/2023	30.11	598.90
MW03D	Water Level	DA	06/08/2023	30.17	598.83
MW03D	Water Level	DA	07/08/2023	30.39	598.62
MW03D	Water Level	DA	08/08/2023	30.65	598.36
MW03D	Water Level	DA	09/25/2023	29.29	599.72
MW03D	Water Level	DA	10/25/2023	29.64	599.37

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
MW03D	Water Level	DA	11/13/2023	32.01	597.00
MW03D	Water Level	DA	12/18/2023	32.08	596.93
MW04S	Water Level	UA	02/13/2023	4.30	621.59
MW04S	Water Level	UA	05/30/2023	6.63	619.26
MW04S	Water Level	UA	08/08/2023	9.80	616.09
MW04S	Water Level	UA	11/13/2023	12.20	613.69
MW05S	Water Level	UA	02/13/2023	5.22	620.73
MW05S	Water Level	UA	05/30/2023	7.25	618.70
MW05S	Water Level	UA	08/08/2023	9.35	616.60
MW05D	Water Level	DA	02/13/2023	19.65	606.26
MW05D	Water Level	DA	05/30/2023	18.29	607.62
MW05D	Water Level	DA	08/08/2023	21.12	604.79
MW06S	Water Level	UA	02/13/2023	4.51	621.64
MW06S	Water Level	UA	05/30/2023	6.45	619.70
MW06S	Water Level	UA	08/08/2023	8.72	617.43
MW06S	Water Level	UA	10/24/2023	9.94	616.21
MW06S	Water Level	UA	11/13/2023	8.91	617.24
MW07S	Water Level	UA	02/13/2023	3.15	624.45
MW07S	Water Level	UA	05/30/2023	5.23	622.37
MW07S	Water Level	UA	08/08/2023	7.79	619.81
MW07S	Water Level	UA	10/24/2023	9.37	618.23
MW07S	Water Level	UA	11/13/2023	8.48	619.12
MW09S	Water Level	UA	02/13/2023	3.14	624.48
MW09S	Water Level	UA	05/30/2023	5.45	622.17
MW09S	Water Level	UA	08/08/2023	8.11	619.51
MW09D	Water Level	LCU	05/30/2023	13.91	613.70
MW09D	Water Level	LCU	08/08/2023	14.73	612.88
MW10S	Water Level	UA	05/30/2023	5.44	619.01
MW10S	Water Level	UA	08/08/2023	8.67	615.78
MW10D	Water Level	LCU	02/14/2023	3.41	621.06
MW10D	Water Level	LCU	05/30/2023	15.73	608.74
MW10D	Water Level	LCU	08/08/2023	18.69	605.78
MW11S	Water Level	UA	02/14/2023	3.78	621.49
MW11S	Water Level	UA	08/08/2023	8.00	617.27

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
MW11D	Water Level	LCU	02/14/2023	4.73	620.79
MW11D	Water Level	LCU	03/30/2023	3.97	621.55
MW11D	Water Level	LCU	04/30/2023	4.00	621.51
MW11D	Water Level	LCU	05/30/2023	4.76	620.75
MW11D	Water Level	LCU	06/08/2023	6.52	618.99
MW11D	Water Level	LCU	07/08/2023	7.38	618.14
MW11D	Water Level	LCU	08/08/2023	8.57	616.95
MW12S	Water Level	UA	02/14/2023	5.30	620.01
MW12S	Water Level	UA	05/30/2023	7.36	617.95
MW12S	Water Level	UA	08/08/2023	10.87	614.44
MW12S	Water Level	UA	10/25/2023	12.51	612.80
MW12S	Water Level	UA	11/13/2023	12.80	612.51
MW12D	Water Level	DA	02/14/2023	13.63	611.58
MW12D	Water Level	DA	03/30/2023	13.17	612.04
MW12D	Water Level	DA	04/30/2023	12.69	612.52
MW12D	Water Level	DA	05/30/2023	12.71	612.50
MW12D	Water Level	DA	06/08/2023	12.80	612.41
MW12D	Water Level	DA	07/08/2023	13.31	611.90
MW12D	Water Level	DA	08/08/2023	13.93	611.28
MW12D	Water Level	DA	09/25/2023	14.86	610.35
MW12D	Water Level	DA	10/25/2023	15.32	609.89
MW12D	Water Level	DA	11/13/2023	15.64	609.57
MW12D	Water Level	DA	12/18/2023	16.00	609.21
MW13S	Water Level	UA	02/13/2023	8.55	617.41
MW13S	Water Level	UA	05/30/2023	10.19	615.77
MW13S	Water Level	UA	08/08/2023	11.34	614.62
MW13S	Water Level	UA	10/25/2023	12.79	613.17
MW13S	Water Level	UA	11/13/2023	12.33	613.63
MW13D	Water Level	DA	02/13/2023	1.20	624.66
MW13D	Water Level	DA	05/30/2023	13.52	612.34
MW13D	Water Level	DA	08/08/2023	12.86	613.00
MW13D	Water Level	DA	10/25/2023	12.75	613.11
MW13D	Water Level	DA	11/13/2023	12.45	613.41
MW16S	Water Level	UA	02/14/2023	6.61	622.86

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
MW16S	Water Level	UA	03/30/2023	3.70	625.77
MW16S	Water Level	UA	04/30/2023	5.10	624.37
MW16S	Water Level	UA	05/30/2023	6.89	622.57
MW16S	Water Level	UA	06/08/2023	8.31	621.16
MW16S	Water Level	UA	07/08/2023	9.95	619.52
MW16S	Water Level	UA	08/08/2023	11.63	617.84
MW16D	Water Level	DA	02/14/2023	14.63	614.75
MW16D	Water Level	DA	03/30/2023	13.05	616.33
MW16D	Water Level	DA	04/30/2023	12.09	617.29
MW16D	Water Level	DA	05/30/2023	11.83	617.55
MW16D	Water Level	DA	06/08/2023	11.85	617.53
MW16D	Water Level	DA	07/08/2023	12.34	617.04
MW16D	Water Level	DA	08/08/2023	12.97	616.41
MW17S	Water Level	UA	05/30/2023	6.91	623.65
MW17S	Water Level	UA	08/08/2023	10.81	619.75
MW17D	Water Level	DA	02/14/2023	19.92	610.37
MW17D	Water Level	DA	05/30/2023	13.33	616.96
MW17D	Water Level	DA	08/08/2023	14.58	615.71
MW20S	Water Level	UA	02/13/2023	8.21	614.69
MW20S	Water Level	UA	03/30/2023	6.59	616.31
MW20S	Water Level	UA	04/30/2023	8.97	613.93
MW20S	Water Level	UA	05/30/2023	9.28	613.61
MW20S	Water Level	UA	06/08/2023	9.56	613.33
MW20S	Water Level	UA	07/08/2023	9.63	613.26
MW20S	Water Level	UA	08/08/2023	10.60	612.30
MW20S	Water Level	UA	09/25/2023	11.53	611.37
MW20S	Water Level	UA	10/25/2023	11.74	611.16
MW20S	Water Level	UA	11/13/2023	11.96	610.94
MW20S	Water Level	UA	12/18/2023	11.60	611.30
R104	Water Level	UA	02/14/2023	7.44	625.40
R104	Water Level	UA	03/30/2023	6.14	626.69
R104	Water Level	UA	04/30/2023	7.47	625.36
R104	Water Level	UA	05/30/2023	8.02	624.81
R104	Water Level	UA	06/08/2023	8.41	624.43

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
R104	Water Level	UA	07/08/2023	8.92	623.92
R104	Water Level	UA	08/08/2023	10.45	622.39
R104	Water Level	UA	09/25/2023	11.50	621.34
R104	Water Level	UA	10/25/2023	12.52	620.32
R104	Water Level	UA	11/13/2023	12.91	619.93
R104	Water Level	UA	12/18/2023	12.81	620.03
R201	Water Level	UA	02/14/2023	2.80	623.54
R201	Water Level	UA	03/30/2023	2.56	623.77
R201	Water Level	UA	04/30/2023	3.95	622.38
R201	Water Level	UA	05/30/2023	5.31	621.02
R201	Water Level	UA	06/08/2023	6.13	620.21
R201	Water Level	UA	07/08/2023	6.75	619.59
R201	Water Level	UA	08/08/2023	11.61	614.73
R201	Water Level	UA	09/25/2023	10.12	616.22
R201	Water Level	UA	10/24/2023	11.20	615.14
R201	Water Level	UA	11/13/2023	11.73	614.61
R201	Water Level	UA	12/18/2023	11.37	614.97
R205	Water Level	UA	02/13/2023	7.49	617.03
R205	Water Level	UA	08/08/2023	9.69	614.83
R205	Water Level	UA	10/25/2023	11.16	613.36
R205	Water Level	UA	11/13/2023	11.48	613.04
R205	Water Level	UA	12/18/2023	11.16	613.36
T127	Water Level	UA	02/13/2023	14.15	616.81
T127	Water Level	UA	05/30/2023	14.56	616.40
T127	Water Level	UA	08/08/2023	15.20	615.76
T127	Water Level	UA	10/25/2023	15.99	614.97
T127	Water Level	UA	11/13/2023	15.95	615.01
T128	Water Level	UA	02/13/2023	13.97	616.96
T128	Water Level	UA	05/30/2023	14.26	616.67
T128	Water Level	UA	08/08/2023	14.80	616.13
T128	Water Level	UA	10/25/2023	15.54	615.39
T128	Water Level	UA	11/13/2023	15.50	615.43
T202	Water Level	UA	02/13/2023	5.04	623.59
T202	Water Level	UA	05/30/2023	5.80	622.83

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
T202	Water Level	UA	08/08/2023	9.23	619.40
T202	Water Level	UA	10/24/2023	11.02	617.61
T202	Water Level	UA	11/13/2023	11.66	616.97
T408	Water Level	LCU	02/13/2023	6.92	617.16
T408	Water Level	LCU	05/30/2023	7.42	616.66
T408	Water Level	LCU	08/08/2023	7.46	616.62
T408	Water Level	LCU	10/24/2023	8.11	615.97
T408	Water Level	LCU	11/13/2023	8.02	616.06
T409	Water Level	LCU	02/13/2023	9.36	615.65
T409	Water Level	LCU	05/30/2023	11.27	613.74
T409	Water Level	LCU	08/08/2023	9.99	615.02
T409	Water Level	LCU	10/24/2023	12.46	612.55
T409	Water Level	LCU	11/13/2023	12.00	613.01
TA31	Water Level	UA	02/13/2023	5.00	621.55
TA31	Water Level	UA	05/30/2023	7.06	619.49
TA31	Water Level	UA	08/08/2023	11.98	614.57
TA31	Water Level	UA	10/24/2023	14.65	611.90
TA31	Water Level	UA	11/13/2023	14.31	612.24
TA33	Water Level	UA	02/13/2023	8.04	617.23
TA33	Water Level	UA	05/30/2023	8.42	616.85
TA33	Water Level	UA	08/08/2023	12.10	613.17
TA33	Water Level	UA	10/24/2023	13.86	611.41
TA33	Water Level	UA	11/13/2023	13.98	611.29
TA34	Water Level	UA	02/13/2023	8.03	618.49
TA34	Water Level	UA	05/30/2023	9.48	617.04
TA34	Water Level	UA	08/08/2023	18.31	608.21
TA34	Water Level	UA	10/24/2023	12.98	613.54
TA34	Water Level	UA	11/13/2023	12.60	613.92
TR32	Water Level	UA	02/13/2023	6.11	615.57
TR32	Water Level	UA	05/30/2023	6.18	615.50
TR32	Water Level	UA	10/24/2023	9.02	612.66
TR32	Water Level	UA	11/13/2023	9.67	612.01
X201	Water Level	S	02/14/2023	--	614.71
X201	Water Level	S	03/30/2023	--	614.53

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
X201	Water Level	S	04/30/2023	--	614.69
X201	Water Level	S	05/30/2023	--	614.93
X201	Water Level	S	08/08/2023	--	615.31
X201	Water Level	S	11/13/2023	[34.00]	[584.47]
X201	Water Level	S	12/12/2023	--	617.10
XPW01	Water Level	CCR	02/13/2023	4.51	630.06
XPW01	Water Level	CCR	03/30/2023	3.99	630.57
XPW01	Water Level	CCR	04/30/2023	4.24	630.32
XPW01	Water Level	CCR	05/30/2023	4.56	630.00
XPW01	Water Level	CCR	08/08/2023	5.29	629.28
XPW01	Water Level	CCR	10/24/2023	6.03	628.54
XPW01	Water Level	CCR	11/13/2023	6.32	628.25
XPW01	Water Level	CCR	12/18/2023	6.11	628.46
XPW02	Water Level	CCR	02/13/2023	9.38	630.31
XPW02	Water Level	CCR	03/30/2023	8.87	630.81
XPW02	Water Level	CCR	04/30/2023	9.11	630.57
XPW02	Water Level	CCR	05/30/2023	9.40	630.28
XPW02	Water Level	CCR	08/08/2023	10.30	629.39
XPW02	Water Level	CCR	09/25/2023	10.71	628.98
XPW02	Water Level	CCR	10/24/2023	10.93	628.76
XPW02	Water Level	CCR	11/13/2023	11.12	628.57
XPW02	Water Level	CCR	12/18/2023	11.02	628.67
NE Riser	Water Level	S	02/14/2023	--	625.24
XSG-01	Water Level	CCR	02/13/2023	5.40	630.12
XSG-01	Water Level	CCR	05/30/2023	5.45	630.07
XSG-01	Water Level	CCR	08/08/2023	6.25	629.27
XSG-01	Water Level	CCR	10/24/2023	7.02	628.50
XSG-01	Water Level	CCR	11/13/2023	10.38	625.14
XSG-01	Water Level	CCR	12/18/2023	7.04	628.48
SG-02	Water Level	SW	02/13/2023	7.25	598.62
SG-02	Water Level	SW	05/30/2023	7.47	598.40
SG-02	Water Level	SW	10/24/2023	7.49	598.38
SG-02	Water Level	SW	11/13/2023	7.36	598.51
SG-02	Water Level	SW	12/18/2023	7.31	598.56

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
SG-03	Water Level	SW	02/13/2023	9.55	585.39
SG-03	Water Level	SW	05/30/2023	9.85	585.09
SG-03	Water Level	SW	08/08/2023	9.65	585.29
SG-03	Water Level	SW	10/24/2023	8.96	585.98
SG-03	Water Level	SW	11/13/2023	9.71	585.23
SG-03	Water Level	SW	12/18/2023	8.92	586.02
SG-04	Water Level	SW	02/13/2023	6.27	593.25
SG-04	Water Level	SW	05/30/2023	6.41	593.11

Notes:
Bracketing [] indicates that the measurement was obtained outside of the 24-hour period from initiaion of depth to groundwater measurements.
BMP = below measuring point
CCR = coal combustion residuals
DA = deep aquifer
LCU = lower confining unit
NAVD88 = North American Vertical Datum of 1988
S = source
SW = surface water

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
OW-1	Water Level	Porewater	1/23/2023	17.38	624.34
OW-1	Water Level	Porewater	2/21/2023	17.06	624.30
OW-1	Water Level	Porewater	3/15/2023	17.32	624.35
OW-1	Water Level	Porewater	4/19/2023	17.19	624.17
OW-1	Water Level	Porewater	5/24/2023	17.29	623.90
OW-1	Water Level	Porewater	6/22/2023	17.34	623.76
OW-1	Water Level	Porewater	7/24/2023	17.41	624.08
OW-1	Water Level	Porewater	8/18/2023	17.49	623.82
OW-1	Water Level	Porewater	9/14/2023	17.58	623.95
OW-1	Water Level	Porewater	10/18/2023	17.47	623.85
OW-1	Water Level	Porewater	11/17/2023	17.55	623.80
OW-1	Water Level	Porewater	12/15/2023	17.56	623.73
OW-2	Water Level	Porewater	1/23/2023	17.73	624.37
OW-2	Water Level	Porewater	2/21/2023	17.42	624.28
OW-2	Water Level	Porewater	3/15/2023	17.72	624.35
OW-2	Water Level	Porewater	4/19/2023	17.55	624.17
OW-2	Water Level	Porewater	5/24/2023	17.65	623.90
OW-2	Water Level	Porewater	6/22/2023	17.71	623.77
OW-2	Water Level	Porewater	7/24/2023	17.80	624.08
OW-2	Water Level	Porewater	8/18/2023	17.90	623.78
OW-2	Water Level	Porewater	9/14/2023	17.89	623.95
OW-2	Water Level	Porewater	10/18/2023	17.83	623.85
OW-2	Water Level	Porewater	11/17/2023	17.91	623.79
OW-2	Water Level	Porewater	12/15/2023	17.91	623.70
OW-3	Water Level	Porewater	1/23/2023	28.39	624.38
OW-3	Water Level	Porewater	2/21/2023	27.30	624.27
OW-3	Water Level	Porewater	3/15/2023	28.36	624.41
OW-3	Water Level	Porewater	4/19/2023	28.19	624.10
OW-3	Water Level	Porewater	5/24/2023	28.31	624.45
OW-3	Water Level	Porewater	6/22/2023	28.33	623.71
OW-3	Water Level	Porewater	7/24/2023	28.45	624.80
OW-3	Water Level	Porewater	8/18/2023	28.55	623.74
OW-3	Water Level	Porewater	9/14/2023	28.53	623.91
OW-3	Water Level	Porewater	10/18/2023	28.47	623.79
OW-3	Water Level	Porewater	11/17/2023	28.57	623.77
OW-3	Water Level	Porewater	12/15/2023	28.53	623.65
OW-5	Water Level	Porewater	1/23/2023	17.73	624.64
OW-5	Water Level	Porewater	2/21/2023	17.57	624.65

Appendix B. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
OW-5	Water Level	Porewater	3/15/2023	17.90	624.70
OW-5	Water Level	Porewater	4/19/2023	17.70	624.32
OW-5	Water Level	Porewater	5/24/2023	17.79	624.41
OW-5	Water Level	Porewater	6/22/2023	17.84	624.27
OW-5	Water Level	Porewater	7/24/2023	17.84	624.43
OW-5	Water Level	Porewater	8/18/2023	17.86	624.10
OW-5	Water Level	Porewater	9/14/2023	17.92	624.30
OW-5	Water Level	Porewater	10/18/2023	18.02	624.21
OW-5	Water Level	Porewater	11/17/2023	18.07	624.16
OW-5	Water Level	Porewater	12/15/2023	18.22	624.16
AP2-D	Water Level	Porewater	1/23/2023	20.20	623.90
AP2-D	Water Level	Porewater	2/21/2023	19.86	624.24
AP2-D	Water Level	Porewater	3/15/2023	20.19	623.91
AP2-D	Water Level	Porewater	4/19/2023	20.01	624.09
AP2-D	Water Level	Porewater	5/24/2023	20.10	624.00
AP2-D	Water Level	Porewater	6/22/2023	20.17	623.93
AP2-D	Water Level	Porewater	7/24/2023	20.25	623.85
AP2-D	Water Level	Porewater	8/18/2023	20.36	623.74
AP2-D	Water Level	Porewater	9/14/2023	20.33	623.77
AP2-D	Water Level	Porewater	10/18/2023	20.28	623.82
AP2-D	Water Level	Porewater	11/17/2023	20.34	623.76
AP2-D	Water Level	Porewater	12/15/2023	20.35	623.75

Notes:
BMP = below measuring point
NAVD88 = North American Vertical Datum of 1988

APPENDIX C
Supplemental Vertical Hydraulic Gradients

Appendix C. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen Ash Pond No. 1

Coffeen Power Plant

Coffeen, IL

Date	G405 Groundwater Elevation (ft NAVD88)	T408 Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UA	LCU (upper)				
2/4/2017	618.47	619.46	-0.99	12.00	-0.08	up
5/13/2017	618.74	619.00	-0.26	12.00	-0.02	up
7/8/2017	618.54	619.12	-0.58	12.00	-0.05	up
10/21/2017	614.47	614.81	-0.34	12.00	-0.03	up
5/8/2018	618.94	615.82	3.12	12.00	0.26	down
8/2/2018	617.55	614.45	3.10	12.00	0.26	down
10/23/2018	616.40	616.30	0.10	12.00	0.01	down
1/15/2019	616.81	617.01	-0.20	12.00	-0.02	up
8/5/2019	617.72	617.15	0.57	12.00	0.05	down
1/20/2020	619.28	619.13	0.15	12.00	0.01	down
8/10/2020	617.62	617.38	0.24	12.00	0.02	down
1/20/2021	617.12	616.85	0.27	12.00	0.02	down
4/20/2021	617.13	616.65	0.48	12.00	0.04	down
7/26/2021	617.37	617.21	0.16	12.00	0.01	down
8/16/2021	617.28	617.22	0.06	12.00	0.00	down
10/25/2021	618.12	615.50	2.62	12.00	0.22	down
2/7/2022	617.28	616.88	0.40	12.00	0.03	down
5/9/2022	617.91	617.78	0.13	12.00	0.01	down
8/23/2022	616.85	616.99	-0.14	12.00	-0.01	up
2/13/2023	617.50	617.16	0.34	12.00	0.03	down
5/30/2023	616.79	616.66	0.13	12.00	0.01	down
8/8/2023	616.78	616.62	0.16	12.00	0.01	down
10/24/2023	615.79	615.97	-0.18	12.00	-0.02	up
11/13/2023	615.90	616.06	-0.16	12.00	-0.01	up
			Middle of screen elevation G405D			610.0
			Middle of screen elevation T408			598.0

Appendix C. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen Ash Pond No. 1

Coffeen Power Plant

Coffeen, IL

Date	G406 Groundwater Elevation (ft NAVD88)	T409 Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UA	LCU (upper)				
2/4/2017	617.52	615.93	1.59	8.23	0.19	down
5/13/2017	616.20	616.75	-0.55	8.23	-0.07	up
7/8/2017	616.29	617.05	-0.76	8.23	-0.09	up
10/21/2017	611.27	612.16	-0.89	8.23	-0.11	up
5/8/2018	615.47	616.02	-0.55	8.23	-0.07	up
8/2/2018	615.75	615.25	0.50	8.23	0.06	down
10/23/2018	614.11	613.96	0.15	8.23	0.02	down
1/15/2019	615.36	614.78	0.58	8.23	0.07	down
8/5/2019	616.50	615.10	1.40	8.23	0.17	down
1/20/2020	617.48	617.16	0.32	8.23	0.04	down
8/10/2020	615.54	615.43	0.11	8.23	0.01	down
1/20/2021	612.97	614.41	-1.44	8.23	-0.17	up
4/20/2021	613.78	615.33	-1.55	8.23	-0.19	up
7/26/2021	614.20	615.72	-1.52	8.23	-0.18	up
8/16/2021	613.82	615.42	-1.60	8.23	-0.19	up
10/25/2021	614.93	616.43	-1.50	8.23	-0.18	up
2/7/2022	613.55	614.97	-1.42	8.23	-0.17	up
5/9/2022	615.36	616.81	-1.45	8.23	-0.18	up
8/23/2022	613.47	610.73	2.74	8.23	0.33	down
2/13/2023	614.11	615.65	-1.54	8.23	-0.19	up
5/30/2023	612.29	613.74	-1.45	8.23	-0.18	up
8/8/2023	613.87	615.02	-1.15	8.23	-0.14	up
10/24/2023	611.28	612.55	-1.27	8.23	-0.15	up
11/13/2023	611.53	613.01	-1.48	8.23	-0.18	up
			Middle of screen elevation G406			605.9
			Middle of screen elevation T409			597.7

Appendix C. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen Ash Pond No. 1

Coffeen Power Plant

Coffeen, IL

Date	T408 Groundwater Elevation (ft NAVD88) LCU (upper)	G45D Groundwater Elevation (ft NAVD88) LCU (lower)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
2/4/2017	619.46	587.71	31.75	13.78	2.30	down
5/13/2017	619.00	586.19	32.81	13.78	2.38	down
7/8/2017	619.12	586.29	32.83	13.78	2.38	down
10/21/2017	614.81	584.69	30.12	13.78	2.19	down
5/8/2018	615.82	587.56	28.26	13.78	2.05	down
8/2/2018	614.45	585.81	28.64	13.78	2.08	down
10/23/2018	616.30	584.60	31.70	13.78	2.30	down
1/15/2019	617.01	586.96	30.05	13.78	2.18	down
8/5/2019	617.15	588.04	29.11	13.78	2.11	down
8/10/2020	617.38	614.21	3.17	13.78	0.23	down
1/20/2021	616.85	614.60	2.25	13.78	0.16	down
4/20/2021	616.65	614.32	2.33	13.78	0.17	down
7/26/2021	617.21	613.58	3.63	13.78	0.26	down
8/16/2021	617.22	613.83	3.39	13.78	0.25	down
10/25/2021	615.50	614.51	0.99	13.78	0.07	down
2/7/2022	616.88	615.01	1.87	13.78	0.14	down
5/9/2022	617.78	614.95	2.83	13.78	0.21	down
8/23/2022	616.99	614.58	2.41	13.78	0.17	down
2/13/2023	617.16	614.69	2.47	13.78	0.18	down
5/30/2023	616.66	613.99	2.67	13.78	0.19	down
8/8/2023	616.62	613.47	3.15	13.78	0.23	down
10/24/2023	615.97	613.40	2.57	13.78	0.19	down
11/13/2023	616.06	613.55	2.51	13.78	0.18	down
			Middle of screen elevation T408			598.0
			Middle of screen elevation G45D			584.2

Appendix C. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen Ash Pond No. 1

Coffeen Power Plant

Coffeen, IL

Date	T409 Groundwater Elevation (ft NAVD88) LCU (upper)	G46D Groundwater Elevation (ft NAVD88) LCU (lower)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
2/4/2017	615.93	586.06	29.87	22.19	1.35	down
5/13/2017	616.75	584.87	31.88	22.19	1.44	down
7/8/2017	617.05	585.22	31.83	22.19	1.43	down
5/8/2018	616.02	585.86	30.16	22.19	1.36	down
8/2/2018	615.25	583.95	31.30	22.19	1.41	down
10/23/2018	613.96	582.05	31.91	22.19	1.44	down
1/15/2019	614.78	583.17	31.61	22.19	1.42	down
8/5/2019	615.10	583.68	31.42	22.19	1.42	down
8/10/2020	615.43	609.00	6.43	22.19	0.29	down
1/20/2021	614.41	610.49	3.92	22.19	0.18	down
4/20/2021	615.33	611.06	4.27	22.19	0.19	down
7/26/2021	615.72	607.21	8.51	22.19	0.38	down
8/16/2021	615.42	608.17	7.25	22.19	0.33	down
10/25/2021	616.43	609.87	6.56	22.19	0.30	down
2/7/2022	614.97	610.71	4.26	22.19	0.19	down
5/9/2022	616.81	611.34	5.47	22.19	0.25	down
8/23/2022	610.73	615.13	-4.40	22.19	-0.20	up
2/13/2023	615.65	610.39	5.26	22.19	0.24	down
5/30/2023	613.74	610.70	3.04	22.19	0.14	down
8/8/2023	615.02	610.14	4.88	22.19	0.22	down
10/24/2023	612.55	609.65	2.90	22.19	0.13	down
11/13/2023	613.01	609.70	3.31	22.19	0.15	down
			Middle of screen elevation T409			597.7
			Middle of screen elevation G46D			575.5

Appendix C. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen Ash Pond No. 1

Coffeen Power Plant

Coffeen, IL

Date	G307 Groundwater Elevation (ft NAVD88)	G307D Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UA	LCU (lower)				
4/20/2021	624.50	622.48	2.02	38.06	0.05	down
5/17/2021	624.45	622.44	2.01	38.06	0.05	down
7/12/2021	624.45	622.59	1.86	38.06	0.05	down
8/16/2021	624.46	621.49	2.97	38.06	0.08	down
2/7/2022	624.60	622.32	2.28	38.06	0.06	down
5/9/2022	624.60	616.31	8.29	38.06	0.22	down
8/23/2022	624.60	615.09	9.51	38.06	0.25	down
2/13/2023	624.60	622.13	2.47	38.06	0.06	down
8/8/2023	623.90	616.99	6.91	38.06	0.18	down
11/13/2023	622.64	612.52	10.12	38.06	0.27	down
			Middle of screen elevation G307			606.7
			Middle of screen elevation G307D			568.6

Date	G311 Groundwater Elevation (ft NAVD88)	G311D Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UA	LCU (lower)				
3/29/2021	616.54	575.42	41.12	43.41	0.95	down
4/22/2021	613.68	575.74	37.94	43.41	0.87	down
5/3/2021	614.01	573.09	40.92	43.41	0.94	down
5/17/2021	613.86	572.40	41.46	43.41	0.96	down
6/9/2021	613.13	573.85	39.28	43.41	0.90	down
6/15/2021	612.78	575.25	37.53	43.41	0.86	down
6/23/2021	612.45	571.74	40.71	43.41	0.94	down
7/12/2021	613.75	571.63	42.12	43.41	0.97	down
7/26/2021	613.05	569.74	43.31	43.41	1.00	down
8/16/2021	613.30	570.34	42.96	43.41	0.99	down
10/25/2021	615.13	583.70	31.43	43.41	0.72	down
2/7/2022	614.28	593.14	21.14	43.41	0.49	down
5/9/2022	615.74	596.43	19.31	43.41	0.44	down
8/23/2022	613.19	597.46	15.73	43.41	0.36	down
5/30/2023	612.78	597.98	14.80	43.41	0.34	down
8/8/2023	611.96	597.72	14.24	43.41	0.33	down
10/24/2023	611.75	597.73	14.02	43.41	0.32	down
11/13/2023	611.66	597.09	14.57	43.41	0.34	down
			Middle of screen elevation G311			606.7
			Middle of screen elevation G311D			563.3

Appendix C. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen Ash Pond No. 1

Coffeen Power Plant

Coffeen, IL

Date	G314 Groundwater Elevation (ft NAVD88)	G314D Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	LCU (upper)	DA (PMP)				
3/29/2021	596.40	572.75	23.65	29.76	0.79	down
4/20/2021	603.16	571.76	31.40	27.40	1.15	down
5/3/2021	604.66	568.77	35.89	27.40	1.31	down
5/17/2021	605.61	566.84	38.77	27.40	1.42	down
6/9/2021	607.54	567.45	40.09	27.40	1.46	down
6/14/2021	608.16	568.60	39.56	27.40	1.44	down
6/23/2021	605.19	566.77	38.42	27.40	1.40	down
7/12/2021	605.32	566.88	38.44	27.40	1.40	down
7/26/2021	606.66	566.65	40.01	27.40	1.46	down
8/16/2021	608.60	567.28	41.32	27.40	1.51	down
10/25/2021	610.36	581.05	29.31	27.40	1.07	down
2/7/2022	607.85	590.46	17.39	27.40	0.63	down
5/9/2022	609.11	594.81	14.30	27.40	0.52	down
8/23/2022	610.58	595.70	14.88	27.40	0.54	down
2/13/2023	607.74	597.30	10.44	27.40	0.38	down
3/30/2023	604.91	603.71	1.20	27.40	0.04	down
4/30/2023	608.34	606.21	2.13	27.40	0.08	down
5/30/2023	609.06	607.00	2.06	27.40	0.08	down
6/8/2023	604.44	601.90	2.54	27.40	0.09	down
7/8/2023	608.20	606.45	1.75	27.40	0.06	down
8/8/2023	609.00	605.92	3.08	27.40	0.11	down
9/25/2023	608.92	605.20	3.72	27.40	0.14	down
10/24/2023	608.58	605.14	3.44	27.40	0.13	down
11/13/2023	608.21	605.73	2.48	27.40	0.09	down
12/18/2023	606.49	606.66	-0.17	27.40	-0.01	up
			Middle of screen elevation G314			594.0
			Middle of screen elevation G314D			566.6

[O: KLT 6/4/21, C:YMD 6/7/21; U:KLT 8/25/21, C:EDP 8/31/21]
[KLT 5/3/24, C: SSW 5/7/24]

Notes:

[1] Distance change was calculated using the midpoint of the piezometer screen and water table surface. If the water table surface was above the top of the monitoring well screen, then distance change was calculated using the midpoint of both screens.

[2] Vertical gradients between ±0.0015 are considered flat, and typically have less than 0.02 foot difference in groundwater elevation between wells.

- - = no data collected on date / no vertical gradient calculated
DA = deep aquifer
dh = head change
dl = distance change
ft = foot/feet
LCU (lower) = lower confining unit (Smithboro)
LCU (upper) = lower confining unit (Vandalia)
NAVD88 = North American Vertical Datum of 1988
PMP = potential migration pathway
UA = uppermost aquifer

Appendix C. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen GMF Gypsum Stack Pond

Coffeen Power Plant

Coffeen, IL

Date	G206 Groundwater Elevation (ft NAVD88)	G206D Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UA	DA (PMP)				
4/20/2021	622.07	585.96	36.11	33.51	1.08	down
5/3/2021	622.60	587.42	35.18	33.51	1.05	down
5/17/2021	622.31	587.81	34.50	33.51	1.03	down
6/9/2021	621.71	584.19	37.52	33.51	1.12	down
6/23/2021	620.54	589.66	30.88	33.51	0.92	down
7/12/2021	622.39	590.72	31.67	33.51	0.95	down
7/26/2021	622.00	591.14	30.86	33.51	0.92	down
8/16/2021	622.08	592.00	30.08	33.51	0.90	down
10/25/2021	622.94	595.04	27.90	33.51	0.83	down
2/7/2022	622.37	598.22	24.15	33.51	0.72	down
5/9/2022	623.70	601.30	22.40	33.51	0.67	down
8/23/2022	621.61	602.86	18.75	33.51	0.56	down
3/30/2023	623.69	601.99	21.70	33.51	0.65	down
4/30/2023	622.54	603.60	18.94	33.51	0.57	down
5/30/2023	621.64	603.91	17.73	33.51	0.53	down
7/8/2023	620.69	604.04	16.65	33.51	0.50	down
8/8/2023	618.93	604.10	14.83	33.51	0.44	down
9/25/2023	618.08	604.06	14.02	33.51	0.42	down
10/25/2023	617.11	603.80	13.31	33.51	0.40	down
11/13/2023	616.66	603.74	12.92	33.51	0.39	down
12/18/2023	616.97	603.82	13.15	33.51	0.39	down
			Middle of screen elevation G206			610.8
			Middle of screen elevation G206D			577.3

[O: KLT 6/4/21, C:YMD 6/7/21][U:KLT 8/25/21, C:EDP 8/31/21]
[KLT 5/3/24, C: SSW 5/7/24]

Notes:

[1] Distance change was calculated using the midpoint of the piezometer screen and water table surface. If the water table surface was above the top of the monitoring well screen, then distance change was calculated using the midpoint of both screens.

[2] Vertical gradients between ±0.0015 are considered flat, and typically have less than 0.02 foot difference in groundwater elevation between wells.

-- = no data collected on date / no vertical gradient calculated

DA = deep aquifer

dh = head change

dl = distance change

ft = foot/feet

NAVD88 = North American Vertical Datum of 1988

PMP = potential migration pathway

UA = uppermost aquifer

Appendix C. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen GMF Recycle Pond

Coffeen Power Plant

Coffeen, IL

Date	G405 Groundwater Elevation (ft NAVD88)	T408 Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UA	LCU (upper)				
2/4/2017	618.47	619.46	-0.99	12.00	-0.08	up
5/13/2017	618.74	619.00	-0.26	12.00	-0.02	up
7/8/2017	618.54	619.12	-0.58	12.00	-0.05	up
10/21/2017	614.47	614.81	-0.34	12.00	-0.03	up
5/8/2018	618.94	615.82	3.12	12.00	0.26	down
8/2/2018	617.55	614.45	3.10	12.00	0.26	down
10/23/2018	616.40	616.30	0.10	12.00	0.01	down
1/15/2019	616.81	617.01	-0.20	12.00	-0.02	up
8/5/2019	617.72	617.15	0.57	12.00	0.05	down
1/20/2020	619.28	619.13	0.15	12.00	0.01	down
8/10/2020	617.62	617.38	0.24	12.00	0.02	down
1/20/2021	617.12	616.85	0.27	12.00	0.02	down
4/20/2021	617.13	616.65	0.48	12.00	0.04	down
7/26/2021	617.37	617.21	0.16	12.00	0.01	down
8/16/2021	617.28	617.22	0.06	12.00	0.005	down
10/25/2021	618.12	615.50	2.62	12.00	0.218	down
2/7/2022	617.28	616.88	0.40	12.00	0.033	down
5/9/2022	617.91	617.78	0.13	12.00	0.011	down
8/23/2022	616.85	616.99	-0.14	12.00	-0.012	up
2/13/2023	617.50	617.16	0.34	12.00	0.028	down
5/30/2023	616.79	616.66	0.13	12.00	0.011	down
8/8/2023	616.78	616.62	0.16	12.00	0.013	down
10/24/2023	615.79	615.97	-0.18	12.00	-0.015	up
11/13/2023	615.90	616.06	-0.16	12.00	-0.013	up
			Middle of screen elevation G405D			610.0
			Middle of screen elevation T408			598.0

Appendix C. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen GMF Recycle Pond

Coffeen Power Plant

Coffeen, IL

Date	G275 Groundwater Elevation (ft NAVD88)	G275D Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UA	DA (PMP)				
4/20/21-4/21/20	605.00	568.33	36.67	42.14	0.87	down
7/12/21-7/13/21	605.63	570.43	35.20	42.77	0.82	down
7/26/2021	605.05	570.35	34.70	42.18	0.82	down
8/16/2021	605.09	571.48	33.61	42.23	0.80	down
10/25/2021	605.17	578.52	26.65	42.30	0.63	down
2/7/2022	605.10	580.46	24.64	42.24	0.58	down
5/9/2022	605.67	581.11	24.56	42.80	0.57	down
2/13/2023	605.24	580.82	24.42	42.38	0.58	down
			Middle of screen elevation G275			605.7
			Middle of screen elevation G275D			562.9

Appendix C. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen GMF Recycle Pond

Coffeen Power Plant

Coffeen, IL

Date	T408 Groundwater Elevation (ft NAVD88)	G45D Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	LCU (upper)	LCU (lower)				
2/4/2017	619.46	587.71	31.75	13.78	2.30	down
5/13/2017	619.00	586.19	32.81	13.78	2.38	down
7/8/2017	619.12	586.29	32.83	13.78	2.38	down
10/21/2017	614.81	584.69	30.12	13.78	2.19	down
5/8/2018	615.82	587.56	28.26	13.78	2.05	down
8/2/2018	614.45	585.81	28.64	13.78	2.08	down
10/23/2018	616.30	584.60	31.70	13.78	2.30	down
1/15/2019	617.01	586.96	30.05	13.78	2.18	down
8/5/2019	617.15	588.04	29.11	13.78	2.11	down
8/10/2020	617.38	614.21	3.17	13.78	0.23	down
1/20/2021	616.85	614.60	2.25	13.78	0.16	down
4/20/2021	616.65	614.32	2.33	13.78	0.17	down
7/26/2021	617.21	613.58	3.63	13.78	0.26	down
8/16/2021	617.22	613.83	3.39	13.78	0.25	down
10/25/2021	615.50	614.51	0.99	13.78	0.07	down
2/7/2022	616.88	615.01	1.87	13.78	0.14	down
5/9/2022	617.78	614.95	2.83	13.78	0.21	down
8/23/2022	616.99	614.58	2.41	13.78	0.17	down
2/13/2023	617.16	614.69	2.47	13.78	0.18	down
5/30/2023	616.66	613.99	2.67	13.78	0.19	down
8/8/2023	616.62	613.47	3.15	13.78	0.23	down
10/24/2023	615.97	613.40	2.57	13.78	0.19	down
11/13/2023	616.06	613.55	2.51	13.78	0.18	down
			Middle of screen elevation T408			598.0
			Middle of screen elevation G45D			584.2

[O: KLT 6/4/21, C:YMD 6/7/21][U:KLT 8/25/21, C:EDP 8/31/21]
[KLT 5/3/24, C: 5/7/24]

Notes:

[1] Distance change was calculated using the midpoint of the piezometer screen and water table surface. If the water table surface was above the top of the monitoring well screen, then distance change was calculated using the midpoint of both screens.

[2] Vertical gradients between ±0.0015 are considered flat, and typically have less than 0.02 foot difference in groundwater elevation between wells.

-- = no data collected on date / no vertical gradient calculated

DA = deep aquifer

dh = head change

dl = distance change

ft = foot/feet

LCU (lower) = lower confining unit (Smithboro)

LCU (upper) = lower confining unit (Vandalia)

NAVD88 = North American Vertical Datum of 1988

PMP = potential migration pathway

UA = uppermost aquifer

APPENDIX D
Historical Field and Laboratory Hydraulic Conductivities

Appendix D. Historical Field and Laboratory Hydraulic Conductivities

Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Well ID	Unit	Method (fh)	Method (rh)	K (fh)	K (rh)	Well Geometric Mean	Approximate Screened Elevation (ft)	Interpreted Unit
Upper-most Aquifer								
R104	Landfill	KGS	B-R	7.0E-05	2.8E-04	1.4E-04	614.4-609.7	Hagarstown Beds
G105		KGS	KGS	1.5E-04	5.7E-05	9.2E-05	613.2-608.4	
G106		B-R	B-R	4.0E-05	7.4E-04	1.7E-04	614.0-609.4	
G107		KGS	KGS	6.3E-05	8.9E-05	7.5E-05	613.9-609.3	
G110		KGS	KGS	4.7E-05	2.0E-05	3.1E-05	612.0-607.4	
G119		KGS	KGS	8.6E-05	8.2E-05	8.4E-05	611.6-607	
G120		low water elevation; no test conducted					614.2-609.7	
G125		KGS	KGS	4.8E-05	4.1E-05	4.4E-05	613.7-609.1	
T127		KGS	KGS	1.2E-03	1.7E-05	1.4E-04	610.5-606	
			Unit Geometric Mean			8.5E-05		
T202	Gypsum Pond	KGS	KGS	4.5E-04	5.5E-04	5.0E-04	614.0-609.6	Hagarstown Beds
G206		B-R	KGS	3.0E-04	1.6E-04	2.2E-04	613.0-608.6	
G208		KGS	KGS	6.0E-05	2.1E-05	3.5E-05	613.0-608.5	
G209		KGS	KGS	2.0E-04	1.6E-04	1.8E-04	612.8-608.3	
G210		KGS	KGS	5.0E-04	4.8E-04	4.9E-04	611.1-606.6	
G212		KGS	KGS	1.3E-04	1.8E-04	1.5E-04	613.9-609.3	
G215		KGS	KGS	5.0E-04	3.5E-04	4.2E-04	611.1-606.7	
G218		KGS	KGS	4.1E-04	4.1E-04	4.1E-04	610.3-605.9	
			Unit Geometric Mean			2.3E-04		
G270	Recycle Pond	KGS	KGS	5.5E-04	4.8E-04	5.1E-04	609.8-605.0	Hagarstown Beds
G271		KGS	KGS	1.6E-04	1.1E-03	4.2E-04	612.9-608.6	
G273		KGS	KGS	1.0E-03	8.3E-04	9.1E-04	611.1-605.6	
G276		low water					606.7-601.9	Hagarstown Beds, v. thin
G279		KGS	KGS	1.7E-03	1.5E-03	1.6E-03	606.8-602.4	Hagarstown Beds
G280		KGS	KGS	1.3E-03	1.3E-03	1.3E-03	610.2-605.3	
G281		KGS	KGS	2.1E-03	8.9E-04	1.4E-03	608.3-603.7	
			Unit Geometric Mean			9.0E-04		
G301	Ash Pond 1	KGS	KGS	2.7E-04	5.0E-04	3.7E-04	609-604.3	Upper Vandalia Till
G302		KGS	KGS	4.9E-04	6.3E-04	5.6E-04	604.7-600.1	
G303		KGS	KGS	5.6E-05	3.1E-05	4.2E-05	609.1-599.1	Hagarstown/Vandalia Till Contact
G304		KGS	KGS	8.9E-04	1.0E-03	9.4E-04	613.5-603.5	Hagarstown Beds
			Unit Geometric Mean			3.0E-04		
G401	Ash Pond 2	B-R	B-R	1.8E-04	2.8E-04	2.2E-04	608.7-603.7	Hagarstown Beds
G402		KGS	KGS	4.5E-04	1.9E-04	2.9E-04	600.6-590.6	Upper Vandalia Till
G403		KGS	KGS	4.3E-05	7.2E-05	5.6E-05	610.7-606.0	Hagarstown Beds, v. thin
G404		KGS	KGS	4.2E-04	3.8E-04	4.0E-04	606.7-601.9	Hagarstown Beds
G405		KGS	KGS	9.8E-04	9.7E-04	9.7E-04	611.9-607.1	
			Unit Geometric Mean			2.7E-04		
G153	SW Pond	KGS	KGS	2.5E-04	5.4E-04	3.7E-04	607.5-603.0	Hagarstown Beds
			Unit Geometric Mean			3.7E-04		
MW03S	2009 Hydrogeo. Invest.	B-R	B-R	6.0E-04	1.1E-03	8.1E-04	613.7-608.6	Hagarstown Beds
MW04S		B-R	B-R	1.3E-03	8.0E-04	1.0E-03	612.6-607.6	
MW10S		B-R	B-R	8.0E-04	8.0E-04	8.0E-04	610.9-604.9	
MW13S		B-R	B-R	1.0E-03	2.0E-04	4.5E-04	611.3-606.1	
MW14S		B-R	B-R	1.0E-03	5.0E-04	7.1E-04	612.4-607.2	
MW15S		B-R	B-R	1.5E-04	8.1E-05	1.1E-04	609.3-604.2	
MW16S		B-R	B-R	6.0E-04	4.5E-04	5.2E-04	611.5-606.3	
MW17S		B-R	B-R	5.8E-04	5.5E-04	5.6E-04	613.1-603	
			Unit Geometric Mean			5.4E-04		
Lower Confining Unit (Vandalia and Smithboro Till)								
T408	Ash Pond 2	KGS	KGS	2.15E-06	7.50E-08	9.02E-07	600.4-595.2	Vandalia Till
T409		KGS	KGS	3.6E-05	3.20E-05	3.41E-05	600.1-594.9	Vandalia Till (sand seam)
G405D		KGS	KGS			4.90E-07	589.1-579	Smithboro Till
G406D		KGS	KGS			4.00E-08	580.3-570.3	
			Unit Geometric Mean			5.55E-06		

Notes:
fh = Falling head test
rh = Rising head test

Hydraulic Conductivity tests analyzed using Aqtesolv® Pro version 4.50 (HydroSOLVE, Inc.)

Test Methods

B-R Bouwer and Rice, 1976. "A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifer with Completely or Partially Penetrating Wells", Water Resources Research v.12, no. 3. American Geophysical Union, Washington, DC. pp. 423-428.

KGS Hyder, Z., J.J. Butler, C.D. McElwee, and W. Liu, 1974. "Slug tests in partially penetrating wells", Water Resources Research, v. 30, no. 11. American Geophysical Union, Washington, DC. pp. 2945-2957.

Appendix D. Historical Field and Laboratory Hydraulic Conductivities
Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Laboratory Tests			
Well/ Soil Boring ID	**Approximate Sample Elevation (ft)**	**Hydraulic Conductivity (cm/sec)**	**Interpreted Unit**
COF-B001	613.0	1.3E-08	Loess - Upper Confining Unit
COF-B003	606.5	2.2E-07	
COF-B004	610.5	5.0E-07	
COF-B007	615.0	7.0E-08	
	Geometric Mean	**1.0E-07**	
G46D	599.2	4.5E-06	Vandalia Till
T408	597.6	1.5E-07	
SB-12	577.7-572.7	6.8E-09	
SB-13	598-593	7.0E-09	
SB-18	603.5-603	8.8E-09	
	Geometric Mean	**4.9E-08**	
SB-09	598.5-598	1.9E-06	Mulberry Grove Silt
SB-16	589-588.5	1.6E-06	
	Geometric Mean	**1.7E-06**	
G45D	586.4	1.0E-07	Smithboro Till
G46D	578.9	2.1E-08	
SB-07	572-571.5	1.1E-09	
	Geometric Mean	**1.3E-08**	
SB-19	569-564	3.4E-09	Deep Confining Unit
SB-16	548-547.5	1.3E-08	
	Geometric Mean	**6.6E-09**	

Natural Resource Technology
AN OBG COMPANY

APPENDIX E
Supplemental Field Hydraulic Conductivities

Appendix E. Supplemental Field Hydraulic Conductivities
Nature and Extent Report
Coffeen Ash Pond No. 1
Coffeen Power Plant
Coffeen, IL

Well ID	Gradient Position	Bottom of Screen Elevation (ft NAVD88)	Screen Length [1] (ft)	Field Identified Screened Material	Slug Type	Analysis Method	Falling Head (Slug In) Hydraulic Conductivity (cm/s)	Rising Head (Slug Out) Hydraulic Conductivity (cm/s)	Minimum Hydraulic Conductivity (cm/s)	Maximum Hydraulic Conductivity (cm/s)	Hydraulic Conductivity Geometric Mean (cm/s)
Uppermost Aquifer											
G301	D	604.31	4.65	(ML)s	solid	Kansas Geological Survey	1.1E-03	1.2E-03	2.6E-04	9.1E-03	2.0E-03
G303	D	599.07	10	CL	solid	Kansas Geological Survey	2.8E-04	2.6E-04			
G308	D	606.70	4.79	s(ML), s(CL), (CL)s	solid	Kansas Geological Survey	5.5E-03	1.6E-03			
G309	D	605.02	4.78	SP, s(CL), (ML)s	solid	Kansas Geological Survey	9.1E-03	8.8E-04			
G310	D	604.86	4.79	SM, s(ML)	solid	Kansas Geological Survey	7.5E-03	5.9E-03			
G311	D	604.28	4.77	s(ML), s(CL)	solid	Bouwer-Rice	1.5E-03	- -			
G312	D	602.34	4.79	s(ML), s(CL)	solid	Kansas Geological Survey	1.1E-03	1.1E-03			
G313	D	600.40	4.81	SP, s(ML), (CL)s	solid	Kansas Geological Survey	2.7E-03	3.5E-03			
G315	D	606.46	4.79	s(CL)	solid	Kansas Geological Survey	6.6E-03	5.8E-03			
Lower Confining Unit											
G307D	D	563.76	9.77	(CL)s	solid	Kansas Geological Survey	3.2E-04	1.2E-04	1.2E-04	2.3E-03	5.0E-04
G311D	D	558.29	9.94	CL	solid	Kansas Geological Survey	3.8E-04	2.1E-04			
G316	D	584.82	4.80	SP, s(ML), (CL)s	solid	Kansas Geological Survey	2.3E-03	2.3E-03			
Deep Aquifer (PMP)											
G314D	D	561.76	9.77	SP, s(CL)	solid	Bouwer-Rice	3.3E-04	2.3E-05	2.3E-05	3.3E-04	8.7E-05

[O: KLT 07/09/21; C:EDP 8/31/21]

Notes:
1. All wells are constructed from 2 inch PVC with 0.01 inch slotted screens.
- - = Test not analyzed/performed
cm/s = centimeters per second
D = downgradient
ft = foot/feet
NAVD88 = North American Vertical Datum of 1988
PMP= potential migration pathway
PVC = polyvinyl chloride

USCS = Unified Soil Classification System
CL = Lean Clay
s(CL) = Sandy Lean Clay
(CL)s = Lean Clay with Sand
s(ML) = Sandy Silt
(ML)s = Silt with Sand
SP = Poorly-Graded Sand

Appendix E. Supplemental Field Hydraulic Conductivities

Nature and Extent Report

GMF Gypsum Stack Pond

Coffeen Power Plant

Coffeen, IL

Well ID	Gradient Position	Bottom of Screen Elevation (ft NAVD88)	Screen Length [1] (ft)	Field Identified Screened Material	Slug Type	Analysis Method	Falling Head (Slug In) Hydraulic Conductivity (cm/s)	Rising Head (Slug Out) Hydraulic Conductivity (cm/s)	Minimum Hydraulic Conductivity (cm/s)	Maximum Hydraulic Conductivity (cm/s)	Hydraulic Conductivity Geometric Mean (cm/s)
Uppermost Aquifer											
G206	D	608.61	4.41	SM, s(CL), CL	solid	Kansas Geological Survey	5.0E-04	4.9E-04	2.5E-04	4.0E-03	1.4E-03
G209	D	608.29	4.54	CL	solid	Kansas Geological Survey	- -	2.5E-04			
G212	D	609.30	4.55	SM, s(CL), CL	solid	Kansas Geological Survey	2.1E-03	1.8E-03			
G215	D	606.68	4.39	SM, s(CL), ML	solid	Kansas Geological Survey	4.0E-03	3.5E-03			
G218	D	605.87	4.44	SM, SC, CL	solid	Kansas Geological Survey	2.6E-03	2.4E-03			

[O: KLT, C:EDP 8/31/21]

Notes:

1. All wells are constructed from 2 inch PVC with 0.01 inch slotted screens.

- - = Test not analyzed/performed
cm/s = centimeters per second
D = downgradient
ft = foot/feet
NAVD88 = North American Vertical Datum of 1988
PVC = polyvinyl chloride

USCS = Unified Soil Classification System

CL = Lean Clay
s(CL) = Sandy Lean Clay
ML = Silt
SC = Clayey Sand
SM = Silty Sand

Appendix E. Supplemental Field Hydraulic Conductivities
Nature and Extent Report
GMF Recycle Pond
Coffeen Power Plant
Coffeen, IL

Well ID	Gradient Position	Bottom of Screen Elevation (ft NAVD88)	Screen Length [1] (ft)	Field Identified Screened Material	Slug Type	Analysis Method	Falling Head (Slug In) Hydraulic Conductivity (cm/s)	Rising Head (Slug Out) Hydraulic Conductivity (cm/s)	Minimum Hydraulic Conductivity (cm/s)	Maximum Hydraulic Conductivity (cm/s)	Hydraulic Conductivity Geometric Mean (cm/s)
Uppermost Aquifer											
G272	D	606.74	4.87	SP to ML, (CL)s	solid	Kansas Geological Survey	1.7E-03	- -	7.8E-04	1.7E-03	1.1E-03
G284	D	602.48	4.77	ML	solid	Kansas Geological Survey	1.2E-03	7.8E-04			
G286	D	601.81	4.79	SP, ML, CL	solid	Kansas Geological Survey	1.2E-03	- -			
G287	D	604.09	4.82	SP, ML, CL	solid	Kansas Geological Survey	1.1E-03	1.1E-03			
Lower Confining Unit (PMP)											
G283	D	590.13	9.78	SP, ML	solid	Kansas Geological Survey	4.2E-03	4.5E-03	2.7E-04	4.5E-03	1.2E-03
G285	D	587.09	9.77	CL	solid	Bouwer-Rice	2.7E-04	4.3E-04			

[O: KLT, C:EDP 8/31/21]

Notes:
1. All wells are constructed from 2 inch PVC with 0.01 inch slotted screens.
- - = Test not analyzed/performed
cm/s = centimeters per second
D = downgradient
ft = foot/feet
NAVD88 = North American Vertical Datum of 1988
PVC = polyvinyl chloride
PMP = potential migration pathway

USCS = Unified Soil Classification System
CL = Lean Clay
(CL)s = Lean Clay with Sand
ML = Silt
SP = Poorly-Graded Sand

APPENDIX F
Surface Water Sampling Locations and Laboratory Analytical Report

GSI Surface Water Sample

Background Surface Water Sample

Figure adapted by Ramboll from Geosyntec-provided figure

N

0 520 Feet

Notes:
Locations are approximate

Surface Water Sampling Locations

134 Cips Lane
Coffeen, Illinois

Geosyntec consultants

St. Louis | July 2021

Figure 3

S:\Company\Projects_post_2014\GLP8005_Coffeen MNA\GIS\Porewater and Sediment Sampling Loactions.mxd 7/22/2021 8:27:18 AM

eurofins | Environment Testing America

ANALYTICAL REPORT

Eurofins TestAmerica, Chicago
2417 Bond Street
University Park, IL 60484
Tel: (708)534-5200

Laboratory Job ID: 500-203343-1
Client Project/Site: GLP8029 Coffeen, IL

For:
Geosyntec Consultants, Inc.
2100 Commonwealth Blvd.
Suite 100
Ann Arbor, Michigan 48105

Attn: Brian Ares

Authorized for release by:
8/20/2021 1:48:27 PM

Robin Kintz, Project Manager II
(708)534-5200
Robin.Kintz@Eurofinset.com

LINKS

Review your project results through TotalAccess

Have a Question? Ask The Expert

Visit us at:
www.eurofinsus.com/Env

The test results in this report meet all 2003 NELAC, 2009 TNI, and 2016 TNI requirements for accredited parameters, exceptions are noted in this report. This report may not be reproduced except in full, and with written approval from the laboratory. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Cover Page 1
Table of Contents 2
Case Narrative 3
Detection Summary 4
Method Summary 8
Sample Summary 9
Client Sample Results 10
Definitions 17
QC Association 18
QC Sample Results 22
Chronicle 27
Certification Summary 31
Chain of Custody 32
Receipt Checklists 33

Job ID: 500-203343-1

Laboratory: Eurofins TestAmerica, Chicago

Narrative

Job Narrative
500-203343-1

Comments
No additional comments.

Receipt
The samples were received on 8/5/2021 9:45 AM. Unless otherwise noted below, the samples arrived in good condition, and where required, properly preserved and on ice. The temperatures of the 2 coolers at receipt time were 1.1º C and 2.5º C.

Metals
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Field Service / Mobile Lab
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

General Chemistry
Methods 300.0, 9056A: Due to the high concentration of Chloride, the matrix spike / matrix spike duplicate (MS/MSD) for analytical batch 500-614638 could not be evaluated for accuracy and precision. The associated laboratory control sample (LCS) met acceptance criteria.

Method 9060A: One of the CCV replicates failed to meet criteria at 89% recovery for DOC. The average was within control; therefore, the data have been reported. The RPD was within control as well. The following samples are affected: D-2-20210803 (500-203343-1), D-1-20210803 (500-203343-2), BKG-1-20210803 (500-203343-3), CL-1-20210803 (500-203343-4), DUP-20210803 (500-203343-5), CL-2-20210803 (500-203343-6), CL-3-20210803 (500-203343-7), (CCB 500-613783/21) and (CCV 500-613783/20).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Detection Summary

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: D-2-20210803 — Lab Sample ID: 500-203343-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Boron	0.30		0.050	0.0056	mg/L	1		6010B	Total/NA
Calcium	45		0.20	0.053	mg/L	1		6010B	Total/NA
Iron	0.24		0.20	0.082	mg/L	1		6010B	Total/NA
Magnesium	13	B	0.10	0.049	mg/L	1		6010B	Total/NA
Manganese	0.20		0.010	0.0023	mg/L	1		6010B	Total/NA
Potassium	3.2	B	0.50	0.066	mg/L	1		6010B	Total/NA
Sodium	13	B	1.0	0.097	mg/L	1		6010B	Total/NA
Boron, Dissolved	0.30		0.050	0.0056	mg/L	1		6010B	Dissolved
Calcium, Dissolved	46		0.20	0.053	mg/L	1		6010B	Dissolved
Iron, Dissolved	0.15	J	0.20	0.082	mg/L	1		6010B	Dissolved
Magnesium, Dissolved	13	B	0.10	0.049	mg/L	1		6010B	Dissolved
Manganese, Dissolved	0.20		0.010	0.0023	mg/L	1		6010B	Dissolved
Potassium, Dissolved	3.2	B	0.50	0.066	mg/L	1		6010B	Dissolved
Sodium, Dissolved	13	B	1.0	0.097	mg/L	1		6010B	Dissolved
Chloride	7.2		0.20	0.17	mg/L	1		9056A	Total/NA
Sulfate	69		4.0	1.9	mg/L	20		9056A	Total/NA
Alkalinity	100		5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	240		10	4.3	mg/L	1		SM 2540C	Total/NA
Ferric Iron	0.24		0.20	0.10	mg/L	1		SM 3500	Total/NA
Phosphorus as PO4	0.24		0.15	0.073	mg/L	1		SM 4500 P E	Total/NA
Sulfide	0.25	J	1.0	0.23	mg/L	1		SM 4500 S2 F	Total/NA
Dissolved Organic Carbon - Duplicate	3.6		1.0	0.47	mg/L	1		9060A	Dissolved

Client Sample ID: D-1-20210803 — Lab Sample ID: 500-203343-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Boron	0.33		0.050	0.0056	mg/L	1		6010B	Total/NA
Calcium	53		0.20	0.053	mg/L	1		6010B	Total/NA
Iron	0.23		0.20	0.082	mg/L	1		6010B	Total/NA
Magnesium	16	B	0.10	0.049	mg/L	1		6010B	Total/NA
Manganese	0.030		0.010	0.0023	mg/L	1		6010B	Total/NA
Potassium	2.5	B	0.50	0.066	mg/L	1		6010B	Total/NA
Sodium	19	B	1.0	0.097	mg/L	1		6010B	Total/NA
Boron, Dissolved	0.32		0.050	0.0056	mg/L	1		6010B	Dissolved
Calcium, Dissolved	52		0.20	0.053	mg/L	1		6010B	Dissolved
Iron, Dissolved	0.13	J	0.20	0.082	mg/L	1		6010B	Dissolved
Magnesium, Dissolved	16	B	0.10	0.049	mg/L	1		6010B	Dissolved
Manganese, Dissolved	0.024		0.010	0.0023	mg/L	1		6010B	Dissolved
Potassium, Dissolved	2.5	B	0.50	0.066	mg/L	1		6010B	Dissolved
Sodium, Dissolved	18	B	1.0	0.097	mg/L	1		6010B	Dissolved
Chloride	9.1		0.40	0.34	mg/L	2		9056A	Total/NA
Sulfate	110		5.0	2.4	mg/L	25		9056A	Total/NA
Alkalinity	100		5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	240		10	4.3	mg/L	1		SM 2540C	Total/NA
Ferric Iron	0.23		0.20	0.10	mg/L	1		SM 3500	Total/NA
Phosphorus as PO4	0.13	J	0.15	0.073	mg/L	1		SM 4500 P E	Total/NA
Dissolved Organic Carbon - Duplicate	3.3		1.0	0.47	mg/L	1		9060A	Dissolved

Client Sample ID: BKG-1-20210803 — Lab Sample ID: 500-203343-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Boron	0.082		0.050	0.0056	mg/L	1		6010B	Total/NA

This Detection Summary does not include radiochemical test results.

Eurofins TestAmerica, Chicago

Detection Summary

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: BKG-1-20210803 (Continued) — Lab Sample ID: 500-203343-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Calcium	20		0.20	0.053	mg/L	1		6010B	Total/NA
Iron	0.27		0.20	0.082	mg/L	1		6010B	Total/NA
Magnesium	10	B	0.10	0.049	mg/L	1		6010B	Total/NA
Manganese	0.037		0.010	0.0023	mg/L	1		6010B	Total/NA
Potassium	4.9	B	0.50	0.066	mg/L	1		6010B	Total/NA
Sodium	12	B	1.0	0.097	mg/L	1		6010B	Total/NA
Boron, Dissolved	0.079		0.050	0.0056	mg/L	1		6010B	Dissolved
Calcium, Dissolved	20		0.20	0.053	mg/L	1		6010B	Dissolved
Iron, Dissolved	0.19	J	0.20	0.082	mg/L	1		6010B	Dissolved
Magnesium, Dissolved	10	B	0.10	0.049	mg/L	1		6010B	Dissolved
Potassium, Dissolved	4.9	B	0.50	0.066	mg/L	1		6010B	Dissolved
Sodium, Dissolved	12	B	1.0	0.097	mg/L	1		6010B	Dissolved
Chloride	12		2.0	1.7	mg/L	10		9056A	Total/NA
Sulfate	36		2.0	0.95	mg/L	10		9056A	Total/NA
Alkalinity	65		5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	72		10	4.3	mg/L	1		SM 2540C	Total/NA
Ferric Iron	0.27		0.20	0.10	mg/L	1		SM 3500	Total/NA
Phosphorus as PO4	0.12	J	0.15	0.073	mg/L	1		SM 4500 P E	Total/NA
Dissolved Organic Carbon - Duplicate	5.0		1.0	0.47	mg/L	1		9060A	Dissolved

Client Sample ID: CL-1-20210803 — Lab Sample ID: 500-203343-4

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Boron	0.10		0.050	0.0056	mg/L	1		6010B	Total/NA
Calcium	23		0.20	0.053	mg/L	1		6010B	Total/NA
Iron	0.38		0.20	0.082	mg/L	1		6010B	Total/NA
Magnesium	11	B	0.10	0.049	mg/L	1		6010B	Total/NA
Manganese	0.037		0.010	0.0023	mg/L	1		6010B	Total/NA
Potassium	4.5	B	0.50	0.066	mg/L	1		6010B	Total/NA
Sodium	11	B	1.0	0.097	mg/L	1		6010B	Total/NA
Boron, Dissolved	0.12		0.050	0.0056	mg/L	1		6010B	Dissolved
Calcium, Dissolved	26		0.20	0.053	mg/L	1		6010B	Dissolved
Iron, Dissolved	0.68		0.20	0.082	mg/L	1		6010B	Dissolved
Magnesium, Dissolved	11	B	0.10	0.049	mg/L	1		6010B	Dissolved
Manganese, Dissolved	0.062		0.010	0.0023	mg/L	1		6010B	Dissolved
Potassium, Dissolved	4.7	B	0.50	0.066	mg/L	1		6010B	Dissolved
Sodium, Dissolved	12	B	1.0	0.097	mg/L	1		6010B	Dissolved
Chloride	11		0.40	0.34	mg/L	2		9056A	Total/NA
Sulfate	33		2.0	0.95	mg/L	10		9056A	Total/NA
Alkalinity	68		5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	120		10	4.3	mg/L	1		SM 2540C	Total/NA
Ferric Iron	0.38		0.20	0.10	mg/L	1		SM 3500	Total/NA
Phosphorus as PO4	0.21		0.15	0.073	mg/L	1		SM 4500 P E	Total/NA
Dissolved Organic Carbon - Duplicate	5.4		1.0	0.47	mg/L	1		9060A	Dissolved

Client Sample ID: DUP-20210803 — Lab Sample ID: 500-203343-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Boron	0.086		0.050	0.0056	mg/L	1		6010B	Total/NA
Calcium	21		0.20	0.053	mg/L	1		6010B	Total/NA
Iron	0.39		0.20	0.082	mg/L	1		6010B	Total/NA
Magnesium	10	B	0.10	0.049	mg/L	1		6010B	Total/NA

This Detection Summary does not include radiochemical test results.

Detection Summary

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: DUP-20210803 (Continued) — Lab Sample ID: 500-203343-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Manganese	0.052		0.010	0.0023	mg/L	1		6010B	Total/NA
Potassium	4.7	B	0.50	0.066	mg/L	1		6010B	Total/NA
Sodium	11	B	1.0	0.097	mg/L	1		6010B	Total/NA
Boron, Dissolved	0.086		0.050	0.0056	mg/L	1		6010B	Dissolved
Calcium, Dissolved	21		0.20	0.053	mg/L	1		6010B	Dissolved
Iron, Dissolved	0.087	J	0.20	0.082	mg/L	1		6010B	Dissolved
Magnesium, Dissolved	10	B	0.10	0.049	mg/L	1		6010B	Dissolved
Potassium, Dissolved	4.7	B	0.50	0.066	mg/L	1		6010B	Dissolved
Sodium, Dissolved	11	B	1.0	0.097	mg/L	1		6010B	Dissolved
Chloride	11		0.40	0.34	mg/L	2		9056A	Total/NA
Sulfate	33		2.0	0.95	mg/L	10		9056A	Total/NA
Alkalinity	65		5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	110		10	4.3	mg/L	1		SM 2540C	Total/NA
Ferric Iron	0.39		0.20	0.10	mg/L	1		SM 3500	Total/NA
Phosphorus as PO4	0.14	J	0.15	0.073	mg/L	1		SM 4500 P E	Total/NA
Dissolved Organic Carbon - Duplicate	4.9		1.0	0.47	mg/L	1		9060A	Dissolved

Client Sample ID: CL-2-20210803 — Lab Sample ID: 500-203343-6

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Boron	0.086		0.050	0.0056	mg/L	1		6010B	Total/NA
Calcium	21		0.20	0.053	mg/L	1		6010B	Total/NA
Iron	0.38		0.20	0.082	mg/L	1		6010B	Total/NA
Magnesium	10	B	0.10	0.049	mg/L	1		6010B	Total/NA
Manganese	0.051		0.010	0.0023	mg/L	1		6010B	Total/NA
Potassium	4.7	B	0.50	0.066	mg/L	1		6010B	Total/NA
Sodium	11	B	1.0	0.097	mg/L	1		6010B	Total/NA
Boron, Dissolved	0.087		0.050	0.0056	mg/L	1		6010B	Dissolved
Calcium, Dissolved	22		0.20	0.053	mg/L	1		6010B	Dissolved
Iron, Dissolved	0.13	J	0.20	0.082	mg/L	1		6010B	Dissolved
Magnesium, Dissolved	10	B	0.10	0.049	mg/L	1		6010B	Dissolved
Potassium, Dissolved	4.7	B	0.50	0.066	mg/L	1		6010B	Dissolved
Sodium, Dissolved	11	B	1.0	0.097	mg/L	1		6010B	Dissolved
Chloride	11		0.40	0.34	mg/L	2		9056A	Total/NA
Sulfate	31		2.0	0.95	mg/L	10		9056A	Total/NA
Alkalinity	65		5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	160		10	4.3	mg/L	1		SM 2540C	Total/NA
Ferric Iron	0.38		0.20	0.10	mg/L	1		SM 3500	Total/NA
Phosphorus as PO4	0.12	J	0.15	0.073	mg/L	1		SM 4500 P E	Total/NA
Dissolved Organic Carbon - Duplicate	4.9		1.0	0.47	mg/L	1		9060A	Dissolved

Client Sample ID: CL-3-20210803 — Lab Sample ID: 500-203343-7

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Boron	0.086		0.050	0.0056	mg/L	1		6010B	Total/NA
Calcium	21		0.20	0.053	mg/L	1		6010B	Total/NA
Iron	0.31		0.20	0.082	mg/L	1		6010B	Total/NA
Magnesium	11	B	0.10	0.049	mg/L	1		6010B	Total/NA
Manganese	0.046		0.010	0.0023	mg/L	1		6010B	Total/NA
Potassium	4.9	B	0.50	0.066	mg/L	1		6010B	Total/NA
Sodium	11	B	1.0	0.097	mg/L	1		6010B	Total/NA
Boron, Dissolved	0.084		0.050	0.0056	mg/L	1		6010B	Dissolved

This Detection Summary does not include radiochemical test results.

Detection Summary

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: CL-3-20210803 (Continued)

Lab Sample ID: 500-203343-7

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Calcium, Dissolved	21		0.20	0.053	mg/L	1		6010B	Dissolved
Magnesium, Dissolved	10	B	0.10	0.049	mg/L	1		6010B	Dissolved
Potassium, Dissolved	4.6	B	0.50	0.066	mg/L	1		6010B	Dissolved
Sodium, Dissolved	11	B	1.0	0.097	mg/L	1		6010B	Dissolved
Chloride	11		0.40	0.34	mg/L	2		9056A	Total/NA
Sulfate	32		2.0	0.95	mg/L	10		9056A	Total/NA
Alkalinity	63		5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	150		10	4.3	mg/L	1		SM 2540C	Total/NA
Ferric Iron	0.31		0.20	0.10	mg/L	1		SM 3500	Total/NA
Phosphorus as PO4	0.095	J	0.15	0.073	mg/L	1		SM 4500 P E	Total/NA
Dissolved Organic Carbon - Duplicate	4.9		1.0	0.47	mg/L	1		9060A	Dissolved

This Detection Summary does not include radiochemical test results.

Method Summary

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Method	Method Description	Protocol	Laboratory
6010B	Metals (ICP)	SW846	TAL CHI
9056A	Anions, Ion Chromatography	SW846	TAL CHI
9060A	Organic Carbon, Dissolved (DOC)	SW846	TAL CHI
SM 2320B	Alkalinity	SM	TAL CHI
SM 2540C	Solids, Total Dissolved (TDS)	SM	TAL CHI
SM 3500	Iron, Ferric	SM	TAL CHI
SM 3500 Fe B	Iron, Ferrous	SM	TAL CHI
SM 4500 P E	Phosphorus	SM	TAL CHI
SM 4500 S2 F	Sulfide, Total	SM	TAL CHI
3010A	Preparation, Total Metals	SW846	TAL CHI
SM 4500 P B	Phosphorous, Total and Ortho	SM	TAL CHI

Protocol References:

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL CHI = Eurofins TestAmerica, Chicago, 2417 Bond Street, University Park, IL 60484, TEL (708)534-5200

Sample Summary

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
500-203343-1	D-2-20210803	Water	08/03/21 10:15	08/05/21 09:45
500-203343-2	D-1-20210803	Water	08/03/21 10:50	08/05/21 09:45
500-203343-3	BKG-1-20210803	Water	08/03/21 12:45	08/05/21 09:45
500-203343-4	CL-1-20210803	Water	08/03/21 13:20	08/05/21 09:45
500-203343-5	DUP-20210803	Water	08/03/21 13:30	08/05/21 09:45
500-203343-6	CL-2-20210803	Water	08/03/21 13:50	08/05/21 09:45
500-203343-7	CL-3-20210803	Water	08/03/21 14:20	08/05/21 09:45

Client Sample Results

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: D-2-20210803

Date Collected: 08/03/21 10:15
Date Received: 08/05/21 09:45

Lab Sample ID: 500-203343-1

Matrix: Water

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	0.30		0.050	0.0056	mg/L		08/10/21 08:44	08/10/21 23:27	1
Calcium	45		0.20	0.053	mg/L		08/10/21 08:44	08/10/21 23:27	1
Cobalt	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/10/21 23:27	1
Iron	0.24		0.20	0.082	mg/L		08/10/21 08:44	08/10/21 23:27	1
Lithium	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/10/21 23:27	1
Magnesium	13	B	0.10	0.049	mg/L		08/10/21 08:44	08/10/21 23:27	1
Manganese	0.20		0.010	0.0023	mg/L		08/10/21 08:44	08/10/21 23:27	1
Potassium	3.2	B	0.50	0.066	mg/L		08/10/21 08:44	08/10/21 23:27	1
Sodium	13	B	1.0	0.097	mg/L		08/10/21 08:44	08/10/21 23:27	1

Method: 6010B - Metals (ICP) - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron, Dissolved	0.30		0.050	0.0056	mg/L		08/10/21 08:44	08/10/21 23:31	1
Calcium, Dissolved	46		0.20	0.053	mg/L		08/10/21 08:44	08/10/21 23:31	1
Cobalt, Dissolved	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/10/21 23:31	1
Iron, Dissolved	0.15	J	0.20	0.082	mg/L		08/10/21 08:44	08/10/21 23:31	1
Lithium, Dissolved	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/10/21 23:31	1
Magnesium, Dissolved	13	B	0.10	0.049	mg/L		08/10/21 08:44	08/10/21 23:31	1
Manganese, Dissolved	0.20		0.010	0.0023	mg/L		08/10/21 08:44	08/10/21 23:31	1
Potassium, Dissolved	3.2	B	0.50	0.066	mg/L		08/10/21 08:44	08/10/21 23:31	1
Sodium, Dissolved	13	B	1.0	0.097	mg/L		08/10/21 08:44	08/10/21 23:31	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	7.2		0.20	0.17	mg/L			08/17/21 16:12	1
Sulfate	69		4.0	1.9	mg/L			08/18/21 12:53	20
Alkalinity	100		5.0	3.7	mg/L			08/15/21 19:00	1
Total Dissolved Solids	240		10	4.3	mg/L			08/09/21 09:49	1
Ferric Iron	0.24		0.20	0.10	mg/L			08/19/21 14:42	1
Ferrous Iron	<0.050	HF	0.050	0.050	mg/L			08/11/21 04:46	1
Phosphorus as PO4	0.24		0.15	0.073	mg/L		08/15/21 12:30	08/18/21 12:20	1
Sulfide	0.25	J	1.0	0.23	mg/L			08/10/21 00:05	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon - Duplicate	3.6		1.0	0.47	mg/L			08/09/21 23:09	1

Client Sample Results

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: D-1-20210803

Date Collected: 08/03/21 10:50
Date Received: 08/05/21 09:45

Lab Sample ID: 500-203343-2

Matrix: Water

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	0.33		0.050	0.0056	mg/L		08/10/21 08:44	08/10/21 23:34	1
Calcium	53		0.20	0.053	mg/L		08/10/21 08:44	08/10/21 23:34	1
Cobalt	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/10/21 23:34	1
Iron	0.23		0.20	0.082	mg/L		08/10/21 08:44	08/10/21 23:34	1
Lithium	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/10/21 23:34	1
Magnesium	16	B	0.10	0.049	mg/L		08/10/21 08:44	08/10/21 23:34	1
Manganese	0.030		0.010	0.0023	mg/L		08/10/21 08:44	08/10/21 23:34	1
Potassium	2.5	B	0.50	0.066	mg/L		08/10/21 08:44	08/10/21 23:34	1
Sodium	19	B	1.0	0.097	mg/L		08/10/21 08:44	08/10/21 23:34	1

Method: 6010B - Metals (ICP) - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron, Dissolved	0.32		0.050	0.0056	mg/L		08/10/21 08:44	08/10/21 23:38	1
Calcium, Dissolved	52		0.20	0.053	mg/L		08/10/21 08:44	08/10/21 23:38	1
Cobalt, Dissolved	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/10/21 23:38	1
Iron, Dissolved	0.13	J	0.20	0.082	mg/L		08/10/21 08:44	08/10/21 23:38	1
Lithium, Dissolved	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/10/21 23:38	1
Magnesium, Dissolved	16	B	0.10	0.049	mg/L		08/10/21 08:44	08/10/21 23:38	1
Manganese, Dissolved	0.024		0.010	0.0023	mg/L		08/10/21 08:44	08/10/21 23:38	1
Potassium, Dissolved	2.5	B	0.50	0.066	mg/L		08/10/21 08:44	08/10/21 23:38	1
Sodium, Dissolved	18	B	1.0	0.097	mg/L		08/10/21 08:44	08/10/21 23:38	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	9.1		0.40	0.34	mg/L			08/19/21 11:37	2
Sulfate	110		5.0	2.4	mg/L			08/18/21 13:07	25
Alkalinity	100		5.0	3.7	mg/L			08/15/21 19:07	1
Total Dissolved Solids	240		10	4.3	mg/L			08/09/21 09:51	1
Ferric Iron	0.23		0.20	0.10	mg/L			08/19/21 14:42	1
Ferrous Iron	<0.050	HF	0.050	0.050	mg/L			08/11/21 04:55	1
Phosphorus as PO4	0.13	J	0.15	0.073	mg/L		08/15/21 12:30	08/18/21 12:21	1
Sulfide	<1.0		1.0	0.23	mg/L			08/10/21 00:08	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon - Duplicate	3.3		1.0	0.47	mg/L			08/09/21 23:16	1

Client Sample Results

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: BKG-1-20210803

Date Collected: 08/03/21 12:45
Date Received: 08/05/21 09:45

Lab Sample ID: 500-203343-3

Matrix: Water

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	0.082		0.050	0.0056	mg/L		08/10/21 08:44	08/10/21 23:42	1
Calcium	20		0.20	0.053	mg/L		08/10/21 08:44	08/10/21 23:42	1
Cobalt	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/10/21 23:42	1
Iron	0.27		0.20	0.082	mg/L		08/10/21 08:44	08/10/21 23:42	1
Lithium	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/10/21 23:42	1
Magnesium	10	B	0.10	0.049	mg/L		08/10/21 08:44	08/10/21 23:42	1
Manganese	0.037		0.010	0.0023	mg/L		08/10/21 08:44	08/10/21 23:42	1
Potassium	4.9	B	0.50	0.066	mg/L		08/10/21 08:44	08/10/21 23:42	1
Sodium	12	B	1.0	0.097	mg/L		08/10/21 08:44	08/10/21 23:42	1

Method: 6010B - Metals (ICP) - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron, Dissolved	0.079		0.050	0.0056	mg/L		08/10/21 08:44	08/10/21 23:46	1
Calcium, Dissolved	20		0.20	0.053	mg/L		08/10/21 08:44	08/10/21 23:46	1
Cobalt, Dissolved	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/10/21 23:46	1
Iron, Dissolved	0.19	J	0.20	0.082	mg/L		08/10/21 08:44	08/10/21 23:46	1
Lithium, Dissolved	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/10/21 23:46	1
Magnesium, Dissolved	10	B	0.10	0.049	mg/L		08/10/21 08:44	08/10/21 23:46	1
Manganese, Dissolved	<0.010		0.010	0.0023	mg/L		08/10/21 08:44	08/10/21 23:46	1
Potassium, Dissolved	4.9	B	0.50	0.066	mg/L		08/10/21 08:44	08/10/21 23:46	1
Sodium, Dissolved	12	B	1.0	0.097	mg/L		08/10/21 08:44	08/10/21 23:46	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	12		2.0	1.7	mg/L			08/17/21 17:48	10
Sulfate	36		2.0	0.95	mg/L			08/18/21 13:48	10
Alkalinity	65		5.0	3.7	mg/L			08/15/21 19:14	1
Total Dissolved Solids	72		10	4.3	mg/L			08/09/21 09:54	1
Ferric Iron	0.27		0.20	0.10	mg/L			08/19/21 14:42	1
Ferrous Iron	<0.050	HF	0.050	0.050	mg/L			08/11/21 04:58	1
Phosphorus as PO4	0.12	J	0.15	0.073	mg/L		08/15/21 12:30	08/18/21 12:22	1
Sulfide	<1.0		1.0	0.23	mg/L			08/10/21 00:12	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon - Duplicate	5.0		1.0	0.47	mg/L			08/09/21 23:26	1

Client Sample Results

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: CL-1-20210803

Date Collected: 08/03/21 13:20
Date Received: 08/05/21 09:45

Lab Sample ID: 500-203343-4

Matrix: Water

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	**0.10**		0.050	0.0056	mg/L		08/10/21 08:44	08/10/21 23:50	1
Calcium	**23**		0.20	0.053	mg/L		08/10/21 08:44	08/10/21 23:50	1
Cobalt	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/10/21 23:50	1
Iron	**0.38**		0.20	0.082	mg/L		08/10/21 08:44	08/10/21 23:50	1
Lithium	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/10/21 23:50	1
Magnesium	**11**	**B**	0.10	0.049	mg/L		08/10/21 08:44	08/10/21 23:50	1
Manganese	**0.037**		0.010	0.0023	mg/L		08/10/21 08:44	08/10/21 23:50	1
Potassium	**4.5**	**B**	0.50	0.066	mg/L		08/10/21 08:44	08/10/21 23:50	1
Sodium	**11**	**B**	1.0	0.097	mg/L		08/10/21 08:44	08/10/21 23:50	1

Method: 6010B - Metals (ICP) - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron, Dissolved	**0.12**		0.050	0.0056	mg/L		08/10/21 08:44	08/10/21 23:54	1
Calcium, Dissolved	**26**		0.20	0.053	mg/L		08/10/21 08:44	08/10/21 23:54	1
Cobalt, Dissolved	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/10/21 23:54	1
Iron, Dissolved	**0.68**		0.20	0.082	mg/L		08/10/21 08:44	08/10/21 23:54	1
Lithium, Dissolved	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/10/21 23:54	1
Magnesium, Dissolved	**11**	**B**	0.10	0.049	mg/L		08/10/21 08:44	08/10/21 23:54	1
Manganese, Dissolved	**0.062**		0.010	0.0023	mg/L		08/10/21 08:44	08/10/21 23:54	1
Potassium, Dissolved	**4.7**	**B**	0.50	0.066	mg/L		08/10/21 08:44	08/10/21 23:54	1
Sodium, Dissolved	**12**	**B**	1.0	0.097	mg/L		08/10/21 08:44	08/10/21 23:54	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**11**		0.40	0.34	mg/L			08/17/21 18:01	2
Sulfate	**33**		2.0	0.95	mg/L			08/18/21 14:01	10
Alkalinity	**68**		5.0	3.7	mg/L			08/15/21 19:21	1
Total Dissolved Solids	**120**		10	4.3	mg/L			08/09/21 09:56	1
Ferric Iron	**0.38**		0.20	0.10	mg/L			08/19/21 14:42	1
Ferrous Iron	<0.050	HF	0.050	0.050	mg/L			08/11/21 05:00	1
Phosphorus as PO4	**0.21**		0.15	0.073	mg/L		08/15/21 12:30	08/18/21 12:23	1
Sulfide	<1.0		1.0	0.23	mg/L			08/10/21 00:16	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon - Duplicate	**5.4**		1.0	0.47	mg/L			08/09/21 23:33	1

Client Sample Results

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: DUP-20210803

Date Collected: 08/03/21 13:30
Date Received: 08/05/21 09:45

Lab Sample ID: 500-203343-5

Matrix: Water

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	0.086		0.050	0.0056	mg/L		08/10/21 08:44	08/10/21 23:58	1
Calcium	21		0.20	0.053	mg/L		08/10/21 08:44	08/10/21 23:58	1
Cobalt	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/10/21 23:58	1
Iron	0.39		0.20	0.082	mg/L		08/10/21 08:44	08/10/21 23:58	1
Lithium	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/10/21 23:58	1
Magnesium	10	B	0.10	0.049	mg/L		08/10/21 08:44	08/10/21 23:58	1
Manganese	0.052		0.010	0.0023	mg/L		08/10/21 08:44	08/10/21 23:58	1
Potassium	4.7	B	0.50	0.066	mg/L		08/10/21 08:44	08/10/21 23:58	1
Sodium	11	B	1.0	0.097	mg/L		08/10/21 08:44	08/10/21 23:58	1

Method: 6010B - Metals (ICP) - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron, Dissolved	0.086		0.050	0.0056	mg/L		08/10/21 08:44	08/11/21 00:14	1
Calcium, Dissolved	21		0.20	0.053	mg/L		08/10/21 08:44	08/11/21 00:14	1
Cobalt, Dissolved	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/11/21 00:14	1
Iron, Dissolved	0.087	J	0.20	0.082	mg/L		08/10/21 08:44	08/11/21 00:14	1
Lithium, Dissolved	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/11/21 00:14	1
Magnesium, Dissolved	10	B	0.10	0.049	mg/L		08/10/21 08:44	08/11/21 00:14	1
Manganese, Dissolved	<0.010		0.010	0.0023	mg/L		08/10/21 08:44	08/11/21 00:14	1
Potassium, Dissolved	4.7	B	0.50	0.066	mg/L		08/10/21 08:44	08/11/21 00:14	1
Sodium, Dissolved	11	B	1.0	0.097	mg/L		08/10/21 08:44	08/11/21 00:14	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	11		0.40	0.34	mg/L			08/17/21 18:28	2
Sulfate	33		2.0	0.95	mg/L			08/18/21 14:15	10
Alkalinity	65		5.0	3.7	mg/L			08/15/21 19:28	1
Total Dissolved Solids	110		10	4.3	mg/L			08/09/21 09:59	1
Ferric Iron	0.39		0.20	0.10	mg/L			08/19/21 14:42	1
Ferrous Iron	<0.050	HF	0.050	0.050	mg/L			08/11/21 05:03	1
Phosphorus as PO4	0.14	J	0.15	0.073	mg/L		08/15/21 12:30	08/18/21 12:42	1
Sulfide	<1.0		1.0	0.23	mg/L			08/10/21 00:20	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon - Duplicate	4.9		1.0	0.47	mg/L			08/09/21 23:40	1

Client Sample Results

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: CL-2-20210803

Date Collected: 08/03/21 13:50
Date Received: 08/05/21 09:45

Lab Sample ID: 500-203343-6

Matrix: Water

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	**0.086**		0.050	0.0056	mg/L		08/10/21 08:44	08/11/21 00:18	1
Calcium	**21**		0.20	0.053	mg/L		08/10/21 08:44	08/11/21 00:18	1
Cobalt	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/11/21 00:18	1
Iron	**0.38**		0.20	0.082	mg/L		08/10/21 08:44	08/11/21 00:18	1
Lithium	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/11/21 00:18	1
Magnesium	**10**	**B**	0.10	0.049	mg/L		08/10/21 08:44	08/11/21 00:18	1
Manganese	**0.051**		0.010	0.0023	mg/L		08/10/21 08:44	08/11/21 00:18	1
Potassium	**4.7**	**B**	0.50	0.066	mg/L		08/10/21 08:44	08/11/21 00:18	1
Sodium	**11**	**B**	1.0	0.097	mg/L		08/10/21 08:44	08/11/21 00:18	1

Method: 6010B - Metals (ICP) - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron, Dissolved	**0.087**		0.050	0.0056	mg/L		08/10/21 08:44	08/11/21 00:21	1
Calcium, Dissolved	**22**		0.20	0.053	mg/L		08/10/21 08:44	08/11/21 00:21	1
Cobalt, Dissolved	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/11/21 00:21	1
Iron, Dissolved	**0.13**	**J**	0.20	0.082	mg/L		08/10/21 08:44	08/11/21 00:21	1
Lithium, Dissolved	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/11/21 00:21	1
Magnesium, Dissolved	**10**	**B**	0.10	0.049	mg/L		08/10/21 08:44	08/11/21 00:21	1
Manganese, Dissolved	<0.010		0.010	0.0023	mg/L		08/10/21 08:44	08/11/21 00:21	1
Potassium, Dissolved	**4.7**	**B**	0.50	0.066	mg/L		08/10/21 08:44	08/11/21 00:21	1
Sodium, Dissolved	**11**	**B**	1.0	0.097	mg/L		08/10/21 08:44	08/11/21 00:21	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**11**		0.40	0.34	mg/L			08/17/21 18:55	2
Sulfate	**31**		2.0	0.95	mg/L			08/18/21 14:29	10
Alkalinity	**65**		5.0	3.7	mg/L			08/15/21 19:35	1
Total Dissolved Solids	**160**		10	4.3	mg/L			08/09/21 10:02	1
Ferric Iron	**0.38**		0.20	0.10	mg/L			08/19/21 14:42	1
Ferrous Iron	<0.050	HF	0.050	0.050	mg/L			08/11/21 05:06	1
Phosphorus as PO4	**0.12**	**J**	0.15	0.073	mg/L		08/15/21 12:30	08/18/21 12:43	1
Sulfide	<1.0		1.0	0.23	mg/L			08/10/21 00:23	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon - Duplicate	**4.9**		1.0	0.47	mg/L			08/09/21 23:47	1

Client Sample Results

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: CL-3-20210803

Date Collected: 08/03/21 14:20
Date Received: 08/05/21 09:45

Lab Sample ID: 500-203343-7

Matrix: Water

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	**0.086**		0.050	0.0056	mg/L		08/10/21 08:44	08/11/21 00:25	1
Calcium	**21**		0.20	0.053	mg/L		08/10/21 08:44	08/11/21 00:25	1
Cobalt	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/11/21 00:25	1
Iron	**0.31**		0.20	0.082	mg/L		08/10/21 08:44	08/11/21 00:25	1
Lithium	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/11/21 00:25	1
Magnesium	**11**	**B**	0.10	0.049	mg/L		08/10/21 08:44	08/11/21 00:25	1
Manganese	**0.046**		0.010	0.0023	mg/L		08/10/21 08:44	08/11/21 00:25	1
Potassium	**4.9**	**B**	0.50	0.066	mg/L		08/10/21 08:44	08/11/21 00:25	1
Sodium	**11**	**B**	1.0	0.097	mg/L		08/10/21 08:44	08/11/21 00:25	1

Method: 6010B - Metals (ICP) - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron, Dissolved	**0.084**		0.050	0.0056	mg/L		08/10/21 08:44	08/11/21 00:29	1
Calcium, Dissolved	**21**		0.20	0.053	mg/L		08/10/21 08:44	08/11/21 00:29	1
Cobalt, Dissolved	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/11/21 00:29	1
Iron, Dissolved	<0.20		0.20	0.082	mg/L		08/10/21 08:44	08/11/21 00:29	1
Lithium, Dissolved	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/11/21 00:29	1
Magnesium, Dissolved	**10**	**B**	0.10	0.049	mg/L		08/10/21 08:44	08/11/21 00:29	1
Manganese, Dissolved	<0.010		0.010	0.0023	mg/L		08/10/21 08:44	08/11/21 00:29	1
Potassium, Dissolved	**4.6**	**B**	0.50	0.066	mg/L		08/10/21 08:44	08/11/21 00:29	1
Sodium, Dissolved	**11**	**B**	1.0	0.097	mg/L		08/10/21 08:44	08/11/21 00:29	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**11**		0.40	0.34	mg/L			08/17/21 19:23	2
Sulfate	**32**		2.0	0.95	mg/L			08/18/21 14:42	10
Alkalinity	**63**		5.0	3.7	mg/L			08/15/21 19:41	1
Total Dissolved Solids	**150**		10	4.3	mg/L			08/09/21 10:04	1
Ferric Iron	**0.31**		0.20	0.10	mg/L			08/19/21 14:42	1
Ferrous Iron	<0.050	HF	0.050	0.050	mg/L			08/11/21 05:09	1
Phosphorus as PO4	**0.095**	**J**	0.15	0.073	mg/L		08/15/21 12:30	08/18/21 12:44	1
Sulfide	<1.0		1.0	0.23	mg/L			08/10/21 00:27	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon - Duplicate	**4.9**		1.0	0.47	mg/L			08/09/21 23:55	1

Qualifiers

Metals

Qualifier	Qualifier Description
B	Compound was found in the blank and sample.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

General Chemistry

Qualifier	Qualifier Description
4	MS, MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore, control limits are not applicable.
HF	Field parameter with a holding time of 15 minutes. Test performed by laboratory at client's request.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

QC Association Summary

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Metals

Prep Batch: 613499

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-203343-1	D-2-20210803	Dissolved	Water	3010A	
500-203343-1	D-2-20210803	Total/NA	Water	3010A	
500-203343-2	D-1-20210803	Dissolved	Water	3010A	
500-203343-2	D-1-20210803	Total/NA	Water	3010A	
500-203343-3	BKG-1-20210803	Dissolved	Water	3010A	
500-203343-3	BKG-1-20210803	Total/NA	Water	3010A	
500-203343-4	CL-1-20210803	Dissolved	Water	3010A	
500-203343-4	CL-1-20210803	Total/NA	Water	3010A	
500-203343-5	DUP-20210803	Dissolved	Water	3010A	
500-203343-5	DUP-20210803	Total/NA	Water	3010A	
500-203343-6	CL-2-20210803	Dissolved	Water	3010A	
500-203343-6	CL-2-20210803	Total/NA	Water	3010A	
500-203343-7	CL-3-20210803	Dissolved	Water	3010A	
500-203343-7	CL-3-20210803	Total/NA	Water	3010A	
MB 500-613499/1-A	Method Blank	Total/NA	Water	3010A	
LCS 500-613499/2-A	Lab Control Sample	Total/NA	Water	3010A	

Analysis Batch: 613679

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-203343-1	D-2-20210803	Dissolved	Water	6010B	613499
500-203343-1	D-2-20210803	Total/NA	Water	6010B	613499
500-203343-2	D-1-20210803	Dissolved	Water	6010B	613499
500-203343-2	D-1-20210803	Total/NA	Water	6010B	613499
500-203343-3	BKG-1-20210803	Dissolved	Water	6010B	613499
500-203343-3	BKG-1-20210803	Total/NA	Water	6010B	613499
500-203343-4	CL-1-20210803	Dissolved	Water	6010B	613499
500-203343-4	CL-1-20210803	Total/NA	Water	6010B	613499
500-203343-5	DUP-20210803	Dissolved	Water	6010B	613499
500-203343-5	DUP-20210803	Total/NA	Water	6010B	613499
500-203343-6	CL-2-20210803	Dissolved	Water	6010B	613499
500-203343-6	CL-2-20210803	Total/NA	Water	6010B	613499
500-203343-7	CL-3-20210803	Dissolved	Water	6010B	613499
500-203343-7	CL-3-20210803	Total/NA	Water	6010B	613499
MB 500-613499/1-A	Method Blank	Total/NA	Water	6010B	613499
LCS 500-613499/2-A	Lab Control Sample	Total/NA	Water	6010B	613499

General Chemistry

Analysis Batch: 613305

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-203343-1	D-2-20210803	Total/NA	Water	SM 2540C	
500-203343-2	D-1-20210803	Total/NA	Water	SM 2540C	
500-203343-3	BKG-1-20210803	Total/NA	Water	SM 2540C	
500-203343-4	CL-1-20210803	Total/NA	Water	SM 2540C	
500-203343-5	DUP-20210803	Total/NA	Water	SM 2540C	
500-203343-6	CL-2-20210803	Total/NA	Water	SM 2540C	
500-203343-7	CL-3-20210803	Total/NA	Water	SM 2540C	
MB 500-613305/1	Method Blank	Total/NA	Water	SM 2540C	
LCS 500-613305/2	Lab Control Sample	Total/NA	Water	SM 2540C	
500-203340-B-2 MS	Matrix Spike	Total/NA	Water	SM 2540C	
500-203340-B-3 DU	Duplicate	Total/NA	Water	SM 2540C	

QC Association Summary

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

General Chemistry

Analysis Batch: 613311

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-203343-1	D-2-20210803	Total/NA	Water	SM 3500 Fe B	
500-203343-2	D-1-20210803	Total/NA	Water	SM 3500 Fe B	
500-203343-3	BKG-1-20210803	Total/NA	Water	SM 3500 Fe B	
500-203343-4	CL-1-20210803	Total/NA	Water	SM 3500 Fe B	
500-203343-5	DUP-20210803	Total/NA	Water	SM 3500 Fe B	
500-203343-6	CL-2-20210803	Total/NA	Water	SM 3500 Fe B	
500-203343-7	CL-3-20210803	Total/NA	Water	SM 3500 Fe B	
MB 500-613311/1	Method Blank	Total/NA	Water	SM 3500 Fe B	
LCS 500-613311/2	Lab Control Sample	Total/NA	Water	SM 3500 Fe B	
500-203343-1 MS	D-2-20210803	Total/NA	Water	SM 3500 Fe B	
500-203343-1 MSD	D-2-20210803	Total/NA	Water	SM 3500 Fe B	

Analysis Batch: 613518

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-203343-1	D-2-20210803	Total/NA	Water	SM 4500 S2 F	
500-203343-2	D-1-20210803	Total/NA	Water	SM 4500 S2 F	
500-203343-3	BKG-1-20210803	Total/NA	Water	SM 4500 S2 F	
500-203343-4	CL-1-20210803	Total/NA	Water	SM 4500 S2 F	
500-203343-5	DUP-20210803	Total/NA	Water	SM 4500 S2 F	
500-203343-6	CL-2-20210803	Total/NA	Water	SM 4500 S2 F	
500-203343-7	CL-3-20210803	Total/NA	Water	SM 4500 S2 F	
MB 500-613518/1	Method Blank	Total/NA	Water	SM 4500 S2 F	
LCS 500-613518/2	Lab Control Sample	Total/NA	Water	SM 4500 S2 F	
180-125221-A-1 MS	Matrix Spike	Total/NA	Water	SM 4500 S2 F	
180-125221-A-1 MSD	Matrix Spike Duplicate	Total/NA	Water	SM 4500 S2 F	

Analysis Batch: 613783

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-203343-1	D-2-20210803	Dissolved	Water	9060A	
500-203343-2	D-1-20210803	Dissolved	Water	9060A	
500-203343-3	BKG-1-20210803	Dissolved	Water	9060A	
500-203343-4	CL-1-20210803	Dissolved	Water	9060A	
500-203343-5	DUP-20210803	Dissolved	Water	9060A	
500-203343-6	CL-2-20210803	Dissolved	Water	9060A	
500-203343-7	CL-3-20210803	Dissolved	Water	9060A	
MB 500-613783/9	Method Blank	Dissolved	Water	9060A	
LCS 500-613783/10	Lab Control Sample	Dissolved	Water	9060A	

Prep Batch: 614309

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-203343-1	D-2-20210803	Total/NA	Water	SM 4500 P B	
500-203343-2	D-1-20210803	Total/NA	Water	SM 4500 P B	
500-203343-3	BKG-1-20210803	Total/NA	Water	SM 4500 P B	
500-203343-4	CL-1-20210803	Total/NA	Water	SM 4500 P B	
500-203343-5	DUP-20210803	Total/NA	Water	SM 4500 P B	
500-203343-6	CL-2-20210803	Total/NA	Water	SM 4500 P B	
500-203343-7	CL-3-20210803	Total/NA	Water	SM 4500 P B	
MB 500-614309/1-A	Method Blank	Total/NA	Water	SM 4500 P B	
LCS 500-614309/2-A	Lab Control Sample	Total/NA	Water	SM 4500 P B	

QC Association Summary

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

General Chemistry

Analysis Batch: 614414

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-203343-1	D-2-20210803	Total/NA	Water	SM 2320B	
500-203343-2	D-1-20210803	Total/NA	Water	SM 2320B	
500-203343-3	BKG-1-20210803	Total/NA	Water	SM 2320B	
500-203343-4	CL-1-20210803	Total/NA	Water	SM 2320B	
500-203343-5	DUP-20210803	Total/NA	Water	SM 2320B	
500-203343-6	CL-2-20210803	Total/NA	Water	SM 2320B	
500-203343-7	CL-3-20210803	Total/NA	Water	SM 2320B	
MB 500-614414/3	Method Blank	Total/NA	Water	SM 2320B	
LCS 500-614414/4	Lab Control Sample	Total/NA	Water	SM 2320B	
500-203363-E-1 DU	Duplicate	Total/NA	Water	SM 2320B	

Analysis Batch: 614638

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-203343-1	D-2-20210803	Total/NA	Water	9056A	
500-203343-3	BKG-1-20210803	Total/NA	Water	9056A	
500-203343-4	CL-1-20210803	Total/NA	Water	9056A	
500-203343-5	DUP-20210803	Total/NA	Water	9056A	
500-203343-6	CL-2-20210803	Total/NA	Water	9056A	
500-203343-7	CL-3-20210803	Total/NA	Water	9056A	
MB 500-614638/3	Method Blank	Total/NA	Water	9056A	
LCS 500-614638/4	Lab Control Sample	Total/NA	Water	9056A	
500-203337-F-2 MS	Matrix Spike	Total/NA	Water	9056A	
500-203337-F-2 MSD	Matrix Spike Duplicate	Total/NA	Water	9056A	

Analysis Batch: 614916

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-203343-1	D-2-20210803	Total/NA	Water	SM 4500 P E	614309
500-203343-2	D-1-20210803	Total/NA	Water	SM 4500 P E	614309
500-203343-3	BKG-1-20210803	Total/NA	Water	SM 4500 P E	614309
500-203343-4	CL-1-20210803	Total/NA	Water	SM 4500 P E	614309
500-203343-5	DUP-20210803	Total/NA	Water	SM 4500 P E	614309
500-203343-6	CL-2-20210803	Total/NA	Water	SM 4500 P E	614309
500-203343-7	CL-3-20210803	Total/NA	Water	SM 4500 P E	614309
MB 500-614309/1-A	Method Blank	Total/NA	Water	SM 4500 P E	614309
LCS 500-614309/2-A	Lab Control Sample	Total/NA	Water	SM 4500 P E	614309

Analysis Batch: 614951

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-203343-1	D-2-20210803	Total/NA	Water	9056A	
500-203343-2	D-1-20210803	Total/NA	Water	9056A	
500-203343-3	BKG-1-20210803	Total/NA	Water	9056A	
500-203343-4	CL-1-20210803	Total/NA	Water	9056A	
500-203343-5	DUP-20210803	Total/NA	Water	9056A	
500-203343-6	CL-2-20210803	Total/NA	Water	9056A	
500-203343-7	CL-3-20210803	Total/NA	Water	9056A	
MB 500-614951/3	Method Blank	Total/NA	Water	9056A	
LCS 500-614951/4	Lab Control Sample	Total/NA	Water	9056A	

Analysis Batch: 615118

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-203343-2	D-1-20210803	Total/NA	Water	9056A	

General Chemistry (Continued)

Analysis Batch: 615118 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
MB 500-615118/3	Method Blank	Total/NA	Water	9056A	
LCS 500-615118/4	Lab Control Sample	Total/NA	Water	9056A	

Analysis Batch: 615136

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-203343-1	D-2-20210803	Total/NA	Water	SM 3500	
500-203343-2	D-1-20210803	Total/NA	Water	SM 3500	
500-203343-3	BKG-1-20210803	Total/NA	Water	SM 3500	
500-203343-4	CL-1-20210803	Total/NA	Water	SM 3500	
500-203343-5	DUP-20210803	Total/NA	Water	SM 3500	
500-203343-6	CL-2-20210803	Total/NA	Water	SM 3500	
500-203343-7	CL-3-20210803	Total/NA	Water	SM 3500	

QC Sample Results

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Method: 6010B - Metals (ICP)

Lab Sample ID: MB 500-613499/1-A
Matrix: Water
Analysis Batch: 613679

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 613499

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	<0.050		0.050	0.0056	mg/L		08/10/21 08:44	08/10/21 22:21	1
Boron, Dissolved	<0.050		0.050	0.0056	mg/L		08/10/21 08:44	08/10/21 22:21	1
Calcium	<0.20		0.20	0.053	mg/L		08/10/21 08:44	08/10/21 22:21	1
Calcium, Dissolved	<0.20		0.20	0.053	mg/L		08/10/21 08:44	08/10/21 22:21	1
Cobalt	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/10/21 22:21	1
Cobalt, Dissolved	<0.0050		0.0050	0.00078	mg/L		08/10/21 08:44	08/10/21 22:21	1
Iron	<0.20		0.20	0.082	mg/L		08/10/21 08:44	08/10/21 22:21	1
Iron, Dissolved	<0.20		0.20	0.082	mg/L		08/10/21 08:44	08/10/21 22:21	1
Lithium	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/10/21 22:21	1
Lithium, Dissolved	<0.010		0.010	0.0044	mg/L		08/10/21 08:44	08/10/21 22:21	1
Magnesium	0.0812	J	0.10	0.049	mg/L		08/10/21 08:44	08/10/21 22:21	1
Magnesium, Dissolved	0.0812	J	0.10	0.049	mg/L		08/10/21 08:44	08/10/21 22:21	1
Manganese	<0.010		0.010	0.0023	mg/L		08/10/21 08:44	08/10/21 22:21	1
Manganese, Dissolved	<0.010		0.010	0.0023	mg/L		08/10/21 08:44	08/10/21 22:21	1
Potassium	0.185	J	0.50	0.066	mg/L		08/10/21 08:44	08/10/21 22:21	1
Potassium, Dissolved	0.185	J	0.50	0.066	mg/L		08/10/21 08:44	08/10/21 22:21	1
Sodium	0.165	J	1.0	0.097	mg/L		08/10/21 08:44	08/10/21 22:21	1
Sodium, Dissolved	0.165	J	1.0	0.097	mg/L		08/10/21 08:44	08/10/21 22:21	1

Lab Sample ID: LCS 500-613499/2-A
Matrix: Water
Analysis Batch: 613679

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 613499

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Boron	1.00	0.822		mg/L		82	80 - 120
Boron, Dissolved	1.00	0.822		mg/L		82	80 - 120
Calcium	10.0	10.7		mg/L		107	80 - 120
Calcium, Dissolved	10.0	10.7		mg/L		107	80 - 120
Cobalt	0.500	0.498		mg/L		100	80 - 120
Cobalt, Dissolved	0.500	0.498		mg/L		100	80 - 120
Iron	1.00	1.15		mg/L		115	80 - 120
Iron, Dissolved	1.00	1.15		mg/L		115	80 - 120
Lithium	0.500	0.525		mg/L		105	80 - 120
Lithium, Dissolved	0.500	0.525		mg/L		105	80 - 120
Magnesium	10.0	10.0		mg/L		100	80 - 120
Magnesium, Dissolved	10.0	10.0		mg/L		100	80 - 120
Manganese	0.500	0.522		mg/L		104	80 - 120
Manganese, Dissolved	0.500	0.522		mg/L		104	80 - 120
Potassium	10.0	10.1		mg/L		101	80 - 120
Potassium, Dissolved	10.0	10.1		mg/L		101	80 - 120
Sodium	10.0	9.94		mg/L		99	80 - 120
Sodium, Dissolved	10.0	9.94		mg/L		99	80 - 120

QC Sample Results

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Method: 9056A - Anions, Ion Chromatography

Lab Sample ID: MB 500-614638/3 — **Client Sample ID: Method Blank**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 614638

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<0.20		0.20	0.17	mg/L			08/17/21 11:40	1

Lab Sample ID: LCS 500-614638/4 — **Client Sample ID: Lab Control Sample**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 614638

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	3.00	2.81		mg/L		94	80 - 120

Lab Sample ID: 500-203337-F-2 MS — **Client Sample ID: Matrix Spike**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 614638

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	430		100	487	4	mg/L		60	80 - 120

Lab Sample ID: 500-203337-F-2 MSD — **Client Sample ID: Matrix Spike Duplicate**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 614638

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Chloride	430		100	491	4	mg/L		64	80 - 120	1	15

Lab Sample ID: MB 500-614951/3 — **Client Sample ID: Method Blank**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 614951

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<0.20		0.20	0.17	mg/L			08/18/21 11:04	1
Sulfate	<0.20		0.20	0.095	mg/L			08/18/21 11:04	1

Lab Sample ID: LCS 500-614951/4 — **Client Sample ID: Lab Control Sample**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 614951

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	3.00	3.27		mg/L		109	80 - 120
Sulfate	5.00	5.30		mg/L		106	80 - 120

Lab Sample ID: MB 500-615118/3 — **Client Sample ID: Method Blank**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 615118

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<0.20		0.20	0.17	mg/L			08/19/21 11:03	1
Sulfate	<0.20		0.20	0.095	mg/L			08/19/21 11:03	1

Method: 9056A - Anions, Ion Chromatography (Continued)

Lab Sample ID: LCS 500-615118/4 — **Client Sample ID: Lab Control Sample**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 615118

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	3.00	3.27		mg/L		109	80 - 120
Sulfate	5.00	5.30		mg/L		106	80 - 120

Method: 9060A - Organic Carbon, Dissolved (DOC)

Lab Sample ID: MB 500-613783/9 — **Client Sample ID: Method Blank**
Matrix: Water — **Prep Type: Dissolved**
Analysis Batch: 613783

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon - Duplicate	<1.0		1.0	0.47	mg/L			08/09/21 21:30	1

Lab Sample ID: LCS 500-613783/10 — **Client Sample ID: Lab Control Sample**
Matrix: Water — **Prep Type: Dissolved**
Analysis Batch: 613783

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
DOC Result 1	10.0	9.57		mg/L		96	86 - 116
DOC Result 2	10.0	9.57		mg/L		96	86 - 116
Dissolved Organic Carbon - Duplicate	10.0	9.57		mg/L		96	86 - 116

Method: SM 2320B - Alkalinity

Lab Sample ID: MB 500-614414/3 — **Client Sample ID: Method Blank**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 614414

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Alkalinity	<5.0		5.0	3.7	mg/L			08/15/21 16:27	1

Lab Sample ID: LCS 500-614414/4 — **Client Sample ID: Lab Control Sample**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 614414

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Alkalinity	500	454		mg/L		91	90 - 110

Lab Sample ID: 500-203363-E-1 DU — **Client Sample ID: Duplicate**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 614414

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Alkalinity	180		181		mg/L		2	20

QC Sample Results

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Method: SM 2540C - Solids, Total Dissolved (TDS)

Lab Sample ID: MB 500-613305/1 — **Client Sample ID: Method Blank**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 613305

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	<10		10	4.3	mg/L			08/09/21 09:31	1

Lab Sample ID: LCS 500-613305/2 — **Client Sample ID: Lab Control Sample**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 613305

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Total Dissolved Solids	250	238		mg/L		95	80 - 120

Lab Sample ID: 500-203340-B-2 MS — **Client Sample ID: Matrix Spike**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 613305

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Total Dissolved Solids	490		250	792		mg/L		120	75 - 125

Lab Sample ID: 500-203340-B-3 DU — **Client Sample ID: Duplicate**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 613305

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Total Dissolved Solids	480		472		mg/L		2	5

Method: SM 3500 Fe B - Iron, Ferrous

Lab Sample ID: MB 500-613311/1 — **Client Sample ID: Method Blank**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 613311

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ferrous Iron	<0.050		0.050	0.050	mg/L			08/11/21 04:41	1

Lab Sample ID: LCS 500-613311/2 — **Client Sample ID: Lab Control Sample**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 613311

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Ferrous Iron	0.500	0.500		mg/L		100	80 - 120

Lab Sample ID: 500-203343-1 MS — **Client Sample ID: D-2-20210803**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 613311

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Ferrous Iron	<0.050	HF	0.500	0.500		mg/L		100	75 - 125

Method: SM 3500 Fe B - Iron, Ferrous (Continued)

Lab Sample ID: 500-203343-1 MSD — **Client Sample ID: D-2-20210803**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 613311

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Ferrous Iron	<0.050	HF	0.500	0.500		mg/L		100	75 - 125	0	20

Method: SM 4500 P E - Phosphorus

Lab Sample ID: MB 500-614309/1-A — **Client Sample ID: Method Blank**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 614916 — **Prep Batch: 614309**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Phosphorus as PO4	<0.15		0.15	0.073	mg/L		08/15/21 12:30	08/18/21 11:49	1

Lab Sample ID: LCS 500-614309/2-A — **Client Sample ID: Lab Control Sample**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 614916 — **Prep Batch: 614309**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Phosphorus as PO4	1.54	1.56		mg/L		101	88 - 123

Method: SM 4500 S2 F - Sulfide, Total

Lab Sample ID: MB 500-613518/1 — **Client Sample ID: Method Blank**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 613518

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Sulfide	<1.0		1.0	0.23	mg/L			08/09/21 23:35	1

Lab Sample ID: LCS 500-613518/2 — **Client Sample ID: Lab Control Sample**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 613518

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Sulfide	3.84	3.87		mg/L		101	85 - 115

Lab Sample ID: 180-125221-A-1 MS — **Client Sample ID: Matrix Spike**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 613518

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Sulfide	<1.0		3.84	3.57		mg/L		93	75 - 125

Lab Sample ID: 180-125221-A-1 MSD — **Client Sample ID: Matrix Spike Duplicate**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 613518

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Sulfide	<1.0		3.84	3.75		mg/L		98	75 - 125	5	20

Lab Chronicle

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: D-2-20210803

Date Collected: 08/03/21 10:15
Date Received: 08/05/21 09:45

Lab Sample ID: 500-203343-1

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Dissolved	Prep	3010A			613499	08/10/21 08:44	BDE	TAL CHI
Dissolved	Analysis	6010B		1	613679	08/10/21 23:31	EEN	TAL CHI
Total/NA	Prep	3010A			613499	08/10/21 08:44	BDE	TAL CHI
Total/NA	Analysis	6010B		1	613679	08/10/21 23:27	EEN	TAL CHI
Total/NA	Analysis	9056A		1	614638	08/17/21 16:12	EAT	TAL CHI
Total/NA	Analysis	9056A		20	614951	08/18/21 12:53	EAT	TAL CHI
Dissolved	Analysis	9060A		1	613783		TMS	TAL CHI
					(Start)	08/09/21 23:09		
					(End)	08/09/21 23:09		
Total/NA	Analysis	SM 2320B		1	614414	08/15/21 19:00	MS	TAL CHI
Total/NA	Analysis	SM 2540C		1	613305	08/09/21 09:49	CLB	TAL CHI
Total/NA	Analysis	SM 3500		1	615136	08/19/21 14:42	PFK	TAL CHI
Total/NA	Analysis	SM 3500 Fe B		1	613311	08/11/21 04:46	CLB	TAL CHI
Total/NA	Prep	SM 4500 P B			614309	08/15/21 12:30	JMP	TAL CHI
Total/NA	Analysis	SM 4500 P E		1	614916	08/18/21 12:20	JMP	TAL CHI
Total/NA	Analysis	SM 4500 S2 F		1	613518		CLB	TAL CHI
					(Start)	08/10/21 00:05		
					(End)	08/10/21 00:08		

Client Sample ID: D-1-20210803

Date Collected: 08/03/21 10:50
Date Received: 08/05/21 09:45

Lab Sample ID: 500-203343-2

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Dissolved	Prep	3010A			613499	08/10/21 08:44	BDE	TAL CHI
Dissolved	Analysis	6010B		1	613679	08/10/21 23:38	EEN	TAL CHI
Total/NA	Prep	3010A			613499	08/10/21 08:44	BDE	TAL CHI
Total/NA	Analysis	6010B		1	613679	08/10/21 23:34	EEN	TAL CHI
Total/NA	Analysis	9056A		25	614951	08/18/21 13:07	EAT	TAL CHI
Total/NA	Analysis	9056A		2	615118	08/19/21 11:37	EAT	TAL CHI
Dissolved	Analysis	9060A		1	613783		TMS	TAL CHI
					(Start)	08/09/21 23:16		
					(End)	08/09/21 23:16		
Total/NA	Analysis	SM 2320B		1	614414	08/15/21 19:07	MS	TAL CHI
Total/NA	Analysis	SM 2540C		1	613305	08/09/21 09:51	CLB	TAL CHI
Total/NA	Analysis	SM 3500		1	615136	08/19/21 14:42	PFK	TAL CHI
Total/NA	Analysis	SM 3500 Fe B		1	613311	08/11/21 04:55	CLB	TAL CHI
Total/NA	Prep	SM 4500 P B			614309	08/15/21 12:30	JMP	TAL CHI
Total/NA	Analysis	SM 4500 P E		1	614916	08/18/21 12:21	JMP	TAL CHI
Total/NA	Analysis	SM 4500 S2 F		1	613518		CLB	TAL CHI
					(Start)	08/10/21 00:08		
					(End)	08/10/21 00:12		

Lab Chronicle

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: BKG-1-20210803

Lab Sample ID: 500-203343-3

Date Collected: 08/03/21 12:45
Matrix: Water
Date Received: 08/05/21 09:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Dissolved	Prep	3010A			613499	08/10/21 08:44	BDE	TAL CHI
Dissolved	Analysis	6010B		1	613679	08/10/21 23:46	EEN	TAL CHI
Total/NA	Prep	3010A			613499	08/10/21 08:44	BDE	TAL CHI
Total/NA	Analysis	6010B		1	613679	08/10/21 23:42	EEN	TAL CHI
Total/NA	Analysis	9056A		10	614638	08/17/21 17:48	EAT	TAL CHI
Total/NA	Analysis	9056A		10	614951	08/18/21 13:48	EAT	TAL CHI
Dissolved	Analysis	9060A		1	613783		TMS	TAL CHI
					(Start)	08/09/21 23:26		
					(End)	08/09/21 23:26		
Total/NA	Analysis	SM 2320B		1	614414	08/15/21 19:14	MS	TAL CHI
Total/NA	Analysis	SM 2540C		1	613305	08/09/21 09:54	CLB	TAL CHI
Total/NA	Analysis	SM 3500		1	615136	08/19/21 14:42	PFK	TAL CHI
Total/NA	Analysis	SM 3500 Fe B		1	613311	08/11/21 04:58	CLB	TAL CHI
Total/NA	Prep	SM 4500 P B			614309	08/15/21 12:30	JMP	TAL CHI
Total/NA	Analysis	SM 4500 P E		1	614916	08/18/21 12:22	JMP	TAL CHI
Total/NA	Analysis	SM 4500 S2 F		1	613518		CLB	TAL CHI
					(Start)	08/10/21 00:12		
					(End)	08/10/21 00:16		

Client Sample ID: CL-1-20210803

Lab Sample ID: 500-203343-4

Date Collected: 08/03/21 13:20
Matrix: Water
Date Received: 08/05/21 09:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Dissolved	Prep	3010A			613499	08/10/21 08:44	BDE	TAL CHI
Dissolved	Analysis	6010B		1	613679	08/10/21 23:54	EEN	TAL CHI
Total/NA	Prep	3010A			613499	08/10/21 08:44	BDE	TAL CHI
Total/NA	Analysis	6010B		1	613679	08/10/21 23:50	EEN	TAL CHI
Total/NA	Analysis	9056A		2	614638	08/17/21 18:01	EAT	TAL CHI
Total/NA	Analysis	9056A		10	614951	08/18/21 14:01	EAT	TAL CHI
Dissolved	Analysis	9060A		1	613783		TMS	TAL CHI
					(Start)	08/09/21 23:33		
					(End)	08/09/21 23:33		
Total/NA	Analysis	SM 2320B		1	614414	08/15/21 19:21	MS	TAL CHI
Total/NA	Analysis	SM 2540C		1	613305	08/09/21 09:56	CLB	TAL CHI
Total/NA	Analysis	SM 3500		1	615136	08/19/21 14:42	PFK	TAL CHI
Total/NA	Analysis	SM 3500 Fe B		1	613311	08/11/21 05:00	CLB	TAL CHI
Total/NA	Prep	SM 4500 P B			614309	08/15/21 12:30	JMP	TAL CHI
Total/NA	Analysis	SM 4500 P E		1	614916	08/18/21 12:23	JMP	TAL CHI
Total/NA	Analysis	SM 4500 S2 F		1	613518		CLB	TAL CHI
					(Start)	08/10/21 00:16		
					(End)	08/10/21 00:20		

Lab Chronicle

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: DUP-20210803

Lab Sample ID: 500-203343-5

Date Collected: 08/03/21 13:30
Matrix: Water
Date Received: 08/05/21 09:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Dissolved	Prep	3010A			613499	08/10/21 08:44	BDE	TAL CHI
Dissolved	Analysis	6010B		1	613679	08/11/21 00:14	EEN	TAL CHI
Total/NA	Prep	3010A			613499	08/10/21 08:44	BDE	TAL CHI
Total/NA	Analysis	6010B		1	613679	08/10/21 23:58	EEN	TAL CHI
Total/NA	Analysis	9056A		2	614638	08/17/21 18:28	EAT	TAL CHI
Total/NA	Analysis	9056A		10	614951	08/18/21 14:15	EAT	TAL CHI
Dissolved	Analysis	9060A		1	613783		TMS	TAL CHI
					(Start)	08/09/21 23:40		
					(End)	08/09/21 23:40		
Total/NA	Analysis	SM 2320B		1	614414	08/15/21 19:28	MS	TAL CHI
Total/NA	Analysis	SM 2540C		1	613305	08/09/21 09:59	CLB	TAL CHI
Total/NA	Analysis	SM 3500		1	615136	08/19/21 14:42	PFK	TAL CHI
Total/NA	Analysis	SM 3500 Fe B		1	613311	08/11/21 05:03	CLB	TAL CHI
Total/NA	Prep	SM 4500 P B			614309	08/15/21 12:30	JMP	TAL CHI
Total/NA	Analysis	SM 4500 P E		1	614916	08/18/21 12:42	JMP	TAL CHI
Total/NA	Analysis	SM 4500 S2 F		1	613518		CLB	TAL CHI
					(Start)	08/10/21 00:20		
					(End)	08/10/21 00:23		

Client Sample ID: CL-2-20210803

Lab Sample ID: 500-203343-6

Date Collected: 08/03/21 13:50
Matrix: Water
Date Received: 08/05/21 09:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Dissolved	Prep	3010A			613499	08/10/21 08:44	BDE	TAL CHI
Dissolved	Analysis	6010B		1	613679	08/11/21 00:21	EEN	TAL CHI
Total/NA	Prep	3010A			613499	08/10/21 08:44	BDE	TAL CHI
Total/NA	Analysis	6010B		1	613679	08/11/21 00:18	EEN	TAL CHI
Total/NA	Analysis	9056A		2	614638	08/17/21 18:55	EAT	TAL CHI
Total/NA	Analysis	9056A		10	614951	08/18/21 14:29	EAT	TAL CHI
Dissolved	Analysis	9060A		1	613783		TMS	TAL CHI
					(Start)	08/09/21 23:47		
					(End)	08/09/21 23:47		
Total/NA	Analysis	SM 2320B		1	614414	08/15/21 19:35	MS	TAL CHI
Total/NA	Analysis	SM 2540C		1	613305	08/09/21 10:02	CLB	TAL CHI
Total/NA	Analysis	SM 3500		1	615136	08/19/21 14:42	PFK	TAL CHI
Total/NA	Analysis	SM 3500 Fe B		1	613311	08/11/21 05:06	CLB	TAL CHI
Total/NA	Prep	SM 4500 P B			614309	08/15/21 12:30	JMP	TAL CHI
Total/NA	Analysis	SM 4500 P E		1	614916	08/18/21 12:43	JMP	TAL CHI
Total/NA	Analysis	SM 4500 S2 F		1	613518		CLB	TAL CHI
					(Start)	08/10/21 00:23		
					(End)	08/10/21 00:27		

Lab Chronicle

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Client Sample ID: CL-3-20210803

Date Collected: 08/03/21 14:20
Date Received: 08/05/21 09:45

Lab Sample ID: 500-203343-7

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Dissolved	Prep	3010A			613499	08/10/21 08:44	BDE	TAL CHI
Dissolved	Analysis	6010B		1	613679	08/11/21 00:29	EEN	TAL CHI
Total/NA	Prep	3010A			613499	08/10/21 08:44	BDE	TAL CHI
Total/NA	Analysis	6010B		1	613679	08/11/21 00:25	EEN	TAL CHI
Total/NA	Analysis	9056A		2	614638	08/17/21 19:23	EAT	TAL CHI
Total/NA	Analysis	9056A		10	614951	08/18/21 14:42	EAT	TAL CHI
Dissolved	Analysis	9060A		1	613783		TMS	TAL CHI
					(Start)	08/09/21 23:55		
					(End)	08/09/21 23:55		
Total/NA	Analysis	SM 2320B		1	614414	08/15/21 19:41	MS	TAL CHI
Total/NA	Analysis	SM 2540C		1	613305	08/09/21 10:04	CLB	TAL CHI
Total/NA	Analysis	SM 3500		1	615136	08/19/21 14:42	PFK	TAL CHI
Total/NA	Analysis	SM 3500 Fe B		1	613311	08/11/21 05:09	CLB	TAL CHI
Total/NA	Prep	SM 4500 P B			614309	08/15/21 12:30	JMP	TAL CHI
Total/NA	Analysis	SM 4500 P E		1	614916	08/18/21 12:44	JMP	TAL CHI
Total/NA	Analysis	SM 4500 S2 F		1	613518		CLB	TAL CHI
					(Start)	08/10/21 00:27		
					(End)	08/10/21 00:31		

Laboratory References:

TAL CHI = Eurofins TestAmerica, Chicago, 2417 Bond Street, University Park, IL 60484, TEL (708)534-5200

Accreditation/Certification Summary

Client: Geosyntec Consultants, Inc.
Project/Site: GLP8029 Coffeen, IL

Job ID: 500-203343-1

Laboratory: Eurofins TestAmerica, Chicago

The accreditations/certifications listed below are applicable to this report.

Authority	Program	Identification Number	Expiration Date
Illinois	NELAP	IL00035	04-29-22

Eurofins TestAmerica, Chicago
2417 Bond Street
University Park IL 60484
Phone 708-534-5200 Fax 708-534-5211

Chain of Custody Record

eurofins Environment Testing America

500-203343 COC

Client Information	Sampler: Nick Williams	Lab PM: Kintz Robin M	Ca	COC No: 500-93566-41606 1
Client Contact: Brian Ares	Phone: 317 694 9143	E-Mail: Robin Kintz@Eurofinset com	Sta	Page: Page 1 of 1
Company: Geosyntec Consultants Inc	PWSID:			Job #: 500-203343
Address: 2100 Commonwealth Blvd Suite 100	Due Date Requested:			
City: Ann Arbor	TAT Requested (days):			
State Zip: MI 48105	Compliance Project: Δ Yes Δ No			
Phone: 734-794-1548(Tel)	PO #: Purchase Order not required			
Email: bares@geosyntec com	WO #:			
Project Name: GLP8029 Coffeen IL	Project #: 50019213			
Site:	SSOW#:			

Analysis Requested

	Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water S=solid O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	9056A - Chloride, Sulfate	6010B - Metals (ICP) - 9 elements	6010B - Dissolved Metals (ICP) - 9 elements	4500_P_E - Phosphorus as PO4	SM4500_S2_F - Sulfide	9060A_Diss - Organic Carbon Dissolved (DOC)	2320B 2540C 3500_F+2_B_Calc 3500_F+3_B_Calc	~~9056A Chloride, Sulfate (Dissolved)~~	Total Number of containers	Special Instructions/Note
				Preservation Code:				N	D	D	S	CB	S	N	N		
1	D-2-20210803	8/3/21	1015	G	W		N	X	X	X	X	X	X	X	X		Filtered in field for
2	D-1-20210803		1050	G	W		N	X	X	X	X	X	X	X	X		Dissolved Metals, DOC,
3	BKG-1-20210803		1245	G	W		N	X	X	X	X	X	X	X	X		~~and Dissolved Chloride,~~
4	CL-1-20210803		1320	G	W		N	X	X	X	X	X	X	X	X		~~Sulfate~~ NW
5	DUP-20210803		1330	G	W		N	X	X	X	X	X	X	X	X		
6	CL-2-20210803		1350	G	W		N	X	X	X	X	X	X	X	X		
7	CL-3-20210803		1420	G	W		N	X	X	X	X	X	X	X	X NW		

Preservation Codes

A	HCL	M	Hexane
B	NaOH	N	None
C	Zn Acetate	O	AsNaO2
D	Nitric Acid	P	Na2O4S
E	NaHSO4	Q	Na2SO3
F	MeOH	R	Na2S2O3
G	Amchlor	S	H2SO4
H	Ascorbic Acid	T	TSP Dodecahydrate
I	Ice	U	Acetone
J	DI Water	V	MCAA
K	EDTA	W	pH 4-5
L	EDA	Z	other (specify)

Other:

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months

Deliverable Requested I II III IV Other (specify)

Special Instructions/QC Requirements

Empty Kit Relinquished by	Date	Time	Method of Shipment

Relinquished by	Date/Time	Company	Received by	Date/Time	Company
[signature]	8/4/21 930	GO	[signature]	8/5/21 0945	ETA
Relinquished by:	Date/Time	Company	Received by:	Date/Time	Company
Relinquished by:	Date/Time	Company	Received by:	Date/Time	Company

Custody Seals Intact: Δ Yes Δ No | Custody Seal No | Cooler Temperature(s) °C and Other Remarks

Login Sample Receipt Checklist

Client: Geosyntec Consultants, Inc.

Job Number: 500-203343-1

Login Number: 203343
List Number: 1
Creator: James, Jeff A

List Source: Eurofins TestAmerica, Chicago

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	1.1, 2.5
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

PDC Laboratories, Inc.

PROFESSIONAL • DEPENDABLE • COMMITTED

November 08, 2016

Rhonald Hasenyager
Hanson Professional Services, Inc.
1525 South Sixth Street
Springfield, IL 62703-2886

Dear Rhonald Hasenyager:

Please find enclosed the analytical results for the sample(s) the laboratory received on **10/25/16 7:45 am** and logged in under work order **6103663**. All testing is performed according to our current TNI certifications unless otherwise noted. This report cannot be reproduced, except in full, without the written permission of PDC Laboratories, Inc.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

PDC Laboratories, Inc. appreciates the opportunity to provide you with analytical expertise. We are always trying to improve our customer service and we welcome you to contact the Vice President , John LaPayne with any feedback you have about your experience with our laboratory.

Sincerely,

Gail J Schindler

Gail Schindler
Project Manager
(309) 692-9688 x1716
gschindler@pdclab.com

NELAP ACCREDITED TNI LABORATORY

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-01**
Name: AP1a
Matrix: Surface Water - Grab

Sampled: 10/24/16 11:52
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	3.2	mg/L		10/25/16 11:16	10/25/16 11:16	TAS	EPA 300.0
Fluoride	< 0.250	mg/L		10/25/16 11:16	10/25/16 11:16	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 11:16	10/25/16 11:16	TAS	EPA 300.0
Sulfate	1500	mg/L		10/27/16 13:02	10/27/16 13:02	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	6.99	pH Units		10/24/16 11:52	10/24/16 11:52	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	90	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Solids - total dissolved solids (TDS)	1800	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	3.1	ug/L		10/26/16 13:38	11/02/16 12:10	JMW	SW 6020
Arsenic	7.2	ug/L		10/26/16 13:38	11/01/16 11:23	JMW	SW 6020
Barium	130	ug/L		10/26/16 13:38	11/01/16 11:23	JMW	SW 6020
Beryllium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:23	JMW	SW 6020
Boron	3800	ug/L		10/26/16 13:38	11/03/16 07:54	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:23	JMW	SW 6020
Calcium	380	mg/L		10/26/16 13:38	11/01/16 11:23	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 11:23	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/01/16 11:23	JMW	SW 6020
Lithium	39	ug/L		10/26/16 13:38	10/27/16 11:24	KJP	SW 6010*
Magnesium	67	mg/L		10/26/16 13:38	11/01/16 11:23	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 13:53	JMW	SW 6020
Molybdenum	47	ug/L		10/26/16 13:38	11/01/16 11:23	JMW	SW 6020
Potassium	7.3	mg/L		10/26/16 13:38	11/01/16 11:23	JMW	SW 6020
Selenium	3.0	ug/L		10/26/16 13:38	11/01/16 11:23	JMW	SW 6020
Sodium	33	mg/L		10/26/16 13:38	11/01/16 11:23	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:23	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-02**
Name: AP1b
Matrix: Surface Water - Grab

Sampled: 10/24/16 11:56
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	13	mg/L		10/27/16 13:20	10/27/16 13:20	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 12:45	10/25/16 12:45	TAS	EPA 300.0
Sulfate	1300	mg/L		10/27/16 13:38	10/27/16 13:38	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	7.01	pH Units		10/24/16 11:56	10/24/16 11:56	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	120	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Fluoride	0.977	mg/L		10/27/16 13:26	10/27/16 13:26	TTH	SM 4500-F C
Solids - total dissolved solids (TDS)	1600	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	3.3	ug/L		10/26/16 13:38	11/02/16 12:23	JMW	SW 6020
Arsenic	17	ug/L		10/26/16 13:38	11/01/16 11:36	JMW	SW 6020
Barium	100	ug/L		10/26/16 13:38	11/01/16 11:36	JMW	SW 6020
Beryllium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:36	JMW	SW 6020
Boron	3100	ug/L		10/26/16 13:38	11/03/16 07:59	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:36	JMW	SW 6020
Calcium	320	mg/L		10/26/16 13:38	11/01/16 11:36	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 11:36	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/01/16 11:36	JMW	SW 6020
Lithium	47	ug/L		10/26/16 13:38	10/27/16 11:33	KJP	SW 6010*
Magnesium	52	mg/L		10/26/16 13:38	11/01/16 11:36	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 14:06	JMW	SW 6020
Molybdenum	100	ug/L		10/26/16 13:38	11/01/16 11:36	JMW	SW 6020
Potassium	18	mg/L		10/26/16 13:38	11/01/16 11:36	JMW	SW 6020
Selenium	6.9	ug/L		10/26/16 13:38	11/01/16 11:36	JMW	SW 6020
Sodium	53	mg/L		10/26/16 13:38	11/01/16 11:36	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:36	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-03**
Name: AP1c
Matrix: Surface Water - Grab

Sampled: 10/24/16 12:10
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	13	mg/L		10/27/16 13:55	10/27/16 13:55	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 13:21	10/25/16 13:21	TAS	EPA 300.0
Sulfate	1600	mg/L		10/27/16 14:13	10/27/16 14:13	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	7.05	pH Units		10/24/16 12:10	10/24/16 12:10	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	80	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Fluoride	0.614	mg/L		10/27/16 13:30	10/27/16 13:30	TTH	SM 4500-F C
Solids - total dissolved solids (TDS)	1900	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 12:26	JMW	SW 6020
Arsenic	18	ug/L		10/26/16 13:38	11/01/16 11:39	JMW	SW 6020
Barium	130	ug/L		10/26/16 13:38	11/01/16 11:39	JMW	SW 6020
Beryllium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:39	JMW	SW 6020
Boron	2900	ug/L		10/26/16 13:38	11/03/16 08:01	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:39	JMW	SW 6020
Calcium	390	mg/L		10/26/16 13:38	11/01/16 11:39	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 11:39	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/01/16 11:39	JMW	SW 6020
Lithium	51	ug/L		10/26/16 13:38	10/27/16 11:36	KJP	SW 6010*
Magnesium	49	mg/L		10/26/16 13:38	11/01/16 11:39	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 14:10	JMW	SW 6020
Molybdenum	81	ug/L		10/26/16 13:38	11/01/16 11:39	JMW	SW 6020
Potassium	18	mg/L		10/26/16 13:38	11/01/16 11:39	JMW	SW 6020
Selenium	3.1	ug/L		10/26/16 13:38	11/01/16 11:39	JMW	SW 6020
Sodium	59	mg/L		10/26/16 13:38	11/01/16 11:39	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:39	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-04**
Name: AP1d
Matrix: Surface Water - Grab

Sampled: 10/24/16 12:15
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	18	mg/L		10/27/16 14:31	10/27/16 14:31	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 13:57	10/25/16 13:57	TAS	EPA 300.0
Sulfate	1000	mg/L		10/27/16 14:48	10/27/16 14:48	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	7.21	pH Units		10/24/16 12:15	10/24/16 12:15	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	90	mg/L		10/25/16 09:29	10/25/16 09:29	CJN	SM 2320B*
Alkalinity - carbonate as CaCO3	< 20	mg/L		10/25/16 09:29	10/25/16 09:29	CJN	SM 2320B*
Fluoride	1.08	mg/L		10/27/16 13:43	10/27/16 13:43	TTH	SM 4500-F C
Solids - total dissolved solids (TDS)	980	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 12:30	JMW	SW 6020
Arsenic	2.0	ug/L		10/26/16 13:38	11/01/16 11:43	JMW	SW 6020
Barium	200	ug/L		10/26/16 13:38	11/01/16 11:43	JMW	SW 6020
Beryllium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:43	JMW	SW 6020
Boron	2000	ug/L		10/26/16 13:38	11/03/16 08:02	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:43	JMW	SW 6020
Calcium	210	mg/L		10/26/16 13:38	11/01/16 11:43	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 11:43	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/01/16 11:43	JMW	SW 6020
Lithium	55	ug/L		10/26/16 13:38	10/27/16 11:39	KJP	SW 6010*
Magnesium	35	mg/L		10/26/16 13:38	11/01/16 11:43	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 14:13	JMW	SW 6020
Molybdenum	31	ug/L		10/26/16 13:38	11/01/16 11:43	JMW	SW 6020
Potassium	26	mg/L		10/26/16 13:38	11/01/16 11:43	JMW	SW 6020
Selenium	1.5	ug/L		10/26/16 13:38	11/01/16 11:43	JMW	SW 6020
Sodium	83	mg/L		10/26/16 13:38	11/01/16 11:43	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:43	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-05**
Name: AP1e
Matrix: Surface Water - Grab

Sampled: 10/24/16 12:01
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	18	mg/L		10/27/16 18:37	10/27/16 18:37	TAS	EPA 300.0
Fluoride	1.00	mg/L		10/25/16 13:26	10/25/16 13:26	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 13:26	10/25/16 13:26	TAS	EPA 300.0
Sulfate	960	mg/L		10/28/16 11:36	10/28/16 11:36	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	7.12	pH Units		10/24/16 12:01	10/24/16 12:01	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	80	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Solids - total dissolved solids (TDS)	1200	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 12:45	JMW	SW 6020
Arsenic	1.4	ug/L		10/26/16 13:38	11/01/16 11:46	JMW	SW 6020
Barium	160	ug/L		10/26/16 13:38	11/01/16 11:46	JMW	SW 6020
Beryllium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:46	JMW	SW 6020
Boron	2100	ug/L		10/26/16 13:38	11/03/16 08:03	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:46	JMW	SW 6020
Calcium	200	mg/L		10/26/16 13:38	11/01/16 11:46	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 11:46	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/01/16 11:46	JMW	SW 6020
Lithium	55	ug/L		10/26/16 13:38	10/27/16 11:48	KJP	SW 6010*
Magnesium	34	mg/L		10/26/16 13:38	11/01/16 11:46	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 14:17	JMW	SW 6020
Molybdenum	30	ug/L		10/26/16 13:38	11/01/16 11:46	JMW	SW 6020
Potassium	26	mg/L		10/26/16 13:38	11/01/16 11:46	JMW	SW 6020
Selenium	1.2	ug/L		10/26/16 13:38	11/01/16 11:46	JMW	SW 6020
Sodium	80	mg/L		10/26/16 13:38	11/01/16 11:46	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:46	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-06**
Name: AP1f
Matrix: Surface Water - Grab

Sampled: 10/24/16 12:40
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	17	mg/L		10/27/16 15:06	10/27/16 15:06	TAS	EPA 300.0
Fluoride	1.00	mg/L		10/25/16 14:03	10/25/16 14:03	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 14:03	10/25/16 14:03	TAS	EPA 300.0
Sulfate	1000	mg/L		10/27/16 15:23	10/27/16 15:23	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	7.20	pH Units		10/24/16 12:40	10/24/16 12:40	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	110	mg/L		10/25/16 09:29	10/25/16 09:29	CJN	SM 2320B*
Alkalinity - carbonate as CaCO3	< 20	mg/L		10/25/16 09:29	10/25/16 09:29	CJN	SM 2320B*
Solids - total dissolved solids (TDS)	1200	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 12:48	JMW	SW 6020
Arsenic	1.5	ug/L		10/26/16 13:38	11/01/16 11:50	JMW	SW 6020
Barium	150	ug/L		10/26/16 13:38	11/01/16 11:50	JMW	SW 6020
Beryllium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:50	JMW	SW 6020
Boron	2100	ug/L		10/26/16 13:38	11/03/16 08:13	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:50	JMW	SW 6020
Calcium	200	mg/L		10/26/16 13:38	11/01/16 11:50	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 11:50	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/01/16 11:50	JMW	SW 6020
Lithium	57	ug/L		10/26/16 13:38	10/27/16 11:51	KJP	SW 6010*
Magnesium	35	mg/L		10/26/16 13:38	11/01/16 11:50	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 14:21	JMW	SW 6020
Molybdenum	31	ug/L		10/26/16 13:38	11/01/16 11:50	JMW	SW 6020
Potassium	26	mg/L		10/26/16 13:38	11/01/16 11:50	JMW	SW 6020
Selenium	1.2	ug/L		10/26/16 13:38	11/01/16 11:50	JMW	SW 6020
Sodium	82	mg/L		10/26/16 13:38	11/01/16 11:50	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 11:50	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-07**
Name: AP1g
Matrix: Surface Water - Grab

Sampled: 10/24/16 12:50
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	17	mg/L		10/27/16 15:41	10/27/16 15:41	TAS	EPA 300.0
Fluoride	1.00	mg/L		10/25/16 15:34	10/25/16 15:34	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 15:34	10/25/16 15:34	TAS	EPA 300.0
Sulfate	970	mg/L		10/28/16 11:54	10/28/16 11:54	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	7.21	pH Units		10/24/16 12:50	10/24/16 12:50	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	75	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Solids - total dissolved solids (TDS)	1200	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 12:52	JMW	SW 6020
Arsenic	1.3	ug/L		10/26/16 13:38	11/01/16 12:09	JMW	SW 6020
Barium	140	ug/L		10/26/16 13:38	11/01/16 14:37	JMW	SW 6020
Beryllium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:09	JMW	SW 6020
Boron	2100	ug/L		10/26/16 13:38	11/03/16 08:16	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:09	JMW	SW 6020
Calcium	210	mg/L		10/26/16 13:38	11/02/16 12:52	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 14:37	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/02/16 12:52	JMW	SW 6020
Lithium	56	ug/L		10/26/16 13:38	10/27/16 11:54	KJP	SW 6010*
Magnesium	32	mg/L		10/26/16 13:38	11/01/16 14:37	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 14:37	JMW	SW 6020
Molybdenum	29	ug/L		10/26/16 13:38	11/01/16 12:09	JMW	SW 6020
Potassium	26	mg/L		10/26/16 13:38	11/01/16 12:09	JMW	SW 6020
Selenium	1.4	ug/L		10/26/16 13:38	11/01/16 12:09	JMW	SW 6020
Sodium	100	mg/L		10/26/16 13:38	11/02/16 12:52	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:09	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-08**
Name: AP1h
Matrix: Surface Water - Grab

Sampled: 10/24/16 12:55
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	17	mg/L		10/27/16 16:51	10/27/16 16:51	TAS	EPA 300.0
Fluoride	0.980	mg/L		10/25/16 16:11	10/25/16 16:11	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 16:11	10/25/16 16:11	TAS	EPA 300.0
Sulfate	1000	mg/L		10/28/16 12:12	10/28/16 12:12	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	7.41	pH Units		10/24/16 12:55	10/24/16 12:55	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	90	mg/L		10/25/16 09:29	10/25/16 09:29	CJN	SM 2320B*
Alkalinity - carbonate as CaCO3	< 20	mg/L		10/25/16 09:29	10/25/16 09:29	CJN	SM 2320B*
Solids - total dissolved solids (TDS)	1200	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 12:55	JMW	SW 6020
Arsenic	1.5	ug/L		10/26/16 13:38	11/01/16 12:12	JMW	SW 6020
Barium	180	ug/L		10/26/16 13:38	11/01/16 14:40	JMW	SW 6020
Beryllium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:12	JMW	SW 6020
Boron	2200	ug/L		10/26/16 13:38	11/03/16 08:18	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:12	JMW	SW 6020
Calcium	230	mg/L		10/26/16 13:38	11/02/16 12:55	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 14:40	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/02/16 12:55	JMW	SW 6020
Lithium	55	ug/L		10/26/16 13:38	10/27/16 11:57	KJP	SW 6010*
Magnesium	30	mg/L		10/26/16 13:38	11/01/16 14:40	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 14:40	JMW	SW 6020
Molybdenum	31	ug/L		10/26/16 13:38	11/01/16 12:12	JMW	SW 6020
Potassium	27	mg/L		10/26/16 13:38	11/01/16 12:12	JMW	SW 6020
Selenium	1.2	ug/L		10/26/16 13:38	11/01/16 12:12	JMW	SW 6020
Sodium	110	mg/L		10/26/16 13:38	11/02/16 12:55	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:12	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-09**
Name: AP2e
Matrix: Surface Water - Grab

Sampled: 10/24/16 11:30
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	< 5.0	mg/L		10/27/16 17:27	10/27/16 17:27	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 14:33	10/25/16 14:33	TAS	EPA 300.0
Sulfate	1500	mg/L		10/28/16 12:31	10/28/16 12:31	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	6.49	pH Units		10/24/16 11:30	10/24/16 11:30	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	55	mg/L		10/25/16 09:29	10/25/16 09:29	CJN	SM 2320B*
Alkalinity - carbonate as CaCO3	< 20	mg/L		10/25/16 09:29	10/25/16 09:29	CJN	SM 2320B*
Fluoride	0.438	mg/L		10/27/16 13:58	10/27/16 13:58	TTH	SM 4500-F C
Solids - total dissolved solids (TDS)	1700	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 12:59	JMW	SW 6020
Arsenic	23	ug/L		10/26/16 13:38	11/01/16 12:16	JMW	SW 6020
Barium	26	ug/L		10/26/16 13:38	11/01/16 14:44	JMW	SW 6020
Beryllium	< 1.0	ug/L		10/26/16 13:38	11/02/16 12:59	JMW	SW 6020
Boron	5300	ug/L		10/26/16 13:38	11/03/16 08:19	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:16	JMW	SW 6020
Calcium	210	mg/L		10/26/16 13:38	11/02/16 12:59	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 14:44	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/02/16 12:59	JMW	SW 6020
Lithium	190	ug/L		10/26/16 13:38	10/27/16 12:00	KJP	SW 6010*
Magnesium	40	mg/L		10/26/16 13:38	11/01/16 14:44	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 14:44	JMW	SW 6020
Molybdenum	90	ug/L		10/26/16 13:38	11/01/16 12:16	JMW	SW 6020
Potassium	27	mg/L		10/26/16 13:38	11/01/16 12:16	JMW	SW 6020
Selenium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:16	JMW	SW 6020
Sodium	25	mg/L		10/26/16 13:38	11/02/16 12:59	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:16	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-10**
Name: AP2f
Matrix: Surface Water - Grab

Sampled: 10/24/16 11:20
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	< 5.0	mg/L		10/27/16 18:02	10/27/16 18:02	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 15:09	10/25/16 15:09	TAS	EPA 300.0
Sulfate	1500	mg/L		10/28/16 12:49	10/28/16 12:49	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	6.42	pH Units		10/24/16 11:20	10/24/16 11:20	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	100	mg/L		10/25/16 09:29	10/25/16 09:29	CJN	SM 2320B*
Alkalinity - carbonate as CaCO3	< 20	mg/L		10/25/16 09:29	10/25/16 09:29	CJN	SM 2320B*
Fluoride	0.398	mg/L		10/27/16 14:02	10/27/16 14:02	TTH	SM 4500-F C
Solids - total dissolved solids (TDS)	1700	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 13:03	JMW	SW 6020
Arsenic	1.2	ug/L		10/26/16 13:38	11/01/16 12:20	JMW	SW 6020
Barium	22	ug/L		10/26/16 13:38	11/01/16 14:47	JMW	SW 6020
Beryllium	< 2.0	ug/L		10/26/16 13:38	11/02/16 13:54	JMW	SW 6020
Boron	2000	ug/L		10/26/16 13:38	11/03/16 08:20	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:20	JMW	SW 6020
Calcium	170	mg/L		10/26/16 13:38	11/02/16 13:54	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 14:47	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/02/16 13:03	JMW	SW 6020
Lithium	130	ug/L		10/26/16 13:38	10/27/16 12:03	KJP	SW 6010*
Magnesium	33	mg/L		10/26/16 13:38	11/01/16 14:47	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 14:47	JMW	SW 6020
Molybdenum	3.2	ug/L		10/26/16 13:38	11/01/16 12:20	JMW	SW 6020
Potassium	21	mg/L		10/26/16 13:38	11/01/16 12:20	JMW	SW 6020
Selenium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:20	JMW	SW 6020
Sodium	14	mg/L		10/26/16 13:38	11/02/16 13:03	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:20	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-11**
Name: AP2g
Matrix: Surface Water - Grab

Sampled: 10/24/16 11:10
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	< 5.0	mg/L		10/27/16 19:12	10/27/16 19:12	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 16:20	10/25/16 16:20	TAS	EPA 300.0
Sulfate	2300	mg/L		10/28/16 13:07	10/28/16 13:07	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	6.46	pH Units		10/24/16 11:10	10/24/16 11:10	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	4.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Fluoride	0.506	mg/L		10/27/16 14:07	10/27/16 14:07	TTH	SM 4500-F C
Solids - total dissolved solids (TDS)	2400	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 13:06	JMW	SW 6020
Arsenic	5.5	ug/L		10/26/16 13:38	11/01/16 12:23	JMW	SW 6020
Barium	20	ug/L		10/26/16 13:38	11/01/16 14:51	JMW	SW 6020
Beryllium	< 2.0	ug/L		10/26/16 13:38	11/02/16 13:57	JMW	SW 6020
Boron	4300	ug/L		10/26/16 13:38	11/03/16 08:22	JMW	SW 6020
Cadmium	4.6	ug/L		10/26/16 13:38	11/01/16 12:23	JMW	SW 6020
Calcium	410	mg/L		10/26/16 13:38	11/02/16 13:57	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 14:51	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/02/16 13:06	JMW	SW 6020
Lithium	180	ug/L		10/26/16 13:38	10/27/16 12:06	KJP	SW 6010*
Magnesium	51	mg/L		10/26/16 13:38	11/01/16 14:51	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 14:51	JMW	SW 6020
Molybdenum	41	ug/L		10/26/16 13:38	11/01/16 12:23	JMW	SW 6020
Potassium	29	mg/L		10/26/16 13:38	11/01/16 12:23	JMW	SW 6020
Selenium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:23	JMW	SW 6020
Sodium	27	mg/L		10/26/16 13:38	11/02/16 13:06	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:23	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-12**
Name: AP2h
Matrix: Surface Water - Grab

Sampled: 10/24/16 11:40
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	1.7	mg/L		10/25/16 16:56	10/25/16 16:56	TAS	EPA 300.0
Fluoride	0.406	mg/L		10/25/16 16:56	10/25/16 16:56	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 16:56	10/25/16 16:56	TAS	EPA 300.0
Sulfate	1300	mg/L		10/28/16 14:57	10/28/16 14:57	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	7.17	pH Units		10/24/16 11:40	10/24/16 11:40	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	140	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Solids - total dissolved solids (TDS)	1500	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 13:10	JMW	SW 6020
Arsenic	75	ug/L		10/26/16 13:38	11/01/16 12:27	JMW	SW 6020
Barium	23	ug/L		10/26/16 13:38	11/01/16 14:55	JMW	SW 6020
Beryllium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:27	JMW	SW 6020
Boron	14000	ug/L		10/26/16 13:38	11/03/16 08:23	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:27	JMW	SW 6020
Calcium	310	mg/L		10/26/16 13:38	11/02/16 13:10	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 14:55	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/02/16 13:10	JMW	SW 6020
Lithium	120	ug/L		10/26/16 13:38	10/27/16 12:09	KJP	SW 6010*
Magnesium	29	mg/L		10/26/16 13:38	11/01/16 14:55	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 14:55	JMW	SW 6020
Molybdenum	570	ug/L		10/26/16 13:38	11/01/16 12:27	JMW	SW 6020
Potassium	40	mg/L		10/26/16 13:38	11/03/16 08:23	JMW	SW 6020
Selenium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:27	JMW	SW 6020
Sodium	39	mg/L		10/26/16 13:38	11/02/16 13:10	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:27	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-13**
Name: CLa
Matrix: Surface Water - Grab

Sampled: 10/24/16 15:30
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	23	mg/L		10/27/16 20:41	10/27/16 20:41	TAS	EPA 300.0
Fluoride	0.443	mg/L		10/25/16 17:32	10/25/16 17:32	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 17:32	10/25/16 17:32	TAS	EPA 300.0
Sulfate	55	mg/L		10/25/16 17:50	10/25/16 17:50	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	7.22	pH Units		10/24/16 15:30	10/24/16 15:30	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	80	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Solids - total dissolved solids (TDS)	190	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 13:14	JMW	SW 6020
Arsenic	1.8	ug/L		10/26/16 13:38	11/01/16 12:30	JMW	SW 6020
Barium	54	ug/L		10/26/16 13:38	11/01/16 14:58	JMW	SW 6020
Beryllium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:30	JMW	SW 6020
Boron	270	ug/L		10/26/16 13:38	11/03/16 08:24	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:30	JMW	SW 6020
Calcium	23	mg/L		10/26/16 13:38	11/02/16 13:14	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 14:58	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/02/16 13:14	JMW	SW 6020
Lithium	< 10	ug/L		10/26/16 13:38	10/27/16 12:12	KJP	SW 6010*
Magnesium	12	mg/L		10/26/16 13:38	11/01/16 14:58	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 14:58	JMW	SW 6020
Molybdenum	5.0	ug/L		10/26/16 13:38	11/01/16 12:30	JMW	SW 6020
Potassium	7.4	mg/L		10/26/16 13:38	11/01/16 12:30	JMW	SW 6020
Selenium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:30	JMW	SW 6020
Sodium	19	mg/L		10/26/16 13:38	11/02/16 13:14	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:30	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-14**
Name: CLb
Matrix: Surface Water - Grab

Sampled: 10/24/16 13:35
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	22	mg/L		10/27/16 20:58	10/27/16 20:58	TAS	EPA 300.0
Fluoride	0.425	mg/L		10/25/16 18:08	10/25/16 18:08	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 18:08	10/25/16 18:08	TAS	EPA 300.0
Sulfate	56	mg/L		10/25/16 18:26	10/25/16 18:26	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	7.52	pH Units		10/24/16 13:35	10/24/16 13:35	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	80	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Solids - total dissolved solids (TDS)	180	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 13:17	JMW	SW 6020
Arsenic	1.8	ug/L		10/26/16 13:38	11/01/16 12:34	JMW	SW 6020
Barium	52	ug/L		10/26/16 13:38	11/01/16 15:02	JMW	SW 6020
Beryllium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:34	JMW	SW 6020
Boron	280	ug/L		10/26/16 13:38	11/03/16 08:26	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:34	JMW	SW 6020
Calcium	23	mg/L		10/26/16 13:38	11/02/16 13:17	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 15:02	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/02/16 13:17	JMW	SW 6020
Lithium	< 10	ug/L		10/26/16 13:38	10/27/16 12:15	KJP	SW 6010*
Magnesium	11	mg/L		10/26/16 13:38	11/01/16 15:02	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 15:02	JMW	SW 6020
Molybdenum	4.9	ug/L		10/26/16 13:38	11/01/16 12:34	JMW	SW 6020
Potassium	7.8	mg/L		10/26/16 13:38	11/01/16 12:34	JMW	SW 6020
Selenium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:34	JMW	SW 6020
Sodium	19	mg/L		10/26/16 13:38	11/02/16 13:17	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:34	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-15**
Name: CLc
Matrix: Surface Water - Grab

Sampled: 10/24/16 13:15
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	22	mg/L		10/27/16 21:16	10/27/16 21:16	TAS	EPA 300.0
Fluoride	0.426	mg/L		10/25/16 18:43	10/25/16 18:43	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 18:43	10/25/16 18:43	TAS	EPA 300.0
Sulfate	54	mg/L		10/25/16 19:01	10/25/16 19:01	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	7.62	pH Units		10/24/16 13:15	10/24/16 13:15	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	75	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Solids - total dissolved solids (TDS)	160	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 13:29	JMW	SW 6020
Arsenic	1.8	ug/L		10/26/16 13:38	11/01/16 12:38	JMW	SW 6020
Barium	56	ug/L		10/26/16 13:38	11/01/16 15:05	JMW	SW 6020
Beryllium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:38	JMW	SW 6020
Boron	280	ug/L		10/26/16 13:38	11/03/16 08:27	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:38	JMW	SW 6020
Calcium	23	mg/L		10/26/16 13:38	11/02/16 13:29	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 15:05	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/02/16 13:29	JMW	SW 6020
Lithium	< 10	ug/L		10/26/16 13:38	10/27/16 12:24	KJP	SW 6010*
Magnesium	12	mg/L		10/26/16 13:38	11/01/16 15:05	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 15:05	JMW	SW 6020
Molybdenum	4.7	ug/L		10/26/16 13:38	11/01/16 12:38	JMW	SW 6020
Potassium	7.4	mg/L		10/26/16 13:38	11/01/16 12:38	JMW	SW 6020
Selenium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:38	JMW	SW 6020
Sodium	19	mg/L		10/26/16 13:38	11/02/16 13:29	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:38	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-16**
Name: CLd
Matrix: Surface Water - Grab

Sampled: 10/24/16 15:55
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	23	mg/L		10/27/16 21:34	10/27/16 21:34	TAS	EPA 300.0
Fluoride	0.421	mg/L		10/25/16 19:55	10/25/16 19:55	TAS	EPA 300.0
Nitrite-N	< 0.15	mg/L		10/25/16 19:55	10/25/16 19:55	TAS	EPA 300.0
Sulfate	54	mg/L		10/25/16 20:13	10/25/16 20:13	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	7.30	pH Units		10/24/16 15:55	10/24/16 15:55	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	80	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Solids - total dissolved solids (TDS)	170	mg/L		10/25/16 14:59	10/25/16 15:33	DMB/ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 13:32	JMW	SW 6020
Arsenic	1.8	ug/L		10/26/16 13:38	11/01/16 12:41	JMW	SW 6020
Barium	54	ug/L		10/26/16 13:38	11/01/16 15:09	JMW	SW 6020
Beryllium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:41	JMW	SW 6020
Boron	270	ug/L		10/26/16 13:38	11/03/16 08:41	JMW	SW 6020
Cadmium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:41	JMW	SW 6020
Calcium	23	mg/L		10/26/16 13:38	11/02/16 13:32	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 15:09	JMW	SW 6020
Cobalt	< 2.0	ug/L		10/26/16 13:38	11/02/16 13:32	JMW	SW 6020
Lithium	< 10	ug/L		10/26/16 13:38	10/27/16 12:27	KJP	SW 6010*
Magnesium	12	mg/L		10/26/16 13:38	11/01/16 15:09	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 13:38	11/01/16 15:09	JMW	SW 6020
Molybdenum	4.8	ug/L		10/26/16 13:38	11/01/16 12:41	JMW	SW 6020
Potassium	7.5	mg/L		10/26/16 13:38	11/01/16 12:41	JMW	SW 6020
Selenium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:41	JMW	SW 6020
Sodium	20	mg/L		10/26/16 13:38	11/02/16 13:32	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 12:41	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-17**
Name: GPa
Matrix: Surface Water - Grab

Sampled: 10/24/16 14:00
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	1900	mg/L		10/27/16 21:51	10/27/16 21:51	TAS	EPA 300.0
Nitrite-N	< 3.0	mg/L		10/26/16 11:42	10/26/16 11:42	TAS	EPA 300.0
Sulfate	17000	mg/L		11/01/16 09:58	11/01/16 09:58	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	7.16	pH Units		10/24/16 14:00	10/24/16 14:00	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	4.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Fluoride	42.7	mg/L		10/27/16 17:31	10/27/16 17:31	TTH	SM 4500-F C
Solids - total dissolved solids (TDS)	17000	mg/L		10/27/16 12:04	10/27/16 12:28	ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 13:36	JMW	SW 6020
Arsenic	4.7	ug/L		10/26/16 13:38	11/02/16 15:00	JMW	SW 6020
Barium	120	ug/L		10/26/16 13:38	11/02/16 13:36	JMW	SW 6020
Beryllium	2.6	ug/L		10/26/16 13:38	11/02/16 14:16	JMW	SW 6020
Boron	59000	ug/L		10/26/16 13:38	11/03/16 08:44	JMW	SW 6020
Cadmium	40	ug/L		10/26/16 13:38	11/02/16 15:53	JMW	SW 6020
Calcium	450	mg/L		10/26/16 13:38	11/02/16 14:16	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 15:20	JMW	SW 6020
Cobalt	52	ug/L		10/26/16 13:38	11/02/16 15:00	JMW	SW 6020
Lithium	300	ug/L		10/26/16 13:38	10/27/16 12:30	KJP	SW 6010*
Magnesium	1500	mg/L		10/26/16 13:38	11/02/16 14:16	JMW	SW 6020
Mercury	< 0.80	ug/L		10/26/16 13:38	11/02/16 15:00	JMW	SW 6020
Molybdenum	130	ug/L		10/26/16 13:38	11/02/16 14:16	JMW	SW 6020
Potassium	210	mg/L		10/26/16 13:38	11/03/16 09:03	JMW	SW 6020
Selenium	890	ug/L		10/26/16 13:38	11/02/16 15:00	JMW	SW 6020
Sodium	620	mg/L		10/26/16 13:38	11/02/16 13:36	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 15:20	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-18**
Name: GPb
Matrix: Surface Water - Grab

Sampled: 10/24/16 14:10
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	2600	mg/L		10/27/16 22:26	10/27/16 22:26	TAS	EPA 300.0
Nitrite-N	< 3.0	mg/L		10/26/16 12:00	10/26/16 12:00	TAS	EPA 300.0
Sulfate	27000	mg/L		10/28/16 14:39	10/28/16 14:39	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	6.65	pH Units		10/24/16 14:10	10/24/16 14:10	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	10	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Fluoride	69.4	mg/L		10/27/16 15:56	10/27/16 15:56	TTH	SM 4500-F C
Solids - total dissolved solids (TDS)	28000	mg/L		10/27/16 12:04	10/27/16 12:28	ARL	SM 2540C
Total Metals - PIA							
Antimony	8.6	ug/L		10/26/16 13:38	11/02/16 14:20	JMW	SW 6020
Arsenic	92	ug/L		10/26/16 13:38	11/02/16 15:03	JMW	SW 6020
Barium	1100	ug/L		10/26/16 13:38	11/02/16 14:20	JMW	SW 6020
Beryllium	< 20	ug/L		10/26/16 13:38	11/02/16 14:34	JMW	SW 6020
Boron	97000	ug/L		10/26/16 13:38	11/03/16 08:45	JMW	SW 6020
Cadmium	67	ug/L		10/26/16 13:38	11/02/16 15:55	JMW	SW 6020
Calcium	1400	mg/L		10/26/16 13:38	11/02/16 14:34	JMW	SW 6020
Chromium	150	ug/L		10/26/16 13:38	11/02/16 15:03	JMW	SW 6020
Cobalt	110	ug/L		10/26/16 13:38	11/02/16 15:03	JMW	SW 6020
Lithium	480	ug/L		10/26/16 13:38	10/27/16 12:33	KJP	SW 6010*
Magnesium	2500	mg/L		10/26/16 13:38	11/02/16 14:34	JMW	SW 6020
Mercury	27	ug/L		10/26/16 13:38	11/02/16 15:03	JMW	SW 6020
Molybdenum	140	ug/L		10/26/16 13:38	11/02/16 15:03	JMW	SW 6020
Potassium	360	mg/L		10/26/16 13:38	11/03/16 08:45	JMW	SW 6020
Selenium	1500	ug/L		10/26/16 13:38	11/02/16 15:03	JMW	SW 6020
Sodium	1000	mg/L		10/26/16 13:38	11/02/16 14:34	JMW	SW 6020
Thallium	< 4.0	ug/L		10/26/16 13:38	11/07/16 15:07	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-19**
Name: GPc
Matrix: Surface Water - Grab

Sampled: 10/24/16 14:20
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	1800	mg/L		10/28/16 01:58	10/28/16 01:58	TAS	EPA 300.0
Nitrite-N	< 3.0	mg/L		10/26/16 12:18	10/26/16 12:18	TAS	EPA 300.0
Sulfate	20000	mg/L		10/28/16 02:16	10/28/16 02:16	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	6.73	pH Units		10/24/16 14:20	10/24/16 14:20	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	5.5	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Fluoride	49.2	mg/L		10/27/16 17:35	10/27/16 17:35	TTH	SM 4500-F C
Solids - total dissolved solids (TDS)	17000	mg/L		10/27/16 12:04	10/27/16 12:28	ARL	SM 2540C
Total Metals - PIA							
Antimony	< 6.0	ug/L		10/26/16 13:38	11/02/16 14:23	JMW	SW 6020
Arsenic	4.4	ug/L		10/26/16 13:38	11/02/16 15:07	JMW	SW 6020
Barium	110	ug/L		10/26/16 13:38	11/02/16 13:43	JMW	SW 6020
Beryllium	2.6	ug/L		10/26/16 13:38	11/02/16 14:23	JMW	SW 6020
Boron	72000	ug/L		10/26/16 13:38	11/03/16 08:46	JMW	SW 6020
Cadmium	41	ug/L		10/26/16 13:38	11/02/16 15:56	JMW	SW 6020
Calcium	570	mg/L		10/26/16 13:38	11/02/16 14:38	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 15:27	JMW	SW 6020
Cobalt	54	ug/L		10/26/16 13:38	11/02/16 15:07	JMW	SW 6020
Lithium	300	ug/L		10/26/16 13:38	10/27/16 12:36	KJP	SW 6010*
Magnesium	1500	mg/L		10/26/16 13:38	11/02/16 14:23	JMW	SW 6020
Mercury	< 0.80	ug/L		10/26/16 13:38	11/02/16 15:07	JMW	SW 6020
Molybdenum	120	ug/L		10/26/16 13:38	11/02/16 14:23	JMW	SW 6020
Potassium	260	mg/L		10/26/16 13:38	11/03/16 08:46	JMW	SW 6020
Selenium	890	ug/L		10/26/16 13:38	11/02/16 15:07	JMW	SW 6020
Sodium	650	mg/L		10/26/16 13:38	11/02/16 13:43	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 15:27	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-20**
Name: GPd
Matrix: Surface Water - Grab

Sampled: 10/24/16 14:30
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	1900	mg/L		10/28/16 03:09	10/28/16 03:09	TAS	EPA 300.0
Nitrite-N	< 3.0	mg/L		10/26/16 12:36	10/26/16 12:36	TAS	EPA 300.0
Sulfate	19000	mg/L		10/28/16 03:26	10/28/16 03:26	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	6.73	pH Units		10/24/16 14:30	10/24/16 14:30	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	6.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Fluoride	51.3	mg/L		10/27/16 17:39	10/27/16 17:39	TTH	SM 4500-F C
Solids - total dissolved solids (TDS)	16000	mg/L		10/27/16 12:04	10/27/16 12:28	ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 13:38	11/02/16 13:47	JMW	SW 6020
Arsenic	4.2	ug/L		10/26/16 13:38	11/02/16 15:10	JMW	SW 6020
Barium	110	ug/L		10/26/16 13:38	11/02/16 13:47	JMW	SW 6020
Beryllium	< 20	ug/L		10/26/16 13:38	11/02/16 14:41	JMW	SW 6020
Boron	66000	ug/L		10/26/16 13:38	11/03/16 08:48	JMW	SW 6020
Cadmium	38	ug/L		10/26/16 13:38	11/02/16 15:57	JMW	SW 6020
Calcium	560	mg/L		10/26/16 13:38	11/02/16 14:41	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 13:38	11/01/16 15:31	JMW	SW 6020
Cobalt	52	ug/L		10/26/16 13:38	11/02/16 15:10	JMW	SW 6020
Lithium	300	ug/L		10/26/16 13:38	10/27/16 12:39	KJP	SW 6010*
Magnesium	1500	mg/L		10/26/16 13:38	11/02/16 14:27	JMW	SW 6020
Mercury	< 0.80	ug/L		10/26/16 13:38	11/02/16 15:10	JMW	SW 6020
Molybdenum	120	ug/L		10/26/16 13:38	11/02/16 14:27	JMW	SW 6020
Potassium	230	mg/L		10/26/16 13:38	11/03/16 08:48	JMW	SW 6020
Selenium	800	ug/L		10/26/16 13:38	11/01/16 15:31	JMW	SW 6020
Sodium	660	mg/L		10/26/16 13:38	11/02/16 13:47	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 13:38	11/01/16 15:31	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-21**
Name: RPb
Matrix: Surface Water - Grab

Sampled: 10/24/16 14:50
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	1800	mg/L		10/28/16 03:44	10/28/16 03:44	TAS	EPA 300.0
Nitrite-N	< 3.0	mg/L		10/26/16 12:53	10/26/16 12:53	TAS	EPA 300.0
Sulfate	18000	mg/L		10/28/16 04:01	10/28/16 04:01	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	6.49	pH Units		10/24/16 14:50	10/24/16 14:50	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Fluoride	44.4	mg/L		10/27/16 17:44	10/27/16 17:44	TTH	SM 4500-F C
Solids - total dissolved solids (TDS)	16000	mg/L		10/27/16 12:04	10/27/16 12:28	ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 11:03	11/01/16 09:42	JMW	SW 6020
Arsenic	2.8	ug/L		10/26/16 11:03	11/02/16 11:16	JMW	SW 6020
Barium	90	ug/L		10/26/16 11:03	11/01/16 09:42	JMW	SW 6020
Beryllium	2.1	ug/L		10/26/16 11:03	11/01/16 10:30	JMW	SW 6020
Boron	56000	ug/L		10/26/16 11:03	11/02/16 16:34	JMW	SW 6020
Cadmium	33	ug/L		10/26/16 11:03	11/02/16 11:32	JMW	SW 6020
Calcium	380	mg/L		10/26/16 11:03	11/01/16 10:30	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 11:03	11/01/16 09:42	JMW	SW 6020
Cobalt	45	ug/L		10/26/16 11:03	11/01/16 09:42	JMW	SW 6020
Lithium	310	ug/L		10/26/16 11:03	10/27/16 11:01	KJP	SW 6010*
Magnesium	1200	mg/L		10/26/16 11:03	11/01/16 10:30	JMW	SW 6020
Mercury	< 0.40	ug/L		10/26/16 11:03	11/02/16 11:16	JMW	SW 6020
Molybdenum	64	ug/L		10/26/16 11:03	11/01/16 10:30	JMW	SW 6020
Potassium	210	mg/L		10/26/16 11:03	11/02/16 11:32	JMW	SW 6020
Selenium	780	ug/L		10/26/16 11:03	11/02/16 11:16	JMW	SW 6020
Sodium	470	mg/L		10/26/16 11:03	11/01/16 09:42	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 11:03	11/01/16 09:42	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-22**
Name: RPc
Matrix: Surface Water - Grab

Sampled: 10/24/16 15:00
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	2000	mg/L		10/28/16 04:19	10/28/16 04:19	TAS	EPA 300.0
Nitrite-N	< 3.0	mg/L		10/26/16 14:05	10/26/16 14:05	TAS	EPA 300.0
Sulfate	20000	mg/L		10/28/16 04:37	10/28/16 04:37	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	6.32	pH Units		10/24/16 15:00	10/24/16 15:00	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Fluoride	45.0	mg/L		10/27/16 17:48	10/27/16 17:48	TTH	SM 4500-F C
Solids - total dissolved solids (TDS)	16000	mg/L		10/27/16 12:04	10/27/16 12:28	ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 11:03	11/01/16 09:46	JMW	SW 6020
Arsenic	3.1	ug/L		10/26/16 11:03	11/02/16 11:20	JMW	SW 6020
Barium	88	ug/L		10/26/16 11:03	11/01/16 09:46	JMW	SW 6020
Beryllium	2.2	ug/L		10/26/16 11:03	11/01/16 10:34	JMW	SW 6020
Boron	59000	ug/L		10/26/16 11:03	11/02/16 16:36	JMW	SW 6020
Cadmium	37	ug/L		10/26/16 11:03	11/02/16 11:36	JMW	SW 6020
Calcium	380	mg/L		10/26/16 11:03	11/01/16 10:34	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 11:03	11/01/16 09:46	JMW	SW 6020
Cobalt	43	ug/L		10/26/16 11:03	11/01/16 09:46	JMW	SW 6020
Lithium	310	ug/L		10/26/16 11:03	10/27/16 11:04	KJP	SW 6010*
Magnesium	1200	mg/L		10/26/16 11:03	11/01/16 10:34	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 11:03	11/02/16 10:36	JMW	SW 6020
Molybdenum	64	ug/L		10/26/16 11:03	11/01/16 10:34	JMW	SW 6020
Potassium	200	mg/L		10/26/16 11:03	11/02/16 11:36	JMW	SW 6020
Selenium	830	ug/L		10/26/16 11:03	11/02/16 11:20	JMW	SW 6020
Sodium	440	mg/L		10/26/16 11:03	11/01/16 09:46	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 11:03	11/01/16 09:46	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-23**
Name: RPd
Matrix: Surface Water - Grab

Sampled: 10/24/16 15:05
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	1600	mg/L		10/28/16 04:25	10/28/16 04:25	TAS	EPA 300.0
Nitrite-N	< 3.0	mg/L		10/26/16 14:23	10/26/16 14:23	TAS	EPA 300.0
Sulfate	16000	mg/L		10/28/16 04:43	10/28/16 04:43	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	6.32	pH Units		10/24/16 15:05	10/24/16 15:05	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Fluoride	51.2	mg/L		10/27/16 17:53	10/27/16 17:53	TTH	SM 4500-F C
Solids - total dissolved solids (TDS)	17000	mg/L		10/27/16 12:04	10/27/16 12:28	ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 11:03	11/01/16 09:49	JMW	SW 6020
Arsenic	3.4	ug/L		10/26/16 11:03	11/02/16 11:23	JMW	SW 6020
Barium	89	ug/L		10/26/16 11:03	11/01/16 09:49	JMW	SW 6020
Beryllium	2.4	ug/L		10/26/16 11:03	11/01/16 10:37	JMW	SW 6020
Boron	59000	ug/L		10/26/16 11:03	11/02/16 16:37	JMW	SW 6020
Cadmium	36	ug/L		10/26/16 11:03	11/02/16 11:40	JMW	SW 6020
Calcium	400	mg/L		10/26/16 11:03	11/01/16 10:37	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 11:03	11/01/16 09:49	JMW	SW 6020
Cobalt	45	ug/L		10/26/16 11:03	11/01/16 09:49	JMW	SW 6020
Lithium	310	ug/L		10/26/16 11:03	10/27/16 11:13	KJP	SW 6010*
Magnesium	1300	mg/L		10/26/16 11:03	11/01/16 10:37	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 11:03	11/02/16 10:39	JMW	SW 6020
Molybdenum	66	ug/L		10/26/16 11:03	11/01/16 10:37	JMW	SW 6020
Potassium	200	mg/L		10/26/16 11:03	11/02/16 11:40	JMW	SW 6020
Selenium	860	ug/L		10/26/16 11:03	11/02/16 11:23	JMW	SW 6020
Sodium	460	mg/L		10/26/16 11:03	11/01/16 09:49	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 11:03	11/01/16 09:49	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

ANALYTICAL RESULTS

Sample: **6103663-24**
Name: RPa
Matrix: Surface Water - Grab

Sampled: 10/24/16 14:40
Received: 10/25/16 07:45

Parameter	Result	Unit	Qualifier	Prepared	Analyzed	Analyst	Method
Anions - PIA							
Chloride	1600	mg/L		10/28/16 05:02	10/28/16 05:02	TAS	EPA 300.0
Nitrite-N	< 3.0	mg/L		10/26/16 13:11	10/26/16 13:11	TAS	EPA 300.0
Sulfate	17000	mg/L		10/28/16 05:20	10/28/16 05:20	TAS	EPA 300.0
Field - PIA							
pH, Field Measured	6.70	pH Units		10/24/16 14:40	10/24/16 14:40	FIELD	Field*
General Chemistry - PIA							
Alkalinity - bicarbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		10/31/16 13:36	10/31/16 13:36	LAM	SM 2320B*
Fluoride	47.0	mg/L		10/27/16 15:52	10/27/16 15:52	TTH	SM 4500-F C
Solids - total dissolved solids (TDS)	16000	mg/L		10/27/16 12:04	10/27/16 12:28	ARL	SM 2540C
Total Metals - PIA							
Antimony	< 3.0	ug/L		10/26/16 11:03	11/01/16 09:53	JMW	SW 6020
Arsenic	3.3	ug/L		10/26/16 11:03	11/02/16 11:27	JMW	SW 6020
Barium	89	ug/L		10/26/16 11:03	11/01/16 09:53	JMW	SW 6020
Beryllium	2.3	ug/L		10/26/16 11:03	11/01/16 10:41	JMW	SW 6020
Boron	60000	ug/L		10/26/16 11:03	11/02/16 16:38	JMW	SW 6020
Cadmium	37	ug/L		10/26/16 11:03	11/02/16 11:43	JMW	SW 6020
Calcium	380	mg/L		10/26/16 11:03	11/01/16 10:41	JMW	SW 6020
Chromium	< 4.0	ug/L		10/26/16 11:03	11/01/16 09:53	JMW	SW 6020
Cobalt	44	ug/L		10/26/16 11:03	11/01/16 09:53	JMW	SW 6020
Lithium	310	ug/L		10/26/16 11:03	10/27/16 11:16	KJP	SW 6010*
Magnesium	1200	mg/L		10/26/16 11:03	11/01/16 10:41	JMW	SW 6020
Mercury	< 0.20	ug/L		10/26/16 11:03	11/02/16 10:43	JMW	SW 6020
Molybdenum	63	ug/L		10/26/16 11:03	11/01/16 10:41	JMW	SW 6020
Potassium	190	mg/L		10/26/16 11:03	11/02/16 11:43	JMW	SW 6020
Selenium	840	ug/L		10/26/16 11:03	11/02/16 11:27	JMW	SW 6020
Sodium	450	mg/L		10/26/16 11:03	11/01/16 09:53	JMW	SW 6020
Thallium	< 1.0	ug/L		10/26/16 11:03	11/01/16 09:53	JMW	SW 6020

PDC Laboratories, Inc.
2231 West Altorfer Drive
Peoria, IL 61615
(800) 752-6651

NOTES

Specific method revisions used for analysis are available upon request.

Certifications

PIA - Peoria, IL
- TNI Accreditation for Drinking Water, Wastewater, Hazardous and Solid Wastes Fields of Testing through IL EPA Lab No. 100230
- Illinois Department of Public Health Bacteriological Analysis in Drinking Water Approved Laboratory Registry No. 17553
- Missouri Department of Natural Resources Certificate of Approval for Microbiological Laboratory Service No. 870
- Drinking Water Certifications: Iowa (240); Kansas (E-10338); Missouri (870)
- Wastewater Certifications: Arkansas (88-0677); Iowa (240); Kansas (E-10338)
- Hazardous/Solid Waste Certifications: Arkansas (88-0677); Iowa (240); Kansas (E-10338)

SPMO - Springfield, MO
- USEPA DMR-QA Program

STL - St. Louis, MO
- TNI Accreditation for Wastewater, Hazardous and Solid Wastes Fields of Testing through KS Lab No. E-10389
- Illinois Department of Public Health Bacteriological Analysis in Drinking Water Approved Laboratory Registry No. 171050
- Drinking Water Certifications: Missouri (1050)
- Missouri Department of Natural Resources

* Not a TNI accredited analyte

Gail J Schindler

Certified by: Gail Schindler, Project Manager

PDC LABORATORIES, INC.
2231 WEST ALTORFER DRIVE
PEORIA, IL 61615
PHONE # 309-692-9688
FAX # 309-692-9689

CHAIN OF CUSTODY RECORD

6JS 10-26-16

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

(1) CLIENT: Hanson Professional Services COFFEEN ENERGY CENTER
PROJECT NUMBER | P.O. NUMBER | MEANS SHIPPED
ADDRESS: 134 CIPS LANE
PHONE NUMBER | FAX NUMBER | DATE SHIPPED
CITY STATE ZIP: COFFEEN IL 62017
SAMPLER (PLEASE PRINT): R. ZINSER
CONTACT PERSON: JOHN ROMANG
SAMPLER'S SIGNATURE:

MATRIX TYPES:
WW- WASTEWATER
DW- DRINKING WATER
GW- GROUND WATER
WWSL- SLUDGE
NAS- SOLID
OTHER: _____

(3) ANALYSIS REQUESTED 6JS 10-26-16

(FOR LAB USE ONLY)
LOGIN # 6103663-24
LOGGED BY: KMA

NATURAL RESOURCE TECHNOLOGY
COFFEEN POND LAKE
GAIL J SCHINDLER

(2) SAMPLE DESCRIPTION	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	TOTAL # OF CONT	SB,AS,BA,BE,ALKHCO3	B,CD,CA,ALK CO3, CL	CR,CR+6,CO,CU,ON,F	PE,PB,LI,MG,MN,HG,MO	NI,GRO,PHENOL,P,SE,	AG,NA,SO4,TL,TDS,ZN	TSS,NO2,NO3,NH3,TKN	REMARKS
							Custom list							
AP1 a	10/24/16	11:52	X		SW	7	per chain							pH 6.99
AP1 b	10/24/16	11:56	X		SW	7								pH 7.01
AP1 c	10/24/16	12:10	X		SW	7								pH 7.05
AP1 d	10/24/16	12:15	X		SW	7								pH 7.21
AP1 e	10/24/16	12:01	X		SW	7								pH 7.12
AP1 f	10/24/16	12:40	X		SW	7								pH 7.20
AP1 g	10/24/16	12:50	X		SW	7								pH 7.21
AP1 h	10/24/16	12:55	X		SW	7								pH 7.41
AP2 e	10/24/16	11:30	X		SW	7								pH 6.49
AP2 f	10/24/16	11:20	X		SW	7								pH 6.42
AP2 g	10/24/16	11:10	X		SW	7								pH 6.46

(5) TURNAROUND TIME REQUESTED (PLEASE CIRCLE) NORMAL RUSH
X(RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
RUSH RESULTS VIA (PLEASE CIRCLE) FAX PHONE
FAX # IF DIFFERENT FROM ABOVE: PHONE # IF DIFFERENT FROM ABOVE:

(6) *The sample temperature will be measured upon receipt at the lab. By initialing this area you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area you allow the lab to proceed with analytical testing regardless of the sample temperature.*

(7) RELINQUISHED BY: (SIGNATURE) DATE 10/25/16 TIME 7:45 | RECEIVED BY: (SIGNATURE) DATE TIME
RELINQUISHED BY: (SIGNATURE) DATE TIME | RECEIVED AT LAB BY: (SIGNATURE) DATE 10/25/16 TIME 7:45

(8) COMMENTS: (FOR LAB USE ONLY)
SAMPLE TEMPERATURE UPON RECEIPT 6 °C
CHILL PROCESS STARTED PRIOR TO RECEIPT Y OR N
SAMPLE(S) RECEIVED ON ICE Y OR N
BOTTLES RECEIVED IN GOOD CONDITION Y OR N
BOTTLES FILLED TO APPROX. THE NECK Y OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) Y OR N

PDC LABORATORIES, INC.
2231 WEST ALTORFER DRIVE
PEORIA, IL 61615

PHONE # 309-692-9688
FAX # 309-692-9689

CHAIN OF CUSTODY RECORD

GJS 10-26-16

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

(1) CLIENT: Hanson Professional Services
COFFEEN ENERGY CENTER

ADDRESS: 134 CIPS LANE

CITY / STATE / ZIP: COFFEEN IL 62017

CONTACT PERSON: JOHN ROMANG

PROJECT NUMBER | P.O. NUMBER | MEANS SHIPPED

PHONE NUMBER | FAX NUMBER | DATE SHIPPED

SAMPLER (PLEASE PRINT): R. ZINSER

SAMPLER'S SIGNATURE: [signature]

MATRIX TYPES:
WW- WASTEWATER
DW- DRINKING WATER
GW- GROUND WATER
WWSL- SLUDGE
NAS- SOLID
OTHER: _____

(3) ANALYSIS REQUESTED: GJS 10-26-16

(FOR LAB USE ONLY)
LOGIN # _____
LOGGED BY: _____

NATURAL RESOURCE TECHNOLOGY
COFFEEN POND LAKE
GAIL J SCHINDLER

(2)

SAMPLE DESCRIPTION	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	TOTAL # OF CONT	SB,AS,BA,BE,ALKHCO3	B,CD,CA,ALK CO3, CL	CR,CR+6,CO,CU,ON,F	FE,PB,LI,MG,MN,HG,MO	NI,GEO,PHENOL,P,SE,	AG,NA,SO4,TL,TDS,ZN	TSS,NO2,NO3,NH3,TKN	REMARKS
AP2 h	10/24/16	11:40	X		SW	7	/	/	/	/	/	/	/	pH 7.17
CL a	10/24/16	15:30	X		SW	7	/	/	/	/	/	/	/	pH 7.22
CL b	10/24/16	13:35	X		SW	7	/	/	/	/	/	/	/	pH 7.52
CL c	10/24/16	13:15	X		SW	7	/	/	/	/	/	/	/	pH 7.62
CL d	10/24/16	15:55	X		SW	7	/	/	/	/	/	/	/	pH 7.30
GP a	10/24/16	14:00	X		SW	7	/	/	/	/	/	/	/	pH 7.16
GP b	10/24/16	14:10	X		SW	7	/	/	/	/	/	/	/	pH 6.65
GP c	10/24/16	14:20	X		SW	7	/	/	/	/	/	/	/	pH 6.73
GP d	10/24/16	14:30	X		SW	7	/	/	/	/	/	/	/	pH 6.73
RP b	10/24/16	14:50	X		SW	7	/	/	/	/	/	/	/	pH 6.49
RP c	10/24/16	15:00	X		SW	7	/	/	/	/	/	/	/	pH 6.32

(5) TURNAROUND TIME REQUESTED (PLEASE CIRCLE) NORMAL RUSH
X(RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
RUSH RESULTS VIA (PLEASE CIRCLE) FAX PHONE
FAX # IF DIFFERENT FROM ABOVE: PHONE # IF DIFFERENT FROM ABOVE:

(6) *The sample temperature will be measured upon receipt at the lab. By initialing this area you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area you allow the lab to proceed with analytical testing regardless of the sample temperature.*

(7) RELINQUISHED BY: (SIGNATURE) [signature] DATE 10/25/16 TIME 7:45
RECEIVED BY: (SIGNATURE) DATE TIME

RELINQUISHED BY: (SIGNATURE) DATE TIME
RECEIVED AT LAB BY: (SIGNATURE) [signature] DATE 10/25/16 TIME 7:45

(8) COMMENTS: (FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT 6 °C
CHILL PROCESS STARTED PRIOR TO RECEIPT Y OR N
SAMPLE(S) RECEIVED ON ICE Y OR N
BOTTLES RECEIVED IN GOOD CONDITION Y OR N
BOTTLES FILLED TO APPROX. THE NECK Y OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) Y OR N

PDC LABORATORIES, INC.
2231 WEST ALTORFER DRIVE
PEORIA, IL 61615

PHONE # 309-692-9688
FAX # 309-692-9689

CHAIN OF CUSTODY RECORD

GJS 10-26-16

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

(1) CLIENT: Hanson Professional Services
COFFEEN ENERGY CENTER

ADDRESS: 134 CIPS LANE

CITY / STATE / ZIP: COFFEEN IL 62017

CONTACT PERSON: JOHN ROMANG

PROJECT NUMBER | P.O. NUMBER | MEANS SHIPPED

PHONE NUMBER | FAX NUMBER | DATE SHIPPED

SAMPLER (PLEASE PRINT): R. ZINSER

SAMPLER'S SIGNATURE: [signature]

MATRIX TYPES:
WW- WASTEWATER
DW- DRINKING WATER
GW- GROUND WATER
WWSL- SLUDGE
NAS- SOLID
OTHER: _____

(3) ANALYSIS REQUESTED: GJS 10-26-16

(FOR LAB USE ONLY)
LOGIN # _____
LOGGED BY: _____

NATURAL RESOURCE TECHNOLOGY
COFFEEN POND LAKE
GAIL J SCHINDLER

(2)

SAMPLE DESCRIPTION	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	TOTAL # OF CONT	SB,AS,BA,BE,ALKHCO3	B,CD,CA,ALK CO3, CL	CR,CR+6,CO,CU,CN,F	FE,PB,LI,MG,MN,HG,MO	NI,GRO,PHENOL,P,SE,	AG,NA,SO4,TL,TDS,ZN	TSS,NO2,NO3,NH3,TKN	REMARKS
RPd	10/24/16	15:05	X		SW	7	/	/	/	/	/	/	/	pH 6.32
RPa	10/24/16	14:40	X		SW	7	/	/	/	/	/	/	/	pH 6.70

(5) TURNAROUND TIME REQUESTED (PLEASE CIRCLE) NORMAL RUSH
X(RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
RUSH RESULTS VIA (PLEASE CIRCLE) FAX PHONE
FAX # IF DIFFERENT FROM ABOVE:
PHONE # IF DIFFERENT FROM ABOVE:

(6) *The sample temperature will be measured upon receipt at the lab. By initialing this area you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area you allow the lab to proceed with analytical testing regardless of the sample temperature.*

(7) RELINQUISHED BY: (SIGNATURE) [signature] DATE 10/25/16 TIME 7:45
RECEIVED BY: (SIGNATURE) DATE TIME

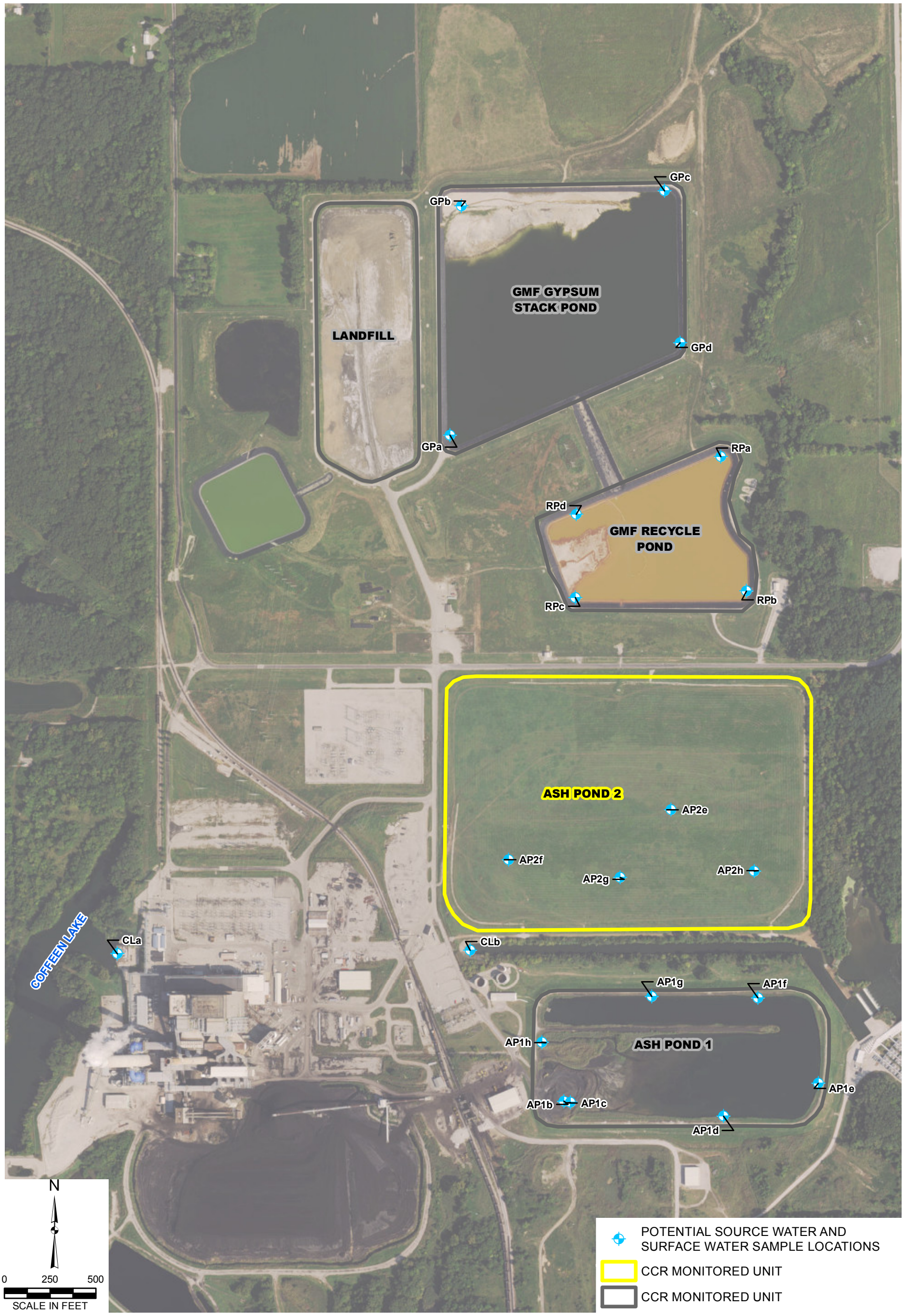
RELINQUISHED BY: (SIGNATURE) DATE TIME
RECEIVED AT LAB BY: (SIGNATURE) [signature] DATE 10/25/16 TIME 7:45

(8) COMMENTS: (FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT 6 °C
CHILL PROCESS STARTED PRIOR TO RECEIPT Y OR N
SAMPLE(S) RECEIVED ON ICE Y OR N
BOTTLES RECEIVED IN GOOD CONDITION Y OR N
BOTTLES FILLED TO APPROX. THE NECK Y OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) Y OR N

Chain of Custody Parameters (as totals)

Antimony
Arsenic
Barium
Beryllium
Bicarbonate Alkalinity
Boron
Cadmium
Calcium
Carbonate Alkalinity
Chloride
Chromium
Cobalt
Fluoride
Lithium
Magnesium
Mercury
Molybdenum
Nitrite
pH
Potassium
Selenium
Sodium
Sulfate
Thallium
Total Dissolved Solids (TDS)



DRAWN BY/DATE:
SDS 12/21/16
REVIEWED BY/DATE:
NRK 12/21/16
APPROVED BY/DATE:
SJC 12/22/16

POTENTIAL SOURCE WATER AND SURFACE WATER SAMPLE LOCATIONS

HYDROGEOLOGIC CHARACTERIZATION REPORT
ASH POND 2
COFFEEN POWER STATION
COFFEEN, IL

PROJECT NO: 2380

FIGURE NO: 14

Natural Resource Technology

Y:\Mapping\Projects\23\2380\MXD\HGCR\Figure 14_Potential Source Water And Surface Water Sample Locations.mxd Author: tcushman; Date/Time: 12/22/2016, 2:59:50 PM

Surface Water Sample Location Map

Coffeen Power Station

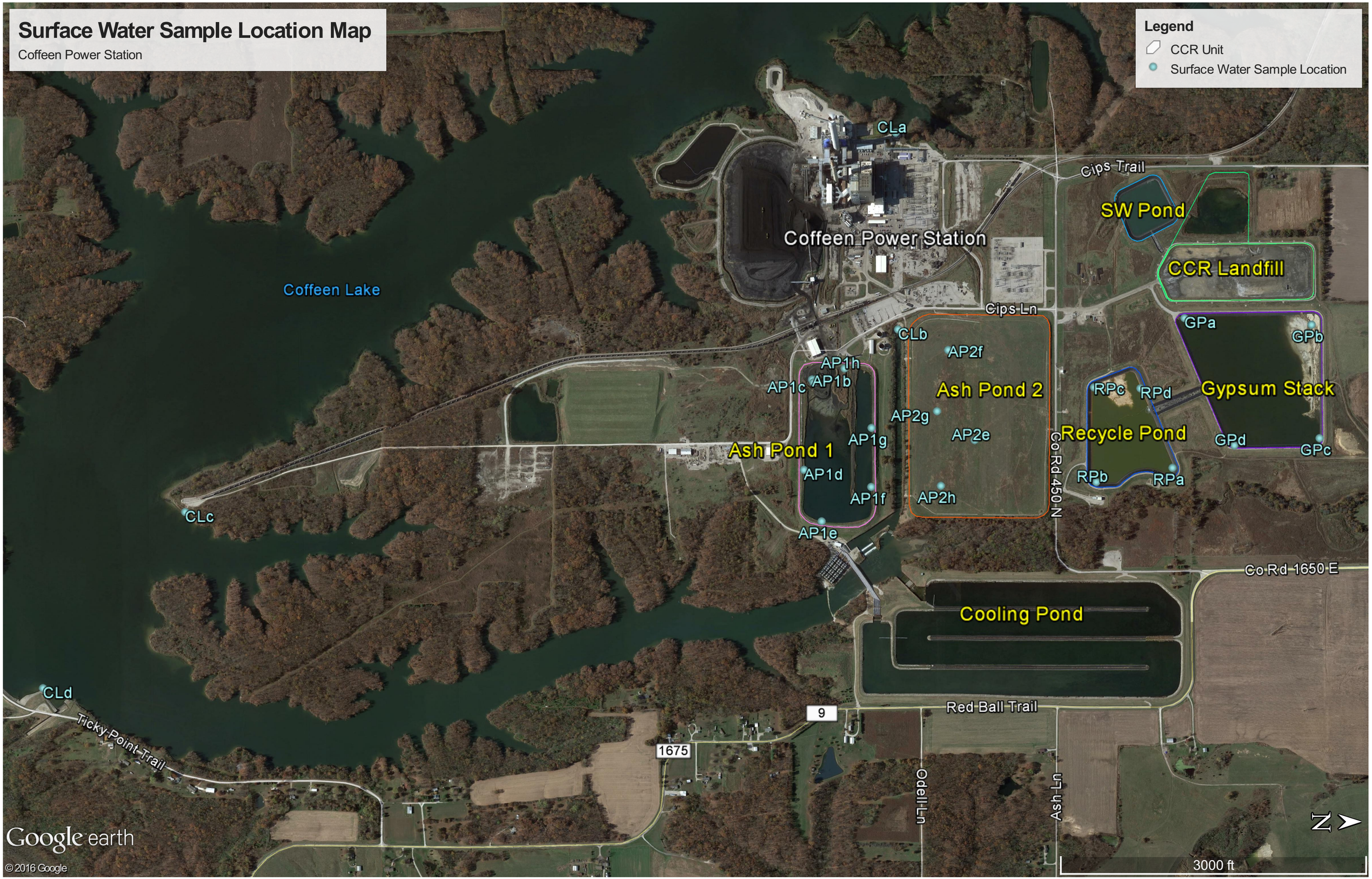


Table 10
Potential Source Water and Surface Water Sampling Results - October 24, 2016
Hydrogeologic Characterization Report
Coffeen Energy Center

Sample ID	Sample Location	Alkalinity, bicarbonate mg/L	Alkalinity, carbonate mg/L	Antimony, Total ug/L	Arsenic, Total ug/L	Barium, Total ug/L	Beryllium, Total ug/L	Boron, Total ug/L	Cadmium, Total ug/L	Calcium, Total mg/l	Chloride, Total mg/L	Chromium, Total ug/L	Cobalt, Total ug/L	Fluoride, Total mg/L	Lithium, Total ug/L	Magnesium, Total mg/L	Mercury, Total ug/L	Molybdenum , Total ug/L	pH	Potassium, Total mg/L	Selenium, Total ug/L	Sodium, Total mg/l	Solids - total dissolved solids (TDS) mg/L	Sulfate, Total mg/L	Thallium, Total ug/L
AP1a	Ash Pond 1	90	< 2.0	3.1	7.2	130	< 1.0	3800	< 1.0	380	3.2	< 4.0	< 2.0	< 0.250	39	67	< 0.20	47	6.99	7.3	3.0	33	1800	1500	< 1.0
AP1b		120	< 2.0	3.3	17	100	< 1.0	3100	< 1.0	320	13	< 4.0	< 2.0	0.977	47	52	< 0.20	100	7.01	18	6.9	53	1600	1300	< 1.0
AP1c		80	< 2.0	< 3.0	18	130	< 1.0	2900	< 1.0	390	13	< 4.0	< 2.0	0.614	51	49	< 0.20	81	7.05	18	3.1	59	1900	1600	< 1.0
AP1d		90	< 20	< 3.0	2.0	200	< 1.0	2000	< 1.0	210	18	< 4.0	< 2.0	1.08	55	35	< 0.20	31	7.21	26	1.5	83	980	1000	< 1.0
AP1e		80	< 2.0	< 3.0	1.4	160	< 1.0	2100	< 1.0	200	18	< 4.0	< 2.0	1.00	55	34	< 0.20	30	7.12	26	1.2	80	1200	960	< 1.0
AP1f		110	< 20	< 3.0	1.5	150	< 1.0	2100	< 1.0	200	17	< 4.0	< 2.0	1.00	57	35	< 0.20	31	7.20	26	1.2	82	1200	1000	< 1.0
AP1g		75	< 2.0	< 3.0	1.3	140	< 1.0	2100	< 1.0	210	17	< 4.0	< 2.0	1.00	56	32	< 0.20	29	7.21	26	1.4	100	1200	970	< 1.0
AP1h		90	< 20	< 3.0	1.5	180	< 1.0	2200	< 1.0	230	17	< 4.0	< 2.0	0.980	55	30	< 0.20	31	7.41	27	1.2	110	1200	1000	< 1.0
AP2e	Ash Pond 2	55	< 20	< 3.0	23	26	< 1.0	5300	< 1.0	210	< 5.0	< 4.0	< 2.0	0.438	190	40	< 0.20	90	6.49	27	< 1.0	25	1700	1500	< 1.0
AP2f		100	< 20	< 3.0	1.2	22	< 2.0	2000	< 1.0	170	< 5.0	< 4.0	< 2.0	0.398	130	33	< 0.20	3.2	6.42	21	< 1.0	14	1700	1500	< 1.0
AP2g		4.0	< 2.0	< 3.0	5.5	20	< 2.0	4300	4.6	410	< 5.0	< 4.0	< 2.0	0.506	180	51	< 0.20	41	6.46	29	< 1.0	27	2400	2300	< 1.0
AP2h		140	< 2.0	< 3.0	75	23	< 1.0	14000	< 1.0	310	1.7	< 4.0	< 2.0	0.406	120	29	< 0.20	570	7.17	40	< 1.0	39	1500	1300	< 1.0
CLa	Coffeen Lake	80	< 2.0	< 3.0	1.8	54	< 1.0	270	< 1.0	23	23	< 4.0	< 2.0	0.443	< 10	12	< 0.20	5.0	7.22	7.4	< 1.0	19	190	55	< 1.0
CLb		80	< 2.0	< 3.0	1.8	52	< 1.0	280	< 1.0	23	22	< 4.0	< 2.0	0.425	< 10	11	< 0.20	4.9	7.52	7.8	< 1.0	19	180	56	< 1.0
CLc		75	< 2.0	< 3.0	1.8	56	< 1.0	280	< 1.0	23	22	< 4.0	< 2.0	0.426	< 10	12	< 0.20	4.7	7.62	7.4	< 1.0	19	160	54	< 1.0
CLd		80	< 2.0	< 3.0	1.8	54	< 1.0	270	< 1.0	23	23	< 4.0	< 2.0	0.421	< 10	12	< 0.20	4.8	7.30	7.5	< 1.0	20	170	54	< 1.0
GPa	Gypsum Stack Pond	4.0	< 2.0	< 3.0	4.7	120	2.6	59000	40	450	1900	< 4.0	52	42.7	300	1500	< 0.80	130	7.16	210	890	620	17000	17000	< 1.0
GPb		10	< 2.0	8.6	92	1100	< 20	97000	67	1400	2600	150	110	69.4	480	2500	27	140	6.65	360	1500	1000	28000	27000	< 4.0
GPc		5.5	< 2.0	< 6.0	4.4	110	2.6	72000	41	570	1800	< 4.0	54	49.2	300	1500	< 0.80	120	6.73	260	890	650	17000	20000	< 1.0
GPd		6.0	< 2.0	< 3.0	4.2	110	< 20	66000	38	560	1900	< 4.0	52	51.3	300	1500	< 0.80	120	6.73	230	800	660	16000	19000	< 1.0
RPa	Gypsum Recycle Pond	< 2.0	< 2.0	< 3.0	3.3	89	2.3	60000	37	380	1600	< 4.0	44	47.0	310	1200	< 0.20	63	6.70	190	840	450	16000	17000	< 1.0
RPb		< 2.0	< 2.0	< 3.0	2.8	90	2.1	56000	33	380	1800	< 4.0	45	44.4	310	1200	< 0.40	64	6.49	210	780	470	16000	18000	< 1.0
RPc		< 2.0	< 2.0	< 3.0	3.1	88	2.2	59000	37	380	2000	< 4.0	43	45.0	310	1200	< 0.20	64	6.32	200	830	440	16000	20000	< 1.0
RPd		< 2.0	< 2.0	< 3.0	3.4	89	2.4	59000	36	400	1600	< 4.0	45	51.2	310	1300	< 0.20	66	6.32	200	860	460	17000	16000	< 1.0

[O:MDM 12/2016, NRK 12/2016]

Natural Resource Technology

APPENDIX G
Geochemical Conceptual Site Model

Geosyntec consultants

engineers | scientists | innovators

Geochemical Conceptual Site Model

Coffeen Power Plant –Ash Pond No. 2

(CCR Unit #102)

Prepared for

Illinois Power Generating Company
1500 Eastport Plaza Drive
Collinsville, Illinois 62234

Prepared by

Geosyntec Consultants, Inc.
134 N. Lasalle Street, Suite 300
Chicago, Illinois 60602

Project Number: GLP8078

June 2024

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY 1

2. INTRODUCTION 2

3. SITE BACKGROUND 3
   3.1 Site Overview 3
   3.2 Groundwater Monitoring Network 4

4. GEOCHEMICAL SITE CONDITIONS 5
   4.1 Constituent Transport and Fate 5
   4.2 Site Solids Characterization 6
      4.2.1 Bulk Characterization: Organic Carbon, Loss on Ignition, Cation Exchange Capacity and Sulfur Content 7
      4.2.2 Total Metals and Boron via Bulk Characterization 8
      4.2.3 Mineralogical Analysis 8
   4.3 Aqueous Geochemistry 9
      4.3.1 Redox/pH Summary 10
      4.3.2 Exceedance Parameters 10
      4.3.3 Pourbaix Diagrams 11
      4.3.4 Total and Dissolved Iron and Manganese Concentrations 12
      4.3.5 Major Ion Distribution and Groundwater Signatures 13

5. EVALUATION OF PARTITION COEFFICIENT RESULTS 14
   5.1 Batch Attenuation Testing 14
   5.2 Partition Coefficient Results 15

6. GEOCHEMICAL CONCEPTUAL SITE MODEL 16
   6.1 Source and Mobilization Mechanisms 16
   6.2 Potential and Observed Attenuation Mechanisms 16

7. REFERENCES 18

LIST OF FIGURES

Figure 1	pH Time Series
Figure 2	ORP Time Series
Figure 3a	Total Boron Concentration Time Series
Figure 3b	Dissolved Boron Concentration Time Series
Figure 4a	Total Sulfate Concentration Time Series
Figure 4b	Dissolved Sulfate Concentration Time Series
Figure 5	Total Dissolved Solids Concentration Time Series
Figure 6	TDS Concentration vs Sulfate Concentration
Figure 7a	Iron Pourbaix Diagram; Crystalline Phases Suppressed
Figure 7b	Iron Pourbaix Diagram
Figure 8	Manganese Pourbaix Diagram
Figure 9	Piper Diagram
Figure 10a	G401 Sulfate Partitioning Coefficients
Figure 10b	G401 Boron Partitioning Coefficients

LIST OF TABLES

Table 1	CEC and LOI of Site Solids
Table 2	Bulk Characterization of Site Solids
Table 3	XRF Analysis of Site Solids
Table 4	XRD Analysis of Site Solids
Table 5	AP2 Porewater Chemistry
Table 6	AP2 Eh-pH Diagram Inputs
Table 7	Total and Dissolved Aqueous Iron and Manganese Results
Table 8	Batch Attenuation Testing Results, G401
Table 9	Partition Coefficient Results, G401

LIST OF ATTACHMENTS

Attachment A: Site Layout Figure

Attachment B: Proposed Part 845 Groundwater Monitoring Network

Attachment C: Monitoring Well Construction Information

Attachment D: Boring Logs

Attachment E: Site Solids Bulk Characterization Analytical Data

Attachment F: X-Ray Fluorescence Analytical Data

Attachment G: X-Ray Diffraction Analytical Data

Attachment H: Site Evaluation Groundwater Data

Attachment I: Antidegradation Assessment Report (Hansen 2017)

ACRONYMS AND ABBREVIATIONS

AP1	Ash Pond No. 1
AP2	Ash Pond No. 2
ASD	alternative source demonstration
bgs	below ground surface
CEC	cation exchange capacity
CCR	coal combustion residuals
cm/s	centimeters per second
COCs	constituents of concern
CPP	Coffeen Power Plant
DA	deep aquifer
DCU	deep confining unit
GCSM	geochemical conceptual site model
GWPS	groundwater protection standards
HSU	hydrostratigraphic unit
I.A.C.	Illinois Administrative Code
IEPA	Illinois Environmental Protection Agency
LCU	lower confining unit
LOI	loss on ignition
meq/100 g	milliequivalents per 100 grams
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
N&E	nature and extent
ORP	oxidation-reduction potential
PMP	potential migration pathway
SU	standard units
TDS	total dissolved solids
UA	uppermost aquifer
UCU	upper confining unit
XRD	X-Ray diffraction
XRF	X-Ray fluorescence

1. EXECUTIVE SUMMARY

A geochemical conceptual site model (GCSM) has been developed to describe subsurface conditions at the Coffeen Power Plant Ash Pond No. 2 (AP2) coal combustion residuals unit (Unit #102). A GCSM describes the environmental media and geochemical processes that contribute to the mobilization, distribution, and attenuation of chemicals in the environment. This report describes the GCSM for parameters that have exceeded the GWPS in AP2 groundwater and which will be addressed in the corrective action plan. The exceedances detected at AP2 were boron, sulfate, pH, and total dissolved solids. Constituents of concern (COC) exceedances are present in one hydrostratigraphic unit at the Site: the uppermost aquifer (UA), comprised predominantly of sandy to gravelly silts with thin sand beds.

Coal combustion residual (CCR) materials are the primary source of constituent loading to the CCR contact water (i.e., CCR porewater or source water). Over an extended period (e.g., months to years), the CCR porewater (i.e., water contained within the interstitial pore spaces of the CCR that can be sampled by low-flow groundwater sampling methods) reaches equilibrium with the CCR materials. The porewater is therefore representative of the mobile phase constituents capable of migrating into the underlying materials and potentially downgradient in groundwater. The AP2 CCR source water is therefore the primary indicator of boron and sulfate available to the groundwater and is considered as the primary source term for environmental investigation and fate and transport modeling. TDS is a measure of inorganic and organic substances in solution. TDS trends are generally consistent with those of sulfate in the AP1 groundwater system.

Conditions within UA groundwater are predicted to favor amorphous iron oxide stability at most locations, and the presence of iron oxides in some Site solids indicates a portion of the boron and sulfate in the groundwater system might be attenuated via surface complexation reactions. Attenuation of the constituents contributing to TDS, such as sulfate, will reduce TDS concentrations as well. Boron may be further attenuated via interactions with clay minerals, which are present in solids across the UA and LCU. Site-specific partition coefficients could not be calculated from the results of batch attenuation testing completed with solids from the Site. These results indicate that chemical attenuation of boron and sulfate is expected to be limited.

Low pH at G401 is potentially caused by geochemical reactions driven by the mixing of porewater and groundwater, although the specific drivers are still under investigation. The low pH values at G401 are likely to be buffered further downgradient by the abundance of carbonate minerals identified in site solids via XRD.

2. INTRODUCTION

This report documents the development of a geochemical conceptual site model (GCSM) to describe subsurface conditions at the Coffeen Power Plant (CPP) Ash Pond No. 2 (AP2) coal combustion residuals (CCR) unit (Unit #102). A GCSM describes the environmental media and geochemical processes that contribute to the mobilization, distribution, and attenuation of constituents of concern (COCs) in the environment. The GCSM was prepared in support of an evaluation of the nature and extent of exceedances of COCs above the groundwater protection standards (GWPS) at AP2. The document has been prepared as an appendix to the CPP AP2 Nature and Extent (N&E) Report prepared by Ramboll Americas Engineering Solutions. Inc. (Ramboll).

Constituents with statistical exceedances above the GWPS at CPP AP2 for the second, third, and fourth quarters of 2023 (Q2 2023, Q3 2023, and Q4 2023) monitoring events completed under Title 35 of the Illinois Administrative Code (35 I.A.C.) § Section 845.630 are boron, sulfate, pH, and total dissolved solids (TDS). For the 2023 events discussed above, exceedances of boron were detected at compliance monitoring wells G401, G402, G404, and G405; exceedances of sulfate were detected at G401, G402, G404, G405, and G406; an exceedance of pH below the GWPS was detected at G401; and exceedances of TDS were detected at G401, G402, G404, and G405 (Ramboll 2024). All exceedances are present within the uppermost aquifer (UA).

An exceedance above the GWPS of cobalt was detected at compliance monitoring well G401 during the Q2 2023 monitoring event. An alternative source demonstration (ASD), as allowed by 35 I.A.C. § 845.650(e), was completed for the cobalt exceedance (Geosyntec 2023a). The cobalt ASD was rejected by the Illinois Environmental Protection Agency (IEPA) on January 11, 2024 (IEPA 2024a); however, the Illinois Power Generating Company has filed a motion for stay with Office of the Clerk of the Pollution Control Board. Therefore, cobalt is not included as a COC in this GCSM.

Exceedances above the GWPS of both sulfate and TDS were detected at compliance monitoring well G407 during the Q2 2023 monitoring event. An ASD, as allowed by 35 I.A.C. § 845.650(e), was completed for the exceedances of TDS and sulfate at G407 (Geosyntec 2023b). The G407 sulfate and TDS ASD was rejected by IEPA on January 11, 2024 (IEPA 2024b); however, the Illinois Power Generating Company has filed a motion for stay with Office of the Clerk of the Pollution Control Board. Therefore, these constituents are not presented as exceedances at G407 within this report, although data for these analytes is included in figures for completeness.

3. SITE BACKGROUND

3.1 Site Overview

An overview of Site characteristics and hydrogeology is presented in the CPP AP2 N&E Report. A Site layout figure is provided in Attachment A.[1] Briefly, the CPP AP2 impoundment is located to the north of the Ash Pond No. 1 CCR unit (Unit #101), and south of the Gypsum Management Facility Recycle Pond (Unit #104). The CPP property is located approximately two miles south of the city of Coffeen, Illinois, and bordered by two lobes of Coffeen Lake to the west, east, and south, and by agricultural land to the north. An unnamed tributary runs north to south to the east of AP2.

AP2 is a 78-acre unlined surface impoundment that received bottom ash and fly ash between 1972 until the mid-1980's, when it was capped with a 2-foot compacted clay and soil cap. AP2 was recapped starting in 2019 using a geomembrane cover system in accordance with a closure plan submitted to the IEPA (AECOM 2017). The cover system installation was completed on November 17, 2020. The geomembrane cap design addresses the potential for slope failure and water infiltration into the closed CCR unit by directing the drainage of surface water (i.e., precipitation) off the cover system.

A Hydrogeologic Site Characterization Report (NRT 2017) has previously described the hydrostratigraphic units (HSUs) present in the vicinity of the CPP AP2, which consist of an Upper Confining Unit (UCU), Uppermost Aquifer (UA), Lower Confining Unit (LCU), Deep Aquifer (DA), and Deep Confining Unit (DCU). The UCU consists of the silt or clayey silt of the Loess Unit and the upper clayey portion of the Hagarstown Member. The UA is predominantly sandy to gravelly silts with thin sand beds, with lithology identified as the Hagarstown Member. The LCU, which contains the Vandalia Member, Mulberry Grove Member, and Smithboro Member, is comprised primarily of sandy to silty till, with discontinuous sand lenses that have been identified as potential migration pathways (PMPs). The DA is predominantly sand and sandy silt/clay units of the Yarmouth Soil and is discontinuous beneath the CPP. CCR within AP2 is underlain by the UCU in the majority of the footprint, with limited direct contact with the UA in pre-construction ravines on the eastern edge of AP2.

Vertical gradients measured near the CPP indicate variable flow directions, although on average it is downward from the UA to the LCU north of AP2 in G405/T408 (0.02 feet per foot); and in G406/T409, south of AP2 near the former discharge flume, it is upward with an average of –0.06 feet per foot. Vertical gradients between the LCU and DA are consistently downward (CPP AP2 N&E Report). Both the DA and the LCU have been identified as PMPs due to the presence of these downward gradients.

[1] This figure is also provided as Figure 2-1 of the CPP AP2 N&E Report.

3.2 Groundwater Monitoring Network

A groundwater monitoring network was proposed in accordance with 35 I.A.C. § 845.630 to monitor groundwater quality which passes the waste boundary as part of the Operating Permit application to IEPA for AP2. The proposed groundwater monitoring network is described in the Groundwater Monitoring Plan (Ramboll 2021b) and shown in Attachment B.[2] Well construction information, including the HSU in which each well is screened, is provided in Attachment C.[3]

Groundwater flow in the vicinity of AP2 is generally to the south and east. The groundwater to the west of AP2 is separated from the groundwater flow regime under AP2 by a groundwater divide. Groundwater flow directions are generally consistent across seasons. A detailed discussion of the hydrology of the Site is presented in Section 2 of the CPP AP2 N&E Report.

[2] This figure is also provided as Figure 2-2 of the CPP AP2 N&E Report.
[3] This table is also provided as Table 3-1 of the CPP AP2 N&E Report.

4. GEOCHEMICAL SITE CONDITIONS

The general behavior of the COCs is discussed in Section 4.1. Summaries of Site solids and aqueous conditions within the relevant HSUs is provided in Section 4.2 and 4.3, respectively, with discussion of how groundwater both upgradient and downgradient of AP2 may interact with the Site solids to affect constituent behavior. This includes discussion of potential sorbing or precipitating phases and how the stability of those phases may be affected by variable groundwater pH and redox conditions.

4.1 Constituent Transport and Fate

Boron is primarily present in groundwater as boric acid ($H_3BO_3^o$) or borate ($B[OH]_4^-$) (Bolan et al., 2023). The speciation of boron depends on pH: at pH below 9.2 standard units (SU), H_3BO_3 is the dominant species (NCBI 2024). Boron is not subject to oxidation/reduction reactions (Lemarchand et al. 2015; Bolan et al. 2023). Boron primarily sorbs to positively charged sites on solid metal oxide phases, including iron and aluminum oxides (Goldberg and Glaubig 1985; Bolan et al. 2023). Boron sorbs most extensively to amorphous metal oxides between pH 7 SU and 8 SU (Goldberg and Glaubig, 1985). Boron can also sorbs to organic surfaces such as humic acids or coal under favorable conditions, most extensively between pH 8 and 10 SU (LeMarchand et al. 2015). Clay minerals have been correlated with boron sorption in soils (Goldberg 1997), with this sorption mechanism presenting an additional potential attenuation mechanism for boron under favorable geochemical conditions.

Sulfate is the primary form of oxidized sulfur (S(VI)) in the environment and is a divalent oxyanion at pH values greater than 2 SU (Stumm and Morgan 1996). Sulfate in groundwater may sorb onto positively charged sites on solid metal oxide phases, most commonly iron and manganese oxides (Brown et al. 1999). The extent and strength of sulfate sorption to metal oxide surfaces depends on pH, ionic strength, and oxide surface area available for sorption. Sulfate can also form insoluble complexes such as barite ($BaSO_4$) (NCBI 2024). Sulfate in groundwater may be reduced to elemental sulfur (S(0)) or sulfide (S(-II)) under sufficiently reducing conditions, a process governed by local microbial communities (Stumm and Morgan 1996). Generally, reduced sulfur is less mobile in groundwater than sulfate because reduced sulfur readily precipitates as metal sulfides (Stumm and Morgan 1996).

TDS is a measure of the mass of dissolved material in water, rather than a specific chemical constituent. Individual constituent contributions to TDS depends on the concentration of that constituent. Typically, major ions (i.e., calcium, sodium, magnesium, potassium, chloride, sulfate, and carbonate species) represent the primary contributors to TDS. As such, TDS is often positively correlated with electrical conductivity and ionic strength (Rusydi 2018, Ghalib et al. 2020). TDS concentrations can be reduced by the removal from aqueous phases of the individual constituents that contribute to TDS.

pH is a measure of the concentration of proton (H^+) species in solution and is presented on a logarithmic scale. pH represents the acidity or basicity of an aqueous solution and is one of the master variables that controls ion speciation and chemical processes within groundwaters. The carbonic acid – carbonate system is the most important acid-base system in groundwaters, typically controlling pH conditions within groundwaters such that they are circumneutral to slightly alkaline, with a pH range between 6-9 SU. The pH of groundwater can be affected by weathering and dissolution reactions of minerals, as wells as the biogeochemical processes associated with sulfur cycling, nitrification, and humic and fulvic acids (Brezonik and Arnold 2011), among other processes.

4.2 Site Solids Characterization

Solid phase data for the CCR source material within the unit were not collected, as the unit has been closed since the mid-1980s.

Solids from across the CPP were characterized to determine the type and abundance of minerals present in the UA and LCU. Solids were characterized using a variety of analytical techniques, to characterize their geochemical properties and to understand their effect on the geochemistry of the groundwater system.[4] The results from these analyses are presented in Tables 1 – 4. Solids were collected from five locations adjacent to the following existing wells in the AP2 monitoring network:

- G270, located upgradient of AP2 to the northwest. Solids were collected within the UA and are considered representative of background conditions for AP2.
- G1001, located downgradient of AP2 to the east, with solids collected within the LCU.
- G401, located downgradient of AP2 to the south, with solids collected within the UA. Statistical exceedances of boron, sulfate, TDS, and pH outside the GWPS limits were determined at G401 during 2023.
- G407, located side-gradient of AP2 to the west. Solids were collected within the UA.
- G410, located side-gradient of AP2 to the west, with solids collected within two intervals within the UA.

The monitoring well locations are shown on Attachment B. Boring logs for these locations are provided in Attachment D.

[4] Sequential extraction procedures are chemical extractions used to dissolve metals from specific solid-associated phases. While useful for solid phase characterization, reporting limits are often elevated for sulfate and boron and samples from the vicinity of CPP AP2 were not submitted for analysis via this technique.

Samples from six additional locations across the Site were analyzed as part of investigations at CPP AP1 but are representative of conditions within the same HSUs beneath AP2. These solids were collected adjacent to existing wells, specifically:

- G306, located upgradient of AP1 to the south and considered representative of background conditions, with solids collected within the UA.
- G307 and G307D, located upgradient of AP1 to the south, with solids collected within five intervals representing the UCU, UA, and LCU.
- G311 and G311D, located downgradient of AP1 to the north, with solids collected within four intervals representing the UCU, UA, and LCU.
- G313, located downgradient of AP1 to the east, with solids collected within the UA.
- G314 and G314D, located downgradient of AP1 to the east, with solids collected within six intervals representing the UCU, UA, LCU, and DA.
- G316, located downgradient of AP1 to the east, with solids collected within two intervals within the UA that were combined for analysis.

A map showing these monitoring well locations and boring logs for these locations are provided in Attachment D.

4.2.1 Bulk Characterization: Organic Carbon, Loss on Ignition, Cation Exchange Capacity and Sulfur Content

Total organic carbon (TOC) represents only the carbon component of organic matter within a solid material, while loss on ignition (LOI) represents the combustible portions of a solid material and is often used as an approximation of organic matter in a sample. The cation exchange capacity (CEC) of a solid represents the total negative surface charge of that material, which is related to the material's surface potential to sorb cations. Amorphous iron hydroxides, organic matter, and clays at circumneutral pH all tend to possess high negative surface charges and therefore tend to contribute to higher CEC values.

The CEC, TOC, and LOI values for Site solids are presented in Table 1 and the analytical data is provided in Attachment E. CEC values range from 3.32 – 31.02 milliequivalents per 100 g of sample (meq/100g), with lower CEC values reported for sandier lithologies (i.e., G307D). TOC abundances range from 0.06 – 1.74 percent by dry weight [% wt], whereas the reported LOI abundances ranged from 2.5 – 12.4 % wt). No clear patterns in CEC, TOC or LOI between HSUs is observed for solids across the Site.

Total sulfur within Site solids was low across all lithologies with all detections less than 0.15% wt. Acid volatile sulfide (AVS) represents the portion of sulfide within a solid material that can be liberated to hydrogen sulfide (H_2S) gas after the acidification of the sample. Sulfide was only

detected at one location (G1001 within the LCU at 0.05 % wt) and the highest detection of AVS was 0.28 milligrams per kilogram (mg/kg), indicating that sulfides have a limited abundance in the Site solids and sulfur is primarily present within other mineral phases. Sulfate concentrations, as measured in solid leachate after HCl digestion, were higher in solids at G307D (UCU and UA; 170-220 mg/kg) and G314D (UA/LCU, 210 mg/kg) compared to similar lithologic units (e.g. G311D). Higher sulfate concentrations at these two locations are consistent with the highest sulfur wt % values detected for these intervals (0.09 – 0.14 wt %).

4.2.2 Total Metals and Boron via Bulk Characterization

Total metals were analyzed to determine the major and trace metal content of the solids. The abundance of total aluminum, iron, and manganese can provide insights into the presence of adsorbing phases, as oxyhydroxides of these metals can provide sorption capacity. The total metals results are presented in Table 2 and the analytical data is provided in Attachment E.

Total iron concentrations are relatively similar between UA solids (4,900 milligrams per kilogram [mg/kg] to 22,000 mg/kg) and those detected for LCU solids (10,000 to 21,000 mg/kg). The abundance of iron within the bulk solids matrix of both the UA and LCU indicates the likelihood of iron-bearing minerals within the system. The presence of iron-bearing minerals was confirmed via X-Ray diffraction (XRD) as discussed in Section 4.2.3. Total manganese concentrations follow a similar pattern to iron, with concentrations in UA solids (34 mg/kg to 1,200 mg/kg) spanning those detected in LCU solids (370 to 470 mg/kg). Aluminum concentrations in UA solids vary from 9,600 mg/kg at the background location G270 to 32,000 mg/kg at the downgradient AP1 compliance location G316. Boron concentrations within solids were analyzed in the vicinity of AP2, with concentrations ranging between 4 to 6 mg/kg.

X-Ray fluorescence (XRF) was conducted for identification of the bulk elemental composition of solids. The XRF data are presented in Table 3 and the analytical data is provided in Attachment F. Solids from across all geologic units at the Site are predominantly composed of silicon (61.7 to 84.6 wt%), followed by calcium (0.5 to 9.1 wt%) and aluminum (4.9 to 8.4 wt%), consistent with the sandy, silty, and clayey lithologies described for these units. Iron is detected in all Site solid samples ranging from 1.69 to 3.71 wt %, with UA solids having lower wt % iron than LCU and DA solids. Manganese was detected in all Site solid samples with concentrations ranging from 0.03 to 0.13 wt %.

4.2.3 Mineralogical Analysis

XRD with Rietveld refinement was conducted for identification of minerals in solid samples. XRD is an analytical technique that provides information about the identity of the crystalline material within a sample but does not provide information about non-crystalline or amorphous phases. XRD results are normalized to 100% of the total weight, meaning that material not characterized by XRD is ignored in the percent calculation.

The XRD data are presented in Table 4 and the analytical data is provided in Attachment G. Solids from all HSUs across the Site were predominantly composed of quartz, ranging from 46.3 to 73.5% of the minerals present. Feldspar minerals including albite (6.1 to 10.4%) and microcline (5.1 to 9.8%), carbonates such as dolomite (0.0 to 15.7 %) and calcite (0.4 to 4.1%), and a variety of clays (1.1 to 12.0% total) were detected as additional primary crystalline mineral phases. Low abundances of magnetite (detected up to 0.2%) were detected in UA solids side gradient of AP2 (G407 and G410), and in LCU and DA solids adjacent to AP1, but otherwise crystalline forms of iron oxides were not detected in Site solids. Metal oxides such as iron, manganese, or aluminum oxides can serve as attenuating surfaces for boron. Ankerite, an iron-bearing carbonate mineral, was detected in all Site solids at abundances from 0.5 to 9.4%. Compared to the XRF detections of iron abundances between 1.7 to 3.7 wt %, these results indicate that the total iron within Site solids is largely associated with minerals other than crystalline iron oxides. No crystalline manganese oxide minerals were detected in Site solids. The manganese-bearing mineral kutnohorite (0.1 to 0.5 %) was detected at low abundances, consistent with the presence of dolomite-like carbonates.

Kaolinite, montmorillonite, and illite have been correlated with boron retention in soils (Goldberg 1997). Of those three clay types, illite has the greatest rate of boron adsorption, and was detected in solid samples from the UA, DA and LCU at abundances ranging from 1.7 to 4.0%. Montmorillonite and kaolinite were also present in a subset of solids from these units (1.0 to 3.2% and 0.6 to 1.1%, respectively). Chlorite was also identified at abundances ranging from 1.1 to 3.9%. The presence of clay minerals within solids presents an additional, if limited, potential attenuation mechanism for boron across the Site.

4.3 Aqueous Geochemistry

Groundwater from wells across the UA and LCU in the vicinity of AP2 were analyzed for a range of geochemical parameters, as presented in Figures 1–9. For clarity in interpretation, the figures present data from the UA and the LCU with differing symbology. UA well locations are shown with circular symbology on the figures and LCU locations are shown with triangular symbology. Background locations G270, G280, and G281, all of which are screened in the UA, are shown with hollow symbology. The groundwater data used in the Site evaluation is summarized in Attachment H.

A limited set of porewater (i.e., CCR contact water) samples have been collected in the recent past, including porewater collected from four locations screened within AP2 CCR in 2016 (AP2e-h; data originally presented in the 2017 *Antidegradation Assessment for Management of Coal Combustion Residuals Impoundment Waters, Coffeen Power Station*; Attachment I) and one sample of leachate collected during construction closure activities in 2020 (CO 102 Pump Q Box). The 2020 leachate sample pH value was analyzed by the analytical laboratory following sampling and was qualified as being analyzed after the acceptable holding time window; it has therefore

been excluded from figures and the following discussion. Other analytes measured for the 2020 AP2 leachate sample were unimpacted and are included throughout.

CCR porewater is water "collected from the interstitial water between waste particles in surface impoundments as it occurs in the field" (USEPA 2014) and represents the material potentially leached from impoundments. The CCR materials are the primary source of constituent loading to the CCR porewater. Over an extended period (e.g., months to years), the CCR porewater (i.e., water) reaches equilibrium with the CCR materials. The concentrations within the porewater are "the most representative data available for impoundments because these data are field-measured concentrations of leachate" (USEPA 2014). Porewater is therefore the most appropriate source term for potential flux out of CCR impoundments.

4.3.1 Redox/pH Summary

The oxidation-reduction (redox) potential (ORP) and pH in aqueous systems are major controls on the speciation and mobility of reactive constituents such as iron, manganese, and sulfate.

AP2 porewater pH values ranged between 6.4 to 7.2 standard units (SU). In wells across the groundwater monitoring network, pH values appear to be stable and circumneutral, with the exception of G401 (Figure 1). Compliance UA groundwater pH values largely range between 6.4 to 7.5 SU, which is a relatively lower range than detected for background UA groundwater with pH values 6.8 to 7.9 SU. Lower pH values were detected at UA well G401 relative to similarly located downgradient UA wells (e.g. G402), with reported values ranging from 5.6 to 6.4 SU, consistently below the GWPS of 6.5 SU. These pH values are also lower than the reported pH values within the AP2 unit. LCU groundwater pH, as represented by values reported for G1001, ranged between 6.8 to 7.0 SU.

Since 2020, positive ORP values have been reported in all groundwater monitoring network wells across the Site (Figure 2). Prior to 2020, groundwater at background wells G270, G280, and G281 was consistently more oxidizing than downgradient UA wells G401, G402, G403, and G404. After cessation of combustion activities and initiation of pond-recapping activities in late 2019 and early 2020, redox conditions at G401, G402, G403, and G404 shifted to more oxidizing conditions that are more consistent with the background locations. G401, G402, G403, and G404 are distributed around AP2, representing upgradient, side gradient, and downgradient locations, such that the detected shift in redox conditions likely relates to changes related to new flow patterns following plant cessation and re-closure activities. Many of the UA wells across the network (G402, G403, G404, and G405) appear to fluctuate seasonally between relatively more oxidizing (winter) and more reducing (summer) conditions. This pattern is not consistently observed across the monitoring network and appears to have developed after the completion of closure construction in 2020, which may have altered recharge conditions at these locations.

4.3.2 Exceedance Parameters

Total boron concentrations in AP2 porewaters and leachate varied from 2.0 to 14 milligrams per liter (mg/L), with concentrations detected above the site-specific GWPS for boron of 2.0 mg/L

(Table 5; Figure 3a). UA background wells G270, G280, and G281 are not detected to exceed the GWPS for boron (Figure 3a). Boron concentrations appear to increase as the sampling location moves east across AP2 (i.e., lower concentrations at G403 compared to G405; locations shown in Attachment B), consistent with the general direction of groundwater flow within the UA beneath the unit. Boron concentrations have been stable above the GWPS at downgradient UA compliance wells G401 and G402, and stable below the GWPS at G403, G406, G407, and G1001. Boron concentrations have increased at G404 following the completion of closure construction, and concentrations at G405 have also increased after a period of decline. Boron dynamics at G404 and G405 may be influenced by increasing porewater elevations within AP2 during closure that are still returning to equilibrium (Section 3.2.1 of the CPP AP2 N&E Report). When measured, dissolved boron represents the majority of total boron at all locations (Figure 3b), consistent with the expectation that the majority of boron is present as neutral boric acid at the pH ranges detected within the monitoring network and would have limited associations with particulates.

Total sulfate concentrations within AP2 porewater and leachate ranged between 1,300 to 2,300 mg/L, above the GWPS of 400 mg/L (Table 5; Figure 4a). Sulfate concentrations in groundwater are largely stable through time across the monitoring network, with sulfate concentrations detected at higher concentrations at G401 (Figure 4a). Sulfate concentration trends at both G404 and G405 are consistent with the changes in boron concentrations described above, although at a lesser magnitude. Measurements of dissolved sulfate within compliance well groundwaters are limited; when measured, dissolved sulfate represents the majority of total sulfate at all locations (Figure 4b), indicative of limited association with suspended solids in the unfiltered samples.

TDS values in AP2 porewater and leachate ranged between 1,500 to 2,400 mg/L, above the GWPS of 1,200 mg/L (Table 5; Figure 5). UA background wells G270 (60 to 510 mg/L), G280 (400 to 608 mg/L), and G281 (700 to 1,000 mg/L) have a similar range of TDS concentrations relative to UA compliance wells (270 to 1,200 mg/L; excluding exceedance wells) and LCU well G1001 (830 to 1,700 mg/L). TDS concentrations at wells with statistically significant exceedances of TDS are higher (460 to 6,600 mg/L), exceeding the range of values for AP2 porewater (1,500 to 2,400 mg/L) at some locations. Total sulfate concentrations are positively linearly correlated with TDS concentrations across wells in the monitoring network ($R^2 = 0.81$; Figure 6), indicating that sulfate is a major contributor to TDS across the AP2 monitoring network.

4.3.3 Pourbaix Diagrams

Eh-pH (Pourbaix) diagrams can be used to illustrate the predicted stability of specific phases at thermodynamic equilibrium under the conditions detected for a groundwater sample. Select crystalline mineral species were suppressed to be representative of groundwater conditions (e.g. mineral formation not anticipated to be kinetically favored for igneous and metamorphic minerals in the low temperature near-surface environment), except when identified in XRD data from solids in the site.

Using conditions detected at compliance well G402 on 6 June 2023 to represent downgradient groundwater within the UA (Table 6), amorphous ferrihydrite is predicted to be the predominant iron species under groundwater conditions at all locations, except for G401, where solid phase iron minerals are not expected to be stable (Figure 7a).[5] The lower predicted stability of ferrihydrite at G401 appears to be driven by the low pH values detected at this location. Conditions at most UA wells, including background wells G270 and G281, are poised on the redox boundary for solid phase iron stability under conditions at G402; the lower aqueous concentrations of iron at other locations (see Table 7) would tend to shift the redox boundary upwards such that aqueous iron is more likely to occur under conditions at other UA wells. Additionally, the higher abundance of total iron at G402, which was used to inform the Eh-pH diagram generation, compared to dissolved iron at G402 (Table 7) may overestimate the stability of solid phase iron species.

When not suppressed, crystalline magnetite is expected to be stable at all locations except G401 (Figure 7b), consistent with the detection of magnetite via XRD near G407 and G410 (Table 4). Magnetite is likely in a dynamic state at G401, with its stability poised between dissolution to aqueous iron and subsequent reprecipitation as amorphous iron oxides. Ankerite, which was identified via XRD and is an analogous iron-bearing carbonate species to siderite, is not expected to be thermodynamically stable within the UA based upon the detected pH and redox conditions. Dissolution of ankerite or magnetite (where present) may provide a source of iron for the subsequent formation of amorphous iron oxide coatings. Overall, these modeling results indicate that amorphous iron oxides (the formation of which is more kinetically favorable than crystalline iron oxides) might be present, although potentially unstable, at some locations within the UA.

The Eh-pH diagrams for manganese show that solid phase manganese minerals, including manganese oxides, are not predicted to be thermodynamically stable under conditions across the Site (Figure 8). Background UA well G280 is the exception, as manganese carbonate mineral rhodochrosite was predicted to be thermodynamically stable. Mineralogical analyses were not completed at well G280 to verify the presence of rhodochrosite, although manganese-bearing carbonate mineral kutnohorite was detected in XRD results throughout the site.[6]

4.3.4 Total and Dissolved Iron and Manganese Concentrations

The distribution of iron and manganese between total and dissolved phases can provide insights on Site redox conditions and constituent behavior. Paired total and dissolved iron and manganese data are only available across the Site for the Q2 and Q3, 2023 sampling events, with results also available for Q4 2023 at the background locations. A comparison of the total and dissolved iron and manganese data for these events is provided in Table 7.

---

[5] Field ORP measurements were converted to Eh by adding +200 millivolts to correct for the Ag/AgCl electrode.

[6] Kutnohorite is a solid-solution carbonate mineral with the chemical formula $(Ca,Mn^{2+})(CO_3)_2$ which is not included in most thermodynamic databases used for geochemical model calculations. Rhodochrosite (manganese carbonate) represents the most analogous mineral to kutnohorite in geochemical modeling efforts.

Total iron concentrations ranged from 0.012 mg/L at UA compliance well G406 on 31 May 2023 to 101 mg/L at downgradient UA well G401 on 11 August 2023. Dissolved iron concentrations ranged from below reporting limits to 93.8 mg/L at downgradient UA well G401 on 11 August 2023. The total and dissolved iron concentrations detected at G401 were over an order of magnitude higher than the reported values elsewhere in the network. Where dissolved iron was detected, the dissolved concentration was at typically less than 50% of the total iron value, and frequently only about 10%, indicating that iron is largely associated with suspended particulates across the AP2 monitoring network. However, dissolved iron concentrations at G401 are more than 93% of the total iron, consistent with the Eh-pH diagram results indicating geochemical conditions favor the stability of dissolved iron at this location driven by consistently lower pH and ORP (Figure 7a).

Total manganese concentrations ranged from 0.0159 mg/L at background UA well G280 on 14 August to 28.8 mg/L at downgradient UA well G401 on 11 August 2023 (Table 7). Dissolved manganese concentrations ranged from 0.0014 mg/L at background UA well G280 on 8 June to 36 mg/L at downgradient UA well G401 on 11 August 2023. Total and dissolved manganese were also much higher at G401 compared to other locations in the monitoring network, consistent with the iron results. Dissolved manganese represents the majority of total manganese concentrations at all locations except for UA background wells G270, G280, and G281 and LCU well G1001. This is consistent with the predicted greater manganese-carbonate mineral stability at G280 (Figure 8).

4.3.5 Major Ion Distribution and Groundwater Signatures

A Piper diagram was constructed using data from AP2 to visualize major ion distributions in groundwater (Figure 9). Piper diagrams are a common tool for assessing geochemical similarities or differences between aqueous samples. The cation composition of the AP2 leachate is dominated by calcium, with the major anion composition sulfate-dominated. Groundwater composition for background wells G270, G280, and G281 has lower contributions of sulfate, greater contributions of carbonate alkalinity (consistent with the presence of carbonates in the UA solids), and major cation distributions of near equal contributions of both monovalent and divalent cations. Groundwater from side gradient UA compliance well G403 and downgradient LCU well G1001 (neither of which exhibited GWPS exceedances) cluster with these background wells. Groundwater from the compliance network wells spans the range between the background wells and AP2 leachate, indicating variable influences from the AP2 CCR unit on groundwater at these locations. G401 groundwater composition is most similar to AP2 porewater leachate, consistent with the relatively higher concentrations of sulfate detected at this location (Figure 4a). These results provide further evidence for the influence of AP2 source water on compliance wells for the unit.

5. EVALUATION OF PARTITION COEFFICIENT RESULTS

Batch test studies combine soil and groundwater collected from the Site to evaluate the attenuation of chemical constituents. Batch attenuation testing was conducted for sulfate and boron to evaluate the potential for sorption and to attempt to generate Site-specific distribution coefficients between the solid and aqueous phase.

5.1 Batch Attenuation Testing

In 2021, Geosyntec conducted a field investigation at AP2 which included completion of one soil boring at G270 ranging in depth from 12 to 16 feet below ground surface. As part of that investigation, soil and groundwater samples were submitted to SiREM Laboratories (Guelph, ON) for batch solid/liquid partitioning testing. One groundwater sample (G401) and one soil sample (G270) were used for batch attenuation testing at five soil:solution ratios (Table 8), each ran in duplicate. Statistically significant exceedances of for boron, sulfate, and TDS were identified at G401, as well as being below the bounds of the GWPS for pH, while G270 is representative of background conditions at AP2. For each treatment, ~0.1 liter of groundwater was brought into contact with varying amounts of soil (0.003 to 0.17 kg, depending on the ratio) and equilibrated over a seven-day period.

An initial sample of the stock solution for each experimental design was collected on Day 0, and a control sample (i.e., G401 groundwater with no aquifer solids) was collected on Day 7 after tumbling in polypropylene bottleware to evaluate any loss to interactions with the bottleware or ambient conditions. Duplicates were constructed for each microcosm, including the control samples. After seven days of contact time, an aliquot of the free liquid was collected and filtered through a 0.45-micron (µm) filter prior to analysis for dissolved concentrations of sulfate and/or boron. Analysis of the dissolved phase is important to adequately measure the partitioning of mass between the solid and liquid fractions of the experiment. The redox and pH were measured for each batch test at the beginning and end of the contact period and in the control samples.

Data obtained from the tests (Table 8) were used to construct isotherms for boron and sulfate; 5-point isotherms were constructed by averaging duplicate results for each soil:solution ratio. Mathematical fitting was used to calculate the attenuation distribution coefficients (K_d), assuming linear adsorption. The linear adsorption equation was used:

$$q_e = K_d \times C_e \qquad \text{Eq. 1}$$

where q_e is the mass of constituent adsorbed to the solid phase at equilibrium, C_e is the remaining aqueous constituent concentration at equilibrium, and K_d is the linear sorption coefficient (reported in liters per kilogram [L/kg]).

Some of the data showed a deviation from a linear trend, and so were also fitted using non-linear isotherms. The non-linear Langmuir isotherm was used:

$$q_e = \frac{q_m K_L C_e}{1 + K_L C_e} \quad \text{Eq. 2}$$

where q_m is the inverse of the slope and K_L is the Langmuir distribution coefficient. The adsorption data were linearized according to:

$$\frac{C_e}{q_e} = \frac{1}{(K_L \times q_m)} + \frac{C_e}{q_m} \quad \text{Eq. 3}$$

A common non-linear Freundlich equation was also used:

$$q_e = K_F (C_e)^{1/n} \quad \text{Eq. 4}$$

where q_e is the mass of constituent adsorbed to the solid phase at equilibrium, C_e is the remaining aqueous constituent concentration at equilibrium, K_F is the Freundlich distribution coefficient, and $1/n$ is a non-linearity constant. The adsorption data were plotted as log-transformed values to perform the non-linear isotherm fitting using the linearized Freundlich equation:

$$log(q_e) = \log(K_F) + (1/n)\log(C_e) \quad \text{Eq. 5}$$

The calculated linear, Langmuir, and Freundlich distribution coefficients (K_d, K_L, and K_F, respectively) and $1/n$ values are shown in Table 9.

5.2 Partition Coefficient Results

The partition coefficient values for G401 groundwater combined with G270 geologic material are presented in Table 9. The linear and Langmuir isotherms for sulfate and boron are provided in Figures 10a and 10b, respectively.

The G401 partition coefficient for boron ranged from -464,440 L/kg for the Langmuir isotherm to -11.08 L/kg for the linear isotherm. A Freundlich isotherm was not fit to the data due to the lack of suitability for log transformation. Neither isotherm showed a high goodness-of-fit (i.e., R^2), with the highest correlation constant 0.44. An accurate boron coefficient could therefore not be calculated from the data.

The G401 partition coefficient for sulfate ranged from -564 L/kg for the Langmuir isotherm to -11.08 L/kg for the linear isotherm. A Freundlich isotherm was not fit to the data due to the lack of suitability for log transformation. Both of the isotherms showed reasonable goodness-of-fit with correlations between 0.56 and 0.60, but both isotherms predicted a negative relationship. An accurate sulfate partition coefficient could therefore not be calculated from the data.

6. GEOCHEMICAL CONCEPTUAL SITE MODEL

6.1 Source and Mobilization Mechanisms

Boron is naturally abundant in coals associated with organic matrices and is concentrated within CCR, primarily as polyborate (B_2O_3) surface coatings on particles (EPRI, 1998; Izquierdo & Querol, 2012). Boron was identified in the CCR porewater or leachate at concentrations up to 14 mg/L. The likely primary source of boron to the UA is the AP2 CCR porewater based on boron concentrations within the source.

Reduced sulfur species (e.g. pyrite) can be naturally abundant in coals; after coal fly ash production, sulfate is the dominant sulfur species associated with fly ash. Sulfate is concentrated on the surface of fly ash particles and the majority of sulfate mineral phases are soluble under environmental conditions, such that sulfate associated with fly ash is leachable (Izquierdo & Querol, 2012). The primary source of sulfate to the UA is AP2 CCR porewater. Sulfate was identified in the CCR leachate or porewater at concentrations up to 2,300 mg/L. Elevated concentrations of sulfate are a major contributor to the exceedances of TDS identified at G401, G402, G404 and G405.

Statistical exceedances of sulfate and TDS indicate that AP2 porewater is influencing groundwater at G401. The reported pH values at G401 (5.6 to 6.4 SU) are lower than those reported in AP2 leachate or porewater (6.4 to 7.2 SU), suggesting that geochemical reactions driven by interaction of porewater with the underlying UCU materials and/or mixing of porewater with groundwater may cause a low pH. These reactions may include iron oxidation and precipitation or carbonate mineral precipitation. Geochemical modeling to support evaluation of corrective actions may clarify the drivers of low pH at AP2. The low pH values at G401 are likely to be buffered further downgradient by the abundance of carbonate minerals identified in site solids via XRD.

6.2 Potential and Observed Attenuation Mechanisms

Boron exceedances were identified in the UA. Boron is anticipated to largely be present as the neutral $B(OH)_3^o$ boric acid species as groundwater pH values in the UA are below the pK_a for boric acid (9.2). The presence of iron oxides in some UA solids (Table 4) and the potential for amorphous ferrihydrite formation based on modeling of Eh-pH conditions indicates a portion of the boron in the groundwater system might be attenuated via surface complexation reactions within portions of the UA. Given the low abundance of total manganese in the solids (Table 2) and the predicted instability of solid manganese phases (Figure 8), manganese oxides are not expected to be an important source of adsorption sites. Boron is also known to be attenuated via interactions with clay minerals (Goldberg 1997); the XRD results identified the presence of clay minerals across the UA (Table 4). These lines of evidence are not supported by batch attenuation testing for boron, which indicated boron chemical attenuation is limited at locations downgradient of AP2.

Sulfate exceedances are currently limited to the UA. Sulfate is typically considered to be a conservative species within groundwater at circumneutral pH conditions, although sorption onto mineral surfaces is a potential attenuation mechanism. Sulfate attenuation is expected to occur largely as the result of sorption onto positively charged iron oxides and oxyhydroxides associated with solids. XRD analyses (Table 4) support the presence of iron oxides crystalline phases across the Site in the UA, with the additional potential for amorphous phases to form at some locations based on modeled redox conditions. However, chemical attenuation of sulfate is anticipated to be limited, as batch attenuation testing was not able to determine a partition coefficient for sulfate at the Site. Any attenuation of sulfate will likely contribute to a reduction of TDS in the groundwater. The low pH values at G401 are likely to be buffered by the abundance of carbonate minerals identified in site solids via XRD.

7. REFERENCES

AECOM. 2017. *Closure and Post-Closure Care Plan for the Coffeen Ash Pond No. 2 at Illinois Power Generating Company, Coffeen Power Station, 134 Cips Lane, Coffeen IL 62107*. January.

Bolan, S., Wijesekara, H., Amarasiri, D., Zhang, T., Ragályi, P., Brdar-Jokanović, M., Rékási, M., Lin, J., Padhye, L., Zhao, H., Wang, L., Rinklebe, J., Wang, H., Siddique, K., Kirkhamn, M., Bolan, N. 2023. "Boron contamination and its risk management in terrestrial and aquatic environmental settings". *Science of the Total Environment*. 164744

Brezonik, P. L., W.A. Arnold. 2011. Water Chemistry: An Introduction to the Chemistry of Natural and Engineered Aquatic Systems. Oxford University Press.

Brown, G E J, V Henrich, W Casey, D Clark, C Eggleston, A Felmy, D W Goodman, M Gratzel, G Maciel, M I McCarthy, K H Nealson, D Sverjensky, M Toney, J M Zachara. 1999. "Metal Oxide Surfaces and Their Interactions with Aqueous Solutions and Microbial Organisms". *Chemical Reviews,* 99, p. 77-174.

EPRI. 1998. "Leaching of Inorganic Constituents from Coal Combustion By-Products Under Field and Laboratory Conditions, Volume 1." Final Report TR-111773-V1.

IEPA. 2024a. "Coffeen Power Plant Ash Pond No. 2; W1350150004-02, Alternative Source Demonstration Submittal." Letter from Darin LeCrone (Illinois Environmental Protection Agency) to Diana Tickner (Electric Energy, Inc.). January 11.

Ghalib, H B, M B Yaqoob, A M Al-Abadi. 2020. "Assessment of the Groundwater at Ali Al-Garbi Area, Iraq using Geochemical Modeling and Environmental Isotopes." Desalination Water Treat. 176, 114-122.

IEPA. 2024b. "Coffeen Power Plant Ash Pond No. 2; W1350150004-02, Alternative Source Demonstration Submittal." Letter from Darin LeCrone (Illinois Environmental Protection Agency) to Diana Tickner (Electric Energy, Inc.). January 11.

Maria Izquierdo, Xavier Querol. 2012. Leaching behaviour of elements from coal combustion fly ash: An overview. International Journal of Coal Geology, 194, 54-66.

Lemarchand, D, A D Jacobson, D Cividini, and F Chabaux. 2015. "The major ion, 87Sr/86Sr, and d11B geochemistry of groundwater in the Wyodak-Anderson coal bed aquifer (Powder River Basin, Wyoming, USA)". Comptes Rendus Geoscience, 347, 348-357.

Geosyntec Consultants, Inc. (Geosyntec). 2023a. "Alternative Source Demonstration. Coffeen Power Plant Ash Pond No. 2 (Unit ID #102), IEPA ID: W1350150004-02, 35 IAC 845.650." December.

Geosyntec Consultants, Inc. (Geosyntec). 2023b. "Alternative Source Demonstration – G407 Sulfate and Total Dissolved Solids. Coffeen Power Plant Ash Pond No. 2 (Unit ID #102), IEPA ID: W1350150004-02, 35 IAC 845.650." December.

Goldberg, S. 1997. "Reactions of Boron with Soils". Plant and Soil, 193, 35-48.

Goldberg, S. and Glaubig, R.A. 1985. Boron Adsorption on Aluminum and Iron Oxide Minerals. *Soil Science Society of America Journal*, 49: 1374-1379.

National Center for Biotechnology Information (NCBI). 2024a. PubChem Compound Summary for CID 7628, Boric Acid. https://pubchem.ncbi.nlm.nih.gov/compound/Boric-Acid. Accessed Feb. 6, 2024.National Center for Biotechnology Information (NCBI)b. 2024. PubChem Compound Summary for CID 24414, Barium Sulfate. https://pubchem.ncbi.nlm.nih.gov/compound/Barium-Sulfate. Accessed Feb. 6. 2024

Natural Resource Technology, Inc. (NRT). 2017. *Hydrogeologic Site Characterization Report, Ash Pond 2, Coffeen Power Station, Coffeen, Illinois*. January.

Ramboll Americas Engineering Solutions, Inc. (Ramboll). 2021. "*Addendum to the Groundwater Monitoring Plan. Coffeen Power Plant, Ash Pond No. 2, Coffeen, Illinois. Illinois Power Generating Company."* October.

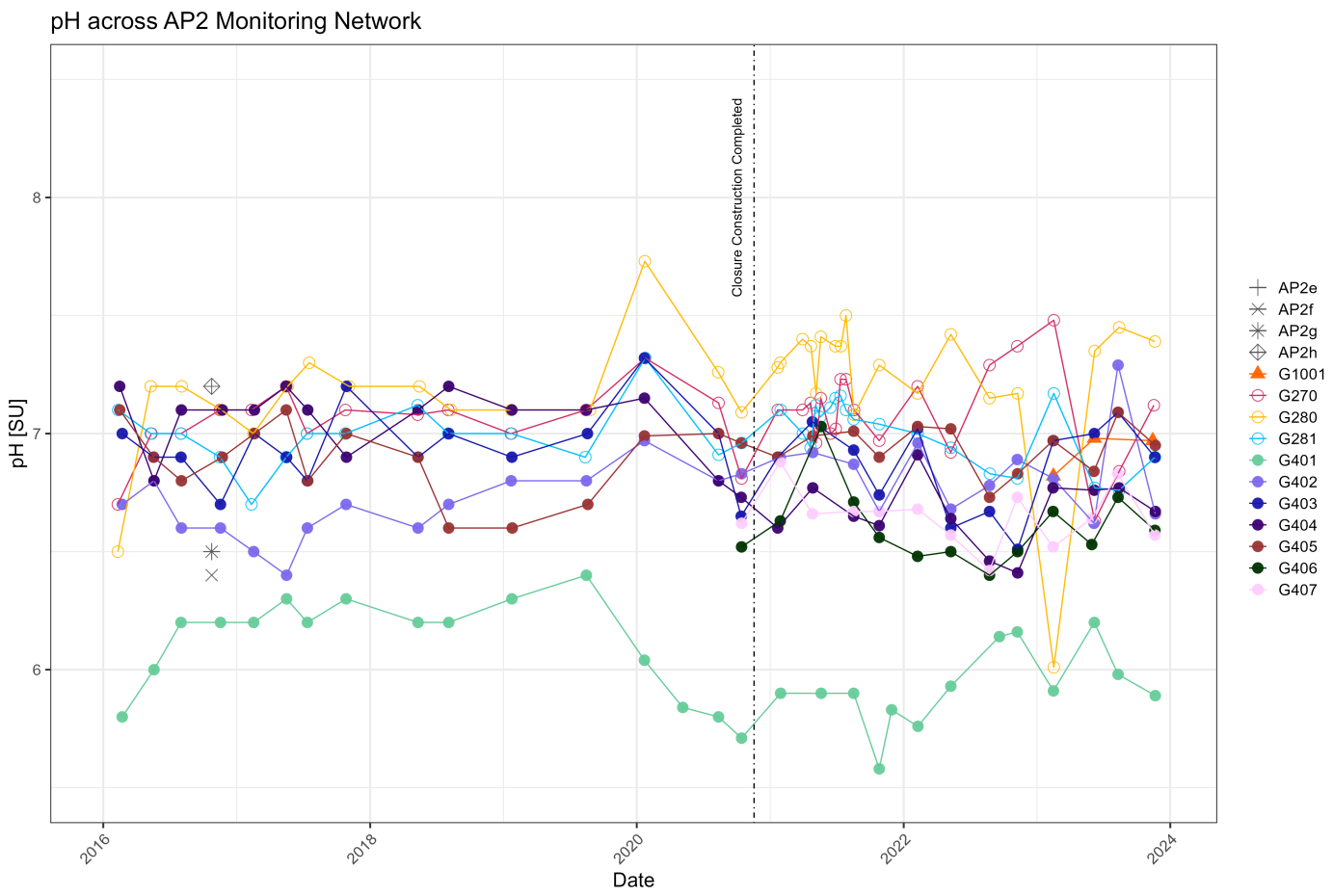
Ramboll. 2024. 35 I.A.C. § 845.610(B)(3)(D) *Groundwater Monitoring Data and Detected Exceedances – 2023 Quarter 4. Ash Pond No.2, Coffeen Power Plant, Coffeen, Illinois*. Ramboll Americas Engineering Solutions, Inc. March.

Rusydi, A. 2018. "Correlation Between Conductivity and Total Dissolved Solids in Various Types of Water: A Review." IOP Conference Series: Earth and Environmental Science. 118, 012019.

Stumm, W., J J Morgan. 1996. Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters, 3rd ed., Wiley-Interscience.

United States Environmental Protection Agency (USEPA). 2014. "Human and Ecological Risk Assessment of Coal Combustion Residuals (2050-AE81)". December.

FIGURES



Notes:
SU: Standard Units
Background wells shown with open symbols.

pH Time Series

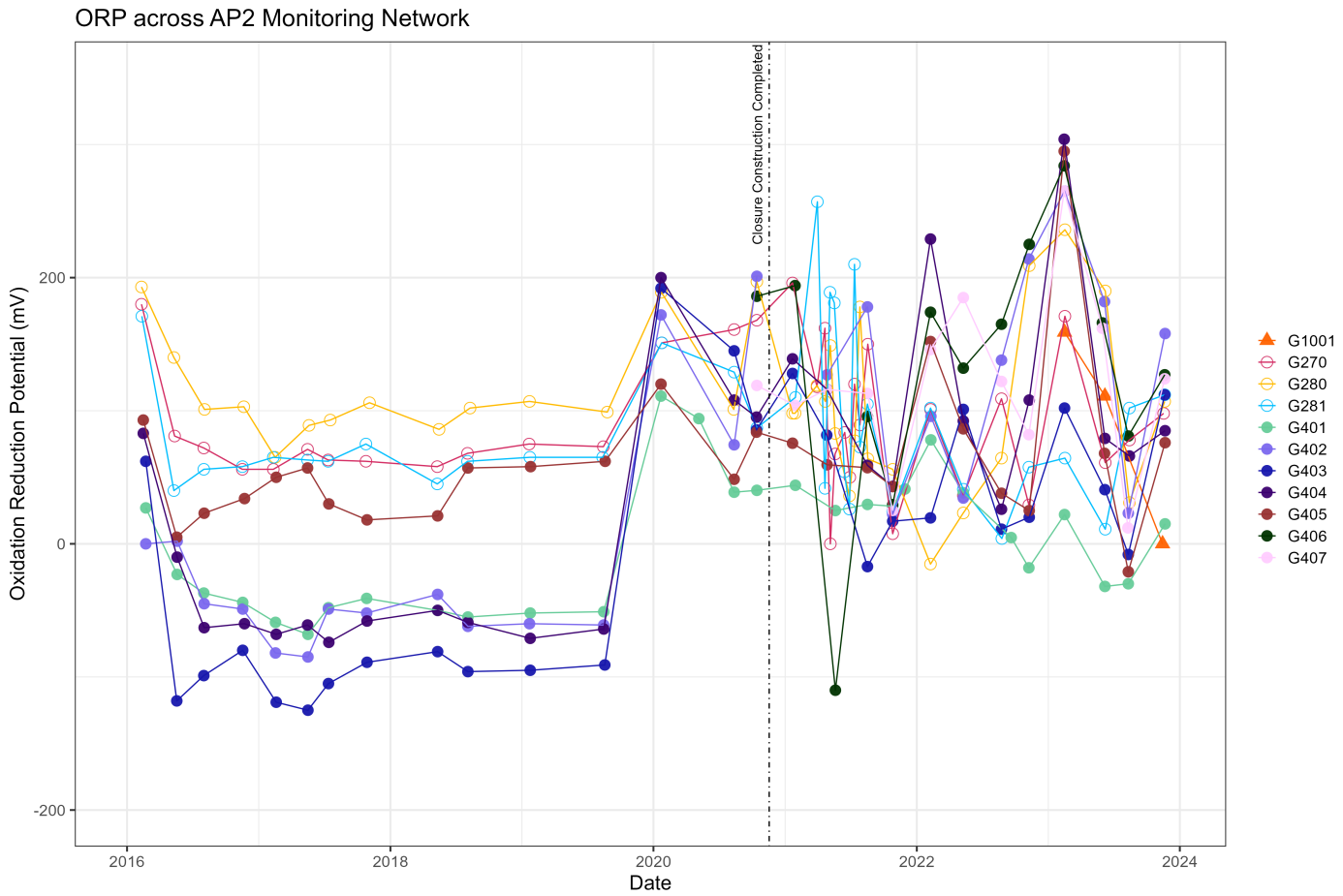
Coffeen Power Plant – Ash Pond No. 2

Geosyntec consultants

Columbus, Ohio | May 2024

Figure 1

Vistra - Groundwater Compliance - Documents\General\GCSM\Coffeen\Figures



Notes:
mV: millivolts
Background wells shown with open symbols.

ORP Time Series

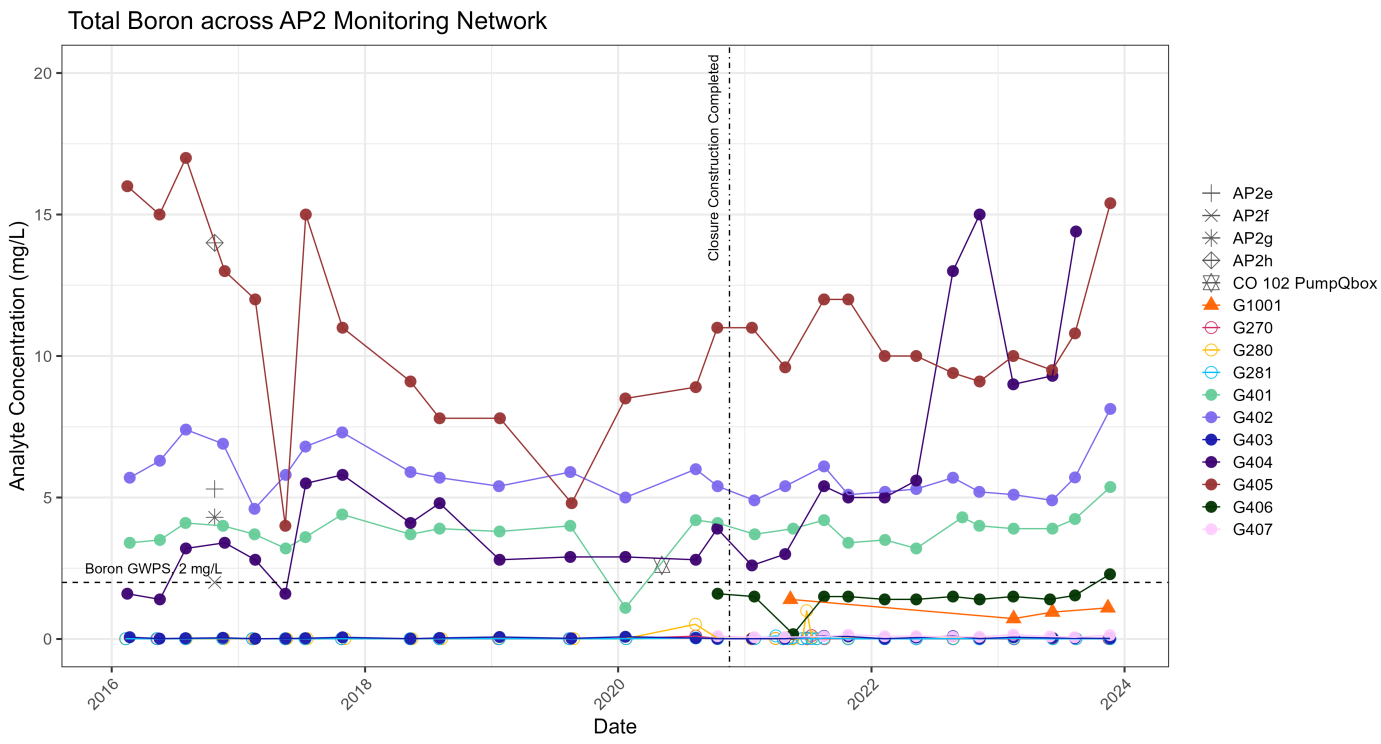
Coffeen Power Plant – Ash Pond No. 2

Geosyntec consultants

Columbus, Ohio | May 2024

Figure **2**

Vistra - Groundwater Compliance - Documents\General\GCSM\Coffeen\Figures



Notes:
mg/L: milligrams per liter
GWPS: Groundwater Protection Standard
Background wells shown with open symbols.

Total Boron Concentration Time Series

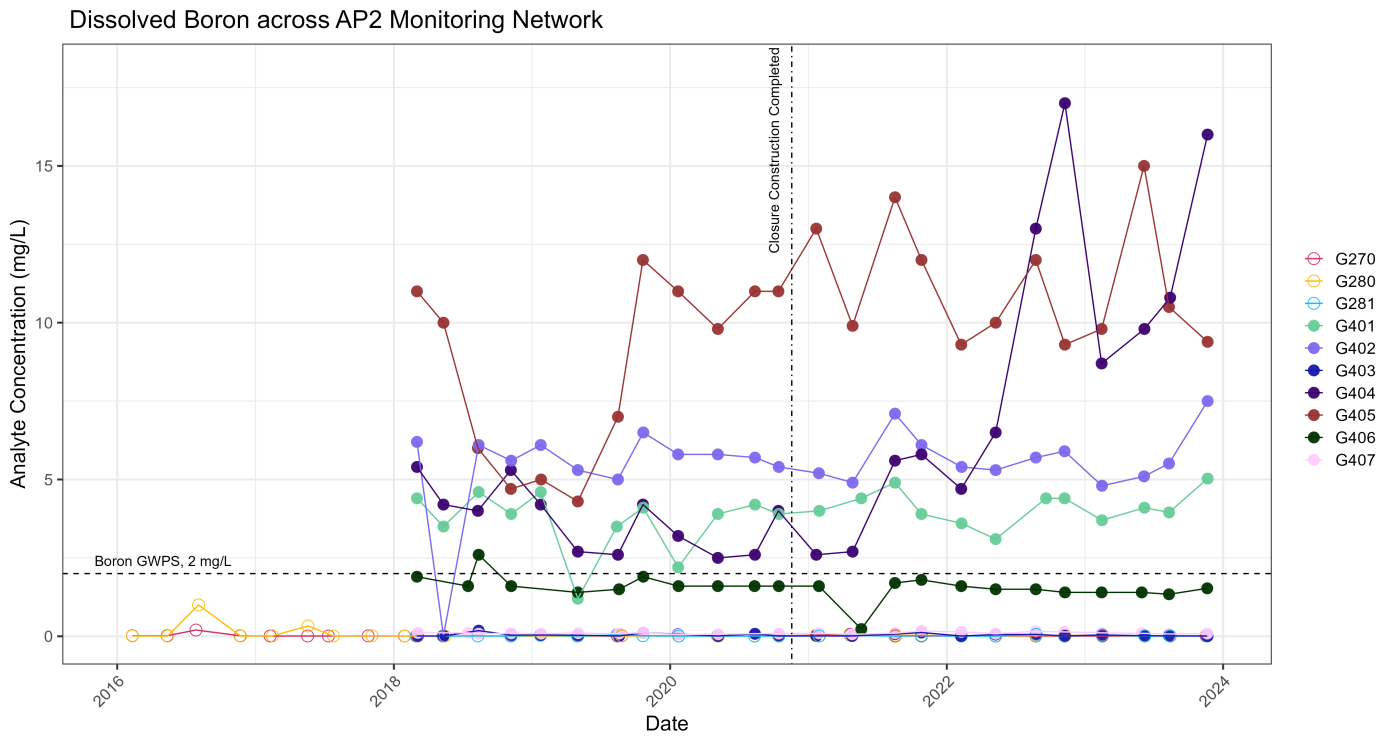
Coffeen Power Plant – Ash Pond No. 2

Geosyntec consultants

Columbus, Ohio | May 2024

Figure **3a**

Vistra - Groundwater Compliance - Documents\General\GCSM\Coffeen\Figures



Notes:
mg/L: milligrams per liter
GWPS: Groundwater Protection Standard
Background wells shown with open symbols.

Dissolved Boron Concentration Time Series

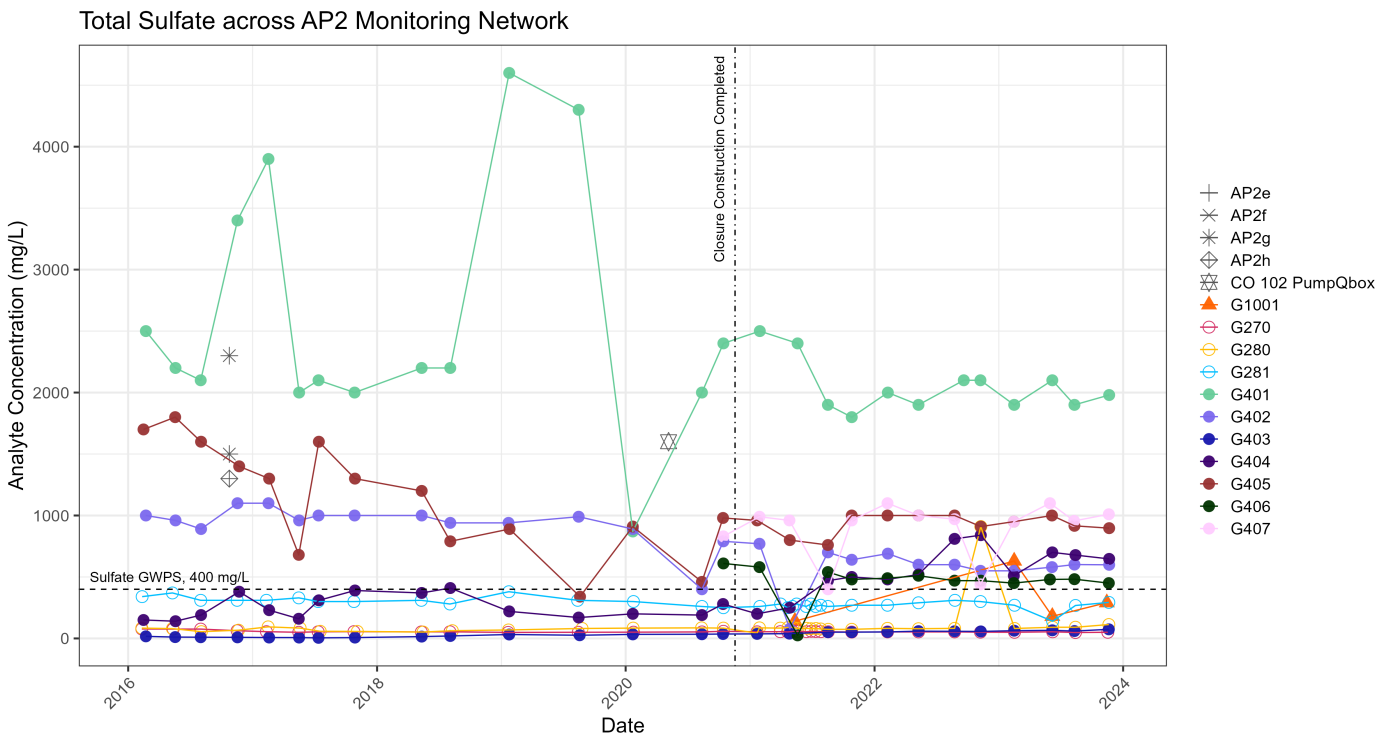
Coffeen Power Plant – Ash Pond No. 2

Geosyntec consultants

Columbus, Ohio | May 2024

Figure **3b**

Vistra - Groundwater Compliance - Documents\General\GCSA\Coffeen\Figures



Notes:
mg/L: milligrams per liter
GWPS: Groundwater Protection Standard
Background wells shown with open symbols.

Total Sulfate Concentration Time Series

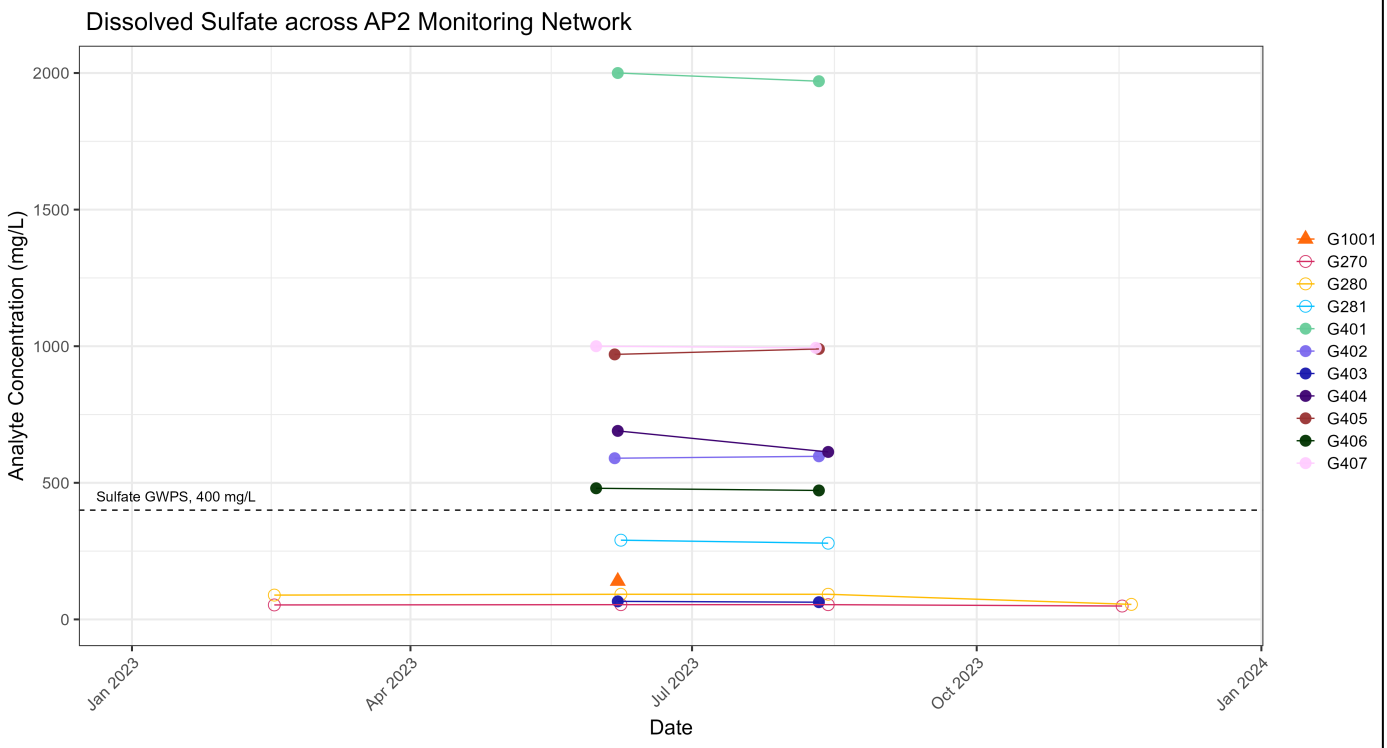
Coffeen Power Plant – Ash Pond No. 2

Geosyntec consultants

Columbus, Ohio | May 2024

Figure **4a**

Vistra - Groundwater Compliance - Documents\General\GCSM\Coffeen\Figures



Notes:
mg/L: milligrams per liter
GWPS: Groundwater Protection Standard
Background wells shown with open symbols.

Dissolved Sulfate Concentration Time Series

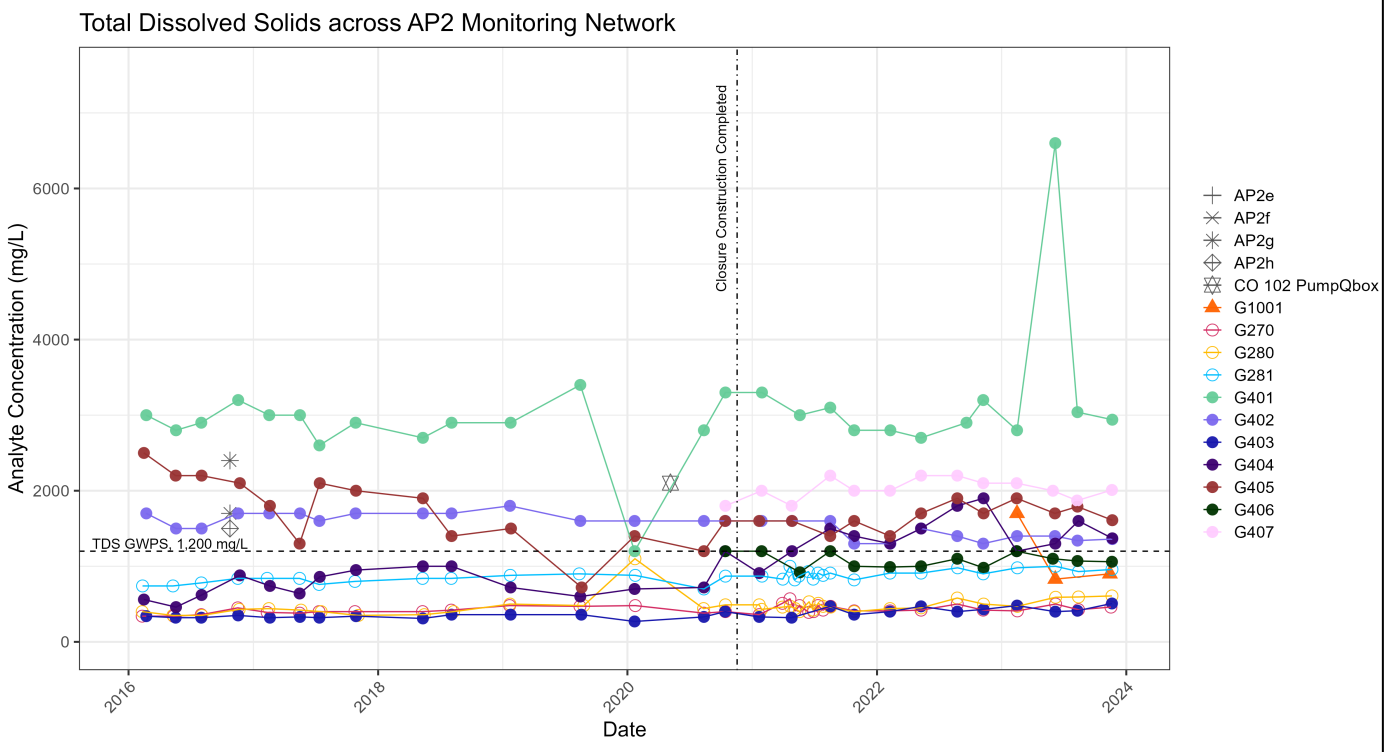
Coffeen Power Plant – Ash Pond No. 2

Geosyntec consultants

Columbus, Ohio | May 2024

Figure **4b**

Vistra - Groundwater Compliance - Documents\General\GCSM\Coffeen\Figures



Notes:
mg/L: milligrams per liter
GWPS: Groundwater Protection Standard
Background wells shown with open symbols.

Total Dissolved Solids Concentration Time Series

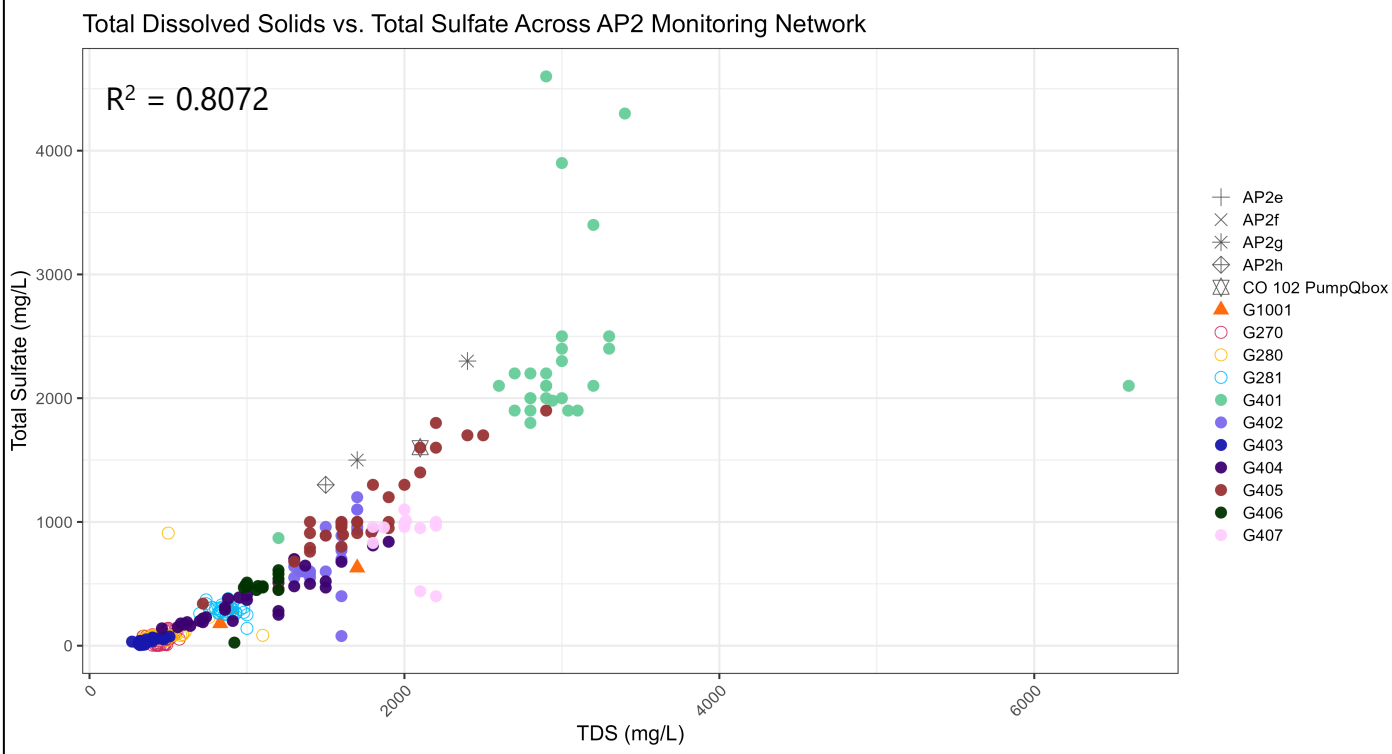
Coffeen Power Plant – Ash Pond No. 2

Geosyntec consultants

Columbus, Ohio | May 2024

Figure **5**

Vistra - Groundwater Compliance - Documents\General\GCSM\Coffeen\Figures



Notes:
mg/L: milligrams per liter
GWPS: Groundwater Protection Standard
Background wells shown with open symbols.
Regression was run using only groundwater results.

TDS Concentration vs Sulfate Concentration

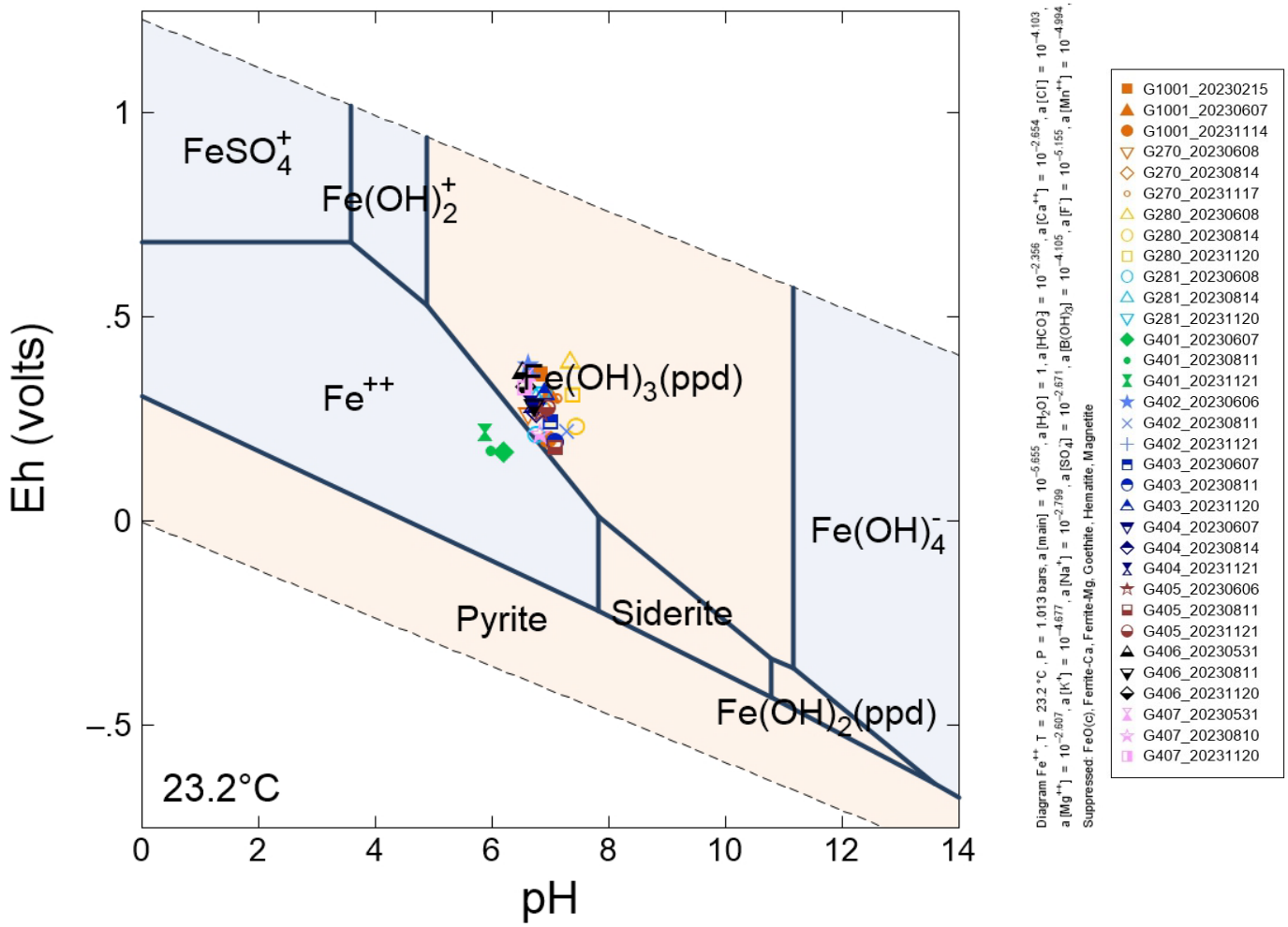
Coffeen Power Plant – Ash Pond No. 2

Geosyntec consultants

Columbus, Ohio | May 2024

Figure 6

Vistra - Groundwater Compliance - Documents\General\GCSM\Coffeen\Figures



Notes:

1. Diagram was generated using conditions detected at well G402 on 6/6/2023.
2. Well G402 is screened in the uppermost aquifer.
3. The most recent available pH and ORP data for each location are displayed.
4. Ferrite-Ca, ferrite-Mg, goethite, crystalline iron oxide, hematite, and magnetite were suppressed during model generation.

Iron Pourbaix Diagram; Crystalline Phases Suppressed

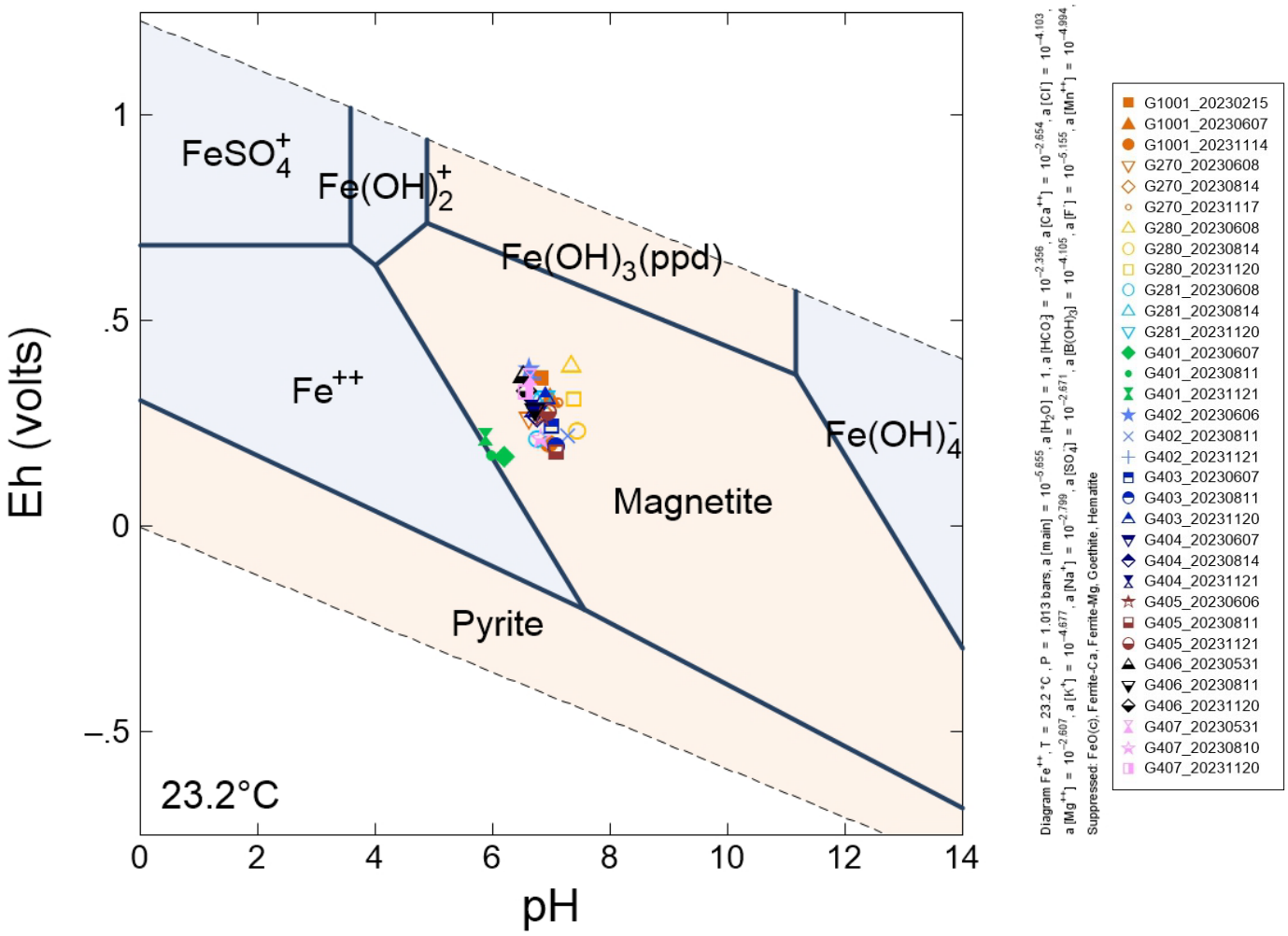
Coffeen Power Plant – Ash Pond No. 2

Geosyntec consultants

Columbus, Ohio | March 2024

Figure **7a**

Vistra - Groundwater Compliance - Documents\General\GCSM\Coffeen\Figures



Notes:

1. Diagram was generated using conditions detected at well G402 on 6/6/2023.
2. Well G402 is screened in the uppermost aquifer.
3. The most recent available pH and ORP data for each location are displayed.
4. Ferrite-Ca, ferrite-Mg, goethite, crystalline iron oxide, and hematite were suppressed during model generation.

Iron Pourbaix Diagram

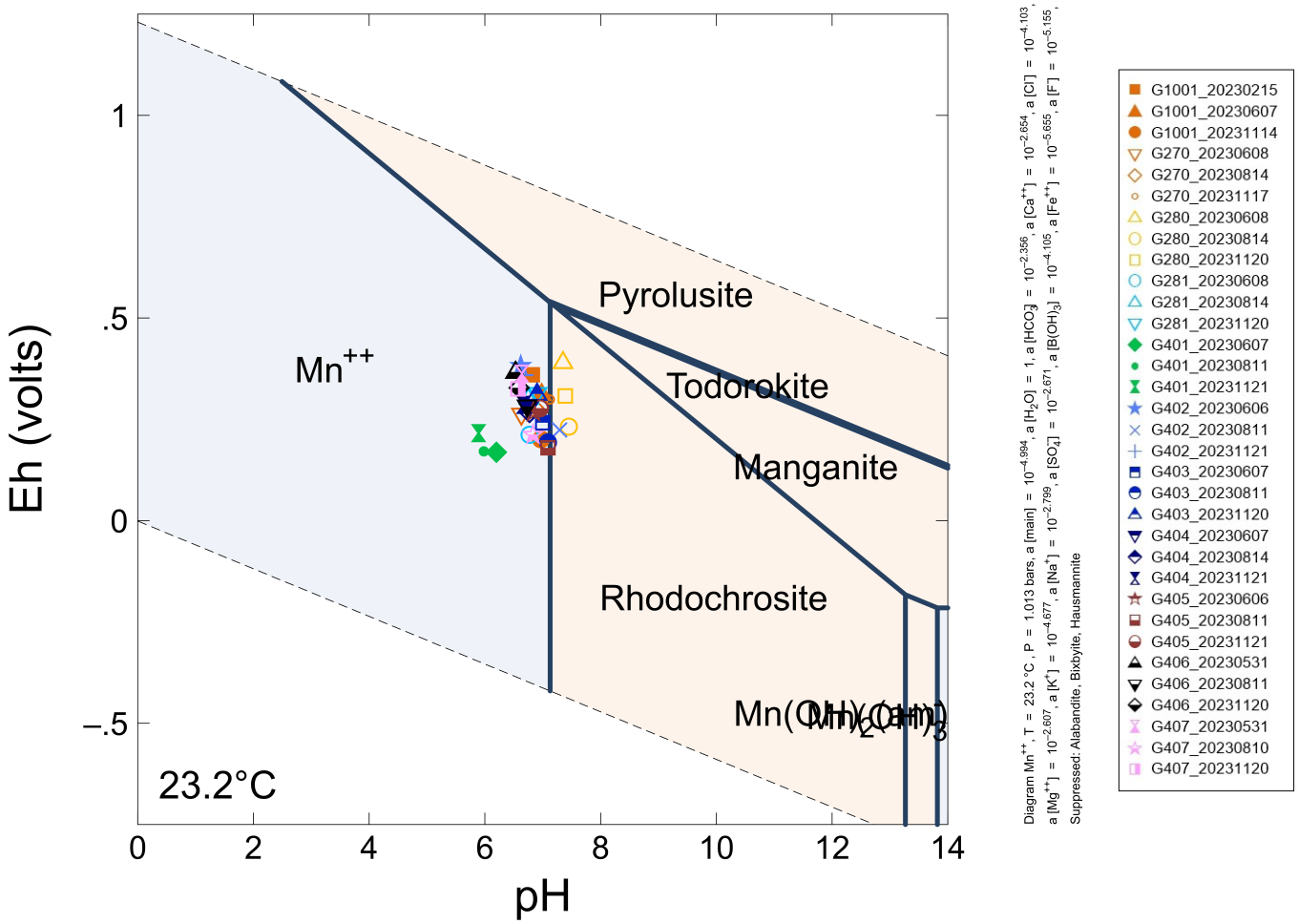
Coffeen Power Plant – Ash Pond No. 2

Geosyntec consultants

Columbus, Ohio | March 2024

Figure **7b**

Vistra - Groundwater Compliance - Documents\General\GCSM\Coffeen\Figures



Notes:

1. Diagram was generated using conditions detected at well G402 on 6/6/2023.
2. Well G402 is screened in the uppermost aquifer.
3. The most recent available pH and ORP data for each location are displayed.
4. Alabandite, bixbyite, and hausmannite were suppressed during model generation.

Manganese Pourbaix Diagram

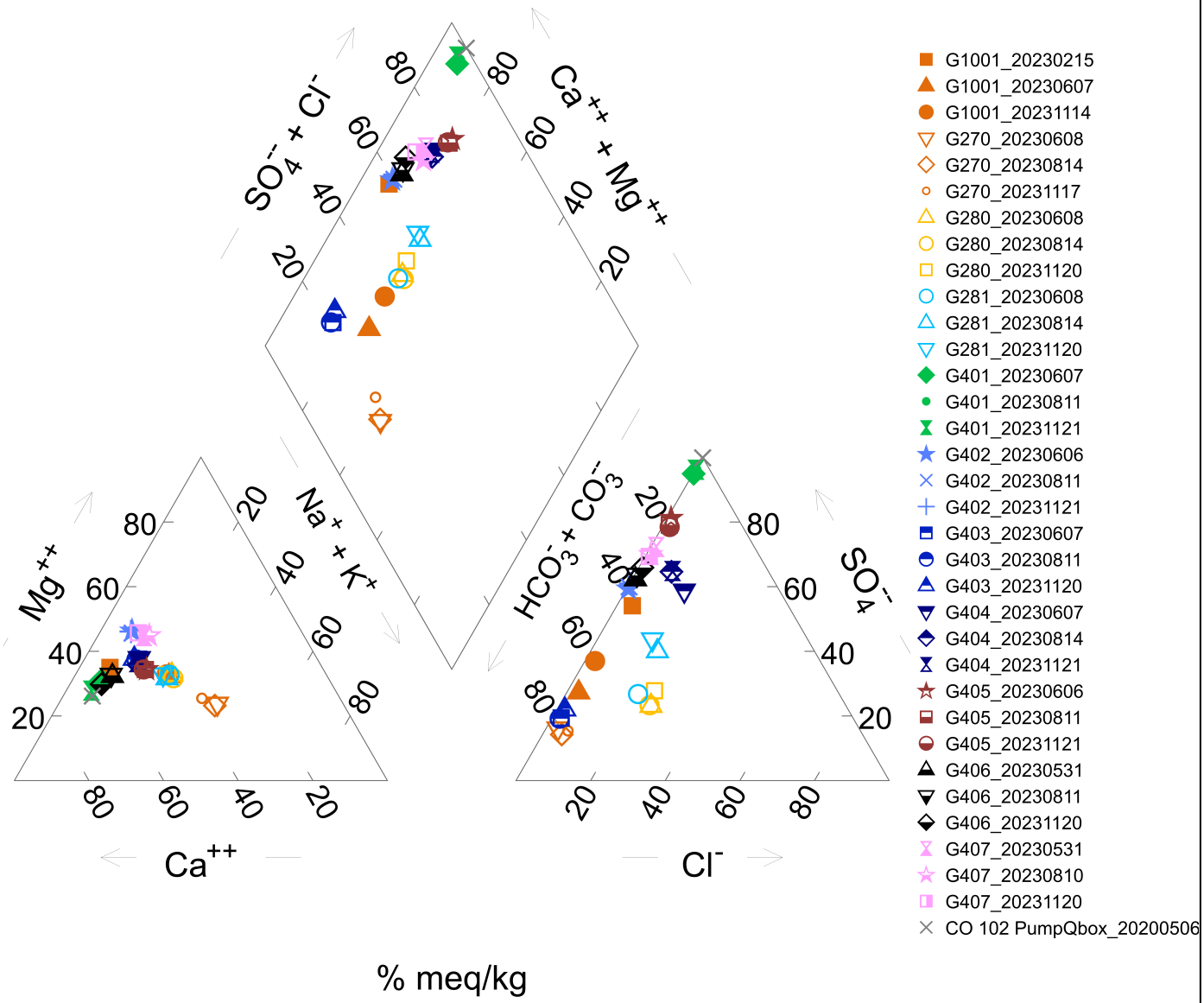
Coffeen Power Plant – Ash Pond No. 2

Geosyntec consultants

Columbus, Ohio | March 2024

Figure **8**

Vistra - Groundwater Compliance - Documents\General\GCSM\Coffeen\Figures



Notes:
1. The three most recent available data points for each location are displayed.
2. Background wells shown with open symbols.

% meq/kg: percent milliequivalents per kilogram

Piper Diagram

Coffeen Power Plant – Ash Pond No. 2

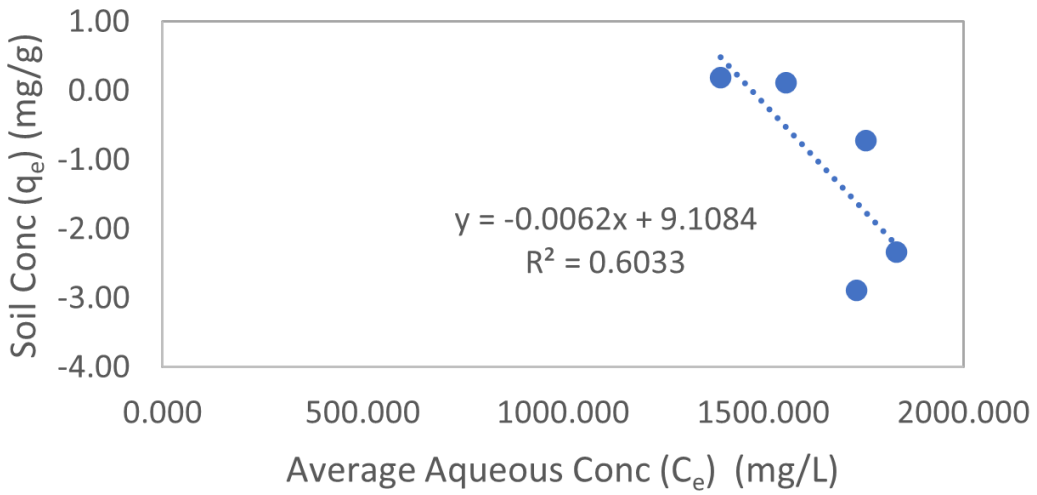
Geosyntec consultants

Figure 9

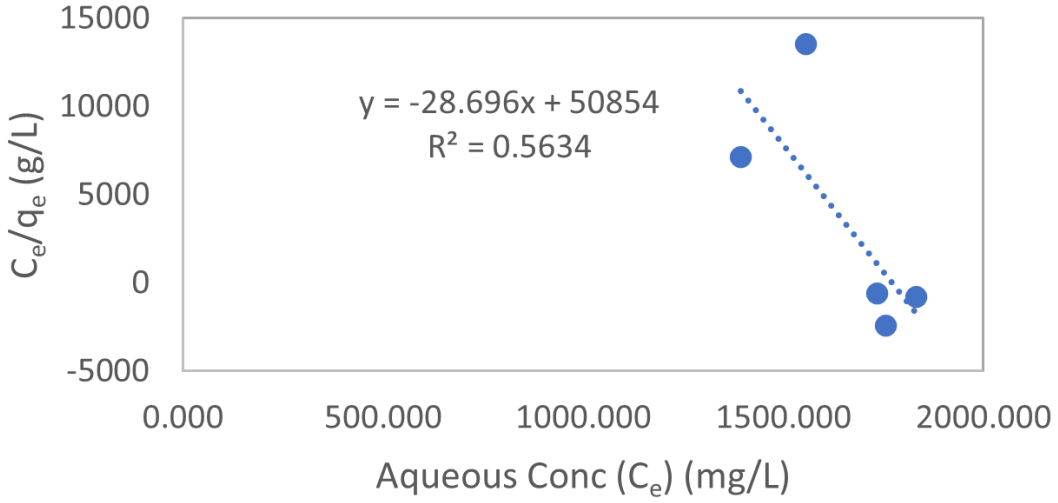
Columbus, Ohio | March 2024

Vistra - Groundwater Compliance - Documents\General\GCSM\Coffeen\Figures

Linear



Langmuir



Notes:
1. The Freundlich isotherm was not calculated because the data were not conducive to log transformation.

q_e - mass of constituent adsorbed to the solid phase
C_e - remaining aqueous constituent concentration
mg/L - milligrams per liter
mg/g - milligrams per gram
g/L - grams per liter

G401 Sulfate Partitioning Coefficients

Coffeen Power Plant – Ash Pond No. 2

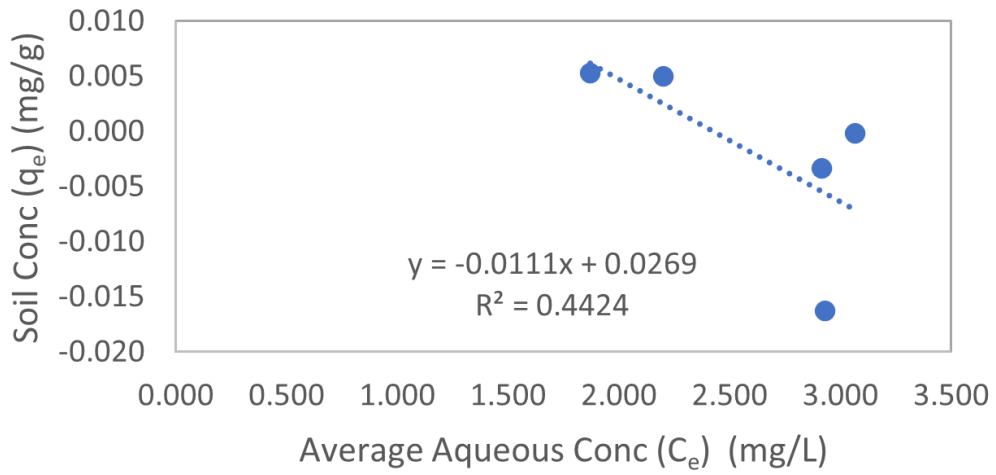
Geosyntec consultants

Columbus, Ohio | March 2024

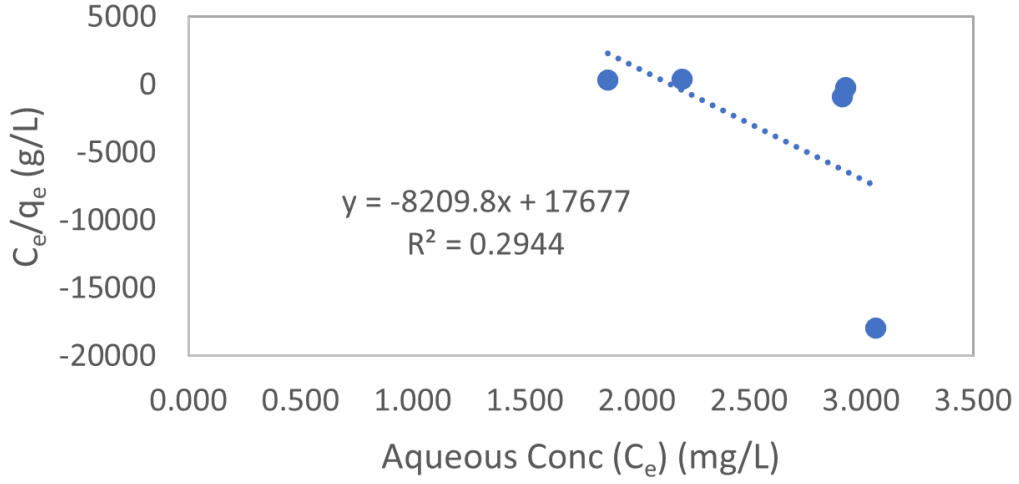
Figure **10a**

Vistra - Groundwater Compliance - Documents\General\GCSM\Coffeen\Figures

Linear



Langmuir



Notes:

1. The Freundlich isotherm was not calculated because the data were not conducive to log transformation.

q_e - mass of constituent adsorbed to the solid phase
C_e - remaining aqueous constituent concentration
mg/L - milligrams per liter
mg/g - milligrams per gram
g/L - grams per liter

G401 Boron Partitioning Coefficients

Coffeen Power Plant – Ash Pond No. 2

Geosyntec consultants

Columbus, Ohio | March 2024

Figure **10b**

Vistra - Groundwater Compliance - Documents\General\GCSM\Coffeen\Figures

TABLES

Table 1. CEC and LOI of Site Solids
Geochemical Conceptual Site Model
Coffeen Power Plant - Ash Pond No. 2

Well ID	G270	G306	G311	G313	G316	G314	G314	G314	G401	G407	G410	G410	G307D
Depth (ft bgs)	(12-16)	(14-16)	(14-15)	(8-9)	(13-14, 15-16)	(13-18)	(18-23)	(38-43)	(16-20)	(10-13)	(11-12)	(12.5-13)	(4-12.8)
Well Characterization	AP2 Background	AP1 Background	AP1 Adjacent	AP1 Compliance	AP1 Compliance	AP1 Compliance	AP1 Compliance	AP1 Compliance	AP2 Compliance	AP2 Compliance	AP2 Sidegradient	AP2 Sidegradient	AP1 Compliance
Sampled Aquifer Unit	UA	UA	UA	UA	UA	LCU	LCU	DA	UA	UA	UA	UA	UCU
Field Boring Log Description	Silty Sand	Sand	Sand	Sand	Sand	Sandy to silty till	Sandy to silty till	Sand and sandy silt/clay	Sand to Sandy Clay	Sandy to gravelly silt	Sandy to gravelly silt	Sandy to gravelly silt	Clay
CEC (meq/100 g solid)	-	-	-	-	-	17.84	18.95	14.39	-	11.41	15.39	31.02	18.82
LOI (%)	-	-	-	-	-	12.43	12.33	12.30	-	2.54	3.75	11.96	-
TOC (%)	0.14	0.41	0.77	0.78	0.26	-	-	-	0.08	-	-	-	0.06
AVS (mg/kg)	<0.19	<0.18	0.24	<0.16M	0.28	<0.22	<0.22	<0.22	<0.19	<0.23	<0.23	<0.21	-
Total Carbon (%)	-	1.65	2.76	3.26	0.46	-	-	-	-	-	-	-	-
Sulfur (%)	<0.005	0.01	0.01	0.01	0.01	-	-	-	0.01	-	-	-	0.01
Sulfide (%)	<0.04	<0.04	<0.04	<0.04	<0.04	-	-	-	<0.04	-	-	-	-

Well ID	G307D	G307D	G307D	G307D	G311D	G311D	G311D	G311D	G314D	G314D	G314D	G1001
Depth (ft bgs)	(12.8-14)	(18-34.9)	(40-54)	(54-60)	(4-12)	(12-14)	(18-42)	(44-52)	(4.2-17)	(17.3-21.6)	(21.8-45.5)	(6-11)
Well Characterization	AP1 Compliance	AP1 Compliance	AP1 Compliance	AP1 Compliance	AP1 Adjacent	AP1 Adjacent	AP1 Adjacent	AP1 Adjacent	AP1 Compliance	AP1 Compliance	AP1 Compliance	AP2 Compliance
Sampled Aquifer Unit	UA	UA	LCU	LCU	UCU	UA	UA	LCU	UCU/UA	UA/LCU	LCU	LCU
Field Boring Log Description	Sand	Sandy to gravelly silt	Clay	Clay	Clay	Sand and sandy silt/clay	Clay	Clay	Clay with trace sand	Clay with trace sand	Clay	Clay with trace sand
CEC (meq/100 g solid)	3.32	3.91	8.31	17.24	9.36	9.23	9.61	13.05	9.44	9.72	12.45	-
LOI (%)	-	-	-	-	-	-	-	-	-	-	-	-
TOC (%)	1.12	1.67	1.24	0.11	<0.0318	1.15	1.48	0.06	<0.0498	1.74	0.85	0.85
AVS (mg/kg)	-	-	-	-	-	-	-	-	-	-	-	-
Total Carbon (%)	-	-	-	-	-	-	-	-	-	-	-	-
Sulfur (%)	<0.0066	0.14	0.09	0.01	0.01	0.08	0.08	0.08	0.01	0.11	<0.008	0.03
Sulfide (%)	-	-	-	-	-	-	-	-	-	-	-	0.05

Notes
Sample depth is shown in feet below ground surface (ft bgs)
Dashes indicate sample was not analyzed for analyte
meq/100 g solid: milliequivalents per 100 grams solids
M - Reporting limit elevated due to matrix interference
LOI: loss on ignition
TOC: total organic carbon
AVS: acid volatile sulfides
mg/kg: milligrams per kilogram
AP1: Ash Pond 1
AP2: Ash Pond 2
CCR: Coal combustion residual
UCU: Upper Confining Unit
LCU: Lower Confining Unit
DA: Deep Aquifer
UA: Uppermost Aquifer

Table 2. Bulk Characterization of Site Solids
Geochemical Conceptual Site Model
Coffeen Power Plant - Ash Pond No. 2

Well ID	**G270**	**G306**	**G311**	**G313**	**G316**	**G307D**	**G307D**	**G307D**	**G307D**	**G307D**	**G311D**	**G311D**	**G311D**	**G311D**	**G314D**	**G314D**	**G314D**	**G401**	**G1001**
Depth (ft bgs)	**(12-16)**	**(14-16)**	**(14-15)**	**(8-9)**	**(13-14, 15-16)**	**(4-12.8)**	**(12.8-14)**	**(18-34.9)**	**(40-54)**	**(54-60)**	**(4-12)**	**(12-14)**	**(18-42)**	**(44-52)**	**(4.2-17)**	**(17.3-21.6)**	**(21.8-45.5)**	**(16-20)**	**(6-11)**
Well Characterization	**AP2 Background**	**AP1 Background**	**AP1 Adjacent**	**AP1 Compliance**	**AP1 Compliance**	**AP1 Compliance**	**AP1 Compliance**	**AP1 Compliance**	**AP1 Compliance**	**AP1 Compliance**	**AP1 Adjacent**	**AP1 Adjacent**	**AP1 Adjacent**	**AP1 Adjacent**	**AP1 Compliance**	**AP1 Compliance**	**AP1 Compliance**	**AP2 Compliance**	**AP2 Compliance**
Sampled Aquifer Unit	**UA**	**UA**	**UA**	**UA**	**UA**	**UCU**	**UA**	**UA**	**LCU**	**LCU**	**UCU**	**UA**	**UA**	**LCU**	**UCU/UA**	**UA/LCU**	**LCU**	**UA**	**LCU**
Field Boring Log Description	**Silty Sand**	**Sand**	**Sand**	**Sand**	**Sand**	**Clay**	**Sand**	**Sandy to gravelly silt**	**Clay**	**Clay**	**Clay**	**Sand and sandy silt/clay**	**Clay**	**Clay**	**Clay with trace cand**	**Clay with trace sand**	**Clay**	**Sand to Sandy Clay**	**Clay with trace sand**
Analyte	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Aluminum	9600	13000	11000	31000	32000	-	-	-	-	-	-	-	-	-	-	-	-	9700	8200
Antimony	<0.8	<0.8	<0.8	<0.8	<0.8	<2.6	<2	<2.6	<2.8	<2.4	<3	<3.2	<3	<2.8	<2.8	<3	<2.4	<0.8	<0.8
Arsenic	12	6.7	2.7	5.6	5.1	7.5	1.7	2.9	5.7	4.2	3.2	3.5	2.8	3.2	1.3	2.7	3.8	5.5	6.2
Barium	210	98	58	310	320	150	10	20	93	110	57	44	69	90	63	27	140	190	120
Beryllium	0.48	0.5	0.4	0.7	0.7	<0.86	<0.66	<0.87	<0.93	<0.79	<1	<1.1	<1	<0.95	<0.93	<1	<0.8	0.35	0.45
Bismuth	0.18	0.1	0.1	0.1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	0.25	0.23
Boron	5	-	-	-	-	<8.6	<6.6	<8.7	<9.3	<7.9	<10	<11	<10	<9.5	<9.3	<10	<8	4	6
Cadmium	0.12	0.1	0.1	0.2	0.1	1.2	<0.66	<0.87	<0.93	<0.79	<1	<1.1	<1	<0.95	<0.93	<1	<0.8	0.03	0.13
Calcium	5000	35000	52000	69000	10000	-	-	-	-	-	-	-	-	-	-	-	-	1900	42000
Chloride	-	-	-	-	-	<10	19	<10	<10	<10	<1	<1	<1	<1	<10	<10	<10	-	-
Chromium	16	130.0	100.0	130.0	150.0	9.5	3.8	8.5	10.0	8.5	10.0	8.0	10.0	12.0	8.7	9.9	25.0	14	15
Cobalt	10	6.0	4.0	7.0	4.0	25.0	1.4	4.5	7.1	6.0	3.1	4.0	5.0	5.9	<1.9	5.2	10.0	6.1	8.8
Copper	12	14	10	12	10	-	-	-	-	-	-	-	-	-	-	-	-	7.8	11
Fluoride	-	-	-	-	-	3.1	<2.5	<2.5	4.2	6.8	<0.25	<0.25	<0.25	<0.25	<2.5	<2.5	3.1	-	-
Iron	22000	-	-	-	-	20000	4900	11000	10000	19000	10000	8600	11000	12000	4900	11000	21000	14000	16000
Lead	12	9.0	7.0	11.0	12.0	15.0	3.3	5.9	7.7	7.2	8.1	5.4	6.9	8.7	5.5	7.3	11.0	9.5	11
Lithium	11	11.0	11.0	19.0	14.0	<4.3	<3.3	10.0	7.1	6.8	<5	6.4	8.4	10.0	<4.6	9.1	28.0	7	9
Magnesium	4700	15000	27000	35000	6700	-	-	-	-	-	-	-	-	-	-	-	-	1600	18000
Manganese	1200	470	310	1200	260	3100	120	290	430	470	110	250	290	380	34	320	370	54	450
Mercury	-	-	-	-	-	<0.17	<0.13	<0.17	<0.19	<0.16	<0.2	<0.21	<0.2	<0.19	<0.19	<0.2	<0.16	-	-
Molybdenum	0.8	5.8	2.7	1.6	8.1	1.3	<0.66	<0.87	1.4	<0.79	<1	1.2	1.2	1.3	<0.93	1.2	<0.8	0.4	1.5
Nickel	20	15	11	17	13	-	-	-	-	-	-	-	-	-	-	-	-	10	15
Nitrogen (total)	-	-	-	-	-	160	<63	260	360	310	510	360	370	530	140	360	260	-	-
Potassium	1400	3700	3600	13000	14000	-	-	-	-	-	-	-	-	-	-	-	-	770	1100
Selenium	<0.7	<0.7	<0.7	<0.7	<0.7	<0.86	<0.66	<0.87	<0.93	<0.79	<1	<1.1	<1	<0.95	<0.93	<1	1.0	<0.7	<0.7
Silver	< 0.05	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	< 0.05	< 0.05
Sodium	110	590	830	6000	6400	-	-	-	-	-	-	-	-	-	-	-	-	80	110
Strontium	10	26	35	100	89	-	-	-	-	-	-	-	-	-	-	-	-	9.1	35
Sulfate	-	-	-	-	-	220	170	30	<10	<10	2	<1	<1	<1	76	210	<10	-	-
Thallium	0.16	0.2	0.1	0.3	0.3	<0.86	<0.66	<0.87	<0.93	<0.79	<1	<1.1	<1	<0.95	<0.93	<1	<0.8	0.12	0.16
Tin	< 0.5	<6	<6	<6	<6	-	-	-	-	-	-	-	-	-	-	-	-	< 0.5	0.6
Titanium	230	370	320	1500	1200	-	-	-	-	-	-	-	-	-	-	-	-	65	170
Uranium	1.46	0.5	0.6	1.0	1.0	-	-	-	-	-	-	-	-	-	-	-	-	0.39	0.82
Vanadium	22	28	20	35	29	-	-	-	-	-	-	-	-	-	-	-	-	14	19
Yttrium	9.4	9	8	11	10	-	-	-	-	-	-	-	-	-	-	-	-	8.2	8.1
Zinc	50	35	27	41	34	-	-	-	-	-	-	-	-	-	-	-	-	28	35

Notes:
Sample depth is shown in feet below ground surface (ft bgs)
Dashes indicate analyte was not reported by lab for sample
Non-detect values are shown as less than the reporting limit
mg/kg: milligrams per kilogram
AP1: Ash Pond 1
AP2: Ash Pond 2
CCR: Coal Combustion Residual
UCU: Upper Confining Unit
LCU: Lower Confining Unit
UA: Uppermost Aquifer

Table 3. XRF Analysis of Site Solids
Geochemical Conceptual Site Model
Coffeen Power Plant - Ash Pond No. 2

Well ID	**G314**	**G314**	**G314**	**G407**	**G410**	**G410**
Depth (ft bgs)	**(13-18)**	**(18-23)**	**(38-43)**	**(10-13)**	**(11-12)**	**(12.5-13)**
Well Characterization	**AP1 Compliance**	**AP1 Compliance**	**AP1 Compliance**	**AP2 Compliance**	**AP2 Sidegradient**	**AP2 Sidegradient**
Sampled Aquifer Unit	**LCU**	**LCU**	**DA**	**UA**	**UA**	**UA**
Field Boring Log Description	**Sandy to silty till**	**Sandy to silty till**	**Sand and sandy silt/clay**	**Sandy to gravelly silt**	**Sandy to gravelly silt**	**Sandy to gravelly silt**
Analyte	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)
Al_2O_3	8.36	8.41	8.35	6.73	8.14	4.92
CaO	6.73	6.72	6.69	0.52	1.04	9.10
Cr_2O_3	<0.01	0.02	0.02	0.01	<0.01	<0.01
Fe_2O_3	3.19	3.48	3.71	2.08	2.77	1.69
K_2O	1.88	1.88	1.89	2.01	2.42	1.59
MgO	3.71	3.66	3.62	0.54	0.77	4.44
Mn_3O_4	0.07	0.07	0.07	0.03	0.13	0.08
Na_2O	0.79	0.80	0.77	0.82	0.85	0.69
P_2O_5	0.07	0.08	0.08	0.06	0.06	0.05
SiO_2	62.07	61.80	61.72	84.59	80.21	64.55
TiO_2	0.49	0.50	0.50	0.36	0.40	0.26
V_2O_5	0.01	<0.01	0.01	<0.01	0.01	<0.01

Notes
Sample depth is shown in feet below ground surface (ft bgs).
Non-detect values are shown as less than the reporting limit.
Results are not normalized to 100%, with some portion of sample mass uncharacterized.
Analytes are presented as the respective oxide species of the element of interest, consistent with the sample processing prior to analysis.
wt %: percentage by weight
AP1: Ash Pond 1
AP2: Ash Pond 2
LCU: Lower Confining Unit
DA: Deep Aquifer
UA: Upper Aquifer

Table 4. XRD Analysis of Site Solids
Geochemical Conceptual Site Model
Coffeen Power Plant - Ash Pond No. 2

Well ID			**G270**	**G306**	**G311**	**G313**	**G316**	**G314**	**G314**	**G314**	**G401**
Depth (ft bgs)			**(12-16)**	**(14-16)**	**(14-15)**	**(8-9)**	**(13-14, 15-16)**	**(13-18)**	**(18-23)**	**(38-43)**	**(16-20)**
Well Characterization			**AP2 Background**	**AP1 Background**	**AP1 Adjacent**	**AP1 Compliance**	**AP1 Compliance**	**AP1 Compliance**	**AP1 Compliance**	**AP1 Compliance**	**AP2 Compliance**
Sampled Aquifer Unit			**UA**	**UA**	**UA**	**UA**	**UA**	**LCU**	**LCU**	**DA**	**UA**
Field Boring Log Description			**Silty Sand**	**Sand**	**Sand**	**Sand**	**Sand**	**Sandy to silty till**	**Sandy to silty till**	**Sand and sandy silt/clay**	**Sand to Sandy Clay**
Mineral/Compound	**Formula**	**Mineral Type**	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)
Quartz	SiO_2	Silicate	60.6	70.9	58.9	51.3	67.6	53.9	67.5	73.5	68.9
Dolomite	$CaMg(CO_3)_2$	Carbonate	0.6	3.5	12.1	15.7	1.9	13.3	0.5	0.0	-
Calcite	$CaCO_3$	Carbonate	-	0.5	2.5	4.1	-	4.1	0.4	-	-
Ankerite	$CaFe(CO_3)_2$	Carbonate	0.5	2.1	5.0	7.7	0.8	7.2	1.2	0.5	0.1
Kutnohorite	$CaMn(CO_3)_2$	Carbonate	-	-	-	-	-	0.5	0.3	0.2	-
Albite	$NaAlSi_3O_8$	Feldspar	9.1	9.6	8.6	7.9	9.6	6.1	8.3	8.2	8.6
Microcline	$KAlSi_3O_8$	Feldspar	9.8	8.5	7.4	7.6	9.8	5.1	9.7	7.8	7.8
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$	Amphibole	3.3	-	-	-	-	0.3	0.7	0.8	1.4
Diopside	$CaMgSi_2O_6$	Pyroxene	1.3	3.1	3.8	4.6	1.3	1.0	0.7	0.7	1.4
Magnetite	Fe_3O_4	Oxide	-	-	-	-	-	-	0.2	0.0	-
Pyrite	FeS_2	Sulfide	0.2	-	-	-	-	-	-	-	-
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	Mica	2.4	-	-	-	-	-	-	-	2.1
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	Mica	9.0	-	-	-	7.3	1.0	4.8	3.3	6.8
Clay Minerals											
Montmorillonite	$(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2 \cdot 10H_2O$	Clay	-	-	-	-	-	1.1	1.0	1.1	-
Illite	$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$	Clay	-	-	-	-	-	4.0	2.0	1.7	-
Illite-Montmorillonite	$KAl_4(Si,Al)_8O_{20}(OH)_4 \cdot 8H_2O$	Clay	-	-	-	-	-	-	-	-	-
Kaolinite	$Al_2Si_2O_5(OH)_4$	Clay	-	-	-	-	-	0.7	1.1	0.7	-
Stilpnomelane	$K(Fe^{2+},Mg,Fe^{3+})_8(Si,Al)_{12}(O,OH)_{27} \cdot n(H_2O)$	Sheet silicate	2.0	-	-	-	-	-	-		2.7
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$	Sheet silicate	1.4	1.8	1.7	1.1	1.7	1.6	1.7	1.5	-
Clay Minerals Total			3.4	1.8	1.7	1.1	1.7	7.4	5.8	5.0	2.7

Notes
Dashes indicate mineral was not identified by lab
Sample depth is shown in feet below ground surface (ft bgs).
ft bgs: feet below ground surface
wt %: percentage by weight
AP1: Ash Pond 1
AP2: Ash Pond 2
LCU: Lower Confining Unit
DA: Deep Aquifer
UA: Uppermost Aquifer

Table 4. XRD Analysis of Site Solids
Geochemical Conceptual Site Model
Coffeen Power Plant - Ash Pond No. 2

Well ID			**G407**	**G410**	**G410**	**G1001**
Depth (ft bgs)			**(10-13)**	**(11-12)**	**(12.5-13)**	**(6-11)**
Well Characterization			**AP2 Compliance**	**AP2 Sidegradient**	**AP2 Sidegradient**	**AP2 Compliance**
Sampled Aquifer Unit			**UA**	**UA**	**UA**	**LCU**
Field Boring Log Description			**Sandy to gravelly silt**	**Sandy to gravelly silt**	**Sandy to gravelly silt**	**Clay with trace sand**
Mineral/Compound	**Formula**	**Mineral Type**	(wt %)	(wt %)	(wt %)	(wt %)
Quartz	SiO_2	Silicate	51.2	50.7	50.5	46.3
Dolomite	$CaMg(CO_3)_2$	Carbonate	6.0	7.6	8.1	11.3
Calcite	$CaCO_3$	Carbonate	2.4	2.6	2.8	4.2
Ankerite	$CaFe(CO_3)_2$	Carbonate	9.4	8.4	8.1	1.5
Kutnohorite	$CaMn(CO_3)_2$	Carbonate	0.1	-	0.2	-
Albite	$NaAlSi_3O_8$	Feldspar	6.8	7.4	7.5	10.4
Microcline	$KAlSi_3O_8$	Feldspar	7.2	5.9	5.8	7.8
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$	Amphibole	0.5	0.6	0.6	0.9
Diopside	$CaMgSi_2O_6$	Pyroxene	0.4	0.5	0.7	0.8
Magnetite	Fe_3O_4	Oxide	0.1	0.1	0.2	-
Pyrite	FeS_2	Sulfide	-	-	-	0.1
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	Mica	-	-	-	2.4
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	Mica	5.5	4.4	4.3	10.3
Montmorillonite	$(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2 \cdot 10H_2O$	Clay	3.2	3.2	2.9	-
Illite	$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$	Clay	3.3	3.0	2.9	-
Illite-Montmorillonite	$KAl_4(Si,Al)_8O_{20}(OH)_4 \cdot 8H_2O$	Clay	-	1.3	1.7	-
Kaolinite	$Al_2Si_2O_5(OH)_4$	Clay	0.9	0.6	0.6	-
Stilpnomelane	$K(Fe^{2+},Mg,Fe^{3+})_8(Si,Al)_{12}(O,OH)_{27} \cdot n(H_2O)$	Sheet silicate	-	-	-	2.6
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$	Sheet silicate	3.0	3.9	3.2	1.5
Clay Minerals Total			10.4	12.0	11.3	4.1

Notes
Dashes indicate mineral was not identified by lab
Sample depth is shown in feet below ground surface (ft bgs).
ft bgs: feet below ground surface
wt %: percentage by weight
AP1: Ash Pond 1
AP2: Ash Pond 2
LCU: Lower Confining Unit
DA: Deep Aquifer
UA: Uppermost Aquifer

Table 5. AP2 Porewater Chemistry
Geochemical Conceptual Site Model
Coffeen Power Plant - Ash Pond No. 2

Location Name		AP2e	AP2f	AP2g	AP2h	CO 102 PumpQbox
Sample Date		**2016/10/24**	**2016/10/24**	**2016/10/24**	**2016/10/24**	**2020/05/06**
Total Boron	(mg/L)	5.3	2	4.3	14	2.6
Dissolved Iron	(mg/L)	-	-	-	-	530
Total Iron	(mg/L)	-	-	-	-	530
Dissolved Manganese	(mg/L)	-	-	-	-	3.2
Total Manganese	(mg/L)	-	-	-	-	3.2
pH	(SU)	6.5	6.4	6.5	7.2	4.82Q
Total Sulfate	(mg/L)	1500	1500	2300	1300	1600
Total Dissolved Solids	(mg/L)	1700	1700	2400	1500	2100
Total Lithium	(mg/L)	0.19	0.13	0.18	0.12	0.14
Dissolved Cobalt	(mg/L)	-	-	-	-	0.0041

Notes
Q - Analysis performed after the acceptable holding time window
SU: standard units
mg/L: milligrams per liter
- : Analyte not included in analyses for sampling date

Table 6. AP2 Eh-pH Diagram Inputs
Geochemical Conceptual Site Model
Coffeen Power Plant - Ash Pond No. 2

Well ID		**G402**
Sample Date		**6/6/2023**
Aquifer Unit		**UA**
Input Parameter	**Unit**	
Temperature	°C	23.2
pH	SU	6.62
Calcium	mg/L	210
Chloride	mg/L	3.4
Bicarbonate Alkalinity	mg/L	500
Magnesium	mg/L	130
Sodium	mg/L	44
Potassium	mg/L	1
Sulfate	mg/L	580
Total Manganese	mg/L	1.3
Total Iron	mg/L	3.5

Notes
°C - degrees Celsius
mg/L - milligrams per liter
SU - standard units
UA - uppermost aquifer

Table 7. Total and Dissolved Aqueous Iron and Manganese Results
Geochemical Conceptual Site Model
Coffeen Power Plant - Ash Pond No. 2

Well ID	Well Characterization	Sampled Aquifer Unit	Date	Total Iron	Dissolved Iron	Total Manganese	Dissolved Manganese
				(mg/L)	(mg/L)	(mg/L)	(mg/L)
G1001	AP2 Compliance	LCU	2023/06/07	0.12	<0.01	0.19	0.14
G270	AP2 Background	UA	2023/06/08	0.68	0.044	0.85	0.079
			2023/08/14	0.147	0.019	0.244	0.157
			2023/11/17	0.119	0.0115	0.197	0.0675
G280	AP2 Background	UA	2023/06/08	0.97	0.0061	0.043	0.0014
			2023/08/14	0.264	<0.0175	0.0159	0.0032
			2023/11/20	0.31	0.0115	0.0452	0.0123
G281	AP2 Background	UA	2023/06/08	0.88	0.016	0.7	0.31
			2023/08/14	0.194	<0.0175	0.352	0.291
G401	AP2 Compliance	UA	2023/06/07	60	84	22	27
			2023/08/11	101	93.8	28.8	36
G402	AP2 Compliance	UA	2023/06/06	3.5	0.0033	1.3	0.86
			2023/08/11	3.58	<0.0115	1.2	0.867
G403	AP2 Compliance	UA	2023/06/07	0.23	0.011	0.4	0.36
			2023/08/11	0.284	0.0763	0.486	0.376
G404	AP2 Compliance	UA	2023/06/07	0.11	0.058	1.3	1.2
			2023/08/14	3.42	0.0718	5.42	2.85
G405	AP2 Compliance	UA	2023/06/06	0.31	0.13	1.1	1.1
			2023/08/11	0.239	0.165	1.15	1.07
G406	AP2 Compliance	UA	2023/05/31	0.012	<0.00072	4.5	4.4
			2023/08/11	0.016	<0.0115	4.76	4.45
G407	AP2 Compliance	UA	2023/05/31	0.073	0.01	0.42	0.38
			2023/08/10	0.0501	0.015	0.285	0.445

Notes
mg/L: milligrams per liter
Non-detect values are shown as less than the reporting limit.
AP2: Ash Pond 2
LCU: Lower Confining Unit
UA: Uppermost Aquifer

Table 8. Batch Attenuation Testing Results, G401
Geochemical Conceptual Site Model
Coffeen Power Plant - Ash Pond No. 2

Groundwater Sample ID	Geologic Material Sample ID	Treatment	Actual Ratio	Date	Day	Replicate	Dissolved Boron	Dissolved Sulfate	pH	ORP
							mg/L	mg/L	SU	mV
G401	--	Groundwater Only Control		19-Aug-21	0	G401-1a	2.6	1,677	3.15	518
						G401-2b	1.9	1,597	3.15	520
						Average Concentration (mg/L)	**2.2**	**1,637**	**3.15**	**519**
				26-Aug-21	7	G401-1	3.2	1,713	3.05	312
						G401-2	3.2	1,618	2.95	369
						Average Concentration (mg/L)	**3.2**	**1,666**	**3.00**	**341**
G401	G270 (12-16 bgs)	2:1 Soil:Water Ratio	2:1.6	19-Aug-21	0					
				26-Aug-21	7	G270:G401 2:1-1	1.8	1,356	6.35	156
						G270:G401 2:1-2	1.9	1,431	6.48	160
						Average Concentration (mg/L)	**1.9**	**1,394**	**6.42**	**158**
		1:1 Soil:Water Ratio	1:1.4	19-Aug-21	0					
				26-Aug-21	7	G270:G401 1:1-1	2.2	1,456	6.42	170
						G270:G401 1:1-2	2.2	1,658	6.46	174
						Average Concentration (mg/L)	**2.2**	**1,557**	**6.44**	**172**
		1:5 Soil:Water Ratio	1:6.1	19-Aug-21	0					
				26-Aug-21	7	G270:G401 1:5-1	3.2	1,708	6.33	347
						G270:G401 1:5-2	3.0	1,805	6.20	327
						Average Concentration (mg/L)	**3.1**	**1,756**	**6.27**	**337**
		1:10 Soil:Water Ratio	1:12.0	19-Aug-21	0					
				26-Aug-21	7	G270:G401 1:10-1	2.7	1,881	6.10	312
						G270:G401 1:10-2	3.1	1,785	6.05	299
						Average Concentration (mg/L)	**2.9**	**1,833**	**6.08**	**306**
		1:20 Soil: Water Ratio	1:29.9	19-Aug-21	0					
				26-Aug-21	7	G270:G401 1:20-1	2.9	1,784	6.05	285
						G270:G401 1:20-2	3.0	1,683	5.86	275
						Average Concentration (mg/L)	**2.9**	**1,734**	**5.96**	**280**

Notes
ID - identification
mg/L - milligrams per liter
mV - millivolts
SU - Standard Units
ORP - oxidation/reduction potential

Table 9. Partition Coefficient Results, G401
Geochemical Conceptual Site Model
Coffeen Power Plant - Ash Pond No. 2

Materials	Analyte	Isotherm	Variable	Value
G401/G270	Boron	Linear	R^2	0.442
			K_D (L/kg)	-11.08
		Langmuir	R^2	0.294
			q_m (mg/g)	0.000
			K_L (L/kg)	-4.64E+05
		Freundlich	R^2	--
			1/n	--
			K_F (L/kg)	--
	Sulfate	Linear	R^2	0.603
			K_D (L/kg)	-6.18
		Langmuir	R^2	0.563
			q_m (mg/g)	-0.035
			K_L (L/kg)	-5.64E+02
		Freundlich	R^2	--
			1/n	--
			K_F (L/kg)	--

Notes

-- - Freundlich isotherm not calculated because the data were not conducive to log transformation

K_D - linear partition coefficient

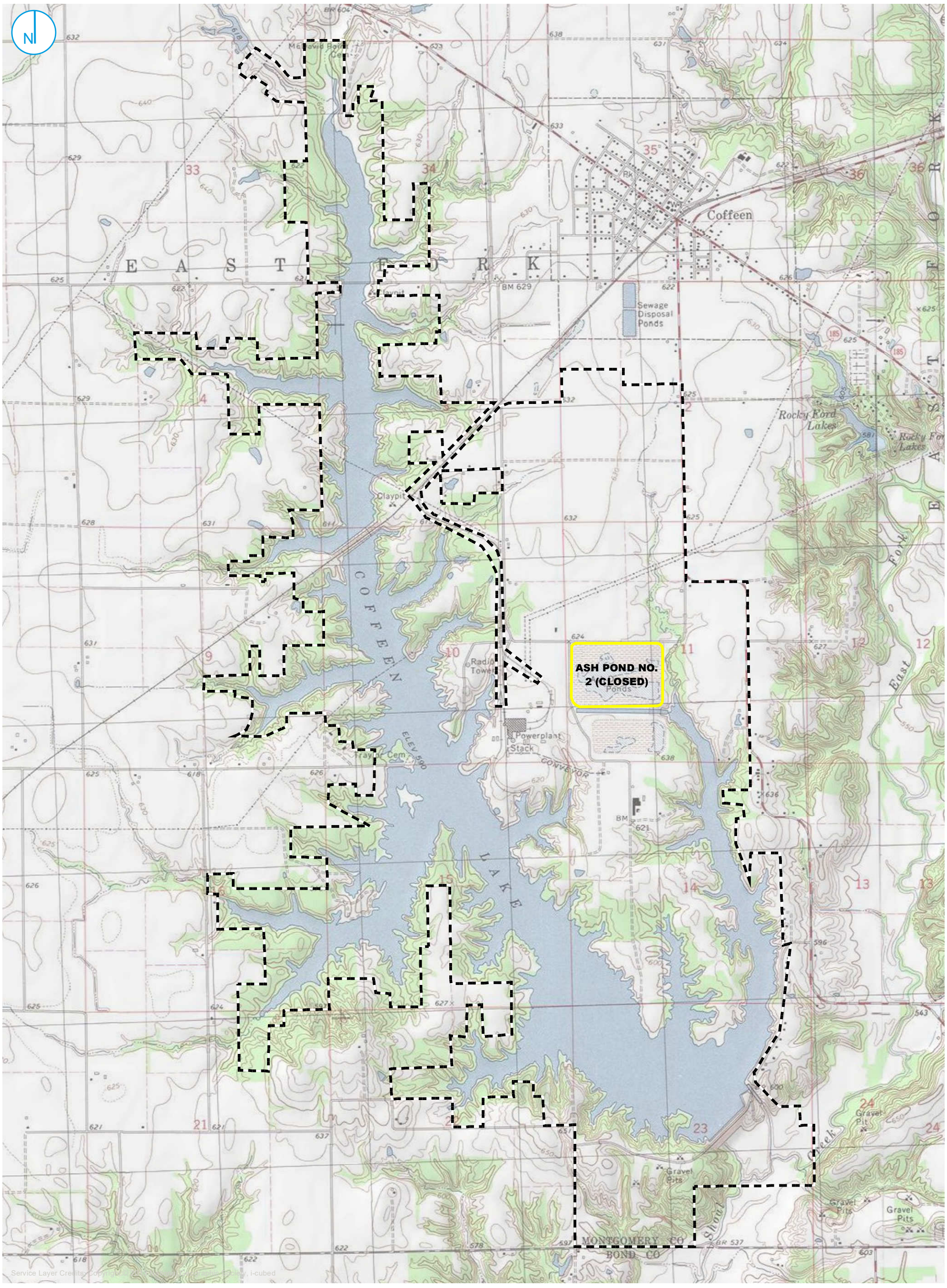
K_L - Langmuir partition coefficient

K_F - Freundlich partition coefficient

q_m - inverse of the slope of the linearized Langmuir isotherm

n - non-linearity constant of the Freundlich isotherm

Attachment A
Site Layout Figure



REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY

0 1,000 2,000 Feet

SITE LOCATION MAP

FIGURE 2-1

NATURE AND EXTENT REPORT
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

Attachment B

Proposed Part 845 Groundwater Monitoring Network

- COMPLIANCE MONITORING WELL
- BACKGROUND MONITORING WELL
- STAFF GAGE, RIVER
- REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- LIMITS OF FINAL COVER
- PROPERTY BOUNDARY

0 275 550 Feet

MONITORING WELL LOCATION MAP

FIGURE 2-2

NATURE AND EXTENT REPORT
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL

Attachment C
Monitoring Well Construction Information

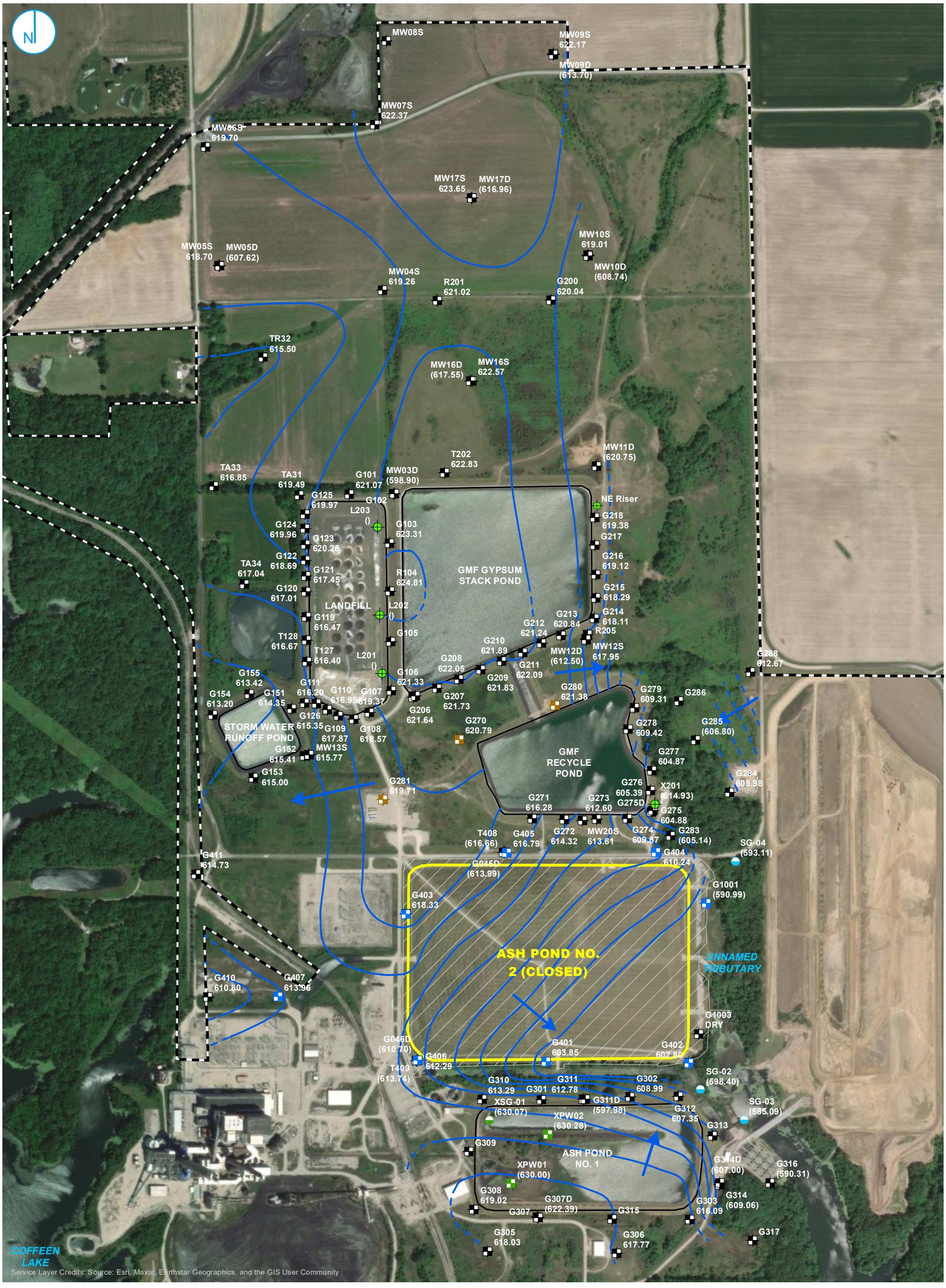
TABLE 2-1. MONITORING WELL LOCATIONS AND CONSTRUCTION DETAILS
GROUNDWATER MONITORING PLAN
COFFEEN POWER PLANT
ASH POND NO. 2
COFFEEN, ILLINOIS

Well Number	Type	HSU	Date Constructed	Top of PVC Elevation (ft)	Measuring Point Elevation (ft)	Measuring Point Description	Ground Elevation (ft)	Screen Top Depth (ft BGS)	Screen Bottom Depth (ft BGS)	Screen Top Elevation (ft)	Screen Bottom Elevation (ft)	Well Depth (ft BGS)	Bottom of Boring Elevation (ft)	Screen Length (ft)	Screen Diameter (inches)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
G1001	C	UA	04/05/2021	597.61	--	Top of PVC	594.82	6.00	11.00	588.82	583.82	11.00	562.82	5	4	39.063324	-89.391236
G270	B	UA	02/26/2008	--	625.86	Top of Disk	623.73	13.13	17.92	610.60	605.81	18.27	605.50	4.8	2	39.066564	-89.397403
G280	B	UA	02/26/2008	625.35	625.35	Top of Riser	623.11	12.79	17.63	610.32	605.48	17.98	605.10	4.8	2	39.067216	-89.394992
G281	B	UA	09/08/2015	--	626.36	Top of Disk	623.82	15.51	20.16	608.31	603.66	20.30	603.50	4.7	2	39.065405	-89.399322
G401	C	UA	09/14/2015	--	625.57	Top of Disk	623.03	14.36	18.79	608.67	604.24	19.29	603.70	4.4	2	39.060259	-89.395295
G402	C	UA	08/27/2010	--	613.37	Top of Disk	610.36	10.00	20.00	600.36	590.36	20.40	590.00	10	2	39.060207	-89.391712
G403	C	UA	09/11/2015	--	626.47	Top of Disk	623.81	13.11	17.78	610.70	606.03	18.15	605.70	4.7	2	39.063167	-89.398779
G404	C	UA	05/01/2007	--	615.67	Top of Disk	613.57	6.42	11.17	607.15	602.40	11.62	601.60	4.8	2	39.064329	-89.392493
G405	C	UA	05/01/2007	--	623.63	Top of Disk	621.40	9.01	13.76	612.39	607.64	14.21	607.20	4.8	2	39.064345	-89.396234
G406	C	UA	08/19/2016	625.36	625.36	Top of PVC	621.86	13.56	18.37	608.30	603.49	18.75	603.10	4.8	2	39.060309	-89.398508
G407	C	UA	08/16/2016	621.32	621.32	Top of PVC	618.35	13.78	18.61	604.57	599.74	19.04	598.40	4.8	2	39.061574	-89.402004
SG-02	WLO	SW	--	--	605.87	Top of Prot Casing	605.87	--	--	--	--	--	--	--	--	39.059695	-89.391429
SG-03	WLO	SW	--	--	594.94	Top of Prot Casing	594.94	--	--	--	--	--	--	--	--	39.059092	-89.390342
SG-04	WLO	SW	--	--	599.52	Top of Prot Casing	599.52	--	--	--	--	--	--	--	--	39.064146	-89.390504

Notes:
All elevation data are presented relative to the North American Vertical Datum 1988 (NAVD88), GEOID 12A
Type refers to the role of the well in the monitoring network: background (B), compliance (C), or water level measurements only (WLO)
WLO wells are temporary pending implementation of impoundment closure per an approved Construction Permit application
-- = data not available
BGS = below ground surface
ft = foot or feet
HSU = Hydrostratigraphic Unit
PVC = polyvinyl chloride
SW = surface water
UA = uppermost aquifer

generated 10/05/2021, 3:12:20 PM CDT

Attachment D
Boring Logs



- COMPLIANCE MONITORING WELL
- BACKGROUND MONITORING WELL
- MONITORING WELL
- PORE WATER WELL
- LEACHATE WELL
- STAFF GAGE, CCR UNIT
- STAFF GAGE, RIVER
- GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
- INFERRED GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION
- REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- LIMITS OF FINAL COVER
- PROPERTY BOUNDARY

0 325 650 Feet

UPPERMOST AQUIFER POTENTIOMETRIC SURFACE MAP MAY 30, 2023 (E001)

FIGURE 2-6

NATURE AND EXTENT REPORT
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL

Geosyntec consultants engineers | scientists | innovators	**Client:** Dynegy **Project:** GLP8005, Coffeen Power Station **Address:** Coffeen, IL 62017	**WELL LOG** **Well No.** G1001 **Page:** 1 of 2

Drilling Start Date:	**04/05/2021**	Boring Depth (ft):	**32**	Well Depth (ft):	**12**
Drilling End Date:	**04/05/2021**	Boring Diameter (in):	**6**	Well Diameter (in):	**1**
Drilling Company:	**Roberts Drilling**	DTW During Drilling (ft):		Screen Slot (in):	**0.010**
Drilling Method:	**Direct Push**	DTW After Drilling (ft):		Riser Material:	**Sch 40 PVC**
Drilling Equipment:	**Geoprobe**	Top of Casing Elev. (ft)		Screen Material:	**Sch 40 PVC Slotted**
Driller:		Ground Elev. (ft):		Seal Material(s):	**Bentonite Chips**
Logged By:	**A. Toye**	Northing, Easting (NAD83):		Filter Pack:	**Sand**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	WELL COMPLETION	COLLECT: Sample Type	COLLECT: Recovery (in)	COLLECT: Blow Counts	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	MEASURE: Lab Sample	DEPTH (ft)
0				DP	24/48			(0') SILT (ML); very dark grayish brown (2.5Y 3/2), medium soft, moist, trace gravel 2-2.5' bgs.		0
				DP	48/48			(4') CLAY (CL); with trace sand, yellowish brown (10YR 5/6), stiff, moist, trace gravel.		
5										5
									Chem (6-11')	
				DP	48/48			(8') As above: medium stiff, brown (10YR 4/3) with yellowish brown (10YR 5/6) mottling.		
10										10
				DP	48/48			(12') CLAY (CL); dark gray (10YR 4/1), medium stiff, moist.		
15										15
				DP	48/48			(16') As above: dark gray (2.5Y 4/1).		
20										20

NOTES: No groundwater encountered.

Geosyntec consultants (engineers | scientists | innovators)	Client: Dynegy Project: GLP8005, Coffeen Power Station Address: Coffeen, IL 62017	WELL LOG Well No. G1001 Page: 2 of 2

Drilling Start Date:	04/05/2021	Boring Depth (ft):	32	Well Depth (ft):	12
Drilling End Date:	04/05/2021	Boring Diameter (in):	6	Well Diameter (in):	1
Drilling Company:	Roberts Drilling	DTW During Drilling (ft):		Screen Slot (in):	0.010
Drilling Method:	Direct Push	DTW After Drilling (ft):		Riser Material:	Sch 40 PVC
Drilling Equipment:	Geoprobe	Top of Casing Elev. (ft)		Screen Material:	Sch 40 PVC Slotted
Driller:		Ground Elev. (ft):		Seal Material(s):	Bentonite Chips
Logged By:	A. Toye	Northing, Easting (NAD83):		Filter Pack:	Sand

DEPTH (ft)	LITHOLOGY	WATER LEVEL	WELL COMPLETION	COLLECT: Sample Type	COLLECT: Recovery (in)	COLLECT: Blow Counts	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	MEASURE: Lab Sample	DEPTH (ft)
20				DP	48/48			(20') As above: gravel at 1 ft.		20
				DP	48/48			(24') As above: dry pocket at 2.8 ft.		
25										25
				DP	18/48			(28') As above: trace gravel and silt at 2 ft.		
30										30
								(32') End of Boring.		
35										35

NOTES: No groundwater encountered.

FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station
Site: CCB Management Facility
Location: Coffeen, Illinois
Project: 05S3004A
DATES: Start: 2/26/2008
Finish: 2/26/2008
WEATHER: Overcast, cold

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-650 Track Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: .

BOREHOLE ID: G270
Well ID: G270
Surface Elev: 622.92 ft. MSL
Completion: 18.27 ft. BGS
Station: 874,801.92N
2,514,996.84E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 16.00 - While drilling
▼ = 5.62 - 3/12/08
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
	20/24 83%	ss	2-2 2-4 N=4			
1A				24		
2A	19/24 79%	ss	3-4 5-9 N=9	22		2.33 B
2B				20		5.04 Sh
3A	20/24 83%	ss	14-5 7-8 N=12	17		2.52 Sh
4A	24/24 100%	ss	8-6 7-5 N=13	21		1.24 BSh
4B				21		1.20 B
5A	22/24 92%	ss	2-3 4-4 N=7	21		1.36 B
6A	24/24 100%	ss	1-2 2-3 N=4	21		0.74 BSh
6B				24		0.78 B
7A	17/24 71%	ss	2-2 2-3 N=4	21		
8A				20		
8B	19/24 79%	ss	1-3 5-6 N=8	17		4.46 Sh
9A	24/24 100%	ss	6-8 30-35 N=38	20		
9B				8		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark grayish brown (10YR4/2), moist, firm, clayey SILT	622
	Dark grayish brown (10YR4/2), moist, firm, silty CLAY	
2	Dark grayish brown (10YR4/2) with 5% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, slight trace sand	620
4	Gray (10YR5/1) with 70% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, slight trace sand and gravel	618
6	Dark gray (10YR4/1) with 5% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, trace sand, slight trace gravel	616
8	Gray (10YR5/1) with 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, trace sand, slight trace gravel	614
10	Gray (10YR5/1) with 60% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, trace sand, slight trace gravel	612
	Gray (10YR5/1), moist, soft, sandy CLAY	
12	Gray (10YR5/1), moist, soft, sandy CLAY, trace gravel	610
14	Gray (10YR5/1), moist, soft, fine- to coarse-grained SAND, trace gravel	
	Dark yellowish brown (10YR4/4), moist, soft, sandy CLAY	608
	Gray (10YR5/1) with 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, slight trace sand and gravel	
16	Yellowish brown (10YR5/4), wet, soft, fine to coarse SAND	606
18	Gray (10YR5/1), moist, hard, silty CLAY, trace sand and gravel	

End of Boring = 18.27 ft. BGS

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: Natural Resource Technology, Inc.
Site: Coffeen Power Station
Location: Coffeen, Illinois
Project: 15E0030
DATES: Start: 5/3/2016
Finish: 5/3/2016
WEATHER: Sunny, calm, warm, lo 60s

CONTRACTOR: Ramsey Geotechnical Engineering LLC
Rig mfg/model: D-50 Turbo Tracked MST 800ATV
Drilling Method: 4 ¼" HSA, split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Keim

BOREHOLE ID: G306
Well ID: G306
Surface Elev: 622.84 ft. MSL
Completion: 18.00 ft. BGS
Station: 2,516,120.41N
871,140.98E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 14, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 5.50 - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type
1A	12/24 *50%*	ss	*1-3 3-4* N=6	14		
2A	24/24 *100%*	ss	*5-4 5-4* N=9	21		
2B				19		
3A	22/24 *92%*	ss	*2-2 3-3* N=5	30		
4A	20/24 *83%*	ss	*3-4 6-6* N=10	26		
5A	24/24 *100%*	ss	*2-2 3-3* N=5	23		
6A	22/24 *92%*	ss	*1-2 3-4* N=5	20		
7A	20/24 *83%*	ss	*5-6 6-6* N=12	21		
8A	20/24 *83%*	ss	*2-2 8-14* N=10	15		
8B				12		
9A	23/24 *96%*	ss	*14-17 28-50/5"* N=45	10		
9B				13		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark brown (10YR2/2), moist, medium, SILT with little clay and few very fine- to medium-grained sand, roots, trace coal fragments.	622
2	Dark gray (10YR4/1) with 5% dark yellowish brown (10YR3/6) mottles, moist, stiff, SILT with little clay and trace very fine- to medium-grained sand.	620
	Gray (10YR6/1) with 10% yellowish brown (10YR5/6) mottles, moist, very stiff, SILT with little clay and trace very fine-grained sand.	
4		618
▼ 6	Gray (10YR6/1) with 20% yellowish brown (10YR5/6) mottles, moist, very stiff, SILT with some clay and trace very fine-grained sand.	616
8		614
10	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, very stiff, silty CLAY with trace very fine- to coarse-grained sand.	612
12	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, stiff, silty CLAY with few very fine- to coarse-grained sand.	610
14	Yellowish brown (10YR5/6), wet, soft, very fine- to coarse-grained sandy CLAY with little silt.	608
	Yellowish brown (10YR5/6), wet, medium dense, silty, very fine- to medium-grained SAND with trace coarse-grained sand.	
16	Yellowish brown (10YR5/6), moist, dense, fine- to coarse-grained SAND with little silt, little very fine-grained sand, and trace small gravel.	606
	Brown (10YR5/3) with 20% dark yellowish brown (10YR4/6) mottles, moist, hard, SILT with little clay, few very fine- to coarse-grained sand, and trace small gravel.	
18		

End of boring = 18.0 feet

Borehole Detail

Remarks

NOTE(S): G306 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Power Station Ash Pond 1
Location: Coffeen, Illinois
Project: 16E0108
DATES: Start: 07/26/2016
Finish: 07/27/2016
WEATHER: Overcast, warm & humid (mid-80s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME 55LC Track Drill
Drilling Method: 4¼" Hollow Stem Auger w/Continuous Split Spoon
FIELD STAFF: Driller: J. Gates
Helper: C. Clines
Eng/Geo: R. Hasenyager

BOREHOLE ID: G307
Well ID: G307
Surface Elev: 622.08 ft. MSL
Completion: 18.22 ft. BGS
Station: 871,398.55N
2,515,553.26E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 14.00 - during drilling
▼ = -1.76 - 7/27/2016 @ 07:30
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	18/24 75%	SS	1-3 3-2 N=6	22		
2A	22/24 92%	SS	2-1 3-3 N=4	28		
3A	24/24 100%	SS	1-2 3-4 N=5	26		
4A	24/24 100%	SS	1-3 3-3 N=6	18		
5A	24/24 100%	SS	3-3 4-5 N=7	19		
6A	24/24 100%	SS	3-3 4-5 N=7	20		
7A	24/24 100%	SS	woh-2 5-13 N=7	20		
7B				11		
8A	24/24 100%	SS	12-9 6-9 N=15	20		
9A	18/18 100%	SS	8-30 50 N=80	8		
	0/9 0%	BD				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Brown (10YR5/3), moist, stiff, SILT with few clay, trace sand, gravel and roots.	
2	Gray (10YR5/1), moist, soft, CLAY, with some silt, trace sand, gravel and roots.	620
4	Gray (10YR5/1) with 30% yellowish brown (10YR5/8) mottles, moist, soft, CLAY with some silt, trace sand, gravel and roots.	618
6		616
8	Yellowish brown (10YR5/6) with 20% gray (10YR5/1) mottles, moist, medium CLAY,with some silt, few very fine- to medium-grained sand, and trace gravel.	614
10		612
12	Gray (10YR5/1), moist, medium, CLAY with little silt and very fine to very coarse sand, trace gravel.	610
	Gray (10YR5/1) with 25% yellowish brown (10YR5/8) mottles, moist, soft, CLAY with some silt, trace sand and gravel.	
14	Gray (10YR6/1), wet, medium dense, very fine- to very coarse-grained SAND with few silt and trace clay.	608
	Yellow brown (10YR5/6), wet. medium dense, very fine- to very coarse-grained SAND, with little silt and trace gravel.	
16	Yellowish brown (10YR5/8), moist, hard, SILT with some clay, little very fine- to very coarse-grained sand and trace gravel.	606
	Gray (10YR5/1), moist, hard, SILT with some clay, little very fine- to very coarse-grained sand and trace gravel.	
18		604

End of boring = 18.2 feet

NOTE(S):

FIELD BORING LOG

HANSON

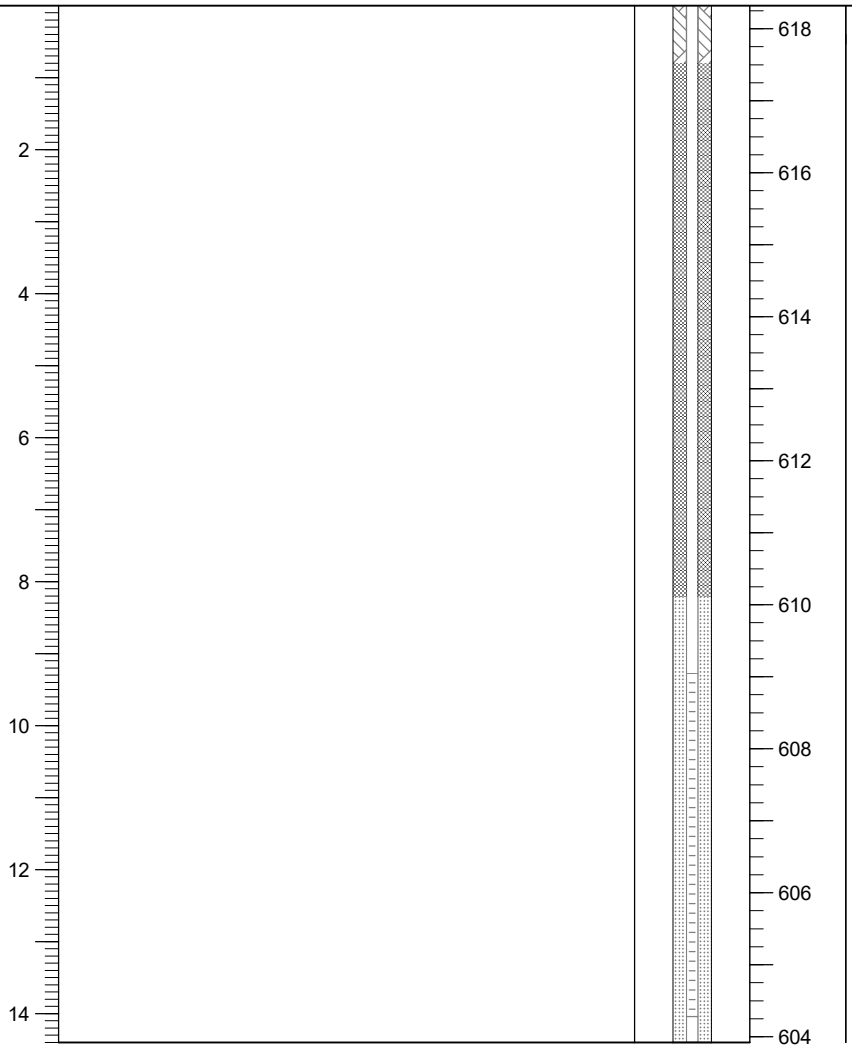
CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 2/5/2021
Finish: 2/5/2021
WEATHER: Clear, cold (20s)

CONTRACTOR: Roberts
Rig mfg/model:
Drilling Method: 4.25" HSA w/SS sampler
FIELD STAFF: Driller: Matt
Helper: Corey
Eng/Geo: C. Colin Winter

BOREHOLE ID: G311
Well ID: G311
Surface Elev: 618.32 ft. MSL
Completion: 14.40 ft. BGS
Station: 872,238.70N
2,515,881.80E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft^3)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks



NOTE(S): G311 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 2/5/2021
Finish: 2/5/2021
WEATHER: Clear, cold (20s)

CONTRACTOR: Roberts
Rig mfg/model: CME-75 Track Rig
Drilling Method: 3.25" HSA w/SS sampler
FIELD STAFF: Driller: Matt
Helper: Corey
Eng/Geo: C. Colin Winter

BOREHOLE ID: G311D
Well ID: G311D
Surface Elev: 618.39 ft. MSL
Completion: 60.00 ft. BGS
Station: 872,238.70N
2,515,881.80E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
= 11.20 - During Drilling
=
=

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
1A	13/24 54%	SS	0-4 4-4 N=8					Yellowish brown (10YR5/6), moist, stiff, lean CLAY, with some silt, few very fine- to fine-grained sand, trace small gravel.	618	
							2			
2A	24/24 100%	SS	3-4 5-6 N=9					Gray (10YR5/1) with 20% yellowish brown (10YR5/6) and 5% very dark grayish brown (10YR3/2) mottles, moist, stiff, lean CLAY, with some silt, trace very fine- to fine-grained sand, and small gravel.	616	
							4			
3A	24/24 100%	SS	2-4 5-7 N=9					Very dark grayish brown (10YR3/2) with 10% gray (10YR5/1) mottles, moist, stiff, lean CLAY, with some silt, trace very fine- to fine-grained sand, and small gravel.	614	
4A	24/24 100%	SH					6		612	
5A	18/24 75%	SS	1-2 4-5 N=6				8	Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, little very fine- to fine-grained sand, few small gravel.	610	
							10		608	
6A	24/24 100%	SS	1-3 3-4 N=6					Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist to wet, medium stiff, lean CLAY, with some very fine- to fine-grained sand, little silt, few small gravel.		
							12	Yellowish brown (10YR5/6), moist to wet, medium stiff, lean CLAY, with some very fine- to fine-grained sand, little silt, few small gravel.	606	
7A	24/24 100%	SS	2-6 12-13 N=18					Gray (10YR5/1), moist to wet, medium stiff, SILT, with some very fine- to fine-grained sand, few clay, trace small gravel.		1" wet, SAND at 13.5 ft.
							14		604	
8A	24/24 100%	SS	2-6 12-13 N=18							
							16	Yellowish brown (10YR5/6), moist, hard, SILT, with some clay, some to little sand, few small gravel.	602	
9A	24/24 100%	SS	6-15 18-22 N=33							Vertical fracture with very fine- to fine-grained sand from 16.9 to 18 ft.
							18		600	
10A	24/24 100%	SS	6-13 16-22 N=29					Dark grayish brown (10YR4/2) with frequent yellowish red (5YR4/6) oxidation along fractures, moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand, trace small gravel.		
							20			

NOTE(S): G311D installed in borehole.

FIELD BORING LOG

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 2/5/2021
Finish: 2/5/2021
WEATHER: Clear, cold (20s)

CONTRACTOR: Roberts
Rig mfg/model: CME-75 Track Rig
Drilling Method: 3.25" HSA w/SS sampler

FIELD STAFF: Driller: Matt
Helper: Corey
Eng/Geo: C. Colin Winter

BOREHOLE ID: G311D
Well ID: G311D
Surface Elev: 618.39 ft. MSL
Completion: 60.00 ft. BGS
Station: 872,238.70N
2,515,881.80E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
= 11.20 - During Drilling
=
=

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Elevation ft. MSL	Remarks
11A	24/24 100%	SS	5-15 20-26 N=35					598	
							22		No oxidation below 22 ft.
12A	12/24 50%	SS	2-3 14-17 N=17					596	
							24		Trace medium gravel below 24 ft.
13A	24/24 100%	SS	6-11 14-20 N=25					594	
14A	24/24 100%	SS	4-8 11-16 N=19				26	592	
							28		
15A	24/24 100%	SH						590	
							30		Dark gray (10YR4/1) with frequent yellowish red (5YR4/6) oxidation along fractures, moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand, trace small gravel.
16A	24/24 100%	SS	0-3 5-8 N=8					588	
							32		
17A	24/24 100%	SS	2-4 6-8 N=10					586	
							34		Gravel plugged shoe in Run 18.
18A	24/24 100%	SS	2-5 7-7 N=12					584	Trace large gravel from 35 to 36 ft.
							36		Trace lignite and wood fragments below 36 ft.
19A	13/24 54%	SS	2-7 8-11 N=15					582	
							38		
20A	24/24 100%	SS	2-6 10-8 N=16					580	
							40		

NOTE(S): G311D installed in borehole.

FIELD BORING LOG

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 2/5/2021
Finish: 2/5/2021
WEATHER: Clear, cold (20s)

CONTRACTOR: Roberts
Rig mfg/model: CME-75 Track Rig
Drilling Method: 3.25" HSA w/SS sampler
FIELD STAFF: Driller: Matt
Helper: Corey
Eng/Geo: C. Colin Winter

BOREHOLE ID: G311D
Well ID: G311D
Surface Elev: 618.39 ft. MSL
Completion: 60.00 ft. BGS
Station: 872,238.70N
2,515,881.80E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
= 11.20 - During Drilling
=
=

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
21A	16/24 67%	SS	3-3 6-8 N=9					Dark gray (10YR4/1) with frequent yellowish red (5YR4/6) oxidation along fractures, moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand, trace small gravel. *[Continued from previous page]*	578	
22A							42	Greenish gray (GLEY15/1) with 20% dark reddish brown (10YR3/2) mottles, moist, medium stiff, lean CLAY, with some silt.	576	
22B	24/24 100%	SS	3-4 7-8 N=11				44		574	
23A	24/24 100%	SS	1-3 5-7 N=8				46		572	
24A	20/24 83%	SS	3-4 10-8 N=14				48	Dark grayish brown (10YR4/1) with frequent yellowish red (5YR4/6) oxidation along fractures, moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand, trace small to large gravel.	570	
25A	24/24 100%	SS	3-5 8-13 N=13				50		568	
26A	24/24 100%	SS	2-5 10-12 N=15				52		566	
27A	24/24 100%	SS	2-6 10-14 N=16				54	Dark gray (10YR4/1) with 20% greenish gray (GLEY15/1) and 5% yellowish brown (10YR5/6) mottles, moist, very stiff, lean CLAY, with some silt, trace very fine-grained sand and small gravel.	564	Trace small gravel below 54.3 ft.
28A	24/24 100%	SS	4-7 7-11 N=14				56	Greenish gray (GLEY16/1) with 40% yellowish brown (10YR5/6) mottles, moist, very stiff, lean CLAY, with some silt, trace very fine-grained sand and small gravel.	562	
29A	24/24 100%	SS	2-5 9-11 N=14				58		560	0.5" small to medium GRAVEL.
30A	24/24 100%	SS	3-7 10-13 N=17				60	Yellowish brown (10YR5/6) with 30% greenish gray (GLEY16/1) mottles, moist, very stiff, lean CLAY, with some silt, trace very fine-grained sand and small gravel.		

NOTE(S): G311D installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: **Start:** 2/5/2021
Finish: 2/5/2021
WEATHER: Clear, cold (20s)

CONTRACTOR: Roberts
Rig mfg/model: CME-75 Track Rig
Drilling Method: 3.25" HSA w/SS sampler

FIELD STAFF: **Driller:** Matt
Helper: Corey
Eng/Geo: C. Colin Winter

BOREHOLE ID: G311D
Well ID: G311D
Surface Elev: 618.39 ft. MSL
Completion: 60.00 ft. BGS
Station: 872,238.70N
2,515,881.80E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▽ = 11.20 - During Drilling
▽ =
▽ =

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft^3)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
								End of boring = 60.0 feet			

NOTE(S): G311D installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/14/2021
Finish: 1/14/2021
WEATHER: Overcast, cool (40s)

CONTRACTOR: Roberts
Rig mfg/model: GeoProbe 8040DT
Drilling Method: 4.25" HSA w/SS sampler

FIELD STAFF: Driller: Matt
Helper: Corey
Eng/Geo: C. Colin Winter

BOREHOLE ID: G313
Well ID: G313
Surface Elev: 611.51 ft. MSL
Completion: 12.00 ft. BGS
Station: 871,976.80N
2,516,803.70E

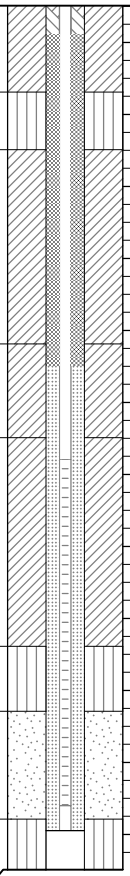
TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▽ = 9.80 - During Drilling
▽ =
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type
1A, 1B	17/24 *71%*	SS	*0-2* *3-3* N=5			
2A	13/24 *54%*	SS	*0-2* *2-3* N=4			
3A	19/24 *79%*	SS	*2-3* *5-5* N=8			
4A	22/24 *92%*	SS	*2-3* *4-5* N=7			
5A	22/24 *92%*	SS	*2-5* *9-12* N=14			
6A, 6B	21/24 *88%*	SS	*9-12* *21-22* N=33			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark yellowish brown (10YR4/4), wet, stiff, lean CLAY, with some silt, few roots, trace small gravel.	
	Gray (10YR6/1) with 15% yellowish brown (10YR5/6) mottles, moist, very stiff, SILT, with little clay, few roots.	610
2	Dark gray (10YR4/1) with 5% black (10YR2/1) mottles, moist, stiff, lean CLAY, with some silt.	608
4	Dark gray (10YR4/1) with 20% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace very fine- to fine-grained sand and small gravel.	606
6	Very dark gray (10YR3/1), moist, stiff, lean CLAY, with some silt, little very fine- to fine-grained sand and small gravel.	604
8	Yellowish brown (10YR5/6) with 10% very dark gray (10YR3/1) mottles, moist, stiff SILT, with some very fine- to fine-grained sand and clay, few small gravel.	602
▽ 10	Yellowish brown (10YR5/4), wet, medium dense, very fine- to medium-grained SAND, with some silt, few small gravel.	
12	Dark grayish brown (10YR4/2) with 10% yellowish brown (10YR5/6) mottles, moist, hard, SILT, with some very fine- to fine-grained sand, few clay and small gravel, trace medium gravel.	600

Borehole Detail



Remarks

End of boring = 12.0 feet

NOTE(S): G313 installed in borehole.

FIELD BORING LOG

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 2/10/2021
Finish: 2/12/2021
WEATHER: Overcast, very cold (10s)

CONTRACTOR: Roberts
Rig mfg/model: CME-75 Track Rig
Drilling Method: 4.25" HSA w/SS sampler
FIELD STAFF: Driller: Matt
Helper: Corey
Eng/Geo: C. Colin Winter

BOREHOLE ID: G314D
Well ID: G314D
Surface Elev: 610.87 ft. MSL
Completion: 100.30 ft. BGS
Station: 871,642.00N
2,516,853.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▽ = During Drilling
▼ =
▼ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
1A	4/24 *17%*	SS	*13-7 4-5* N=11					Moist, dense, small to large GRAVEL. [FILL]	610	
	1/24 *4%*	SS	*3-4 5-5* N=9				2	Gray (10YR6/1) with 30% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, few very fine- to fine-grained sand, trace small gravel.	608	
3A	24/24 *100%*	SS	*1-3 4-5* N=7				4		606	
4A	24/24 *100%*	SS	*2-5 15-17* N=20				6		604	
5A	24/24 *100%*	SS	*4-10 12-16* N=22				8	Yellowish brown (10YR5/6) with occasional yellowish red (5YR4/6) oxidation along fractures, moist, hard, lean CLAY, with some silt and very fine- to fine-grained sand, trace small gravel.	602	
6A	24/24 *100%*	SS	*4-5 14-18* N=19				10		600	1" wet, SAND, with some silt at 11.6 ft.
7A	24/24 *100%*	SS	*3-11 14-18* N=25				12	Yellowish brown (10YR5/6) with 10% very dark grayish brown (10YR3/2) mottles and occasional yellowish red (5YR4/6) oxidation along fractures, moist, hard, lean CLAY, with some silt and very fine- to fine-grained sand, trace small gravel.	598	
8A	24/24 *100%*	SS	*3-9 13-18* N=22				14		596	
9A	24/24 *100%*	SS	*1-7 9-13* N=16				16		594	
							18	Yellowish brown (10YR5/6) with 10% very dark grayish brown (10YR3/2) and 10% dark yellowish brown (10YR4/6) mottles and occasional yellowish red (5YR4/6) oxidation along fractures, moist, hard, lean CLAY, with some silt and very fine- to fine-grained sand, trace small gravel. Dark grayish brown (10YR4/2) with 15% yellowish brown (10YR5/6) mottles and occasional yellowish red (5YR4/6) oxidation along fractures, moist, hard, lean CLAY, with some silt and very fine- to fine-grained sand, trace small gravel.	592	
							20			

NOTE(S): G314D installed in borehole.

FIELD BORING LOG

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 2/10/2021
Finish: 2/12/2021
WEATHER: Overcast, very cold (10s)

CONTRACTOR: Roberts
Rig mfg/model: CME-75 Track Rig
Drilling Method: 4.25" HSA w/SS sampler
FIELD STAFF: Driller: Matt
Helper: Corey
Eng/Geo: C. Colin Winter

BOREHOLE ID: G314D
Well ID: G314D
Surface Elev: 610.87 ft. MSL
Completion: 100.30 ft. BGS
Station: 871,642.00N
2,516,853.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
= During Drilling
=
=

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
10A	24/24 100%	SS	1-5 10-13 N=15			
11A	24/24 100%	SS	1-6 9-12 N=15			
12A	24/24 100%	SS	4-7 10-13 N=17			
13A	24/24 100%	SS	3-7 10-13 N=17			
14A	24/24 100%	SS	4-6 10-10 N=16			
15A	24/24 100%	SS	3-9 10-12 N=19			
16A	24/24 100%	SS	2-3 7-8 N=10			
17A	24/24 100%	SS	2-4 7-9 N=11			
18A	21/24 88%	SH				
			2-5			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
		590	1" wet, SAND, with some silt at 20 ft.
22	Dark grayish brown (10YR4/2) with 15% yellowish brown (10YR5/6) and 5% dark yellowish brown (10YR4/6) mottles and occasional yellowish red (5YR4/6) oxidation along fractures, moist, hard, lean CLAY, with some silt and very fine- to fine-grained sand, trace small gravel. *[Continued from previous page]*	588	Frequent oxidation below 21.7 ft.
24		586	
26	Dark grayish brown (10YR4/2), moist, hard, lean CLAY, with some silt and very fine- to fine-grained sand, trace small gravel.	584	
28		582	1 ft vertical fracture with yellowish red (5YR4/6) oxidation at 28.3 ft.
30		580	
32		578	
34			Trace roots below 34 ft.
	Gray (GLEY15/), moist, stiff, lean CLAY, with some silt.	576	
36	Dark grayish brown (10YR4/2), moist, hard, lean CLAY, with some silt and very fine- to fine-grained sand, trace small gravel and roots.	574	
38		572	
40			

NOTE(S): G314D installed in borehole.

FIELD BORING LOG

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 2/10/2021
Finish: 2/12/2021
WEATHER: Overcast, very cold (10s)

CONTRACTOR: Roberts
Rig mfg/model: CME-75 Track Rig
Drilling Method: 4.25" HSA w/SS sampler
FIELD STAFF: Driller: Matt
Helper: Corey
Eng/Geo: C. Colin Winter

BOREHOLE ID: G314D
Well ID: G314D
Surface Elev: 610.87 ft. MSL
Completion: 100.30 ft. BGS
Station: 871,642.00N
2,516,853.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▽ = During Drilling
▼ =
▼ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
19A	24/24 100%	SS	7-12 N=12			
20A	24/24 100%	SS	4-8 10-14 N=18			
21A	24/24 100%	SS	3-9 13-16 N=22			
22A 22B	24/24 100%	SS	12-31 14-11 N=45			
23A	24/24 100%	SS	3-4 6-9 N=10			
24A	24/24 100%	SS	5-11 14-17 N=25			
25A	24/24 100%	SS	4-6 11-15 N=17			
26A	20/24 83%	SS	4-5 18-30 N=23			
27A	20/24 83%	SS	9-22 33-33 N=55			
28A	24/24 100%	SS	7-19 29-43			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
		570	Trace medium gravel below 41.3 ft.
42	Dark grayish brown (10YR4/2), moist, hard, lean CLAY, with some silt and very fine- to fine-grained sand, trace small gravel and roots. *[Continued from previous page]*	568	
44		566	
46	Gray (10YR5/1), wet, dense, SAND, with some silt, few small gravel.	564	
48	Gray (GLEY15/) with 10% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace very fine-grained sand.	562	1" SILT, with some sand at 48.2 ft.
50		560	
52	Yellowish brown (10YR5/6) with 20% gray (GLEY15/) mottles, moist, stiff, lean CLAY, with some silt, trace very fine-grained sand.	558	
54		556	
56	Yellowish brown (10YR5/6), moist, hard, lean CLAY, with some silt, little very fine- to fine-grained sand and small gravel.	554	
58	Yellowish brown (10YR5/6) with 20% gray (GLEY15/) mottles, moist, hard, lean CLAY, with some silt, little very fine- to fine-grained sand and small gravel.	552	
60	Yellowish brown (10YR5/6) with 10% gray (GLEY15/) and 5% dark yellowish brown (10YR4/6) mottles, moist, hard, lean CLAY, with some silt, little very fine- to fine-grained sand and small gravel.		

NOTE(S): G314D installed in borehole.

FIELD BORING LOG

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 2/10/2021
Finish: 2/12/2021
WEATHER: Overcast, very cold (10s)

CONTRACTOR: Roberts
Rig mfg/model: CME-75 Track Rig
Drilling Method: 4.25" HSA w/SS sampler
FIELD STAFF: Driller: Matt
Helper: Corey
Eng/Geo: C. Colin Winter

BOREHOLE ID: G314D
Well ID: G314D
Surface Elev: 610.87 ft. MSL
Completion: 100.30 ft. BGS
Station: 871,642.00N
2,516,853.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▽ = During Drilling
▼ =
▼ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
			N=48								
29A	20/24 83%	SS	13-20 30-38 N=50				62			550	
30A	24/24 100%	SS	8-15 30-34 N=45				64	Yellowish brown (10YR5/6) with 10% gray (GLEY15/) and 5% dark yellowish brown (10YR4/6) mottles, moist, hard, lean CLAY, with some silt, little very fine- to fine-grained sand and small gravel. *[Continued from previous page]*		548	
31A	24/24 100%	SS	5-17 28-29 N=45				66			546	
32A	24/24 100%	SS	7-18 29-43 N=47				68	Yellowish brown (10YR5/6) with 10% gray (GLEY15/), 5% dark yellowish brown (10YR4/6) and 5% very dark grayish brown (10YR3/2) mottles, moist, hard, lean CLAY, with some silt, little very fine- to fine-grained sand and small gravel.		544	
33A	24/24 100%	SS	5-14 32-26 N=46				70	Dark grayish brown (10YR4/2) with 5% gray (GLEY15/), 5% yellowish brown (10YR5/6), and 5% light gray (10YR7/1) mottles, moist, hard, lean CLAY, with some silt, little sand and gravel.		542	
34A	24/24 100%	SS	8-17 26-38 N=43				72	Yellowish brown (10YR5/6) with 5% gray (GLEY15/), 5% dark grayish brown (10YR4/2), and 5% light gray (10YR7/1) mottles.		540	
35A	24/24 100%	SS	5-12 24-24 N=36				74	Dark grayish brown (10YR4/2) with 5% gray (GLEY15/), 5% yellowish brown (10YR5/6), and 5% light gray (10YR7/1) mottles.		538	
36A	24/24 100%	SS	14-24 20-33 N=44				76	Dark grayish brown (10YR5/2) with 20% reddish brown (5YR4/4) and 5% light gray (10YR7/1) mottles, moist, hard, lean CLAY, with some silt, trace very fine- to fine-grained sand and small gravel.		536	
37A	24/24 100%	SS	6-14 17-31 N=31				78	Dark gray (10YR4/1) with 5% light gray (10YR7/1) mottles, moist, hard, lean CLAY, with some silt, trace very fine- to fine-grained sand and small gravel.		534	
							80			532	

NOTE(S): G314D installed in borehole.

FIELD BORING LOG

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 2/10/2021
Finish: 2/12/2021
WEATHER: Overcast, very cold (10s)

CONTRACTOR: Roberts
Rig mfg/model: CME-75 Track Rig
Drilling Method: 4.25" HSA w/SS sampler
FIELD STAFF: Driller: Matt
Helper: Corey
Eng/Geo: C. Colin Winter

BOREHOLE ID: G314D
Well ID: G314D
Surface Elev: 610.87 ft. MSL
Completion: 100.30 ft. BGS
Station: 871,642.00N
2,516,853.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
= During Drilling
=
=

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
38A	24/24 100%	SS	7-17 21-29 N=38				82	Dark gray (10YR4/1) with 5% light gray (10YR7/1) mottles, moist, hard, lean CLAY, with some silt, trace very fine- to fine-grained sand and small gravel. *[Continued from previous page]*	530	Trace roots at 82 ft.
39A	24/24 100%	SS	8-24 26-27 N=50				84	Very dark gray (10YR3/1), moist, hard, lean CLAY, with some silt.	528	
40A	24/24 100%	SS	5-9 10-13 N=19				86	Dark gray (10YR4/1) with 5% black (10YR2/1) mottles, moist, hard, lean CLAY, with some silt.	526	
41A	24/24 100%	SS	6-10 25-33 N=35				88	Dark greenish gray (GLEY14/1) with 5% yellowish brown (10YR5/6) mottles, moist, hard, lean CLAY, with some silt.	524	Few very fine- to fine-grained sand below 88 ft.
42A	11/11 100%	SS	3-50/5"				90	Light reddish brown (2.5YR6/3) with 10% gray (GLEY15/), dry, hard, SILT, with few clay and very fine-grained sand.	522	
43A	5/5 100%	SS	50/5"				92		520	
44A	5/5 100%	SS	50/5"				94		518	
45A	8/8 100%	SS	49-50/2"				96		516	
46A	11/11 100%	SS	25-50/5"				98	Light reddish brown (2.5YR6/3) with 10% gray (GLEY15/) and 5% dark yellowish brown (10YR4/6) mottles, dry, hard, SILT, with few clay and very fine-grained sand.	514	
							100		512	

NOTE(S): G314D installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: **Start:** 2/10/2021
Finish: 2/12/2021
WEATHER: Overcast, very cold (10s)

CONTRACTOR: Roberts
Rig mfg/model: CME-75 Track Rig
Drilling Method: 4.25" HSA w/SS sampler
FIELD STAFF: **Driller:** Matt
Helper: Corey
Eng/Geo: C. Colin Winter

BOREHOLE ID: G314D
Well ID: G314D
Surface Elev: 610.87 ft. MSL
Completion: 100.30 ft. BGS
Station: 871,642.00N
2,516,853.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
= During Drilling
=
=

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft^3)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail / Elevation ft. MSL / Remarks
47A	3/3 *100%*	SS	*50/3"*					**End of boring = 100.3 feet**	

NOTE(S): G314D installed in borehole.

FIELD BORING LOG

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/14/2021
Finish: 1/14/2021
WEATHER: Overcast, cold (30s)

CONTRACTOR: Roberts
Rig mfg/model: GeoProbe 8040DT
Drilling Method: 4.25" HSA w/SS sampler
FIELD STAFF: Driller: Matt
Helper: Corey
Eng/Geo: C. Colin Winter

BOREHOLE ID: G316
Well ID: G316
Surface Elev: 599.64 ft. MSL
Completion: 15.75 ft. BGS
Station: 871,643.10N
2,517,211.60E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
= 8.60 - During Drilling
= 13.80 - During Drilling
=

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type
1A	15/24 *63%*	SS	*10-9 5-4* N=14			
2A	10/24 *42%*	SS	*1-3 4-6* N=7			
3A	14/24 *58%*	SS	*2-2 3-3* N=5			
4A	10/24 *42%*	SS	*0-1 1-2* N=2			
5A						
5B	22/24 *92%*	SS	*1-1 1-2* N=2			
6A	20/24 *83%*	SS	*1-2 4-7* N=6			
7A	22/24 *92%*	SS	*0-2 3-3* N=5			
8A	21/17 *124%*	SS	*2-2 26-50/3"* N=28			
8B						

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Brown (10YR5/3), moist, medium dense, small to large GRAVEL, with some clay and fine to coarse grained sand. [FILL]	
2	Gray (10YR5/1), moist, hard, lean CLAY, with some silt, few small gravel and very fine- to fine-grained sand.	598
4	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, few small gravel and very fine- to fine-grained sand.	596
6	Gray (10YR5/1) with 30% black (10YR2/1) mottles, moist, stiff, lean CLAY, with some silt, few very fine-grained sand, organics and wood fragments.	594
8	Very dark gray (10YR3/1), wet, medium stiff to stiff, SILT, with some clay and very fine- to fine-grained sand.	592
10	Brown (10YR4/3), moist, very stiff, lean CLAY, with some silt, little very fine- to fine-grained sand, few small gravel.	590
12	Dark gray (10YR4/1) with 20% yellowish brown (10YR5/6) mottles, moist, medium stiff to stiff, lean CLAY, with some silt, little very fine- to fine-grained sand, few small gravel.	588
14	Brown (10YR4/3), wet, loose, very fine- to fine-grained SAND, with some silt, trace clay.	586
	Yellowish brown (10YR5/6), moist, hard, SILT, with some very fine- to fine-grained sand, trace small gravel.	584

End of boring = 15.75 feet

Borehole Detail

Remarks

NOTE(S): G316 installed in borehole.

FIELD BORING LOG

CLIENT: Natural Resource Technology, Inc.
Site: Coffeen Energy Center
Location: Coffeen, Illinois
Project: 15E0030
DATES: Start: 9/14/2015
Finish: 9/14/2015
WEATHER: Sunny, hi 60's

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: D-50 Turbo Tracked MST 800ATV
Drilling Method: Hollow Stem Auger (3¼"overdrill / 4¼")
FIELD STAFF: Driller: D. Crump
Helper: D. Groves
Eng/Geo: R. Hasenyager

BOREHOLE ID: G401
Well ID: G401
Surface Elev: 623.03 ft. MSL
Completion: 19.30 ft. BGS
Station: 2,515,614.84N
872,510.57E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	16/24 67%	ss	2-2 3-7 N=5	17		
2A	21/24 88%	ss	8-11 8-9 N=19	17		1.80
2B				25		
3A	23/24 96%	ss	3-4 7-8 N=11	23		2.50
4A	24/24 100%	ss	8-9 12-14 N=21	21		3.30
4B				19		2.80
5A	24/24 100%	ss	2-3 4-5 N=7	21		1.30
6A	24/24 100%	ss	2-4 5-6 N=9	17		2.50
7A	24/24 100%	ss	9-7 8-9 N=15	21		1.40
8A	24/24 100%	ss	2-3 2-4 N=5	17		1.30
8B				19		
9A	20/24 83%	ss	5-4 5-10 N=9	21		
9B				16		
10A	12/16 75%	ss	23-41 50/4"	6		4.50

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark grayish brown (10YR4/2), moist, soft, CLAY with little silt and trace very fine- to fine-grained sand - FILL.	
	Yellowish brown (10YR5/6) moist, medium, CLAY with some silt and trace very fine- to coarse-grained sand - FILL.	622
2	Dark gray (10YR4/1), moist, stiff, SILT with little clay and trace very fine-grained sand.	
	Yellowish brown (10YR5/6), moist, stiff, CLAY with some silt and trace very fine- to fine-grained sand.	620
4	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, medium, CLAY with some silt and trace very fine- to fine-grained sand.	618
6		616
8	Gray (10YR5/1) with 30% yellowish brown (10YR5/8) mottles, moist, stiff, SILT and very fine-grained SAND with trace clay.	
10	Gray (10YR5/1) with 30% yellowish brown (10YR5/6) mottles, moist, medium, CLAY with some silt and trace very fine- to fine-grained sand.	614
12		612
14		610
	Gray (10YR6/1), moist soft, CLAY with very fine- to fine-grained sand and little silt.	608
16	Yellowish brown (10YR5/6), wet, loose, very fine- to fine-grained SAND with trace silt.	
	Yellowish brown (10YR5/6), wet medium, SILT with some very fine-grained sand and little clay.	606
	Yellowish brown (10YR5/6), wet, loose, very fine- to medium-grained SAND with trace silt.	
18	Gray (10YR5/1), moist, very hard, SILT with few clay and little very fine- to very coarse sand.	604

End of boring = 19.3 feet

NOTE(S): G401 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Natural Resources Technology, Inc.
Site: Coffeen Power Station - Ash Pond 2
Location: 134 CIPS Lane, Coffeen, IL 62017
Project: 16E0080
DATES: Start: 8/16/2016
Finish: 8/16/2016
WEATHER: Rain, (mid-70s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4 1/4" Hollow Stem Auger
FIELD STAFF: Driller: J. Dittmaier
Helper: M. Hill
Eng/Geo: K. Theesfeld

BOREHOLE ID: G407
Well ID: G407
Surface Elev: 618.35 ft. MSL
Completion: 20.00 ft. BGS
Station: 2,513,705.87N
2,513,705.87E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 10, **Tier** 7 N.; **Range** 3 W.

WATER LEVEL INFORMATION:
▼ = 16.00 - During Drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	12/24 50%	ss	4-3 3-3 N=6	14		3.50
2A	20/24 83%	ss	2-2 4-4 N=6	18		1.50
3A	23/24 96%	ss	1-2 3-4 N=5	19		1.75
4A	24/24 100%	ss	1-3 3-5 N=6	19		1.50
5A	21/24 88%	ss	1-2 4-4 N=6	19		0.50
6A	22/24 92%	ss	1-2 2-1 N=4	17		
7A	24/24 100%	ss	7-29 33-17 N=62	8		
8A	24/24 100%	ss	3-7 12-17 N=19	12		4.50
9A	24/24 100%	ss	4-9 14-20 N=23	13		4.00
10A	24/24 100%	ss	2-8 14-19 N=22	14		4.50

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark gray (10YR3/1), wet, medium, SILT with some organics. [Fill]	618
	Gray (10YR6/1), wet, loose, SAND with some gravel and little clay. [Fill]	
2	Yellowish brown (10YR5/6) with 5% dark yellowish brown (10YR3/6) mottles, moist, very stiff, SILT with some clay and trace very fine- to fine-grained sand.	616
	Brown (10YR5/3) with 10% yellowish brown (10YR5/6) mottles, moist, stiff, SILT with some clay, little fine- to coarse-grained sand, and trace small gravel.	
4	Brown (10YR5/3) with 25% yellowish brown (10YR5/6) mottles, moist, stiff, CLAY with some silt, trace fine-grained sand and trace small gravel.	614
6	Brown (10YR5/3) with 10% yellowish brown (10YR5/6) mottles, moist, stiff, CLAY with some silt, little fine- to coarse-grained sand and trace small gravel.	612
8	Yellowish brown (10YR5/6) with 25% brown (10YR5/3) mottles, moist, medium, CLAY with few silt, few fine-grained sand, and trace small gravel.	610
10	Yellowish brown (10YR5/8) with 5% gray (10YR5/1) mottles, moist, very loose, fine-grained SAND with some clay and trace small gravel.	608
12	Gray (10YR5/1) with 25% yellowish brown (10YR5/8) mottles, moist, very dense, fine-grained SAND	606
14	Brown (10YR5/3), moist, hard, SILT with some clay and little fine- to coarse-grained sand.	604
	Yellowish brown (10YR5/4) with 5% yellowish brown (10YR5/6) and 5% black (10YR2/1) mottles, SILT with some clay and little fine- to coarse-grained sand.	
▼ 16		602
	Yellowish brown (10YR5/4) with 5% yellowish brown (10YR5/6), 5% dark gray (10YR4/1) and 5% black (10YR2/1) mottles, moist, hard, SILT with little fine- to coarse-grained sand and trace small gravel.	
18		600
	Yellowish brown (10YR5/4) with 5% yellowish brown (10YR5/6), 5% dark gray (10YR4/1) and 5% black (10YR2/1) mottles, wet, stiff, SILT with little fine- to coarse-grained sand and little small gravel.	
20	Dark grayish brown (10YR4/2) with 10% dark yellowish brown (10YR3/6) mottles, moist, hard, CLAY with some silt, little fine- to coarse-grained sand and trace small gravel.	

End of Boring = 20.0 ft. BGS

Borehole Detail

Remarks

NOTE(S): G407 installed in boring.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Company
Site: Coffeen Power Station - Ash Pond 2
Location: Coffeen, Illinois
Project: 16E0031A
DATES: Start: 2/23/2018
Finish: 2/23/2018
WEATHER: Overcast, mild (mid-40s)

CONTRACTOR: Bulldog Drilling, Inc.
Rig mfg/model: CME-750 ATV Drill
Drilling Method: 4¼" HSA with continuous split spoon

FIELD STAFF: Driller: C. Dutton
Helper: M. Baetje
Eng/Geo: R. Hasenyager

BOREHOLE ID: G410
Well ID: G410
Surface Elev: 617.21 ft. MSL
Completion: 14.09 ft. BGS
Station: 872,968.54N
2,513,206.33E

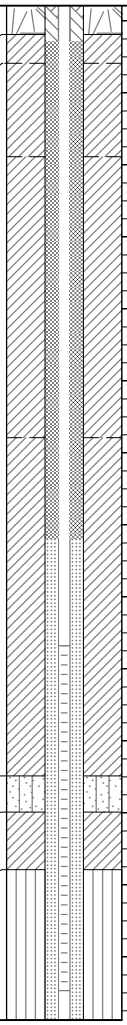
TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen
Township: East Fork
Section 10, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = 11.00 - During drilling
▼ = 13.30 - Upon completion
▽ = 4.82 - 1 March 2018

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type
1A	14/24 *58%*	SS	*2-3 1-5* N=4	26.7		
2A	15/24 *63%*	SS	*4-4 4-5* N=8	25.2		
3A	17/24 *71%*	SS	*2-3 4-6* N=7	17.9		
4A	20/24 *83%*	SS	*3-4 5-6* N=9	17.2		
5A	11/24 *46%*	SS	*3-3 5-6* N=8	17.5		
6A	22/24 *92%*	SS	*2-3 4-6* N=7	16.9		
6B				16.8		
7A	24/24 *100%*	SS	*6-28 36-42* N=64	10.3		
	0/1 *0%*	BD				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Light gray (10YR7/1), moist, loose, very fine- to very coarse-grained SAND with few small to medium gravel.	
	Very dark grayish brown (10YR3/2), moist, soft, CLAY with some silt and trace very fine- to fine-grained sand.	
	Yellowish brown (10YR5/4), moist, soft, CLAY with some silt and trace very fine- to fine-grained sand.	616
2		
	Gray (10YR6/1) with 25% yellowish brown (10YR5/6) mottles, moist, medium,CLAY with some silt and trace very fine- to fine-grained sand.	614
4		
		612
6		
		610
8	Gray (10YR5/1) with 30% yellowish brown (10YR5/8) mottles, moist, medium, CLAY with some silt, little very fine- to very coarse-grained sand, and trace small to medium gravel.	608
10		
	Gray (10YR6/1), moist, loose, very fine- to medium-grained SAND with few silt and few clay.	606
	Yellowish brown (10YR5/8) with 10% gray (10YR5/1) mottles, moist, medium, CLAY with some silt, little very fine- to very coarse-grained sand, and trace small to medium gravel.	
12		
	Yellowish brown (10YR5/6), moist, hard, SILT with some clay, few very fine- to very coarse-grained sand, and trace small to medium gravel.	604
14		

Borehole Detail



Remarks

End of Boring = 14.09 ft bgs

NOTE(S):

Attachment E

Site Solids Bulk Characterization Analytical Data

September 15, 2021

Michael Healy
SiREM
130 Stone Road West
Guelph, Ontario, Canada N1G 3Z2

RE: Report of Findings, Measurement of AVS
Client ID: Coffeen AP1 MNA
PRIMA ID: Sirem 08312021-Coffeen AP1

Dear Mr. Healy:

This letter report describes the results of analyses conducted on four soil samples. Each soil was analyzed for acid volatile sulfide (AVS). Results are reported herein.

Sample Receipt and Preparation

Samples were received on August 31, 2021. The samples were placed in an anaerobic glovebox upon receipt. All sample preparation was conducted in the glove box.

Procedures

AVS was measured via sequential extraction of soil based on methods provided by Microseeps, Inc. In order to minimize exposure of the soil or extraction fluid to oxygen, the soil samples were transferred to the extraction vessel while in the glove box and the extractions were carried out on the bench top under a flow of nitrogen. A brief description of the extraction procedure is provided below.

WAS-Fe. Approximately 10 g of soil is extracted with 1 N hydrochloric acid (HCl) for 30 minutes at room temperature (approximately 20° C), after which an aliquot of the HCl is withdrawn and analyzed for ferrous iron and total iron colorimetrically using a Hach DR2800 spectrophotometer and appropriate Hach test kit reagents. Dilutions are made as needed using deoxygenated, deionized (DO/DI) water.

AVS. Hydrogen sulfide generated during the WAS extraction step is collected in a trap filled with 1.25 N sodium hydroxide (NaOH). After collection of the WAS Fe sample, concentrated HCl is added to the soil and the mixture is heated for 30 minutes. The concentration of sulfide in trap is then measured using the methylene blue method via a

Hach DR2800 spectrophotometer and appropriate Hach test kit reagents. Dilutions are made as needed using DO/DI water.

Results

The amount of AVS in each sample is shown in **Table 1** (attached). QC results are given in **Table 2** (attached).

If you have any questions regarding these results, please give me a call at 916-939-7300. Thank you for the opportunity to be of service.

Sincerely,
PRIMA Environmental, Inc.

Cindy G. Schreier

Cindy G. Schreier, Ph.D.
President

Attachments

Table 1. AVS Results.

Sample	AVS, mg/kg
SB-306-(14-16)	< 0.18
SB-311-(14-15)	0.24
SB-313-(8-9)	< 1.6 M
SB-316-(13-14, 15-16)	0.28

M Reporting limit elevated due to matrix interference

Table 2. QC Results for AVS.

Sample ID	Result	Units
Blank *		
AVS	< 0.025	mg/L
FeS standard		
Sulfide concentration	365	g/kg
AVS	378	g/kg
% Recovered as AVS	104	%

* A blank was run in the absence of a solid material. Therefore, values are concentrations in the extraction fluids or traps.

5070 Robert J Mathews Parkway, Suite 300
El Dorado Hills, CA 95762
916-939-7300
www.primaenvironmental.com

Sample Receipt Summary

Date/Time: 8/31/21 10:40

Client/Company: SiRem - AVS 08312021

Project: Coffeen AP1 MNA

	Yes	No	N/A
Custody seals intact?	☐	☐	☒
Chain of custody Present?	☒	☐	☐
If no, list number of samples and Sample ID			
Ice present?	☒ Blue ice	☐	☐
If no, what is temperature? _____			
Samples in good condition?	☒	☐	☐
If no, explain:			
Do sample IDs on containers match IDs on COC?	☒	☐	☐
If no, explain:			

Other Comments:
electrical tape around lids.
Store in glovebox

PRIMA ENVIRONMENTAL INC.
Mathews Parkway, Suite 300 El Dorado Hills, CA 95762
(916) 939-7300; (916) 939-7398 Fax
www.primaenvironmental.com

CHAIN of CUSTODY

Project Manager: Michael Healey
Project Name: Coffeen AP1 MNA
Job Number:
Sampler Signature:

Phone: (519) 822-2265
Fax: (519) 822-3151
Email: mhealey@siremlab.com
TAT: 1 week

SAMPLE ID	Date	Time	Matrix	# Containers	Analysis: Acid Volatile Sulfide										Comments
SB-306-(14-16)	26-Aug-21	12:15	S	1	X										
SB-311-(14-15)	26-Aug-21	12:30	S	1	X										
SB-313-(8-9)	26-Aug-21	12:45	S	1	X										
SB-316-(13-14,15-16)	26-Aug-21	1:00	S	1	X										

Special Instructions	Relinquished by:		Received by:
	Company SiREM	Date 26 Aug 21	Company
	Printed Name Rachel Hallman	Time 12:00 pm.	Printed Name
	Signature		Signature
	Relinquished by:		**Received by:**
	Company	Date 8/31/21	Company PRIMA
	Printed Name	Time 10:40	Printed Name Molly Scott
	Signature		Signature

Matrix key: S - soil/sediment; W - water; OT - other

September 1, 2021

Michael Healy
SiREM
130 Stone Road West
Guelph, Ontario, Canada N1G 3Z2

RE: Report of Findings, Measurement of AVS
Client ID: Coffeen MNA
PRIMA ID: Sirem 08202021-Coffeen

Dear Mr. Healy:

This letter report describes the results of analyses conducted on two soil samples. Each soil was analyzed for acid volatile sulfide (AVS). Results are reported herein.

Sample Receipt and Preparation

Samples were received on August 20, 2021. The samples were frozen upon receipt, then thawed in a nitrogen-filled glove box. All sample preparation was conducted in the glove box.

Procedures

AVS was measured via sequential extraction of soil based on methods provided by Microseeps, Inc. In order to minimize exposure of the soil or extraction fluid to oxygen, the soil samples were transferred to the extraction vessel while in the glove box and the extractions were carried out on the bench top under a flow of nitrogen. A brief description of the extraction procedure is provided below.

WAS-Fe. Approximately 10 g of soil is extracted with 1 N hydrochloric acid (HCl) for 30 minutes at room temperature (approximately 20° C), after which an aliquot of the HCl is withdrawn and analyzed for ferrous iron and total iron colorimetrically using a Hach DR2800 spectrophotometer and appropriate Hach test kit reagents. Dilutions are made as needed using deoxygenated, deionized (DO/DI) water.

AVS. Hydrogen sulfide generated during the WAS extraction step is collected in a trap filled with 1.25 N sodium hydroxide (NaOH). After collection of the WAS Fe sample, concentrated HCl is added to the soil and the mixture is heated for 30 minutes. The

concentration of sulfide in trap is then measured using the methylene blue method via a Hach DR2800 spectrophotometer and appropriate Hach test kit reagents. Dilutions are made as needed using DO/DI water.

Results

The amount of AVS in each sample is shown in **Table 1** (attached). QC results are given in **Table 2** (attached).

If you have any questions regarding these results, please give me a call at 916-939-7300. Thank you for the opportunity to be of service.

Sincerely,
PRIMA Environmental, Inc.

Cindy G. Schreier

Cindy G. Schreier, Ph.D.
President

Attachments

Table 1. AVS Results.

Sample	AVS, mg/kg
401B-(16-20)	< 0.19
270A-(12-16)	< 0.19

Table 2. QC Results for AVS.

Sample ID	Result	Units
Blank *		
AVS	< 0.025	mg/L
FeS standard		
Sulfide concentration	365	g/kg
AVS	364	g/kg
% Recovered as AVS	100	%

* A blank was run in the absence of a solid material. Therefore, values are concentrations in the extraction fluids or traps.

5070 Robert J Mathews Parkway, Suite 300
El Dorado Hills, CA 95762
916-939-7300
www.primaenvironmental.com

Sample Receipt Summary

Date/Time: 8/20/21 10:00 AM

Client/Company: SiRem lab - Michael Healey

Project: Coffeen MNA (2)
Miami Fort MNA (4)
Vermillion MNA (5)

	Yes	No	N/A
Custody seals intact?	☐	☐	☒
Chain of custody Present?	☒	☐	☐

If no, list number of samples and Sample ID

Ice present?	☒	☐	☐

If no, what is temperature? _____

Samples in good condition?	☒	☐	☐

If no, explain:

Ice appears melted.

Do sample IDs on containers match IDs on COC?	☒	☐	☐

If no, explain:

3 Chains of custody
11 soil Jars Total

Other Comments:

PRIMA ENVIRONMENTAL INC.
Mathews Parkway, Suite 300 El Dorado Hills, CA 95762
(916) 939-7300; (916) 939-7398 Fax
www.primaenvironmental.com

CHAIN of CUSTODY

Project Manager: Michael Healey
Project Name: Coffeen MNA
Job Number:
Sampler Signature:

Phone: (519) 822-2265
Fax: (519) 822-3151
Email: mhealey@siremlab.com
TAT: 1 week

SAMPLE ID	Date	Time	Matrix	# Containers	Acid Volatile Sulfide										Comments
401B-(16-20)	18-Aug-21	3:00	S	1	X										
270A-(12-16)	18-Aug-21	3:15	S	1	X										

Analysis

Special Instructions	Relinquished by:			Received by:	
	Company	SiREM Labs	Date 18 Aug 21	Company PRIMA	8/20/21
	Printed Name	Rachel Hallman	Time 5:30 pm.	Printed Name Chris B.	10:00 AM
	Signature			Signature	
	Relinquished by:			Received by:	
	Company		Date	Company	
	Printed Name		Time	Printed Name	
	Signature			Signature	

Matrix key: S - soil/sediment; W - water; OT - other

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

13-September-2021

SiREM Laboratory
Attn : Michael Healey

130 Stone Road W, Guelph
Canada, N1G 3Z2
Phone: 519-822-2265, Fax:519-822-3151

Date Rec. : 13 September 2021
LR Report: **CA15261-SEP21**
Reference: P.O# 800003210A

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Sample ID	Sample Date & Time	S %
1: Analysis Start Date		13-Sep-21
2: Analysis Start Time		15:44
3: Analysis Completed Date		13-Sep-21
4: Analysis Completed Time		17:17
5: G1001-(6-11)	17-May-21 10:00	0.031
6: 401B-(16-20)	17-May-21 10:15	0.008
7: 270A-(12-16)	17-May-21 10:30	< 0.005

Catharine Arnold

CHARTERED CATHARINE ARNOLD CHEMIST

Catharine Arnold, B.Sc., C.Chem
Project Specialist,
Environment, Health & Safety

OnLine LIMS

0002638711

Data reported represents the sample submitted to SGS. Reproduction of this analytical report in full or in part is prohibited without prior written approval. Please refer to SGS General Conditions of Services located at https://www.sgs.ca/en/terms-and-conditions (Printed copies are available upon request.)
Test method information available upon request. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.
SGS Canada Inc. Environment-Health & Safety statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Project : Coffeen AP1 MNA, PO# 800003210A

21-December-2021

SiREM Laboratory
Attn : Michael Healey

130 Stone Road W, Guelph
Canada, N1G 3Z2
Phone: 519-822-2265, Fax:519-822-3151

Date Rec. : 16 November 2021
LR Report: **CA14794-NOV21**
Reference: Project Name: Coffeen AP1 MNA, PO# 800003210A

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Sample ID	Sample Date & Time	B g/t
5: SB-306-(14-16)	26-Aug-21 10:00	< 40
6: SB-311-(14-15)	26-Aug-21 10:15	< 40
7: SB-313-(8-9)	26-Aug-21 10:30	< 40
8: SB-316-(13-14,15-16)	26-Aug-21 10:45	< 40

Catharine Arnold

Catharine Arnold, B.Sc., C.Chem
Project Specialist,
Environment, Health & Safety

OnLine LIMS

0002751323

Data reported represents the sample submitted to SGS. Reproduction of this analytical report in full or in part is prohibited without prior written approval. Please refer to SGS General Conditions of Services located at https://www.sgs.ca/en/terms-and-conditions (Printed copies are available upon request.)
Test method information available upon request. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.
SGS Canada Inc. Environment-Health & Safety statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

13-September-2021

SiREM Laboratory
Attn : Michael Healey

130 Stone Road W
Guelph, ON
N1G 3Z2, Canada

Phone: 519-822-2265
Fax:519-822-3151

Date Rec. : 31 August 2021
LR Report: **CA19062-AUG21**
Reference: Project Name: Coffeen AP1 MNA, PO# 800003210A

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Completed Date	4: Analysis Completed Time	5: SB-306-(14-16)	6: SB-311-(14-15)	7: SB-313-(8-9)	8: SB-316-(13-14,15-16)
Sample Date & Time					26-Aug-21 10:00	26-Aug-21 10:15	26-Aug-21 10:30	26-Aug-21 10:45
Ag [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	< 0.5	< 0.5	< 0.5	< 0.5
Al [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	13000	11000	31000	32000
As [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	6.7	2.7	5.6	5.1
Ba [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	98	58	310	320
Be [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	0.45	0.37	0.73	0.69
Bi [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	0.10	0.10	0.11	0.12
Ca [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	35000	52000	69000	10000
Cd [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	0.11	0.08	0.20	0.06
Co [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	6	4	7	4
Cr [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	130	100	130	150
Cu [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	14	10	12	10
Fe [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	20000	12000	27000	17000
K [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	3700	3600	13000	14000
Li [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	11	11	19	14
Mg [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	15000	27000	35000	6700
Mn [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	470	310	1200	260
Mo [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	5.8	2.7	1.6	8.1
Na [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	590	830	6000	6400
Ni [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	15	11	17	13
P [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	230	200	250	230
Pb [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	9	7	11	12
Sb [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	< 0.8	< 0.8	< 0.8	< 0.8
Se [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	< 0.7	< 0.7	< 0.7	< 0.7
Sn [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	< 6	< 6	< 6	< 6
Sr [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	26	35	100	89
Ti [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	370	320	1500	1200
Tl [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	0.15	0.13	0.26	0.31
U [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	0.54	0.55	1.0	1.0
V [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	28	20	35	29
Y [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	9.1	8.2	11	10
Zn [µg/g]	09-Sep-21	19:00	10-Sep-21	10:47	35	27	41	34
C [%]	10-Sep-21	08:20	10-Sep-21	14:51	1.65	2.76	3.26	0.457

OnLine LIMS

0002638704

Data reported represents the sample submitted to SGS. Reproduction of this analytical report in full or in part is prohibited without prior written approval. Please refer to SGS General Conditions of Services located at https://www.sgs.ca/en/terms-and-conditions (Printed copies are available upon request.)
Test method information available upon request. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.
SGS Canada Inc. Environment-Health & Safety statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

LR Report : **CA19062-AUG21**

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Completed Date	4: Analysis Completed Time	5: SB-306-(14-16)	6: SB-311-(14-15)	7: SB-313-(8-9)	8: SB-316-(13-14,15-16)
S [%]	10-Sep-21	08:20	10-Sep-21	14:51	0.005	0.014	0.007	0.012
TOC [%]	10-Sep-21	14:26	10-Sep-21	16:31	0.413	0.772	0.775	0.257
Sulphide [%]	10-Sep-21	18:37	13-Sep-21	09:15	< 0.04	< 0.04	< 0.04	< 0.04

Catharine Arnold

CHARTERED CATHARINE ARNOLD CHEMIST

Catharine Arnold, B.Sc., C.Chem
Project Specialist,
Environment, Health & Safety

OnLine LIMS

0002638704

Data reported represents the sample submitted to SGS. Reproduction of this analytical report in full or in part is prohibited without prior written approval. Please refer to SGS General Conditions of Services located at https://www.sgs.ca/en/terms-and-conditions (Printed copies are available upon request.)
Test method information available upon request. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.
SGS Canada Inc. Environment-Health & Safety statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Project : Coffeen MNA

09-June-2021

SiREM Laboratory
Attn : Michael Healey

130 Stone Road W
Guelph, ON
N1G 3Z2, Canada

Phone: 519-822-2265
Fax:519-822-3151

Date Rec. : 18 May 2021
LR Report: **CA12646-MAY21**
Reference: P.O# 800003210A

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Completed Date	4: Analysis Completed Time	5: G1001-(6-11)	6: 401B-(16-20)	7: 270A-(12-16)
Sample Date & Time					17-May-21 10:00	17-May-21 10:15	17-May-21 10:30
Temp Upon Receipt [°C]	---	---	---	---	5.0	5.0	5.0
Sulphide1 [%]	03-Jun-21	15:12	03-Jun-21	16:31	0.05	< 0.04	< 0.04
TOC [%]	07-Jun-21	09:12	07-Jun-21	15:08	0.852	0.082	0.138
Ag [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	< 0.05	< 0.05	< 0.05
Al [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	8200	9700	9600
As [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	6.2	5.5	12
Ba [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	120	190	210
Be [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	0.45	0.35	0.48
B [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	6	4	5
Bi [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	0.23	0.25	0.18
Ca [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	42000	1900	5000
Cd [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	0.13	0.03	0.12
Co [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	8.8	6.1	10
Cr [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	15	14	16
Cu [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	11	7.8	12
Fe [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	16000	14000	22000
K [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	1100	770	1400
Li [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	9	7	11
Mg [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	18000	1600	4700
Mn [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	450	540	1200
Mo [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	1.5	0.4	0.8
Na [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	110	80	110
Ni [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	15	10	20
Pb [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	11	9.5	12
Sb [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	< 0.8	< 0.8	< 0.8
Se [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	< 0.7	< 0.7	< 0.7
Sn [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	0.6	< 0.5	< 0.5
Sr [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	35	9.1	10
Ti [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	170	65	230
Tl [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	0.16	0.12	0.16
U [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	0.82	0.39	0.46
V [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	19	14	22
W [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	0.07	0.04	0.13

OnLine LIMS

0002522990

Data reported represents the sample submitted to SGS. Reproduction of this analytical report in full or in part is prohibited without prior written approval. Please refer to SGS General Conditions of Services located at https://www.sgs.ca/en/terms-and-conditions (Printed copies are available upon request.)
Test method information available upon request. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.
SGS Canada Inc. Environment-Health & Safety statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Project : Coffeen MNA

LR Report : **CA12646-MAY21**

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Completed Date	4: Analysis Completed Time	5: G1001-(6-11)	6: 401B-(16-20)	7: 270A-(12-16)
Y [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	8.1	8.2	9.4
Zn [µg/g]	04-Jun-21	15:33	07-Jun-21	10:42	35	28	50

Catharine Arnold

Catharine Arnold, B.Sc., C.Chem
Project Specialist,
Environment, Health & Safety

OnLine LIMS

0002522990

Data reported represents the sample submitted to SGS. Reproduction of this analytical report in full or in part is prohibited without prior written approval. Please refer to SGS General Conditions of Services located at https://www.sgs.ca/en/terms-and-conditions (Printed copies are available upon request.)
Test method information available upon request. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.
SGS Canada Inc. Environment-Health & Safety statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

Attachment F
X-Ray Fluorescence Analytical Data

ANALYSIS REPORT BBM23-31378

To F400101 SGS CANADA INC
LISA THOMPSON
185 Concession Street
Lakefield K0L 2H0
ON
CANADA

Order Number	PO#	Date Received	23-Aug-2023
Submission Number	CA19113-JUL23 / 6 Pulp	Date Analysed	30-Aug-2023 - 06-Sep-2023
Number of Samples	6	Date Completed	09-Sep-2023
		SGS Order Number	BBM23-31378

Methods Summary

Number of Sample	Method Code	Description
6	G_PHY01V	Loss on ignition (LOI), Furnace, variable wt, variable temp
6	GO_XRF72	Borate Fusion, XRF, Ore Grade

Comments

Preparation of samples was performed at the SGS Lakefield site.
Analysis of samples was performed at the SGS Burnaby site.

Authorised Signatory

John Chiang
Laboratory Operations Manager

SCC Accredited LAB
LAB Accrédité CCN TM

This document is issued by the Company under its General Conditions of Service accessible at https://www.sgs.com/en/Terms-and-Conditions.aspx. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.
WARNING: The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted. The findings report on the samples provided by the client and are not intended for commercial or contractual settlement purposes.

- not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

SGS Canada Inc. | NAM Minerals Geochemistry 3260 Production Way Burnaby BC. V5A 4W4 CANADA t +1 (604) 638 2349 f +1 (604) 444 5486 www.sgs.com

Member of the SGS Group (SGS SA)

Order Number PO#
Submission Number CA19113-JUL23 / 6 Pulp
Number of Samples 6

ANALYSIS REPORT BBM23-31378

Element	LOI	@Al2O3	@CaO	@Cr2O3	@Fe2O3	@K2O
Method	G_PHY01V	GO_XRF72	GO_XRF72	GO_XRF72	GO_XRF72	GO_XRF72
Lower Limit	-10	0.01	0.01	0.01	0.01	0.01
Upper Limit	100	100	60	5	100	70
Unit	%	%	%	%	%	%
COF1-13-18-20230619	12.4300	8.36	6.73	<0.01	3.19	1.88
COF1-18-23-20230619	12.3300	8.41	6.72	0.02	3.48	1.88
COF1-38-43-20230619	12.3000	8.35	6.69	0.02	3.71	1.89
COF2-10-13-20230619	2.53949	6.73	0.52	0.01	2.08	2.01
COF3-11-12-20230619	3.75000	8.14	1.04	<0.01	2.77	2.42
COF3-12.5-13-20230619	11.9572	4.92	9.10	<0.01	1.69	1.59
*Std OREAS 70b	6.78796	-	-	-	-	-
*Std OREAS 70b	-	7.12	4.28	0.18	7.95	0.71
*Blk BLANK	-	<0.01	<0.01	<0.01	<0.01	<0.01
*Std OREAS 751	-	15.87	1.04	<0.01	2.40	2.89

Element	@MgO	Mn3O4	@Na2O	@P2O5	@SiO2	@TiO2
Method	GO_XRF72	GO_XRF72	GO_XRF72	GO_XRF72	GO_XRF72	GO_XRF72
Lower Limit	0.01	0.01	0.01	0.01	0.01	0.01
Upper Limit	100	100	60	55	100	100
Unit	%	%	%	%	%	%
COF1-13-18-20230619	3.71	0.07	0.79	0.07	62.07	0.49
COF1-18-23-20230619	3.66	0.07	0.80	0.08	61.80	0.50
COF1-38-43-20230619	3.62	0.07	0.77	0.08	61.72	0.50
COF2-10-13-20230619	0.54	0.03	0.82	0.06	84.59	0.36
COF3-11-12-20230619	0.77	0.13	0.85	0.06	80.21	0.40
COF3-12.5-13-20230619	4.44	0.08	0.69	0.05	64.55	0.26
*Std OREAS 70b	22.38	0.16	1.04	0.05	48.48	0.30
*Blk BLANK	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
*Std OREAS 751	0.50	0.10	3.40	0.27	71.34	0.24

- not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

SGS Canada Inc. | NAM Minerals Geochemistry 3260 Production Way Burnaby BC. V5A 4W4 CANADA t +1 (604) 638 2349 f +1 (604) 444 5486 www.sgs.com

Member of the SGS Group (SGS SA)

Order Number	PO#
Submission Number	CA19113-JUL23 / 6 Pulp
Number of Samples	6

ANALYSIS REPORT BBM23-31378

Element	@V2O5	Sum
Method	GO_XRF72	GO_XRF72
Lower Limit	0.01	0.01
Upper Limit	10	100
Unit	%	%
COF1-13-18-20230619	0.01	87.60
COF1-18-23-20230619	<0.01	87.86
COF1-38-43-20230619	0.01	87.81
COF2-10-13-20230619	<0.01	97.81
COF3-11-12-20230619	0.01	96.90
COF3-12.5-13-20230619	<0.01	87.45
*Std OREAS 70b	0.01	93.40
*Blk BLANK	<0.01	0.03
*Std OREAS 751	<0.01	98.27

SGS Canada Minerals Burnaby conforms to the requirements of ISO/IEC17025 for specific tests as listed on their scope of accreditation found at https://www.scc.ca/en/search/laboratories/sgs
Tests and Elements marked with an "@" symbol in the report denote ISO/IEC17025 accreditation.

- not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

SGS Canada Inc. | NAM Minerals Geochemistry 3260 Production Way Burnaby BC. V5A 4W4 CANADA t +1 (604) 638 2349 f +1 (604) 444 5486 www.sgs.com

Member of the SGS Group (SGS SA)

Attachment G
X-Ray Diffraction Analytical Data

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*Environmental Services*
Project Number/ LIMS No.	*Custom XRD/MI4544-MAY21*
Sample Receipt:	*May 27, 2021*
Sample Analysis:	*May 31, 2021*
Reporting Date:	*June 17, 2021*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 35 kV, 40 mA Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°
Interpretations :	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPIus Eva and Topas software.
Detection Limit :	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Quantitative XRD Results
3) XRD Pattern(s)

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

ACCREDITATION: SGS Minerals Services Lakefield is accredited to the requirements of ISO/IEC 17025 for specific tests as listed on our scope of accreditation, including geochemical, mineralogical and trade mineral tests. To view a list of the accredited methods, please visit the following website and search SGS Canada - Minerals Services - Lakefield: http://palcan.scc.ca/SpecsSearch/GLSearchForm.do.

Method Summary

The Rietveld Method of Mineral Identification by XRD (ME-LR-MIN-MET-MN-D05) method used by SGS Minerals Services is accredited to the requirements of ISO/IEC 17025.

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

DISCLAIMER: This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

WARNING: The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

Summary of Rietveld Quantitative Analysis X-Ray Diffraction Results

Mineral/Compound	G1001-(6-11) MAY4544-01 (wt %)	401B-(16-20) MAY4544-02 (wt %)	270A-(12-16) MAY4544-03 (wt %)
Quartz	46.3	68.9	60.6
Muscovite	10.3	6.8	9.0
Biotite	2.4	2.1	2.4
Microcline	7.8	7.8	9.8
Albite	10.4	8.6	9.1
Calcite	4.2	-	-
Dolomite	11.3	-	0.6
Ankerite	1.5	0.1	0.5
Chlorite	1.5	-	1.4
Pyrite	0.1	-	0.2
Stilpnomelane	2.6	2.7	2.0
Diopside	0.8	1.4	1.3
Actinolite	0.9	1.4	3.3
TOTAL	100	100	100

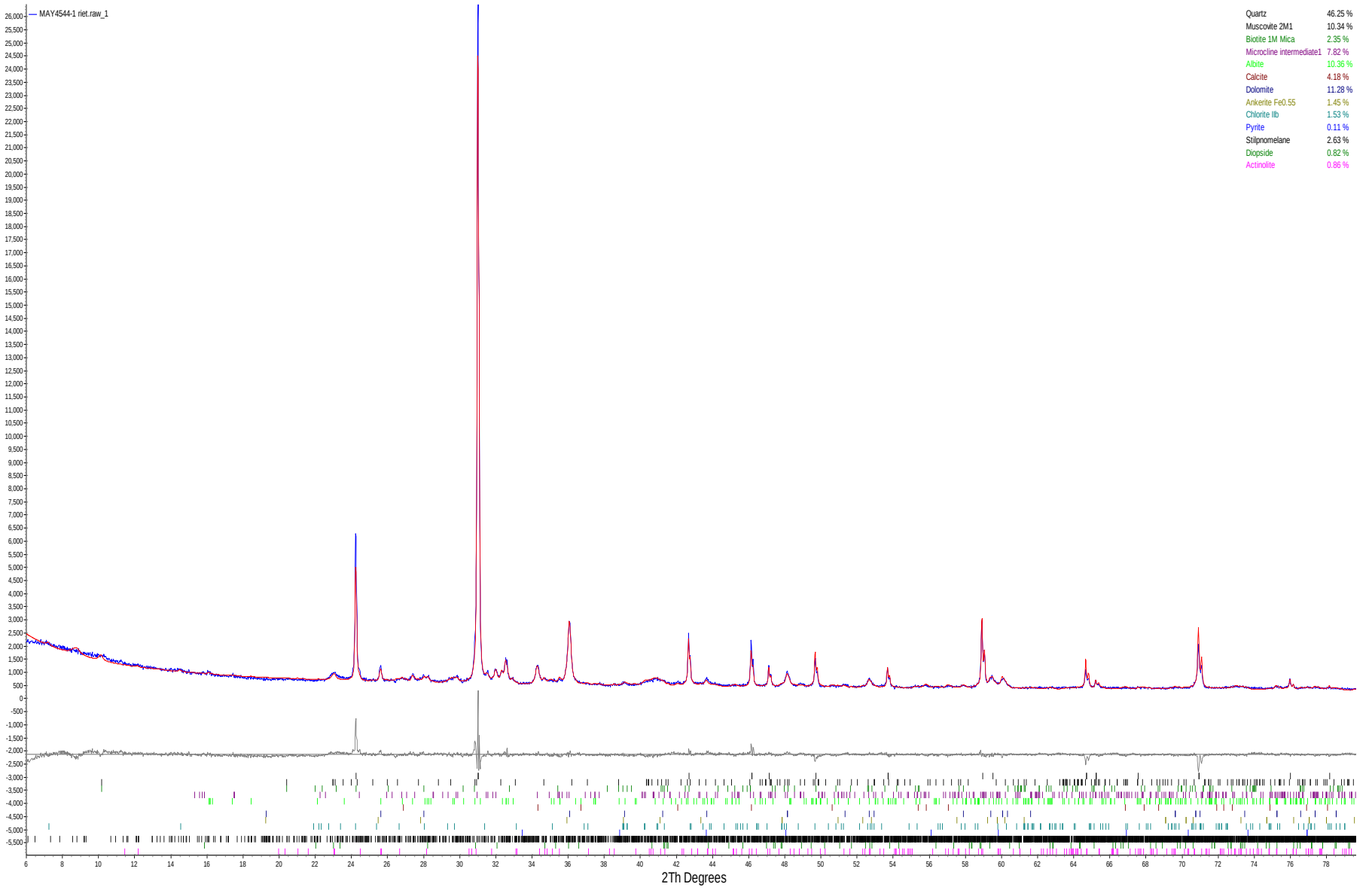
Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identified by the analyst and not included in the refinement calculation for the sample.

The weight percent quantities indicated have been normalized to a sum of 100%. The quantity of amorphous material has not been determined.

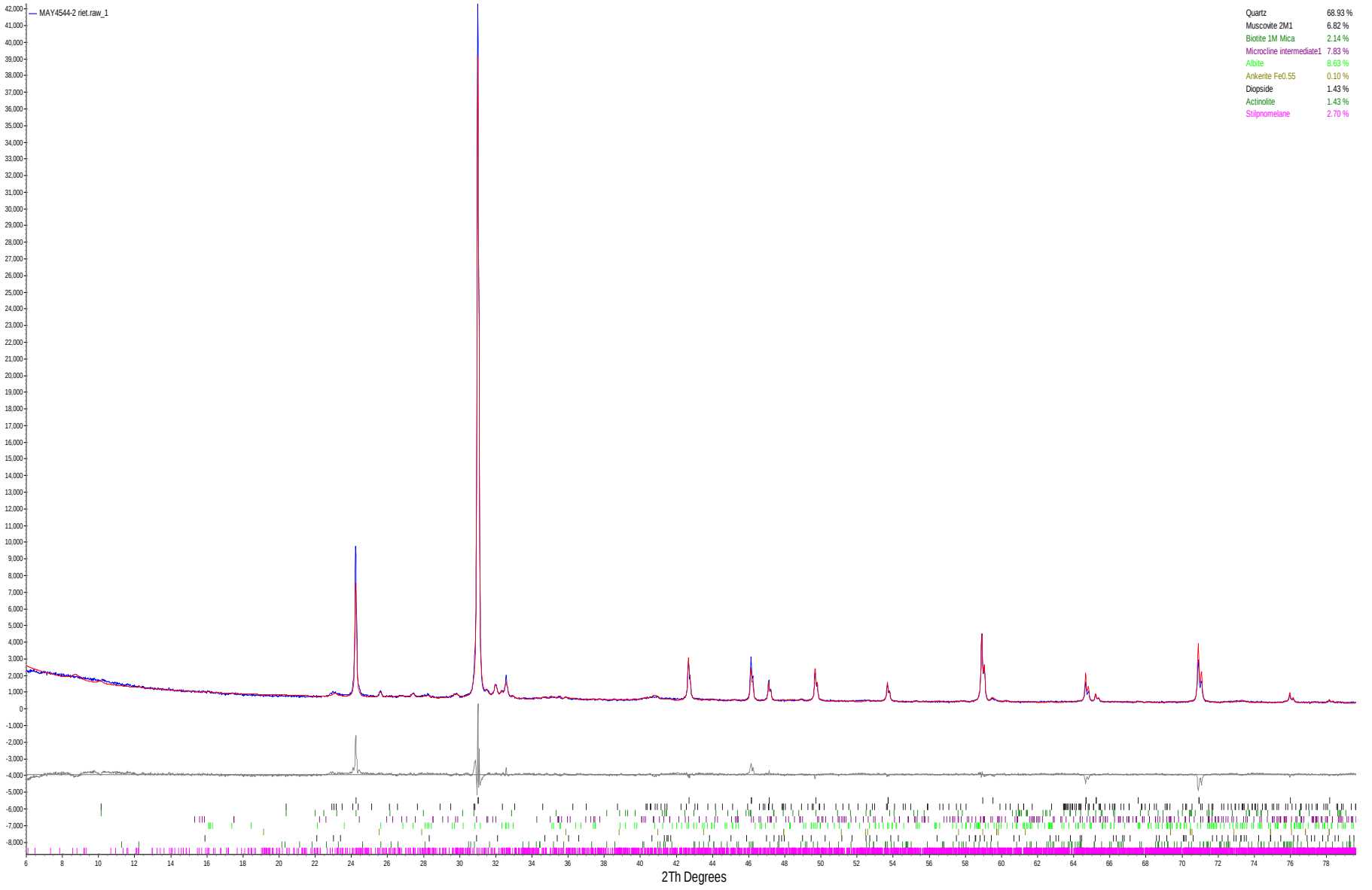
Mineral/Compound	Formula
Quartz	SiO_2
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$
Microcline	$KAlSi_3O_8$
Albite	$NaAlSi_3O_8$
Calcite	$CaCO_3$
Dolomite	$CaMg(CO_3)_2$
Ankerite	$CaFe(CO_3)_2$
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$
Pyrite	FeS_2
Stilpnomelane	$K(Fe^{2+},Mg,Fe^{3+})_8(Si,Al)_{12}(O,OH)_{27}\cdot n(H_2O)$
Diopside	$CaMgSi_2O_6$
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$

G1001-(6-11)



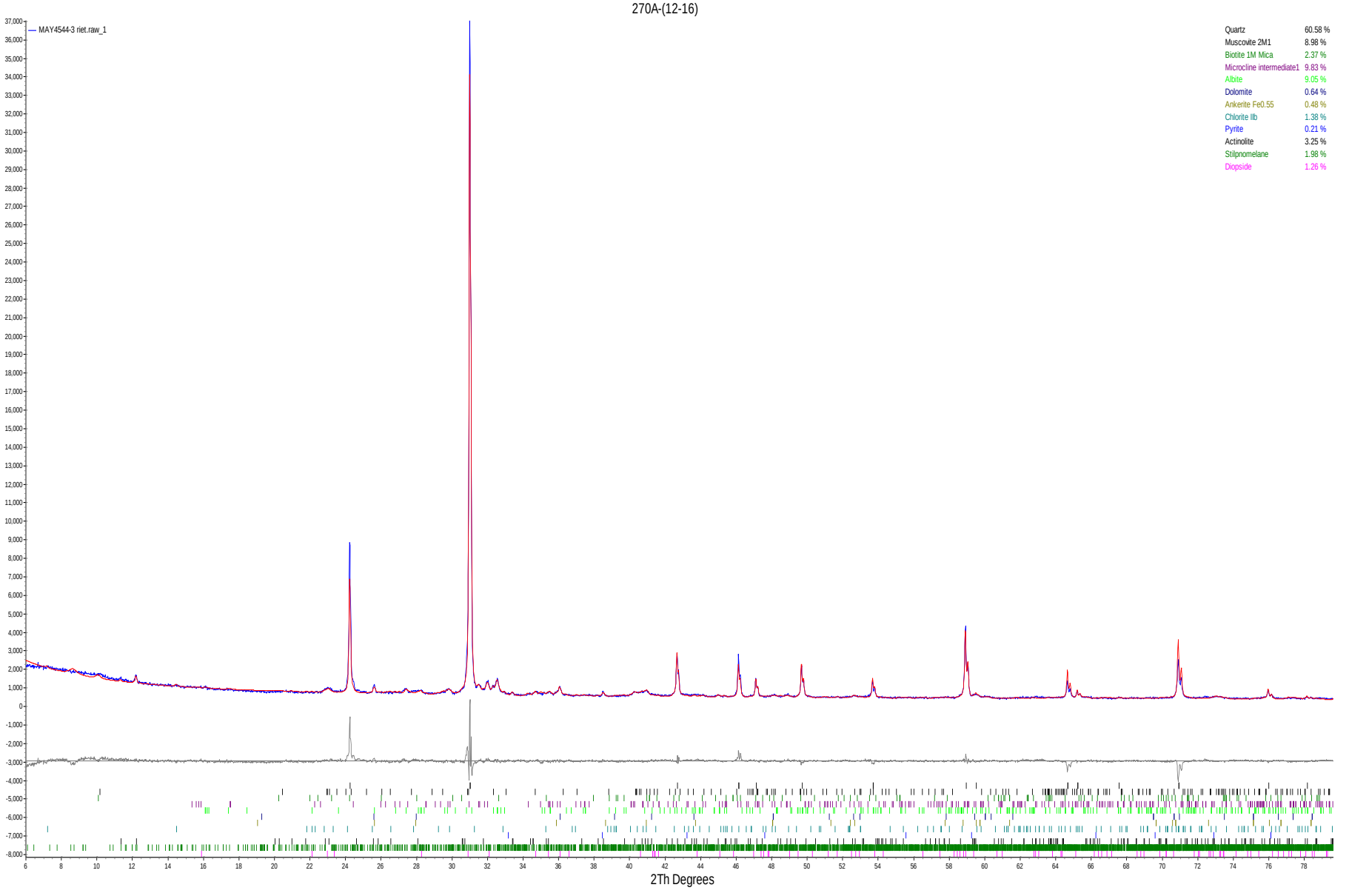
Quartz	46.25 %
Muscovite 2M1	10.34 %
Biotite 1M Mica	2.35 %
Microcline intermediate1	7.82 %
Albite	10.36 %
Calcite	4.18 %
Dolomite	11.28 %
Ankerite Fe0.55	1.45 %
Chlorite IIb	1.53 %
Pyrite	0.11 %
Stilpnomelane	2.63 %
Diopside	0.82 %
Actinolite	0.86 %

401B-(16-20)



Quartz	68.93 %
Muscovite 2M1	6.82 %
Biotite 1M Mica	2.14 %
Microcline intermediate1	7.83 %
Albite	8.63 %
Ankerite Fe0.55	0.10 %
Diopside	1.43 %
Actinolite	1.43 %
Stilpnomelane	2.70 %

270A-(12-16)



Quartz	60.58 %
Muscovite 2M1	8.98 %
Biotite 1M Mica	2.37 %
Microcline intermediate1	9.83 %
Albite	9.05 %
Dolomite	0.64 %
Ankerite Fe0.55	0.48 %
Chlorite IIb	1.38 %
Pyrite	0.21 %
Actinolite	3.25 %
Stilpnomelane	1.98 %
Diopside	1.26 %

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*Environmental Services*
Project Number/ LIMS No.	*Custom XRD/MI4509-SEP21*
Sample Receipt:	*September 9, 2021*
Sample Analysis:	*September 24, 2021*
Reporting Date:	*October 22, 2021*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 35 kV, 40 mA Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°
Interpretations :	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit :	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Quantitative XRD Results
3) XRD Pattern(s)

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

ACCREDITATION: SGS Minerals Services Lakefield is accredited to the requirements of ISO/IEC 17025 for specific tests as listed on our scope of accreditation, including geochemical, mineralogical and trade mineral tests. To view a list of the accredited methods, please visit the following website and search SGS Canada - Minerals Services - Lakefield: http://palcan.scc.ca/SpecsSearch/GLSearchForm.do.

Method Summary

The Rietveld Method of Mineral Identification by XRD (ME-LR-MIN-MET-MN-D05) method used by SGS Minerals Services is accredited to the requirements of ISO/IEC 17025.

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

DISCLAIMER: This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

WARNING: The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

SGS Minerals
a division of SGS Canada Inc.
P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0
Tel: (705) 652-2000 Fax: (705) 652-6365 www.sgs.com www.sgs.com/met
Member of the SGS Group (SGS SA)

Summary of Rietveld Quantitative Analysis X-Ray Diffraction Results

Mineral/Compound	SB-306-(14-16) SEP4509-01 (wt %)	SB-311-(14-15) SEP4509-02 (wt %)	SB-313-(8-9) SEP4509-03 (wt %)	SB-316-(13-14,15-16) SEP4509-04 (wt %)
Quartz	70.9	58.9	51.3	67.6
Microcline	8.5	7.4	7.6	9.8
Albite	9.6	8.6	7.9	9.6
Calcite	0.5	2.5	4.1	-
Dolomite	3.5	12.1	15.7	1.9
Ankerite	2.1	5.0	7.7	0.8
Chlorite	1.8	1.7	1.1	1.7
Diopside	3.1	3.8	4.6	1.3
Muscovite	-	-	-	7.3
TOTAL	100	100	100	100

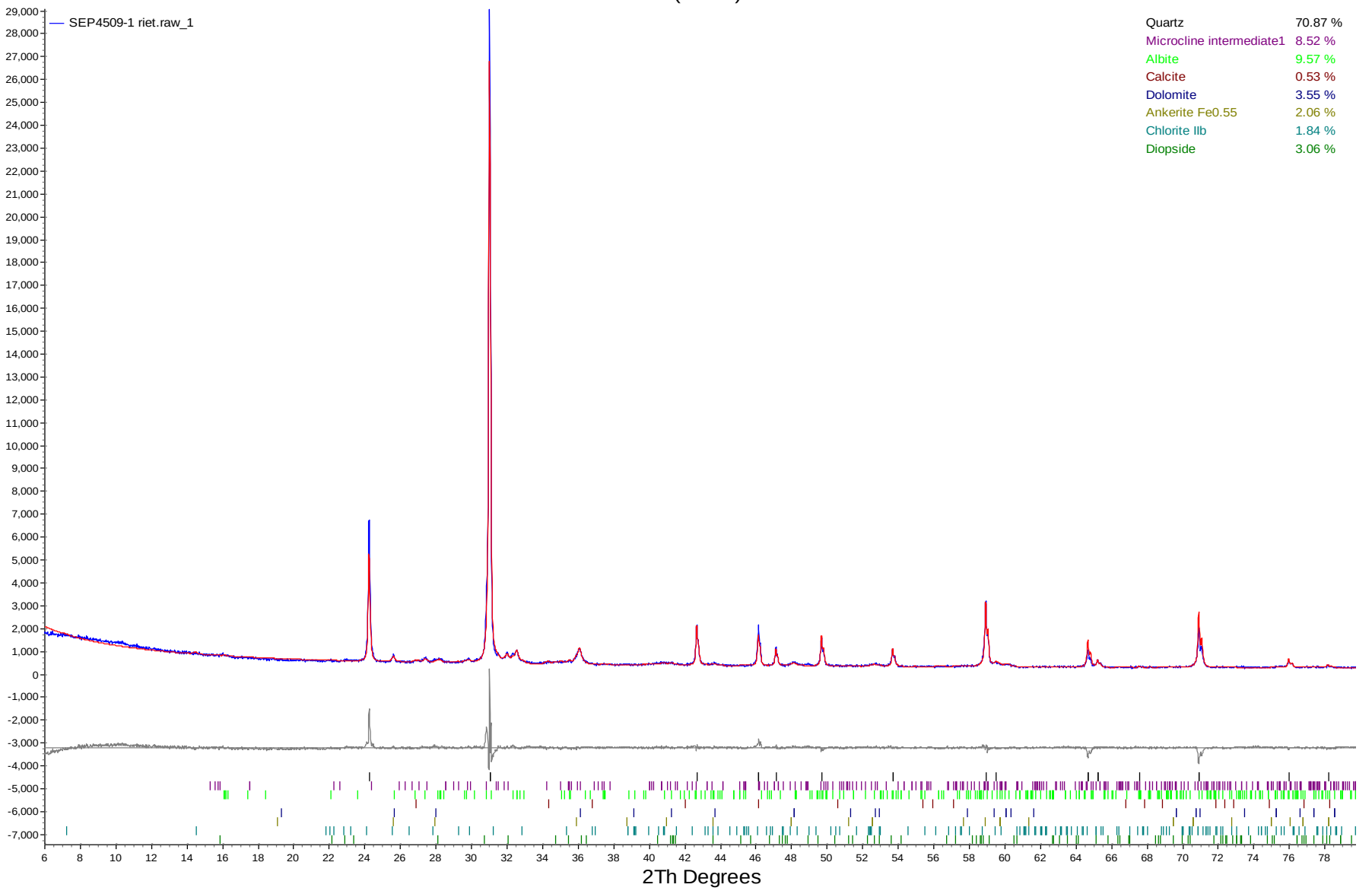
Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identified by the analyst and not included in the refinement calculation for the sample.

The weight percent quantities indicated have been normalized to a sum of 100%. The quantity of amorphous material has not been determined.

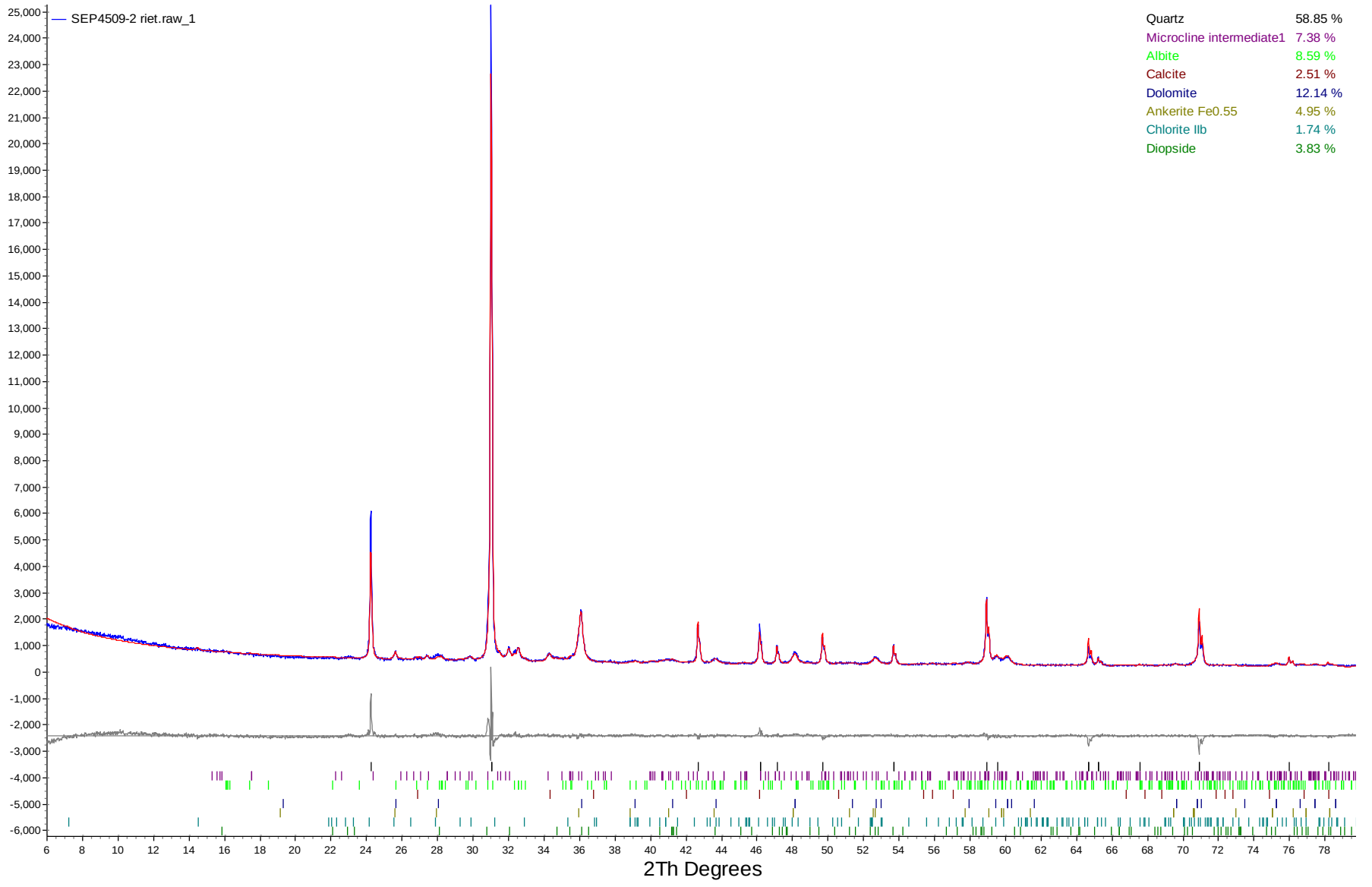
Mineral/Compound	Formula
Quartz	SiO_2
Microcline	$KAlSi_3O_8$
Albite	$NaAlSi_3O_8$
Calcite	$CaCO_3$
Dolomite	$CaMg(CO_3)_2$
Ankerite	$CaFe(CO_3)_2$
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$
Diopside	$CaMgSi_2O_6$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$

SB-306-(14-16)



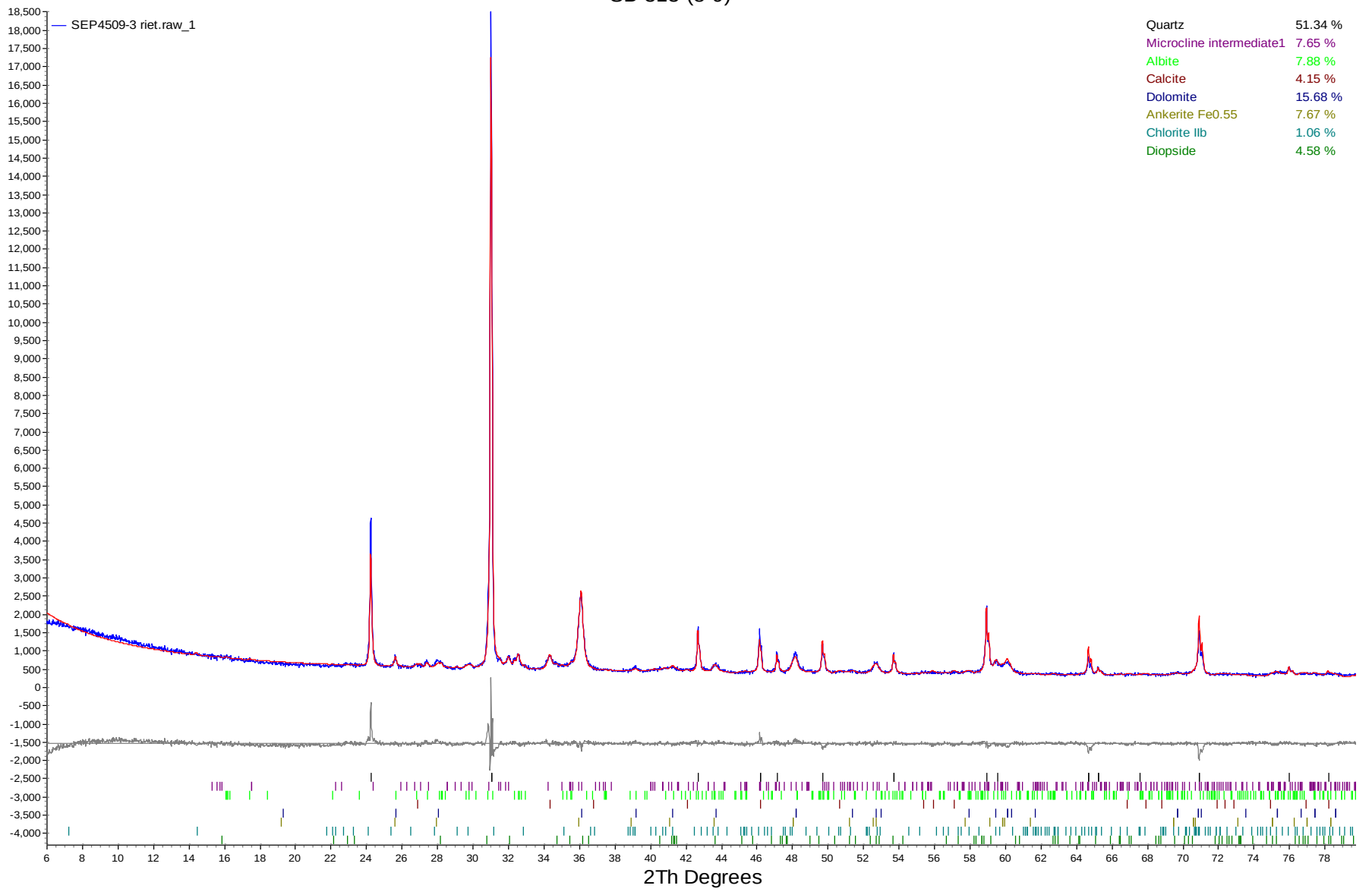
Quartz	70.87 %
Microcline intermediate1	8.52 %
Albite	9.57 %
Calcite	0.53 %
Dolomite	3.55 %
Ankerite Fe0.55	2.06 %
Chlorite IIb	1.84 %
Diopside	3.06 %

SB-311-(14-15)



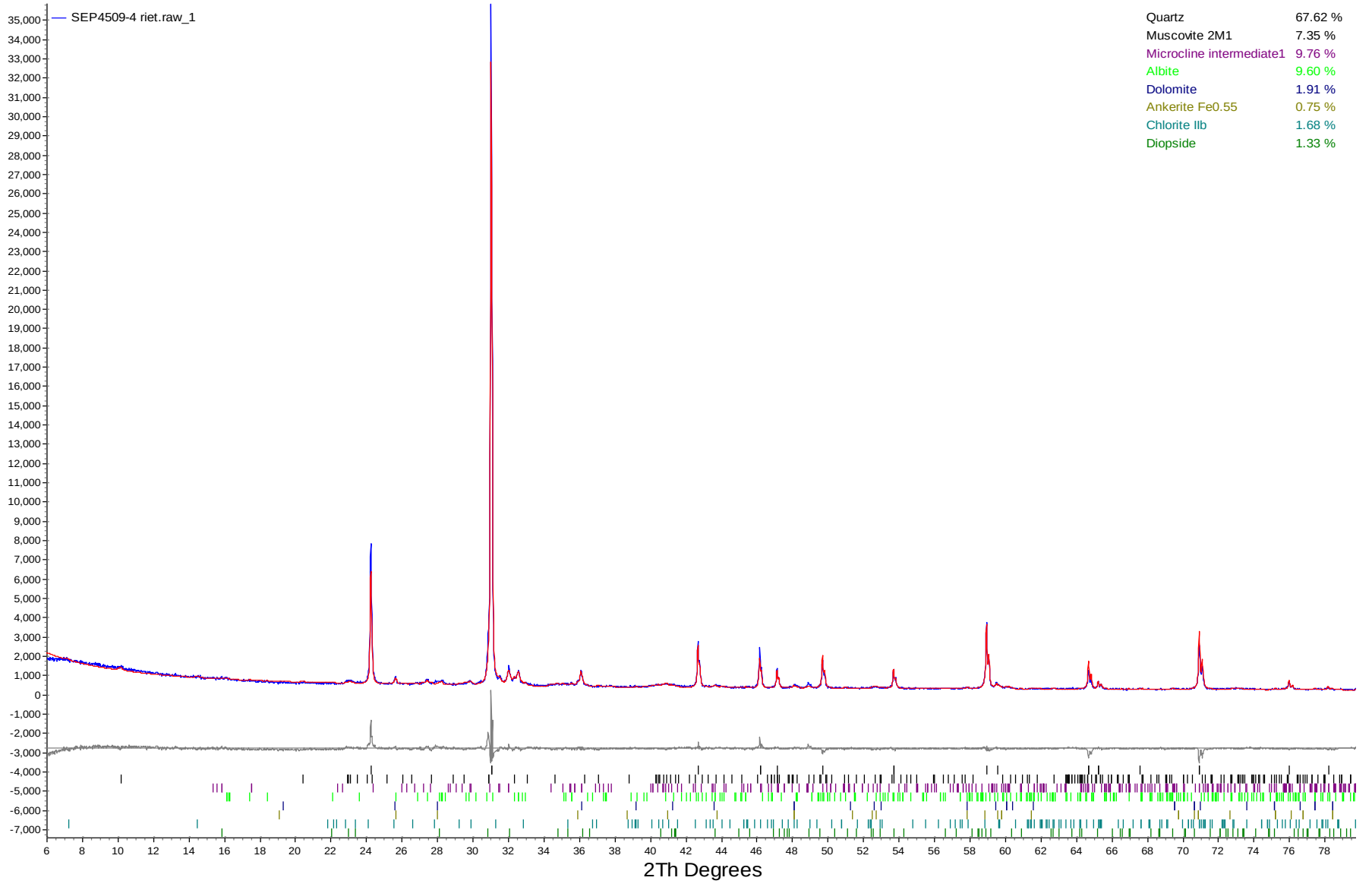
Quartz	58.85 %
Microcline intermediate1	7.38 %
Albite	8.59 %
Calcite	2.51 %
Dolomite	12.14 %
Ankerite Fe0.55	4.95 %
Chlorite IIb	1.74 %
Diopside	3.83 %

SB-313-(8-9)



Quartz	51.34 %
Microcline intermediate1	7.65 %
Albite	7.88 %
Calcite	4.15 %
Dolomite	15.68 %
Ankerite Fe0.55	7.67 %
Chlorite IIb	1.06 %
Diopside	4.58 %

SB-316-(13-14,15-16)



Quartz	67.62 %
Muscovite 2M1	7.35 %
Microcline intermediate1	9.76 %
Albite	9.60 %
Dolomite	1.91 %
Ankerite Fe0.55	0.75 %
Chlorite IIb	1.68 %
Diopside	1.33 %

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*Environmental Services*
Project Number/ LIMS No.	*Custom XRD/MI4528-AUG23*
Sample Receipt:	*August 10, 2023*
Sample Analysis:	*August 31, 2023*
Reporting Date:	*September 15, 2023*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 35 kV, 40 mA; Detector: LYNXEYE Regular Scanning: Step: 0.02°, Step time: 0.75s, 2θ range: 6-80° Clay Section Scanning: Step: 0.01°, Step time:0.2s, 2θ range: 3-40°
Interpretations :	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit :	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Quantitative XRD Results
3) XRD Pattern(s)

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

ACCREDITATION: SGS Natural Resources Lakefield is accredited to the requirements of ISO/IEC 17025 for specific tests as listed on our scope of accreditation, including geochemical, mineralogical and trade mineral tests. To view a list of the accredited methods, please visit the following website and search SGS Canada Inc. - Minerals: https://www.scc.ca/en/search/palcan.

Method Summary

The Rietveld Method of Mineral Identification by XRD (ME-LR-MIN-MET-MN-D05) method used by SGS Natural Resources is accredited to the requirements of ISO/IEC 17025.

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Clay Mineral Separation and Identification:

Clay minerals are typically fine-grained (<2 µm) phyllosilicates in sedimentary rock. Due to the poor crystallinity and fine size of clay minerals, separation of the clay fraction from bulk samples by centrifuge is required. A slide of the oriented clay fraction is prepared and scanned followed by a series of procedures (the addition of ethylene glycol and high temperature heating). Clay minerals are identified by their individual diffraction patterns and changes in their diffraction pattern after different treatments. Clay speciation and mineral identification of the bulk sample are performed using DIFFRACplus EVA (Bruker AXS).

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

DISCLAIMER: This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

WARNING: The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

Summary of Rietveld Quantitative Analysis X-Ray Diffraction Results

Mineral/Compound	COF1-13-18-20230619 AUG4528-01 (wt %)	COF1-18-23-20230619 AUG4528-02 (wt %)	COF1-38-43-20230619 AUG4528-03 (wt %)	COF2-10-13-20230619 AUG4528-04 (wt %)	COF3-11-12-20230619 AUG4528-05 (wt %)	COF3-12.5-13-20230619 AUG4528-06 (wt %)
Quartz	53.9	67.5	73.5	51.2	50.7	50.5
Chlorite	1.6	1.7	1.5	3.0	3.9	3.2
Albite	6.1	8.3	8.2	6.8	7.4	7.5
Microcline	5.1	9.7	7.8	7.2	5.9	5.8
Calcite	4.1	0.4	-	2.4	2.6	2.8
Ankerite	7.2	1.2	0.5	9.4	8.4	8.1
Dolomite	13.3	0.5	0.0	6.0	7.6	8.1
Actinolite	0.3	0.7	0.8	0.5	0.6	0.6
Diopside	1.0	0.7	0.7	0.4	0.5	0.7
Kutnohorite	0.5	0.3	0.2	0.1	-	0.2
Muscovite	1.0	4.8	3.3	5.5	4.4	4.3
Magnetite	-	0.2	0.0	0.1	0.1	0.2
Clay	-	-	-	-	-	-
Illite	4.0	2.0	1.7	3.3	3.0	2.9
Montmorillonite	1.1	1.0	1.1	3.2	3.2	2.9
Kaolinite	0.7	1.1	0.7	0.9	0.6	0.6
Illite-Montmorillonite	-	-	-	-	1.3	1.7
TOTAL	100	100	100	100	100	100

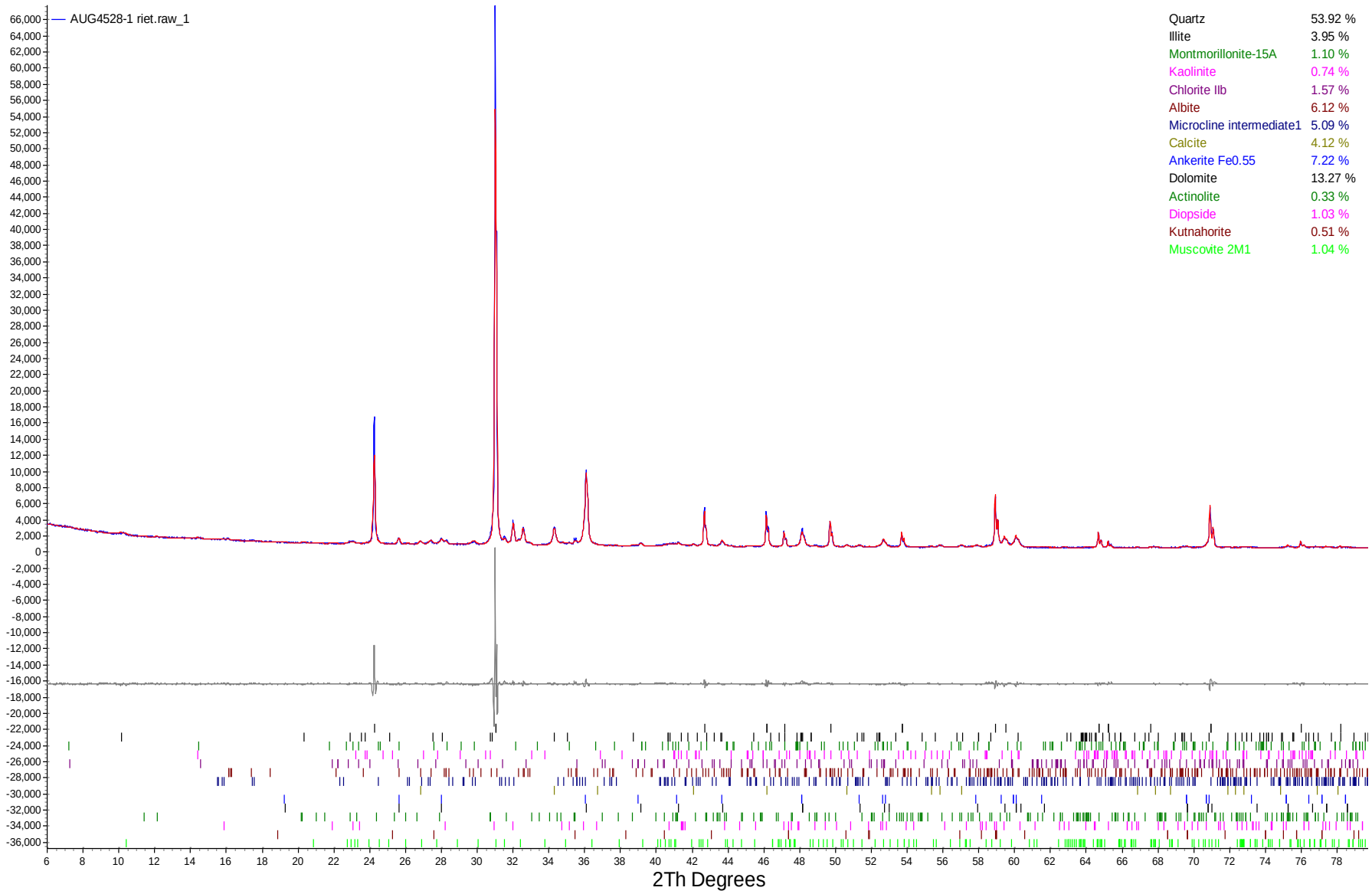
Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identified by the analyst and not included in the refinement calculation for the sample.

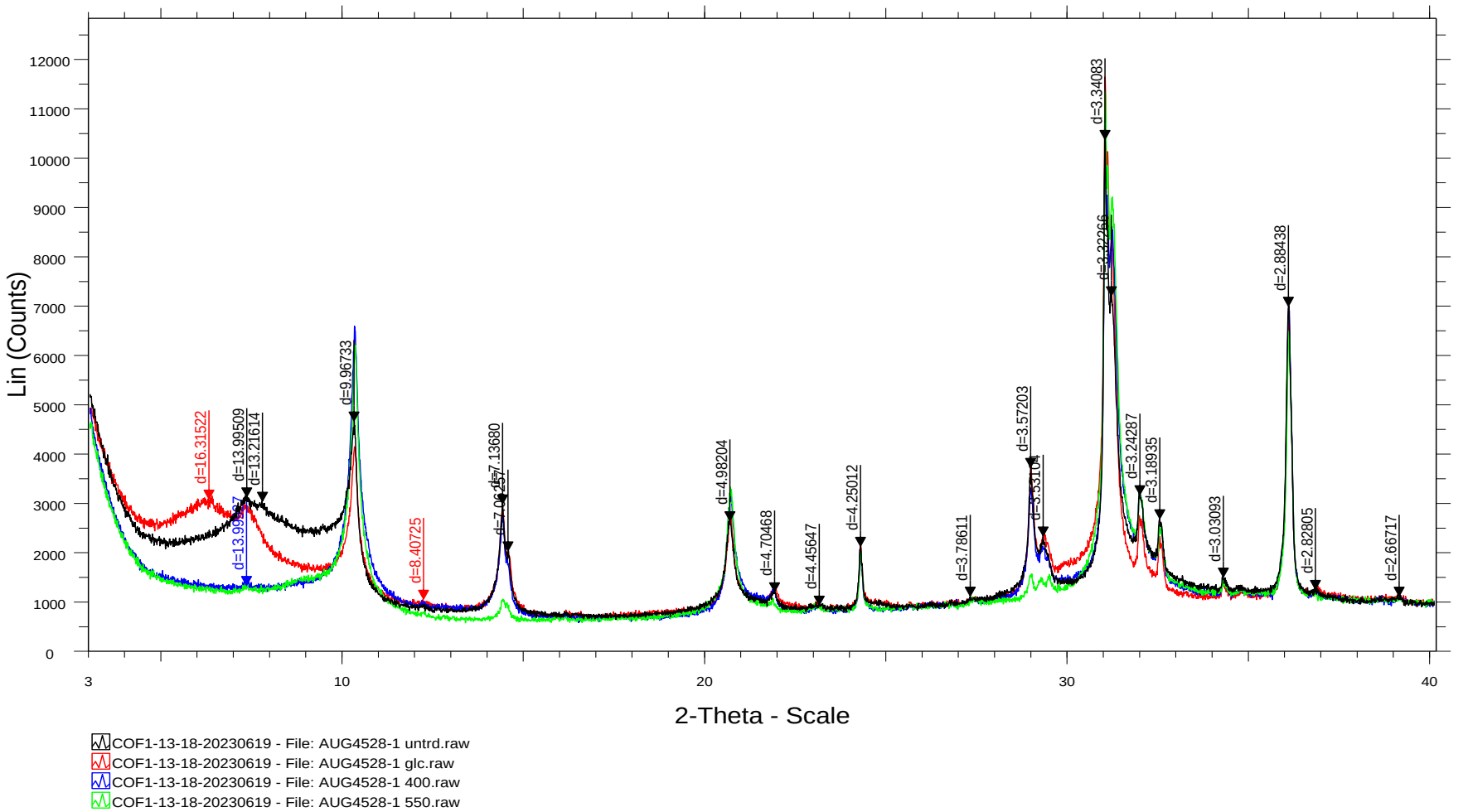
The weight percent quantities indicated have been normalized to a sum of 100%. The quantity of amorphous material has not been determined.

Mineral/Compound	Formula
Quartz	SiO_2
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$
Albite	$NaAlSi_3O_8$
Microcline	$KAlSi_3O_8$
Calcite	$CaCO_3$
Ankerite	$CaFe(CO_3)_2$
Dolomite	$CaMg(CO_3)_2$
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$
Diopside	$CaMgSi_2O_6$
Kutnohorite	$CaMn(CO_3)_2$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Magnetite	Fe_3O_4
Illite	$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$
Montmorillonite	$(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2 \cdot 10H_2O$
Kaolinite	$Al_2Si_2O_5(OH)_4$
Illite-Montmorillonite	$KAl_4(Si,Al)_8O_{20}(OH)_4 \cdot 8H_2O$

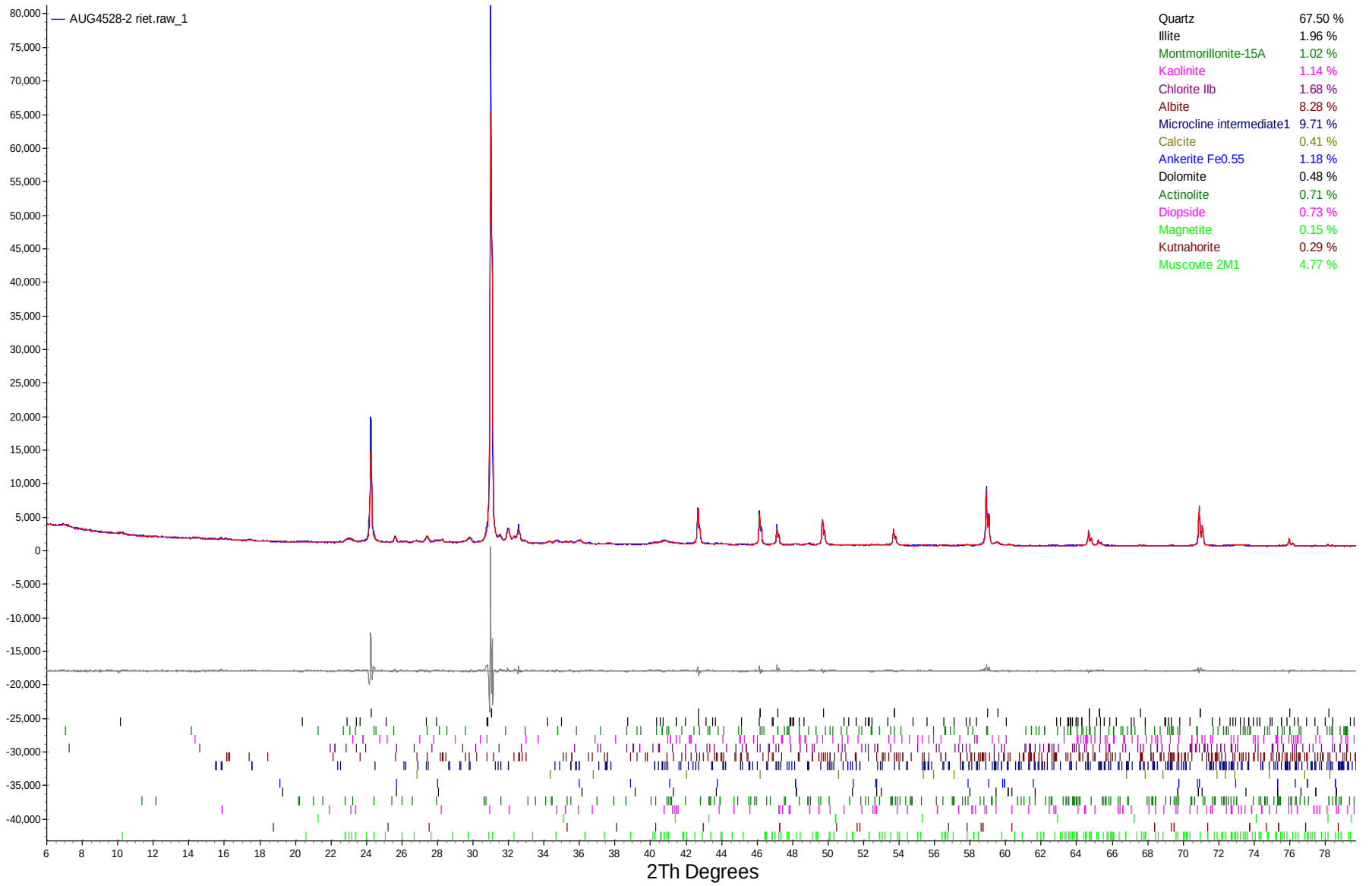
COF1-13-18-20230619



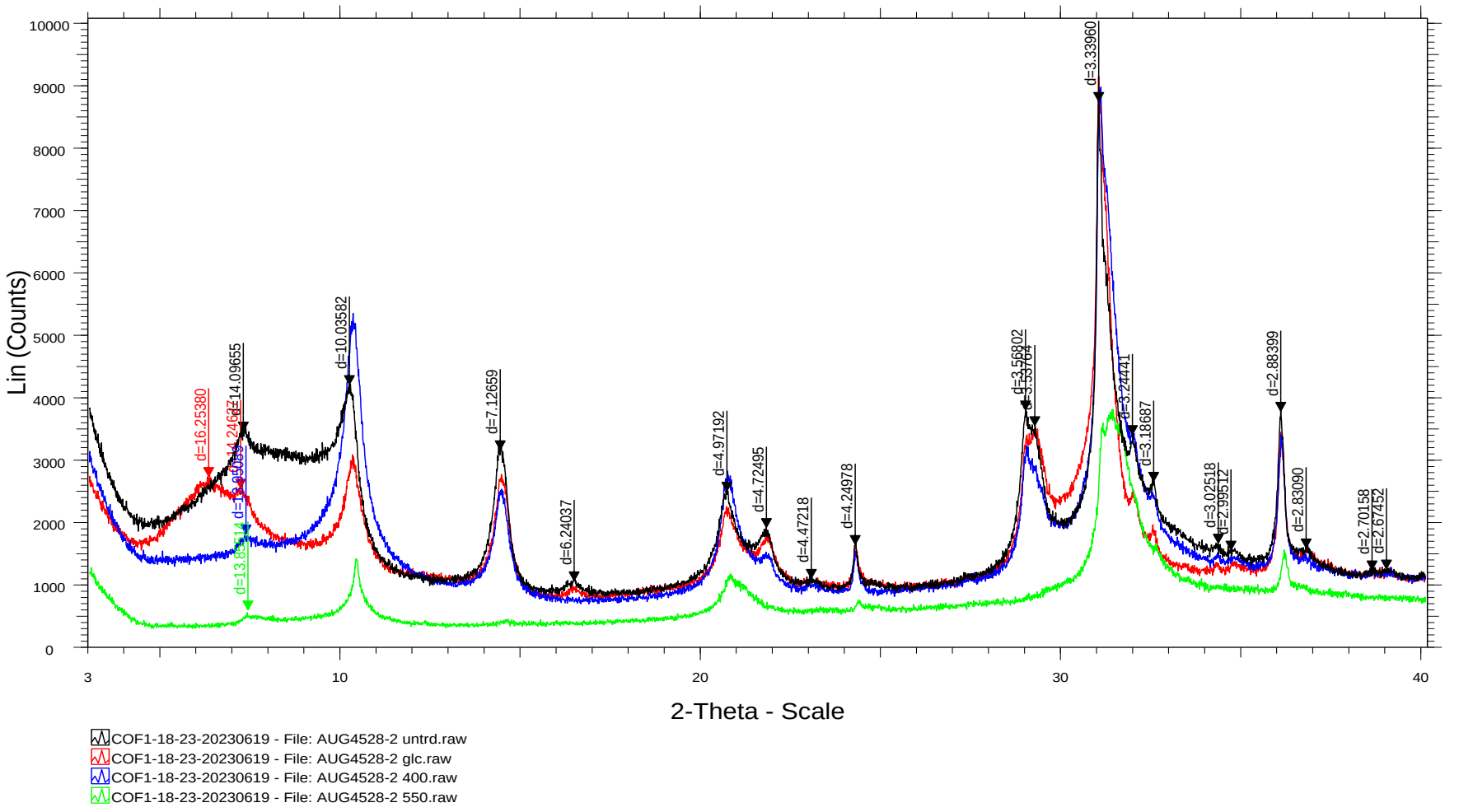
COF1-13-18-20230619



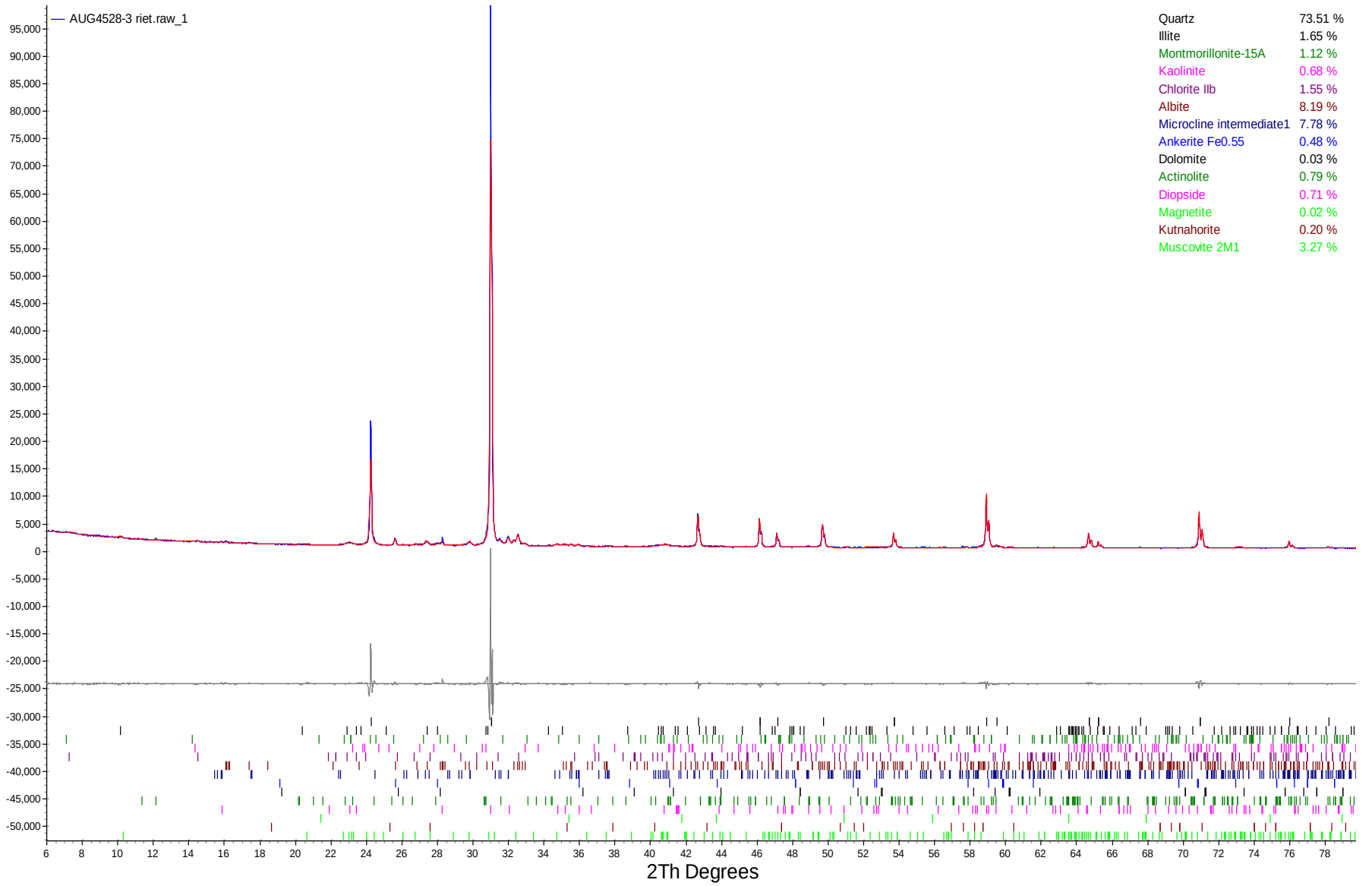
COF1-18-23-20230619



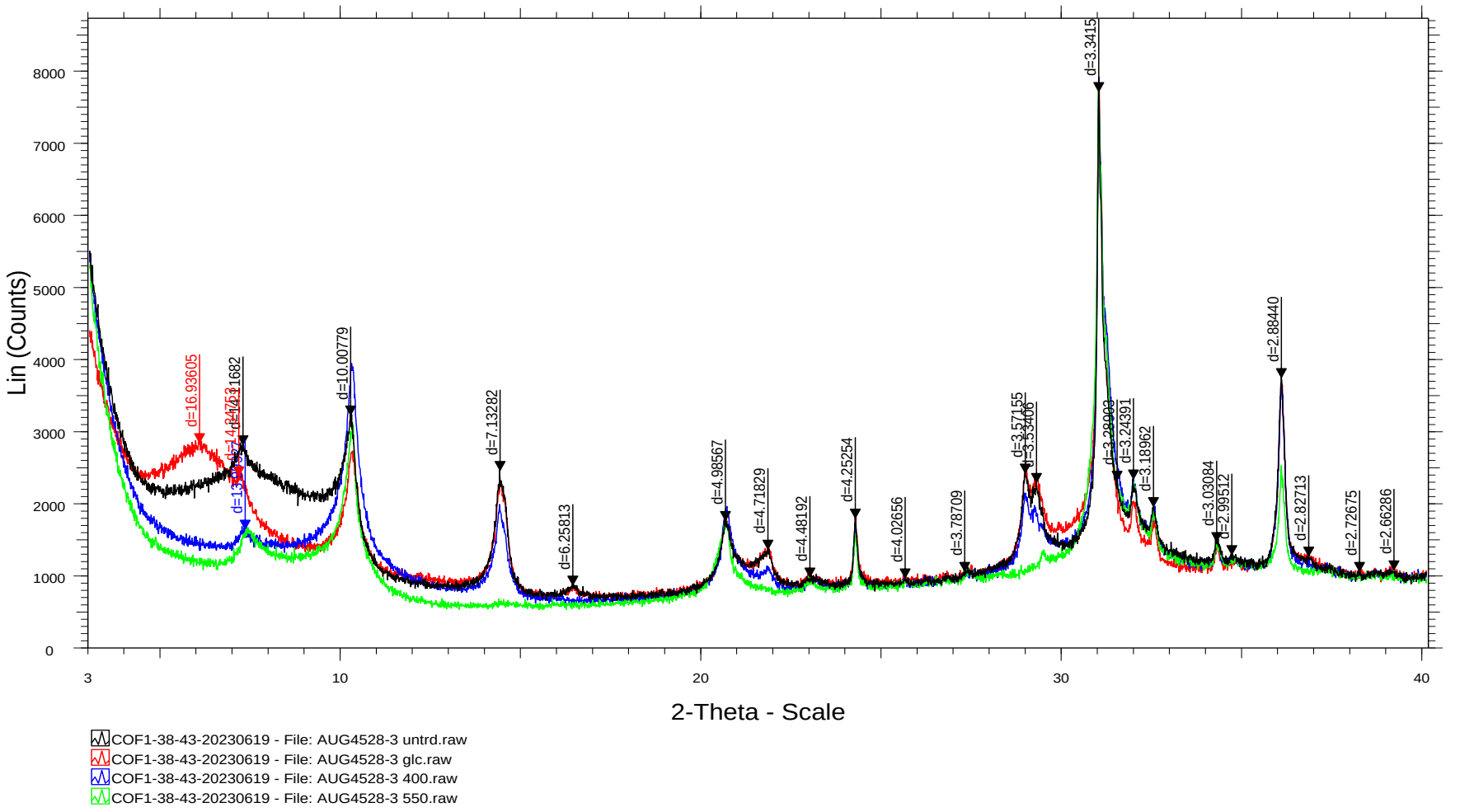
COF1-18-23-20230619



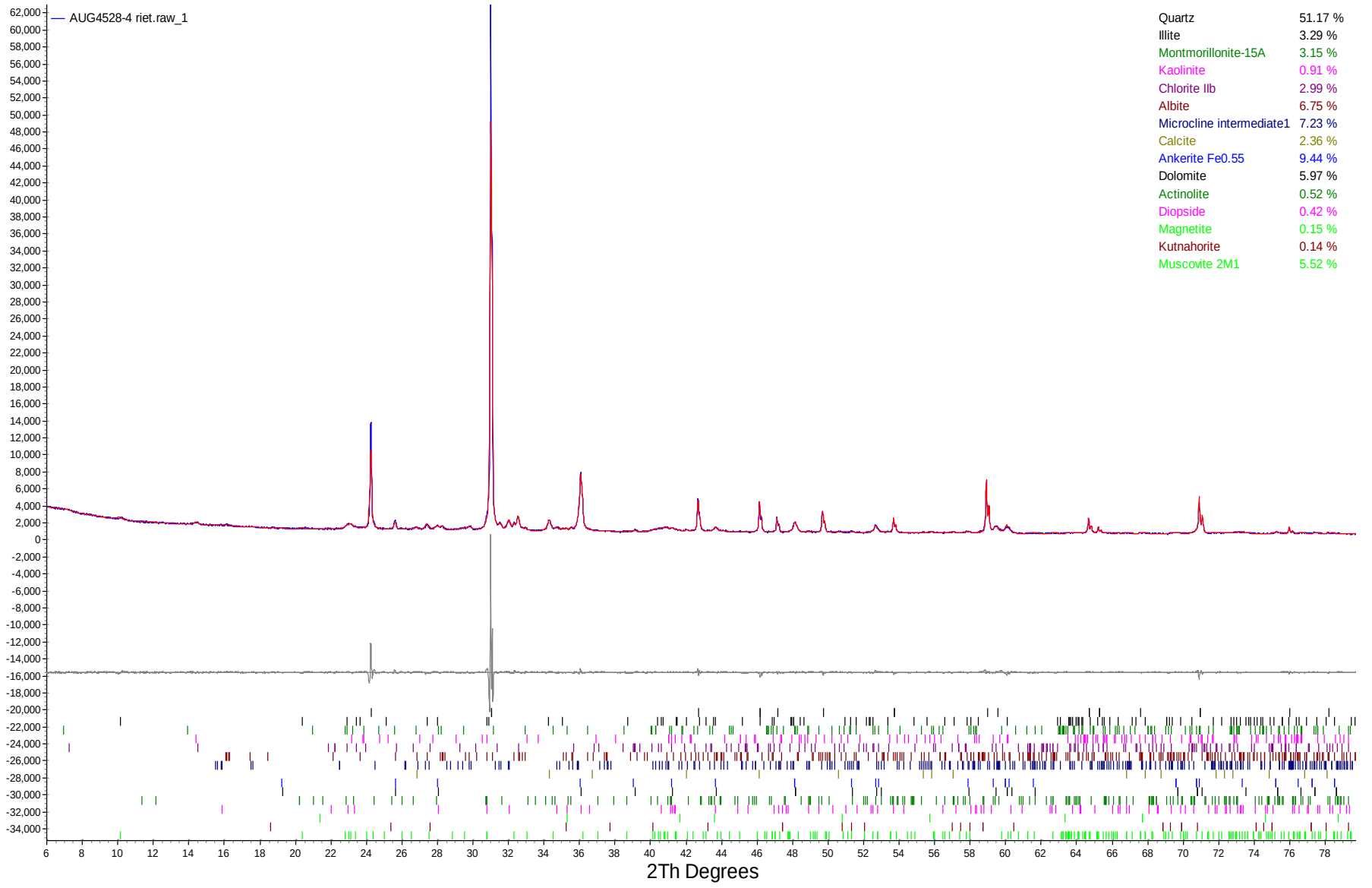
COF1-38-43-20230619



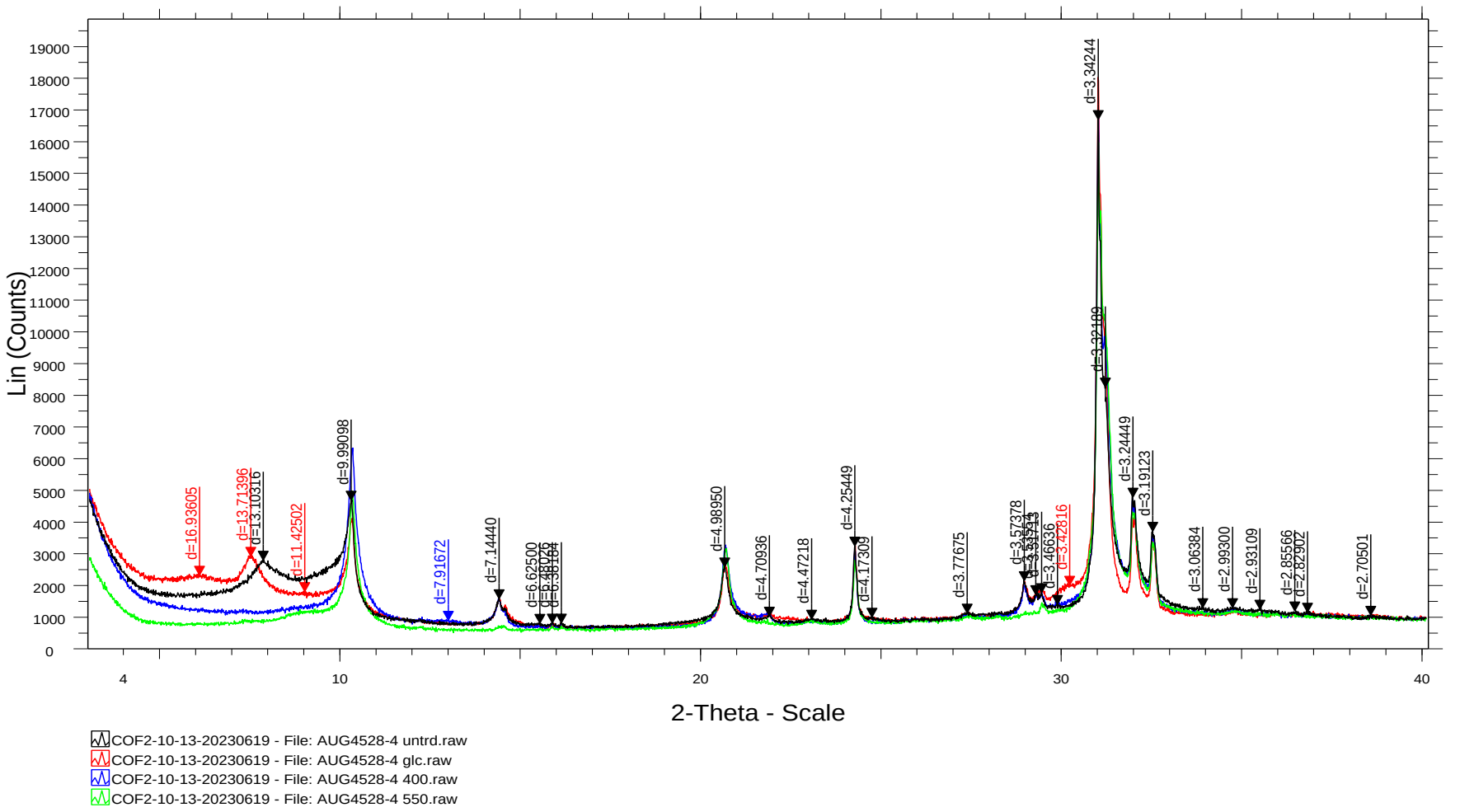
COF1-38-43-20230619



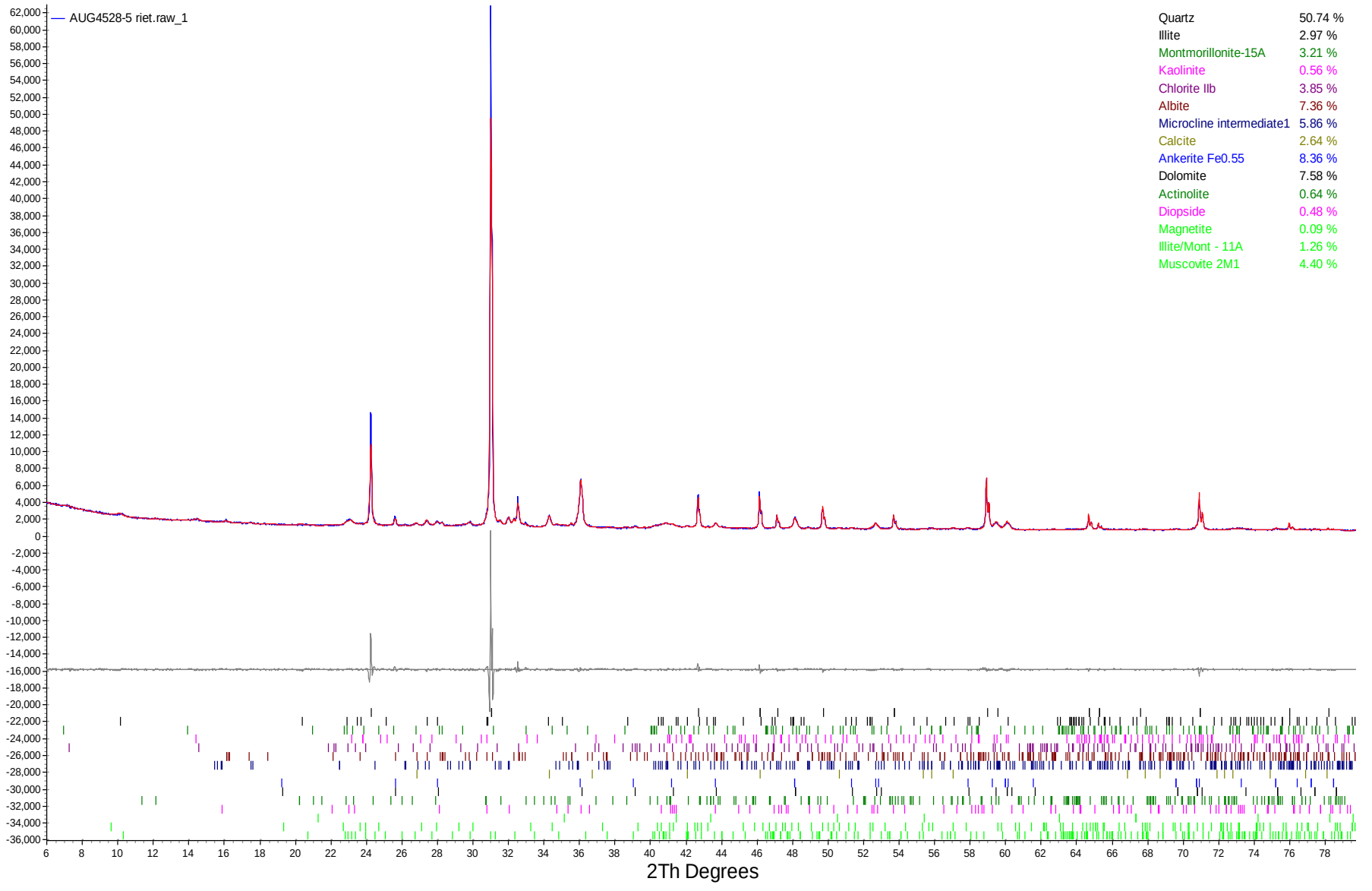
COF2-10-13-20230619



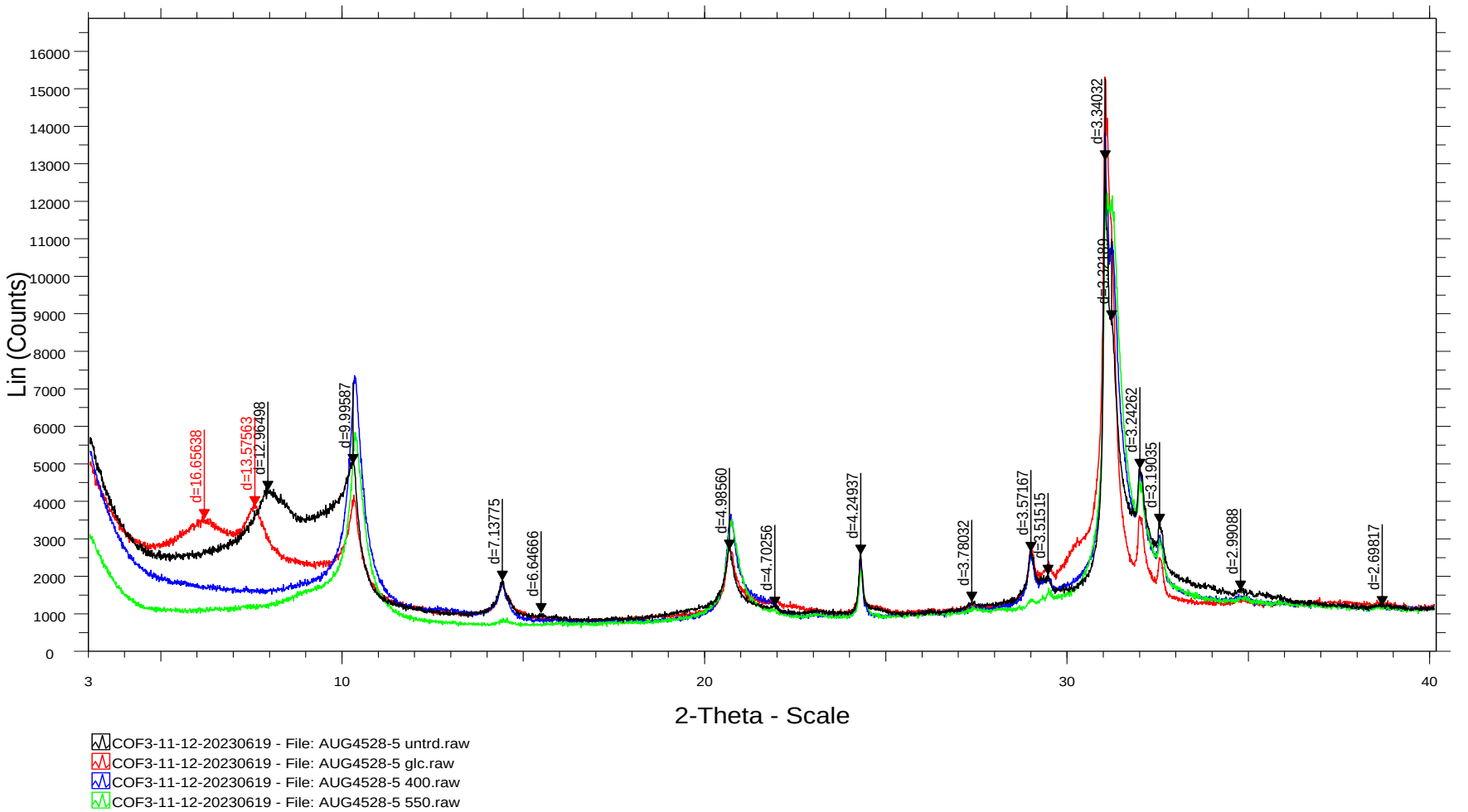
COF2-10-13-20230619



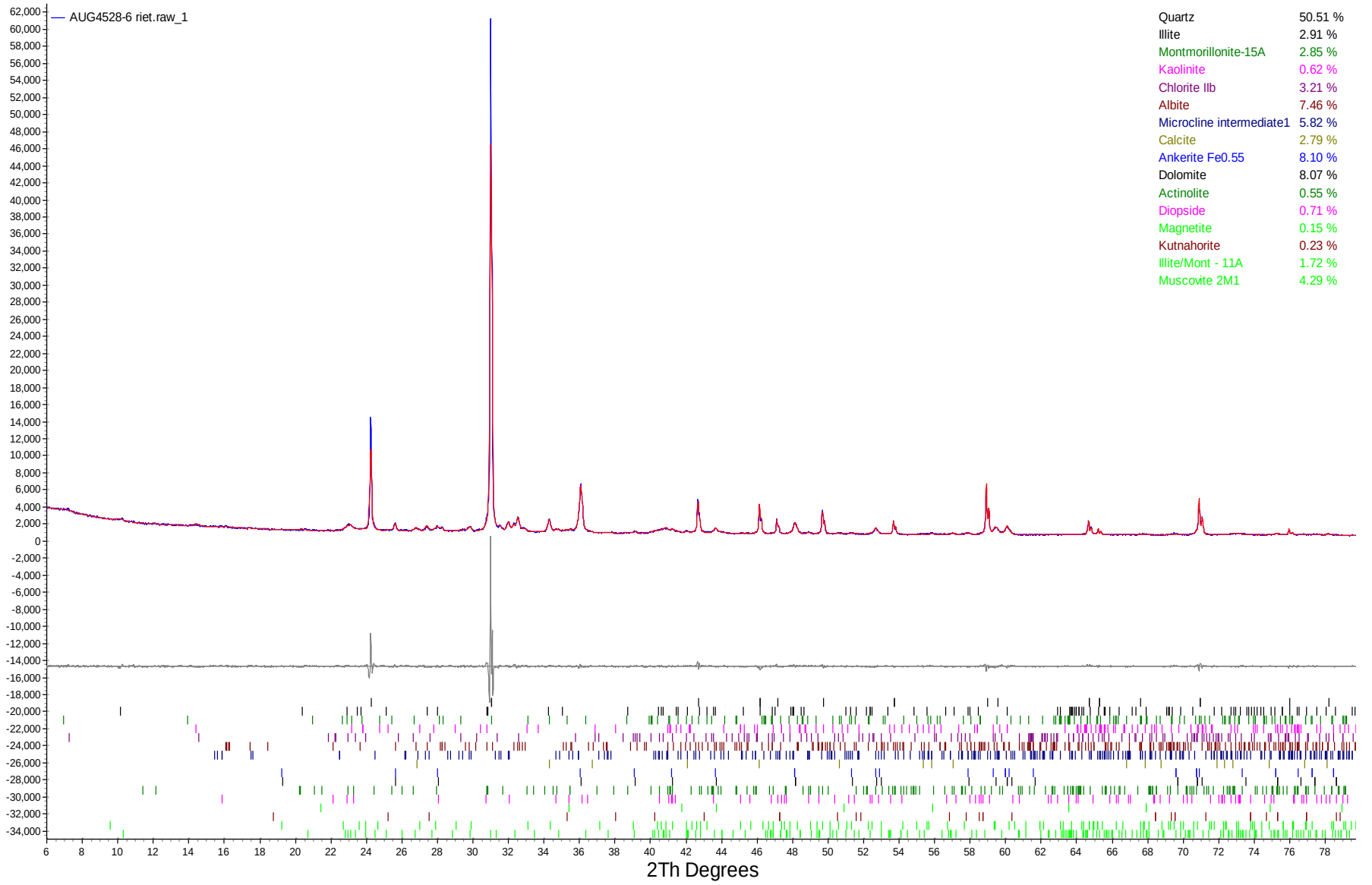
COF3-11-12-20230619



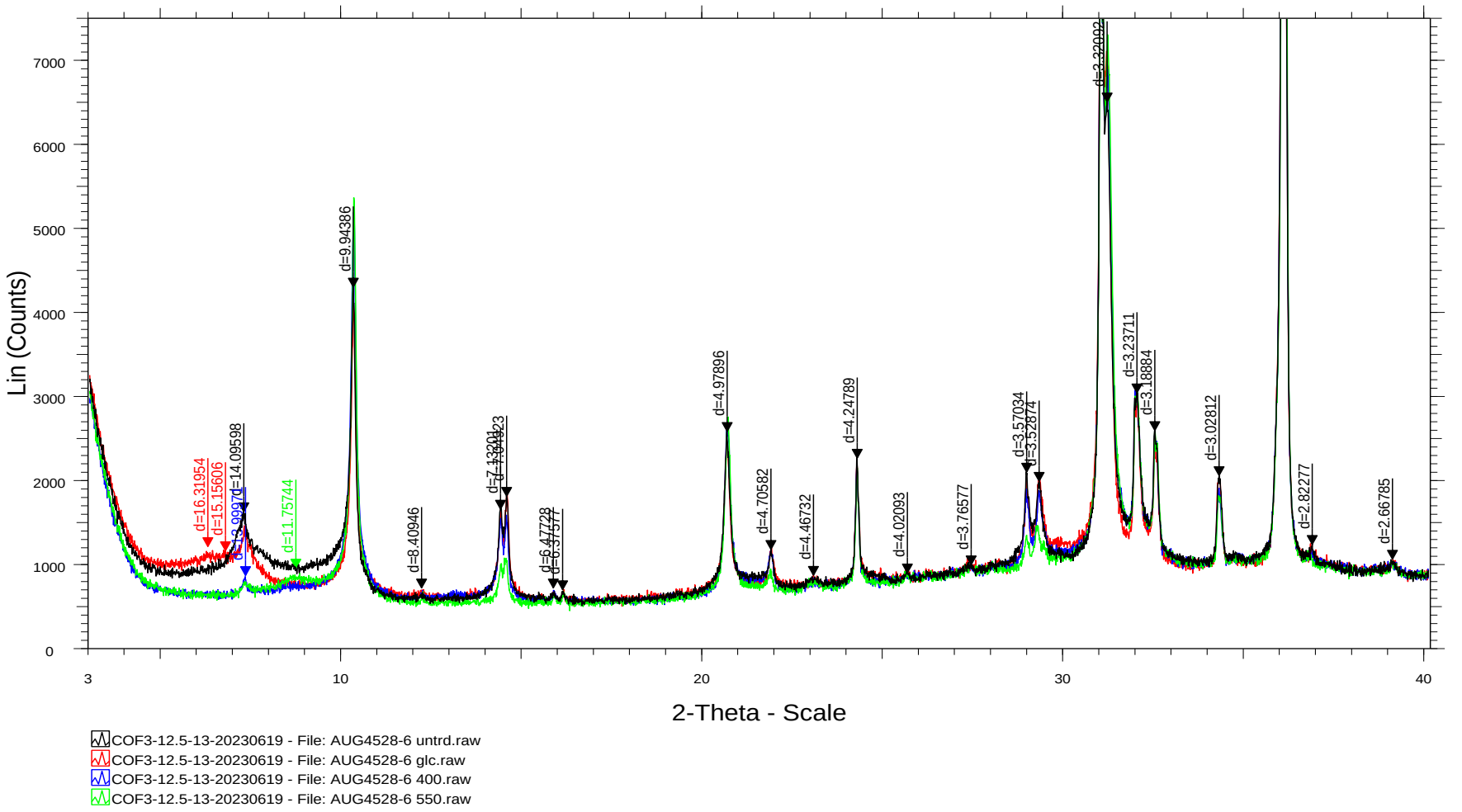
COF3-11-12-20230619



COF3-12.5-13-20230619



COF3-12.5-13-20230619



Attachment H
Site Evaluation Groundwater Data

Attachment H. Site Evaluation Groundwater Data
Geochemical Conceptual Site Model
Coffeen Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

HSU	Location	Well Type	Date	Parameter	Unit	Result
LCU	G1001	C	2023/02/15	pH (field)	SU	6.8
LCU	G1001	C	2023/06/07	pH (field)	SU	7.0
LCU	G1001	C	2023/11/14	pH (field)	SU	7.0
LCU	G1001	C	2023/02/15	Oxidation Reduction Potential	mV	159
LCU	G1001	C	2023/06/07	Oxidation Reduction Potential	mV	111
LCU	G1001	C	2023/11/14	Oxidation Reduction Potential	mV	<-300
LCU	G1001	C	2023/02/15	Eh	V	0.36
LCU	G1001	C	2023/06/07	Eh	V	0.30
LCU	G1001	C	2023/11/14	Eh	V	-0.11
LCU	G1001	C	2021/05/12	Alkalinity, bicarbonate	mg/L CaCO3	720
LCU	G1001	C	2023/02/15	Alkalinity, bicarbonate	mg/L CaCO3	620
LCU	G1001	C	2023/06/07	Alkalinity, bicarbonate	mg/L CaCO3	580
LCU	G1001	C	2023/11/14	Alkalinity, bicarbonate	mg/L CaCO3	605
LCU	G1001	C	2023/02/15	Barium, total	mg/L	0.200
LCU	G1001	C	2023/06/07	Barium, total	mg/L	0.0710
LCU	G1001	C	2023/11/14	Barium, total	mg/L	0.0917
LCU	G1001	C	2021/05/12	Boron, total	mg/L	1.40
LCU	G1001	C	2023/02/15	Boron, total	mg/L	0.720
LCU	G1001	C	2023/06/07	Boron, total	mg/L	0.950
LCU	G1001	C	2023/11/14	Boron, total	mg/L	1.10
LCU	G1001	C	2021/05/12	Calcium, total	mg/L	160
LCU	G1001	C	2023/02/15	Calcium, total	mg/L	430
LCU	G1001	C	2023/06/07	Calcium, total	mg/L	140
LCU	G1001	C	2023/11/14	Calcium, total	mg/L	131
LCU	G1001	C	2021/05/12	Chloride, total	mg/L	29.0
LCU	G1001	C	2023/02/15	Chloride, total	mg/L	36.0
LCU	G1001	C	2023/06/07	Chloride, total	mg/L	15.0
LCU	G1001	C	2023/11/14	Chloride, total	mg/L	16.0
LCU	G1001	C	2021/05/12	Cobalt, total	mg/L	0.000200
LCU	G1001	C	2023/02/15	Cobalt, total	mg/L	0.0490
LCU	G1001	C	2023/06/07	Cobalt, total	mg/L	<0.00048
LCU	G1001	C	2023/11/14	Cobalt, total	mg/L	0.00190
LCU	G1001	C	2023/06/07	Ferrous Iron, dissolved	mg/L	0.0450
LCU	G1001	C	2021/05/12	Iron, dissolved	mg/L	0.0170
LCU	G1001	C	2023/06/07	Iron, dissolved	mg/L	<0.00072
LCU	G1001	C	2021/05/12	Magnesium, total	mg/L	85.0
LCU	G1001	C	2023/02/15	Magnesium, total	mg/L	160
LCU	G1001	C	2023/06/07	Magnesium, total	mg/L	65.0
LCU	G1001	C	2023/11/14	Magnesium, total	mg/L	61.0
LCU	G1001	C	2021/05/12	Manganese, dissolved	mg/L	0.230
LCU	G1001	C	2023/06/07	Manganese, dissolved	mg/L	0.140
LCU	G1001	C	2021/05/12	Potassium, total	mg/L	6.70
LCU	G1001	C	2023/02/15	Potassium, total	mg/L	6.70
LCU	G1001	C	2023/06/07	Potassium, total	mg/L	2.50
LCU	G1001	C	2023/11/14	Potassium, total	mg/L	2.24
LCU	G1001	C	2023/06/07	Silicon, dissolved	mg/L	8.40
LCU	G1001	C	2021/05/12	Sodium, total	mg/L	34.0
LCU	G1001	C	2023/02/15	Sodium, total	mg/L	67.0
LCU	G1001	C	2023/06/07	Sodium, total	mg/L	94.0
LCU	G1001	C	2023/11/14	Sodium, total	mg/L	84.6
LCU	G1001	C	2021/05/12	Sulfate, total	mg/L	140
LCU	G1001	C	2023/02/15	Sulfate, total	mg/L	630
LCU	G1001	C	2023/06/07	Sulfate, total	mg/L	180
LCU	G1001	C	2023/11/14	Sulfate, total	mg/L	291
LCU	G1001	C	2023/02/15	Temperature (Celsius)	degrees C	10.2
LCU	G1001	C	2023/06/07	Temperature (Celsius)	degrees C	19.1

LCU	G1001	C	2023/11/14	Temperature (Celsius)	degrees C	16.7
LCU	G1001	C	2023/02/15	Total Dissolved Solids	mg/L	1,700
LCU	G1001	C	2023/06/07	Total Dissolved Solids	mg/L	830
LCU	G1001	C	2023/11/14	Total Dissolved Solids	mg/L	900
UA	G270	B	2015/01/20	pH (field)	SU	7.4
UA	G270	B	2015/04/13	pH (field)	SU	6.9
UA	G270	B	2015/07/22	pH (field)	SU	7.4
UA	G270	B	2015/10/05	pH (field)	SU	7.2
UA	G270	B	2015/11/20	pH (field)	SU	6.8
UA	G270	B	2016/02/10	pH (field)	SU	6.7
UA	G270	B	2016/05/12	pH (field)	SU	7.0
UA	G270	B	2016/08/01	pH (field)	SU	7.0
UA	G270	B	2016/11/16	pH (field)	SU	7.1
UA	G270	B	2017/02/10	pH (field)	SU	7.1
UA	G270	B	2017/05/16	pH (field)	SU	7.2
UA	G270	B	2017/07/12	pH (field)	SU	7.0
UA	G270	B	2017/10/25	pH (field)	SU	7.1
UA	G270	B	2018/05/11	pH (field)	SU	7.1
UA	G270	B	2018/08/03	pH (field)	SU	7.1
UA	G270	B	2019/01/21	pH (field)	SU	7.0
UA	G270	B	2019/08/15	pH (field)	SU	7.1
UA	G270	B	2020/01/24	pH (field)	SU	7.3
UA	G270	B	2020/08/12	pH (field)	SU	7.1
UA	G270	B	2020/10/14	pH (field)	SU	6.8
UA	G270	B	2021/01/21	pH (field)	SU	7.1
UA	G270	B	2021/03/30	pH (field)	SU	7.1
UA	G270	B	2021/04/21	pH (field)	SU	7.1
UA	G270	B	2021/05/06	pH (field)	SU	7.0
UA	G270	B	2021/05/19	pH (field)	SU	7.2
UA	G270	B	2021/06/15	pH (field)	SU	7.0
UA	G270	B	2021/06/29	pH (field)	SU	7.0
UA	G270	B	2021/07/12	pH (field)	SU	7.2
UA	G270	B	2021/07/27	pH (field)	SU	7.2
UA	G270	B	2021/08/18	pH (field)	SU	7.1
UA	G270	B	2021/10/26	pH (field)	SU	7.0
UA	G270	B	2022/02/08	pH (field)	SU	7.2
UA	G270	B	2022/05/10	pH (field)	SU	6.9
UA	G270	B	2022/08/24	pH (field)	SU	7.3
UA	G270	B	2022/11/08	pH (field)	SU	7.4
UA	G270	B	2023/02/16	pH (field)	SU	7.5
UA	G270	B	2023/06/08	pH (field)	SU	6.6
UA	G270	B	2023/08/14	pH (field)	SU	6.8
UA	G270	B	2023/11/17	pH (field)	SU	7.1
UA	G270	B	2015/11/20	Oxidation Reduction Potential	mV	-32.0
UA	G270	B	2016/02/10	Oxidation Reduction Potential	mV	180
UA	G270	B	2016/05/12	Oxidation Reduction Potential	mV	81.0
UA	G270	B	2016/08/01	Oxidation Reduction Potential	mV	72.0
UA	G270	B	2016/11/16	Oxidation Reduction Potential	mV	56.0
UA	G270	B	2017/02/10	Oxidation Reduction Potential	mV	56.0
UA	G270	B	2017/05/16	Oxidation Reduction Potential	mV	71.0
UA	G270	B	2017/07/12	Oxidation Reduction Potential	mV	63.0
UA	G270	B	2017/10/25	Oxidation Reduction Potential	mV	62.0
UA	G270	B	2018/05/11	Oxidation Reduction Potential	mV	58.0
UA	G270	B	2018/08/03	Oxidation Reduction Potential	mV	68.0
UA	G270	B	2019/01/21	Oxidation Reduction Potential	mV	75.0
UA	G270	B	2019/08/15	Oxidation Reduction Potential	mV	73.0
UA	G270	B	2020/01/24	Oxidation Reduction Potential	mV	151
UA	G270	B	2020/08/12	Oxidation Reduction Potential	mV	161
UA	G270	B	2020/10/14	Oxidation Reduction Potential	mV	168
UA	G270	B	2021/01/21	Oxidation Reduction Potential	mV	196
UA	G270	B	2021/03/30	Oxidation Reduction Potential	mV	118
UA	G270	B	2021/04/21	Oxidation Reduction Potential	mV	162
UA	G270	B	2021/05/19	Oxidation Reduction Potential	mV	67.5

UA	G270	B	2021/06/15	Oxidation Reduction Potential	mV	83.7
UA	G270	B	2021/06/29	Oxidation Reduction Potential	mV	50.0
UA	G270	B	2021/07/12	Oxidation Reduction Potential	mV	120
UA	G270	B	2021/07/27	Oxidation Reduction Potential	mV	89.3
UA	G270	B	2021/08/18	Oxidation Reduction Potential	mV	150
UA	G270	B	2021/10/26	Oxidation Reduction Potential	mV	7.60
UA	G270	B	2022/02/08	Oxidation Reduction Potential	mV	101
UA	G270	B	2022/05/10	Oxidation Reduction Potential	mV	36.3
UA	G270	B	2022/08/24	Oxidation Reduction Potential	mV	109
UA	G270	B	2022/11/08	Oxidation Reduction Potential	mV	29.2
UA	G270	B	2023/02/16	Oxidation Reduction Potential	mV	171
UA	G270	B	2023/06/08	Oxidation Reduction Potential	mV	61.0
UA	G270	B	2023/08/14	Oxidation Reduction Potential	mV	78.0
UA	G270	B	2023/11/17	Oxidation Reduction Potential	mV	98.0
UA	G270	B	2015/11/20	Eh	V	0.16
UA	G270	B	2016/02/10	Eh	V	0.38
UA	G270	B	2016/05/12	Eh	V	0.28
UA	G270	B	2016/08/01	Eh	V	0.27
UA	G270	B	2016/11/16	Eh	V	0.25
UA	G270	B	2017/02/10	Eh	V	0.25
UA	G270	B	2017/05/16	Eh	V	0.27
UA	G270	B	2017/07/12	Eh	V	0.26
UA	G270	B	2017/10/25	Eh	V	0.26
UA	G270	B	2018/05/11	Eh	V	0.25
UA	G270	B	2018/08/03	Eh	V	0.26
UA	G270	B	2019/01/21	Eh	V	0.27
UA	G270	B	2019/08/15	Eh	V	0.27
UA	G270	B	2020/01/24	Eh	V	0.35
UA	G270	B	2020/08/12	Eh	V	0.35
UA	G270	B	2020/10/14	Eh	V	0.36
UA	G270	B	2021/01/21	Eh	V	0.39
UA	G270	B	2021/03/30	Eh	V	0.32
UA	G270	B	2021/04/21	Eh	V	0.36
UA	G270	B	2021/05/19	Eh	V	0.26
UA	G270	B	2021/06/15	Eh	V	0.28
UA	G270	B	2021/06/29	Eh	V	0.24
UA	G270	B	2021/07/12	Eh	V	0.31
UA	G270	B	2021/07/27	Eh	V	0.28
UA	G270	B	2021/08/18	Eh	V	0.34
UA	G270	B	2022/02/08	Eh	V	0.30
UA	G270	B	2022/05/10	Eh	V	0.23
UA	G270	B	2022/08/24	Eh	V	0.30
UA	G270	B	2022/11/08	Eh	V	0.22
UA	G270	B	2023/02/16	Eh	V	0.37
UA	G270	B	2023/06/08	Eh	V	0.26
UA	G270	B	2023/08/14	Eh	V	0.27
UA	G270	B	2023/11/17	Eh	V	0.29
UA	G270	B	2015/01/20	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G270	B	2015/04/13	Alkalinity, bicarbonate	mg/L CaCO3	310
UA	G270	B	2016/11/16	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G270	B	2017/05/16	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G270	B	2017/07/12	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G270	B	2020/01/24	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G270	B	2020/08/12	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G270	B	2021/01/21	Alkalinity, bicarbonate	mg/L CaCO3	320
UA	G270	B	2021/03/30	Alkalinity, bicarbonate	mg/L CaCO3	320
UA	G270	B	2021/04/21	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G270	B	2021/05/06	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G270	B	2021/05/19	Alkalinity, bicarbonate	mg/L CaCO3	310
UA	G270	B	2021/06/15	Alkalinity, bicarbonate	mg/L CaCO3	310
UA	G270	B	2021/06/29	Alkalinity, bicarbonate	mg/L CaCO3	310
UA	G270	B	2021/07/12	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G270	B	2021/07/27	Alkalinity, bicarbonate	mg/L CaCO3	320

UA	G270	B	2021/08/18	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G270	B	2022/02/08	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G270	B	2022/08/24	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G270	B	2023/02/16	Alkalinity, bicarbonate	mg/L CaCO3	320
UA	G270	B	2023/06/08	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G270	B	2023/08/14	Alkalinity, bicarbonate	mg/L CaCO3	347
UA	G270	B	2023/11/17	Alkalinity, bicarbonate	mg/L CaCO3	325
UA	G270	B	2022/08/24	Alkalinity, carbonate	mg/L CaCO3	10.0
UA	G270	B	2015/04/13	Barium, total	mg/L	0.0500
UA	G270	B	2015/07/22	Barium, total	mg/L	0.0490
UA	G270	B	2015/10/05	Barium, total	mg/L	0.0370
UA	G270	B	2015/11/20	Barium, total	mg/L	0.0450
UA	G270	B	2016/02/10	Barium, total	mg/L	0.0320
UA	G270	B	2016/05/12	Barium, total	mg/L	0.0340
UA	G270	B	2016/08/01	Barium, total	mg/L	0.0370
UA	G270	B	2016/11/16	Barium, total	mg/L	0.0310
UA	G270	B	2017/02/10	Barium, total	mg/L	0.0360
UA	G270	B	2017/05/16	Barium, total	mg/L	0.0330
UA	G270	B	2017/07/12	Barium, total	mg/L	0.0350
UA	G270	B	2018/05/11	Barium, total	mg/L	0.0380
UA	G270	B	2018/08/03	Barium, total	mg/L	0.0360
UA	G270	B	2019/01/21	Barium, total	mg/L	0.0470
UA	G270	B	2019/08/15	Barium, total	mg/L	0.0400
UA	G270	B	2020/01/24	Barium, total	mg/L	0.0380
UA	G270	B	2020/08/12	Barium, total	mg/L	0.0420
UA	G270	B	2020/10/14	Barium, total	mg/L	0.0430
UA	G270	B	2021/01/21	Barium, total	mg/L	0.0390
UA	G270	B	2021/03/30	Barium, total	mg/L	0.0450
UA	G270	B	2021/04/21	Barium, total	mg/L	0.0360
UA	G270	B	2021/05/06	Barium, total	mg/L	0.0410
UA	G270	B	2021/05/19	Barium, total	mg/L	0.0340
UA	G270	B	2021/06/15	Barium, total	mg/L	0.0340
UA	G270	B	2021/06/29	Barium, total	mg/L	0.0330
UA	G270	B	2021/07/12	Barium, total	mg/L	0.0350
UA	G270	B	2021/07/27	Barium, total	mg/L	0.0330
UA	G270	B	2021/08/18	Barium, total	mg/L	0.0340
UA	G270	B	2021/10/26	Barium, total	mg/L	0.0330
UA	G270	B	2022/02/08	Barium, total	mg/L	0.0330
UA	G270	B	2022/05/10	Barium, total	mg/L	0.0370
UA	G270	B	2022/08/24	Barium, total	mg/L	0.0360
UA	G270	B	2022/11/08	Barium, total	mg/L	0.0380
UA	G270	B	2023/02/16	Barium, total	mg/L	0.0410
UA	G270	B	2023/06/08	Barium, total	mg/L	0.0640
UA	G270	B	2023/08/14	Barium, total	mg/L	0.0467
UA	G270	B	2023/11/17	Barium, total	mg/L	0.0649
UA	G270	B	2015/01/20	Boron, total	mg/L	<0.01
UA	G270	B	2015/04/13	Boron, total	mg/L	0.0470
UA	G270	B	2015/07/22	Boron, total	mg/L	<0.01
UA	G270	B	2015/10/05	Boron, total	mg/L	<0.01
UA	G270	B	2015/11/20	Boron, total	mg/L	<0.0023
UA	G270	B	2016/02/10	Boron, total	mg/L	<0.0023
UA	G270	B	2016/05/12	Boron, total	mg/L	<0.0023
UA	G270	B	2016/08/01	Boron, total	mg/L	<0.0023
UA	G270	B	2016/11/16	Boron, total	mg/L	0.0180
UA	G270	B	2017/02/10	Boron, total	mg/L	<0.0023
UA	G270	B	2017/05/16	Boron, total	mg/L	<0.0023
UA	G270	B	2017/07/12	Boron, total	mg/L	<0.0023
UA	G270	B	2017/10/25	Boron, total	mg/L	0.0110
UA	G270	B	2018/05/11	Boron, total	mg/L	<0.0079
UA	G270	B	2018/08/03	Boron, total	mg/L	<0.0034
UA	G270	B	2019/01/21	Boron, total	mg/L	<0.0034
UA	G270	B	2019/08/15	Boron, total	mg/L	<0.0034
UA	G270	B	2020/01/24	Boron, total	mg/L	0.0150

UA	G270	B	2020/08/12	Boron, total	mg/L	0.100
UA	G270	B	2020/10/14	Boron, total	mg/L	0.0180
UA	G270	B	2021/01/21	Boron, total	mg/L	<0.008
UA	G270	B	2021/03/30	Boron, total	mg/L	0.0200
UA	G270	B	2021/04/21	Boron, total	mg/L	<0.01
UA	G270	B	2021/05/06	Boron, total	mg/L	0.0130
UA	G270	B	2021/05/19	Boron, total	mg/L	<0.008
UA	G270	B	2021/06/15	Boron, total	mg/L	0.0110
UA	G270	B	2021/06/29	Boron, total	mg/L	<0.008
UA	G270	B	2021/07/12	Boron, total	mg/L	0.120
UA	G270	B	2021/07/27	Boron, total	mg/L	<0.008
UA	G270	B	2021/08/18	Boron, total	mg/L	0.0120
UA	G270	B	2021/10/26	Boron, total	mg/L	<0.01
UA	G270	B	2022/02/08	Boron, total	mg/L	0.0120
UA	G270	B	2022/05/10	Boron, total	mg/L	<0.0071
UA	G270	B	2022/08/24	Boron, total	mg/L	<0.0071
UA	G270	B	2022/11/08	Boron, total	mg/L	0.00900
UA	G270	B	2023/02/16	Boron, total	mg/L	<0.0071
UA	G270	B	2023/06/08	Boron, total	mg/L	0.0140
UA	G270	B	2023/08/14	Boron, total	mg/L	<0.0092
UA	G270	B	2023/11/17	Boron, total	mg/L	<0.0125
UA	G270	B	2015/01/20	Calcium, total	mg/L	70.0
UA	G270	B	2015/04/13	Calcium, total	mg/L	70.0
UA	G270	B	2015/11/20	Calcium, total	mg/L	59.0
UA	G270	B	2016/02/10	Calcium, total	mg/L	49.0
UA	G270	B	2016/05/12	Calcium, total	mg/L	57.0
UA	G270	B	2016/08/01	Calcium, total	mg/L	50.0
UA	G270	B	2016/11/16	Calcium, total	mg/L	48.0
UA	G270	B	2017/02/10	Calcium, total	mg/L	53.0
UA	G270	B	2017/05/16	Calcium, total	mg/L	54.0
UA	G270	B	2017/07/12	Calcium, total	mg/L	52.0
UA	G270	B	2017/10/25	Calcium, total	mg/L	56.0
UA	G270	B	2018/05/11	Calcium, total	mg/L	53.0
UA	G270	B	2018/08/03	Calcium, total	mg/L	57.0
UA	G270	B	2019/01/21	Calcium, total	mg/L	56.0
UA	G270	B	2019/08/15	Calcium, total	mg/L	54.0
UA	G270	B	2020/01/24	Calcium, total	mg/L	59.0
UA	G270	B	2020/08/12	Calcium, total	mg/L	58.0
UA	G270	B	2020/10/14	Calcium, total	mg/L	61.0
UA	G270	B	2021/01/21	Calcium, total	mg/L	59.0
UA	G270	B	2021/03/30	Calcium, total	mg/L	58.0
UA	G270	B	2021/04/21	Calcium, total	mg/L	55.0
UA	G270	B	2021/05/06	Calcium, total	mg/L	57.0
UA	G270	B	2021/05/19	Calcium, total	mg/L	53.0
UA	G270	B	2021/06/15	Calcium, total	mg/L	60.0
UA	G270	B	2021/06/29	Calcium, total	mg/L	56.0
UA	G270	B	2021/07/12	Calcium, total	mg/L	55.0
UA	G270	B	2021/07/27	Calcium, total	mg/L	52.0
UA	G270	B	2021/08/18	Calcium, total	mg/L	55.0
UA	G270	B	2021/10/26	Calcium, total	mg/L	49.0
UA	G270	B	2022/02/08	Calcium, total	mg/L	53.0
UA	G270	B	2022/05/10	Calcium, total	mg/L	59.0
UA	G270	B	2022/08/24	Calcium, total	mg/L	56.0
UA	G270	B	2022/11/08	Calcium, total	mg/L	57.0
UA	G270	B	2023/02/16	Calcium, total	mg/L	56.0
UA	G270	B	2023/06/08	Calcium, total	mg/L	57.0
UA	G270	B	2023/08/14	Calcium, total	mg/L	57.9
UA	G270	B	2023/11/17	Calcium, total	mg/L	58.1
UA	G270	B	2015/01/20	Chloride, total	mg/L	18.0
UA	G270	B	2015/04/13	Chloride, total	mg/L	20.0
UA	G270	B	2015/07/22	Chloride, total	mg/L	15.0
UA	G270	B	2015/10/05	Chloride, total	mg/L	11.0
UA	G270	B	2015/11/20	Chloride, total	mg/L	12.0

UA	G270	B	2016/02/10	Chloride, total	mg/L	16.0
UA	G270	B	2016/05/12	Chloride, total	mg/L	12.0
UA	G270	B	2016/08/01	Chloride, total	mg/L	15.0
UA	G270	B	2016/11/16	Chloride, total	mg/L	12.0
UA	G270	B	2017/02/10	Chloride, total	mg/L	11.0
UA	G270	B	2017/05/16	Chloride, total	mg/L	9.70
UA	G270	B	2017/07/12	Chloride, total	mg/L	12.0
UA	G270	B	2017/10/25	Chloride, total	mg/L	13.0
UA	G270	B	2018/05/11	Chloride, total	mg/L	7.90
UA	G270	B	2018/08/03	Chloride, total	mg/L	8.60
UA	G270	B	2019/01/21	Chloride, total	mg/L	9.60
UA	G270	B	2019/08/15	Chloride, total	mg/L	9.80
UA	G270	B	2020/01/24	Chloride, total	mg/L	10.0
UA	G270	B	2020/08/12	Chloride, total	mg/L	12.0
UA	G270	B	2020/10/14	Chloride, total	mg/L	12.0
UA	G270	B	2021/01/21	Chloride, total	mg/L	10.0
UA	G270	B	2021/03/30	Chloride, total	mg/L	14.0
UA	G270	B	2021/04/21	Chloride, total	mg/L	16.0
UA	G270	B	2021/05/06	Chloride, total	mg/L	11.0
UA	G270	B	2021/05/19	Chloride, total	mg/L	10.0
UA	G270	B	2021/06/15	Chloride, total	mg/L	12.0
UA	G270	B	2021/06/29	Chloride, total	mg/L	12.0
UA	G270	B	2021/07/12	Chloride, total	mg/L	11.0
UA	G270	B	2021/07/27	Chloride, total	mg/L	12.0
UA	G270	B	2021/08/18	Chloride, total	mg/L	12.0
UA	G270	B	2021/10/26	Chloride, total	mg/L	9.90
UA	G270	B	2022/02/08	Chloride, total	mg/L	8.70
UA	G270	B	2022/05/10	Chloride, total	mg/L	9.30
UA	G270	B	2022/08/24	Chloride, total	mg/L	9.70
UA	G270	B	2022/11/08	Chloride, total	mg/L	9.00
UA	G270	B	2023/02/16	Chloride, total	mg/L	7.80
UA	G270	B	2023/06/08	Chloride, total	mg/L	8.30
UA	G270	B	2023/08/14	Chloride, total	mg/L	13.0
UA	G270	B	2023/11/17	Chloride, total	mg/L	15.0
UA	G270	B	2015/04/13	Cobalt, total	mg/L	<0.002
UA	G270	B	2015/07/22	Cobalt, total	mg/L	<0.002
UA	G270	B	2015/10/05	Cobalt, total	mg/L	<0.002
UA	G270	B	2015/11/20	Cobalt, total	mg/L	<0.000017
UA	G270	B	2016/02/10	Cobalt, total	mg/L	<0.000017
UA	G270	B	2016/05/12	Cobalt, total	mg/L	<0.000017
UA	G270	B	2016/08/01	Cobalt, total	mg/L	<0.000017
UA	G270	B	2016/11/16	Cobalt, total	mg/L	<0.000017
UA	G270	B	2017/02/10	Cobalt, total	mg/L	<0.000017
UA	G270	B	2017/05/16	Cobalt, total	mg/L	<0.000017
UA	G270	B	2017/07/12	Cobalt, total	mg/L	<0.000017
UA	G270	B	2018/05/11	Cobalt, total	mg/L	<0.00086
UA	G270	B	2018/08/03	Cobalt, total	mg/L	<0.00067
UA	G270	B	2019/01/21	Cobalt, total	mg/L	<0.00067
UA	G270	B	2019/08/15	Cobalt, total	mg/L	<0.00067
UA	G270	B	2020/01/24	Cobalt, total	mg/L	<0.00067
UA	G270	B	2020/08/12	Cobalt, total	mg/L	<0.00022
UA	G270	B	2020/10/14	Cobalt, total	mg/L	<0.002
UA	G270	B	2021/01/21	Cobalt, total	mg/L	<0.00022
UA	G270	B	2021/03/30	Cobalt, total	mg/L	<0.00022
UA	G270	B	2021/04/21	Cobalt, total	mg/L	<0.00022
UA	G270	B	2021/05/06	Cobalt, total	mg/L	<0.00022
UA	G270	B	2021/05/19	Cobalt, total	mg/L	<0.00022
UA	G270	B	2021/06/15	Cobalt, total	mg/L	<0.00022
UA	G270	B	2021/06/29	Cobalt, total	mg/L	<0.00022
UA	G270	B	2021/07/12	Cobalt, total	mg/L	<0.00022
UA	G270	B	2021/07/27	Cobalt, total	mg/L	<0.00022
UA	G270	B	2021/08/18	Cobalt, total	mg/L	<0.00022
UA	G270	B	2021/10/26	Cobalt, total	mg/L	<0.002

UA	G270	B	2022/02/08	Cobalt, total	mg/L	<0.00048
UA	G270	B	2022/05/10	Cobalt, total	mg/L	<0.00048
UA	G270	B	2022/08/24	Cobalt, total	mg/L	<0.00048
UA	G270	B	2022/11/08	Cobalt, total	mg/L	<0.00048
UA	G270	B	2023/02/16	Cobalt, total	mg/L	<0.00048
UA	G270	B	2023/06/08	Cobalt, total	mg/L	0.000640
UA	G270	B	2023/08/14	Cobalt, total	mg/L	0.000300
UA	G270	B	2023/11/17	Cobalt, total	mg/L	0.000200
UA	G270	B	2023/06/08	Ferrous Iron, dissolved	mg/L	0.260
UA	G270	B	2015/01/20	Iron, dissolved	mg/L	<0.01
UA	G270	B	2015/04/13	Iron, dissolved	mg/L	0.0210
UA	G270	B	2015/07/22	Iron, dissolved	mg/L	0.180
UA	G270	B	2015/10/05	Iron, dissolved	mg/L	0.0840
UA	G270	B	2016/02/10	Iron, dissolved	mg/L	0.0180
UA	G270	B	2016/05/12	Iron, dissolved	mg/L	<0.01
UA	G270	B	2016/07/27	Iron, dissolved	mg/L	0.0180
UA	G270	B	2016/11/21	Iron, dissolved	mg/L	<0.01
UA	G270	B	2017/02/08	Iron, dissolved	mg/L	<0.01
UA	G270	B	2017/05/18	Iron, dissolved	mg/L	0.0110
UA	G270	B	2017/07/12	Iron, dissolved	mg/L	0.0760
UA	G270	B	2017/10/25	Iron, dissolved	mg/L	<0.01
UA	G270	B	2018/01/29	Iron, dissolved	mg/L	0.280
UA	G270	B	2018/05/11	Iron, dissolved	mg/L	0.0120
UA	G270	B	2018/08/10	Iron, dissolved	mg/L	0.0570
UA	G270	B	2018/11/06	Iron, dissolved	mg/L	<0.01
UA	G270	B	2019/01/21	Iron, dissolved	mg/L	0.0460
UA	G270	B	2019/05/01	Iron, dissolved	mg/L	<0.01
UA	G270	B	2019/08/15	Iron, dissolved	mg/L	<0.01
UA	G270	B	2019/10/21	Iron, dissolved	mg/L	0.0430
UA	G270	B	2020/01/24	Iron, dissolved	mg/L	<0.01
UA	G270	B	2020/05/07	Iron, dissolved	mg/L	<0.01
UA	G270	B	2020/08/11	Iron, dissolved	mg/L	<0.01
UA	G270	B	2020/10/14	Iron, dissolved	mg/L	<0.01
UA	G270	B	2021/01/21	Iron, dissolved	mg/L	<0.01
UA	G270	B	2021/04/21	Iron, dissolved	mg/L	<0.01
UA	G270	B	2021/08/18	Iron, dissolved	mg/L	<0.01
UA	G270	B	2021/10/26	Iron, dissolved	mg/L	<0.01
UA	G270	B	2022/02/08	Iron, dissolved	mg/L	<0.01
UA	G270	B	2022/05/10	Iron, dissolved	mg/L	0.160
UA	G270	B	2022/08/24	Iron, dissolved	mg/L	<0.00072
UA	G270	B	2022/11/08	Iron, dissolved	mg/L	0.00360
UA	G270	B	2023/02/16	Iron, dissolved	mg/L	<0.00072
UA	G270	B	2023/06/08	Iron, dissolved	mg/L	0.0440
UA	G270	B	2023/08/14	Iron, dissolved	mg/L	0.0190
UA	G270	B	2023/11/17	Iron, dissolved	mg/L	<0.0115
UA	G270	B	2015/04/13	Magnesium, total	mg/L	32.0
UA	G270	B	2016/11/16	Magnesium, total	mg/L	22.0
UA	G270	B	2017/05/16	Magnesium, total	mg/L	27.0
UA	G270	B	2017/07/12	Magnesium, total	mg/L	24.0
UA	G270	B	2020/01/24	Magnesium, total	mg/L	26.0
UA	G270	B	2020/08/12	Magnesium, total	mg/L	25.0
UA	G270	B	2021/01/21	Magnesium, total	mg/L	24.0
UA	G270	B	2021/03/30	Magnesium, total	mg/L	26.0
UA	G270	B	2021/04/21	Magnesium, total	mg/L	26.0
UA	G270	B	2021/05/06	Magnesium, total	mg/L	25.0
UA	G270	B	2021/05/19	Magnesium, total	mg/L	24.0
UA	G270	B	2021/06/15	Magnesium, total	mg/L	25.0
UA	G270	B	2021/06/29	Magnesium, total	mg/L	25.0
UA	G270	B	2021/07/12	Magnesium, total	mg/L	25.0
UA	G270	B	2021/07/27	Magnesium, total	mg/L	24.0
UA	G270	B	2021/08/18	Magnesium, total	mg/L	24.0
UA	G270	B	2022/02/08	Magnesium, total	mg/L	22.0
UA	G270	B	2022/08/24	Magnesium, total	mg/L	25.0

UA	G270	B	2023/02/16	Magnesium, total	mg/L	21.0
UA	G270	B	2023/06/08	Magnesium, total	mg/L	24.0
UA	G270	B	2023/08/14	Magnesium, total	mg/L	23.4
UA	G270	B	2023/11/17	Magnesium, total	mg/L	24.1
UA	G270	B	2015/01/20	Manganese, dissolved	mg/L	0.0110
UA	G270	B	2015/04/13	Manganese, dissolved	mg/L	0.00550
UA	G270	B	2015/07/22	Manganese, dissolved	mg/L	0.470
UA	G270	B	2015/10/05	Manganese, dissolved	mg/L	0.0560
UA	G270	B	2016/02/10	Manganese, dissolved	mg/L	0.0120
UA	G270	B	2016/05/12	Manganese, dissolved	mg/L	0.0290
UA	G270	B	2016/07/27	Manganese, dissolved	mg/L	0.00320
UA	G270	B	2016/11/21	Manganese, dissolved	mg/L	0.0260
UA	G270	B	2017/02/08	Manganese, dissolved	mg/L	0.00110
UA	G270	B	2017/05/18	Manganese, dissolved	mg/L	0.0250
UA	G270	B	2017/07/12	Manganese, dissolved	mg/L	0.400
UA	G270	B	2017/10/25	Manganese, dissolved	mg/L	0.00870
UA	G270	B	2018/01/29	Manganese, dissolved	mg/L	0.0770
UA	G270	B	2018/03/05	Manganese, dissolved	mg/L	0.00240
UA	G270	B	2019/05/01	Manganese, dissolved	mg/L	<0.001
UA	G270	B	2019/08/15	Manganese, dissolved	mg/L	0.00220
UA	G270	B	2020/01/24	Manganese, dissolved	mg/L	<0.001
UA	G270	B	2020/10/14	Manganese, dissolved	mg/L	0.0540
UA	G270	B	2021/01/21	Manganese, dissolved	mg/L	0.00340
UA	G270	B	2021/04/21	Manganese, dissolved	mg/L	<0.001
UA	G270	B	2021/08/18	Manganese, dissolved	mg/L	0.0100
UA	G270	B	2021/10/26	Manganese, dissolved	mg/L	0.0240
UA	G270	B	2022/02/08	Manganese, dissolved	mg/L	<0.001
UA	G270	B	2022/05/10	Manganese, dissolved	mg/L	0.00210
UA	G270	B	2022/08/24	Manganese, dissolved	mg/L	0.00130
UA	G270	B	2022/11/08	Manganese, dissolved	mg/L	0.0150
UA	G270	B	2023/02/16	Manganese, dissolved	mg/L	0.00430
UA	G270	B	2023/06/08	Manganese, dissolved	mg/L	0.0790
UA	G270	B	2023/08/14	Manganese, dissolved	mg/L	0.157
UA	G270	B	2023/11/17	Manganese, dissolved	mg/L	0.0675
UA	G270	B	2023/08/14	Phosphate, dissolved	mg/L	0.0210
UA	G270	B	2015/04/13	Potassium, total	mg/L	0.790
UA	G270	B	2016/11/16	Potassium, total	mg/L	0.720
UA	G270	B	2017/05/16	Potassium, total	mg/L	0.720
UA	G270	B	2017/07/12	Potassium, total	mg/L	0.800
UA	G270	B	2020/01/24	Potassium, total	mg/L	0.880
UA	G270	B	2020/08/12	Potassium, total	mg/L	0.570
UA	G270	B	2021/01/21	Potassium, total	mg/L	1.20
UA	G270	B	2021/03/30	Potassium, total	mg/L	1.00
UA	G270	B	2021/04/21	Potassium, total	mg/L	0.860
UA	G270	B	2021/05/06	Potassium, total	mg/L	0.840
UA	G270	B	2021/05/19	Potassium, total	mg/L	0.500
UA	G270	B	2021/06/15	Potassium, total	mg/L	0.630
UA	G270	B	2021/06/29	Potassium, total	mg/L	0.580
UA	G270	B	2021/07/12	Potassium, total	mg/L	0.630
UA	G270	B	2021/07/27	Potassium, total	mg/L	0.590
UA	G270	B	2021/08/18	Potassium, total	mg/L	0.690
UA	G270	B	2022/02/08	Potassium, total	mg/L	0.580
UA	G270	B	2022/08/24	Potassium, total	mg/L	0.620
UA	G270	B	2023/02/16	Potassium, total	mg/L	0.620
UA	G270	B	2023/06/08	Potassium, total	mg/L	0.670
UA	G270	B	2023/08/14	Potassium, total	mg/L	0.757
UA	G270	B	2023/11/17	Potassium, total	mg/L	0.749
UA	G270	B	2023/06/08	Silicon, dissolved	mg/L	7.40
UA	G270	B	2023/08/14	Silicon, dissolved	mg/L	6.48
UA	G270	B	2015/04/13	Sodium, total	mg/L	91.0
UA	G270	B	2016/11/16	Sodium, total	mg/L	77.0
UA	G270	B	2017/05/16	Sodium, total	mg/L	88.0
UA	G270	B	2017/07/12	Sodium, total	mg/L	78.0

UA	G270	B	2020/01/24	Sodium, total	mg/L	82.0
UA	G270	B	2020/08/12	Sodium, total	mg/L	78.0
UA	G270	B	2021/01/21	Sodium, total	mg/L	87.0
UA	G270	B	2021/03/30	Sodium, total	mg/L	81.0
UA	G270	B	2021/04/21	Sodium, total	mg/L	84.0
UA	G270	B	2021/05/06	Sodium, total	mg/L	88.0
UA	G270	B	2021/05/19	Sodium, total	mg/L	87.0
UA	G270	B	2021/06/15	Sodium, total	mg/L	92.0
UA	G270	B	2021/06/29	Sodium, total	mg/L	85.0
UA	G270	B	2021/07/12	Sodium, total	mg/L	79.0
UA	G270	B	2021/07/27	Sodium, total	mg/L	89.0
UA	G270	B	2021/08/18	Sodium, total	mg/L	100
UA	G270	B	2022/02/08	Sodium, total	mg/L	89.0
UA	G270	B	2022/08/24	Sodium, total	mg/L	98.0
UA	G270	B	2023/02/16	Sodium, total	mg/L	81.0
UA	G270	B	2023/06/08	Sodium, total	mg/L	82.0
UA	G270	B	2023/08/14	Sodium, total	mg/L	80.3
UA	G270	B	2023/11/17	Sodium, total	mg/L	67.1
UA	G270	B	2015/01/20	Sulfate, total	mg/L	140
UA	G270	B	2015/04/13	Sulfate, total	mg/L	120
UA	G270	B	2015/07/22	Sulfate, total	mg/L	110
UA	G270	B	2015/10/05	Sulfate, total	mg/L	82.0
UA	G270	B	2015/11/20	Sulfate, total	mg/L	89.0
UA	G270	B	2016/02/10	Sulfate, total	mg/L	77.0
UA	G270	B	2016/05/12	Sulfate, total	mg/L	76.0
UA	G270	B	2016/08/01	Sulfate, total	mg/L	76.0
UA	G270	B	2016/11/16	Sulfate, total	mg/L	63.0
UA	G270	B	2017/02/10	Sulfate, total	mg/L	55.0
UA	G270	B	2017/05/16	Sulfate, total	mg/L	50.0
UA	G270	B	2017/07/12	Sulfate, total	mg/L	54.0
UA	G270	B	2017/10/25	Sulfate, total	mg/L	55.0
UA	G270	B	2018/05/11	Sulfate, total	mg/L	53.0
UA	G270	B	2018/08/03	Sulfate, total	mg/L	54.0
UA	G270	B	2019/01/21	Sulfate, total	mg/L	49.0
UA	G270	B	2019/08/15	Sulfate, total	mg/L	50.0
UA	G270	B	2020/01/24	Sulfate, total	mg/L	51.0
UA	G270	B	2020/08/12	Sulfate, total	mg/L	53.0
UA	G270	B	2020/10/14	Sulfate, total	mg/L	58.0
UA	G270	B	2021/01/21	Sulfate, total	mg/L	54.0
UA	G270	B	2021/03/30	Sulfate, total	mg/L	55.0
UA	G270	B	2021/04/21	Sulfate, total	mg/L	53.0
UA	G270	B	2021/05/06	Sulfate, total	mg/L	57.0
UA	G270	B	2021/05/19	Sulfate, total	mg/L	58.0
UA	G270	B	2021/06/15	Sulfate, total	mg/L	55.0
UA	G270	B	2021/06/29	Sulfate, total	mg/L	58.0
UA	G270	B	2021/07/12	Sulfate, total	mg/L	56.0
UA	G270	B	2021/07/27	Sulfate, total	mg/L	55.0
UA	G270	B	2021/08/18	Sulfate, total	mg/L	54.0
UA	G270	B	2021/10/26	Sulfate, total	mg/L	52.0
UA	G270	B	2022/02/08	Sulfate, total	mg/L	53.0
UA	G270	B	2022/05/10	Sulfate, total	mg/L	53.0
UA	G270	B	2022/08/24	Sulfate, total	mg/L	53.0
UA	G270	B	2022/11/08	Sulfate, total	mg/L	51.0
UA	G270	B	2023/02/16	Sulfate, total	mg/L	50.0
UA	G270	B	2023/06/08	Sulfate, total	mg/L	54.0
UA	G270	B	2023/08/14	Sulfate, total	mg/L	48.0
UA	G270	B	2023/11/17	Sulfate, total	mg/L	50.0
UA	G270	B	2015/11/20	Temperature (Celsius)	degrees C	16.6
UA	G270	B	2016/02/10	Temperature (Celsius)	degrees C	8.00
UA	G270	B	2016/05/12	Temperature (Celsius)	degrees C	16.8
UA	G270	B	2016/08/01	Temperature (Celsius)	degrees C	17.6
UA	G270	B	2016/11/16	Temperature (Celsius)	degrees C	14.5
UA	G270	B	2017/02/10	Temperature (Celsius)	degrees C	15.0

UA	G270	B	2017/05/16	Temperature (Celsius)	degrees C	15.4
UA	G270	B	2017/07/12	Temperature (Celsius)	degrees C	17.3
UA	G270	B	2017/10/25	Temperature (Celsius)	degrees C	12.7
UA	G270	B	2018/05/11	Temperature (Celsius)	degrees C	13.5
UA	G270	B	2018/08/03	Temperature (Celsius)	degrees C	15.9
UA	G270	B	2019/01/21	Temperature (Celsius)	degrees C	12.0
UA	G270	B	2019/08/15	Temperature (Celsius)	degrees C	17.0
UA	G270	B	2020/01/24	Temperature (Celsius)	degrees C	9.70
UA	G270	B	2020/08/12	Temperature (Celsius)	degrees C	18.5
UA	G270	B	2020/10/14	Temperature (Celsius)	degrees C	16.5
UA	G270	B	2021/01/21	Temperature (Celsius)	degrees C	11.6
UA	G270	B	2021/03/30	Temperature (Celsius)	degrees C	12.2
UA	G270	B	2021/04/21	Temperature (Celsius)	degrees C	11.9
UA	G270	B	2021/05/06	Temperature (Celsius)	degrees C	12.2
UA	G270	B	2021/05/19	Temperature (Celsius)	degrees C	15.2
UA	G270	B	2021/06/15	Temperature (Celsius)	degrees C	19.8
UA	G270	B	2021/06/29	Temperature (Celsius)	degrees C	20.5
UA	G270	B	2021/07/12	Temperature (Celsius)	degrees C	18.5
UA	G270	B	2021/07/27	Temperature (Celsius)	degrees C	20.4
UA	G270	B	2021/08/18	Temperature (Celsius)	degrees C	20.2
UA	G270	B	2022/02/08	Temperature (Celsius)	degrees C	10.4
UA	G270	B	2022/05/10	Temperature (Celsius)	degrees C	14.6
UA	G270	B	2022/08/24	Temperature (Celsius)	degrees C	19.7
UA	G270	B	2022/11/08	Temperature (Celsius)	degrees C	16.4
UA	G270	B	2023/02/16	Temperature (Celsius)	degrees C	8.90
UA	G270	B	2023/06/08	Temperature (Celsius)	degrees C	14.6
UA	G270	B	2023/08/14	Temperature (Celsius)	degrees C	15.2
UA	G270	B	2023/11/17	Temperature (Celsius)	degrees C	15.2
UA	G270	B	2015/01/20	Total Dissolved Solids	mg/L	500
UA	G270	B	2015/04/13	Total Dissolved Solids	mg/L	540
UA	G270	B	2015/07/22	Total Dissolved Solids	mg/L	550
UA	G270	B	2015/10/05	Total Dissolved Solids	mg/L	480
UA	G270	B	2015/11/20	Total Dissolved Solids	mg/L	400
UA	G270	B	2016/02/10	Total Dissolved Solids	mg/L	340
UA	G270	B	2016/05/12	Total Dissolved Solids	mg/L	340
UA	G270	B	2016/08/01	Total Dissolved Solids	mg/L	360
UA	G270	B	2016/11/16	Total Dissolved Solids	mg/L	450
UA	G270	B	2017/02/10	Total Dissolved Solids	mg/L	390
UA	G270	B	2017/05/16	Total Dissolved Solids	mg/L	380
UA	G270	B	2017/07/12	Total Dissolved Solids	mg/L	400
UA	G270	B	2017/10/25	Total Dissolved Solids	mg/L	400
UA	G270	B	2018/05/11	Total Dissolved Solids	mg/L	400
UA	G270	B	2018/08/03	Total Dissolved Solids	mg/L	420
UA	G270	B	2019/01/21	Total Dissolved Solids	mg/L	480
UA	G270	B	2019/08/15	Total Dissolved Solids	mg/L	470
UA	G270	B	2020/01/24	Total Dissolved Solids	mg/L	480
UA	G270	B	2020/08/12	Total Dissolved Solids	mg/L	380
UA	G270	B	2020/10/14	Total Dissolved Solids	mg/L	400
UA	G270	B	2021/01/21	Total Dissolved Solids	mg/L	360
UA	G270	B	2021/03/30	Total Dissolved Solids	mg/L	510
UA	G270	B	2021/04/21	Total Dissolved Solids	mg/L	570
UA	G270	B	2021/05/06	Total Dissolved Solids	mg/L	410
UA	G270	B	2021/05/19	Total Dissolved Solids	mg/L	480
UA	G270	B	2021/06/15	Total Dissolved Solids	mg/L	390
UA	G270	B	2021/06/29	Total Dissolved Solids	mg/L	400
UA	G270	B	2021/07/12	Total Dissolved Solids	mg/L	480
UA	G270	B	2021/07/27	Total Dissolved Solids	mg/L	420
UA	G270	B	2021/08/18	Total Dissolved Solids	mg/L	470
UA	G270	B	2021/10/26	Total Dissolved Solids	mg/L	410
UA	G270	B	2022/02/08	Total Dissolved Solids	mg/L	410
UA	G270	B	2022/05/10	Total Dissolved Solids	mg/L	420
UA	G270	B	2022/08/24	Total Dissolved Solids	mg/L	500
UA	G270	B	2022/11/08	Total Dissolved Solids	mg/L	420

UA	G270	B	2023/02/16	Total Dissolved Solids	mg/L	410
UA	G270	B	2023/06/08	Total Dissolved Solids	mg/L	500
UA	G270	B	2023/08/14	Total Dissolved Solids	mg/L	426
UA	G270	B	2023/11/17	Total Dissolved Solids	mg/L	460
UA	G280	B	2015/01/21	pH (field)	SU	7.6
UA	G280	B	2015/04/13	pH (field)	SU	7.2
UA	G280	B	2015/07/23	pH (field)	SU	7.6
UA	G280	B	2015/10/08	pH (field)	SU	7.7
UA	G280	B	2015/11/24	pH (field)	SU	7.4
UA	G280	B	2016/02/10	pH (field)	SU	6.5
UA	G280	B	2016/05/10	pH (field)	SU	7.2
UA	G280	B	2016/08/03	pH (field)	SU	7.2
UA	G280	B	2016/11/20	pH (field)	SU	7.1
UA	G280	B	2017/02/15	pH (field)	SU	7.0
UA	G280	B	2017/05/20	pH (field)	SU	7.2
UA	G280	B	2017/07/18	pH (field)	SU	7.3
UA	G280	B	2017/11/04	pH (field)	SU	7.2
UA	G280	B	2018/05/16	pH (field)	SU	7.2
UA	G280	B	2018/08/10	pH (field)	SU	7.1
UA	G280	B	2019/01/22	pH (field)	SU	7.1
UA	G280	B	2019/08/26	pH (field)	SU	7.1
UA	G280	B	2020/01/23	pH (field)	SU	7.7
UA	G280	B	2020/08/11	pH (field)	SU	7.3
UA	G280	B	2020/10/14	pH (field)	SU	7.1
UA	G280	B	2021/01/21	pH (field)	SU	7.3
UA	G280	B	2021/01/28	pH (field)	SU	7.3
UA	G280	B	2021/03/30	pH (field)	SU	7.4
UA	G280	B	2021/04/22	pH (field)	SU	7.4
UA	G280	B	2021/05/06	pH (field)	SU	7.2
UA	G280	B	2021/05/19	pH (field)	SU	7.4
UA	G280	B	2021/06/28	pH (field)	SU	7.4
UA	G280	B	2021/07/13	pH (field)	SU	7.4
UA	G280	B	2021/07/27	pH (field)	SU	7.5
UA	G280	B	2021/08/18	pH (field)	SU	7.1
UA	G280	B	2021/10/26	pH (field)	SU	7.3
UA	G280	B	2022/02/08	pH (field)	SU	7.2
UA	G280	B	2022/05/10	pH (field)	SU	7.4
UA	G280	B	2022/08/24	pH (field)	SU	7.2
UA	G280	B	2022/11/09	pH (field)	SU	7.2
UA	G280	B	2023/02/16	pH (field)	SU	6.0
UA	G280	B	2023/06/08	pH (field)	SU	7.3
UA	G280	B	2023/08/14	pH (field)	SU	7.4
UA	G280	B	2023/11/20	pH (field)	SU	7.4
UA	G280	B	2015/11/24	Oxidation Reduction Potential	mV	18.0
UA	G280	B	2016/02/10	Oxidation Reduction Potential	mV	193
UA	G280	B	2016/05/10	Oxidation Reduction Potential	mV	140
UA	G280	B	2016/08/03	Oxidation Reduction Potential	mV	101
UA	G280	B	2016/11/20	Oxidation Reduction Potential	mV	103
UA	G280	B	2017/02/15	Oxidation Reduction Potential	mV	65.0
UA	G280	B	2017/05/20	Oxidation Reduction Potential	mV	89.0
UA	G280	B	2017/07/18	Oxidation Reduction Potential	mV	93.0
UA	G280	B	2017/11/04	Oxidation Reduction Potential	mV	106
UA	G280	B	2018/05/16	Oxidation Reduction Potential	mV	86.0
UA	G280	B	2018/08/10	Oxidation Reduction Potential	mV	102
UA	G280	B	2019/01/22	Oxidation Reduction Potential	mV	107
UA	G280	B	2019/08/26	Oxidation Reduction Potential	mV	99.0
UA	G280	B	2020/01/23	Oxidation Reduction Potential	mV	189
UA	G280	B	2020/08/11	Oxidation Reduction Potential	mV	101
UA	G280	B	2020/10/14	Oxidation Reduction Potential	mV	197
UA	G280	B	2021/01/21	Oxidation Reduction Potential	mV	98.1
UA	G280	B	2021/01/28	Oxidation Reduction Potential	mV	98.1
UA	G280	B	2021/03/30	Oxidation Reduction Potential	mV	119
UA	G280	B	2021/04/22	Oxidation Reduction Potential	mV	107

UA	G280	B	2021/05/06	Oxidation Reduction Potential	mV	149
UA	G280	B	2021/05/19	Oxidation Reduction Potential	mV	82.9
UA	G280	B	2021/06/28	Oxidation Reduction Potential	mV	36.0
UA	G280	B	2021/07/13	Oxidation Reduction Potential	mV	77.4
UA	G280	B	2021/07/27	Oxidation Reduction Potential	mV	178
UA	G280	B	2021/08/18	Oxidation Reduction Potential	mV	63.9
UA	G280	B	2021/10/26	Oxidation Reduction Potential	mV	56.0
UA	G280	B	2022/02/08	Oxidation Reduction Potential	mV	-15.2
UA	G280	B	2022/05/10	Oxidation Reduction Potential	mV	23.2
UA	G280	B	2022/08/24	Oxidation Reduction Potential	mV	64.4
UA	G280	B	2022/11/09	Oxidation Reduction Potential	mV	209
UA	G280	B	2023/02/16	Oxidation Reduction Potential	mV	236
UA	G280	B	2023/06/08	Oxidation Reduction Potential	mV	190
UA	G280	B	2023/08/14	Oxidation Reduction Potential	mV	31.0
UA	G280	B	2023/11/20	Oxidation Reduction Potential	mV	107
UA	G280	B	2015/11/24	Eh	V	0.21
UA	G280	B	2016/02/10	Eh	V	0.39
UA	G280	B	2016/05/10	Eh	V	0.33
UA	G280	B	2016/08/03	Eh	V	0.29
UA	G280	B	2016/11/20	Eh	V	0.30
UA	G280	B	2017/02/15	Eh	V	0.26
UA	G280	B	2017/05/20	Eh	V	0.28
UA	G280	B	2017/07/18	Eh	V	0.28
UA	G280	B	2017/11/04	Eh	V	0.30
UA	G280	B	2018/05/16	Eh	V	0.28
UA	G280	B	2018/08/10	Eh	V	0.30
UA	G280	B	2019/01/22	Eh	V	0.30
UA	G280	B	2019/08/26	Eh	V	0.29
UA	G280	B	2020/01/23	Eh	V	0.39
UA	G280	B	2020/08/11	Eh	V	0.29
UA	G280	B	2020/10/14	Eh	V	0.39
UA	G280	B	2021/01/21	Eh	V	0.30
UA	G280	B	2021/01/28	Eh	V	0.30
UA	G280	B	2021/03/30	Eh	V	0.32
UA	G280	B	2021/04/22	Eh	V	0.30
UA	G280	B	2021/05/06	Eh	V	0.35
UA	G280	B	2021/05/19	Eh	V	0.28
UA	G280	B	2021/06/28	Eh	V	0.23
UA	G280	B	2021/07/13	Eh	V	0.27
UA	G280	B	2021/07/27	Eh	V	0.37
UA	G280	B	2021/08/18	Eh	V	0.26
UA	G280	B	2022/02/08	Eh	V	0.18
UA	G280	B	2022/05/10	Eh	V	0.22
UA	G280	B	2022/08/24	Eh	V	0.26
UA	G280	B	2022/11/09	Eh	V	0.40
UA	G280	B	2023/02/16	Eh	V	0.44
UA	G280	B	2023/06/08	Eh	V	0.39
UA	G280	B	2023/08/14	Eh	V	0.23
UA	G280	B	2023/11/20	Eh	V	0.30
UA	G280	B	2015/01/21	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G280	B	2015/04/13	Alkalinity, bicarbonate	mg/L CaCO3	250
UA	G280	B	2017/07/18	Alkalinity, bicarbonate	mg/L CaCO3	250
UA	G280	B	2020/01/23	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G280	B	2021/01/28	Alkalinity, bicarbonate	mg/L CaCO3	250
UA	G280	B	2021/03/30	Alkalinity, bicarbonate	mg/L CaCO3	220
UA	G280	B	2021/04/22	Alkalinity, bicarbonate	mg/L CaCO3	250
UA	G280	B	2021/05/06	Alkalinity, bicarbonate	mg/L CaCO3	240
UA	G280	B	2021/05/19	Alkalinity, bicarbonate	mg/L CaCO3	240
UA	G280	B	2021/06/16	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G280	B	2021/06/28	Alkalinity, bicarbonate	mg/L CaCO3	220
UA	G280	B	2021/07/13	Alkalinity, bicarbonate	mg/L CaCO3	250
UA	G280	B	2021/07/27	Alkalinity, bicarbonate	mg/L CaCO3	250
UA	G280	B	2022/02/08	Alkalinity, bicarbonate	mg/L CaCO3	220

UA	G280	B	2022/08/24	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G280	B	2023/02/16	Alkalinity, bicarbonate	mg/L CaCO3	250
UA	G280	B	2023/06/08	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G280	B	2023/08/14	Alkalinity, bicarbonate	mg/L CaCO3	262
UA	G280	B	2023/11/20	Alkalinity, bicarbonate	mg/L CaCO3	254
UA	G280	B	2022/08/24	Alkalinity, carbonate	mg/L CaCO3	10.0
UA	G280	B	2015/04/13	Barium, total	mg/L	0.0450
UA	G280	B	2015/07/23	Barium, total	mg/L	0.0490
UA	G280	B	2015/10/08	Barium, total	mg/L	0.0560
UA	G280	B	2015/11/24	Barium, total	mg/L	0.110
UA	G280	B	2016/02/10	Barium, total	mg/L	0.0450
UA	G280	B	2016/05/10	Barium, total	mg/L	0.0450
UA	G280	B	2016/08/03	Barium, total	mg/L	0.0450
UA	G280	B	2016/11/20	Barium, total	mg/L	0.0440
UA	G280	B	2017/02/15	Barium, total	mg/L	0.0520
UA	G280	B	2017/05/20	Barium, total	mg/L	0.0420
UA	G280	B	2017/07/18	Barium, total	mg/L	0.0410
UA	G280	B	2018/05/16	Barium, total	mg/L	0.0380
UA	G280	B	2018/08/10	Barium, total	mg/L	0.0380
UA	G280	B	2019/01/22	Barium, total	mg/L	0.0700
UA	G280	B	2019/08/26	Barium, total	mg/L	0.0450
UA	G280	B	2020/01/23	Barium, total	mg/L	0.0410
UA	G280	B	2020/08/11	Barium, total	mg/L	0.210
UA	G280	B	2020/10/14	Barium, total	mg/L	0.0440
UA	G280	B	2021/01/21	Barium, total	mg/L	0.0450
UA	G280	B	2021/01/28	Barium, total	mg/L	0.0430
UA	G280	B	2021/03/30	Barium, total	mg/L	0.0420
UA	G280	B	2021/04/22	Barium, total	mg/L	0.0400
UA	G280	B	2021/05/06	Barium, total	mg/L	0.0400
UA	G280	B	2021/05/19	Barium, total	mg/L	0.0380
UA	G280	B	2021/06/16	Barium, total	mg/L	0.0420
UA	G280	B	2021/06/28	Barium, total	mg/L	0.0430
UA	G280	B	2021/07/13	Barium, total	mg/L	0.0410
UA	G280	B	2021/07/27	Barium, total	mg/L	0.0420
UA	G280	B	2021/08/18	Barium, total	mg/L	0.0460
UA	G280	B	2021/10/26	Barium, total	mg/L	0.0380
UA	G280	B	2022/02/08	Barium, total	mg/L	0.0420
UA	G280	B	2022/05/10	Barium, total	mg/L	0.0400
UA	G280	B	2022/08/24	Barium, total	mg/L	0.0450
UA	G280	B	2022/11/09	Barium, total	mg/L	0.0440
UA	G280	B	2023/02/16	Barium, total	mg/L	0.0420
UA	G280	B	2023/06/08	Barium, total	mg/L	0.0490
UA	G280	B	2023/08/14	Barium, total	mg/L	0.0531
UA	G280	B	2023/11/20	Barium, total	mg/L	0.0611
UA	G280	B	2015/01/21	Boron, total	mg/L	<0.01
UA	G280	B	2015/04/13	Boron, total	mg/L	<0.01
UA	G280	B	2015/07/23	Boron, total	mg/L	<0.01
UA	G280	B	2015/10/08	Boron, total	mg/L	0.0240
UA	G280	B	2015/11/24	Boron, total	mg/L	0.0290
UA	G280	B	2016/02/10	Boron, total	mg/L	<0.0023
UA	G280	B	2016/05/10	Boron, total	mg/L	<0.0023
UA	G280	B	2016/08/03	Boron, total	mg/L	<0.0023
UA	G280	B	2016/11/20	Boron, total	mg/L	<0.0023
UA	G280	B	2017/02/15	Boron, total	mg/L	<0.0023
UA	G280	B	2017/05/20	Boron, total	mg/L	<0.0023
UA	G280	B	2017/07/18	Boron, total	mg/L	<0.0023
UA	G280	B	2017/11/04	Boron, total	mg/L	0.0130
UA	G280	B	2018/05/16	Boron, total	mg/L	<0.0034
UA	G280	B	2018/08/10	Boron, total	mg/L	<0.0034
UA	G280	B	2019/01/22	Boron, total	mg/L	0.0260
UA	G280	B	2019/08/26	Boron, total	mg/L	0.0110
UA	G280	B	2020/01/23	Boron, total	mg/L	0.0150
UA	G280	B	2020/08/11	Boron, total	mg/L	0.520

UA	G280	B	2020/10/14	Boron, total	mg/L	0.0250
UA	G280	B	2021/01/21	Boron, total	mg/L	0.0120
UA	G280	B	2021/01/28	Boron, total	mg/L	<0.008
UA	G280	B	2021/03/30	Boron, total	mg/L	0.0150
UA	G280	B	2021/04/22	Boron, total	mg/L	0.0150
UA	G280	B	2021/05/06	Boron, total	mg/L	0.0570
UA	G280	B	2021/05/19	Boron, total	mg/L	<0.008
UA	G280	B	2021/06/16	Boron, total	mg/L	<0.0046
UA	G280	B	2021/06/28	Boron, total	mg/L	1.00
UA	G280	B	2021/07/13	Boron, total	mg/L	0.0500
UA	G280	B	2021/07/27	Boron, total	mg/L	<0.008
UA	G280	B	2021/08/18	Boron, total	mg/L	0.0280
UA	G280	B	2021/10/26	Boron, total	mg/L	0.0250
UA	G280	B	2022/02/08	Boron, total	mg/L	<0.0046
UA	G280	B	2022/05/10	Boron, total	mg/L	<0.0071
UA	G280	B	2022/08/24	Boron, total	mg/L	0.0230
UA	G280	B	2022/11/09	Boron, total	mg/L	0.0210
UA	G280	B	2023/02/16	Boron, total	mg/L	0.0290
UA	G280	B	2023/06/08	Boron, total	mg/L	0.0200
UA	G280	B	2023/08/14	Boron, total	mg/L	<0.0092
UA	G280	B	2023/11/20	Boron, total	mg/L	0.0100
UA	G280	B	2015/01/21	Calcium, total	mg/L	74.0
UA	G280	B	2015/04/13	Calcium, total	mg/L	71.0
UA	G280	B	2015/11/24	Calcium, total	mg/L	120
UA	G280	B	2016/02/10	Calcium, total	mg/L	60.0
UA	G280	B	2016/05/10	Calcium, total	mg/L	63.0
UA	G280	B	2016/08/03	Calcium, total	mg/L	65.0
UA	G280	B	2016/11/20	Calcium, total	mg/L	63.0
UA	G280	B	2017/02/15	Calcium, total	mg/L	64.0
UA	G280	B	2017/05/20	Calcium, total	mg/L	54.0
UA	G280	B	2017/07/18	Calcium, total	mg/L	67.0
UA	G280	B	2017/11/04	Calcium, total	mg/L	63.0
UA	G280	B	2018/05/16	Calcium, total	mg/L	57.0
UA	G280	B	2018/08/10	Calcium, total	mg/L	62.0
UA	G280	B	2019/01/22	Calcium, total	mg/L	82.0
UA	G280	B	2019/08/26	Calcium, total	mg/L	72.0
UA	G280	B	2020/01/23	Calcium, total	mg/L	73.0
UA	G280	B	2020/08/11	Calcium, total	mg/L	220
UA	G280	B	2020/10/14	Calcium, total	mg/L	78.0
UA	G280	B	2021/01/21	Calcium, total	mg/L	77.0
UA	G280	B	2021/01/28	Calcium, total	mg/L	73.0
UA	G280	B	2021/03/30	Calcium, total	mg/L	62.0
UA	G280	B	2021/04/22	Calcium, total	mg/L	63.0
UA	G280	B	2021/05/06	Calcium, total	mg/L	64.0
UA	G280	B	2021/05/19	Calcium, total	mg/L	64.0
UA	G280	B	2021/06/16	Calcium, total	mg/L	73.0
UA	G280	B	2021/06/28	Calcium, total	mg/L	72.0
UA	G280	B	2021/07/13	Calcium, total	mg/L	70.0
UA	G280	B	2021/07/27	Calcium, total	mg/L	74.0
UA	G280	B	2021/08/18	Calcium, total	mg/L	69.0
UA	G280	B	2021/10/26	Calcium, total	mg/L	65.0
UA	G280	B	2022/02/08	Calcium, total	mg/L	68.0
UA	G280	B	2022/05/10	Calcium, total	mg/L	69.0
UA	G280	B	2022/08/24	Calcium, total	mg/L	80.0
UA	G280	B	2022/11/09	Calcium, total	mg/L	70.0
UA	G280	B	2023/02/16	Calcium, total	mg/L	72.0
UA	G280	B	2023/06/08	Calcium, total	mg/L	79.0
UA	G280	B	2023/08/14	Calcium, total	mg/L	79.5
UA	G280	B	2023/11/20	Calcium, total	mg/L	91.5
UA	G280	B	2015/01/21	Chloride, total	mg/L	62.0
UA	G280	B	2015/04/13	Chloride, total	mg/L	67.0
UA	G280	B	2015/07/23	Chloride, total	mg/L	53.0
UA	G280	B	2015/10/08	Chloride, total	mg/L	54.0

UA	G280	B	2015/11/24	Chloride, total	mg/L	54.0
UA	G280	B	2016/02/10	Chloride, total	mg/L	52.0
UA	G280	B	2016/05/10	Chloride, total	mg/L	50.0
UA	G280	B	2016/08/03	Chloride, total	mg/L	46.0
UA	G280	B	2016/11/20	Chloride, total	mg/L	49.0
UA	G280	B	2017/02/15	Chloride, total	mg/L	46.0
UA	G280	B	2017/05/20	Chloride, total	mg/L	44.0
UA	G280	B	2017/07/18	Chloride, total	mg/L	46.0
UA	G280	B	2017/11/04	Chloride, total	mg/L	48.0
UA	G280	B	2018/05/16	Chloride, total	mg/L	43.0
UA	G280	B	2018/08/10	Chloride, total	mg/L	55.0
UA	G280	B	2019/01/22	Chloride, total	mg/L	52.0
UA	G280	B	2019/08/26	Chloride, total	mg/L	60.0
UA	G280	B	2020/01/23	Chloride, total	mg/L	64.0
UA	G280	B	2020/08/11	Chloride, total	mg/L	68.0
UA	G280	B	2020/10/14	Chloride, total	mg/L	67.0
UA	G280	B	2021/01/21	Chloride, total	mg/L	33.0
UA	G280	B	2021/01/28	Chloride, total	mg/L	64.0
UA	G280	B	2021/03/30	Chloride, total	mg/L	49.0
UA	G280	B	2021/04/22	Chloride, total	mg/L	55.0
UA	G280	B	2021/05/06	Chloride, total	mg/L	43.0
UA	G280	B	2021/05/19	Chloride, total	mg/L	46.0
UA	G280	B	2021/06/16	Chloride, total	mg/L	67.0
UA	G280	B	2021/06/28	Chloride, total	mg/L	65.0
UA	G280	B	2021/07/13	Chloride, total	mg/L	65.0
UA	G280	B	2021/07/27	Chloride, total	mg/L	63.0
UA	G280	B	2021/08/18	Chloride, total	mg/L	59.0
UA	G280	B	2021/10/26	Chloride, total	mg/L	58.0
UA	G280	B	2022/02/08	Chloride, total	mg/L	51.0
UA	G280	B	2022/05/10	Chloride, total	mg/L	58.0
UA	G280	B	2022/08/24	Chloride, total	mg/L	93.0
UA	G280	B	2022/11/09	Chloride, total	mg/L	710
UA	G280	B	2023/02/16	Chloride, total	mg/L	63.0
UA	G280	B	2023/06/08	Chloride, total	mg/L	71.0
UA	G280	B	2023/08/14	Chloride, total	mg/L	70.0
UA	G280	B	2023/11/20	Chloride, total	mg/L	70.0
UA	G280	B	2015/04/13	Cobalt, total	mg/L	<0.002
UA	G280	B	2015/07/23	Cobalt, total	mg/L	<0.002
UA	G280	B	2015/10/08	Cobalt, total	mg/L	<0.002
UA	G280	B	2015/11/24	Cobalt, total	mg/L	0.00590
UA	G280	B	2016/02/10	Cobalt, total	mg/L	<0.000017
UA	G280	B	2016/05/10	Cobalt, total	mg/L	<0.000017
UA	G280	B	2016/08/03	Cobalt, total	mg/L	<0.000017
UA	G280	B	2016/11/20	Cobalt, total	mg/L	<0.000017
UA	G280	B	2017/02/15	Cobalt, total	mg/L	<0.000017
UA	G280	B	2017/05/20	Cobalt, total	mg/L	<0.000017
UA	G280	B	2017/07/18	Cobalt, total	mg/L	<0.000017
UA	G280	B	2018/05/16	Cobalt, total	mg/L	<0.00067
UA	G280	B	2019/01/22	Cobalt, total	mg/L	0.00330
UA	G280	B	2019/08/26	Cobalt, total	mg/L	<0.00067
UA	G280	B	2020/01/23	Cobalt, total	mg/L	<0.00067
UA	G280	B	2020/08/11	Cobalt, total	mg/L	0.00600
UA	G280	B	2020/10/14	Cobalt, total	mg/L	<0.002
UA	G280	B	2021/01/21	Cobalt, total	mg/L	<0.002
UA	G280	B	2021/01/28	Cobalt, total	mg/L	<0.00022
UA	G280	B	2021/03/30	Cobalt, total	mg/L	<0.00022
UA	G280	B	2021/04/22	Cobalt, total	mg/L	<0.00022
UA	G280	B	2021/05/06	Cobalt, total	mg/L	<0.00022
UA	G280	B	2021/05/19	Cobalt, total	mg/L	<0.00022
UA	G280	B	2021/06/16	Cobalt, total	mg/L	<0.00022
UA	G280	B	2021/06/28	Cobalt, total	mg/L	<0.00019
UA	G280	B	2021/07/13	Cobalt, total	mg/L	<0.00022
UA	G280	B	2021/07/27	Cobalt, total	mg/L	<0.00022

UA	G280	B	2021/08/18	Cobalt, total	mg/L	<0.00022
UA	G280	B	2021/10/26	Cobalt, total	mg/L	<0.002
UA	G280	B	2022/02/08	Cobalt, total	mg/L	<0.00019
UA	G280	B	2022/05/10	Cobalt, total	mg/L	<0.00048
UA	G280	B	2022/08/24	Cobalt, total	mg/L	<0.00048
UA	G280	B	2022/11/09	Cobalt, total	mg/L	<0.00048
UA	G280	B	2023/02/16	Cobalt, total	mg/L	<0.00048
UA	G280	B	2023/06/08	Cobalt, total	mg/L	<0.00048
UA	G280	B	2023/08/14	Cobalt, total	mg/L	0.000300
UA	G280	B	2023/11/20	Cobalt, total	mg/L	0.000200
UA	G280	B	2023/06/08	Ferrous Iron, dissolved	mg/L	<0.02
UA	G280	B	2015/01/21	Iron, dissolved	mg/L	0.0180
UA	G280	B	2015/04/13	Iron, dissolved	mg/L	0.270
UA	G280	B	2015/07/23	Iron, dissolved	mg/L	<0.01
UA	G280	B	2015/10/08	Iron, dissolved	mg/L	0.0120
UA	G280	B	2016/02/10	Iron, dissolved	mg/L	0.0200
UA	G280	B	2016/05/13	Iron, dissolved	mg/L	<0.01
UA	G280	B	2016/08/03	Iron, dissolved	mg/L	0.0160
UA	G280	B	2016/11/22	Iron, dissolved	mg/L	0.0520
UA	G280	B	2017/02/14	Iron, dissolved	mg/L	0.0110
UA	G280	B	2017/05/19	Iron, dissolved	mg/L	<0.01
UA	G280	B	2017/07/25	Iron, dissolved	mg/L	0.0120
UA	G280	B	2017/11/04	Iron, dissolved	mg/L	0.400
UA	G280	B	2018/01/30	Iron, dissolved	mg/L	0.130
UA	G280	B	2018/05/16	Iron, dissolved	mg/L	<0.01
UA	G280	B	2018/08/10	Iron, dissolved	mg/L	0.0120
UA	G280	B	2018/11/06	Iron, dissolved	mg/L	<0.01
UA	G280	B	2019/01/22	Iron, dissolved	mg/L	0.0530
UA	G280	B	2019/05/01	Iron, dissolved	mg/L	<0.01
UA	G280	B	2019/08/26	Iron, dissolved	mg/L	<0.01
UA	G280	B	2019/10/22	Iron, dissolved	mg/L	<0.01
UA	G280	B	2020/01/23	Iron, dissolved	mg/L	0.0110
UA	G280	B	2020/05/07	Iron, dissolved	mg/L	<0.01
UA	G280	B	2020/10/14	Iron, dissolved	mg/L	<0.01
UA	G280	B	2021/01/21	Iron, dissolved	mg/L	<0.01
UA	G280	B	2021/01/28	Iron, dissolved	mg/L	<0.01
UA	G280	B	2021/04/22	Iron, dissolved	mg/L	<0.01
UA	G280	B	2021/08/18	Iron, dissolved	mg/L	<0.01
UA	G280	B	2021/10/26	Iron, dissolved	mg/L	0.0180
UA	G280	B	2022/02/08	Iron, dissolved	mg/L	<0.01
UA	G280	B	2022/05/10	Iron, dissolved	mg/L	<0.00072
UA	G280	B	2022/08/24	Iron, dissolved	mg/L	0.0180
UA	G280	B	2022/11/09	Iron, dissolved	mg/L	0.00780
UA	G280	B	2023/02/16	Iron, dissolved	mg/L	0.00470
UA	G280	B	2023/06/08	Iron, dissolved	mg/L	0.00610
UA	G280	B	2023/08/14	Iron, dissolved	mg/L	<0.0175
UA	G280	B	2023/11/20	Iron, dissolved	mg/L	<0.0115
UA	G280	B	2015/04/13	Magnesium, total	mg/L	36.0
UA	G280	B	2017/07/18	Magnesium, total	mg/L	31.0
UA	G280	B	2020/01/23	Magnesium, total	mg/L	36.0
UA	G280	B	2021/01/28	Magnesium, total	mg/L	37.0
UA	G280	B	2021/03/30	Magnesium, total	mg/L	32.0
UA	G280	B	2021/04/22	Magnesium, total	mg/L	33.0
UA	G280	B	2021/05/06	Magnesium, total	mg/L	31.0
UA	G280	B	2021/05/19	Magnesium, total	mg/L	33.0
UA	G280	B	2021/06/16	Magnesium, total	mg/L	36.0
UA	G280	B	2021/06/28	Magnesium, total	mg/L	38.0
UA	G280	B	2021/07/13	Magnesium, total	mg/L	37.0
UA	G280	B	2021/07/27	Magnesium, total	mg/L	36.0
UA	G280	B	2022/02/08	Magnesium, total	mg/L	30.0
UA	G280	B	2022/08/24	Magnesium, total	mg/L	41.0
UA	G280	B	2023/06/08	Magnesium, total	mg/L	38.0
UA	G280	B	2023/08/14	Magnesium, total	mg/L	36.6

UA	G280	B	2023/11/20	Magnesium, total	mg/L	42.7
UA	G280	B	2015/01/21	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2015/04/13	Manganese, dissolved	mg/L	0.0260
UA	G280	B	2015/07/23	Manganese, dissolved	mg/L	0.0740
UA	G280	B	2015/10/08	Manganese, dissolved	mg/L	0.00350
UA	G280	B	2016/02/10	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2016/05/13	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2016/08/03	Manganese, dissolved	mg/L	0.00760
UA	G280	B	2016/11/22	Manganese, dissolved	mg/L	0.0690
UA	G280	B	2017/02/14	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2017/05/19	Manganese, dissolved	mg/L	0.00460
UA	G280	B	2017/07/25	Manganese, dissolved	mg/L	0.00230
UA	G280	B	2017/11/04	Manganese, dissolved	mg/L	0.0590
UA	G280	B	2018/01/30	Manganese, dissolved	mg/L	0.00670
UA	G280	B	2018/03/01	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2018/05/16	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2019/05/01	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2019/08/26	Manganese, dissolved	mg/L	0.00190
UA	G280	B	2020/01/23	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2020/05/07	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2020/10/14	Manganese, dissolved	mg/L	0.00360
UA	G280	B	2021/01/21	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2021/01/28	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2021/04/22	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2021/08/18	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2021/10/26	Manganese, dissolved	mg/L	0.00180
UA	G280	B	2022/02/08	Manganese, dissolved	mg/L	0.00120
UA	G280	B	2022/05/10	Manganese, dissolved	mg/L	<0.00023
UA	G280	B	2022/08/24	Manganese, dissolved	mg/L	0.00100
UA	G280	B	2022/11/09	Manganese, dissolved	mg/L	0.00550
UA	G280	B	2023/02/16	Manganese, dissolved	mg/L	0.00200
UA	G280	B	2023/06/08	Manganese, dissolved	mg/L	0.00140
UA	G280	B	2023/08/14	Manganese, dissolved	mg/L	0.00320
UA	G280	B	2023/11/20	Manganese, dissolved	mg/L	0.0123
UA	G280	B	2023/08/14	Phosphate, dissolved	mg/L	0.0370
UA	G280	B	2015/04/13	Potassium, total	mg/L	0.580
UA	G280	B	2017/07/18	Potassium, total	mg/L	0.580
UA	G280	B	2020/01/23	Potassium, total	mg/L	0.440
UA	G280	B	2021/01/28	Potassium, total	mg/L	0.540
UA	G280	B	2021/03/30	Potassium, total	mg/L	0.570
UA	G280	B	2021/04/22	Potassium, total	mg/L	0.470
UA	G280	B	2021/05/06	Potassium, total	mg/L	0.470
UA	G280	B	2021/05/19	Potassium, total	mg/L	0.350
UA	G280	B	2021/06/16	Potassium, total	mg/L	0.340
UA	G280	B	2021/06/28	Potassium, total	mg/L	0.460
UA	G280	B	2021/07/13	Potassium, total	mg/L	0.330
UA	G280	B	2021/07/27	Potassium, total	mg/L	0.360
UA	G280	B	2022/02/08	Potassium, total	mg/L	6.70
UA	G280	B	2022/08/24	Potassium, total	mg/L	0.420
UA	G280	B	2023/02/16	Potassium, total	mg/L	0.520
UA	G280	B	2023/06/08	Potassium, total	mg/L	0.580
UA	G280	B	2023/08/14	Potassium, total	mg/L	0.539
UA	G280	B	2023/11/20	Potassium, total	mg/L	0.644
UA	G280	B	2023/06/08	Silicon, dissolved	mg/L	8.20
UA	G280	B	2023/08/14	Silicon, dissolved	mg/L	7.33
UA	G280	B	2015/04/13	Sodium, total	mg/L	65.0
UA	G280	B	2017/07/18	Sodium, total	mg/L	49.0
UA	G280	B	2020/01/23	Sodium, total	mg/L	60.0
UA	G280	B	2021/01/28	Sodium, total	mg/L	60.0
UA	G280	B	2021/03/30	Sodium, total	mg/L	61.0
UA	G280	B	2021/04/22	Sodium, total	mg/L	60.0
UA	G280	B	2021/05/06	Sodium, total	mg/L	60.0
UA	G280	B	2021/05/19	Sodium, total	mg/L	61.0

UA	G280	B	2021/06/16	Sodium, total	mg/L	50.0
UA	G280	B	2021/06/28	Sodium, total	mg/L	53.0
UA	G280	B	2021/07/13	Sodium, total	mg/L	54.0
UA	G280	B	2021/07/27	Sodium, total	mg/L	52.0
UA	G280	B	2022/02/08	Sodium, total	mg/L	53.0
UA	G280	B	2022/08/24	Sodium, total	mg/L	62.0
UA	G280	B	2023/02/16	Sodium, total	mg/L	61.0
UA	G280	B	2023/06/08	Sodium, total	mg/L	56.0
UA	G280	B	2023/08/14	Sodium, total	mg/L	58.5
UA	G280	B	2023/11/20	Sodium, total	mg/L	60.7
UA	G280	B	2015/01/21	Sulfate, total	mg/L	87.0
UA	G280	B	2015/04/13	Sulfate, total	mg/L	86.0
UA	G280	B	2015/07/23	Sulfate, total	mg/L	74.0
UA	G280	B	2015/10/08	Sulfate, total	mg/L	92.0
UA	G280	B	2015/11/24	Sulfate, total	mg/L	94.0
UA	G280	B	2016/02/10	Sulfate, total	mg/L	84.0
UA	G280	B	2016/05/10	Sulfate, total	mg/L	80.0
UA	G280	B	2016/08/03	Sulfate, total	mg/L	55.0
UA	G280	B	2016/11/20	Sulfate, total	mg/L	67.0
UA	G280	B	2017/02/15	Sulfate, total	mg/L	94.0
UA	G280	B	2017/05/20	Sulfate, total	mg/L	84.0
UA	G280	B	2017/07/18	Sulfate, total	mg/L	58.0
UA	G280	B	2017/11/04	Sulfate, total	mg/L	57.0
UA	G280	B	2018/05/16	Sulfate, total	mg/L	52.0
UA	G280	B	2018/08/10	Sulfate, total	mg/L	63.0
UA	G280	B	2019/01/22	Sulfate, total	mg/L	69.0
UA	G280	B	2019/08/26	Sulfate, total	mg/L	81.0
UA	G280	B	2020/01/23	Sulfate, total	mg/L	84.0
UA	G280	B	2020/08/11	Sulfate, total	mg/L	86.0
UA	G280	B	2020/10/14	Sulfate, total	mg/L	84.0
UA	G280	B	2021/01/21	Sulfate, total	mg/L	43.0
UA	G280	B	2021/01/28	Sulfate, total	mg/L	86.0
UA	G280	B	2021/03/30	Sulfate, total	mg/L	84.0
UA	G280	B	2021/04/22	Sulfate, total	mg/L	89.0
UA	G280	B	2021/05/06	Sulfate, total	mg/L	92.0
UA	G280	B	2021/05/19	Sulfate, total	mg/L	81.0
UA	G280	B	2021/06/16	Sulfate, total	mg/L	82.0
UA	G280	B	2021/06/28	Sulfate, total	mg/L	79.0
UA	G280	B	2021/07/13	Sulfate, total	mg/L	81.0
UA	G280	B	2021/07/27	Sulfate, total	mg/L	77.0
UA	G280	B	2021/08/18	Sulfate, total	mg/L	74.0
UA	G280	B	2021/10/26	Sulfate, total	mg/L	74.0
UA	G280	B	2022/02/08	Sulfate, total	mg/L	82.0
UA	G280	B	2022/05/10	Sulfate, total	mg/L	79.0
UA	G280	B	2022/08/24	Sulfate, total	mg/L	82.0
UA	G280	B	2022/11/09	Sulfate, total	mg/L	910
UA	G280	B	2023/02/16	Sulfate, total	mg/L	81.0
UA	G280	B	2023/06/08	Sulfate, total	mg/L	91.0
UA	G280	B	2023/08/14	Sulfate, total	mg/L	91.0
UA	G280	B	2023/11/20	Sulfate, total	mg/L	113
UA	G280	B	2015/11/24	Temperature (Celsius)	degrees C	16.0
UA	G280	B	2016/02/10	Temperature (Celsius)	degrees C	8.20
UA	G280	B	2016/05/10	Temperature (Celsius)	degrees C	16.0
UA	G280	B	2016/08/03	Temperature (Celsius)	degrees C	17.7
UA	G280	B	2016/11/20	Temperature (Celsius)	degrees C	14.7
UA	G280	B	2017/02/15	Temperature (Celsius)	degrees C	15.5
UA	G280	B	2017/05/20	Temperature (Celsius)	degrees C	14.9
UA	G280	B	2017/07/18	Temperature (Celsius)	degrees C	22.4
UA	G280	B	2017/11/04	Temperature (Celsius)	degrees C	13.5
UA	G280	B	2018/05/16	Temperature (Celsius)	degrees C	14.9
UA	G280	B	2018/08/10	Temperature (Celsius)	degrees C	15.9
UA	G280	B	2019/01/22	Temperature (Celsius)	degrees C	11.6
UA	G280	B	2019/08/26	Temperature (Celsius)	degrees C	17.0

UA	G280	B	2020/01/23	Temperature (Celsius)	degrees C	10.4
UA	G280	B	2020/08/11	Temperature (Celsius)	degrees C	19.0
UA	G280	B	2020/10/14	Temperature (Celsius)	degrees C	16.5
UA	G280	B	2021/01/21	Temperature (Celsius)	degrees C	12.1
UA	G280	B	2021/01/28	Temperature (Celsius)	degrees C	12.1
UA	G280	B	2021/03/30	Temperature (Celsius)	degrees C	13.4
UA	G280	B	2021/04/22	Temperature (Celsius)	degrees C	13.1
UA	G280	B	2021/05/06	Temperature (Celsius)	degrees C	12.9
UA	G280	B	2021/05/19	Temperature (Celsius)	degrees C	15.0
UA	G280	B	2021/06/28	Temperature (Celsius)	degrees C	20.9
UA	G280	B	2021/07/13	Temperature (Celsius)	degrees C	18.1
UA	G280	B	2021/07/27	Temperature (Celsius)	degrees C	20.2
UA	G280	B	2021/08/18	Temperature (Celsius)	degrees C	19.8
UA	G280	B	2022/02/08	Temperature (Celsius)	degrees C	9.90
UA	G280	B	2022/05/10	Temperature (Celsius)	degrees C	17.8
UA	G280	B	2022/08/24	Temperature (Celsius)	degrees C	19.1
UA	G280	B	2022/11/09	Temperature (Celsius)	degrees C	16.4
UA	G280	B	2023/02/16	Temperature (Celsius)	degrees C	9.90
UA	G280	B	2023/06/08	Temperature (Celsius)	degrees C	15.4
UA	G280	B	2023/08/14	Temperature (Celsius)	degrees C	15.5
UA	G280	B	2023/11/20	Temperature (Celsius)	degrees C	14.7
UA	G280	B	2015/01/21	Total Dissolved Solids	mg/L	540
UA	G280	B	2015/04/13	Total Dissolved Solids	mg/L	480
UA	G280	B	2015/07/23	Total Dissolved Solids	mg/L	480
UA	G280	B	2015/10/08	Total Dissolved Solids	mg/L	450
UA	G280	B	2015/11/24	Total Dissolved Solids	mg/L	460
UA	G280	B	2016/02/10	Total Dissolved Solids	mg/L	400
UA	G280	B	2016/05/10	Total Dissolved Solids	mg/L	350
UA	G280	B	2016/08/03	Total Dissolved Solids	mg/L	350
UA	G280	B	2016/11/20	Total Dissolved Solids	mg/L	430
UA	G280	B	2017/02/15	Total Dissolved Solids	mg/L	440
UA	G280	B	2017/05/20	Total Dissolved Solids	mg/L	420
UA	G280	B	2017/07/18	Total Dissolved Solids	mg/L	400
UA	G280	B	2017/11/04	Total Dissolved Solids	mg/L	350
UA	G280	B	2018/05/16	Total Dissolved Solids	mg/L	360
UA	G280	B	2018/08/10	Total Dissolved Solids	mg/L	400
UA	G280	B	2019/01/22	Total Dissolved Solids	mg/L	500
UA	G280	B	2019/08/26	Total Dissolved Solids	mg/L	480
UA	G280	B	2020/01/23	Total Dissolved Solids	mg/L	1,100
UA	G280	B	2020/08/11	Total Dissolved Solids	mg/L	440
UA	G280	B	2020/10/14	Total Dissolved Solids	mg/L	490
UA	G280	B	2021/01/21	Total Dissolved Solids	mg/L	490
UA	G280	B	2021/01/28	Total Dissolved Solids	mg/L	430
UA	G280	B	2021/03/30	Total Dissolved Solids	mg/L	460
UA	G280	B	2021/04/22	Total Dissolved Solids	mg/L	470
UA	G280	B	2021/05/06	Total Dissolved Solids	mg/L	440
UA	G280	B	2021/05/19	Total Dissolved Solids	mg/L	400
UA	G280	B	2021/06/16	Total Dissolved Solids	mg/L	530
UA	G280	B	2021/06/28	Total Dissolved Solids	mg/L	420
UA	G280	B	2021/07/13	Total Dissolved Solids	mg/L	510
UA	G280	B	2021/07/27	Total Dissolved Solids	mg/L	470
UA	G280	B	2021/08/18	Total Dissolved Solids	mg/L	460
UA	G280	B	2021/10/26	Total Dissolved Solids	mg/L	400
UA	G280	B	2022/02/08	Total Dissolved Solids	mg/L	440
UA	G280	B	2022/05/10	Total Dissolved Solids	mg/L	450
UA	G280	B	2022/08/24	Total Dissolved Solids	mg/L	580
UA	G280	B	2022/11/09	Total Dissolved Solids	mg/L	500
UA	G280	B	2023/02/16	Total Dissolved Solids	mg/L	470
UA	G280	B	2023/06/08	Total Dissolved Solids	mg/L	590
UA	G280	B	2023/08/14	Total Dissolved Solids	mg/L	594
UA	G280	B	2023/11/20	Total Dissolved Solids	mg/L	608
UA	G281	B	2015/11/20	pH (field)	SU	7.0
UA	G281	B	2016/02/11	pH (field)	SU	7.1

UA	G281	B	2016/05/10	pH (field)	SU	7.0
UA	G281	B	2016/08/01	pH (field)	SU	7.0
UA	G281	B	2016/11/16	pH (field)	SU	6.9
UA	G281	B	2017/02/10	pH (field)	SU	6.7
UA	G281	B	2017/05/16	pH (field)	SU	6.9
UA	G281	B	2017/07/12	pH (field)	SU	7.0
UA	G281	B	2017/10/25	pH (field)	SU	7.0
UA	G281	B	2018/05/11	pH (field)	SU	7.1
UA	G281	B	2018/08/03	pH (field)	SU	7.0
UA	G281	B	2019/01/23	pH (field)	SU	7.0
UA	G281	B	2019/08/13	pH (field)	SU	6.9
UA	G281	B	2020/01/24	pH (field)	SU	7.3
UA	G281	B	2020/08/12	pH (field)	SU	6.9
UA	G281	B	2020/10/14	pH (field)	SU	7.0
UA	G281	B	2021/01/29	pH (field)	SU	7.1
UA	G281	B	2021/03/31	pH (field)	SU	7.0
UA	G281	B	2021/04/21	pH (field)	SU	6.9
UA	G281	B	2021/05/05	pH (field)	SU	7.1
UA	G281	B	2021/05/17	pH (field)	SU	7.1
UA	G281	B	2021/06/14	pH (field)	SU	7.1
UA	G281	B	2021/06/28	pH (field)	SU	7.2
UA	G281	B	2021/07/12	pH (field)	SU	7.2
UA	G281	B	2021/07/27	pH (field)	SU	7.1
UA	G281	B	2021/08/17	pH (field)	SU	7.1
UA	G281	B	2021/10/26	pH (field)	SU	7.0
UA	G281	B	2022/02/08	pH (field)	SU	7.0
UA	G281	B	2022/05/10	pH (field)	SU	6.9
UA	G281	B	2022/08/25	pH (field)	SU	6.8
UA	G281	B	2022/11/08	pH (field)	SU	6.8
UA	G281	B	2023/02/16	pH (field)	SU	7.2
UA	G281	B	2023/06/08	pH (field)	SU	6.8
UA	G281	B	2023/08/14	pH (field)	SU	6.8
UA	G281	B	2023/11/20	pH (field)	SU	6.9
UA	G281	B	2015/11/20	Oxidation Reduction Potential	mV	-18.0
UA	G281	B	2016/02/11	Oxidation Reduction Potential	mV	171
UA	G281	B	2016/05/10	Oxidation Reduction Potential	mV	40.0
UA	G281	B	2016/08/01	Oxidation Reduction Potential	mV	56.0
UA	G281	B	2016/11/16	Oxidation Reduction Potential	mV	58.0
UA	G281	B	2017/02/10	Oxidation Reduction Potential	mV	65.0
UA	G281	B	2017/05/16	Oxidation Reduction Potential	mV	63.0
UA	G281	B	2017/07/12	Oxidation Reduction Potential	mV	62.0
UA	G281	B	2017/10/25	Oxidation Reduction Potential	mV	75.0
UA	G281	B	2018/05/11	Oxidation Reduction Potential	mV	45.0
UA	G281	B	2018/08/03	Oxidation Reduction Potential	mV	62.0
UA	G281	B	2019/01/23	Oxidation Reduction Potential	mV	65.0
UA	G281	B	2019/08/13	Oxidation Reduction Potential	mV	65.0
UA	G281	B	2020/01/24	Oxidation Reduction Potential	mV	151
UA	G281	B	2020/08/12	Oxidation Reduction Potential	mV	129
UA	G281	B	2020/10/14	Oxidation Reduction Potential	mV	87.1
UA	G281	B	2021/01/29	Oxidation Reduction Potential	mV	110
UA	G281	B	2021/03/31	Oxidation Reduction Potential	mV	257
UA	G281	B	2021/04/21	Oxidation Reduction Potential	mV	41.7
UA	G281	B	2021/05/05	Oxidation Reduction Potential	mV	189
UA	G281	B	2021/05/17	Oxidation Reduction Potential	mV	181
UA	G281	B	2021/06/14	Oxidation Reduction Potential	mV	54.1
UA	G281	B	2021/06/28	Oxidation Reduction Potential	mV	26.1
UA	G281	B	2021/07/12	Oxidation Reduction Potential	mV	210
UA	G281	B	2021/07/27	Oxidation Reduction Potential	mV	72.7
UA	G281	B	2021/08/17	Oxidation Reduction Potential	mV	105
UA	G281	B	2021/10/26	Oxidation Reduction Potential	mV	24.5
UA	G281	B	2022/02/08	Oxidation Reduction Potential	mV	102
UA	G281	B	2022/05/10	Oxidation Reduction Potential	mV	41.0
UA	G281	B	2022/08/25	Oxidation Reduction Potential	mV	4.00

UA	G281	B	2022/11/08	Oxidation Reduction Potential	mV	57.6
UA	G281	B	2023/02/16	Oxidation Reduction Potential	mV	64.4
UA	G281	B	2023/06/08	Oxidation Reduction Potential	mV	11.0
UA	G281	B	2023/08/14	Oxidation Reduction Potential	mV	102
UA	G281	B	2023/11/20	Oxidation Reduction Potential	mV	112
UA	G281	B	2015/11/20	Eh	V	0.18
UA	G281	B	2016/02/11	Eh	V	0.37
UA	G281	B	2016/05/10	Eh	V	0.24
UA	G281	B	2016/08/01	Eh	V	0.25
UA	G281	B	2016/11/16	Eh	V	0.25
UA	G281	B	2017/02/10	Eh	V	0.26
UA	G281	B	2017/05/16	Eh	V	0.26
UA	G281	B	2017/07/12	Eh	V	0.26
UA	G281	B	2017/10/25	Eh	V	0.27
UA	G281	B	2018/05/11	Eh	V	0.24
UA	G281	B	2018/08/03	Eh	V	0.26
UA	G281	B	2019/01/23	Eh	V	0.26
UA	G281	B	2019/08/13	Eh	V	0.26
UA	G281	B	2020/01/24	Eh	V	0.35
UA	G281	B	2020/08/12	Eh	V	0.32
UA	G281	B	2020/10/14	Eh	V	0.28
UA	G281	B	2021/01/29	Eh	V	0.31
UA	G281	B	2021/03/31	Eh	V	0.46
UA	G281	B	2021/04/21	Eh	V	0.24
UA	G281	B	2021/05/05	Eh	V	0.39
UA	G281	B	2021/05/17	Eh	V	0.38
UA	G281	B	2021/06/14	Eh	V	0.25
UA	G281	B	2021/06/28	Eh	V	0.22
UA	G281	B	2021/07/12	Eh	V	0.40
UA	G281	B	2021/07/27	Eh	V	0.26
UA	G281	B	2021/08/17	Eh	V	0.30
UA	G281	B	2021/10/26	Eh	V	0.22
UA	G281	B	2022/02/08	Eh	V	0.30
UA	G281	B	2022/05/10	Eh	V	0.23
UA	G281	B	2022/08/25	Eh	V	0.20
UA	G281	B	2022/11/08	Eh	V	0.25
UA	G281	B	2023/02/16	Eh	V	0.26
UA	G281	B	2023/06/08	Eh	V	0.20
UA	G281	B	2023/08/14	Eh	V	0.29
UA	G281	B	2023/11/20	Eh	V	0.31
UA	G281	B	2016/11/16	Alkalinity, bicarbonate	mg/L CaCO3	370
UA	G281	B	2017/05/16	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G281	B	2017/07/12	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G281	B	2020/01/24	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G281	B	2020/08/12	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G281	B	2021/01/29	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G281	B	2021/03/31	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G281	B	2021/04/21	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G281	B	2021/05/05	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G281	B	2021/05/17	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G281	B	2021/06/14	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G281	B	2021/06/28	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G281	B	2021/07/12	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G281	B	2021/07/27	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G281	B	2021/08/17	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G281	B	2022/02/08	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G281	B	2022/08/25	Alkalinity, bicarbonate	mg/L CaCO3	390
UA	G281	B	2023/02/16	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G281	B	2023/06/08	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G281	B	2023/08/14	Alkalinity, bicarbonate	mg/L CaCO3	357
UA	G281	B	2023/11/20	Alkalinity, bicarbonate	mg/L CaCO3	358
UA	G281	B	2022/08/25	Alkalinity, carbonate	mg/L CaCO3	10.0
UA	G281	B	2015/11/20	Barium, total	mg/L	0.140

UA	G281	B	2016/02/11	Barium, total	mg/L	0.0670
UA	G281	B	2016/05/10	Barium, total	mg/L	0.0720
UA	G281	B	2016/08/01	Barium, total	mg/L	0.0780
UA	G281	B	2016/11/16	Barium, total	mg/L	0.0810
UA	G281	B	2017/02/10	Barium, total	mg/L	0.0800
UA	G281	B	2017/05/16	Barium, total	mg/L	0.0810
UA	G281	B	2017/07/12	Barium, total	mg/L	0.0870
UA	G281	B	2018/05/11	Barium, total	mg/L	0.0810
UA	G281	B	2018/08/03	Barium, total	mg/L	0.100
UA	G281	B	2019/01/23	Barium, total	mg/L	0.0720
UA	G281	B	2019/08/13	Barium, total	mg/L	0.0910
UA	G281	B	2020/01/24	Barium, total	mg/L	0.0700
UA	G281	B	2020/08/12	Barium, total	mg/L	0.0570
UA	G281	B	2020/10/14	Barium, total	mg/L	0.0630
UA	G281	B	2021/01/29	Barium, total	mg/L	0.0640
UA	G281	B	2021/03/31	Barium, total	mg/L	0.0660
UA	G281	B	2021/04/21	Barium, total	mg/L	0.0610
UA	G281	B	2021/05/05	Barium, total	mg/L	0.0650
UA	G281	B	2021/05/17	Barium, total	mg/L	0.0860
UA	G281	B	2021/06/14	Barium, total	mg/L	0.0600
UA	G281	B	2021/06/28	Barium, total	mg/L	0.0620
UA	G281	B	2021/07/12	Barium, total	mg/L	0.0610
UA	G281	B	2021/07/27	Barium, total	mg/L	0.0610
UA	G281	B	2021/08/17	Barium, total	mg/L	0.0650
UA	G281	B	2021/10/26	Barium, total	mg/L	0.0600
UA	G281	B	2022/02/08	Barium, total	mg/L	0.0650
UA	G281	B	2022/05/10	Barium, total	mg/L	0.0630
UA	G281	B	2022/08/25	Barium, total	mg/L	0.0680
UA	G281	B	2022/11/08	Barium, total	mg/L	0.0520
UA	G281	B	2023/02/16	Barium, total	mg/L	0.0650
UA	G281	B	2023/06/08	Barium, total	mg/L	0.0710
UA	G281	B	2023/08/14	Barium, total	mg/L	0.0707
UA	G281	B	2023/11/20	Barium, total	mg/L	0.0651
UA	G281	B	2015/11/20	Boron, total	mg/L	<0.0023
UA	G281	B	2016/02/11	Boron, total	mg/L	0.0100
UA	G281	B	2016/05/10	Boron, total	mg/L	<0.0023
UA	G281	B	2016/08/01	Boron, total	mg/L	0.0120
UA	G281	B	2016/11/16	Boron, total	mg/L	0.0220
UA	G281	B	2017/02/10	Boron, total	mg/L	<0.0023
UA	G281	B	2017/05/16	Boron, total	mg/L	<0.0023
UA	G281	B	2017/07/12	Boron, total	mg/L	<0.0023
UA	G281	B	2017/10/25	Boron, total	mg/L	0.0120
UA	G281	B	2018/05/11	Boron, total	mg/L	<0.0079
UA	G281	B	2018/08/03	Boron, total	mg/L	0.0130
UA	G281	B	2019/01/23	Boron, total	mg/L	0.0130
UA	G281	B	2019/08/13	Boron, total	mg/L	<0.0034
UA	G281	B	2020/01/24	Boron, total	mg/L	0.0110
UA	G281	B	2020/08/12	Boron, total	mg/L	0.0370
UA	G281	B	2020/10/14	Boron, total	mg/L	0.0160
UA	G281	B	2021/01/29	Boron, total	mg/L	<0.008
UA	G281	B	2021/03/31	Boron, total	mg/L	0.110
UA	G281	B	2021/04/21	Boron, total	mg/L	<0.008
UA	G281	B	2021/05/05	Boron, total	mg/L	0.0150
UA	G281	B	2021/05/17	Boron, total	mg/L	0.0430
UA	G281	B	2021/06/14	Boron, total	mg/L	<0.008
UA	G281	B	2021/06/28	Boron, total	mg/L	0.0360
UA	G281	B	2021/07/12	Boron, total	mg/L	<0.008
UA	G281	B	2021/07/27	Boron, total	mg/L	<0.008
UA	G281	B	2021/08/17	Boron, total	mg/L	0.0320
UA	G281	B	2021/10/26	Boron, total	mg/L	<0.01
UA	G281	B	2022/02/08	Boron, total	mg/L	<0.0046
UA	G281	B	2022/05/10	Boron, total	mg/L	<0.0071
UA	G281	B	2022/08/25	Boron, total	mg/L	0.0140

UA	G281	B	2022/11/08	Boron, total	mg/L	<0.0071
UA	G281	B	2023/02/16	Boron, total	mg/L	0.0210
UA	G281	B	2023/06/08	Boron, total	mg/L	<0.0071
UA	G281	B	2023/08/14	Boron, total	mg/L	<0.0092
UA	G281	B	2023/11/20	Boron, total	mg/L	<0.0092
UA	G281	B	2015/11/20	Calcium, total	mg/L	150
UA	G281	B	2016/02/11	Calcium, total	mg/L	120
UA	G281	B	2016/05/10	Calcium, total	mg/L	130
UA	G281	B	2016/08/01	Calcium, total	mg/L	140
UA	G281	B	2016/11/16	Calcium, total	mg/L	110
UA	G281	B	2017/02/10	Calcium, total	mg/L	120
UA	G281	B	2017/05/16	Calcium, total	mg/L	130
UA	G281	B	2017/07/12	Calcium, total	mg/L	130
UA	G281	B	2017/10/25	Calcium, total	mg/L	110
UA	G281	B	2018/05/11	Calcium, total	mg/L	120
UA	G281	B	2018/08/03	Calcium, total	mg/L	130
UA	G281	B	2019/01/23	Calcium, total	mg/L	130
UA	G281	B	2019/08/13	Calcium, total	mg/L	140
UA	G281	B	2020/01/24	Calcium, total	mg/L	140
UA	G281	B	2020/08/12	Calcium, total	mg/L	130
UA	G281	B	2020/10/14	Calcium, total	mg/L	130
UA	G281	B	2021/01/29	Calcium, total	mg/L	130
UA	G281	B	2021/03/31	Calcium, total	mg/L	130
UA	G281	B	2021/04/21	Calcium, total	mg/L	130
UA	G281	B	2021/05/05	Calcium, total	mg/L	130
UA	G281	B	2021/05/17	Calcium, total	mg/L	130
UA	G281	B	2021/06/14	Calcium, total	mg/L	140
UA	G281	B	2021/06/28	Calcium, total	mg/L	130
UA	G281	B	2021/07/12	Calcium, total	mg/L	130
UA	G281	B	2021/07/27	Calcium, total	mg/L	120
UA	G281	B	2021/08/17	Calcium, total	mg/L	140
UA	G281	B	2021/10/26	Calcium, total	mg/L	130
UA	G281	B	2022/02/08	Calcium, total	mg/L	130
UA	G281	B	2022/05/10	Calcium, total	mg/L	140
UA	G281	B	2022/08/25	Calcium, total	mg/L	150
UA	G281	B	2022/11/08	Calcium, total	mg/L	110
UA	G281	B	2023/02/16	Calcium, total	mg/L	130
UA	G281	B	2023/06/08	Calcium, total	mg/L	130
UA	G281	B	2023/08/14	Calcium, total	mg/L	137
UA	G281	B	2023/11/20	Calcium, total	mg/L	152
UA	G281	B	2015/11/20	Chloride, total	mg/L	74.0
UA	G281	B	2016/02/11	Chloride, total	mg/L	55.0
UA	G281	B	2016/05/10	Chloride, total	mg/L	72.0
UA	G281	B	2016/08/01	Chloride, total	mg/L	70.0
UA	G281	B	2016/11/16	Chloride, total	mg/L	68.0
UA	G281	B	2017/02/10	Chloride, total	mg/L	67.0
UA	G281	B	2017/05/16	Chloride, total	mg/L	68.0
UA	G281	B	2017/07/12	Chloride, total	mg/L	75.0
UA	G281	B	2017/10/25	Chloride, total	mg/L	64.0
UA	G281	B	2018/05/11	Chloride, total	mg/L	69.0
UA	G281	B	2018/08/03	Chloride, total	mg/L	66.0
UA	G281	B	2019/01/23	Chloride, total	mg/L	85.0
UA	G281	B	2019/08/13	Chloride, total	mg/L	72.0
UA	G281	B	2020/01/24	Chloride, total	mg/L	75.0
UA	G281	B	2020/08/12	Chloride, total	mg/L	81.0
UA	G281	B	2020/10/14	Chloride, total	mg/L	79.0
UA	G281	B	2021/01/29	Chloride, total	mg/L	100
UA	G281	B	2021/03/31	Chloride, total	mg/L	90.0
UA	G281	B	2021/04/21	Chloride, total	mg/L	120
UA	G281	B	2021/05/05	Chloride, total	mg/L	86.0
UA	G281	B	2021/05/17	Chloride, total	mg/L	85.0
UA	G281	B	2021/06/14	Chloride, total	mg/L	76.0
UA	G281	B	2021/06/28	Chloride, total	mg/L	86.0

UA	G281	B	2021/07/12	Chloride, total	mg/L	73.0
UA	G281	B	2021/07/27	Chloride, total	mg/L	73.0
UA	G281	B	2021/08/17	Chloride, total	mg/L	89.0
UA	G281	B	2021/10/26	Chloride, total	mg/L	160
UA	G281	B	2022/02/08	Chloride, total	mg/L	78.0
UA	G281	B	2022/05/10	Chloride, total	mg/L	85.0
UA	G281	B	2022/08/25	Chloride, total	mg/L	69.0
UA	G281	B	2022/11/08	Chloride, total	mg/L	63.0
UA	G281	B	2023/02/16	Chloride, total	mg/L	76.0
UA	G281	B	2023/06/08	Chloride, total	mg/L	75.0
UA	G281	B	2023/08/14	Chloride, total	mg/L	88.0
UA	G281	B	2023/11/20	Chloride, total	mg/L	74.0
UA	G281	B	2015/11/20	Cobalt, total	mg/L	0.00560
UA	G281	B	2016/02/11	Cobalt, total	mg/L	<0.000017
UA	G281	B	2016/05/10	Cobalt, total	mg/L	<0.000017
UA	G281	B	2016/08/01	Cobalt, total	mg/L	<0.000017
UA	G281	B	2016/11/16	Cobalt, total	mg/L	<0.000017
UA	G281	B	2017/02/10	Cobalt, total	mg/L	<0.000017
UA	G281	B	2017/05/16	Cobalt, total	mg/L	<0.000017
UA	G281	B	2017/07/12	Cobalt, total	mg/L	<0.000017
UA	G281	B	2018/05/11	Cobalt, total	mg/L	0.00230
UA	G281	B	2018/08/03	Cobalt, total	mg/L	0.00360
UA	G281	B	2019/01/23	Cobalt, total	mg/L	<0.00067
UA	G281	B	2019/08/13	Cobalt, total	mg/L	<0.00067
UA	G281	B	2020/01/24	Cobalt, total	mg/L	<0.00067
UA	G281	B	2020/08/12	Cobalt, total	mg/L	<0.00022
UA	G281	B	2020/10/14	Cobalt, total	mg/L	<0.002
UA	G281	B	2021/01/29	Cobalt, total	mg/L	<0.00022
UA	G281	B	2021/03/31	Cobalt, total	mg/L	<0.00022
UA	G281	B	2021/04/21	Cobalt, total	mg/L	<0.00022
UA	G281	B	2021/05/05	Cobalt, total	mg/L	<0.00022
UA	G281	B	2021/05/17	Cobalt, total	mg/L	0.00260
UA	G281	B	2021/06/14	Cobalt, total	mg/L	<0.00022
UA	G281	B	2021/06/28	Cobalt, total	mg/L	<0.00019
UA	G281	B	2021/07/12	Cobalt, total	mg/L	<0.00022
UA	G281	B	2021/07/27	Cobalt, total	mg/L	<0.00022
UA	G281	B	2021/08/17	Cobalt, total	mg/L	<0.00022
UA	G281	B	2021/10/26	Cobalt, total	mg/L	<0.002
UA	G281	B	2022/02/08	Cobalt, total	mg/L	<0.00019
UA	G281	B	2022/05/10	Cobalt, total	mg/L	<0.00048
UA	G281	B	2022/08/25	Cobalt, total	mg/L	0.000740
UA	G281	B	2022/11/08	Cobalt, total	mg/L	<0.00048
UA	G281	B	2023/02/16	Cobalt, total	mg/L	<0.00048
UA	G281	B	2023/06/08	Cobalt, total	mg/L	0.000990
UA	G281	B	2023/08/14	Cobalt, total	mg/L	0.000400
UA	G281	B	2023/11/20	Cobalt, total	mg/L	0.000600
UA	G281	B	2023/06/08	Ferrous Iron, dissolved	mg/L	0.260
UA	G281	B	2020/08/11	Iron, dissolved	mg/L	<0.01
UA	G281	B	2020/10/14	Iron, dissolved	mg/L	<0.01
UA	G281	B	2021/01/29	Iron, dissolved	mg/L	<0.01
UA	G281	B	2021/04/21	Iron, dissolved	mg/L	0.0620
UA	G281	B	2021/08/17	Iron, dissolved	mg/L	<0.01
UA	G281	B	2021/10/26	Iron, dissolved	mg/L	<0.01
UA	G281	B	2022/02/08	Iron, dissolved	mg/L	<0.01
UA	G281	B	2022/05/10	Iron, dissolved	mg/L	0.00350
UA	G281	B	2022/08/25	Iron, dissolved	mg/L	0.00820
UA	G281	B	2022/11/08	Iron, dissolved	mg/L	0.0250
UA	G281	B	2023/02/16	Iron, dissolved	mg/L	1.20
UA	G281	B	2023/06/08	Iron, dissolved	mg/L	0.0160
UA	G281	B	2023/08/14	Iron, dissolved	mg/L	<0.0175
UA	G281	B	2023/11/20	Iron, dissolved	mg/L	<0.0115
UA	G281	B	2016/11/16	Magnesium, total	mg/L	66.0
UA	G281	B	2017/05/16	Magnesium, total	mg/L	59.0

UA	G281	B	2017/07/12	Magnesium, total	mg/L	63.0
UA	G281	B	2020/01/24	Magnesium, total	mg/L	67.0
UA	G281	B	2020/08/12	Magnesium, total	mg/L	60.0
UA	G281	B	2021/01/29	Magnesium, total	mg/L	61.0
UA	G281	B	2021/03/31	Magnesium, total	mg/L	53.0
UA	G281	B	2021/04/21	Magnesium, total	mg/L	58.0
UA	G281	B	2021/05/05	Magnesium, total	mg/L	62.0
UA	G281	B	2021/05/17	Magnesium, total	mg/L	63.0
UA	G281	B	2021/06/14	Magnesium, total	mg/L	61.0
UA	G281	B	2021/06/28	Magnesium, total	mg/L	61.0
UA	G281	B	2021/07/12	Magnesium, total	mg/L	58.0
UA	G281	B	2021/07/27	Magnesium, total	mg/L	59.0
UA	G281	B	2021/08/17	Magnesium, total	mg/L	64.0
UA	G281	B	2022/02/08	Magnesium, total	mg/L	60.0
UA	G281	B	2022/08/25	Magnesium, total	mg/L	67.0
UA	G281	B	2023/02/16	Magnesium, total	mg/L	62.0
UA	G281	B	2023/06/08	Magnesium, total	mg/L	61.0
UA	G281	B	2023/08/14	Magnesium, total	mg/L	61.0
UA	G281	B	2023/11/20	Magnesium, total	mg/L	68.5
UA	G281	B	2018/03/01	Manganese, dissolved	mg/L	0.160
UA	G281	B	2018/05/11	Manganese, dissolved	mg/L	0.0200
UA	G281	B	2018/08/11	Manganese, dissolved	mg/L	0.340
UA	G281	B	2018/11/06	Manganese, dissolved	mg/L	0.360
UA	G281	B	2019/01/23	Manganese, dissolved	mg/L	0.450
UA	G281	B	2019/05/02	Manganese, dissolved	mg/L	0.0590
UA	G281	B	2019/08/13	Manganese, dissolved	mg/L	0.300
UA	G281	B	2019/10/21	Manganese, dissolved	mg/L	0.350
UA	G281	B	2020/01/24	Manganese, dissolved	mg/L	0.0690
UA	G281	B	2020/05/05	Manganese, dissolved	mg/L	0.100
UA	G281	B	2020/08/11	Manganese, dissolved	mg/L	0.170
UA	G281	B	2020/10/14	Manganese, dissolved	mg/L	0.160
UA	G281	B	2021/01/29	Manganese, dissolved	mg/L	0.0390
UA	G281	B	2021/04/21	Manganese, dissolved	mg/L	0.0610
UA	G281	B	2021/08/17	Manganese, dissolved	mg/L	0.110
UA	G281	B	2021/10/26	Manganese, dissolved	mg/L	0.150
UA	G281	B	2022/02/08	Manganese, dissolved	mg/L	0.0300
UA	G281	B	2022/05/10	Manganese, dissolved	mg/L	0.0710
UA	G281	B	2022/08/25	Manganese, dissolved	mg/L	0.180
UA	G281	B	2022/11/08	Manganese, dissolved	mg/L	0.140
UA	G281	B	2023/02/16	Manganese, dissolved	mg/L	0.250
UA	G281	B	2023/06/08	Manganese, dissolved	mg/L	0.310
UA	G281	B	2023/08/14	Manganese, dissolved	mg/L	0.291
UA	G281	B	2023/11/20	Manganese, dissolved	mg/L	0.306
UA	G281	B	2023/08/14	Phosphate, dissolved	mg/L	0.0340
UA	G281	B	2016/11/16	Potassium, total	mg/L	0.880
UA	G281	B	2017/05/16	Potassium, total	mg/L	0.800
UA	G281	B	2017/07/12	Potassium, total	mg/L	1.10
UA	G281	B	2020/01/24	Potassium, total	mg/L	0.620
UA	G281	B	2020/08/12	Potassium, total	mg/L	0.360
UA	G281	B	2021/01/29	Potassium, total	mg/L	0.610
UA	G281	B	2021/03/31	Potassium, total	mg/L	1.40
UA	G281	B	2021/04/21	Potassium, total	mg/L	0.400
UA	G281	B	2021/05/05	Potassium, total	mg/L	1.50
UA	G281	B	2021/05/17	Potassium, total	mg/L	0.840
UA	G281	B	2021/06/14	Potassium, total	mg/L	0.430
UA	G281	B	2021/06/28	Potassium, total	mg/L	0.450
UA	G281	B	2021/07/12	Potassium, total	mg/L	0.440
UA	G281	B	2021/07/27	Potassium, total	mg/L	0.420
UA	G281	B	2021/08/17	Potassium, total	mg/L	0.590
UA	G281	B	2022/02/08	Potassium, total	mg/L	0.510
UA	G281	B	2022/08/25	Potassium, total	mg/L	0.730
UA	G281	B	2023/02/16	Potassium, total	mg/L	0.550
UA	G281	B	2023/06/08	Potassium, total	mg/L	0.530

UA	G281	B	2023/08/14	Potassium, total	mg/L	0.609
UA	G281	B	2023/11/20	Potassium, total	mg/L	0.663
UA	G281	B	2023/06/08	Silicon, dissolved	mg/L	10.0
UA	G281	B	2023/08/14	Silicon, dissolved	mg/L	8.59
UA	G281	B	2016/11/16	Sodium, total	mg/L	86.0
UA	G281	B	2017/05/16	Sodium, total	mg/L	80.0
UA	G281	B	2017/07/12	Sodium, total	mg/L	86.0
UA	G281	B	2020/01/24	Sodium, total	mg/L	90.0
UA	G281	B	2020/08/12	Sodium, total	mg/L	88.0
UA	G281	B	2021/01/29	Sodium, total	mg/L	90.0
UA	G281	B	2021/03/31	Sodium, total	mg/L	79.0
UA	G281	B	2021/04/21	Sodium, total	mg/L	83.0
UA	G281	B	2021/05/05	Sodium, total	mg/L	93.0
UA	G281	B	2021/05/17	Sodium, total	mg/L	88.0
UA	G281	B	2021/06/14	Sodium, total	mg/L	83.0
UA	G281	B	2021/06/28	Sodium, total	mg/L	86.0
UA	G281	B	2021/07/12	Sodium, total	mg/L	78.0
UA	G281	B	2021/07/27	Sodium, total	mg/L	85.0
UA	G281	B	2021/08/17	Sodium, total	mg/L	100
UA	G281	B	2022/02/08	Sodium, total	mg/L	89.0
UA	G281	B	2022/08/25	Sodium, total	mg/L	100
UA	G281	B	2023/02/16	Sodium, total	mg/L	100
UA	G281	B	2023/06/08	Sodium, total	mg/L	89.0
UA	G281	B	2023/08/14	Sodium, total	mg/L	90.7
UA	G281	B	2023/11/20	Sodium, total	mg/L	93.3
UA	G281	B	2015/11/20	Sulfate, total	mg/L	300
UA	G281	B	2016/02/11	Sulfate, total	mg/L	340
UA	G281	B	2016/05/10	Sulfate, total	mg/L	370
UA	G281	B	2016/08/01	Sulfate, total	mg/L	310
UA	G281	B	2016/11/16	Sulfate, total	mg/L	310
UA	G281	B	2017/02/10	Sulfate, total	mg/L	310
UA	G281	B	2017/05/16	Sulfate, total	mg/L	330
UA	G281	B	2017/07/12	Sulfate, total	mg/L	300
UA	G281	B	2017/10/25	Sulfate, total	mg/L	300
UA	G281	B	2018/05/11	Sulfate, total	mg/L	310
UA	G281	B	2018/08/03	Sulfate, total	mg/L	280
UA	G281	B	2019/01/23	Sulfate, total	mg/L	380
UA	G281	B	2019/08/13	Sulfate, total	mg/L	310
UA	G281	B	2020/01/24	Sulfate, total	mg/L	300
UA	G281	B	2020/08/12	Sulfate, total	mg/L	260
UA	G281	B	2020/10/14	Sulfate, total	mg/L	250
UA	G281	B	2021/01/29	Sulfate, total	mg/L	260
UA	G281	B	2021/03/31	Sulfate, total	mg/L	280
UA	G281	B	2021/04/21	Sulfate, total	mg/L	250
UA	G281	B	2021/05/05	Sulfate, total	mg/L	260
UA	G281	B	2021/05/17	Sulfate, total	mg/L	280
UA	G281	B	2021/06/14	Sulfate, total	mg/L	260
UA	G281	B	2021/06/28	Sulfate, total	mg/L	280
UA	G281	B	2021/07/12	Sulfate, total	mg/L	260
UA	G281	B	2021/07/27	Sulfate, total	mg/L	270
UA	G281	B	2021/08/17	Sulfate, total	mg/L	260
UA	G281	B	2021/10/26	Sulfate, total	mg/L	270
UA	G281	B	2022/02/08	Sulfate, total	mg/L	270
UA	G281	B	2022/05/10	Sulfate, total	mg/L	290
UA	G281	B	2022/08/25	Sulfate, total	mg/L	310
UA	G281	B	2022/11/08	Sulfate, total	mg/L	300
UA	G281	B	2023/02/16	Sulfate, total	mg/L	270
UA	G281	B	2023/06/08	Sulfate, total	mg/L	140
UA	G281	B	2023/08/14	Sulfate, total	mg/L	268
UA	G281	B	2023/11/20	Sulfate, total	mg/L	293
UA	G281	B	2015/11/20	Temperature (Celsius)	degrees C	16.8
UA	G281	B	2016/02/11	Temperature (Celsius)	degrees C	8.00
UA	G281	B	2016/05/10	Temperature (Celsius)	degrees C	15.5

UA	G281	B	2016/08/01	Temperature (Celsius)	degrees C	16.7
UA	G281	B	2016/11/16	Temperature (Celsius)	degrees C	13.6
UA	G281	B	2017/02/10	Temperature (Celsius)	degrees C	14.5
UA	G281	B	2017/05/16	Temperature (Celsius)	degrees C	15.4
UA	G281	B	2017/07/12	Temperature (Celsius)	degrees C	16.5
UA	G281	B	2017/10/25	Temperature (Celsius)	degrees C	13.0
UA	G281	B	2018/05/11	Temperature (Celsius)	degrees C	14.3
UA	G281	B	2018/08/03	Temperature (Celsius)	degrees C	16.1
UA	G281	B	2019/01/23	Temperature (Celsius)	degrees C	11.9
UA	G281	B	2019/08/13	Temperature (Celsius)	degrees C	17.4
UA	G281	B	2020/01/24	Temperature (Celsius)	degrees C	9.70
UA	G281	B	2020/08/12	Temperature (Celsius)	degrees C	21.5
UA	G281	B	2020/10/14	Temperature (Celsius)	degrees C	17.9
UA	G281	B	2021/01/29	Temperature (Celsius)	degrees C	9.40
UA	G281	B	2021/03/31	Temperature (Celsius)	degrees C	11.1
UA	G281	B	2021/04/21	Temperature (Celsius)	degrees C	12.0
UA	G281	B	2021/05/05	Temperature (Celsius)	degrees C	14.0
UA	G281	B	2021/05/17	Temperature (Celsius)	degrees C	15.0
UA	G281	B	2021/06/14	Temperature (Celsius)	degrees C	20.8
UA	G281	B	2021/06/28	Temperature (Celsius)	degrees C	20.7
UA	G281	B	2021/07/12	Temperature (Celsius)	degrees C	19.9
UA	G281	B	2021/07/27	Temperature (Celsius)	degrees C	20.4
UA	G281	B	2021/08/17	Temperature (Celsius)	degrees C	20.7
UA	G281	B	2021/10/26	Temperature (Celsius)	degrees C	17.3
UA	G281	B	2022/02/08	Temperature (Celsius)	degrees C	10.6
UA	G281	B	2022/05/10	Temperature (Celsius)	degrees C	17.8
UA	G281	B	2022/08/25	Temperature (Celsius)	degrees C	21.0
UA	G281	B	2022/11/08	Temperature (Celsius)	degrees C	17.9
UA	G281	B	2023/02/16	Temperature (Celsius)	degrees C	9.20
UA	G281	B	2023/06/08	Temperature (Celsius)	degrees C	18.4
UA	G281	B	2023/08/14	Temperature (Celsius)	degrees C	18.6
UA	G281	B	2023/11/20	Temperature (Celsius)	degrees C	16.1
UA	G281	B	2015/11/20	Total Dissolved Solids	mg/L	820
UA	G281	B	2016/02/11	Total Dissolved Solids	mg/L	740
UA	G281	B	2016/05/10	Total Dissolved Solids	mg/L	740
UA	G281	B	2016/08/01	Total Dissolved Solids	mg/L	780
UA	G281	B	2016/11/16	Total Dissolved Solids	mg/L	840
UA	G281	B	2017/02/10	Total Dissolved Solids	mg/L	840
UA	G281	B	2017/05/16	Total Dissolved Solids	mg/L	840
UA	G281	B	2017/07/12	Total Dissolved Solids	mg/L	760
UA	G281	B	2017/10/25	Total Dissolved Solids	mg/L	800
UA	G281	B	2018/05/11	Total Dissolved Solids	mg/L	840
UA	G281	B	2018/08/03	Total Dissolved Solids	mg/L	840
UA	G281	B	2019/01/23	Total Dissolved Solids	mg/L	880
UA	G281	B	2019/08/13	Total Dissolved Solids	mg/L	900
UA	G281	B	2020/01/24	Total Dissolved Solids	mg/L	880
UA	G281	B	2020/08/12	Total Dissolved Solids	mg/L	700
UA	G281	B	2020/10/14	Total Dissolved Solids	mg/L	870
UA	G281	B	2021/01/29	Total Dissolved Solids	mg/L	870
UA	G281	B	2021/03/31	Total Dissolved Solids	mg/L	830
UA	G281	B	2021/04/21	Total Dissolved Solids	mg/L	1,000
UA	G281	B	2021/05/05	Total Dissolved Solids	mg/L	820
UA	G281	B	2021/05/17	Total Dissolved Solids	mg/L	870
UA	G281	B	2021/06/14	Total Dissolved Solids	mg/L	930
UA	G281	B	2021/06/28	Total Dissolved Solids	mg/L	830
UA	G281	B	2021/07/12	Total Dissolved Solids	mg/L	910
UA	G281	B	2021/07/27	Total Dissolved Solids	mg/L	880
UA	G281	B	2021/08/17	Total Dissolved Solids	mg/L	910
UA	G281	B	2021/10/26	Total Dissolved Solids	mg/L	820
UA	G281	B	2022/02/08	Total Dissolved Solids	mg/L	910
UA	G281	B	2022/05/10	Total Dissolved Solids	mg/L	910
UA	G281	B	2022/08/25	Total Dissolved Solids	mg/L	980
UA	G281	B	2022/11/08	Total Dissolved Solids	mg/L	900

UA	G281	B	2023/02/16	Total Dissolved Solids	mg/L	980
UA	G281	B	2023/06/08	Total Dissolved Solids	mg/L	1,000
UA	G281	B	2023/08/14	Total Dissolved Solids	mg/L	930
UA	G281	B	2023/11/20	Total Dissolved Solids	mg/L	958
UA	G401	C	2015/11/21	pH (field)	SU	6.0
UA	G401	C	2016/02/22	pH (field)	SU	5.8
UA	G401	C	2016/05/19	pH (field)	SU	6.0
UA	G401	C	2016/08/01	pH (field)	SU	6.2
UA	G401	C	2016/11/17	pH (field)	SU	6.2
UA	G401	C	2017/02/16	pH (field)	SU	6.2
UA	G401	C	2017/05/17	pH (field)	SU	6.3
UA	G401	C	2017/07/13	pH (field)	SU	6.2
UA	G401	C	2017/10/27	pH (field)	SU	6.3
UA	G401	C	2018/05/12	pH (field)	SU	6.2
UA	G401	C	2018/08/04	pH (field)	SU	6.2
UA	G401	C	2019/01/24	pH (field)	SU	6.3
UA	G401	C	2019/08/16	pH (field)	SU	6.4
UA	G401	C	2020/01/22	pH (field)	SU	6.0
UA	G401	C	2020/05/06	pH (field)	SU	5.8
UA	G401	C	2020/08/12	pH (field)	SU	5.8
UA	G401	C	2020/10/14	pH (field)	SU	5.7
UA	G401	C	2021/01/29	pH (field)	SU	5.9
UA	G401	C	2021/05/20	pH (field)	SU	5.9
UA	G401	C	2021/08/17	pH (field)	SU	5.9
UA	G401	C	2021/10/26	pH (field)	SU	5.6
UA	G401	C	2021/11/29	pH (field)	SU	5.8
UA	G401	C	2022/02/09	pH (field)	SU	5.8
UA	G401	C	2022/05/10	pH (field)	SU	5.9
UA	G401	C	2022/09/20	pH (field)	SU	6.1
UA	G401	C	2022/11/08	pH (field)	SU	6.2
UA	G401	C	2023/02/15	pH (field)	SU	5.9
UA	G401	C	2023/06/07	pH (field)	SU	6.2
UA	G401	C	2023/08/11	pH (field)	SU	6.0
UA	G401	C	2023/11/21	pH (field)	SU	5.9
UA	G401	C	2015/11/21	Oxidation Reduction Potential	mV	-16.0
UA	G401	C	2016/02/22	Oxidation Reduction Potential	mV	27.0
UA	G401	C	2016/05/19	Oxidation Reduction Potential	mV	-23.0
UA	G401	C	2016/08/01	Oxidation Reduction Potential	mV	-37.0
UA	G401	C	2016/11/17	Oxidation Reduction Potential	mV	-44.0
UA	G401	C	2017/02/16	Oxidation Reduction Potential	mV	-59.0
UA	G401	C	2017/05/17	Oxidation Reduction Potential	mV	-68.0
UA	G401	C	2017/07/13	Oxidation Reduction Potential	mV	-48.0
UA	G401	C	2017/10/27	Oxidation Reduction Potential	mV	-41.0
UA	G401	C	2018/05/12	Oxidation Reduction Potential	mV	-50.0
UA	G401	C	2018/08/04	Oxidation Reduction Potential	mV	-55.0
UA	G401	C	2019/01/24	Oxidation Reduction Potential	mV	-52.0
UA	G401	C	2019/08/16	Oxidation Reduction Potential	mV	-51.0
UA	G401	C	2020/01/22	Oxidation Reduction Potential	mV	111
UA	G401	C	2020/05/06	Oxidation Reduction Potential	mV	94.1
UA	G401	C	2020/08/12	Oxidation Reduction Potential	mV	38.8
UA	G401	C	2020/10/14	Oxidation Reduction Potential	mV	40.2
UA	G401	C	2021/01/29	Oxidation Reduction Potential	mV	44.0
UA	G401	C	2021/05/20	Oxidation Reduction Potential	mV	25.0
UA	G401	C	2021/08/17	Oxidation Reduction Potential	mV	29.6
UA	G401	C	2021/10/26	Oxidation Reduction Potential	mV	28.3
UA	G401	C	2021/11/29	Oxidation Reduction Potential	mV	41.2
UA	G401	C	2022/02/09	Oxidation Reduction Potential	mV	78.1
UA	G401	C	2022/05/10	Oxidation Reduction Potential	mV	38.4
UA	G401	C	2022/09/20	Oxidation Reduction Potential	mV	4.70
UA	G401	C	2022/11/08	Oxidation Reduction Potential	mV	-18.0
UA	G401	C	2023/02/15	Oxidation Reduction Potential	mV	22.0
UA	G401	C	2023/06/07	Oxidation Reduction Potential	mV	-32.0
UA	G401	C	2023/08/11	Oxidation Reduction Potential	mV	-30.0

UA	G401	C	2023/11/21	Oxidation Reduction Potential	mV	15.0
UA	G401	C	2015/11/21	Eh	V	0.18
UA	G401	C	2016/02/22	Eh	V	0.22
UA	G401	C	2016/05/19	Eh	V	0.17
UA	G401	C	2016/08/01	Eh	V	0.16
UA	G401	C	2016/11/17	Eh	V	0.15
UA	G401	C	2017/02/16	Eh	V	0.14
UA	G401	C	2017/05/17	Eh	V	0.13
UA	G401	C	2017/07/13	Eh	V	0.15
UA	G401	C	2017/10/27	Eh	V	0.16
UA	G401	C	2018/05/12	Eh	V	0.15
UA	G401	C	2018/08/04	Eh	V	0.14
UA	G401	C	2019/01/24	Eh	V	0.15
UA	G401	C	2019/08/16	Eh	V	0.14
UA	G401	C	2020/01/22	Eh	V	0.31
UA	G401	C	2020/05/06	Eh	V	0.29
UA	G401	C	2020/08/12	Eh	V	0.23
UA	G401	C	2020/10/14	Eh	V	0.23
UA	G401	C	2021/01/29	Eh	V	0.24
UA	G401	C	2021/05/20	Eh	V	0.22
UA	G401	C	2021/08/17	Eh	V	0.22
UA	G401	C	2021/10/26	Eh	V	0.22
UA	G401	C	2021/11/29	Eh	V	0.24
UA	G401	C	2022/02/09	Eh	V	0.27
UA	G401	C	2022/05/10	Eh	V	0.23
UA	G401	C	2022/09/20	Eh	V	0.19
UA	G401	C	2022/11/08	Eh	V	0.18
UA	G401	C	2023/02/15	Eh	V	0.22
UA	G401	C	2023/06/07	Eh	V	0.17
UA	G401	C	2023/08/11	Eh	V	0.16
UA	G401	C	2023/11/21	Eh	V	0.21
UA	G401	C	2020/01/22	Alkalinity, bicarbonate	mg/L CaCO3	110
UA	G401	C	2021/01/29	Alkalinity, bicarbonate	mg/L CaCO3	50.0
UA	G401	C	2021/08/17	Alkalinity, bicarbonate	mg/L CaCO3	88.0
UA	G401	C	2022/02/09	Alkalinity, bicarbonate	mg/L CaCO3	75.0
UA	G401	C	2022/09/20	Alkalinity, bicarbonate	mg/L CaCO3	60.0
UA	G401	C	2023/02/15	Alkalinity, bicarbonate	mg/L CaCO3	80.0
UA	G401	C	2023/06/07	Alkalinity, bicarbonate	mg/L CaCO3	140
UA	G401	C	2023/08/11	Alkalinity, bicarbonate	mg/L CaCO3	96.0
UA	G401	C	2023/11/21	Alkalinity, bicarbonate	mg/L CaCO3	99.0
UA	G401	C	2022/09/20	Alkalinity, carbonate	mg/L CaCO3	10.0
UA	G401	C	2015/11/21	Barium, total	mg/L	0.0370
UA	G401	C	2016/02/22	Barium, total	mg/L	0.0150
UA	G401	C	2016/05/19	Barium, total	mg/L	0.0140
UA	G401	C	2016/08/01	Barium, total	mg/L	0.0530
UA	G401	C	2016/11/17	Barium, total	mg/L	0.0210
UA	G401	C	2017/02/16	Barium, total	mg/L	0.420
UA	G401	C	2017/05/17	Barium, total	mg/L	0.300
UA	G401	C	2017/07/13	Barium, total	mg/L	0.570
UA	G401	C	2018/05/12	Barium, total	mg/L	0.140
UA	G401	C	2018/08/04	Barium, total	mg/L	1.50
UA	G401	C	2019/01/24	Barium, total	mg/L	0.300
UA	G401	C	2019/08/16	Barium, total	mg/L	0.190
UA	G401	C	2020/01/22	Barium, total	mg/L	0.0120
UA	G401	C	2020/08/12	Barium, total	mg/L	0.0100
UA	G401	C	2020/10/14	Barium, total	mg/L	0.0120
UA	G401	C	2021/01/29	Barium, total	mg/L	0.0130
UA	G401	C	2021/05/20	Barium, total	mg/L	0.0120
UA	G401	C	2021/08/17	Barium, total	mg/L	0.00970
UA	G401	C	2021/10/26	Barium, total	mg/L	0.0100
UA	G401	C	2022/02/09	Barium, total	mg/L	0.0110
UA	G401	C	2022/05/10	Barium, total	mg/L	0.0140
UA	G401	C	2022/09/20	Barium, total	mg/L	0.0110

UA	G401	C	2022/11/08	Barium, total	mg/L	0.00920
UA	G401	C	2023/02/15	Barium, total	mg/L	0.0110
UA	G401	C	2023/06/07	Barium, total	mg/L	0.0100
UA	G401	C	2023/08/11	Barium, total	mg/L	0.0118
UA	G401	C	2023/11/21	Barium, total	mg/L	0.0132
UA	G401	C	2015/11/21	Boron, total	mg/L	3.30
UA	G401	C	2016/02/22	Boron, total	mg/L	3.40
UA	G401	C	2016/05/19	Boron, total	mg/L	3.50
UA	G401	C	2016/08/01	Boron, total	mg/L	4.10
UA	G401	C	2016/11/17	Boron, total	mg/L	4.00
UA	G401	C	2017/02/16	Boron, total	mg/L	3.70
UA	G401	C	2017/05/17	Boron, total	mg/L	3.20
UA	G401	C	2017/07/13	Boron, total	mg/L	3.60
UA	G401	C	2017/10/27	Boron, total	mg/L	4.40
UA	G401	C	2018/05/12	Boron, total	mg/L	3.70
UA	G401	C	2018/08/04	Boron, total	mg/L	3.90
UA	G401	C	2019/01/24	Boron, total	mg/L	3.80
UA	G401	C	2019/08/16	Boron, total	mg/L	4.00
UA	G401	C	2020/01/22	Boron, total	mg/L	1.10
UA	G401	C	2020/08/12	Boron, total	mg/L	4.20
UA	G401	C	2020/10/14	Boron, total	mg/L	4.10
UA	G401	C	2021/01/29	Boron, total	mg/L	3.70
UA	G401	C	2021/05/20	Boron, total	mg/L	3.90
UA	G401	C	2021/08/17	Boron, total	mg/L	4.20
UA	G401	C	2021/10/26	Boron, total	mg/L	3.40
UA	G401	C	2022/02/09	Boron, total	mg/L	3.50
UA	G401	C	2022/05/10	Boron, total	mg/L	3.20
UA	G401	C	2022/09/20	Boron, total	mg/L	4.30
UA	G401	C	2022/11/08	Boron, total	mg/L	4.00
UA	G401	C	2023/02/15	Boron, total	mg/L	3.90
UA	G401	C	2023/06/07	Boron, total	mg/L	3.90
UA	G401	C	2023/08/11	Boron, total	mg/L	4.24
UA	G401	C	2023/11/21	Boron, total	mg/L	5.37
UA	G401	C	2015/11/21	Calcium, total	mg/L	440
UA	G401	C	2016/02/22	Calcium, total	mg/L	330
UA	G401	C	2016/05/19	Calcium, total	mg/L	380
UA	G401	C	2016/08/01	Calcium, total	mg/L	450
UA	G401	C	2016/11/17	Calcium, total	mg/L	400
UA	G401	C	2017/02/16	Calcium, total	mg/L	440
UA	G401	C	2017/05/17	Calcium, total	mg/L	470
UA	G401	C	2017/07/13	Calcium, total	mg/L	470
UA	G401	C	2017/10/27	Calcium, total	mg/L	490
UA	G401	C	2018/05/12	Calcium, total	mg/L	450
UA	G401	C	2018/08/04	Calcium, total	mg/L	690
UA	G401	C	2019/01/24	Calcium, total	mg/L	560
UA	G401	C	2019/08/16	Calcium, total	mg/L	550
UA	G401	C	2020/01/22	Calcium, total	mg/L	210
UA	G401	C	2020/08/12	Calcium, total	mg/L	520
UA	G401	C	2020/10/14	Calcium, total	mg/L	530
UA	G401	C	2021/01/29	Calcium, total	mg/L	490
UA	G401	C	2021/05/20	Calcium, total	mg/L	480
UA	G401	C	2021/08/17	Calcium, total	mg/L	550
UA	G401	C	2021/10/26	Calcium, total	mg/L	440
UA	G401	C	2022/02/09	Calcium, total	mg/L	450
UA	G401	C	2022/05/10	Calcium, total	mg/L	410
UA	G401	C	2022/09/20	Calcium, total	mg/L	490
UA	G401	C	2022/11/08	Calcium, total	mg/L	450
UA	G401	C	2023/02/15	Calcium, total	mg/L	480
UA	G401	C	2023/06/07	Calcium, total	mg/L	490
UA	G401	C	2023/08/11	Calcium, total	mg/L	509
UA	G401	C	2023/11/21	Calcium, total	mg/L	553
UA	G401	C	2015/11/21	Chloride, total	mg/L	3.60
UA	G401	C	2016/02/22	Chloride, total	mg/L	6.00

UA	G401	C	2016/05/19	Chloride, total	mg/L	3.00
UA	G401	C	2016/08/01	Chloride, total	mg/L	5.30
UA	G401	C	2016/11/17	Chloride, total	mg/L	<0.1
UA	G401	C	2017/02/16	Chloride, total	mg/L	2.40
UA	G401	C	2017/05/17	Chloride, total	mg/L	3.40
UA	G401	C	2017/07/13	Chloride, total	mg/L	2.60
UA	G401	C	2017/10/27	Chloride, total	mg/L	3.20
UA	G401	C	2018/05/12	Chloride, total	mg/L	2.20
UA	G401	C	2018/08/04	Chloride, total	mg/L	2.10
UA	G401	C	2019/01/24	Chloride, total	mg/L	3.10
UA	G401	C	2019/08/16	Chloride, total	mg/L	2.50
UA	G401	C	2020/01/22	Chloride, total	mg/L	8.60
UA	G401	C	2020/08/12	Chloride, total	mg/L	2.70
UA	G401	C	2020/10/14	Chloride, total	mg/L	4.40
UA	G401	C	2021/01/29	Chloride, total	mg/L	2.30
UA	G401	C	2021/05/20	Chloride, total	mg/L	5.90
UA	G401	C	2021/08/17	Chloride, total	mg/L	14.0
UA	G401	C	2021/10/26	Chloride, total	mg/L	12.0
UA	G401	C	2022/02/09	Chloride, total	mg/L	6.40
UA	G401	C	2022/05/10	Chloride, total	mg/L	6.00
UA	G401	C	2022/09/20	Chloride, total	mg/L	2.90
UA	G401	C	2022/11/08	Chloride, total	mg/L	2.60
UA	G401	C	2023/02/15	Chloride, total	mg/L	4.60
UA	G401	C	2023/06/07	Chloride, total	mg/L	3.60
UA	G401	C	2023/08/11	Chloride, total	mg/L	3.00
UA	G401	C	2023/11/21	Chloride, total	mg/L	3.00
UA	G401	C	2015/11/21	Cobalt, total	mg/L	0.250
UA	G401	C	2016/02/22	Cobalt, total	mg/L	0.240
UA	G401	C	2016/05/19	Cobalt, total	mg/L	0.270
UA	G401	C	2016/08/01	Cobalt, total	mg/L	0.280
UA	G401	C	2016/11/17	Cobalt, total	mg/L	0.270
UA	G401	C	2017/02/16	Cobalt, total	mg/L	0.280
UA	G401	C	2017/05/17	Cobalt, total	mg/L	0.290
UA	G401	C	2017/07/13	Cobalt, total	mg/L	0.360
UA	G401	C	2018/05/12	Cobalt, total	mg/L	0.300
UA	G401	C	2018/08/04	Cobalt, total	mg/L	0.420
UA	G401	C	2019/01/24	Cobalt, total	mg/L	0.310
UA	G401	C	2019/08/16	Cobalt, total	mg/L	0.300
UA	G401	C	2020/01/22	Cobalt, total	mg/L	0.0460
UA	G401	C	2020/08/12	Cobalt, total	mg/L	0.260
UA	G401	C	2020/10/14	Cobalt, total	mg/L	0.280
UA	G401	C	2021/01/29	Cobalt, total	mg/L	0.240
UA	G401	C	2021/05/20	Cobalt, total	mg/L	0.190
UA	G401	C	2021/08/17	Cobalt, total	mg/L	0.170
UA	G401	C	2021/10/26	Cobalt, total	mg/L	0.140
UA	G401	C	2022/02/09	Cobalt, total	mg/L	0.150
UA	G401	C	2022/05/10	Cobalt, total	mg/L	0.110
UA	G401	C	2022/09/20	Cobalt, total	mg/L	0.140
UA	G401	C	2022/11/08	Cobalt, total	mg/L	0.110
UA	G401	C	2023/02/15	Cobalt, total	mg/L	0.120
UA	G401	C	2023/06/07	Cobalt, total	mg/L	0.110
UA	G401	C	2023/08/11	Cobalt, total	mg/L	0.156
UA	G401	C	2023/11/21	Cobalt, total	mg/L	0.206
UA	G401	C	2023/06/07	Ferrous Iron, dissolved	mg/L	6.00
UA	G401	C	2020/08/12	Iron, dissolved	mg/L	190
UA	G401	C	2020/10/14	Iron, dissolved	mg/L	190
UA	G401	C	2021/01/29	Iron, dissolved	mg/L	120
UA	G401	C	2021/05/20	Iron, dissolved	mg/L	130
UA	G401	C	2021/08/17	Iron, dissolved	mg/L	130
UA	G401	C	2021/10/26	Iron, dissolved	mg/L	98.0
UA	G401	C	2022/02/09	Iron, dissolved	mg/L	71.0
UA	G401	C	2022/05/10	Iron, dissolved	mg/L	62.0
UA	G401	C	2022/09/20	Iron, dissolved	mg/L	92.0

UA	G401	C	2022/11/08	Iron, dissolved	mg/L	66.0
UA	G401	C	2023/02/15	Iron, dissolved	mg/L	56.0
UA	G401	C	2023/06/07	Iron, dissolved	mg/L	84.0
UA	G401	C	2023/08/11	Iron, dissolved	mg/L	93.8
UA	G401	C	2023/11/21	Iron, dissolved	mg/L	95.2
UA	G401	C	2017/07/13	Magnesium, total	mg/L	160
UA	G401	C	2020/01/22	Magnesium, total	mg/L	64.0
UA	G401	C	2021/01/29	Magnesium, total	mg/L	140
UA	G401	C	2021/08/17	Magnesium, total	mg/L	160
UA	G401	C	2022/02/09	Magnesium, total	mg/L	140
UA	G401	C	2022/09/20	Magnesium, total	mg/L	160
UA	G401	C	2023/02/15	Magnesium, total	mg/L	140
UA	G401	C	2023/06/07	Magnesium, total	mg/L	150
UA	G401	C	2023/08/11	Magnesium, total	mg/L	141
UA	G401	C	2023/11/21	Magnesium, total	mg/L	142
UA	G401	C	2018/03/03	Manganese, dissolved	mg/L	38.0
UA	G401	C	2018/05/12	Manganese, dissolved	mg/L	32.0
UA	G401	C	2018/08/13	Manganese, dissolved	mg/L	30.0
UA	G401	C	2018/11/07	Manganese, dissolved	mg/L	38.0
UA	G401	C	2019/01/24	Manganese, dissolved	mg/L	45.0
UA	G401	C	2019/05/02	Manganese, dissolved	mg/L	10.0
UA	G401	C	2019/08/13	Manganese, dissolved	mg/L	40.0
UA	G401	C	2019/10/22	Manganese, dissolved	mg/L	39.0
UA	G401	C	2020/01/22	Manganese, dissolved	mg/L	17.0
UA	G401	C	2020/05/06	Manganese, dissolved	mg/L	38.0
UA	G401	C	2020/08/12	Manganese, dissolved	mg/L	44.0
UA	G401	C	2020/10/14	Manganese, dissolved	mg/L	47.0
UA	G401	C	2021/01/29	Manganese, dissolved	mg/L	45.0
UA	G401	C	2021/05/20	Manganese, dissolved	mg/L	43.0
UA	G401	C	2021/08/17	Manganese, dissolved	mg/L	38.0
UA	G401	C	2021/10/26	Manganese, dissolved	mg/L	33.0
UA	G401	C	2022/02/09	Manganese, dissolved	mg/L	27.0
UA	G401	C	2022/05/10	Manganese, dissolved	mg/L	21.0
UA	G401	C	2022/09/20	Manganese, dissolved	mg/L	31.0
UA	G401	C	2022/11/08	Manganese, dissolved	mg/L	28.0
UA	G401	C	2023/02/15	Manganese, dissolved	mg/L	24.0
UA	G401	C	2023/06/07	Manganese, dissolved	mg/L	27.0
UA	G401	C	2023/08/11	Manganese, dissolved	mg/L	36.0
UA	G401	C	2023/11/21	Manganese, dissolved	mg/L	24.5
UA	G401	C	2023/08/11	Phosphate, dissolved	mg/L	0.0610
UA	G401	C	2017/07/13	Potassium, total	mg/L	12.0
UA	G401	C	2020/01/22	Potassium, total	mg/L	2.00
UA	G401	C	2021/01/29	Potassium, total	mg/L	3.90
UA	G401	C	2021/08/17	Potassium, total	mg/L	3.60
UA	G401	C	2022/02/09	Potassium, total	mg/L	3.20
UA	G401	C	2022/09/20	Potassium, total	mg/L	3.00
UA	G401	C	2023/02/15	Potassium, total	mg/L	2.50
UA	G401	C	2023/06/07	Potassium, total	mg/L	2.20
UA	G401	C	2023/08/11	Potassium, total	mg/L	2.86
UA	G401	C	2023/11/21	Potassium, total	mg/L	2.80
UA	G401	C	2023/06/07	Silicon, dissolved	mg/L	16.0
UA	G401	C	2023/08/11	Silicon, dissolved	mg/L	15.2
UA	G401	C	2017/07/13	Sodium, total	mg/L	47.0
UA	G401	C	2020/01/22	Sodium, total	mg/L	79.0
UA	G401	C	2021/01/29	Sodium, total	mg/L	69.0
UA	G401	C	2021/08/17	Sodium, total	mg/L	83.0
UA	G401	C	2022/02/09	Sodium, total	mg/L	81.0
UA	G401	C	2022/09/20	Sodium, total	mg/L	77.0
UA	G401	C	2023/02/15	Sodium, total	mg/L	74.0
UA	G401	C	2023/06/07	Sodium, total	mg/L	71.0
UA	G401	C	2023/08/11	Sodium, total	mg/L	71.4
UA	G401	C	2023/11/21	Sodium, total	mg/L	64.0
UA	G401	C	2015/11/21	Sulfate, total	mg/L	2,300

UA	G401	C	2016/02/22	Sulfate, total	mg/L	2,500
UA	G401	C	2016/05/19	Sulfate, total	mg/L	2,200
UA	G401	C	2016/08/01	Sulfate, total	mg/L	2,100
UA	G401	C	2016/11/17	Sulfate, total	mg/L	3,400
UA	G401	C	2017/02/16	Sulfate, total	mg/L	3,900
UA	G401	C	2017/05/17	Sulfate, total	mg/L	2,000
UA	G401	C	2017/07/13	Sulfate, total	mg/L	2,100
UA	G401	C	2017/10/27	Sulfate, total	mg/L	2,000
UA	G401	C	2018/05/12	Sulfate, total	mg/L	2,200
UA	G401	C	2018/08/04	Sulfate, total	mg/L	2,200
UA	G401	C	2019/01/24	Sulfate, total	mg/L	4,600
UA	G401	C	2019/08/16	Sulfate, total	mg/L	4,300
UA	G401	C	2020/01/22	Sulfate, total	mg/L	870
UA	G401	C	2020/08/12	Sulfate, total	mg/L	2,000
UA	G401	C	2020/10/14	Sulfate, total	mg/L	2,400
UA	G401	C	2021/01/29	Sulfate, total	mg/L	2,500
UA	G401	C	2021/05/20	Sulfate, total	mg/L	2,400
UA	G401	C	2021/08/17	Sulfate, total	mg/L	1,900
UA	G401	C	2021/10/26	Sulfate, total	mg/L	1,800
UA	G401	C	2022/02/09	Sulfate, total	mg/L	2,000
UA	G401	C	2022/05/10	Sulfate, total	mg/L	1,900
UA	G401	C	2022/09/20	Sulfate, total	mg/L	2,100
UA	G401	C	2022/11/08	Sulfate, total	mg/L	2,100
UA	G401	C	2023/02/15	Sulfate, total	mg/L	1,900
UA	G401	C	2023/06/07	Sulfate, total	mg/L	2,100
UA	G401	C	2023/08/11	Sulfate, total	mg/L	1,900
UA	G401	C	2023/11/21	Sulfate, total	mg/L	1,980
UA	G401	C	2015/11/21	Temperature (Celsius)	degrees C	17.0
UA	G401	C	2016/02/22	Temperature (Celsius)	degrees C	13.5
UA	G401	C	2016/05/19	Temperature (Celsius)	degrees C	20.0
UA	G401	C	2016/08/01	Temperature (Celsius)	degrees C	18.9
UA	G401	C	2016/11/17	Temperature (Celsius)	degrees C	13.6
UA	G401	C	2017/02/16	Temperature (Celsius)	degrees C	14.3
UA	G401	C	2017/05/17	Temperature (Celsius)	degrees C	15.2
UA	G401	C	2017/07/13	Temperature (Celsius)	degrees C	17.3
UA	G401	C	2017/10/27	Temperature (Celsius)	degrees C	13.7
UA	G401	C	2018/05/12	Temperature (Celsius)	degrees C	14.7
UA	G401	C	2018/08/04	Temperature (Celsius)	degrees C	17.0
UA	G401	C	2019/01/24	Temperature (Celsius)	degrees C	11.7
UA	G401	C	2019/08/16	Temperature (Celsius)	degrees C	17.1
UA	G401	C	2020/01/22	Temperature (Celsius)	degrees C	12.3
UA	G401	C	2020/05/06	Temperature (Celsius)	degrees C	14.8
UA	G401	C	2020/08/12	Temperature (Celsius)	degrees C	21.0
UA	G401	C	2020/10/14	Temperature (Celsius)	degrees C	18.1
UA	G401	C	2021/01/29	Temperature (Celsius)	degrees C	10.2
UA	G401	C	2021/05/20	Temperature (Celsius)	degrees C	16.6
UA	G401	C	2021/08/17	Temperature (Celsius)	degrees C	21.2
UA	G401	C	2021/10/26	Temperature (Celsius)	degrees C	15.0
UA	G401	C	2021/11/29	Temperature (Celsius)	degrees C	14.0
UA	G401	C	2022/02/09	Temperature (Celsius)	degrees C	13.1
UA	G401	C	2022/05/10	Temperature (Celsius)	degrees C	17.4
UA	G401	C	2022/09/20	Temperature (Celsius)	degrees C	23.4
UA	G401	C	2022/11/08	Temperature (Celsius)	degrees C	18.1
UA	G401	C	2023/02/15	Temperature (Celsius)	degrees C	15.4
UA	G401	C	2023/06/07	Temperature (Celsius)	degrees C	12.3
UA	G401	C	2023/08/11	Temperature (Celsius)	degrees C	17.5
UA	G401	C	2023/11/21	Temperature (Celsius)	degrees C	12.9
UA	G401	C	2015/11/21	Total Dissolved Solids	mg/L	3,000
UA	G401	C	2016/02/22	Total Dissolved Solids	mg/L	3,000
UA	G401	C	2016/05/19	Total Dissolved Solids	mg/L	2,800
UA	G401	C	2016/08/01	Total Dissolved Solids	mg/L	2,900
UA	G401	C	2016/11/17	Total Dissolved Solids	mg/L	3,200
UA	G401	C	2017/02/16	Total Dissolved Solids	mg/L	3,000

UA	G401	C	2017/05/17	Total Dissolved Solids	mg/L	3,000
UA	G401	C	2017/07/13	Total Dissolved Solids	mg/L	2,600
UA	G401	C	2017/10/27	Total Dissolved Solids	mg/L	2,900
UA	G401	C	2018/05/12	Total Dissolved Solids	mg/L	2,700
UA	G401	C	2018/08/04	Total Dissolved Solids	mg/L	2,900
UA	G401	C	2019/01/24	Total Dissolved Solids	mg/L	2,900
UA	G401	C	2019/08/16	Total Dissolved Solids	mg/L	3,400
UA	G401	C	2020/01/22	Total Dissolved Solids	mg/L	1,200
UA	G401	C	2020/08/12	Total Dissolved Solids	mg/L	2,800
UA	G401	C	2020/10/14	Total Dissolved Solids	mg/L	3,300
UA	G401	C	2021/01/29	Total Dissolved Solids	mg/L	3,300
UA	G401	C	2021/05/20	Total Dissolved Solids	mg/L	3,000
UA	G401	C	2021/08/17	Total Dissolved Solids	mg/L	3,100
UA	G401	C	2021/10/26	Total Dissolved Solids	mg/L	2,800
UA	G401	C	2022/02/09	Total Dissolved Solids	mg/L	2,800
UA	G401	C	2022/05/10	Total Dissolved Solids	mg/L	2,700
UA	G401	C	2022/09/20	Total Dissolved Solids	mg/L	2,900
UA	G401	C	2022/11/08	Total Dissolved Solids	mg/L	3,200
UA	G401	C	2023/02/15	Total Dissolved Solids	mg/L	2,800
UA	G401	C	2023/06/07	Total Dissolved Solids	mg/L	6,600
UA	G401	C	2023/08/11	Total Dissolved Solids	mg/L	3,040
UA	G401	C	2023/11/21	Total Dissolved Solids	mg/L	2,940
UA	G402	C	2015/11/21	pH (field)	SU	6.8
UA	G402	C	2016/02/22	pH (field)	SU	6.7
UA	G402	C	2016/05/19	pH (field)	SU	6.8
UA	G402	C	2016/08/02	pH (field)	SU	6.6
UA	G402	C	2016/11/17	pH (field)	SU	6.6
UA	G402	C	2017/02/16	pH (field)	SU	6.5
UA	G402	C	2017/05/17	pH (field)	SU	6.4
UA	G402	C	2017/07/13	pH (field)	SU	6.6
UA	G402	C	2017/10/27	pH (field)	SU	6.7
UA	G402	C	2018/05/12	pH (field)	SU	6.6
UA	G402	C	2018/08/04	pH (field)	SU	6.7
UA	G402	C	2019/01/22	pH (field)	SU	6.8
UA	G402	C	2019/08/16	pH (field)	SU	6.8
UA	G402	C	2020/01/22	pH (field)	SU	7.0
UA	G402	C	2020/08/12	pH (field)	SU	6.8
UA	G402	C	2020/10/14	pH (field)	SU	6.8
UA	G402	C	2021/01/28	pH (field)	SU	6.9
UA	G402	C	2021/04/27	pH (field)	SU	6.9
UA	G402	C	2021/08/17	pH (field)	SU	6.9
UA	G402	C	2021/10/26	pH (field)	SU	6.7
UA	G402	C	2022/02/09	pH (field)	SU	7.0
UA	G402	C	2022/05/10	pH (field)	SU	6.7
UA	G402	C	2022/08/24	pH (field)	SU	6.8
UA	G402	C	2022/11/08	pH (field)	SU	6.9
UA	G402	C	2023/02/15	pH (field)	SU	6.8
UA	G402	C	2023/06/06	pH (field)	SU	6.6
UA	G402	C	2023/08/11	pH (field)	SU	7.3
UA	G402	C	2023/11/21	pH (field)	SU	6.7
UA	G402	C	2015/11/21	Oxidation Reduction Potential	mV	89.0
UA	G402	C	2016/05/19	Oxidation Reduction Potential	mV	2.00
UA	G402	C	2016/08/02	Oxidation Reduction Potential	mV	-45.0
UA	G402	C	2016/11/17	Oxidation Reduction Potential	mV	-49.0
UA	G402	C	2017/02/16	Oxidation Reduction Potential	mV	-82.0
UA	G402	C	2017/05/17	Oxidation Reduction Potential	mV	-85.0
UA	G402	C	2017/07/13	Oxidation Reduction Potential	mV	-49.0
UA	G402	C	2017/10/27	Oxidation Reduction Potential	mV	-52.0
UA	G402	C	2018/05/12	Oxidation Reduction Potential	mV	-38.0
UA	G402	C	2018/08/04	Oxidation Reduction Potential	mV	-62.0
UA	G402	C	2019/01/22	Oxidation Reduction Potential	mV	-60.0
UA	G402	C	2019/08/16	Oxidation Reduction Potential	mV	-61.0
UA	G402	C	2020/01/22	Oxidation Reduction Potential	mV	172

UA	G402	C	2020/08/12	Oxidation Reduction Potential	mV	74.4
UA	G402	C	2020/10/14	Oxidation Reduction Potential	mV	201
UA	G402	C	2021/01/28	Oxidation Reduction Potential	mV	391
UA	G402	C	2021/04/27	Oxidation Reduction Potential	mV	127
UA	G402	C	2021/08/17	Oxidation Reduction Potential	mV	178
UA	G402	C	2021/10/26	Oxidation Reduction Potential	mV	22.2
UA	G402	C	2022/02/09	Oxidation Reduction Potential	mV	95.8
UA	G402	C	2022/05/10	Oxidation Reduction Potential	mV	34.4
UA	G402	C	2022/08/24	Oxidation Reduction Potential	mV	138
UA	G402	C	2022/11/08	Oxidation Reduction Potential	mV	214
UA	G402	C	2023/02/15	Oxidation Reduction Potential	mV	265
UA	G402	C	2023/06/06	Oxidation Reduction Potential	mV	182
UA	G402	C	2023/08/11	Oxidation Reduction Potential	mV	23.0
UA	G402	C	2023/11/21	Oxidation Reduction Potential	mV	158
UA	G402	C	2015/11/21	Eh	V	0.28
UA	G402	C	2016/05/19	Eh	V	0.19
UA	G402	C	2016/08/02	Eh	V	0.15
UA	G402	C	2016/11/17	Eh	V	0.15
UA	G402	C	2017/02/16	Eh	V	0.11
UA	G402	C	2017/05/17	Eh	V	0.11
UA	G402	C	2017/07/13	Eh	V	0.14
UA	G402	C	2017/10/27	Eh	V	0.14
UA	G402	C	2018/05/12	Eh	V	0.16
UA	G402	C	2018/08/04	Eh	V	0.13
UA	G402	C	2019/01/22	Eh	V	0.14
UA	G402	C	2019/08/16	Eh	V	0.13
UA	G402	C	2020/01/22	Eh	V	0.37
UA	G402	C	2020/08/12	Eh	V	0.27
UA	G402	C	2020/10/14	Eh	V	0.39
UA	G402	C	2021/01/28	Eh	V	0.59
UA	G402	C	2021/04/27	Eh	V	0.32
UA	G402	C	2021/08/17	Eh	V	0.37
UA	G402	C	2021/10/26	Eh	V	0.22
UA	G402	C	2022/02/09	Eh	V	0.29
UA	G402	C	2022/05/10	Eh	V	0.23
UA	G402	C	2022/08/24	Eh	V	0.33
UA	G402	C	2022/11/08	Eh	V	0.41
UA	G402	C	2023/02/15	Eh	V	0.46
UA	G402	C	2023/06/06	Eh	V	0.37
UA	G402	C	2023/08/11	Eh	V	0.22
UA	G402	C	2023/11/21	Eh	V	0.35
UA	G402	C	2017/07/13	Alkalinity, bicarbonate	mg/L CaCO3	480
UA	G402	C	2020/01/22	Alkalinity, bicarbonate	mg/L CaCO3	500
UA	G402	C	2021/01/28	Alkalinity, bicarbonate	mg/L CaCO3	490
UA	G402	C	2021/08/17	Alkalinity, bicarbonate	mg/L CaCO3	500
UA	G402	C	2022/02/09	Alkalinity, bicarbonate	mg/L CaCO3	490
UA	G402	C	2022/08/24	Alkalinity, bicarbonate	mg/L CaCO3	490
UA	G402	C	2023/02/15	Alkalinity, bicarbonate	mg/L CaCO3	490
UA	G402	C	2023/06/06	Alkalinity, bicarbonate	mg/L CaCO3	500
UA	G402	C	2023/08/11	Alkalinity, bicarbonate	mg/L CaCO3	508
UA	G402	C	2023/11/21	Alkalinity, bicarbonate	mg/L CaCO3	486
UA	G402	C	2022/08/24	Alkalinity, carbonate	mg/L CaCO3	10.0
UA	G402	C	2015/11/21	Barium, total	mg/L	0.0820
UA	G402	C	2016/02/22	Barium, total	mg/L	0.110
UA	G402	C	2016/05/19	Barium, total	mg/L	0.0850
UA	G402	C	2016/08/02	Barium, total	mg/L	0.0470
UA	G402	C	2016/11/17	Barium, total	mg/L	0.0540
UA	G402	C	2017/02/16	Barium, total	mg/L	0.0280
UA	G402	C	2017/05/17	Barium, total	mg/L	0.0290
UA	G402	C	2017/07/13	Barium, total	mg/L	0.0760
UA	G402	C	2018/05/12	Barium, total	mg/L	0.0410
UA	G402	C	2018/08/04	Barium, total	mg/L	0.0620
UA	G402	C	2019/01/22	Barium, total	mg/L	0.0420

UA	G402	C	2019/08/16	Barium, total	mg/L	0.0360
UA	G402	C	2020/01/22	Barium, total	mg/L	0.0250
UA	G402	C	2020/08/12	Barium, total	mg/L	0.0240
UA	G402	C	2020/10/14	Barium, total	mg/L	0.0300
UA	G402	C	2021/01/28	Barium, total	mg/L	0.0200
UA	G402	C	2021/04/27	Barium, total	mg/L	0.0190
UA	G402	C	2021/08/17	Barium, total	mg/L	0.0240
UA	G402	C	2021/10/26	Barium, total	mg/L	0.0190
UA	G402	C	2022/02/09	Barium, total	mg/L	0.0270
UA	G402	C	2022/05/10	Barium, total	mg/L	0.0310
UA	G402	C	2022/08/24	Barium, total	mg/L	0.0310
UA	G402	C	2022/11/08	Barium, total	mg/L	0.0200
UA	G402	C	2023/02/15	Barium, total	mg/L	0.0240
UA	G402	C	2023/06/06	Barium, total	mg/L	0.0260
UA	G402	C	2023/08/11	Barium, total	mg/L	0.0290
UA	G402	C	2023/11/21	Barium, total	mg/L	0.0281
UA	G402	C	2015/11/21	Boron, total	mg/L	6.60
UA	G402	C	2016/02/22	Boron, total	mg/L	5.70
UA	G402	C	2016/05/19	Boron, total	mg/L	6.30
UA	G402	C	2016/08/02	Boron, total	mg/L	7.40
UA	G402	C	2016/11/17	Boron, total	mg/L	6.90
UA	G402	C	2017/02/16	Boron, total	mg/L	4.60
UA	G402	C	2017/05/17	Boron, total	mg/L	5.80
UA	G402	C	2017/07/13	Boron, total	mg/L	6.80
UA	G402	C	2017/10/27	Boron, total	mg/L	7.30
UA	G402	C	2018/05/12	Boron, total	mg/L	5.90
UA	G402	C	2018/08/04	Boron, total	mg/L	5.70
UA	G402	C	2019/01/22	Boron, total	mg/L	5.40
UA	G402	C	2019/08/16	Boron, total	mg/L	5.90
UA	G402	C	2020/01/22	Boron, total	mg/L	5.00
UA	G402	C	2020/08/12	Boron, total	mg/L	6.00
UA	G402	C	2020/10/14	Boron, total	mg/L	5.40
UA	G402	C	2021/01/28	Boron, total	mg/L	4.90
UA	G402	C	2021/04/27	Boron, total	mg/L	5.40
UA	G402	C	2021/08/17	Boron, total	mg/L	6.10
UA	G402	C	2021/10/26	Boron, total	mg/L	5.10
UA	G402	C	2022/02/09	Boron, total	mg/L	5.20
UA	G402	C	2022/05/10	Boron, total	mg/L	5.30
UA	G402	C	2022/08/24	Boron, total	mg/L	5.70
UA	G402	C	2022/11/08	Boron, total	mg/L	5.20
UA	G402	C	2023/02/15	Boron, total	mg/L	5.10
UA	G402	C	2023/06/06	Boron, total	mg/L	4.90
UA	G402	C	2023/08/11	Boron, total	mg/L	5.71
UA	G402	C	2023/11/21	Boron, total	mg/L	8.13
UA	G402	C	2015/11/21	Calcium, total	mg/L	270
UA	G402	C	2016/02/22	Calcium, total	mg/L	220
UA	G402	C	2016/05/19	Calcium, total	mg/L	270
UA	G402	C	2016/08/02	Calcium, total	mg/L	240
UA	G402	C	2016/11/17	Calcium, total	mg/L	240
UA	G402	C	2017/02/16	Calcium, total	mg/L	240
UA	G402	C	2017/05/17	Calcium, total	mg/L	240
UA	G402	C	2017/07/13	Calcium, total	mg/L	250
UA	G402	C	2017/10/27	Calcium, total	mg/L	260
UA	G402	C	2018/05/12	Calcium, total	mg/L	240
UA	G402	C	2018/08/04	Calcium, total	mg/L	270
UA	G402	C	2019/01/22	Calcium, total	mg/L	260
UA	G402	C	2019/08/16	Calcium, total	mg/L	270
UA	G402	C	2020/01/22	Calcium, total	mg/L	250
UA	G402	C	2020/08/12	Calcium, total	mg/L	250
UA	G402	C	2020/10/14	Calcium, total	mg/L	250
UA	G402	C	2021/01/28	Calcium, total	mg/L	230
UA	G402	C	2021/04/27	Calcium, total	mg/L	230
UA	G402	C	2021/08/17	Calcium, total	mg/L	240

UA	G402	C	2021/10/26	Calcium, total	mg/L	200
UA	G402	C	2022/02/09	Calcium, total	mg/L	230
UA	G402	C	2022/05/10	Calcium, total	mg/L	230
UA	G402	C	2022/08/24	Calcium, total	mg/L	230
UA	G402	C	2022/11/08	Calcium, total	mg/L	180
UA	G402	C	2023/02/15	Calcium, total	mg/L	210
UA	G402	C	2023/06/06	Calcium, total	mg/L	210
UA	G402	C	2023/08/11	Calcium, total	mg/L	212
UA	G402	C	2023/11/21	Calcium, total	mg/L	213
UA	G402	C	2015/11/21	Chloride, total	mg/L	2.80
UA	G402	C	2016/02/22	Chloride, total	mg/L	2.80
UA	G402	C	2016/05/19	Chloride, total	mg/L	1.50
UA	G402	C	2016/08/02	Chloride, total	mg/L	2.20
UA	G402	C	2016/11/17	Chloride, total	mg/L	2.60
UA	G402	C	2017/02/16	Chloride, total	mg/L	2.50
UA	G402	C	2017/05/17	Chloride, total	mg/L	2.50
UA	G402	C	2017/07/13	Chloride, total	mg/L	2.50
UA	G402	C	2017/10/27	Chloride, total	mg/L	3.50
UA	G402	C	2018/05/12	Chloride, total	mg/L	2.20
UA	G402	C	2018/08/04	Chloride, total	mg/L	2.30
UA	G402	C	2019/01/22	Chloride, total	mg/L	1.90
UA	G402	C	2019/08/16	Chloride, total	mg/L	2.20
UA	G402	C	2020/01/22	Chloride, total	mg/L	<0.36
UA	G402	C	2020/08/12	Chloride, total	mg/L	1.10
UA	G402	C	2020/10/14	Chloride, total	mg/L	1.90
UA	G402	C	2021/01/28	Chloride, total	mg/L	<0.96
UA	G402	C	2021/04/27	Chloride, total	mg/L	<1
UA	G402	C	2021/08/17	Chloride, total	mg/L	2.40
UA	G402	C	2021/10/26	Chloride, total	mg/L	<5
UA	G402	C	2022/02/09	Chloride, total	mg/L	2.50
UA	G402	C	2022/05/10	Chloride, total	mg/L	1.90
UA	G402	C	2022/08/24	Chloride, total	mg/L	3.00
UA	G402	C	2022/11/08	Chloride, total	mg/L	1.60
UA	G402	C	2023/02/15	Chloride, total	mg/L	2.10
UA	G402	C	2023/06/06	Chloride, total	mg/L	3.40
UA	G402	C	2023/08/11	Chloride, total	mg/L	3.00
UA	G402	C	2023/11/21	Chloride, total	mg/L	2.00
UA	G402	C	2015/11/21	Cobalt, total	mg/L	0.0140
UA	G402	C	2016/02/22	Cobalt, total	mg/L	0.0150
UA	G402	C	2016/05/19	Cobalt, total	mg/L	0.0190
UA	G402	C	2016/08/02	Cobalt, total	mg/L	0.00740
UA	G402	C	2016/11/17	Cobalt, total	mg/L	0.00700
UA	G402	C	2017/02/16	Cobalt, total	mg/L	0.00470
UA	G402	C	2017/05/17	Cobalt, total	mg/L	0.00690
UA	G402	C	2017/07/13	Cobalt, total	mg/L	0.0170
UA	G402	C	2018/05/12	Cobalt, total	mg/L	0.00770
UA	G402	C	2018/08/04	Cobalt, total	mg/L	0.0100
UA	G402	C	2019/01/22	Cobalt, total	mg/L	0.00760
UA	G402	C	2019/08/16	Cobalt, total	mg/L	0.00450
UA	G402	C	2020/01/22	Cobalt, total	mg/L	0.00210
UA	G402	C	2020/08/12	Cobalt, total	mg/L	<0.00022
UA	G402	C	2020/10/14	Cobalt, total	mg/L	0.00300
UA	G402	C	2021/01/28	Cobalt, total	mg/L	<0.00022
UA	G402	C	2021/04/27	Cobalt, total	mg/L	<0.002
UA	G402	C	2021/08/17	Cobalt, total	mg/L	<0.00022
UA	G402	C	2021/10/26	Cobalt, total	mg/L	<0.002
UA	G402	C	2022/02/09	Cobalt, total	mg/L	0.00440
UA	G402	C	2022/05/10	Cobalt, total	mg/L	0.00370
UA	G402	C	2022/08/24	Cobalt, total	mg/L	0.00360
UA	G402	C	2022/11/08	Cobalt, total	mg/L	0.000930
UA	G402	C	2023/02/15	Cobalt, total	mg/L	0.00260
UA	G402	C	2023/06/06	Cobalt, total	mg/L	0.00350
UA	G402	C	2023/08/11	Cobalt, total	mg/L	0.00240

UA	G402	C	2023/11/21	Cobalt, total	mg/L	0.00150
UA	G402	C	2023/06/06	Ferrous Iron, dissolved	mg/L	0.260
UA	G402	C	2020/08/12	Iron, dissolved	mg/L	<0.01
UA	G402	C	2020/10/14	Iron, dissolved	mg/L	0.0110
UA	G402	C	2021/01/28	Iron, dissolved	mg/L	<0.01
UA	G402	C	2021/04/27	Iron, dissolved	mg/L	<0.01
UA	G402	C	2021/08/17	Iron, dissolved	mg/L	<0.01
UA	G402	C	2021/10/26	Iron, dissolved	mg/L	0.0120
UA	G402	C	2022/02/09	Iron, dissolved	mg/L	<0.01
UA	G402	C	2022/05/10	Iron, dissolved	mg/L	0.00790
UA	G402	C	2022/08/24	Iron, dissolved	mg/L	0.00580
UA	G402	C	2022/11/08	Iron, dissolved	mg/L	0.00860
UA	G402	C	2023/02/15	Iron, dissolved	mg/L	0.00110
UA	G402	C	2023/06/06	Iron, dissolved	mg/L	0.00330
UA	G402	C	2023/08/11	Iron, dissolved	mg/L	<0.0115
UA	G402	C	2023/11/21	Iron, dissolved	mg/L	0.0170
UA	G402	C	2017/07/13	Magnesium, total	mg/L	170
UA	G402	C	2020/01/22	Magnesium, total	mg/L	170
UA	G402	C	2021/01/28	Magnesium, total	mg/L	150
UA	G402	C	2021/08/17	Magnesium, total	mg/L	150
UA	G402	C	2022/02/09	Magnesium, total	mg/L	140
UA	G402	C	2022/08/24	Magnesium, total	mg/L	140
UA	G402	C	2023/02/15	Magnesium, total	mg/L	120
UA	G402	C	2023/06/06	Magnesium, total	mg/L	130
UA	G402	C	2023/08/11	Magnesium, total	mg/L	128
UA	G402	C	2023/11/21	Magnesium, total	mg/L	130
UA	G402	C	2018/03/03	Manganese, dissolved	mg/L	1.90
UA	G402	C	2018/05/12	Manganese, dissolved	mg/L	0.180
UA	G402	C	2018/08/13	Manganese, dissolved	mg/L	0.760
UA	G402	C	2018/11/07	Manganese, dissolved	mg/L	0.620
UA	G402	C	2019/01/24	Manganese, dissolved	mg/L	0.580
UA	G402	C	2019/05/02	Manganese, dissolved	mg/L	0.870
UA	G402	C	2019/08/16	Manganese, dissolved	mg/L	0.790
UA	G402	C	2019/10/22	Manganese, dissolved	mg/L	0.890
UA	G402	C	2020/01/22	Manganese, dissolved	mg/L	1.00
UA	G402	C	2020/05/06	Manganese, dissolved	mg/L	1.00
UA	G402	C	2020/08/12	Manganese, dissolved	mg/L	0.860
UA	G402	C	2020/10/14	Manganese, dissolved	mg/L	0.870
UA	G402	C	2021/01/28	Manganese, dissolved	mg/L	0.610
UA	G402	C	2021/04/27	Manganese, dissolved	mg/L	0.710
UA	G402	C	2021/08/17	Manganese, dissolved	mg/L	0.980
UA	G402	C	2021/10/26	Manganese, dissolved	mg/L	0.910
UA	G402	C	2022/02/09	Manganese, dissolved	mg/L	0.510
UA	G402	C	2022/05/10	Manganese, dissolved	mg/L	0.700
UA	G402	C	2022/08/24	Manganese, dissolved	mg/L	0.890
UA	G402	C	2022/11/08	Manganese, dissolved	mg/L	0.800
UA	G402	C	2023/02/15	Manganese, dissolved	mg/L	0.400
UA	G402	C	2023/06/06	Manganese, dissolved	mg/L	0.860
UA	G402	C	2023/08/11	Manganese, dissolved	mg/L	0.867
UA	G402	C	2023/11/21	Manganese, dissolved	mg/L	0.718
UA	G402	C	2023/08/11	Phosphate, dissolved	mg/L	0.141
UA	G402	C	2017/07/13	Potassium, total	mg/L	3.00
UA	G402	C	2020/01/22	Potassium, total	mg/L	1.10
UA	G402	C	2021/01/28	Potassium, total	mg/L	1.00
UA	G402	C	2021/08/17	Potassium, total	mg/L	1.10
UA	G402	C	2022/02/09	Potassium, total	mg/L	1.20
UA	G402	C	2022/08/24	Potassium, total	mg/L	1.70
UA	G402	C	2023/02/15	Potassium, total	mg/L	0.790
UA	G402	C	2023/06/06	Potassium, total	mg/L	1.00
UA	G402	C	2023/08/11	Potassium, total	mg/L	1.27
UA	G402	C	2023/11/21	Potassium, total	mg/L	0.996
UA	G402	C	2023/06/06	Silicon, dissolved	mg/L	14.0
UA	G402	C	2023/08/11	Silicon, dissolved	mg/L	13.9

UA	G402	C	2017/07/13	Sodium, total	mg/L	55.0
UA	G402	C	2020/01/22	Sodium, total	mg/L	66.0
UA	G402	C	2021/01/28	Sodium, total	mg/L	54.0
UA	G402	C	2021/08/17	Sodium, total	mg/L	54.0
UA	G402	C	2022/02/09	Sodium, total	mg/L	53.0
UA	G402	C	2022/08/24	Sodium, total	mg/L	50.0
UA	G402	C	2023/02/15	Sodium, total	mg/L	45.0
UA	G402	C	2023/06/06	Sodium, total	mg/L	44.0
UA	G402	C	2023/08/11	Sodium, total	mg/L	45.9
UA	G402	C	2023/11/21	Sodium, total	mg/L	43.6
UA	G402	C	2015/11/21	Sulfate, total	mg/L	1,200
UA	G402	C	2016/02/22	Sulfate, total	mg/L	1,000
UA	G402	C	2016/05/19	Sulfate, total	mg/L	960
UA	G402	C	2016/08/02	Sulfate, total	mg/L	890
UA	G402	C	2016/11/17	Sulfate, total	mg/L	1,100
UA	G402	C	2017/02/16	Sulfate, total	mg/L	1,100
UA	G402	C	2017/05/17	Sulfate, total	mg/L	960
UA	G402	C	2017/07/13	Sulfate, total	mg/L	1,000
UA	G402	C	2017/10/27	Sulfate, total	mg/L	1,000
UA	G402	C	2018/05/12	Sulfate, total	mg/L	1,000
UA	G402	C	2018/08/04	Sulfate, total	mg/L	940
UA	G402	C	2019/01/22	Sulfate, total	mg/L	940
UA	G402	C	2019/08/16	Sulfate, total	mg/L	990
UA	G402	C	2020/01/22	Sulfate, total	mg/L	890
UA	G402	C	2020/08/12	Sulfate, total	mg/L	400
UA	G402	C	2020/10/14	Sulfate, total	mg/L	790
UA	G402	C	2021/01/28	Sulfate, total	mg/L	770
UA	G402	C	2021/04/27	Sulfate, total	mg/L	78.0
UA	G402	C	2021/08/17	Sulfate, total	mg/L	700
UA	G402	C	2021/10/26	Sulfate, total	mg/L	640
UA	G402	C	2022/02/09	Sulfate, total	mg/L	690
UA	G402	C	2022/05/10	Sulfate, total	mg/L	600
UA	G402	C	2022/08/24	Sulfate, total	mg/L	600
UA	G402	C	2022/11/08	Sulfate, total	mg/L	550
UA	G402	C	2023/02/15	Sulfate, total	mg/L	550
UA	G402	C	2023/06/06	Sulfate, total	mg/L	580
UA	G402	C	2023/08/11	Sulfate, total	mg/L	601
UA	G402	C	2023/11/21	Sulfate, total	mg/L	599
UA	G402	C	2015/11/21	Temperature (Celsius)	degrees C	17.5
UA	G402	C	2016/02/22	Temperature (Celsius)	degrees C	12.3
UA	G402	C	2016/05/19	Temperature (Celsius)	degrees C	18.9
UA	G402	C	2016/08/02	Temperature (Celsius)	degrees C	19.0
UA	G402	C	2016/11/17	Temperature (Celsius)	degrees C	14.3
UA	G402	C	2017/02/16	Temperature (Celsius)	degrees C	14.9
UA	G402	C	2017/05/17	Temperature (Celsius)	degrees C	15.4
UA	G402	C	2017/07/13	Temperature (Celsius)	degrees C	17.3
UA	G402	C	2017/10/27	Temperature (Celsius)	degrees C	13.0
UA	G402	C	2018/05/12	Temperature (Celsius)	degrees C	13.6
UA	G402	C	2018/08/04	Temperature (Celsius)	degrees C	15.0
UA	G402	C	2019/01/22	Temperature (Celsius)	degrees C	11.2
UA	G402	C	2019/08/16	Temperature (Celsius)	degrees C	17.2
UA	G402	C	2020/01/22	Temperature (Celsius)	degrees C	11.2
UA	G402	C	2020/08/12	Temperature (Celsius)	degrees C	21.6
UA	G402	C	2020/10/14	Temperature (Celsius)	degrees C	17.6
UA	G402	C	2021/01/28	Temperature (Celsius)	degrees C	10.2
UA	G402	C	2021/04/27	Temperature (Celsius)	degrees C	15.1
UA	G402	C	2021/08/17	Temperature (Celsius)	degrees C	19.5
UA	G402	C	2021/10/26	Temperature (Celsius)	degrees C	18.2
UA	G402	C	2022/02/09	Temperature (Celsius)	degrees C	12.1
UA	G402	C	2022/05/10	Temperature (Celsius)	degrees C	15.5
UA	G402	C	2022/08/24	Temperature (Celsius)	degrees C	19.8
UA	G402	C	2022/11/08	Temperature (Celsius)	degrees C	16.7
UA	G402	C	2023/02/15	Temperature (Celsius)	degrees C	12.5

UA	G402	C	2023/06/06	Temperature (Celsius)	degrees C	23.2
UA	G402	C	2023/08/11	Temperature (Celsius)	degrees C	18.1
UA	G402	C	2023/11/21	Temperature (Celsius)	degrees C	15.0
UA	G402	C	2015/11/21	Total Dissolved Solids	mg/L	1,700
UA	G402	C	2016/02/22	Total Dissolved Solids	mg/L	1,700
UA	G402	C	2016/05/19	Total Dissolved Solids	mg/L	1,500
UA	G402	C	2016/08/02	Total Dissolved Solids	mg/L	1,500
UA	G402	C	2016/11/17	Total Dissolved Solids	mg/L	1,700
UA	G402	C	2017/02/16	Total Dissolved Solids	mg/L	1,700
UA	G402	C	2017/05/17	Total Dissolved Solids	mg/L	1,700
UA	G402	C	2017/07/13	Total Dissolved Solids	mg/L	1,600
UA	G402	C	2017/10/27	Total Dissolved Solids	mg/L	1,700
UA	G402	C	2018/05/12	Total Dissolved Solids	mg/L	1,700
UA	G402	C	2018/08/04	Total Dissolved Solids	mg/L	1,700
UA	G402	C	2019/01/22	Total Dissolved Solids	mg/L	1,800
UA	G402	C	2019/08/16	Total Dissolved Solids	mg/L	1,600
UA	G402	C	2020/01/22	Total Dissolved Solids	mg/L	1,600
UA	G402	C	2020/08/12	Total Dissolved Solids	mg/L	1,600
UA	G402	C	2020/10/14	Total Dissolved Solids	mg/L	1,600
UA	G402	C	2021/01/28	Total Dissolved Solids	mg/L	1,600
UA	G402	C	2021/04/27	Total Dissolved Solids	mg/L	1,600
UA	G402	C	2021/08/17	Total Dissolved Solids	mg/L	1,600
UA	G402	C	2021/10/26	Total Dissolved Solids	mg/L	1,300
UA	G402	C	2022/02/09	Total Dissolved Solids	mg/L	1,300
UA	G402	C	2022/05/10	Total Dissolved Solids	mg/L	1,500
UA	G402	C	2022/08/24	Total Dissolved Solids	mg/L	1,400
UA	G402	C	2022/11/08	Total Dissolved Solids	mg/L	1,300
UA	G402	C	2023/02/15	Total Dissolved Solids	mg/L	1,400
UA	G402	C	2023/06/06	Total Dissolved Solids	mg/L	1,400
UA	G402	C	2023/08/11	Total Dissolved Solids	mg/L	1,340
UA	G402	C	2023/11/21	Total Dissolved Solids	mg/L	1,360
UA	G403	C	2015/11/23	pH (field)	SU	7.2
UA	G403	C	2016/02/22	pH (field)	SU	7.0
UA	G403	C	2016/05/18	pH (field)	SU	6.9
UA	G403	C	2016/08/01	pH (field)	SU	6.9
UA	G403	C	2016/11/17	pH (field)	SU	6.7
UA	G403	C	2017/02/18	pH (field)	SU	7.0
UA	G403	C	2017/05/17	pH (field)	SU	6.9
UA	G403	C	2017/07/13	pH (field)	SU	6.8
UA	G403	C	2017/10/28	pH (field)	SU	7.2
UA	G403	C	2018/05/12	pH (field)	SU	6.9
UA	G403	C	2018/08/04	pH (field)	SU	7.0
UA	G403	C	2019/01/24	pH (field)	SU	6.9
UA	G403	C	2019/08/19	pH (field)	SU	7.0
UA	G403	C	2020/01/22	pH (field)	SU	7.3
UA	G403	C	2020/08/12	pH (field)	SU	7.0
UA	G403	C	2020/10/13	pH (field)	SU	6.7
UA	G403	C	2021/01/21	pH (field)	SU	6.9
UA	G403	C	2021/04/26	pH (field)	SU	7.0
UA	G403	C	2021/08/17	pH (field)	SU	6.9
UA	G403	C	2021/10/26	pH (field)	SU	6.7
UA	G403	C	2022/02/08	pH (field)	SU	7.0
UA	G403	C	2022/05/10	pH (field)	SU	6.6
UA	G403	C	2022/08/24	pH (field)	SU	6.7
UA	G403	C	2022/11/09	pH (field)	SU	6.5
UA	G403	C	2023/02/15	pH (field)	SU	7.0
UA	G403	C	2023/06/07	pH (field)	SU	7.0
UA	G403	C	2023/08/11	pH (field)	SU	7.1
UA	G403	C	2023/11/20	pH (field)	SU	6.9
UA	G403	C	2015/11/23	Oxidation Reduction Potential	mV	-23.0
UA	G403	C	2016/02/22	Oxidation Reduction Potential	mV	62.0
UA	G403	C	2016/05/18	Oxidation Reduction Potential	mV	-118
UA	G403	C	2016/08/01	Oxidation Reduction Potential	mV	-99.0

UA	G403	C	2016/11/17	Oxidation Reduction Potential	mV	-80.0
UA	G403	C	2017/02/18	Oxidation Reduction Potential	mV	-119
UA	G403	C	2017/05/17	Oxidation Reduction Potential	mV	-125
UA	G403	C	2017/07/13	Oxidation Reduction Potential	mV	-105
UA	G403	C	2017/10/28	Oxidation Reduction Potential	mV	-89.0
UA	G403	C	2018/05/12	Oxidation Reduction Potential	mV	-81.0
UA	G403	C	2018/08/04	Oxidation Reduction Potential	mV	-96.0
UA	G403	C	2019/01/24	Oxidation Reduction Potential	mV	-95.0
UA	G403	C	2019/08/19	Oxidation Reduction Potential	mV	-91.0
UA	G403	C	2020/01/22	Oxidation Reduction Potential	mV	192
UA	G403	C	2020/08/12	Oxidation Reduction Potential	mV	145
UA	G403	C	2020/10/13	Oxidation Reduction Potential	mV	85.6
UA	G403	C	2021/01/21	Oxidation Reduction Potential	mV	128
UA	G403	C	2021/04/26	Oxidation Reduction Potential	mV	81.7
UA	G403	C	2021/08/17	Oxidation Reduction Potential	mV	-17.1
UA	G403	C	2021/10/26	Oxidation Reduction Potential	mV	17.0
UA	G403	C	2022/02/08	Oxidation Reduction Potential	mV	19.5
UA	G403	C	2022/05/10	Oxidation Reduction Potential	mV	101
UA	G403	C	2022/08/24	Oxidation Reduction Potential	mV	11.0
UA	G403	C	2022/11/09	Oxidation Reduction Potential	mV	20.0
UA	G403	C	2023/02/15	Oxidation Reduction Potential	mV	102
UA	G403	C	2023/06/07	Oxidation Reduction Potential	mV	40.7
UA	G403	C	2023/08/11	Oxidation Reduction Potential	mV	-8.00
UA	G403	C	2023/11/20	Oxidation Reduction Potential	mV	112
UA	G403	C	2015/11/23	Eh	V	0.17
UA	G403	C	2016/02/22	Eh	V	0.26
UA	G403	C	2016/05/18	Eh	V	0.076
UA	G403	C	2016/08/01	Eh	V	0.094
UA	G403	C	2016/11/17	Eh	V	0.12
UA	G403	C	2017/02/18	Eh	V	0.077
UA	G403	C	2017/05/17	Eh	V	0.070
UA	G403	C	2017/07/13	Eh	V	0.089
UA	G403	C	2017/10/28	Eh	V	0.11
UA	G403	C	2018/05/12	Eh	V	0.11
UA	G403	C	2018/08/04	Eh	V	0.099
UA	G403	C	2019/01/24	Eh	V	0.10
UA	G403	C	2019/08/19	Eh	V	0.10
UA	G403	C	2020/01/22	Eh	V	0.39
UA	G403	C	2020/08/12	Eh	V	0.34
UA	G403	C	2020/10/13	Eh	V	0.28
UA	G403	C	2021/01/21	Eh	V	0.33
UA	G403	C	2021/04/26	Eh	V	0.28
UA	G403	C	2021/08/17	Eh	V	0.17
UA	G403	C	2021/10/26	Eh	V	0.21
UA	G403	C	2022/02/08	Eh	V	0.22
UA	G403	C	2022/05/10	Eh	V	0.29
UA	G403	C	2022/08/24	Eh	V	0.20
UA	G403	C	2022/11/09	Eh	V	0.21
UA	G403	C	2023/02/15	Eh	V	0.30
UA	G403	C	2023/06/07	Eh	V	0.24
UA	G403	C	2023/08/11	Eh	V	0.18
UA	G403	C	2023/11/20	Eh	V	0.31
UA	G403	C	2017/07/13	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G403	C	2020/01/22	Alkalinity, bicarbonate	mg/L CaCO3	320
UA	G403	C	2021/01/21	Alkalinity, bicarbonate	mg/L CaCO3	310
UA	G403	C	2021/08/17	Alkalinity, bicarbonate	mg/L CaCO3	320
UA	G403	C	2022/02/08	Alkalinity, bicarbonate	mg/L CaCO3	310
UA	G403	C	2022/08/24	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G403	C	2023/02/15	Alkalinity, bicarbonate	mg/L CaCO3	310
UA	G403	C	2023/06/07	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G403	C	2023/08/11	Alkalinity, bicarbonate	mg/L CaCO3	315
UA	G403	C	2023/11/20	Alkalinity, bicarbonate	mg/L CaCO3	323
UA	G403	C	2022/08/24	Alkalinity, carbonate	mg/L CaCO3	10.0

UA	G403	C	2015/11/23	Barium, total	mg/L	0.140
UA	G403	C	2016/02/22	Barium, total	mg/L	0.130
UA	G403	C	2016/05/18	Barium, total	mg/L	0.160
UA	G403	C	2016/08/01	Barium, total	mg/L	0.240
UA	G403	C	2016/11/17	Barium, total	mg/L	0.200
UA	G403	C	2017/02/18	Barium, total	mg/L	0.150
UA	G403	C	2017/05/17	Barium, total	mg/L	0.140
UA	G403	C	2017/07/13	Barium, total	mg/L	0.170
UA	G403	C	2018/05/12	Barium, total	mg/L	0.150
UA	G403	C	2018/08/04	Barium, total	mg/L	0.150
UA	G403	C	2019/01/24	Barium, total	mg/L	0.140
UA	G403	C	2019/08/19	Barium, total	mg/L	0.140
UA	G403	C	2020/01/22	Barium, total	mg/L	0.130
UA	G403	C	2020/08/12	Barium, total	mg/L	0.120
UA	G403	C	2020/10/13	Barium, total	mg/L	0.110
UA	G403	C	2021/01/21	Barium, total	mg/L	0.110
UA	G403	C	2021/04/26	Barium, total	mg/L	0.110
UA	G403	C	2021/08/17	Barium, total	mg/L	0.120
UA	G403	C	2021/10/26	Barium, total	mg/L	0.110
UA	G403	C	2022/02/08	Barium, total	mg/L	0.130
UA	G403	C	2022/05/10	Barium, total	mg/L	0.120
UA	G403	C	2022/08/24	Barium, total	mg/L	0.110
UA	G403	C	2022/11/09	Barium, total	mg/L	0.0950
UA	G403	C	2023/02/15	Barium, total	mg/L	0.120
UA	G403	C	2023/06/07	Barium, total	mg/L	0.120
UA	G403	C	2023/08/11	Barium, total	mg/L	0.118
UA	G403	C	2023/11/20	Barium, total	mg/L	0.139
UA	G403	C	2015/11/23	Boron, total	mg/L	0.0390
UA	G403	C	2016/02/22	Boron, total	mg/L	0.0640
UA	G403	C	2016/05/18	Boron, total	mg/L	0.0140
UA	G403	C	2016/08/01	Boron, total	mg/L	0.0270
UA	G403	C	2016/11/17	Boron, total	mg/L	0.0420
UA	G403	C	2017/02/18	Boron, total	mg/L	<0.0023
UA	G403	C	2017/05/17	Boron, total	mg/L	0.0170
UA	G403	C	2017/07/13	Boron, total	mg/L	0.0270
UA	G403	C	2017/10/28	Boron, total	mg/L	0.0600
UA	G403	C	2018/05/12	Boron, total	mg/L	0.0100
UA	G403	C	2018/08/04	Boron, total	mg/L	0.0370
UA	G403	C	2019/01/24	Boron, total	mg/L	0.0710
UA	G403	C	2019/08/19	Boron, total	mg/L	0.0220
UA	G403	C	2020/01/22	Boron, total	mg/L	0.0790
UA	G403	C	2020/08/12	Boron, total	mg/L	0.0330
UA	G403	C	2020/10/13	Boron, total	mg/L	<0.01
UA	G403	C	2021/01/21	Boron, total	mg/L	<0.008
UA	G403	C	2021/04/26	Boron, total	mg/L	<0.01
UA	G403	C	2021/08/17	Boron, total	mg/L	0.110
UA	G403	C	2021/10/26	Boron, total	mg/L	0.0880
UA	G403	C	2022/02/08	Boron, total	mg/L	<0.0046
UA	G403	C	2022/05/10	Boron, total	mg/L	0.0500
UA	G403	C	2022/08/24	Boron, total	mg/L	0.100
UA	G403	C	2022/11/09	Boron, total	mg/L	0.0140
UA	G403	C	2023/02/15	Boron, total	mg/L	0.0630
UA	G403	C	2023/06/07	Boron, total	mg/L	0.0350
UA	G403	C	2023/08/11	Boron, total	mg/L	0.0287
UA	G403	C	2023/11/20	Boron, total	mg/L	0.0200
UA	G403	C	2015/11/23	Calcium, total	mg/L	78.0
UA	G403	C	2016/02/22	Calcium, total	mg/L	69.0
UA	G403	C	2016/05/18	Calcium, total	mg/L	71.0
UA	G403	C	2016/08/01	Calcium, total	mg/L	140
UA	G403	C	2016/11/17	Calcium, total	mg/L	72.0
UA	G403	C	2017/02/18	Calcium, total	mg/L	63.0
UA	G403	C	2017/05/17	Calcium, total	mg/L	63.0
UA	G403	C	2017/07/13	Calcium, total	mg/L	67.0

UA	G403	C	2017/10/28	Calcium, total	mg/L	67.0
UA	G403	C	2018/05/12	Calcium, total	mg/L	70.0
UA	G403	C	2018/08/04	Calcium, total	mg/L	71.0
UA	G403	C	2019/01/24	Calcium, total	mg/L	71.0
UA	G403	C	2019/08/19	Calcium, total	mg/L	77.0
UA	G403	C	2020/01/22	Calcium, total	mg/L	74.0
UA	G403	C	2020/08/12	Calcium, total	mg/L	76.0
UA	G403	C	2020/10/13	Calcium, total	mg/L	70.0
UA	G403	C	2021/01/21	Calcium, total	mg/L	77.0
UA	G403	C	2021/04/26	Calcium, total	mg/L	79.0
UA	G403	C	2021/08/17	Calcium, total	mg/L	84.0
UA	G403	C	2021/10/26	Calcium, total	mg/L	70.0
UA	G403	C	2022/02/08	Calcium, total	mg/L	76.0
UA	G403	C	2022/05/10	Calcium, total	mg/L	82.0
UA	G403	C	2022/08/24	Calcium, total	mg/L	80.0
UA	G403	C	2022/11/09	Calcium, total	mg/L	70.0
UA	G403	C	2023/02/15	Calcium, total	mg/L	79.0
UA	G403	C	2023/06/07	Calcium, total	mg/L	78.0
UA	G403	C	2023/08/11	Calcium, total	mg/L	77.7
UA	G403	C	2023/11/20	Calcium, total	mg/L	85.9
UA	G403	C	2015/11/23	Chloride, total	mg/L	6.80
UA	G403	C	2016/02/22	Chloride, total	mg/L	4.10
UA	G403	C	2016/05/18	Chloride, total	mg/L	2.70
UA	G403	C	2016/08/01	Chloride, total	mg/L	4.50
UA	G403	C	2016/11/17	Chloride, total	mg/L	4.00
UA	G403	C	2017/02/18	Chloride, total	mg/L	3.40
UA	G403	C	2017/05/17	Chloride, total	mg/L	3.30
UA	G403	C	2017/07/13	Chloride, total	mg/L	5.80
UA	G403	C	2017/10/28	Chloride, total	mg/L	4.10
UA	G403	C	2018/05/12	Chloride, total	mg/L	3.70
UA	G403	C	2018/08/04	Chloride, total	mg/L	3.90
UA	G403	C	2019/01/24	Chloride, total	mg/L	4.60
UA	G403	C	2019/08/19	Chloride, total	mg/L	3.90
UA	G403	C	2020/01/22	Chloride, total	mg/L	4.60
UA	G403	C	2020/08/12	Chloride, total	mg/L	3.60
UA	G403	C	2020/10/13	Chloride, total	mg/L	4.10
UA	G403	C	2021/01/21	Chloride, total	mg/L	4.50
UA	G403	C	2021/04/26	Chloride, total	mg/L	4.70
UA	G403	C	2021/08/17	Chloride, total	mg/L	4.50
UA	G403	C	2021/10/26	Chloride, total	mg/L	4.70
UA	G403	C	2022/02/08	Chloride, total	mg/L	5.00
UA	G403	C	2022/05/10	Chloride, total	mg/L	5.70
UA	G403	C	2022/08/24	Chloride, total	mg/L	6.00
UA	G403	C	2022/11/09	Chloride, total	mg/L	4.00
UA	G403	C	2023/02/15	Chloride, total	mg/L	5.70
UA	G403	C	2023/06/07	Chloride, total	mg/L	6.20
UA	G403	C	2023/08/11	Chloride, total	mg/L	5.00
UA	G403	C	2023/11/20	Chloride, total	mg/L	5.00
UA	G403	C	2015/11/23	Cobalt, total	mg/L	<0.000017
UA	G403	C	2016/02/22	Cobalt, total	mg/L	<0.000017
UA	G403	C	2016/05/18	Cobalt, total	mg/L	<0.000017
UA	G403	C	2016/08/01	Cobalt, total	mg/L	0.00290
UA	G403	C	2016/11/17	Cobalt, total	mg/L	0.00240
UA	G403	C	2017/02/18	Cobalt, total	mg/L	0.00200
UA	G403	C	2017/05/17	Cobalt, total	mg/L	0.00210
UA	G403	C	2017/07/13	Cobalt, total	mg/L	0.00220
UA	G403	C	2018/05/12	Cobalt, total	mg/L	0.00310
UA	G403	C	2018/08/04	Cobalt, total	mg/L	0.00340
UA	G403	C	2019/01/24	Cobalt, total	mg/L	0.00310
UA	G403	C	2019/08/19	Cobalt, total	mg/L	0.00270
UA	G403	C	2020/01/22	Cobalt, total	mg/L	<0.00067
UA	G403	C	2020/08/12	Cobalt, total	mg/L	<0.00022
UA	G403	C	2020/10/13	Cobalt, total	mg/L	<0.002

UA	G403	C	2021/01/21	Cobalt, total	mg/L	<0.00022
UA	G403	C	2021/04/26	Cobalt, total	mg/L	<0.002
UA	G403	C	2021/08/17	Cobalt, total	mg/L	<0.00022
UA	G403	C	2021/10/26	Cobalt, total	mg/L	<0.002
UA	G403	C	2022/02/08	Cobalt, total	mg/L	0.00230
UA	G403	C	2022/05/10	Cobalt, total	mg/L	0.000790
UA	G403	C	2022/08/24	Cobalt, total	mg/L	<0.00048
UA	G403	C	2022/11/09	Cobalt, total	mg/L	<0.00048
UA	G403	C	2023/02/15	Cobalt, total	mg/L	<0.00048
UA	G403	C	2023/06/07	Cobalt, total	mg/L	0.000760
UA	G403	C	2023/08/11	Cobalt, total	mg/L	0.00250
UA	G403	C	2023/11/20	Cobalt, total	mg/L	0.00260
UA	G403	C	2023/06/07	Ferrous Iron, dissolved	mg/L	<0.02
UA	G403	C	2020/08/12	Iron, dissolved	mg/L	0.0540
UA	G403	C	2020/10/13	Iron, dissolved	mg/L	0.0310
UA	G403	C	2021/01/21	Iron, dissolved	mg/L	<0.01
UA	G403	C	2021/04/26	Iron, dissolved	mg/L	<0.01
UA	G403	C	2021/08/17	Iron, dissolved	mg/L	<0.01
UA	G403	C	2021/10/26	Iron, dissolved	mg/L	0.0500
UA	G403	C	2022/02/08	Iron, dissolved	mg/L	<0.01
UA	G403	C	2022/05/10	Iron, dissolved	mg/L	<0.00072
UA	G403	C	2022/08/24	Iron, dissolved	mg/L	0.00310
UA	G403	C	2022/11/09	Iron, dissolved	mg/L	0.00440
UA	G403	C	2023/02/15	Iron, dissolved	mg/L	<0.00072
UA	G403	C	2023/06/07	Iron, dissolved	mg/L	0.0110
UA	G403	C	2023/08/11	Iron, dissolved	mg/L	0.0763
UA	G403	C	2023/11/20	Iron, dissolved	mg/L	0.0373
UA	G403	C	2017/07/13	Magnesium, total	mg/L	34.0
UA	G403	C	2020/01/22	Magnesium, total	mg/L	36.0
UA	G403	C	2021/01/21	Magnesium, total	mg/L	33.0
UA	G403	C	2021/08/17	Magnesium, total	mg/L	39.0
UA	G403	C	2022/02/08	Magnesium, total	mg/L	35.0
UA	G403	C	2022/08/24	Magnesium, total	mg/L	37.0
UA	G403	C	2023/02/15	Magnesium, total	mg/L	34.0
UA	G403	C	2023/06/07	Magnesium, total	mg/L	37.0
UA	G403	C	2023/08/11	Magnesium, total	mg/L	36.2
UA	G403	C	2023/11/20	Magnesium, total	mg/L	40.2
UA	G403	C	2018/03/03	Manganese, dissolved	mg/L	0.420
UA	G403	C	2018/05/12	Manganese, dissolved	mg/L	0.180
UA	G403	C	2018/08/13	Manganese, dissolved	mg/L	1.40
UA	G403	C	2018/11/07	Manganese, dissolved	mg/L	0.850
UA	G403	C	2019/01/24	Manganese, dissolved	mg/L	0.270
UA	G403	C	2019/05/02	Manganese, dissolved	mg/L	0.180
UA	G403	C	2019/08/19	Manganese, dissolved	mg/L	1.10
UA	G403	C	2019/10/22	Manganese, dissolved	mg/L	1.10
UA	G403	C	2020/01/22	Manganese, dissolved	mg/L	0.00790
UA	G403	C	2020/05/07	Manganese, dissolved	mg/L	0.0360
UA	G403	C	2020/08/12	Manganese, dissolved	mg/L	0.440
UA	G403	C	2020/10/13	Manganese, dissolved	mg/L	0.200
UA	G403	C	2021/01/21	Manganese, dissolved	mg/L	0.00460
UA	G403	C	2021/04/26	Manganese, dissolved	mg/L	0.00440
UA	G403	C	2021/08/17	Manganese, dissolved	mg/L	0.340
UA	G403	C	2021/10/26	Manganese, dissolved	mg/L	0.790
UA	G403	C	2022/02/08	Manganese, dissolved	mg/L	0.00390
UA	G403	C	2022/05/10	Manganese, dissolved	mg/L	0.00350
UA	G403	C	2022/08/24	Manganese, dissolved	mg/L	0.160
UA	G403	C	2022/11/09	Manganese, dissolved	mg/L	0.200
UA	G403	C	2023/02/15	Manganese, dissolved	mg/L	0.000280
UA	G403	C	2023/06/07	Manganese, dissolved	mg/L	0.360
UA	G403	C	2023/08/11	Manganese, dissolved	mg/L	0.376
UA	G403	C	2023/11/20	Manganese, dissolved	mg/L	0.264
UA	G403	C	2023/08/11	Phosphate, dissolved	mg/L	0.0680
UA	G403	C	2017/07/13	Potassium, total	mg/L	0.760

UA	G403	C	2020/01/22	Potassium, total	mg/L	0.710
UA	G403	C	2021/01/21	Potassium, total	mg/L	0.450
UA	G403	C	2021/08/17	Potassium, total	mg/L	0.460
UA	G403	C	2022/02/08	Potassium, total	mg/L	0.760
UA	G403	C	2022/08/24	Potassium, total	mg/L	0.550
UA	G403	C	2023/02/15	Potassium, total	mg/L	0.410
UA	G403	C	2023/06/07	Potassium, total	mg/L	0.450
UA	G403	C	2023/08/11	Potassium, total	mg/L	0.562
UA	G403	C	2023/11/20	Potassium, total	mg/L	0.573
UA	G403	C	2023/06/07	Silicon, dissolved	mg/L	9.20
UA	G403	C	2023/08/11	Silicon, dissolved	mg/L	8.36
UA	G403	C	2017/07/13	Sodium, total	mg/L	22.0
UA	G403	C	2020/01/22	Sodium, total	mg/L	23.0
UA	G403	C	2021/01/21	Sodium, total	mg/L	24.0
UA	G403	C	2021/08/17	Sodium, total	mg/L	26.0
UA	G403	C	2022/02/08	Sodium, total	mg/L	25.0
UA	G403	C	2022/08/24	Sodium, total	mg/L	28.0
UA	G403	C	2023/02/15	Sodium, total	mg/L	29.0
UA	G403	C	2023/06/07	Sodium, total	mg/L	27.0
UA	G403	C	2023/08/11	Sodium, total	mg/L	25.4
UA	G403	C	2023/11/20	Sodium, total	mg/L	26.3
UA	G403	C	2015/11/23	Sulfate, total	mg/L	35.0
UA	G403	C	2016/02/22	Sulfate, total	mg/L	17.0
UA	G403	C	2016/05/18	Sulfate, total	mg/L	11.0
UA	G403	C	2016/08/01	Sulfate, total	mg/L	9.90
UA	G403	C	2016/11/17	Sulfate, total	mg/L	8.90
UA	G403	C	2017/02/18	Sulfate, total	mg/L	7.40
UA	G403	C	2017/05/17	Sulfate, total	mg/L	7.10
UA	G403	C	2017/07/13	Sulfate, total	mg/L	4.90
UA	G403	C	2017/10/28	Sulfate, total	mg/L	7.00
UA	G403	C	2018/05/12	Sulfate, total	mg/L	15.0
UA	G403	C	2018/08/04	Sulfate, total	mg/L	20.0
UA	G403	C	2019/01/24	Sulfate, total	mg/L	32.0
UA	G403	C	2019/08/19	Sulfate, total	mg/L	26.0
UA	G403	C	2020/01/22	Sulfate, total	mg/L	33.0
UA	G403	C	2020/08/12	Sulfate, total	mg/L	34.0
UA	G403	C	2020/10/13	Sulfate, total	mg/L	36.0
UA	G403	C	2021/01/21	Sulfate, total	mg/L	37.0
UA	G403	C	2021/04/26	Sulfate, total	mg/L	39.0
UA	G403	C	2021/08/17	Sulfate, total	mg/L	51.0
UA	G403	C	2021/10/26	Sulfate, total	mg/L	51.0
UA	G403	C	2022/02/08	Sulfate, total	mg/L	53.0
UA	G403	C	2022/05/10	Sulfate, total	mg/L	59.0
UA	G403	C	2022/08/24	Sulfate, total	mg/L	58.0
UA	G403	C	2022/11/09	Sulfate, total	mg/L	57.0
UA	G403	C	2023/02/15	Sulfate, total	mg/L	63.0
UA	G403	C	2023/06/07	Sulfate, total	mg/L	66.0
UA	G403	C	2023/08/11	Sulfate, total	mg/L	60.0
UA	G403	C	2023/11/20	Sulfate, total	mg/L	74.0
UA	G403	C	2015/11/23	Temperature (Celsius)	degrees C	15.8
UA	G403	C	2016/02/22	Temperature (Celsius)	degrees C	11.0
UA	G403	C	2016/05/18	Temperature (Celsius)	degrees C	17.8
UA	G403	C	2016/08/01	Temperature (Celsius)	degrees C	17.9
UA	G403	C	2016/11/17	Temperature (Celsius)	degrees C	14.5
UA	G403	C	2017/02/18	Temperature (Celsius)	degrees C	14.9
UA	G403	C	2017/05/17	Temperature (Celsius)	degrees C	15.2
UA	G403	C	2017/07/13	Temperature (Celsius)	degrees C	17.8
UA	G403	C	2017/10/28	Temperature (Celsius)	degrees C	13.8
UA	G403	C	2018/05/12	Temperature (Celsius)	degrees C	15.7
UA	G403	C	2018/08/04	Temperature (Celsius)	degrees C	15.9
UA	G403	C	2019/01/24	Temperature (Celsius)	degrees C	11.8
UA	G403	C	2019/08/19	Temperature (Celsius)	degrees C	16.9
UA	G403	C	2020/01/22	Temperature (Celsius)	degrees C	9.70

UA	G403	C	2020/08/12	Temperature (Celsius)	degrees C	21.6
UA	G403	C	2020/10/13	Temperature (Celsius)	degrees C	17.0
UA	G403	C	2021/01/21	Temperature (Celsius)	degrees C	12.6
UA	G403	C	2021/04/26	Temperature (Celsius)	degrees C	16.2
UA	G403	C	2021/08/17	Temperature (Celsius)	degrees C	20.7
UA	G403	C	2021/10/26	Temperature (Celsius)	degrees C	16.8
UA	G403	C	2022/02/08	Temperature (Celsius)	degrees C	11.1
UA	G403	C	2022/05/10	Temperature (Celsius)	degrees C	17.4
UA	G403	C	2022/08/24	Temperature (Celsius)	degrees C	19.2
UA	G403	C	2022/11/09	Temperature (Celsius)	degrees C	19.0
UA	G403	C	2023/02/15	Temperature (Celsius)	degrees C	13.4
UA	G403	C	2023/06/07	Temperature (Celsius)	degrees C	15.8
UA	G403	C	2023/08/11	Temperature (Celsius)	degrees C	18.7
UA	G403	C	2023/11/20	Temperature (Celsius)	degrees C	15.1
UA	G403	C	2015/11/23	Total Dissolved Solids	mg/L	320
UA	G403	C	2016/02/22	Total Dissolved Solids	mg/L	340
UA	G403	C	2016/05/18	Total Dissolved Solids	mg/L	320
UA	G403	C	2016/08/01	Total Dissolved Solids	mg/L	320
UA	G403	C	2016/11/17	Total Dissolved Solids	mg/L	350
UA	G403	C	2017/02/18	Total Dissolved Solids	mg/L	320
UA	G403	C	2017/05/17	Total Dissolved Solids	mg/L	330
UA	G403	C	2017/07/13	Total Dissolved Solids	mg/L	320
UA	G403	C	2017/10/28	Total Dissolved Solids	mg/L	340
UA	G403	C	2018/05/12	Total Dissolved Solids	mg/L	310
UA	G403	C	2018/08/04	Total Dissolved Solids	mg/L	360
UA	G403	C	2019/01/24	Total Dissolved Solids	mg/L	360
UA	G403	C	2019/08/19	Total Dissolved Solids	mg/L	360
UA	G403	C	2020/01/22	Total Dissolved Solids	mg/L	270
UA	G403	C	2020/08/12	Total Dissolved Solids	mg/L	330
UA	G403	C	2020/10/13	Total Dissolved Solids	mg/L	400
UA	G403	C	2021/01/21	Total Dissolved Solids	mg/L	330
UA	G403	C	2021/04/26	Total Dissolved Solids	mg/L	320
UA	G403	C	2021/08/17	Total Dissolved Solids	mg/L	470
UA	G403	C	2021/10/26	Total Dissolved Solids	mg/L	360
UA	G403	C	2022/02/08	Total Dissolved Solids	mg/L	400
UA	G403	C	2022/05/10	Total Dissolved Solids	mg/L	470
UA	G403	C	2022/08/24	Total Dissolved Solids	mg/L	400
UA	G403	C	2022/11/09	Total Dissolved Solids	mg/L	430
UA	G403	C	2023/02/15	Total Dissolved Solids	mg/L	480
UA	G403	C	2023/06/07	Total Dissolved Solids	mg/L	400
UA	G403	C	2023/08/11	Total Dissolved Solids	mg/L	412
UA	G403	C	2023/11/20	Total Dissolved Solids	mg/L	508
UA	G404	C	2015/11/21	pH (field)	SU	6.7
UA	G404	C	2016/02/15	pH (field)	SU	7.2
UA	G404	C	2016/05/19	pH (field)	SU	6.8
UA	G404	C	2016/08/02	pH (field)	SU	7.1
UA	G404	C	2016/11/22	pH (field)	SU	7.1
UA	G404	C	2017/02/18	pH (field)	SU	7.1
UA	G404	C	2017/05/16	pH (field)	SU	7.2
UA	G404	C	2017/07/14	pH (field)	SU	7.1
UA	G404	C	2017/10/28	pH (field)	SU	6.9
UA	G404	C	2018/05/12	pH (field)	SU	7.1
UA	G404	C	2018/08/04	pH (field)	SU	7.2
UA	G404	C	2019/01/24	pH (field)	SU	7.1
UA	G404	C	2019/08/16	pH (field)	SU	7.1
UA	G404	C	2020/01/22	pH (field)	SU	7.2
UA	G404	C	2020/08/12	pH (field)	SU	6.8
UA	G404	C	2020/10/13	pH (field)	SU	6.7
UA	G404	C	2021/01/21	pH (field)	SU	6.6
UA	G404	C	2021/04/27	pH (field)	SU	6.8
UA	G404	C	2021/08/17	pH (field)	SU	6.7
UA	G404	C	2021/10/26	pH (field)	SU	6.6
UA	G404	C	2022/02/08	pH (field)	SU	6.9

UA	G404	C	2022/05/10	pH (field)	SU	6.6
UA	G404	C	2022/08/24	pH (field)	SU	6.5
UA	G404	C	2022/11/09	pH (field)	SU	6.4
UA	G404	C	2023/02/14	pH (field)	SU	6.8
UA	G404	C	2023/06/07	pH (field)	SU	6.8
UA	G404	C	2023/08/14	pH (field)	SU	6.8
UA	G404	C	2023/11/21	pH (field)	SU	6.7
UA	G404	C	2015/10/07	pH (field)	SU	7.5
UA	G404	C	2015/11/21	Oxidation Reduction Potential	mV	28.0
UA	G404	C	2016/02/15	Oxidation Reduction Potential	mV	83.0
UA	G404	C	2016/05/19	Oxidation Reduction Potential	mV	-10.0
UA	G404	C	2016/08/02	Oxidation Reduction Potential	mV	-63.0
UA	G404	C	2016/11/22	Oxidation Reduction Potential	mV	-60.0
UA	G404	C	2017/02/18	Oxidation Reduction Potential	mV	-68.0
UA	G404	C	2017/05/16	Oxidation Reduction Potential	mV	-61.0
UA	G404	C	2017/07/14	Oxidation Reduction Potential	mV	-74.0
UA	G404	C	2017/10/28	Oxidation Reduction Potential	mV	-58.0
UA	G404	C	2018/05/12	Oxidation Reduction Potential	mV	-50.0
UA	G404	C	2018/08/04	Oxidation Reduction Potential	mV	-59.0
UA	G404	C	2019/01/24	Oxidation Reduction Potential	mV	-71.0
UA	G404	C	2019/08/16	Oxidation Reduction Potential	mV	-64.0
UA	G404	C	2020/01/22	Oxidation Reduction Potential	mV	200
UA	G404	C	2020/08/12	Oxidation Reduction Potential	mV	108
UA	G404	C	2020/10/13	Oxidation Reduction Potential	mV	95.2
UA	G404	C	2021/01/21	Oxidation Reduction Potential	mV	139
UA	G404	C	2021/04/27	Oxidation Reduction Potential	mV	116
UA	G404	C	2021/08/17	Oxidation Reduction Potential	mV	59.0
UA	G404	C	2021/10/26	Oxidation Reduction Potential	mV	43.2
UA	G404	C	2022/02/08	Oxidation Reduction Potential	mV	229
UA	G404	C	2022/05/10	Oxidation Reduction Potential	mV	92.3
UA	G404	C	2022/08/24	Oxidation Reduction Potential	mV	26.0
UA	G404	C	2022/11/09	Oxidation Reduction Potential	mV	108
UA	G404	C	2023/02/14	Oxidation Reduction Potential	mV	304
UA	G404	C	2023/06/07	Oxidation Reduction Potential	mV	79.2
UA	G404	C	2023/08/14	Oxidation Reduction Potential	mV	66.0
UA	G404	C	2023/11/21	Oxidation Reduction Potential	mV	85.0
UA	G404	C	2015/11/21	Eh	V	0.22
UA	G404	C	2016/02/15	Eh	V	0.28
UA	G404	C	2016/05/19	Eh	V	0.18
UA	G404	C	2016/08/02	Eh	V	0.13
UA	G404	C	2016/11/22	Eh	V	0.13
UA	G404	C	2017/02/18	Eh	V	0.13
UA	G404	C	2017/05/16	Eh	V	0.13
UA	G404	C	2017/07/14	Eh	V	0.12
UA	G404	C	2017/10/28	Eh	V	0.14
UA	G404	C	2018/05/12	Eh	V	0.15
UA	G404	C	2018/08/04	Eh	V	0.14
UA	G404	C	2019/01/24	Eh	V	0.13
UA	G404	C	2019/08/16	Eh	V	0.13
UA	G404	C	2020/01/22	Eh	V	0.40
UA	G404	C	2020/08/12	Eh	V	0.30
UA	G404	C	2020/10/13	Eh	V	0.29
UA	G404	C	2021/01/21	Eh	V	0.34
UA	G404	C	2021/04/27	Eh	V	0.31
UA	G404	C	2021/08/17	Eh	V	0.25
UA	G404	C	2021/10/26	Eh	V	0.24
UA	G404	C	2022/02/08	Eh	V	0.43
UA	G404	C	2022/05/10	Eh	V	0.29
UA	G404	C	2022/08/24	Eh	V	0.22
UA	G404	C	2022/11/09	Eh	V	0.30
UA	G404	C	2023/02/14	Eh	V	0.50
UA	G404	C	2023/06/07	Eh	V	0.27
UA	G404	C	2023/08/14	Eh	V	0.26

UA	G404	C	2023/11/21	Eh	V	0.28
UA	G404	C	2017/07/14	Alkalinity, bicarbonate	mg/L CaCO3	420
UA	G404	C	2020/01/22	Alkalinity, bicarbonate	mg/L CaCO3	330
UA	G404	C	2021/01/21	Alkalinity, bicarbonate	mg/L CaCO3	320
UA	G404	C	2021/08/17	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G404	C	2022/02/08	Alkalinity, bicarbonate	mg/L CaCO3	310
UA	G404	C	2022/08/24	Alkalinity, bicarbonate	mg/L CaCO3	390
UA	G404	C	2023/02/14	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G404	C	2023/06/07	Alkalinity, bicarbonate	mg/L CaCO3	390
UA	G404	C	2023/08/14	Alkalinity, bicarbonate	mg/L CaCO3	348
UA	G404	C	2023/11/21	Alkalinity, bicarbonate	mg/L CaCO3	326
UA	G404	C	2022/08/24	Alkalinity, carbonate	mg/L CaCO3	10.0
UA	G404	C	2015/11/21	Barium, total	mg/L	0.0500
UA	G404	C	2016/02/15	Barium, total	mg/L	0.0430
UA	G404	C	2016/05/19	Barium, total	mg/L	0.0410
UA	G404	C	2016/08/02	Barium, total	mg/L	0.0550
UA	G404	C	2016/11/22	Barium, total	mg/L	0.0520
UA	G404	C	2017/02/18	Barium, total	mg/L	0.0440
UA	G404	C	2017/05/16	Barium, total	mg/L	0.0610
UA	G404	C	2017/07/14	Barium, total	mg/L	0.0420
UA	G404	C	2018/05/12	Barium, total	mg/L	0.0420
UA	G404	C	2018/08/04	Barium, total	mg/L	0.0360
UA	G404	C	2019/01/24	Barium, total	mg/L	0.0370
UA	G404	C	2019/08/16	Barium, total	mg/L	0.0500
UA	G404	C	2020/01/22	Barium, total	mg/L	0.0330
UA	G404	C	2020/08/12	Barium, total	mg/L	0.0370
UA	G404	C	2020/10/13	Barium, total	mg/L	0.0370
UA	G404	C	2021/01/21	Barium, total	mg/L	0.0420
UA	G404	C	2021/04/27	Barium, total	mg/L	0.0400
UA	G404	C	2021/08/17	Barium, total	mg/L	0.0480
UA	G404	C	2021/10/26	Barium, total	mg/L	0.0360
UA	G404	C	2022/02/08	Barium, total	mg/L	0.0280
UA	G404	C	2022/05/10	Barium, total	mg/L	0.0270
UA	G404	C	2022/08/24	Barium, total	mg/L	0.0290
UA	G404	C	2022/11/09	Barium, total	mg/L	0.0220
UA	G404	C	2023/02/14	Barium, total	mg/L	0.0170
UA	G404	C	2023/06/07	Barium, total	mg/L	0.0190
UA	G404	C	2023/08/14	Barium, total	mg/L	0.0420
UA	G404	C	2023/11/21	Barium, total	mg/L	0.0369
UA	G404	C	2015/10/07	Barium, total	mg/L	0.0450
UA	G404	C	2015/11/21	Boron, total	mg/L	2.10
UA	G404	C	2016/02/15	Boron, total	mg/L	1.60
UA	G404	C	2016/05/19	Boron, total	mg/L	1.40
UA	G404	C	2016/08/02	Boron, total	mg/L	3.20
UA	G404	C	2016/11/22	Boron, total	mg/L	3.40
UA	G404	C	2017/02/18	Boron, total	mg/L	2.80
UA	G404	C	2017/05/16	Boron, total	mg/L	1.60
UA	G404	C	2017/07/14	Boron, total	mg/L	5.50
UA	G404	C	2017/10/28	Boron, total	mg/L	5.80
UA	G404	C	2018/05/12	Boron, total	mg/L	4.10
UA	G404	C	2018/08/04	Boron, total	mg/L	4.80
UA	G404	C	2019/01/24	Boron, total	mg/L	2.80
UA	G404	C	2019/08/16	Boron, total	mg/L	2.90
UA	G404	C	2020/01/22	Boron, total	mg/L	2.90
UA	G404	C	2020/08/12	Boron, total	mg/L	2.80
UA	G404	C	2020/10/13	Boron, total	mg/L	3.90
UA	G404	C	2021/01/21	Boron, total	mg/L	2.60
UA	G404	C	2021/04/27	Boron, total	mg/L	3.00
UA	G404	C	2021/08/17	Boron, total	mg/L	5.40
UA	G404	C	2021/10/26	Boron, total	mg/L	5.00
UA	G404	C	2022/02/08	Boron, total	mg/L	5.00
UA	G404	C	2022/05/10	Boron, total	mg/L	5.60
UA	G404	C	2022/08/24	Boron, total	mg/L	13.0

UA	G404	C	2022/11/09	Boron, total	mg/L	15.0
UA	G404	C	2023/02/14	Boron, total	mg/L	9.00
UA	G404	C	2023/06/07	Boron, total	mg/L	9.30
UA	G404	C	2023/08/14	Boron, total	mg/L	14.4
UA	G404	C	2023/11/21	Boron, total	mg/L	21.2
UA	G404	C	2015/10/07	Boron, total	mg/L	4.70
UA	G404	C	2015/11/21	Calcium, total	mg/L	110
UA	G404	C	2016/02/15	Calcium, total	mg/L	110
UA	G404	C	2016/05/19	Calcium, total	mg/L	89.0
UA	G404	C	2016/08/02	Calcium, total	mg/L	120
UA	G404	C	2016/11/22	Calcium, total	mg/L	120
UA	G404	C	2017/02/18	Calcium, total	mg/L	120
UA	G404	C	2017/05/16	Calcium, total	mg/L	110
UA	G404	C	2017/07/14	Calcium, total	mg/L	160
UA	G404	C	2017/10/28	Calcium, total	mg/L	160
UA	G404	C	2018/05/12	Calcium, total	mg/L	150
UA	G404	C	2018/08/04	Calcium, total	mg/L	180
UA	G404	C	2019/01/24	Calcium, total	mg/L	120
UA	G404	C	2019/08/16	Calcium, total	mg/L	110
UA	G404	C	2020/01/22	Calcium, total	mg/L	150
UA	G404	C	2020/08/12	Calcium, total	mg/L	140
UA	G404	C	2020/10/13	Calcium, total	mg/L	170
UA	G404	C	2021/01/21	Calcium, total	mg/L	160
UA	G404	C	2021/04/27	Calcium, total	mg/L	180
UA	G404	C	2021/08/17	Calcium, total	mg/L	240
UA	G404	C	2021/10/26	Calcium, total	mg/L	200
UA	G404	C	2022/02/08	Calcium, total	mg/L	200
UA	G404	C	2022/05/10	Calcium, total	mg/L	230
UA	G404	C	2022/08/24	Calcium, total	mg/L	290
UA	G404	C	2022/11/09	Calcium, total	mg/L	250
UA	G404	C	2023/02/14	Calcium, total	mg/L	180
UA	G404	C	2023/06/07	Calcium, total	mg/L	230
UA	G404	C	2023/08/14	Calcium, total	mg/L	216
UA	G404	C	2023/11/21	Calcium, total	mg/L	273
UA	G404	C	2015/11/21	Chloride, total	mg/L	53.0
UA	G404	C	2016/02/15	Chloride, total	mg/L	49.0
UA	G404	C	2016/05/19	Chloride, total	mg/L	46.0
UA	G404	C	2016/08/02	Chloride, total	mg/L	62.0
UA	G404	C	2016/11/22	Chloride, total	mg/L	61.0
UA	G404	C	2017/02/18	Chloride, total	mg/L	62.0
UA	G404	C	2017/05/16	Chloride, total	mg/L	64.0
UA	G404	C	2017/07/14	Chloride, total	mg/L	68.0
UA	G404	C	2017/10/28	Chloride, total	mg/L	57.0
UA	G404	C	2018/05/12	Chloride, total	mg/L	82.0
UA	G404	C	2018/08/04	Chloride, total	mg/L	69.0
UA	G404	C	2019/01/24	Chloride, total	mg/L	100
UA	G404	C	2019/08/16	Chloride, total	mg/L	100
UA	G404	C	2020/01/22	Chloride, total	mg/L	190
UA	G404	C	2020/08/12	Chloride, total	mg/L	170
UA	G404	C	2020/10/13	Chloride, total	mg/L	160
UA	G404	C	2021/01/21	Chloride, total	mg/L	190
UA	G404	C	2021/04/27	Chloride, total	mg/L	200
UA	G404	C	2021/08/17	Chloride, total	mg/L	190
UA	G404	C	2021/10/26	Chloride, total	mg/L	190
UA	G404	C	2022/02/08	Chloride, total	mg/L	160
UA	G404	C	2022/05/10	Chloride, total	mg/L	150
UA	G404	C	2022/08/24	Chloride, total	mg/L	120
UA	G404	C	2022/11/09	Chloride, total	mg/L	110
UA	G404	C	2023/02/14	Chloride, total	mg/L	74.0
UA	G404	C	2023/06/07	Chloride, total	mg/L	140
UA	G404	C	2023/08/14	Chloride, total	mg/L	73.0
UA	G404	C	2023/11/21	Chloride, total	mg/L	71.0
UA	G404	C	2015/10/07	Chloride, total	mg/L	33.0

UA	G404	C	2015/11/21	Cobalt, total	mg/L	<0.000017
UA	G404	C	2016/02/15	Cobalt, total	mg/L	<0.000017
UA	G404	C	2016/05/19	Cobalt, total	mg/L	<0.000017
UA	G404	C	2016/08/02	Cobalt, total	mg/L	<0.000017
UA	G404	C	2016/11/22	Cobalt, total	mg/L	<0.000017
UA	G404	C	2017/02/18	Cobalt, total	mg/L	<0.000017
UA	G404	C	2017/05/16	Cobalt, total	mg/L	<0.000017
UA	G404	C	2017/07/14	Cobalt, total	mg/L	<0.000017
UA	G404	C	2018/05/12	Cobalt, total	mg/L	<0.00086
UA	G404	C	2018/08/04	Cobalt, total	mg/L	<0.00067
UA	G404	C	2019/01/24	Cobalt, total	mg/L	<0.00067
UA	G404	C	2019/08/16	Cobalt, total	mg/L	0.00290
UA	G404	C	2020/01/22	Cobalt, total	mg/L	<0.00067
UA	G404	C	2020/08/12	Cobalt, total	mg/L	<0.00022
UA	G404	C	2020/10/13	Cobalt, total	mg/L	<0.002
UA	G404	C	2021/01/21	Cobalt, total	mg/L	<0.00022
UA	G404	C	2021/04/27	Cobalt, total	mg/L	<0.002
UA	G404	C	2021/08/17	Cobalt, total	mg/L	<0.00022
UA	G404	C	2021/10/26	Cobalt, total	mg/L	<0.002
UA	G404	C	2022/02/08	Cobalt, total	mg/L	<0.00019
UA	G404	C	2022/05/10	Cobalt, total	mg/L	<0.00048
UA	G404	C	2022/08/24	Cobalt, total	mg/L	<0.00048
UA	G404	C	2022/11/09	Cobalt, total	mg/L	<0.00048
UA	G404	C	2023/02/14	Cobalt, total	mg/L	<0.00048
UA	G404	C	2023/06/07	Cobalt, total	mg/L	<0.00048
UA	G404	C	2023/08/14	Cobalt, total	mg/L	0.00330
UA	G404	C	2023/11/21	Cobalt, total	mg/L	0.000600
UA	G404	C	2015/10/07	Cobalt, total	mg/L	<0.002
UA	G404	C	2023/06/07	Ferrous Iron, dissolved	mg/L	0.100
UA	G404	C	2020/08/12	Iron, dissolved	mg/L	0.0330
UA	G404	C	2020/10/13	Iron, dissolved	mg/L	0.130
UA	G404	C	2021/01/21	Iron, dissolved	mg/L	0.0300
UA	G404	C	2021/04/27	Iron, dissolved	mg/L	<0.01
UA	G404	C	2021/08/17	Iron, dissolved	mg/L	0.160
UA	G404	C	2021/10/26	Iron, dissolved	mg/L	0.820
UA	G404	C	2022/02/08	Iron, dissolved	mg/L	0.210
UA	G404	C	2022/05/10	Iron, dissolved	mg/L	0.400
UA	G404	C	2022/08/24	Iron, dissolved	mg/L	0.750
UA	G404	C	2022/11/09	Iron, dissolved	mg/L	0.0490
UA	G404	C	2023/02/14	Iron, dissolved	mg/L	<0.00072
UA	G404	C	2023/06/07	Iron, dissolved	mg/L	0.0580
UA	G404	C	2023/08/14	Iron, dissolved	mg/L	0.0718
UA	G404	C	2023/11/21	Iron, dissolved	mg/L	0.0944
UA	G404	C	2015/10/07	Iron, dissolved	mg/L	0.530
UA	G404	C	2017/07/14	Magnesium, total	mg/L	89.0
UA	G404	C	2020/01/22	Magnesium, total	mg/L	73.0
UA	G404	C	2021/01/21	Magnesium, total	mg/L	71.0
UA	G404	C	2021/08/17	Magnesium, total	mg/L	110
UA	G404	C	2022/02/08	Magnesium, total	mg/L	97.0
UA	G404	C	2022/08/24	Magnesium, total	mg/L	130
UA	G404	C	2023/02/14	Magnesium, total	mg/L	80.0
UA	G404	C	2023/06/07	Magnesium, total	mg/L	110
UA	G404	C	2023/08/14	Magnesium, total	mg/L	95.7
UA	G404	C	2023/11/21	Magnesium, total	mg/L	124
UA	G404	C	2018/03/03	Manganese, dissolved	mg/L	0.520
UA	G404	C	2018/05/12	Manganese, dissolved	mg/L	0.0220
UA	G404	C	2018/08/11	Manganese, dissolved	mg/L	1.50
UA	G404	C	2018/11/06	Manganese, dissolved	mg/L	0.290
UA	G404	C	2019/01/24	Manganese, dissolved	mg/L	0.0610
UA	G404	C	2019/05/02	Manganese, dissolved	mg/L	0.00960
UA	G404	C	2019/08/16	Manganese, dissolved	mg/L	0.170
UA	G404	C	2019/10/21	Manganese, dissolved	mg/L	0.300
UA	G404	C	2020/01/22	Manganese, dissolved	mg/L	0.0320

UA	G404	C	2020/05/06	Manganese, dissolved	mg/L	0.0820
UA	G404	C	2020/08/12	Manganese, dissolved	mg/L	0.330
UA	G404	C	2020/10/13	Manganese, dissolved	mg/L	0.300
UA	G404	C	2021/01/21	Manganese, dissolved	mg/L	0.150
UA	G404	C	2021/04/27	Manganese, dissolved	mg/L	0.200
UA	G404	C	2021/08/17	Manganese, dissolved	mg/L	0.920
UA	G404	C	2021/10/26	Manganese, dissolved	mg/L	1.20
UA	G404	C	2022/02/08	Manganese, dissolved	mg/L	0.100
UA	G404	C	2022/05/10	Manganese, dissolved	mg/L	0.180
UA	G404	C	2022/08/24	Manganese, dissolved	mg/L	1.40
UA	G404	C	2022/11/09	Manganese, dissolved	mg/L	1.80
UA	G404	C	2023/02/14	Manganese, dissolved	mg/L	0.330
UA	G404	C	2023/06/07	Manganese, dissolved	mg/L	1.20
UA	G404	C	2023/08/14	Manganese, dissolved	mg/L	2.85
UA	G404	C	2023/11/21	Manganese, dissolved	mg/L	1.46
UA	G404	C	2015/10/07	Manganese, dissolved	mg/L	0.330
UA	G404	C	2023/08/14	Phosphate, dissolved	mg/L	<0.005
UA	G404	C	2017/07/14	Potassium, total	mg/L	1.20
UA	G404	C	2020/01/22	Potassium, total	mg/L	0.330
UA	G404	C	2021/01/21	Potassium, total	mg/L	0.280
UA	G404	C	2021/08/17	Potassium, total	mg/L	0.480
UA	G404	C	2022/02/08	Potassium, total	mg/L	0.420
UA	G404	C	2022/08/24	Potassium, total	mg/L	0.720
UA	G404	C	2023/02/14	Potassium, total	mg/L	0.230
UA	G404	C	2023/06/07	Potassium, total	mg/L	0.430
UA	G404	C	2023/08/14	Potassium, total	mg/L	0.627
UA	G404	C	2023/11/21	Potassium, total	mg/L	0.594
UA	G404	C	2023/06/07	Silicon, dissolved	mg/L	11.0
UA	G404	C	2023/08/14	Silicon, dissolved	mg/L	10.2
UA	G404	C	2017/07/14	Sodium, total	mg/L	64.0
UA	G404	C	2020/01/22	Sodium, total	mg/L	58.0
UA	G404	C	2021/01/21	Sodium, total	mg/L	56.0
UA	G404	C	2021/08/17	Sodium, total	mg/L	87.0
UA	G404	C	2022/02/08	Sodium, total	mg/L	72.0
UA	G404	C	2022/08/24	Sodium, total	mg/L	96.0
UA	G404	C	2023/02/14	Sodium, total	mg/L	70.0
UA	G404	C	2023/06/07	Sodium, total	mg/L	81.0
UA	G404	C	2023/08/14	Sodium, total	mg/L	78.6
UA	G404	C	2023/11/21	Sodium, total	mg/L	94.0
UA	G404	C	2015/11/21	Sulfate, total	mg/L	180
UA	G404	C	2016/02/15	Sulfate, total	mg/L	150
UA	G404	C	2016/05/19	Sulfate, total	mg/L	140
UA	G404	C	2016/08/02	Sulfate, total	mg/L	190
UA	G404	C	2016/11/22	Sulfate, total	mg/L	380
UA	G404	C	2017/02/18	Sulfate, total	mg/L	230
UA	G404	C	2017/05/16	Sulfate, total	mg/L	160
UA	G404	C	2017/07/14	Sulfate, total	mg/L	310
UA	G404	C	2017/10/28	Sulfate, total	mg/L	390
UA	G404	C	2018/05/12	Sulfate, total	mg/L	370
UA	G404	C	2018/08/04	Sulfate, total	mg/L	410
UA	G404	C	2019/01/24	Sulfate, total	mg/L	220
UA	G404	C	2019/08/16	Sulfate, total	mg/L	170
UA	G404	C	2020/01/22	Sulfate, total	mg/L	200
UA	G404	C	2020/08/12	Sulfate, total	mg/L	190
UA	G404	C	2020/10/13	Sulfate, total	mg/L	280
UA	G404	C	2021/01/21	Sulfate, total	mg/L	200
UA	G404	C	2021/04/27	Sulfate, total	mg/L	250
UA	G404	C	2021/08/17	Sulfate, total	mg/L	470
UA	G404	C	2021/10/26	Sulfate, total	mg/L	500
UA	G404	C	2022/02/08	Sulfate, total	mg/L	480
UA	G404	C	2022/05/10	Sulfate, total	mg/L	520
UA	G404	C	2022/08/24	Sulfate, total	mg/L	810
UA	G404	C	2022/11/09	Sulfate, total	mg/L	840

UA	G404	C	2023/02/14	Sulfate, total	mg/L	510
UA	G404	C	2023/06/07	Sulfate, total	mg/L	700
UA	G404	C	2023/08/14	Sulfate, total	mg/L	678
UA	G404	C	2023/11/21	Sulfate, total	mg/L	647
UA	G404	C	2015/10/07	Sulfate, total	mg/L	290
UA	G404	C	2015/11/21	Temperature (Celsius)	degrees C	17.0
UA	G404	C	2016/02/15	Temperature (Celsius)	degrees C	8.10
UA	G404	C	2016/05/19	Temperature (Celsius)	degrees C	18.7
UA	G404	C	2016/08/02	Temperature (Celsius)	degrees C	19.5
UA	G404	C	2016/11/22	Temperature (Celsius)	degrees C	16.0
UA	G404	C	2017/02/18	Temperature (Celsius)	degrees C	15.9
UA	G404	C	2017/05/16	Temperature (Celsius)	degrees C	15.4
UA	G404	C	2017/07/14	Temperature (Celsius)	degrees C	18.7
UA	G404	C	2017/10/28	Temperature (Celsius)	degrees C	13.6
UA	G404	C	2018/05/12	Temperature (Celsius)	degrees C	14.4
UA	G404	C	2018/08/04	Temperature (Celsius)	degrees C	15.5
UA	G404	C	2019/01/24	Temperature (Celsius)	degrees C	11.3
UA	G404	C	2019/08/16	Temperature (Celsius)	degrees C	17.0
UA	G404	C	2020/01/22	Temperature (Celsius)	degrees C	7.60
UA	G404	C	2020/08/12	Temperature (Celsius)	degrees C	22.9
UA	G404	C	2020/10/13	Temperature (Celsius)	degrees C	18.8
UA	G404	C	2021/01/21	Temperature (Celsius)	degrees C	10.7
UA	G404	C	2021/04/27	Temperature (Celsius)	degrees C	17.6
UA	G404	C	2021/08/17	Temperature (Celsius)	degrees C	24.4
UA	G404	C	2021/10/26	Temperature (Celsius)	degrees C	18.6
UA	G404	C	2022/02/08	Temperature (Celsius)	degrees C	8.90
UA	G404	C	2022/05/10	Temperature (Celsius)	degrees C	18.1
UA	G404	C	2022/08/24	Temperature (Celsius)	degrees C	22.7
UA	G404	C	2022/11/09	Temperature (Celsius)	degrees C	19.8
UA	G404	C	2023/02/14	Temperature (Celsius)	degrees C	10.7
UA	G404	C	2023/06/07	Temperature (Celsius)	degrees C	17.3
UA	G404	C	2023/08/14	Temperature (Celsius)	degrees C	19.4
UA	G404	C	2023/11/21	Temperature (Celsius)	degrees C	13.7
UA	G404	C	2015/11/21	Total Dissolved Solids	mg/L	580
UA	G404	C	2016/02/15	Total Dissolved Solids	mg/L	560
UA	G404	C	2016/05/19	Total Dissolved Solids	mg/L	460
UA	G404	C	2016/08/02	Total Dissolved Solids	mg/L	620
UA	G404	C	2016/11/22	Total Dissolved Solids	mg/L	880
UA	G404	C	2017/02/18	Total Dissolved Solids	mg/L	740
UA	G404	C	2017/05/16	Total Dissolved Solids	mg/L	640
UA	G404	C	2017/07/14	Total Dissolved Solids	mg/L	860
UA	G404	C	2017/10/28	Total Dissolved Solids	mg/L	950
UA	G404	C	2018/05/12	Total Dissolved Solids	mg/L	1,000
UA	G404	C	2018/08/04	Total Dissolved Solids	mg/L	1,000
UA	G404	C	2019/01/24	Total Dissolved Solids	mg/L	720
UA	G404	C	2019/08/16	Total Dissolved Solids	mg/L	600
UA	G404	C	2020/01/22	Total Dissolved Solids	mg/L	700
UA	G404	C	2020/08/12	Total Dissolved Solids	mg/L	720
UA	G404	C	2020/10/13	Total Dissolved Solids	mg/L	1,200
UA	G404	C	2021/01/21	Total Dissolved Solids	mg/L	910
UA	G404	C	2021/04/27	Total Dissolved Solids	mg/L	1,200
UA	G404	C	2021/08/17	Total Dissolved Solids	mg/L	1,500
UA	G404	C	2021/10/26	Total Dissolved Solids	mg/L	1,400
UA	G404	C	2022/02/08	Total Dissolved Solids	mg/L	1,300
UA	G404	C	2022/05/10	Total Dissolved Solids	mg/L	1,500
UA	G404	C	2022/08/24	Total Dissolved Solids	mg/L	1,800
UA	G404	C	2022/11/09	Total Dissolved Solids	mg/L	1,900
UA	G404	C	2023/02/14	Total Dissolved Solids	mg/L	1,200
UA	G404	C	2023/06/07	Total Dissolved Solids	mg/L	1,300
UA	G404	C	2023/08/14	Total Dissolved Solids	mg/L	1,600
UA	G404	C	2023/11/21	Total Dissolved Solids	mg/L	1,370
UA	G404	C	2015/10/07	Total Dissolved Solids	mg/L	860
UA	G405	C	2015/11/21	pH (field)	SU	6.8

UA	G405	C	2016/02/15	pH (field)	SU	7.1
UA	G405	C	2016/05/18	pH (field)	SU	6.9
UA	G405	C	2016/08/02	pH (field)	SU	6.8
UA	G405	C	2016/11/22	pH (field)	SU	6.9
UA	G405	C	2017/02/18	pH (field)	SU	7.0
UA	G405	C	2017/05/16	pH (field)	SU	7.1
UA	G405	C	2017/07/14	pH (field)	SU	6.8
UA	G405	C	2017/10/28	pH (field)	SU	7.0
UA	G405	C	2018/05/12	pH (field)	SU	6.9
UA	G405	C	2018/08/04	pH (field)	SU	6.6
UA	G405	C	2019/01/25	pH (field)	SU	6.6
UA	G405	C	2019/08/20	pH (field)	SU	6.7
UA	G405	C	2020/01/22	pH (field)	SU	7.0
UA	G405	C	2020/08/12	pH (field)	SU	7.0
UA	G405	C	2020/10/13	pH (field)	SU	7.0
UA	G405	C	2021/01/21	pH (field)	SU	6.9
UA	G405	C	2021/04/27	pH (field)	SU	7.0
UA	G405	C	2021/08/17	pH (field)	SU	7.0
UA	G405	C	2021/10/26	pH (field)	SU	6.9
UA	G405	C	2022/02/08	pH (field)	SU	7.0
UA	G405	C	2022/05/10	pH (field)	SU	7.0
UA	G405	C	2022/08/24	pH (field)	SU	6.7
UA	G405	C	2022/11/09	pH (field)	SU	6.8
UA	G405	C	2023/02/14	pH (field)	SU	7.0
UA	G405	C	2023/06/06	pH (field)	SU	6.8
UA	G405	C	2023/08/11	pH (field)	SU	7.1
UA	G405	C	2023/11/21	pH (field)	SU	7.0
UA	G405	C	2015/10/07	pH (field)	SU	7.4
UA	G405	C	2015/11/21	Oxidation Reduction Potential	mV	23.0
UA	G405	C	2016/02/15	Oxidation Reduction Potential	mV	93.0
UA	G405	C	2016/05/18	Oxidation Reduction Potential	mV	5.00
UA	G405	C	2016/08/02	Oxidation Reduction Potential	mV	23.0
UA	G405	C	2016/11/22	Oxidation Reduction Potential	mV	34.0
UA	G405	C	2017/02/18	Oxidation Reduction Potential	mV	50.0
UA	G405	C	2017/05/16	Oxidation Reduction Potential	mV	57.0
UA	G405	C	2017/07/14	Oxidation Reduction Potential	mV	30.0
UA	G405	C	2017/10/28	Oxidation Reduction Potential	mV	18.0
UA	G405	C	2018/05/12	Oxidation Reduction Potential	mV	21.0
UA	G405	C	2018/08/04	Oxidation Reduction Potential	mV	57.0
UA	G405	C	2019/01/25	Oxidation Reduction Potential	mV	58.0
UA	G405	C	2019/08/20	Oxidation Reduction Potential	mV	62.0
UA	G405	C	2020/01/22	Oxidation Reduction Potential	mV	120
UA	G405	C	2020/08/12	Oxidation Reduction Potential	mV	48.5
UA	G405	C	2020/10/13	Oxidation Reduction Potential	mV	83.9
UA	G405	C	2021/01/21	Oxidation Reduction Potential	mV	75.6
UA	G405	C	2021/04/27	Oxidation Reduction Potential	mV	59.4
UA	G405	C	2021/08/17	Oxidation Reduction Potential	mV	57.2
UA	G405	C	2021/10/26	Oxidation Reduction Potential	mV	43.0
UA	G405	C	2022/02/08	Oxidation Reduction Potential	mV	152
UA	G405	C	2022/05/10	Oxidation Reduction Potential	mV	86.4
UA	G405	C	2022/08/24	Oxidation Reduction Potential	mV	38.0
UA	G405	C	2022/11/09	Oxidation Reduction Potential	mV	25.0
UA	G405	C	2023/02/14	Oxidation Reduction Potential	mV	295
UA	G405	C	2023/06/06	Oxidation Reduction Potential	mV	68.0
UA	G405	C	2023/08/11	Oxidation Reduction Potential	mV	-21.0
UA	G405	C	2023/11/21	Oxidation Reduction Potential	mV	76.0
UA	G405	C	2015/11/21	Eh	V	0.22
UA	G405	C	2016/02/15	Eh	V	0.29
UA	G405	C	2016/05/18	Eh	V	0.20
UA	G405	C	2016/08/02	Eh	V	0.22
UA	G405	C	2016/11/22	Eh	V	0.23
UA	G405	C	2017/02/18	Eh	V	0.25
UA	G405	C	2017/05/16	Eh	V	0.25

UA	G405	C	2017/07/14	Eh	V	0.22
UA	G405	C	2017/10/28	Eh	V	0.21
UA	G405	C	2018/05/12	Eh	V	0.22
UA	G405	C	2018/08/04	Eh	V	0.25
UA	G405	C	2019/01/25	Eh	V	0.26
UA	G405	C	2019/08/20	Eh	V	0.26
UA	G405	C	2020/01/22	Eh	V	0.32
UA	G405	C	2020/08/12	Eh	V	0.24
UA	G405	C	2020/10/13	Eh	V	0.28
UA	G405	C	2021/01/21	Eh	V	0.27
UA	G405	C	2021/04/27	Eh	V	0.25
UA	G405	C	2021/08/17	Eh	V	0.25
UA	G405	C	2021/10/26	Eh	V	0.24
UA	G405	C	2022/02/08	Eh	V	0.35
UA	G405	C	2022/05/10	Eh	V	0.28
UA	G405	C	2022/08/24	Eh	V	0.23
UA	G405	C	2022/11/09	Eh	V	0.22
UA	G405	C	2023/02/14	Eh	V	0.49
UA	G405	C	2023/06/06	Eh	V	0.26
UA	G405	C	2023/08/11	Eh	V	0.17
UA	G405	C	2023/11/21	Eh	V	0.27
UA	G405	C	2017/07/14	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G405	C	2020/01/22	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G405	C	2021/01/21	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G405	C	2021/08/17	Alkalinity, bicarbonate	mg/L CaCO3	270
UA	G405	C	2022/02/08	Alkalinity, bicarbonate	mg/L CaCO3	250
UA	G405	C	2022/08/24	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G405	C	2023/02/14	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G405	C	2023/06/06	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G405	C	2023/08/11	Alkalinity, bicarbonate	mg/L CaCO3	286
UA	G405	C	2023/11/21	Alkalinity, bicarbonate	mg/L CaCO3	286
UA	G405	C	2022/08/24	Alkalinity, carbonate	mg/L CaCO3	10.0
UA	G405	C	2015/11/21	Barium, total	mg/L	0.0510
UA	G405	C	2016/02/15	Barium, total	mg/L	0.0180
UA	G405	C	2016/05/18	Barium, total	mg/L	0.0200
UA	G405	C	2016/08/02	Barium, total	mg/L	0.0280
UA	G405	C	2016/11/22	Barium, total	mg/L	0.0220
UA	G405	C	2017/02/18	Barium, total	mg/L	0.0210
UA	G405	C	2017/05/16	Barium, total	mg/L	0.0240
UA	G405	C	2017/07/14	Barium, total	mg/L	0.0350
UA	G405	C	2018/05/12	Barium, total	mg/L	0.0260
UA	G405	C	2018/08/04	Barium, total	mg/L	0.0200
UA	G405	C	2019/01/25	Barium, total	mg/L	0.0410
UA	G405	C	2019/08/20	Barium, total	mg/L	0.0360
UA	G405	C	2020/01/22	Barium, total	mg/L	0.0300
UA	G405	C	2020/08/12	Barium, total	mg/L	0.0220
UA	G405	C	2020/10/13	Barium, total	mg/L	0.0220
UA	G405	C	2021/01/21	Barium, total	mg/L	0.0200
UA	G405	C	2021/04/27	Barium, total	mg/L	0.0140
UA	G405	C	2021/08/17	Barium, total	mg/L	0.0150
UA	G405	C	2021/10/26	Barium, total	mg/L	0.0150
UA	G405	C	2022/02/08	Barium, total	mg/L	0.0150
UA	G405	C	2022/05/10	Barium, total	mg/L	0.0150
UA	G405	C	2022/08/24	Barium, total	mg/L	0.0160
UA	G405	C	2022/11/09	Barium, total	mg/L	0.0140
UA	G405	C	2023/02/14	Barium, total	mg/L	0.0200
UA	G405	C	2023/06/06	Barium, total	mg/L	0.0130
UA	G405	C	2023/08/11	Barium, total	mg/L	0.0158
UA	G405	C	2023/11/21	Barium, total	mg/L	0.0259
UA	G405	C	2015/10/07	Barium, total	mg/L	0.0690
UA	G405	C	2015/11/21	Boron, total	mg/L	17.0
UA	G405	C	2016/02/15	Boron, total	mg/L	16.0
UA	G405	C	2016/05/18	Boron, total	mg/L	15.0

UA	G405	C	2016/08/02	Boron, total	mg/L	17.0
UA	G405	C	2016/11/22	Boron, total	mg/L	13.0
UA	G405	C	2017/02/18	Boron, total	mg/L	12.0
UA	G405	C	2017/05/16	Boron, total	mg/L	4.00
UA	G405	C	2017/07/14	Boron, total	mg/L	15.0
UA	G405	C	2017/10/28	Boron, total	mg/L	11.0
UA	G405	C	2018/05/12	Boron, total	mg/L	9.10
UA	G405	C	2018/08/04	Boron, total	mg/L	7.80
UA	G405	C	2019/01/25	Boron, total	mg/L	7.80
UA	G405	C	2019/08/20	Boron, total	mg/L	4.80
UA	G405	C	2020/01/22	Boron, total	mg/L	8.50
UA	G405	C	2020/08/12	Boron, total	mg/L	8.90
UA	G405	C	2020/10/13	Boron, total	mg/L	11.0
UA	G405	C	2021/01/21	Boron, total	mg/L	11.0
UA	G405	C	2021/04/27	Boron, total	mg/L	9.60
UA	G405	C	2021/08/17	Boron, total	mg/L	12.0
UA	G405	C	2021/10/26	Boron, total	mg/L	12.0
UA	G405	C	2022/02/08	Boron, total	mg/L	10.0
UA	G405	C	2022/05/10	Boron, total	mg/L	10.0
UA	G405	C	2022/08/24	Boron, total	mg/L	9.40
UA	G405	C	2022/11/09	Boron, total	mg/L	9.10
UA	G405	C	2023/02/14	Boron, total	mg/L	10.0
UA	G405	C	2023/06/06	Boron, total	mg/L	9.50
UA	G405	C	2023/08/11	Boron, total	mg/L	10.8
UA	G405	C	2023/11/21	Boron, total	mg/L	15.4
UA	G405	C	2015/10/07	Boron, total	mg/L	20.0
UA	G405	C	2015/11/21	Calcium, total	mg/L	330
UA	G405	C	2016/02/15	Calcium, total	mg/L	320
UA	G405	C	2016/05/18	Calcium, total	mg/L	320
UA	G405	C	2016/08/02	Calcium, total	mg/L	280
UA	G405	C	2016/11/22	Calcium, total	mg/L	250
UA	G405	C	2017/02/18	Calcium, total	mg/L	270
UA	G405	C	2017/05/16	Calcium, total	mg/L	190
UA	G405	C	2017/07/14	Calcium, total	mg/L	320
UA	G405	C	2017/10/28	Calcium, total	mg/L	300
UA	G405	C	2018/05/12	Calcium, total	mg/L	260
UA	G405	C	2018/08/04	Calcium, total	mg/L	220
UA	G405	C	2019/01/25	Calcium, total	mg/L	220
UA	G405	C	2019/08/20	Calcium, total	mg/L	140
UA	G405	C	2020/01/22	Calcium, total	mg/L	240
UA	G405	C	2020/08/12	Calcium, total	mg/L	220
UA	G405	C	2020/10/13	Calcium, total	mg/L	220
UA	G405	C	2021/01/21	Calcium, total	mg/L	250
UA	G405	C	2021/04/27	Calcium, total	mg/L	210
UA	G405	C	2021/08/17	Calcium, total	mg/L	250
UA	G405	C	2021/10/26	Calcium, total	mg/L	230
UA	G405	C	2022/02/08	Calcium, total	mg/L	260
UA	G405	C	2022/05/10	Calcium, total	mg/L	280
UA	G405	C	2022/08/24	Calcium, total	mg/L	250
UA	G405	C	2022/11/09	Calcium, total	mg/L	220
UA	G405	C	2023/02/14	Calcium, total	mg/L	260
UA	G405	C	2023/06/06	Calcium, total	mg/L	250
UA	G405	C	2023/08/11	Calcium, total	mg/L	253
UA	G405	C	2023/11/21	Calcium, total	mg/L	248
UA	G405	C	2015/11/21	Chloride, total	mg/L	14.0
UA	G405	C	2016/02/15	Chloride, total	mg/L	11.0
UA	G405	C	2016/05/18	Chloride, total	mg/L	9.30
UA	G405	C	2016/08/02	Chloride, total	mg/L	3.40
UA	G405	C	2016/11/22	Chloride, total	mg/L	19.0
UA	G405	C	2017/02/18	Chloride, total	mg/L	21.0
UA	G405	C	2017/05/16	Chloride, total	mg/L	47.0
UA	G405	C	2017/07/14	Chloride, total	mg/L	20.0
UA	G405	C	2017/10/28	Chloride, total	mg/L	26.0

UA	G405	C	2018/05/12	Chloride, total	mg/L	23.0
UA	G405	C	2018/08/04	Chloride, total	mg/L	22.0
UA	G405	C	2019/01/25	Chloride, total	mg/L	14.0
UA	G405	C	2019/08/20	Chloride, total	mg/L	17.0
UA	G405	C	2020/01/22	Chloride, total	mg/L	10.0
UA	G405	C	2020/08/12	Chloride, total	mg/L	13.0
UA	G405	C	2020/10/13	Chloride, total	mg/L	12.0
UA	G405	C	2021/01/21	Chloride, total	mg/L	5.90
UA	G405	C	2021/04/27	Chloride, total	mg/L	7.00
UA	G405	C	2021/08/17	Chloride, total	mg/L	7.80
UA	G405	C	2021/10/26	Chloride, total	mg/L	11.0
UA	G405	C	2022/02/08	Chloride, total	mg/L	6.20
UA	G405	C	2022/05/10	Chloride, total	mg/L	5.80
UA	G405	C	2022/08/24	Chloride, total	mg/L	6.90
UA	G405	C	2022/11/09	Chloride, total	mg/L	9.10
UA	G405	C	2023/02/14	Chloride, total	mg/L	9.90
UA	G405	C	2023/06/06	Chloride, total	mg/L	8.90
UA	G405	C	2023/08/11	Chloride, total	mg/L	14.0
UA	G405	C	2023/11/21	Chloride, total	mg/L	17.0
UA	G405	C	2015/10/07	Chloride, total	mg/L	7.10
UA	G405	C	2015/11/21	Cobalt, total	mg/L	0.00340
UA	G405	C	2016/02/15	Cobalt, total	mg/L	<0.000017
UA	G405	C	2016/05/18	Cobalt, total	mg/L	<0.000017
UA	G405	C	2016/08/02	Cobalt, total	mg/L	0.00380
UA	G405	C	2016/11/22	Cobalt, total	mg/L	0.00210
UA	G405	C	2017/02/18	Cobalt, total	mg/L	<0.000017
UA	G405	C	2017/05/16	Cobalt, total	mg/L	<0.000017
UA	G405	C	2017/07/14	Cobalt, total	mg/L	0.00260
UA	G405	C	2018/05/12	Cobalt, total	mg/L	0.00300
UA	G405	C	2018/08/04	Cobalt, total	mg/L	<0.00067
UA	G405	C	2019/01/25	Cobalt, total	mg/L	0.00380
UA	G405	C	2019/08/20	Cobalt, total	mg/L	<0.00067
UA	G405	C	2020/01/22	Cobalt, total	mg/L	<0.00067
UA	G405	C	2020/08/12	Cobalt, total	mg/L	<0.00022
UA	G405	C	2020/10/13	Cobalt, total	mg/L	<0.002
UA	G405	C	2021/01/21	Cobalt, total	mg/L	<0.00022
UA	G405	C	2021/04/27	Cobalt, total	mg/L	<0.002
UA	G405	C	2021/08/17	Cobalt, total	mg/L	<0.00022
UA	G405	C	2021/10/26	Cobalt, total	mg/L	<0.002
UA	G405	C	2022/02/08	Cobalt, total	mg/L	<0.00019
UA	G405	C	2022/05/10	Cobalt, total	mg/L	0.00110
UA	G405	C	2022/08/24	Cobalt, total	mg/L	0.00100
UA	G405	C	2022/11/09	Cobalt, total	mg/L	0.000790
UA	G405	C	2023/02/14	Cobalt, total	mg/L	0.00160
UA	G405	C	2023/06/06	Cobalt, total	mg/L	0.000870
UA	G405	C	2023/08/11	Cobalt, total	mg/L	0.00110
UA	G405	C	2023/11/21	Cobalt, total	mg/L	0.00150
UA	G405	C	2015/10/07	Cobalt, total	mg/L	0.00440
UA	G405	C	2023/06/06	Ferrous Iron, dissolved	mg/L	0.250
UA	G405	C	2020/08/12	Iron, dissolved	mg/L	0.0290
UA	G405	C	2020/10/13	Iron, dissolved	mg/L	0.0520
UA	G405	C	2021/01/21	Iron, dissolved	mg/L	0.0390
UA	G405	C	2021/04/27	Iron, dissolved	mg/L	0.0720
UA	G405	C	2021/08/17	Iron, dissolved	mg/L	0.0690
UA	G405	C	2021/10/26	Iron, dissolved	mg/L	0.0690
UA	G405	C	2022/02/08	Iron, dissolved	mg/L	0.0520
UA	G405	C	2022/05/10	Iron, dissolved	mg/L	0.0630
UA	G405	C	2022/08/24	Iron, dissolved	mg/L	0.0950
UA	G405	C	2022/11/09	Iron, dissolved	mg/L	0.120
UA	G405	C	2023/02/14	Iron, dissolved	mg/L	0.110
UA	G405	C	2023/06/06	Iron, dissolved	mg/L	0.130
UA	G405	C	2023/08/11	Iron, dissolved	mg/L	0.165
UA	G405	C	2023/11/21	Iron, dissolved	mg/L	0.0788

UA	G405	C	2015/10/07	Iron, dissolved	mg/L	<0.01
UA	G405	C	2017/07/14	Magnesium, total	mg/L	160
UA	G405	C	2020/01/22	Magnesium, total	mg/L	110
UA	G405	C	2021/01/21	Magnesium, total	mg/L	100
UA	G405	C	2021/08/17	Magnesium, total	mg/L	110
UA	G405	C	2022/02/08	Magnesium, total	mg/L	120
UA	G405	C	2022/08/24	Magnesium, total	mg/L	100
UA	G405	C	2023/02/14	Magnesium, total	mg/L	110
UA	G405	C	2023/06/06	Magnesium, total	mg/L	110
UA	G405	C	2023/08/11	Magnesium, total	mg/L	110
UA	G405	C	2023/11/21	Magnesium, total	mg/L	107
UA	G405	C	2018/03/03	Manganese, dissolved	mg/L	1.10
UA	G405	C	2018/05/12	Manganese, dissolved	mg/L	<0.001
UA	G405	C	2018/08/11	Manganese, dissolved	mg/L	0.490
UA	G405	C	2018/11/06	Manganese, dissolved	mg/L	0.0690
UA	G405	C	2019/01/25	Manganese, dissolved	mg/L	0.130
UA	G405	C	2019/05/02	Manganese, dissolved	mg/L	0.290
UA	G405	C	2019/08/16	Manganese, dissolved	mg/L	0.580
UA	G405	C	2019/10/21	Manganese, dissolved	mg/L	0.910
UA	G405	C	2020/01/22	Manganese, dissolved	mg/L	1.00
UA	G405	C	2020/05/06	Manganese, dissolved	mg/L	0.870
UA	G405	C	2020/08/12	Manganese, dissolved	mg/L	0.810
UA	G405	C	2020/10/13	Manganese, dissolved	mg/L	0.800
UA	G405	C	2021/01/21	Manganese, dissolved	mg/L	0.880
UA	G405	C	2021/04/27	Manganese, dissolved	mg/L	0.950
UA	G405	C	2021/08/17	Manganese, dissolved	mg/L	1.10
UA	G405	C	2021/10/26	Manganese, dissolved	mg/L	0.990
UA	G405	C	2022/02/08	Manganese, dissolved	mg/L	0.920
UA	G405	C	2022/05/10	Manganese, dissolved	mg/L	1.00
UA	G405	C	2022/08/24	Manganese, dissolved	mg/L	1.20
UA	G405	C	2022/11/09	Manganese, dissolved	mg/L	1.10
UA	G405	C	2023/02/14	Manganese, dissolved	mg/L	1.30
UA	G405	C	2023/06/06	Manganese, dissolved	mg/L	1.10
UA	G405	C	2023/08/11	Manganese, dissolved	mg/L	1.07
UA	G405	C	2023/11/21	Manganese, dissolved	mg/L	0.868
UA	G405	C	2015/10/07	Manganese, dissolved	mg/L	2.00
UA	G405	C	2023/08/11	Phosphate, dissolved	mg/L	0.0520
UA	G405	C	2017/07/14	Potassium, total	mg/L	0.950
UA	G405	C	2020/01/22	Potassium, total	mg/L	0.430
UA	G405	C	2021/01/21	Potassium, total	mg/L	0.460
UA	G405	C	2021/08/17	Potassium, total	mg/L	0.500
UA	G405	C	2022/02/08	Potassium, total	mg/L	0.460
UA	G405	C	2022/08/24	Potassium, total	mg/L	0.560
UA	G405	C	2023/02/14	Potassium, total	mg/L	0.510
UA	G405	C	2023/06/06	Potassium, total	mg/L	0.410
UA	G405	C	2023/08/11	Potassium, total	mg/L	0.566
UA	G405	C	2023/11/21	Potassium, total	mg/L	0.594
UA	G405	C	2023/06/06	Silicon, dissolved	mg/L	8.00
UA	G405	C	2023/08/11	Silicon, dissolved	mg/L	7.81
UA	G405	C	2017/07/14	Sodium, total	mg/L	120
UA	G405	C	2020/01/22	Sodium, total	mg/L	100
UA	G405	C	2021/01/21	Sodium, total	mg/L	110
UA	G405	C	2021/08/17	Sodium, total	mg/L	120
UA	G405	C	2022/02/08	Sodium, total	mg/L	110
UA	G405	C	2022/08/24	Sodium, total	mg/L	100
UA	G405	C	2023/02/14	Sodium, total	mg/L	100
UA	G405	C	2023/06/06	Sodium, total	mg/L	110
UA	G405	C	2023/08/11	Sodium, total	mg/L	109
UA	G405	C	2023/11/21	Sodium, total	mg/L	103
UA	G405	C	2015/11/21	Sulfate, total	mg/L	1,700
UA	G405	C	2016/02/15	Sulfate, total	mg/L	1,700
UA	G405	C	2016/05/18	Sulfate, total	mg/L	1,800
UA	G405	C	2016/08/02	Sulfate, total	mg/L	1,600

UA	G405	C	2016/11/22	Sulfate, total	mg/L	1,400
UA	G405	C	2017/02/18	Sulfate, total	mg/L	1,300
UA	G405	C	2017/05/16	Sulfate, total	mg/L	680
UA	G405	C	2017/07/14	Sulfate, total	mg/L	1,600
UA	G405	C	2017/10/28	Sulfate, total	mg/L	1,300
UA	G405	C	2018/05/12	Sulfate, total	mg/L	1,200
UA	G405	C	2018/08/04	Sulfate, total	mg/L	790
UA	G405	C	2019/01/25	Sulfate, total	mg/L	890
UA	G405	C	2019/08/20	Sulfate, total	mg/L	340
UA	G405	C	2020/01/22	Sulfate, total	mg/L	910
UA	G405	C	2020/08/12	Sulfate, total	mg/L	460
UA	G405	C	2020/10/13	Sulfate, total	mg/L	980
UA	G405	C	2021/01/21	Sulfate, total	mg/L	960
UA	G405	C	2021/04/27	Sulfate, total	mg/L	800
UA	G405	C	2021/08/17	Sulfate, total	mg/L	760
UA	G405	C	2021/10/26	Sulfate, total	mg/L	1,000
UA	G405	C	2022/02/08	Sulfate, total	mg/L	1,000
UA	G405	C	2022/05/10	Sulfate, total	mg/L	1,000
UA	G405	C	2022/08/24	Sulfate, total	mg/L	1,000
UA	G405	C	2022/11/09	Sulfate, total	mg/L	910
UA	G405	C	2023/02/14	Sulfate, total	mg/L	950
UA	G405	C	2023/06/06	Sulfate, total	mg/L	1,000
UA	G405	C	2023/08/11	Sulfate, total	mg/L	916
UA	G405	C	2023/11/21	Sulfate, total	mg/L	897
UA	G405	C	2015/10/07	Sulfate, total	mg/L	1,900
UA	G405	C	2015/11/21	Temperature (Celsius)	degrees C	16.7
UA	G405	C	2016/02/15	Temperature (Celsius)	degrees C	9.40
UA	G405	C	2016/05/18	Temperature (Celsius)	degrees C	17.1
UA	G405	C	2016/08/02	Temperature (Celsius)	degrees C	18.9
UA	G405	C	2016/11/22	Temperature (Celsius)	degrees C	13.8
UA	G405	C	2017/02/18	Temperature (Celsius)	degrees C	15.0
UA	G405	C	2017/05/16	Temperature (Celsius)	degrees C	15.1
UA	G405	C	2017/07/14	Temperature (Celsius)	degrees C	17.8
UA	G405	C	2017/10/28	Temperature (Celsius)	degrees C	13.0
UA	G405	C	2018/05/12	Temperature (Celsius)	degrees C	15.1
UA	G405	C	2018/08/04	Temperature (Celsius)	degrees C	16.0
UA	G405	C	2019/01/25	Temperature (Celsius)	degrees C	12.1
UA	G405	C	2019/08/20	Temperature (Celsius)	degrees C	17.2
UA	G405	C	2020/01/22	Temperature (Celsius)	degrees C	7.60
UA	G405	C	2020/08/12	Temperature (Celsius)	degrees C	24.1
UA	G405	C	2020/10/13	Temperature (Celsius)	degrees C	19.6
UA	G405	C	2021/01/21	Temperature (Celsius)	degrees C	11.9
UA	G405	C	2021/04/27	Temperature (Celsius)	degrees C	17.4
UA	G405	C	2021/08/17	Temperature (Celsius)	degrees C	22.7
UA	G405	C	2021/10/26	Temperature (Celsius)	degrees C	17.7
UA	G405	C	2022/02/08	Temperature (Celsius)	degrees C	9.60
UA	G405	C	2022/05/10	Temperature (Celsius)	degrees C	18.8
UA	G405	C	2022/08/24	Temperature (Celsius)	degrees C	22.8
UA	G405	C	2022/11/09	Temperature (Celsius)	degrees C	19.8
UA	G405	C	2023/02/14	Temperature (Celsius)	degrees C	10.6
UA	G405	C	2023/06/06	Temperature (Celsius)	degrees C	19.7
UA	G405	C	2023/08/11	Temperature (Celsius)	degrees C	18.2
UA	G405	C	2023/11/21	Temperature (Celsius)	degrees C	15.3
UA	G405	C	2015/11/21	Total Dissolved Solids	mg/L	2,400
UA	G405	C	2016/02/15	Total Dissolved Solids	mg/L	2,500
UA	G405	C	2016/05/18	Total Dissolved Solids	mg/L	2,200
UA	G405	C	2016/08/02	Total Dissolved Solids	mg/L	2,200
UA	G405	C	2016/11/22	Total Dissolved Solids	mg/L	2,100
UA	G405	C	2017/02/18	Total Dissolved Solids	mg/L	1,800
UA	G405	C	2017/05/16	Total Dissolved Solids	mg/L	1,300
UA	G405	C	2017/07/14	Total Dissolved Solids	mg/L	2,100
UA	G405	C	2017/10/28	Total Dissolved Solids	mg/L	2,000
UA	G405	C	2018/05/12	Total Dissolved Solids	mg/L	1,900

UA	G405	C	2018/08/04	Total Dissolved Solids	mg/L	1,400
UA	G405	C	2019/01/25	Total Dissolved Solids	mg/L	1,500
UA	G405	C	2019/08/20	Total Dissolved Solids	mg/L	720
UA	G405	C	2020/01/22	Total Dissolved Solids	mg/L	1,400
UA	G405	C	2020/08/12	Total Dissolved Solids	mg/L	1,200
UA	G405	C	2020/10/13	Total Dissolved Solids	mg/L	1,600
UA	G405	C	2021/01/21	Total Dissolved Solids	mg/L	1,600
UA	G405	C	2021/04/27	Total Dissolved Solids	mg/L	1,600
UA	G405	C	2021/08/17	Total Dissolved Solids	mg/L	1,400
UA	G405	C	2021/10/26	Total Dissolved Solids	mg/L	1,600
UA	G405	C	2022/02/08	Total Dissolved Solids	mg/L	1,400
UA	G405	C	2022/05/10	Total Dissolved Solids	mg/L	1,700
UA	G405	C	2022/08/24	Total Dissolved Solids	mg/L	1,900
UA	G405	C	2022/11/09	Total Dissolved Solids	mg/L	1,700
UA	G405	C	2023/02/14	Total Dissolved Solids	mg/L	1,900
UA	G405	C	2023/06/06	Total Dissolved Solids	mg/L	1,700
UA	G405	C	2023/08/11	Total Dissolved Solids	mg/L	1,790
UA	G405	C	2023/11/21	Total Dissolved Solids	mg/L	1,610
UA	G405	C	2015/10/07	Total Dissolved Solids	mg/L	2,900
UA	G406	C	2020/10/14	pH (field)	SU	6.5
UA	G406	C	2021/01/28	pH (field)	SU	6.6
UA	G406	C	2021/05/20	pH (field)	SU	7.0
UA	G406	C	2021/08/17	pH (field)	SU	6.7
UA	G406	C	2021/10/26	pH (field)	SU	6.6
UA	G406	C	2022/02/08	pH (field)	SU	6.5
UA	G406	C	2022/05/10	pH (field)	SU	6.5
UA	G406	C	2022/08/24	pH (field)	SU	6.4
UA	G406	C	2022/11/09	pH (field)	SU	6.5
UA	G406	C	2023/02/14	pH (field)	SU	6.7
UA	G406	C	2023/05/31	pH (field)	SU	6.5
UA	G406	C	2023/08/11	pH (field)	SU	6.7
UA	G406	C	2023/11/20	pH (field)	SU	6.6
UA	G406	C	2020/10/14	Oxidation Reduction Potential	mV	186
UA	G406	C	2021/01/28	Oxidation Reduction Potential	mV	194
UA	G406	C	2021/05/20	Oxidation Reduction Potential	mV	-110
UA	G406	C	2021/08/17	Oxidation Reduction Potential	mV	95.7
UA	G406	C	2021/10/26	Oxidation Reduction Potential	mV	29.4
UA	G406	C	2022/02/08	Oxidation Reduction Potential	mV	174
UA	G406	C	2022/05/10	Oxidation Reduction Potential	mV	132
UA	G406	C	2022/08/24	Oxidation Reduction Potential	mV	165
UA	G406	C	2022/11/09	Oxidation Reduction Potential	mV	225
UA	G406	C	2023/02/14	Oxidation Reduction Potential	mV	284
UA	G406	C	2023/05/31	Oxidation Reduction Potential	mV	166
UA	G406	C	2023/08/11	Oxidation Reduction Potential	mV	81.0
UA	G406	C	2023/11/20	Oxidation Reduction Potential	mV	127
UA	G406	C	2020/10/14	Eh	V	0.38
UA	G406	C	2021/01/28	Eh	V	0.39
UA	G406	C	2021/05/20	Eh	V	0.078
UA	G406	C	2021/08/17	Eh	V	0.29
UA	G406	C	2021/10/26	Eh	V	0.22
UA	G406	C	2022/02/08	Eh	V	0.37
UA	G406	C	2022/05/10	Eh	V	0.33
UA	G406	C	2022/08/24	Eh	V	0.36
UA	G406	C	2022/11/09	Eh	V	0.42
UA	G406	C	2023/02/14	Eh	V	0.48
UA	G406	C	2023/05/31	Eh	V	0.36
UA	G406	C	2023/08/11	Eh	V	0.28
UA	G406	C	2023/11/20	Eh	V	0.32
UA	G406	C	2023/02/14	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G406	C	2023/05/31	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G406	C	2023/08/11	Alkalinity, bicarbonate	mg/L CaCO3	347
UA	G406	C	2023/11/20	Alkalinity, bicarbonate	mg/L CaCO3	289
UA	G406	C	2020/10/14	Barium, total	mg/L	0.0130

UA	G406	C	2021/01/28	Barium, total	mg/L	0.0120
UA	G406	C	2021/05/20	Barium, total	mg/L	0.730
UA	G406	C	2021/08/17	Barium, total	mg/L	0.0140
UA	G406	C	2021/10/26	Barium, total	mg/L	0.0140
UA	G406	C	2022/02/08	Barium, total	mg/L	0.0160
UA	G406	C	2022/05/10	Barium, total	mg/L	0.0150
UA	G406	C	2022/08/24	Barium, total	mg/L	0.0130
UA	G406	C	2022/11/09	Barium, total	mg/L	0.0120
UA	G406	C	2023/02/14	Barium, total	mg/L	0.0150
UA	G406	C	2023/05/31	Barium, total	mg/L	0.0130
UA	G406	C	2023/08/11	Barium, total	mg/L	0.0139
UA	G406	C	2023/11/20	Barium, total	mg/L	0.0201
UA	G406	C	2020/10/14	Boron, total	mg/L	1.60
UA	G406	C	2021/01/28	Boron, total	mg/L	1.50
UA	G406	C	2021/05/20	Boron, total	mg/L	0.170
UA	G406	C	2021/08/17	Boron, total	mg/L	1.50
UA	G406	C	2021/10/26	Boron, total	mg/L	1.50
UA	G406	C	2022/02/08	Boron, total	mg/L	1.40
UA	G406	C	2022/05/10	Boron, total	mg/L	1.40
UA	G406	C	2022/08/24	Boron, total	mg/L	1.50
UA	G406	C	2022/11/09	Boron, total	mg/L	1.40
UA	G406	C	2023/02/14	Boron, total	mg/L	1.50
UA	G406	C	2023/05/31	Boron, total	mg/L	1.40
UA	G406	C	2023/08/11	Boron, total	mg/L	1.54
UA	G406	C	2023/11/20	Boron, total	mg/L	2.29
UA	G406	C	2020/10/14	Calcium, total	mg/L	230
UA	G406	C	2021/01/28	Calcium, total	mg/L	210
UA	G406	C	2021/05/20	Calcium, total	mg/L	190
UA	G406	C	2021/08/17	Calcium, total	mg/L	210
UA	G406	C	2021/10/26	Calcium, total	mg/L	190
UA	G406	C	2022/02/08	Calcium, total	mg/L	210
UA	G406	C	2022/05/10	Calcium, total	mg/L	210
UA	G406	C	2022/08/24	Calcium, total	mg/L	220
UA	G406	C	2022/11/09	Calcium, total	mg/L	180
UA	G406	C	2023/02/14	Calcium, total	mg/L	200
UA	G406	C	2023/05/31	Calcium, total	mg/L	190
UA	G406	C	2023/08/11	Calcium, total	mg/L	193
UA	G406	C	2023/11/20	Calcium, total	mg/L	206
UA	G406	C	2020/10/14	Chloride, total	mg/L	3.70
UA	G406	C	2021/01/28	Chloride, total	mg/L	2.40
UA	G406	C	2021/05/20	Chloride, total	mg/L	5.50
UA	G406	C	2021/08/17	Chloride, total	mg/L	3.90
UA	G406	C	2021/10/26	Chloride, total	mg/L	3.50
UA	G406	C	2022/02/08	Chloride, total	mg/L	4.80
UA	G406	C	2022/05/10	Chloride, total	mg/L	<4.8
UA	G406	C	2022/08/24	Chloride, total	mg/L	3.00
UA	G406	C	2022/11/09	Chloride, total	mg/L	2.70
UA	G406	C	2023/02/14	Chloride, total	mg/L	4.10
UA	G406	C	2023/05/31	Chloride, total	mg/L	<4.8
UA	G406	C	2023/08/11	Chloride, total	mg/L	4.00
UA	G406	C	2023/11/20	Chloride, total	mg/L	5.00
UA	G406	C	2020/10/14	Cobalt, total	mg/L	<0.002
UA	G406	C	2021/01/28	Cobalt, total	mg/L	<0.002
UA	G406	C	2021/05/20	Cobalt, total	mg/L	<0.002
UA	G406	C	2021/08/17	Cobalt, total	mg/L	<0.002
UA	G406	C	2021/10/26	Cobalt, total	mg/L	<0.002
UA	G406	C	2022/02/08	Cobalt, total	mg/L	<0.002
UA	G406	C	2022/05/10	Cobalt, total	mg/L	<0.00048
UA	G406	C	2022/08/24	Cobalt, total	mg/L	<0.00048
UA	G406	C	2022/11/09	Cobalt, total	mg/L	<0.00048
UA	G406	C	2023/02/14	Cobalt, total	mg/L	<0.00048
UA	G406	C	2023/05/31	Cobalt, total	mg/L	0.000520
UA	G406	C	2023/08/11	Cobalt, total	mg/L	0.000800

UA	G406	C	2023/11/20	Cobalt, total	mg/L	0.000800
UA	G406	C	2023/05/31	Ferrous Iron, dissolved	mg/L	0.180
UA	G406	C	2020/08/11	Iron, dissolved	mg/L	0.0170
UA	G406	C	2020/10/14	Iron, dissolved	mg/L	<0.01
UA	G406	C	2021/01/28	Iron, dissolved	mg/L	<0.01
UA	G406	C	2021/05/20	Iron, dissolved	mg/L	7.90
UA	G406	C	2021/08/17	Iron, dissolved	mg/L	<0.01
UA	G406	C	2021/10/26	Iron, dissolved	mg/L	<0.01
UA	G406	C	2022/02/08	Iron, dissolved	mg/L	<0.01
UA	G406	C	2022/05/10	Iron, dissolved	mg/L	0.000980
UA	G406	C	2022/08/24	Iron, dissolved	mg/L	0.00580
UA	G406	C	2022/11/09	Iron, dissolved	mg/L	0.00270
UA	G406	C	2023/02/14	Iron, dissolved	mg/L	<0.00072
UA	G406	C	2023/05/31	Iron, dissolved	mg/L	<0.00072
UA	G406	C	2023/08/11	Iron, dissolved	mg/L	<0.0115
UA	G406	C	2023/11/20	Iron, dissolved	mg/L	<0.0115
UA	G406	C	2023/02/14	Magnesium, total	mg/L	76.0
UA	G406	C	2023/05/31	Magnesium, total	mg/L	65.0
UA	G406	C	2023/08/11	Magnesium, total	mg/L	65.7
UA	G406	C	2023/11/20	Magnesium, total	mg/L	60.1
UA	G406	C	2018/07/16	Manganese, dissolved	mg/L	4.80
UA	G406	C	2018/08/13	Manganese, dissolved	mg/L	3.90
UA	G406	C	2019/05/02	Manganese, dissolved	mg/L	4.20
UA	G406	C	2019/08/19	Manganese, dissolved	mg/L	4.50
UA	G406	C	2019/10/22	Manganese, dissolved	mg/L	4.60
UA	G406	C	2020/01/23	Manganese, dissolved	mg/L	4.00
UA	G406	C	2020/05/06	Manganese, dissolved	mg/L	4.50
UA	G406	C	2020/08/11	Manganese, dissolved	mg/L	5.10
UA	G406	C	2020/10/14	Manganese, dissolved	mg/L	5.50
UA	G406	C	2021/01/28	Manganese, dissolved	mg/L	4.30
UA	G406	C	2021/05/20	Manganese, dissolved	mg/L	0.170
UA	G406	C	2021/08/17	Manganese, dissolved	mg/L	4.90
UA	G406	C	2021/10/26	Manganese, dissolved	mg/L	4.10
UA	G406	C	2022/02/08	Manganese, dissolved	mg/L	2.20
UA	G406	C	2022/05/10	Manganese, dissolved	mg/L	2.20
UA	G406	C	2022/08/24	Manganese, dissolved	mg/L	4.20
UA	G406	C	2022/11/09	Manganese, dissolved	mg/L	4.60
UA	G406	C	2023/02/14	Manganese, dissolved	mg/L	2.10
UA	G406	C	2023/05/31	Manganese, dissolved	mg/L	4.40
UA	G406	C	2023/08/11	Manganese, dissolved	mg/L	4.45
UA	G406	C	2023/11/20	Manganese, dissolved	mg/L	4.55
UA	G406	C	2023/08/11	Phosphate, dissolved	mg/L	0.0430
UA	G406	C	2023/02/14	Potassium, total	mg/L	0.160
UA	G406	C	2023/05/31	Potassium, total	mg/L	0.150
UA	G406	C	2023/08/11	Potassium, total	mg/L	0.263
UA	G406	C	2023/11/20	Potassium, total	mg/L	0.255
UA	G406	C	2023/05/31	Silicon, dissolved	mg/L	14.0
UA	G406	C	2023/08/11	Silicon, dissolved	mg/L	11.9
UA	G406	C	2023/02/14	Sodium, total	mg/L	43.0
UA	G406	C	2023/05/31	Sodium, total	mg/L	38.0
UA	G406	C	2023/08/11	Sodium, total	mg/L	37.2
UA	G406	C	2023/11/20	Sodium, total	mg/L	32.5
UA	G406	C	2020/10/14	Sulfate, total	mg/L	610
UA	G406	C	2021/01/28	Sulfate, total	mg/L	580
UA	G406	C	2021/05/20	Sulfate, total	mg/L	25.0
UA	G406	C	2021/08/17	Sulfate, total	mg/L	540
UA	G406	C	2021/10/26	Sulfate, total	mg/L	480
UA	G406	C	2022/02/08	Sulfate, total	mg/L	490
UA	G406	C	2022/05/10	Sulfate, total	mg/L	510
UA	G406	C	2022/08/24	Sulfate, total	mg/L	470
UA	G406	C	2022/11/09	Sulfate, total	mg/L	470
UA	G406	C	2023/02/14	Sulfate, total	mg/L	450
UA	G406	C	2023/05/31	Sulfate, total	mg/L	480

UA	G406	C	2023/08/11	Sulfate, total	mg/L	482
UA	G406	C	2023/11/20	Sulfate, total	mg/L	450
UA	G406	C	2020/10/14	Temperature (Celsius)	degrees C	17.5
UA	G406	C	2021/01/28	Temperature (Celsius)	degrees C	12.1
UA	G406	C	2021/05/20	Temperature (Celsius)	degrees C	26
UA	G406	C	2021/08/17	Temperature (Celsius)	degrees C	18.9
UA	G406	C	2021/10/26	Temperature (Celsius)	degrees C	16.8
UA	G406	C	2022/02/08	Temperature (Celsius)	degrees C	12.3
UA	G406	C	2022/05/10	Temperature (Celsius)	degrees C	16.2
UA	G406	C	2022/08/24	Temperature (Celsius)	degrees C	20.5
UA	G406	C	2022/11/09	Temperature (Celsius)	degrees C	19.1
UA	G406	C	2023/02/14	Temperature (Celsius)	degrees C	12.6
UA	G406	C	2023/05/31	Temperature (Celsius)	degrees C	21.2
UA	G406	C	2023/08/11	Temperature (Celsius)	degrees C	16.9
UA	G406	C	2023/11/20	Temperature (Celsius)	degrees C	15.7
UA	G406	C	2020/10/14	Total Dissolved Solids	mg/L	1,200
UA	G406	C	2021/01/28	Total Dissolved Solids	mg/L	1,200
UA	G406	C	2021/05/20	Total Dissolved Solids	mg/L	920
UA	G406	C	2021/08/17	Total Dissolved Solids	mg/L	1,200
UA	G406	C	2021/10/26	Total Dissolved Solids	mg/L	1,000
UA	G406	C	2022/02/08	Total Dissolved Solids	mg/L	990
UA	G406	C	2022/05/10	Total Dissolved Solids	mg/L	1,000
UA	G406	C	2022/08/24	Total Dissolved Solids	mg/L	1,100
UA	G406	C	2022/11/09	Total Dissolved Solids	mg/L	980
UA	G406	C	2023/02/14	Total Dissolved Solids	mg/L	1,200
UA	G406	C	2023/05/31	Total Dissolved Solids	mg/L	1,100
UA	G406	C	2023/08/11	Total Dissolved Solids	mg/L	1,070
UA	G406	C	2023/11/20	Total Dissolved Solids	mg/L	1,060
UA	G407	C	2020/10/14	pH (field)	SU	6.6
UA	G407	C	2021/01/28	pH (field)	SU	6.9
UA	G407	C	2021/04/26	pH (field)	SU	6.7
UA	G407	C	2021/08/17	pH (field)	SU	6.7
UA	G407	C	2021/10/26	pH (field)	SU	6.7
UA	G407	C	2022/02/08	pH (field)	SU	6.7
UA	G407	C	2022/05/10	pH (field)	SU	6.6
UA	G407	C	2022/08/24	pH (field)	SU	6.4
UA	G407	C	2022/11/08	pH (field)	SU	6.7
UA	G407	C	2023/02/14	pH (field)	SU	6.5
UA	G407	C	2023/05/31	pH (field)	SU	6.6
UA	G407	C	2023/08/10	pH (field)	SU	6.8
UA	G407	C	2023/11/20	pH (field)	SU	6.6
UA	G407	C	2020/10/14	Oxidation Reduction Potential	mV	119
UA	G407	C	2021/01/28	Oxidation Reduction Potential	mV	104
UA	G407	C	2021/04/26	Oxidation Reduction Potential	mV	116
UA	G407	C	2021/08/17	Oxidation Reduction Potential	mV	113
UA	G407	C	2021/10/26	Oxidation Reduction Potential	mV	25.1
UA	G407	C	2022/02/08	Oxidation Reduction Potential	mV	146
UA	G407	C	2022/05/10	Oxidation Reduction Potential	mV	185
UA	G407	C	2022/08/24	Oxidation Reduction Potential	mV	122
UA	G407	C	2022/11/08	Oxidation Reduction Potential	mV	82.0
UA	G407	C	2023/02/14	Oxidation Reduction Potential	mV	265
UA	G407	C	2023/05/31	Oxidation Reduction Potential	mV	162
UA	G407	C	2023/08/10	Oxidation Reduction Potential	mV	12.0
UA	G407	C	2023/11/20	Oxidation Reduction Potential	mV	124
UA	G407	C	2020/10/14	Eh	V	0.31
UA	G407	C	2021/01/28	Eh	V	0.30
UA	G407	C	2021/04/26	Eh	V	0.31
UA	G407	C	2021/08/17	Eh	V	0.30
UA	G407	C	2021/10/26	Eh	V	0.22
UA	G407	C	2022/02/08	Eh	V	0.34
UA	G407	C	2022/05/10	Eh	V	0.38
UA	G407	C	2022/08/24	Eh	V	0.31
UA	G407	C	2022/11/08	Eh	V	0.28

UA	G407	C	2023/02/14	Eh	V	0.46
UA	G407	C	2023/05/31	Eh	V	0.35
UA	G407	C	2023/08/10	Eh	V	0.20
UA	G407	C	2023/11/20	Eh	V	0.32
UA	G407	C	2023/02/14	Alkalinity, bicarbonate	mg/L CaCO3	460
UA	G407	C	2023/05/31	Alkalinity, bicarbonate	mg/L CaCO3	510
UA	G407	C	2023/08/10	Alkalinity, bicarbonate	mg/L CaCO3	502
UA	G407	C	2023/11/20	Alkalinity, bicarbonate	mg/L CaCO3	550
UA	G407	C	2020/10/14	Barium, total	mg/L	0.0140
UA	G407	C	2021/01/28	Barium, total	mg/L	0.0120
UA	G407	C	2021/04/26	Barium, total	mg/L	0.0130
UA	G407	C	2021/08/17	Barium, total	mg/L	0.0120
UA	G407	C	2021/10/26	Barium, total	mg/L	0.0120
UA	G407	C	2022/02/08	Barium, total	mg/L	0.0470
UA	G407	C	2022/05/10	Barium, total	mg/L	0.0120
UA	G407	C	2022/08/24	Barium, total	mg/L	0.0110
UA	G407	C	2022/11/08	Barium, total	mg/L	0.0120
UA	G407	C	2023/02/14	Barium, total	mg/L	0.0130
UA	G407	C	2023/05/31	Barium, total	mg/L	0.0120
UA	G407	C	2023/08/10	Barium, total	mg/L	0.0132
UA	G407	C	2023/11/20	Barium, total	mg/L	0.0193
UA	G407	C	2020/10/14	Boron, total	mg/L	0.100
UA	G407	C	2021/01/28	Boron, total	mg/L	0.0630
UA	G407	C	2021/04/26	Boron, total	mg/L	0.0650
UA	G407	C	2021/08/17	Boron, total	mg/L	0.0900
UA	G407	C	2021/10/26	Boron, total	mg/L	0.150
UA	G407	C	2022/02/08	Boron, total	mg/L	0.100
UA	G407	C	2022/05/10	Boron, total	mg/L	0.100
UA	G407	C	2022/08/24	Boron, total	mg/L	0.0760
UA	G407	C	2022/11/08	Boron, total	mg/L	0.0770
UA	G407	C	2023/02/14	Boron, total	mg/L	0.150
UA	G407	C	2023/05/31	Boron, total	mg/L	0.0900
UA	G407	C	2023/08/10	Boron, total	mg/L	0.0614
UA	G407	C	2023/11/20	Boron, total	mg/L	0.139
UA	G407	C	2020/10/14	Calcium, total	mg/L	250
UA	G407	C	2021/01/28	Calcium, total	mg/L	270
UA	G407	C	2021/04/26	Calcium, total	mg/L	340
UA	G407	C	2021/08/17	Calcium, total	mg/L	290
UA	G407	C	2021/10/26	Calcium, total	mg/L	280
UA	G407	C	2022/02/08	Calcium, total	mg/L	400
UA	G407	C	2022/05/10	Calcium, total	mg/L	280
UA	G407	C	2022/08/24	Calcium, total	mg/L	300
UA	G407	C	2022/11/08	Calcium, total	mg/L	290
UA	G407	C	2023/02/14	Calcium, total	mg/L	270
UA	G407	C	2023/05/31	Calcium, total	mg/L	270
UA	G407	C	2023/08/10	Calcium, total	mg/L	230
UA	G407	C	2023/11/20	Calcium, total	mg/L	397
UA	G407	C	2020/10/14	Chloride, total	mg/L	12.0
UA	G407	C	2021/01/28	Chloride, total	mg/L	11.0
UA	G407	C	2021/04/26	Chloride, total	mg/L	15.0
UA	G407	C	2021/08/17	Chloride, total	mg/L	16.0
UA	G407	C	2021/10/26	Chloride, total	mg/L	15.0
UA	G407	C	2022/02/08	Chloride, total	mg/L	12.0
UA	G407	C	2022/05/10	Chloride, total	mg/L	13.0
UA	G407	C	2022/08/24	Chloride, total	mg/L	11.0
UA	G407	C	2022/11/08	Chloride, total	mg/L	11.0
UA	G407	C	2023/02/14	Chloride, total	mg/L	12.0
UA	G407	C	2023/05/31	Chloride, total	mg/L	17.0
UA	G407	C	2023/08/10	Chloride, total	mg/L	11.0
UA	G407	C	2023/11/20	Chloride, total	mg/L	12.0
UA	G407	C	2020/10/14	Cobalt, total	mg/L	<0.002
UA	G407	C	2021/01/28	Cobalt, total	mg/L	<0.002
UA	G407	C	2021/04/26	Cobalt, total	mg/L	<0.002

UA	G407	C	2021/08/17	Cobalt, total	mg/L	<0.002
UA	G407	C	2021/10/26	Cobalt, total	mg/L	<0.002
UA	G407	C	2022/02/08	Cobalt, total	mg/L	0.00620
UA	G407	C	2022/05/10	Cobalt, total	mg/L	0.000490
UA	G407	C	2022/08/24	Cobalt, total	mg/L	0.000930
UA	G407	C	2022/11/08	Cobalt, total	mg/L	<0.00048
UA	G407	C	2023/02/14	Cobalt, total	mg/L	<0.00048
UA	G407	C	2023/05/31	Cobalt, total	mg/L	0.000700
UA	G407	C	2023/08/10	Cobalt, total	mg/L	0.000800
UA	G407	C	2023/11/20	Cobalt, total	mg/L	0.00200
UA	G407	C	2023/05/31	Ferrous Iron, dissolved	mg/L	0.270
UA	G407	C	2020/08/11	Iron, dissolved	mg/L	0.0150
UA	G407	C	2020/10/14	Iron, dissolved	mg/L	<0.01
UA	G407	C	2021/01/28	Iron, dissolved	mg/L	<0.01
UA	G407	C	2021/04/26	Iron, dissolved	mg/L	0.0170
UA	G407	C	2021/08/17	Iron, dissolved	mg/L	0.0460
UA	G407	C	2021/10/26	Iron, dissolved	mg/L	<0.01
UA	G407	C	2022/02/08	Iron, dissolved	mg/L	<0.01
UA	G407	C	2022/05/10	Iron, dissolved	mg/L	0.0140
UA	G407	C	2022/08/24	Iron, dissolved	mg/L	0.0130
UA	G407	C	2022/11/08	Iron, dissolved	mg/L	0.0310
UA	G407	C	2023/02/14	Iron, dissolved	mg/L	0.0190
UA	G407	C	2023/05/31	Iron, dissolved	mg/L	0.0100
UA	G407	C	2023/08/10	Iron, dissolved	mg/L	0.0150
UA	G407	C	2023/11/20	Iron, dissolved	mg/L	0.0279
UA	G407	C	2023/02/14	Magnesium, total	mg/L	170
UA	G407	C	2023/05/31	Magnesium, total	mg/L	170
UA	G407	C	2023/08/10	Magnesium, total	mg/L	151
UA	G407	C	2023/11/20	Magnesium, total	mg/L	250
UA	G407	C	2018/03/05	Manganese, dissolved	mg/L	0.0770
UA	G407	C	2018/07/16	Manganese, dissolved	mg/L	1.30
UA	G407	C	2018/08/13	Manganese, dissolved	mg/L	0.0740
UA	G407	C	2018/11/07	Manganese, dissolved	mg/L	0.400
UA	G407	C	2019/01/25	Manganese, dissolved	mg/L	0.280
UA	G407	C	2019/05/03	Manganese, dissolved	mg/L	1.20
UA	G407	C	2019/08/19	Manganese, dissolved	mg/L	0.240
UA	G407	C	2019/10/22	Manganese, dissolved	mg/L	1.20
UA	G407	C	2020/01/23	Manganese, dissolved	mg/L	0.430
UA	G407	C	2020/05/07	Manganese, dissolved	mg/L	0.590
UA	G407	C	2020/08/11	Manganese, dissolved	mg/L	0.450
UA	G407	C	2020/10/14	Manganese, dissolved	mg/L	0.160
UA	G407	C	2021/01/28	Manganese, dissolved	mg/L	0.290
UA	G407	C	2021/04/26	Manganese, dissolved	mg/L	0.220
UA	G407	C	2021/08/17	Manganese, dissolved	mg/L	0.260
UA	G407	C	2021/10/26	Manganese, dissolved	mg/L	0.320
UA	G407	C	2022/02/08	Manganese, dissolved	mg/L	0.310
UA	G407	C	2022/05/10	Manganese, dissolved	mg/L	0.220
UA	G407	C	2022/08/24	Manganese, dissolved	mg/L	0.360
UA	G407	C	2022/11/08	Manganese, dissolved	mg/L	0.260
UA	G407	C	2023/02/14	Manganese, dissolved	mg/L	0.210
UA	G407	C	2023/05/31	Manganese, dissolved	mg/L	0.380
UA	G407	C	2023/08/10	Manganese, dissolved	mg/L	0.445
UA	G407	C	2023/11/20	Manganese, dissolved	mg/L	0.316
UA	G407	C	2023/08/10	Phosphate, dissolved	mg/L	<0.005
UA	G407	C	2023/02/14	Potassium, total	mg/L	2.90
UA	G407	C	2023/05/31	Potassium, total	mg/L	2.70
UA	G407	C	2023/08/10	Potassium, total	mg/L	2.76
UA	G407	C	2023/11/20	Potassium, total	mg/L	4.14
UA	G407	C	2023/05/31	Silicon, dissolved	mg/L	9.80
UA	G407	C	2023/08/10	Silicon, dissolved	mg/L	8.89
UA	G407	C	2023/02/14	Sodium, total	mg/L	90.0
UA	G407	C	2023/05/31	Sodium, total	mg/L	88.0
UA	G407	C	2023/08/10	Sodium, total	mg/L	85.8

UA	G407	C	2023/11/20	Sodium, total	mg/L	106
UA	G407	C	2020/10/14	Sulfate, total	mg/L	830
UA	G407	C	2021/01/28	Sulfate, total	mg/L	990
UA	G407	C	2021/04/26	Sulfate, total	mg/L	960
UA	G407	C	2021/08/17	Sulfate, total	mg/L	400
UA	G407	C	2021/10/26	Sulfate, total	mg/L	960
UA	G407	C	2022/02/08	Sulfate, total	mg/L	1,100
UA	G407	C	2022/05/10	Sulfate, total	mg/L	1,000
UA	G407	C	2022/08/24	Sulfate, total	mg/L	970
UA	G407	C	2022/11/08	Sulfate, total	mg/L	440
UA	G407	C	2023/02/14	Sulfate, total	mg/L	950
UA	G407	C	2023/05/31	Sulfate, total	mg/L	1,100
UA	G407	C	2023/08/10	Sulfate, total	mg/L	956
UA	G407	C	2023/11/20	Sulfate, total	mg/L	1,010
UA	G407	C	2020/10/14	Temperature (Celsius)	degrees C	18.3
UA	G407	C	2021/01/28	Temperature (Celsius)	degrees C	9.90
UA	G407	C	2021/04/26	Temperature (Celsius)	degrees C	17.1
UA	G407	C	2021/08/17	Temperature (Celsius)	degrees C	20.5
UA	G407	C	2021/10/26	Temperature (Celsius)	degrees C	17.6
UA	G407	C	2022/02/08	Temperature (Celsius)	degrees C	11.2
UA	G407	C	2022/05/10	Temperature (Celsius)	degrees C	15.2
UA	G407	C	2022/08/24	Temperature (Celsius)	degrees C	21.2
UA	G407	C	2022/11/08	Temperature (Celsius)	degrees C	18.0
UA	G407	C	2023/02/14	Temperature (Celsius)	degrees C	11.5
UA	G407	C	2023/05/31	Temperature (Celsius)	degrees C	19.2
UA	G407	C	2023/08/10	Temperature (Celsius)	degrees C	19.2
UA	G407	C	2023/11/20	Temperature (Celsius)	degrees C	14.2
UA	G407	C	2020/10/14	Total Dissolved Solids	mg/L	1,800
UA	G407	C	2021/01/28	Total Dissolved Solids	mg/L	2,000
UA	G407	C	2021/04/26	Total Dissolved Solids	mg/L	1,800
UA	G407	C	2021/08/17	Total Dissolved Solids	mg/L	2,200
UA	G407	C	2021/10/26	Total Dissolved Solids	mg/L	2,000
UA	G407	C	2022/02/08	Total Dissolved Solids	mg/L	2,000
UA	G407	C	2022/05/10	Total Dissolved Solids	mg/L	2,200
UA	G407	C	2022/08/24	Total Dissolved Solids	mg/L	2,200
UA	G407	C	2022/11/08	Total Dissolved Solids	mg/L	2,100
UA	G407	C	2023/02/14	Total Dissolved Solids	mg/L	2,100
UA	G407	C	2023/05/31	Total Dissolved Solids	mg/L	2,000
UA	G407	C	2023/08/10	Total Dissolved Solids	mg/L	1,870
UA	G407	C	2023/11/20	Total Dissolved Solids	mg/L	2,010

Notes:

< = results is less than detection limit

B = Background

C = Compliance

HSU = Hydrostratigraphic Unit

LCU = Lower Confining Unit

UA = Uppermost Aquifer

mg/L = milligrams per liter

SU = standard units

V = volts

Attachment I

Antidegradation Assessment Report
(Hansen 2017)

ATTACHMENT V

Antidegradation Assessment for Management of Coal Combustion Residuals Impoundment Waters

Coffeen Power Station
Illinois Power Generating Company
NPDES Permit No. IL0000108

November 21, 2017

Prepared for:

Illinois Power Generating Company
1500 Eastport Plaza Drive
Collinsville, Illinois 62234

Prepared by:

Hanson Professional Services Inc.
1525 South Sixth Street
Springfield, Illinois 62703

HANSON
Engineering | Planning | Allied Services

Table of Contents

Section Page

1. Introduction ... 3
2. Purpose and Anticipated Benefits ... 3
3. Identification and Characterization of the Affected Water Body ... 5
4. Identification of Proposed Pollutant Load Increases or Potential Impacts on Uses ... 5
   - 4.1 Water Sampling and Analyses ... 5
   - 4.2 Pollutant Load Increases from Ash Pond Unwatering Discharge ... 6
   - 4.3 Pollutant Load Increases from Ash Pond Dewatering Discharge ... 10
5. Fate and Effect of Parameters Proposed for Increased Loading ... 10
6. Assessments of Alternatives for Less Increase in Loading or Minimal Environmental Degradation ... 12
   - 6.1 Water Management Alternatives Considered ... 12
   - 6.2 Alternatives that Avoid Discharge to Receiving Water ... 13
     - 6.2.1 No Action Alternative ... 13
     - 6.2.2 Mechanical Evaporation ... 13
     - 6.2.3 Agricultural Irrigation ... 13
     - 6.2.4 Land Application ... 14
     - 6.2.5 Use CCR Dewaters in Power Generation Plant Processes ... 14
   - 6.3 Alternatives that Discharge to Receiving Water ... 14
     - 6.3.1 Discharge through Existing NPDES Outfall ... 14
     - 6.3.2 Direct Discharge with Additional Treatment ... 15
7. Identification of Preferred Alternative ... 15
8. References ... 15

Figures and Tables

Figure 1 Site Map ... 4
Table 1 Water Samples Collected and Analyzed ... 5
Table 2 Ash Pond Unwaters and Receiving Waters Sample Analytical Results ... 6
Table 3 Ash Pond Dewaters Sample Analytical Results ... 8
Table 4 Antidegradation Assessment – Ash Pond Unwaters ... 9
Table 5 Antidegradation Assessment – Ash Pond Dewaters ... 11
Table 6 Water Management Alternatives Considered ... 13

Appendices

Appendix A EcoCAT Report

Copyright © 2017 by Hanson Professional Services Inc. All rights reserved. This document is intended solely for the use of the individual or the entity to which it is addressed. The information contained in this document shall not be duplicated, stored electronically, or distributed, in whole or in part, without the express written permission of Hanson Professional Services Inc., 1525 S. Sixth Street, Springfield, IL 62703-2886 (217)788-2450, www.hanson-inc.com. Unauthorized reproduction or transmission of any part of this document is a violation of federal law.

1. Introduction

Illinois Power Generating Company (IPGC) will be applying for a modification to NPDES Permit No. IL0000108 to reflect the planned physical alterations at the Coffeen Power Station (Coffeen, or "plant") required to meet the U.S. Environmental Protection Agency (USEPA) coal combustion residuals (CCR) rules. These physical alterations will require short-term discharge of waters from coal combustion residuals (CCR) surface impoundments, also known as "ash ponds". The ash ponds assessed in this report include Ash Ponds 1 and 2. Ash Pond 1 is currently an existing operating CCR impoundment, while Ash Pond 2 is an inactive CCR impoundment previously covered with a soil cover system that will require replacement in accordance with the federal CCR rules. This report assesses the potential effects of proposed pollutant load increases on the water quality of Coffeen Lake in accordance with the requirements of 35 Ill. Adm. Code §302.105. Alternatives considered to avoid discharging the waters are discussed.

2. Purpose and Anticipated Benefits

USEPA issued a final rule (the "CCR Rule") that regulates the disposal of CCR under Subtitle D of the Resource Conservation and Recovery Act (RCRA). The CCR Rule, effective October 19, 2015, establishes minimum national criteria for continued operation of CCR surface impoundments.[1] To comply with the CCR Rule, IPGC may need to close Coffeen Ash Ponds 1 and 2 by the end of the timeframe allowed by the Rule. Figure 1 illustrates the layout of the Coffeen ash ponds.

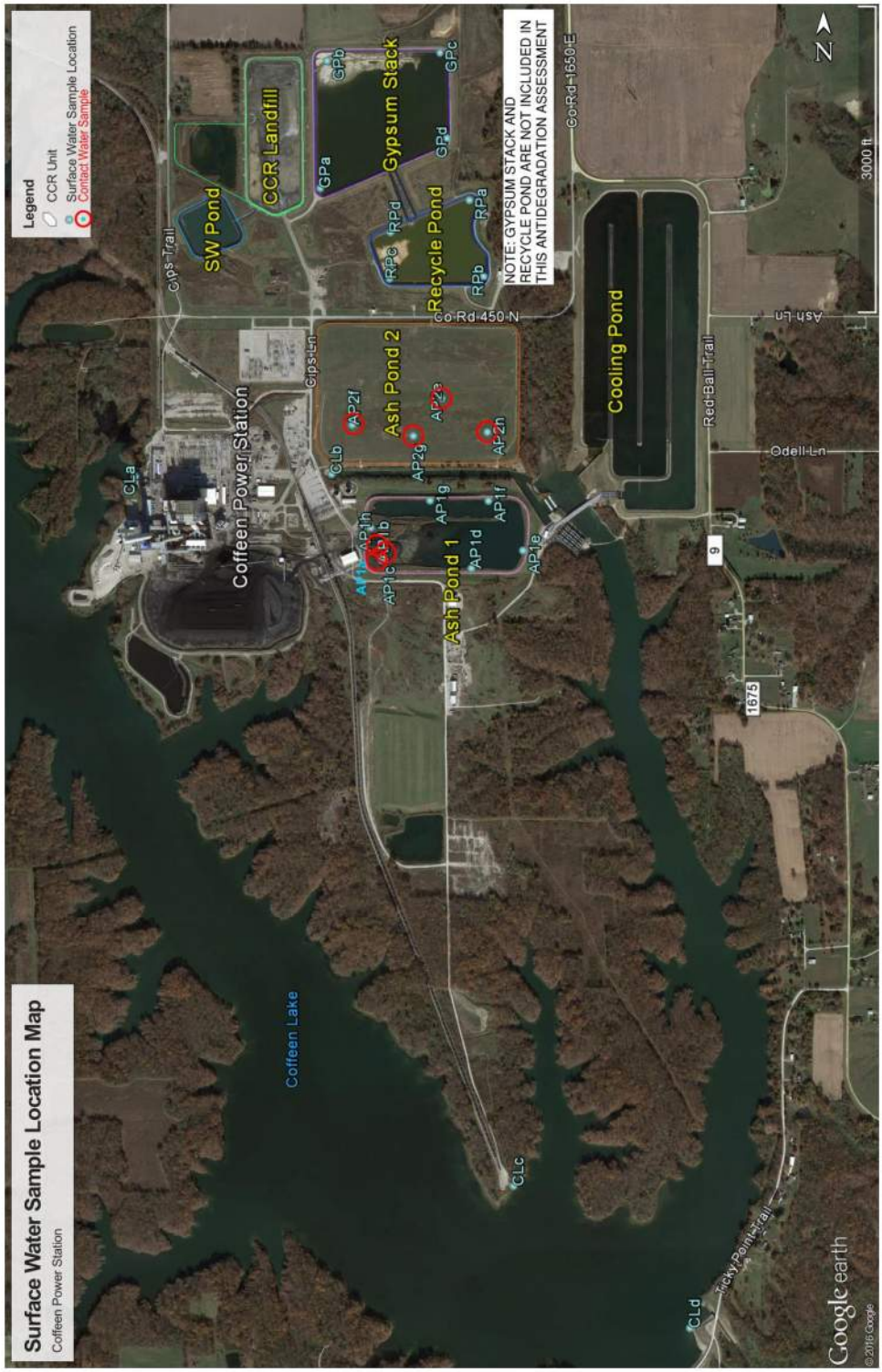
The closure plan for the Coffeen ash ponds includes removal of open water from the ash ponds, referred to as "unwatering;" partial removal of pore water contained in CCR-filled portions of the ash ponds, referred to as "dewatering;" grading and shaping the dewatered CCR surface to facilitate storm water runoff; and installation of a compacted vegetated earthen or composite cover system. Both unwatering and dewatering Ash Pond 1 is necessary to grade the CCR and construct the cover system. No unwaters are present in Ash Pond 2. Dewatering Ash Pond 2 will be necessary. The existing dewatering system in Ash Pond 2, which currently directs the dewaters to the Coffeen plant's Gypsum Management Facility (GMF) ponds, may be adequate to maintain the phreatic surface in the pond far enough below the existing cap to facilitate pond closure. However, this report evaluates the Ash Pond 2 dewaters in case the GMF ponds are overwhelmed and discharge of Ash Pond 2 dewaters is needed.

Due to the large volume of water contained in the ash ponds and the schedule constraints, the preferred alternative to remove the water is to discharge it through the existing NPDES-permitted outfall to Coffeen Lake.

The following sections of this report describe the water sampling, analytical laboratory results, hydraulic and concentration modeling, and alternatives considered to demonstrate the proposed short-term discharge of waters from the ash ponds will result in the continued attainment of water quality standards in Coffeen Lake.

[1] In September 2017, USEPA granted petitions to reconsider the CCR rule. USEPA's reconsideration process may result in revisions to the CCR rule that would change IPGC's current closure plans and future planning regarding the CCR surface impoundments at Coffeen.

Figure 1 Site Map



3. Identification and Characterization of the Affected Water Body

Coffeen Lake (segment ROG) is an artificial cooling lake. The lake is listed on the 2016 *Illinois Integrated Water Quality Report and Section 303(d) List*. Fish consumption use is impaired, with a cause of mercury. A Total Maximum Daily Load (TMDL) has been completed for Coffeen Lake that sets allocations for phosphorus.

The IDNR EcoCAT system does not list any state threatened or endangered aquatic species as residing in the receiving water body near the Coffeen plant. A copy of the EcoCAT report is included in Appendix A.

4. Identification of Proposed Pollutant Load Increases or Potential Impacts on Uses

4.1 Water Sampling and Analyses

PDC Laboratories, Inc. (PDC), under subcontract and field oversight by Hanson Professional Services Inc. (Hanson), collected water samples from the ash ponds and receiving waters on October 24, 2016. Grab samples were collected from open water accumulated in Ash Pond 1 to characterize waters that would be discharged during “unwatering” of the ash pond; these waters are referred to in this report as “unwaters.” Ash Pond 2 is inactive and was previously covered. Unwaters are not associated with Ash Pond 2.

Grab samples were collected from test pits excavated in the CCR-filled portion of Ash Pond 1 and from wells installed in Ash Pond 2 to characterize waters that would be discharged during “dewatering” of the cells; these waters are referred to in this report as “dewaters.” The test pits in Ash Pond 1 were excavated the day before sampling, allowing CCR materials to settle overnight to reduce suspended solids in the samples. Each of the four operable wells in Ash Pond 2 was activated separately and allowed to run until the water appeared clear, then grab samples were collected from the pump discharge. Grab water samples were also collected from Coffeen Lake to evaluate the receiving water that may be affected by the proposed discharges.

In order to further characterize the dewaters as requested by Illinois EPA, an additional round of selected grab samples was collected on January 26, 2017. Table 1 summarizes the water samples collected. Figure 1 shows the sampling locations.

Table 1. Water Samples Collected and Analyzed

Impoundment/Waterbody Sampled	Unwater Samples	Dewater Samples
Ash Pond 1	AP1d, AP1e, AP1f, AP1g, AP1h	AP1a, AP1b, AP1c
Ash Pond 2	None	AP2e, AP2f, AP2g, AP2h

	Receiving Water	
Coffeen Lake	CLa, CLb, CLc, CLd	

The water samples were analyzed by PDC for constituents reviewed and approved by Illinois EPA in an email to Ms. Jacquelyn Bush of IPGC on October 11, 2016. PDC is accredited by Illinois EPA to conduct the laboratory analyses for this assessment. The laboratory analytical reports are included in Appendix B.

Table 2 summarizes the constituents analyzed and the analytical results of samples of the ash pond unwaters and the receiving water. The individual analytical results at each sample location were averaged for evaluation in this antidegradation assessment. None of the representative average unwaters concentrations exceeded the General Effluent Standards listed in 35 Ill. Adm. Code §304.

Table 3 summarizes the constituents analyzed and the analytical results of samples collected from CCR-filled portions of the ash ponds to characterize waters that would be discharged during dewatering the ponds. The individual analytical results at each sample location were averaged for evaluation in this antidegradation assessment. The representative average dewater concentrations of total suspended solids (TSS) in Ash Pond 1, Ash Pond 2, and the combined ash pond dewaters exceeded the General Effluent Standard of 15 mg/L listed in 35 Ill. Adm. Code §304. The representative average dewater concentrations of iron and manganese in Ash Pond 2 dewaters exceeded their respective General Effluent Standards of 2.0 mg/L and 1.0 mg/L. The representative average combined ash pond dewaters concentration of iron exceeded the General Effluent Standard. The representative average concentrations of manganese in Ash Pond 1 dewaters and the combined ash pond dewaters were less than the General Effluent Standard. All other analytes were less than the General Effluent Standards.

4.2 Pollutant Load Increases from Ash Pond Unwatering Discharge

Discharge of unwaters would occur from removal of the free surface water in Ash Pond 1. These waters result from the normal operation of the Coffeen plant and, except for storm water precipitation into the ash pond cells, are generally drawn from Coffeen Lake. These waters are currently discharged under the authorization of the plant's NPDES permit. No unwaters are present in Ash Pond 2.

The means and methods of collecting and conveying the unwaters are undetermined at this time. For purposes of this antidegradation assessment, substances in unwaters at concentrations less than the General Effluent Standards at 35 Ill. Adm. Code §304 are considered to be protective of the receiving water quality, i.e., would not cause degradation of the receiving water quality. As shown in Table 2, the representative average unwater concentrations of all the analytes were less than the General Effluent Standards.

Table 4 shows the estimated mass of each substance proposed to be discharged through the existing NPDES outfall to the Coffeen Lake receiving water (the "Added Load"). The Added Load calculations compensate for the existing receiving water quality by subtracting the "Source Load" of each substance based on the analytical results of the lake samples. Table 4 also estimates the predicted effects of discharging the unwaters to the lake and demonstrates the proposed discharge will not cause exceedances of the Public and Food Processing Water Supply Use Standards at 35 Ill. Adm. Code §302 Subpart C. For substances with no Public and Food Processing Water Supply Use Standard, the chronic General Use Water Quality Standards at 35 Ill. Adm. Code §302 Subpart B were used for comparison. Lake concentrations were calculated at normal pool volume. For substances where concentrations in the lake already exceed the applicable water quality standards (oil and grease, phenols, and phosphorus), the concentrations of these substances in the proposed unwaters discharge are equivalent to the existing lake concentrations. Table 4 illustrates the proposed unwaters discharge will not increase the existing concentrations of oil and grease, phenols, and phosphorus in the lake.

The estimated volume of unwaters to be discharged as part of the CCR closure plan is 40 million gallons. The unwatering rate for Ash Pond 1 will vary depending on schedule and pump rates. The calculations shown in Table 4 assume pumping rates of about 347 gpm (0.5 million gallons per day (MGD)) could remove the free water in approximately 80 days.

Table 2. Ash Pond Unwaters and Receiving Waters Sample Analytical Results

		General Effluent Standards	Ash pond surface water samples (Collected October 24, 2016) All concentration units converted to mg/L for comparison to limits.						Receiving Water				
			Ash Pond 1 Unwaters					Representative Unwaters Concentrations	Coffeen Lake				Representative Lake Concentrations
Sample Date			10/24/2016	10/24/2016	10/24/2016	10/24/2016	10/24/2016		10/24/2016	10/24/2016	10/24/2016	10/24/2016	
Sample ID	Units	35 IAC 304	AP1d	AP1e	AP1f	AP1g	AP1h		CLa	CLb	CLc	CLd	
Ammonia	mg/L	3	<0.1	<0.1	<0.1	<0.1	<0.1	0.05	<0.1	<0.1	<0.1	<0.1	0.05
Arsenic	mg/L	0.25	0.002	0.0014	0.0015	0.0013	0.0015	0.0015	0.0018	0.0018	0.0018	0.0018	0.0018
Barium	mg/L	2.0	0.2	0.16	0.15	0.14	0.18	0.17	0.054	0.052	0.056	0.054	0.054
Boron	mg/L		2	2.1	2.1	2.1	2.2	2.1	0.27	0.28	0.28	0.27	0.28
Cadmium	mg/L	0.15	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	<0.001	<0.001	<0.001	<0.001	0.0005
Chloride	mg/L		18	18	17	17	17	17	0.023	0.022	0.022	0.023	0.023
Chromium	mg/L	1.0	<0.004	<0.004	<0.004	<0.004	<0.004	0.002	<0.004	<0.004	<0.004	<0.004	0.002
Chromium (hexavalent)	mg/L	0.1	<0.005	<0.005	0.0074	<0.005	<0.005	0.0035	<0.005	<0.005	<0.005	<0.005	0.0025
Copper	mg/L	0.5	0.033	0.016	0.017	0.015	0.014	0.019	0.0091	0.013	0.011	0.012	0.011
Cyanide	mg/L	0.1	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	<0.005	<0.005	<0.005	<0.005	0.0025
Fluoride	mg/L	15.0	1.08	1.00	1.00	1.00	0.98	1.01	0.443	0.425	0.426	0.421	0.429
Iron	mg/L	2.0	0.54	0.15	0.11	0.089	0.46	0.27	0.22	0.2	0.27	0.14	0.2
Lead	mg/L	0.2	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	<0.001	<0.001	<0.001	<0.001	0.0005
Manganese	mg/L	1.0	0.015	0.0095	0.0089	0.0081	0.0097	0.0102	0.015	0.022	0.026	0.024	0.022
Mercury	mg/L	0.0005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	<0.0002	<0.0002	<0.0002	<0.0002	0.0001
Nickel	mg/L	1.0	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	<0.005	<0.005	<0.005	<0.005	0.0025
Nitrate	mg/L		<0.02	<0.02	<0.02	<0.02	<0.02	0.01	0.07	0.07	0.06	0.07	0.07
Nitrite	mg/L												
Total K Nitrogen	mg/L		<1.0	<1.0	<1.0	<1.0	<1.0	0.5	1.3	1.1	<1.0	<1.0	1.2
Oil and Grease	mg/L	15.0	<6.0	<6.5	<5.7	<5.9	<6.0	6.0	<5.9	<5.7	<5.9	<6.0	2.9
pH		6 to 9	7.21	7.12	7.20	7.21	7.41	7.23	7.22	7.52	7.62	7.30	7.42
Phenols	mg/L	0.3	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	<0.005	<0.005	<0.005	<0.005	0.0025
Phosphorus	mg/L	1.0	0.18	0.12	0.12	0.12	0.15	0.14	0.16	0.14	0.15	0.17	0.16
Selenium	mg/L		0.0015	0.0012	0.0012	0.0014	0.0012	0.0013	<0.001	<0.001	<0.001	<0.001	0.0005
Silver	mg/L	0.1	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	<0.005	<0.005	<0.005	<0.005	0.0025
Sulfate	mg/L		1000	960	1000	970	1000	986	55	56	54	54	55
Total Dissolved Solids (TDS)	mg/L		980	1200	1200	1200	1200	1156	190	180	160	170	175
Total Suspended Solids (TSS)	mg/L	15.0	9.2	5.6	8	4	6	6.6	7.6	4.8	4.8	<4.0	4.8
Zinc	mg/L	1.0	<0.006	<0.006	<0.006	<0.006	<0.006	0.003	0.006	0.006	<0.006	0.015	0.0075

Notes:
1. Metals are total concentrations
2. Non-detect results are assumed to be half the laboratory reporting limit for calculations.
3. Ash Pond 2 contains no unwaters.

Table 3. Ash Pond Dewaters Sample Analytical Results

		General Effluent Standards	Ash pond CCR contact water samples (Collected October 24, 2016 and January 26, 2017) All concentration units converted to mg/L for comparison to limits.																
			Ash Pond 1						Ash Pond 1	Ash Pond 2								Ash Pond 2	Combined Ash Ponds
Sample Date			10/24/2016	1/26/2017	10/24/2016	1/26/2017	10/24/2016	1/26/2017	Representative Average	10/24/2016	1/26/2017	10/24/2016	1/26/2017	10/24/2016	1/26/2017	10/24/2016	1/26/2017	Representative Average	Representative Average
Sample ID	Units	35 IAC 304	AP1a	AP1a	AP1b	AP1b	AP1c	AP1c	Dewater Concentrations	AP2e	AP2e	AP2f	AP2f	AP2g	AP2g	AP2h	AP2h	Dewater Concentrations	Dewater Concentrations
Ammonia	mg/L	3	<0.1	<0.1	0.7	0.67	0.42	0.22	0.35	0.65	0.84	1.1	0.92	0.86	0.8	0.82	0.64	0.83	0.59
Arsenic	mg/L	0.25	0.0072	0.0093	0.017	0.0073	0.018	0.01	0.011	0.023	0.014	0.0012	<0.001	0.0055	0.0044	0.075	0.034	0.022	0.017
Barium	mg/L	2.0	0.13	0.13	0.1	0.099	0.13	0.25	0.14	0.026	0.019	0.022	0.014	0.02	0.015	0.023	0.013	0.02	0.08
Boron	mg/L		3.8	1.6	3.1	2.3	2.9	1.6	2.6	5.3	4.2	2	1.6	4.3	3.1	14	6.8	5.2	3.86
Cadmium	mg/L	0.15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	<0.001	<0.001	<0.001	<0.001	0.0046	0.012	<0.001	<0.001	0.0025	0.00
Chloride	mg/L		3.2	9	13	10	13	14	10.4	<5	<5	<5	<5	<5	<5	1.7	1.6	2.3	6.3
Chromium	mg/L	1.0	<0.004	0.0045	<0.004	0.0052	<0.004	0.0057	0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.002	0.003
Chromium (hexavalent)	mg/L	0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	<0.005	<0.005	0.0055	<0.005	<0.005	<0.005	<0.005	<0.005	0.0030	0.0028
Copper	mg/L	0.5	<0.003	<0.003	<0.003	<0.003	0.0043	0.0041	0.0024	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.0015	0.0020
Cyanide	mg/L	0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025
Fluoride	mg/L	15.0	<0.25	0.142	0.977	0.507	0.614	0.512	0.480	0.438	0.485	0.398	0.32	0.506	0.377	0.406	0.181	0.389	0.434
Iron	mg/L	2.0	0.57	0.9	0.83	1.2	0.77	2.2	1.08	350	320	460	380	360	290	24	22	276	138
Lead	mg/L	0.2	<0.001	<0.001	<0.001	0.0012	<0.001	0.0015	0.0008	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0006
Manganese	mg/L	1.0	0.012	0.0086	0.074	0.041	0.053	0.022	0.035	2.0	1.9	2.3	2.0	2.9	2.2	1.0	0.9	1.90	0.97
Mercury	mg/L	0.0005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001
Nickel	mg/L	1.0	<0.005	<0.005	0.0061	0.0087	<0.005	<0.005	0.0041	<0.005	<0.005	<0.005	<0.005	0.0064	<0.005	<0.005	<0.005	0.0030	0.0036
Nitrate	mg/L		<0.02	<0.1	<0.02	<0.1	<0.02	<0.1	0.06	<0.02	<0.1	<0.02	<0.1	<0.02	<0.1	<0.02	<0.1	0.06	0.06
Nitrite	mg/L			<0.1		<0.1		<0.1	0.05		<0.1		<0.15		<0.15		<0.1	0.11	0.08
Total K Nitrogen	mg/L		<1.0	0.35	1.5	0.0014	1.4	0.6	0.65	1.2	0.78	1.5	0.77	1.1	0.81	1.4	0.9	1.06	0.85
Oil and Grease	mg/L	15.0	<5.7	<3.2	7.8	<3.1	8.3	<3.1	3.9	<6.0	<3.1	<5.9	<3.2	<5.7	<3.3	<5.7	<3	4.5	4.21
pH		6 to 9	6.99	6.52	7.01	6.92	7.05	6.85	6.890	6.49	5.96	6.42	5.99	6.46	6.34	7.17	6.27	6.39	6.64
Phenols	mg/L	0.3	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	<0.005	0.019	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	0.004
Phosphorus	mg/L	1.0	0.21	0.16	0.16	0.065	0.17	0.22	0.16	0.84	0.16	0.83	0.4	0.17	0.1	0.26	0.038	0.35	0.26
Selenium	mg/L		0.003	0.018	0.0069	0.0021	0.0031	0.003	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0033
Silver	mg/L	0.1	<0.005	<0.003	<0.005	<0.003	<0.005	<0.003	0.002	<0.005	<0.003	<0.005	<0.003	<0.005	<0.003	<0.005	<0.003	0.004	0.003
Sulfate	mg/L		1500	1300	1300	1500	1600	1200	1400	1500	1400	1500	1200	2300	1800	1300	880	1485	1443
Total Dissolved Solids (TDS)	mg/L		1800	1900	1600	2200	1900	1700	1850	1700	1800	1700	1600	2400	2600	1500	1400	1838	1844
Total Suspended Solids (TSS)	mg/L	15.0	17	8.8	27	20	9.6	58	23	120	110	120	160	120	150	22	39	105	64
Zinc	mg/L	1.0	<0.006	<0.006	0.0092	0.0064	0.0082	0.0064	0.006	0.017	0.02	<0.006	<0.006	0.016	0.028	<0.006	<0.006	0.012	0.009

Notes:
1. Metals are total concentrations
2. Non-detect results are assumed to be half the laboratory reporting limit for calculations.

ATTACHMENT V

HANSON

Table 4. Antidegradation Assessment - Ash Pond Unwaters

This table shows the "Added Load" of pollutants from unwaters that would be discharged to Coffeen Lake.
The table shows the proposed discharge will not cause exceedances of the 35 IAC Section 302 Public and Food Processing Water Supply Standards in the lake.

Contaminant	35 IAC 304 (mg/L)	35 IAC 302 Chronic (mg/L)	Ash Pond 1 - Unwaters					Flow Mixing with Process Water			Coffeen Lake					
			Treatment Flowrate (gpm) = 347					Average Flowrate (gpm) = 305,500			Normal Pool Volume (gallons) = 7,039,440,000					
			Total Volume (gallons) = 40,000,000													
			Concentration (mg/L)	Meet 304?	Total Load (lbs)	Source Load (lbs)	Added Load (lbs)	Process Water Concentration - CLb (mg/L)	Concentration at Outfall (mg/L)	Meet 304?	Coffeen Lake (mg/L)	Lake Meet 302?	Lake Conc. w/ Effluent (mg/L)	Meet 302?	Meet Lake?	Additional Treatment to meet 302 or Lake (lbs)
Ammonia	3	2.08	**0.05**	yes	16.69	16.69	0.00	0.05	0.05	yes	0.05	yes	0.05	yes	-	-
Arsenic	0.25	0.05	**0.0015**	yes	0.51	0.60	-0.09	0.0018	0.002	yes	0.002	yes	0.002	yes	-	-
Barium	2	1.0	**0.17**	yes	55.42	18.03	37.39	0.052	0.052	yes	0.054	yes	0.054	yes	-	-
Boron	-	1.0	**2.1**	-	701.06	91.81	609.25	0.28	0.282	-	0.275	yes	0.275	yes	-	-
Cadmium	0.15	0.010	**0.0005**	yes	0.17	0.17	0.00	0.0005	0.0005	yes	0.0005	yes	0.0005	yes	-	-
Chloride	-	250	**17**	-	5,808.8	7.5	5,801.25	0.022	0.042	-	0.023	yes	0.023	yes	-	-
Chromium	1	0.050	**0.002**	yes	0.67	0.67	0.00	0.002	0.0020	yes	0.0020	yes	0.0020	yes	-	-
Chromium (hex)	0.1	0.011	**0.003**	yes	1.16	0.83	0.33	0.0025	0.0025	yes	0.0025	yes	0.0025	yes	-	-
Copper	0.5	0.015	**0.019**	yes	6.34	3.76	2.58	0.013	0.0130	yes	0.0113	yes	0.0113	yes	-	-
Cyanide	0.1	5.2	**0.0025**	yes	0.83	0.83	0.00	0.0025	0.0025	yes	0.0025	yes	0.0025	yes	-	-
Fluoride	15	1.4	**1.01**	yes	337.8	143.1	194.71	0.425	0.426	yes	0.429	yes	0.429	yes	-	-
Iron	2	0.3	**0.27**	yes	90	69.27	20.80	0.20	0.20	yes	0.208	yes	0.207	yes	-	-
Lead	0.2	0.050	**0.0005**	yes	0.17	0.17	0.00	0.0005	0.0005	yes	0.0005	yes	0.0005	yes	-	-
Manganese	1	1.0	**0.0102**	yes	3.42	7.26	-3.84	0.0220	0.0220	yes	0.0218	yes	0.0218	yes	-	-
Mercury	0.0005	0.0011	**0.0001**	yes	0.0334	0.03	0.00	0.0005	0.0005	yes	0.0001	yes	0.0001	yes	-	-
Nickel	1	0.007	**0.0025**	yes	0.83	0.83	0.00	0.0025	0.0025	yes	0.0025	yes	0.0025	yes	-	-
Nitrate (302.304)	-	10	**0.01**	-	3.34	23.37	-20.03	0.07	0.070	-	0.070	yes	0.070	yes	-	-
Nitrite	-	-	**-**	-	-	-	-	-	-	-	-	-	-	-	-	-
O&G	15	0.1	**6.0**	yes	2,009.7	980.6	1,029.05	2.85	2.9	yes	2.9	no	2.9	no	yes	-
pH	6 to 9	6 to 9	**7.23**	yes	-	-	-	7.52	7.52	yes	7.42	yes	7.42	yes	-	-
Phenols	0.3	0.001	**0.0025**	yes	0.83	0.83	0.00	0.0025	0.0025	yes	0.0025	no	0.0025	no	yes	-
Phosphorus	1	0.05	**0.14**	yes	46.07	51.74	-5.68	0.14	0.14	yes	0.16	no	0.15	no	yes	-
Selenium	-	0.01	**0.0013**	-	0.43	0.17	0.27	0.0005	0.0005	-	0.0005	yes	0.0005	yes	-	-
Silver	0.1	0.005	**0.0025**	yes	0.83	0.83	0.00	0.0025	0.0025	yes	0.0025	yes	0.0025	yes	-	-
Sulfate	-	250	**986**	-	329,163	18,278	310,885.71	56.0	57.1	-	54.8	yes	54.8	yes	-	-
TDS	-	500	**1156**	-	385,916	58,421	327,494.10	180	181	-	175	yes	175	yes	-	-
TSS	15	-	**7**	yes	2,190	1,602	587.55	4.8	4.8	yes	4.8	yes	4.8	-	-	-
TKN	-	-	**0.5**	-	166.9	400.6	-233.69	1.1	1.1	-	1.2	yes	1.2	-	-	-
Zinc	1	0.041	**0.003**	yes	1.00	2.50	-1.50	0.0060	0.0060	yes	0.0075	yes	0.0075	yes	-	-

Notes

* Hardness-based numeric water quality standards are calculated using analytical result of 110 mg/L from January 13, 2017 sampling.
* Concentration is represented as a mean of all samples collected. Non-detect results were assumed to be half of the detection limit.
* Concentration at outfall is weighted based on flow rate and concentration of process water flow.
* Additional treatment is the amount of additional treament needed to reduce the concentration of the effluent water to meet either the 302 water quality standard or the concentration of the source water (Coffeen

4.3 Pollutant Load Increases from Ash Pond Dewatering Discharge

Discharge of dewaters would occur from removal of the water from pore spaces in deposited ash in Ash Ponds 1 and 2. The means and methods of collecting and conveying the dewaters are undetermined at this time. This antidegradation assessment assumes the dewaters from Ash Ponds 1 and 2 will be combined for discharge.

For purposes of this antidegradation assessment, substances in dewaters at concentrations less than the General Effluent Standards at 35 Ill. Adm. Code §304 are considered to be protective of the receiving water quality, i.e., would not cause degradation of the receiving water quality. As shown in Table 3 and Table 5, the representative average dewater concentrations of TSS in Ash Pond 1, Ash Pond 2, and the combined ash pond dewaters exceeded the General Effluent Standard. The representative average dewater concentrations of iron and manganese in Ash Pond 2 dewaters exceeded their respective General Effluent Standards. The representative average combined ash pond dewaters concentration of iron exceeded the General Effluent Standard. The representative average concentrations of manganese in Ash Pond 1 dewaters and the combined ash pond dewaters were less than the General Effluent Standard. All other analytes were less than the General Effluent Standards.

Table 5 shows the estimated mass of each substance proposed to be discharged through the existing NPDES outfall to Coffeen Lake receiving water (the “Added Load”). Table 5 estimates the predicted effects of discharging the dewaters to the lake and demonstrates the proposed discharge will not cause exceedances of the Public and Food Processing Water Supply Use Standards at 35 Ill. Adm. Code §302 Subpart C. For substances with no Public and Food Processing Water Supply Use Standard, the chronic General Use Water Quality Standards at 35 Ill. Adm. Code §302 Subpart B were used for comparison. Lake concentrations were calculated at normal pool volume. For substances where concentrations in the lake already exceed the applicable water quality standards (oil and grease, phenols, and phosphorus), the concentrations of these substances in the proposed dewaters discharge are equivalent to the existing lake concentrations. Table 5 illustrates the proposed dewaters discharge will not increase the existing concentrations of oil and grease, phenols, and phosphorus in the lake.

The estimated combined volume of dewaters to be discharged from Ash Ponds 1 and 2 as part of the CCR closure plan is 25 million gallons. The dewaters are expected to be discharged over approximately 120 to 180 days, at a rate of approximately 0.1 to 0.2 MGD. Ash Pond 2 may be dewatered using the pumps in the existing wells. The dewatering volume may be reduced if less dewatering is required to construct the cover system. The proposed short-term CCR dewatering discharge will contribute a negligible effect on receiving water concentrations.

5. Fate and Effect of Parameters Proposed for Increased Loading

Tables 4 and 5 show the estimated mass of each substance proposed to be discharged through the existing NPDES outfall to Coffeen Lake from the ash pond unwatering and dewatering activities (the “Added Load” on each table). The tables also estimate the predicted effects of discharging the unwaters and dewaters and demonstrate the proposed discharges will not cause exceedances of the Public and Food Processing Water Supply Use Standards at 35 Ill. Adm. Code §302 Subpart C or increase the existing lake concentrations. For substances with no Public and Food Processing Water Supply Use Standard, the chronic General Use Water Quality Standards at 35 Ill. Adm. Code §302 Subpart B were used for comparison.

ATTACHMENT V

Table 5. Antidegradation Assessment - Ash Pond Dewaters

This table shows the "Added Load" of pollutants from dewaters that would be discharged to Coffeen Lake.
The table shows the proposed discharge will not cause exceedances of the 35 IAC Section 302 Public and Food Processing Water Supply Standards in the lake.

Contaminant	35 IAC 304 (mg/L)	35 IAC 302 Chronic (mg/L)	Ash Ponds 1 and 2 - Dewaters					Flow Mixing with Process Water			Coffeen Lake					
			Treatment Flowrate (gpm) = 100					Average Flowrate (gpm) = 305,500			Normal Pool Volume (gallons) = 7,039,440,000					
			Total Volume (gallons) = 25,000,000													
			Concentration (mg/L)	Meet 304?	Total Load (lbs)	Source Load (lbs)	Added Load (lbs)	Process Water Concentration - CLb (mg/L)	Concentration at Outfall (mg/L)	Meet 304?	Coffeen Lake (mg/L)	Lake Meet 302?	Lake Conc. w/ Effluent (mg/L)	Meet 302?	Meet Lake?	Additional Treatment to meet 302 or Lake (lbs)
Ammonia	3	2.08	**0.59**	yes	123.15	10.43	112.71	0.05	0.05	yes	0.05	yes	0.05	yes	-	-
Arsenic	0.25	0.05	**0.0170**	yes	3.54	0.38	3.16	0.0018	0.002	yes	0.002	yes	0.002	yes	-	-
Barium	2	1.0	**0.08**	yes	16.57	11.27	5.30	0.052	0.052	yes	0.054	yes	0.054	yes	-	-
Boron	-	1.0	**3.9**	-	804.60	57.38	747.22	0.280	0.281	-	0.275	yes	0.275	yes	-	-
Cadmium	0.15	0.010	**0.0015**	yes	0.31	0.10	0.20	0.0005	0.0005	yes	0.0005	yes	0.0005	yes	-	-
Chloride	-	250	**6**	-	1,320.1	4.7	1,315.44	0.022	0.024	-	0.023	yes	0.023	yes	-	-
Chromium	1	0.050	**0.003**	yes	0.58	0.42	0.16	0.002	0.0020	yes	0.0020	yes	0.0020	yes	-	-
Chromium (hex)	0.1	0.011	**0.003**	yes	0.57	0.52	0.05	0.0025	0.0025	yes	0.0025	yes	0.0025	yes	-	-
Copper	0.5	0.015	**0.002**	yes	0.41	2.35	-1.95	0.013	0.0130	yes	0.0113	yes	0.0113	yes	-	-
Cyanide	0.1	5.2	**0.0025**	yes	0.52	0.52	0.00	0.0025	0.0025	yes	0.0025	yes	0.0025	yes	-	-
Fluoride	15	1.4	**0.43**	yes	90.6	89.5	1.13	0.425	0.425	yes	0.429	yes	0.429	yes	-	-
Iron	2	0.3	**138.41**	no	28,880	43.29	28,836.56	0.20	0.25	yes	0.21	yes	0.21	yes	-	-
Lead	0.2	0.050	**0.0006**	yes	0.13	0.10	0.03	0.0005	0.0005	yes	0.0005	yes	0.0005	yes	-	-
Manganese	1	1.0	**0.9657**	yes	201.49	4.54	196.95	0.022	0.0223	yes	0.0218	yes	0.0218	yes	-	-
Mercury	0.0005	0.0011	**0.0001**	yes	0.0209	0.02	0.00	0.0005	0.0005	yes	0.0001	yes	0.0001	yes	-	-
Nickel	1	0.007	**0.0036**	yes	0.74	0.52	0.22	0.0025	0.0025	yes	0.0025	yes	0.0025	yes	-	-
Nitrate (302.304)	-	10	**0.06**	-	12.52	14.61	-2.09	0.07	0.070	-	0.070	yes	0.070	yes	-	-
Nitrite	-	-	**-**	-	-	-	-	-	-	-	-	-	-	-	-	-
O&G	15	0.1	**4.2**	yes	879.4	612.9	266.46	2.85	2.9	yes	2.9	no	2.9	no	yes	-
pH	6 to 9	6 to 9	**6.64**	yes	-	-	-	7.52	7.52	yes	7.42	yes	7.42	yes	-	-
Phenols	0.3	0.001	**0.0035**	yes	0.74	0.52	0.22	0.0025	0.0025	yes	0.0025	no	0.0025	no	yes	-
Phosphorus	1	0.05	**0.26**	yes	53.61	32.34	21.27	0.14	0.14	yes	0.16	no	0.15	no	yes	-
Selenium	-	0.01	**0.0033**	-	0.68	0.10	0.58	0.0005	0.0005	-	0.0005	yes	0.0005	yes	-	-
Silver	0.1	0.005	**0.0030**	yes	0.63	0.52	0.10	0.0025	0.0025	yes	0.0025	yes	0.0025	yes	-	-
Sulfate	-	250	**1443**	-	300,975	11,423	289,551	56	56.5	-	54.8	yes	54.8	yes	-	-
TDS	-	500	**1844**	-	384,695	36,513	348,182	180	181	-	175	yes	175	yes	-	-
TSS	15	-	**64**	no	13,408	1,002	12,406.74	4.8	4.8	yes	4.8	yes	4.8	-	-	-
TKN	-	-	**0.9**	-	178.2	250.4	-72.22	1.1	1.1	-	1.2	yes	1.2	-	-	-
Zinc	1	0.041	**0.009**	yes	1.84	1.56	0.28	0.006	0.0060	yes	0.0075	yes	0.0075	yes	-	-

Notes

* Hardness-based numeric water quality standards are calculated using analytical result of 110 mg/L from January 13, 2017 sampling.
* Concentration is represented as a mean of all samples collected. Non-detect results were assumed to be half of the detection limit.
* Concentration at outfall is weighted based on flow rate and concentration of process water flow.
* Additional treatment is the amount of additional treament needed to reduce the concentration of the effluent water to meet either the 302 water quality standard or the concentration of the source water (Coffeen

Fish consumption use of Coffeen Lake is listed as impaired, with a cause of mercury. A TMDL has been completed for Coffeen Lake that sets allocations for phosphorus. The concentrations of mercury in the proposed discharges will not cause exceedances of the Public and Food Processing Water Supply Use Standards. The proposed unwaters and dewaters discharges will not increase the existing lake concentrations of the causes of impairment. Since the proposed short-term discharges would not cause exceedances of the Public and Food Processing Water Supply Use standards or contribute to the cause of impairment in the lake, adverse impacts to the existing uses of the water body are not anticipated.

6. Assessments of Alternatives for Less Increase in Loading or Minimal Environmental Degradation

6.1 Water Management Alternatives Considered

Discharge of unwaters would occur from removal of the free surface water in Ash Pond 1. These waters result from the normal operation of the Coffeen plant and, except for storm water precipitation into the ash pond cells, are generally drawn from Coffeen Lake. These waters comply with the General Effluent Standards at 35 Ill. Adm. Code §304 and are currently discharged under the authorization of the plant's NPDES permit. No unwaters are present in Ash Pond 2.

IPGC has considered management alternatives for the dewaters that could avoid or minimize increase in pollutant loading to the receiving water. In addition to assessment of potential degradation of receiving waters that could result from the dewatering discharges, an important criterion used in the alternatives analysis is the reliability of the time required to remove the dewaters from the ash ponds. The unwatering and dewatering must be completed in a limited time frame to enable the regulatory-driven CCR closure construction activities. The alternatives are summarized in Table 6 and discussed in the following sections.

Table 6. Water Management Alternatives Considered

<u>Alternatives that Avoid Discharge to Receiving Water</u>

- No action. (No unwatering or dewatering of ash ponds.)
- Mechanical evaporation.
- Agricultural irrigation.
- Land application.
- Use ash pond water in power generation plant processes.

<u>Alternatives that Discharge to Receiving Water</u>

- ✓ Discharge through existing NPDES Outfall 001. This is the preferred alternative.
- Discharge with additional treatment.
  - Coagulation/flocculation.
  - Precipitation/filtration.
  - Reverse osmosis.

6.2 Alternatives that Avoid Discharge to Receiving Water

6.2.1 No Action Alternative

The closure plan for the Coffeen Ash Ponds 1 and 2 includes installation of a compacted earthen material and vegetated or composite cover system. Site preparation for installation of the cover system requires removal of open water from the ash ponds and partial removal of pore water contained in CCR-filled portions of the ash ponds. Impoundment closure to comply with the federal CCR Rule could not be achieved without removing the unwaters and dewaters. Therefore, the no action alternative is not feasible and is excluded from further consideration.

6.2.2 Mechanical Evaporation

IPGC and Hanson evaluated dewatering the ash ponds by mechanical evaporation. Hanson consulted with one mechanical evaporation equipment provider to discuss the feasibility of removing the ash pond dewaters by evaporation. Based on the information reviewed and the typical climate in this project area, mechanical evaporators could each be expected to evaporate approximately 60,000 gallons per day. Multiple evaporators would be needed to remove the estimated 25 million gallons of dewaters from the ash ponds.

Evaporation rates would be dependent upon many factors such as performance of the evaporation equipment, water make-up and chemistry, ambient temperature and humidity, solar radiation, wind, free flow of air over the ash ponds, and other factors. Evaporation could occur only in the warmer months, between approximately April and October, with the most efficient evaporation occurring in mid-summer.

It is unlikely that ideal evaporation conditions would occur for enough duration to eliminate the total 25 million gallons of dewaters. The unpredictability of weather and unreliability of evaporation rates make this alternative infeasible to comply with the CCR closure timeframes.

6.2.3 Agricultural Irrigation

IPGC and Hanson evaluated using the CCR dewaters for agricultural irrigation. The Coffeen plant is located in a rural agricultural area, although the plant is situated between Coffeen Lake and other waterbodies including East Fork Shoal Creek and Rocky Ford Lakes. Review of aerial photography does not indicate that irrigation is currently used in the vicinity of the plant. Dewaters could be pumped from the ash ponds and piped to fields east of the plant. However, the nearest agricultural fields do not appear to be feasible for the installation of large irrigation rigs due to the presence of large high-voltage electric transmission lines. The nearest fields that could potentially be irrigated would require running about 1.2 miles of temporary piping across and along County Road 1650E. It is unknown if permission could be obtained from the landowners and/or tenant farmers to utilize the irrigation rigs in their fields, and what conditions or payments may be required to obtain permission. It is likely IPGC would have to compensate the farmers for at least one season of crops. Since the purpose of the irrigation would be to remove the dewaters from the ash ponds, it is likely that water would be applied at higher rates than desired for crop growth, resulting in damaged crop or diminished yields.

IPGC has not estimated the cost to negotiate permissions and install the temporary piping to the agricultural irrigation rig(s). As with the mechanical evaporation discussed above, it is unlikely that ideal conditions would occur for enough duration to eliminate the total 25 million gallons of dewaters. The unpredictability of weather and unreliability of evaporation and infiltration rates make this alternative

infeasible to comply with the CCR closure timeframes. The technical obstacles and potential detrimental effects to local farms make this alternative infeasible for the proposed short-term discharge.

6.2.4 Land Application

IPGC and Hanson evaluated land application of the CCR dewaters. Dewaters could be utilized on site for dust control. Land-applied water would be dissipated by evaporation and infiltration. In order to avoid discharge to the receiving water, land application would need to be controlled so that surface runoff did not occur. Due to the large volume of dewaters to be removed, the relatively compact size of the Coffeen plant, and the small area of pervious surfaces for infiltration, it is unlikely the dewaters could be eliminated in a timely manner by land application on stored coal or ground surfaces without causing plant inefficiency (wet coal) or safety or housekeeping issues. Land application is infeasible to eliminate the total 25 million gallons of dewaters within the CCR closure timeframes.

6.2.5 Use CCR Dewaters in Power Generation Plant Processes

IPGC and Hanson evaluated using the CCR dewaters in power plant processes. The plant uses makeup water for various processes. However, the quality of the dewaters, including concentrations of iron, sulfate, TSS, and total dissolved solids (TDS) would not be usable in the processes without substantial pretreatment. The likely pretreatment processes would generate waste streams that would result in wastewater discharges or disposal. Due to the undesirable water quality and the large volume of dewaters, it is infeasible to eliminate the anticipated total 25 million gallons of dewaters by using it in plant processes.

Currently the existing Ash Pond 2 dewatering system is directed to the GMF system, which recirculates to the “closed-loop” scrubber system. This dewatering system could be adequate to lower the Ash Pond 2 phreatic surface, facilitate Ash Pond 2 closure, and reduce the volume of Ash Pond 2 dewaters that would need to be discharged to Coffeen Lake during Ash Pond 2 closure. However, the GMF ystem could be overwhelmed with the large volume of Ash Pond 2 dewaters. Therefore, the option to discharge Ash Pond 2 dewaters to Coffeen Lake must be available.

6.3 Alternatives that Discharge to Receiving Water

6.3.1 Discharge through Existing NPDES Outfall

IPGC and Hanson evaluated discharging the dewaters through the existing NPDES Outfall 001. This is the normal operation and discharge of the ash pond waters. The dewaters would be conveyed through the outfall using existing infrastructure, including pumps, piping, and outfall structures.

Table 5 estimates the predicted effects of discharging the dewaters to the lake and demonstrates the proposed discharge will not cause exceedances of the Public and Food Processing Water Supply Use Standards or the chronic General Use Water Quality Standards at 35 Ill. Adm. Code §302. For substances where concentrations in the lake already exceed the applicable water quality standards (oil and grease, phenols, and phosphorus), the concentrations of these substances in the proposed dewaters discharge are equivalent to the existing lake concentrations. Table 5 illustrates the proposed dewaters discharge will not increase the existing concentrations of oil and grease, phenols, and phosphorus in the lake.

Pollutant loading from the proposed dewatering would increase during the short-term discharges (approximately 120 to 180 days). Considering the demonstration presented in Table 5, no adverse

impacts to the existing uses of the receiving water are anticipated. Pollutant loading would decrease when the short-term dewaters discharges are completed. This alternative eliminates the dewaters in the shortest time and will enable the dewatering to be completed within the CCR closure timeframes.

6.3.2 Direct Discharge with Additional Treatment

IPGC and Hanson conducted cursory evaluations of treatment processes to reduce pollutant concentrations in the dewaters discharges. Wastewater pretreatment processes could conceivably be installed prior to Outfall 001. Pretreatment processes including oxidation, precipitation, coagulation, and flocculation would reduce the TSS in the dewaters and could reduce the dissolved concentrations of certain pollutants such as iron and manganese. However, industry experience has shown that biological treatment, chemical precipitation, or ion exchange processes are not effective in reducing concentrations of boron.

Specialized adsorption processes or reverse osmosis (RO) could be utilized to reduce the concentration of boron in the ash pond dewaters. These technologies are complex, expensive, and generate waste streams that need to be disposed or treated. Considering the large volume of dewaters (25 million gallons total), it is predicted the volumes of wastewaters from the pretreatment processes would be substantially large and concentrated to make these processes infeasible for the proposed short-term discharges of ash pond dewaters.

7. Identification of Preferred Alternative

Discharging the unwaters and dewaters through the existing NPDES outfall is consistent with the plant's normal operation. This alternative would use existing infrastructure at minimal or no additional cost and has been demonstrated to not cause exceedances of the Public and Food Processing Water Supply Standard or the chronic General Use Water Quality Standards. This alternative will remove the dewaters in the shortest practicable time to comply with the CCR closure timeframes. Discharging the dewaters through the existing NPDES outfall is IPGC's preferred alternative.

8. References

Integrated Water Quality Report and 303d Lists. (2016). Retrieved from Illinois Environmental Protection Agency: http://www.epa.illinois.gov/topics/water-quality/watershed-management/tmdls/303d-list/index

National Water Quality Monitoring Council. (2016, October 26). Retrieved from http://www.waterqualitydata.us/portal/

Illinois Environmental Protection Agency. *Public Notice/Fact Sheet* (2009, July 30). Notice No. SMT:05012101.daa. NPDES Permit IL0000108.

Illinois Environmental Protection Agency. *Public Notice/Fact Sheet* (2011, April 25). Notice No. SMT:05012102.daa. NPDES Permit IL0000108.

Illinois Environmental Protection Agency. *Public Notice/Fact Sheet* (2015, August 31). Notice No. SMT:15070201.smt. NPDES Permit IL0000108.

Appendix

EcoCAT Report

ATTACHMENT V

EcoCAT
Ecological Compliance Assessment Tool

Applicant:	Hanson Professional Services Inc.	*IDNR Project Number:*	1704719
Contact:	Doug Dorsey	*Date:*	11/25/2016
Address:	1525 S. 6th St. Springfield, IL 62703		
Project:	Coffeen Lake		
Address:	134 CIPS Lane, Coffeen		

Description: Antidegradation study for CCR Discharge

Natural Resource Review Results

This project was submitted for information only. It is not a consultation under Part 1075.

The Illinois Natural Heritage Database shows the following protected resources may be in the vicinity of the project location:

Eastern Blue-Eyed Grass *(Sisyrinchium atlanticum)*

Location

The applicant is responsible for the accuracy of the location submitted for the project.

County: Montgomery

Township, Range, Section:
7N, 3W, 3
7N, 3W, 4
7N, 3W, 9
7N, 3W, 10
7N, 3W, 11
7N, 3W, 14
7N, 3W, 15
7N, 3W, 22
7N, 3W, 23

IL Department of Natural Resources Contact
Impact Assessment Section
217-785-5500
Division of Ecosystems & Environment

Disclaimer

The Illinois Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of natural resources in Illinois. This review reflects the information existing in the Database at the time of this inquiry, and should not be regarded as a final statement on the site being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are encountered during the project's implementation, compliance with applicable statutes and regulations is required.

Terms of Use

By using this website, you acknowledge that you have read and agree to these terms. These terms may be revised by IDNR as necessary. If you continue to use the EcoCAT application after we post changes to these terms, it will mean that you accept such changes. If at any time you do not accept the Terms of Use, you may not continue to use the website.

1. The IDNR EcoCAT website was developed so that units of local government, state agencies and the public could request information or begin natural resource consultations on-line for the Illinois Endangered Species Protection Act, Illinois Natural Areas Preservation Act, and Illinois Interagency Wetland Policy Act. EcoCAT uses databases, Geographic Information System mapping, and a set of programmed decision rules to determine if proposed actions are in the vicinity of protected natural resources. By indicating your agreement to the Terms of Use for this application, you warrant that you will not use this web site for any other purpose.

2. Unauthorized attempts to upload, download, or change information on this website are strictly prohibited and may be punishable under the Computer Fraud and Abuse Act of 1986 and/or the National Information Infrastructure Protection Act.

3. IDNR reserves the right to enhance, modify, alter, or suspend the website at any time without notice, or to terminate or restrict access.

Security

EcoCAT operates on a state of Illinois computer system. We may use software to monitor traffic and to identify unauthorized attempts to upload, download, or change information, to cause harm or otherwise to damage this site. Unauthorized attempts to upload, download, or change information on this server is strictly prohibited by law.

Unauthorized use, tampering with or modification of this system, including supporting hardware or software, may subject the violator to criminal and civil penalties. In the event of unauthorized intrusion, all relevant information regarding possible violation of law may be provided to law enforcement officials.

Privacy

EcoCAT generates a public record subject to disclosure under the Freedom of Information Act. Otherwise, IDNR uses the information submitted to EcoCAT solely for internal tracking purposes.

Appendix E

Groundwater Polishing Evaluation Report

Geosyntec consultants

engineers | scientists | innovators

Groundwater Polishing Evaluation Report

Coffeen Power Plant – Ash Pond No. 2 Unit

(IEPA ID No. W1350150004-02)

Prepared for

Illinois Power Generating Company
1500 Eastport Plaza Drive
Collinsville, Illinois 62234

Prepared by

Geosyntec Consultants, Inc.
500 W. Wilson Bridge Road, Suite 250
Worthington, Ohio 43085

Project Number: GLP8078

June 10, 2025

EXECUTIVE SUMMARY 1

1. INTRODUCTION 3

2. SITE BACKGROUND 5
   2.1 Site Overview 5
   2.2 Identified Exceedances of the GWPS 6
   2.3 Geochemical Conceptual Site Model 7

3. GROUNDWATER POLISHING REMEDY EVALUATION 8
   3.1 Methods 8
      3.1.1 Model Set-Up 9
   3.2 Results and Discussion 10
      3.2.1 Model Results 10
      3.2.2 Speciation Modeling 13
      3.2.3 Reaction modeling 13

4. CONCLUSIONS 15

5. REFERENCES 16

LIST OF TABLES

Table 1 Summary of Geochemical Model Inputs

Table 2 Geochemical Modeling Response of Sorbing Phases

LIST OF INTERNAL FIGURES

Figure 1 Percentage of Sorbed Boron

Figure 2 Modeled Boron Behavior

Figure 3 Percentage of Sorbed Sulfate

Figure 4 Modeled Sulfate Behavior

Figure 5 Modeled Sorbing Phase Behavior

LIST OF ATTACHMENTS

Attachment A	Potentiometric Surface Map – August 2023
Attachment B	PHREEQC Input File and Thermodynamic Database
Attachment C	Details of Geochemical Model Parameterization
Attachment D	Complete Geochemical Modeling Outputs

ACRONYMS AND ABBREVIATIONS

AP1	Ash Pond No. 1
AP2	Ash Pond No. 2
CAAA	Corrective Actions Alternative Analysis
CCR	Coal combustion residuals
COC	Constituent of concern
CPP	Coffeen Power Plant
DA	Deep aquifer
DCU	Deep confining unit
GCSM	Geochemical conceptual site model
GWPS	Groundwater protection standard
IEPA	Illinois Environmental Protection Agency
LCU	Lowermost confining unit
mg/kg	milligrams per kilogram
redox	oxidation-reduction
SEP	Sequential extraction procedure
SRNL	Savannah River National Laboratory
UA	Uppermost aquifer
UCU	Uppermost confining unit
USEPA	United States Environmental Protection Agency
TDS	Total dissolved solids
XRD	X-ray diffraction

EXECUTIVE SUMMARY

This document has been prepared as an attachment to the Corrective Action Alternatives Analysis (CAAA) prepared by Gradient for Coffeen Power Plant Ash Pond No. 2 (AP2) Unit. The constituents of concern (COCs) addressed this document are boron, pH, sulfate, and total dissolved solids (TDS), which have been identified as having exceedances[1] of the site-specific groundwater protection standards (GWPS) at the time of this analysis. Natural geochemical processes may be appropriate as a "polishing step" for residual plume management after effective source control implementation if there are no risks to receptors and/or the contaminant plume is not expanding (United States Environmental Protection Agency [USEPA] 1999; USEPA 2015). Source control is a major component of every corrective action considered in the CAAA, and there are no risks to human health or the environment at Coffeen AP2.

Natural groundwater polishing processes, which include both physical and chemical mechanisms, reduce the concentration of COCs in the groundwater. After source control is implemented, a geochemical trailing gradient may form in the subsurface as conditions undergo a return to background water quality which could affect chemical groundwater polishing mechanisms (Savannah River National Laboratory, 2011). This report supports groundwater polishing as a component of the proposed corrective action by evaluating the contribution of chemical mechanisms to groundwater polishing under current conditions and after source control implementation. The groundwater flow and transport model estimated the time to reach the GWPS based on hydraulic properties of the aquifer. The results of this groundwater polishing evaluation contextualize these estimates by evaluating the potential for attenuation of COCs and for previously attenuated COCs to be mobilized to groundwater as groundwater quality returns to background conditions.

Groundwater polishing mechanisms were assessed using speciation and reaction geochemical models: speciation models assess the distribution of constituents between solid and aqueous phases, and reaction models evaluate how that distribution may change with changing site conditions (USEPA 2015). Inputs to the model include geochemically reactive solid mineral phases, compliance well groundwater composition, and background groundwater composition based on site-specific data.

The results of the groundwater polishing evaluation indicate that some chemical attenuation of boron and sulfate is feasible under current conditions through sorption to iron and aluminum oxide solids and, in the case of sulfate, barite precipitation. Modeling indicates that boron and sulfate attenuation via sorption onto mineral surfaces should remain stable under future conditions, as iron and aluminum oxide mineral phases are predicted to experience minor (if any) dissolution with background groundwater interaction. Additionally, barite precipitation was predicted in all future

[1] Throughout this document, "exceedance" or "exceedances" is intended to refer only to potential exceedances of proposed applicable background statistics or Groundwater Protection Standards as described in the proposed groundwater monitoring program which was submitted to the IEPA on October 25, 2021 as part of Illinois Power Resource Generating, LLC's operating permit application for the Coffeen Power Plant Ash Pond No. 2. That operating permit application, including the proposed groundwater monitoring program, remains under review by the IEPA and therefore Illinois Power Resource Generating, LLC has not identified any actual exceedances.

scenarios. Remobilization of sulfate is unlikely to affect the estimated time to reach the GWPS based on modeling results; however, mobilization of currently attenuated boron at some locations could result in a longer time to reach the GWPS compared to sulfate. It is anticipated that attenuation of sulfate will contribute to a reduction in TDS concentrations. The low pH exceedance at a single well is predicted to resolve due to influence from near-neutral pH background groundwater. These results will inform corrective action groundwater monitoring and adaptive site management, critical components of every corrective action considered in the CAAA.

1. INTRODUCTION

This document has been prepared as an attachment to the Corrective Action Alternatives Analysis (CAAA) prepared by Gradient for Coffeen Power Plant (CPP) Ash Pond No. 2 (AP2) Unit. The purpose of the CAAA is to holistically evaluate potentially viable corrective actions to remediate groundwater and achieve compliance with site-specific groundwater protection standards (GWPS) for all monitored parameters under Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845.600. The constituents of concern (COCs) addressed in this document are boron, pH, sulfate, and total dissolved solids (TDS)[2], which have been identified as having exceedances of the site-specific groundwater protection standard (GWPS) at the time of this analysis. In the CAAA, all corrective actions considered consist of source control and residual plume management. Natural geochemical processes may be appropriate as a "polishing step" for residual plume management after effective source control implementation, if there are no risks to receptors and/or the contaminant plume is not expanding (United States Environmental Protection Agency [USEPA] 1999; USEPA 2015). Source control is a major component of every corrective action considered in the CAAA, and there are no risks to human health or the environment at Coffeen AP2.[3]

Groundwater polishing processes include both physical and chemical mechanisms within the groundwater which reduce the concentration of COCs in the groundwater. Physical components of groundwater polishing, including advection, dilution, and dispersion, are assessed by groundwater flow and transport modeling (Groundwater Modeling Technical Memorandum[4]). Chemical mechanisms of groundwater polishing include sorption and mineral precipitation. After source control is implemented, a geochemical trailing gradient may form in the subsurface as conditions undergo a return to background water quality which could affect chemical groundwater polishing mechanisms (Savannah River National Laboratory [SRNL], 2011). The chemical mechanisms of groundwater polishing at Coffeen AP2 are evaluated herein using a geochemical modeling-based approach informed by site-specific data. This report uses geochemical modeling to evaluate the influence of chemical mechanisms on groundwater polishing under current conditions and after source control implementation.

The groundwater flow and transport model (Groundwater Modeling Technical Memorandum[5]) estimated the time for sulfate (as a conservative surrogate) to reach the GWPS under different potential corrective actions based on physical components of groundwater polishing and did not incorporate any potential chemical controls on parameter distribution. This geochemical modeling effort supports the assessment of groundwater polishing as a component of the proposed corrective action by evaluating the potential for chemical attenuation of boron and sulfate before and after source control as a means of contextualizing the times estimated in the flow and transport model.

---

[2] TDS measurements represent the total mass of dissolved constituents in a sample rather than a single chemical behavior. Because sulfate is the dominant contributor to TDS, results for sulfate in this analysis also apply to TDS.
[3] The Human Health and Ecological Risk Assessment serves as Appendix A of the CAAA to which this report is attached.
[4] The Groundwater Modeling Technical Memorandum serves as Appendix B of the CAAA Supporting Information Report; the CAAA Supporting Information Report serves as Appendix B of the CAAA to which this report is attached.
[5] Ibid.

This analysis also provides an initial foundation for understanding groundwater chemistry to inform adaptive site management as a key component of the Corrective Action Groundwater Monitoring Program[6].

[6] The Corrective Action Groundwater Monitoring Program serves as Appendix B.1 to the Construction Permit Application.

2. SITE BACKGROUND

2.1 Site Overview

A thorough overview of general site characteristics is presented in Section 1 of the CAAA to which this document is attached and summarized here. The CPP property is located approximately two miles south of the city of Coffeen, Illinois, and bordered by two lobes of Coffeen Lake to the west, east, and south, and by agricultural land to the north. The CPP AP2 impoundment is located to the north of the CPP Ash Pond No. 1 (AP1) coal combustion residuals (CCR) unit (IEPA No. W1350150004-0101), and south of the Gypsum Management Facility Recycle Pond (IEPAIEPA No. W1350150004-04). An unnamed tributary runs north to south to the east of AP2. AP2 is a 78-acre unlined surface impoundment that received bottom ash and fly ash between 1972 until the mid-1980's, when it was capped with a 2-foot compacted clay and soil cap. AP2 was closed starting in 2019 in accordance with the closure plan that was submitted to and approved by IEPA using a geomembrane cover system. The cover system installation was completed on November 17, 2020. The geomembrane cap design addresses the potential for slope failure and water infiltration into the closed CCR unit by directing the drainage of surface water (i.e., precipitation) off the cover system.

A groundwater monitoring network was proposed in accordance with 35 I.A.C. § 845.630 to monitor groundwater quality which passes the waste boundary as part of the Operating Permit Application to Illinois Environmental Protection Agency (IEPA) for the AP2 unit (Burns & McDonnell 2021). The proposed groundwater monitoring network is shown in **Attachment A**. The monitoring network consists of 8 compliance monitoring wells (G401, G402, G403, G404, G405, G406, G407, and G1001) and 3 background wells (G270, G280, and G281).

The geology underlying the Site in the vicinity of AP2 consists of five distinct hydrostratigraphic units (NRT, 2017; Ramboll, 2021[7]):

- **Upper Confining Unit (UCU):** The UCU underlies the majority of the AP2 footprint. It consists of a Loess Unit and the upper portion of the Hagarstown Member, which has low permeability clays and silts with generally greater than 60% fines. The UCU was encountered across most of the CPP.
- **Uppermost Aquifer (UA):** The UA is comprised of moderately permeable sands, silty sand, and clayey gravel of the Hagarstown Member and, in some portions of the Site, the Vandalia Member. Limited direct contact between AP2 CCR and the UA may occur in pre-construction ravines on the eastern edge of the AP2 footprint.

[7] This document references a Hydrogeologic Site Characterization Report prepared by Ramboll that discusses conditions at CPP Ash Pond. No. 1 (Unit No. 101) but is referenced here due to the presence of identical hydrostratigraphic units given their proximity.

- **Lower Confining Unit (LCU):** The LCU underlies the UA. It consists of three low hydraulic conductivity soils: the sandy clay till of the Vandalia Member, the silt of the Mulberry Grove Formation, and the compacted clay till of the Smithboro Member.
- **Deep Aquifer (DA):** The DA is a thin (generally less than 5 ft thick), discontinuous unit composed of sands and silty sand units of the Yarmouth Soil.
- **Deep Confining Unit (DCU):** The DCU underlies the DA. It consists of the Lierle Clay of the Banner Formation and acts as an aquitard due to its low hydraulic conductivity.

There is a groundwater flow divide within the UA in the center of the CPP property between the two lobes of Coffeen Lake. Groundwater in the UA flows from the center of the CPP property west toward Coffeen Lake on the western side of the groundwater flow divide, and east toward the Unnamed Tributary, the eastern lobe of Coffeen Lake, and the discharge flume on the eastern side of the groundwater flow divide. AP2 is east of the groundwater flow divide, so groundwater flow in the vicinity of AP2 is generally to the south and east. The groundwater to the west of AP2 is separated from the groundwater flow regime under AP2 by the groundwater divide. Groundwater flow within the UA has little vertical component due to the underlying low-permeability LCU. The flow direction in the UA is consistent and likely influenced by the proximity to and hydraulic connection with Coffeen Lake. A map showing representative groundwater flow direction in the UA at the site is shown in **Attachment A**.

2.2 Identified Exceedances of the GWPS

The following GWPS exceedances at compliance groundwater monitoring wells likely attributable to Coffeen AP2 were observed from 2023 Q2 through 2023 Q4 (Ramboll, 2024):

- Boron – Observed at monitoring wells G401, G402, G404, and G405.
- pH – Observed at monitoring well G401.
- Sulfate – Observed at monitoring wells G401, G402, G404, G405, and G406.
- TDS – Observed at monitoring wells G401, G402, G404, and G405.

The data set for geochemical modeling was finalized after the 2023 Q4 sampling event. Groundwater at these compliance wells is representative of groundwater conditions downgradient of the unit, and samples may be referred to as downgradient groundwater.

Modeling parameters with observed exceedances is appropriate to the scope of the CAAA. Additionally, the selected remedy will meet the performance standards of 35 I.A.C. § 845.670(d) and the Corrective Action Plan will be submitted to the Agency on or before June 12, 2025. Once implemented and completed, the selected remedy will attain the GWPSs.

GWPS exceedances within the AP2 network are only present within the UA. No GWPS exceedances were noted within other hydrostratigraphic units.

2.3 Geochemical Conceptual Site Model

A Geochemical Conceptual Site Model (GCSM)[8] was developed for CPP AP2 to describe the geochemical processes that contribute to mobilization and attenuation of constituents in the environment under current conditions, including evaluating whether chemical interactions of COCs with aquifer solids contribute to attenuation of aqueous concentrations at compliance monitoring wells. This discussion relies on lab reports and raw data previously presented in the Nature and Extent Report previously submitted to IEPA on June 12, 2024 (Ramboll 2024) in accordance with 35 I.A.C. § 845.650(d)(1) and provided again in full as Appendix D of the CAAA to which this report is attached.

The primary source of boron and sulfate to groundwater of the UA within the monitoring network is AP2 CCR porewater, based on boron and sulfate concentrations within the source and relationships to hydrogeological patterns at the Site.

Limited variability in pH or oxidation-reduction (redox) conditions is observed between upgradient (background) and downgradient locations since the completion of source control in 2020, with pH values in the UA observed to be generally stable and circumneutral, and redox conditions observed to be relatively oxidizing. pH values within background wells are consistently circumneutral, such that mixing with downgradient compliance wells will maintain near-neutral pH conditions. Some wells within the UA appear to have redox fluctuations related to seasonal conditions since completion of closure activities.

Boron and sulfate in the groundwater system may be attenuated via adsorption and surface complexation reactions within portions of the UA. Boron and sorption to iron oxyhydroxide phases in particular is well-studied and is likely occurring within the subsurface near AP2 due to the ubiquitous nature of these materials. Groundwater conditions from the UA are predicted to favor amorphous iron oxide stability at some locations. The detected presence of iron oxides, including magnetite, in some site solids supports the potential for occurrence of this mechanism. The presence of clay minerals (e.g., kaolinite) in UA solids material suggests that adsorption to clays may be another potential attenuation mechanism for boron at locations near AP2. Additionally, boron sorption to aluminum oxide phases is also common in natural systems with low to neutral pH conditions. Crystalline aluminum oxide mineral phases were not detected in mineralogical analyses of aquifer solids samples, although amorphous aluminum oxide solid phases are widespread in natural environments and likely constitute another boron attenuation mechanism near AP2.

The GCSM findings suggest the potential for chemical attenuation of both boron and sulfate based on detected abundances of iron oxide and clay minerals and groundwater redox conditions favorable for the stability of these potential sorbing surfaces.

[8] The GCSM is a component of the Nature and Extent Report previously submitted to IEPA (Ramboll 2024) and is provided as Appendix D of the CAAA to which this report is attached.

3. GROUNDWATER POLISHING REMEDY EVALUATION

This groundwater polishing evaluation uses geochemical modeling to evaluate chemical attenuation of COCs under current conditions and to predict changes in attenuation at exceedance locations following source control. This evaluation will therefore further assess if chemical mechanisms of groundwater polishing will contribute to the remedy achieving the GWPS in a reasonable amount of time. Speciation and reaction models are geochemical models that can be used to evaluate the potential for chemical attenuation in groundwater. Speciation models assess the distribution of constituents between solid and aqueous phases, and reaction models evaluate how that distribution may change with changing site conditions (USEPA 2015). The results of geochemical modeling provide insight into groundwater polishing mechanisms and additional context for the time estimated to reach the GWPS determined by the groundwater flow and transport model[9], which is based on hydraulic properties of the aquifer and does not take into account chemical interactions occurring within the hydrologic unit.

3.1 Methods

Geochemical modeling was done in PHREEQC Version 3 (USGS 2021) using a modified MINETQ v4 thermodynamic database (as described in relevant sections below). The geochemical modeling of groundwater polishing under current/future conditions completed includes speciation and reaction modeling (US EPA 2015):

1. Speciation: To understand groundwater polishing mechanisms under current conditions, a solid phase representative of site conditions is equilibrated with current downgradient groundwater. The results of speciation modeling represent the association of COCs with the solid phase under current conditions through mechanisms such as sorption or precipitation.
2. Reaction: In the reaction modeling, the solid phase generated during the speciation modeling phase is reacted iteratively with background groundwater. These results represent the geochemical conditions expected after the source is controlled during which a trailing geochemical gradient may be created (SRNL 2011). The reactions with background groundwater assess the potential for a trailing geochemical gradient to drive changes in groundwater chemistry. Persistence of elevated groundwater COC concentrations over several reaction iterations suggests a trailing geochemical gradient may be more likely to affect the time to reach the GWPS.

The equilibrium thermodynamic modeling approach used herein allows that the solid and aqueous phases reach equilibrium during each step. The primary goal of this model is to inform the assessment of whether groundwater polishing is an appropriate remedy for the site by evaluating dominant geochemical reactions that may occur at time scales relevant to groundwater flow, including adsorption and certain mineral dissolution/precipitation (i.e., iron and aluminum

[9] The Groundwater Modeling Technical Memorandum serves as Appendix B.1 of the CAAA Supporting Information Report; the CAAA Supporting Information Report serves as Appendix B of the CAAA to which this report is attached.

(hydr)oxides, carbonates, and some sulfates) as identified in the GCSM[10]. The model therefore includes those parameters that are expected to contribute to those reactions (as discussed below) and does not include every constituent of the solid phase and groundwater in order to capture "the salient aspects of the system's behavior without introducing unnecessary complexity" (USEPA 2015). This model is therefore a semi-quantitative estimation of chemical behavior in the subsurface rather than a prediction of groundwater quality, consistent with USEPA guidance that geochemical modeling "is often most helpful for identifying relative changes in contaminant speciation and distribution" (USEPA 2015).

3.1.1 Model Set-Up

Inputs to the model include solid phase composition, downgradient groundwater composition for wells with boron and sulfate GWPS exceedances, and background groundwater composition. The PHREEQC input file and modified MINTEQ v4 database are provided in **Attachment B**. The data included for model parameterization is summarized in **Table 1** and discussed in greater detail in **Attachment C**. All data used in the model and discussed below are provided in the Nature and Extent Report[11].

3.1.1.1 Solid Phase Inputs

Iron hydroxide (ferrihydrite, [$Fe(OH)_3$]) and aluminum hydroxide (gibbsite, [$Al(OH)_3$]) are wide-spread in the environment known to act as sorbing phases for many groundwater constituents, including boron and sulfate (Dzombak and Morel 1990; Karamalidis and Dzombak 2010). Model input concentrations for ferrihydrite and gibbsite are ideally derived from sequential extraction procedure (SEP) analyses of iron and aluminum respectively. Because SEP analyses for iron and aluminum were not completed for AP2 samples, model input concentrations for crystalline iron oxide for AP2 were derived using site-specific total metals and mineralogy (X-ray diffraction [XRD]) datasets, and input concentrations for ferrihydrite were taken from an SEP dataset compiled from analogous geological systems as described in greater detail in **Attachment C**. Gibbsite input concentrations for AP2 were taken directly from the analogous compiled SEP dataset.

Metal oxide concentrations representing the 25th percentile, median, and 75th percentile of the observed data were used to test the sensitivity of the model to the amount of sorbing phase present. Both ferrihydrite and goethite were allowed to dissolve or precipitate in the reaction phase of the model.

Calcite and dolomite were included as mineral phases in the model because carbonate mineral formation and dissolution are often major controls on groundwater pH (Stumm and Morgan 1996; Stackelberg et al. 2020). Calcite is present in site aquifer solids in excess. Dolomite was

---

[10] The GCSM is a component of the Nature and Extent Report previously submitted to IEPA (Ramboll 2024) and is provided as Appendix D of the CAAA to which this report is attached.

[11] The Nature and Extent Report was previously submitted to IEPA (Ramboll 2024) and is provided as Appendix D of the CAAA to which this report is attached. The Nature and Extent report contains laboratory reports and tabulated results from solid phase analysis and tabulated results from groundwater analyses. Laboratory reports for groundwater data are provided quarterly to IEPA and posted to the facility's operating record in accordance with 35 I.A.C. § 845.800(d)(15).

not detected in site-specific XRD samples. Model inputs for both minerals were based on site-specific XRD results. Both calcite and dolomite were allowed to dissolve or precipitate in the reaction phase of the model.

Barite ($BaSO_4$) and gypsum ($CaSO_4$) are minerals that contain sulfate and have the potential to form under ambient environmental conditions in a timeframe consistent with the remedial effort. These minerals therefore may affect sulfate attenuation. Neither mineral phase was observed in mineralogical results for the site; therefore, both were made available to precipitate from the aqueous solution but did not have initial concentrations provided.

3.1.1.2 Aqueous Inputs

In addition to the boron and sulfate, the following parameters are included to capture the expected attenuation and mobilization mechanisms (see **Section 2.3**):

- Temperature, pH, and pe (calculated from field-measured oxidation-reduction potential based on groundwater temperature).
- Major ions: Alkalinity, chloride, fluoride, calcium, magnesium, potassium, and sodium.
- Oxyanions: Silicon and phosphate.
- Redox-active metals: Aluminum, iron, and manganese.
- Remaining constituents regulated under 35 I.A.C. § 845.600[12].

This full suite of geochemical parameters for this model was measured in Quarter 2 and Quarter 3, 2023. The medians of these results were used in the model to represent average groundwater interacting with the solid phase. For downgradient wells with exceedances of boron and/or sulfate (**Section 2.2**), the median for each parameter was calculated for each location individually. For background wells, a single median for each parameter was calculated using data from all background locations (see **Section 2.1**).

3.2 Results and Discussion

3.2.1 Model Results

Geochemical modeling results are shown on **Figures 1 through 5** below. Current geochemical conditions are represented in model output figures as 'Speciation Model' and subsequent reaction calculation results are represented with 'First Reaction' and 'Second Reaction'. Full modeling results are provided in **Attachment D**.

[12] Mercury, thallium, total dissolved solids, and radium were not included in the model. Mercury reactions within the environment are highly complex and would require a separate modeling effort, and the high frequency of non-detect concentrations in the groundwater indicate it would not contribute to model outcomes. Thallium forms a non-reactive monovalent cation and is rarely detected in the groundwater and is therefore not expected to contribute to model outcomes. Total dissolved solids are not a chemical parameter, but rather the result of other chemical abundances taken together. Radium is not included in most thermodynamic databases.

Figure 1: Percentage of Sorbed Boron

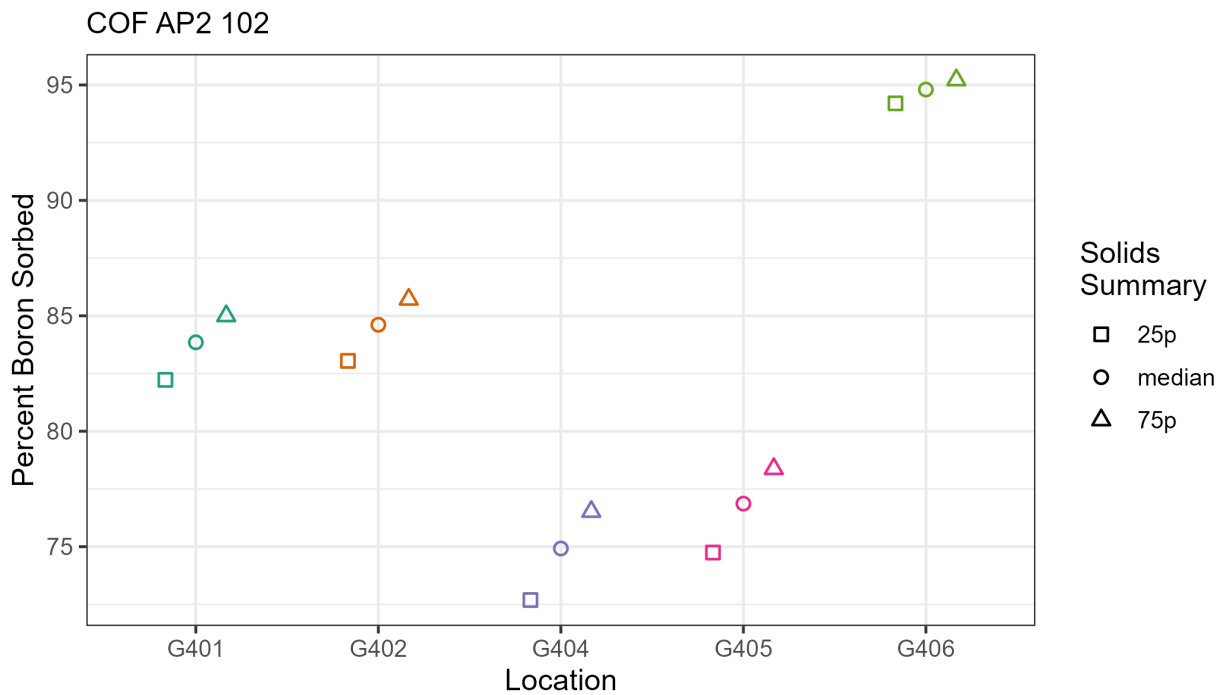


Figure 2: Modeled Boron Behavior

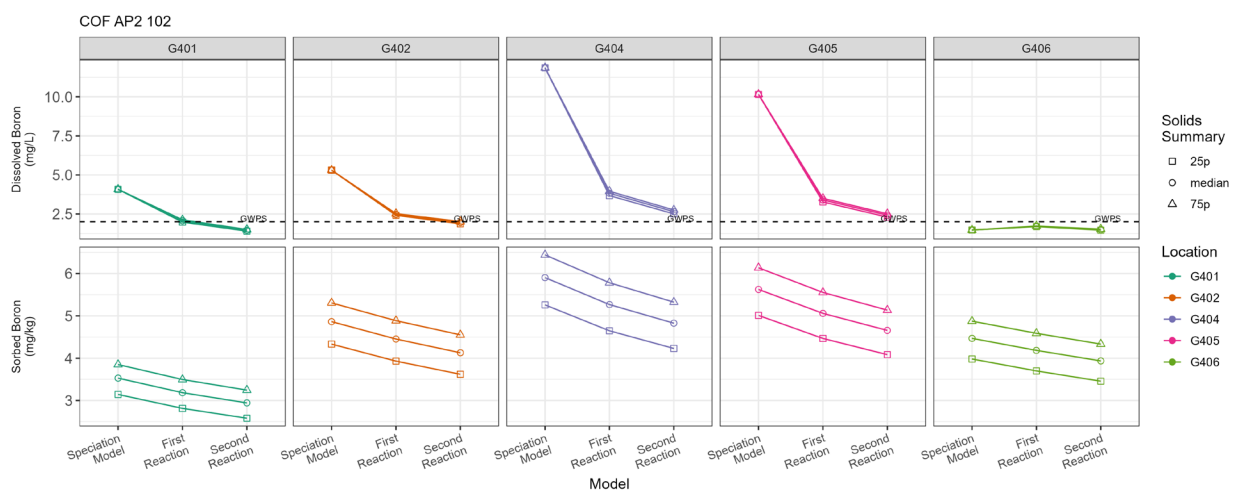


Figure 3: Percentage of Sorbed Sulfate

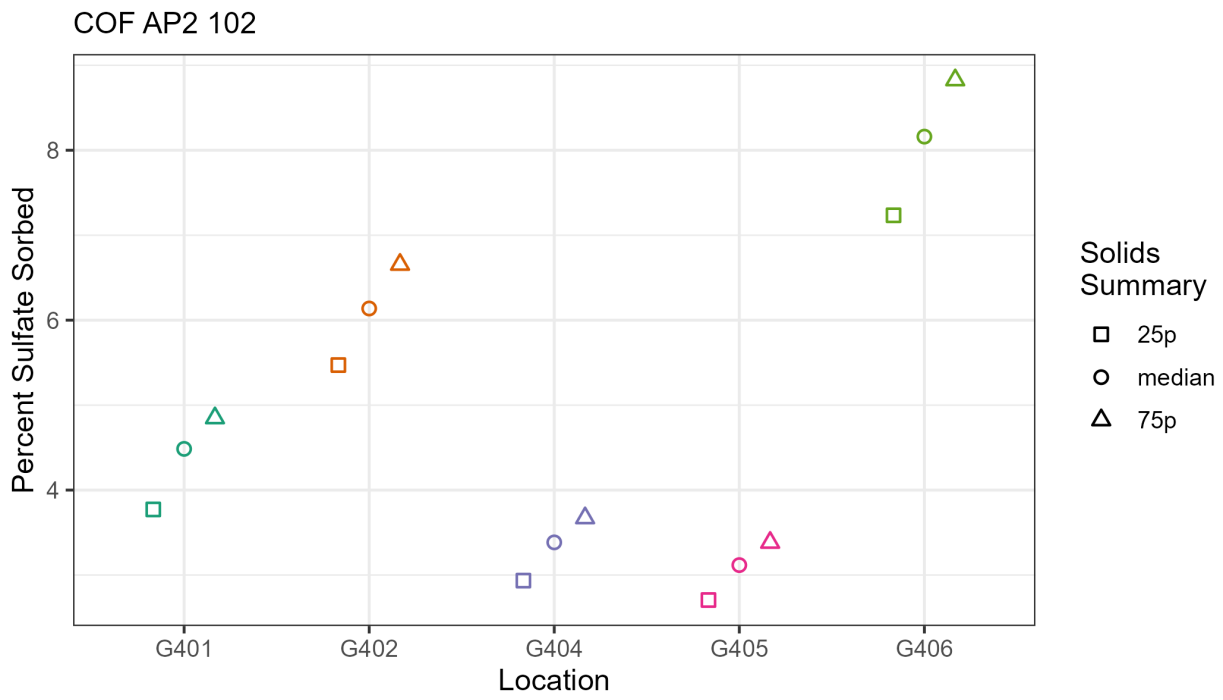


Figure 4: Modeled Sulfate Behavior

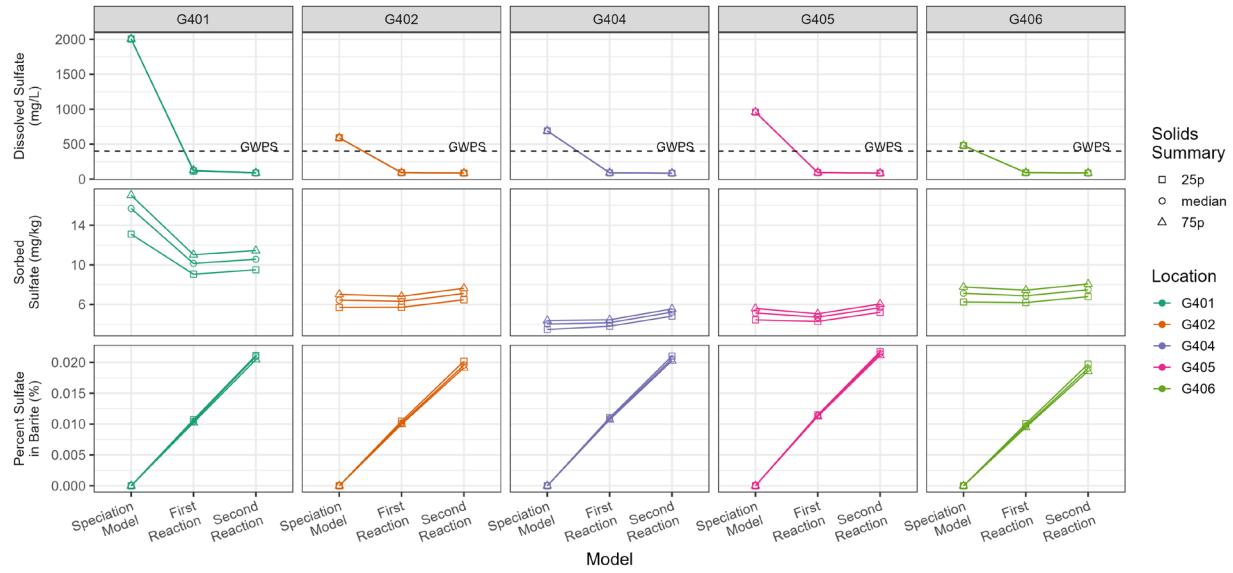
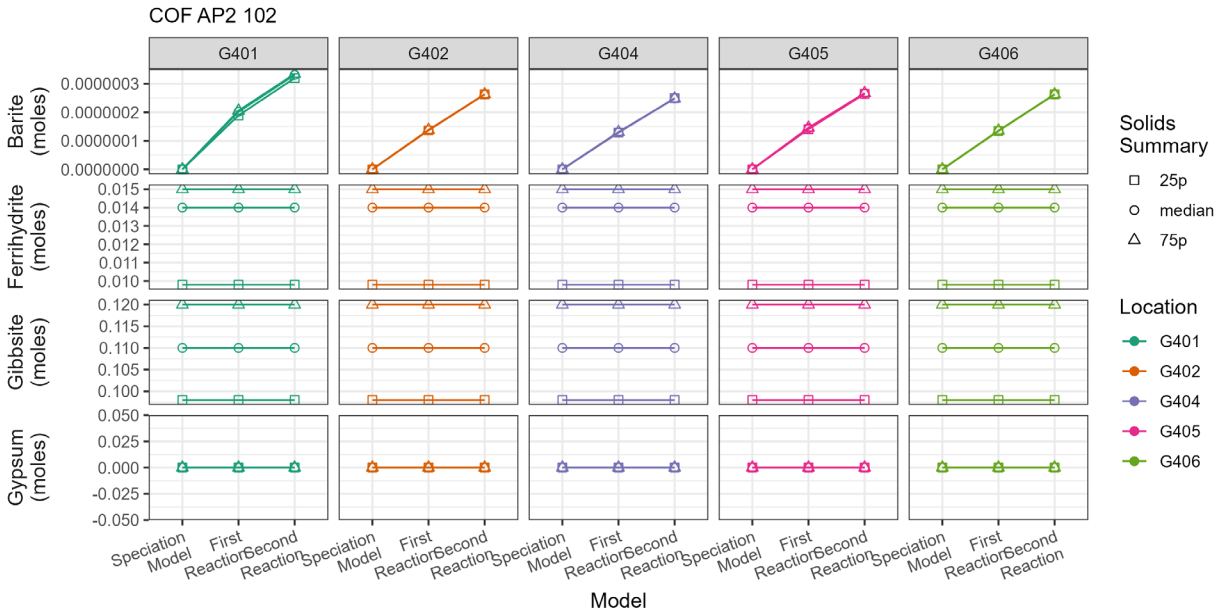


Figure 5: Modeled Sorbing Phase Behavior



3.2.2 Speciation Modeling

Results of speciation modeling support the determination of the GCSM that chemical attenuation of boron is likely to occur. Speciation calculations indicate that between 70 to 86% of boron present in groundwater at compliance wells with boron exceedances will sorb to mineral surfaces (**Figure 1**), with most of the predicted sorption associated with the aluminum oxide (gibbsite) phase (**Attachment D**). Sensitivity assessments demonstrate the influence of variable sorbing mineral mass inputs on boron sorption, with the 25th percentile and 75th percentile values for mineral mass accounting for differences of up to 8% of aqueous boron sorbed under current conditions. These results suggest that boron sorption under current geochemical conditions is thermodynamically favorable, although the absolute amount of sorbed boron is somewhat sensitive to the amount of sorbent.

Speciation calculations for sulfate indicate that in wells with sulfate exceedances approximately 3 to 8% of sulfate present in (modeled) downgradient compliance well groundwater will sorb to mineral surfaces (**Figure 3**). Sensitivity assessments demonstrate a minor influence of variable sorbing mineral mass inputs on sulfate sorption, with the 25th percentile and 75th percentile values for mineral mass accounting for differences of up to 2% of aqueous sulfate sorbed under current conditions. These results suggest that some component of sulfate sorption is predicted under current geochemical conditions, although sulfate sorption is less favorable than boron sorption.

3.2.3 Reaction modeling

Reaction modeling results of conditions following source control demonstrate that aqueous boron and sulfate concentrations change with background groundwater interaction. Aqueous boron concentrations are predicted to decrease with each iterative reaction at all wells with boron exceedances (**Figure 2**). Some minor degree of boron desorption is predicted for all wells following each iterative reaction; however, the impact of this desorption on aqueous boron

concentrations is generally offset by background groundwater containing less aqueous boron. G401 and G402 are predicted to achieve the boron GWPS after the second iterative reaction for all model scenarios. G404 and G405 are not predicted to achieve the boron GWPS after the second iterative reaction although boron concentrations continue to decrease. These results suggest that in some locations, mobilization of currently attenuated boron could result in a longer observed time to reach the GWPS compared to sulfate.

Aqueous sulfate concentrations are predicted to decrease at all wells with each iterative reaction (**Figure 4**). Some degree of sulfate desorption is predicted with background groundwater interaction in model, particularly at G401; however, the impact of this desorption on aqueous sulfate concentrations is offset by interaction with background groundwater containing less aqueous sulfate. Barite precipitation is predicted in all post-source control scenarios (**Figure 5**), which provides an additional attenuation mechanism for aqueous sulfate. All modeled wells are predicted to achieve the sulfate GWPS within one iterative reaction, indicating that mobilization of currently attenuated sulfate is unlikely to affect the time to reach the GWPS.

Boron and sulfate are predicted to sorb to ferrihydrite and gibbsite. Both minerals are predicted to be stable and exhibit minor (less than 0.01%, **Table 2**) predicted dissolution under post-source control conditions (**Figure 5**). Barite is predicted to precipitate under post-source control conditions in all model scenarios. The predicted stability of sorbing mineral phases and precipitation of barite under post-source control conditions demonstrates the continued feasibility of boron and sulfate chemical attenuation mechanisms in AP2.

These results suggest that chemical attenuation of boron and sulfate should remain feasible following source control efforts. The primary chemical attenuation mechanism for boron is anticipated to be sorption to aluminum and iron oxide mineral phases which are predicted to be stable in post-source control conditions. Chemical attenuation mechanisms for sulfate are expected to include sorption to iron and aluminum oxide minerals and precipitation of barite. These results suggest that mobilization of currently attenuated sulfate is unlikely to affect the modeled time to reach the GWPS, and that mobilization of previously attenuated boron may result in a longer observed time to reach the GWPS compared to sulfate. Chemical attenuation of sulfate is also expected to contribute to a reduction in TDS at locations G401, G402, G404, and G405. The low pH exceedance at G401 is modeled to resolve after the first iterative reaction due to the influence of more circumneutral pH groundwater migrating from background locations and its interactions with aquifer solids present in the UA.

4. CONCLUSIONS

This report evaluated the contribution of chemical mechanisms to groundwater polishing via geochemical modeling. The results of the groundwater polishing evaluation also contextualize estimates of the modeled time to reach the GWPS by evaluating potential changes in boron and sulfate attenuation as groundwater quality returns to background conditions.

Geochemical modeling of current AP2 geochemical conditions demonstrates chemical attenuation of boron and sulfate via sorption to aquifer solids, particularly iron and aluminum oxides and (applicable to sulfate only) precipitation of barite. Modeling of anticipated future conditions predicts a minor component of desorption of boron and sulfate from solids that will be offset by interaction with background groundwater containing lower concentrations of these COCs, resulting in net aqueous concentration decreases at all wells with exceedances. Barite precipitation is predicted under future conditions, which will provide an additional attenuation mechanism for sulfate. Modeling also predicts that iron and aluminum oxide sorbing minerals phases will remain stable in post-source control conditions, and as a result this chemical attenuation mechanism will remain viable. It is expected that attenuation of sulfate will also contribute to a reduction in TDS at all wells with TDS exceedances. It is also expected that the low pH values at G401 will resolve due to interaction with neutral pH background groundwater and the buffering capacity of the carbonate minerals in the UA.

Results of the geochemical modeling suggest that mobilization of currently attenuated sulfate is unlikely to affect the modeled time to reach the GWPS, and that mobilization of previously attenuated boron may result in a longer observed time to reach the GWPS compared to sulfate. The results will inform corrective action groundwater monitoring and adaptive site management, critical components of every corrective action considered in the CAAA.

5. REFERENCES

Burns & McDonnell. 2021. Initial Operating Permit – Coffeen Ash Pond 2. October.

Dzombak D.A. and Morel F.M.M. 1990. Surface Complexation Modeling: Hydrous Ferric Oxide. John Wiley & Sons, New York.

Karamalidis A.K. and Dzombak D.A. 2010. Surface Complexation Modeling: Gibbsite. John Wiley & Sons, New York.

Natural Resource Technology [NRT]. 2017. Hydrogeologic Site Characterization Report – Ash Pond No. 2 Coffeen Power Station, Coffeen Illinois. January.

Ramboll. 2021. Hydrogeologic Site Characterization Report – Coffeen Power Plant Ash Pond No. 1. October.

Ramboll. 2024. Nature and Extent Report – Coffeen Power Plant, Ash Pond No. 2, IEPA ID No. 102. April.

Savannah River National Laboratory. 2011. The Scenarios Approach to Attenuation-Based Remedies for Inorganic and Radionuclide Contaminants. SRNL-STI-2011-00459. August.

Stackelberg P.E., Belitz K., Brown C.J., Erickson M.L., Elliot S.M., Kauffman L.J., Ransom K.M., and Reddy J.E. 2020. Machine Learning Predictions of pH in the Glacial Aquifer System, Northern USA. Groundwater, 59(3):352-368. https://doi.org/10.1111/gwat.13063

Stumm W. and Morgan J.J. 1996. Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters. Third edition. John Wiley & Sons, New York.

USEPA. 1999. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. Office of Solid Waste and Emergency Response. Directive 9200.4-17P. April.

USEPA. 2015. Use of Monitored Natural Attenuation for Inorganic Contaminants in Groundwater at Superfund Sites. Office of Solid Waste and Emergency Response. Directive 9283.1-36. August.

United States Geological Survey (USGS). 2021. PHREEQC Version 3. December. https://www.usgs.gov/software/phreeqc-version-3

TABLES

Table 1. Summary of Geochemical Model Inputs
Groundwater Polishing Evaluation Report
Coffeen Power Plant - Ash Pond No. 2

Model Component	Parameters	Data source(s)
Solid Phase	Iron (hydr)oxides, aluminum (hydr)oxides	Site-specific total metals and X-ray diffraction results from solid samples (crystalline iron oxides). Analoguous compiled sequential extraction procedure dataset (ferrihydrite and gibbsite).
	Calcite and dolomite	X-ray diffraction results
Downgradient groundwater (COC exceedance locations)	Sulfate, iron, manganese, major ions[1], 845 constituents[1]	Median concentrations per well from data collected in Q2 and Q3 2023
Background groundwater		Median concentrations from all network background wells using data collected in Q2 and Q3 2023

[1]See Section 3.1.1.2 for details.

Table 2 - Geochemical Modelin Response of Sorbing Phases
Groundwater Polishing Evaluation Report
Coffeen Power Plant - Ash Pond No. 2

Parameter	Hydrostratigraphic Unit	Location	Summary Type	First Reaction Change		Second Reaction Change	
				mg/kg	%	mg/kg	%
Barite	UA	G401	25p	0.00735	NA	0.0124	69.19
			median	0.00786	NA	0.0129	64.04
			75p	0.00800	NA	0.0130	62.63
		G402	25p	0.00531	NA	0.0102	92.76
			median	0.00534	NA	0.0102	91.33
			75p	0.00538	NA	0.0102	90.20
		G404	25p	0.00500	NA	0.00970	93.74
			median	0.00506	NA	0.00967	91.11
			75p	0.00509	NA	0.00966	89.72
		G405	25p	0.00548	NA	0.0103	87.71
			median	0.00561	NA	0.0104	84.71
			75p	0.00567	NA	0.0104	83.23
		G406	25p	0.00523	NA	0.0102	95.80
			median	0.00526	NA	0.0102	94.22
			75p	0.00528	NA	0.0102	93.37
Ferrihydrite	UA	G401	25p	175	<0.01	175	<0.01
			median	249	<0.01	249	<0.01
			75p	267	<0.01	267	<0.01
		G402	25p	175	<0.01	175	<0.01
			median	249	<0.01	249	<0.01
			75p	267	<0.01	267	<0.01
		G404	25p	175	<0.01	175	<0.01
			median	249	<0.01	249	<0.01
			75p	267	<0.01	267	<0.01
		G405	25p	175	<0.01	175	<0.01
			median	249	<0.01	249	<0.01
			75p	267	<0.01	267	<0.01
		G406	25p	175	<0.01	175	<0.01
			median	249	<0.01	249	<0.01
			75p	267	<0.01	267	<0.01
Gibbsite	UA	G401	25p	1270	<0.01	1270	<0.01
			median	1430	<0.01	1430	<0.01
			75p	1560	<0.01	1560	<0.01
		G402	25p	1270	<0.01	1270	<0.01
			median	1430	<0.01	1430	<0.01
			75p	1560	<0.01	1560	<0.01
		G404	25p	1270	<0.01	1270	<0.01
			median	1430	<0.01	1430	<0.01
			75p	1560	<0.01	1560	<0.01
		G405	25p	1270	<0.01	1270	<0.01
			median	1430	<0.01	1430	<0.01
			75p	1560	<0.01	1560	<0.01
		G406	25p	1270	<0.01	1270	<0.01
			median	1430	<0.01	1430	<0.01
			75p	1560	<0.01	1560	<0.01

Notes:
% = percent
25p = 25th percentile
75p = 75th percentile
mg/kg = milligram/kilogram
UA = Uppermost Aquifer
NA = not applicable

ATTACHMENT A

Operating Permit Network Map and Potentiometric Surface (August 2023)

- COMPLIANCE MONITORING WELL
- BACKGROUND WELL
- LEACHATE WELL
- MONITORING WELL
- STAFF GAGE, CCR UNIT
- STAFF GAGE, RIVER
- GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
- INFERRED GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION
- REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- LIMITS OF FINAL COVER
- PROPERTY BOUNDARY

0 325 650 Feet

NOTES:
1. ELEVATIONS IN PARENTHESES WERE NOT USED FOR CONTOURING.
2. ELEVATIONS IN BRACKETS WERE OBTAINED OUTSIDE OF THE 24-HOUR PERIOD FROM INITIATION OF DEPTH TO GROUNDWATER MEASUREMENTS BUT WITHIN THE SAME SAMPLING EVENT.
3. ELEVATION CONTOURS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

POTENTIOMETRIC SURFACE MAP
AUGUST 8, 2023

2023 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
ASH POND NO. 2
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

ATTACHMENT B

PHREEQC Input Files and Thermodynamic Database

25th Percentile Metal Oxides/No Charge Balance

```
SELECTED_OUTPUT 1
-file COF_845_102_25p_cb-false_out.csv
-charge_balance true
-percent_error true
-totals S(6) B Li As C(4) Cl F Ca Mg Na K Ba Si P Mn Fe Al Sb Be Cd Cr Co Pb Mo Se Hfo_s
Hfo_w Hao_
-molalities Hfo_wOH Hfo_wOH2+ Hfo_wOHSO4-2 Hfo_wSO4- Hfo_wOSi(OH)3
Hfo_wOSiO(OH)2- Hfo_wHCO3 Hfo_wCO3- Hfo_wPO4-2
Hfo_wHPO4- Hfo_wH2PO4 Hfo_sCO3- Hfo_sHCO3
Hfo_sHPO4- Hfo_sH2BO3 Hfo_sH2PO4 Hfo_sOSi(OH)3
Hfo_sOSiO(OH)2- Hfo_sOHSO4-2 Hfo_sSO4-
Hao_SO4- Hao_OHSO4-2 Hao_H2BO3 Hao_H3BO4-
-equilibrium_phases Ferrihydrite Gibbsite Barite Calcite Dolomite(ordered) Gypsum
-saturation_indices Ferrihydrite Gibbsite Barite Calcite Dolomite(ordered) Gypsum

SOLUTION 1 #G401 (C - UA)
redox pe
units mg/l
density 1
pH 6.09
pe 3.185
temp 14.9
S(6) 2000 as SO4
B 4.07
Li 0.02185
As 0.000795
C(4) 70.7 as CO3
Cl 3.3
F 0.201
Ca 499.5
Mg 145.5
Na 71.2
K 2.53
Ba 0.0109
Si 15.6
P 0.011975
Mn 31.5
Fe 88.9
Al 0.00335
Sb 0.0002575
Be 0.0001975
Cd 0.000335
Cr 0.000875
Co 0.133
Pb 0.000205
Mo 0.000335
Se 0.000335
end

SOLUTION 2 #G402 (C - UA)
redox pe
units mg/l
density 1
```

```
pH 6.955
pe 5.335
temp 20.65
S(6) 590.5 as SO4
B 5.305
Li 0.0215
As 0.00375
C(4) 302 as CO3
Cl 3.2
F 0.2635
Ca 211
Mg 129
Na 44.95
K 1.135
Ba 0.0275
Si 13.95
P 0.024975
Mn 0.8635
Fe 0.004525
Al 0.007625
Sb 0.0002575
Be 0.0001975
Cd 0.000235
Cr 0.0034
Co 0.00295
Pb 0.00225
Mo 0.00235
Se 0.000335
end
SOLUTION 3 #G404 (C - UA)
redox pe
units mg/l
density 1
pH 6.765
pe 4.9
temp 18.35
S(6) 689 as SO4
B 11.85
Li 0.00785
As 0.0007225
C(4) 221.5 as CO3
Cl 106.5
F 0.1235
Ca 223
Mg 102.85
Na 79.8
K 0.5285
Ba 0.0305
Si 10.6
P 0.003225
Mn 2.025
Fe 0.0649
Al 0.003475
```

```
Sb 0.0006575
Be 0.0001975
Cd 0.000285
Cr 0.00175
Co 0.00177
Pb 0.000355
Mo 0.000735
Se 0.000335
end
SOLUTION 4 #G405 (C - UA)
redox pe
units mg/l
density 1
pH 6.965
pe 4.03
temp 18.95
S(6) 958 as SO4
B 10.15
Li 0.00425
As 0.000855
C(4) 169.5 as CO3
Cl 11.45
F 0.2905
Ca 251.5
Mg 110
Na 109.5
K 0.488
Ba 0.0144
Si 7.905
P 0.010475
Mn 1.085
Fe 0.1475
Al 0.005225
Sb 0.00101
Be 0.0001975
Cd 0.000235
Cr 0.000875
Co 0.000985
Pb 0.000465
Mo 0.001
Se 0.00075
end
SOLUTION 5 #G406 (C - UA)
redox pe
units mg/l
density 1
pH 6.63
pe 5.755
temp 19.05
S(6) 481 as SO4
B 1.47
Li 0.01095
As 0.0002725
```

```
C(4) 212 as CO3
Cl 3.2
F 0.267
Ca 191.5
Mg 65.35
Na 37.6
K 0.2065
Ba 0.01345
Si 12.95
P 0.008975
Mn 4.425
Fe 0.003055
Al 0.005175
Sb 0.0002575
Be 0.0001975
Cd 0.000235
Cr 0.000875
Co 0.00066
Pb 0.000205
Mo 0.000335
Se 0.000335
end

EQUILIBRIUM_PHASES 1 #G401 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.098
Ferrihydrite 0 0.0098
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 1
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 1
save surface 1
end

EQUILIBRIUM_PHASES 2 #G402 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.098
Ferrihydrite 0 0.0098
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 2
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 2
save surface 2
end

EQUILIBRIUM_PHASES 3 #G404 (C - UA) - 25p
Barite 0 0
```

```
Gypsum 0 0
Gibbsite 0 0.098
Ferrihydrite 0 0.0098
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 3
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 3
save surface 3
end

EQUILIBRIUM_PHASES 4 #G405 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.098
Ferrihydrite 0 0.0098
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 4
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 4
save surface 4
end

EQUILIBRIUM_PHASES 5 #G406 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.098
Ferrihydrite 0 0.0098
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 5
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 5
save surface 5
end

SOLUTION 6 #average background
redox pe
units mg/l
density 1
pH 6.805
pe 4.95
temp 15.45
S(6) 91
B 0.0046
Li 0.0027
As 0.000485
```

```
C(4) 209
Cl 70.5 charge
F 0.305
Ca 79.25
Mg 37.3
Na 81.15
K 0.5945
Ba 0.05855
Si 7.8
P 0.0083
Mn 0.118
Fe 0.012375
Al 0.013
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.00035
Pb 0.000405
Mo 0.0007
Se 0.000335

SAVE solution 6

end

#FIRST REACTION

#G401 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G401 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G402 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G402 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
```

```
SAVE surface 2
end

#G404 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G404 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G405 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#G405 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#G406 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end

#G406 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end
```

25th Percentile Metal Oxides/Charge Balance on Chloride

```
SELECTED_OUTPUT 1
-file COF_845_102_25p_cb-true_out.csv
-charge_balance true
-percent_error true
-totals S(6) B Li As C(4) Cl F Ca Mg Na K Ba Si P Mn Fe Al Sb Be Cd Cr Co Pb Mo Se Hfo_s
Hfo_w Hao_
-molalities Hfo_wOH Hfo_wOH2+ Hfo_wOHSO4-2 Hfo_wSO4- Hfo_wOSi(OH)3
Hfo_wOSiO(OH)2- Hfo_wHCO3 Hfo_wCO3- Hfo_wPO4-2
Hfo_wHPO4- Hfo_wH2PO4 Hfo_sCO3- Hfo_sHCO3
Hfo_sHPO4- Hfo_sH2BO3 Hfo_sH2PO4 Hfo_sOSi(OH)3
Hfo_sOSiO(OH)2- Hfo_sOHSO4-2 Hfo_sSO4-
Hao_SO4- Hao_OHSO4-2 Hao_H2BO3 Hao_H3BO4-
-equilibrium_phases Ferrihydrite Gibbsite Barite Calcite Dolomite(ordered) Gypsum
-saturation_indices Ferrihydrite Gibbsite Barite Calcite Dolomite(ordered) Gypsum

SOLUTION 1 #G401 (C - UA)
redox pe
units mg/l
density 1
pH 6.09
pe 3.185
temp 14.9
S(6) 2000 as SO4
B 4.07
Li 0.02185
As 0.000795
C(4) 70.7 as CO3
Cl 3.3 charge
F 0.201
Ca 499.5
Mg 145.5
Na 71.2
K 2.53
Ba 0.0109
Si 15.6
P 0.011975
Mn 31.5
Fe 88.9
Al 0.00335
Sb 0.0002575
Be 0.0001975
Cd 0.000335
Cr 0.000875
Co 0.133
Pb 0.000205
Mo 0.000335
Se 0.000335
end

SOLUTION 2 #G402 (C - UA)
redox pe
units mg/l
density 1
```

```
pH 6.955
pe 5.335
temp 20.65
S(6) 590.5 as SO4
B 5.305
Li 0.0215
As 0.00375
C(4) 302 as CO3
Cl 3.2 charge
F 0.2635
Ca 211
Mg 129
Na 44.95
K 1.135
Ba 0.0275
Si 13.95
P 0.024975
Mn 0.8635
Fe 0.004525
Al 0.007625
Sb 0.0002575
Be 0.0001975
Cd 0.000235
Cr 0.0034
Co 0.00295
Pb 0.00225
Mo 0.00235
Se 0.000335
end
SOLUTION 3 #G404 (C - UA)
redox pe
units mg/l
density 1
pH 6.765
pe 4.9
temp 18.35
S(6) 689 as SO4
B 11.85
Li 0.00785
As 0.0007225
C(4) 221.5 as CO3
Cl 106.5 charge
F 0.1235
Ca 223
Mg 102.85
Na 79.8
K 0.5285
Ba 0.0305
Si 10.6
P 0.003225
Mn 2.025
Fe 0.0649
Al 0.003475
```

```
Sb 0.0006575
Be 0.0001975
Cd 0.000285
Cr 0.00175
Co 0.00177
Pb 0.000355
Mo 0.000735
Se 0.000335
end
SOLUTION 4 #G405 (C - UA)
redox pe
units mg/l
density 1
pH 6.965
pe 4.03
temp 18.95
S(6) 958 as SO4
B 10.15
Li 0.00425
As 0.000855
C(4) 169.5 as CO3
Cl 11.45 charge
F 0.2905
Ca 251.5
Mg 110
Na 109.5
K 0.488
Ba 0.0144
Si 7.905
P 0.010475
Mn 1.085
Fe 0.1475
Al 0.005225
Sb 0.00101
Be 0.0001975
Cd 0.000235
Cr 0.000875
Co 0.000985
Pb 0.000465
Mo 0.001
Se 0.00075
end
SOLUTION 5 #G406 (C - UA)
redox pe
units mg/l
density 1
pH 6.63
pe 5.755
temp 19.05
S(6) 481 as SO4
B 1.47
Li 0.01095
As 0.0002725
```

```
C(4) 212 as CO3
Cl 3.2 charge
F 0.267
Ca 191.5
Mg 65.35
Na 37.6
K 0.2065
Ba 0.01345
Si 12.95
P 0.008975
Mn 4.425
Fe 0.003055
Al 0.005175
Sb 0.0002575
Be 0.0001975
Cd 0.000235
Cr 0.000875
Co 0.00066
Pb 0.000205
Mo 0.000335
Se 0.000335
end

EQUILIBRIUM_PHASES 1 #G401 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.098
Ferrihydrite 0 0.0098
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 1
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 1
save surface 1
end

EQUILIBRIUM_PHASES 2 #G402 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.098
Ferrihydrite 0 0.0098
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 2
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 2
save surface 2
end

EQUILIBRIUM_PHASES 3 #G404 (C - UA) - 25p
Barite 0 0
```

```
Gypsum 0 0
Gibbsite 0 0.098
Ferrihydrite 0 0.0098
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 3
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 3
save surface 3
end

EQUILIBRIUM_PHASES 4 #G405 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.098
Ferrihydrite 0 0.0098
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 4
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 4
save surface 4
end

EQUILIBRIUM_PHASES 5 #G406 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.098
Ferrihydrite 0 0.0098
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 5
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 5
save surface 5
end

SOLUTION 6 #average background
redox pe
units mg/l
density 1
pH 6.805
pe 4.95
temp 15.45
S(6) 91
B 0.0046
Li 0.0027
As 0.000485
```

```
C(4) 209
Cl 70.5 charge
F 0.305
Ca 79.25
Mg 37.3
Na 81.15
K 0.5945
Ba 0.05855
Si 7.8
P 0.0083
Mn 0.118
Fe 0.012375
Al 0.013
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.00035
Pb 0.000405
Mo 0.0007
Se 0.000335

SAVE solution 6

end

#FIRST REACTION

#G401 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G401 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G402 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G402 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
```

```
SAVE surface 2
end

#G404 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G404 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G405 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#G405 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#G406 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end

#G406 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end
```

75th Percentile Metal Oxides/No Charge Balance

```
SELECTED_OUTPUT 1
-file COF_845_102_75p_cb-false_out.csv
-charge_balance true
-percent_error true
-totals S(6) B Li As C(4) Cl F Ca Mg Na K Ba Si P Mn Fe Al Sb Be Cd Cr Co Pb Mo Se Hfo_s
Hfo_w Hao_
-molalities Hfo_wOH Hfo_wOH2+ Hfo_wOHSO4-2 Hfo_wSO4- Hfo_wOSi(OH)3
Hfo_wOSiO(OH)2- Hfo_wHCO3 Hfo_wCO3- Hfo_wPO4-2
Hfo_wHPO4- Hfo_wH2PO4 Hfo_sCO3- Hfo_sHCO3
Hfo_sHPO4- Hfo_sH2BO3 Hfo_sH2PO4 Hfo_sOSi(OH)3
Hfo_sOSiO(OH)2- Hfo_sOHSO4-2 Hfo_sSO4-
Hao_SO4- Hao_OHSO4-2 Hao_H2BO3 Hao_H3BO4-
-equilibrium_phases Ferrihydrite Gibbsite Barite Calcite Dolomite(ordered) Gypsum
-saturation_indices Ferrihydrite Gibbsite Barite Calcite Dolomite(ordered) Gypsum

SOLUTION 1 #G401 (C - UA)
redox pe
units mg/l
density 1
pH 6.09
pe 3.185
temp 14.9
S(6) 2000 as SO4
B 4.07
Li 0.02185
As 0.000795
C(4) 70.7 as CO3
Cl 3.3
F 0.201
Ca 499.5
Mg 145.5
Na 71.2
K 2.53
Ba 0.0109
Si 15.6
P 0.011975
Mn 31.5
Fe 88.9
Al 0.00335
Sb 0.0002575
Be 0.0001975
Cd 0.000335
Cr 0.000875
Co 0.133
Pb 0.000205
Mo 0.000335
Se 0.000335
end

SOLUTION 2 #G402 (C - UA)
redox pe
units mg/l
density 1
```

```
pH 6.955
pe 5.335
temp 20.65
S(6) 590.5 as SO4
B 5.305
Li 0.0215
As 0.00375
C(4) 302 as CO3
Cl 3.2
F 0.2635
Ca 211
Mg 129
Na 44.95
K 1.135
Ba 0.0275
Si 13.95
P 0.024975
Mn 0.8635
Fe 0.004525
Al 0.007625
Sb 0.0002575
Be 0.0001975
Cd 0.000235
Cr 0.0034
Co 0.00295
Pb 0.00225
Mo 0.00235
Se 0.000335
end
SOLUTION 3 #G404 (C - UA)
redox pe
units mg/l
density 1
pH 6.765
pe 4.9
temp 18.35
S(6) 689 as SO4
B 11.85
Li 0.00785
As 0.0007225
C(4) 221.5 as CO3
Cl 106.5
F 0.1235
Ca 223
Mg 102.85
Na 79.8
K 0.5285
Ba 0.0305
Si 10.6
P 0.003225
Mn 2.025
Fe 0.0649
Al 0.003475
```

```
Sb 0.0006575
Be 0.0001975
Cd 0.000285
Cr 0.00175
Co 0.00177
Pb 0.000355
Mo 0.000735
Se 0.000335
end
SOLUTION 4 #G405 (C - UA)
redox pe
units mg/l
density 1
pH 6.965
pe 4.03
temp 18.95
S(6) 958 as SO4
B 10.15
Li 0.00425
As 0.000855
C(4) 169.5 as CO3
Cl 11.45
F 0.2905
Ca 251.5
Mg 110
Na 109.5
K 0.488
Ba 0.0144
Si 7.905
P 0.010475
Mn 1.085
Fe 0.1475
Al 0.005225
Sb 0.00101
Be 0.0001975
Cd 0.000235
Cr 0.000875
Co 0.000985
Pb 0.000465
Mo 0.001
Se 0.00075
end
SOLUTION 5 #G406 (C - UA)
redox pe
units mg/l
density 1
pH 6.63
pe 5.755
temp 19.05
S(6) 481 as SO4
B 1.47
Li 0.01095
As 0.0002725
```

```
C(4) 212 as CO3
Cl 3.2
F 0.267
Ca 191.5
Mg 65.35
Na 37.6
K 0.2065
Ba 0.01345
Si 12.95
P 0.008975
Mn 4.425
Fe 0.003055
Al 0.005175
Sb 0.0002575
Be 0.0001975
Cd 0.000235
Cr 0.000875
Co 0.00066
Pb 0.000205
Mo 0.000335
Se 0.000335
end

EQUILIBRIUM_PHASES 1 #G401 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.12
Ferrihydrite 0 0.015
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 1
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 1
save surface 1
end

EQUILIBRIUM_PHASES 2 #G402 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.12
Ferrihydrite 0 0.015
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 2
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 2
save surface 2
end

EQUILIBRIUM_PHASES 3 #G404 (C - UA) - 75p
Barite 0 0
```

```
Gypsum 0 0
Gibbsite 0 0.12
Ferrihydrite 0 0.015
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 3
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 3
save surface 3
end

EQUILIBRIUM_PHASES 4 #G405 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.12
Ferrihydrite 0 0.015
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 4
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 4
save surface 4
end

EQUILIBRIUM_PHASES 5 #G406 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.12
Ferrihydrite 0 0.015
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 5
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 5
save surface 5
end

SOLUTION 6 #average background
redox pe
units mg/l
density 1
pH 6.805
pe 4.95
temp 15.45
S(6) 91
B 0.0046
Li 0.0027
As 0.000485
```

```
C(4) 209
Cl 70.5 charge
F 0.305
Ca 79.25
Mg 37.3
Na 81.15
K 0.5945
Ba 0.05855
Si 7.8
P 0.0083
Mn 0.118
Fe 0.012375
Al 0.013
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.00035
Pb 0.000405
Mo 0.0007
Se 0.000335

SAVE solution 6

end

#FIRST REACTION

#G401 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G401 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G402 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G402 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
```

```
SAVE surface 2
end

#G404 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G404 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G405 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#G405 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#G406 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end

#G406 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end
```

75th Percentile Metal Oxides/Charge Balance on Chloride

```
SELECTED_OUTPUT 1
-file COF_845_102_75p_cb-true_out.csv
-charge_balance true
-percent_error true
-totals S(6) B Li As C(4) Cl F Ca Mg Na K Ba Si P Mn Fe Al Sb Be Cd Cr Co Pb Mo Se Hfo_s
Hfo_w Hao_
-molalities Hfo_wOH Hfo_wOH2+ Hfo_wOHSO4-2 Hfo_wSO4- Hfo_wOSi(OH)3
Hfo_wOSiO(OH)2- Hfo_wHCO3 Hfo_wCO3- Hfo_wPO4-2
Hfo_wHPO4- Hfo_wH2PO4 Hfo_sCO3- Hfo_sHCO3
Hfo_sHPO4- Hfo_sH2BO3 Hfo_sH2PO4 Hfo_sOSi(OH)3
Hfo_sOSiO(OH)2- Hfo_sOHSO4-2 Hfo_sSO4-
Hao_SO4- Hao_OHSO4-2 Hao_H2BO3 Hao_H3BO4-
-equilibrium_phases Ferrihydrite Gibbsite Barite Calcite Dolomite(ordered) Gypsum
-saturation_indices Ferrihydrite Gibbsite Barite Calcite Dolomite(ordered) Gypsum

SOLUTION 1 #G401 (C - UA)
redox pe
units mg/l
density 1
pH 6.09
pe 3.185
temp 14.9
S(6) 2000 as SO4
B 4.07
Li 0.02185
As 0.000795
C(4) 70.7 as CO3
Cl 3.3 charge
F 0.201
Ca 499.5
Mg 145.5
Na 71.2
K 2.53
Ba 0.0109
Si 15.6
P 0.011975
Mn 31.5
Fe 88.9
Al 0.00335
Sb 0.0002575
Be 0.0001975
Cd 0.000335
Cr 0.000875
Co 0.133
Pb 0.000205
Mo 0.000335
Se 0.000335
end

SOLUTION 2 #G402 (C - UA)
redox pe
units mg/l
density 1
```

```
pH 6.955
pe 5.335
temp 20.65
S(6) 590.5 as SO4
B 5.305
Li 0.0215
As 0.00375
C(4) 302 as CO3
Cl 3.2 charge
F 0.2635
Ca 211
Mg 129
Na 44.95
K 1.135
Ba 0.0275
Si 13.95
P 0.024975
Mn 0.8635
Fe 0.004525
Al 0.007625
Sb 0.0002575
Be 0.0001975
Cd 0.000235
Cr 0.0034
Co 0.00295
Pb 0.00225
Mo 0.00235
Se 0.000335
end
SOLUTION 3 #G404 (C - UA)
redox pe
units mg/l
density 1
pH 6.765
pe 4.9
temp 18.35
S(6) 689 as SO4
B 11.85
Li 0.00785
As 0.0007225
C(4) 221.5 as CO3
Cl 106.5 charge
F 0.1235
Ca 223
Mg 102.85
Na 79.8
K 0.5285
Ba 0.0305
Si 10.6
P 0.003225
Mn 2.025
Fe 0.0649
Al 0.003475
```

```
Sb 0.0006575
Be 0.0001975
Cd 0.000285
Cr 0.00175
Co 0.00177
Pb 0.000355
Mo 0.000735
Se 0.000335
end
SOLUTION 4 #G405 (C - UA)
redox pe
units mg/l
density 1
pH 6.965
pe 4.03
temp 18.95
S(6) 958 as SO4
B 10.15
Li 0.00425
As 0.000855
C(4) 169.5 as CO3
Cl 11.45 charge
F 0.2905
Ca 251.5
Mg 110
Na 109.5
K 0.488
Ba 0.0144
Si 7.905
P 0.010475
Mn 1.085
Fe 0.1475
Al 0.005225
Sb 0.00101
Be 0.0001975
Cd 0.000235
Cr 0.000875
Co 0.000985
Pb 0.000465
Mo 0.001
Se 0.00075
end
SOLUTION 5 #G406 (C - UA)
redox pe
units mg/l
density 1
pH 6.63
pe 5.755
temp 19.05
S(6) 481 as SO4
B 1.47
Li 0.01095
As 0.0002725
```

```
C(4) 212 as CO3
Cl 3.2 charge
F 0.267
Ca 191.5
Mg 65.35
Na 37.6
K 0.2065
Ba 0.01345
Si 12.95
P 0.008975
Mn 4.425
Fe 0.003055
Al 0.005175
Sb 0.0002575
Be 0.0001975
Cd 0.000235
Cr 0.000875
Co 0.00066
Pb 0.000205
Mo 0.000335
Se 0.000335
end

EQUILIBRIUM_PHASES 1 #G401 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.12
Ferrihydrite 0 0.015
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 1
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 1
save surface 1
end

EQUILIBRIUM_PHASES 2 #G402 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.12
Ferrihydrite 0 0.015
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 2
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 2
save surface 2
end

EQUILIBRIUM_PHASES 3 #G404 (C - UA) - 75p
Barite 0 0
```

```
Gypsum 0 0
Gibbsite 0 0.12
Ferrihydrite 0 0.015
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 3
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 3
save surface 3
end

EQUILIBRIUM_PHASES 4 #G405 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.12
Ferrihydrite 0 0.015
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 4
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 4
save surface 4
end

EQUILIBRIUM_PHASES 5 #G406 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.12
Ferrihydrite 0 0.015
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 5
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 5
save surface 5
end

SOLUTION 6 #average background
redox pe
units mg/l
density 1
pH 6.805
pe 4.95
temp 15.45
S(6) 91
B 0.0046
Li 0.0027
As 0.000485
```

```
C(4) 209
Cl 70.5 charge
F 0.305
Ca 79.25
Mg 37.3
Na 81.15
K 0.5945
Ba 0.05855
Si 7.8
P 0.0083
Mn 0.118
Fe 0.012375
Al 0.013
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.00035
Pb 0.000405
Mo 0.0007
Se 0.000335

SAVE solution 6

end

#FIRST REACTION

#G401 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G401 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G402 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G402 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
```

```
SAVE surface 2
end

#G404 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G404 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G405 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#G405 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#G406 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end

#G406 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end
```

Median Metal Oxides/No Charge Balance

```
SELECTED_OUTPUT 1
-file COF_845_102_median_cb-false_out.csv
-charge_balance true
-percent_error true
-totals S(6) B Li As C(4) Cl F Ca Mg Na K Ba Si P Mn Fe Al Sb Be Cd Cr Co Pb Mo Se Hfo_s
Hfo_w Hao_
-molalities Hfo_wOH Hfo_wOH2+ Hfo_wOHSO4-2 Hfo_wSO4- Hfo_wOSi(OH)3
Hfo_wOSiO(OH)2- Hfo_wHCO3 Hfo_wCO3- Hfo_wPO4-2
Hfo_wHPO4- Hfo_wH2PO4 Hfo_sCO3- Hfo_sHCO3
Hfo_sHPO4- Hfo_sH2BO3 Hfo_sH2PO4 Hfo_sOSi(OH)3
Hfo_sOSiO(OH)2- Hfo_sOHSO4-2 Hfo_sSO4-
Hao_SO4- Hao_OHSO4-2 Hao_H2BO3 Hao_H3BO4-
-equilibrium_phases Ferrihydrite Gibbsite Barite Calcite Dolomite(ordered) Gypsum
-saturation_indices Ferrihydrite Gibbsite Barite Calcite Dolomite(ordered) Gypsum

SOLUTION 1 #G401 (C - UA)
redox pe
units mg/l
density 1
pH 6.09
pe 3.185
temp 14.9
S(6) 2000 as SO4
B 4.07
Li 0.02185
As 0.000795
C(4) 70.7 as CO3
Cl 3.3
F 0.201
Ca 499.5
Mg 145.5
Na 71.2
K 2.53
Ba 0.0109
Si 15.6
P 0.011975
Mn 31.5
Fe 88.9
Al 0.00335
Sb 0.0002575
Be 0.0001975
Cd 0.000335
Cr 0.000875
Co 0.133
Pb 0.000205
Mo 0.000335
Se 0.000335
end

SOLUTION 2 #G402 (C - UA)
redox pe
units mg/l
density 1
```

```
pH 6.955
pe 5.335
temp 20.65
S(6) 590.5 as SO4
B 5.305
Li 0.0215
As 0.00375
C(4) 302 as CO3
Cl 3.2
F 0.2635
Ca 211
Mg 129
Na 44.95
K 1.135
Ba 0.0275
Si 13.95
P 0.024975
Mn 0.8635
Fe 0.004525
Al 0.007625
Sb 0.0002575
Be 0.0001975
Cd 0.000235
Cr 0.0034
Co 0.00295
Pb 0.00225
Mo 0.00235
Se 0.000335
end

SOLUTION 3 #G404 (C - UA)
redox pe
units mg/l
density 1
pH 6.765
pe 4.9
temp 18.35
S(6) 689 as SO4
B 11.85
Li 0.00785
As 0.0007225
C(4) 221.5 as CO3
Cl 106.5
F 0.1235
Ca 223
Mg 102.85
Na 79.8
K 0.5285
Ba 0.0305
Si 10.6
P 0.003225
Mn 2.025
Fe 0.0649
Al 0.003475
```

```
Sb 0.0006575
Be 0.0001975
Cd 0.000285
Cr 0.00175
Co 0.00177
Pb 0.000355
Mo 0.000735
Se 0.000335
end
SOLUTION 4 #G405 (C - UA)
redox pe
units mg/l
density 1
pH 6.965
pe 4.03
temp 18.95
S(6) 958 as SO4
B 10.15
Li 0.00425
As 0.000855
C(4) 169.5 as CO3
Cl 11.45
F 0.2905
Ca 251.5
Mg 110
Na 109.5
K 0.488
Ba 0.0144
Si 7.905
P 0.010475
Mn 1.085
Fe 0.1475
Al 0.005225
Sb 0.00101
Be 0.0001975
Cd 0.000235
Cr 0.000875
Co 0.000985
Pb 0.000465
Mo 0.001
Se 0.00075
end
SOLUTION 5 #G406 (C - UA)
redox pe
units mg/l
density 1
pH 6.63
pe 5.755
temp 19.05
S(6) 481 as SO4
B 1.47
Li 0.01095
As 0.0002725
```

```
C(4) 212 as CO3
Cl 3.2
F 0.267
Ca 191.5
Mg 65.35
Na 37.6
K 0.2065
Ba 0.01345
Si 12.95
P 0.008975
Mn 4.425
Fe 0.003055
Al 0.005175
Sb 0.0002575
Be 0.0001975
Cd 0.000235
Cr 0.000875
Co 0.00066
Pb 0.000205
Mo 0.000335
Se 0.000335
end

EQUILIBRIUM_PHASES 1 #G401 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.11
Ferrihydrite 0 0.014
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 1
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 1
save surface 1
end

EQUILIBRIUM_PHASES 2 #G402 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.11
Ferrihydrite 0 0.014
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 2
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 2
save surface 2
end

EQUILIBRIUM_PHASES 3 #G404 (C - UA) - median
Barite 0 0
```

```
Gypsum 0 0
Gibbsite 0 0.11
Ferrihydrite 0 0.014
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 3
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 3
save surface 3
end

EQUILIBRIUM_PHASES 4 #G405 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.11
Ferrihydrite 0 0.014
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 4
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 4
save surface 4
end

EQUILIBRIUM_PHASES 5 #G406 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.11
Ferrihydrite 0 0.014
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 5
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 5
save surface 5
end

SOLUTION 6 #average background
redox pe
units mg/l
density 1
pH 6.805
pe 4.95
temp 15.45
S(6) 91
B 0.0046
Li 0.0027
As 0.000485
```

```
C(4) 209
Cl 70.5 charge
F 0.305
Ca 79.25
Mg 37.3
Na 81.15
K 0.5945
Ba 0.05855
Si 7.8
P 0.0083
Mn 0.118
Fe 0.012375
Al 0.013
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.00035
Pb 0.000405
Mo 0.0007
Se 0.000335

SAVE solution 6

end

#FIRST REACTION

#G401 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G401 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G402 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G402 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
```

```
SAVE surface 2
end

#G404 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G404 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G405 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#G405 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#G406 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end

#G406 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end
```

Median Metal Oxides/Charge Balance on Chloride

```
SELECTED_OUTPUT 1
-file COF_845_102_median_cb-true_out.csv
-charge_balance true
-percent_error true
-totals S(6) B Li As C(4) Cl F Ca Mg Na K Ba Si P Mn Fe Al Sb Be Cd Cr Co Pb Mo Se Hfo_s
Hfo_w Hao_
-molalities Hfo_wOH Hfo_wOH2+ Hfo_wOHSO4-2 Hfo_wSO4- Hfo_wOSi(OH)3
Hfo_wOSiO(OH)2- Hfo_wHCO3 Hfo_wCO3- Hfo_wPO4-2
Hfo_wHPO4- Hfo_wH2PO4 Hfo_sCO3- Hfo_sHCO3
Hfo_sHPO4- Hfo_sH2BO3 Hfo_sH2PO4 Hfo_sOSi(OH)3
Hfo_sOSiO(OH)2- Hfo_sOHSO4-2 Hfo_sSO4-
Hao_SO4- Hao_OHSO4-2 Hao_H2BO3 Hao_H3BO4-
-equilibrium_phases Ferrihydrite Gibbsite Barite Calcite Dolomite(ordered) Gypsum
-saturation_indices Ferrihydrite Gibbsite Barite Calcite Dolomite(ordered) Gypsum

SOLUTION 1 #G401 (C - UA)
redox pe
units mg/l
density 1
pH 6.09
pe 3.185
temp 14.9
S(6) 2000 as SO4
B 4.07
Li 0.02185
As 0.000795
C(4) 70.7 as CO3
Cl 3.3 charge
F 0.201
Ca 499.5
Mg 145.5
Na 71.2
K 2.53
Ba 0.0109
Si 15.6
P 0.011975
Mn 31.5
Fe 88.9
Al 0.00335
Sb 0.0002575
Be 0.0001975
Cd 0.000335
Cr 0.000875
Co 0.133
Pb 0.000205
Mo 0.000335
Se 0.000335
end

SOLUTION 2 #G402 (C - UA)
redox pe
units mg/l
density 1
```

```
pH 6.955
pe 5.335
temp 20.65
S(6) 590.5 as SO4
B 5.305
Li 0.0215
As 0.00375
C(4) 302 as CO3
Cl 3.2 charge
F 0.2635
Ca 211
Mg 129
Na 44.95
K 1.135
Ba 0.0275
Si 13.95
P 0.024975
Mn 0.8635
Fe 0.004525
Al 0.007625
Sb 0.0002575
Be 0.0001975
Cd 0.000235
Cr 0.0034
Co 0.00295
Pb 0.00225
Mo 0.00235
Se 0.000335
end
SOLUTION 3 #G404 (C - UA)
redox pe
units mg/l
density 1
pH 6.765
pe 4.9
temp 18.35
S(6) 689 as SO4
B 11.85
Li 0.00785
As 0.0007225
C(4) 221.5 as CO3
Cl 106.5 charge
F 0.1235
Ca 223
Mg 102.85
Na 79.8
K 0.5285
Ba 0.0305
Si 10.6
P 0.003225
Mn 2.025
Fe 0.0649
Al 0.003475
```

```
Sb 0.0006575
Be 0.0001975
Cd 0.000285
Cr 0.00175
Co 0.00177
Pb 0.000355
Mo 0.000735
Se 0.000335
end
SOLUTION 4 #G405 (C - UA)
redox pe
units mg/l
density 1
pH 6.965
pe 4.03
temp 18.95
S(6) 958 as SO4
B 10.15
Li 0.00425
As 0.000855
C(4) 169.5 as CO3
Cl 11.45 charge
F 0.2905
Ca 251.5
Mg 110
Na 109.5
K 0.488
Ba 0.0144
Si 7.905
P 0.010475
Mn 1.085
Fe 0.1475
Al 0.005225
Sb 0.00101
Be 0.0001975
Cd 0.000235
Cr 0.000875
Co 0.000985
Pb 0.000465
Mo 0.001
Se 0.00075
end
SOLUTION 5 #G406 (C - UA)
redox pe
units mg/l
density 1
pH 6.63
pe 5.755
temp 19.05
S(6) 481 as SO4
B 1.47
Li 0.01095
As 0.0002725
```

```
C(4) 212 as CO3
Cl 3.2 charge
F 0.267
Ca 191.5
Mg 65.35
Na 37.6
K 0.2065
Ba 0.01345
Si 12.95
P 0.008975
Mn 4.425
Fe 0.003055
Al 0.005175
Sb 0.0002575
Be 0.0001975
Cd 0.000235
Cr 0.000875
Co 0.00066
Pb 0.000205
Mo 0.000335
Se 0.000335
end

EQUILIBRIUM_PHASES 1 #G401 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.11
Ferrihydrite 0 0.014
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 1
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 1
save surface 1
end

EQUILIBRIUM_PHASES 2 #G402 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.11
Ferrihydrite 0 0.014
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 2
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 2
save surface 2
end

EQUILIBRIUM_PHASES 3 #G404 (C - UA) - median
Barite 0 0
```

```
Gypsum 0 0
Gibbsite 0 0.11
Ferrihydrite 0 0.014
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 3
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 3
save surface 3
end

EQUILIBRIUM_PHASES 4 #G405 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.11
Ferrihydrite 0 0.014
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 4
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 4
save surface 4
end

EQUILIBRIUM_PHASES 5 #G406 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.11
Ferrihydrite 0 0.014
Calcite 0 1
Dolomite(ordered) 0 2

SURFACE 5
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 5
save surface 5
end

SOLUTION 6 #average background
redox pe
units mg/l
density 1
pH 6.805
pe 4.95
temp 15.45
S(6) 91
B 0.0046
Li 0.0027
As 0.000485
```

```
C(4) 209
Cl 70.5 charge
F 0.305
Ca 79.25
Mg 37.3
Na 81.15
K 0.5945
Ba 0.05855
Si 7.8
P 0.0083
Mn 0.118
Fe 0.012375
Al 0.013
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.00035
Pb 0.000405
Mo 0.0007
Se 0.000335

SAVE solution 6

end

#FIRST REACTION

#G401 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G401 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G402 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G402 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
```

```
SAVE surface 2
end

#G404 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G404 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G405 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#G405 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#G406 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end

#G406 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end
```

Database

```
#$Id: minteq.v4.dat 12387 2017-02-09 16:41:47Z dlpark $
SOLUTION_MASTER_SPECIES
Alkalinity CO3-2 2.0 HCO3 61.0173
E e- 0 0 0
O H2O 0 O 16.00
O(-2) H2O 0 O
O(0) O2 0 O
Ag Ag+ 0.0 Ag 107.868
Al Al+3 0.0 Al 26.9815
As H3AsO4 -1.0 As 74.9216
As(3) H3AsO3 0.0 As
As(5) H3AsO4 -1.0 As
B H3BO3 0.0 B 10.81
Ba Ba+2 0.0 Ba 137.33
Be Be+2 0.0 Be 9.0122
Br Br- 0.0 Br 79.904
C CO3-2 2.0 CO3 12.0111
C(4) CO3-2 2.0 CO3 12.0111
Cyanide Cyanide- 1.0 Cyanide 26.0177
Dom_a Dom_a 0.0 C 12.0111
Dom_b Dom_b 0.0 C 12.0111
Dom_c Dom_c 0.0 C 12.0111
Ca Ca+2 0.0 Ca 40.078
Cd Cd+2 0.0 Cd 112.41
Cl Cl- 0.0 Cl 35.453
Co Co+3 -1.0 Co 58.9332
Co(2) Co+2 0.0 Co
Co(3) Co+3 -1.0 Co
Cr CrO4-2 1.0 Cr 51.996
Cr(2) Cr+2 0.0 Cr
Cr(3) Cr(OH)2+ 0.0 Cr
Cr(6) CrO4-2 1.0 Cr
Cu Cu+2 0.0 Cu 63.546
Cu(1) Cu+ 0.0 Cu
Cu(2) Cu+2 0.0 Cu
F F- 0.0 F 18.9984
Fe Fe+3 -2.0 Fe 55.847
Fe(2) Fe+2 0.0 Fe
Fe(3) Fe+3 -2.0 Fe
H H+ -1.0 H 1.0079
H(0) H2 0 H
H(1) H+ -1.0 H
Hg Hg(OH)2 0.0 Hg 200.59
Hg(0) Hg 0.0 Hg
Hg(1) Hg2+2 0.0 Hg
Hg(2) Hg(OH)2 0.0 Hg
I I- 0.0 I 126.904
K K+ 0.0 K 39.0983
Li Li+ 0.0 Li 6.941
Mg Mg+2 0.0 Mg 24.305
Mn Mn+3 0.0 Mn 54.938
```

Mn(2) Mn+2 0.0 Mn
Mn(3) Mn+3 0.0 Mn
Mn(6) MnO4-2 0.0 Mn
Mn(7) MnO4- 0.0 Mn
Mo MoO4-2 0.0 Mo 95.94
N NO3- 0.0 N 14.0067
N(-3) NH4+ 0.0 N
N(3) NO2- 0.0 N
N(5) NO3- 0.0 N
Na Na+ 0.0 Na 22.9898
Ni Ni+2 0.0 Ni 58.69
P PO4-3 2.0 P 30.9738
Pb Pb+2 0.0 Pb 207.2
S SO4-2 0.0 SO4 32.066
S(-2) HS- 1.0 S
#S(0) S 0.0 S
S(6) SO4-2 0.0 SO4
Sb Sb(OH)6- 0.0 Sb 121.75
Sb(3) Sb(OH)3 0.0 Sb
Sb(5) Sb(OH)6- 0.0 Sb
Se SeO4-2 0.0 Se 78.96
Se(-2) HSe- 0.0 Se
Se(4) HSeO3- 0.0 Se
Se(6) SeO4-2 0.0 Se
Si H4SiO4 0.0 SiO2 28.0843
Sn Sn(OH)6-2 0.0 Sn 118.71
Sn(2) Sn(OH)2 0.0 Sn
Sn(4) Sn(OH)6-2 0.0 Sn
Sr Sr+2 0.0 Sr 87.62
Tl Tl(OH)3 0.0 Tl 204.383
Tl(1) Tl+ 0.0 Tl
Tl(3) Tl(OH)3 0.0 Tl
U UO2+2 0.0 U 238.029
U(3) U+3 0.0 U
U(4) U+4 -4.0 U
U(5) UO2+ 0.0 U
U(6) UO2+2 0.0 U
V VO2+ -2.0 V 50.94
V(2) V+2 0.0 V
V(3) V+3 -3.0 V
V(4) VO+2 0.0 V
V(5) VO2+ -2.0 V
Zn Zn+2 0.0 Zn 65.39
Benzoate Benzoate- 0.0 121.116 121.116
Phenylacetate Phenylacetate- 0.0 135.142 135.142
Isophthalate Isophthalate-2 0.0 164.117 164.117
Diethylamine Diethylamine 1.0 73.138 73.138
Butylamine Butylamine 1.0 73.138 73.138
Methylamine Methylamine 1.0 31.057 31.057
Dimethylamine Dimethylamine 1.0 45.084 45.084
Hexylamine Hexylamine 1.0 101.192 101.192
Ethylenediamine Ethylenediamine 2.0 60.099 60.099
Propylamine Propylamine 1.0 59.111 59.111
Isopropylamine Isopropylamine 1.0 59.111 59.111

```
Trimethylamine Trimethylamine 1.0 59.111 59.111
Citrate Citrate-3 2.0 189.102 189.102
Nta Nta-3 1.0 188.117 188.117
Edta Edta-4 2.0 288.214 288.214
Propionate Propionate- 1.0 73.072 73.072
Butyrate Butyrate- 1.0 87.098 87.098
Isobutyrate Isobutyrate- 1.0 87.098 87.098
Two_picoline Two_picoline 1.0 93.128 93.128
Three_picoline Three_picoline 1.0 93.128 93.128
Four_picoline Four_picoline 1.0 93.128 93.128
Formate Formate- 0.0 45.018 45.018
Isovalerate Isovalerate- 1.0 101.125 101.125
Valerate Valerate- 1.0 101.125 101.125
Acetate Acetate- 1.0 59.045 59.045
Tartarate Tartarate-2 0.0 148.072 148.072
Glycine Glycine- 1.0 74.059 74.059
Salicylate Salicylate-2 1.0 136.107 136.107
Glutamate Glutamate-2 1.0 145.115 145.115
Phthalate Phthalate-2 1.0 164.117 164.117
SOLUTION_SPECIES
e- = e-
log_k 0
H2O = H2O
log_k 0
Ag+ = Ag+
log_k 0
Al+3 = Al+3
log_k 0
H3AsO4 = H3AsO4
log_k 0
H3BO3 = H3BO3
log_k 0
Ba+2 = Ba+2
log_k 0
Be+2 = Be+2
log_k 0
Br- = Br-
log_k 0
CO3-2 = CO3-2
log_k 0
Cyanide- = Cyanide-
log_k 0
Dom_a = Dom_a
log_k 0
Dom_b = Dom_b
log_k 0
Dom_c = Dom_c
log_k 0
Ca+2 = Ca+2
log_k 0
Cd+2 = Cd+2
log_k 0
Cl- = Cl-
log_k 0
```

Co+3 = Co+3
log_k 0
CrO4-2 = CrO4-2
log_k 0
Cu+2 = Cu+2
log_k 0
F- = F-
log_k 0
Fe+3 = Fe+3
log_k 0
H+ = H+
log_k 0
Hg(OH)2 = Hg(OH)2
log_k 0
I- = I-
log_k 0
K+ = K+
log_k 0
Li+ = Li+
log_k 0
Mg+2 = Mg+2
log_k 0
Mn+3 = Mn+3
log_k 0
MoO4-2 = MoO4-2
log_k 0
NO3- = NO3-
log_k 0
Na+ = Na+
log_k 0
Ni+2 = Ni+2
log_k 0
PO4-3 = PO4-3
log_k 0
Pb+2 = Pb+2
log_k 0
SO4-2 = SO4-2
log_k 0
Sb(OH)6- = Sb(OH)6-
log_k 0
SeO4-2 = SeO4-2
log_k 0
H4SiO4 = H4SiO4
log_k 0
Sn(OH)6-2 = Sn(OH)6-2
log_k 0
Sr+2 = Sr+2
log_k 0
Tl(OH)3 = Tl(OH)3
log_k 0
UO2+2 = UO2+2
log_k 0
VO2+ = VO2+
log_k 0

Benzoate- = Benzoate-
log_k 0
Phenylacetate- = Phenylacetate-
log_k 0
Isophthalate-2 = Isophthalate-2
log_k 0
Zn+2 = Zn+2
log_k 0
Diethylamine = Diethylamine
log_k 0
Butylamine = Butylamine
log_k 0
Methylamine = Methylamine
log_k 0
Dimethylamine = Dimethylamine
log_k 0
Hexylamine = Hexylamine
log_k 0
Ethylenediamine = Ethylenediamine
log_k 0
Propylamine = Propylamine
log_k 0
Isopropylamine = Isopropylamine
log_k 0
Trimethylamine = Trimethylamine
log_k 0
Citrate-3 = Citrate-3
log_k 0
Nta-3 = Nta-3
log_k 0
Edta-4 = Edta-4
log_k 0
Propionate- = Propionate-
log_k 0
Butyrate- = Butyrate-
log_k 0
Isobutyrate- = Isobutyrate-
log_k 0
Two_picoline = Two_picoline
log_k 0
Three_picoline = Three_picoline
log_k 0
Four_picoline = Four_picoline
log_k 0
Formate- = Formate-
log_k 0
Isovalerate- = Isovalerate-
log_k 0
Valerate- = Valerate-
log_k 0
Acetate- = Acetate-
log_k 0
Tartarate-2 = Tartarate-2
log_k 0

```
Glycine- = Glycine-
log_k 0
Salicylate-2 = Salicylate-2
log_k 0
Glutamate-2 = Glutamate-2
log_k 0
Phthalate-2 = Phthalate-2
log_k 0
SOLUTION_SPECIES
Fe+3 + e- = Fe+2
log_k 13.032
delta_h -42.7 kJ
-gamma 0 0
# Id: 2802810
# log K source: Bard85
# Delta H source: Bard85
#T and ionic strength:
H3AsO4 + 2e- + 2H+ = H3AsO3 + H2O
log_k 18.898
delta_h -125.6 kJ
-gamma 0 0
# Id: 600610
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
Sb(OH)6- + 2e- + 3H+ = Sb(OH)3 + 3H2O
log_k 24.31
delta_h 0 kJ
-gamma 0 0
# Id: 7407410
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
UO2+2 + 3e- + 4H+ = U+3 + 2H2O
log_k 0.42
delta_h -42 kJ
-gamma 0 0
# Id: 8908930
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
UO2+2 + 2e- + 4H+ = U+4 + 2H2O
log_k 9.216
delta_h -144.1 kJ
-gamma 0 0
# Id: 8918930
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
UO2+2 + e- = UO2+
log_k 2.785
delta_h -13.8 kJ
-gamma 0 0
# Id: 8928930
```

```
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
e- + Mn+3 = Mn+2
log_k 25.35
delta_h -107.8 kJ
-gamma 0 0
# Id: 4704710
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
Co+3 + e- = Co+2
log_k 32.4
delta_h 0 kJ
-gamma 0 0
# Id: 2002010
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
Cu+2 + e- = Cu+
log_k 2.69
delta_h 6.9 kJ
-gamma 0 0
# Id: 2302310
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
V+3 + e- = V+2
log_k -4.31
delta_h 0 kJ
-gamma 0 0
# Id: 9009010
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
VO+2 + e- + 2H+ = V+3 + H2O
log_k 5.696
delta_h 0 kJ
-gamma 0 0
# Id: 9019020
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
VO2+ + e- + 2H+ = VO+2 + H2O
log_k 16.903
delta_h -122.7 kJ
-gamma 0 0
# Id: 9029030
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
SO4-2 + 9H+ + 8e- = HS- + 4H2O
log_k 33.66
delta_h -60.14 kJ
```

```
-gamma 0 0
# Id: 7307320
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Sn(OH)6-2 + 2e- + 4H+ = Sn(OH)2 + 4H2O
log_k 19.2
delta_h 0 kJ
-gamma 0 0
# Id: 7907910
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
Tl(OH)3 + 2e- + 3H+ = Tl+ + 3H2O
log_k 45.55
delta_h 0 kJ
-gamma 0 0
# Id: 8708710
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
HSeO3- + 6e- + 6H+ = HSe- + 3H2O
log_k 44.86
delta_h 0 kJ
-gamma 0 0
# Id: 7607610
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
SeO4-2 + 2e- + 3H+ = HSeO3- + H2O
log_k 36.308
delta_h -201.2 kJ
-gamma 0 0
# Id: 7617620
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
0.5Hg2+2 + e- = Hg
log_k 6.5667
delta_h -45.735 kJ
-gamma 0 0
# Id: 3600000
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:

2Hg(OH)2 + 4H+ + 2e- = Hg2+2 + 4H2O
log_k 43.185
delta_h -63.59 kJ
-gamma 0 0
# Id: 3603610
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
```

```
Cr(OH)2+ + 2H+ + e- = Cr+2 + 2H2O
log_k 2.947
delta_h 6.36 kJ
-gamma 0 0
# Id: 2102110
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
CrO4-2 + 6H+ + 3e- = Cr(OH)2+ + 2H2O
log_k 67.376
delta_h -103 kJ
-gamma 0 0
# Id: 2112120
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:

2H2O = O2 + 4H+ + 4e-
# Adjusted for equation to aqueous species
log_k -85.9951
-analytic 38.0229 7.99407E-03 -2.7655e+004 -1.4506e+001 199838.45

2 H+ + 2 e- = H2
log_k -3.15
delta_h -1.759 kcal

NO3- + 2 H+ + 2 e- = NO2- + H2O
log_k 28.570
delta_h -43.760 kcal
-gamma 3.0000 0.0000

NO3- + 10 H+ + 8 e- = NH4+ + 3 H2O
log_k 119.077
delta_h -187.055 kcal
-gamma 2.5000 0.0000

Mn+2 + 4H2O = MnO4- + 8H+ + 5e-
log_k -127.794
delta_h 822.67 kJ
-gamma 3 0
# Id: 4700020
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
Mn+2 + 4H2O = MnO4-2 + 8H+ + 4e-
log_k -118.422
delta_h 711.07 kJ
-gamma 5 0
# Id: 4700021
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
HS- = S-2 + H+
log_k -17.3
delta_h 49.4 kJ
-gamma 5 0
# Id: 3307301
```

```
# log K source: LMa1987
# Delta H source: NIST2.1.1
#T and ionic strength: 0.00 25.0
HSe- = Se-2 + H+
log_k -15
delta_h 48.116 kJ
-gamma 0 0
# Id: 3307601
# log K source: SCD3.02 (1968 DKa)
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Tl(OH)3 + 3H+ = Tl+3 + 3H2O
log_k 3.291
delta_h 0 kJ
-gamma 0 0
# Id: 8713300
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
0.5Hg2+2 + e- = Hg
log_k 6.5667
delta_h -45.735 kJ
-gamma 0 0
# Id: 3600000
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
Hg(OH)2 + 2H+ = Hg+2 + 2H2O
log_k 6.194
delta_h -39.72 kJ
-gamma 0 0
# Id: 3613300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cr(OH)2+ + 2H+ = Cr+3 + 2H2O
log_k 9.5688
delta_h -129.62 kJ
-gamma 0 0
# Id: 2113300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.10 20.0
H2O = OH- + H+
log_k -13.997
delta_h 55.81 kJ
-gamma 3.5 0
# Id: 3300020
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Sn(OH)2 + 2H+ = Sn+2 + 2H2O
log_k 7.094
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 7903301
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Sn(OH)2 + H+ = SnOH+ + H2O
log_k 3.697
delta_h 0 kJ
-gamma 0 0
# Id: 7903302
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Sn(OH)2 + H2O = Sn(OH)3- + H+
log_k -9.497
delta_h 0 kJ
-gamma 0 0
# Id: 7903303
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
2Sn(OH)2 + 2H+ = Sn2(OH)2+2 + 2H2O
log_k 9.394
delta_h 0 kJ
-gamma 0 0
# Id: 7903304
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
3Sn(OH)2 + 2H+ = Sn3(OH)4+2 + 2H2O
log_k 14.394
delta_h 0 kJ
-gamma 0 0
# Id: 7903305
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Sn(OH)2 = HSnO2- + H+
log_k -8.9347
delta_h 0 kJ
-gamma 0 0
# Id: 7903306
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
Sn(OH)6-2 + 6H+ = Sn+4 + 6H2O
log_k 21.2194
delta_h 0 kJ
-gamma 0 0
# Id: 7913301
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
Sn(OH)6-2 = SnO3-2 + 3H2O
```

```
log_k -2.2099
delta_h 0 kJ
-gamma 0 0
# Id: 7913302
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
Pb+2 + H2O = PbOH+ + H+
log_k -7.597
delta_h 0 kJ
-gamma 0 0
# Id: 6003300
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Pb+2 + 2H2O = Pb(OH)2 + 2H+
log_k -17.094
delta_h 0 kJ
-gamma 0 0
# Id: 6003301
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Pb+2 + 3H2O = Pb(OH)3- + 3H+
log_k -28.091
delta_h 0 kJ
-gamma 0 0
# Id: 6003302
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
2Pb+2 + H2O = Pb2OH+3 + H+
log_k -6.397
delta_h 0 kJ
-gamma 0 0
# Id: 6003303
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
3Pb+2 + 4H2O = Pb3(OH)4+2 + 4H+
log_k -23.888
delta_h 115.24 kJ
-gamma 0 0
# Id: 6003304
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Pb+2 + 4H2O = Pb(OH)4-2 + 4H+
log_k -39.699
delta_h 0 kJ
-gamma 0 0
# Id: 6003305
# log K source: MTQ3.11
# Delta H source: MTQ3.11
```

```
#T and ionic strength:
4Pb+2 + 4H2O = Pb4(OH)4+4 + 4H+
log_k -19.988
delta_h 88.24 kJ
-gamma 0 0
# Id: 6003306
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
H3BO3 + F- = BF(OH)3-
log_k -0.399
delta_h 7.7404 kJ
-gamma 2.5 0
# Id: 902700
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
H3BO3 + 2F- + H+ = BF2(OH)2- + H2O
log_k 7.63
delta_h 6.8408 kJ
-gamma 2.5 0
# Id: 902701
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
H3BO3 + 3F- + 2H+ = BF3OH- + 2H2O
log_k 13.22
delta_h -20.4897 kJ
-gamma 2.5 0
# Id: 902702
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
Al+3 + H2O = AlOH+2 + H+
log_k -4.997
delta_h 47.81 kJ
-gamma 5.4 0
# Id: 303300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Al+3 + 2H2O = Al(OH)2+ + 2H+
log_k -10.094
delta_h 0 kJ
-gamma 5.4 0
# Id: 303301
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Al+3 + 3H2O = Al(OH)3 + 3H+
log_k -16.791
delta_h 0 kJ
-gamma 0 0
# Id: 303303
```

```
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Al+3 + 4H2O = Al(OH)4- + 4H+
log_k -22.688
delta_h 173.24 kJ
-gamma 4.5 0
# Id: 303302
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Tl+ + H2O = TlOH + H+
log_k -13.207
delta_h 56.81 kJ
-gamma 0 0
# Id: 8703300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Tl(OH)3 + 2H+ = TlOH+2 + 2H2O
log_k 2.694
delta_h 0 kJ
-gamma 0 0
# Id: 8713301
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Tl(OH)3 + H+ = Tl(OH)2+ + H2O
log_k 1.897
delta_h 0 kJ
-gamma 0 0
# Id: 8713302
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Tl(OH)3 + H2O = Tl(OH)4- + H+
log_k -11.697
delta_h 0 kJ
-gamma 0 0
# Id: 8713303
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Zn+2 + H2O = ZnOH+ + H+
log_k -8.997
delta_h 55.81 kJ
-gamma 0 0
# Id: 9503300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Zn+2 + 2H2O = Zn(OH)2 + 2H+
log_k -17.794
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 9503301
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Zn+2 + 3H2O = Zn(OH)3- + 3H+
log_k -28.091
delta_h 0 kJ
-gamma 0 0
# Id: 9503302
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Zn+2 + 4H2O = Zn(OH)4-2 + 4H+
log_k -40.488
delta_h 0 kJ
-gamma 0 0
# Id: 9503303
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Cd+2 + H2O = CdOH+ + H+
log_k -10.097
delta_h 54.81 kJ
-gamma 0 0
# Id: 1603300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cd+2 + 2H2O = Cd(OH)2 + 2H+
log_k -20.294
delta_h 0 kJ
-gamma 0 0
# Id: 1603301
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Cd+2 + 3H2O = Cd(OH)3- + 3H+
log_k -32.505
delta_h 0 kJ
-gamma 0 0
# Id: 1603302
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 3.00 25.0
Cd+2 + 4H2O = Cd(OH)4-2 + 4H+
log_k -47.288
delta_h 0 kJ
-gamma 0 0
# Id: 1603303
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
2Cd+2 + H2O = Cd2OH+3 + H+
```

```
log_k -9.397
delta_h 45.81 kJ
-gamma 0 0
# Id: 1603304
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Hg(OH)2 + H+ = HgOH+ + H2O
log_k 2.797
delta_h -18.91 kJ
-gamma 0 0
# Id: 3613302
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Hg(OH)2 + H2O = Hg(OH)3- + H+
log_k -14.897
delta_h 0 kJ
-gamma 0 0
# Id: 3613303
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Cu+2 + H2O = CuOH+ + H+
log_k -7.497
delta_h 35.81 kJ
-gamma 4 0
# Id: 2313300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cu+2 + 2H2O = Cu(OH)2 + 2H+
log_k -16.194
delta_h 0 kJ
-gamma 0 0
# Id: 2313301
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Cu+2 + 3H2O = Cu(OH)3- + 3H+
log_k -26.879
delta_h 0 kJ
-gamma 0 0
# Id: 2313302
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Cu+2 + 4H2O = Cu(OH)4-2 + 4H+
log_k -39.98
delta_h 0 kJ
-gamma 0 0
# Id: 2313303
# log K source: NIST46.3
# Delta H source: MTQ3.11
```

```
#T and ionic strength:  1.00 25.0
2Cu+2 + 2H2O = Cu2(OH)2+2 + 2H+
log_k -10.594
delta_h 76.62 kJ
-gamma 0 0
# Id:  2313304
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Ag+ + H2O = AgOH + H+
log_k -11.997
delta_h 0 kJ
-gamma 0 0
# Id:  203300
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
Ag+ + 2H2O = Ag(OH)2- + 2H+
log_k -24.004
delta_h 0 kJ
-gamma 0 0
# Id:  203301
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
Ni+2 + H2O = NiOH+ + H+
log_k -9.897
delta_h 51.81 kJ
-gamma 0 0
# Id:  5403300
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Ni+2 + 2H2O = Ni(OH)2 + 2H+
log_k -18.994
delta_h 0 kJ
-gamma 0 0
# Id:  5403301
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
Ni+2 + 3H2O = Ni(OH)3- + 3H+
log_k -29.991
delta_h 0 kJ
-gamma 0 0
# Id:  5403302
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
Co+2 + H2O = CoOH+ + H+
log_k -9.697
delta_h 0 kJ
-gamma 0 0
# Id:  2003300
```

```
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Co+2 + 2H2O = Co(OH)2 + 2H+
log_k -18.794
delta_h 0 kJ
-gamma 0 0
# Id: 2003301
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Co+2 + 3H2O = Co(OH)3- + 3H+
log_k -31.491
delta_h 0 kJ
-gamma 0 0
# Id: 2003302
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Co+2 + 4H2O = Co(OH)4-2 + 4H+
log_k -46.288
delta_h 0 kJ
-gamma 0 0
# Id: 2003303
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
2Co+2 + H2O = Co2OH+3 + H+
log_k -10.997
delta_h 0 kJ
-gamma 0 0
# Id: 2003304
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
4Co+2 + 4H2O = Co4(OH)4+4 + 4H+
log_k -30.488
delta_h 0 kJ
-gamma 0 0
# Id: 2003306
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Co+2 + 2H2O = CoOOH- + 3H+
log_k -32.0915
delta_h 260.454 kJ
-gamma 0 0
# Id: 2003305
# log K source: NIST2.1.1
# Delta H source: MTQ3.11
#T and ionic strength:
Co+3 + H2O = CoOH+2 + H+
log_k -1.291
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 2013300
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 3.00 25.0
Fe+2 + H2O = FeOH+ + H+
log_k -9.397
delta_h 55.81 kJ
-gamma 5 0
# Id: 2803300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Fe+2 + 2H2O = Fe(OH)2 + 2H+
log_k -20.494
delta_h 119.62 kJ
-gamma 0 0
# Id: 2803302
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Fe+2 + 3H2O = Fe(OH)3- + 3H+
log_k -28.991
delta_h 126.43 kJ
-gamma 5 0
# Id: 2803301
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Fe+3 + H2O = FeOH+2 + H+
log_k -2.187
delta_h 41.81 kJ
-gamma 5 0
# Id: 2813300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Fe+3 + 2H2O = Fe(OH)2+ + 2H+
log_k -4.594
delta_h 0 kJ
-gamma 5.4 0
# Id: 2813301
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Fe+3 + 3H2O = Fe(OH)3 + 3H+
log_k -12.56
delta_h 103.8 kJ
-gamma 0 0
# Id: 2813302
# log K source: Nord90
# Delta H source: Nord90
#T and ionic strength: 0.00 25.0
Fe+3 + 4H2O = Fe(OH)4- + 4H+
```

```
log_k -21.588
delta_h 0 kJ
-gamma 5.4 0
# Id: 2813303
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
2Fe+3 + 2H2O = Fe2(OH)2+4 + 2H+
log_k -2.854
delta_h 57.62 kJ
-gamma 0 0
# Id: 2813304
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
3Fe+3 + 4H2O = Fe3(OH)4+5 + 4H+
log_k -6.288
delta_h 65.24 kJ
-gamma 0 0
# Id: 2813305
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Mn+2 + H2O = MnOH+ + H+
log_k -10.597
delta_h 55.81 kJ
-gamma 5 0
# Id: 4703300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Mn+2 + 3H2O = Mn(OH)3- + 3H+
log_k -34.8
delta_h 0 kJ
-gamma 5 0
# Id: 4703301
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Mn+2 + 4H2O = Mn(OH)4-2 + 4H+
log_k -48.288
delta_h 0 kJ
-gamma 5 0
# Id: 4703302
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Mn+2 + 4H2O = MnO4- + 8H+ + 5e-
log_k -127.794
delta_h 822.67 kJ
-gamma 3 0
# Id: 4700020
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
```

```
#T and ionic strength:
Mn+2 + 4H2O = MnO4-2 + 8H+ + 4e-
log_k -118.422
delta_h 711.07 kJ
-gamma 5 0
# Id: 4700021
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
Cr(OH)2+ + H+ = Cr(OH)+2 + H2O
log_k 5.9118
delta_h -77.91 kJ
-gamma 0 0
# Id: 2113301
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cr(OH)2+ + H2O = Cr(OH)3 + H+
log_k -8.4222
delta_h 0 kJ
-gamma 0 0
# Id: 2113302
# log K source: SCD3.02 (1983 RCa)
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Cr(OH)2+ + 2H2O = Cr(OH)4- + 2H+
log_k -17.8192
delta_h 0 kJ
-gamma 0 0
# Id: 2113303
# log K source: SCD3.02 (1983 RCa)
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Cr(OH)2+ = CrO2- + 2H+
log_k -17.7456
delta_h 0 kJ
-gamma 0 0
# Id: 2113304
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
V+2 + H2O = VOH+ + H+
log_k -6.487
delta_h 59.81 kJ
-gamma 0 0
# Id: 9003300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
V+3 + H2O = VOH+2 + H+
log_k -2.297
delta_h 43.81 kJ
-gamma 0 0
# Id: 9013300
```

```
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
V+3 + 2H2O = V(OH)2+ + 2H+
log_k -6.274
delta_h 0 kJ
-gamma 0 0
# Id: 9013301
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 20.0
V+3 + 3H2O = V(OH)3 + 3H+
log_k -3.0843
delta_h 0 kJ
-gamma 0 0
# Id: 9013302
# log K source: SCD3.02 (1978 TKa)
# Delta H source: MTQ3.11
#T and ionic strength: 0.10 20.0
2V+3 + 2H2O = V2(OH)2+4 + 2H+
log_k -3.794
delta_h 0 kJ
-gamma 0 0
# Id: 9013304
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
2V+3 + 3H2O = V2(OH)3+3 + 3H+
log_k -10.1191
delta_h 0 kJ
-gamma 0 0
# Id: 9013303
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 3.00 25.0
VO+2 + 2H2O = V(OH)3+ + H+
log_k -5.697
delta_h 0 kJ
-gamma 0 0
# Id: 9023300
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
2VO+2 + 2H2O = H2V2O4+2 + 2H+
log_k -6.694
delta_h 53.62 kJ
-gamma 0 0
# Id: 9023301
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
U+4 + H2O = UOH+3 + H+
log_k -0.597
delta_h 47.81 kJ
```

```
-gamma 0 0
# Id: 8913300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
U+4 + 2H2O = U(OH)2+2 + 2H+
log_k -2.27
delta_h 74.1823 kJ
-gamma 0 0
# Id: 8913301
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
U+4 + 3H2O = U(OH)3+ + 3H+
log_k -4.935
delta_h 94.7467 kJ
-gamma 0 0
# Id: 8913302
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
U+4 + 4H2O = U(OH)4 + 4H+
log_k -8.498
delta_h 103.596 kJ
-gamma 0 0
# Id: 8913303
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
U+4 + 5H2O = U(OH)5- + 5H+
log_k -13.12
delta_h 115.374 kJ
-gamma 0 0
# Id: 8913304
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
6U+4 + 15H2O = U6(OH)15+9 + 15H+
log_k -17.155
delta_h 0 kJ
-gamma 0 0
# Id: 8913305
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
UO2+2 + H2O = UO2OH+ + H+
log_k -5.897
delta_h 47.81 kJ
-gamma 0 0
# Id: 8933300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
2UO2+2 + 2H2O = (UO2)2(OH)2+2 + 2H+
```

```
log_k -5.574
delta_h 41.82 kJ
-gamma 0 0
# Id: 8933301
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
3UO2+2 + 5H2O = (UO2)3(OH)5+ + 5H+
log_k -15.585
delta_h 108.05 kJ
-gamma 0 0
# Id: 8933302
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Be+2 + H2O = BeOH+ + H+
log_k -5.397
delta_h 0 kJ
-gamma 6.5 0
# Id: 1103301
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Be+2 + 2H2O = Be(OH)2 + 2H+
log_k -13.594
delta_h 0 kJ
-gamma 6.5 0
# Id: 1103302
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Be+2 + 3H2O = Be(OH)3- + 3H+
log_k -23.191
delta_h 0 kJ
-gamma 6.5 0
# Id: 1103303
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Be+2 + 4H2O = Be(OH)4-2 + 4H+
log_k -37.388
delta_h 0 kJ
-gamma 6.5 0
# Id: 1103304
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
2Be+2 + H2O = Be2OH+3 + H+
log_k -3.177
delta_h 0 kJ
-gamma 6.5 0
# Id: 1103305
# log K source: NIST46.4
# Delta H source: MTQ3.11
```

```
#T and ionic strength:  0.10 25.0
3Be+2 + 3H2O = Be3(OH)3+3 + 3H+
log_k -8.8076
delta_h 0 kJ
-gamma 6.5 0
# Id:  1103306
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  0.10 25.0
Mg+2 + H2O = MgOH+ + H+
log_k -11.397
delta_h 67.81 kJ
-gamma 6.5 0
# Id:  4603300
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Ca+2 + H2O = CaOH+ + H+
log_k -12.697
delta_h 64.11 kJ
-gamma 6 0
# Id:  1503300
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Sr+2 + H2O = SrOH+ + H+
log_k -13.177
delta_h 60.81 kJ
-gamma 5 0
# Id:  8003300
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Ba+2 + H2O = BaOH+ + H+
log_k -13.357
delta_h 60.81 kJ
-gamma 5 0
# Id:  1003300
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
H+ + F- = HF
log_k 3.17
delta_h 13.3 kJ
-gamma 0 0
# Id:  3302700
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
H+ + 2F- = HF2-
log_k 3.75
delta_h 17.4 kJ
-gamma 3.5 0
# Id:  3302701
```

```
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
2F- + 2H+ = H2F2
log_k 6.768
delta_h 0 kJ
-gamma 0 0
# Id: 3302702
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Sb(OH)3 + F- + H+ = SbOF + 2H2O
log_k 6.1864
delta_h 0 kJ
-gamma 0 0
# Id: 7402700
# log K source: PNL89
# Delta H source: PNL89
#T and ionic strength:
Sb(OH)3 + F- + H+ = Sb(OH)2F + H2O
log_k 6.1937
delta_h 0 kJ
-gamma 0 0
# Id: 7402702
# log K source: PNL89
# Delta H source: PNL89
#T and ionic strength:
H4SiO4 + 4H+ + 6F- = SiF6-2 + 4H2O
log_k 30.18
delta_h -68 kJ
-gamma 5 0
# Id: 7702700
# log K source: Nord90
# Delta H source: Nord90
#T and ionic strength: 0.00 25.0
Sn(OH)2 + 2H+ + F- = SnF+ + 2H2O
log_k 11.582
delta_h 0 kJ
-gamma 0 0
# Id: 7902701
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Sn(OH)2 + 2H+ + 2F- = SnF2 + 2H2O
log_k 14.386
delta_h 0 kJ
-gamma 0 0
# Id: 7902702
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Sn(OH)2 + 2H+ + 3F- = SnF3- + 2H2O
log_k 17.206
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 7902703
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Sn(OH)6-2 + 6H+ + 6F- = SnF6-2 + 6H2O
log_k 33.5844
delta_h 0 kJ
-gamma 0 0
# Id: 7912701
# log K source: Bard85
# Delta H source: MTQ3.11
#T and ionic strength:
Pb+2 + F- = PbF+
log_k 1.848
delta_h 0 kJ
-gamma 0 0
# Id: 6002700
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Pb+2 + 2F- = PbF2
log_k 3.142
delta_h 0 kJ
-gamma 0 0
# Id: 6002701
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Pb+2 + 3F- = PbF3-
log_k 3.42
delta_h 0 kJ
-gamma 0 0
# Id: 6002702
# log K source: SCD3.02 (1956 TKa)
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Pb+2 + 4F- = PbF4-2
log_k 3.1
delta_h 0 kJ
-gamma 0 0
# Id: 6002703
# log K source: SCD3.02 (1956 TKa)
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
H3BO3 + 3H+ + 4F- = BF4- + 3H2O
log_k 19.912
delta_h -18.67 kJ
-gamma 2.5 0
# Id: 902703
# log K source: NIST46.3
# Delta H source: NIST2.1.1
#T and ionic strength: 1.00 25.0
Al+3 + F- = AlF+2
```

```
log_k 7
delta_h 4.6 kJ
-gamma 5.4 0
# Id: 302700
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Al+3 + 2F- = AlF2+
log_k 12.6
delta_h 8.3 kJ
-gamma 5.4 0
# Id: 302701
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Al+3 + 3F- = AlF3
log_k 16.7
delta_h 8.7 kJ
-gamma 0 0
# Id: 302702
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Al+3 + 4F- = AlF4-
log_k 19.4
delta_h 8.7 kJ
-gamma 4.5 0
# Id: 302703
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Tl+ + F- = TlF
log_k 0.1
delta_h 0 kJ
-gamma 0 0
# Id: 8702700
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Zn+2 + F- = ZnF+
log_k 1.3
delta_h 11 kJ
-gamma 0 0
# Id: 9502700
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cd+2 + F- = CdF+
log_k 1.2
delta_h 5 kJ
-gamma 0 0
# Id: 1602700
# log K source: NIST46.3
# Delta H source: NIST46.3
```

```
#T and ionic strength:  0.00 25.0
Cd+2 + 2F- = CdF2
log_k 1.5
delta_h 0 kJ
-gamma 0 0
# Id:  1602701
# log K source:  MTQ3.11
# Delta H source:  MTQ3.11
#T and ionic strength:
Hg(OH)2 + 2H+ + F- = HgF+ + 2H2O
log_k 7.763
delta_h -35.72 kJ
-gamma 0 0
# Id:  3612701
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.50 25.0
Cu+2 + F- = CuF+
log_k 1.8
delta_h 13 kJ
-gamma 0 0
# Id:  2312700
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Ag+ + F- = AgF
log_k 0.4
delta_h 12 kJ
-gamma 0 0
# Id:  202700
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Ni+2 + F- = NiF+
log_k 1.4
delta_h 7.1 kJ
-gamma 0 0
# Id:  5402700
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Co+2 + F- = CoF+
log_k 1.5
delta_h 9.2 kJ
-gamma 0 0
# Id:  2002700
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.00 25.0
Fe+3 + F- = FeF+2
log_k 6.04
delta_h 10 kJ
-gamma 5 0
# Id:  2812700
```

```
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Fe+3 + 2F- = FeF2+
log_k 10.4675
delta_h 17 kJ
-gamma 5 0
# Id: 2812701
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.50 25.0
Fe+3 + 3F- = FeF3
log_k 13.617
delta_h 29 kJ
-gamma 0 0
# Id: 2812702
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.50 25.0
Mn+2 + F- = MnF+
log_k 1.6
delta_h 11 kJ
-gamma 5 0
# Id: 4702700
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cr(OH)2+ + 2H+ + F- = CrF+2 + 2H2O
log_k 14.7688
delta_h -70.2452 kJ
-gamma 0 0
# Id: 2112700
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
VO+2 + F- = VOF+
log_k 3.778
delta_h 7.9 kJ
-gamma 0 0
# Id: 9022700
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 1.00 25.0
VO+2 + 2F- = VOF2
log_k 6.352
delta_h 14 kJ
-gamma 0 0
# Id: 9022701
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 1.00 25.0
VO+2 + 3F- = VOF3-
log_k 7.902
delta_h 20 kJ
```

```
-gamma 0 0
# Id: 9022702
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 1.00 25.0
VO+2 + 4F- = VOF4-2
log_k 8.508
delta_h 26 kJ
-gamma 0 0
# Id: 9022703
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 1.00 25.0
VO2+ + F- = VO2F
log_k 3.244
delta_h 0 kJ
-gamma 0 0
# Id: 9032700
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
VO2+ + 2F- = VO2F2-
log_k 5.804
delta_h 0 kJ
-gamma 0 0
# Id: 9032701
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 20.0
VO2+ + 3F- = VO2F3-2
log_k 6.9
delta_h 0 kJ
-gamma 0 0
# Id: 9032702
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 20.0
VO2+ + 4F- = VO2F4-3
log_k 6.592
delta_h 0 kJ
-gamma 0 0
# Id: 9032703
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 20.0
U+4 + F- = UF+3
log_k 9.3
delta_h 21.1292 kJ
-gamma 0 0
# Id: 8912700
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
U+4 + 2F- = UF2+2
```

```
log_k 16.4
delta_h 30.1248 kJ
-gamma 0 0
# Id: 8912701
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
U+4 + 3F- = UF3+
log_k 21.6
delta_h 29.9156 kJ
-gamma 0 0
# Id: 8912702
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
U+4 + 4F- = UF4
log_k 23.64
delta_h 19.2464 kJ
-gamma 0 0
# Id: 8912703
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
U+4 + 5F- = UF5-
log_k 25.238
delta_h 20.2924 kJ
-gamma 0 0
# Id: 8912704
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
U+4 + 6F- = UF6-2
log_k 27.718
delta_h 13.8072 kJ
-gamma 0 0
# Id: 8912705
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
UO2+2 + F- = UO2F+
log_k 5.14
delta_h 1 kJ
-gamma 0 0
# Id: 8932700
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
UO2+2 + 2F- = UO2F2
log_k 8.6
delta_h 2 kJ
-gamma 0 0
# Id: 8932701
# log K source: NIST46.3
# Delta H source: NIST46.3
```

```
#T and ionic strength:  0.00 25.0
UO2+2 + 3F- = UO2F3-
log_k 11
delta_h 2 kJ
-gamma 0 0
# Id:  8932702
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
UO2+2 + 4F- = UO2F4-2
log_k 11.9
delta_h 0.4 kJ
-gamma 0 0
# Id:  8932703
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Be+2 + F- = BeF+
log_k 5.249
delta_h 0 kJ
-gamma 0 0
# Id:  1102701
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.50 25.0
Be+2 + 2F- = BeF2
log_k 9.1285
delta_h -4 kJ
-gamma 0 0
# Id:  1102702
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.50 25.0
Be+2 + 3F- = BeF3-
log_k 11.9085
delta_h -8 kJ
-gamma 0 0
# Id:  1102703
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.50 25.0
Mg+2 + F- = MgF+
log_k 2.05
delta_h 13 kJ
-gamma 4.5 0
# Id:  4602700
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Ca+2 + F- = CaF+
log_k 1.038
delta_h 14 kJ
-gamma 5 0
# Id:  1502700
```

```
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 1.00 25.0
Sr+2 + F- = SrF+
log_k 0.548
delta_h 16 kJ
-gamma 0 0
# Id: 8002701
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 1.00 25.0
Na+ + F- = NaF
log_k -0.2
delta_h 12 kJ
-gamma 0 0
# Id: 5002700
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Sn(OH)2 + 2H+ + Cl- = SnCl+ + 2H2O
log_k 8.734
delta_h 0 kJ
-gamma 0 0
# Id: 7901801
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Sn(OH)2 + 2H+ + 2Cl- = SnCl2 + 2H2O
log_k 9.524
delta_h 0 kJ
-gamma 0 0
# Id: 7901802
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Sn(OH)2 + 2H+ + 3Cl- = SnCl3- + 2H2O
log_k 8.3505
delta_h 0 kJ
-gamma 0 0
# Id: 7901803
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 2.00 25.0
Pb+2 + Cl- = PbCl+
log_k 1.55
delta_h 8.7 kJ
-gamma 0 0
# Id: 6001800
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Pb+2 + 2Cl- = PbCl2
log_k 2.2
delta_h 12 kJ
```

```
-gamma 0 0
# Id: 6001801
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Pb+2 + 3Cl- = PbCl3-
log_k 1.8
delta_h 4 kJ
-gamma 0 0
# Id: 6001802
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Pb+2 + 4Cl- = PbCl4-2
log_k 1.46
delta_h 14.7695 kJ
-gamma 0 0
# Id: 6001803
# log K source: SCD3.02 (1984 SEa)
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Tl+ + Cl- = TlCl
log_k 0.51
delta_h -6.2 kJ
-gamma 0 0
# Id: 8701800
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Tl+ + 2Cl- = TlCl2-
log_k 0.28
delta_h 0 kJ
-gamma 0 0
# Id: 8701801
# log K source: SCD3.02 (1992 RAb)
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Tl(OH)3 + 3H+ + Cl- = TlCl+2 + 3H2O
log_k 11.011
delta_h 0 kJ
-gamma 0 0
# Id: 8711800
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Tl(OH)3 + 3H+ + 2Cl- = TlCl2+ + 3H2O
log_k 16.771
delta_h 0 kJ
-gamma 0 0
# Id: 8711801
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Tl(OH)3 + 3H+ + 3Cl- = TlCl3 + 3H2O
```

```
log_k 19.791
delta_h 0 kJ
-gamma 0 0
# Id: 8711802
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Tl(OH)3 + 3H+ + 4Cl- = TlCl4- + 3H2O
log_k 21.591
delta_h 0 kJ
-gamma 0 0
# Id: 8711803
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Tl(OH)3 + Cl- + 2H+ = TlOHCl+ + 2H2O
log_k 10.629
delta_h 0 kJ
-gamma 0 0
# Id: 8711804
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Zn+2 + Cl- = ZnCl+
log_k 0.4
delta_h 5.4 kJ
-gamma 4 0
# Id: 9501800
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Zn+2 + 2Cl- = ZnCl2
log_k 0.6
delta_h 37 kJ
-gamma 0 0
# Id: 9501801
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Zn+2 + 3Cl- = ZnCl3-
log_k 0.5
delta_h 39.999 kJ
-gamma 4 0
# Id: 9501802
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Zn+2 + 4Cl- = ZnCl4-2
log_k 0.199
delta_h 45.8566 kJ
-gamma 5 0
# Id: 9501803
# log K source: MTQ3.11
# Delta H source: MTQ3.11
```

```
#T and ionic strength:
Zn+2 + H2O + Cl- = ZnOHCl + H+
log_k -7.48
delta_h 0 kJ
-gamma 0 0
# Id: 9501804
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Cd+2 + Cl- = CdCl+
log_k 1.98
delta_h 1 kJ
-gamma 0 0
# Id: 1601800
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cd+2 + 2Cl- = CdCl2
log_k 2.6
delta_h 3 kJ
-gamma 0 0
# Id: 1601801
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cd+2 + 3Cl- = CdCl3-
log_k 2.4
delta_h 10 kJ
-gamma 0 0
# Id: 1601802
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cd+2 + H2O + Cl- = CdOHCl + H+
log_k -7.404
delta_h 18.2213 kJ
-gamma 0 0
# Id: 1601803
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Hg(OH)2 + 2H+ + Cl- = HgCl+ + 2H2O
log_k 13.494
delta_h -62.72 kJ
-gamma 0 0
# Id: 3611800
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Hg(OH)2 + 2H+ + 2Cl- = HgCl2 + 2H2O
log_k 20.194
delta_h -92.42 kJ
-gamma 0 0
# Id: 3611801
```

```
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Hg(OH)2 + 2H+ + 3Cl- = HgCl3- + 2H2O
log_k 21.194
delta_h -94.02 kJ
-gamma 0 0
# Id: 3611802
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Hg(OH)2 + 2H+ + 4Cl- = HgCl4-2 + 2H2O
log_k 21.794
delta_h -100.72 kJ
-gamma 0 0
# Id: 3611803
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Hg(OH)2 + Cl- + I- + 2H+ = HgClI + 2H2O
log_k 25.532
delta_h -135.3 kJ
-gamma 0 0
# Id: 3611804
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
Hg(OH)2 + H+ + Cl- = HgClOH + H2O
log_k 10.444
delta_h -42.72 kJ
-gamma 0 0
# Id: 3611805
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 1.00 25.0
Cu+2 + Cl- = CuCl+
log_k 0.2
delta_h 8.3 kJ
-gamma 4 0
# Id: 2311800
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cu+2 + 2Cl- = CuCl2
log_k -0.26
delta_h 44.183 kJ
-gamma 0 0
# Id: 2311801
# log K source: SCD3.02 (1989 IPa)
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Cu+2 + 3Cl- = CuCl3-
log_k -2.29
delta_h 57.279 kJ
```

```
-gamma 4 0
# Id: 2311802
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Cu+2 + 4Cl- = CuCl4-2
log_k -4.59
delta_h 32.5515 kJ
-gamma 5 0
# Id: 2311803
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Cu+ + 2Cl- = CuCl2-
log_k 5.42
delta_h -1.7573 kJ
-gamma 4 0
# Id: 2301800
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Cu+ + 3Cl- = CuCl3-2
log_k 4.75
delta_h 1.0878 kJ
-gamma 5 0
# Id: 2301801
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Cu+ + Cl- = CuCl
log_k 3.1
delta_h 0 kJ
-gamma 0 0
# Id: 2301802
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Ag+ + Cl- = AgCl
log_k 3.31
delta_h -12 kJ
-gamma 0 0
# Id: 201800
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Ag+ + 2Cl- = AgCl2-
log_k 5.25
delta_h -16 kJ
-gamma 0 0
# Id: 201801
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Ag+ + 3Cl- = AgCl3-2
```

```
log_k 5.2
delta_h 0 kJ
-gamma 0 0
# Id: 201802
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Ag+ + 4Cl- = AgCl4-3
log_k 5.51
delta_h 0 kJ
-gamma 0 0
# Id: 201803
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Ni+2 + Cl- = NiCl+
log_k 0.408
delta_h 2 kJ
-gamma 0 0
# Id: 5401800
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 1.00 25.0
Ni+2 + 2Cl- = NiCl2
log_k -1.89
delta_h 0 kJ
-gamma 0 0
# Id: 5401801
# log K source: SCD3.02 (1989 IPa)
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Co+2 + Cl- = CoCl+
log_k 0.539
delta_h 2 kJ
-gamma 0 0
# Id: 2001800
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.50 25.0
Co+3 + Cl- = CoCl+2
log_k 2.3085
delta_h 16 kJ
-gamma 0 0
# Id: 2011800
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.50 25.0
Fe+3 + Cl- = FeCl+2
log_k 1.48
delta_h 23 kJ
-gamma 5 0
# Id: 2811800
# log K source: NIST46.3
# Delta H source: NIST46.3
```

```
#T and ionic strength: 0.00 25.0
Fe+3 + 2Cl- = FeCl2+
log_k 2.13
delta_h 0 kJ
-gamma 5 0
# Id: 2811801
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Fe+3 + 3Cl- = FeCl3
log_k 1.13
delta_h 0 kJ
-gamma 0 0
# Id: 2811802
# log K source: Nord90
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Mn+2 + Cl- = MnCl+
log_k 0.1
delta_h 0 kJ
-gamma 5 0
# Id: 4701800
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 20.0
Mn+2 + 2Cl- = MnCl2
log_k 0.25
delta_h 0 kJ
-gamma 0 0
# Id: 4701801
# log K source: Nord90
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Mn+2 + 3Cl- = MnCl3-
log_k -0.31
delta_h 0 kJ
-gamma 5 0
# Id: 4701802
# log K source: Nord90
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Cr(OH)2+ + 2H+ + Cl- = CrCl+2 + 2H2O
log_k 9.6808
delta_h -103.62 kJ
-gamma 0 0
# Id: 2111800
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 1.00 25.0
Cr(OH)2+ + 2Cl- + 2H+ = CrCl2+ + 2H2O
log_k 8.658
delta_h -39.2208 kJ
-gamma 0 0
# Id: 2111801
```

```
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Cr(OH)2+ + 2Cl- + H+ = CrOHCl2 + H2O
log_k 2.9627
delta_h 0 kJ
-gamma 0 0
# Id: 2111802
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
VO+2 + Cl- = VOCl+
log_k 0.448
delta_h 0 kJ
-gamma 0 0
# Id: 9021800
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 20.0
U+4 + Cl- = UCl+3
log_k 1.7
delta_h -20 kJ
-gamma 0 0
# Id: 8911800
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
UO2+2 + Cl- = UO2Cl+
log_k 0.21
delta_h 16 kJ
-gamma 0 0
# Id: 8931800
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Be+2 + Cl- = BeCl+
log_k 0.2009
delta_h 0 kJ
-gamma 5 0
# Id: 1101801
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.70 20.0
Sn(OH)2 + 2H+ + Br- = SnBr+ + 2H2O
log_k 8.254
delta_h 0 kJ
-gamma 0 0
# Id: 7901301
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Sn(OH)2 + 2H+ + 2Br- = SnBr2 + 2H2O
log_k 8.794
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 7901302
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Sn(OH)2 + 2H+ + 3Br- = SnBr3- + 2H2O
log_k 7.48
delta_h 0 kJ
-gamma 0 0
# Id: 7901303
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 3.00 25.0
Pb+2 + Br- = PbBr+
log_k 1.7
delta_h 8 kJ
-gamma 0 0
# Id: 6001300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Pb+2 + 2Br- = PbBr2
log_k 2.6
delta_h -4 kJ
-gamma 0 0
# Id: 6001301
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Tl+ + Br- = TlBr
log_k 0.91
delta_h -12 kJ
-gamma 0 0
# Id: 8701300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Tl+ + 2Br- = TlBr2-
log_k -0.384
delta_h 12.36 kJ
-gamma 0 0
# Id: 8701301
# log K source: NIST46.3
# Delta H source: NIST2.1.1
#T and ionic strength: 4.00 25.0
Tl+ + Br- + Cl- = TlBrCl-
log_k 0.8165
delta_h 0 kJ
-gamma 0 0
# Id: 8701302
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Tl+ + I- + Br- = TlIBr-
```

log_k 2.185
delta_h 0 kJ
-gamma 0 0
Id: 8703802
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
Tl(OH)3 + 3H+ + Br- = TlBr+2 + 3H2O
log_k 12.803
delta_h 0 kJ
-gamma 0 0
Id: 8711300
log K source: NIST46.3
Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Tl(OH)3 + 3H+ + 2Br- = TlBr2+ + 3H2O
log_k 20.711
delta_h 0 kJ
-gamma 0 0
Id: 8711301
log K source: NIST46.3
Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Tl(OH)3 + 3Br- + 3H+ = TlBr3 + 3H2O
log_k 27.0244
delta_h 0 kJ
-gamma 0 0
Id: 8711302
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
Tl(OH)3 + 4Br- + 3H+ = TlBr4- + 3H2O
log_k 31.1533
delta_h 0 kJ
-gamma 0 0
Id: 8711303
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
Zn+2 + Br- = ZnBr+
log_k -0.07
delta_h 1 kJ
-gamma 0 0
Id: 9501300
log K source: NIST46.3
Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Zn+2 + 2Br- = ZnBr2
log_k -0.98
delta_h 0 kJ
-gamma 0 0
Id: 9501301
log K source: MTQ3.11
Delta H source: MTQ3.11

```
#T and ionic strength:
Cd+2 + Br- = CdBr+
log_k 2.15
delta_h -3 kJ
-gamma 0 0
# Id: 1601300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cd+2 + 2Br- = CdBr2
log_k 3
delta_h -3 kJ
-gamma 0 0
# Id: 1601301
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Hg(OH)2 + 2H+ + Br- = HgBr+ + 2H2O
log_k 15.803
delta_h -81.92 kJ
-gamma 0 0
# Id: 3611301
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.50 25.0
Hg(OH)2 + 2H+ + 2Br- = HgBr2 + 2H2O
log_k 24.2725
delta_h -127.12 kJ
-gamma 0 0
# Id: 3611302
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.50 25.0
Hg(OH)2 + 2H+ + 3Br- = HgBr3- + 2H2O
log_k 26.7025
delta_h -138.82 kJ
-gamma 0 0
# Id: 3611303
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.50 25.0
Hg(OH)2 + 2H+ + 4Br- = HgBr4-2 + 2H2O
log_k 27.933
delta_h -153.72 kJ
-gamma 0 0
# Id: 3611304
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.50 25.0
Hg(OH)2 + Br- + Cl- + 2H+ = HgBrCl + 2H2O
log_k 22.1811
delta_h -113.77 kJ
-gamma 0 0
# Id: 3611305
```

```
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
Hg(OH)2 + Br- + I- + 2H+ = HgBrI + 2H2O
log_k 27.3133
delta_h -151.27 kJ
-gamma 0 0
# Id: 3611306
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
Hg(OH)2 + Br- + 3I- + 2H+ = HgBrI3-2 + 2H2O
log_k 34.2135
delta_h 0 kJ
-gamma 0 0
# Id: 3611307
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Hg(OH)2 + 2Br- + 2I- + 2H+ = HgBr2I2-2 + 2H2O
log_k 32.3994
delta_h 0 kJ
-gamma 0 0
# Id: 3611308
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Hg(OH)2 + 3Br- + I- + 2H+ = HgBr3I-2 + 2H2O
log_k 30.1528
delta_h 0 kJ
-gamma 0 0
# Id: 3611309
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Hg(OH)2 + H+ + Br- = HgBrOH + H2O
log_k 12.433
delta_h 0 kJ
-gamma 0 0
# Id: 3613301
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.50 25.0
Ag+ + Br- = AgBr
log_k 4.6
delta_h 0 kJ
-gamma 0 0
# Id: 201300
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Ag+ + 2Br- = AgBr2-
log_k 7.5
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 201301
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Ag+ + 3Br- = AgBr3-2
log_k 8.1
delta_h 0 kJ
-gamma 0 0
# Id: 201302
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Ni+2 + Br- = NiBr+
log_k 0.5
delta_h 0 kJ
-gamma 0 0
# Id: 5401300
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Cr(OH)2+ + Br- + 2H+ = CrBr+2 + 2H2O
log_k 7.5519
delta_h -46.9068 kJ
-gamma 0 0
# Id: 2111300
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Be+2 + Br- = BeBr+
log_k 0.1009
delta_h 0 kJ
-gamma 5 0
# Id: 1101301
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.70 20.0
Pb+2 + I- = PbI+
log_k 2
delta_h 0 kJ
-gamma 0 0
# Id: 6003800
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Pb+2 + 2I- = PbI2
log_k 3.2
delta_h 0 kJ
-gamma 0 0
# Id: 6003801
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Tl+ + I- = TlI
```

log_k 1.4279
delta_h 0 kJ
-gamma 0 0
Id: 8703800
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
Tl+ + 2I- = TlI2-
log_k 1.8588
delta_h 0 kJ
-gamma 0 0
Id: 8703801
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
Tl(OH)3 + 4I- + 3H+ = TlI4- + 3H2O
log_k 34.7596
delta_h 0 kJ
-gamma 0 0
Id: 8713800
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
Zn+2 + I- = ZnI+
log_k -2.0427
delta_h -4 kJ
-gamma 0 0
Id: 9503800
log K source: NIST46.3
Delta H source: NIST46.3
#T and ionic strength: 3.00 25.0
Zn+2 + 2I- = ZnI2
log_k -1.69
delta_h 0 kJ
-gamma 0 0
Id: 9503801
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
Cd+2 + I- = CdI+
log_k 2.28
delta_h -9.6 kJ
-gamma 0 0
Id: 1603800
log K source: NIST46.3
Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cd+2 + 2I- = CdI2
log_k 3.92
delta_h -12 kJ
-gamma 0 0
Id: 1603801
log K source: NIST46.3
Delta H source: NIST46.3

```
#T and ionic strength:  0.00 25.0
Hg(OH)2 + 2H+ + I- = HgI+ + 2H2O
log_k 19.603
delta_h -111.22 kJ
-gamma 0 0
# Id:  3613801
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.50 25.0
Hg(OH)2 + 2H+ + 2I- = HgI2 + 2H2O
log_k 30.8225
delta_h -182.72 kJ
-gamma 0 0
# Id:  3613802
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.50 25.0
Hg(OH)2 + 2H+ + 3I- = HgI3- + 2H2O
log_k 34.6025
delta_h -194.22 kJ
-gamma 0 0
# Id:  3613803
# log K source:  NIST46.4
# Delta H source:  NIST2.1.1
#T and ionic strength:  0.50 25.0
Hg(OH)2 + 2H+ + 4I- = HgI4-2 + 2H2O
log_k 36.533
delta_h -220.72 kJ
-gamma 0 0
# Id:  3613804
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.50 25.0
Ag+ + I- = AgI
log_k 6.6
delta_h 0 kJ
-gamma 0 0
# Id:  203800
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 18.0
Ag+ + 2I- = AgI2-
log_k 11.7
delta_h 0 kJ
-gamma 0 0
# Id:  203801
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 18.0
Ag+ + 3I- = AgI3-2
log_k 12.6
delta_h -122 kJ
-gamma 0 0
# Id:  203802
```

```
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Ag+ + 4I- = AgI4-3
log_k 14.229
delta_h 0 kJ
-gamma 0 0
# Id: 203803
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 2.00 25.0
Cr(OH)2+ + I- + 2H+ = CrI+2 + 2H2O
log_k 4.8289
delta_h 0 kJ
-gamma 0 0
# Id: 2113800
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
H+ + HS- = H2S
log_k 7.02
delta_h -22 kJ
-gamma 0 0
# Id: 3307300
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Pb+2 + 2HS- = Pb(HS)2
log_k 15.27
delta_h 0 kJ
-gamma 0 0
# Id: 6007300
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Pb+2 + 3HS- = Pb(HS)3-
log_k 16.57
delta_h 0 kJ
-gamma 0 0
# Id: 6007301
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Tl+ + HS- = TlHS
log_k 2.474
delta_h 0 kJ
-gamma 0 0
# Id: 8707300
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
2Tl+ + HS- = Tl2HS+
log_k 5.974
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 8707301
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
2Tl+ + 3HS- + H2O = Tl2OH(HS)3-2 + H+
log_k 1.0044
delta_h 0 kJ
-gamma 0 0
# Id: 8707302
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
2Tl+ + 2HS- + 2H2O = Tl2(OH)2(HS)2-2 + 2H+
log_k -11.0681
delta_h 0 kJ
-gamma 0 0
# Id: 8707303
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Zn+2 + 2HS- = Zn(HS)2
log_k 12.82
delta_h 0 kJ
-gamma 0 0
# Id: 9507300
# log K source: DHa1993
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Zn+2 + 3HS- = Zn(HS)3-
log_k 16.1
delta_h 0 kJ
-gamma 0 0
# Id: 9507301
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Zn+2 + 3HS- = ZnS(HS)2-2 + H+
log_k 6.12
delta_h 0 kJ
-gamma 0 0
# Id: 9507302
# log K source: DHa1993
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Zn+2 + 2HS- + 2HS- = Zn(HS)4-2
log_k 14.64
delta_h 0 kJ
-gamma 0 0
# Id: 9507303
# log K source: DHa1993
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Zn+2 + 2HS- = ZnS(HS)- + H+
```

```
log_k 6.81
delta_h 0 kJ
-gamma 0 0
# Id: 9507304
# log K source: DHa1993
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Cd+2 + HS- = CdHS+
log_k 8.008
delta_h 0 kJ
-gamma 0 0
# Id: 1607300
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Cd+2 + 2HS- = Cd(HS)2
log_k 15.212
delta_h 0 kJ
-gamma 0 0
# Id: 1607301
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Cd+2 + 3HS- = Cd(HS)3-
log_k 17.112
delta_h 0 kJ
-gamma 0 0
# Id: 1607302
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Cd+2 + 4HS- = Cd(HS)4-2
log_k 19.308
delta_h 0 kJ
-gamma 0 0
# Id: 1607303
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Hg(OH)2 + 2HS- = HgS2-2 + 2H2O
log_k 29.414
delta_h 0 kJ
-gamma 0 0
# Id: 3617300
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 20.0
Hg(OH)2 + 2H+ + 2HS- = Hg(HS)2 + 2H2O
log_k 44.516
delta_h 0 kJ
-gamma 0 0
# Id: 3617301
# log K source: NIST46.3
# Delta H source: MTQ3.11
```

```
#T and ionic strength:  1.00 20.0
Hg(OH)2 + H+ + 2HS- = HgHS2- + 2H2O
log_k 38.122
delta_h 0 kJ
-gamma 0 0
# Id:  3617302
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  1.00 20.0
Cu+2 + 3HS- = Cu(HS)3-
log_k 25.899
delta_h 0 kJ
-gamma 0 0
# Id:  2317300
# log K source:  MTQ3.11
# Delta H source:  MTQ3.11
#T and ionic strength:
Ag+ + HS- = AgHS
log_k 13.8145
delta_h 0 kJ
-gamma 0 0
# Id:  207300
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.10 20.0
Ag+ + 2HS- = Ag(HS)2-
log_k 17.9145
delta_h 0 kJ
-gamma 0 0
# Id:  207301
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.10 20.0
Fe+2 + 2HS- = Fe(HS)2
log_k 8.95
delta_h 0 kJ
-gamma 0 0
# Id:  2807300
# log K source:  MTQ3.11
# Delta H source:  MTQ3.11
#T and ionic strength:
Fe+2 + 3HS- = Fe(HS)3-
log_k 10.987
delta_h 0 kJ
-gamma 0 0
# Id:  2807301
# log K source:  MTQ3.11
# Delta H source:  MTQ3.11
#T and ionic strength:
HS- = S2-2 + H+
log_k -11.7828
delta_h 46.4 kJ
-gamma 0 0
-no_check
```

```
# Id: 7317300
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
HS- = S3-2 + H+
log_k -10.7667
delta_h 42.2 kJ
-gamma 0 0
-no_check
# Id: 7317301
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
HS- = S4-2 + H+
log_k -9.9608
delta_h 39.3 kJ
-gamma 0 0
-no_check
# Id: 7317302
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
HS- = S5-2 + H+
log_k -9.3651
delta_h 37.6 kJ
-gamma 0 0
-no_check
# Id: 7317303
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
HS- = S6-2 + H+
log_k -9.881
delta_h 0 kJ
-gamma 0 0
-no_check
# Id: 7317304
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
2Sb(OH)3 + 4HS- + 2H+ = Sb2S4-2 + 6H2O
log_k 49.3886
delta_h -321.78 kJ
-gamma 0 0
# Id: 7407300
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
Cu+ + 2HS- = Cu(S4)2-3 + 2H+
log_k 3.39
delta_h 0 kJ
-gamma 23 0
-no_check
# Id: 2307300
```

```
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Cu+ + 2HS- = CuS4S5-3 + 2H+
log_k 2.66
delta_h 0 kJ
-gamma 25 0
-no_check
# Id: 2307301
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Ag+ + 2HS- = Ag(S4)2-3 + 2H+
log_k 0.991
delta_h 0 kJ
-gamma 22 0
-no_check
# Id: 207302
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Ag+ + 2HS- = AgS4S5-3 + 2H+
log_k 0.68
delta_h 0 kJ
-gamma 24 0
-no_check
# Id: 207303
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Ag+ + 2HS- = Ag(HS)S4-2 + H+
log_k 10.431
delta_h 0 kJ
-gamma 15 0
-no_check
# Id: 207304
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
H+ + SO4-2 = HSO4-
log_k 1.99
delta_h 22 kJ
-gamma 4.5 0
# Id: 3307320
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
NH4+ + SO4-2 = NH4SO4-
log_k 1.03
delta_h 0 kJ
-gamma 5 0
# Id: 4907320
# log K source: NIST46.3
# Delta H source: MTQ3.11
```

```
#T and ionic strength:  0.00 25.0
Pb+2 + SO4-2 = PbSO4
log_k 2.69
delta_h 0 kJ
-gamma 0 0
# Id:  6007320
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
Pb+2 + 2SO4-2 = Pb(SO4)2-2
log_k 3.47
delta_h 0 kJ
-gamma 0 0
# Id:  6007321
# log K source:  SCD3.02 (1960 RKa)
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
Al+3 + SO4-2 = AlSO4+
log_k 3.89
delta_h 28 kJ
-gamma 4.5 0
# Id:  307320
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Al+3 + 2SO4-2 = Al(SO4)2-
log_k 4.92
delta_h 11.9 kJ
-gamma 4.5 0
# Id:  307321
# log K source:  Nord90
# Delta H source:  Nord90
#T and ionic strength:  0.00 25.0
Tl+ + SO4-2 = TlSO4-
log_k 1.37
delta_h -0.8 kJ
-gamma 0 0
# Id:  8707320
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Zn+2 + SO4-2 = ZnSO4
log_k 2.34
delta_h 6.2 kJ
-gamma 0 0
# Id:  9507320
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Zn+2 + 2SO4-2 = Zn(SO4)2-2
log_k 3.28
delta_h 0 kJ
-gamma 0 0
# Id:  9507321
```

```
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Cd+2 + SO4-2 = CdSO4
log_k 2.37
delta_h 8.7 kJ
-gamma 0 0
# Id: 1607320
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cd+2 + 2SO4-2 = Cd(SO4)2-2
log_k 3.5
delta_h 0 kJ
-gamma 0 0
# Id: 1607321
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Hg(OH)2 + 2H+ + SO4-2 = HgSO4 + 2H2O
log_k 8.612
delta_h 0 kJ
-gamma 0 0
# Id: 3617320
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.50 25.0
Cu+2 + SO4-2 = CuSO4
log_k 2.36
delta_h 8.7 kJ
-gamma 0 0
# Id: 2317320
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Ag+ + SO4-2 = AgSO4-
log_k 1.3
delta_h 6.2 kJ
-gamma 0 0
# Id: 207320
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Ni+2 + SO4-2 = NiSO4
log_k 2.3
delta_h 5.8 kJ
-gamma 0 0
# Id: 5407320
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Ni+2 + 2SO4-2 = Ni(SO4)2-2
log_k 0.82
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 5407321
# log K source: SCD3.02 (1978 BLa)
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Co+2 + SO4-2 = CoSO4
log_k 2.3
delta_h 6.2 kJ
-gamma 0 0
# Id: 2007320
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Fe+2 + SO4-2 = FeSO4
log_k 2.39
delta_h 8 kJ
-gamma 0 0
# Id: 2807320
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Fe+3 + SO4-2 = FeSO4+
log_k 4.05
delta_h 25 kJ
-gamma 5 0
# Id: 2817320
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Fe+3 + 2SO4-2 = Fe(SO4)2-
log_k 5.38
delta_h 19.2 kJ
-gamma 0 0
# Id: 2817321
# log K source: Nord90
# Delta H source: Nord90
#T and ionic strength: 0.00 25.0
Mn+2 + SO4-2 = MnSO4
log_k 2.25
delta_h 8.7 kJ
-gamma 0 0
# Id: 4707320
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cr(OH)2+ + 2H+ + SO4-2 = CrSO4+ + 2H2O
log_k 12.9371
delta_h -98.62 kJ
-gamma 0 0
# Id: 2117320
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 1.00 50.0
Cr(OH)2+ + H+ + SO4-2 = CrOHSO4 + H2O
```

```
log_k 8.2871
delta_h 0 kJ
-gamma 0 0
# Id: 2117321
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.10 25.0
2Cr(OH)2+ + SO4-2 + 2H+ = Cr2(OH)2SO4+2 + 2H2O
log_k 16.155
delta_h 0 kJ
-gamma 0 0
# Id: 2117323
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
2Cr(OH)2+ + 2SO4-2 + 2H+ = Cr2(OH)2(SO4)2 + 2H2O
log_k 17.9288
delta_h 0 kJ
-gamma 0 0
# Id: 2117324
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
U+4 + SO4-2 = USO4+2
log_k 6.6
delta_h 8 kJ
-gamma 0 0
# Id: 8917320
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
U+4 + 2SO4-2 = U(SO4)2
log_k 10.5
delta_h 33 kJ
-gamma 0 0
# Id: 8917321
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
UO2+2 + SO4-2 = UO2SO4
log_k 3.18
delta_h 20 kJ
-gamma 0 0
# Id: 8937320
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
UO2+2 + 2SO4-2 = UO2(SO4)2-2
log_k 4.3
delta_h 38 kJ
-gamma 0 0
# Id: 8937321
# log K source: NIST46.3
# Delta H source: NIST46.3
```

```
#T and ionic strength:  0.00 25.0
V+3 + SO4-2 = VSO4+
log_k 2.674
delta_h 0 kJ
-gamma 0 0
# Id:  9017320
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  1.00 25.0
VO+2 + SO4-2 = VOSO4
log_k 2.44
delta_h 17 kJ
-gamma 0 0
# Id:  9027320
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
VO2+ + SO4-2 = VO2SO4-
log_k 1.378
delta_h 0 kJ
-gamma 0 0
# Id:  9037320
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  1.00 20.0
Be+2 + SO4-2 = BeSO4
log_k 2.19
delta_h 29 kJ
-gamma 0 0
# Id:  1107321
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.00 25.0
Be+2 + 2SO4-2 = Be(SO4)2-2
log_k 2.596
delta_h 0 kJ
-gamma 0 0
# Id:  1107322
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  1.00 25.0
Mg+2 + SO4-2 = MgSO4
log_k 2.26
delta_h 5.8 kJ
-gamma 0 0
# Id:  4607320
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Ca+2 + SO4-2 = CaSO4
log_k 2.36
delta_h 7.1 kJ
-gamma 0 0
# Id:  1507320
```

```
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Sr+2 + SO4-2 = SrSO4
log_k 2.3
delta_h 8 kJ
-gamma 0 0
# Id: 8007321
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Li+ + SO4-2 = LiSO4-
log_k 0.64
delta_h 0 kJ
-gamma 5 0
# Id: 4407320
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Na+ + SO4-2 = NaSO4-
log_k 0.73
delta_h 1 kJ
-gamma 5.4 0
# Id: 5007320
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
K+ + SO4-2 = KSO4-
log_k 0.85
delta_h 4.1 kJ
-gamma 5.4 0
# Id: 4107320
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
HSe- + H+ = H2Se
log_k 3.89
delta_h 3.3 kJ
-gamma 0 0
# Id: 3307600
# log K source: NIST46.3
# Delta H source: NIST2.1.1
#T and ionic strength: 0.00 25.0
2Ag+ + HSe- = Ag2Se + H+
log_k 34.911
delta_h 0 kJ
-gamma 0 0
# Id: 207600
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Ag+ + H2O + 2HSe- = AgOH(Se)2-4 + 3H+
log_k -20.509
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 207601
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Mn+2 + HSe- = MnSe + H+
log_k -5.385
delta_h 0 kJ
-gamma 0 0
# Id: 4707600
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
HSeO3- = SeO3-2 + H+
log_k -8.4
delta_h 5.02 kJ
-gamma 0 0
# Id: 3307611
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
HSeO3- + H+ = H2SeO3
log_k 2.63
delta_h 6.2 kJ
-gamma 0 0
# Id: 3307610
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cd+2 + 2HSeO3- = Cd(SeO3)2-2 + 2H+
log_k -10.884
delta_h 0 kJ
-gamma 0 0
# Id: 1607610
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Ag+ + HSeO3- = AgSeO3- + H+
log_k -5.592
delta_h 0 kJ
-gamma 0 0
# Id: 207610
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Ag+ + 2HSeO3- = Ag(SeO3)2-3 + 2H+
log_k -13.04
delta_h 0 kJ
-gamma 0 0
# Id: 207611
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Fe+3 + HSeO3- = FeHSeO3+2
```

```
log_k 3.422
delta_h 25 kJ
-gamma 0 0
# Id: 2817610
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 1.00 25.0
SeO4-2 + H+ = HSeO4-
log_k 1.7
delta_h 23 kJ
-gamma 0 0
# Id: 3307620
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Zn+2 + SeO4-2 = ZnSeO4
log_k 2.19
delta_h 0 kJ
-gamma 0 0
# Id: 9507620
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Zn+2 + 2SeO4-2 = Zn(SeO4)2-2
log_k 2.196
delta_h 0 kJ
-gamma 0 0
# Id: 9507621
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Cd+2 + SeO4-2 = CdSeO4
log_k 2.27
delta_h 0 kJ
-gamma 0 0
# Id: 1607620
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Ni+2 + SeO4-2 = NiSeO4
log_k 2.67
delta_h 14 kJ
-gamma 0 0
# Id: 5407620
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Co+2 + SeO4-2 = CoSeO4
log_k 2.7
delta_h 12 kJ
-gamma 0 0
# Id: 2007621
# log K source: NIST46.4
# Delta H source: NIST46.4
```

```
#T and ionic strength:  0.00 25.0
Mn+2 + SeO4-2 = MnSeO4
log_k 2.43
delta_h 14 kJ
-gamma 0 0
# Id:  4707620
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.00 25.0
NH4+ = NH3 + H+
log_k -9.244
delta_h 52 kJ
-gamma 0 0
# Id:  3304900
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Ag+ + NH4+ = AgNH3+ + H+
log_k -5.934
delta_h -72 kJ
-gamma 0 0
# Id:  204901
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.00 25.0
Ag+ + 2NH4+ = Ag(NH3)2+ + 2H+
log_k -11.268
delta_h -160 kJ
-gamma 0 0
# Id:  204902
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.00 25.0
Hg(OH)2 + H+ + NH4+ = HgNH3+2 + 2H2O
log_k 5.75
delta_h 0 kJ
-gamma 0 0
# Id:  3614900
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  2.00 22.0
Hg(OH)2 + 2NH4+ = Hg(NH3)2+2 + 2H2O
log_k 5.506
delta_h -246.72 kJ
-gamma 0 0
# Id:  3614901
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  1.00 25.0
Hg(OH)2 + 3NH4+ = Hg(NH3)3+2 + 2H2O + H+
log_k -3.138
delta_h -312.72 kJ
-gamma 0 0
# Id:  3614902
```

```
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 2.00 25.0
Hg(OH)2 + 4NH4+ = Hg(NH3)4+2 + 2H2O + 2H+
log_k -11.482
delta_h -379.72 kJ
-gamma 0 0
# Id: 3614903
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.10 25.0
Cu+2 + NH4+ = CuNH3+2 + H+
log_k -5.234
delta_h -72 kJ
-gamma 0 0
# Id: 2314901
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ni+2 + NH4+ = NiNH3+2 + H+
log_k -6.514
delta_h -67 kJ
-gamma 0 0
# Id: 5404901
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Ni+2 + 2NH4+ = Ni(NH3)2+2 + 2H+
log_k -13.598
delta_h -111.6 kJ
-gamma 0 0
# Id: 5404902
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Co+2 + NH4+ = Co(NH3)+2 + H+
log_k -7.164
delta_h -65 kJ
-gamma 0 0
# Id: 2004900
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Co+2 + 2NH4+ = Co(NH3)2+2 + 2H+
log_k -14.778
delta_h 0 kJ
-gamma 0 0
# Id: 2004901
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 2.00 25.0
Co+2 + 3NH4+ = Co(NH3)3+2 + 3H+
log_k -22.922
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 2004902
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 2.00 25.0
Co+2 + 4NH4+ = Co(NH3)4+2 + 4H+
log_k -31.446
delta_h 0 kJ
-gamma 0 0
# Id: 2004903
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 2.00 30.0
Co+2 + 5NH4+ = Co(NH3)5+2 + 5H+
log_k -40.47
delta_h 0 kJ
-gamma 0 0
# Id: 2004904
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 2.00 30.0
Co+3 + 6NH4+ + H2O = Co(NH3)6OH+2 + 7H+
log_k -43.7148
delta_h 0 kJ
-gamma 0 0
# Id: 2014901
# log K source: NIST2.1.1
# Delta H source: MTQ3.11
#T and ionic strength:
Co+3 + 5NH4+ + Cl- = Co(NH3)5Cl+2 + 5H+
log_k -17.9584
delta_h 113.38 kJ
-gamma 0 0
# Id: 2014902
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
Co+3 + 6NH4+ + Cl- = Co(NH3)6Cl+2 + 6H+
log_k -33.9179
delta_h 104.34 kJ
-gamma 0 0
# Id: 2014903
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
Co+3 + 6NH4+ + Br- = Co(NH3)6Br+2 + 6H+
log_k -33.8884
delta_h 110.57 kJ
-gamma 0 0
# Id: 2014904
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
Co+3 + 6NH4+ + I- = Co(NH3)6I+2 + 6H+
```

log_k -33.4808
delta_h 115.44 kJ
-gamma 0 0
Id: 2014905
log K source: NIST2.1.1
Delta H source: NIST2.1.1
#T and ionic strength:
Co+3 + 6NH4+ + SO4-2 = Co(NH3)6SO4+ + 6H+
log_k -28.9926
delta_h 124.5 kJ
-gamma 0 0
Id: 2014906
log K source: NIST2.1.1
Delta H source: NIST2.1.1
#T and ionic strength:
Cr(OH)2+ + 6NH4+ = Cr(NH3)6+3 + 2H2O + 4H+
log_k -32.8952
delta_h 0 kJ
-gamma 0 0
Id: 2114900
log K source: NIST46.3
Delta H source: MTQ3.11
#T and ionic strength: 4.50 25.0
Cr(OH)2+ + 5NH4+ = Cr(NH3)5OH+2 + 4H+ + H2O
log_k -30.2759
delta_h 0 kJ
-gamma 0 0
Id: 2114901
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
Cr(OH)2+ + 6NH4+ + Cl- = Cr(NH3)6Cl+2 + 2H2O + 4H+
log_k -31.7932
delta_h 0 kJ
-gamma 0 0
Id: 2114904
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
Cr(OH)2+ + 6NH4+ + Br- = Cr(NH3)6Br+2 + 4H+ + 2H2O
log_k -31.887
delta_h 0 kJ
-gamma 0 0
Id: 2114905
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
Cr(OH)2+ + 6NH4+ + I- = Cr(NH3)6I+2 + 4H+ + 2H2O
log_k -32.008
delta_h 0 kJ
-gamma 0 0
Id: 2114906
log K source: MTQ3.11
Delta H source: MTQ3.11

#T and ionic strength:
#Cr(OH)2+ + 4NH4+ = cis+ + 4H+
log_k -29.8574
delta_h 0 kJ
-gamma 0 0
Id: 4902113
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
#Cr(OH)2+ + 4NH4+ = trans+ + 4H+
log_k -30.5537
delta_h 0 kJ
-gamma 0 0
Id: 4902114
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
Ca+2 + NH4+ = CaNH3+2 + H+
log_k -9.144
delta_h 0 kJ
-gamma 0 0
Id: 1504901
log K source: NIST46.4
Delta H source: MTQ3.11
#T and ionic strength: 0.50 25.0
Ca+2 + 2NH4+ = Ca(NH3)2+2 + 2H+
log_k -18.788
delta_h 0 kJ
-gamma 0 0
Id: 1504902
log K source: NIST46.4
Delta H source: MTQ3.11
#T and ionic strength: 0.50 25.0
Sr+2 + NH4+ = SrNH3+2 + H+
log_k -9.344
delta_h 0 kJ
-gamma 0 0
Id: 8004901
log K source: NIST46.4
Delta H source: MTQ3.11
#T and ionic strength: 0.50 25.0
Ba+2 + NH4+ = BaNH3+2 + H+
log_k -9.444
delta_h 0 kJ
-gamma 0 0
Id: 1004901
log K source: NIST46.4
Delta H source: MTQ3.11
#T and ionic strength: 0.50 25.0
Tl+ + NO2- = TlNO2
log_k 0.83
delta_h 0 kJ
-gamma 0 0
Id: 8704910

```
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Ag+ + NO2- = AgNO2
log_k 2.32
delta_h -29 kJ
-gamma 0 0
# Id: 204911
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ag+ + 2NO2- = Ag(NO2)2-
log_k 2.51
delta_h -46 kJ
-gamma 0 0
# Id: 204910
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cu+2 + NO2- = CuNO2+
log_k 2.02
delta_h 0 kJ
-gamma 0 0
# Id: 2314911
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Cu+2 + 2NO2- = Cu(NO2)2
log_k 3.03
delta_h 0 kJ
-gamma 0 0
# Id: 2314912
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Co+2 + NO2- = CoNO2+
log_k 0.848
delta_h 0 kJ
-gamma 0 0
# Id: 2004911
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Sn(OH)2 + 2H+ + NO3- = SnNO3+ + 2H2O
log_k 7.942
delta_h 0 kJ
-gamma 0 0
# Id: 7904921
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 25.0
Pb+2 + NO3- = PbNO3+
log_k 1.17
delta_h 2 kJ
```

```
-gamma 0 0
# Id: 6004920
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Pb+2 + 2NO3- = Pb(NO3)2
log_k 1.4
delta_h -6.6 kJ
-gamma 0 0
# Id: 6004921
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Tl+ + NO3- = TlNO3
log_k 0.33
delta_h -2 kJ
-gamma 0 0
# Id: 8704920
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Tl(OH)3 + NO3- + 3H+ = TlNO3+2 + 3H2O
log_k 7.0073
delta_h 0 kJ
-gamma 0 0
# Id: 8714920
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Cd+2 + NO3- = CdNO3+
log_k 0.5
delta_h -21 kJ
-gamma 0 0
# Id: 1604920
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Cd+2 + 2NO3- = Cd(NO3)2
log_k 0.2
delta_h 0 kJ
-gamma 0 0
# Id: 1604921
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Hg(OH)2 + 2H+ + NO3- = HgNO3+ + 2H2O
log_k 5.7613
delta_h 0 kJ
-gamma 0 0
# Id: 3614920
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 3.00 25.0
Hg(OH)2 + 2H+ + 2NO3- = Hg(NO3)2 + 2H2O
```

```
log_k 5.38
delta_h 0 kJ
-gamma 0 0
# Id: 3614921
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 3.00 25.0
Cu+2 + NO3- = CuNO3+
log_k 0.5
delta_h -4.1 kJ
-gamma 0 0
# Id: 2314921
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Cu+2 + 2NO3- = Cu(NO3)2
log_k -0.4
delta_h 0 kJ
-gamma 0 0
# Id: 2314922
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Zn+2 + NO3- = ZnNO3+
log_k 0.4
delta_h -4.6 kJ
-gamma 0 0
# Id: 9504921
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Zn+2 + 2NO3- = Zn(NO3)2
log_k -0.3
delta_h 0 kJ
-gamma 0 0
# Id: 9504922
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Ag+ + NO3- = AgNO3
log_k -0.1
delta_h 22.6 kJ
-gamma 0 0
# Id: 204920
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Ni+2 + NO3- = NiNO3+
log_k 0.4
delta_h 0 kJ
-gamma 0 0
# Id: 5404921
# log K source: NIST46.4
# Delta H source: MTQ3.11
```

```
#T and ionic strength:  0.00 25.0
Co+2 + NO3- = CoNO3+
log_k 0.2
delta_h 0 kJ
-gamma 0 0
# Id:  2004921
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
Co+2 + 2NO3- = Co(NO3)2
log_k 0.5085
delta_h 0 kJ
-gamma 0 0
# Id:  2004922
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  0.50 25.0
Fe+3 + NO3- = FeNO3+2
log_k 1
delta_h -37 kJ
-gamma 0 0
# Id:  2814921
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.00 25.0
Mn+2 + NO3- = MnNO3+
log_k 0.2
delta_h 0 kJ
-gamma 0 0
# Id:  4704921
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
Mn+2 + 2NO3- = Mn(NO3)2
log_k 0.6
delta_h -1.6569 kJ
-gamma 0 0
# Id:  4704920
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
Cr(OH)2+ + NO3- + 2H+ = CrNO3+2 + 2H2O
log_k 8.2094
delta_h -65.4378 kJ
-gamma 0 0
# Id:  2114920
# log K source:  MTQ3.11
# Delta H source:  MTQ3.11
#T and ionic strength:
UO2+2 + NO3- = UO2NO3+
log_k 0.3
delta_h -12 kJ
-gamma 0 0
# Id:  8934921
```

```
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
VO2+ + NO3- = VO2NO3
log_k -0.296
delta_h 0 kJ
-gamma 0 0
# Id: 9034920
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 1.00 20.0
Ca+2 + NO3- = CaNO3+
log_k 0.5
delta_h -5.4 kJ
-gamma 0 0
# Id: 1504921
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Sr+2 + NO3- = SrNO3+
log_k 0.6
delta_h -10 kJ
-gamma 0 0
# Id: 8004921
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ba+2 + NO3- = BaNO3+
log_k 0.7
delta_h -13 kJ
-gamma 0 0
# Id: 1004921
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
H+ + Cyanide- = HCyanide
log_k 9.21
delta_h -43.63 kJ
-gamma 0 0
# Id: 3301431
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Cd+2 + Cyanide- = CdCyanide+
log_k 6.01
delta_h -30 kJ
-gamma 0 0
# Id: 1601431
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Cd+2 + 2Cyanide- = Cd(Cyanide)2
log_k 11.12
delta_h -54.3 kJ
```

```
-gamma 0 0
# Id: 1601432
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Cd+2 + 3Cyanide- = Cd(Cyanide)3-
log_k 15.65
delta_h -90.3 kJ
-gamma 0 0
# Id: 1601433
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Cd+2 + 4Cyanide- = Cd(Cyanide)4-2
log_k 17.92
delta_h -112 kJ
-gamma 0 0
# Id: 1601434
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Hg(OH)2 + 2H+ + Cyanide- = HgCyanide+ + 2H2O
log_k 23.194
delta_h -136.72 kJ
-gamma 0 0
# Id: 3611431
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Hg(OH)2 + 2H+ + 2Cyanide- = Hg(Cyanide)2 + 2H2O
log_k 38.944
delta_h 154.28 kJ
-gamma 0 0
# Id: 3611432
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Hg(OH)2 + 2H+ + 3Cyanide- = Hg(Cyanide)3- + 2H2O
log_k 42.504
delta_h -262.72 kJ
-gamma 0 0
# Id: 3611433
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Hg(OH)2 + 2H+ + 4Cyanide- = Hg(Cyanide)4-2 + 2H2O
log_k 45.164
delta_h -288.72 kJ
-gamma 0 0
# Id: 3611434
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Cu+ + 2Cyanide- = Cu(Cyanide)2-
```

```
log_k 21.9145
delta_h -121 kJ
-gamma 0 0
# Id: 2301432
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Cu+ + 3Cyanide- = Cu(Cyanide)3-2
log_k 27.2145
delta_h -167.4 kJ
-gamma 0 0
# Id: 2301433
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Cu+ + 4Cyanide- = Cu(Cyanide)4-3
log_k 28.7145
delta_h -214.2 kJ
-gamma 0 0
# Id: 2301431
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ag+ + 2Cyanide- = Ag(Cyanide)2-
log_k 20.48
delta_h -137 kJ
-gamma 0 0
# Id: 201432
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ag+ + 3Cyanide- = Ag(Cyanide)3-2
log_k 21.7
delta_h -140 kJ
-gamma 0 0
# Id: 201433
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ag+ + H2O + Cyanide- = Ag(Cyanide)OH- + H+
log_k -0.777
delta_h 0 kJ
-gamma 0 0
# Id: 201431
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Ni+2 + 4Cyanide- = Ni(Cyanide)4-2
log_k 30.2
delta_h -180 kJ
-gamma 0 0
# Id: 5401431
# log K source: NIST46.4
# Delta H source: NIST46.4
```

```
#T and ionic strength:  0.00 25.0
Ni+2 + 4Cyanide- + H+ = NiH(Cyanide)4-
log_k 36.0289
delta_h 0 kJ
-gamma 0 0
# Id:  5401432
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  0.10 25.0
Ni+2 + 4Cyanide- + 2H+ = NiH2Cyanide4
log_k 40.7434
delta_h 0 kJ
-gamma 0 0
# Id:  5401433
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  0.10 25.0
Ni+2 + 4Cyanide- + 3H+ = NiH3(Cyanide)4+
log_k 43.3434
delta_h 0 kJ
-gamma 0 0
# Id:  5401434
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  0.10 25.0
Co+2 + 3Cyanide- = Co(Cyanide)3-
log_k 14.312
delta_h 0 kJ
-gamma 0 0
# Id:  2001431
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  1.00 25.0
Co+2 + 5Cyanide- = Co(Cyanide)5-3
log_k 23
delta_h -257 kJ
-gamma 0 0
# Id:  2001432
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  1.00 25.0
Fe+2 + 6Cyanide- = Fe(Cyanide)6-4
log_k 35.4
delta_h -358 kJ
-gamma 0 0
# Id:  2801431
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.00 25.0
H+ + Fe+2 + 6Cyanide- = HFe(Cyanide)6-3
log_k 39.71
delta_h -356 kJ
-gamma 0 0
# Id:  2801432
```

```
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
2H+ + Fe+2 + 6Cyanide- = H2Fe(Cyanide)6-2
log_k 42.11
delta_h -352 kJ
-gamma 0 0
# Id: 2801433
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Fe+3 + 6Cyanide- = Fe(Cyanide)6-3
log_k 43.6
delta_h -293 kJ
-gamma 0 0
# Id: 2811431
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
2Fe+3 + 6Cyanide- = Fe2(Cyanide)6
log_k 47.6355
delta_h -218 kJ
-gamma 0 0
# Id: 2811432
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.50 25.0
Sn(OH)2 + Fe+3 + 6Cyanide- + 2H+ = SnFe(Cyanide)6- + 2H2O
log_k 53.54
delta_h 0 kJ
-gamma 0 0
# Id: 7901431
# log K source: Ba1987
# Delta H source:
#T and ionic strength: 0.00 25.0
NH4+ + Fe+2 + 6Cyanide- = NH4Fe(Cyanide)6-3
log_k 37.7
delta_h -354 kJ
-gamma 0 0
# Id: 4901431
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Tl+ + Fe+2 + 6Cyanide- = TlFe(Cyanide)6-3
log_k 38.4
delta_h -365.5 kJ
-gamma 0 0
# Id: 8701432
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Mg+2 + Fe+3 + 6Cyanide- = MgFe(Cyanide)6-
log_k 46.39
delta_h -290 kJ
```

```
-gamma 0 0
# Id: 4601431
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Mg+2 + Fe+2 + 6Cyanide- = MgFe(Cyanide)6-2
log_k 39.21
delta_h -346 kJ
-gamma 0 0
# Id: 4601432
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ca+2 + Fe+3 + 6Cyanide- = CaFe(Cyanide)6-
log_k 46.43
delta_h -291 kJ
-gamma 0 0
# Id: 1501431
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ca+2 + Fe+2 + 6Cyanide- = CaFe(Cyanide)6-2
log_k 39.1
delta_h -347 kJ
-gamma 0 0
# Id: 1501432
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
2Ca+2 + Fe+2 + 6Cyanide- = Ca2Fe(Cyanide)6
log_k 40.6
delta_h -350.201 kJ
-gamma 0 0
# Id: 1501433
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Sr+2 + Fe+3 + 6Cyanide- = SrFe(Cyanide)6-
log_k 46.45
delta_h -292 kJ
-gamma 0 0
# Id: 8001431
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Sr+2 + Fe+2 + 6Cyanide- = SrFe(Cyanide)6-2
log_k 39.1
delta_h -350 kJ
-gamma 0 0
# Id: 8001432
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ba+2 + Fe+2 + 6Cyanide- = BaFe(Cyanide)6-2
```

```
log_k 39.19
delta_h -342 kJ
-gamma 0 0
# Id: 1001430
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ba+2 + Fe+3 + 6Cyanide- = BaFe(Cyanide)6-
log_k 46.48
delta_h -292 kJ
-gamma 0 0
# Id: 1001431
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Na+ + Fe+2 + 6Cyanide- = NaFe(Cyanide)6-3
log_k 37.6
delta_h -354 kJ
-gamma 0 0
# Id: 5001431
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
K+ + Fe+2 + 6Cyanide- = KFe(Cyanide)6-3
log_k 37.75
delta_h -353.9 kJ
-gamma 0 0
# Id: 4101433
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
K+ + Fe+3 + 6Cyanide- = KFe(Cyanide)6-2
log_k 45.04
delta_h -291 kJ
-gamma 0 0
# Id: 4101430
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
H+ + PO4-3 = HPO4-2
log_k 12.375
delta_h -15 kJ
-gamma 5 0
# Id: 3305800
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
2H+ + PO4-3 = H2PO4-
log_k 19.573
delta_h -18 kJ
-gamma 5.4 0
# Id: 3305801
# log K source: NIST46.3
# Delta H source: NIST46.3
```

```
#T and ionic strength:  0.00 25.0
3H+ + PO4-3 = H3PO4
log_k 21.721
delta_h -10.1 kJ
-gamma 0 0
# Id:  3305802
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
Co+2 + H+ + PO4-3 = CoHPO4
log_k 15.4128
delta_h 0 kJ
-gamma 0 0
# Id:  2005800
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  0.10 25.0
Fe+2 + 2H+ + PO4-3 = FeH2PO4+
log_k 22.273
delta_h 0 kJ
-gamma 5.4 0
# Id:  2805800
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
Fe+2 + H+ + PO4-3 = FeHPO4
log_k 15.975
delta_h 0 kJ
-gamma 0 0
# Id:  2805801
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
Fe+3 + 2H+ + PO4-3 = FeH2PO4+2
log_k 23.8515
delta_h 0 kJ
-gamma 5.4 0
# Id:  2815801
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.50 25.0
Fe+3 + H+ + PO4-3 = FeHPO4+
log_k 22.292
delta_h -30.5432 kJ
-gamma 5.4 0
# Id:  2815800
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.50 25.0
Cr(OH)2+ + 4H+ + PO4-3 = CrH2PO4+2 + 2H2O
log_k 31.9068
delta_h 0 kJ
-gamma 0 0
# Id:  2115800
```

```
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
U+4 + PO4-3 + H+ = UHPO4+2
log_k 24.443
delta_h 31.38 kJ
-gamma 0 0
# Id: 8915800
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
U+4 + 2PO4-3 + 2H+ = U(HPO4)2
log_k 46.833
delta_h 7.1128 kJ
-gamma 0 0
# Id: 8915801
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
U+4 + 3PO4-3 + 3H+ = U(HPO4)3-2
log_k 67.564
delta_h -32.6352 kJ
-gamma 0 0
# Id: 8915802
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
U+4 + 4PO4-3 + 4H+ = U(HPO4)4-4
log_k 88.483
delta_h -110.876 kJ
-gamma 0 0
# Id: 8915803
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
UO2+2 + H+ + PO4-3 = UO2HPO4
log_k 19.655
delta_h -8.7864 kJ
-gamma 0 0
# Id: 8935800
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
UO2+2 + 2PO4-3 + 2H+ = UO2(HPO4)2-2
log_k 42.988
delta_h -47.6934 kJ
-gamma 0 0
# Id: 8935801
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
UO2+2 + 2H+ + PO4-3 = UO2H2PO4+
log_k 22.833
delta_h -15.4808 kJ
```

```
-gamma 0 0
# Id: 8935802
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
UO2+2 + 2PO4-3 + 4H+ = UO2(H2PO4)2
log_k 44.7
delta_h -69.036 kJ
-gamma 0 0
# Id: 8935803
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
UO2+2 + 3PO4-3 + 6H+ = UO2(H2PO4)3-
log_k 66.245
delta_h -119.662 kJ
-gamma 0 0
# Id: 8935804
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
UO2+2 + PO4-3 = UO2PO4-
log_k 13.25
delta_h 0 kJ
-gamma 0 0
# Id: 8935805
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Mg+2 + PO4-3 = MgPO4-
log_k 4.654
delta_h 12.9704 kJ
-gamma 5.4 0
# Id: 4605800
# log K source: SCD3.02 (1993 GMa)
# Delta H source: MTQ3.11
#T and ionic strength: 0.20 25.0
Mg+2 + 2H+ + PO4-3 = MgH2PO4+
log_k 21.2561
delta_h -4.6861 kJ
-gamma 5.4 0
# Id: 4605801
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 37.0
Mg+2 + H+ + PO4-3 = MgHPO4
log_k 15.175
delta_h -3 kJ
-gamma 0 0
# Id: 4605802
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Ca+2 + H+ + PO4-3 = CaHPO4
```

```
log_k 15.035
delta_h -3 kJ
-gamma 0 0
# Id: 1505800
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Ca+2 + PO4-3 = CaPO4-
log_k 6.46
delta_h 12.9704 kJ
-gamma 5.4 0
# Id: 1505801
# log K source: SCD3.02 (1993 GMa)
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Ca+2 + 2H+ + PO4-3 = CaH2PO4+
log_k 20.923
delta_h -6 kJ
-gamma 5.4 0
# Id: 1505802
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Sr+2 + H+ + PO4-3 = SrHPO4
log_k 14.8728
delta_h 0 kJ
-gamma 0 0
# Id: 8005800
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.10 25.0
Sr+2 + 2H+ + PO4-3 = SrH2PO4+
log_k 20.4019
delta_h 0 kJ
-gamma 0 0
# Id: 8005801
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.10 20.0
Na+ + H+ + PO4-3 = NaHPO4-
log_k 13.445
delta_h 0 kJ
-gamma 5.4 0
# Id: 5005800
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
K+ + H+ + PO4-3 = KHPO4-
log_k 13.255
delta_h 0 kJ
-gamma 5.4 0
# Id: 4105800
# log K source: NIST46.3
# Delta H source: MTQ3.11
```

```
#T and ionic strength:  0.00 25.0
H3AsO3 = AsO3-3 + 3H+
log_k -34.744
delta_h 84.726 kJ
-gamma 0 0
# Id:  3300602
# log K source:  MTQ3.11
# Delta H source:  MTQ3.11
#T and ionic strength:
H3AsO3 = HAsO3-2 + 2H+
log_k -21.33
delta_h 59.4086 kJ
-gamma 0 0
# Id:  3300601
# log K source:  MTQ3.11
# Delta H source:  MTQ3.11
#T and ionic strength:
H3AsO3 = H2AsO3- + H+
log_k -9.29
delta_h 27.41 kJ
-gamma 0 0
# Id:  3300600
# log K source:  NIST46.4
# Delta H source:  NIST2.1.1
#T and ionic strength:  0.00 25.0
H3AsO3 + H+ = H4AsO3+
log_k -0.305
delta_h 0 kJ
-gamma 0 0
# Id:  3300603
# log K source:  MTQ3.11
# Delta H source:  MTQ3.11
#T and ionic strength:
H3AsO4 = AsO4-3 + 3H+
log_k -20.7
delta_h 12.9 kJ
-gamma 0 0
# Id:  3300613
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.00 25.0
H3AsO4 = HAsO4-2 + 2H+
log_k -9.2
delta_h -4.1 kJ
-gamma 0 0
# Id:  3300612
# log K source:  NIST46.4
# Delta H source:  NIST46.4
#T and ionic strength:  0.00 25.0
H3AsO4 = H2AsO4- + H+
log_k -2.24
delta_h -7.1 kJ
-gamma 0 0
# Id:  3300611
```

```
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Sb(OH)3 + H2O = Sb(OH)4- + H+
log_k -12.0429
delta_h 69.8519 kJ
-gamma 0 0
# Id: 7400020
# log K source: PNL89
# Delta H source: PNL89
#T and ionic strength:
Sb(OH)3 + H+ = Sb(OH)2+ + H2O
log_k 1.3853
delta_h 0 kJ
-gamma 0 0
# Id: 7403302
# log K source: PNL89
# Delta H source: PNL89
#T and ionic strength:
Sb(OH)3 = HSbO2 + H2O
log_k -0.0105
delta_h -0.13 kJ
-gamma 0 0
# Id: 7400021
# log K source: NIST2.1.1
# Delta H source: NIST2.1.1
#T and ionic strength:
Sb(OH)3 = SbO2- + H2O + H+
log_k -11.8011
delta_h 70.1866 kJ
-gamma 0 0
# Id: 7403301
# log K source: PNL89
# Delta H source: PNL89
#T and ionic strength:
Sb(OH)3 + H+ = SbO+ + 2H2O
log_k 0.9228
delta_h 8.2425 kJ
-gamma 0 0
# Id: 7403300
# log K source: PNL89
# Delta H source: PNL89
#T and ionic strength:
Sb(OH)6- = SbO3- + 3H2O
log_k 2.9319
delta_h 0 kJ
-gamma 0 0
# Id: 7410021
# log K source: PNL89
# Delta H source: PNL89
#T and ionic strength:
Sb(OH)6- + 2H+ = SbO2+ + 4H2O
log_k 2.3895
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 7413300
# log K source: PNL89
# Delta H source: PNL89
#T and ionic strength:
H+ + CO3-2 = HCO3-
log_k 10.329
delta_h -14.6 kJ
-gamma 5.4 0
# Id: 3301400
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
2H+ + CO3-2 = H2CO3
log_k 16.681
delta_h -23.76 kJ
-gamma 0 0
# Id: 3301401
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Pb+2 + 2CO3-2 = Pb(CO3)2-2
log_k 9.938
delta_h 0 kJ
-gamma 0 0
# Id: 6001400
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.50 25.0
Pb+2 + CO3-2 = PbCO3
log_k 6.478
delta_h 0 kJ
-gamma 0 0
# Id: 6001401
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.50 25.0
Pb+2 + CO3-2 + H+ = PbHCO3+
log_k 13.2
delta_h 0 kJ
-gamma 0 0
# Id: 6001402
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
Zn+2 + CO3-2 = ZnCO3
log_k 4.76
delta_h 0 kJ
-gamma 0 0
# Id: 9501401
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Zn+2 + H+ + CO3-2 = ZnHCO3+
```

```
log_k 11.829
delta_h 0 kJ
-gamma 0 0
# Id: 9501400
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Hg(OH)2 + 2H+ + CO3-2 = HgCO3 + 2H2O
log_k 18.272
delta_h 0 kJ
-gamma 0 0
# Id: 3611401
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.50 25.0
Hg(OH)2 + 2H+ + 2CO3-2 = Hg(CO3)2-2 + 2H2O
log_k 21.772
delta_h 0 kJ
-gamma 0 0
# Id: 3611402
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.50 25.0
Hg(OH)2 + 3H+ + CO3-2 = HgHCO3+ + 2H2O
log_k 22.542
delta_h 0 kJ
-gamma 0 0
# Id: 3611403
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.50 25.0
Cd+2 + CO3-2 = CdCO3
log_k 4.3578
delta_h 0 kJ
-gamma 0 0
# Id: 1601401
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.10 25.0
Cd+2 + H+ + CO3-2 = CdHCO3+
log_k 10.6863
delta_h 0 kJ
-gamma 0 0
# Id: 1601400
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 3.00 25.0
Cd+2 + 2CO3-2 = Cd(CO3)2-2
log_k 7.2278
delta_h 0 kJ
-gamma 0 0
# Id: 1601403
# log K source: NIST46.4
# Delta H source: MTQ3.11
```

```
#T and ionic strength:  0.10 20.0
Cu+2 + CO3-2 = CuCO3
log_k 6.77
delta_h 0 kJ
-gamma 0 0
# Id:  2311400
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
Cu+2 + H+ + CO3-2 = CuHCO3+
log_k 12.129
delta_h 0 kJ
-gamma 0 0
# Id:  2311402
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
Cu+2 + 2CO3-2 = Cu(CO3)2-2
log_k 10.2
delta_h 0 kJ
-gamma 0 0
# Id:  2311401
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
Ni+2 + CO3-2 = NiCO3
log_k 4.5718
delta_h 0 kJ
-gamma 0 0
# Id:  5401401
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.70 25.0
Ni+2 + H+ + CO3-2 = NiHCO3+
log_k 12.4199
delta_h 0 kJ
-gamma 0 0
# Id:  5401400
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.70 25.0
Co+2 + CO3-2 = CoCO3
log_k 4.228
delta_h 0 kJ
-gamma 0 0
# Id:  2001400
# log K source:  NIST46.4
# Delta H source:  MTQ3.11
#T and ionic strength:  0.50 25.0
Co+2 + H+ + CO3-2 = CoHCO3+
log_k 12.2199
delta_h 0 kJ
-gamma 0 0
# Id:  2001401
```

```
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.70 25.0
Fe+2 + H+ + CO3-2 = FeHCO3+
log_k 11.429
delta_h 0 kJ
-gamma 6 0
# Id: 2801400
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Mn+2 + H+ + CO3-2 = MnHCO3+
log_k 11.629
delta_h -10.6 kJ
-gamma 5 0
# Id: 4701400
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
UO2+2 + CO3-2 = UO2CO3
log_k 9.6
delta_h 4 kJ
-gamma 0 0
# Id: 8931400
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
UO2+2 + 2CO3-2 = UO2(CO3)2-2
log_k 16.9
delta_h 16 kJ
-gamma 0 0
# Id: 8931401
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
UO2+2 + 3CO3-2 = UO2(CO3)3-4
log_k 21.6
delta_h -40 kJ
-gamma 0 0
# Id: 8931402
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Be+2 + CO3-2 = BeCO3
log_k 6.2546
delta_h 0 kJ
-gamma 0 0
# Id: 1101401
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 3.00 25.0
Mg+2 + CO3-2 = MgCO3
log_k 2.92
delta_h 12 kJ
```

```
-gamma 0 0
# Id: 4601400
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Mg+2 + H+ + CO3-2 = MgHCO3+
log_k 11.339
delta_h -10.6 kJ
-gamma 4 0
# Id: 4601401
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Ca+2 + H+ + CO3-2 = CaHCO3+
log_k 11.599
delta_h 5.4 kJ
-gamma 6 0
# Id: 1501400
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
CO3-2 + Ca+2 = CaCO3
log_k 3.2
delta_h 16 kJ
-gamma 0 0
# Id: 1501401
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
Sr+2 + CO3-2 = SrCO3
log_k 2.81
delta_h 20 kJ
-gamma 0 0
# Id: 8001401
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Sr+2 + H+ + CO3-2 = SrHCO3+
log_k 11.539
delta_h 10.4 kJ
-gamma 6 0
# Id: 8001400
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ba+2 + CO3-2 = BaCO3
log_k 2.71
delta_h 16 kJ
-gamma 0 0
# Id: 1001401
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ba+2 + H+ + CO3-2 = BaHCO3+
```

```
log_k 11.309
delta_h 10.4 kJ
-gamma 6 0
# Id: 1001400
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Na+ + CO3-2 = NaCO3-
log_k 1.27
delta_h -20.35 kJ
-gamma 5.4 0
# Id: 5001400
# log K source: NIST46.3
# Delta H source: NIST2.1.1
#T and ionic strength: 0.00 25.0
Na+ + H+ + CO3-2 = NaHCO3
log_k 10.079
delta_h -28.3301 kJ
-gamma 0 0
# Id: 5001401
# log K source: NIST46.3
# Delta H source: NIST2.1.1
#T and ionic strength: 0.00 25.0
H4SiO4 = H2SiO4-2 + 2H+
log_k -23.04
delta_h 61 kJ
-gamma 5.4 0
# Id: 3307701
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
H4SiO4 = H3SiO4- + H+
log_k -9.84
delta_h 20 kJ
-gamma 4 0
# Id: 3307700
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
UO2+2 + H4SiO4 = UO2H3SiO4+ + H+
log_k -1.9111
delta_h 0 kJ
-gamma 0 0
# Id: 8937700
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.10 25.0
H3BO3 = H2BO3- + H+
log_k -9.236
delta_h 13 kJ
-gamma 2.5 0
# Id: 3300900
# log K source: NIST46.4
# Delta H source: NIST46.4
```

```
#T and ionic strength: 0.00 25.0
2H3BO3 = H5(BO3)2- + H+
log_k -9.306
delta_h 8.4 kJ
-gamma 2.5 0
# Id: 3300901
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
3H3BO3 = H8(BO3)3- + H+
log_k -7.306
delta_h 29.4 kJ
-gamma 2.5 0
# Id: 3300902
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ag+ + H3BO3 = AgH2BO3 + H+
log_k -8.036
delta_h 0 kJ
-gamma 2.5 0
# Id: 200901
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Mg+2 + H3BO3 = MgH2BO3+ + H+
log_k -7.696
delta_h 13 kJ
-gamma 2.5 0
# Id: 4600901
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ca+2 + H3BO3 = CaH2BO3+ + H+
log_k -7.476
delta_h 17 kJ
-gamma 2.5 0
# Id: 1500901
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Sr+2 + H3BO3 = SrH2BO3+ + H+
log_k -7.686
delta_h 17 kJ
-gamma 2.5 0
# Id: 8000901
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ba+2 + H3BO3 = BaH2BO3+ + H+
log_k -7.746
delta_h 17 kJ
-gamma 2.5 0
# Id: 1000901
```

```
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Na+ + H3BO3 = NaH2BO3 + H+
log_k -9.036
delta_h 0 kJ
-gamma 2.5 0
# Id: 5000901
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
CrO4-2 + H+ = HCrO4-
log_k 6.51
delta_h 2 kJ
-gamma 0 0
# Id: 2123300
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
CrO4-2 + 2H+ = H2CrO4
log_k 6.4188
delta_h 39 kJ
-gamma 0 0
# Id: 2123301
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 20.0
2CrO4-2 + 2H+ = Cr2O7-2 + H2O
log_k 14.56
delta_h -15 kJ
-gamma 0 0
# Id: 2123302
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
CrO4-2 + Cl- + 2H+ = CrO3Cl- + H2O
log_k 7.3086
delta_h 0 kJ
-gamma 0 0
# Id: 2121800
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
CrO4-2 + SO4-2 + 2H+ = CrO3SO4-2 + H2O
log_k 8.9937
delta_h 0 kJ
-gamma 0 0
# Id: 2127320
# log K source: MTQ3.11
# Delta H source: MTQ3.11
#T and ionic strength:
CrO4-2 + 4H+ + PO4-3 = CrO3H2PO4- + H2O
log_k 29.3634
delta_h 0 kJ
```

-gamma 0 0
Id: 2125800
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
CrO4-2 + 3H+ + PO4-3 = CrO3HPO4-2 + H2O
log_k 26.6806
delta_h 0 kJ
-gamma 0 0
Id: 2125801
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
CrO4-2 + Na+ = NaCrO4-
log_k 0.6963
delta_h 0 kJ
-gamma 0 0
Id: 5002120
log K source: MTQ3.11
Delta H source: MTQ3.11
#T and ionic strength:
K+ + CrO4-2 = KCrO4-
log_k 0.57
delta_h 0 kJ
-gamma 0 0
Id: 4102120
log K source: NIST46.4
Delta H source: MTQ3.11
#T and ionic strength: 0.00 18.0
MoO4-2 + H+ = HMoO4-
log_k 4.2988
delta_h 20 kJ
-gamma 0 0
Id: 3304801
log K source: NIST46.4
Delta H source: NIST46.4
#T and ionic strength: 0.00 20.0
MoO4-2 + 2H+ = H2MoO4
log_k 8.1636
delta_h -26 kJ
-gamma 0 0
Id: 3304802
log K source: NIST46.4
Delta H source: NIST46.4
#T and ionic strength: 0.00 20.0
7MoO4-2 + 8H+ = Mo7O24-6 + 4H2O
log_k 52.99
delta_h -228 kJ
-gamma 0 0
Id: 3304803
log K source: NIST46.4
Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
7MoO4-2 + 9H+ = HMo7O24-5 + 4H2O

log_k 59.3768
delta_h -218 kJ
-gamma 0 0
Id: 3304804
log K source: NIST46.4
Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
7MoO4-2 + 10H+ = H2Mo7O24-4 + 4H2O
log_k 64.159
delta_h -215 kJ
-gamma 0 0
Id: 3304805
log K source: NIST46.4
Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
7MoO4-2 + 11H+ = H3Mo7O24-3 + 4H2O
log_k 67.405
delta_h -217 kJ
-gamma 0 0
Id: 3304806
log K source: NIST46.4
Delta H source: NIST46.4
#T and ionic strength: 1.00 25.0
6MoO4-2 + Al+3 + 6H+ = AlMo6O21-3 + 3H2O
log_k 54.9925
delta_h 0 kJ
-gamma 0 0
Id: 304801
log K source: NIST46.4
Delta H source: MTQ3.11
#T and ionic strength: 0.50 25.0
MoO4-2 + 2Ag+ = Ag2MoO4
log_k -0.4219
delta_h -1.18 kJ
-gamma 0 0
Id: 204801
log K source: Bard85
Delta H source: Bard85
#T and ionic strength:
VO2+ + 2H2O = VO4-3 + 4H+
log_k -30.2
delta_h -25 kJ
-gamma 0 0
Id: 9033303
log K source: NIST46.4
Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
VO2+ + 2H2O = HVO4-2 + 3H+
log_k -15.9
delta_h 0 kJ
-gamma 0 0
Id: 9033302
log K source: NIST46.3
Delta H source: NIST46.3

```
#T and ionic strength:  0.00 25.0
VO2+ + 2H2O = H2VO4- + 2H+
log_k -7.3
delta_h 0 kJ
-gamma 0 0
# Id:  9033301
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
VO2+ + 2H2O = H3VO4 + H+
log_k -3.3
delta_h 44.4759 kJ
-gamma 0 0
# Id:  9033300
# log K source:  MTQ3.11
# Delta H source:  MTQ3.11
#T and ionic strength:
2VO2+ + 3H2O = V2O7-4 + 6H+
log_k -31.24
delta_h -28 kJ
-gamma 0 0
# Id:  9030020
# log K source:  NIST46.3
# Delta H source:  NIST46.3
#T and ionic strength:  0.00 25.0
2VO2+ + 3H2O = HV2O7-3 + 5H+
log_k -20.67
delta_h 0 kJ
-gamma 0 0
# Id:  9030021
# log K source:  NIST46.3
# Delta H source:  MTQ3.11
#T and ionic strength:  0.00 25.0
2VO2+ + 3H2O = H3V2O7- + 3H+
log_k -3.79
delta_h 0 kJ
-gamma 0 0
# Id:  9030022
# log K source:  MTQ3.11
# Delta H source:  MTQ3.11
#T and ionic strength:
3VO2+ + 3H2O = V3O9-3 + 6H+
log_k -15.88
delta_h 0 kJ
-gamma 0 0
# Id:  9030023
# log K source:  MTQ3.11
# Delta H source:  MTQ3.11
#T and ionic strength:
4VO2+ + 4H2O = V4O12-4 + 8H+
log_k -20.56
delta_h -87 kJ
-gamma 0 0
# Id:  9030024
```

```
# log K source: NIST46.3
# Delta H source: NIST46.3
#T and ionic strength: 0.00 25.0
10VO2+ + 8H2O = V10O28-6 + 16H+
log_k -24.0943
delta_h 0 kJ
-gamma 0 0
# Id: 9030025
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.10 20.0
10VO2+ + 8H2O = HV10O28-5 + 15H+
log_k -15.9076
delta_h 90.0397 kJ
-gamma 0 0
# Id: 9030026
# log K source: NIST46.4
# Delta H source: MTQ3.11
#T and ionic strength: 0.10 20.0
10VO2+ + 8H2O = H2V10O28-4 + 14H+
log_k -10.7
delta_h 0 kJ
-gamma 0 0
# Id: 9030027
# log K source: NIST46.3
# Delta H source: MTQ3.11
#T and ionic strength: 0.00 25.0
Benzoate- + H+ = H(Benzoate)
log_k 4.202
delta_h -0.4602 kJ
-gamma 0 0
# Id: 3309171
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Benzoate- + Pb+2 = Pb(Benzoate)+
log_k 2.4
delta_h 0 kJ
-gamma 0 0
# Id: 6009171
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Benzoate- + Al+3 = Al(Benzoate)+2
log_k 2.05
delta_h 0 kJ
-gamma 0 0
# Id: 309171
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Benzoate- + Al+3 + H2O = AlOH(Benzoate)+ + H+
log_k -0.56
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 309172
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Benzoate- + Zn+2 = Zn(Benzoate)+
log_k 1.7
delta_h 0 kJ
-gamma 0 0
# Id: 9509171
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Benzoate- + Cd+2 = Cd(Benzoate)+
log_k 1.8
delta_h 0 kJ
-gamma 0 0
# Id: 1609171
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
2Benzoate- + Cd+2 = Cd(Benzoate)2
log_k 1.82
delta_h 0 kJ
-gamma 0 0
# Id: 1609172
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Benzoate- + Cu+2 = Cu(Benzoate)+
log_k 2.19
delta_h 0 kJ
-gamma 0 0
# Id: 2319171
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Benzoate- + Ag+ = Ag(Benzoate)
log_k 0.91
delta_h 0 kJ
-gamma 0 0
# Id: 209171
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Benzoate- + Ni+2 = Ni(Benzoate)+
log_k 1.86
delta_h 0 kJ
-gamma 0 0
# Id: 5409171
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Co+2 + Benzoate- = Co(Benzoate)+
```

```
log_k 1.0537
delta_h 12 kJ
-gamma 0 0
# Id: 2009171
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.50 30.0
Benzoate- + Mn+2 = Mn(Benzoate)+
log_k 2.06
delta_h 0 kJ
-gamma 0 0
# Id: 4709171
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Benzoate- + Mg+2 = Mg(Benzoate)+
log_k 1.26
delta_h 0 kJ
-gamma 0 0
# Id: 4609171
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Benzoate- + Ca+2 = Ca(Benzoate)+
log_k 1.55
delta_h 0 kJ
-gamma 0 0
# Id: 1509171
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Phenylacetate- + H+ = H(Phenylacetate)
log_k 4.31
delta_h 2.1757 kJ
-gamma 0 0
# Id: 3309181
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Phenylacetate- + Zn+2 = Zn(Phenylacetate)+
log_k 1.57
delta_h 0 kJ
-gamma 0 0
# Id: 9509181
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Phenylacetate- + Cu+2 = Cu(Phenylacetate)+
log_k 1.97
delta_h 0 kJ
-gamma 0 0
# Id: 2319181
# log K source: NIST46.2
# Delta H source: NIST46.2
```

```
#T and ionic strength:
Co+2 + Phenylacetate- = Co(Phenylacetate)+
log_k 0.591
delta_h 0 kJ
-gamma 0 0
# Id: 2009181
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 2.00 25.0
Co+2 + 2Phenylacetate- = Co(Phenylacetate)2
log_k 0.4765
delta_h 0 kJ
-gamma 0 0
# Id: 2009182
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 2.00 25.0
Isophthalate-2 + H+ = H(Isophthalate)-
log_k 4.5
delta_h 1.6736 kJ
-gamma 0 0
# Id: 3309201
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Isophthalate-2 + 2H+ = H2(Isophthalate)
log_k 8
delta_h 1.6736 kJ
-gamma 0 0
# Id: 3309202
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Isophthalate-2 + Pb+2 = Pb(Isophthalate)
log_k 2.99
delta_h 0 kJ
-gamma 0 0
# Id: 6009201
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
2Isophthalate-2 + Pb+2 = Pb(Isophthalate)2-2
log_k 4.18
delta_h 0 kJ
-gamma 0 0
# Id: 6009202
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Isophthalate-2 + Pb+2 + H+ = PbH(Isophthalate)+
log_k 6.69
delta_h 0 kJ
-gamma 0 0
# Id: 6009203
```

```
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Isophthalate-2 + Cd+2 = Cd(Isophthalate)
log_k 2.15
delta_h 0 kJ
-gamma 0 0
# Id: 1609201
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
2Isophthalate-2 + Cd+2 = Cd(Isophthalate)2-2
log_k 2.99
delta_h 0 kJ
-gamma 0 0
# Id: 1609202
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Isophthalate-2 + Cd+2 + H+ = CdH(Isophthalate)+
log_k 5.73
delta_h 0 kJ
-gamma 0 0
# Id: 1609203
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Isophthalate-2 + Ca+2 = Ca(Isophthalate)
log_k 2
delta_h 0 kJ
-gamma 0 0
# Id: 1509200
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Isophthalate-2 + Ba+2 = Ba(Isophthalate)
log_k 1.55
delta_h 0 kJ
-gamma 0 0
# Id: 1009201
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
H+ + Diethylamine = H(Diethylamine)+
log_k 10.933
delta_h -53.1368 kJ
-gamma 0 0
# Id: 3309551
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Diethylamine = Zn(Diethylamine)+2
log_k 2.74
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 9509551
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Zn+2 + 2Diethylamine = Zn(Diethylamine)2+2
log_k 5.27
delta_h 0 kJ
-gamma 0 0
# Id: 9509552
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Zn+2 + 3Diethylamine = Zn(Diethylamine)3+2
log_k 7.71
delta_h 0 kJ
-gamma 0 0
# Id: 9509553
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Zn+2 + 4Diethylamine = Zn(Diethylamine)4+2
log_k 9.84
delta_h 0 kJ
-gamma 0 0
# Id: 9509554
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + Diethylamine = Cd(Diethylamine)+2
log_k 2.73
delta_h 0 kJ
-gamma 0 0
# Id: 1609551
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + 2Diethylamine = Cd(Diethylamine)2+2
log_k 4.86
delta_h 0 kJ
-gamma 0 0
# Id: 1609552
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + 3Diethylamine = Cd(Diethylamine)3+2
log_k 6.37
delta_h 0 kJ
-gamma 0 0
# Id: 1609553
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + 4Diethylamine = Cd(Diethylamine)4+2
```

```
log_k 7.32
delta_h 0 kJ
-gamma 0 0
# Id: 1609554
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Ag+ + Diethylamine = Ag(Diethylamine)+
log_k 2.98
delta_h 0 kJ
-gamma 0 0
# Id: 209551
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Diethylamine = Ag(Diethylamine)2+
log_k 6.38
delta_h -44.7688 kJ
-gamma 0 0
# Id: 209552
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Diethylamine = Ni(Diethylamine)+2
log_k 2.78
delta_h 0 kJ
-gamma 0 0
# Id: 5409551
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Ni+2 + 2Diethylamine = Ni(Diethylamine)2+2
log_k 4.97
delta_h 0 kJ
-gamma 0 0
# Id: 5409552
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Ni+2 + 3Diethylamine = Ni(Diethylamine)3+2
log_k 6.72
delta_h 0 kJ
-gamma 0 0
# Id: 5409553
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Ni+2 + 4Diethylamine = Ni(Diethylamine)4+2
log_k 7.93
delta_h 0 kJ
-gamma 0 0
# Id: 5409554
# log K source: SCD2.62
# Delta H source: SCD2.62
```

#T and ionic strength:
Ni+2 + 5Diethylamine = Ni(Diethylamine)5+2
log_k 8.87
delta_h 0 kJ
-gamma 0 0
Id: 5409555
log K source: SCD2.62
Delta H source: SCD2.62
#T and ionic strength:
H+ + Butylamine = H(Butylamine)+
log_k 10.64
delta_h -58.2831 kJ
-gamma 0 0
Id: 3309561
log K source: NIST46.2
Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + Butylamine + 2H+ = Hg(Butylamine)+2 + 2H2O
log_k 14.84
delta_h 0 kJ
-gamma 0 0
Id: 3619561
log K source: NIST46.2
Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + 2Butylamine + 2H+ = Hg(Butylamine)2+2 + 2H2O
log_k 24.24
delta_h 0 kJ
-gamma 0 0
Id: 3619562
log K source: NIST46.2
Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + 3Butylamine + 2H+ = Hg(Butylamine)3+2 + 2H2O
log_k 25.1
delta_h 0 kJ
-gamma 0 0
Id: 3619563
log K source: NIST46.2
Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + 4Butylamine + 2H+ = Hg(Butylamine)4+2 + 2H2O
log_k 26.1
delta_h 0 kJ
-gamma 0 0
Id: 3619564
log K source: NIST46.2
Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Butylamine = Ag(Butylamine)+
log_k 3.42
delta_h -16.736 kJ
-gamma 0 0
Id: 209561

```
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Butylamine = Ag(Butylamine)2+
log_k 7.47
delta_h -52.7184 kJ
-gamma 0 0
# Id: 209562
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
H+ + Methylamine = H(Methylamine)+
log_k 10.64
delta_h -55.2288 kJ
-gamma 0 0
# Id: 3309581
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Methylamine = Cd(Methylamine)+2
log_k 2.75
delta_h 0 kJ
-gamma 0 0
# Id: 1609581
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + 2Methylamine = Cd(Methylamine)2+2
log_k 4.81
delta_h -29.288 kJ
-gamma 0 0
# Id: 1609582
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + 3Methylamine = Cd(Methylamine)3+2
log_k 5.94
delta_h 0 kJ
-gamma 0 0
# Id: 1609583
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + 4Methylamine = Cd(Methylamine)4+2
log_k 6.55
delta_h -58.576 kJ
-gamma 0 0
# Id: 1609584
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + Methylamine + 2H+ = Hg(Methylamine)+2 + 2H2O
log_k 14.76
delta_h 0 kJ
```

-gamma 0 0
Id: 3619581
log K source: NIST46.2
Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + 2Methylamine + 2H+ = Hg(Methylamine)2+2 + 2H2O
log_k 23.96
delta_h 0 kJ
-gamma 0 0
Id: 3619582
log K source: NIST46.2
Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + 3Methylamine + 2H+ = Hg(Methylamine)3+2 + 2H2O
log_k 24.3
delta_h 0 kJ
-gamma 0 0
Id: 3619583
log K source: NIST46.2
Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + 4Methylamine + 2H+ = Hg(Methylamine)4+2 + 2H2O
log_k 24.6
delta_h 0 kJ
-gamma 0 0
Id: 3619584
log K source: NIST46.2
Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Methylamine = Cu(Methylamine)+2
log_k 4.11
delta_h 0 kJ
-gamma 0 0
Id: 2319581
log K source: NIST46.2
Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 2Methylamine = Cu(Methylamine)2+2
log_k 7.51
delta_h 0 kJ
-gamma 0 0
Id: 2319582
log K source: NIST46.2
Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 3Methylamine = Cu(Methylamine)3+2
log_k 10.21
delta_h 0 kJ
-gamma 0 0
Id: 2319583
log K source: NIST46.2
Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 4Methylamine = Cu(Methylamine)4+2

```
log_k 12.08
delta_h 0 kJ
-gamma 0 0
# Id: 2319584
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Methylamine = Ag(Methylamine)+
log_k 3.07
delta_h -12.552 kJ
-gamma 0 0
# Id: 209581
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Methylamine = Ag(Methylamine)2+
log_k 6.89
delta_h -48.9528 kJ
-gamma 0 0
# Id: 209582
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Methylamine = Ni(Methylamine)+2
log_k 2.23
delta_h 0 kJ
-gamma 0 0
# Id: 5409581
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
H+ + Dimethylamine = H(Dimethylamine)+
log_k 10.774
delta_h -50.208 kJ
-gamma 0 0
# Id: 3309591
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Dimethylamine = Ag(Dimethylamine)2+
log_k 5.37
delta_h -40.5848 kJ
-gamma 0 0
# Id: 209591
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Dimethylamine = Ni(Dimethylamine)+2
log_k 1.47
delta_h 0 kJ
-gamma 0 0
# Id: 5409591
# log K source: NIST46.2
# Delta H source: NIST46.2
```

```
#T and ionic strength:
H+ + Hexylamine = H(Hexylamine)+
log_k 10.63
delta_h -58.576 kJ
-gamma 0 0
# Id: 3309611
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Hexylamine = Ag(Hexylamine)+
log_k 3.54
delta_h -25.104 kJ
-gamma 0 0
# Id: 209611
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Hexylamine = Ag(Hexylamine)2+
log_k 7.55
delta_h -53.1368 kJ
-gamma 0 0
# Id: 209612
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
H+ + Ethylenediamine = H(Ethylenediamine)+
log_k 9.928
delta_h -49.7896 kJ
-gamma 0 0
# Id: 3309631
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
2H+ + Ethylenediamine = H2(Ethylenediamine)+2
log_k 16.776
delta_h -95.3952 kJ
-gamma 0 0
# Id: 3309632
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Pb+2 + Ethylenediamine = Pb(Ethylenediamine)+2
log_k 5.04
delta_h 0 kJ
-gamma 0 0
# Id: 6009631
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Pb+2 + 2Ethylenediamine = Pb(Ethylenediamine)2+2
log_k 8.5
delta_h 0 kJ
-gamma 0 0
# Id: 6009632
```

```
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Ethylenediamine = Zn(Ethylenediamine)+2
log_k 5.66
delta_h -29.288 kJ
-gamma 0 0
# Id: 9509631
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + 2Ethylenediamine = Zn(Ethylenediamine)2+2
log_k 10.6
delta_h -48.116 kJ
-gamma 0 0
# Id: 9509632
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + 3Ethylenediamine = Zn(Ethylenediamine)3+2
log_k 13.9
delta_h -71.5464 kJ
-gamma 0 0
# Id: 9509633
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Ethylenediamine = Cd(Ethylenediamine)+2
log_k 5.41
delta_h -28.4512 kJ
-gamma 0 0
# Id: 1609631
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + 2Ethylenediamine = Cd(Ethylenediamine)2+2
log_k 9.9
delta_h -55.6472 kJ
-gamma 0 0
# Id: 1609632
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + 3Ethylenediamine = Cd(Ethylenediamine)3+2
log_k 11.6
delta_h -82.4248 kJ
-gamma 0 0
# Id: 1609633
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + Ethylenediamine + 2H+ = Hg(Ethylenediamine)+2 + 2H2O
log_k 20.4
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 3619631
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + 2Ethylenediamine + 2H+ = Hg(Ethylenediamine)2+2 + 2H2O
log_k 29.3
delta_h -173.218 kJ
-gamma 0 0
# Id: 3619632
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + 2Ethylenediamine + 3H+ = HgH(Ethylenediamine)2+3 + 2H2O
log_k 34.7
delta_h 0 kJ
-gamma 0 0
# Id: 3619633
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+ + 2Ethylenediamine = Cu(Ethylenediamine)2+
log_k 11.2
delta_h 0 kJ
-gamma 0 0
# Id: 2309631
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Ethylenediamine = Cu(Ethylenediamine)+2
log_k 10.5
delta_h -52.7184 kJ
-gamma 0 0
# Id: 2319631
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 2Ethylenediamine = Cu(Ethylenediamine)2+2
log_k 19.6
delta_h -105.437 kJ
-gamma 0 0
# Id: 2319632
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Ethylenediamine = Ag(Ethylenediamine)+
log_k 4.6
delta_h -48.9528 kJ
-gamma 0 0
# Id: 209631
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Ethylenediamine = Ag(Ethylenediamine)2+
```

```
log_k 7.5
delta_h -52.3 kJ
-gamma 0 0
# Id: 209632
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Ethylenediamine + H+ = AgH(Ethylenediamine)+2
log_k 11.99
delta_h -75.312 kJ
-gamma 0 0
# Id: 209633
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
2Ag+ + Ethylenediamine = Ag2(Ethylenediamine)+2
log_k 6.5
delta_h 0 kJ
-gamma 0 0
# Id: 209634
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
2Ag+ + 2Ethylenediamine = Ag2(Ethylenediamine)2+2
log_k 12.7
delta_h -97.0688 kJ
-gamma 0 0
# Id: 209635
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Ethylenediamine + 2H+ = Ag(HEthylenediamine)2+3
log_k 24
delta_h -150.206 kJ
-gamma 0 0
# Id: 209636
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Ethylenediamine + H+ = AgH(Ethylenediamine)2+2
log_k 8.4
delta_h -47.6976 kJ
-gamma 0 0
# Id: 209637
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Ethylenediamine = Ni(Ethylenediamine)+2
log_k 7.32
delta_h -37.656 kJ
-gamma 0 0
# Id: 5409631
# log K source: NIST46.2
# Delta H source: NIST46.2
```

```
#T and ionic strength:
Ni+2 + 2Ethylenediamine = Ni(Ethylenediamine)2+2
log_k 13.5
delta_h -76.5672 kJ
-gamma 0 0
# Id: 5409632
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + 3Ethylenediamine = Ni(Ethylenediamine)3+2
log_k 17.6
delta_h -117.152 kJ
-gamma 0 0
# Id: 5409633
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Co+2 + Ethylenediamine = Co(Ethylenediamine)+2
log_k 5.5
delta_h -28 kJ
-gamma 0 0
# Id: 2009631
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Co+2 + 2Ethylenediamine = Co(Ethylenediamine)2+2
log_k 10.1
delta_h -58.5 kJ
-gamma 0 0
# Id: 2009632
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Co+2 + 3Ethylenediamine = Co(Ethylenediamine)3+2
log_k 13.2
delta_h -92.8 kJ
-gamma 0 0
# Id: 2009633
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Co+3 + 2Ethylenediamine = Co(Ethylenediamine)2+3
log_k 34.7
delta_h 0 kJ
-gamma 0 0
# Id: 2019631
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 1.00 25.0
Co+3 + 3Ethylenediamine = Co(Ethylenediamine)3+3
log_k 48.69
delta_h 0 kJ
-gamma 0 0
# Id: 2019632
```

```
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 1.50 30.0
Fe+2 + Ethylenediamine = Fe(Ethylenediamine)+2
log_k 4.26
delta_h 0 kJ
-gamma 0 0
# Id: 2809631
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+2 + 2Ethylenediamine = Fe(Ethylenediamine)2+2
log_k 7.73
delta_h 0 kJ
-gamma 0 0
# Id: 2809632
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+2 + 3Ethylenediamine = Fe(Ethylenediamine)3+2
log_k 10.17
delta_h 0 kJ
-gamma 0 0
# Id: 2809633
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mn+2 + Ethylenediamine = Mn(Ethylenediamine)+2
log_k 2.74
delta_h -11.7152 kJ
-gamma 0 0
# Id: 4709631
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mn+2 + 2Ethylenediamine = Mn(Ethylenediamine)2+2
log_k 4.8
delta_h -25.104 kJ
-gamma 0 0
# Id: 4709632
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cr(OH)2+ + 2Ethylenediamine + 2H+ = Cr(Ethylenediamine)2+3 + 2H2O
log_k 22.57
delta_h 0 kJ
-gamma 0 0
# Id: 2119631
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cr(OH)2+ + 3Ethylenediamine + 2H+ = Cr(Ethylenediamine)3+3 + 2H2O
log_k 29
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 2119632
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mg+2 + Ethylenediamine = Mg(Ethylenediamine)+2
log_k 0.37
delta_h 0 kJ
-gamma 0 0
# Id: 4609631
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Ethylenediamine = Ca(Ethylenediamine)+2
log_k 0.11
delta_h 0 kJ
-gamma 0 0
# Id: 1509631
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
H+ + Propylamine = H(Propylamine)+
log_k 10.566
delta_h -57.53 kJ
-gamma 0 0
# Id: 3309641
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Propylamine = Zn(Propylamine)+2
log_k 2.42
delta_h 0 kJ
-gamma 0 0
# Id: 9509641
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Zn+2 + 2Propylamine = Zn(Propylamine)2+2
log_k 4.85
delta_h 0 kJ
-gamma 0 0
# Id: 9509642
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Zn+2 + 3Propylamine = Zn(Propylamine)3+2
log_k 7.38
delta_h 0 kJ
-gamma 0 0
# Id: 9509643
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Zn+2 + 4Propylamine = Zn(Propylamine)4+2
```

```
log_k 9.49
delta_h 0 kJ
-gamma 0 0
# Id: 9509644
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + Propylamine = Cd(Propylamine)+2
log_k 2.62
delta_h 0 kJ
-gamma 0 0
# Id: 1609641
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + 2Propylamine = Cd(Propylamine)2+2
log_k 4.64
delta_h 0 kJ
-gamma 0 0
# Id: 1609642
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + 3Propylamine = Cd(Propylamine)3+2
log_k 6.03
delta_h 0 kJ
-gamma 0 0
# Id: 1609643
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Ag+ + Propylamine = Ag(Propylamine)+
log_k 3.45
delta_h -12.552 kJ
-gamma 0 0
# Id: 209641
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Propylamine = Ag(Propylamine)2+
log_k 7.44
delta_h -53.1368 kJ
-gamma 0 0
# Id: 209642
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Propylamine = Ni(Propylamine)+2
log_k 2.81
delta_h 0 kJ
-gamma 0 0
# Id: 5409641
# log K source: SCD2.62
# Delta H source: SCD2.62
```

```
#T and ionic strength:
Ni+2 + 2Propylamine = Ni(Propylamine)2+2
log_k 5.02
delta_h 0 kJ
-gamma 0 0
# Id: 5409642
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Ni+2 + 3Propylamine = Ni(Propylamine)3+2
log_k 6.79
delta_h 0 kJ
-gamma 0 0
# Id: 5409643
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Ni+2 + 4Propylamine = Ni(Propylamine)4+2
log_k 8.31
delta_h 0 kJ
-gamma 0 0
# Id: 5409644
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
H+ + Isopropylamine = H(Isopropylamine)+
log_k 10.67
delta_h -58.3668 kJ
-gamma 0 0
# Id: 3309651
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Isopropylamine = Zn(Isopropylamine)+2
log_k 2.37
delta_h 0 kJ
-gamma 0 0
# Id: 9509651
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Zn+2 + 2Isopropylamine = Zn(Isopropylamine)2+2
log_k 4.67
delta_h 0 kJ
-gamma 0 0
# Id: 9509652
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Zn+2 + 3Isopropylamine = Zn(Isopropylamine)3+2
log_k 7.14
delta_h 0 kJ
-gamma 0 0
# Id: 9509653
```

```
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Zn+2 + 4Isopropylamine = Zn(Isopropylamine)4+2
log_k 9.44
delta_h 0 kJ
-gamma 0 0
# Id: 9509654
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + Isopropylamine = Cd(Isopropylamine)+2
log_k 2.55
delta_h 0 kJ
-gamma 0 0
# Id: 1609651
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + 2Isopropylamine = Cd(Isopropylamine)2+2
log_k 4.57
delta_h 0 kJ
-gamma 0 0
# Id: 1609652
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + 3Isopropylamine = Cd(Isopropylamine)3+2
log_k 6.07
delta_h 0 kJ
-gamma 0 0
# Id: 1609653
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + 4Isopropylamine = Cd(Isopropylamine)4+2
log_k 6.9
delta_h 0 kJ
-gamma 0 0
# Id: 1609654
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Hg(OH)2 + Isopropylamine + 2H+ = Hg(Isopropylamine)+2 + 2H2O
log_k 14.85
delta_h 0 kJ
-gamma 0 0
# Id: 3619651
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + 2Isopropylamine + 2H+ = Hg(Isopropylamine)2+2 + 2H2O
log_k 24.37
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 3619652
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Isopropylamine = Ag(Isopropylamine)+
log_k 3.67
delta_h -23.8488 kJ
-gamma 0 0
# Id: 209651
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Isopropylamine = Ag(Isopropylamine)2+
log_k 7.77
delta_h -59.8312 kJ
-gamma 0 0
# Id: 209652
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Isopropylamine = Ni(Isopropylamine)+2
log_k 2.71
delta_h 0 kJ
-gamma 0 0
# Id: 5409651
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Ni+2 + 2Isopropylamine = Ni(Isopropylamine)2+2
log_k 4.86
delta_h 0 kJ
-gamma 0 0
# Id: 5409652
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Ni+2 + 3Isopropylamine = Ni(Isopropylamine)3+2
log_k 6.57
delta_h 0 kJ
-gamma 0 0
# Id: 5409653
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Ni+2 + 4Isopropylamine = Ni(Isopropylamine)4+2
log_k 7.83
delta_h 0 kJ
-gamma 0 0
# Id: 5409654
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Ni+2 + 5Isopropylamine = Ni(Isopropylamine)5+2
```

```
log_k 8.43
delta_h 0 kJ
-gamma 0 0
# Id: 5409655
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
H+ + Trimethylamine = H(Trimethylamine)+
log_k 9.8
delta_h -36.8192 kJ
-gamma 0 0
# Id: 3309661
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Trimethylamine = Ag(Trimethylamine)+
log_k 1.701
delta_h 0 kJ
-gamma 0 0
# Id: 209661
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
H+ + Citrate-3 = H(Citrate)-2
log_k 6.396
delta_h 3.3472 kJ
-gamma 0 0
# Id: 3309671
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
2H+ + Citrate-3 = H2(Citrate)-
log_k 11.157
delta_h 1.297 kJ
-gamma 0 0
# Id: 3309672
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
3H+ + Citrate-3 = H3(Citrate)
log_k 14.285
delta_h -2.7614 kJ
-gamma 0 0
# Id: 3309673
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Pb+2 + Citrate-3 = Pb(Citrate)-
log_k 7.27
delta_h 0 kJ
-gamma 0 0
# Id: 6009671
# log K source: SCD2.62
# Delta H source: SCD2.62
```

```
#T and ionic strength:
Pb+2 + 2Citrate-3 = Pb(Citrate)2-4
log_k 6.53
delta_h 0 kJ
-gamma 0 0
# Id: 6009672
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Al+3 + Citrate-3 = Al(Citrate)
log_k 9.97
delta_h 0 kJ
-gamma 0 0
# Id: 309671
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Al+3 + 2Citrate-3 = Al(Citrate)2-3
log_k 14.8
delta_h 0 kJ
-gamma 0 0
# Id: 309672
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Al+3 + Citrate-3 + H+ = AlH(Citrate)+
log_k 12.85
delta_h 0 kJ
-gamma 0 0
# Id: 309673
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Tl+ + Citrate-3 = Tl(Citrate)-2
log_k 1.48
delta_h 0 kJ
-gamma 0 0
# Id: 8709671
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Citrate-3 = Zn(Citrate)-
log_k 6.21
delta_h 8.368 kJ
-gamma 0 0
# Id: 9509671
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + 2Citrate-3 = Zn(Citrate)2-4
log_k 7.4
delta_h 25.104 kJ
-gamma 0 0
# Id: 9509672
```

```
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Citrate-3 + H+ = ZnH(Citrate)
log_k 10.2
delta_h 3.3472 kJ
-gamma 0 0
# Id: 9509673
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Citrate-3 + 2H+ = ZnH2(Citrate)+
log_k 12.84
delta_h 0 kJ
-gamma 0 0
# Id: 9509674
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + Citrate-3 = Cd(Citrate)-
log_k 4.98
delta_h 8.368 kJ
-gamma 0 0
# Id: 1609671
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Citrate-3 + H+ = CdH(Citrate)
log_k 9.44
delta_h 3.3472 kJ
-gamma 0 0
# Id: 1609672
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Citrate-3 + 2H+ = CdH2(Citrate)+
log_k 12.9
delta_h 0 kJ
-gamma 0 0
# Id: 1609673
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + 2Citrate-3 = Cd(Citrate)2-4
log_k 5.9
delta_h 20.92 kJ
-gamma 0 0
# Id: 1609674
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + Citrate-3 + 2H+ = Hg(Citrate)- + 2H2O
log_k 18.3
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 3619671
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Citrate-3 = Cu(Citrate)-
log_k 7.57
delta_h 0 kJ
-gamma 0 0
# Id: 2319671
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cu+2 + 2Citrate-3 = Cu(Citrate)2-4
log_k 8.9
delta_h 0 kJ
-gamma 0 0
# Id: 2319672
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cu+2 + Citrate-3 + H+ = CuH(Citrate)
log_k 10.87
delta_h 11.7152 kJ
-gamma 0 0
# Id: 2319673
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Citrate-3 + 2H+ = CuH2(Citrate)+
log_k 13.23
delta_h 0 kJ
-gamma 0 0
# Id: 2319674
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
2Cu+2 + 2Citrate-3 = Cu2(Citrate)2-2
log_k 16.9
delta_h 41.84 kJ
-gamma 0 0
# Id: 2319675
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Citrate-3 = Ni(Citrate)-
log_k 6.59
delta_h 16.736 kJ
-gamma 0 0
# Id: 5409671
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Citrate-3 + H+ = NiH(Citrate)
```

```
log_k 10.5
delta_h 15.8992 kJ
-gamma 0 0
# Id: 5409672
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Citrate-3 + 2H+ = NiH2(Citrate)+
log_k 13.3
delta_h 0 kJ
-gamma 0 0
# Id: 5409673
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + 2Citrate-3 = Ni(Citrate)2-4
log_k 8.77
delta_h 12.552 kJ
-gamma 0 0
# Id: 5409674
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + 2Citrate-3 + H+ = NiH(Citrate)2-3
log_k 14.9
delta_h 32.6352 kJ
-gamma 0 0
# Id: 5409675
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Co+2 + Citrate-3 = Co(Citrate)-
log_k 6.1867
delta_h 0 kJ
-gamma 0 0
# Id: 2009671
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Co+2 + H+ + Citrate-3 = CoHCitrate
log_k 10.4438
delta_h 0 kJ
-gamma 0 0
# Id: 2009672
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Co+2 + 2H+ + Citrate-3 = CoH2Citrate+
log_k 12.7859
delta_h 0 kJ
-gamma 0 0
# Id: 2009673
# log K source: NIST46.4
# Delta H source: NIST46.2
```

```
#T and ionic strength:  0.10 20.0
Fe+2 + Citrate-3 = Fe(Citrate)-
log_k 6.1
delta_h 0 kJ
-gamma 0 0
# Id:  2809671
# log K source:  NIST46.2
# Delta H source:  NIST46.2
#T and ionic strength:
Fe+2 + Citrate-3 + H+ = FeH(Citrate)
log_k 10.2
delta_h 0 kJ
-gamma 0 0
# Id:  2809672
# log K source:  NIST46.2
# Delta H source:  NIST46.2
#T and ionic strength:
Fe+3 + Citrate-3 = Fe(Citrate)
log_k 13.1
delta_h 0 kJ
-gamma 0 0
# Id:  2819671
# log K source:  NIST46.2
# Delta H source:  NIST46.2
#T and ionic strength:
Fe+3 + Citrate-3 + H+ = FeH(Citrate)+
log_k 14.4
delta_h 0 kJ
-gamma 0 0
# Id:  2819672
# log K source:  NIST46.2
# Delta H source:  NIST46.2
#T and ionic strength:
Mn+2 + Citrate-3 = Mn(Citrate)-
log_k 4.28
delta_h 0 kJ
-gamma 0 0
# Id:  4709671
# log K source:  SCD2.62
# Delta H source:  SCD2.62
#T and ionic strength:
Mn+2 + Citrate-3 + H+ = MnH(Citrate)
log_k 9.6
delta_h 0 kJ
-gamma 0 0
# Id:  4709672
# log K source:  NIST46.2
# Delta H source:  NIST46.2
#T and ionic strength:
Be+2 + Citrate-3 = Be(Citrate)-
log_k 5.534
delta_h 0 kJ
-gamma 0 0
# Id:  1109671
```

```
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 1.00 25.0
Be+2 + H+ + Citrate-3 = BeH(Citrate)
log_k 9.442
delta_h 0 kJ
-gamma 0 0
# Id: 1109672
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 1.00 25.0
Ca+2 + Citrate-3 = Ca(Citrate)-
log_k 4.87
delta_h -8.368 kJ
-gamma 0 0
# Id: 1509671
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Citrate-3 + H+ = CaH(Citrate)
log_k 9.26
delta_h -0.8368 kJ
-gamma 0 0
# Id: 1509672
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Citrate-3 + 2H+ = CaH2(Citrate)+
log_k 12.257
delta_h 0 kJ
-gamma 0 0
# Id: 1509673
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Mg+2 + Citrate-3 = Mg(Citrate)-
log_k 4.89
delta_h 8.368 kJ
-gamma 0 0
# Id: 4609671
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mg+2 + Citrate-3 + H+ = MgH(Citrate)
log_k 8.91
delta_h 3.3472 kJ
-gamma 0 0
# Id: 4609672
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mg+2 + Citrate-3 + 2H+ = MgH2(Citrate)+
log_k 12.2
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 4609673
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Sr+2 + Citrate-3 = Sr(Citrate)-
log_k 4.3367
delta_h 0 kJ
-gamma 0 0
# Id: 8009671
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Sr+2 + H+ + Citrate-3 = SrH(Citrate)
log_k 8.9738
delta_h 0 kJ
-gamma 0 0
# Id: 8009672
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Sr+2 + 2H+ + Citrate-3 = SrH2(Citrate)+
log_k 12.4859
delta_h 0 kJ
-gamma 0 0
# Id: 8009673
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Ba+2 + Citrate-3 = Ba(Citrate)-
log_k 4.1
delta_h 0 kJ
-gamma 0 0
# Id: 1009671
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ba+2 + Citrate-3 + H+ = BaH(Citrate)
log_k 8.74
delta_h 0 kJ
-gamma 0 0
# Id: 1009672
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ba+2 + Citrate-3 + 2H+ = BaH2(Citrate)+
log_k 12.3
delta_h 0 kJ
-gamma 0 0
# Id: 1009673
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Na+ + Citrate-3 = Na(Citrate)-2
```

```
log_k 1.03
delta_h -2.8033 kJ
-gamma 0 0
# Id: 5009671
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
2Na+ + Citrate-3 = Na2(Citrate)-
log_k 1.5
delta_h -5.1045 kJ
-gamma 0 0
# Id: 5009672
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Na+ + Citrate-3 + H+ = NaH(Citrate)-
log_k 6.45
delta_h -3.5982 kJ
-gamma 0 0
# Id: 5009673
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
K+ + Citrate-3 = K(Citrate)-2
log_k 1.1
delta_h 5.4392 kJ
-gamma 0 0
# Id: 4109671
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
H+ + Nta-3 = H(Nta)-2
log_k 10.278
delta_h -18.828 kJ
-gamma 0 0
# Id: 3309681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
2H+ + Nta-3 = H2(Nta)-
log_k 13.22
delta_h -17.9912 kJ
-gamma 0 0
# Id: 3309682
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
3H+ + Nta-3 = H3(Nta)
log_k 15.22
delta_h -16.3176 kJ
-gamma 0 0
# Id: 3309683
# log K source: NIST46.2
# Delta H source: NIST46.2
```

```
#T and ionic strength:
4H+ + Nta-3 = H4(Nta)+
log_k 16.22
delta_h -16.3176 kJ
-gamma 0 0
# Id: 3309684
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Pb+2 + Nta-3 = Pb(Nta)-
log_k 12.7
delta_h -15.8992 kJ
-gamma 0 0
# Id: 6009681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Pb+2 + Nta-3 + H+ = PbH(Nta)
log_k 15.3
delta_h 0 kJ
-gamma 0 0
# Id: 6009682
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Al+3 + Nta-3 = Al(Nta)
log_k 13.3
delta_h 0 kJ
-gamma 0 0
# Id: 309681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Al+3 + Nta-3 + H+ = AlH(Nta)+
log_k 15.2
delta_h 0 kJ
-gamma 0 0
# Id: 309682
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Al+3 + Nta-3 + H2O = AlOH(Nta)- + H+
log_k 8
delta_h 0 kJ
-gamma 0 0
# Id: 309683
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Tl+ + Nta-3 = Tl(Nta)-2
log_k 5.39
delta_h 0 kJ
-gamma 0 0
# Id: 8709681
```

```
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Nta-3 = Zn(Nta)-
log_k 11.95
delta_h -3.7656 kJ
-gamma 0 0
# Id: 9509681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + 2Nta-3 = Zn(Nta)2-4
log_k 14.88
delta_h -15.0624 kJ
-gamma 0 0
# Id: 9509682
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Nta-3 + H2O = ZnOH(Nta)-2 + H+
log_k 1.46
delta_h 46.4424 kJ
-gamma 0 0
# Id: 9509683
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Nta-3 = Cd(Nta)-
log_k 11.07
delta_h -16.736 kJ
-gamma 0 0
# Id: 1609681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + 2Nta-3 = Cd(Nta)2-4
log_k 15.03
delta_h -38.0744 kJ
-gamma 0 0
# Id: 1609682
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Nta-3 + H2O = CdOH(Nta)-2 + H+
log_k -0.61
delta_h 29.288 kJ
-gamma 0 0
# Id: 1609683
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + Nta-3 + 2H+ = Hg(Nta)- + 2H2O
log_k 21.7
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 3619681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Nta-3 = Cu(Nta)-
log_k 14.4
delta_h -7.9496 kJ
-gamma 0 0
# Id: 2319681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 2Nta-3 = Cu(Nta)2-4
log_k 18.1
delta_h -37.2376 kJ
-gamma 0 0
# Id: 2319682
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Nta-3 + H+ = CuH(Nta)
log_k 16.2
delta_h 0 kJ
-gamma 0 0
# Id: 2319683
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Nta-3 + H2O = CuOH(Nta)-2 + H+
log_k 4.8
delta_h 25.5224 kJ
-gamma 0 0
# Id: 2319684
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Nta-3 = Ag(Nta)-2
log_k 6
delta_h -26.3592 kJ
-gamma 0 0
# Id: 209681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Nta-3 = Ni(Nta)-
log_k 12.79
delta_h -10.0416 kJ
-gamma 0 0
# Id: 5409681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + 2Nta-3 = Ni(Nta)2-4
```

```
log_k 16.96
delta_h -32.6352 kJ
-gamma 0 0
# Id: 5409682
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Nta-3 + H2O = NiOH(Nta)-2 + H+
log_k 1.5
delta_h 15.0624 kJ
-gamma 0 0
# Id: 5409683
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Co+2 + Nta-3 = Co(Nta)-
log_k 11.6667
delta_h -0.4 kJ
-gamma 0 0
# Id: 2009681
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Co+2 + 2Nta-3 = Co(Nta)2-4
log_k 14.9734
delta_h -20 kJ
-gamma 0 0
# Id: 2009682
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Co+2 + Nta-3 + H2O = CoOH(Nta)-2 + H+
log_k 0.4378
delta_h 45.6 kJ
-gamma 0 0
# Id: 2009683
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Fe+2 + Nta-3 = Fe(Nta)-
log_k 10.19
delta_h 0 kJ
-gamma 0 0
# Id: 2809681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+2 + 2Nta-3 = Fe(Nta)2-4
log_k 12.62
delta_h 0 kJ
-gamma 0 0
# Id: 2809682
# log K source: NIST46.2
# Delta H source: NIST46.2
```

```
#T and ionic strength:
Fe+2 + Nta-3 + H+ = FeH(Nta)
log_k 12.29
delta_h 0 kJ
-gamma 0 0
# Id: 2809683
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+2 + Nta-3 + H2O = FeOH(Nta)-2 + H+
log_k -1.06
delta_h 0 kJ
-gamma 0 0
# Id: 2809684
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+3 + Nta-3 = Fe(Nta)
log_k 17.8
delta_h 13.3888 kJ
-gamma 0 0
# Id: 2819681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+3 + 2Nta-3 = Fe(Nta)2-3
log_k 25.9
delta_h 0 kJ
-gamma 0 0
# Id: 2819682
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+3 + Nta-3 + H2O = FeOH(Nta)- + H+
log_k 13.23
delta_h 0 kJ
-gamma 0 0
# Id: 2819683
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mn+2 + Nta-3 = Mn(Nta)-
log_k 8.573
delta_h 5.8576 kJ
-gamma 0 0
# Id: 4709681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mn+2 + 2Nta-3 = Mn(Nta)2-4
log_k 11.58
delta_h -17.1544 kJ
-gamma 0 0
# Id: 4709682
```

```
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cr(OH)2+ + Nta-3 + 2H+ = Cr(Nta) + 2H2O
log_k 21.2
delta_h 0 kJ
-gamma 0 0
# Id: 2119681
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cr(OH)2+ + 2Nta-3 + 2H+ = Cr(Nta)2-3 + 2H2O
log_k 29.5
delta_h 0 kJ
-gamma 0 0
# Id: 2119682
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
MoO4-2 + 2H+ + Nta-3 = MoO3(Nta)-3 + H2O
log_k 19.5434
delta_h -69 kJ
-gamma 0 0
# Id: 4809681
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
MoO4-2 + 3H+ + Nta-3 = MoO3H(Nta)-2 + H2O
log_k 23.3954
delta_h -71 kJ
-gamma 0 0
# Id: 4809682
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 1.00 25.0
MoO4-2 + 4H+ + Nta-3 = MoO3H2(Nta)- + H2O
log_k 25.3534
delta_h -71 kJ
-gamma 0 0
# Id: 4809683
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 1.00 25.0
Be+2 + Nta-3 = Be(Nta)-
log_k 9.0767
delta_h 25 kJ
-gamma 0 0
# Id: 1109681
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Mg+2 + Nta-3 = Mg(Nta)-
log_k 6.5
delta_h 17.9912 kJ
```

```
-gamma 0 0
# Id: 4609681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Nta-3 = Ca(Nta)-
log_k 7.608
delta_h -5.6902 kJ
-gamma 0 0
# Id: 1509681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + 2Nta-3 = Ca(Nta)2-4
log_k 8.81
delta_h -32.6352 kJ
-gamma 0 0
# Id: 1509682
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Sr+2 + Nta-3 = Sr(Nta)-
log_k 6.2767
delta_h -2.2 kJ
-gamma 0 0
# Id: 8009681
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Ba+2 + Nta-3 = Ba(Nta)-
log_k 5.875
delta_h -6.025 kJ
-gamma 0 0
# Id: 1009681
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
H+ + Edta-4 = H(Edta)-3
log_k 10.948
delta_h -23.4304 kJ
-gamma 0 0
# Id: 3309691
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
2H+ + Edta-4 = H2(Edta)-2
log_k 17.221
delta_h -41.0032 kJ
-gamma 0 0
# Id: 3309692
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
3H+ + Edta-4 = H3(Edta)-
```

```
log_k 20.34
delta_h -35.564 kJ
-gamma 0 0
# Id: 3309693
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
4H+ + Edta-4 = H4(Edta)
log_k 22.5
delta_h -34.3088 kJ
-gamma 0 0
# Id: 3309694
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
5H+ + Edta-4 = H5(Edta)+
log_k 24
delta_h -32.2168 kJ
-gamma 0 0
# Id: 3309695
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Sn(OH)2 + 2H+ + Edta-4 = Sn(Edta)-2 + 2H2O
log_k 27.026
delta_h 0 kJ
-gamma 0 0
# Id: 7909691
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 1.00 20.0
Sn(OH)2 + 3H+ + Edta-4 = SnH(Edta)- + 2H2O
log_k 29.934
delta_h 0 kJ
-gamma 0 0
# Id: 7909692
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 1.00 20.0
Sn(OH)2 + 4H+ + Edta-4 = SnH2(Edta) + 2H2O
log_k 31.638
delta_h 0 kJ
-gamma 0 0
# Id: 7909693
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 1.00 20.0
Pb+2 + Edta-4 = Pb(Edta)-2
log_k 19.8
delta_h -54.8104 kJ
-gamma 0 0
# Id: 6009691
# log K source: NIST46.2
# Delta H source: NIST46.2
```

```
#T and ionic strength:
Pb+2 + Edta-4 + H+ = PbH(Edta)-
log_k 23
delta_h 0 kJ
-gamma 0 0
# Id: 6009692
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Pb+2 + Edta-4 + 2H+ = PbH2(Edta)
log_k 24.9
delta_h 0 kJ
-gamma 0 0
# Id: 6009693
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Al+3 + Edta-4 = Al(Edta)-
log_k 19.1
delta_h 52.7184 kJ
-gamma 0 0
# Id: 309690
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Al+3 + Edta-4 + H+ = AlH(Edta)
log_k 21.8
delta_h 36.4008 kJ
-gamma 0 0
# Id: 309691
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Al+3 + Edta-4 + H2O = AlOH(Edta)-2 + H+
log_k 12.8
delta_h 73.6384 kJ
-gamma 0 0
# Id: 309692
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Tl+ + Edta-4 = Tl(Edta)-3
log_k 7.27
delta_h -43.5136 kJ
-gamma 0 0
# Id: 8709691
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Tl+ + Edta-4 + H+ = TlH(Edta)-2
log_k 13.68
delta_h 0 kJ
-gamma 0 0
# Id: 8709692
```

```
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Edta-4 = Zn(Edta)-2
log_k 18
delta_h -19.2464 kJ
-gamma 0 0
# Id: 9509691
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Edta-4 + H+ = ZnH(Edta)-
log_k 21.4
delta_h -28.4512 kJ
-gamma 0 0
# Id: 9509692
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Edta-4 + H2O = ZnOH(Edta)-3 + H+
log_k 5.8
delta_h 0 kJ
-gamma 0 0
# Id: 9509693
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Edta-4 = Cd(Edta)-2
log_k 18.2
delta_h -38.0744 kJ
-gamma 0 0
# Id: 1609691
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Edta-4 + H+ = CdH(Edta)-
log_k 21.5
delta_h -39.748 kJ
-gamma 0 0
# Id: 1609692
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + Edta-4 + 2H+ = Hg(Edta)-2 + 2H2O
log_k 29.3
delta_h -125.102 kJ
-gamma 0 0
# Id: 3619691
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + Edta-4 + 3H+ = HgH(Edta)- + 2H2O
log_k 32.9
delta_h -128.449 kJ
```

```
-gamma 0 0
# Id: 3619692
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Edta-4 = Cu(Edta)-2
log_k 20.5
delta_h -34.7272 kJ
-gamma 0 0
# Id: 2319691
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Edta-4 + H+ = CuH(Edta)-
log_k 24
delta_h -43.0952 kJ
-gamma 0 0
# Id: 2319692
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Edta-4 + 2H+ = CuH2(Edta)
log_k 26.2
delta_h 0 kJ
-gamma 0 0
# Id: 2319693
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Edta-4 + H2O = CuOH(Edta)-3 + H+
log_k 8.5
delta_h 0 kJ
-gamma 0 0
# Id: 2319694
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Edta-4 = Ag(Edta)-3
log_k 8.08
delta_h -31.38 kJ
-gamma 0 0
# Id: 209691
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Edta-4 + H+ = AgH(Edta)-2
log_k 15.21
delta_h 0 kJ
-gamma 0 0
# Id: 209693
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Ni+2 + Edta-4 = Ni(Edta)-2
```

```
log_k 20.1
delta_h -30.9616 kJ
-gamma 0 0
# Id: 5409691
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Edta-4 + H+ = NiH(Edta)-
log_k 23.6
delta_h -38.4928 kJ
-gamma 0 0
# Id: 5409692
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Edta-4 + H2O = NiOH(Edta)-3 + H+
log_k 7.6
delta_h 0 kJ
-gamma 0 0
# Id: 5409693
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Co+2 + Edta-4 = Co(Edta)-2
log_k 18.1657
delta_h -15 kJ
-gamma 0 0
# Id: 2009691
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Co+2 + Edta-4 + H+ = CoH(Edta)-
log_k 21.5946
delta_h -22.9 kJ
-gamma 0 0
# Id: 2009692
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Co+2 + Edta-4 + 2H+ = CoH2(Edta)
log_k 23.4986
delta_h 0 kJ
-gamma 0 0
# Id: 2009693
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 1.00 25.0
Co+3 + Edta-4 = Co(Edta)-
log_k 43.9735
delta_h 0 kJ
-gamma 0 0
# Id: 2019691
# log K source: NIST46.4
# Delta H source: NIST46.2
```

```
#T and ionic strength:  0.10 25.0
Co+3 + Edta-4 + H+ = CoH(Edta)
log_k 47.168
delta_h 0 kJ
-gamma 0 0
# Id:  2019692
# log K source:  NIST46.4
# Delta H source:  NIST46.2
#T and ionic strength:  0.10 20.0
Fe+2 + Edta-4 = Fe(Edta)-2
log_k 16
delta_h -16.736 kJ
-gamma 0 0
# Id:  2809690
# log K source:  NIST46.2
# Delta H source:  NIST46.2
#T and ionic strength:
Fe+2 + Edta-4 + H+ = FeH(Edta)-
log_k 19.06
delta_h -27.6144 kJ
-gamma 0 0
# Id:  2809691
# log K source:  NIST46.2
# Delta H source:  NIST46.2
#T and ionic strength:
Fe+2 + Edta-4 + H2O = FeOH(Edta)-3 + H+
log_k 6.5
delta_h 0 kJ
-gamma 0 0
# Id:  2809692
# log K source:  SCD2.62
# Delta H source:  SCD2.62
#T and ionic strength:
Fe+2 + Edta-4 + 2H2O = Fe(OH)2(Edta)-4 + 2H+
log_k -4
delta_h 0 kJ
-gamma 0 0
# Id:  2809693
# log K source:  SCD2.62
# Delta H source:  SCD2.62
#T and ionic strength:
Fe+3 + Edta-4 = Fe(Edta)-
log_k 27.7
delta_h -11.2968 kJ
-gamma 0 0
# Id:  2819690
# log K source:  NIST46.2
# Delta H source:  NIST46.2
#T and ionic strength:
Fe+3 + Edta-4 + H+ = FeH(Edta)
log_k 29.2
delta_h -11.7152 kJ
-gamma 0 0
# Id:  2819691
```

```
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+3 + Edta-4 + H2O = FeOH(Edta)-2 + H+
log_k 19.9
delta_h 0 kJ
-gamma 0 0
# Id: 2819692
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+3 + Edta-4 + 2H2O = Fe(OH)2(Edta)-3 + 2H+
log_k 9.85
delta_h 0 kJ
-gamma 0 0
# Id: 2819693
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Mn+2 + Edta-4 = Mn(Edta)-2
log_k 15.6
delta_h -19.2464 kJ
-gamma 0 0
# Id: 4709691
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mn+2 + Edta-4 + H+ = MnH(Edta)-
log_k 19.1
delta_h -24.2672 kJ
-gamma 0 0
# Id: 4709692
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cr+2 + Edta-4 = Cr(Edta)-2
log_k 15.3
delta_h 0 kJ
-gamma 0 0
# Id: 2109691
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cr+2 + Edta-4 + H+ = CrH(Edta)-
log_k 19.1
delta_h 0 kJ
-gamma 0 0
# Id: 2109692
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cr(OH)2+ + Edta-4 + 2H+ = Cr(Edta)- + 2H2O
log_k 35.5
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 2119691
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cr(OH)2+ + Edta-4 + 3H+ = CrH(Edta) + 2H2O
log_k 37.4
delta_h 0 kJ
-gamma 0 0
# Id: 2119692
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cr(OH)2+ + Edta-4 + H+ = CrOH(Edta)-2 + H2O
log_k 27.7
delta_h 0 kJ
-gamma 0 0
# Id: 2119693
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Be+2 + Edta-4 = Be(Edta)-2
log_k 11.4157
delta_h 41 kJ
-gamma 0 0
# Id: 1109691
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Mg+2 + Edta-4 = Mg(Edta)-2
log_k 10.57
delta_h 13.8072 kJ
-gamma 0 0
# Id: 4609690
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mg+2 + Edta-4 + H+ = MgH(Edta)-
log_k 14.97
delta_h 0 kJ
-gamma 0 0
# Id: 4609691
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Edta-4 = Ca(Edta)-2
log_k 12.42
delta_h -25.5224 kJ
-gamma 0 0
# Id: 1509690
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Edta-4 + H+ = CaH(Edta)-
```

```
log_k 15.9
delta_h 0 kJ
-gamma 0 0
# Id: 1509691
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Sr+2 + Edta-4 = Sr(Edta)-2
log_k 10.4357
delta_h -17 kJ
-gamma 0 0
# Id: 8009691
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Sr+2 + Edta-4 + H+ = SrH(Edta)-
log_k 14.7946
delta_h 0 kJ
-gamma 0 0
# Id: 8009692
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 20.0
Ba+2 + Edta-4 = Ba(Edta)-2
log_k 7.72
delta_h -20.5016 kJ
-gamma 0 0
# Id: 1009691
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Na+ + Edta-4 = Na(Edta)-3
log_k 2.7
delta_h -5.8576 kJ
-gamma 0 0
# Id: 5009690
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
K+ + Edta-4 = K(Edta)-3
log_k 1.7
delta_h 0 kJ
-gamma 0 0
# Id: 4109690
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
H+ + Propionate- = H(Propionate)
log_k 4.874
delta_h 0.66 kJ
-gamma 0 0
# Id: 3309711
# log K source: NIST46.4
# Delta H source: NIST46.4
```

```
#T and ionic strength: 0.00 25.0
Pb+2 + Propionate- = Pb(Propionate)+
log_k 2.64
delta_h 0 kJ
-gamma 0 0
# Id: 6009711
# log K source: NIST46.4
# Delta H source: SCD2.62
#T and ionic strength: 0.00 35.0
Pb+2 + 2Propionate- = Pb(Propionate)2
log_k 3.1765
delta_h 0 kJ
-gamma 0 0
# Id: 6009712
# log K source: NIST46.4
# Delta H source: SCD2.62
#T and ionic strength: 2.00 25.0
Zn+2 + Propionate- = Zn(Propionate)+
log_k 1.4389
delta_h 0 kJ
-gamma 0 0
# Id: 9509711
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Zn+2 + 2Propionate- = Zn(Propionate)2
log_k 1.842
delta_h 0 kJ
-gamma 0 0
# Id: 9509712
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 1.00 25.0
Cd+2 + Propionate- = Cd(Propionate)+
log_k 1.598
delta_h 0 kJ
-gamma 0 0
# Id: 1609711
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 1.00 25.0
Cd+2 + 2Propionate- = Cd(Propionate)2
log_k 2.472
delta_h 0 kJ
-gamma 0 0
# Id: 1609712
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 1.00 25.0
Hg(OH)2 + 2H+ + Propionate- = Hg(Propionate)+ + 2H2O
log_k 10.594
delta_h 0 kJ
-gamma 0 0
# Id: 3619711
```

```
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Cu+2 + Propionate- = Cu(Propionate)+
log_k 2.22
delta_h 4.1 kJ
-gamma 0 0
# Id: 2319711
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Cu+2 + 2Propionate- = Cu(Propionate)2
log_k 3.5
delta_h 0 kJ
-gamma 0 0
# Id: 2319712
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Ni+2 + Propionate- = Ni(Propionate)+
log_k 0.908
delta_h 0 kJ
-gamma 0 0
# Id: 5409711
# log K source: NIST46.4
# Delta H source: SCD2.62
#T and ionic strength: 1.00 25.0
Co+2 + Propionate- = Co(Propionate)+
log_k 0.671
delta_h 4.6 kJ
-gamma 0 0
# Id: 2009711
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 2.00 25.0
Co+2 + 2Propionate- = Co(Propionate)2
log_k 0.5565
delta_h 16 kJ
-gamma 0 0
# Id: 2009712
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 2.00 25.0
Fe+3 + Propionate- = Fe(Propionate)+2
log_k 4.012
delta_h 0 kJ
-gamma 0 0
# Id: 2819711
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 1.00 20.0
Cr(OH)2+ + 2H+ + Propionate- = Cr(Propionate)+2 + 2H2O
log_k 15.0773
delta_h 0 kJ
```

-gamma 0 0
Id: 2119711
log K source: NIST46.4
Delta H source: SCD2.62
#T and ionic strength: 0.50 25.0
Cr(OH)2+ + 2H+ + 2Propionate- = Cr(Propionate)2+ + 2H2O
log_k 17.9563
delta_h 0 kJ
-gamma 0 0
Id: 2119712
log K source: NIST46.4
Delta H source: SCD2.62
#T and ionic strength: 0.50 25.0
Cr(OH)2+ + 2H+ + 3Propionate- = Cr(Propionate)3 + 2H2O
log_k 20.8858
delta_h 0 kJ
-gamma 0 0
Id: 2119713
log K source: NIST46.4
Delta H source: SCD2.62
#T and ionic strength: 0.50 25.0
Mg+2 + Propionate- = Mg(Propionate)+
log_k 0.9689
delta_h 4.2677 kJ
-gamma 0 0
Id: 4609710
log K source: NIST46.4
Delta H source: SCD2.62
#T and ionic strength: 0.10 25.0
Ca+2 + Propionate- = Ca(Propionate)+
log_k 0.9289
delta_h 3.3472 kJ
-gamma 0 0
Id: 1509710
log K source: NIST46.4
Delta H source: SCD2.62
#T and ionic strength: 0.10 25.0
Sr+2 + Propionate- = Sr(Propionate)+
log_k 0.8589
delta_h 0 kJ
-gamma 0 0
Id: 8009711
log K source: NIST46.4
Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Ba+2 + Propionate- = Ba(Propionate)+
log_k 0.7689
delta_h 0 kJ
-gamma 0 0
Id: 1009711
log K source: NIST46.4
Delta H source: SCD2.62
#T and ionic strength: 0.10 25.0
Ba+2 + 2Propionate- = Ba(Propionate)2

```
log_k 0.9834
delta_h 0 kJ
-gamma 0 0
# Id: 1009712
# log K source: NIST46.4
# Delta H source: SCD2.62
#T and ionic strength: 0.10 25.0
H+ + Butyrate- = H(Butyrate)
log_k 4.819
delta_h 2.8 kJ
-gamma 0 0
# Id: 3309721
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Pb+2 + Butyrate- = Pb(Butyrate)+
log_k 2.101
delta_h 0 kJ
-gamma 0 0
# Id: 6009721
# log K source: NIST46.4
# Delta H source: SCD2.62
#T and ionic strength: 2.00 25.0
Zn+2 + Butyrate- = Zn(Butyrate)+
log_k 1.4289
delta_h 0 kJ
-gamma 0 0
# Id: 9509721
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Hg(OH)2 + 2H+ + Butyrate- = Hg(Butyrate)+ + 2H2O
log_k 10.3529
delta_h 0 kJ
-gamma 0 0
# Id: 3619721
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Cu+2 + Butyrate- = Cu(Butyrate)+
log_k 2.14
delta_h 0 kJ
-gamma 0 0
# Id: 2319721
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Ni+2 + Butyrate- = Ni(Butyrate)+
log_k 0.691
delta_h 0 kJ
-gamma 0 0
# Id: 5409721
# log K source: NIST46.4
# Delta H source: SCD2.62
```

```
#T and ionic strength: 2.00 25.0
Co+2 + Butyrate- = Co(Butyrate)+
log_k 0.591
delta_h 0 kJ
-gamma 0 0
# Id: 2009721
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 2.00 25.0
Co+2 + 2Butyrate- = Co(Butyrate)2
log_k 0.7765
delta_h 0 kJ
-gamma 0 0
# Id: 2009722
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 2.00 25.0
Mg+2 + Butyrate- = Mg(Butyrate)+
log_k 0.9589
delta_h 0 kJ
-gamma 0 0
# Id: 4609720
# log K source: NIST46.4
# Delta H source: SCD2.62
#T and ionic strength: 0.10 25.0
Ca+2 + Butyrate- = Ca(Butyrate)+
log_k 0.9389
delta_h 3.3472 kJ
-gamma 0 0
# Id: 1509720
# log K source: NIST46.4
# Delta H source: SCD2.62
#T and ionic strength: 0.10 25.0
Sr+2 + Butyrate- = Sr(Butyrate)+
log_k 0.7889
delta_h 0 kJ
-gamma 0 0
# Id: 8009721
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Ba+2 + Butyrate- = Ba(Butyrate)+
log_k 0.7389
delta_h 0 kJ
-gamma 0 0
# Id: 1009721
# log K source: NIST46.4
# Delta H source: SCD2.62
#T and ionic strength: 0.10 25.0
Ba+2 + 2Butyrate- = Ba(Butyrate)2
log_k 0.88
delta_h 0 kJ
-gamma 0 0
# Id: 1009722
```

```
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
H+ + Isobutyrate- = H(Isobutyrate)
log_k 4.849
delta_h 3.2217 kJ
-gamma 0 0
# Id: 3309731
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Isobutyrate- = Zn(Isobutyrate)+
log_k 1.44
delta_h 0 kJ
-gamma 0 0
# Id: 9509731
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Isobutyrate- = Cu(Isobutyrate)+
log_k 2.17
delta_h 0 kJ
-gamma 0 0
# Id: 2319731
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 2Isobutyrate- = Cu(Isobutyrate)2
log_k 3.3
delta_h 0 kJ
-gamma 0 0
# Id: 2319732
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+3 + Isobutyrate- = Fe(Isobutyrate)+2
log_k 4.2
delta_h 0 kJ
-gamma 0 0
# Id: 2819731
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Isobutyrate- = Ca(Isobutyrate)+
log_k 0.51
delta_h 0 kJ
-gamma 0 0
# Id: 1509731
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
H+ + Two_picoline = H(Two_picoline)+
log_k 5.95
delta_h -25.5224 kJ
```

```
-gamma 0 0
# Id: 3309801
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Two_picoline = Cu(Two_picoline)+2
log_k 1.3
delta_h 0 kJ
-gamma 0 0
# Id: 2319801
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 2Two_picoline = Cu(Two_picoline)2+2
log_k 2.8
delta_h 0 kJ
-gamma 0 0
# Id: 2319802
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+ + Two_picoline = Cu(Two_picoline)+
log_k 5.4
delta_h 0 kJ
-gamma 0 0
# Id: 2309801
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+ + 2Two_picoline = Cu(Two_picoline)2+
log_k 7.65
delta_h 0 kJ
-gamma 0 0
# Id: 2309802
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+ + 3Two_picoline = Cu(Two_picoline)3+
log_k 8.5
delta_h 0 kJ
-gamma 0 0
# Id: 2309803
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Two_picoline = Ag(Two_picoline)+
log_k 2.32
delta_h -24.2672 kJ
-gamma 0 0
# Id: 209801
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Two_picoline = Ag(Two_picoline)2+
```

```
log_k 4.68
delta_h -42.6768 kJ
-gamma 0 0
# Id: 209802
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Two_picoline = Ni(Two_picoline)+2
log_k 0.4
delta_h 0 kJ
-gamma 0 0
# Id: 5409801
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
H+ + Three_picoline = H(Three_picoline)+
log_k 5.7
delta_h -23.8488 kJ
-gamma 0 0
# Id: 3309811
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Three_picoline = Zn(Three_picoline)+2
log_k 1
delta_h 0 kJ
-gamma 0 0
# Id: 9509811
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + 2Three_picoline = Zn(Three_picoline)2+2
log_k 2.1
delta_h 0 kJ
-gamma 0 0
# Id: 9509812
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + 3Three_picoline = Zn(Three_picoline)3+2
log_k 2.6
delta_h 0 kJ
-gamma 0 0
# Id: 9509813
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + 4Three_picoline = Zn(Three_picoline)4+2
log_k 3.7
delta_h 0 kJ
-gamma 0 0
# Id: 9509814
# log K source: NIST46.2
# Delta H source: NIST46.2
```

```
#T and ionic strength:
Cd+2 + Three_picoline = Cd(Three_picoline)+2
log_k 1.42
delta_h 0 kJ
-gamma 0 0
# Id: 1609811
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + 2Three_picoline = Cd(Three_picoline)2+2
log_k 2.27
delta_h 0 kJ
-gamma 0 0
# Id: 1609812
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + 3Three_picoline = Cd(Three_picoline)3+2
log_k 3.6
delta_h 0 kJ
-gamma 0 0
# Id: 1609813
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + 4Three_picoline = Cd(Three_picoline)4+2
log_k 4
delta_h 0 kJ
-gamma 0 0
# Id: 1609814
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+ + Three_picoline = Cu(Three_picoline)+
log_k 5.6
delta_h 0 kJ
-gamma 0 0
# Id: 2309811
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+ + 2Three_picoline = Cu(Three_picoline)2+
log_k 7.78
delta_h 0 kJ
-gamma 0 0
# Id: 2309812
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+ + 3Three_picoline = Cu(Three_picoline)3+
log_k 8.6
delta_h 0 kJ
-gamma 0 0
# Id: 2309813
```

```
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+ + 4Three_picoline = Cu(Three_picoline)4+
log_k 9
delta_h 0 kJ
-gamma 0 0
# Id: 2309814
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Three_picoline = Cu(Three_picoline)+2
log_k 2.77
delta_h 0 kJ
-gamma 0 0
# Id: 2319811
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 2Three_picoline = Cu(Three_picoline)2+2
log_k 4.8
delta_h 0 kJ
-gamma 0 0
# Id: 2319812
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 3Three_picoline = Cu(Three_picoline)3+2
log_k 6.3
delta_h 0 kJ
-gamma 0 0
# Id: 2319813
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 4Three_picoline = Cu(Three_picoline)4+2
log_k 7.2
delta_h 0 kJ
-gamma 0 0
# Id: 2319814
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Three_picoline = Ag(Three_picoline)+
log_k 2.2
delta_h -21.7568 kJ
-gamma 0 0
# Id: 209811
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Three_picoline = Ag(Three_picoline)2+
log_k 4.46
delta_h -49.7896 kJ
```

```
-gamma 0 0
# Id: 209812
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Three_picoline = Ni(Three_picoline)+2
log_k 1.87
delta_h 0 kJ
-gamma 0 0
# Id: 5409811
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + 2Three_picoline = Ni(Three_picoline)2+2
log_k 3.3
delta_h 0 kJ
-gamma 0 0
# Id: 5409812
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + 3Three_picoline = Ni(Three_picoline)3+2
log_k 4.1
delta_h 0 kJ
-gamma 0 0
# Id: 5409813
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + 4Three_picoline = Ni(Three_picoline)4+2
log_k 4.6
delta_h 0 kJ
-gamma 0 0
# Id: 5409814
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Co+2 + Three_picoline = Co(Three_picoline)+2
log_k 1.4
delta_h 0 kJ
-gamma 0 0
# Id: 2009811
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.50 25.0
Co+2 + 2Three_picoline = Co(Three_picoline)2+2
log_k 2.2
delta_h 0 kJ
-gamma 0 0
# Id: 2009812
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.50 25.0
Co+2 + 3Three_picoline = Co(Three_picoline)3+2
```

```
log_k 2.5
delta_h 0 kJ
-gamma 0 0
# Id: 2009813
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.50 25.0
H+ + Four_picoline = H(Four_picoline)+
log_k 6.03
delta_h -25.3132 kJ
-gamma 0 0
# Id: 3309821
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Four_picoline = Zn(Four_picoline)+2
log_k 1.4
delta_h 0 kJ
-gamma 0 0
# Id: 9509821
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + 2Four_picoline = Zn(Four_picoline)2+2
log_k 2.11
delta_h 0 kJ
-gamma 0 0
# Id: 9509822
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + 3Four_picoline = Zn(Four_picoline)3+2
log_k 2.85
delta_h 0 kJ
-gamma 0 0
# Id: 9509823
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Four_picoline = Cd(Four_picoline)+2
log_k 1.59
delta_h 0 kJ
-gamma 0 0
# Id: 1609821
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + 2Four_picoline = Cd(Four_picoline)2+2
log_k 2.4
delta_h 0 kJ
-gamma 0 0
# Id: 1609822
# log K source: SCD2.62
# Delta H source: SCD2.62
```

```
#T and ionic strength:
Cd+2 + 3Four_picoline = Cd(Four_picoline)3+2
log_k 3.18
delta_h 0 kJ
-gamma 0 0
# Id: 1609823
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + 4Four_picoline = Cd(Four_picoline)4+2
log_k 4
delta_h 0 kJ
-gamma 0 0
# Id: 1609824
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+ + Four_picoline = Cu(Four_picoline)+
log_k 5.65
delta_h 0 kJ
-gamma 0 0
# Id: 2309821
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+ + 2Four_picoline = Cu(Four_picoline)2+
log_k 8.2
delta_h 0 kJ
-gamma 0 0
# Id: 2309822
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+ + 3Four_picoline = Cu(Four_picoline)3+
log_k 8.8
delta_h 0 kJ
-gamma 0 0
# Id: 2309823
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+ + 4Four_picoline = Cu(Four_picoline)4+
log_k 9.2
delta_h 0 kJ
-gamma 0 0
# Id: 2309824
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Four_picoline = Cu(Four_picoline)+2
log_k 2.88
delta_h 0 kJ
-gamma 0 0
# Id: 2319821
```

```
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 2Four_picoline = Cu(Four_picoline)2+2
log_k 5.16
delta_h 0 kJ
-gamma 0 0
# Id: 2319822
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 3Four_picoline = Cu(Four_picoline)3+2
log_k 6.77
delta_h 0 kJ
-gamma 0 0
# Id: 2319823
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 4Four_picoline = Cu(Four_picoline)4+2
log_k 8.08
delta_h 0 kJ
-gamma 0 0
# Id: 2319824
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 5Four_picoline = Cu(Four_picoline)5+2
log_k 8.3
delta_h 0 kJ
-gamma 0 0
# Id: 2319825
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Four_picoline = Ag(Four_picoline)+
log_k 2.03
delta_h -25.5224 kJ
-gamma 0 0
# Id: 209821
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Four_picoline = Ag(Four_picoline)2+
log_k 4.39
delta_h -53.5552 kJ
-gamma 0 0
# Id: 209822
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Four_picoline = Ni(Four_picoline)+2
log_k 2.11
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 5409821
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + 2Four_picoline = Ni(Four_picoline)2+2
log_k 3.59
delta_h 0 kJ
-gamma 0 0
# Id: 5409822
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + 3Four_picoline = Ni(Four_picoline)3+2
log_k 4.34
delta_h 0 kJ
-gamma 0 0
# Id: 5409823
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + 4Four_picoline = Ni(Four_picoline)4+2
log_k 4.7
delta_h 0 kJ
-gamma 0 0
# Id: 5409824
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Co+2 + Four_picoline = Co(Four_picoline)+2
log_k 1.56
delta_h 0 kJ
-gamma 0 0
# Id: 2009821
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.50 25.0
Co+2 + 2Four_picoline = Co(Four_picoline)2+2
log_k 2.51
delta_h 0 kJ
-gamma 0 0
# Id: 2009822
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.50 25.0
Co+2 + 3Four_picoline = Co(Four_picoline)3+2
log_k 2.94
delta_h 0 kJ
-gamma 0 0
# Id: 2009823
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.50 25.0
Co+2 + 4Four_picoline = Co(Four_picoline)4+2
```

```
log_k 3.17
delta_h 0 kJ
-gamma 0 0
# Id: 2009824
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.50 25.0
H+ + Formate- = H(Formate)
log_k 3.745
delta_h 0.1674 kJ
-gamma 0 0
# Id: 3309831
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Pb+2 + Formate- = Pb(Formate)+
log_k 2.2
delta_h 0 kJ
-gamma 0 0
# Id: 6009831
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Zn+2 + Formate- = Zn(Formate)+
log_k 1.44
delta_h 0 kJ
-gamma 0 0
# Id: 9509831
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Formate- = Cd(Formate)+
log_k 1.7
delta_h 0 kJ
-gamma 0 0
# Id: 1609831
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Hg(OH)2 + Formate- + 2H+ = Hg(Formate)+ + 2H2O
log_k 9.6
delta_h 0 kJ
-gamma 0 0
# Id: 3619831
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Formate- = Cu(Formate)+
log_k 2
delta_h 0 kJ
-gamma 0 0
# Id: 2319831
# log K source: NIST46.2
# Delta H source: NIST46.2
```

```
#T and ionic strength:
Ni+2 + Formate- = Ni(Formate)+
log_k 1.22
delta_h 0 kJ
-gamma 0 0
# Id: 5409831
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Co+2 + Formate- = Co(Formate)+
log_k 1.209
delta_h 0 kJ
-gamma 0 0
# Id: 2009831
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.50 30.0
Co+2 + 2Formate- = Co(Formate)2
log_k 1.1365
delta_h 0 kJ
-gamma 0 0
# Id: 2009832
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 2.00 25.0
Cr+2 + Formate- = Cr(Formate)+
log_k 1.07
delta_h 0 kJ
-gamma 0 0
# Id: 2109831
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mg+2 + Formate- = Mg(Formate)+
log_k 1.43
delta_h 0 kJ
-gamma 0 0
# Id: 4609831
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Formate- = Ca(Formate)+
log_k 1.43
delta_h 4.184 kJ
-gamma 0 0
# Id: 1509831
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Sr+2 + Formate- = Sr(Formate)+
log_k 1.39
delta_h 4 kJ
-gamma 0 0
# Id: 8009831
```

```
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ba+2 + Formate- = Ba(Formate)+
log_k 1.38
delta_h 0 kJ
-gamma 0 0
# Id: 1009831
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
H+ + Isovalerate- = H(Isovalerate)
log_k 4.781
delta_h 4.5606 kJ
-gamma 0 0
# Id: 3309841
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Isovalerate- = Zn(Isovalerate)+
log_k 1.39
delta_h 0 kJ
-gamma 0 0
# Id: 9509841
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Isovalerate- = Cu(Isovalerate)+
log_k 2.08
delta_h 0 kJ
-gamma 0 0
# Id: 2319841
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Isovalerate- = Ca(Isovalerate)+
log_k 0.2
delta_h 0 kJ
-gamma 0 0
# Id: 1509841
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
H+ + Valerate- = H(Valerate)
log_k 4.843
delta_h 2.887 kJ
-gamma 0 0
# Id: 3309851
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Valerate- = Cu(Valerate)+
log_k 2.12
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 2319851
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Valerate- = Ca(Valerate)+
log_k 0.3
delta_h 0 kJ
-gamma 0 0
# Id: 1509851
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Ba+2 + Valerate- = Ba(Valerate)+
log_k -0.2
delta_h 0 kJ
-gamma 0 0
# Id: 1009851
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
H+ + Acetate- = H(Acetate)
log_k 4.757
delta_h 0.41 kJ
-gamma 0 0
# Id: 3309921
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Sn(OH)2 + 2H+ + Acetate- = Sn(Acetate)+ + 2H2O
log_k 10.0213
delta_h 0 kJ
-gamma 0 0
# Id: 7909921
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 3.00 25.0
Sn(OH)2 + 2H+ + 2Acetate- = Sn(Acetate)2 + 2H2O
log_k 12.32
delta_h 0 kJ
-gamma 0 0
# Id: 7909922
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 3.00 25.0
Sn(OH)2 + 2H+ + 3Acetate- = Sn(Acetate)3- + 2H2O
log_k 13.55
delta_h 0 kJ
-gamma 0 0
# Id: 7909923
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 3.00 25.0
Pb+2 + Acetate- = Pb(Acetate)+
```

```
log_k 2.68
delta_h -0.4 kJ
-gamma 0 0
# Id: 6009921
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Pb+2 + 2Acetate- = Pb(Acetate)2
log_k 4.08
delta_h -0.8 kJ
-gamma 0 0
# Id: 6009922
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Tl+ + Acetate- = Tl(Acetate)
log_k -0.11
delta_h 0 kJ
-gamma 0 0
# Id: 8709921
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Zn+2 + Acetate- = Zn(Acetate)+
log_k 1.58
delta_h 8.3 kJ
-gamma 0 0
# Id: 9509921
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Zn+2 + 2Acetate- = Zn(Acetate)2
log_k 2.6434
delta_h 22 kJ
-gamma 0 0
# Id: 9509922
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Cd+2 + Acetate- = Cd(Acetate)+
log_k 1.93
delta_h 9.6 kJ
-gamma 0 0
# Id: 1609921
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Cd+2 + 2Acetate- = Cd(Acetate)2
log_k 2.86
delta_h 15 kJ
-gamma 0 0
# Id: 1609922
# log K source: NIST46.4
# Delta H source: NIST46.4
```

```
#T and ionic strength: 0.00 25.0
Hg(OH)2 + 2H+ + Acetate- = Hg(Acetate)+ + 2H2O
log_k 10.494
delta_h 0 kJ
-gamma 0 0
# Id: 3619920
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Hg(OH)2 + 2H+ + 2Acetate- = Hg(Acetate)2 + 2H2O
log_k 13.83
delta_h 0 kJ
-gamma 0 0
# Id: 3619921
# log K source: NIST46.4
# Delta H source: SCD2.62
#T and ionic strength: 3.00 25.0
Cu+2 + Acetate- = Cu(Acetate)+
log_k 2.21
delta_h 7.1 kJ
-gamma 0 0
# Id: 2319921
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Cu+2 + 2Acetate- = Cu(Acetate)2
log_k 3.4
delta_h 12 kJ
-gamma 0 0
# Id: 2319922
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Cu+2 + 3Acetate- = Cu(Acetate)3-
log_k 3.9434
delta_h 6.2 kJ
-gamma 0 0
# Id: 2319923
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Ag+ + Acetate- = Ag(Acetate)
log_k 0.73
delta_h 3 kJ
-gamma 0 0
# Id: 209921
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ag+ + 2Acetate- = Ag(Acetate)2-
log_k 0.64
delta_h 3 kJ
-gamma 0 0
# Id: 209922
```

```
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ni+2 + Acetate- = Ni(Acetate)+
log_k 1.37
delta_h 8.7 kJ
-gamma 0 0
# Id: 5409921
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Ni+2 + 2Acetate- = Ni(Acetate)2
log_k 2.1
delta_h 10 kJ
-gamma 0 0
# Id: 5409922
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Co+2 + Acetate- = Co(Acetate)+
log_k 1.38
delta_h 0 kJ
-gamma 0 0
# Id: 2009921
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Co+2 + 2Acetate- = Co(Acetate)2
log_k 0.7565
delta_h 0 kJ
-gamma 0 0
# Id: 2009922
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 2.00 25.0
Fe+2 + Acetate- = Fe(Acetate)+
log_k 1.4
delta_h 0 kJ
-gamma 0 0
# Id: 2809920
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Fe+3 + Acetate- = Fe(Acetate)+2
log_k 4.0234
delta_h 0 kJ
-gamma 0 0
# Id: 2819920
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 20.0
Fe+3 + 2Acetate- = Fe(Acetate)2+
log_k 7.5723
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 2819921
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 20.0
Fe+3 + 3Acetate- = Fe(Acetate)3
log_k 9.5867
delta_h 0 kJ
-gamma 0 0
# Id: 2819922
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 20.0
Mn+2 + Acetate- = Mn(Acetate)+
log_k 1.4
delta_h 0 kJ
-gamma 0 0
# Id: 4709920
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Cr+2 + Acetate- = Cr(Acetate)+
log_k 1.8
delta_h 0 kJ
-gamma 0 0
# Id: 2109921
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Cr+2 + 2Acetate- = Cr(Acetate)2
log_k 2.92
delta_h 0 kJ
-gamma 0 0
# Id: 2109922
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Cr(OH)2+ + 2H+ + Acetate- = Cr(Acetate)+2 + 2H2O
log_k 15.0073
delta_h -125.62 kJ
-gamma 0 0
# Id: 2119921
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.50 25.0
Cr(OH)2+ + 2H+ + 2Acetate- = Cr(Acetate)2+ + 2H2O
log_k 17.9963
delta_h -117.62 kJ
-gamma 0 0
# Id: 2119922
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.50 25.0
Cr(OH)2+ + 2H+ + 3Acetate- = Cr(Acetate)3 + 2H2O
```

```
log_k 20.7858
delta_h -96.62 kJ
-gamma 0 0
# Id: 2119923
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.50 25.0
Be+2 + Acetate- = Be(Acetate)+
log_k 2.0489
delta_h 0 kJ
-gamma 0 0
# Id: 1109921
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Be+2 + 2Acetate- = Be(Acetate)2
log_k 3.0034
delta_h 0 kJ
-gamma 0 0
# Id: 1109922
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Mg+2 + Acetate- = Mg(Acetate)+
log_k 1.27
delta_h 0 kJ
-gamma 0 0
# Id: 4609920
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Ca+2 + Acetate- = Ca(Acetate)+
log_k 1.18
delta_h 4 kJ
-gamma 0 0
# Id: 1509920
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Sr+2 + Acetate- = Sr(Acetate)+
log_k 1.14
delta_h 0 kJ
-gamma 0 0
# Id: 8009921
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Ba+2 + Acetate- = Ba(Acetate)+
log_k 1.07
delta_h 0 kJ
-gamma 0 0
# Id: 1009921
# log K source: NIST46.4
# Delta H source: NIST46.2
```

```
#T and ionic strength: 0.00 25.0
Na+ + Acetate- = Na(Acetate)
log_k -0.18
delta_h 12 kJ
-gamma 0 0
# Id: 5009920
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
K+ + Acetate- = K(Acetate)
log_k -0.1955
delta_h 4.184 kJ
-gamma 0 0
# Id: 4109921
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
H+ + Tartarate-2 = H(Tartarate)-
log_k 4.366
delta_h -0.7531 kJ
-gamma 0 0
# Id: 3309931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
2H+ + Tartarate-2 = H2(Tartarate)
log_k 7.402
delta_h -3.6819 kJ
-gamma 0 0
# Id: 3309932
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Sn(OH)2 + 2H+ + Tartarate-2 = Sn(Tartarate) + 2H2O
log_k 13.1518
delta_h 0 kJ
-gamma 0 0
# Id: 7909931
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 20.0
Pb+2 + Tartarate-2 = Pb(Tartarate)
log_k 3.98
delta_h 0 kJ
-gamma 0 0
# Id: 6009931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Al+3 + 2Tartarate-2 = Al(Tartarate)2-
log_k 9.37
delta_h 0 kJ
-gamma 0 0
# Id: 309931
```

```
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Tl+ + Tartarate-2 = Tl(Tartarate)-
log_k 1.4
delta_h 0 kJ
-gamma 0 0
# Id: 8709931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Tl+ + Tartarate-2 + H+ = TlH(Tartarate)
log_k 4.8
delta_h 0 kJ
-gamma 0 0
# Id: 8709932
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Tartarate-2 = Zn(Tartarate)
log_k 3.43
delta_h 0 kJ
-gamma 0 0
# Id: 9509931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + 2Tartarate-2 = Zn(Tartarate)2-2
log_k 5.5
delta_h 0 kJ
-gamma 0 0
# Id: 9509932
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Tartarate-2 + H+ = ZnH(Tartarate)+
log_k 5.9
delta_h 0 kJ
-gamma 0 0
# Id: 9509933
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Tartarate-2 = Cd(Tartarate)
log_k 2.7
delta_h 0 kJ
-gamma 0 0
# Id: 1609931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + 2Tartarate-2 = Cd(Tartarate)2-2
log_k 4.1
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 1609932
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + Tartarate-2 + 2H+ = Hg(Tartarate) + 2H2O
log_k 14
delta_h 0 kJ
-gamma 0 0
# Id: 3619931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Tartarate-2 = Cu(Tartarate)
log_k 3.97
delta_h 0 kJ
-gamma 0 0
# Id: 2319931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Tartarate-2 + H+ = CuH(Tartarate)+
log_k 6.7
delta_h 0 kJ
-gamma 0 0
# Id: 2319932
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Tartarate-2 = Ni(Tartarate)
log_k 3.46
delta_h 0 kJ
-gamma 0 0
# Id: 5409931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Tartarate-2 + H+ = NiH(Tartarate)+
log_k 5.89
delta_h 0 kJ
-gamma 0 0
# Id: 5409932
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Co+2 + Tartarate-2 = Co(Tartarate)
log_k 3.05
delta_h 0 kJ
-gamma 0 0
# Id: 2009931
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Co+2 + 2Tartarate-2 = Co(Tartarate)2-2
```

```
log_k 4
delta_h 0 kJ
-gamma 0 0
# Id: 2009932
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Co+2 + H+ + Tartarate-2 = CoH(Tartarate)+
log_k 5.754
delta_h 0 kJ
-gamma 0 0
# Id: 2009933
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 1.00 20.0
Fe+2 + Tartarate-2 = Fe(Tartarate)
log_k 3.1
delta_h 0 kJ
-gamma 0 0
# Id: 2809931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+3 + Tartarate-2 = Fe(Tartarate)+
log_k 7.78
delta_h 0 kJ
-gamma 0 0
# Id: 2819931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mn+2 + Tartarate-2 = Mn(Tartarate)
log_k 3.38
delta_h 0 kJ
-gamma 0 0
# Id: 4709931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mn+2 + Tartarate-2 + H+ = MnH(Tartarate)+
log_k 6
delta_h 0 kJ
-gamma 0 0
# Id: 4709932
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mg+2 + Tartarate-2 = Mg(Tartarate)
log_k 2.3
delta_h 0 kJ
-gamma 0 0
# Id: 4609931
# log K source: NIST46.2
# Delta H source: NIST46.2
```

```
#T and ionic strength:
Mg+2 + Tartarate-2 + H+ = MgH(Tartarate)+
log_k 5.75
delta_h 0 kJ
-gamma 0 0
# Id: 4609932
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Be+2 + Tartarate-2 = Be(Tartarate)
log_k 2.768
delta_h 0 kJ
-gamma 0 0
# Id: 1109931
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.50 25.0
Be+2 + 2Tartarate-2 = Be(Tartarate)2-2
log_k 4.008
delta_h 0 kJ
-gamma 0 0
# Id: 1109932
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.50 25.0
Ca+2 + Tartarate-2 = Ca(Tartarate)
log_k 2.8
delta_h -8.368 kJ
-gamma 0 0
# Id: 1509931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Tartarate-2 + H+ = CaH(Tartarate)+
log_k 5.86
delta_h -9.1211 kJ
-gamma 0 0
# Id: 1509932
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Sr+2 + Tartarate-2 = Sr(Tartarate)
log_k 2.55
delta_h 0 kJ
-gamma 0 0
# Id: 8009931
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 20.0
Sr+2 + H+ + Tartarate-2 = SrH(Tartarate)+
log_k 5.8949
delta_h 0 kJ
-gamma 0 0
# Id: 8009932
```

```
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Ba+2 + Tartarate-2 = Ba(Tartarate)
log_k 2.54
delta_h 0 kJ
-gamma 0 0
# Id: 1009931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ba+2 + Tartarate-2 + H+ = BaH(Tartarate)+
log_k 5.77
delta_h 0 kJ
-gamma 0 0
# Id: 1009932
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Na+ + Tartarate-2 = Na(Tartarate)-
log_k 0.9
delta_h -0.8368 kJ
-gamma 0 0
# Id: 5009931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Na+ + Tartarate-2 + H+ = NaH(Tartarate)
log_k 4.58
delta_h -2.8451 kJ
-gamma 0 0
# Id: 5009932
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
K+ + Tartarate-2 = K(Tartarate)-
log_k 0.8
delta_h 0 kJ
-gamma 0 0
# Id: 4109931
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
H+ + Glycine- = H(Glycine)
log_k 9.778
delta_h -44.3504 kJ
-gamma 0 0
# Id: 3309941
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
2H+ + Glycine- = H2(Glycine)+
log_k 12.128
delta_h -48.4507 kJ
```

```
-gamma 0 0
# Id: 3309942
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Pb+2 + Glycine- = Pb(Glycine)+
log_k 5.47
delta_h 0 kJ
-gamma 0 0
# Id: 6009941
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Pb+2 + 2Glycine- = Pb(Glycine)2
log_k 8.86
delta_h 0 kJ
-gamma 0 0
# Id: 6009942
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Tl+ + Glycine- = Tl(Glycine)
log_k 1.72
delta_h 0 kJ
-gamma 0 0
# Id: 8709941
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Glycine- = Zn(Glycine)+
log_k 5.38
delta_h -11.7152 kJ
-gamma 0 0
# Id: 9509941
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + 2Glycine- = Zn(Glycine)2
log_k 9.81
delta_h -24.2672 kJ
-gamma 0 0
# Id: 9509942
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + 3Glycine- = Zn(Glycine)3-
log_k 12.3
delta_h -39.748 kJ
-gamma 0 0
# Id: 9509943
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Glycine- = Cd(Glycine)+
```

```
log_k 4.69
delta_h -8.7864 kJ
-gamma 0 0
# Id: 1609941
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + 2Glycine- = Cd(Glycine)2
log_k 8.4
delta_h -22.5936 kJ
-gamma 0 0
# Id: 1609942
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + 3Glycine- = Cd(Glycine)3-
log_k 10.7
delta_h -35.9824 kJ
-gamma 0 0
# Id: 1609943
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + Glycine- + 2H+ = Hg(Glycine)+ + 2H2O
log_k 17
delta_h 0 kJ
-gamma 0 0
# Id: 3619941
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Hg(OH)2 + 2Glycine- + 2H+ = Hg(Glycine)2 + 2H2O
log_k 25.8
delta_h 0 kJ
-gamma 0 0
# Id: 3619942
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cu+ + 2Glycine- = Cu(Glycine)2-
log_k 10.3
delta_h 0 kJ
-gamma 0 0
# Id: 2309941
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Glycine- = Cu(Glycine)+
log_k 8.57
delta_h -25.104 kJ
-gamma 0 0
# Id: 2319941
# log K source: NIST46.2
# Delta H source: NIST46.2
```

```
#T and ionic strength:
Cu+2 + 2Glycine- = Cu(Glycine)2
log_k 15.7
delta_h -54.8104 kJ
-gamma 0 0
# Id: 2319942
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Glycine- = Ag(Glycine)
log_k 3.51
delta_h -19.2464 kJ
-gamma 0 0
# Id: 209941
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Glycine- = Ag(Glycine)2-
log_k 6.89
delta_h -48.116 kJ
-gamma 0 0
# Id: 209942
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Glycine- = Ni(Glycine)+
log_k 6.15
delta_h -18.828 kJ
-gamma 0 0
# Id: 5409941
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + 2Glycine- = Ni(Glycine)2
log_k 11.12
delta_h -38.0744 kJ
-gamma 0 0
# Id: 5409942
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + 3Glycine- = Ni(Glycine)3-
log_k 14.63
delta_h -62.3416 kJ
-gamma 0 0
# Id: 5409943
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Co+2 + Glycine- = Co(Glycine)+
log_k 5.07
delta_h -12 kJ
-gamma 0 0
# Id: 2009941
```

```
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Co+2 + 2Glycine- = Co(Glycine)2
log_k 9.07
delta_h -26 kJ
-gamma 0 0
# Id: 2009942
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Co+2 + 3Glycine- = Co(Glycine)3-
log_k 11.6
delta_h -41 kJ
-gamma 0 0
# Id: 2009943
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Co+2 + Glycine- + H2O = CoOH(Glycine) + H+
log_k -5.02
delta_h 0 kJ
-gamma 0 0
# Id: 2009944
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Fe+2 + Glycine- = Fe(Glycine)+
log_k 4.31
delta_h -15.0624 kJ
-gamma 0 0
# Id: 2809941
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+2 + 2Glycine- = Fe(Glycine)2
log_k 8.29
delta_h 0 kJ
-gamma 0 0
# Id: 2809942
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+3 + Glycine- = Fe(Glycine)+2
log_k 9.38
delta_h 0 kJ
-gamma 0 0
# Id: 2819941
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+3 + Glycine- + H+ = FeH(Glycine)+3
log_k 11.55
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 2819942
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mn+2 + Glycine- = Mn(Glycine)+
log_k 3.19
delta_h -1.2552 kJ
-gamma 0 0
# Id: 4709941
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mn+2 + 2Glycine- = Mn(Glycine)2
log_k 5.4
delta_h 0 kJ
-gamma 0 0
# Id: 4709942
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cr(OH)2+ + Glycine- + 2H+ = Cr(Glycine)+2 + 2H2O
log_k 18.7
delta_h 0 kJ
-gamma 0 0
# Id: 2119941
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cr(OH)2+ + 2Glycine- + 2H+ = Cr(Glycine)2+ + 2H2O
log_k 25.6
delta_h 0 kJ
-gamma 0 0
# Id: 2119942
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cr(OH)2+ + 3Glycine- + 2H+ = Cr(Glycine)3 + 2H2O
log_k 31.6
delta_h 0 kJ
-gamma 0 0
# Id: 2119943
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Mg+2 + Glycine- = Mg(Glycine)+
log_k 2.08
delta_h 4.184 kJ
-gamma 0 0
# Id: 4609941
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Glycine- = Ca(Glycine)+
```

```
log_k 1.39
delta_h -4.184 kJ
-gamma 0 0
# Id: 1509941
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Glycine- + H+ = CaH(Glycine)+2
log_k 10.1
delta_h -35.9824 kJ
-gamma 0 0
# Id: 1509942
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Sr+2 + Glycine- = Sr(Glycine)+
log_k 0.91
delta_h 0 kJ
-gamma 0 0
# Id: 8009941
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.00 25.0
Ba+2 + Glycine- = Ba(Glycine)+
log_k 0.77
delta_h 0 kJ
-gamma 0 0
# Id: 1009941
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
H+ + Salicylate-2 = H(Salicylate)-
log_k 13.7
delta_h -35.7732 kJ
-gamma 0 0
# Id: 3309951
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
2H+ + Salicylate-2 = H2(Salicylate)
log_k 16.8
delta_h -38.7857 kJ
-gamma 0 0
# Id: 3309952
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Salicylate-2 = Zn(Salicylate)
log_k 7.71
delta_h 0 kJ
-gamma 0 0
# Id: 9509951
# log K source: SCD2.62
# Delta H source: SCD2.62
```

```
#T and ionic strength:
Zn+2 + Salicylate-2 + H+ = ZnH(Salicylate)+
log_k 15.5
delta_h 0 kJ
-gamma 0 0
# Id: 9509952
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Salicylate-2 = Cd(Salicylate)
log_k 6.2
delta_h 0 kJ
-gamma 0 0
# Id: 1609951
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Salicylate-2 + H+ = CdH(Salicylate)+
log_k 16
delta_h 0 kJ
-gamma 0 0
# Id: 1609952
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Salicylate-2 = Cu(Salicylate)
log_k 11.3
delta_h -17.9912 kJ
-gamma 0 0
# Id: 2319951
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 2Salicylate-2 = Cu(Salicylate)2-2
log_k 19.3
delta_h 0 kJ
-gamma 0 0
# Id: 2319952
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Salicylate-2 + H+ = CuH(Salicylate)+
log_k 14.8
delta_h 0 kJ
-gamma 0 0
# Id: 2319953
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Salicylate-2 = Ni(Salicylate)
log_k 8.2
delta_h 0 kJ
-gamma 0 0
# Id: 5409951
```

```
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + 2Salicylate-2 = Ni(Salicylate)2-2
log_k 12.64
delta_h 0 kJ
-gamma 0 0
# Id: 5409952
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Co+2 + Salicylate-2 = Co(Salicylate)
log_k 7.4289
delta_h 0 kJ
-gamma 0 0
# Id: 2009951
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 20.0
Co+2 + 2Salicylate-2 = Co(Salicylate)2-2
log_k 11.8
delta_h 0 kJ
-gamma 0 0
# Id: 2009952
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 20.0
Fe+2 + Salicylate-2 = Fe(Salicylate)
log_k 7.2
delta_h 0 kJ
-gamma 0 0
# Id: 2809951
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+2 + 2Salicylate-2 = Fe(Salicylate)2-2
log_k 11.6
delta_h 0 kJ
-gamma 0 0
# Id: 2809952
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+3 + Salicylate-2 = Fe(Salicylate)+
log_k 17.6
delta_h 0 kJ
-gamma 0 0
# Id: 2819951
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Fe+3 + 2Salicylate-2 = Fe(Salicylate)2-
log_k 29.3
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 2819952
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mn+2 + Salicylate-2 = Mn(Salicylate)
log_k 6.5
delta_h 0 kJ
-gamma 0 0
# Id: 4709951
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mn+2 + 2Salicylate-2 = Mn(Salicylate)2-2
log_k 10.1
delta_h 0 kJ
-gamma 0 0
# Id: 4709952
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Be+2 + Salicylate-2 = Be(Salicylate)
log_k 13.3889
delta_h -31.7732 kJ
-gamma 0 0
# Id: 1109951
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.10 25.0
Be+2 + 2Salicylate-2 = Be(Salicylate)2-2
log_k 23.25
delta_h 0 kJ
-gamma 0 0
# Id: 1109952
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Mg+2 + Salicylate-2 = Mg(Salicylate)
log_k 5.76
delta_h 0 kJ
-gamma 0 0
# Id: 4609951
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Mg+2 + Salicylate-2 + H+ = MgH(Salicylate)+
log_k 15.3
delta_h 0 kJ
-gamma 0 0
# Id: 4609952
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Ca+2 + Salicylate-2 = Ca(Salicylate)
```

```
log_k 4.05
delta_h 0 kJ
-gamma 0 0
# Id: 1509951
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Salicylate-2 + H+ = CaH(Salicylate)+
log_k 14.3
delta_h 0 kJ
-gamma 0 0
# Id: 1509952
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ba+2 + Salicylate-2 + H+ = BaH(Salicylate)+
log_k 13.9
delta_h 0 kJ
-gamma 0 0
# Id: 1009951
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
H+ + Glutamate-2 = H(Glutamate)-
log_k 9.96
delta_h -41.0032 kJ
-gamma 0 0
# Id: 3309961
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
2H+ + Glutamate-2 = H2(Glutamate)
log_k 14.26
delta_h -43.5136 kJ
-gamma 0 0
# Id: 3309962
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
3H+ + Glutamate-2 = H3(Glutamate)+
log_k 16.42
delta_h -46.8608 kJ
-gamma 0 0
# Id: 3309963
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Pb+2 + Glutamate-2 = Pb(Glutamate)
log_k 6.43
delta_h 0 kJ
-gamma 0 0
# Id: 6009961
# log K source: SCD2.62
# Delta H source: SCD2.62
```

```
#T and ionic strength:
Pb+2 + 2Glutamate-2 = Pb(Glutamate)2-2
log_k 8.61
delta_h 0 kJ
-gamma 0 0
# Id: 6009962
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Pb+2 + Glutamate-2 + H+ = PbH(Glutamate)+
log_k 14.08
delta_h 0 kJ
-gamma 0 0
# Id: 6009963
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Al+3 + Glutamate-2 + H+ = AlH(Glutamate)+2
log_k 13.07
delta_h 0 kJ
-gamma 0 0
# Id: 309961
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Glutamate-2 = Zn(Glutamate)
log_k 6.2
delta_h 0 kJ
-gamma 0 0
# Id: 9509961
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Zn+2 + 2Glutamate-2 = Zn(Glutamate)2-2
log_k 9.13
delta_h 0 kJ
-gamma 0 0
# Id: 9509962
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Zn+2 + 3Glutamate-2 = Zn(Glutamate)3-4
log_k 9.8
delta_h 0 kJ
-gamma 0 0
# Id: 9509963
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cd+2 + Glutamate-2 = Cd(Glutamate)
log_k 4.7
delta_h 0 kJ
-gamma 0 0
# Id: 1609961
```

```
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + 2Glutamate-2 = Cd(Glutamate)2-2
log_k 7.59
delta_h 0 kJ
-gamma 0 0
# Id: 1609962
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Hg(OH)2 + Glutamate-2 + 2H+ = Hg(Glutamate) + 2H2O
log_k 19.8
delta_h 0 kJ
-gamma 0 0
# Id: 3619961
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Hg(OH)2 + 2Glutamate-2 + 2H+ = Hg(Glutamate)2-2 + 2H2O
log_k 26.2
delta_h 0 kJ
-gamma 0 0
# Id: 3619962
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cu+2 + Glutamate-2 = Cu(Glutamate)
log_k 9.17
delta_h -20.92 kJ
-gamma 0 0
# Id: 2319961
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 2Glutamate-2 = Cu(Glutamate)2-2
log_k 15.78
delta_h -48.116 kJ
-gamma 0 0
# Id: 2319962
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Glutamate-2 + H+ = CuH(Glutamate)+
log_k 13.3
delta_h -28.0328 kJ
-gamma 0 0
# Id: 2319963
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + Glutamate-2 = Ag(Glutamate)-
log_k 4.22
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 209961
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ag+ + 2Glutamate-2 = Ag(Glutamate)2-3
log_k 7.36
delta_h 0 kJ
-gamma 0 0
# Id: 209962
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
2Ag+ + Glutamate-2 = Ag2(Glutamate)
log_k 3.4
delta_h 0 kJ
-gamma 0 0
# Id: 209963
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Glutamate-2 = Ni(Glutamate)
log_k 6.47
delta_h 0 kJ
-gamma 0 0
# Id: 5409961
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + 2Glutamate-2 = Ni(Glutamate)2-2
log_k 10.7
delta_h -30.9616 kJ
-gamma 0 0
# Id: 5409962
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Co+2 + Glutamate-2 = Co(Glutamate)
log_k 5.4178
delta_h 0 kJ
-gamma 0 0
# Id: 2009961
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Co+2 + 2Glutamate-2 = Co(Glutamate)2-2
log_k 8.7178
delta_h 0 kJ
-gamma 0 0
# Id: 2009962
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Mn+2 + Glutamate-2 = Mn(Glutamate)
```

log_k 4.95
delta_h 0 kJ
-gamma 0 0
Id: 4709961
log K source: SCD2.62
Delta H source: SCD2.62
#T and ionic strength:
Mn+2 + 2Glutamate-2 = Mn(Glutamate)2-2
log_k 8.48
delta_h 0 kJ
-gamma 0 0
Id: 4709962
log K source: SCD2.62
Delta H source: SCD2.62
#T and ionic strength:
Cr(OH)2+ + Glutamate-2 + 2H+ = Cr(Glutamate)+ + 2H2O
log_k 22.6
delta_h 0 kJ
-gamma 0 0
Id: 2119961
log K source: SCD2.62
Delta H source: SCD2.62
#T and ionic strength:
Cr(OH)2+ + 2Glutamate-2 + 2H+ = Cr(Glutamate)2- + 2H2O
log_k 30.7
delta_h 0 kJ
-gamma 0 0
Id: 2119962
log K source: SCD2.62
Delta H source: SCD2.62
#T and ionic strength:
Cr(OH)2+ + Glutamate-2 + 3H+ = CrH(Glutamate)+2 + 2H2O
log_k 25.2
delta_h 0 kJ
-gamma 0 0
Id: 2119963
log K source: SCD2.62
Delta H source: SCD2.62
#T and ionic strength:
Mg+2 + Glutamate-2 = Mg(Glutamate)
log_k 2.8
delta_h 0 kJ
-gamma 0 0
Id: 4609961
log K source: NIST46.2
Delta H source: NIST46.2
#T and ionic strength:
Ca+2 + Glutamate-2 = Ca(Glutamate)
log_k 2.06
delta_h 0 kJ
-gamma 0 0
Id: 1509961
log K source: NIST46.2
Delta H source: NIST46.2

```
#T and ionic strength:
Ca+2 + Glutamate-2 + H+ = CaH(Glutamate)+
log_k 11.13
delta_h 0 kJ
-gamma 0 0
# Id: 1509962
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Sr+2 + Glutamate-2 = Sr(Glutamate)
log_k 2.2278
delta_h 0 kJ
-gamma 0 0
# Id: 8009961
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.10 25.0
Ba+2 + Glutamate-2 = Ba(Glutamate)
log_k 2.14
delta_h 0 kJ
-gamma 0 0
# Id: 1009961
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
H+ + Phthalate-2 = H(Phthalate)-
log_k 5.408
delta_h 2.1757 kJ
-gamma 0 0
# Id: 3309971
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
2H+ + Phthalate-2 = H2(Phthalate)
log_k 8.358
delta_h 4.8534 kJ
-gamma 0 0
# Id: 3309972
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Pb+2 + Phthalate-2 = Pb(Phthalate)
log_k 4.26
delta_h 0 kJ
-gamma 0 0
# Id: 6009971
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Pb+2 + 2Phthalate-2 = Pb(Phthalate)2-2
log_k 4.83
delta_h 0 kJ
-gamma 0 0
# Id: 6009972
```

```
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Pb+2 + Phthalate-2 + H+ = PbH(Phthalate)+
log_k 6.98
delta_h 0 kJ
-gamma 0 0
# Id: 6009973
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Al+3 + Phthalate-2 = Al(Phthalate)+
log_k 4.56
delta_h 0 kJ
-gamma 0 0
# Id: 309971
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Al+3 + 2Phthalate-2 = Al(Phthalate)2-
log_k 7.2
delta_h 0 kJ
-gamma 0 0
# Id: 309972
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + Phthalate-2 = Zn(Phthalate)
log_k 2.91
delta_h 13.3888 kJ
-gamma 0 0
# Id: 9509971
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Zn+2 + 2Phthalate-2 = Zn(Phthalate)2-2
log_k 4.2
delta_h 0 kJ
-gamma 0 0
# Id: 9509972
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Phthalate-2 = Cd(Phthalate)
log_k 3.43
delta_h 0 kJ
-gamma 0 0
# Id: 1609971
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + Phthalate-2 + H+ = CdH(Phthalate)+
log_k 6.3
delta_h 0 kJ
```

```
-gamma 0 0
# Id: 1609973
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cd+2 + 2Phthalate-2 = Cd(Phthalate)2-2
log_k 3.7
delta_h 0 kJ
-gamma 0 0
# Id: 1609972
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Phthalate-2 = Cu(Phthalate)
log_k 4.02
delta_h 8.368 kJ
-gamma 0 0
# Id: 2319971
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + Phthalate-2 + H+ = CuH(Phthalate)+
log_k 7.1
delta_h 3.8493 kJ
-gamma 0 0
# Id: 2319970
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cu+2 + 2Phthalate-2 = Cu(Phthalate)2-2
log_k 5.3
delta_h 15.8992 kJ
-gamma 0 0
# Id: 2319972
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Phthalate-2 = Ni(Phthalate)
log_k 2.95
delta_h 7.5312 kJ
-gamma 0 0
# Id: 5409971
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Ni+2 + Phthalate-2 + H+ = NiH(Phthalate)+
log_k 6.6
delta_h 0 kJ
-gamma 0 0
# Id: 5409972
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Co+2 + Phthalate-2 = Co(Phthalate)
```

```
log_k 2.83
delta_h 7.9 kJ
-gamma 0 0
# Id: 2009971
# log K source: NIST46.4
# Delta H source: NIST46.4
#T and ionic strength: 0.00 25.0
Co+2 + H+ + Phthalate-2 = CoH(Phthalate)+
log_k 7.227
delta_h 0 kJ
-gamma 0 0
# Id: 2009972
# log K source: NIST46.4
# Delta H source: NIST46.2
#T and ionic strength: 0.50 25.0
Mn+2 + Phthalate-2 = Mn(Phthalate)
log_k 2.74
delta_h 10.0416 kJ
-gamma 0 0
# Id: 4709971
# log K source: NIST46.2
# Delta H source: NIST46.2
#T and ionic strength:
Cr(OH)2+ + Phthalate-2 + 2H+ = Cr(Phthalate)+ + 2H2O
log_k 16.3
delta_h 0 kJ
-gamma 0 0
# Id: 2119971
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cr(OH)2+ + 2Phthalate-2 + 2H+ = Cr(Phthalate)2- + 2H2O
log_k 21.2
delta_h 0 kJ
-gamma 0 0
# Id: 2119972
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Cr(OH)2+ + 3Phthalate-2 + 2H+ = Cr(Phthalate)3-3 + 2H2O
log_k 23.3
delta_h 0 kJ
-gamma 0 0
# Id: 2119973
# log K source: SCD2.62
# Delta H source: SCD2.62
#T and ionic strength:
Be+2 + Phthalate-2 = Be(Phthalate)
log_k 4.8278
delta_h 0 kJ
-gamma 0 0
# Id: 1109971
# log K source: NIST46.4
# Delta H source: NIST46.2
```

```
#T and ionic strength:  0.10 25.0
Be+2 + 2Phthalate-2 = Be(Phthalate)2-2
log_k 6.5478
delta_h 0 kJ
-gamma 0 0
# Id:  1109972
# log K source:  NIST46.4
# Delta H source:  NIST46.2
#T and ionic strength:  0.10 25.0
Mg+2 + Phthalate-2 = Mg(Phthalate)
log_k 2.49
delta_h 0 kJ
-gamma 0 0
# Id:  4609971
# log K source:  SCD2.62
# Delta H source:  SCD2.62
#T and ionic strength:
Ca+2 + Phthalate-2 = Ca(Phthalate)
log_k 2.45
delta_h 0 kJ
-gamma 0 0
# Id:  1509970
# log K source:  NIST46.2
# Delta H source:  NIST46.2
#T and ionic strength:
Ca+2 + Phthalate-2 + H+ = CaH(Phthalate)+
log_k 6.43
delta_h 0 kJ
-gamma 0 0
# Id:  1509971
# log K source:  NIST46.2
# Delta H source:  NIST46.2
#T and ionic strength:
Ba+2 + Phthalate-2 = Ba(Phthalate)
log_k 2.33
delta_h 0 kJ
-gamma 0 0
# Id:  1009971
# log K source:  NIST46.2
# Delta H source:  NIST46.2
#T and ionic strength:
Na+ + Phthalate-2 = Na(Phthalate)-
log_k 0.8
delta_h 4.184 kJ
-gamma 0 0
# Id:  5009970
# log K source:  NIST46.2
# Delta H source:  NIST46.2
#T and ionic strength:
K+ + Phthalate-2 = K(Phthalate)-
log_k 0.7
delta_h 3.7656 kJ
-gamma 0 0
# Id:  4109971
```

```
# log K source:  NIST46.2
# Delta H source:  NIST46.2
#T and ionic strength:
PHASES
Sulfur
S + H+ + 2e- = HS-
log_k -2.1449
delta_h -16.3 kJ
Semetal(hex
Se + H+ + 2e- = HSe-
log_k -7.7084
delta_h 15.9 kJ
Semetal(am)
Se + H+ + 2e- = HSe-
log_k -7.1099
delta_h 10.8784 kJ
Sbmetal
Sb + 3H2O = Sb(OH)3 + 3H+ + 3e-
log_k -11.6889
delta_h 83.89 kJ
Snmetal(wht)
Sn + 2H2O = Sn(OH)2 + 2H+ + 2e-
log_k -2.3266
delta_h -0 kJ
Pbmetal
Pb = Pb+2 + 2e-
log_k 4.2462
delta_h 0.92 kJ
Tlmetal
Tl = Tl+ + e-
log_k 5.6762
delta_h 5.36 kJ
Znmetal
Zn = Zn+2 + 2e-
log_k 25.7886
delta_h -153.39 kJ
Cdmetal(alpha)
Cd = Cd+2 + 2e-
log_k 13.5147
delta_h -75.33 kJ
Cdmetal(gamma)
Cd = Cd+2 + 2e-
log_k 13.618
delta_h -75.92 kJ
Hgmetal(l)
Hg = 0.5Hg2+2 + e-
log_k -13.4517
delta_h 83.435 kJ
Cumetal
Cu = Cu+ + e-
log_k -8.756
delta_h 71.67 kJ
Agmetal
Ag = Ag+ + e-
```

log_k -13.5065
delta_h 105.79 kJ
Crmetal
Cr = Cr+2 + 2e-
log_k 30.4831
delta_h -172 kJ
Vmetal
V = V+3 + 3e-
log_k 44.0253
delta_h -259 kJ
Stibnite
Sb2S3 + 6H2O = 2Sb(OH)3 + 3H+ + 3HS-
log_k -50.46
delta_h 293.78 kJ
Orpiment
As2S3 + 6H2O = 2H3AsO3 + 3HS- + 3H+
log_k -61.0663
delta_h 350.68 kJ
Realgar
AsS + 3H2O = H3AsO3 + HS- + 2H+ + e-
log_k -19.747
delta_h 127.8 kJ
SnS
SnS + 2H2O = Sn(OH)2 + H+ + HS-
log_k -19.114
delta_h -0 kJ
SnS2
SnS2 + 6H2O = Sn(OH)6-2 + 4H+ + 2HS-
log_k -57.4538
delta_h -0 kJ
Galena
PbS + H+ = Pb+2 + HS-
log_k -13.97
delta_h 80 kJ
Tl2S
Tl2S + H+ = 2Tl+ + HS-
log_k -7.19
delta_h 91.52 kJ
ZnS(am)
ZnS + H+ = Zn+2 + HS-
log_k -9.052
delta_h 15.3553 kJ
Sphalerite
ZnS + H+ = Zn+2 + HS-
log_k -11.45
delta_h 30 kJ
Wurtzite
ZnS + H+ = Zn+2 + HS-
log_k -8.95
delta_h 21.171 kJ
Greenockite
CdS + H+ = Cd+2 + HS-
log_k -14.36
delta_h 55 kJ

Hg2S
Hg2S + H+ = Hg2+2 + HS-
log_k -11.6765
delta_h 69.7473 kJ
Cinnabar
HgS + 2H2O = Hg(OH)2 + H+ + HS-
log_k -45.694
delta_h 253.76 kJ
Metacinnabar
HgS + 2H2O = Hg(OH)2 + H+ + HS-
log_k -45.094
delta_h 253.72 kJ
Chalcocite
Cu2S + H+ = 2Cu+ + HS-
log_k -34.92
delta_h 168 kJ
Djurleite
Cu0.066Cu1.868S + H+ = 0.066Cu+2 + 1.868Cu+ + HS-
log_k -33.92
delta_h 200.334 kJ
Anilite
Cu0.25Cu1.5S + H+ = 0.25Cu+2 + 1.5Cu+ + HS-
log_k -31.878
delta_h 182.15 kJ
BlaubleiII
Cu0.6Cu0.8S + H+ = 0.6Cu+2 + 0.8Cu+ + HS-
log_k -27.279
delta_h -0 kJ
BlaubleiI
Cu0.9Cu0.2S + H+ = 0.9Cu+2 + 0.2Cu+ + HS-
log_k -24.162
delta_h -0 kJ
Covellite
CuS + H+ = Cu+2 + HS-
log_k -22.3
delta_h 97 kJ
Chalcopyrite
CuFeS2 + 2H+ = Cu+2 + Fe+2 + 2HS-
log_k -35.27
delta_h 148.448 kJ
Acanthite
Ag2S + H+ = 2Ag+ + HS-
log_k -36.22
delta_h 227 kJ
NiS(alpha)
NiS + H+ = Ni+2 + HS-
log_k -5.6
delta_h -0 kJ
NiS(beta)
NiS + H+ = Ni+2 + HS-
log_k -11.1
delta_h -0 kJ
NiS(gamma)
NiS + H+ = Ni+2 + HS-

log_k -12.8
delta_h -0 kJ
CoS(alpha)
CoS + H+ = Co+2 + HS-
log_k -7.44
delta_h -0 kJ
CoS(beta)
CoS + H+ = Co+2 + HS-
log_k -11.07
delta_h -0 kJ
FeS(ppt)
FeS + H+ = Fe+2 + HS-
log_k -2.95
delta_h -11 kJ
Greigite
Fe3S4 + 4H+ = 2Fe+3 + Fe+2 + 4HS-
log_k -45.035
delta_h -0 kJ
Mackinawite
FeS + H+ = Fe+2 + HS-
log_k -3.6
delta_h -0 kJ
Pyrite
FeS2 + 2H+ + 2e- = Fe+2 + 2HS-
log_k -18.5082
delta_h 49.844 kJ
MnS(grn)
MnS + H+ = Mn+2 + HS-
log_k 0.17
delta_h -32 kJ
MnS(pnk)
MnS + H+ = Mn+2 + HS-
log_k 3.34
delta_h -0 kJ
MoS2
MoS2 + 4H2O = MoO4-2 + 6H+ + 2HS- + 2e-
log_k -70.2596
delta_h 389.02 kJ
BeS
BeS + H+ = Be+2 + HS-
log_k 19.38
delta_h -0 kJ
BaS
BaS + H+ = Ba+2 + HS-
log_k 16.18
delta_h -0 kJ
Hg2(Cyanide)2
Hg2(Cyanide)2 = Hg2+2 + 2Cyanide-
log_k -39.3
delta_h -0 kJ
CuCyanide
CuCyanide = Cu+ + Cyanide-
log_k -19.5
delta_h -19 kJ

AgCyanide
AgCyanide = Ag+ + Cyanide-
log_k -15.74
delta_h 110.395 kJ
Ag2(Cyanide)2
Ag2(Cyanide)2 = 2Ag+ + 2Cyanide-
log_k -11.3289
delta_h -0 kJ
NaCyanide(cubic)
NaCyanide = Cyanide- + Na+
log_k 1.6012
delta_h 0.969 kJ
KCyanide(cubic)
KCyanide = Cyanide- + K+
log_k 1.4188
delta_h 11.93 kJ
Pb2Fe(Cyanide)6
Pb2Fe(Cyanide)6 = 2Pb+2 + Fe+2 + 6Cyanide-
log_k -53.42
delta_h -0 kJ
Zn2Fe(Cyanide)6
Zn2Fe(Cyanide)6 = 2Zn+2 + Fe+2 + 6Cyanide-
log_k -51.08
delta_h -0 kJ
Cd2Fe(Cyanide)6
Cd2Fe(Cyanide)6 = 2Cd+2 + Fe+2 + 6Cyanide-
log_k -52.78
delta_h -0 kJ
Ag4Fe(Cyanide)6
Ag4Fe(Cyanide)6 = 4Ag+ + Fe+2 + 6Cyanide-
log_k -79.47
delta_h -0 kJ
Ag3Fe(Cyanide)6
Ag3Fe(Cyanide)6 = 3Ag+ + Fe+3 + 6Cyanide-
log_k -72.7867
delta_h -0 kJ
Mn3(Fe(Cyanide)6)2
Mn3(Fe(Cyanide)6)2 = 3Mn+2 + 2Fe+3 + 12Cyanide-
log_k -105.4
delta_h -0 kJ
Sb2Se3
Sb2Se3 + 6H2O = 2Sb(OH)3 + 3HSe- + 3H+
log_k -67.7571
delta_h 343.046 kJ
SnSe
SnSe + 2H2O = Sn(OH)2 + H+ + HSe-
log_k -30.494
delta_h -0 kJ
SnSe2
SnSe2 + 6H2O = Sn(OH)6-2 + 4H+ + 2HSe-
log_k -65.1189
delta_h -0 kJ
Clausthalite
PbSe + H+ = Pb+2 + HSe-

log_k -27.1
delta_h 119.72 kJ
Tl2Se
Tl2Se + H+ = 2Tl+ + HSe-
log_k -18.1
delta_h 85.62 kJ
ZnSe
ZnSe + H+ = Zn+2 + HSe-
log_k -14.4
delta_h 25.51 kJ
CdSe
CdSe + H+ = Cd+2 + HSe-
log_k -20.2
delta_h 75.9814 kJ
HgSe
HgSe + 2H2O = Hg(OH)2 + H+ + HSe-
log_k -55.694
delta_h -0 kJ
Cu2Se(alpha)
Cu2Se + H+ = 2Cu+ + HSe-
log_k -45.8
delta_h 214.263 kJ
Cu3Se2
Cu3Se2 + 2H+ = 2HSe- + 2Cu+ + Cu+2
log_k -63.4911
delta_h 340.327 kJ
CuSe
CuSe + H+ = Cu+2 + HSe-
log_k -33.1
delta_h 121.127 kJ
CuSe2
CuSe2 + 2H+ + 2e- = 2HSe- + Cu+2
log_k -33.3655
delta_h 140.582 kJ
Ag2Se
Ag2Se + H+ = 2Ag+ + HSe-
log_k -48.7
delta_h 265.48 kJ
NiSe
NiSe + H+ = Ni+2 + HSe-
log_k -17.7
delta_h -0 kJ
CoSe
CoSe + H+ = Co+2 + HSe-
log_k -16.2
delta_h -0 kJ
FeSe
FeSe + H+ = Fe+2 + HSe-
log_k -11
delta_h 2.092 kJ
Ferroselite
FeSe2 + 2H+ + 2e- = 2HSe- + Fe+2
log_k -18.5959
delta_h 47.2792 kJ

MnSe
MnSe + H+ = Mn+2 + HSe-
log_k 3.5
delta_h -98.15 kJ
AlSb
AlSb + 3H2O = Sb(OH)3 + 6e- + Al+3 + 3H+
log_k 65.6241
delta_h -0 kJ
ZnSb
ZnSb + 3H2O = Sb(OH)3 + 5e- + Zn+2 + 3H+
log_k 11.0138
delta_h -54.8773 kJ
CdSb
CdSb + 3H2O = Sb(OH)3 + 5e- + 3H+ + Cd+2
log_k -0.3501
delta_h 22.36 kJ
Cu2Sb:3H2O
Cu2Sb:3H2O = Sb(OH)3 + 6e- + 3H+ + Cu+ + Cu+2
log_k -34.8827
delta_h 233.237 kJ
Cu3Sb
Cu3Sb + 3H2O = Sb(OH)3 + 6e- + 3H+ + 3Cu+
log_k -42.5937
delta_h 308.131 kJ
#Ag4Sb
Ag4Sb + 3H2O = Sb(OH)3 + 6e- + 3Ag+ + 3H+
log_k -56.1818
delta_h -0 kJ
Breithauptite
NiSb + 3H2O = Sb(OH)3 + 5e- + 3H+ + Ni+2
log_k -18.5225
delta_h 96.0019 kJ
MnSb
MnSb + 3H2O = Mn+3 + Sb(OH)3 + 6e- + 3H+
log_k -2.9099
delta_h 21.1083 kJ
Mn2Sb
Mn2Sb + 3H2O = 2Mn+2 + Sb(OH)3 + 7e- + 3H+
log_k 61.0796
delta_h -0 kJ
USb2
USb2 + 8H2O = UO2+2 + 2Sb(OH)3 + 12e- + 10H+
log_k 29.5771
delta_h -103.56 kJ
U3Sb4
U3Sb4 + 12H2O = 3U+4 + 4Sb(OH)3 + 24e- + 12H+
log_k 152.383
delta_h -986.04 kJ
Mg2Sb3
Mg2Sb3 + 9H2O = 2Mg+2 + 3Sb(OH)3 + 9H+ + 13e-
log_k 74.6838
delta_h -0 kJ
Ca3Sb2
Ca3Sb2 + 6H2O = 3Ca+2 + 2Sb(OH)3 + 6H+ + 12e-

log_k 142.974
delta_h -732.744 kJ
NaSb
NaSb + 3H2O = Na+ + Sb(OH)3 + 3H+ + 4e-
log_k 23.1658
delta_h -93.45 kJ
Na3Sb
Na3Sb + 3H2O = 3Na+ + Sb(OH)3 + 3H+ + 6e-
log_k 94.4517
delta_h -432.13 kJ
SeO2
SeO2 + H2O = HSeO3- + H+
log_k 0.1246
delta_h 1.4016 kJ
SeO3
SeO3 + H2O = SeO4-2 + 2H+
log_k 21.044
delta_h -146.377 kJ
Sb2O5
Sb2O5 + 7H2O = 2Sb(OH)6- + 2H+
log_k -9.6674
delta_h -0 kJ
SbO2
SbO2 + 4H2O = Sb(OH)6- + e- + 2H+
log_k -27.8241
delta_h -0 kJ
Sb2O4
Sb2O4 + 2H2O + 2H+ + 2e- = 2Sb(OH)3
log_k 3.4021
delta_h -68.04 kJ
Sb4O6(cubic)
Sb4O6 + 6H2O = 4Sb(OH)3
log_k -18.2612
delta_h 61.1801 kJ
Sb4O6(orth)
Sb4O6 + 6H2O = 4Sb(OH)3
log_k -17.9012
delta_h 37.6801 kJ
Sb(OH)3
Sb(OH)3 = Sb(OH)3
log_k -7.1099
delta_h 30.1248 kJ
Senarmontite
Sb2O3 + 3H2O = 2Sb(OH)3
log_k -12.3654
delta_h 30.6478 kJ
Valentinite
Sb2O3 + 3H2O = 2Sb(OH)3
log_k -8.4806
delta_h 19.0163 kJ
Chalcedony
SiO2 + 2H2O = H4SiO4
log_k -3.55
delta_h 19.7 kJ

Cristobalite
SiO2 + 2H2O = H4SiO4
log_k -3.35
delta_h 20.006 kJ
Quartz
SiO2 + 2H2O = H4SiO4
log_k -4
delta_h 22.36 kJ
SiO2(am-gel)
SiO2 + 2H2O = H4SiO4
log_k -2.71
delta_h 14 kJ
SiO2(am-ppt)
SiO2 + 2H2O = H4SiO4
log_k -2.74
delta_h 15.15 kJ
SnO
SnO + H2O = Sn(OH)2
log_k -4.9141
delta_h -0 kJ
SnO2
SnO2 + 4H2O = Sn(OH)6-2 + 2H+
log_k -28.9749
delta_h -0 kJ
Sn(OH)2
Sn(OH)2 = Sn(OH)2
log_k -5.4309
delta_h -0 kJ
Sn(OH)4
Sn(OH)4 + 2H2O = Sn(OH)6-2 + 2H+
log_k -22.2808
delta_h -0 kJ
H2Sn(OH)6
H2Sn(OH)6 = Sn(OH)6-2 + 2H+
log_k -23.5281
delta_h -0 kJ
Massicot
PbO + 2H+ = Pb+2 + H2O
log_k 12.894
delta_h -66.848 kJ
Litharge
PbO + 2H+ = Pb+2 + H2O
log_k 12.694
delta_h -65.501 kJ
PbO:0.3H2O
PbO:0.33H2O + 2H+ = Pb+2 + 1.33H2O
log_k 12.98
delta_h -0 kJ
Plattnerite
PbO2 + 4H+ + 2e- = Pb+2 + 2H2O
log_k 49.6001
delta_h -296.27 kJ
Pb(OH)2
Pb(OH)2 + 2H+ = Pb+2 + 2H2O

log_k 8.15
delta_h -58.5342 kJ
Pb2O(OH)2
Pb2O(OH)2 + 4H+ = 2Pb+2 + 3H2O
log_k 26.188
delta_h -0 kJ
Al(OH)3(am)
Al(OH)3 + 3H+ = Al+3 + 3H2O
log_k 10.8
delta_h -111 kJ
Boehmite
AlOOH + 3H+ = Al+3 + 2H2O
log_k 8.578
delta_h -117.696 kJ
Diaspore
AlOOH + 3H+ = Al+3 + 2H2O
log_k 6.873
delta_h -103.052 kJ
Gibbsite
Al(OH)3 + 3H+ = Al+3 + 3H2O
log_k 8.291
delta_h -95.3952 kJ
Tl2O
Tl2O + 2H+ = 2Tl+ + H2O
log_k 27.0915
delta_h -96.41 kJ
TlOH
TlOH + H+ = Tl+ + H2O
log_k 12.9186
delta_h -41.57 kJ
Avicennite
Tl2O3 + 3H2O = 2Tl(OH)3
log_k -13
delta_h -0 kJ
Tl(OH)3
Tl(OH)3 = Tl(OH)3
log_k -5.441
delta_h -0 kJ
Zn(OH)2(am)
Zn(OH)2 + 2H+ = Zn+2 + 2H2O
log_k 12.474
delta_h -80.62 kJ
Zn(OH)2
Zn(OH)2 + 2H+ = Zn+2 + 2H2O
log_k 12.2
delta_h -0 kJ
Zn(OH)2(beta)
Zn(OH)2 + 2H+ = Zn+2 + 2H2O
log_k 11.754
delta_h -83.14 kJ
Zn(OH)2(gamma)
Zn(OH)2 + 2H+ = Zn+2 + 2H2O
log_k 11.734
delta_h -0 kJ

Zn(OH)2(epsilon)
Zn(OH)2 + 2H+ = Zn+2 + 2H2O
log_k 11.534
delta_h -81.8 kJ
ZnO(active)
ZnO + 2H+ = Zn+2 + H2O
log_k 11.1884
delta_h -88.76 kJ
Zincite
ZnO + 2H+ = Zn+2 + H2O
log_k 11.334
delta_h -89.62 kJ
Cd(OH)2(am)
Cd(OH)2 + 2H+ = Cd+2 + 2H2O
log_k 13.73
delta_h -86.9017 kJ
Cd(OH)2
Cd(OH)2 + 2H+ = Cd+2 + 2H2O
log_k 13.644
delta_h -94.62 kJ
Monteponite
CdO + 2H+ = Cd+2 + H2O
log_k 15.1034
delta_h -103.4 kJ
Hg2(OH)2
Hg2(OH)2 + 2H+ = Hg2+2 + 2H2O
log_k 5.2603
delta_h -0 kJ
Montroydite
HgO + H2O = Hg(OH)2
log_k -3.64
delta_h -38.9 kJ
Hg(OH)2
Hg(OH)2 = Hg(OH)2
log_k -3.4963
delta_h -0 kJ
Cuprite
Cu2O + 2H+ = 2Cu+ + H2O
log_k -1.406
delta_h -124.02 kJ
Cu(OH)2
Cu(OH)2 + 2H+ = Cu+2 + 2H2O
log_k 8.674
delta_h -56.42 kJ
Tenorite
CuO + 2H+ = Cu+2 + H2O
log_k 7.644
delta_h -64.867 kJ
Ag2O
Ag2O + 2H+ = 2Ag+ + H2O
log_k 12.574
delta_h -45.62 kJ
Ni(OH)2
Ni(OH)2 + 2H+ = Ni+2 + 2H2O

log_k 12.794
delta_h -95.96 kJ
Bunsenite
NiO + 2H+ = Ni+2 + H2O
log_k 12.4456
delta_h -100.13 kJ
CoO
CoO + 2H+ = Co+2 + H2O
log_k 13.5864
delta_h -106.295 kJ
Co(OH)2
Co(OH)2 + 2H+ = Co+2 + 2H2O
log_k 13.094
delta_h -0 kJ
Co(OH)3
Co(OH)3 + 3H+ = Co+3 + 3H2O
log_k -2.309
delta_h -92.43 kJ
#Wustite-0.11
WUSTITE-0.11 + 2H+ = 0.947Fe+2 + H2O
log_k 11.6879
delta_h -103.938 kJ
Fe(OH)2
Fe(OH)2 + 2H+ = Fe+2 + 2H2O
log_k 13.564
delta_h -0 kJ
Ferrihydrite
Fe(OH)3 + 3H+ = Fe+3 + 3H2O
log_k 3.191
delta_h -73.374 kJ
Fe3(OH)8
Fe3(OH)8 + 8H+ = 2Fe+3 + Fe+2 + 8H2O
log_k 20.222
delta_h -0 kJ
Goethite
FeOOH + 3H+ = Fe+3 + 2H2O
log_k 0.491
delta_h -60.5843 kJ
Pyrolusite
MnO2 + 4H+ + 2e- = Mn+2 + 2H2O
log_k 41.38
delta_h -272 kJ
Birnessite
MnO2 + 4H+ + e- = Mn+3 + 2H2O
log_k 18.091
delta_h -0 kJ
Nsutite
MnO2 + 4H+ + e- = Mn+3 + 2H2O
log_k 17.504
delta_h -0 kJ
Pyrochroite
Mn(OH)2 + 2H+ = Mn+2 + 2H2O
log_k 15.194
delta_h -97.0099 kJ

Manganite
MnOOH + 3H+ + e- = Mn+2 + 2H2O
log_k 25.34
delta_h -0 kJ
Cr(OH)2
Cr(OH)2 + 2H+ = Cr+2 + 2H2O
log_k 10.8189
delta_h -35.6058 kJ
Cr(OH)3(am)
Cr(OH)3 + H+ = Cr(OH)2+ + H2O
log_k -0.75
delta_h -0 kJ
Cr(OH)3
Cr(OH)3 + H+ = Cr(OH)2+ + H2O
log_k 1.3355
delta_h -29.7692 kJ
CrO3
CrO3 + H2O = CrO4-2 + 2H+
log_k -3.2105
delta_h -5.2091 kJ
MoO3
MoO3 + H2O = MoO4-2 + 2H+
log_k -8
delta_h -0 kJ
VO
VO + 2H+ = V+3 + H2O + e-
log_k 14.7563
delta_h -113.041 kJ
V(OH)3
V(OH)3 + 3H+ = V+3 + 3H2O
log_k 7.591
delta_h -0 kJ
VO(OH)2
VO(OH)2 + 2H+ = VO+2 + 2H2O
log_k 5.1506
delta_h -0 kJ
Uraninite
UO2 + 4H+ = U+4 + 2H2O
log_k -4.6693
delta_h -77.86 kJ
UO2(am)
UO2 + 4H+ = U+4 + 2H2O
log_k 0.934
delta_h -109.746 kJ
UO3
UO3 + 2H+ = UO2+2 + H2O
log_k 7.7
delta_h -81.0299 kJ
Gummite
UO3 + 2H+ = UO2+2 + H2O
log_k 7.6718
delta_h -81.0299 kJ
UO2(OH)2(beta)
UO2(OH)2 + 2H+ = UO2+2 + 2H2O

log_k 5.6116
delta_h -56.7599 kJ
Schoepite
UO2(OH)2:H2O + 2H+ = UO2+2 + 3H2O
log_k 5.994
delta_h -49.79 kJ
Be(OH)2(am)
Be(OH)2 + 2H+ = Be+2 + 2H2O
log_k 7.194
delta_h -0 kJ
Be(OH)2(alpha)
Be(OH)2 + 2H+ = Be+2 + 2H2O
log_k 6.894
delta_h -0 kJ
Be(OH)2(beta)
Be(OH)2 + 2H+ = Be+2 + 2H2O
log_k 6.494
delta_h -0 kJ
Brucite
Mg(OH)2 + 2H+ = Mg+2 + 2H2O
log_k 16.844
delta_h -113.996 kJ
Periclase
MgO + 2H+ = Mg+2 + H2O
log_k 21.5841
delta_h -151.23 kJ
Mg(OH)2(active)
Mg(OH)2 + 2H+ = Mg+2 + 2H2O
log_k 18.794
delta_h -0 kJ
Lime
CaO + 2H+ = Ca+2 + H2O
log_k 32.6993
delta_h -193.91 kJ
Portlandite
Ca(OH)2 + 2H+ = Ca+2 + 2H2O
log_k 22.804
delta_h -128.62 kJ
Ba(OH)2:8H2O
Ba(OH)2:8H2O + 2H+ = Ba+2 + 10H2O
log_k 24.394
delta_h -54.32 kJ
Cu(SbO3)2
Cu(SbO3)2 + 6H+ + 4e- = 2Sb(OH)3 + Cu+2
log_k 45.2105
delta_h -0 kJ
Arsenolite
As4O6 + 6H2O = 4H3AsO3
log_k -2.76
delta_h 59.9567 kJ
Claudetite
As4O6 + 6H2O = 4H3AsO3
log_k -3.065
delta_h 55.6054 kJ

As2O5
As2O5 + 3H2O = 2H3AsO4
log_k 6.7061
delta_h -22.64 kJ
Pb2O3
Pb2O3 + 6H+ + 2e- = 2Pb+2 + 3H2O
log_k 61.04
delta_h -0 kJ
Minium
Pb3O4 + 8H+ + 2e- = 3Pb+2 + 4H2O
log_k 73.5219
delta_h -421.874 kJ
Al2O3
Al2O3 + 6H+ = 2Al+3 + 3H2O
log_k 19.6524
delta_h -258.59 kJ
Co3O4
Co3O4 + 8H+ = Co+2 + 2Co+3 + 4H2O
log_k -10.4956
delta_h -107.5 kJ
CoFe2O4
CoFe2O4 + 8H+ = Co+2 + 2Fe+3 + 4H2O
log_k -3.5281
delta_h -158.82 kJ
Magnetite
Fe3O4 + 8H+ = 2Fe+3 + Fe+2 + 4H2O
log_k 3.4028
delta_h -208.526 kJ
Hercynite
FeAl2O4 + 8H+ = Fe+2 + 2Al+3 + 4H2O
log_k 22.893
delta_h -313.92 kJ
Hematite
Fe2O3 + 6H+ = 2Fe+3 + 3H2O
log_k -1.418
delta_h -128.987 kJ
Maghemite
Fe2O3 + 6H+ = 2Fe+3 + 3H2O
log_k 6.386
delta_h -0 kJ
Lepidocrocite
FeOOH + 3H+ = Fe+3 + 2H2O
log_k 1.371
delta_h -0 kJ
Hausmannite
Mn3O4 + 8H+ + 2e- = 3Mn+2 + 4H2O
log_k 61.03
delta_h -421 kJ
Bixbyite
Mn2O3 + 6H+ = 2Mn+3 + 3H2O
log_k -0.6445
delta_h -124.49 kJ
Cr2O3
Cr2O3 + H2O + 2H+ = 2Cr(OH)2+

log_k -2.3576
delta_h -50.731 kJ
#V2O3
V2O3 + 3H+ = V+3 + 1.5H2O
log_k 4.9
delta_h -82.5085 kJ
V3O5
V3O5 + 4H+ = 3VO+2 + 2H2O + 2e-
log_k 1.8361
delta_h -98.46 kJ
#V2O4
V2O4 + 2H+ = VO+2 + H2O
log_k 4.27
delta_h -58.8689 kJ
V4O7
V4O7 + 6H+ = 4VO+2 + 3H2O + 2e-
log_k 7.1865
delta_h -163.89 kJ
V6O13
V6O13 + 2H+ = 6VO2+ + H2O + 4e-
log_k -60.86
delta_h 271.5 kJ
V2O5
V2O5 + 2H+ = 2VO2+ + H2O
log_k -1.36
delta_h 34 kJ
U4O9
U4O9 + 18H+ + 2e- = 4U+4 + 9H2O
log_k -3.0198
delta_h -426.87 kJ
U3O8
U3O8 + 16H+ + 4e- = 3U+4 + 8H2O
log_k 21.0834
delta_h -485.44 kJ
Spinel
MgAl2O4 + 8H+ = Mg+2 + 2Al+3 + 4H2O
log_k 36.8476
delta_h -388.012 kJ
Magnesioferrite
Fe2MgO4 + 8H+ = Mg+2 + 2Fe+3 + 4H2O
log_k 16.8597
delta_h -278.92 kJ
Natron
Na2CO3:10H2O = 2Na+ + CO3-2 + 10H2O
log_k -1.311
delta_h 65.8771 kJ
Cuprousferrite
CuFeO2 + 4H+ = Cu+ + Fe+3 + 2H2O
log_k -8.9171
delta_h -15.89 kJ
Cupricferrite
CuFe2O4 + 8H+ = Cu+2 + 2Fe+3 + 4H2O
log_k 5.9882
delta_h -210.21 kJ

FeCr2O4
FeCr2O4 + 4H+ = 2Cr(OH)2+ + Fe+2
log_k 7.2003
delta_h -140.4 kJ
MgCr2O4
MgCr2O4 + 4H+ = 2Cr(OH)2+ + Mg+2
log_k 16.2007
delta_h -179.4 kJ
SbF3
SbF3 + 3H2O = Sb(OH)3 + 3H+ + 3F-
log_k -10.2251
delta_h -6.7279 kJ
PbF2
PbF2 = Pb+2 + 2F-
log_k -7.44
delta_h 20 kJ
ZnF2
ZnF2 = Zn+2 + 2F-
log_k -0.5343
delta_h -59.69 kJ
CdF2
CdF2 = Cd+2 + 2F-
log_k -1.2124
delta_h -46.22 kJ
Hg2F2
Hg2F2 = Hg2+2 + 2F-
log_k -10.3623
delta_h -18.486 kJ
CuF
CuF = Cu+ + F-
log_k -4.9056
delta_h 16.648 kJ
CuF2
CuF2 = Cu+2 + 2F-
log_k 1.115
delta_h -66.901 kJ
CuF2:2H2O
CuF2:2H2O = Cu+2 + 2F- + 2H2O
log_k -4.55
delta_h -15.2716 kJ
AgF:4H2O
AgF:4H2O = Ag+ + F- + 4H2O
log_k 1.0491
delta_h 15.4202 kJ
CoF2
CoF2 = Co+2 + 2F-
log_k -1.5969
delta_h -57.368 kJ
CoF3
CoF3 = Co+3 + 3F-
log_k -1.4581
delta_h -123.692 kJ
CrF3
CrF3 + 2H2O = Cr(OH)2+ + 3F- + 2H+

log_k -11.3367
delta_h -23.3901 kJ
VF4
VF4 + H2O = VO+2 + 4F- + 2H+
log_k 14.93
delta_h -199.117 kJ
UF4
UF4 = U+4 + 4F-
log_k -29.5371
delta_h -79.0776 kJ
UF4:2.5H2O
UF4:2.5H2O = U+4 + 4F- + 2.5H2O
log_k -32.7179
delta_h 24.325 kJ
MgF2
MgF2 = Mg+2 + 2F-
log_k -8.13
delta_h -8 kJ
Fluorite
CaF2 = Ca+2 + 2F-
log_k -10.5
delta_h 8 kJ
SrF2
SrF2 = Sr+2 + 2F-
log_k -8.58
delta_h 4 kJ
BaF2
BaF2 = Ba+2 + 2F-
log_k -5.82
delta_h 4 kJ
Cryolite
Na3AlF6 = 3Na+ + Al+3 + 6F-
log_k -33.84
delta_h 38 kJ
SbCl3
SbCl3 + 3H2O = Sb(OH)3 + 3Cl- + 3H+
log_k 0.5719
delta_h -35.18 kJ
SnCl2
SnCl2 + 2H2O = Sn(OH)2 + 2H+ + 2Cl-
log_k -9.2752
delta_h -0 kJ
Cotunnite
PbCl2 = Pb+2 + 2Cl-
log_k -4.78
delta_h 26.166 kJ
Matlockite
PbClF = Pb+2 + Cl- + F-
log_k -8.9733
delta_h 33.19 kJ
Phosgenite
PbCl2:PbCO3 = 2Pb+2 + 2Cl- + CO3-2
log_k -19.81
delta_h -0 kJ

Laurionite
PbOHCl + H+ = Pb+2 + Cl- + H2O
log_k 0.623
delta_h -0 kJ
Pb2(OH)3Cl
Pb2(OH)3Cl + 3H+ = 2Pb+2 + 3H2O + Cl-
log_k 8.793
delta_h -0 kJ
TlCl
TlCl = Tl+ + Cl-
log_k -3.74
delta_h 41 kJ
ZnCl2
ZnCl2 = Zn+2 + 2Cl-
log_k 7.05
delta_h -72.5 kJ
Zn2(OH)3Cl
Zn2(OH)3Cl + 3H+ = 2Zn+2 + 3H2O + Cl-
log_k 15.191
delta_h -0 kJ
Zn5(OH)8Cl2
Zn5(OH)8Cl2 + 8H+ = 5Zn+2 + 8H2O + 2Cl-
log_k 38.5
delta_h -0 kJ
CdCl2
CdCl2 = Cd+2 + 2Cl-
log_k -0.6588
delta_h -18.58 kJ
CdCl2:1H2O
CdCl2:1H2O = Cd+2 + 2Cl- + H2O
log_k -1.6932
delta_h -7.47 kJ
CdCl2:2.5H2O
CdCl2:2.5H2O = Cd+2 + 2Cl- + 2.5H2O
log_k -1.913
delta_h 7.2849 kJ
CdOHCl
CdOHCl + H+ = Cd+2 + H2O + Cl-
log_k 3.5373
delta_h -30.93 kJ
Calomel
Hg2Cl2 = Hg2+2 + 2Cl-
log_k -17.91
delta_h 92 kJ
HgCl2
HgCl2 + 2H2O = Hg(OH)2 + 2Cl- + 2H+
log_k -21.2621
delta_h 107.82 kJ
Nantokite
CuCl = Cu+ + Cl-
log_k -6.73
delta_h 42.662 kJ
Melanothallite
CuCl2 = Cu+2 + 2Cl-

log_k 6.2572
delta_h -63.407 kJ
Atacamite
Cu2(OH)3Cl + 3H+ = 2Cu+2 + 3H2O + Cl-
log_k 7.391
delta_h -93.43 kJ
Cerargyrite
AgCl = Ag+ + Cl-
log_k -9.75
delta_h 65.2 kJ
CoCl2
CoCl2 = Co+2 + 2Cl-
log_k 8.2672
delta_h -79.815 kJ
CoCl2:6H2O
CoCl2:6H2O = Co+2 + 2Cl- + 6H2O
log_k 2.5365
delta_h 8.0598 kJ
(Co(NH3)6)Cl3
(Co(NH3)6)Cl3 + 6H+ = Co+3 + 6NH4+ + 3Cl-
log_k 20.0317
delta_h -33.1 kJ
(Co(NH3)5OH2)Cl3
(Co(NH3)5OH2)Cl3 + 5H+ = Co+3 + 5NH4+ + 3Cl- + H2O
log_k 11.7351
delta_h -25.37 kJ
(Co(NH3)5Cl)Cl2
(Co(NH3)5Cl)Cl2 + 5H+ = Co+3 + 5NH4+ + 3Cl-
log_k 4.5102
delta_h -10.74 kJ
Fe(OH)2.7Cl.3
Fe(OH)2.7Cl.3 + 2.7H+ = Fe+3 + 2.7H2O + 0.3Cl-
log_k -3.04
delta_h -0 kJ
MnCl2:4H2O
MnCl2:4H2O = Mn+2 + 2Cl- + 4H2O
log_k 2.7151
delta_h -10.83 kJ
CrCl2
CrCl2 = Cr+2 + 2Cl-
log_k 14.0917
delta_h -110.76 kJ
CrCl3
CrCl3 + 2H2O = Cr(OH)2+ + 3Cl- + 2H+
log_k 15.1145
delta_h -121.08 kJ
VCl2
VCl2 = V+3 + 2Cl- + e-
log_k 18.8744
delta_h -141.16 kJ
VCl3
VCl3 = V+3 + 3Cl-
log_k 23.4326
delta_h -179.54 kJ

VOCl
VOCl + 2H+ = V+3 + Cl- + H2O
log_k 11.1524
delta_h -104.91 kJ
VOCl2
VOCl2 = VO+2 + 2Cl-
log_k 12.7603
delta_h -117.76 kJ
VO2Cl
VO2Cl = VO2+ + Cl-
log_k 2.8413
delta_h -40.28 kJ
Halite
NaCl = Na+ + Cl-
log_k 1.6025
delta_h 3.7 kJ
SbBr3
SbBr3 + 3H2O = Sb(OH)3 + 3Br- + 3H+
log_k 0.9689
delta_h -20.94 kJ
SnBr2
SnBr2 + 2H2O = Sn(OH)2 + 2H+ + 2Br-
log_k -9.5443
delta_h -0 kJ
SnBr4
SnBr4 + 6H2O = Sn(OH)6-2 + 6H+ + 4Br-
log_k -28.8468
delta_h -0 kJ
PbBr2
PbBr2 = Pb+2 + 2Br-
log_k -5.3
delta_h 35.499 kJ
PbBrF
PbBrF = Pb+2 + Br- + F-
log_k -8.49
delta_h -0 kJ
TlBr
TlBr = Tl+ + Br-
log_k -5.44
delta_h 54 kJ
ZnBr2:2H2O
ZnBr2:2H2O = Zn+2 + 2Br- + 2H2O
log_k 5.2005
delta_h -30.67 kJ
CdBr2:4H2O
CdBr2:4H2O = Cd+2 + 2Br- + 4H2O
log_k -2.425
delta_h 30.5001 kJ
Hg2Br2
Hg2Br2 = Hg2+2 + 2Br-
log_k -22.25
delta_h 133 kJ
HgBr2
HgBr2 + 2H2O = Hg(OH)2 + 2Br- + 2H+

log_k -25.2734
delta_h 138.492 kJ
CuBr
CuBr = Cu+ + Br-
log_k -8.3
delta_h 54.86 kJ
Cu2(OH)3Br
Cu2(OH)3Br + 3H+ = 2Cu+2 + 3H2O + Br-
log_k 7.9085
delta_h -93.43 kJ
Bromyrite
AgBr = Ag+ + Br-
log_k -12.3
delta_h 84.5 kJ
(Co(NH3)6)Br3
(Co(NH3)6)Br3 + 6H+ = Co+3 + 6NH4+ + 3Br-
log_k 18.3142
delta_h -21.1899 kJ
(Co(NH3)5Cl)Br2
(Co(NH3)5Cl)Br2 + 5H+ = Co+3 + 5NH4+ + Cl- + 2Br-
log_k 5.0295
delta_h -6.4 kJ
CrBr3
CrBr3 + 2H2O = Cr(OH)2+ + 3Br- + 2H+
log_k 19.9086
delta_h -141.323 kJ
AsI3
AsI3 + 3H2O = H3AsO3 + 3I- + 3H+
log_k 4.2307
delta_h 3.15 kJ
SbI3
SbI3 + 3H2O = Sb(OH)3 + 3H+ + 3I-
log_k -0.538
delta_h 13.5896 kJ
PbI2
PbI2 = Pb+2 + 2I-
log_k -8.1
delta_h 62 kJ
TlI
TlI = Tl+ + I-
log_k -7.23
delta_h 75 kJ
ZnI2
ZnI2 = Zn+2 + 2I-
log_k 7.3055
delta_h -58.92 kJ
CdI2
CdI2 = Cd+2 + 2I-
log_k -3.5389
delta_h 13.82 kJ
Hg2I2
Hg2I2 = Hg2+2 + 2I-
log_k -28.34
delta_h 163 kJ

Coccinite
HgI2 + 2H2O = Hg(OH)2 + 2H+ + 2I-
log_k -34.9525
delta_h 210.72 kJ
HgI2:2NH3
HgI2:2NH3 + 2H2O = Hg(OH)2 + 2I- + 2NH4+
log_k -16.2293
delta_h 132.18 kJ
HgI2:6NH3
HgI2:6NH3 + 2H2O + 4H+ = Hg(OH)2 + 2I- + 6NH4+
log_k 33.7335
delta_h -90.3599 kJ
CuI
CuI = Cu+ + I-
log_k -12
delta_h 82.69 kJ
Iodyrite
AgI = Ag+ + I-
log_k -16.08
delta_h 110 kJ
(Co(NH3)6)I3
(Co(NH3)6)I3 + 6H+ = Co+3 + 6NH4+ + 3I-
log_k 16.5831
delta_h -9.6999 kJ
(Co(NH3)5Cl)I2
(Co(NH3)5Cl)I2 + 5H+ = Co+3 + 5NH4+ + Cl- + 2I-
log_k 5.5981
delta_h 0.66 kJ
CrI3
CrI3 + 2H2O = Cr(OH)2+ + 3I- + 2H+
log_k 20.4767
delta_h -134.419 kJ
Cerussite
PbCO3 = Pb+2 + CO3-2
log_k -13.13
delta_h 24.79 kJ
Pb2OCO3
Pb2OCO3 + 2H+ = 2Pb+2 + H2O + CO3-2
log_k -0.5578
delta_h -40.8199 kJ
Pb3O2CO3
Pb3O2CO3 + 4H+ = 3Pb+2 + CO3-2 + 2H2O
log_k 11.02
delta_h -110.583 kJ
Hydrocerussite
Pb3(OH)2(CO3)2 + 2H+ = 3Pb+2 + 2H2O + 2CO3-2
log_k -18.7705
delta_h -0 kJ
Pb10(OH)6O(CO3)6
Pb10(OH)6O(CO3)6 + 8H+ = 10Pb+2 + 6CO3-2 + 7H2O
log_k -8.76
delta_h -0 kJ
Tl2CO3
Tl2CO3 = 2Tl+ + CO3-2

log_k -3.8367
delta_h 35.49 kJ
Smithsonite
ZnCO3 = Zn+2 + CO3-2
log_k -10
delta_h -15.84 kJ
ZnCO3:1H2O
ZnCO3:1H2O = Zn+2 + CO3-2 + H2O
log_k -10.26
delta_h -0 kJ
Otavite
CdCO3 = Cd+2 + CO3-2
log_k -12
delta_h -0.55 kJ
Hg2CO3
Hg2CO3 = Hg2+2 + CO3-2
log_k -16.05
delta_h 45.14 kJ
Hg3O2CO3
Hg3O2CO3 + 4H2O = 3Hg(OH)2 + 2H+ + CO3-2
log_k -29.682
delta_h -0 kJ
CuCO3
CuCO3 = Cu+2 + CO3-2
log_k -11.5
delta_h -0 kJ
Malachite
Cu2(OH)2CO3 + 2H+ = 2Cu+2 + 2H2O + CO3-2
log_k -5.306
delta_h 76.38 kJ
Azurite
Cu3(OH)2(CO3)2 + 2H+ = 3Cu+2 + 2H2O + 2CO3-2
log_k -16.906
delta_h -95.22 kJ
Ag2CO3
Ag2CO3 = 2Ag+ + CO3-2
log_k -11.09
delta_h 42.15 kJ
NiCO3
NiCO3 = Ni+2 + CO3-2
log_k -6.87
delta_h -41.589 kJ
CoCO3
CoCO3 = Co+2 + CO3-2
log_k -9.98
delta_h -12.7612 kJ
Siderite
FeCO3 = Fe+2 + CO3-2
log_k -10.24
delta_h -16 kJ
Rhodochrosite
MnCO3 = Mn+2 + CO3-2
log_k -10.58
delta_h -1.88 kJ

Rutherfordine
UO2CO3 = UO2+2 + CO3-2
log_k -14.5
delta_h -3.03 kJ
Artinite
MgCO3:Mg(OH)2:3H2O + 2H+ = 2Mg+2 + CO3-2 + 5H2O
log_k 9.6
delta_h -120.257 kJ
Hydromagnesite
Mg5(CO3)4(OH)2:4H2O + 2H+ = 5Mg+2 + 4CO3-2 + 6H2O
log_k -8.766
delta_h -218.447 kJ
Magnesite
MgCO3 = Mg+2 + CO3-2
log_k -7.46
delta_h 20 kJ
Nesquehonite
MgCO3:3H2O = Mg+2 + CO3-2 + 3H2O
log_k -4.67
delta_h -24.2212 kJ
Aragonite
CaCO3 = Ca+2 + CO3-2
log_k -8.3
delta_h -12 kJ
Calcite
CaCO3 = Ca+2 + CO3-2
log_k -8.48
delta_h -8 kJ
Dolomite(ordered)
CaMg(CO3)2 = Ca+2 + Mg+2 + 2CO3-2
log_k -17.09
delta_h -39.5 kJ
Dolomite(disordered)
CaMg(CO3)2 = Ca+2 + Mg+2 + 2CO3-2
log_k -16.54
delta_h -46.4 kJ
Huntite
CaMg3(CO3)4 = 3Mg+2 + Ca+2 + 4CO3-2
log_k -29.968
delta_h -107.78 kJ
Strontianite
SrCO3 = Sr+2 + CO3-2
log_k -9.27
delta_h -0 kJ
Witherite
BaCO3 = Ba+2 + CO3-2
log_k -8.57
delta_h 4 kJ
Thermonatrite
Na2CO3:H2O = 2Na+ + CO3-2 + H2O
log_k 0.637
delta_h -10.4799 kJ
TlNO3
TlNO3 = Tl+ + NO3-

log_k -1.6127
delta_h 42.44 kJ
Zn(NO3)2:6H2O
Zn(NO3)2:6H2O = Zn+2 + 2NO3- + 6H2O
log_k 3.3153
delta_h 24.5698 kJ
Cu2(OH)3NO3
Cu2(OH)3NO3 + 3H+ = 2Cu+2 + 3H2O + NO3-
log_k 9.251
delta_h -72.5924 kJ
(Co(NH3)6)(NO3)3
(Co(NH3)6)(NO3)3 + 6H+ = Co+3 + 6NH4+ + 3NO3-
log_k 17.9343
delta_h 1.59 kJ
(Co(NH3)5Cl)(NO3)2
(Co(NH3)5Cl)(NO3)2 + 5H+ = Co+3 + 5NH4+ + Cl- + 2NO3-
log_k 6.2887
delta_h 6.4199 kJ
UO2(NO3)2
UO2(NO3)2 = UO2+2 + 2NO3-
log_k 12.1476
delta_h -83.3999 kJ
UO2(NO3)2:2H2O
UO2(NO3)2:2H2O = UO2+2 + 2NO3- + 2H2O
log_k 4.851
delta_h -25.355 kJ
UO2(NO3)2:3H2O
UO2(NO3)2:3H2O = UO2+2 + 2NO3- + 3H2O
log_k 3.39
delta_h -9.1599 kJ
UO2(NO3)2:6H2O
UO2(NO3)2:6H2O = UO2+2 + 2NO3- + 6H2O
log_k 2.0464
delta_h 20.8201 kJ
Pb(BO2)2
Pb(BO2)2 + 2H2O + 2H+ = Pb+2 + 2H3BO3
log_k 6.5192
delta_h -15.6119 kJ
Zn(BO2)2
Zn(BO2)2 + 2H2O + 2H+ = Zn+2 + 2H3BO3
log_k 8.29
delta_h -0 kJ
Cd(BO2)2
Cd(BO2)2 + 2H2O + 2H+ = Cd+2 + 2H3BO3
log_k 9.84
delta_h -0 kJ
Co(BO2)2
Co(BO2)2 + 2H2O + 2H+ = Co+2 + 2H3BO3
log_k 27.0703
delta_h -0 kJ
SnSO4
SnSO4 + 2H2O = Sn(OH)2 + 2H+ + SO4-2
log_k -56.9747
delta_h -0 kJ

Sn(SO4)2
Sn(SO4)2 + 6H2O = Sn(OH)6-2 + 6H+ + 2SO4-2
log_k -15.2123
delta_h -0 kJ
Larnakite
PbO:PbSO4 + 2H+ = 2Pb+2 + SO4-2 + H2O
log_k -0.4344
delta_h -21.83 kJ
Pb3O2SO4
Pb3O2SO4 + 4H+ = 3Pb+2 + SO4-2 + 2H2O
log_k 10.6864
delta_h -79.14 kJ
Pb4O3SO4
Pb4O3SO4 + 6H+ = 4Pb+2 + SO4-2 + 3H2O
log_k 21.8772
delta_h -136.45 kJ
Anglesite
PbSO4 = Pb+2 + SO4-2
log_k -7.79
delta_h 12 kJ
Pb4(OH)6SO4
Pb4(OH)6SO4 + 6H+ = 4Pb+2 + SO4-2 + 6H2O
log_k 21.1
delta_h -0 kJ
AlOHSO4
AlOHSO4 + H+ = Al+3 + SO4-2 + H2O
log_k -3.23
delta_h -0 kJ
Al4(OH)10SO4
Al4(OH)10SO4 + 10H+ = 4Al+3 + SO4-2 + 10H2O
log_k 22.7
delta_h -0 kJ
Tl2SO4
Tl2SO4 = 2Tl+ + SO4-2
log_k -3.7868
delta_h 33.1799 kJ
Zn2(OH)2SO4
Zn2(OH)2SO4 + 2H+ = 2Zn+2 + 2H2O + SO4-2
log_k 7.5
delta_h -0 kJ
Zn4(OH)6SO4
Zn4(OH)6SO4 + 6H+ = 4Zn+2 + 6H2O + SO4-2
log_k 28.4
delta_h -0 kJ
Zn3O(SO4)2
Zn3O(SO4)2 + 2H+ = 3Zn+2 + 2SO4-2 + H2O
log_k 18.9135
delta_h -258.08 kJ
Zincosite
ZnSO4 = Zn+2 + SO4-2
log_k 3.9297
delta_h -82.586 kJ
ZnSO4:1H2O
ZnSO4:1H2O = Zn+2 + SO4-2 + H2O

log_k -0.638
delta_h -44.0699 kJ
Bianchite
ZnSO4:6H2O = Zn+2 + SO4-2 + 6H2O
log_k -1.765
delta_h -0.6694 kJ
Goslarite
ZnSO4:7H2O = Zn+2 + SO4-2 + 7H2O
log_k -2.0112
delta_h 14.21 kJ
Cd3(OH)4SO4
Cd3(OH)4SO4 + 4H+ = 3Cd+2 + 4H2O + SO4-2
log_k 22.56
delta_h -0 kJ
Cd3(OH)2(SO4)2
Cd3(OH)2(SO4)2 + 2H+ = 3Cd+2 + 2H2O + 2SO4-2
log_k 6.71
delta_h -0 kJ
Cd4(OH)6SO4
Cd4(OH)6SO4 + 6H+ = 4Cd+2 + 6H2O + SO4-2
log_k 28.4
delta_h -0 kJ
CdSO4
CdSO4 = Cd+2 + SO4-2
log_k -0.1722
delta_h -51.98 kJ
CdSO4:1H2O
CdSO4:1H2O = Cd+2 + SO4-2 + H2O
log_k -1.7261
delta_h -31.5399 kJ
CdSO4:2.67H2O
CdSO4:2.67H2O = Cd+2 + SO4-2 + 2.67H2O
log_k -1.873
delta_h -17.9912 kJ
Hg2SO4
Hg2SO4 = Hg2+2 + SO4-2
log_k -6.13
delta_h 5.4 kJ
HgSO4
HgSO4 + 2H2O = Hg(OH)2 + SO4-2 + 2H+
log_k -9.4189
delta_h 14.6858 kJ
Cu2SO4
Cu2SO4 = 2Cu+ + SO4-2
log_k -1.95
delta_h -19.079 kJ
Antlerite
Cu3(OH)4SO4 + 4H+ = 3Cu+2 + 4H2O + SO4-2
log_k 8.788
delta_h -0 kJ
Brochantite
Cu4(OH)6SO4 + 6H+ = 4Cu+2 + 6H2O + SO4-2
log_k 15.222
delta_h -202.86 kJ

Langite
Cu4(OH)6SO4:H2O + 6H+ = 4Cu+2 + 7H2O + SO4-2
log_k 17.4886
delta_h -165.55 kJ
CuOCuSO4
CuOCuSO4 + 2H+ = 2Cu+2 + H2O + SO4-2
log_k 10.3032
delta_h -137.777 kJ
CuSO4
CuSO4 = Cu+2 + SO4-2
log_k 2.9395
delta_h -73.04 kJ
Chalcanthite
CuSO4:5H2O = Cu+2 + SO4-2 + 5H2O
log_k -2.64
delta_h 6.025 kJ
Ag2SO4
Ag2SO4 = 2Ag+ + SO4-2
log_k -4.82
delta_h 17 kJ
Ni4(OH)6SO4
Ni4(OH)6SO4 + 6H+ = 4Ni+2 + SO4-2 + 6H2O
log_k 32
delta_h -0 kJ
Retgersite
NiSO4:6H2O = Ni+2 + SO4-2 + 6H2O
log_k -2.04
delta_h 4.6024 kJ
Morenosite
NiSO4:7H2O = Ni+2 + SO4-2 + 7H2O
log_k -2.1449
delta_h 12.1802 kJ
CoSO4
CoSO4 = Co+2 + SO4-2
log_k 2.8024
delta_h -79.277 kJ
CoSO4:6H2O
CoSO4:6H2O = Co+2 + SO4-2 + 6H2O
log_k -2.4726
delta_h 1.0801 kJ
Melanterite
FeSO4:7H2O = Fe+2 + SO4-2 + 7H2O
log_k -2.209
delta_h 20.5 kJ
Fe2(SO4)3
Fe2(SO4)3 = 2Fe+3 + 3SO4-2
log_k -3.7343
delta_h -242.028 kJ
H-Jarosite
(H3O)Fe3(SO4)2(OH)6 + 5H+ = 3Fe+3 + 2SO4-2 + 7H2O
log_k -12.1
delta_h -230.748 kJ
Na-Jarosite
NaFe3(SO4)2(OH)6 + 6H+ = Na+ + 3Fe+3 + 2SO4-2 + 6H2O

log_k -11.2
delta_h -151.377 kJ
K-Jarosite
KFe3(SO4)2(OH)6 + 6H+ = K+ + 3Fe+3 + 2SO4-2 + 6H2O
log_k -14.8
delta_h -130.875 kJ
MnSO4
MnSO4 = Mn+2 + SO4-2
log_k 2.5831
delta_h -64.8401 kJ
Mn2(SO4)3
Mn2(SO4)3 = 2Mn+3 + 3SO4-2
log_k -5.711
delta_h -163.427 kJ
VOSO4
VOSO4 = VO+2 + SO4-2
log_k 3.6097
delta_h -86.7401 kJ
Epsomite
MgSO4:7H2O = Mg+2 + SO4-2 + 7H2O
log_k -2.1265
delta_h 11.5601 kJ
Anhydrite
CaSO4 = Ca+2 + SO4-2
log_k -4.36
delta_h -7.2 kJ
Gypsum
CaSO4:2H2O = Ca+2 + SO4-2 + 2H2O
log_k -4.61
delta_h 1 kJ
Celestite
SrSO4 = Sr+2 + SO4-2
log_k -6.62
delta_h 2 kJ
Barite
BaSO4 = Ba+2 + SO4-2
log_k -9.98
delta_h 23 kJ
Mirabilite
Na2SO4:10H2O = 2Na+ + SO4-2 + 10H2O
log_k -1.114
delta_h 79.4416 kJ
Thenardite
Na2SO4 = 2Na+ + SO4-2
log_k 0.3217
delta_h -9.121 kJ
K-Alum
KAl(SO4)2:12H2O = K+ + Al+3 + 2SO4-2 + 12H2O
log_k -5.17
delta_h 30.2085 kJ
Alunite
KAl3(SO4)2(OH)6 + 6H+ = K+ + 3Al+3 + 2SO4-2 + 6H2O
log_k -1.4
delta_h -210 kJ

(NH4)2CrO4
(NH4)2CrO4 = CrO4-2 + 2NH4+
log_k 0.4046
delta_h 9.163 kJ
PbCrO4
PbCrO4 = Pb+2 + CrO4-2
log_k -12.6
delta_h 44.18 kJ
Tl2CrO4
Tl2CrO4 = 2Tl+ + CrO4-2
log_k -12.01
delta_h 74.27 kJ
Hg2CrO4
Hg2CrO4 = Hg2+2 + CrO4-2
log_k -8.7
delta_h -0 kJ
CuCrO4
CuCrO4 = Cu+2 + CrO4-2
log_k -5.44
delta_h -0 kJ
Ag2CrO4
Ag2CrO4 = 2Ag+ + CrO4-2
log_k -11.59
delta_h 62 kJ
MgCrO4
MgCrO4 = CrO4-2 + Mg+2
log_k 5.3801
delta_h -88.9518 kJ
CaCrO4
CaCrO4 = Ca+2 + CrO4-2
log_k -2.2657
delta_h -26.945 kJ
SrCrO4
SrCrO4 = Sr+2 + CrO4-2
log_k -4.65
delta_h -10.1253 kJ
BaCrO4
BaCrO4 = Ba+2 + CrO4-2
log_k -9.67
delta_h 33 kJ
Li2CrO4
Li2CrO4 = CrO4-2 + 2Li+
log_k 4.8568
delta_h -45.2792 kJ
Na2CrO4
Na2CrO4 = CrO4-2 + 2Na+
log_k 2.9302
delta_h -19.6301 kJ
Na2Cr2O7
Na2Cr2O7 + H2O = 2CrO4-2 + 2Na+ + 2H+
log_k -9.8953
delta_h 22.1961 kJ
K2CrO4
K2CrO4 = CrO4-2 + 2K+

log_k -0.5134
delta_h 18.2699 kJ
K2Cr2O7
K2Cr2O7 + H2O = 2CrO4-2 + 2K+ + 2H+
log_k -17.2424
delta_h 80.7499 kJ
Hg2SeO3
Hg2SeO3 + H+ = Hg2+2 + HSeO3-
log_k -4.657
delta_h -0 kJ
HgSeO3
HgSeO3 + 2H2O = Hg(OH)2 + H+ + HSeO3-
log_k -12.43
delta_h -0 kJ
Ag2SeO3
Ag2SeO3 + H+ = 2Ag+ + HSeO3-
log_k -7.15
delta_h 39.68 kJ
CuSeO3:2H2O
CuSeO3:2H2O + H+ = Cu+2 + HSeO3- + 2H2O
log_k 0.5116
delta_h -36.861 kJ
NiSeO3:2H2O
NiSeO3:2H2O + H+ = HSeO3- + Ni+2 + 2H2O
log_k 2.8147
delta_h -31.0034 kJ
CoSeO3
CoSeO3 + H+ = Co+2 + HSeO3-
log_k 1.32
delta_h -0 kJ
Fe2(SeO3)3:2H2O
Fe2(SeO3)3:2H2O + 3H+ = 3HSeO3- + 2Fe+3 + 2H2O
log_k -20.6262
delta_h -0 kJ
Fe2(OH)4SeO3
Fe2(OH)4SeO3 + 5H+ = HSeO3- + 2Fe+3 + 4H2O
log_k 1.5539
delta_h -0 kJ
MnSeO3
MnSeO3 + H+ = Mn+2 + HSeO3-
log_k 1.13
delta_h -0 kJ
MnSeO3:2H2O
MnSeO3:2H2O + H+ = HSeO3- + Mn+2 + 2H2O
log_k 0.9822
delta_h 8.4935 kJ
MgSeO3:6H2O
MgSeO3:6H2O + H+ = Mg+2 + HSeO3- + 6H2O
log_k 3.0554
delta_h 5.23 kJ
CaSeO3:2H2O
CaSeO3:2H2O + H+ = HSeO3- + Ca+2 + 2H2O
log_k 2.8139
delta_h -19.4556 kJ

SrSeO3
SrSeO3 + H+ = Sr+2 + HSeO3-
log_k 2.3
delta_h -0 kJ
BaSeO3
BaSeO3 + H+ = Ba+2 + HSeO3-
log_k 1.83
delta_h 11.98 kJ
Na2SeO3:5H2O
Na2SeO3:5H2O + H+ = 2Na+ + HSeO3- + 5H2O
log_k 10.3
delta_h -0 kJ
PbSeO4
PbSeO4 = Pb+2 + SeO4-2
log_k -6.84
delta_h 15 kJ
Tl2SeO4
Tl2SeO4 = 2Tl+ + SeO4-2
log_k -4.1
delta_h 43 kJ
ZnSeO4:6H2O
ZnSeO4:6H2O = Zn+2 + SeO4-2 + 6H2O
log_k -1.52
delta_h -0 kJ
CdSeO4:2H2O
CdSeO4:2H2O = Cd+2 + SeO4-2 + 2H2O
log_k -1.85
delta_h -0 kJ
Ag2SeO4
Ag2SeO4 = 2Ag+ + SeO4-2
log_k -8.91
delta_h -43.5 kJ
CuSeO4:5H2O
CuSeO4:5H2O = Cu+2 + SeO4-2 + 5H2O
log_k -2.44
delta_h -0 kJ
NiSeO4:6H2O
NiSeO4:6H2O = Ni+2 + SeO4-2 + 6H2O
log_k -1.52
delta_h -0 kJ
CoSeO4:6H2O
CoSeO4:6H2O = Co+2 + SeO4-2 + 6H2O
log_k -1.53
delta_h -0 kJ
MnSeO4:5H2O
MnSeO4:5H2O = Mn+2 + SeO4-2 + 5H2O
log_k -2.05
delta_h -0 kJ
UO2SeO4:4H2O
UO2SeO4:4H2O = UO2+2 + SeO4-2 + 4H2O
log_k -2.25
delta_h -0 kJ
MgSeO4:6H2O
MgSeO4:6H2O = Mg+2 + SeO4-2 + 6H2O

log_k -1.2
delta_h -0 kJ
CaSeO4:2H2O
CaSeO4:2H2O = Ca+2 + SeO4-2 + 2H2O
log_k -3.02
delta_h -8.3 kJ
SrSeO4
SrSeO4 = Sr+2 + SeO4-2
log_k -4.4
delta_h 0.4 kJ
BaSeO4
BaSeO4 = Ba+2 + SeO4-2
log_k -7.46
delta_h 22 kJ
BeSeO4:4H2O
BeSeO4:4H2O = Be+2 + SeO4-2 + 4H2O
log_k -2.94
delta_h -0 kJ
Na2SeO4
Na2SeO4 = 2Na+ + SeO4-2
log_k 1.28
delta_h -0 kJ
K2SeO4
K2SeO4 = 2K+ + SeO4-2
log_k -0.73
delta_h -0 kJ
(NH4)2SeO4
(NH4)2SeO4 = 2NH4+ + SeO4-2
log_k 0.45
delta_h -0 kJ
H2MoO4
H2MoO4 = MoO4-2 + 2H+
log_k -12.8765
delta_h 49 kJ
PbMoO4
PbMoO4 = Pb+2 + MoO4-2
log_k -15.62
delta_h 53.93 kJ
Al2(MoO4)3
Al2(MoO4)3 = 3MoO4-2 + 2Al+3
log_k 2.3675
delta_h -260.8 kJ
Tl2MoO4
Tl2MoO4 = MoO4-2 + 2Tl+
log_k -7.9887
delta_h -0 kJ
ZnMoO4
ZnMoO4 = MoO4-2 + Zn+2
log_k -10.1254
delta_h -10.6901 kJ
CdMoO4
CdMoO4 = MoO4-2 + Cd+2
log_k -14.1497
delta_h 19.48 kJ

CuMoO4
CuMoO4 = MoO4-2 + Cu+2
log_k -13.0762
delta_h 12.2 kJ
Ag2MoO4
Ag2MoO4 = 2Ag+ + MoO4-2
log_k -11.55
delta_h 52.7 kJ
NiMoO4
NiMoO4 = MoO4-2 + Ni+2
log_k -11.1421
delta_h 1.3 kJ
CoMoO4
CoMoO4 = MoO4-2 + Co+2
log_k -7.7609
delta_h -23.3999 kJ
FeMoO4
FeMoO4 = MoO4-2 + Fe+2
log_k -10.091
delta_h -11.1 kJ
BeMoO4
BeMoO4 = MoO4-2 + Be+2
log_k -1.7817
delta_h -56.4 kJ
MgMoO4
MgMoO4 = Mg+2 + MoO4-2
log_k -1.85
delta_h -0 kJ
CaMoO4
CaMoO4 = Ca+2 + MoO4-2
log_k -7.95
delta_h -2 kJ
BaMoO4
BaMoO4 = MoO4-2 + Ba+2
log_k -6.9603
delta_h 10.96 kJ
Li2MoO4
Li2MoO4 = MoO4-2 + 2Li+
log_k 2.4416
delta_h -33.9399 kJ
Na2MoO4
Na2MoO4 = MoO4-2 + 2Na+
log_k 1.4901
delta_h -9.98 kJ
Na2MoO4:2H2O
Na2MoO4:2H2O = MoO4-2 + 2Na+ + 2H2O
log_k 1.224
delta_h -0 kJ
Na2Mo2O7
Na2Mo2O7 + H2O = 2MoO4-2 + 2Na+ + 2H+
log_k -16.5966
delta_h 56.2502 kJ
K2MoO4
K2MoO4 = MoO4-2 + 2K+

log_k 3.2619
delta_h -3.38 kJ
PbHPO4
PbHPO4 = Pb+2 + H+ + PO4-3
log_k -23.805
delta_h -0 kJ
Pb3(PO4)2
Pb3(PO4)2 = 3Pb+2 + 2PO4-3
log_k -43.53
delta_h -0 kJ
Pyromorphite
Pb5(PO4)3Cl = 5Pb+2 + 3PO4-3 + Cl-
log_k -84.43
delta_h -0 kJ
Hydroxylpyromorphite
Pb5(PO4)3OH + H+ = 5Pb+2 + 3PO4-3 + H2O
log_k -62.79
delta_h -0 kJ
Plumbgummite
PbAl3(PO4)2(OH)5:H2O + 5H+ = Pb+2 + 3Al+3 + 2PO4-3 + 6H2O
log_k -32.79
delta_h -0 kJ
Hinsdalite
PbAl3PO4SO4(OH)6 + 6H+ = Pb+2 + 3Al+3 + PO4-3 + SO4-2 + 6H2O
log_k -2.5
delta_h -0 kJ
Tsumebite
Pb2CuPO4(OH)3:3H2O + 3H+ = 2Pb+2 + Cu+2 + PO4-3 + 6H2O
log_k -9.79
delta_h -0 kJ
Zn3(PO4)2:4H2O
Zn3(PO4)2:4H2O = 3Zn+2 + 2PO4-3 + 4H2O
log_k -35.42
delta_h -0 kJ
Cd3(PO4)2
Cd3(PO4)2 = 3Cd+2 + 2PO4-3
log_k -32.6
delta_h -0 kJ
Hg2HPO4
Hg2HPO4 = Hg2+2 + H+ + PO4-3
log_k -24.775
delta_h -0 kJ
Cu3(PO4)2
Cu3(PO4)2 = 3Cu+2 + 2PO4-3
log_k -36.85
delta_h -0 kJ
Cu3(PO4)2:3H2O
Cu3(PO4)2:3H2O = 3Cu+2 + 2PO4-3 + 3H2O
log_k -35.12
delta_h -0 kJ
Ag3PO4
Ag3PO4 = 3Ag+ + PO4-3
log_k -17.59
delta_h -0 kJ

Ni3(PO4)2
Ni3(PO4)2 = 3Ni+2 + 2PO4-3
log_k -31.3
delta_h -0 kJ
CoHPO4
CoHPO4 = Co+2 + PO4-3 + H+
log_k -19.0607
delta_h -0 kJ
Co3(PO4)2
Co3(PO4)2 = 3Co+2 + 2PO4-3
log_k -34.6877
delta_h -0 kJ
Vivianite
Fe3(PO4)2:8H2O = 3Fe+2 + 2PO4-3 + 8H2O
log_k -36
delta_h -0 kJ
Strengite
FePO4:2H2O = Fe+3 + PO4-3 + 2H2O
log_k -26.4
delta_h -9.3601 kJ
Mn3(PO4)2
Mn3(PO4)2 = 3Mn+2 + 2PO4-3
log_k -23.827
delta_h 8.8701 kJ
MnHPO4
MnHPO4 = Mn+2 + PO4-3 + H+
log_k -25.4
delta_h -0 kJ
(VO)3(PO4)2
(VO)3(PO4)2 = 3VO+2 + 2PO4-3
log_k -25.1
delta_h -0 kJ
Mg3(PO4)2
Mg3(PO4)2 = 3Mg+2 + 2PO4-3
log_k -23.28
delta_h -0 kJ
MgHPO4:3H2O
MgHPO4:3H2O = Mg+2 + H+ + PO4-3 + 3H2O
log_k -18.175
delta_h -0 kJ
FCO3Apatite
Ca9.316Na0.36Mg0.144(PO4)4.8(CO3)1.2F2.48 = 9.316Ca+2 + 0.36Na+ + 0.144Mg+2 + 4.8PO4-3 + 1.2CO3-2 + 2.48F-
log_k -114.4
delta_h 164.808 kJ
Hydroxylapatite
Ca5(PO4)3OH + H+ = 5Ca+2 + 3PO4-3 + H2O
log_k -44.333
delta_h -0 kJ
CaHPO4:2H2O
CaHPO4:2H2O = Ca+2 + H+ + PO4-3 + 2H2O
log_k -18.995
delta_h 23 kJ
CaHPO4

CaHPO4 = Ca+2 + H+ + PO4-3
log_k -19.275
delta_h 31 kJ
Ca3(PO4)2(beta)
Ca3(PO4)2 = 3Ca+2 + 2PO4-3
log_k -28.92
delta_h 54 kJ
Ca4H(PO4)3:3H2O
Ca4H(PO4)3:3H2O = 4Ca+2 + H+ + 3PO4-3 + 3H2O
log_k -47.08
delta_h -0 kJ
SrHPO4
SrHPO4 = Sr+2 + H+ + PO4-3
log_k -19.295
delta_h -0 kJ
BaHPO4
BaHPO4 = Ba+2 + H+ + PO4-3
log_k -19.775
delta_h -0 kJ
U(HPO4)2:4H2O
U(HPO4)2:4H2O = U+4 + 2PO4-3 + 2H+ + 4H2O
log_k -51.584
delta_h 16.0666 kJ
(UO2)3(PO4)2
(UO2)3(PO4)2 = 3UO2+2 + 2PO4-3
log_k -49.4
delta_h 397.062 kJ
UO2HPO4
UO2HPO4 = UO2+2 + H+ + PO4-3
log_k -24.225
delta_h -0 kJ
Uramphite
(NH4)2(UO2)2(PO4)2 = 2UO2+2 + 2NH4+ + 2PO4-3
log_k -51.749
delta_h 40.5848 kJ
Przhevalskite
Pb(UO2)2(PO4)2 = 2UO2+2 + Pb+2 + 2PO4-3
log_k -44.365
delta_h -46.024 kJ
Torbernite
Cu(UO2)2(PO4)2 = 2UO2+2 + Cu+2 + 2PO4-3
log_k -45.279
delta_h -66.5256 kJ
Bassetite
Fe(UO2)2(PO4)2 = 2UO2+2 + Fe+2 + 2PO4-3
log_k -44.485
delta_h -83.2616 kJ
Saleeite
Mg(UO2)2(PO4)2 = 2UO2+2 + Mg+2 + 2PO4-3
log_k -43.646
delta_h -84.4331 kJ
Ningyoite
CaU(PO4)2:2H2O = U+4 + Ca+2 + 2PO4-3 + 2H2O
log_k -53.906

delta_h -9.4977 kJ
H-Autunite
H2(UO2)2(PO4)2 = 2UO2+2 + 2H+ + 2PO4-3
log_k -47.931
delta_h -15.0624 kJ
Autunite
Ca(UO2)2(PO4)2 = 2UO2+2 + Ca+2 + 2PO4-3
log_k -43.927
delta_h -59.9986 kJ
Sr-Autunite
Sr(UO2)2(PO4)2 = 2UO2+2 + Sr+2 + 2PO4-3
log_k -44.457
delta_h -54.6012 kJ
Na-Autunite
Na2(UO2)2(PO4)2 = 2UO2+2 + 2Na+ + 2PO4-3
log_k -47.409
delta_h -1.9246 kJ
K-Autunite
K2(UO2)2(PO4)2 = 2UO2+2 + 2K+ + 2PO4-3
log_k -48.244
delta_h 24.5182 kJ
Uranocircite
Ba(UO2)2(PO4)2 = 2UO2+2 + Ba+2 + 2PO4-3
log_k -44.631
delta_h -42.2584 kJ
Pb3(AsO4)2
Pb3(AsO4)2 + 6H+ = 3Pb+2 + 2H3AsO4
log_k 5.8
delta_h -0 kJ
AlAsO4:2H2O
AlAsO4:2H2O + 3H+ = Al+3 + H3AsO4 + 2H2O
log_k 4.8
delta_h -0 kJ
Zn3(AsO4)2:2.5H2O
Zn3(AsO4)2:2.5H2O + 6H+ = 3Zn+2 + 2H3AsO4 + 2.5H2O
log_k 13.65
delta_h -0 kJ
Cu3(AsO4)2:2H2O
Cu3(AsO4)2:2H2O + 6H+ = 3Cu+2 + 2H3AsO4 + 2H2O
log_k 6.1
delta_h -0 kJ
Ag3AsO3
Ag3AsO3 + 3H+ = 3Ag+ + H3AsO3
log_k 2.1573
delta_h -0 kJ
Ag3AsO4
Ag3AsO4 + 3H+ = 3Ag+ + H3AsO4
log_k -2.7867
delta_h -0 kJ
Ni3(AsO4)2:8H2O
Ni3(AsO4)2:8H2O + 6H+ = 3Ni+2 + 2H3AsO4 + 8H2O
log_k 15.7
delta_h -0 kJ
Co3(AsO4)2

Co3(AsO4)2 + 6H+ = 3Co+2 + 2H3AsO4
log_k 13.0341
delta_h -0 kJ
FeAsO4:2H2O
FeAsO4:2H2O + 3H+ = Fe+3 + H3AsO4 + 2H2O
log_k 0.4
delta_h -0 kJ
Mn3(AsO4)2:8H2O
Mn3(AsO4)2:8H2O + 6H+ = 3Mn+2 + 2H3AsO4 + 8H2O
log_k 12.5
delta_h -0 kJ
Ca3(AsO4)2:4H2O
Ca3(AsO4)2:4H2O + 6H+ = 3Ca+2 + 2H3AsO4 + 4H2O
log_k 22.3
delta_h -0 kJ
Ba3(AsO4)2
Ba3(AsO4)2 + 6H+ = 3Ba+2 + 2H3AsO4
log_k -8.91
delta_h 11.0458 kJ
#NH4VO3
NH4VO3 + 2H+ = 2VO2+ + H2O
log_k 3.8
delta_h 30 kJ
Pb3(VO4)2
Pb3(VO4)2 + 8H+ = 3Pb+2 + 2VO2+ + 4H2O
log_k 6.14
delta_h -72.6342 kJ
Pb2V2O7
Pb2V2O7 + 6H+ = 2Pb+2 + 2VO2+ + 3H2O
log_k -1.9
delta_h -26.945 kJ
AgVO3
AgVO3 + 2H+ = Ag+ + VO2+ + H2O
log_k 0.77
delta_h -0 kJ
Ag2HVO4
Ag2HVO4 + 3H+ = 2Ag+ + VO2+ + 2H2O
log_k 1.48
delta_h -0 kJ
Ag3H2VO5
Ag3H2VO5 + 4H+ = 3Ag+ + VO2+ + 3H2O
log_k 5.18
delta_h -0 kJ
Fe(VO3)2
Fe(VO3)2 + 4H+ = Fe+2 + 2VO2+ + 2H2O
log_k -3.72
delta_h -61.6722 kJ
Mn(VO3)2
Mn(VO3)2 + 4H+ = Mn+2 + 2VO2+ + 2H2O
log_k 4.9
delta_h -92.4664 kJ
Mg(VO3)2
Mg(VO3)2 + 4H+ = Mg+2 + 2VO2+ + 2H2O
log_k 11.28

delta_h -136.649 kJ
Mg2V2O7
Mg2V2O7 + 6H+ = 2Mg+2 + 2VO2+ + 3H2O
log_k 26.36
delta_h -255.224 kJ
Carnotite
KUO2VO4 + 4H+ = K+ + UO2+2 + VO2+ + 2H2O
log_k 0.23
delta_h -36.4008 kJ
Tyuyamunite
Ca(UO2)2(VO4)2 + 8H+ = Ca+2 + 2UO2+2 + 2VO2+ + 4H2O
log_k 4.08
delta_h -153.134 kJ
Ca(VO3)2
Ca(VO3)2 + 4H+ = Ca+2 + 2VO2+ + 2H2O
log_k 5.66
delta_h -84.7678 kJ
Ca3(VO4)2
Ca3(VO4)2 + 8H+ = 3Ca+2 + 2VO2+ + 4H2O
log_k 38.96
delta_h -293.466 kJ
Ca2V2O7
Ca2V2O7 + 6H+ = 2Ca+2 + 2VO2+ + 3H2O
log_k 17.5
delta_h -159.494 kJ
Ca3(VO4)2:4H2O
Ca3(VO4)2:4H2O + 8H+ = 3Ca+2 + 2VO2+ + 8H2O
log_k 39.86
delta_h -0 kJ
Ca2V2O7:2H2O
Ca2V2O7:2H2O + 6H+ = 2Ca+2 + 2VO2+ + 5H2O
log_k 21.552
delta_h -0 kJ
Ba3(VO4)2:4H2O
Ba3(VO4)2:4H2O + 8H+ = 3Ba+2 + 2VO2+ + 8H2O
log_k 32.94
delta_h -0 kJ
Ba2V2O7:2H2O
Ba2V2O7:2H2O + 6H+ = 2Ba+2 + 2VO2+ + 5H2O
log_k 15.872
delta_h -0 kJ
NaVO3
NaVO3 + 2H+ = Na+ + VO2+ + H2O
log_k 3.8582
delta_h -30.1799 kJ
Na3VO4
Na3VO4 + 4H+ = 3Na+ + VO2+ + 2H2O
log_k 36.6812
delta_h -184.61 kJ
Na4V2O7
Na4V2O7 + 6H+ = 4Na+ + 2VO2+ + 3H2O
log_k 37.4
delta_h -201.083 kJ
Halloysite

Al2Si2O5(OH)4 + 6H+ = 2Al+3 + 2H4SiO4 + H2O
log_k 9.5749
delta_h -181.43 kJ
Kaolinite
Al2Si2O5(OH)4 + 6H+ = 2Al+3 + 2H4SiO4 + H2O
log_k 7.435
delta_h -148 kJ
Greenalite
Fe3Si2O5(OH)4 + 6H+ = 3Fe+2 + 2H4SiO4 + H2O
log_k 20.81
delta_h -0 kJ
Chrysotile
Mg3Si2O5(OH)4 + 6H+ = 3Mg+2 + 2H4SiO4 + H2O
log_k 32.2
delta_h -196 kJ
Sepiolite
Mg2Si3O7.5OH:3H2O + 4H+ + 0.5H2O = 2Mg+2 + 3H4SiO4
log_k 15.76
delta_h -114.089 kJ
Sepiolite(A)
Mg2Si3O7.5OH:3H2O + 0.5H2O + 4H+ = 2Mg+2 + 3H4SiO4
log_k 18.78
delta_h -0 kJ
PHASES
O2(g)
O2 + 4H+ + 4e- = 2H2O
log_k 83.0894
delta_h -571.66 kJ
CH4(g)
CH4 + 3H2O = CO3-2 + 8e- + 10H+
log_k -41.0452
delta_h 257.133 kJ
CO2(g)
CO2 + H2O = 2H+ + CO3-2
log_k -18.147
delta_h 4.06 kJ
H2S(g)
H2S = H+ + HS-
log_k -8.01
delta_h -0 kJ
H2Se(g)
H2Se = HSe- + H+
log_k -4.96
delta_h -15.3 kJ
Hg(g)
Hg = 0.5Hg2+2 + e-
log_k -7.8733
delta_h 22.055 kJ
Hg2(g)
Hg2 = Hg2+2 + 2e-
log_k -14.9554
delta_h 58.07 kJ
Hg(CH3)2(g)
Hg(CH3)2 + 8H2O = Hg(OH)2 + 2CO3-2 + 16e- + 20H+

```
log_k -73.7066
delta_h 481.99 kJ
HgF(g)
HgF = 0.5Hg2+2 + F-
log_k 32.6756
delta_h -254.844 kJ
HgF2(g)
HgF2 + 2H2O = Hg(OH)2 + 2F- + 2H+
log_k 12.5652
delta_h -165.186 kJ
HgCl(g)
HgCl = 0.5Hg2+2 + Cl-
log_k 19.4966
delta_h -162.095 kJ
HgBr(g)
HgBr = 0.5Hg2+2 + Br-
log_k 16.7566
delta_h -142.157 kJ
HgBr2(g)
HgBr2 + 2H2O = Hg(OH)2 + 2Br- + 2H+
log_k -18.3881
delta_h 54.494 kJ
HgI(g)
HgI = 0.5Hg2+2 + I-
log_k 11.3322
delta_h -106.815 kJ
HgI2(g)
HgI2 + 2H2O = Hg(OH)2 + 2I- + 2H+
log_k -27.2259
delta_h 114.429 kJ
SURFACE_MASTER_SPECIES
Hfo_s Hfo_sOH
Hfo_w Hfo_wOH
Hao_ Hao_OH #hydrous aluminum oxides - gibbsite
SURFACE_SPECIES
Hfo_wOH = Hfo_wOH
log_k 0.0
Hfo_sOH = Hfo_sOH
log_k 0.0
Hao_OH = Hao_OH
log_k 0.0

Hfo_sOH + H+ = Hfo_sOH2+
log_k 7.29
delta_h 0 kJ
# Id: 8113302
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH = Hfo_sO- + H+
log_k -8.93
delta_h 0 kJ
# Id: 8113301
# log K source:
```

```
# Delta H source:
#T and ionic strength:
Hfo_wOH + H+ = Hfo_wOH2+
log_k 7.29
delta_h 0 kJ
# Id: 8123302
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH = Hfo_wO- + H+
log_k -8.93
delta_h 0 kJ
# Id: 8123301
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + Ba+2 = Hfo_sOHBa+2
log_k 5.46
delta_h 0 kJ
# Id: 8111000
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + Ba+2 = Hfo_wOBa+ + H+
log_k -7.2
delta_h 0 kJ
# Id: 8121000
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + Ca+2 = Hfo_sOHCa+2
log_k 4.97
delta_h 0 kJ
# Id: 8111500
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + Ca+2 = Hfo_wOCa+ + H+
log_k -5.85
delta_h 0 kJ
# Id: 8121500
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + Mg+2 = Hfo_wOMg+ + H+
log_k -4.6
delta_h 0 kJ
# Id: 8124600
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + Ag+ = Hfo_sOAg + H+
log_k -1.72
delta_h 0 kJ
```

```
# Id: 8110200
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + Ag+ = Hfo_wOAg + H+
log_k -5.3
delta_h 0 kJ
# Id: 8120200
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + Ni+2 = Hfo_sONi+ + H+
log_k 0.37
delta_h 0 kJ
# Id: 8115400
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + Ni+2 = Hfo_wONi+ + H+
log_k -2.5
delta_h 0 kJ
# Id: 8125400
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + Cd+2 = Hfo_sOCd+ + H+
log_k 0.47
delta_h 0 kJ
# Id: 8111600
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + Cd+2 = Hfo_wOCd+ + H+
log_k -2.9
delta_h 0 kJ
# Id: 8121600
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + Co+2 = Hfo_sOCo+ + H+
log_k -0.46
delta_h 0 kJ
# Id: 8112000
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + Co+2 = Hfo_wOCo+ + H+
log_k -3.01
delta_h 0 kJ
# Id: 8122000
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + Zn+2 = Hfo_sOZn+ + H+
```

```
log_k 0.99
delta_h 0 kJ
# Id: 8119500
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + Zn+2 = Hfo_wOZn+ + H+
log_k -1.99
delta_h 0 kJ
# Id: 8129500
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + Cu+2 = Hfo_sOCu+ + H+
log_k 2.89
delta_h 0 kJ
# Id: 8112310
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + Cu+2 = Hfo_wOCu+ + H+
log_k 0.6
delta_h 0 kJ
# Id: 8123100
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + Pb+2 = Hfo_sOPb+ + H+
log_k 4.65
delta_h 0 kJ
# Id: 8116000
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + Pb+2 = Hfo_wOPb+ + H+
log_k 0.3
delta_h 0 kJ
# Id: 8126000
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + Be+2 = Hfo_sOBe+ + H+
log_k 5.7
delta_h 0 kJ
# Id: 8111100
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + Be+2 = Hfo_wOBe+ + H+
log_k 3.3
delta_h 0 kJ
# Id: 8121100
# log K source:
# Delta H source:
```

#T and ionic strength:
Hfo_sOH + Hg(OH)2 + H+ = Hfo_sOHg+ + 2H2O
log_k 13.95
delta_h 0 kJ
Id: 8113610
log K source:
Delta H source:
#T and ionic strength:
Hfo_wOH + Hg(OH)2 + H+ = Hfo_wOHg+ + 2H2O
log_k 12.64
delta_h 0 kJ
Id: 8123610
log K source:
Delta H source:
#T and ionic strength:
Hfo_sOH + Sn(OH)2 + H+ = Hfo_sOSn+ + 2H2O
log_k 15.1
delta_h 0 kJ
Id: 8117900
log K source:
Delta H source:
#T and ionic strength:
Hfo_wOH + Sn(OH)2 + H+ = Hfo_wOSn+ + 2H2O
log_k 13
delta_h 0 kJ
Id: 8127900
log K source:
Delta H source:
#T and ionic strength:
Hfo_sOH + Cr(OH)2+ = Hfo_sOCrOH+ + H2O
log_k 11.63
delta_h 0 kJ
Id: 8112110
log K source:
Delta H source:
#T and ionic strength:
Hfo_sOH + H3AsO3 = Hfo_sH2AsO3 + H2O
log_k 5.41
delta_h 0 kJ
Id: 8110600
log K source:
Delta H source:
#T and ionic strength:
Hfo_wOH + H3AsO3 = Hfo_wH2AsO3 + H2O
log_k 5.41
delta_h 0 kJ
Id: 8120600
log K source:
Delta H source:
#T and ionic strength:
Hfo_sOH + H3BO3 = Hfo_sH2BO3 + H2O
log_k 0.62
delta_h 0 kJ
Id: 8110900

```
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + H3BO3 = Hfo_wH2BO3 + H2O
log_k 0.62
delta_h 0 kJ
# Id: 8120900
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + PO4-3 + 3H+ = Hfo_sH2PO4 + H2O
log_k 31.29
delta_h 0 kJ
# Id: 8115800
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + PO4-3 + 3H+ = Hfo_wH2PO4 + H2O
log_k 31.29
delta_h 0 kJ
# Id: 8125800
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + PO4-3 + 2H+ = Hfo_sHPO4- + H2O
log_k 25.39
delta_h 0 kJ
# Id: 8115801
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + PO4-3 + 2H+ = Hfo_wHPO4- + H2O
log_k 25.39
delta_h 0 kJ
# Id: 8125801
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + PO4-3 + H+ = Hfo_sPO4-2 + H2O
log_k 17.72
delta_h 0 kJ
# Id: 8115802
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + PO4-3 + H+ = Hfo_wPO4-2 + H2O
log_k 17.72
delta_h 0 kJ
# Id: 8125802
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + H3AsO4 = Hfo_sH2AsO4 + H2O
log_k 8.61
```

```
delta_h 0 kJ
# Id: 8110610
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + H3AsO4 = Hfo_wH2AsO4 + H2O
log_k 8.61
delta_h 0 kJ
# Id: 8120610
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + H3AsO4 = Hfo_sHAsO4- + H2O + H+
log_k 2.81
delta_h 0 kJ
# Id: 8110611
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + H3AsO4 = Hfo_wHAsO4- + H2O + H+
log_k 2.81
delta_h 0 kJ
# Id: 8120611
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + H3AsO4 = Hfo_sOHAsO4-3 + 3H+
log_k -10.12
delta_h 0 kJ
# Id: 8110613
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + H3AsO4 = Hfo_wOHAsO4-3 + 3H+
log_k -10.12
delta_h 0 kJ
# Id: 8120613
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + VO2+ + 2H2O = Hfo_sOHVO4-3 + 4H+
log_k -16.63
delta_h 0 kJ
# Id: 8119031
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + VO2+ + 2H2O = Hfo_wOHVO4-3 + 4H+
log_k -16.63
delta_h 0 kJ
# Id: 8129031
# log K source:
# Delta H source:
#T and ionic strength:
```

Hfo_sOH + SO4-2 + H+ = Hfo_sSO4- + H2O
log_k 7.78
delta_h 0 kJ
Id: 8117320
log K source:
Delta H source:
#T and ionic strength:
Hfo_wOH + SO4-2 + H+ = Hfo_wSO4- + H2O
log_k 7.78
delta_h 0 kJ
Id: 8127320
log K source:
Delta H source:
#T and ionic strength:
Hfo_sOH + SO4-2 = Hfo_sOHSO4-2
log_k 0.79
delta_h 0 kJ
Id: 8117321
log K source:
Delta H source:
#T and ionic strength:
Hfo_wOH + SO4-2 = Hfo_wOHSO4-2
log_k 0.79
delta_h 0 kJ
Id: 8127321
log K source:
Delta H source:
#T and ionic strength:
Hfo_sOH + HSeO3- = Hfo_sSeO3- + H2O
log_k 4.29
delta_h 0 kJ
Id: 8117610
log K source:
Delta H source:
#T and ionic strength:
Hfo_wOH + HSeO3- = Hfo_wSeO3- + H2O
log_k 4.29
delta_h 0 kJ
Id: 8127610
log K source:
Delta H source:
#T and ionic strength:
Hfo_sOH + HSeO3- = Hfo_sOHSeO3-2 + H+
log_k -3.23
delta_h 0 kJ
Id: 8117611
log K source:
Delta H source:
#T and ionic strength:
Hfo_wOH + HSeO3- = Hfo_wOHSeO3-2 + H+
log_k -3.23
delta_h 0 kJ
Id: 8127611
log K source:

```
# Delta H source:
#T and ionic strength:
Hfo_sOH + SeO4-2 + H+ = Hfo_sSeO4- + H2O
log_k 7.73
delta_h 0 kJ
# Id: 8117620
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + SeO4-2 + H+ = Hfo_wSeO4- + H2O
log_k 7.73
delta_h 0 kJ
# Id: 8127620
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + SeO4-2 = Hfo_sOHSeO4-2
log_k 0.8
delta_h 0 kJ
# Id: 8117621
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + SeO4-2 = Hfo_wOHSeO4-2
log_k 0.8
delta_h 0 kJ
# Id: 8127621
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + CrO4-2 + H+ = Hfo_sCrO4- + H2O
log_k 10.85
delta_h 0 kJ
# Id: 8112120
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + CrO4-2 + H+ = Hfo_wCrO4- + H2O
log_k 10.85
delta_h 0 kJ
# Id: 8122120
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + CrO4-2 = Hfo_sOHCrO4-2
log_k 3.9
delta_h 0 kJ
# Id: 8112121
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + CrO4-2 = Hfo_wOHCrO4-2
log_k 3.9
delta_h 0 kJ
```

Id: 8122121
log K source:
Delta H source:
#T and ionic strength:
Hfo_sOH + MoO4-2 + H+ = Hfo_sMoO4- + H2O
log_k 9.5
delta_h 0 kJ
Id: 8114800
log K source:
Delta H source:
#T and ionic strength:
Hfo_wOH + MoO4-2 + H+ = Hfo_wMoO4- + H2O
log_k 9.5
delta_h 0 kJ
Id: 8124800
log K source:
Delta H source:
#T and ionic strength:
Hfo_sOH + MoO4-2 = Hfo_sOHMoO4-2
log_k 2.4
delta_h 0 kJ
Id: 8114801
log K source:
Delta H source:
#T and ionic strength:
Hfo_wOH + MoO4-2 = Hfo_wOHMoO4-2
log_k 2.4
delta_h 0 kJ
Id: 8124801
log K source:
Delta H source:
#T and ionic strength:
Hfo_sOH + Sb(OH)6- + H+ = Hfo_sSbO(OH)4 + 2H2O
log_k 8.4
delta_h 0 kJ
Id: 8117410
log K source:
Delta H source:
#T and ionic strength:
Hfo_wOH + Sb(OH)6- + H+ = Hfo_wSbO(OH)4 + 2H2O
log_k 8.4
delta_h 0 kJ
Id: 8127410
log K source:
Delta H source:
#T and ionic strength:
Hfo_sOH + Sb(OH)6- = Hfo_sOHSbO(OH)4- + H2O
log_k 1.3
delta_h 0 kJ
Id: 8117411
log K source:
Delta H source:
#T and ionic strength:
Hfo_wOH + Sb(OH)6- = Hfo_wOHSbO(OH)4- + H2O

```
log_k 1.3
delta_h 0 kJ
# Id: 8127411
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + Cyanide- + H+ = Hfo_sCyanide + H2O
log_k 13
delta_h 0 kJ
# Id: 8111430
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + Cyanide- + H+ = Hfo_wCyanide + H2O
log_k 13
delta_h 0 kJ
# Id: 8121430
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_sOH + Cyanide- = Hfo_sOHCyanide-
log_k 5.7
delta_h 0 kJ
# Id: 8111431
# log K source:
# Delta H source:
#T and ionic strength:
Hfo_wOH + Cyanide- = Hfo_wOHCyanide-
log_k 5.7
delta_h 0 kJ
# Id: 8121431
# log K source:
# Delta H source:
#T and ionic strength:
#Additions from GWB Minteq
Hfo_wOH + H4SiO4 = Hfo_wOSi(OH)3 + H2O
log_k 4.28
delta_h 0 kJ
Hfo_wOH + H4SiO4 = Hfo_wOSiO(OH)2- + H+ + H2O
log_k -3.22
delta_h 0 kJ
Hfo_sOH + H4SiO4 = Hfo_sOSi(OH)3 + H2O
log_k 4.28
delta_h 0
Hfo_sOH + H4SiO4 = Hfo_sOSiO(OH)2- + H+ + H2O
log_k -3.22
delta_h 0
Hfo_wOH + CO3-2 + H+ = Hfo_wCO3- + H2O
log_k 12.56
delta_h 0
Hfo_wOH + CO3-2 + 2H+= Hfo_wHCO3 + H2O
log_k 20.62
delta_h 0
Hfo_sOH + CO3-2 + H+ = Hfo_sCO3- + H2O
```

```
log_k 12.56
delta_h 0
Hfo_sOH + CO3-2 + 2H+= Hfo_sHCO3 + H2O
log_k 20.62
delta_h 0

#Karamalidis and Dzombak sorption to gibbsite (hao) as compiled in Cravotta 2021 (https://doi.org/10.1016/j.apgeochem.2020.104845) Table S4 unless otherwise noted
Hao_OH + Cu+2 = Hao_OCu+ + H+
log_k 0.25
Hao_OH + Pb+2 = Hao_OPb+ + H+
log_k 0.37
Hao_OH + Co+2 = Hao_OCo+ + H+
log_k -2.52
Hao_OH + Cd+2 = Hao_OCd+ + H+
log_k -2.73
Hao_OH + Mn+2 = Hao_OMn+ + H+
log_k -5.49
Hao_OH + Fe+2 = Hao_OFe+ + H+
log_k -3.77
Hao_OH + Ca+2 = Hao_OCa+ + H+
log_k -10.49
Hao_OH + Mg+2 = Hao_OMg+ + H+
log_k -5.93
Hao_OH + Ba+2 = Hao_OBa+ + H+
log_k -8.5
Hao_OH + Sr+2 = Hao_OSr+ + H+
log_k -8.26
Hao_OH + Zn+2 = Hao_OZn+ + H+
log_k -0.96
Hao_OH + PO4-3 + 3 H+ = Hao_H2PO4 + H2O
log_k 26.89
Hao_OH + PO4-3 + 2H+ = Hao_HPO4- + H2O
log_k 19.37
Hao_OH + PO4-3 + H+ = Hao_PO4-2 + H2O
log_k 13.57
#Hao_OH + SO4-2 + H+ = Hao_SO4- + H2O
# log_k -0.45
#Hao_OH + SO4-2 = Hao_OHSO4-2
# log_k 1.19
Hao_OH + F- + H+ = Hao_F + H2O
log_k 8.78
Hao_OH + F- = Hao_OHF-
log_k 2.88
Hao_OH + 2 F- + H+ = Hao_F2- + H2O
log_k 11.94
Hao_OH + H4SiO4 = Hao_OH4SiO4- + H+
log_k -4.16

#Modified value from Goldberg and Glaubig (1985)
Hao_OH + H3BO3 = Hao_H2BO3 + H2O
Log_k 4.83
Hao_OH + H3BO3 = Hao_H3BO4- + H+
Log_k -7.40

#Modified value from Kitadai et al. (2018)
```

```
Hao_OH + SO4-2 + H+ = Hao_SO4- + H2O
log_k 2.4
#Modified value from Kitadai et al. (2018)
Hao_OH + SO4-2 = Hao_OHSO4-2
log_k 7.5

END
```

ATTACHMENT C
Details of Geochemical Model Parameterization

Attachment C. Details of Geochemical Model Parameterization

Introduction

This appendix to the Groundwater Polishing Report for the Coffeen Power Plant (CPP) Ash Pond No. 2 (AP2) Unit provides detailed information regarding geochemical model parameterization. The information provided includes sources of thermodynamic data, sources of data used in model parameterization, summarized values, and calculation methods. All solid-phase data is fully documented in the Nature and Extent Report.[1] All aqueous data have been posted to the facility's operating record in accordance with Title 35 of the Illinois Administrative Code § 845.800(d)(15).

Solid Phase Inputs

The solid phase inputs to the model included iron (hydr)oxides and aluminum (hydr)oxides. These phases tend to have relatively rapid precipitation kinetics and form an outer layer on the surfaces of aquifer solids, creating surface area for sorption and attenuation of boron. Input concentrations for iron and aluminum (hydr)oxides are ideally derived using sequential extraction procedure (SEP) data. SEP methods employ chemical extractants to dissolve metals from specific solid-associated phases. SEP methods use progressively stronger reagents to solubilize metals from increasingly recalcitrant phases. Although these procedures do not identify the discrete solid phases in a soil/aquifer matrix, they provide a means to evaluate and characterize the metal binding mechanisms and relative stability of metals in each phase, and to estimate the available mass of the respective attenuating phase(s) (i.e., aluminum and iron [hydr]oxide). However, SEP analyses were not completed on Coffeen AP2 samples. The dataset constraints necessitated alternative means of deriving oxide inputs.

Because SEP analyses were not completed on any CPP AP2 samples, model input concentrations for ferrihydrite and gibbsite were derived using site-specific total metals and the proportion of total metals as crystalline metal oxides or amorphous metal oxides compiled from SEP datasets consisting of samples collected from similar geologic systems at various power generating facilities across Illinois. Much of the Coffeen AP2 uppermost aquifer (UA) consists of the Hagarstown Member, so the analogous dataset for the UA is comprised of samples collected from various power generating facilities across Illinois specifically within the Hagarstown Member. The geologic similarity (regional geology, similar lithologies and depositional environments, similar mineral assemblages) between the samples comprising this dataset and the CPP AP2 subsurface make this dataset appropriate for estimating the amount and distribution of sorbing solid phases in the absence of a

[1] The Nature and Extent Report was previously submitted to IEPA on June 12, 2024, and provided with relevant updates as Appendix D of the CAAA to which this report is attached.

complete site-specific dataset. SEP data for iron and aluminum is available for 3 Hagarstown Member solid phase samples collected from a different power generating unit.

Total solid-phase iron was measured in three AP2 UA solids samples at concentrations ranging from 14,000 milligrams per kilogram (mg/kg) to 22,000 mg/kg. Six AP2 UA solid samples were analyzed for mineralogy via X-ray diffraction analysis. X-ray diffraction analysis identified multiple minerals containing iron in their crystal structures, only one of which is an iron oxide mineral (magnetite). The crystalline iron component for the UA was determined by applying a proportion of 0.0006 (representative of 0.06 weight % - the average magnetite component of AP2 UA samples) to the median total iron value from UA samples.

The amorphous ferrihydrite component for the UA was based on the 25th percentile of amorphous ferrihydrite distribution in the analogous compiled SEP dataset.

The gibbsite component of the models was determined using the average mass of aluminum associated with the oxide fraction from the compiled SEP dataset described above.

In thermodynamic modeling, the amount of sorbing phase present is typically the dominant control on the concentration of constituents sorbed under a given pH. Therefore, different amounts of metal oxides were used to test the sensitivity of the model to the amount of sorbing phase present. The amount of metal oxides used were derived from the 25th percentile, median (*i.e.*, 50th percentile), and 75th percentile of the SEP results for the relevant iron and aluminum phases.

Sorption of inorganic constituents to iron (hydr)oxides in the MINTEQ v4 database[2] is represented by the hydrous ferric oxide (HFO) thermodynamic dataset presented in Dzombak and Morel (1990). Sorption of inorganic constituents to aluminum (hydr)oxides is represented by the hydrous aluminum oxide (HAO) thermodynamic data presented in Karamalidis and Dzombak (2010), Goldberg and Glaubig (1985) (boron), and Kitadai et al. (2018) (sulfate). These sorption data are based on gibbsite, a nearly ubiquitous crystalline aluminum hydroxide mineral (Karamalidis and Dzombak 2010).

The quantities of HFO and HAO in the model are represented by ferrihydrite ($Fe(OH)_3$) and gibbsite ($Al(OH)_3$), respectively. Ferrihydrite is the most similar naturally occurring iron oxide to HFO (Dzombak and Morel, 1990), and sorption data for HAO was determined using gibbsite (Karamalidis and Dzombak 2010). Metal concentrations are presented in milligrams per kilogram of dry weight (mg/kg dw), whereas ferrihydrite and gibbsite inputs to the model represent moles of solid phase associated with one liter (L) of aqueous phase. The concentrations of iron and aluminum were converted to moles of ferrihydrite and gibbsite (respectively) according to the following:

The mass in kilograms (kg) of solid in the model (i.e., per 1 L of water) was calculated by:

$$Solid\ Mass\ In\ Model\ (kg) = \frac{(1-\phi)}{\phi} \times \frac{1000\ cm^3\ water}{L\ water} \times 1\ L\ water\ \times \rho\ \times \frac{1\ kg\ solid}{1000\ g\ solid}$$

Where:

[2] The default MINTEQ v4 database for PHREEQC does not include sorption data for carbonate and silicate to HFO. Thermodynamic constants for sorption of carbonate and silicate to HFO were added from the MINTEQ database associated with the Geochemist's Workbench software program.

ϕ = porosity (water volume in cubic centimeters [cm^3] / total volume in cm^3)

ρ = density of the solid (grams [g]/cm^3)

Porosity and density represent the median of measurements each hydrostratigraphic unit as reported in the Hydrogeologic Characterization Report[3].

Moles of ferrihydrite and gibbsite were determined using metal concentrations as described above, the molar mass of iron or aluminum, and the mass of solid phase in the model:

$$Moles\ of\ Metal\ Oxide = \frac{mg\ Fe\ or\ Al}{kg\ solid} \times \frac{g}{1000\ mg} \times \frac{moles\ Fe\ or\ Al}{g\ Fe\ or\ Al} \times kg\ Solid\ Mass\ in\ Model$$

The moles of ferrihydrite and gibbsite are represented by moles of Fe or Al (respectively) in a 1:1 ratio mased on the mineral formula. Ferrihydrite and gibbsite were allowed to precipitate or dissolve in the reaction phase of the model to evaluate the impact of source control on sorbing phase availability.

Calcite and dolomite were included as mineral phases in the model because carbonate mineral formation and dissolution are often major controls on groundwater pH. Calcite is a common carbonate mineral and was detected at levels of greater than 1% by weight in X-ray diffraction analysis and are therefore considered to be present in excess within the aquifer. Dolomite was not detected in AP2 UA XRD samples and was therefore not added to the initial model input. Therefore, the mass fractions reported in the X-ray diffraction are used as model inputs for the UA. Both calcite and dolomite were allowed to precipitate in the reaction phase of the model.

Barite and gypsum are common sulfate minerals that have the potential to form under ambient environmental conditions. Neither mineral was detected in X-ray diffraction results at well locations containing exceedances of GWPSs. Therefore, barite and gypsum did not have initial concentrations in the model but were allowed to precipitate or dissolve in the reaction phase of the model.

Aqueous Inputs

In addition to the constituent of concern boron, the following parameters are included in the model and are anticipated to capture the expected attenuation and mobilization mechanisms for reasons detailed below:

- Temperature, pH and pe: pH and pe (a measure of redox potential) are major controls on chemical attenuation and mobility.
- Chloride, potassium, and sodium: Major ions in groundwater typically required for the model to reach charge balance.
- Carbonate ion, calcium, and magnesium: Major ions in groundwater that may also form common minerals, including carbonates. Carbonate mineral formation and dissolution is often a major

[3] The Hydrogeologic Characterization Report was previously submitted to IEPA as part of the Closure Permit Application and is provided as Appendix B.2 to the Construction Permit Application.

control on groundwater pH. Bicarbonate and carbonate ions, a major component of groundwater alkalinity, may also compete with sulfate/boron for sorbing sites.

- Silicon and phosphate: Silicate and phosphate are oxyanions that compete with sulfate/boron for sorbing sites.
- Aluminum, iron, and manganese: As discussed above, iron and aluminum form reactive metal (hydr)oxide minerals which have high capacities for sorbing other ions on their surfaces. Although sorption to manganese oxides was not considered in this model, manganese behaves similarly to iron and is included for completeness.
- Remaining constituents regulated under 35 IAC § 845.600[4]: Although these parameters are not subject to corrective action at CPP AP2, they are included in the model for completeness.

Values for pe and carbonate ion concentrations were derived from values previously reported in the analytical data according to the following methods.

pe is a non-dimension scale of redox potential and is calculated from oxidation reduction potential (ORP). First, the field-measured ORP was converted to Eh (i.e., the redox potential normalized to the standard hydrogen electrode). The following equation provided in the Horiba water quality meter instruction manual[5] was used:

$$Eh = ORP + 206 - 0.7*(T - 25)$$

Where both Eh and ORP are in volts (V) and T is temperature in degrees Celsius. Eh is then converted to pe:

$$pe = (Eh * F) / (2.303 * R * T)$$

Where:

F = Faraday constant (96,500 Joules (J) / V-equivalent)

R = Molar gas constant (8.31 J / Kelvin (K)-mole)

T = temperature in Kelvin

Data reported for groundwater at the site include carbonate and bicarbonate alkalinity in units of mg of calcium carbonate per liter (mg $CaCO_3$/L). For use in modeling, it is convenient to convert these values to a single carbonate (CO_3^{2-}) ion concentration. Because carbonate and bicarbonate alkalinity are reported in the same units (i.e., standardized to mg $CaCO_3$) and represent different protonation states of the same inorganic carbon oxyanion, they were summed to represent total alkalinity due to carbonate. This summed alkalinity was converted to concentration of carbonate ion according to the following equation:

[4] Mercury, thallium, total dissolved solids, and radium were not included in the model. Mercury reactions within the environment are highly complex and would require a separate modeling effort. Thallium forms a non-reactive monovalent cation and is rarely detected in the groundwater and is therefore not expected to contribute to model outcomes. Total dissolved solids are not a chemical parameter, but rather the result of other chemical abundances taken together. Radium is not included in most thermodynamic databases.

[5] https://static.horiba.com/fileadmin/Horiba/Products/Process_and_Environmental/Water_Pollution/Instruction_Manuals/U-50/U-50_Manual.pdf

$$\frac{mg\ CO_3^{2-}}{L} = \frac{mg\ CaCO_3}{L} \times \frac{mole\ CaCO_3}{100.1\ mg\ CaCO_3} \times \frac{1\ mole\ CO_3^{2-}}{1\ mole\ CaCO_3} \times \frac{60\ mg\ CO_3^{2-}}{mole\ CO_3^{2-}}$$

The full suite of geochemical parameters for this model was measured in Quarter 2 and Quarter 3, 2023. The medians of these results were used in the model to represent average groundwater interacting with the solid phase. For downgradient wells the median for each parameter was calculated for each location individually. For background wells, a single median for each parameter was calculated using data from all three background locations measured in Quarter 2 and Quarter 3, 2023.

The model was run without charge balancing and with charge balancing on chloride. The results during the reaction modeling did not substantially differ with and without charge balancing on chloride. The results presented in the Groundwater Polishing Report therefore represent the model results using charge balancing on chloride.

References

Appelo C.A.J. and Postma D. 2005. Geochemistry, Groundwater, and Pollution. 2nd Edition. A.A. Balkema Publishers, member of Taylor & Francis Group. The Netherlands.

Dzombak D.A. and Morel F.M.M. 1990. Surface Complexation Modeling: Hydrous Ferric Oxide. John Wiley & Sons, New York.

Goldberg S. and Glaubig R.A. 1985. Boron Adsorption on Aluminum and Iron Oxide Minerals. *Soil Science Society of America Journal* **49**(6):1374-1379.

Karamalidis A.K. and Dzombak D.A. 2010. Surface Complexation Modeling: Gibbsite. John Wiley & Sons, New York.

Kitadai N., Nishiuchi K, and Tanaka M. 2018. A comprehensive predictive model for sulfate adsorption on oxide minerals. *Geochimica et Cosmochimica Acta* **238**:150-168.

ATTACHMENT D
Complete Geochemical Modeling Outputs

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	pH	pe	charge	pct_err	S(6)	B	Li	As	C(4)	Cl
G401	C - UA	Initial Soln	TRUE	25p	6.09	3.18	-1.86e-16	-3.06e-13	0.0209	0.000378	3.16e-06	1.06e-08	0.00118	0.00230
G402	C - UA	Initial Soln	TRUE	25p	6.96	5.33	6.32e-17	1.65e-13	0.00615	0.000491	3.10e-06	5.01e-08	0.00504	0.00670
G404	C - UA	Initial Soln	TRUE	25p	6.76	4.90	3.95e-12	1.05e-08	0.00718	0.00110	1.13e-06	9.66e-09	0.00370	0.00605
G405	C - UA	Initial Soln	TRUE	25p	6.96	4.03	2.68e-18	6.48e-15	0.00999	0.000940	6.13e-07	1.14e-08	0.00283	0.00413
G406	C - UA	Initial Soln	TRUE	25p	6.63	5.75	2.11e-16	7.58e-13	0.00501	0.000136	1.58e-06	3.64e-09	0.00354	0.00431
G401	C - UA	Speciation Model	TRUE	25p	6.09	3.18	-1.72e-16	-2.83e-13	0.0209	0.000378	3.16e-06	1.06e-08	0.00118	0.00230
G402	C - UA	Speciation Model	TRUE	25p	6.96	5.33	7.53e-17	1.97e-13	0.00615	0.000491	3.10e-06	5.01e-08	0.00504	0.00670
G404	C - UA	Speciation Model	TRUE	25p	6.76	4.90	3.95e-12	1.05e-08	0.00718	0.00110	1.13e-06	9.66e-09	0.00370	0.00605
G405	C - UA	Speciation Model	TRUE	25p	6.96	4.03	-2.53e-18	-6.12e-15	0.00999	0.000940	6.13e-07	1.14e-08	0.00283	0.00413
G406	C - UA	Speciation Model	TRUE	25p	6.63	5.75	2.23e-16	8.01e-13	0.00501	0.000136	1.58e-06	3.64e-09	0.00354	0.00431
G401	C - UA	First Reaction	TRUE	25p	7.34	-4.93e-01	-1.62e-04	-6.76e-01	0.00120	0.000183	3.89e-07	7.23e-09	0.00463	0.00608
G401	C - UA	Second Reaction	TRUE	25p	7.39	-4.62e-01	-4.21e-06	-1.86e-02	0.000920	0.000130	3.89e-07	5.58e-09	0.00429	0.00608
G402	C - UA	First Reaction	TRUE	25p	7.35	3.59	-9.48e-05	-4.08e-01	0.000947	0.000224	3.89e-07	2.61e-08	0.00462	0.00608
G402	C - UA	Second Reaction	TRUE	25p	7.39	3.36	-1.66e-07	-7.33e-04	0.000900	0.000173	3.89e-07	2.48e-08	0.00427	0.00608
G404	C - UA	First Reaction	TRUE	25p	7.33	2.55	-8.16e-05	-3.49e-01	0.000927	0.000340	3.89e-07	6.79e-09	0.00475	0.00608
G404	C - UA	Second Reaction	TRUE	25p	7.38	2.57	6.31e-07	0.00278	0.000884	0.000232	3.89e-07	6.65e-09	0.00435	0.00608
G405	C - UA	First Reaction	TRUE	25p	7.36	1.72	-1.22e-04	-5.27e-01	0.000958	0.000303	3.89e-07	1.09e-08	0.00452	0.00608
G405	C - UA	Second Reaction	TRUE	25p	7.39	1.79	2.42e-07	0.00107	0.000890	0.000213	3.89e-07	1.12e-08	0.00427	0.00608
G406	C - UA	First Reaction	TRUE	25p	7.33	3.56	-1.02e-04	-4.35e-01	0.000952	0.000157	3.89e-07	2.68e-09	0.00482	0.00608
G406	C - UA	Second Reaction	TRUE	25p	7.38	3.34	-2.70e-06	-1.19e-02	0.000910	0.000135	3.89e-07	2.47e-09	0.00433	0.00608
G401	C - UA	Initial Soln	TRUE	75p	6.09	3.18	-1.86e-16	-3.06e-13	0.0209	0.000378	3.16e-06	1.06e-08	0.00118	0.00230
G402	C - UA	Initial Soln	TRUE	75p	6.96	5.33	6.32e-17	1.65e-13	0.00615	0.000491	3.10e-06	5.01e-08	0.00504	0.00670
G404	C - UA	Initial Soln	TRUE	75p	6.76	4.90	3.95e-12	1.05e-08	0.00718	0.00110	1.13e-06	9.66e-09	0.00370	0.00605
G405	C - UA	Initial Soln	TRUE	75p	6.96	4.03	2.68e-18	6.48e-15	0.00999	0.000940	6.13e-07	1.14e-08	0.00283	0.00413
G406	C - UA	Initial Soln	TRUE	75p	6.63	5.75	2.11e-16	7.58e-13	0.00501	0.000136	1.58e-06	3.64e-09	0.00354	0.00431
G401	C - UA	Speciation Model	TRUE	75p	6.09	3.18	-1.72e-16	-2.83e-13	0.0209	0.000378	3.16e-06	1.06e-08	0.00118	0.00230
G402	C - UA	Speciation Model	TRUE	75p	6.96	5.33	7.53e-17	1.97e-13	0.00615	0.000491	3.10e-06	5.01e-08	0.00504	0.00670
G404	C - UA	Speciation Model	TRUE	75p	6.76	4.90	3.95e-12	1.05e-08	0.00718	0.00110	1.13e-06	9.66e-09	0.00370	0.00605
G405	C - UA	Speciation Model	TRUE	75p	6.96	4.03	-2.53e-18	-6.12e-15	0.00999	0.000940	6.13e-07	1.14e-08	0.00283	0.00413
G406	C - UA	Speciation Model	TRUE	75p	6.63	5.75	2.23e-16	8.01e-13	0.00501	0.000136	1.58e-06	3.64e-09	0.00354	0.00431
G401	C - UA	First Reaction	TRUE	75p	7.32	-4.69e-01	-1.59e-04	-6.49e-01	0.00132	0.000197	3.89e-07	7.71e-09	0.00477	0.00608
G401	C - UA	Second Reaction	TRUE	75p	7.38	-4.72e-01	-1.00e-05	-4.39e-02	0.000922	0.000139	3.89e-07	5.64e-09	0.00438	0.00608
G402	C - UA	First Reaction	TRUE	75p	7.33	3.67	-1.07e-04	-4.54e-01	0.000960	0.000234	3.89e-07	2.70e-08	0.00477	0.00608
G402	C - UA	Second Reaction	TRUE	75p	7.38	3.42	-1.50e-06	-6.59e-03	0.000897	0.000186	3.89e-07	2.39e-08	0.00435	0.00608
G404	C - UA	First Reaction	TRUE	75p	7.31	2.57	-8.49e-05	-3.58e-01	0.000943	0.000366	3.89e-07	6.94e-09	0.00493	0.00608
G404	C - UA	Second Reaction	TRUE	75p	7.37	2.57	-6.00e-07	-2.63e-03	0.000879	0.000255	3.89e-07	6.20e-09	0.00444	0.00608
G405	C - UA	First Reaction	TRUE	75p	7.35	1.72	-1.36e-04	-5.84e-01	0.000981	0.000324	3.89e-07	1.08e-08	0.00462	0.00608
G405	C - UA	Second Reaction	TRUE	75p	7.38	1.77	-1.07e-06	-4.71e-03	0.000886	0.000233	3.89e-07	1.05e-08	0.00433	0.00608
G406	C - UA	First Reaction	TRUE	75p	7.30	3.64	-1.09e-04	-4.56e-01	0.000968	0.000160	3.89e-07	2.81e-09	0.00503	0.00608
G406	C - UA	Second Reaction	TRUE	75p	7.37	3.40	-5.18e-06	-2.26e-02	0.000909	0.000142	3.89e-07	2.34e-09	0.00444	0.00608
G401	C - UA	Initial Soln	TRUE	median	6.09	3.18	-1.86e-16	-3.06e-13	0.0209	0.000378	3.16e-06	1.06e-08	0.00118	0.00230
G402	C - UA	Initial Soln	TRUE	median	6.96	5.33	6.32e-17	1.65e-13	0.00615	0.000491	3.10e-06	5.01e-08	0.00504	0.00670
G404	C - UA	Initial Soln	TRUE	median	6.76	4.90	3.95e-12	1.05e-08	0.00718	0.00110	1.13e-06	9.66e-09	0.00370	0.00605
G405	C - UA	Initial Soln	TRUE	median	6.96	4.03	2.68e-18	6.48e-15	0.00999	0.000940	6.13e-07	1.14e-08	0.00283	0.00413
G406	C - UA	Initial Soln	TRUE	median	6.63	5.75	2.11e-16	7.58e-13	0.00501	0.000136	1.58e-06	3.64e-09	0.00354	0.00431
G401	C - UA	Speciation Model	TRUE	median	6.09	3.18	-1.72e-16	-2.83e-13	0.0209	0.000378	3.16e-06	1.06e-08	0.00118	0.00230
G402	C - UA	Speciation Model	TRUE	median	6.96	5.33	7.53e-17	1.97e-13	0.00615	0.000491	3.10e-06	5.01e-08	0.00504	0.00670
G404	C - UA	Speciation Model	TRUE	median	6.76	4.90	3.95e-12	1.05e-08	0.00718	0.00110	1.13e-06	9.66e-09	0.00370	0.00605
G405	C - UA	Speciation Model	TRUE	median	6.96	4.03	-2.53e-18	-6.12e-15	0.00999	0.000940	6.13e-07	1.14e-08	0.00283	0.00413
G406	C - UA	Speciation Model	TRUE	median	6.63	5.75	2.23e-16	8.01e-13	0.00501	0.000136	1.58e-06	3.64e-09	0.00354	0.00431
G401	C - UA	First Reaction	TRUE	median	7.32	-4.66e-01	-1.43e-04	-5.87e-01	0.00129	0.000191	3.89e-07	7.49e-09	0.00474	0.00608
G401	C - UA	Second Reaction	TRUE	median	7.38	-4.61e-01	-8.05e-06	-3.53e-02	0.000922	0.000135	3.89e-07	5.53e-09	0.00436	0.00608
G402	C - UA	First Reaction	TRUE	median	7.33	3.64	-9.69e-05	-4.14e-01	0.000955	0.000229	3.89e-07	2.68e-08	0.00474	0.00608
G402	C - UA	Second Reaction	TRUE	median	7.38	3.40	-8.80e-07	-3.87e-03	0.000898	0.000181	3.89e-07	2.40e-08	0.00433	0.00608
G404	C - UA	First Reaction	TRUE	median	7.32	2.58	-7.64e-05	-3.23e-01	0.000939	0.000354	3.89e-07	6.89e-09	0.00490	0.00608
G404	C - UA	Second Reaction	TRUE	median	7.37	2.58	-7.61e-08	-3.34e-04	0.000881	0.000245	3.89e-07	6.25e-09	0.00442	0.00608
G405	C - UA	First Reaction	TRUE	median	7.35	1.73	-1.24e-04	-5.32e-01	0.000974	0.000315	3.89e-07	1.08e-08	0.00460	0.00608
G405	C - UA	Second Reaction	TRUE	median	7.38	1.78	-4.58e-07	-2.02e-03	0.000888	0.000224	3.89e-07	1.06e-08	0.00432	0.00608
G406	C - UA	First Reaction	TRUE	median	7.31	3.62	-9.90e-05	-4.15e-01	0.000963	0.000158	3.89e-07	2.78e-09	0.00499	0.00608
G406	C - UA	Second Reaction	TRUE	median	7.37	3.38	-4.20e-06	-1.83e-02	0.000909	0.000139	3.89e-07	2.35e-09	0.00441	0.00608
G401	C - UA	Initial Soln	FALSE	25p	6.09	3.18	0.00221	3.78	0.0209	0.000378	3.16e-06	1.06e-08	0.00118	9.34e-05
G402	C - UA	Initial Soln	FALSE	25p	6.96	5.33	0.00661	21.1	0.00615	0.000491	3.10e-06	5.01e-08	0.00504	9.04e-05
G404	C - UA	Initial Soln	FALSE	25p	6.76	4.90	0.00304	8.79	0.00718	0.00110	1.13e-06	9.66e-09	0.00370	0.00301
G405	C - UA	Initial Soln	FALSE	25p	6.96	4.03	0.00380	10.2	0.00999	0.000940	6.13e-07	1.14e-08	0.00283	0.000323
G406	C - UA	Initial Soln	FALSE	25p	6.63	5.75	0.00422	18.0	0.00501	0.000136	1.58e-06	3.64e-09	0.00354	9.04e-05
G401	C - UA	Speciation Model	FALSE	25p	6.09	3.18	0.00221	3.78	0.0209	0.000378	3.16e-06	1.06e-08	0.00118	9.34e-05
G402	C - UA	Speciation Model	FALSE	25p	6.96	5.33	0.00661	21.1	0.00615	0.000491	3.10e-06	5.01e-08	0.00504	9.04e-05
G404	C - UA	Speciation Model	FALSE	25p	6.76	4.90	0.00304	8.79	0.00718	0.00110	1.13e-06	9.66e-09	0.00370	0.00301
G405	C - UA	Speciation Model	FALSE	25p	6.96	4.03	0.00380	10.2	0.00999	0.000940	6.13e-07	1.14e-08	0.00283	0.000323
G406	C - UA	Speciation Model	FALSE	25p	6.63	5.75	0.00422	18.0	0.00501	0.000136	1.58e-06	3.64e-09	0.00354	9.04e-05
G401	C - UA	First Reaction	FALSE	25p	7.34	-4.97e-01	-1.59e-04	-6.62e-01	0.00120	0.000183	3.89e-07	7.31e-09	0.00463	0.00608
G401	C - UA	Second Reaction	FALSE	25p	7.39	-4.66e-01	-4.14e-06	-1.82e-02	0.000920	0.000129	3.89e-07	5.64e-09	0.00429	0.00608

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	pH	pe	charge	pct_err	S(6)	B	Li	As	C(4)	Cl
G402	C - UA	First Reaction	FALSE	25p	7.35	3.58	-8.19e-05	-3.53e-01	0.000943	0.000222	3.89e-07	2.73e-08	0.00461	0.00608
G402	C - UA	Second Reaction	FALSE	25p	7.39	3.36	4.77e-08	0.000211	0.000900	0.000173	3.89e-07	2.59e-08	0.00427	0.00608
G404	C - UA	First Reaction	FALSE	25p	7.33	2.54	-7.68e-05	-3.29e-01	0.000925	0.000341	3.89e-07	6.93e-09	0.00475	0.00608
G404	C - UA	Second Reaction	FALSE	25p	7.38	2.57	7.30e-07	0.00322	0.000884	0.000232	3.89e-07	6.79e-09	0.00435	0.00608
G405	C - UA	First Reaction	FALSE	25p	7.36	1.71	-1.15e-04	-4.99e-01	0.000955	0.000303	3.89e-07	1.11e-08	0.00451	0.00608
G405	C - UA	Second Reaction	FALSE	25p	7.39	1.78	3.60e-07	0.00159	0.000890	0.000213	3.89e-07	1.15e-08	0.00427	0.00608
G406	C - UA	First Reaction	FALSE	25p	7.33	3.55	-9.05e-05	-3.85e-01	0.000948	0.000156	3.89e-07	2.76e-09	0.00481	0.00608
G406	C - UA	Second Reaction	FALSE	25p	7.38	3.33	-2.52e-06	-1.11e-02	0.000910	0.000134	3.89e-07	2.55e-09	0.00433	0.00608
G401	C - UA	Initial Soln	FALSE	75p	6.09	3.18	0.00221	3.78	0.0209	0.000378	3.16e-06	1.06e-08	0.00118	9.34e-05
G402	C - UA	Initial Soln	FALSE	75p	6.96	5.33	0.00661	21.1	0.00615	0.000491	3.10e-06	5.01e-08	0.00504	9.04e-05
G404	C - UA	Initial Soln	FALSE	75p	6.76	4.90	0.00304	8.79	0.00718	0.00110	1.13e-06	9.66e-09	0.00370	0.00301
G405	C - UA	Initial Soln	FALSE	75p	6.96	4.03	0.00380	10.2	0.00999	0.000940	6.13e-07	1.14e-08	0.00283	0.000323
G406	C - UA	Initial Soln	FALSE	75p	6.63	5.75	0.00422	18.0	0.00501	0.000136	1.58e-06	3.64e-09	0.00354	9.04e-05
G401	C - UA	Speciation Model	FALSE	75p	6.09	3.18	0.00221	3.78	0.0209	0.000378	3.16e-06	1.06e-08	0.00118	9.34e-05
G402	C - UA	Speciation Model	FALSE	75p	6.96	5.33	0.00661	21.1	0.00615	0.000491	3.10e-06	5.01e-08	0.00504	9.04e-05
G404	C - UA	Speciation Model	FALSE	75p	6.76	4.90	0.00304	8.79	0.00718	0.00110	1.13e-06	9.66e-09	0.00370	0.00301
G405	C - UA	Speciation Model	FALSE	75p	6.96	4.03	0.00380	10.2	0.00999	0.000940	6.13e-07	1.14e-08	0.00283	0.000323
G406	C - UA	Speciation Model	FALSE	75p	6.63	5.75	0.00422	18.0	0.00501	0.000136	1.58e-06	3.64e-09	0.00354	9.04e-05
G401	C - UA	First Reaction	FALSE	75p	7.32	-4.74e-01	-1.55e-04	-6.34e-01	0.00132	0.000197	3.89e-07	7.80e-09	0.00477	0.00608
G401	C - UA	Second Reaction	FALSE	75p	7.38	-4.76e-01	-9.93e-06	-4.34e-02	0.000922	0.000139	3.89e-07	5.70e-09	0.00438	0.00608
G402	C - UA	First Reaction	FALSE	75p	7.33	3.66	-9.15e-05	-3.90e-01	0.000955	0.000232	3.89e-07	2.82e-08	0.00477	0.00608
G402	C - UA	Second Reaction	FALSE	75p	7.38	3.42	-1.20e-06	-5.28e-03	0.000897	0.000186	3.89e-07	2.50e-08	0.00435	0.00608
G404	C - UA	First Reaction	FALSE	75p	7.31	2.56	-7.96e-05	-3.36e-01	0.000941	0.000366	3.89e-07	7.08e-09	0.00493	0.00608
G404	C - UA	Second Reaction	FALSE	75p	7.37	2.56	-4.64e-07	-2.03e-03	0.000878	0.000255	3.89e-07	6.33e-09	0.00444	0.00608
G405	C - UA	First Reaction	FALSE	75p	7.35	1.71	-1.29e-04	-5.52e-01	0.000978	0.000324	3.89e-07	1.11e-08	0.00461	0.00608
G405	C - UA	Second Reaction	FALSE	75p	7.38	1.76	-9.08e-07	-4.00e-03	0.000886	0.000233	3.89e-07	1.08e-08	0.00433	0.00608
G406	C - UA	First Reaction	FALSE	75p	7.30	3.63	-9.54e-05	-3.99e-01	0.000963	0.000159	3.89e-07	2.89e-09	0.00503	0.00608
G406	C - UA	Second Reaction	FALSE	75p	7.37	3.39	-4.92e-06	-2.15e-02	0.000909	0.000141	3.89e-07	2.41e-09	0.00444	0.00608
G401	C - UA	Initial Soln	FALSE	median	6.09	3.18	0.00221	3.78	0.0209	0.000378	3.16e-06	1.06e-08	0.00118	9.34e-05
G402	C - UA	Initial Soln	FALSE	median	6.96	5.33	0.00661	21.1	0.00615	0.000491	3.10e-06	5.01e-08	0.00504	9.04e-05
G404	C - UA	Initial Soln	FALSE	median	6.76	4.90	0.00304	8.79	0.00718	0.00110	1.13e-06	9.66e-09	0.00370	0.00301
G405	C - UA	Initial Soln	FALSE	median	6.96	4.03	0.00380	10.2	0.00999	0.000940	6.13e-07	1.14e-08	0.00283	0.000323
G406	C - UA	Initial Soln	FALSE	median	6.63	5.75	0.00422	18.0	0.00501	0.000136	1.58e-06	3.64e-09	0.00354	9.04e-05
G401	C - UA	Speciation Model	FALSE	median	6.09	3.18	0.00221	3.78	0.0209	0.000378	3.16e-06	1.06e-08	0.00118	9.34e-05
G402	C - UA	Speciation Model	FALSE	median	6.96	5.33	0.00661	21.1	0.00615	0.000491	3.10e-06	5.01e-08	0.00504	9.04e-05
G404	C - UA	Speciation Model	FALSE	median	6.76	4.90	0.00304	8.79	0.00718	0.00110	1.13e-06	9.66e-09	0.00370	0.00301
G405	C - UA	Speciation Model	FALSE	median	6.96	4.03	0.00380	10.2	0.00999	0.000940	6.13e-07	1.14e-08	0.00283	0.000323
G406	C - UA	Speciation Model	FALSE	median	6.63	5.75	0.00422	18.0	0.00501	0.000136	1.58e-06	3.64e-09	0.00354	9.04e-05
G401	C - UA	First Reaction	FALSE	median	7.32	-4.70e-01	-1.40e-04	-5.74e-01	0.00129	0.000191	3.89e-07	7.59e-09	0.00474	0.00608
G401	C - UA	Second Reaction	FALSE	median	7.38	-4.65e-01	-7.96e-06	-3.49e-02	0.000922	0.000135	3.89e-07	5.59e-09	0.00436	0.00608
G402	C - UA	First Reaction	FALSE	median	7.33	3.64	-8.32e-05	-3.55e-01	0.000950	0.000227	3.89e-07	2.80e-08	0.00474	0.00608
G402	C - UA	Second Reaction	FALSE	median	7.38	3.40	-6.23e-07	-2.74e-03	0.000898	0.000180	3.89e-07	2.51e-08	0.00433	0.00608
G404	C - UA	First Reaction	FALSE	median	7.32	2.57	-7.16e-05	-3.03e-01	0.000937	0.000355	3.89e-07	7.02e-09	0.00490	0.00608
G404	C - UA	Second Reaction	FALSE	median	7.37	2.57	4.09e-08	0.000179	0.000881	0.000245	3.89e-07	6.37e-09	0.00442	0.00608
G405	C - UA	First Reaction	FALSE	median	7.35	1.72	-1.17e-04	-5.03e-01	0.000972	0.000315	3.89e-07	1.11e-08	0.00459	0.00608
G405	C - UA	Second Reaction	FALSE	median	7.38	1.77	-3.20e-07	-1.41e-03	0.000888	0.000224	3.89e-07	1.09e-08	0.00432	0.00608
G406	C - UA	First Reaction	FALSE	median	7.31	3.61	-8.65e-05	-3.63e-01	0.000959	0.000157	3.89e-07	2.86e-09	0.00498	0.00608
G406	C - UA	Second Reaction	FALSE	median	7.37	3.38	-3.98e-06	-1.74e-02	0.000910	0.000138	3.89e-07	2.42e-09	0.00441	0.00608

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	F	Ca	Mg	Na	K	Ba	Si	P	Mn	Fe
G401	C - UA	Initial Soln	TRUE	25p	1.06e-05	0.0125	0.00600	0.00311	6.49e-05	7.96e-08	0.000260	3.88e-07	0.000575	0.00160
G402	C - UA	Initial Soln	TRUE	25p	1.39e-05	0.00527	0.00531	0.00196	2.91e-05	2.01e-07	0.000232	8.07e-07	1.57e-05	8.11e-08
G404	C - UA	Initial Soln	TRUE	25p	6.51e-06	0.00557	0.00424	0.00348	1.35e-05	2.22e-07	0.000177	1.04e-07	3.69e-05	1.16e-06
G405	C - UA	Initial Soln	TRUE	25p	1.53e-05	0.00629	0.00453	0.00477	1.25e-05	1.05e-07	0.000132	3.39e-07	1.98e-05	2.65e-06
G406	C - UA	Initial Soln	TRUE	25p	1.41e-05	0.00478	0.00269	0.00164	5.29e-06	9.80e-08	0.000216	2.90e-07	8.06e-05	5.48e-08
G401	C - UA	Speciation Model	TRUE	25p	1.06e-05	0.0125	0.00600	0.00311	6.49e-05	7.96e-08	0.000260	3.88e-07	0.000575	0.00160
G402	C - UA	Speciation Model	TRUE	25p	1.39e-05	0.00527	0.00531	0.00196	2.91e-05	2.01e-07	0.000232	8.07e-07	1.57e-05	8.11e-08
G404	C - UA	Speciation Model	TRUE	25p	6.51e-06	0.00557	0.00424	0.00348	1.35e-05	2.22e-07	0.000177	1.04e-07	3.69e-05	1.16e-06
G405	C - UA	Speciation Model	TRUE	25p	1.53e-05	0.00629	0.00453	0.00477	1.25e-05	1.05e-07	0.000132	3.39e-07	1.98e-05	2.65e-06
G406	C - UA	Speciation Model	TRUE	25p	1.41e-05	0.00478	0.00269	0.00164	5.29e-06	9.80e-08	0.000216	2.90e-07	8.06e-05	5.48e-08
G401	C - UA	First Reaction	TRUE	25p	1.62e-05	0.00224	0.00222	0.00353	1.52e-05	2.34e-07	9.49e-05	1.54e-06	6.04e-06	4.70e-05
G401	C - UA	Second Reaction	TRUE	25p	1.60e-05	0.00207	0.00206	0.00353	1.52e-05	2.94e-07	9.24e-05	1.54e-06	2.72e-06	3.03e-05
G402	C - UA	First Reaction	TRUE	25p	1.60e-05	0.00215	0.00213	0.00353	1.52e-05	2.90e-07	0.000108	8.84e-07	2.56e-06	9.27e-09
G402	C - UA	Second Reaction	TRUE	25p	1.61e-05	0.00208	0.00206	0.00353	1.52e-05	3.00e-07	0.000104	8.92e-07	2.07e-06	9.71e-09
G404	C - UA	First Reaction	TRUE	25p	1.60e-05	0.00217	0.00216	0.00353	1.52e-05	2.97e-07	8.58e-05	1.98e-07	2.59e-06	4.92e-08
G404	C - UA	Second Reaction	TRUE	25p	1.61e-05	0.00208	0.00207	0.00353	1.52e-05	3.06e-07	8.49e-05	2.10e-07	2.00e-06	3.48e-08
G405	C - UA	First Reaction	TRUE	25p	1.60e-05	0.00213	0.00211	0.00353	1.52e-05	2.85e-07	9.66e-05	6.21e-07	2.43e-06	2.50e-07
G405	C - UA	Second Reaction	TRUE	25p	1.60e-05	0.00207	0.00206	0.00353	1.52e-05	3.03e-07	9.79e-05	6.49e-07	2.00e-06	1.75e-07
G406	C - UA	First Reaction	TRUE	25p	1.63e-05	0.00218	0.00217	0.00353	1.52e-05	2.91e-07	8.90e-05	7.07e-07	1.56e-05	1.04e-08
G406	C - UA	Second Reaction	TRUE	25p	1.61e-05	0.00209	0.00208	0.00353	1.52e-05	2.97e-07	8.55e-05	7.19e-07	6.52e-06	1.03e-08
G401	C - UA	Initial Soln	TRUE	75p	1.06e-05	0.0125	0.00600	0.00311	6.49e-05	7.96e-08	0.000260	3.88e-07	0.000575	0.00160
G402	C - UA	Initial Soln	TRUE	75p	1.39e-05	0.00527	0.00531	0.00196	2.91e-05	2.01e-07	0.000232	8.07e-07	1.57e-05	8.11e-08
G404	C - UA	Initial Soln	TRUE	75p	6.51e-06	0.00557	0.00424	0.00348	1.35e-05	2.22e-07	0.000177	1.04e-07	3.69e-05	1.16e-06
G405	C - UA	Initial Soln	TRUE	75p	1.53e-05	0.00629	0.00453	0.00477	1.25e-05	1.05e-07	0.000132	3.39e-07	1.98e-05	2.65e-06
G406	C - UA	Initial Soln	TRUE	75p	1.41e-05	0.00478	0.00269	0.00164	5.29e-06	9.80e-08	0.000216	2.90e-07	8.06e-05	5.48e-08
G401	C - UA	Speciation Model	TRUE	75p	1.06e-05	0.0125	0.00600	0.00311	6.49e-05	7.96e-08	0.000260	3.88e-07	0.000575	0.00160
G402	C - UA	Speciation Model	TRUE	75p	1.39e-05	0.00527	0.00531	0.00196	2.91e-05	2.01e-07	0.000232	8.07e-07	1.57e-05	8.11e-08
G404	C - UA	Speciation Model	TRUE	75p	6.51e-06	0.00557	0.00424	0.00348	1.35e-05	2.22e-07	0.000177	1.04e-07	3.69e-05	1.16e-06
G405	C - UA	Speciation Model	TRUE	75p	1.53e-05	0.00629	0.00453	0.00477	1.25e-05	1.05e-07	0.000132	3.39e-07	1.98e-05	2.65e-06
G406	C - UA	Speciation Model	TRUE	75p	1.41e-05	0.00478	0.00269	0.00164	5.29e-06	9.80e-08	0.000216	2.90e-07	8.06e-05	5.48e-08
G401	C - UA	First Reaction	TRUE	75p	1.63e-05	0.00232	0.00230	0.00353	1.52e-05	2.16e-07	9.67e-05	1.54e-06	6.86e-06	5.23e-05
G401	C - UA	Second Reaction	TRUE	75p	1.60e-05	0.00209	0.00208	0.00353	1.52e-05	2.95e-07	8.90e-05	1.50e-06	2.93e-06	3.35e-05
G402	C - UA	First Reaction	TRUE	75p	1.60e-05	0.00218	0.00217	0.00353	1.52e-05	2.88e-07	0.000111	8.85e-07	2.68e-06	9.30e-09
G402	C - UA	Second Reaction	TRUE	75p	1.61e-05	0.00209	0.00208	0.00353	1.52e-05	3.02e-07	0.000101	8.72e-07	2.10e-06	9.47e-09
G404	C - UA	First Reaction	TRUE	75p	1.60e-05	0.00221	0.00220	0.00353	1.52e-05	2.95e-07	8.72e-05	1.95e-07	2.74e-06	5.40e-08
G404	C - UA	Second Reaction	TRUE	75p	1.60e-05	0.00210	0.00209	0.00353	1.52e-05	3.09e-07	8.04e-05	1.97e-07	2.02e-06	3.75e-08
G405	C - UA	First Reaction	TRUE	75p	1.60e-05	0.00215	0.00214	0.00353	1.52e-05	2.80e-07	9.67e-05	6.12e-07	2.54e-06	2.72e-07
G405	C - UA	Second Reaction	TRUE	75p	1.60e-05	0.00208	0.00207	0.00353	1.52e-05	3.05e-07	9.37e-05	6.24e-07	2.02e-06	1.91e-07
G406	C - UA	First Reaction	TRUE	75p	1.64e-05	0.00223	0.00222	0.00353	1.52e-05	2.89e-07	9.15e-05	7.08e-07	1.77e-05	1.07e-08
G406	C - UA	Second Reaction	TRUE	75p	1.61e-05	0.00211	0.00210	0.00353	1.52e-05	2.99e-07	8.15e-05	6.90e-07	7.68e-06	1.02e-08
G401	C - UA	Initial Soln	TRUE	median	1.06e-05	0.0125	0.00600	0.00311	6.49e-05	7.96e-08	0.000260	3.88e-07	0.000575	0.00160
G402	C - UA	Initial Soln	TRUE	median	1.39e-05	0.00527	0.00531	0.00196	2.91e-05	2.01e-07	0.000232	8.07e-07	1.57e-05	8.11e-08
G404	C - UA	Initial Soln	TRUE	median	6.51e-06	0.00557	0.00424	0.00348	1.35e-05	2.22e-07	0.000177	1.04e-07	3.69e-05	1.16e-06
G405	C - UA	Initial Soln	TRUE	median	1.53e-05	0.00629	0.00453	0.00477	1.25e-05	1.05e-07	0.000132	3.39e-07	1.98e-05	2.65e-06
G406	C - UA	Initial Soln	TRUE	median	1.41e-05	0.00478	0.00269	0.00164	5.29e-06	9.80e-08	0.000216	2.90e-07	8.06e-05	5.48e-08
G401	C - UA	Speciation Model	TRUE	median	1.06e-05	0.0125	0.00600	0.00311	6.49e-05	7.96e-08	0.000260	3.88e-07	0.000575	0.00160
G402	C - UA	Speciation Model	TRUE	median	1.39e-05	0.00527	0.00531	0.00196	2.91e-05	2.01e-07	0.000232	8.07e-07	1.57e-05	8.11e-08
G404	C - UA	Speciation Model	TRUE	median	6.51e-06	0.00557	0.00424	0.00348	1.35e-05	2.22e-07	0.000177	1.04e-07	3.69e-05	1.16e-06
G405	C - UA	Speciation Model	TRUE	median	1.53e-05	0.00629	0.00453	0.00477	1.25e-05	1.05e-07	0.000132	3.39e-07	1.98e-05	2.65e-06
G406	C - UA	Speciation Model	TRUE	median	1.41e-05	0.00478	0.00269	0.00164	5.29e-06	9.80e-08	0.000216	2.90e-07	8.06e-05	5.48e-08
G401	C - UA	First Reaction	TRUE	median	1.63e-05	0.00231	0.00229	0.00353	1.52e-05	2.20e-07	9.62e-05	1.54e-06	6.50e-06	5.04e-05
G401	C - UA	Second Reaction	TRUE	median	1.60e-05	0.00209	0.00208	0.00353	1.52e-05	2.95e-07	8.93e-05	1.51e-06	2.82e-06	3.22e-05
G402	C - UA	First Reaction	TRUE	median	1.60e-05	0.00218	0.00216	0.00353	1.52e-05	2.89e-07	0.000110	8.84e-07	2.63e-06	9.36e-09
G402	C - UA	Second Reaction	TRUE	median	1.61e-05	0.00209	0.00208	0.00353	1.52e-05	3.01e-07	0.000101	8.74e-07	2.09e-06	9.61e-09
G404	C - UA	First Reaction	TRUE	median	1.60e-05	0.00220	0.00219	0.00353	1.52e-05	2.96e-07	8.67e-05	1.95e-07	2.68e-06	5.23e-08
G404	C - UA	Second Reaction	TRUE	median	1.60e-05	0.00210	0.00209	0.00353	1.52e-05	3.08e-07	8.09e-05	1.99e-07	2.01e-06	3.64e-08
G405	C - UA	First Reaction	TRUE	median	1.60e-05	0.00215	0.00214	0.00353	1.52e-05	2.82e-07	9.64e-05	6.13e-07	2.50e-06	2.63e-07
G405	C - UA	Second Reaction	TRUE	median	1.60e-05	0.00208	0.00207	0.00353	1.52e-05	3.04e-07	9.42e-05	6.28e-07	2.01e-06	1.84e-07
G406	C - UA	First Reaction	TRUE	median	1.64e-05	0.00222	0.00221	0.00353	1.52e-05	2.90e-07	9.08e-05	7.06e-07	1.68e-05	1.07e-08
G406	C - UA	Second Reaction	TRUE	median	1.61e-05	0.00211	0.00209	0.00353	1.52e-05	2.99e-07	8.19e-05	6.93e-07	7.14e-06	1.03e-08
G401	C - UA	Initial Soln	FALSE	25p	1.06e-05	0.0125	0.00600	0.00311	6.49e-05	7.96e-08	0.000260	3.88e-07	0.000575	0.00160
G402	C - UA	Initial Soln	FALSE	25p	1.39e-05	0.00527	0.00531	0.00196	2.91e-05	2.01e-07	0.000232	8.07e-07	1.57e-05	8.11e-08
G404	C - UA	Initial Soln	FALSE	25p	6.51e-06	0.00557	0.00424	0.00348	1.35e-05	2.22e-07	0.000177	1.04e-07	3.69e-05	1.16e-06
G405	C - UA	Initial Soln	FALSE	25p	1.53e-05	0.00629	0.00453	0.00477	1.25e-05	1.05e-07	0.000132	3.39e-07	1.98e-05	2.65e-06
G406	C - UA	Initial Soln	FALSE	25p	1.41e-05	0.00478	0.00269	0.00164	5.29e-06	9.80e-08	0.000216	2.90e-07	8.06e-05	5.48e-08
G401	C - UA	Speciation Model	FALSE	25p	1.06e-05	0.0125	0.00600	0.00311	6.49e-05	7.96e-08	0.000260	3.88e-07	0.000575	0.00160
G402	C - UA	Speciation Model	FALSE	25p	1.39e-05	0.00527	0.00531	0.00196	2.91e-05	2.01e-07	0.000232	8.07e-07	1.57e-05	8.11e-08
G404	C - UA	Speciation Model	FALSE	25p	6.51e-06	0.00557	0.00424	0.00348	1.35e-05	2.22e-07	0.000177	1.04e-07	3.69e-05	1.16e-06
G405	C - UA	Speciation Model	FALSE	25p	1.53e-05	0.00629	0.00453	0.00477	1.25e-05	1.05e-07	0.000132	3.39e-07	1.98e-05	2.65e-06
G406	C - UA	Speciation Model	FALSE	25p	1.41e-05	0.00478	0.00269	0.00164	5.29e-06	9.80e-08	0.000216	2.90e-07	8.06e-05	5.48e-08
G401	C - UA	First Reaction	FALSE	25p	1.62e-05	0.00224	0.00222	0.00353	1.52e-05	2.34e-07	9.48e-05	1.54e-06	6.08e-06	4.74e-05
G401	C - UA	Second Reaction	FALSE	25p	1.60e-05	0.00207	0.00206	0.00353	1.52e-05	2.94e-07	9.23e-05	1.54e-06	2.73e-06	3.06e-05

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	F	Ca	Mg	Na	K	Ba	Si	P	Mn	Fe
G402	C - UA	First Reaction	FALSE	25p	1.60e-05	0.00215	0.00213	0.00353	1.52e-05	2.91e-07	0.000108	8.87e-07	2.61e-06	9.29e-09
G402	C - UA	Second Reaction	FALSE	25p	1.61e-05	0.00208	0.00206	0.00353	1.52e-05	3.00e-07	0.000103	8.96e-07	2.09e-06	9.73e-09
G404	C - UA	First Reaction	FALSE	25p	1.60e-05	0.00217	0.00216	0.00353	1.52e-05	2.98e-07	8.57e-05	1.99e-07	2.62e-06	5.00e-08
G404	C - UA	Second Reaction	FALSE	25p	1.61e-05	0.00208	0.00207	0.00353	1.52e-05	3.06e-07	8.48e-05	2.10e-07	2.01e-06	3.53e-08
G405	C - UA	First Reaction	FALSE	25p	1.60e-05	0.00213	0.00211	0.00353	1.52e-05	2.86e-07	9.64e-05	6.23e-07	2.46e-06	2.55e-07
G405	C - UA	Second Reaction	FALSE	25p	1.60e-05	0.00207	0.00206	0.00353	1.52e-05	3.03e-07	9.78e-05	6.52e-07	2.01e-06	1.79e-07
G406	C - UA	First Reaction	FALSE	25p	1.63e-05	0.00218	0.00217	0.00353	1.52e-05	2.92e-07	8.88e-05	7.12e-07	1.60e-05	1.04e-08
G406	C - UA	Second Reaction	FALSE	25p	1.61e-05	0.00209	0.00208	0.00353	1.52e-05	2.97e-07	8.54e-05	7.24e-07	6.69e-06	1.03e-08
G401	C - UA	Initial Soln	FALSE	75p	1.06e-05	0.0125	0.00600	0.00311	6.49e-05	7.96e-08	0.000260	3.88e-07	0.000575	0.00160
G402	C - UA	Initial Soln	FALSE	75p	1.39e-05	0.00527	0.00531	0.00196	2.91e-05	2.01e-07	0.000232	8.07e-07	1.57e-05	8.11e-08
G404	C - UA	Initial Soln	FALSE	75p	6.51e-06	0.00557	0.00424	0.00348	1.35e-05	2.22e-07	0.000177	1.04e-07	3.69e-05	1.16e-06
G405	C - UA	Initial Soln	FALSE	75p	1.53e-05	0.00629	0.00453	0.00477	1.25e-05	1.05e-07	0.000132	3.39e-07	1.98e-05	2.65e-06
G406	C - UA	Initial Soln	FALSE	75p	1.41e-05	0.00478	0.00269	0.00164	5.29e-06	9.80e-08	0.000216	2.90e-07	8.06e-05	5.48e-08
G401	C - UA	Speciation Model	FALSE	75p	1.06e-05	0.0125	0.00600	0.00311	6.49e-05	7.96e-08	0.000260	3.88e-07	0.000575	0.00160
G402	C - UA	Speciation Model	FALSE	75p	1.39e-05	0.00527	0.00531	0.00196	2.91e-05	2.01e-07	0.000232	8.07e-07	1.57e-05	8.11e-08
G404	C - UA	Speciation Model	FALSE	75p	6.51e-06	0.00557	0.00424	0.00348	1.35e-05	2.22e-07	0.000177	1.04e-07	3.69e-05	1.16e-06
G405	C - UA	Speciation Model	FALSE	75p	1.53e-05	0.00629	0.00453	0.00477	1.25e-05	1.05e-07	0.000132	3.39e-07	1.98e-05	2.65e-06
G406	C - UA	Speciation Model	FALSE	75p	1.41e-05	0.00478	0.00269	0.00164	5.29e-06	9.80e-08	0.000216	2.90e-07	8.06e-05	5.48e-08
G401	C - UA	First Reaction	FALSE	75p	1.63e-05	0.00232	0.00230	0.00353	1.52e-05	2.16e-07	9.66e-05	1.54e-06	6.91e-06	5.29e-05
G401	C - UA	Second Reaction	FALSE	75p	1.60e-05	0.00209	0.00208	0.00353	1.52e-05	2.95e-07	8.89e-05	1.50e-06	2.93e-06	3.38e-05
G402	C - UA	First Reaction	FALSE	75p	1.60e-05	0.00218	0.00217	0.00353	1.52e-05	2.90e-07	0.000110	8.88e-07	2.74e-06	9.32e-09
G402	C - UA	Second Reaction	FALSE	75p	1.61e-05	0.00209	0.00208	0.00353	1.52e-05	3.02e-07	0.000101	8.76e-07	2.12e-06	9.49e-09
G404	C - UA	First Reaction	FALSE	75p	1.60e-05	0.00221	0.00220	0.00353	1.52e-05	2.96e-07	8.70e-05	1.96e-07	2.78e-06	5.49e-08
G404	C - UA	Second Reaction	FALSE	75p	1.60e-05	0.00210	0.00209	0.00353	1.52e-05	3.09e-07	8.03e-05	1.98e-07	2.03e-06	3.81e-08
G405	C - UA	First Reaction	FALSE	75p	1.60e-05	0.00215	0.00214	0.00353	1.52e-05	2.81e-07	9.65e-05	6.14e-07	2.57e-06	2.78e-07
G405	C - UA	Second Reaction	FALSE	75p	1.60e-05	0.00208	0.00207	0.00353	1.52e-05	3.05e-07	9.36e-05	6.27e-07	2.03e-06	1.95e-07
G406	C - UA	First Reaction	FALSE	75p	1.64e-05	0.00223	0.00222	0.00353	1.52e-05	2.90e-07	9.13e-05	7.12e-07	1.83e-05	1.07e-08
G406	C - UA	Second Reaction	FALSE	75p	1.61e-05	0.00211	0.00210	0.00353	1.52e-05	2.99e-07	8.14e-05	6.94e-07	7.90e-06	1.02e-08
G401	C - UA	Initial Soln	FALSE	median	1.06e-05	0.0125	0.00600	0.00311	6.49e-05	7.96e-08	0.000260	3.88e-07	0.000575	0.00160
G402	C - UA	Initial Soln	FALSE	median	1.39e-05	0.00527	0.00531	0.00196	2.91e-05	2.01e-07	0.000232	8.07e-07	1.57e-05	8.11e-08
G404	C - UA	Initial Soln	FALSE	median	6.51e-06	0.00557	0.00424	0.00348	1.35e-05	2.22e-07	0.000177	1.04e-07	3.69e-05	1.16e-06
G405	C - UA	Initial Soln	FALSE	median	1.53e-05	0.00629	0.00453	0.00477	1.25e-05	1.05e-07	0.000132	3.39e-07	1.98e-05	2.65e-06
G406	C - UA	Initial Soln	FALSE	median	1.41e-05	0.00478	0.00269	0.00164	5.29e-06	9.80e-08	0.000216	2.90e-07	8.06e-05	5.48e-08
G401	C - UA	Speciation Model	FALSE	median	1.06e-05	0.0125	0.00600	0.00311	6.49e-05	7.96e-08	0.000260	3.88e-07	0.000575	0.00160
G402	C - UA	Speciation Model	FALSE	median	1.39e-05	0.00527	0.00531	0.00196	2.91e-05	2.01e-07	0.000232	8.07e-07	1.57e-05	8.11e-08
G404	C - UA	Speciation Model	FALSE	median	6.51e-06	0.00557	0.00424	0.00348	1.35e-05	2.22e-07	0.000177	1.04e-07	3.69e-05	1.16e-06
G405	C - UA	Speciation Model	FALSE	median	1.53e-05	0.00629	0.00453	0.00477	1.25e-05	1.05e-07	0.000132	3.39e-07	1.98e-05	2.65e-06
G406	C - UA	Speciation Model	FALSE	median	1.41e-05	0.00478	0.00269	0.00164	5.29e-06	9.80e-08	0.000216	2.90e-07	8.06e-05	5.48e-08
G401	C - UA	First Reaction	FALSE	median	1.63e-05	0.00231	0.00229	0.00353	1.52e-05	2.20e-07	9.61e-05	1.54e-06	6.55e-06	5.09e-05
G401	C - UA	Second Reaction	FALSE	median	1.60e-05	0.00209	0.00208	0.00353	1.52e-05	2.95e-07	8.93e-05	1.51e-06	2.83e-06	3.24e-05
G402	C - UA	First Reaction	FALSE	median	1.60e-05	0.00218	0.00216	0.00353	1.52e-05	2.90e-07	0.000110	8.87e-07	2.68e-06	9.38e-09
G402	C - UA	Second Reaction	FALSE	median	1.61e-05	0.00209	0.00208	0.00353	1.52e-05	3.01e-07	0.000101	8.78e-07	2.10e-06	9.63e-09
G404	C - UA	First Reaction	FALSE	median	1.60e-05	0.00220	0.00219	0.00353	1.52e-05	2.96e-07	8.66e-05	1.96e-07	2.71e-06	5.31e-08
G404	C - UA	Second Reaction	FALSE	median	1.60e-05	0.00210	0.00209	0.00353	1.52e-05	3.08e-07	8.08e-05	1.99e-07	2.02e-06	3.70e-08
G405	C - UA	First Reaction	FALSE	median	1.60e-05	0.00215	0.00214	0.00353	1.52e-05	2.82e-07	9.63e-05	6.15e-07	2.53e-06	2.69e-07
G405	C - UA	Second Reaction	FALSE	median	1.60e-05	0.00208	0.00207	0.00353	1.52e-05	3.04e-07	9.40e-05	6.30e-07	2.02e-06	1.88e-07
G406	C - UA	First Reaction	FALSE	median	1.64e-05	0.00222	0.00221	0.00353	1.52e-05	2.91e-07	9.06e-05	7.11e-07	1.74e-05	1.07e-08
G406	C - UA	Second Reaction	FALSE	median	1.61e-05	0.00211	0.00209	0.00353	1.52e-05	2.99e-07	8.18e-05	6.98e-07	7.33e-06	1.03e-08

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	Al	Sb	Be	Cd	Cr	Co	Pb	Mo	Se	Hfo_s
G401	C - UA	Initial Soln	TRUE	25p	1.25e-07	2.12e-09	2.20e-08	2.99e-09	1.69e-08	2.26e-06	9.92e-10	3.50e-09	4.26e-09	0
G402	C - UA	Initial Soln	TRUE	25p	2.83e-07	2.12e-09	2.19e-08	2.09e-09	6.55e-08	5.01e-08	1.09e-08	2.45e-08	4.25e-09	0
G404	C - UA	Initial Soln	TRUE	25p	1.29e-07	5.41e-09	2.19e-08	2.54e-09	3.37e-08	3.01e-08	1.72e-09	7.67e-09	4.25e-09	0
G405	C - UA	Initial Soln	TRUE	25p	1.94e-07	8.31e-09	2.20e-08	2.09e-09	1.69e-08	1.67e-08	2.25e-09	1.04e-08	9.51e-09	0
G406	C - UA	Initial Soln	TRUE	25p	1.92e-07	2.12e-09	2.19e-08	2.09e-09	1.68e-08	1.12e-08	9.90e-10	3.50e-09	4.25e-09	0
G401	C - UA	Speciation Model	TRUE	25p	1.25e-07	2.12e-09	2.20e-08	2.99e-09	1.69e-08	2.26e-06	9.92e-10	3.50e-09	4.26e-09	4.90e-05
G402	C - UA	Speciation Model	TRUE	25p	2.83e-07	2.12e-09	2.19e-08	2.09e-09	6.55e-08	5.01e-08	1.09e-08	2.45e-08	4.25e-09	4.90e-05
G404	C - UA	Speciation Model	TRUE	25p	1.29e-07	5.41e-09	2.19e-08	2.54e-09	3.37e-08	3.01e-08	1.72e-09	7.67e-09	4.25e-09	4.90e-05
G405	C - UA	Speciation Model	TRUE	25p	1.94e-07	8.31e-09	2.20e-08	2.09e-09	1.69e-08	1.67e-08	2.25e-09	1.04e-08	9.51e-09	4.90e-05
G406	C - UA	Speciation Model	TRUE	25p	1.92e-07	2.12e-09	2.19e-08	2.09e-09	1.68e-08	1.12e-08	9.90e-10	3.50e-09	4.25e-09	4.90e-05
G401	C - UA	First Reaction	TRUE	25p	4.94e-08	2.53e-09	2.04e-09	1.34e-10	5.94e-10	8.37e-08	1.37e-10	9.23e-09	3.58e-08	4.90e-05
G401	C - UA	Second Reaction	TRUE	25p	5.31e-08	2.53e-09	1.87e-09	1.02e-10	5.50e-10	5.64e-08	1.01e-10	7.42e-09	4.27e-09	4.90e-05
G402	C - UA	First Reaction	TRUE	25p	5.00e-08	2.53e-09	7.92e-09	5.13e-10	2.60e-08	1.16e-08	4.90e-09	8.87e-09	3.06e-09	4.90e-05
G402	C - UA	Second Reaction	TRUE	25p	5.31e-08	2.53e-09	7.23e-09	3.97e-10	2.31e-08	8.69e-09	3.77e-09	7.42e-09	3.12e-09	4.90e-05
G404	C - UA	First Reaction	TRUE	25p	4.89e-08	2.53e-09	6.51e-09	3.02e-10	8.00e-09	3.39e-09	5.30e-10	8.27e-09	3.92e-09	4.90e-05
G404	C - UA	Second Reaction	TRUE	25p	5.24e-08	2.53e-09	5.84e-09	2.09e-10	7.14e-09	2.23e-09	3.59e-10	7.42e-09	3.91e-09	4.90e-05
G405	C - UA	First Reaction	TRUE	25p	5.09e-08	2.53e-09	1.13e-08	3.95e-10	7.39e-09	2.86e-09	1.04e-09	8.54e-09	9.98e-09	4.90e-05
G405	C - UA	Second Reaction	TRUE	25p	5.31e-08	2.53e-09	1.06e-08	2.90e-10	6.83e-09	2.04e-09	7.57e-10	7.45e-09	9.53e-09	4.90e-05
G406	C - UA	First Reaction	TRUE	25p	4.84e-08	2.53e-09	4.50e-09	1.11e-09	3.51e-09	5.71e-09	1.45e-09	7.66e-09	4.16e-09	4.90e-05
G406	C - UA	Second Reaction	TRUE	25p	5.25e-08	2.53e-09	4.00e-09	9.18e-10	3.17e-09	4.64e-09	1.21e-09	7.35e-09	4.00e-09	4.90e-05
G401	C - UA	Initial Soln	TRUE	75p	1.25e-07	2.12e-09	2.20e-08	2.99e-09	1.69e-08	2.26e-06	9.92e-10	3.50e-09	4.26e-09	0
G402	C - UA	Initial Soln	TRUE	75p	2.83e-07	2.12e-09	2.19e-08	2.09e-09	6.55e-08	5.01e-08	1.09e-08	2.45e-08	4.25e-09	0
G404	C - UA	Initial Soln	TRUE	75p	1.29e-07	5.41e-09	2.19e-08	2.54e-09	3.37e-08	3.01e-08	1.72e-09	7.67e-09	4.25e-09	0
G405	C - UA	Initial Soln	TRUE	75p	1.94e-07	8.31e-09	2.20e-08	2.09e-09	1.69e-08	1.67e-08	2.25e-09	1.04e-08	9.51e-09	0
G406	C - UA	Initial Soln	TRUE	75p	1.92e-07	2.12e-09	2.19e-08	2.09e-09	1.68e-08	1.12e-08	9.90e-10	3.50e-09	4.25e-09	0
G401	C - UA	Speciation Model	TRUE	75p	1.25e-07	2.12e-09	2.20e-08	2.99e-09	1.69e-08	2.26e-06	9.92e-10	3.50e-09	4.26e-09	7.50e-05
G402	C - UA	Speciation Model	TRUE	75p	2.83e-07	2.12e-09	2.19e-08	2.09e-09	6.55e-08	5.01e-08	1.09e-08	2.45e-08	4.25e-09	7.50e-05
G404	C - UA	Speciation Model	TRUE	75p	1.29e-07	5.41e-09	2.19e-08	2.54e-09	3.37e-08	3.01e-08	1.72e-09	7.67e-09	4.25e-09	7.50e-05
G405	C - UA	Speciation Model	TRUE	75p	1.94e-07	8.31e-09	2.20e-08	2.09e-09	1.69e-08	1.67e-08	2.25e-09	1.04e-08	9.51e-09	7.50e-05
G406	C - UA	Speciation Model	TRUE	75p	1.92e-07	2.12e-09	2.19e-08	2.09e-09	1.68e-08	1.12e-08	9.90e-10	3.50e-09	4.25e-09	7.50e-05
G401	C - UA	First Reaction	TRUE	75p	4.80e-08	2.53e-09	2.13e-09	1.43e-10	6.17e-10	9.26e-08	1.42e-10	1.02e-08	5.25e-08	7.50e-05
G401	C - UA	Second Reaction	TRUE	75p	5.22e-08	2.53e-09	1.90e-09	1.07e-10	5.53e-10	6.17e-08	1.05e-10	7.54e-09	4.31e-09	7.50e-05
G402	C - UA	First Reaction	TRUE	75p	4.87e-08	2.53e-09	8.27e-09	5.48e-10	2.71e-08	1.25e-08	5.21e-09	9.61e-09	3.06e-09	7.50e-05
G402	C - UA	Second Reaction	TRUE	75p	5.23e-08	2.53e-09	7.36e-09	4.25e-10	2.38e-08	9.39e-09	4.05e-09	7.53e-09	2.95e-09	7.50e-05
G404	C - UA	First Reaction	TRUE	75p	4.75e-08	2.53e-09	6.85e-09	3.33e-10	8.42e-09	3.78e-09	5.81e-10	8.71e-09	3.97e-09	7.50e-05
G404	C - UA	Second Reaction	TRUE	75p	5.15e-08	2.53e-09	5.98e-09	2.27e-10	7.30e-09	2.47e-09	3.94e-10	7.49e-09	3.72e-09	7.50e-05
G405	C - UA	First Reaction	TRUE	75p	5.00e-08	2.53e-09	1.17e-08	4.26e-10	7.64e-09	3.11e-09	1.12e-09	9.09e-09	1.02e-08	7.50e-05
G405	C - UA	Second Reaction	TRUE	75p	5.26e-08	2.53e-09	1.07e-08	3.12e-10	6.93e-09	2.22e-09	8.21e-10	7.56e-09	9.57e-09	7.50e-05
G406	C - UA	First Reaction	TRUE	75p	4.68e-08	2.53e-09	4.76e-09	1.17e-09	3.67e-09	6.07e-09	1.51e-09	7.83e-09	4.27e-09	7.50e-05
G406	C - UA	Second Reaction	TRUE	75p	5.15e-08	2.53e-09	4.10e-09	9.66e-10	3.22e-09	4.92e-09	1.27e-09	7.35e-09	3.85e-09	7.50e-05
G401	C - UA	Initial Soln	TRUE	median	1.25e-07	2.12e-09	2.20e-08	2.99e-09	1.69e-08	2.26e-06	9.92e-10	3.50e-09	4.26e-09	0
G402	C - UA	Initial Soln	TRUE	median	2.83e-07	2.12e-09	2.19e-08	2.09e-09	6.55e-08	5.01e-08	1.09e-08	2.45e-08	4.25e-09	0
G404	C - UA	Initial Soln	TRUE	median	1.29e-07	5.41e-09	2.19e-08	2.54e-09	3.37e-08	3.01e-08	1.72e-09	7.67e-09	4.25e-09	0
G405	C - UA	Initial Soln	TRUE	median	1.94e-07	8.31e-09	2.20e-08	2.09e-09	1.69e-08	1.67e-08	2.25e-09	1.04e-08	9.51e-09	0
G406	C - UA	Initial Soln	TRUE	median	1.92e-07	2.12e-09	2.19e-08	2.09e-09	1.68e-08	1.12e-08	9.90e-10	3.50e-09	4.25e-09	0
G401	C - UA	Speciation Model	TRUE	median	1.25e-07	2.12e-09	2.20e-08	2.99e-09	1.69e-08	2.26e-06	9.92e-10	3.50e-09	4.26e-09	7.00e-05
G402	C - UA	Speciation Model	TRUE	median	2.83e-07	2.12e-09	2.19e-08	2.09e-09	6.55e-08	5.01e-08	1.09e-08	2.45e-08	4.25e-09	7.00e-05
G404	C - UA	Speciation Model	TRUE	median	1.29e-07	5.41e-09	2.19e-08	2.54e-09	3.37e-08	3.01e-08	1.72e-09	7.67e-09	4.25e-09	7.00e-05
G405	C - UA	Speciation Model	TRUE	median	1.94e-07	8.31e-09	2.20e-08	2.09e-09	1.69e-08	1.67e-08	2.25e-09	1.04e-08	9.51e-09	7.00e-05
G406	C - UA	Speciation Model	TRUE	median	1.92e-07	2.12e-09	2.19e-08	2.09e-09	1.68e-08	1.12e-08	9.90e-10	3.50e-09	4.25e-09	7.00e-05
G401	C - UA	First Reaction	TRUE	median	4.82e-08	2.53e-09	2.11e-09	1.40e-10	6.12e-10	8.94e-08	1.38e-10	9.99e-09	4.93e-08	7.00e-05
G401	C - UA	Second Reaction	TRUE	median	5.24e-08	2.53e-09	1.89e-09	1.04e-10	5.52e-10	5.95e-08	1.02e-10	7.51e-09	4.31e-09	7.00e-05
G402	C - UA	First Reaction	TRUE	median	4.89e-08	2.53e-09	8.21e-09	5.36e-10	2.68e-08	1.21e-08	5.09e-09	9.47e-09	3.05e-09	7.00e-05
G402	C - UA	Second Reaction	TRUE	median	5.25e-08	2.53e-09	7.33e-09	4.13e-10	2.35e-08	9.11e-09	3.93e-09	7.51e-09	2.97e-09	7.00e-05
G404	C - UA	First Reaction	TRUE	median	4.77e-08	2.53e-09	6.79e-09	3.22e-10	8.33e-09	3.64e-09	5.61e-10	8.62e-09	3.95e-09	7.00e-05
G404	C - UA	Second Reaction	TRUE	median	5.17e-08	2.53e-09	5.95e-09	2.20e-10	7.25e-09	2.37e-09	3.79e-10	7.48e-09	3.74e-09	7.00e-05
G405	C - UA	First Reaction	TRUE	median	5.01e-08	2.53e-09	1.16e-08	4.14e-10	7.58e-09	3.02e-09	1.09e-09	8.99e-09	1.01e-08	7.00e-05
G405	C - UA	Second Reaction	TRUE	median	5.27e-08	2.53e-09	1.07e-08	3.03e-10	6.90e-09	2.15e-09	7.95e-10	7.54e-09	9.56e-09	7.00e-05
G406	C - UA	First Reaction	TRUE	median	4.71e-08	2.53e-09	4.71e-09	1.15e-09	3.63e-09	5.96e-09	1.49e-09	7.79e-09	4.24e-09	7.00e-05
G406	C - UA	Second Reaction	TRUE	median	5.17e-08	2.53e-09	4.08e-09	9.48e-10	3.20e-09	4.82e-09	1.24e-09	7.35e-09	3.86e-09	7.00e-05
G401	C - UA	Initial Soln	FALSE	25p	1.25e-07	2.12e-09	2.20e-08	2.99e-09	1.69e-08	2.26e-06	9.92e-10	3.50e-09	4.26e-09	0
G402	C - UA	Initial Soln	FALSE	25p	2.83e-07	2.12e-09	2.19e-08	2.09e-09	6.55e-08	5.01e-08	1.09e-08	2.45e-08	4.25e-09	0
G404	C - UA	Initial Soln	FALSE	25p	1.29e-07	5.41e-09	2.19e-08	2.54e-09	3.37e-08	3.01e-08	1.72e-09	7.67e-09	4.25e-09	0
G405	C - UA	Initial Soln	FALSE	25p	1.94e-07	8.31e-09	2.20e-08	2.09e-09	1.69e-08	1.67e-08	2.25e-09	1.04e-08	9.51e-09	0
G406	C - UA	Initial Soln	FALSE	25p	1.92e-07	2.12e-09	2.19e-08	2.09e-09	1.68e-08	1.12e-08	9.90e-10	3.50e-09	4.25e-09	0
G401	C - UA	Speciation Model	FALSE	25p	1.25e-07	2.12e-09	2.20e-08	2.99e-09	1.69e-08	2.26e-06	9.92e-10	3.50e-09	4.26e-09	4.90e-05
G402	C - UA	Speciation Model	FALSE	25p	2.83e-07	2.12e-09	2.19e-08	2.09e-09	6.55e-08	5.01e-08	1.09e-08	2.45e-08	4.25e-09	4.90e-05
G404	C - UA	Speciation Model	FALSE	25p	1.29e-07	5.41e-09	2.19e-08	2.54e-09	3.37e-08	3.01e-08	1.72e-09	7.67e-09	4.25e-09	4.90e-05
G405	C - UA	Speciation Model	FALSE	25p	1.94e-07	8.31e-09	2.20e-08	2.09e-09	1.69e-08	1.67e-08	2.25e-09	1.04e-08	9.51e-09	4.90e-05
G406	C - UA	Speciation Model	FALSE	25p	1.92e-07	2.12e-09	2.19e-08	2.09e-09	1.68e-08	1.12e-08	9.90e-10	3.50e-09	4.25e-09	4.90e-05
G401	C - UA	First Reaction	FALSE	25p	4.95e-08	2.53e-09	2.04e-09	1.41e-10	5.99e-10	8.47e-08	1.39e-10	9.25e-09	3.59e-08	4.90e-05
G401	C - UA	Second Reaction	FALSE	25p	5.31e-08	2.53e-09	1.87e-09	1.07e-10	5.54e-10	5.71e-08	1.03e-10	7.42e-09	4.27e-09	4.90e-05

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	Al	Sb	Be	Cd	Cr	Co	Pb	Mo	Se	Hfo_s
G402	C - UA	First Reaction	FALSE	25p	5.00e-08	2.53e-09	7.90e-09	6.64e-10	2.64e-08	1.21e-08	5.07e-09	8.93e-09	3.10e-09	4.90e-05
G402	C - UA	Second Reaction	FALSE	25p	5.31e-08	2.53e-09	7.22e-09	5.12e-10	2.35e-08	9.13e-09	3.91e-09	7.42e-09	3.16e-09	4.90e-05
G404	C - UA	First Reaction	FALSE	25p	4.89e-08	2.53e-09	6.50e-09	3.40e-10	8.05e-09	3.50e-09	5.46e-10	8.30e-09	3.95e-09	4.90e-05
G404	C - UA	Second Reaction	FALSE	25p	5.24e-08	2.53e-09	5.83e-09	2.34e-10	7.19e-09	2.30e-09	3.70e-10	7.43e-09	3.93e-09	4.90e-05
G405	C - UA	First Reaction	FALSE	25p	5.09e-08	2.53e-09	1.13e-08	4.53e-10	7.44e-09	2.96e-09	1.07e-09	8.57e-09	1.01e-08	4.90e-05
G405	C - UA	Second Reaction	FALSE	25p	5.31e-08	2.53e-09	1.06e-08	3.32e-10	6.87e-09	2.11e-09	7.80e-10	7.45e-09	9.62e-09	4.90e-05
G406	C - UA	First Reaction	FALSE	25p	4.84e-08	2.53e-09	4.49e-09	1.34e-09	3.56e-09	5.91e-09	1.51e-09	7.69e-09	4.21e-09	4.90e-05
G406	C - UA	Second Reaction	FALSE	25p	5.25e-08	2.53e-09	3.99e-09	1.10e-09	3.22e-09	4.81e-09	1.26e-09	7.35e-09	4.04e-09	4.90e-05
G401	C - UA	Initial Soln	FALSE	75p	1.25e-07	2.12e-09	2.20e-08	2.99e-09	1.69e-08	2.26e-06	9.92e-10	3.50e-09	4.26e-09	0
G402	C - UA	Initial Soln	FALSE	75p	2.83e-07	2.12e-09	2.19e-08	2.09e-09	6.55e-08	5.01e-08	1.09e-08	2.45e-08	4.25e-09	0
G404	C - UA	Initial Soln	FALSE	75p	1.29e-07	5.41e-09	2.19e-08	2.54e-09	3.37e-08	3.01e-08	1.72e-09	7.67e-09	4.25e-09	0
G405	C - UA	Initial Soln	FALSE	75p	1.94e-07	8.31e-09	2.20e-08	2.09e-09	1.69e-08	1.67e-08	2.25e-09	1.04e-08	9.51e-09	0
G406	C - UA	Initial Soln	FALSE	75p	1.92e-07	2.12e-09	2.19e-08	2.09e-09	1.68e-08	1.12e-08	9.90e-10	3.50e-09	4.25e-09	0
G401	C - UA	Speciation Model	FALSE	75p	1.25e-07	2.12e-09	2.20e-08	2.99e-09	1.69e-08	2.26e-06	9.92e-10	3.50e-09	4.26e-09	7.50e-05
G402	C - UA	Speciation Model	FALSE	75p	2.83e-07	2.12e-09	2.19e-08	2.09e-09	6.55e-08	5.01e-08	1.09e-08	2.45e-08	4.25e-09	7.50e-05
G404	C - UA	Speciation Model	FALSE	75p	1.29e-07	5.41e-09	2.19e-08	2.54e-09	3.37e-08	3.01e-08	1.72e-09	7.67e-09	4.25e-09	7.50e-05
G405	C - UA	Speciation Model	FALSE	75p	1.94e-07	8.31e-09	2.20e-08	2.09e-09	1.69e-08	1.67e-08	2.25e-09	1.04e-08	9.51e-09	7.50e-05
G406	C - UA	Speciation Model	FALSE	75p	1.92e-07	2.12e-09	2.19e-08	2.09e-09	1.68e-08	1.12e-08	9.90e-10	3.50e-09	4.25e-09	7.50e-05
G401	C - UA	First Reaction	FALSE	75p	4.80e-08	2.53e-09	2.13e-09	1.52e-10	6.22e-10	9.37e-08	1.44e-10	1.02e-08	5.27e-08	7.50e-05
G401	C - UA	Second Reaction	FALSE	75p	5.22e-08	2.53e-09	1.90e-09	1.12e-10	5.58e-10	6.24e-08	1.07e-10	7.54e-09	4.31e-09	7.50e-05
G402	C - UA	First Reaction	FALSE	75p	4.87e-08	2.53e-09	8.25e-09	7.10e-10	2.75e-08	1.31e-08	5.39e-09	9.71e-09	3.10e-09	7.50e-05
G402	C - UA	Second Reaction	FALSE	75p	5.24e-08	2.53e-09	7.35e-09	5.48e-10	2.41e-08	9.86e-09	4.19e-09	7.54e-09	2.99e-09	7.50e-05
G404	C - UA	First Reaction	FALSE	75p	4.75e-08	2.53e-09	6.85e-09	3.75e-10	8.47e-09	3.90e-09	5.99e-10	8.74e-09	3.99e-09	7.50e-05
G404	C - UA	Second Reaction	FALSE	75p	5.15e-08	2.53e-09	5.97e-09	2.54e-10	7.35e-09	2.54e-09	4.06e-10	7.50e-09	3.75e-09	7.50e-05
G405	C - UA	First Reaction	FALSE	75p	5.00e-08	2.53e-09	1.17e-08	4.89e-10	7.68e-09	3.22e-09	1.16e-09	9.14e-09	1.03e-08	7.50e-05
G405	C - UA	Second Reaction	FALSE	75p	5.26e-08	2.53e-09	1.07e-08	3.58e-10	6.98e-09	2.30e-09	8.46e-10	7.57e-09	9.66e-09	7.50e-05
G406	C - UA	First Reaction	FALSE	75p	4.69e-08	2.53e-09	4.75e-09	1.41e-09	3.72e-09	6.28e-09	1.57e-09	7.86e-09	4.32e-09	7.50e-05
G406	C - UA	Second Reaction	FALSE	75p	5.15e-08	2.53e-09	4.09e-09	1.16e-09	3.27e-09	5.09e-09	1.31e-09	7.35e-09	3.89e-09	7.50e-05
G401	C - UA	Initial Soln	FALSE	median	1.25e-07	2.12e-09	2.20e-08	2.99e-09	1.69e-08	2.26e-06	9.92e-10	3.50e-09	4.26e-09	0
G402	C - UA	Initial Soln	FALSE	median	2.83e-07	2.12e-09	2.19e-08	2.09e-09	6.55e-08	5.01e-08	1.09e-08	2.45e-08	4.25e-09	0
G404	C - UA	Initial Soln	FALSE	median	1.29e-07	5.41e-09	2.19e-08	2.54e-09	3.37e-08	3.01e-08	1.72e-09	7.67e-09	4.25e-09	0
G405	C - UA	Initial Soln	FALSE	median	1.94e-07	8.31e-09	2.20e-08	2.09e-09	1.69e-08	1.67e-08	2.25e-09	1.04e-08	9.51e-09	0
G406	C - UA	Initial Soln	FALSE	median	1.92e-07	2.12e-09	2.19e-08	2.09e-09	1.68e-08	1.12e-08	9.90e-10	3.50e-09	4.25e-09	0
G401	C - UA	Speciation Model	FALSE	median	1.25e-07	2.12e-09	2.20e-08	2.99e-09	1.69e-08	2.26e-06	9.92e-10	3.50e-09	4.26e-09	7.00e-05
G402	C - UA	Speciation Model	FALSE	median	2.83e-07	2.12e-09	2.19e-08	2.09e-09	6.55e-08	5.01e-08	1.09e-08	2.45e-08	4.25e-09	7.00e-05
G404	C - UA	Speciation Model	FALSE	median	1.29e-07	5.41e-09	2.19e-08	2.54e-09	3.37e-08	3.01e-08	1.72e-09	7.67e-09	4.25e-09	7.00e-05
G405	C - UA	Speciation Model	FALSE	median	1.94e-07	8.31e-09	2.20e-08	2.09e-09	1.69e-08	1.67e-08	2.25e-09	1.04e-08	9.51e-09	7.00e-05
G406	C - UA	Speciation Model	FALSE	median	1.92e-07	2.12e-09	2.19e-08	2.09e-09	1.68e-08	1.12e-08	9.90e-10	3.50e-09	4.25e-09	7.00e-05
G401	C - UA	First Reaction	FALSE	median	4.82e-08	2.53e-09	2.11e-09	1.48e-10	6.17e-10	9.05e-08	1.40e-10	1.00e-08	4.95e-08	7.00e-05
G401	C - UA	Second Reaction	FALSE	median	5.24e-08	2.53e-09	1.89e-09	1.10e-10	5.56e-10	6.02e-08	1.03e-10	7.51e-09	4.31e-09	7.00e-05
G402	C - UA	First Reaction	FALSE	median	4.89e-08	2.53e-09	8.18e-09	6.94e-10	2.72e-08	1.28e-08	5.27e-09	9.56e-09	3.09e-09	7.00e-05
G402	C - UA	Second Reaction	FALSE	median	5.25e-08	2.53e-09	7.32e-09	5.34e-10	2.39e-08	9.57e-09	4.07e-09	7.51e-09	3.01e-09	7.00e-05
G404	C - UA	First Reaction	FALSE	median	4.77e-08	2.53e-09	6.78e-09	3.62e-10	8.38e-09	3.76e-09	5.78e-10	8.66e-09	3.98e-09	7.00e-05
G404	C - UA	Second Reaction	FALSE	median	5.17e-08	2.53e-09	5.94e-09	2.46e-10	7.30e-09	2.45e-09	3.90e-10	7.48e-09	3.77e-09	7.00e-05
G405	C - UA	First Reaction	FALSE	median	5.01e-08	2.53e-09	1.16e-08	4.76e-10	7.63e-09	3.12e-09	1.12e-09	9.03e-09	1.02e-08	7.00e-05
G405	C - UA	Second Reaction	FALSE	median	5.27e-08	2.53e-09	1.07e-08	3.47e-10	6.95e-09	2.22e-09	8.18e-10	7.54e-09	9.65e-09	7.00e-05
G406	C - UA	First Reaction	FALSE	median	4.71e-08	2.53e-09	4.70e-09	1.39e-09	3.68e-09	6.17e-09	1.54e-09	7.83e-09	4.29e-09	7.00e-05
G406	C - UA	Second Reaction	FALSE	median	5.17e-08	2.53e-09	4.07e-09	1.14e-09	3.25e-09	4.99e-09	1.29e-09	7.35e-09	3.90e-09	7.00e-05

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	Hfo_w	Hao_	m_Hfo_wOH	m_Hfo_wOH2+	m_Hfo_wOHSO4-2	m_Hfo_wSO4-	m_Hfo_wOSi(OH)3	m_Hfo_wOSiO(OH)2-	m_Hfo_wHCO3	m_Hfo_wCO3-
G401	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	TRUE	25p	0.00196	0.00323	0.000103	0.000384	7.02e-05	0.000131	0.000519	8.58e-05	0.000465	2.12e-05
G402	C - UA	Speciation Model	TRUE	25p	0.00196	0.00323	9.11e-05	9.21e-05	5.62e-06	2.85e-06	0.000406	0.000248	0.000606	0.000102
G404	C - UA	Speciation Model	TRUE	25p	0.00196	0.00323	0.000109	0.000119	1.66e-05	9.09e-06	0.000368	0.000208	0.000712	0.000111
G405	C - UA	Speciation Model	TRUE	25p	0.00196	0.00323	0.000138	0.000107	2.25e-05	8.77e-06	0.000349	0.000278	0.000486	0.000106
G406	C - UA	Speciation Model	TRUE	25p	0.00196	0.00323	9.63e-05	0.000135	1.27e-05	8.95e-06	0.000398	0.000175	0.000780	9.44e-05
G401	C - UA	First Reaction	TRUE	25p	0.00196	0.00323	0.000199	0.000159	8.54e-07	3.43e-07	0.000361	0.000278	0.000529	0.000112
G401	C - UA	Second Reaction	TRUE	25p	0.00196	0.00323	0.000210	0.000157	6.49e-07	2.43e-07	0.000370	0.000306	0.000468	0.000107
G402	C - UA	First Reaction	TRUE	25p	0.00196	0.00323	0.000164	0.000102	9.06e-07	2.81e-07	0.000338	0.000337	0.000428	0.000117
G402	C - UA	Second Reaction	TRUE	25p	0.00196	0.00323	0.000173	0.000102	8.47e-07	2.49e-07	0.000342	0.000360	0.000385	0.000111
G404	C - UA	First Reaction	TRUE	25p	0.00196	0.00323	0.000185	0.000108	1.18e-06	3.48e-07	0.000302	0.000318	0.000511	0.000148
G404	C - UA	Second Reaction	TRUE	25p	0.00196	0.00323	0.000195	0.000109	1.08e-06	3.01e-07	0.000316	0.000349	0.000448	0.000136
G405	C - UA	First Reaction	TRUE	25p	0.00196	0.00323	0.000162	8.27e-05	1.26e-06	3.23e-07	0.000299	0.000361	0.000403	0.000134
G405	C - UA	Second Reaction	TRUE	25p	0.00196	0.00323	0.000166	8.29e-05	1.10e-06	2.77e-07	0.000310	0.000382	0.000368	0.000125
G406	C - UA	First Reaction	TRUE	25p	0.00196	0.00323	0.000188	0.000127	9.69e-07	3.27e-07	0.000320	0.000293	0.000536	0.000135
G406	C - UA	Second Reaction	TRUE	25p	0.00196	0.00323	0.000203	0.000127	9.15e-07	2.86e-07	0.000331	0.000327	0.000463	0.000126
G401	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	TRUE	75p	0.00300	0.00396	0.000158	0.000588	0.000108	0.000201	0.000794	0.000131	0.000711	3.24e-05
G402	C - UA	Speciation Model	TRUE	75p	0.00300	0.00396	0.000139	0.000141	8.61e-06	4.37e-06	0.000622	0.000379	0.000927	0.000156
G404	C - UA	Speciation Model	TRUE	75p	0.00300	0.00396	0.000166	0.000181	2.54e-05	1.39e-05	0.000563	0.000318	0.00109	0.000170
G405	C - UA	Speciation Model	TRUE	75p	0.00300	0.00396	0.000211	0.000164	3.45e-05	1.34e-05	0.000535	0.000425	0.000744	0.000163
G406	C - UA	Speciation Model	TRUE	75p	0.00300	0.00396	0.000147	0.000207	1.95e-05	1.37e-05	0.000609	0.000267	0.00119	0.000144
G401	C - UA	First Reaction	TRUE	75p	0.00300	0.00396	0.000297	0.000245	1.44e-06	5.95e-07	0.000548	0.000410	0.000847	0.000174
G401	C - UA	Second Reaction	TRUE	75p	0.00300	0.00396	0.000323	0.000241	1.04e-06	3.90e-07	0.000548	0.000451	0.000750	0.000170
G402	C - UA	First Reaction	TRUE	75p	0.00300	0.00396	0.000244	0.000155	1.41e-06	4.47e-07	0.000517	0.000502	0.000683	0.000183
G402	C - UA	Second Reaction	TRUE	75p	0.00300	0.00396	0.000266	0.000156	1.34e-06	3.96e-07	0.000511	0.000537	0.000612	0.000177
G404	C - UA	First Reaction	TRUE	75p	0.00300	0.00396	0.000274	0.000165	1.86e-06	5.62e-07	0.000456	0.000468	0.000821	0.000232
G404	C - UA	Second Reaction	TRUE	75p	0.00300	0.00396	0.000300	0.000167	1.75e-06	4.87e-07	0.000461	0.000513	0.000722	0.000221
G405	C - UA	First Reaction	TRUE	75p	0.00300	0.00396	0.000245	0.000126	2.02e-06	5.22e-07	0.000452	0.000541	0.000638	0.000211
G405	C - UA	Second Reaction	TRUE	75p	0.00300	0.00396	0.000257	0.000127	1.78e-06	4.42e-07	0.000458	0.000570	0.000584	0.000200
G406	C - UA	First Reaction	TRUE	75p	0.00300	0.00396	0.000278	0.000193	1.50e-06	5.25e-07	0.000485	0.000430	0.000865	0.000211
G406	C - UA	Second Reaction	TRUE	75p	0.00300	0.00396	0.000311	0.000194	1.48e-06	4.64e-07	0.000484	0.000479	0.000747	0.000204
G401	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	TRUE	median	0.00280	0.00363	0.000147	0.000548	0.000100	0.000187	0.000741	0.000123	0.000664	3.03e-05
G402	C - UA	Speciation Model	TRUE	median	0.00280	0.00363	0.000130	0.000132	8.04e-06	4.08e-06	0.000580	0.000354	0.000865	0.000145
G404	C - UA	Speciation Model	TRUE	median	0.00280	0.00363	0.000155	0.000169	2.37e-05	1.30e-05	0.000526	0.000297	0.00102	0.000158
G405	C - UA	Speciation Model	TRUE	median	0.00280	0.00363	0.000197	0.000153	3.22e-05	1.25e-05	0.000499	0.000397	0.000694	0.000152
G406	C - UA	Speciation Model	TRUE	median	0.00280	0.00363	0.000138	0.000193	1.82e-05	1.28e-05	0.000568	0.000250	0.00111	0.000135
G401	C - UA	First Reaction	TRUE	median	0.00280	0.00363	0.000279	0.000229	1.32e-06	5.42e-07	0.000512	0.000385	0.000784	0.000162
G401	C - UA	Second Reaction	TRUE	median	0.00280	0.00363	0.000301	0.000225	9.65e-07	3.62e-07	0.000514	0.000424	0.000694	0.000158
G402	C - UA	First Reaction	TRUE	median	0.00280	0.00363	0.000229	0.000145	1.31e-06	4.14e-07	0.000482	0.000471	0.000633	0.000170
G402	C - UA	Second Reaction	TRUE	median	0.00280	0.00363	0.000248	0.000146	1.25e-06	3.68e-07	0.000479	0.000503	0.000567	0.000164
G404	C - UA	First Reaction	TRUE	median	0.00280	0.00363	0.000258	0.000154	1.73e-06	5.20e-07	0.000426	0.000440	0.000760	0.000216
G404	C - UA	Second Reaction	TRUE	median	0.00280	0.00363	0.000281	0.000156	1.63e-06	4.52e-07	0.000433	0.000482	0.000668	0.000205
G405	C - UA	First Reaction	TRUE	median	0.00280	0.00363	0.000229	0.000118	1.87e-06	4.82e-07	0.000422	0.000507	0.000592	0.000196
G405	C - UA	Second Reaction	TRUE	median	0.00280	0.00363	0.000239	0.000119	1.65e-06	4.11e-07	0.000430	0.000535	0.000542	0.000186
G406	C - UA	First Reaction	TRUE	median	0.00280	0.00363	0.000261	0.000181	1.40e-06	4.86e-07	0.000453	0.000404	0.000800	0.000196
G406	C - UA	Second Reaction	TRUE	median	0.00280	0.00363	0.000291	0.000181	1.38e-06	4.30e-07	0.000455	0.000450	0.000691	0.000188
G401	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	FALSE	25p	0.00196	0.00323	0.000103	0.000384	7.05e-05	0.000132	0.000518	8.58e-05	0.000465	2.12e-05
G402	C - UA	Speciation Model	FALSE	25p	0.00196	0.00323	9.08e-05	9.16e-05	5.72e-06	2.89e-06	0.000404	0.000247	0.000607	0.000102
G404	C - UA	Speciation Model	FALSE	25p	0.00196	0.00323	0.000108	0.000118	1.68e-05	9.17e-06	0.000367	0.000208	0.000713	0.000111
G405	C - UA	Speciation Model	FALSE	25p	0.00196	0.00323	0.000138	0.000107	2.28e-05	8.84e-06	0.000349	0.000278	0.000486	0.000107
G406	C - UA	Speciation Model	FALSE	25p	0.00196	0.00323	9.61e-05	0.000134	1.30e-05	9.08e-06	0.000397	0.000175	0.000781	9.49e-05
G401	C - UA	First Reaction	FALSE	25p	0.00196	0.00323	0.000199	0.000159	8.55e-07	3.42e-07	0.000361	0.000278	0.000529	0.000112
G401	C - UA	Second Reaction	FALSE	25p	0.00196	0.00323	0.000210	0.000157	6.50e-07	2.43e-07	0.000370	0.000306	0.000468	0.000107

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	Hfo_w	Hao_	m_Hfo_wOH	m_Hfo_wOH2+	m_Hfo_wOHSO4-2	m_Hfo_wSO4-	m_Hfo_wOSi(OH)3	m_Hfo_wOSiO(OH)2-	m_Hfo_wHCO3	m_Hfo_wCO3-
G402	C - UA	First Reaction	FALSE	25p	0.00196	0.00323	0.000164	0.000102	9.01e-07	2.80e-07	0.000338	0.000336	0.000428	0.000117
G402	C - UA	Second Reaction	FALSE	25p	0.00196	0.00323	0.000173	0.000102	8.45e-07	2.49e-07	0.000342	0.000359	0.000385	0.000111
G404	C - UA	First Reaction	FALSE	25p	0.00196	0.00323	0.000185	0.000108	1.18e-06	3.48e-07	0.000302	0.000317	0.000511	0.000148
G404	C - UA	Second Reaction	FALSE	25p	0.00196	0.00323	0.000195	0.000109	1.08e-06	3.01e-07	0.000316	0.000349	0.000448	0.000136
G405	C - UA	First Reaction	FALSE	25p	0.00196	0.00323	0.000162	8.28e-05	1.26e-06	3.22e-07	0.000299	0.000361	0.000403	0.000134
G405	C - UA	Second Reaction	FALSE	25p	0.00196	0.00323	0.000166	8.30e-05	1.10e-06	2.77e-07	0.000310	0.000382	0.000368	0.000125
G406	C - UA	First Reaction	FALSE	25p	0.00196	0.00323	0.000189	0.000127	9.66e-07	3.26e-07	0.000320	0.000293	0.000535	0.000135
G406	C - UA	Second Reaction	FALSE	25p	0.00196	0.00323	0.000203	0.000127	9.15e-07	2.86e-07	0.000330	0.000327	0.000463	0.000126
G401	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	FALSE	75p	0.00300	0.00396	0.000158	0.000587	0.000108	0.000202	0.000793	0.000131	0.000711	3.25e-05
G402	C - UA	Speciation Model	FALSE	75p	0.00300	0.00396	0.000139	0.000140	8.76e-06	4.43e-06	0.000619	0.000379	0.000929	0.000156
G404	C - UA	Speciation Model	FALSE	75p	0.00300	0.00396	0.000166	0.000181	2.57e-05	1.40e-05	0.000562	0.000318	0.00109	0.000170
G405	C - UA	Speciation Model	FALSE	75p	0.00300	0.00396	0.000211	0.000163	3.48e-05	1.35e-05	0.000534	0.000425	0.000744	0.000163
G406	C - UA	Speciation Model	FALSE	75p	0.00300	0.00396	0.000147	0.000206	1.98e-05	1.39e-05	0.000607	0.000268	0.00120	0.000145
G401	C - UA	First Reaction	FALSE	75p	0.00300	0.00396	0.000297	0.000245	1.44e-06	5.95e-07	0.000548	0.000410	0.000847	0.000174
G401	C - UA	Second Reaction	FALSE	75p	0.00300	0.00396	0.000323	0.000241	1.04e-06	3.90e-07	0.000547	0.000451	0.000750	0.000170
G402	C - UA	First Reaction	FALSE	75p	0.00300	0.00396	0.000245	0.000155	1.40e-06	4.45e-07	0.000516	0.000501	0.000683	0.000183
G402	C - UA	Second Reaction	FALSE	75p	0.00300	0.00396	0.000266	0.000156	1.34e-06	3.96e-07	0.000511	0.000535	0.000612	0.000177
G404	C - UA	First Reaction	FALSE	75p	0.00300	0.00396	0.000274	0.000165	1.86e-06	5.60e-07	0.000456	0.000468	0.000821	0.000232
G404	C - UA	Second Reaction	FALSE	75p	0.00300	0.00396	0.000301	0.000167	1.75e-06	4.87e-07	0.000461	0.000512	0.000723	0.000221
G405	C - UA	First Reaction	FALSE	75p	0.00300	0.00396	0.000245	0.000126	2.01e-06	5.20e-07	0.000451	0.000540	0.000638	0.000210
G405	C - UA	Second Reaction	FALSE	75p	0.00300	0.00396	0.000257	0.000127	1.78e-06	4.42e-07	0.000458	0.000570	0.000584	0.000200
G406	C - UA	First Reaction	FALSE	75p	0.00300	0.00396	0.000278	0.000194	1.50e-06	5.23e-07	0.000485	0.000429	0.000865	0.000211
G406	C - UA	Second Reaction	FALSE	75p	0.00300	0.00396	0.000312	0.000194	1.48e-06	4.64e-07	0.000484	0.000478	0.000748	0.000204
G401	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	FALSE	median	0.00280	0.00363	0.000147	0.000548	0.000101	0.000188	0.000740	0.000123	0.000664	3.03e-05
G402	C - UA	Speciation Model	FALSE	median	0.00280	0.00363	0.000130	0.000131	8.17e-06	4.13e-06	0.000578	0.000353	0.000867	0.000146
G404	C - UA	Speciation Model	FALSE	median	0.00280	0.00363	0.000155	0.000169	2.40e-05	1.31e-05	0.000525	0.000297	0.00102	0.000159
G405	C - UA	Speciation Model	FALSE	median	0.00280	0.00363	0.000197	0.000153	3.25e-05	1.26e-05	0.000498	0.000396	0.000695	0.000152
G406	C - UA	Speciation Model	FALSE	median	0.00280	0.00363	0.000137	0.000192	1.85e-05	1.30e-05	0.000567	0.000250	0.00112	0.000136
G401	C - UA	First Reaction	FALSE	median	0.00280	0.00363	0.000279	0.000229	1.32e-06	5.42e-07	0.000512	0.000385	0.000784	0.000163
G401	C - UA	Second Reaction	FALSE	median	0.00280	0.00363	0.000301	0.000225	9.66e-07	3.62e-07	0.000513	0.000424	0.000695	0.000158
G402	C - UA	First Reaction	FALSE	median	0.00280	0.00363	0.000230	0.000145	1.30e-06	4.12e-07	0.000481	0.000470	0.000633	0.000170
G402	C - UA	Second Reaction	FALSE	median	0.00280	0.00363	0.000248	0.000146	1.25e-06	3.68e-07	0.000478	0.000502	0.000567	0.000164
G404	C - UA	First Reaction	FALSE	median	0.00280	0.00363	0.000258	0.000154	1.73e-06	5.18e-07	0.000426	0.000439	0.000760	0.000216
G404	C - UA	Second Reaction	FALSE	median	0.00280	0.00363	0.000281	0.000156	1.63e-06	4.52e-07	0.000433	0.000481	0.000668	0.000205
G405	C - UA	First Reaction	FALSE	median	0.00280	0.00363	0.000230	0.000118	1.86e-06	4.80e-07	0.000422	0.000506	0.000592	0.000196
G405	C - UA	Second Reaction	FALSE	median	0.00280	0.00363	0.000239	0.000119	1.65e-06	4.11e-07	0.000430	0.000534	0.000542	0.000186
G406	C - UA	First Reaction	FALSE	median	0.00280	0.00363	0.000262	0.000181	1.40e-06	4.84e-07	0.000452	0.000404	0.000800	0.000196
G406	C - UA	Second Reaction	FALSE	median	0.00280	0.00363	0.000291	0.000181	1.38e-06	4.30e-07	0.000454	0.000450	0.000691	0.000188

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	m_Hfo_wPO4-2	m_Hfo_wHPO4-	m_Hfo_wH2PO4	m_Hfo_sCO3-	m_Hfo_sHCO3	m_Hfo_sHPO4-	m_Hfo_sH2BO3	m_Hfo_sH2PO4	m_Hfo_sOSi(OH)3	m_Hfo_sOSiO(OH)2-
G401	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	TRUE	25p	4.87e-06	4.35e-05	6.61e-06	1.90e-08	4.17e-07	3.90e-08	1.47e-10	5.92e-09	4.65e-07	7.69e-08
G402	C - UA	Speciation Model	TRUE	25p	1.04e-05	2.52e-05	1.04e-06	6.01e-09	3.58e-08	1.49e-09	1.10e-11	6.13e-11	2.40e-08	1.46e-08
G404	C - UA	Speciation Model	TRUE	25p	2.75e-06	7.19e-06	3.20e-07	1.64e-08	1.05e-07	1.06e-09	7.38e-11	4.73e-11	5.45e-08	3.08e-08
G405	C - UA	Speciation Model	TRUE	25p	1.08e-05	2.02e-05	6.38e-07	1.64e-08	7.50e-08	3.11e-09	8.37e-11	9.84e-11	5.39e-08	4.29e-08
G406	C - UA	Speciation Model	TRUE	25p	7.10e-06	2.39e-05	1.37e-06	2.83e-08	2.34e-07	7.17e-09	1.64e-11	4.10e-10	1.19e-07	5.24e-08
G401	C - UA	First Reaction	TRUE	25p	1.80e-05	3.46e-05	1.13e-06	6.41e-08	3.02e-07	1.97e-08	8.62e-11	6.43e-10	2.06e-07	1.59e-07
G401	C - UA	Second Reaction	TRUE	25p	1.85e-05	3.30e-05	1.00e-06	5.91e-08	2.59e-07	1.83e-08	6.22e-11	5.56e-10	2.05e-07	1.70e-07
G402	C - UA	First Reaction	TRUE	25p	1.43e-05	2.12e-05	5.34e-07	5.60e-09	2.04e-08	1.01e-09	7.22e-12	2.54e-11	1.61e-08	1.61e-08
G402	C - UA	Second Reaction	TRUE	25p	1.45e-05	2.04e-05	4.88e-07	5.38e-09	1.86e-08	9.86e-10	5.99e-12	2.36e-11	1.65e-08	1.74e-08
G404	C - UA	First Reaction	TRUE	25p	4.23e-06	5.95e-06	1.42e-07	1.97e-08	6.81e-08	7.93e-10	3.46e-11	1.90e-11	4.03e-08	4.23e-08
G404	C - UA	Second Reaction	TRUE	25p	4.38e-06	5.87e-06	1.33e-07	1.80e-08	5.92e-08	7.74e-10	2.46e-11	1.76e-11	4.17e-08	4.61e-08
G405	C - UA	First Reaction	TRUE	25p	1.39e-05	1.70e-05	3.54e-07	2.00e-08	6.02e-08	2.54e-09	3.03e-11	5.28e-11	4.46e-08	5.39e-08
G405	C - UA	Second Reaction	TRUE	25p	1.39e-05	1.67e-05	3.39e-07	1.87e-08	5.51e-08	2.50e-09	2.18e-11	5.08e-11	4.64e-08	5.73e-08
G406	C - UA	First Reaction	TRUE	25p	1.20e-05	1.94e-05	5.32e-07	2.94e-08	1.17e-07	4.22e-09	2.66e-11	1.16e-10	6.97e-08	6.38e-08
G406	C - UA	Second Reaction	TRUE	25p	1.24e-05	1.86e-05	4.72e-07	2.65e-08	9.75e-08	3.92e-09	2.38e-11	9.96e-11	6.97e-08	6.89e-08
G401	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	TRUE	75p	7.46e-06	6.66e-05	1.01e-05	2.91e-08	6.38e-07	5.97e-08	2.25e-10	9.06e-09	7.11e-07	1.18e-07
G402	C - UA	Speciation Model	TRUE	75p	1.59e-05	3.86e-05	1.59e-06	9.19e-09	5.47e-08	2.28e-09	1.69e-11	9.38e-11	3.67e-08	2.24e-08
G404	C - UA	Speciation Model	TRUE	75p	4.20e-06	1.10e-05	4.90e-07	2.51e-08	1.61e-07	1.63e-09	1.13e-10	7.24e-11	8.34e-08	4.71e-08
G405	C - UA	Speciation Model	TRUE	75p	1.66e-05	3.09e-05	9.76e-07	2.51e-08	1.15e-07	4.77e-09	1.28e-10	1.51e-10	8.25e-08	6.56e-08
G406	C - UA	Speciation Model	TRUE	75p	1.09e-05	3.66e-05	2.09e-06	4.33e-08	3.58e-07	1.10e-08	2.52e-11	6.28e-10	1.83e-07	8.02e-08
G401	C - UA	First Reaction	TRUE	75p	2.72e-05	5.39e-05	1.81e-06	1.01e-07	4.91e-07	3.12e-08	1.40e-10	1.05e-09	3.18e-07	2.37e-07
G401	C - UA	Second Reaction	TRUE	75p	2.87e-05	5.15e-05	1.57e-06	9.56e-08	4.21e-07	2.89e-08	1.04e-10	8.81e-10	3.07e-07	2.53e-07
G402	C - UA	First Reaction	TRUE	75p	2.16e-05	3.29e-05	8.51e-07	8.80e-09	3.29e-08	1.58e-09	1.13e-11	4.09e-11	2.49e-08	2.42e-08
G402	C - UA	Second Reaction	TRUE	75p	2.24e-05	3.16e-05	7.57e-07	8.50e-09	2.94e-08	1.52e-09	9.82e-12	3.64e-11	2.46e-08	2.58e-08
G404	C - UA	First Reaction	TRUE	75p	6.37e-06	9.18e-06	2.25e-07	3.11e-08	1.10e-07	1.23e-09	5.56e-11	3.01e-11	6.12e-08	6.27e-08
G404	C - UA	Second Reaction	TRUE	75p	6.71e-06	8.93e-06	2.02e-07	2.94e-08	9.58e-08	1.18e-09	4.20e-11	2.68e-11	6.12e-08	6.80e-08
G405	C - UA	First Reaction	TRUE	75p	2.13e-05	2.63e-05	5.51e-07	3.15e-08	9.54e-08	3.93e-09	4.91e-11	8.24e-11	6.75e-08	8.09e-08
G405	C - UA	Second Reaction	TRUE	75p	2.16e-05	2.56e-05	5.18e-07	3.00e-08	8.76e-08	3.84e-09	3.69e-11	7.76e-11	6.87e-08	8.55e-08
G406	C - UA	First Reaction	TRUE	75p	1.81e-05	3.02e-05	8.57e-07	4.68e-08	1.92e-07	6.70e-09	4.08e-11	1.90e-10	1.08e-07	9.53e-08
G406	C - UA	Second Reaction	TRUE	75p	1.92e-05	2.88e-05	7.31e-07	4.33e-08	1.59e-07	6.12e-09	3.88e-11	1.56e-10	1.03e-07	1.02e-07
G401	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	TRUE	median	6.96e-06	6.22e-05	9.44e-06	2.71e-08	5.95e-07	5.57e-08	2.10e-10	8.46e-09	6.64e-07	1.10e-07
G402	C - UA	Speciation Model	TRUE	median	1.48e-05	3.60e-05	1.48e-06	8.58e-09	5.11e-08	2.12e-09	1.58e-11	8.75e-11	3.43e-08	2.09e-08
G404	C - UA	Speciation Model	TRUE	median	3.92e-06	1.03e-05	4.57e-07	2.34e-08	1.51e-07	1.52e-09	1.05e-10	6.76e-11	7.78e-08	4.39e-08
G405	C - UA	Speciation Model	TRUE	median	1.55e-05	2.88e-05	9.11e-07	2.34e-08	1.07e-07	4.45e-09	1.20e-10	1.41e-10	7.70e-08	6.12e-08
G406	C - UA	Speciation Model	TRUE	median	1.01e-05	3.42e-05	1.95e-06	4.04e-08	3.34e-07	1.02e-08	2.35e-11	5.86e-10	1.71e-07	7.49e-08
G401	C - UA	First Reaction	TRUE	median	2.55e-05	5.02e-05	1.68e-06	9.39e-08	4.53e-07	2.90e-08	1.27e-10	9.68e-10	2.96e-07	2.23e-07
G401	C - UA	Second Reaction	TRUE	median	2.67e-05	4.79e-05	1.46e-06	8.85e-08	3.89e-07	2.69e-08	9.39e-11	8.17e-10	2.88e-07	2.38e-07
G402	C - UA	First Reaction	TRUE	median	2.02e-05	3.07e-05	7.88e-07	8.20e-09	3.05e-08	1.48e-09	1.04e-11	3.80e-11	2.32e-08	2.27e-08
G402	C - UA	Second Reaction	TRUE	median	2.09e-05	2.95e-05	7.04e-07	7.93e-09	2.74e-08	1.42e-09	8.93e-12	3.40e-11	2.31e-08	2.43e-08
G404	C - UA	First Reaction	TRUE	median	5.96e-06	8.55e-06	2.08e-07	2.89e-08	1.02e-07	1.15e-09	5.06e-11	2.79e-11	5.71e-08	5.89e-08
G404	C - UA	Second Reaction	TRUE	median	6.27e-06	8.34e-06	1.88e-07	2.72e-08	8.87e-08	1.11e-09	3.76e-11	2.50e-11	5.75e-08	6.39e-08
G405	C - UA	First Reaction	TRUE	median	1.99e-05	2.45e-05	5.12e-07	2.93e-08	8.86e-08	3.66e-09	4.46e-11	7.66e-11	6.32e-08	7.58e-08
G405	C - UA	Second Reaction	TRUE	median	2.01e-05	2.39e-05	4.83e-07	2.78e-08	8.13e-08	3.59e-09	3.32e-11	7.24e-11	6.45e-08	8.02e-08
G406	C - UA	First Reaction	TRUE	median	1.69e-05	2.81e-05	7.92e-07	4.35e-08	1.77e-07	6.22e-09	3.78e-11	1.75e-10	1.00e-07	8.95e-08
G406	C - UA	Second Reaction	TRUE	median	1.79e-05	2.68e-05	6.80e-07	4.01e-08	1.47e-07	5.71e-09	3.55e-11	1.45e-10	9.68e-08	9.59e-08
G401	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	FALSE	25p	4.88e-06	4.35e-05	6.60e-06	1.89e-08	4.15e-07	3.89e-08	1.47e-10	5.90e-09	4.63e-07	7.66e-08
G402	C - UA	Speciation Model	FALSE	25p	1.04e-05	2.52e-05	1.04e-06	5.97e-09	3.54e-08	1.47e-09	1.09e-11	6.05e-11	2.36e-08	1.44e-08
G404	C - UA	Speciation Model	FALSE	25p	2.76e-06	7.21e-06	3.20e-07	1.64e-08	1.05e-07	1.06e-09	7.33e-11	4.71e-11	5.41e-08	3.06e-08
G405	C - UA	Speciation Model	FALSE	25p	1.09e-05	2.02e-05	6.38e-07	1.64e-08	7.47e-08	3.11e-09	8.31e-11	9.81e-11	5.36e-08	4.26e-08
G406	C - UA	Speciation Model	FALSE	25p	7.18e-06	2.41e-05	1.37e-06	2.83e-08	2.33e-07	7.17e-09	1.63e-11	4.08e-10	1.18e-07	5.21e-08
G401	C - UA	First Reaction	FALSE	25p	1.81e-05	3.46e-05	1.13e-06	6.39e-08	3.01e-07	1.97e-08	8.59e-11	6.41e-10	2.05e-07	1.58e-07
G401	C - UA	Second Reaction	FALSE	25p	1.85e-05	3.30e-05	1.00e-06	5.89e-08	2.58e-07	1.82e-08	6.19e-11	5.54e-10	2.04e-07	1.69e-07

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	m_Hfo_wPO4-2	m_Hfo_wHPO4-	m_Hfo_wH2PO4	m_Hfo_sCO3-	m_Hfo_sHCO3	m_Hfo_sHPO4-	m_Hfo_sH2BO3	m_Hfo_sH2PO4	m_Hfo_sOSi(OH)3	m_Hfo_sOSiO(OH)2-
G402	C - UA	First Reaction	FALSE	25p	1.43e-05	2.13e-05	5.36e-07	5.49e-09	2.00e-08	9.95e-10	7.06e-12	2.51e-11	1.58e-08	1.57e-08
G402	C - UA	Second Reaction	FALSE	25p	1.45e-05	2.05e-05	4.90e-07	5.28e-09	1.83e-08	9.73e-10	5.87e-12	2.33e-11	1.62e-08	1.70e-08
G404	C - UA	First Reaction	FALSE	25p	4.24e-06	5.97e-06	1.43e-07	1.96e-08	6.76e-08	7.91e-10	3.44e-11	1.89e-11	4.00e-08	4.20e-08
G404	C - UA	Second Reaction	FALSE	25p	4.40e-06	5.89e-06	1.34e-07	1.79e-08	5.88e-08	7.72e-10	2.45e-11	1.76e-11	4.14e-08	4.58e-08
G405	C - UA	First Reaction	FALSE	25p	1.40e-05	1.71e-05	3.55e-07	1.99e-08	5.98e-08	2.54e-09	3.01e-11	5.27e-11	4.43e-08	5.35e-08
G405	C - UA	Second Reaction	FALSE	25p	1.40e-05	1.67e-05	3.41e-07	1.86e-08	5.48e-08	2.49e-09	2.17e-11	5.08e-11	4.61e-08	5.69e-08
G406	C - UA	First Reaction	FALSE	25p	1.21e-05	1.95e-05	5.35e-07	2.90e-08	1.15e-07	4.20e-09	2.61e-11	1.15e-10	6.87e-08	6.30e-08
G406	C - UA	Second Reaction	FALSE	25p	1.25e-05	1.87e-05	4.76e-07	2.62e-08	9.62e-08	3.90e-09	2.34e-11	9.90e-11	6.88e-08	6.80e-08
G401	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	FALSE	75p	7.46e-06	6.67e-05	1.01e-05	2.90e-08	6.35e-07	5.95e-08	2.24e-10	9.02e-09	7.08e-07	1.17e-07
G402	C - UA	Speciation Model	FALSE	75p	1.60e-05	3.86e-05	1.59e-06	9.13e-09	5.42e-08	2.26e-09	1.66e-11	9.27e-11	3.62e-08	2.21e-08
G404	C - UA	Speciation Model	FALSE	75p	4.22e-06	1.10e-05	4.90e-07	2.50e-08	1.61e-07	1.63e-09	1.12e-10	7.21e-11	8.28e-08	4.69e-08
G405	C - UA	Speciation Model	FALSE	75p	1.67e-05	3.10e-05	9.77e-07	2.51e-08	1.14e-07	4.76e-09	1.27e-10	1.50e-10	8.20e-08	6.53e-08
G406	C - UA	Speciation Model	FALSE	75p	1.10e-05	3.68e-05	2.10e-06	4.33e-08	3.56e-07	1.10e-08	2.49e-11	6.25e-10	1.81e-07	7.98e-08
G401	C - UA	First Reaction	FALSE	75p	2.73e-05	5.39e-05	1.81e-06	1.01e-07	4.89e-07	3.11e-08	1.40e-10	1.05e-09	3.16e-07	2.36e-07
G401	C - UA	Second Reaction	FALSE	75p	2.87e-05	5.15e-05	1.57e-06	9.53e-08	4.20e-07	2.88e-08	1.04e-10	8.78e-10	3.06e-07	2.52e-07
G402	C - UA	First Reaction	FALSE	75p	2.17e-05	3.30e-05	8.55e-07	8.63e-09	3.23e-08	1.56e-09	1.11e-11	4.03e-11	2.44e-08	2.37e-08
G402	C - UA	Second Reaction	FALSE	75p	2.25e-05	3.17e-05	7.61e-07	8.34e-09	2.89e-08	1.50e-09	9.61e-12	3.59e-11	2.41e-08	2.53e-08
G404	C - UA	First Reaction	FALSE	75p	6.39e-06	9.21e-06	2.26e-07	3.09e-08	1.09e-07	1.23e-09	5.54e-11	3.01e-11	6.07e-08	6.23e-08
G404	C - UA	Second Reaction	FALSE	75p	6.73e-06	8.96e-06	2.02e-07	2.92e-08	9.53e-08	1.18e-09	4.18e-11	2.67e-11	6.08e-08	6.75e-08
G405	C - UA	First Reaction	FALSE	75p	2.13e-05	2.64e-05	5.54e-07	3.13e-08	9.49e-08	3.92e-09	4.88e-11	8.23e-11	6.71e-08	8.03e-08
G405	C - UA	Second Reaction	FALSE	75p	2.16e-05	2.57e-05	5.20e-07	2.98e-08	8.71e-08	3.84e-09	3.67e-11	7.75e-11	6.83e-08	8.49e-08
G406	C - UA	First Reaction	FALSE	75p	1.82e-05	3.04e-05	8.62e-07	4.62e-08	1.90e-07	6.66e-09	4.00e-11	1.89e-10	1.06e-07	9.41e-08
G406	C - UA	Second Reaction	FALSE	75p	1.94e-05	2.90e-05	7.36e-07	4.28e-08	1.57e-07	6.09e-09	3.81e-11	1.55e-10	1.02e-07	1.01e-07
G401	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	FALSE	median	6.97e-06	6.22e-05	9.44e-06	2.70e-08	5.93e-07	5.55e-08	2.09e-10	8.42e-09	6.61e-07	1.09e-07
G402	C - UA	Speciation Model	FALSE	median	1.49e-05	3.61e-05	1.48e-06	8.52e-09	5.06e-08	2.11e-09	1.55e-11	8.65e-11	3.37e-08	2.06e-08
G404	C - UA	Speciation Model	FALSE	median	3.94e-06	1.03e-05	4.57e-07	2.34e-08	1.50e-07	1.52e-09	1.05e-10	6.73e-11	7.73e-08	4.37e-08
G405	C - UA	Speciation Model	FALSE	median	1.56e-05	2.89e-05	9.12e-07	2.34e-08	1.07e-07	4.44e-09	1.19e-10	1.40e-10	7.65e-08	6.09e-08
G406	C - UA	Speciation Model	FALSE	median	1.03e-05	3.44e-05	1.96e-06	4.04e-08	3.32e-07	1.02e-08	2.33e-11	5.83e-10	1.69e-07	7.45e-08
G401	C - UA	First Reaction	FALSE	median	2.55e-05	5.02e-05	1.67e-06	9.37e-08	4.52e-07	2.89e-08	1.27e-10	9.64e-10	2.95e-07	2.22e-07
G401	C - UA	Second Reaction	FALSE	median	2.68e-05	4.79e-05	1.46e-06	8.83e-08	3.88e-07	2.68e-08	9.35e-11	8.14e-10	2.87e-07	2.37e-07
G402	C - UA	First Reaction	FALSE	median	2.03e-05	3.08e-05	7.92e-07	8.05e-09	2.99e-08	1.45e-09	1.02e-11	3.74e-11	2.28e-08	2.22e-08
G402	C - UA	Second Reaction	FALSE	median	2.10e-05	2.96e-05	7.08e-07	7.78e-09	2.69e-08	1.40e-09	8.75e-12	3.36e-11	2.27e-08	2.38e-08
G404	C - UA	First Reaction	FALSE	median	5.98e-06	8.58e-06	2.09e-07	2.88e-08	1.01e-07	1.14e-09	5.03e-11	2.78e-11	5.67e-08	5.85e-08
G404	C - UA	Second Reaction	FALSE	median	6.29e-06	8.36e-06	1.89e-07	2.70e-08	8.81e-08	1.10e-09	3.74e-11	2.49e-11	5.71e-08	6.35e-08
G405	C - UA	First Reaction	FALSE	median	1.99e-05	2.46e-05	5.14e-07	2.91e-08	8.81e-08	3.65e-09	4.44e-11	7.65e-11	6.27e-08	7.53e-08
G405	C - UA	Second Reaction	FALSE	median	2.02e-05	2.40e-05	4.85e-07	2.77e-08	8.08e-08	3.58e-09	3.30e-11	7.23e-11	6.41e-08	7.97e-08
G406	C - UA	First Reaction	FALSE	median	1.71e-05	2.83e-05	7.97e-07	4.30e-08	1.75e-07	6.19e-09	3.71e-11	1.74e-10	9.90e-08	8.83e-08
G406	C - UA	Second Reaction	FALSE	median	1.81e-05	2.70e-05	6.85e-07	3.96e-08	1.45e-07	5.67e-09	3.48e-11	1.44e-10	9.55e-08	9.46e-08

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	m_Hfo_sOHSO4-2	m_Hfo_sSO4-	m_Hao_SO4-	m_Hao_OHSO4-2	m_Hao_H2BO3	m_Hao_H3BO4-	Ferrihydrite	d_Ferrihydrite	Gibbsite	d_Gibbsite
G401	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	TRUE	25p	6.29e-08	1.18e-07	5.80e-13	0.000617	0.00175	8.70e-12	0.00980	0	0.0980	0
G402	C - UA	Speciation Model	TRUE	25p	3.32e-10	1.68e-10	3.68e-14	0.000348	0.00241	1.06e-10	0.00980	0	0.0980	0
G404	C - UA	Speciation Model	TRUE	25p	2.46e-09	1.35e-09	3.42e-14	0.000191	0.00292	7.66e-11	0.00980	0	0.0980	0
G405	C - UA	Speciation Model	TRUE	25p	3.48e-09	1.35e-09	3.00e-14	0.000246	0.00278	1.07e-10	0.00980	0	0.0980	0
G406	C - UA	Speciation Model	TRUE	25p	3.81e-09	2.68e-09	1.40e-13	0.000369	0.00221	2.73e-11	0.00980	0	0.0980	0
G401	C - UA	First Reaction	TRUE	25p	4.88e-10	1.95e-10	1.30e-14	0.000565	0.00156	3.19e-10	0.00980	7.81e-07	0.0980	4.33e-07
G401	C - UA	Second Reaction	TRUE	25p	3.60e-10	1.35e-10	1.20e-14	0.000593	0.00143	3.32e-10	0.00980	3.97e-08	0.0980	4.29e-07
G402	C - UA	First Reaction	TRUE	25p	4.32e-11	1.34e-11	9.66e-15	0.000356	0.00218	3.76e-10	0.00980	1.60e-07	0.0980	4.32e-07
G402	C - UA	Second Reaction	TRUE	25p	4.10e-11	1.21e-11	1.00e-14	0.000404	0.00201	3.79e-10	0.00980	1.61e-07	0.0980	4.29e-07
G404	C - UA	First Reaction	TRUE	25p	1.58e-10	4.64e-11	7.10e-15	0.000236	0.00258	4.02e-10	0.00980	1.60e-07	0.0980	4.33e-07
G404	C - UA	Second Reaction	TRUE	25p	1.42e-10	3.97e-11	8.15e-15	0.000300	0.00235	4.05e-10	0.00980	1.60e-07	0.0980	4.30e-07
G405	C - UA	First Reaction	TRUE	25p	1.89e-10	4.82e-11	7.50e-15	0.000266	0.00248	4.12e-10	0.00980	1.60e-07	0.0980	4.31e-07
G405	C - UA	Second Reaction	TRUE	25p	1.66e-10	4.15e-11	8.55e-15	0.000324	0.00227	4.02e-10	0.00980	1.61e-07	0.0980	4.29e-07
G406	C - UA	First Reaction	TRUE	25p	2.11e-10	7.12e-11	1.22e-14	0.000386	0.00206	3.03e-10	0.00980	1.60e-07	0.0980	4.34e-07
G406	C - UA	Second Reaction	TRUE	25p	1.93e-10	6.03e-11	1.16e-14	0.000423	0.00192	3.28e-10	0.00980	1.61e-07	0.0980	4.30e-07
G401	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	TRUE	75p	9.63e-08	1.80e-07	7.10e-13	0.000755	0.00214	1.06e-11	0.0150	0	0.120	0
G402	C - UA	Speciation Model	TRUE	75p	5.08e-10	2.58e-10	4.51e-14	0.000426	0.00295	1.30e-10	0.0150	0	0.120	0
G404	C - UA	Speciation Model	TRUE	75p	3.76e-09	2.06e-09	4.18e-14	0.000234	0.00358	9.38e-11	0.0150	0	0.120	0
G405	C - UA	Speciation Model	TRUE	75p	5.32e-09	2.07e-09	3.68e-14	0.000302	0.00341	1.31e-10	0.0150	0	0.120	0
G406	C - UA	Speciation Model	TRUE	75p	5.83e-09	4.11e-09	1.71e-13	0.000452	0.00271	3.34e-11	0.0150	0	0.120	0
G401	C - UA	First Reaction	TRUE	75p	8.33e-10	3.45e-10	1.68e-14	0.000687	0.00194	3.70e-10	0.0150	1.14e-06	0.120	4.34e-07
G401	C - UA	Second Reaction	TRUE	75p	5.84e-10	2.19e-10	1.46e-14	0.000713	0.00180	4.13e-10	0.0150	-4.89e-08	0.120	4.30e-07
G402	C - UA	First Reaction	TRUE	75p	6.76e-11	2.15e-11	1.21e-14	0.000425	0.00271	4.47e-10	0.0150	1.60e-07	0.120	4.33e-07
G402	C - UA	Second Reaction	TRUE	75p	6.46e-11	1.90e-11	1.20e-14	0.000475	0.00253	4.69e-10	0.0150	1.60e-07	0.120	4.30e-07
G404	C - UA	First Reaction	TRUE	75p	2.50e-10	7.53e-11	8.69e-15	0.000276	0.00321	4.77e-10	0.0150	1.60e-07	0.120	4.35e-07
G404	C - UA	Second Reaction	TRUE	75p	2.33e-10	6.46e-11	9.55e-15	0.000345	0.00296	4.99e-10	0.0150	1.60e-07	0.120	4.31e-07
G405	C - UA	First Reaction	TRUE	75p	3.02e-10	7.80e-11	9.11e-15	0.000314	0.00309	4.97e-10	0.0150	1.60e-07	0.120	4.32e-07
G405	C - UA	Second Reaction	TRUE	75p	2.67e-10	6.63e-11	1.00e-14	0.000376	0.00285	5.02e-10	0.0150	1.60e-07	0.120	4.29e-07
G406	C - UA	First Reaction	TRUE	75p	3.34e-10	1.16e-10	1.57e-14	0.000463	0.00255	3.52e-10	0.0150	1.60e-07	0.120	4.35e-07
G406	C - UA	Second Reaction	TRUE	75p	3.16e-10	9.88e-11	1.42e-14	0.000502	0.00241	3.99e-10	0.0150	1.60e-07	0.120	4.31e-07
G401	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	TRUE	median	8.99e-08	1.68e-07	6.50e-13	0.000692	0.00196	9.76e-12	0.0140	0	0.110	0
G402	C - UA	Speciation Model	TRUE	median	4.74e-10	2.41e-10	4.13e-14	0.000390	0.00270	1.19e-10	0.0140	0	0.110	0
G404	C - UA	Speciation Model	TRUE	median	3.51e-09	1.92e-09	3.83e-14	0.000215	0.00328	8.60e-11	0.0140	0	0.110	0
G405	C - UA	Speciation Model	TRUE	median	4.97e-09	1.93e-09	3.37e-14	0.000277	0.00312	1.20e-10	0.0140	0	0.110	0
G406	C - UA	Speciation Model	TRUE	median	5.45e-09	3.83e-09	1.57e-13	0.000414	0.00248	3.06e-11	0.0140	0	0.110	0
G401	C - UA	First Reaction	TRUE	median	7.62e-10	3.13e-10	1.54e-14	0.000632	0.00177	3.41e-10	0.0140	1.05e-06	0.110	4.34e-07
G401	C - UA	Second Reaction	TRUE	median	5.41e-10	2.03e-10	1.35e-14	0.000659	0.00164	3.74e-10	0.0140	-2.88e-08	0.110	4.30e-07
G402	C - UA	First Reaction	TRUE	median	6.30e-11	1.99e-11	1.11e-14	0.000393	0.00247	4.11e-10	0.0140	1.60e-07	0.110	4.33e-07
G402	C - UA	Second Reaction	TRUE	median	6.04e-11	1.78e-11	1.11e-14	0.000443	0.00229	4.26e-10	0.0140	1.61e-07	0.110	4.30e-07
G404	C - UA	First Reaction	TRUE	median	2.32e-10	6.96e-11	8.07e-15	0.000258	0.00293	4.37e-10	0.0140	1.60e-07	0.110	4.34e-07
G404	C - UA	Second Reaction	TRUE	median	2.16e-10	6.00e-11	8.97e-15	0.000325	0.00268	4.54e-10	0.0140	1.60e-07	0.110	4.30e-07
G405	C - UA	First Reaction	TRUE	median	2.80e-10	7.20e-11	8.45e-15	0.000292	0.00281	4.55e-10	0.0140	1.60e-07	0.110	4.32e-07
G405	C - UA	Second Reaction	TRUE	median	2.48e-10	6.16e-11	9.38e-15	0.000353	0.00259	4.55e-10	0.0140	1.61e-07	0.110	4.29e-07
G406	C - UA	First Reaction	TRUE	median	3.10e-10	1.08e-10	1.43e-14	0.000428	0.00232	3.25e-10	0.0140	1.60e-07	0.110	4.35e-07
G406	C - UA	Second Reaction	TRUE	median	2.93e-10	9.15e-11	1.31e-14	0.000466	0.00219	3.64e-10	0.0140	1.60e-07	0.110	4.30e-07
G401	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	FALSE	25p	6.30e-08	1.18e-07	5.80e-13	0.000617	0.00174	8.67e-12	0.00980	0	0.0980	0
G402	C - UA	Speciation Model	FALSE	25p	3.34e-10	1.69e-10	3.69e-14	0.000346	0.00240	1.05e-10	0.00980	0	0.0980	0
G404	C - UA	Speciation Model	FALSE	25p	2.47e-09	1.35e-09	3.41e-14	0.000189	0.00292	7.58e-11	0.00980	0	0.0980	0
G405	C - UA	Speciation Model	FALSE	25p	3.50e-09	1.36e-09	3.00e-14	0.000244	0.00278	1.06e-10	0.00980	0	0.0980	0
G406	C - UA	Speciation Model	FALSE	25p	3.86e-09	2.70e-09	1.40e-13	0.000367	0.00220	2.70e-11	0.00980	0	0.0980	0
G401	C - UA	First Reaction	FALSE	25p	4.86e-10	1.95e-10	1.29e-14	0.000566	0.00156	3.19e-10	0.00980	7.91e-07	0.0980	4.33e-07
G401	C - UA	Second Reaction	FALSE	25p	3.59e-10	1.34e-10	1.20e-14	0.000594	0.00143	3.32e-10	0.00980	3.61e-08	0.0980	4.29e-07

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	m_Hfo_sOHSO4-2	m_Hfo_sSO4-	m_Hao_SO4-	m_Hao_OHSO4-2	m_Hao_H2BO3	m_Hao_H3BO4-	Ferrihydrite	d_Ferrihydrite	Gibbsite	d_Gibbsite
G402	C - UA	First Reaction	FALSE	25p	4.21e-11	1.31e-11	9.68e-15	0.000359	0.00218	3.77e-10	0.00980	1.60e-07	0.0980	4.32e-07
G402	C - UA	Second Reaction	FALSE	25p	4.02e-11	1.18e-11	1.01e-14	0.000406	0.00200	3.78e-10	0.00980	1.61e-07	0.0980	4.29e-07
G404	C - UA	First Reaction	FALSE	25p	1.56e-10	4.60e-11	7.08e-15	0.000236	0.00258	4.03e-10	0.00980	1.60e-07	0.0980	4.33e-07
G404	C - UA	Second Reaction	FALSE	25p	1.41e-10	3.95e-11	8.15e-15	0.000300	0.00235	4.05e-10	0.00980	1.60e-07	0.0980	4.30e-07
G405	C - UA	First Reaction	FALSE	25p	1.87e-10	4.78e-11	7.49e-15	0.000267	0.00248	4.13e-10	0.00980	1.60e-07	0.0980	4.31e-07
G405	C - UA	Second Reaction	FALSE	25p	1.64e-10	4.12e-11	8.55e-15	0.000325	0.00227	4.03e-10	0.00980	1.61e-07	0.0980	4.29e-07
G406	C - UA	First Reaction	FALSE	25p	2.08e-10	7.00e-11	1.23e-14	0.000388	0.00205	3.03e-10	0.00980	1.60e-07	0.0980	4.34e-07
G406	C - UA	Second Reaction	FALSE	25p	1.90e-10	5.95e-11	1.16e-14	0.000425	0.00191	3.27e-10	0.00980	1.61e-07	0.0980	4.30e-07
G401	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	FALSE	75p	9.64e-08	1.80e-07	7.10e-13	0.000755	0.00213	1.06e-11	0.0150	0	0.120	0
G402	C - UA	Speciation Model	FALSE	75p	5.11e-10	2.58e-10	4.52e-14	0.000424	0.00294	1.29e-10	0.0150	0	0.120	0
G404	C - UA	Speciation Model	FALSE	75p	3.78e-09	2.07e-09	4.17e-14	0.000232	0.00358	9.29e-11	0.0150	0	0.120	0
G405	C - UA	Speciation Model	FALSE	75p	5.35e-09	2.08e-09	3.67e-14	0.000299	0.00341	1.30e-10	0.0150	0	0.120	0
G406	C - UA	Speciation Model	FALSE	75p	5.91e-09	4.14e-09	1.72e-13	0.000450	0.00270	3.30e-11	0.0150	0	0.120	0
G401	C - UA	First Reaction	FALSE	75p	8.31e-10	3.44e-10	1.68e-14	0.000689	0.00194	3.70e-10	0.0150	1.15e-06	0.120	4.34e-07
G401	C - UA	Second Reaction	FALSE	75p	5.82e-10	2.18e-10	1.46e-14	0.000715	0.00180	4.13e-10	0.0150	-5.46e-08	0.120	4.30e-07
G402	C - UA	First Reaction	FALSE	75p	6.60e-11	2.10e-11	1.21e-14	0.000428	0.00270	4.48e-10	0.0150	1.60e-07	0.120	4.33e-07
G402	C - UA	Second Reaction	FALSE	75p	6.34e-11	1.87e-11	1.20e-14	0.000479	0.00252	4.69e-10	0.0150	1.60e-07	0.120	4.30e-07
G404	C - UA	First Reaction	FALSE	75p	2.48e-10	7.47e-11	8.67e-15	0.000276	0.00321	4.78e-10	0.0150	1.60e-07	0.120	4.35e-07
G404	C - UA	Second Reaction	FALSE	75p	2.31e-10	6.42e-11	9.55e-15	0.000345	0.00296	5.00e-10	0.0150	1.60e-07	0.120	4.31e-07
G405	C - UA	First Reaction	FALSE	75p	2.99e-10	7.73e-11	9.10e-15	0.000314	0.00308	4.98e-10	0.0150	1.60e-07	0.120	4.32e-07
G405	C - UA	Second Reaction	FALSE	75p	2.65e-10	6.59e-11	1.00e-14	0.000376	0.00285	5.02e-10	0.0150	1.60e-07	0.120	4.29e-07
G406	C - UA	First Reaction	FALSE	75p	3.28e-10	1.15e-10	1.57e-14	0.000466	0.00254	3.52e-10	0.0150	1.60e-07	0.120	4.35e-07
G406	C - UA	Second Reaction	FALSE	75p	3.12e-10	9.75e-11	1.42e-14	0.000505	0.00240	3.98e-10	0.0150	1.60e-07	0.120	4.31e-07
G401	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G402	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G404	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G405	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G406	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0	0
G401	C - UA	Speciation Model	FALSE	median	8.99e-08	1.68e-07	6.51e-13	0.000692	0.00196	9.73e-12	0.0140	0	0.110	0
G402	C - UA	Speciation Model	FALSE	median	4.77e-10	2.41e-10	4.14e-14	0.000388	0.00269	1.18e-10	0.0140	0	0.110	0
G404	C - UA	Speciation Model	FALSE	median	3.53e-09	1.93e-09	3.82e-14	0.000212	0.00328	8.51e-11	0.0140	0	0.110	0
G405	C - UA	Speciation Model	FALSE	median	5.00e-09	1.94e-09	3.37e-14	0.000274	0.00312	1.19e-10	0.0140	0	0.110	0
G406	C - UA	Speciation Model	FALSE	median	5.51e-09	3.86e-09	1.57e-13	0.000412	0.00247	3.03e-11	0.0140	0	0.110	0
G401	C - UA	First Reaction	FALSE	median	7.60e-10	3.12e-10	1.54e-14	0.000634	0.00177	3.41e-10	0.0140	1.06e-06	0.110	4.34e-07
G401	C - UA	Second Reaction	FALSE	median	5.40e-10	2.02e-10	1.35e-14	0.000660	0.00163	3.73e-10	0.0140	-3.40e-08	0.110	4.30e-07
G402	C - UA	First Reaction	FALSE	median	6.15e-11	1.95e-11	1.11e-14	0.000396	0.00246	4.11e-10	0.0140	1.60e-07	0.110	4.33e-07
G402	C - UA	Second Reaction	FALSE	median	5.92e-11	1.75e-11	1.12e-14	0.000446	0.00228	4.26e-10	0.0140	1.61e-07	0.110	4.30e-07
G404	C - UA	First Reaction	FALSE	median	2.30e-10	6.91e-11	8.05e-15	0.000258	0.00293	4.38e-10	0.0140	1.60e-07	0.110	4.34e-07
G404	C - UA	Second Reaction	FALSE	median	2.14e-10	5.96e-11	8.97e-15	0.000325	0.00268	4.54e-10	0.0140	1.60e-07	0.110	4.30e-07
G405	C - UA	First Reaction	FALSE	median	2.77e-10	7.14e-11	8.44e-15	0.000293	0.00281	4.56e-10	0.0140	1.60e-07	0.110	4.32e-07
G405	C - UA	Second Reaction	FALSE	median	2.46e-10	6.12e-11	9.38e-15	0.000353	0.00259	4.55e-10	0.0140	1.61e-07	0.110	4.29e-07
G406	C - UA	First Reaction	FALSE	median	3.05e-10	1.06e-10	1.43e-14	0.000430	0.00232	3.25e-10	0.0140	1.60e-07	0.110	4.35e-07
G406	C - UA	Second Reaction	FALSE	median	2.89e-10	9.03e-11	1.31e-14	0.000468	0.00218	3.63e-10	0.0140	1.60e-07	0.110	4.30e-07

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	Barite	d_Barite	Calcite	d_Calcite	Dolomite(ordered)	d_Dolomite(ordered)	Gypsum	d_Gypsum	si_Ferrihydrite	si_Gibbsite
G401	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	1.08	-3.06e-01
G402	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0.958	0.892
G404	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	1.67	0.644
G405	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	2.00	0.745
G406	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0	0	0	0	0.390	0.792
G401	C - UA	Speciation Model	TRUE	25p	0	0	1.00	0	2.00	0	0	0	1.08	-3.06e-01
G402	C - UA	Speciation Model	TRUE	25p	0	0	1.00	0	2.00	0	0	0	0.958	0.892
G404	C - UA	Speciation Model	TRUE	25p	0	0	1.00	0	2.00	0	0	0	1.67	0.644
G405	C - UA	Speciation Model	TRUE	25p	0	0	1.00	0	2.00	0	0	0	2.00	0.745
G406	C - UA	Speciation Model	TRUE	25p	0	0	1.00	0	2.00	0	0	0	0.390	0.792
G401	C - UA	First Reaction	TRUE	25p	1.89e-07	1.89e-07	1.00	0.000757	2.00	-1.03e-03	0	0	0	0
G401	C - UA	Second Reaction	TRUE	25p	3.20e-07	1.31e-07	1.00	0.000544	2.00	-6.40e-04	0	0	0	0
G402	C - UA	First Reaction	TRUE	25p	1.37e-07	1.37e-07	1.00	0.000626	2.00	-7.99e-04	0	0	0	0
G402	C - UA	Second Reaction	TRUE	25p	2.63e-07	1.27e-07	1.00	0.000542	2.00	-6.40e-04	0	0	0	0
G404	C - UA	First Reaction	TRUE	25p	1.29e-07	1.29e-07	1.00	0.000716	2.00	-9.11e-04	0	0	0	0
G404	C - UA	Second Reaction	TRUE	25p	2.49e-07	1.21e-07	1.00	0.000577	2.00	-6.83e-04	0	0	0	0
G405	C - UA	First Reaction	TRUE	25p	1.41e-07	1.41e-07	1.00	0.000678	2.00	-8.28e-04	0	0	0	0
G405	C - UA	Second Reaction	TRUE	25p	2.64e-07	1.24e-07	1.00	0.000558	2.00	-6.50e-04	0	0	0	0
G406	C - UA	First Reaction	TRUE	25p	1.34e-07	1.34e-07	1.00	0.000709	2.00	-9.19e-04	0	0	0	0
G406	C - UA	Second Reaction	TRUE	25p	2.63e-07	1.29e-07	1.00	0.000537	2.00	-6.49e-04	0	0	0	0
G401	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	1.08	-3.06e-01
G402	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0.958	0.892
G404	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	1.67	0.644
G405	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	2.00	0.745
G406	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0	0	0	0	0.390	0.792
G401	C - UA	Speciation Model	TRUE	75p	0	0	1.00	0	2.00	0	0	0	1.08	-3.06e-01
G402	C - UA	Speciation Model	TRUE	75p	0	0	1.00	0	2.00	0	0	0	0.958	0.892
G404	C - UA	Speciation Model	TRUE	75p	0	0	1.00	0	2.00	0	0	0	1.67	0.644
G405	C - UA	Speciation Model	TRUE	75p	0	0	1.00	0	2.00	0	0	0	2.00	0.745
G406	C - UA	Speciation Model	TRUE	75p	0	0	1.00	0	2.00	0	0	0	0.390	0.792
G401	C - UA	First Reaction	TRUE	75p	2.06e-07	2.06e-07	1.00	0.000830	2.00	-1.20e-03	0	0	0	0
G401	C - UA	Second Reaction	TRUE	75p	3.35e-07	1.29e-07	1.00	0.000564	2.00	-6.78e-04	0	0	0	0
G402	C - UA	First Reaction	TRUE	75p	1.38e-07	1.38e-07	1.00	0.000655	2.00	-8.64e-04	0	0	0	0
G402	C - UA	Second Reaction	TRUE	75p	2.63e-07	1.25e-07	1.00	0.000561	2.00	-6.73e-04	0	0	0	0
G404	C - UA	First Reaction	TRUE	75p	1.31e-07	1.31e-07	1.00	0.000761	2.00	-1.00e-03	0	0	0	0
G404	C - UA	Second Reaction	TRUE	75p	2.48e-07	1.17e-07	1.00	0.000601	2.00	-7.25e-04	0	0	0	0
G405	C - UA	First Reaction	TRUE	75p	1.46e-07	1.46e-07	1.00	0.000716	2.00	-8.95e-04	0	0	0	0
G405	C - UA	Second Reaction	TRUE	75p	2.67e-07	1.21e-07	1.00	0.000574	2.00	-6.77e-04	0	0	0	0
G406	C - UA	First Reaction	TRUE	75p	1.36e-07	1.36e-07	1.00	0.000762	2.00	-1.02e-03	0	0	0	0
G406	C - UA	Second Reaction	TRUE	75p	2.63e-07	1.27e-07	1.00	0.000559	2.00	-6.93e-04	0	0	0	0
G401	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	1.08	-3.06e-01
G402	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0.958	0.892
G404	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	1.67	0.644
G405	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	2.00	0.745
G406	C - UA	Initial Soln	TRUE	median	0	0	0	0	0	0	0	0	0.390	0.792
G401	C - UA	Speciation Model	TRUE	median	0	0	1.00	0	2.00	0	0	0	1.08	-3.06e-01
G402	C - UA	Speciation Model	TRUE	median	0	0	1.00	0	2.00	0	0	0	0.958	0.892
G404	C - UA	Speciation Model	TRUE	median	0	0	1.00	0	2.00	0	0	0	1.67	0.644
G405	C - UA	Speciation Model	TRUE	median	0	0	1.00	0	2.00	0	0	0	2.00	0.745
G406	C - UA	Speciation Model	TRUE	median	0	0	1.00	0	2.00	0	0	0	0.390	0.792
G401	C - UA	First Reaction	TRUE	median	2.02e-07	2.02e-07	1.00	0.000809	2.00	-1.16e-03	0	0	0	0
G401	C - UA	Second Reaction	TRUE	median	3.31e-07	1.29e-07	1.00	0.000558	2.00	-6.69e-04	0	0	0	0
G402	C - UA	First Reaction	TRUE	median	1.37e-07	1.37e-07	1.00	0.000647	2.00	-8.50e-04	0	0	0	0
G402	C - UA	Second Reaction	TRUE	median	2.63e-07	1.25e-07	1.00	0.000555	2.00	-6.65e-04	0	0	0	0
G404	C - UA	First Reaction	TRUE	median	1.30e-07	1.30e-07	1.00	0.000747	2.00	-9.79e-04	0	0	0	0
G404	C - UA	Second Reaction	TRUE	median	2.49e-07	1.19e-07	1.00	0.000593	2.00	-7.14e-04	0	0	0	0
G405	C - UA	First Reaction	TRUE	median	1.44e-07	1.44e-07	1.00	0.000703	2.00	-8.78e-04	0	0	0	0
G405	C - UA	Second Reaction	TRUE	median	2.66e-07	1.22e-07	1.00	0.000568	2.00	-6.69e-04	0	0	0	0
G406	C - UA	First Reaction	TRUE	median	1.35e-07	1.35e-07	1.00	0.000745	2.00	-9.98e-04	0	0	0	0
G406	C - UA	Second Reaction	TRUE	median	2.63e-07	1.27e-07	1.00	0.000553	2.00	-6.83e-04	0	0	0	0
G401	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	1.08	-3.05e-01
G402	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0.962	0.894
G404	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	1.67	0.645
G405	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	2.00	0.746
G406	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0	0	0	0	0.393	0.794
G401	C - UA	Speciation Model	FALSE	25p	0	0	1.00	0	2.00	0	0	0	1.08	-3.05e-01
G402	C - UA	Speciation Model	FALSE	25p	0	0	1.00	0	2.00	0	0	0	0.962	0.894
G404	C - UA	Speciation Model	FALSE	25p	0	0	1.00	0	2.00	0	0	0	1.67	0.645
G405	C - UA	Speciation Model	FALSE	25p	0	0	1.00	0	2.00	0	0	0	2.00	0.746
G406	C - UA	Speciation Model	FALSE	25p	0	0	1.00	0	2.00	0	0	0	0.393	0.794
G401	C - UA	First Reaction	FALSE	25p	1.89e-07	1.89e-07	1.00	0.000756	2.00	-1.03e-03	0	0	0	0
G401	C - UA	Second Reaction	FALSE	25p	3.20e-07	1.31e-07	1.00	0.000544	2.00	-6.40e-04	0	0	0	0

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	Barite	d_Barite	Calcite	d_Calcite	Dolomite(ordered)	d_Dolomite(ordered)	Gypsum	d_Gypsum	si_Ferrihydrite	si_Gibbsite
G402	C - UA	First Reaction	FALSE	25p	1.35e-07	1.35e-07	1.00	0.000620	2.00	-7.93e-04	0	0	0	0
G402	C - UA	Second Reaction	FALSE	25p	2.62e-07	1.27e-07	1.00	0.000542	2.00	-6.40e-04	0	0	0	0
G404	C - UA	First Reaction	FALSE	25p	1.28e-07	1.28e-07	1.00	0.000714	2.00	-9.09e-04	0	0	0	0
G404	C - UA	Second Reaction	FALSE	25p	2.49e-07	1.21e-07	1.00	0.000577	2.00	-6.83e-04	0	0	0	0
G405	C - UA	First Reaction	FALSE	25p	1.40e-07	1.40e-07	1.00	0.000675	2.00	-8.25e-04	0	0	0	0
G405	C - UA	Second Reaction	FALSE	25p	2.64e-07	1.24e-07	1.00	0.000558	2.00	-6.50e-04	0	0	0	0
G406	C - UA	First Reaction	FALSE	25p	1.33e-07	1.33e-07	1.00	0.000703	2.00	-9.13e-04	0	0	0	0
G406	C - UA	Second Reaction	FALSE	25p	2.62e-07	1.29e-07	1.00	0.000536	2.00	-6.48e-04	0	0	0	0
G401	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	1.08	-3.05e-01
G402	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0.962	0.894
G404	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	1.67	0.645
G405	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	2.00	0.746
G406	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0	0	0	0	0.393	0.794
G401	C - UA	Speciation Model	FALSE	75p	0	0	1.00	0	2.00	0	0	0	1.08	-3.05e-01
G402	C - UA	Speciation Model	FALSE	75p	0	0	1.00	0	2.00	0	0	0	0.962	0.894
G404	C - UA	Speciation Model	FALSE	75p	0	0	1.00	0	2.00	0	0	0	1.67	0.645
G405	C - UA	Speciation Model	FALSE	75p	0	0	1.00	0	2.00	0	0	0	2.00	0.746
G406	C - UA	Speciation Model	FALSE	75p	0	0	1.00	0	2.00	0	0	0	0.393	0.794
G401	C - UA	First Reaction	FALSE	75p	2.06e-07	2.06e-07	1.00	0.000829	2.00	-1.20e-03	0	0	0	0
G401	C - UA	Second Reaction	FALSE	75p	3.35e-07	1.29e-07	1.00	0.000564	2.00	-6.78e-04	0	0	0	0
G402	C - UA	First Reaction	FALSE	75p	1.37e-07	1.37e-07	1.00	0.000647	2.00	-8.56e-04	0	0	0	0
G402	C - UA	Second Reaction	FALSE	75p	2.61e-07	1.25e-07	1.00	0.000560	2.00	-6.73e-04	0	0	0	0
G404	C - UA	First Reaction	FALSE	75p	1.30e-07	1.30e-07	1.00	0.000759	2.00	-9.99e-04	0	0	0	0
G404	C - UA	Second Reaction	FALSE	75p	2.48e-07	1.17e-07	1.00	0.000601	2.00	-7.25e-04	0	0	0	0
G405	C - UA	First Reaction	FALSE	75p	1.45e-07	1.45e-07	1.00	0.000712	2.00	-8.92e-04	0	0	0	0
G405	C - UA	Second Reaction	FALSE	75p	2.66e-07	1.21e-07	1.00	0.000574	2.00	-6.77e-04	0	0	0	0
G406	C - UA	First Reaction	FALSE	75p	1.35e-07	1.35e-07	1.00	0.000755	2.00	-1.02e-03	0	0	0	0
G406	C - UA	Second Reaction	FALSE	75p	2.61e-07	1.27e-07	1.00	0.000559	2.00	-6.92e-04	0	0	0	0
G401	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	1.08	-3.05e-01
G402	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0.962	0.894
G404	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	1.67	0.645
G405	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	2.00	0.746
G406	C - UA	Initial Soln	FALSE	median	0	0	0	0	0	0	0	0	0.393	0.794
G401	C - UA	Speciation Model	FALSE	median	0	0	1.00	0	2.00	0	0	0	1.08	-3.05e-01
G402	C - UA	Speciation Model	FALSE	median	0	0	1.00	0	2.00	0	0	0	0.962	0.894
G404	C - UA	Speciation Model	FALSE	median	0	0	1.00	0	2.00	0	0	0	1.67	0.645
G405	C - UA	Speciation Model	FALSE	median	0	0	1.00	0	2.00	0	0	0	2.00	0.746
G406	C - UA	Speciation Model	FALSE	median	0	0	1.00	0	2.00	0	0	0	0.393	0.794
G401	C - UA	First Reaction	FALSE	median	2.02e-07	2.02e-07	1.00	0.000808	2.00	-1.16e-03	0	0	0	0
G401	C - UA	Second Reaction	FALSE	median	3.31e-07	1.29e-07	1.00	0.000558	2.00	-6.69e-04	0	0	0	0
G402	C - UA	First Reaction	FALSE	median	1.36e-07	1.36e-07	1.00	0.000640	2.00	-8.43e-04	0	0	0	0
G402	C - UA	Second Reaction	FALSE	median	2.61e-07	1.25e-07	1.00	0.000555	2.00	-6.65e-04	0	0	0	0
G404	C - UA	First Reaction	FALSE	median	1.29e-07	1.29e-07	1.00	0.000745	2.00	-9.77e-04	0	0	0	0
G404	C - UA	Second Reaction	FALSE	median	2.48e-07	1.19e-07	1.00	0.000593	2.00	-7.14e-04	0	0	0	0
G405	C - UA	First Reaction	FALSE	median	1.44e-07	1.44e-07	1.00	0.000700	2.00	-8.75e-04	0	0	0	0
G405	C - UA	Second Reaction	FALSE	median	2.66e-07	1.22e-07	1.00	0.000568	2.00	-6.69e-04	0	0	0	0
G406	C - UA	First Reaction	FALSE	median	1.34e-07	1.34e-07	1.00	0.000739	2.00	-9.92e-04	0	0	0	0
G406	C - UA	Second Reaction	FALSE	median	2.61e-07	1.27e-07	1.00	0.000553	2.00	-6.82e-04	0	0	0	0

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	si_Barite	si_Calcite	si_Dolomite(ordered)	si_Gypsum
G401	C - UA	Initial Soln	TRUE	25p	0.453	-1.81e+00	-3.92e+00	-4.99e-02
G402	C - UA	Initial Soln	TRUE	25p	0.388	-1.02e-01	-1.09e-01	-7.21e-01
G404	C - UA	Initial Soln	TRUE	25p	0.550	-4.83e-01	-1.03e+00	-6.24e-01
G405	C - UA	Initial Soln	TRUE	25p	0.334	-3.42e-01	-7.54e-01	-4.83e-01
G406	C - UA	Initial Soln	TRUE	25p	0.0996	-6.77e-01	-1.54e+00	-7.58e-01
G401	C - UA	Speciation Model	TRUE	25p	0.453	-1.81e+00	-3.92e+00	-4.99e-02
G402	C - UA	Speciation Model	TRUE	25p	0.388	-1.02e-01	-1.09e-01	-7.21e-01
G404	C - UA	Speciation Model	TRUE	25p	0.550	-4.83e-01	-1.03e+00	-6.24e-01
G405	C - UA	Speciation Model	TRUE	25p	0.334	-3.42e-01	-7.54e-01	-4.83e-01
G406	C - UA	Speciation Model	TRUE	25p	0.0996	-6.77e-01	-1.54e+00	-7.58e-01
G401	C - UA	First Reaction	TRUE	25p	0	0	0	-1.55e+00
G401	C - UA	Second Reaction	TRUE	25p	0	0	0	-1.68e+00
G402	C - UA	First Reaction	TRUE	25p	0	0	0	-1.66e+00
G402	C - UA	Second Reaction	TRUE	25p	0	0	0	-1.69e+00
G404	C - UA	First Reaction	TRUE	25p	0	0	0	-1.67e+00
G404	C - UA	Second Reaction	TRUE	25p	0	0	0	-1.69e+00
G405	C - UA	First Reaction	TRUE	25p	0	0	0	-1.66e+00
G405	C - UA	Second Reaction	TRUE	25p	0	0	0	-1.69e+00
G406	C - UA	First Reaction	TRUE	25p	0	0	0	-1.65e+00
G406	C - UA	Second Reaction	TRUE	25p	0	0	0	-1.68e+00
G401	C - UA	Initial Soln	TRUE	75p	0.453	-1.81e+00	-3.92e+00	-4.99e-02
G402	C - UA	Initial Soln	TRUE	75p	0.388	-1.02e-01	-1.09e-01	-7.21e-01
G404	C - UA	Initial Soln	TRUE	75p	0.550	-4.83e-01	-1.03e+00	-6.24e-01
G405	C - UA	Initial Soln	TRUE	75p	0.334	-3.42e-01	-7.54e-01	-4.83e-01
G406	C - UA	Initial Soln	TRUE	75p	0.0996	-6.77e-01	-1.54e+00	-7.58e-01
G401	C - UA	Speciation Model	TRUE	75p	0.453	-1.81e+00	-3.92e+00	-4.99e-02
G402	C - UA	Speciation Model	TRUE	75p	0.388	-1.02e-01	-1.09e-01	-7.21e-01
G404	C - UA	Speciation Model	TRUE	75p	0.550	-4.83e-01	-1.03e+00	-6.24e-01
G405	C - UA	Speciation Model	TRUE	75p	0.334	-3.42e-01	-7.54e-01	-4.83e-01
G406	C - UA	Speciation Model	TRUE	75p	0.0996	-6.77e-01	-1.54e+00	-7.58e-01
G401	C - UA	First Reaction	TRUE	75p	0	0	0	-1.50e+00
G401	C - UA	Second Reaction	TRUE	75p	0	0	0	-1.68e+00
G402	C - UA	First Reaction	TRUE	75p	0	0	0	-1.65e+00
G402	C - UA	Second Reaction	TRUE	75p	0	0	0	-1.69e+00
G404	C - UA	First Reaction	TRUE	75p	0	0	0	-1.65e+00
G404	C - UA	Second Reaction	TRUE	75p	0	0	0	-1.70e+00
G405	C - UA	First Reaction	TRUE	75p	0	0	0	-1.64e+00
G405	C - UA	Second Reaction	TRUE	75p	0	0	0	-1.69e+00
G406	C - UA	First Reaction	TRUE	75p	0	0	0	-1.64e+00
G406	C - UA	Second Reaction	TRUE	75p	0	0	0	-1.68e+00
G401	C - UA	Initial Soln	TRUE	median	0.453	-1.81e+00	-3.92e+00	-4.99e-02
G402	C - UA	Initial Soln	TRUE	median	0.388	-1.02e-01	-1.09e-01	-7.21e-01
G404	C - UA	Initial Soln	TRUE	median	0.550	-4.83e-01	-1.03e+00	-6.24e-01
G405	C - UA	Initial Soln	TRUE	median	0.334	-3.42e-01	-7.54e-01	-4.83e-01
G406	C - UA	Initial Soln	TRUE	median	0.0996	-6.77e-01	-1.54e+00	-7.58e-01
G401	C - UA	Speciation Model	TRUE	median	0.453	-1.81e+00	-3.92e+00	-4.99e-02
G402	C - UA	Speciation Model	TRUE	median	0.388	-1.02e-01	-1.09e-01	-7.21e-01
G404	C - UA	Speciation Model	TRUE	median	0.550	-4.83e-01	-1.03e+00	-6.24e-01
G405	C - UA	Speciation Model	TRUE	median	0.334	-3.42e-01	-7.54e-01	-4.83e-01
G406	C - UA	Speciation Model	TRUE	median	0.0996	-6.77e-01	-1.54e+00	-7.58e-01
G401	C - UA	First Reaction	TRUE	median	0	0	0	-1.52e+00
G401	C - UA	Second Reaction	TRUE	median	0	0	0	-1.68e+00
G402	C - UA	First Reaction	TRUE	median	0	0	0	-1.65e+00
G402	C - UA	Second Reaction	TRUE	median	0	0	0	-1.69e+00
G404	C - UA	First Reaction	TRUE	median	0	0	0	-1.66e+00
G404	C - UA	Second Reaction	TRUE	median	0	0	0	-1.69e+00
G405	C - UA	First Reaction	TRUE	median	0	0	0	-1.65e+00
G405	C - UA	Second Reaction	TRUE	median	0	0	0	-1.69e+00
G406	C - UA	First Reaction	TRUE	median	0	0	0	-1.64e+00
G406	C - UA	Second Reaction	TRUE	median	0	0	0	-1.68e+00
G401	C - UA	Initial Soln	FALSE	25p	0.457	-1.80e+00	-3.91e+00	-4.73e-02
G402	C - UA	Initial Soln	FALSE	25p	0.406	-9.06e-02	-8.64e-02	-7.06e-01
G404	C - UA	Initial Soln	FALSE	25p	0.559	-4.79e-01	-1.02e+00	-6.17e-01
G405	C - UA	Initial Soln	FALSE	25p	0.344	-3.37e-01	-7.44e-01	-4.75e-01
G406	C - UA	Initial Soln	FALSE	25p	0.115	-6.68e-01	-1.52e+00	-7.46e-01
G401	C - UA	Speciation Model	FALSE	25p	0.457	-1.80e+00	-3.91e+00	-4.73e-02
G402	C - UA	Speciation Model	FALSE	25p	0.406	-9.06e-02	-8.64e-02	-7.06e-01
G404	C - UA	Speciation Model	FALSE	25p	0.559	-4.79e-01	-1.02e+00	-6.17e-01
G405	C - UA	Speciation Model	FALSE	25p	0.344	-3.37e-01	-7.44e-01	-4.75e-01
G406	C - UA	Speciation Model	FALSE	25p	0.115	-6.68e-01	-1.52e+00	-7.46e-01
G401	C - UA	First Reaction	FALSE	25p	0	0	0	-1.55e+00
G401	C - UA	Second Reaction	FALSE	25p	0	0	0	-1.68e+00

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond No. 2
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	si_Barite	si_Calcite	si_Dolomite(ordered)	si_Gypsum
G402	C - UA	First Reaction	FALSE	25p	0	0	0	-1.66e+00
G402	C - UA	Second Reaction	FALSE	25p	0	0	0	-1.69e+00
G404	C - UA	First Reaction	FALSE	25p	0	0	0	-1.67e+00
G404	C - UA	Second Reaction	FALSE	25p	0	0	0	-1.69e+00
G405	C - UA	First Reaction	FALSE	25p	0	0	0	-1.66e+00
G405	C - UA	Second Reaction	FALSE	25p	0	0	0	-1.69e+00
G406	C - UA	First Reaction	FALSE	25p	0	0	0	-1.66e+00
G406	C - UA	Second Reaction	FALSE	25p	0	0	0	-1.68e+00
G401	C - UA	Initial Soln	FALSE	75p	0.457	-1.80e+00	-3.91e+00	-4.73e-02
G402	C - UA	Initial Soln	FALSE	75p	0.406	-9.06e-02	-8.64e-02	-7.06e-01
G404	C - UA	Initial Soln	FALSE	75p	0.559	-4.79e-01	-1.02e+00	-6.17e-01
G405	C - UA	Initial Soln	FALSE	75p	0.344	-3.37e-01	-7.44e-01	-4.75e-01
G406	C - UA	Initial Soln	FALSE	75p	0.115	-6.68e-01	-1.52e+00	-7.46e-01
G401	C - UA	Speciation Model	FALSE	75p	0.457	-1.80e+00	-3.91e+00	-4.73e-02
G402	C - UA	Speciation Model	FALSE	75p	0.406	-9.06e-02	-8.64e-02	-7.06e-01
G404	C - UA	Speciation Model	FALSE	75p	0.559	-4.79e-01	-1.02e+00	-6.17e-01
G405	C - UA	Speciation Model	FALSE	75p	0.344	-3.37e-01	-7.44e-01	-4.75e-01
G406	C - UA	Speciation Model	FALSE	75p	0.115	-6.68e-01	-1.52e+00	-7.46e-01
G401	C - UA	First Reaction	FALSE	75p	0	0	0	-1.51e+00
G401	C - UA	Second Reaction	FALSE	75p	0	0	0	-1.68e+00
G402	C - UA	First Reaction	FALSE	75p	0	0	0	-1.65e+00
G402	C - UA	Second Reaction	FALSE	75p	0	0	0	-1.69e+00
G404	C - UA	First Reaction	FALSE	75p	0	0	0	-1.66e+00
G404	C - UA	Second Reaction	FALSE	75p	0	0	0	-1.70e+00
G405	C - UA	First Reaction	FALSE	75p	0	0	0	-1.65e+00
G405	C - UA	Second Reaction	FALSE	75p	0	0	0	-1.69e+00
G406	C - UA	First Reaction	FALSE	75p	0	0	0	-1.64e+00
G406	C - UA	Second Reaction	FALSE	75p	0	0	0	-1.68e+00
G401	C - UA	Initial Soln	FALSE	median	0.457	-1.80e+00	-3.91e+00	-4.73e-02
G402	C - UA	Initial Soln	FALSE	median	0.406	-9.06e-02	-8.64e-02	-7.06e-01
G404	C - UA	Initial Soln	FALSE	median	0.559	-4.79e-01	-1.02e+00	-6.17e-01
G405	C - UA	Initial Soln	FALSE	median	0.344	-3.37e-01	-7.44e-01	-4.75e-01
G406	C - UA	Initial Soln	FALSE	median	0.115	-6.68e-01	-1.52e+00	-7.46e-01
G401	C - UA	Speciation Model	FALSE	median	0.457	-1.80e+00	-3.91e+00	-4.73e-02
G402	C - UA	Speciation Model	FALSE	median	0.406	-9.06e-02	-8.64e-02	-7.06e-01
G404	C - UA	Speciation Model	FALSE	median	0.559	-4.79e-01	-1.02e+00	-6.17e-01
G405	C - UA	Speciation Model	FALSE	median	0.344	-3.37e-01	-7.44e-01	-4.75e-01
G406	C - UA	Speciation Model	FALSE	median	0.115	-6.68e-01	-1.52e+00	-7.46e-01
G401	C - UA	First Reaction	FALSE	median	0	0	0	-1.52e+00
G401	C - UA	Second Reaction	FALSE	median	0	0	0	-1.68e+00
G402	C - UA	First Reaction	FALSE	median	0	0	0	-1.65e+00
G402	C - UA	Second Reaction	FALSE	median	0	0	0	-1.69e+00
G404	C - UA	First Reaction	FALSE	median	0	0	0	-1.66e+00
G404	C - UA	Second Reaction	FALSE	median	0	0	0	-1.69e+00
G405	C - UA	First Reaction	FALSE	median	0	0	0	-1.65e+00
G405	C - UA	Second Reaction	FALSE	median	0	0	0	-1.69e+00
G406	C - UA	First Reaction	FALSE	median	0	0	0	-1.65e+00
G406	C - UA	Second Reaction	FALSE	median	0	0	0	-1.68e+00

NOTES:
All model results are in units of moles with the exceptions of:
pH and pe (standard units)
charge (equivalents)
Results beginning with 'd_' (change from prior model step)
Results beginning with 'si_' (saturation index)

APPENDIX B
DRAWINGS AND MATERIAL SPECIFICATIONS FOR SELECTED REMEDY

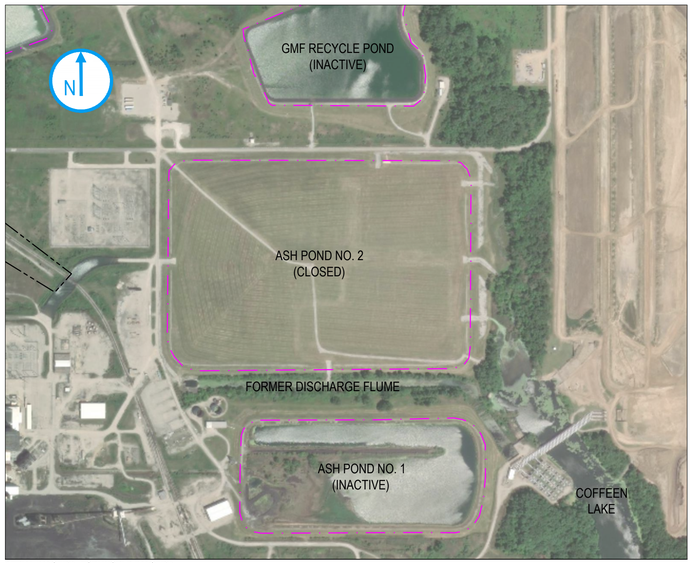
SAVED: 6/3/25 9:57 AM

CORRECTIVE ACTION PERMIT-LEVEL DESIGN

COFFEEN ASH POND NO. 2

COFFEEN POWER PLANT, COFFEEN, IL

HORIZONTAL GROUNDWATER EXTRACTION (GWE) WELL

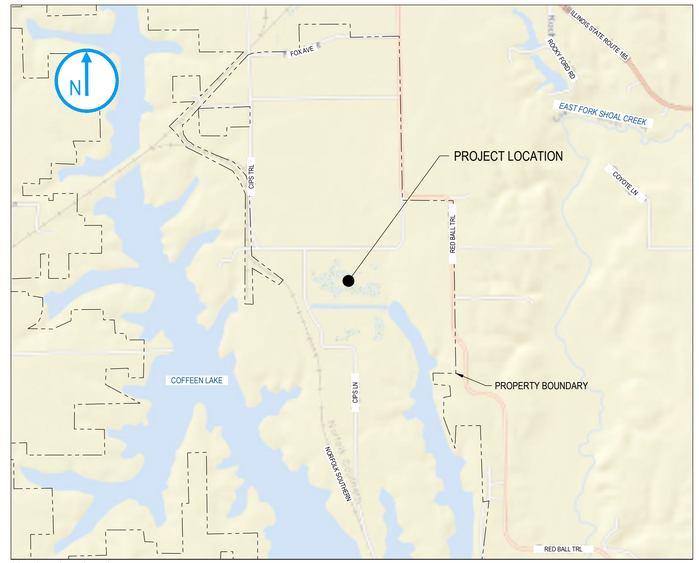


AERIAL IMAGERY: ESRI WORLD IMAGERY

LOCATION MAP

500' 0 500'

SCALE: 1"=500'



SOURCE: ESRI WORLD STREET MAP

VICINITY MAP

2000' 0 2000'

SCALE: 1"=2000'

SHEET INDEX

GENERAL	
G-000	COVER
CIVIL	
C-101	OVERALL SITE PLAN
C-201	ENLARGED PLAN AND PROFILE
C-401	AIR COMPRESSOR EXTRACTION PUMP SHED SCHEMATIC

ILLINOIS POWER GENERATING COMPANY

COFFEEN POWER PLANT

134 CIPS LANE, COFFEEN, IL 62017

JUNE 2025

RAMBOLL

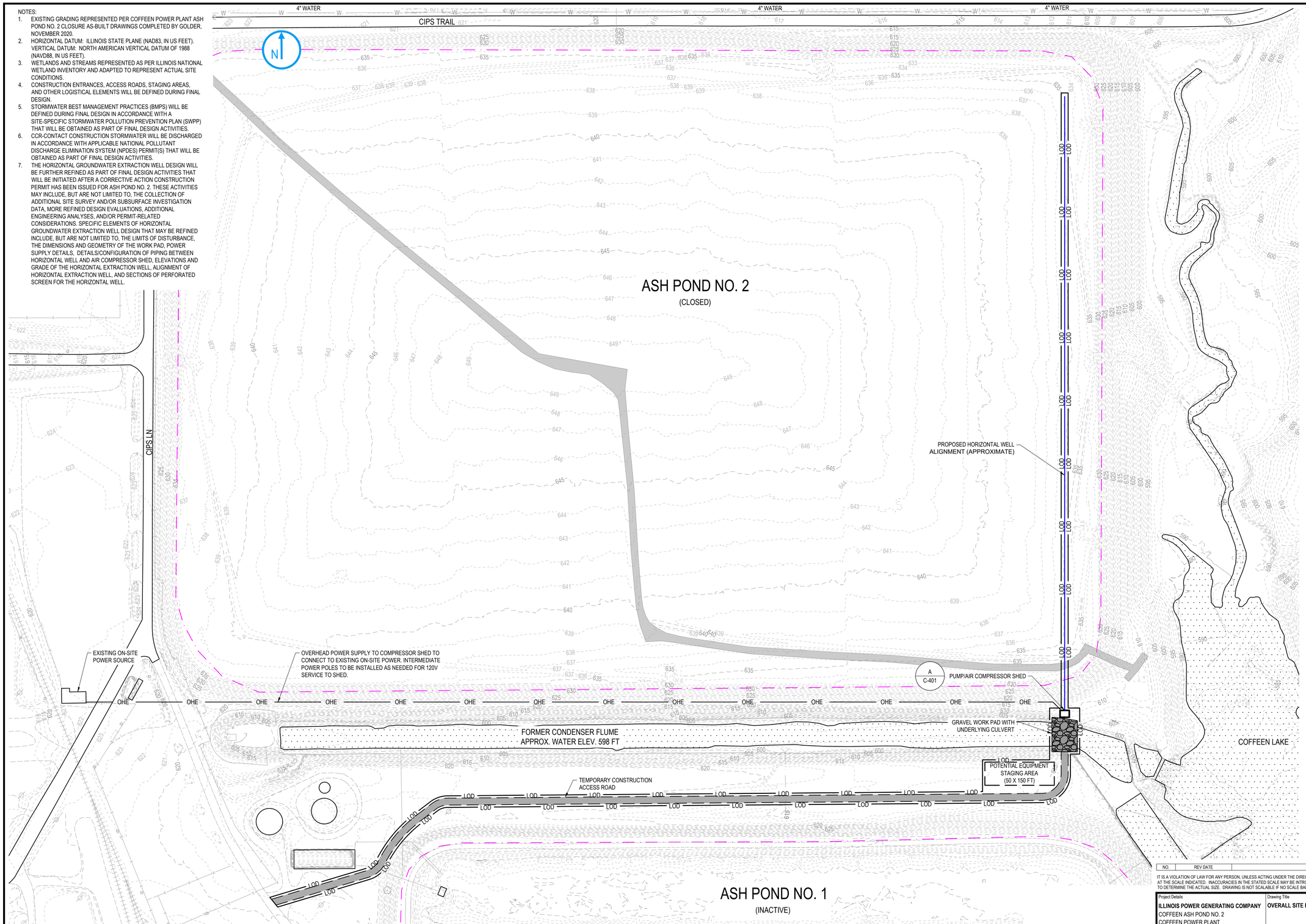
RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

C:\DC\ACCDOC\SR\AMBOLL GRUPPEN AS\RUS-1940106781-004 VISTRA - COFFEEN AP2\PROJECT FILES\4 DELIVERY\40 WIP\401 CIVIL\DRAWINGS\G-000_COF-AP2.DWG

1940110241-001

NOTES:

1. EXISTING GRADING REPRESENTED PER COFFEEN POWER PLANT ASH POND NO. 2 CLOSURE AS-BUILT DRAWINGS COMPLETED BY GOLDER, NOVEMBER 2020.
2. HORIZONTAL DATUM: ILLINOIS STATE PLANE (NAD83, IN US FEET). VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88, IN US FEET).
3. WETLANDS AND STREAMS REPRESENTED AS PER ILLINOIS NATIONAL WETLAND INVENTORY AND ADAPTED TO REPRESENT ACTUAL SITE CONDITIONS.
4. CONSTRUCTION ENTRANCES, ACCESS ROADS, STAGING AREAS, AND OTHER LOGISTICAL ELEMENTS WILL BE DEFINED DURING FINAL DESIGN.
5. STORMWATER BEST MANAGEMENT PRACTICES (BMPS) WILL BE DEFINED DURING FINAL DESIGN IN ACCORDANCE WITH A SITE-SPECIFIC STORMWATER POLLUTION PREVENTION PLAN (SWPP) THAT WILL BE OBTAINED AS PART OF FINAL DESIGN ACTIVITIES.
6. CCR-CONTACT CONSTRUCTION STORMWATER WILL BE DISCHARGED IN ACCORDANCE WITH APPLICABLE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT(S) THAT WILL BE OBTAINED AS PART OF FINAL DESIGN ACTIVITIES.
7. THE HORIZONTAL GROUNDWATER EXTRACTION WELL DESIGN WILL BE FURTHER REFINED AS PART OF FINAL DESIGN ACTIVITIES THAT WILL BE INITIATED AFTER A CORRECTIVE ACTION CONSTRUCTION PERMIT HAS BEEN ISSUED FOR ASH POND NO. 2. THESE ACTIVITIES MAY INCLUDE, BUT ARE NOT LIMITED TO, THE COLLECTION OF ADDITIONAL SITE SURVEY AND/OR SUBSURFACE INVESTIGATION DATA, MORE REFINED DESIGN EVALUATIONS, ADDITIONAL ENGINEERING ANALYSES, AND/OR PERMIT-RELATED CONSIDERATIONS. SPECIFIC ELEMENTS OF HORIZONTAL GROUNDWATER EXTRACTION WELL DESIGN THAT MAY BE REFINED INCLUDE, BUT ARE NOT LIMITED TO, THE LIMITS OF DISTURBANCE, THE DIMENSIONS AND GEOMETRY OF THE WORK PAD, POWER SUPPLY DETAILS, DETAILS/CONFIGURATION OF PIPING BETWEEN HORIZONTAL WELL AND AIR COMPRESSOR SHED, ELEVATIONS AND GRADE OF THE HORIZONTAL EXTRACTION WELL, ALIGNMENT OF HORIZONTAL EXTRACTION WELL, AND SECTIONS OF PERFORATED SCREEN FOR THE HORIZONTAL WELL.



OVERALL SITE PLAN

100' 0 100'
SCALE: 1"=100'

LEGEND

EXISTING

- MAJOR CONTOUR
- MINOR CONTOUR
- APPROXIMATE SITE BOUNDARY
- APPROXIMATE LIMITS OF CCR UNITS
- BODY OF WATER (LAKE, POND, RAVINE, ETC.)
- GRAVEL ACCESS ROAD
- RAILROAD
- FENCE
- GUARDRAIL
- SEWER - GRAVITY, AND MANHOLE
- SEWER - FORCEMAIN
- STORMDRAIN, AND CULVERT
- WATERMAIN
- UNDERGROUND ELECTRICAL
- OVERHEAD ELECTRICAL
- UTILITY POLE
- LIGHT POLE

CORRECTIVE ACTION CONSTRUCTION

- STAGING AREA
- STRUCTURE
- GRAVEL WORK PAD
- ACCESS ROAD
- OVERHEAD ELECTRICAL
- HORIZONTAL WELL ALIGNMENT (APPROXIMATE)
- LIMITS OF DISTURBANCE

100' 0 100' 200'
SCALE IN FEET

NO.	REV DATE	REVISION	INT.

IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED ENGINEER, TO ALTER THIS DOCUMENT. THIS DRAWING WAS PREPARED AT THE SCALE INDICATED. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR TO DETERMINE THE ACTUAL SIZE. DRAWING IS NOT SCALABLE IF NO SCALE BAR IS PRESENT.

Project Details
ILLINOIS POWER GENERATING COMPANY
COFFEEN ASH POND NO. 2
COFFEEN POWER PLANT
134 CIPS LANE, COFFEEN, IL 62017

Drawing Title
OVERALL SITE PLAN

RAMBOLL
RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.
234 W. FLORIDA ST.
MILWAUKEE, WI 53204
414-837-3607

Location:

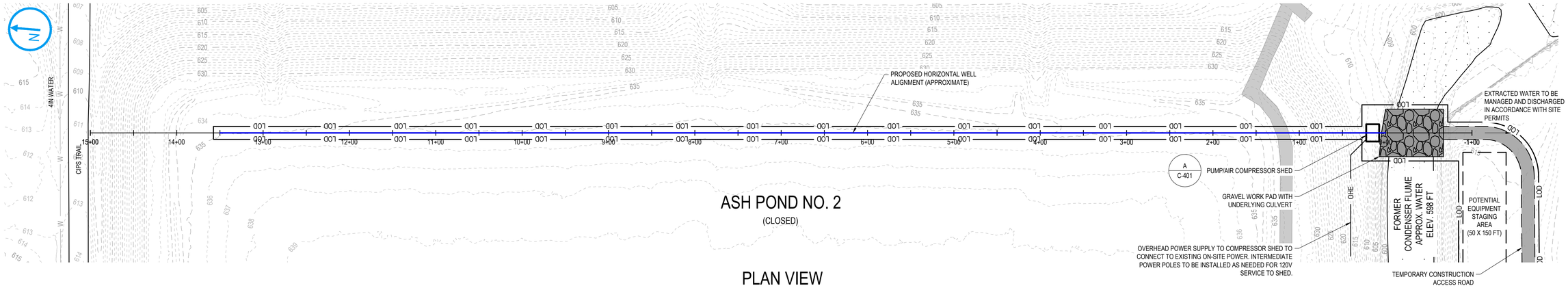
Designer / Professional Engineer Responsible: J. BOND

Project Number	Designed by	Drawn by	Checked by	Approved by	Date
1940110241-001	K. NOHR	B. LEMMON	S. SLAGLE-GARRETT	J. BOND	JUNE 2025

Project Status	Drawing Number	Scale	Sc	Rev.
CORRECTIVE ACTION PERMIT-LEVEL DESIGN	C-101	AS NOTED	x	x

SAVED: 6/4/25 12:14 PM
C:\DC\ACCDOCS\RAMBOLL GRUPPEN AS\RUS-1940106781-004 VISTRA - COFFEEN AP2\PROJECT FILES\4 DELIVERY\40 WIP\401 CIVIL\DRAWINGS\C-101_COF-AP2.DWG

SAVED: 6/4/25 2:54 PM



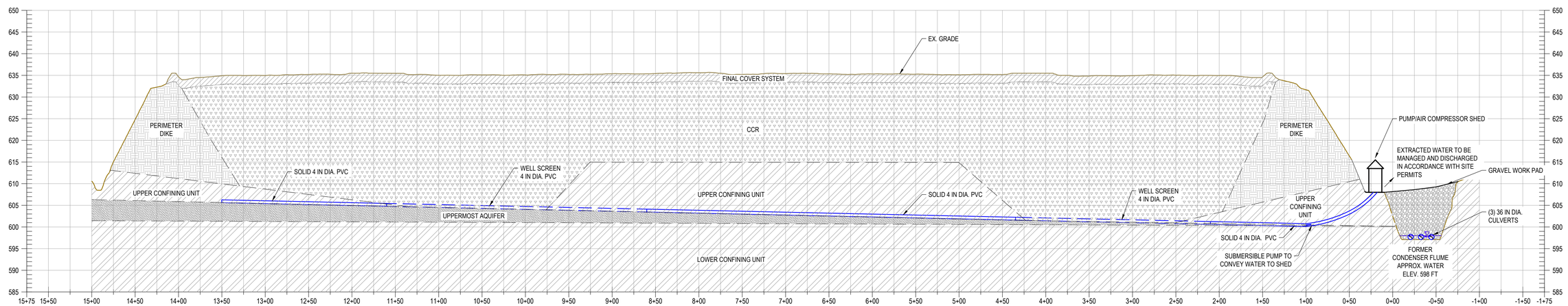
ASH POND NO. 2

(CLOSED)

PLAN VIEW

60' 0 60'

SCALE: 1"=60'



PROFILE STATION 0+00 TO 13+50

60' 0 60' — SCALE HORZ. 1" = 60'

12' 0 12' — SCALE: VERT. 1"=12'

NOTE: HORIZONTAL WELL FEATURES DRAWN NOT TO SCALE.
LITHOLOGIC CONTACTS ARE APPROXIMATE.

LEGEND

EXISTING

360	MAJOR CONTOUR	S	SEWER - GRAVITY, AND MANHOLE
358	MINOR CONTOUR	SF SF	SEWER - FORCEMAIN
	APPROXIMATE SITE BOUNDARY		STORMDRAIN, AND CULVERT
	BODY OF WATER (LAKE, POND, RAVINE, ETC.)	W	WATERMAIN
	GRAVEL ACCESS ROAD	UE	UNDERGROUND ELECTRICAL
X X	FENCE	OHE	OVERHEAD ELECTRICAL
	GUARDRAIL		UTILITY POLE
			LIGHT POLE

CORRECTIVE ACTION CONSTRUCTION

	STAGING AREA
	STRUCTURE
	GRAVEL WORK PAD
	ACCESS ROAD
OHE	OVERHEAD ELECTRICAL
	HORIZONTAL WELL ALIGNMENT (APPROXIMATE)
LOD	LIMITS OF DISTURBANCE

NOTES:

1. EXISTING GRADING REPRESENTED PER COFFEEN POWER PLANT ASH POND NO. 2 CLOSURE AS-BUILT DRAWINGS COMPLETED BY GOLDER, NOVEMBER 2020.
2. HORIZONTAL DATUM: ILLINOIS STATE PLANE (NAD83, IN US FEET).
3. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88, IN US FEET).
4. SUBSURFACE INTERFACES BETWEEN DIFFERENT UNITS ARE APPROXIMATE AND BASED ON DATA FROM THE "HYDROGEOLOGIC SITE CHARACTERIZATION REPORT, ASH POND 2, COFFEEN POWER STATION" PREPARED BY NATURAL RESOURCE TECHNOLOGY, DATED JANUARY 24, 2017.
5. THE HORIZONTAL WELL ALIGNMENT, INCLUDING ELEVATIONS AND SCREENED INTERVALS, IS APPROXIMATE AND WILL ALSO BE ADJUSTED BASED ON FUTURE SUBSURFACE INVESTIGATION PROGRAMS.
6. CONSTRUCTION ENTRANCES, ACCESS ROADS, STAGING AREAS, AND OTHER LOGISTICAL ELEMENTS WILL BE DEFINED DURING FINAL DESIGN.
7. STORMWATER BEST MANAGEMENT PRACTICES (BMPS) WILL BE DEFINED DURING FINAL DESIGN IN ACCORDANCE WITH A SITE-SPECIFIC STORMWATER POLLUTION PREVENTION PLAN (SWPP) THAT WILL BE OBTAINED AS PART OF FINAL DESIGN ACTIVITIES.
8. CCR-CONTACT CONSTRUCTION STORMWATER WILL BE DISCHARGED IN ACCORDANCE WITH APPLICABLE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT(S) THAT WILL BE OBTAINED AS PART OF FINAL DESIGN ACTIVITIES. CCR GENERATED AS PART OF WELL INSTALLATION WILL BE DISPOSED OF IN ON-SITE LANDFILL. DETAILS TO BE DEFINED DURING LATER DESIGN STAGES.
9. THE HORIZONTAL GROUNDWATER EXTRACTION WELL DESIGN WILL BE FURTHER REFINED AS PART OF FINAL DESIGN ACTIVITIES THAT WILL BE INITIATED AFTER A CORRECTIVE ACTION CONSTRUCTION PERMIT HAS BEEN ISSUED FOR ASH POND NO. 2. THESE ACTIVITIES MAY INCLUDE, BUT ARE NOT LIMITED TO, THE COLLECTION OF ADDITIONAL SITE SURVEY AND/OR SUBSURFACE INVESTIGATION DATA, MORE REFINED DESIGN EVALUATIONS, ADDITIONAL ENGINEERING ANALYSES, AND/OR PERMIT-RELATED CONSIDERATIONS. SPECIFIC ELEMENTS OF HORIZONTAL GROUNDWATER EXTRACTION WELL DESIGN THAT MAY BE REFINED INCLUDE, BUT ARE NOT LIMITED TO, THE LIMITS OF DISTURBANCE, THE DIMENSIONS AND GEOMETRY OF THE WORK PAD, POWER SUPPLY DETAILS, DETAILS/CONFIGURATION OF PIPING BETWEEN HORIZONTAL WELL AND AIR COMPRESSOR SHED, ELEVATIONS AND GRADE OF THE HORIZONTAL EXTRACTION WELL, ALIGNMENT OF HORIZONTAL EXTRACTION WELL, AND SECTIONS OF PERFORATED SCREEN FOR THE HORIZONTAL WELL.
10. A CONCRETE PAD AND VAULT WILL BE CONSTRUCTED AT GROUND SURFACE AT THE ENTRY POINT FOR THE HORIZONTAL WELL AND WILL BE SEALED WITH GROUT.
11. WORK PAD BACKFILL SHOULD BE IDOT CA-2, CA-4, OR CA-6 GRAVEL, IN ACCORDANCE WITH ARTICLE 1004 OF THE 2022 IDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION.
12. CULVERTS SHOULD BE PRECAST, REINFORCED CONCRETE CULVERT PIPE WITH FLARED END SECTIONS IN ACCORDANCE WITH ARTICLE 1042 OF THE 2022 IDOT STANDARD SPECIFICATION, OF A SUFFICIENT DIAMETER AND NUMBER TO ALLOW STORMWATER FLOWS DURING A 100-YEAR, 24-HOUR STORM EVENT TO PASS THROUGH THE FORMER CONDENSER FLUME.

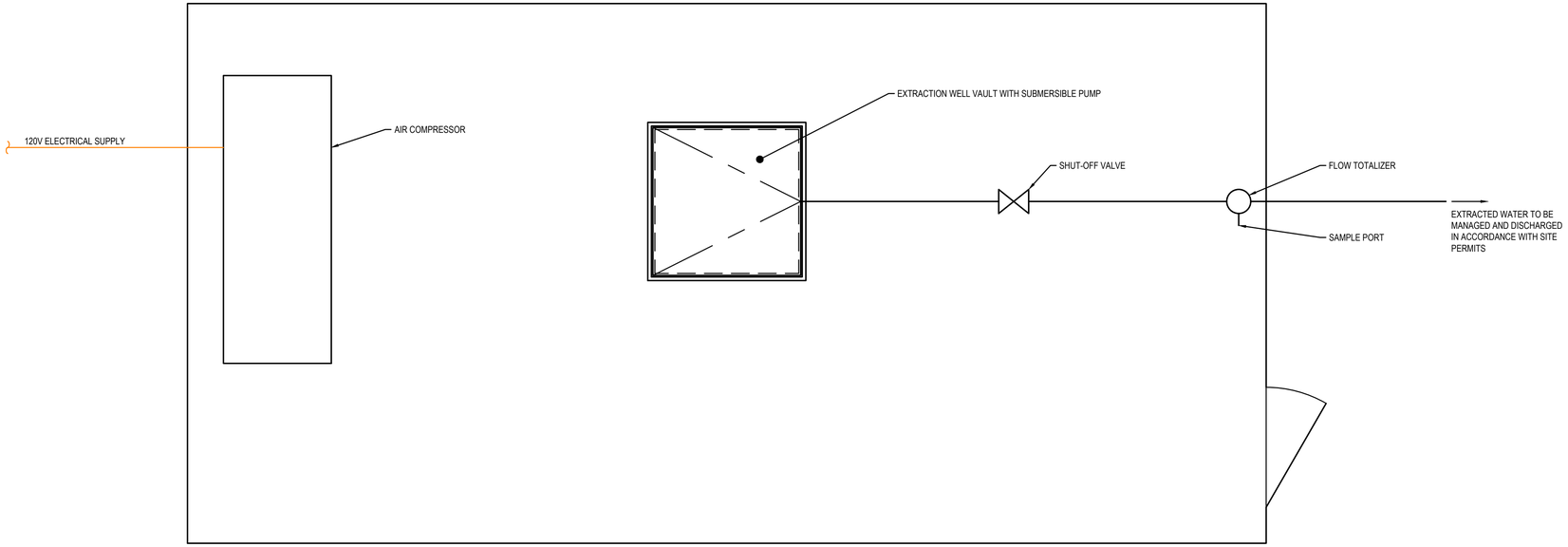
NO.	REV DATE	REVISION	INT.

IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED ENGINEER, TO ALTER THIS DOCUMENT. THIS DRAWING WAS PREPARED AT THE SCALE INDICATED. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR TO DETERMINE THE ACTUAL SIZE. DRAWING IS NOT SCALABLE IF NO SCALE BAR IS PRESENT.

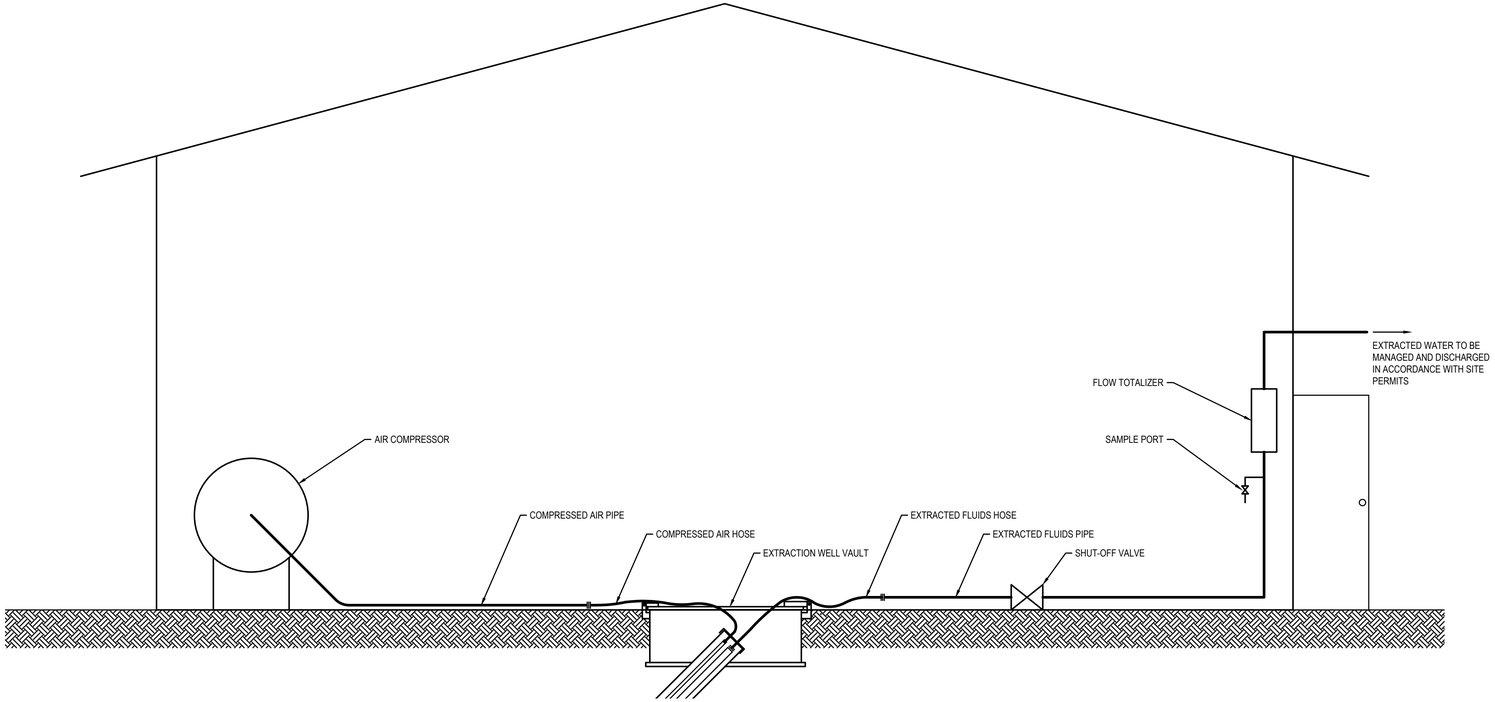
Project Details **ILLINOIS POWER GENERATING COMPANY** COFFEEN ASH POND NO. 2 COFFEEN POWER PLANT 134 CIPS LANE, COFFEEN, IL 62017	Drawing Title **ENLARGED PLAN AND PROFILE**			RAMBOLL **RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.** 234 W. FLORIDA ST, MILWAUKEE, WI 53204 414-837-3607	
Location:	Designer / Professional Engineer Responsible: J. BOND				
Project Number **1940110241-001**	Designed by K. NOHR	Drawn by B. LEMMON	Checked by S. SLAGLE-GARRETT	Approved by J. BOND	Date JUNE 2025
Project Status CORRECTIVE ACTION PERMIT-LEVEL DESIGN	Drawing Number **C-201**			Scale AS NOTED	Sc. x / Rev. x

C:\DCAC\DOCS\RAMBOLL GRUPPEN AS\RUS-1940106781-004 VISTRA - COFFEEN AP2\PROJECT FILES\4 DELIVERY\40 WIP\401 CIVIL\DRAWING\SC-201_CCP-AP2.DWG

SAVED: 6/4/25 12:25 PM



TOP PLAN



FRONT ELEVATION

A

AIR COMPRESSOR/EXTRACTION PUMP SHED SCHEMATIC

NOT TO SCALE

NO.	REV DATE	REVISION	INT.

IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED ENGINEER, TO ALTER THIS DOCUMENT. THIS DRAWING WAS PREPARED AT THE SCALE INDICATED. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR TO DETERMINE THE ACTUAL SIZE. DRAWING IS NOT SCALABLE IF NO SCALE BAR IS PRESENT.

Project Details
ILLINOIS POWER GENERATING COMPANY
COFFEEN ASH POND NO. 2
COFFEEN POWER PLANT
134 CIPS LANE, COFFEEN, IL 62017

Location:

Drawing Title
AIR COMPRESSOR/ EXTRACTION PUMP SHED SCHEMATIC

Designer / Professional Engineer Responsible:
J. BOND

RAMBOLL
RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.
234 W. FLORIDA ST,
MILWAUKEE, WI 53204
414-837-3607

Project Number	Designed by	Drawn by	Checked by	Approved by	Date
1940110241-001	K. NOHR	B. LEMMON	S. SLAGLE-GARRETT	J. BOND	JUNE 2025

Project Status	Drawing Number	Scale	Sc	Rev.
CORRECTIVE ACTION PERMIT-LEVEL DESIGN	**C-401**	AS NOTED	x	x

C:\DC\ACCDOCS\RAMBOLL GRUPPEN AS\RUS-1940110781-004 VISTRA - COFFEEN AP2\PROJECT FILES\4 DELIVERY\40 WIP\401 CIVIL\DRAWING\SC-401_COF-AP2.DWG

APPENDIX H
PUBLIC NOTIFICATION AND PUBLIC MEETING CERTIFICATION (845.220(a)(9))

Coffeen Public Meeting Summary, May 1, 2025

On April 1, 2025, Illinois Power Generating Company ("IPGC") made available to the public its proposed plans to implement corrective action at the previously closed Ash Pond No. 2 located at the Coffeen Power Plant. On Wednesday, May 1, 2025 IPGC held in-person public meetings at 3:00 pm and 5:00 pm at the East Fork Township Building in Coffeen, IL to present its decision-making process. A discussion of the corrective measures assessment and corrective action alternatives analysis, including an objective comparison of pros and cons and projected groundwater impacts for each of the alternatives, was presented at these meetings. During the question-and-answer portion of the meetings, the public asked questions relating to the proposed remedial measures which the company addressed. As required by Section 845.240(g), this document provides a general summary of the issues or comments raised by the public relating to the closure, a summary of the company's responses to those issues or comments, and a summary of any revisions or changes made to the proposed corrective action as a result of issues and comments raised by the public. This document also provides as required by 845.240(f)(3), written responses to the questions not addressed during the public meetings.

Issue/Topic		Summary of Response Provided at Meeting	Additional Written Response
1.	Closure Method	The purpose of the current public meeting is to discuss the corrective action evaluation for groundwater remediation at Ash Pond No. 2. Ash Pond No. 2, containing predominantly fly ash, was closed in 2020 with an IEPA approved cover system. Benefits of closure include removal of free liquids and the hydraulic head, and minimizing water infiltration into the impoundment. Closure was completed in accordance with a closure plan that meets regulations and was approved by IEPA in 2018. Groundwater protection standards will be met despite Ash Pond No. 2 being unlined, and there is no risk to human health and the environment.	
2.	Groundwater Impacts and Monitoring	A risk assessment confirmed that Ash Pond No. 2 is not adversely impacting human health and the environment; specifically Ash Pond No. 2 is not negatively impacting Coffeen Lake and does not present a risk to recreators of Coffeen Lake. The risk assessment did take into account consumption of locally caught fish.	

		No potable water wells are impacted. The geology at the site has been robustly characterized and the groundwater monitoring network comprehensively monitors all groundwater flow directions at appropriate depths. Our groundwater monitoring results indicate the following constituents were above groundwater protection standards: boron, sulfate, and total dissolved solids. The corrective action will reduce, to the maximum extent feasible, further releases and minimize further migration of CCR-derived constituents in groundwater until the groundwater protection standards are achieved. Adaptive site management action will be taken if the remedy performance does not correspond with the expected performance. Groundwater is required to be monitored quarterly for a minimum of 30 years beginning after closure to ensure conditions are as anticipated. Groundwater monitoring will continue until groundwater protection standards are met.	
3.	Corrective Action Plan	Corrective action will consist of a horizontal well approximately 1,300 feet along the east base of the unit. Construction activities will be managed in accordance with regulatory requirements to limit fugitive dust. Groundwater collected from the horizontal well will be treated on-site, monitored and discharged in accordance with the site's National Pollutant Discharge Elimination System (NPDES) permit, approved and implemented through IEPA. All applicable discharge limits to ensure protection of the lake will be met. Specific treatment of collected water will be designed once corrective action plans are approved.	

		The system will continue to be in operation until monitoring data shows groundwater protection standards are met and in conjunction with IEPA approval. Additional information and drawings are provided in the draft corrective action plan previously posted on IPGC publicly accessible website (noted below).	
4.	Working with IEPA	Previous closure of Ash Pond No. 2 was completed with IEPA approval. IPGC has submitted an operating permit application under Part 845 in 2021. No permit has been issued yet. As IEPA continues to implement Part 845, IPGC will continue to meet regulations.	
5.	More Information	Additional information about the items discussed in this Public Meeting can be found online. Data and documents for compliance with the Illinois CCR Rule: www.luminant.com/ccr/illinois-ccr/	

APPENDIX I
CONTRACTOR TRAINING CERTIFICATION
(45 ILCS 5/22.59(b)(4))

Dianna Tickner
Illinois Power Generating Company
1500 Eastport Plaza Drive
Collinsville, IL 62234

June 10, 2025

Illinois Environmental Protection Agency
DWPC – Permits MC # 15
ATTN: Part 845 Coal Combustion Residual Rule Submittal
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

Re: 415 ILCS 5/22.59(b)(4) Certification Statement
Coffeen Power Plant Ash Pond 2 (IEPA ID # W1350150004-02)

Dear Mr. Darin LeCrone:

For the above-referenced CCR surface impoundments and in accordance with 415 ILCS 5/22.59(b)(4), Illinois Power Generating Company certify that all contractors, subcontractors, and installers utilized to construct, install, modify, or close a CCR surface impoundment will be participants in a training program that is approved by and registered with the US Department of Labor's Employment and Training Administration and that includes instruction in the following: erosion control, environmental remediation, operation of heavy equipment and excavation.

Sincerely,
Illinois Power Generating Company

Dianna Tickner
Sr. Director, Decommissioning & Demolition