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 GMF Recycle Pond; IEPA ID # W1350150004-04

Dear Mr. LeCrone:

In accordance with 35 I.A.C. § 845.200, Illinois Power Generating Company (“IPGC”) is submitting a supplement to the previously submitted operating permit application for the Coffeen Power Plant GMF Recycle Pond (IEPA ID # W1350150004-04) to address the corrective action requirements of Part 845.

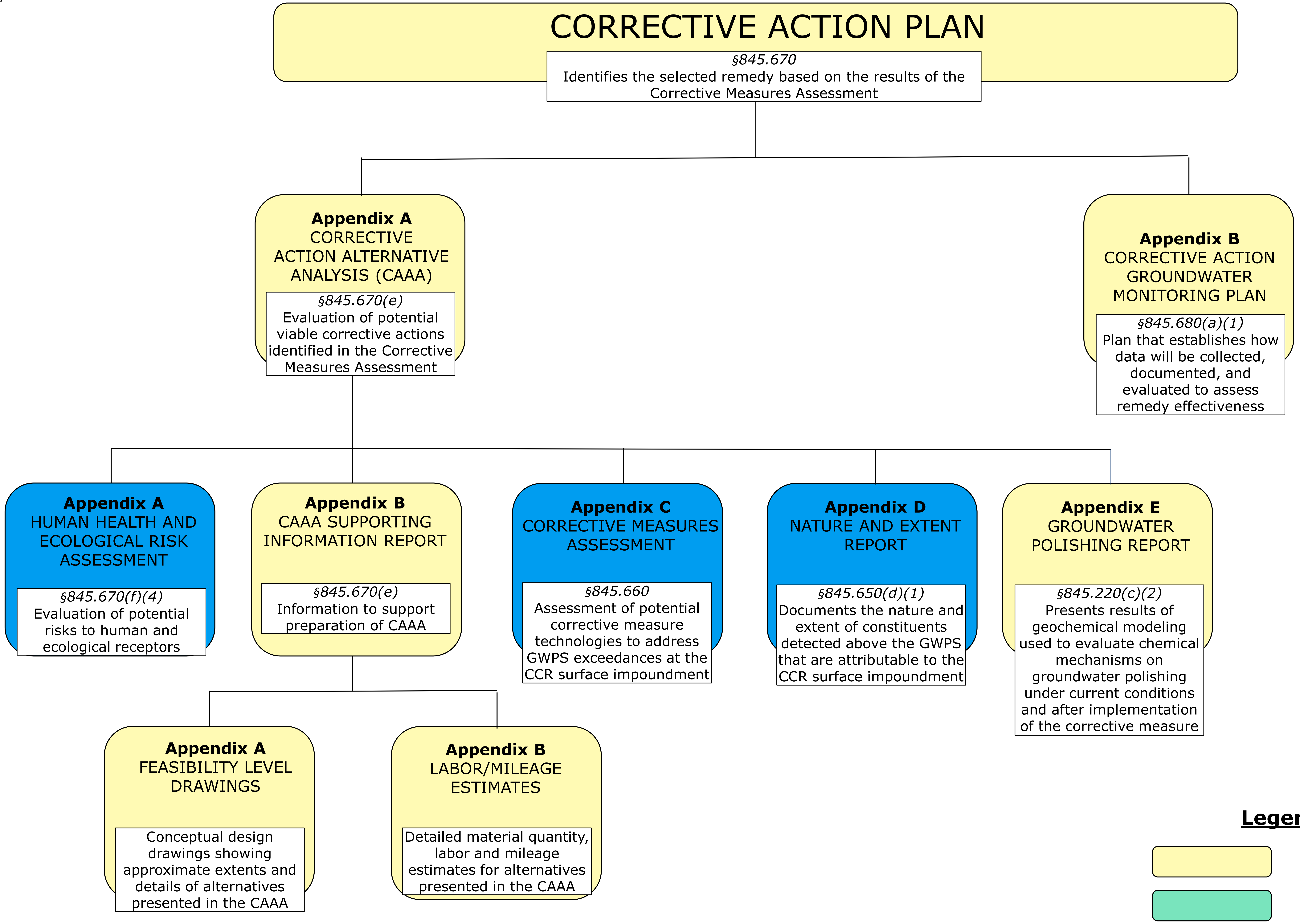
Coffeen previously submitted an operating permit application for Coffeen Power Plant GMF Recycle Pond on October 25, 2021. The enclosed supplemental information is being submitted in accordance with 35 I.A.C. § 845.200(a)(3) in order to “[modify] the facility’s operating permit when the approved corrective action does not require the modification of the CCR surface impoundment.” This amendment includes a corrective action plan containing corrective action alternatives analysis and corrective action groundwater monitoring program. One hardcopy is provided with this submittal.

Sincerely,

Phil Morris
Sr. Director, Environmental

Enclosures

Visual Road Map for Corrective Action
Supplement to Operating Permit Application
Coffeen Power Plant, GMF Recycle Pond
Coffeen, IL



CORRECTIVE ACTION PLAN

§845.670
Identifies the selected remedy based on the results of the Corrective Measures Assessment

Appendix A
CORRECTIVE ACTION ALTERNATIVE ANALYSIS (CAAA)

§845.670(e)
Evaluation of potential viable corrective actions identified in the Corrective Measures Assessment

Appendix A
HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

§845.670(f)(4)
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Appendix B
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§845.670(e)
Information to support preparation of CAAA

Appendix A
FEASIBILITY LEVEL DRAWINGS

Conceptual design drawings showing approximate extents and details of alternatives presented in the CAAA

Appendix B
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Detailed material quantity, labor and mileage estimates for alternatives presented in the CAAA

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§845.660
Assessment of potential corrective measure technologies to address GWPS exceedances at the CCR surface impoundment

Appendix D
NATURE AND EXTENT REPORT

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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 B
CORRECTIVE ACTION GROUNDWATER MONITORING PLAN

§845.680(a)(1)
Plan that establishes how data will be collected, documented, and evaluated to assess remedy effectiveness

<u>Legend</u>

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

Road Map for Corrective Action
Supplement to Operating Permit Application
Coffeen Power Plant, GMF Recycle Pond
Coffeen, IL

		Location of Information Demonstrating Compliance			Version History			
Section	**Rule Text**	**Document**	**Section or Appendix**	**PDF Page No. & Hyperlink**	**Submitted Previously**	**Updated Version**	**New Submittal**	**Notes**
Section 845.620 - Hydrogeologic Site Characterization								
845.620	Hydrogeologic Site Characterization	---	---	---	x			HCR was prepared on October 25, 2021 and was included as Appendix D to CP application submitted on July 28, 2022.
Section 845.660 - Assessment of Corrective Measures								
845.660	Assessment of Corrective Measures	CMA	---	165	x			Resubmittal with no updates. Attached as Appendix C in CAAA.
Section 845.670 - Corrective Action Plan								
845.670(a)	The owner or operator must prepare a semi-annual report describing the progress in selecting a remedy and developing a CAP. The semi-annual report must be submitted to IEPA and placed in the operating record as required by 35 I.A.C. § 845.800(d)(17).							
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.	Supplement to Operating Permit Application	---	1			x	A corrective action CP is not required when the proposed corrective action does not require modification of the CCR SI or the installation or modification of related treatment or mitigation facilities per 845.200(a)(3)
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;	CMA	---	165	x			Resubmittal with no updates. Attached as Appendix C in CAAA.
845.670(c)(2)	Identify a selected remedy that at a minimum, meets the standards listed in subsection (d);	CAAA	Section 2	48			x	
845.670(c)(3)	Contain the corrective action alternatives analysis specified in subsection (e); and	CAAA	Section 2	48			x	
845.670(c)(4)	Contain proposed schedules for implementation, including an analysis of the factors in subsection (f).	CAP	Table 1	25			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	53			x	
845.670(d)(2)	Attain the GWPS specified in 35 I.A.C. § 845.600;	CAAA	Section 2.2.6	60			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	54			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	67			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	48			x	
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	53			x	
845.670(e)(1)(A)	Magnitude of reduction of existing risks;	CAAA	Section 2.2.1	53			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	55			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	55			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	55			x	
845.670(e)(1)(E)	Time until GWPS in 35 I.A.C. § 845.600 are achieved;	CAAA	Section 2.2.6	60			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	62			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	62			x	
845.670(e)(1)(H)	Potential need for replacement of the remedy.	CAAA	Section 2.2.9	63			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	54			x	
845.670(e)(2)(A)	The extent to which containment practices will reduce further releases; and	CAAA	Section 2.2.2	54			x	
845.670(e)(2)(B)	The extent to which treatment technologies may be used.	CAAA	Section 2.2.2	54			x	
845.670(e)(3)	The ease or difficulty of implementing each potential remedy based on consideration of the following types of factors:							
845.670(e)(3)(A)	Degree of difficulty associated with constructing the technology;	CAAA	Section 2.3.1	64			x	
845.670(e)(3)(B)	Expected operational reliability of the technologies;	CAAA	Section 2.3.2	64			x	
845.670(e)(3)(C)	Need to coordinate with and obtain necessary approvals and permits from other agencies;	CAAA	Section 2.3.3	65			x	
845.670(e)(3)(D)	Availability of necessary equipment and specialists; and	CAAA	Section 2.3.4	65			x	
845.670(e)(3)(E)	Available capacity and location of needed treatment, storage, and disposal services.	CAAA	Section 2.3.5	66			x	
845.670(e)(4)	The degree to which community concerns are addressed by each potential remedy.	CAAA	Section 2.4	66			x	

Road Map for Corrective Action
Supplement to Operating Permit Application
Coffeen Power Plant, GMF Recycle Pond
Coffeen, IL

Section	**Rule Text**	**Location of Information Demonstrating Compliance**			**Version History**			**Notes**
		Document	**Section or Appendix**	**PDF Page No. & Hyperlink**	**Submitted Previously**	**Updated Version**	**New Submittal**	
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	16			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	16			x	
845.670(f)(3)	Availability of treatment or disposal capacity for CCR managed during implementation of the remedy;	CAP	Section 3.3	16			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	16			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	16			x	
845.670(f)(5)(B)	Proximity and withdrawal rate of users;	CAP	Section 3.3	16			x	
845.670(f)(5)(C)	Groundwater quantity and quality;	CAP	Section 3.3	16			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	16			x	
845.670(f)(5)(E)	The hydrogeologic characteristic of the facility and surrounding land; and	CAP	Section 3.3	16			x	
845.670(f)(5)(F)	The availability of alternative water supplies; and	CAP	Section 3.3	16			x	
845.670(f)(6)	Other relevant factors.	CAP	Section 3.3.1	20			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	891			x	
845.680(a)(1)(B)	Documents the effectiveness of the corrective action remedy; and	CA GMP	Section 3	895			x	
845.680(a)(1)(C)	Demonstrates compliance with the groundwater protection standard under subsection (c).	CA GMP	Section 3	895			x	
845.680(a)(2)	Implement the corrective action remedy approved by the Agency under Section 845.670; and	CAP	Section 1.4	10			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	21			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	21			x	
845.680(a)(3)(C)	Actual or potential contamination of sensitive ecosystems or current or potential drinking water supplies;	CAP	Section 3.4	21			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	21			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	21			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	21			x	
845.680(a)(3)(G)	Other situations that may pose threats to human health and the environment.	CAP	Section 3.4	21			x	

Notes:
CAA = Closure Alternatives Analysis
CAAA = Corrective Action Alternatives Analysis
CAP = corrective action plan
CCR = coal combustion residuals
CMA = Corrective Measures Assessment
CP = Construction Permit
GMP = Groundwater Monitoring Plan
GWPS = groundwater protection standards
HCR = Hydrogeologic Site Characterization Report
IEPA = Illinois Environmental Protection Agency
SI = Surface Impoundment

Intended for

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

Date

June 10, 2025

Project No.

1940110241-001

CORRECTIVE ACTION PLAN

COFFEEN POWER PLANT, GMF RECYCLE POND, IEPA ID NO. W1350150004-04

Bright ideas. Sustainable change.

CORRECTIVE ACTION PLAN
COFFEEN POWER PLANT, GMF RECYCLE POND, IEPA ID NO. W1350150004-04

Project name	**Coffeen Power Plant GMF Recycle Pond**
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	**Melanie Conklin**
Approved by	**Brian 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

Melanie K. Conklin

Melanie Conklin
Project Manager

Brian G. Hennings, PG
Project Officer, Hydrogeology

CONTENTS

TABLES

APPENDICES

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
CA GMP	Corrective Action Groundwater Monitoring Plan
CAA	Closure Alternatives Analysis
CAAA	Corrective Action Alternatives Analysis
CAAA-SIR	Corrective Action Alternatives Analysis Supporting Information Report
CAP	Corrective Action Plan
CBR	closure-by-removal
CCR	coal combustion residuals
cm/s	centimeters per second
CMA	Corrective Measures Assessment
COC	constituent of concern
COI	constituent of interest
COF	Coffeen Power Station
CP	construction permit
CPP	Coffeen Power Plant
CY	cubic yards
DA	deep aquifer
DCU	deep confining unit
GMF RP	Gypsum Management Facility Recycle Pond (“the site”)
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
IPGC	Illinois Power Generation Company
ISGS	Illinois State Geological Survey
LCU	lower confining unit
No.	number
OP	operating permit
PMP	potential migration pathway
Ramboll	Ramboll Americas Engineering Solutions, Inc.
SI	surface impoundment
UA	uppermost aquifer
UCU	upper confining unit
USEPA	United States Environmental Protection Agency

1. INTRODUCTION

1.1 Plant and Site Information

Illinois Power Generation 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, Illinois. IPGC intends to complete groundwater corrective action for the Gypsum Management Facility Recycle Pond (GMF RP) coal combustion residuals (CCR) surface impoundment (SI), which is identified by Illinois Environmental Protection Agency (IEPA) identification (ID) number (No.) W1350150004-04, CCR Unit ID No. 104, and National Inventory of Dams No. IL50578. This Corrective Action Plan (CAP) has been prepared for the GMF RP at the CPP under the requirements of the 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 requirements of the Title 40 Code of Federal Regulations (40 C.F.R.) § 257 Subpart D, herein referred to as the Federal CCR Rule [2].

1.2 Organization of the Corrective Action Plan

This CAP is organized in the following manner:

- **Section 1** includes an introduction to the GMF RP, 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 a supplement to the submitted operating permit (OP) application for the GMF RP as required by 35 I.A.C. § 845.200(a)(3).

1.3 Permit Status

The following 35 I.A.C. § 845 permit applications have previously been submitted to IEPA by IPGC for the GMF RP:

- An OP application, as required by 35 I.A.C. § 845.230, was submitted on October 25, 2021 [3].
- A construction permit (CP) application for final closure of the GMF RP, as required by 35 I.A.C. § 845.220, including a CCR SI Final Closure Plan, as required by 35 I.A.C. § 845.720, was submitted on July 28, 2022 [4].
    - The Final Closure Plan selected closure-by-removal (CBR) as the most appropriate closure method for the GMF RP [5].

As of the date of this CAP, IPGC's OP and final closure CP applications for the GMF RP are pending with IEPA.

1.4 Selected Corrective Action Remedy

Groundwater polishing (GWP) following source control (*i.e.,* CBR) presented within the Final Closure Plan [5] has been identified as the most appropriate remedy for the GMF RP, based on the CAAA provided in **Appendix A**. Potential remedies evaluated in the CAAA included source control with GWP and source control with groundwater extraction (GWE).

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 is also attached to the CAAA. This report presents results from geochemical modeling of exceedance[1] parameters addressed at the GMF RP 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 the groundwater protection standards (GWPS) estimated in the flow and transport model.

1.4.1 Narrative Description of Selected Corrective Action Remedy

Corrective action will consist of the source control, as outlined in the Final Closure Plan for the GMF RP [5]. The source control will be followed by GWP. The proposed closure exceeds the minimum Closure Performance Standards listed in 35 I.A.C. § 845.750. The closure will include removing free liquids in accordance with the performance standard in 35 I.A.C. § 845. The closure will control infiltration in accordance with the performance standard in 35 I.A.C. § 845, thus removing the hydraulic head that can force leachate into subsurface soils and is the mechanism that can drive risk (United States Environmental Protection Agency, [6]):

> *EPA's risk assessment shows that the highest risks are associated with CCR surface impoundments due to the hydraulic head imposed by impounded water. Dewatered CCR surface impoundments will no longer be subjected to hydraulic head so the risk of releases, including the risk that the unit will leach into the groundwater, would be no greater than those from CCR landfills.*

The GMF RP will be closed using a CBR approach consisting of excavating approximately 51,000 cubic yards (CY) of CCR and hauling it to the on-site Coffeen Landfill for disposal. Source control will also include removing the existing geomembrane liner from the GMF RP, performing decontamination of the subgrade soils (as and if needed) to remove remaining CCR from the unit. The proposed source control is predicted to attain the GWPS within approximately 5 years after closure completion [7]. These source control activities will serve as the primary groundwater corrective measure at the GMF RP.

1.4.1.1 Narrative Discussion of Remedy Design and Function

The USEPA has stated that source control is the most effective means of ensuring the timely attainment of remediation objectives [8]. Natural geochemical processes are appropriate as a

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

"polishing step" for residual plume management after effective source control implementation (*i.e.*, GWP) because there are no risks to receptors and the contaminant plume is not expanding. GWP will achieve the GWPS by natural physical and chemical mechanisms within the groundwater, which reduce the concentrations of COCs. Therefore, selection of the groundwater monitoring network, groundwater monitoring, and adaptive management are critical components of remedy design and function which are further described in **Section 1.4.2**.

1.4.2 Narrative Description of Proposed Groundwater Monitoring

Corrective action groundwater monitoring will be conducted 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 to inform adaptive management decisions if performance metrics are not achieved. A Corrective Action Groundwater Monitoring Plan (CA GMP) with details on how the groundwater monitoring network will be monitored, how the data will be analyzed, and what will trigger adaptive site management directions is included as **Appendix B**. Information associated with 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).
- Laboratory parameters include major ions for evaluating groundwater chemistry and 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. 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 corrective action at the GMF RP. 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 [9]. The goals and performance metrics of each phase of remedy evaluation are presented in Section 3 of the CA GMP (**Appendix B**).
- Documentation of remedy progress metrics will be provided in the Annual Groundwater Monitoring and Corrective Action 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 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, 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 the GMF RP that, when coupled with the source control 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 Integration of Corrective Action with Source Control (Final Closure)

All documents, assessments, and analyses performed as part of this CAP assume that the source control presented in the Final Closure Plan [5] for the GMF RP will also be implemented. Source control is the primary corrective action for the GMF RP and will consist of removing free liquids from the CCR and completing CBR. This is estimated to include moving a total of 51,000 CY of CCR from the GMF RP, disposing it in the on-site Coffeen Landfill, and disposal of the existing geomembrane liner under the GMF RP. When source control is completed, CCR will be removed from the former GMF RP footprint, and the soils will be graded to promote surface water drainage and preclude the impoundment of water within the closed-by-removal GMF RP.

Groundwater modeling performed to support the Final Closure Plan estimates that source control activities are expected to result in GWPS being achieved approximately 5 years after closure completion, without implementing other forms of corrective action [7].

The remedy presented in this CAP is supplemental to the removal of free liquids, completion of source control via closure, and disposing the CCR within an on-site landfill, which when combined, are the primary remedial action that will be performed at the site. The proposed CAP remedy will address residual groundwater impacts that are expected to remain in native soils beyond the limits of the GMF RP after source control is completed.

2.2 Corrective Measures Assessment

The CMA [10] was performed for the GMF RP and submitted to the IEPA on June 12, 2024, after the exceedances of the GWPS were identified. The CMA considered a total of four corrective measures for the GMF RP, including:

- Source control with GWP
- Source control with GWE
- Source control with groundwater cutoff wall
- Source control with *in-situ* chemical treatment

Based on the CMA, two corrective measures, including source control with GWP and source control with GWE, were identified as potentially viable corrective measures for the GMF RP and were included for further evaluation, design advancement, and comparative assessment within the CAAA for the GMF RP. The other corrective measures were determined by the CMA to be unlikely to be viable for the GMF RP and were not evaluated further within the CAAA.

2.3 Analysis of Corrective Action Alternatives

2.3.1 Corrective Action Alternatives Analysis Supporting Information Report

The CAAA for the GMF RP was prepared by Gradient based on a 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 and source control with GWE corrective measures identified as potentially viable for the GMF RP 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.

2.3.2 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 GWP was identified as the most appropriate corrective action for the GMF RP and was selected for further design development as part of this CAP.

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 the selected source control with GWP remedy 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 the GMF RP pose no risk to human health or the environment. There are also no unacceptable risks to human health and the environment under future conditions as discussed in the risk assessment provided in the CAAA (**Appendix A**). Concentrations of CCR-derived constituents are anticipated to decline once the GMF RP is closed and the GWP remedy is in place, as presented in the CAAA (**Appendix A)**.

> *(2) Attain the groundwater protection standards specified in 35 I.A.C. § 845.600;*

Groundwater modeling indicates source control with GWP (described in the Groundwater Modeling Report included in the Final Closure Plan), which is selected as the remedy of this CAP, will result in attainment of the GWPS within the current monitoring network within approximately 5 years of final closure completion [7].

> *(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;*

The GMF RP will be closed using a CBR approach which will act as the main control mechanism to prevent further releases of CCR-derived constituents. 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 the GMF RP.

> *(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 closure will be done in accordance with all 35 I.A.C. § 845 requirements and the submitted Final Closure Plan [5].

3.3 Schedule for Implementation

As presented in Section 4.1 of the CMA and in **Section 1.4.1.1** of this CAP, source control is the most effective means of ensuring the timely attainment of remediation objectives [10]. With groundwater from the GMF RP impoundment and potential groundwater contributions to surface water posing no unacceptable risks to human health or the environment [11], GWP is an appropriate "polishing step" provided the corrective action is managed within a reasonable timeframe.

The source control with GWP remedy will successfully attain GWPS in a reasonable time [7]**,** as discussed in the following subsections. Groundwater modeling performed to support the Final Closure Plan indicates that the timeframe to attain GWPS for all wells in the GMF RP monitoring network is approximately 5 years following completion of source control [7].

35 I.A.C. § 845.670(f): 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 implementing and completing the source control with GWP remedy at the GMF RP 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 [12] was submitted to the IEPA on June 12, 2024 and is included with relevant updates as Appendix D to the CAAA report (**Appendix A**). Groundwater modeling and geochemical analysis were performed by Ramboll as part of the Final Closure Plan [7] 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;

Remedies were evaluated in the CAAA (**Appendix A**), and it was determined that the selected remedy (source control with GWP) 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 [7]. For the selected remedy, the results indicate that groundwater will achieve compliance with the GWPS approximately 5 years after completion of source control, which is described in **Section 1.4.1**.

As documented in the CMA, source control via a CBR approach is a proven method for addressing groundwater contamination [10]. The proposed CBR approach is consistent with the requirements of 40 C.F.R. § 257 and 35 I.A.C. § 845.

GWP processes include both physical and chemical mechanisms within the groundwater which reduce the concentrations of COCs in the groundwater. Physical components of GWP are described by groundwater flow and transport modeling [7]. The contribution of chemical mechanisms to GWP under current conditions and after source control implementation are evaluated using a geochemical modeling-based approach [13]. When combined with source control, GWP processes will achieve the GWPS in a reasonable timeframe.

<u>35 I.A.C. § 845.670(f)(3)</u>: Availability of treatment or disposal capacity for CCR managed during implementation of the remedy;

The selected remedy includes source control followed by GWP. The CCR will be disposed in the on-site Coffeen Landfill as proposed in the CP for final closure [4]. GWP is not expected to result in the management of any appreciable volume of CCR. Therefore, the treatment and disposal capacity of CCR is not an applicable consideration for the selected remedy.

<u>35 I.A.C. § 845.670(f)(4)</u>: 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**) that considers the potential risks to human health and the environment before completion of the remedy. The overall conclusion is that groundwater from the GMF RP impoundment and potential groundwater contributions to surface water pose no unacceptable risks to human health or the environment. 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 [11].

<u>35 I.A.C. § 845.670(f)(5):</u> 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 D in the CP application for final closure [14]. The uppermost aquifer (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. The UA is absent beneath the GMF RP due to excavation during construction of the CCR unit. The underlying lower confining unit (LCU), and where present the deep aquifer (DA), have been identified as potential migration pathways (PMPs) because downward vertical gradients indicate that there is the potential for impacts to migrate towards these units. Groundwater flows east to southeast across the GMF RP toward an unnamed tributary leading to Coffeen Lake; however, the GMF RP is lined and water elevations within the GMF RP do not vary coincidentally with surrounding groundwater elevations.

As set forth in 35 I.A.C. § 620.210, groundwater within the UA in the vicinity of the GMF RP meets the definition of Class I – Potable Resource Groundwater, as geologic material with a hydraulic conductivity of 1 x 10^{-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 GMF RP impoundment and potential groundwater contributions to surface water pose no unacceptable risks to human health or the environment.

Source control followed by GWP 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. GWP and adaptive site management following source control will function until the GWPS is achieved in accordance with the CA GMP (**Appendix B**). 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 the HCR, Section 5.1 and attachments; and were considered in the CAAA as part of the Human Health and Ecological Risk Assessment which concluded that groundwater from the GMF RP impoundment and potential groundwater contributions to surface water pose no unacceptable risks to human health or the environment. Exceedances of the GWPS will remain within the property boundary[2] which is controlled by IPGC. 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 2021 utilizing federal and state databases to assess nearby pumping wells, drinking water receptors, and other uses of water in the vicinity of the GMF RP. A search of the Illinois State Geological Survey (ISGS) Illinois Water and Related Wells (ILWATER) Map identified 16 wells located within 1,000 meters of the GMF RP. The wells that were identified included 13 monitoring wells and three farm/domestic wells. One of the three farm/domestic wells (121352283200) is located southeast of the GMF RP, side/downgradient to the GMF RP 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 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 two farm/domestic wells, they are located north of the GMF RP, *i.e.*, upgradient/side-gradient to GMF RP, where groundwater in the vicinity flows east to southeast toward the east lobe of Coffeen Lake and on the west side of the unnamed tributary to Coffeen Lake.

The assessment concluded there are no existing off-site water wells, potable or non-potable, that could potentially be impacted by groundwater from the GMF RP. This information was also considered in the CAAA as part of the Human Health and Ecological Risk Assessment, which concluded that groundwater from the GMF RP impoundment and potential groundwater contributions to surface water pose no unacceptable risks to human health or the environment.

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[2] Based on the Nature & Extent Report attached to the CAAA with addendum as Appendix D.

In the absence of changes in current and future uses, there is no applicable scheduling consideration for proximity and withdrawal rates of users.

<u>35 I.A.C. § 845.670(f)(5)(C)</u>: Groundwater quantity and quality;

Per 35 I.A.C. § 620.210, groundwater within the UA at GMF RP meets the definition of Class I – Potable Resource Groundwater [14]. The Human Health and Ecological Risk Assessment (Appendix A in CAAA) concluded that groundwater from the GMF RP impoundment and potential groundwater contributions to surface water pose no unacceptable risks to human health or the environment. The selected remedy includes source control followed by GWP. GWP does not include the management of any volume of groundwater.

<u>35 I.A.C. § 845.670(f)(5)(D)</u>: The potential impact to the subsurface ecosystem, wildlife, other natural resources, crops, vegetation, and physical structures caused by exposure to CCR constituents;

Potential surface receptors are discussed in HCR Sections 5.2 and 5.3. A survey to identify surface water features, nature preserves, and historic sites was conducted for a 1,000-meter radius around the GMF RP. Section 3.6 of the Human Health and Ecological Risk Assessment included as Appendix A of the CAA and CMA/CAAA Report discusses the ecological risk evaluation.

1. Ecological receptors exposed to surface water include aquatic and marsh plants, amphibians, reptiles, and fish. The risk evaluation showed that none of the constituents of interest (COIs) in surface water exceeded protective screening benchmarks.
2. 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.
3. 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). Mercury was the only ecological COI identified as having potential bioaccumulative effects. However, the modeled concentrations did not exceed benchmarks protective of bioaccumulative effects. Therefore, mercury is 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.

Overall, this evaluation demonstrated that none of the COIs evaluated are expected to pose an unacceptable risk to ecological receptors. The selected remedy will reduce the concentrations of COIs in groundwater. In the absence of unacceptable risks to ecological receptors, there is no applicable scheduling consideration.

<u>35 I.A.C. § 845.670(f)(5)(E)</u>: The hydrogeologic characteristic of the facility and surrounding land; and

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

- **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) near the unnamed tributary to 16 feet, and the clayey portion of the Hagarstown member is up to 6 feet thick. The Loess Unit was excavated within the footprint of the GMF RP during construction of the impoundment.

- **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 and was excavated within the footprint of the GMF RP during construction of the impoundment. 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 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 Final Closure Plan and CAAA, respectively, included in **Appendix A**, which estimate the time to reach the GWPS for remedial alternatives.

<u>35 I.A.C. § 845.670(f)(5)(F):</u> The availability of alternative water supplies.

As discussed in subsection 35 I.A.C. § 845.670(f)(5)(B) above, there were potentially 16 water wells identified within 1,000 meters of GMF RP [14]. 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

<u>35 I.A.C. § 845.670(f)(6):</u> Other relevant factors.

No additional factors were identified for consideration.

3.4 Necessity of Interim Measures

Source control using the CBR approach is projected to be complete within four to six years after approval of the final closure CP application [4]. 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. Upon completion of source control, the GMF RP will immediately transition to GWP, therefore no interim measures are required. Further, all subsections of this requirement are discussed as follows.

<u>35 I.A.C. § 845.680(a)(3)(A)</u>: Time required to develop and implement a final remedy.

Source control with GWP will be completed in accordance with the schedule provided in **Table 1**. The GWPS will be achieved within a reasonable time frame.

<u>35 I.A.C. § 845.680(a)(3)(B)</u>: 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].

<u>35 I.A.C. § 845.680(a)(3)(C)</u>: 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 [12]. 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 the GMF RP [11].

<u>35 I.A.C. § 845.680(a)(3)(D)</u>: Further degradation of the groundwater that may occur if remedial action is not initiated expeditiously.

The selected remedy of source control with GWP will achieve the GWPS in a reasonable time frame, 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.

<u>35 I.A.C. § 845.680(a)(3)(E)</u>: 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, the selected remedy of source control with GWP will achieve the GWPS in a reasonable timeframe, and no unacceptable risks to human health or the environment have been identified. No interim measure is expected to further prevent migration of constituents more expeditiously than implementation of the selected remedy.

<u>35 I.A.C. § 845.680(a)(3)(F)</u>: 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.

As stated above, GWP will be implemented immediately after source control is completed. As the GMF RP will be closed by removal, no container or handling system will be in use.

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 GMF RP CCR leachate poses threats to human health and 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 Impoundment," 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 Opertaing Permit, Coffeen GMF Recycle Pond," Coffeen, IL, October 25, 2021.

[4] Golder Associates USA, Inc., "Part 845 Construction Permit Application for Gypsum Management Facility Recycle Pond," July 28, 2022.

[5] Golder Associates USA, Inc., "Final Closure Plan for the Gypsum Mangement Facility Recycle Pond," Coffeen, IL, July 28, 2022.

[6] United States Environmental Protection Agency (USEPA), "40 CFR Parts 257 and 261 Hazardous and Solid Waste [EPA–HQ–RCRA–2009–0640; FRL–9919–44–OSWER]," April 17, 2015.

[7] Ramboll Americas Engineering Solutions, Inc., "Groundwater Modeling Report GMF Gypsum Stack Pond and GMF Recycle Pond," July 28, 2022.

[8] United States Environmental Protection Agency, "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. Directive No. 9200.U-17P.," Office of Solid Waste and Emergency Response, Washington D.C., 1999.

[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, Inc., "35 I.A.C. § 845 Corrective Measures Assessment, GMF Recycle Pond, Coffeen Power Plant," Coffeen, IL, June 12, 2024.

[11] Gradient Corp, "Human Health and Ecological Risk Assessment, Gypsum Management Facility Gypsum Stack Pond and Gypsum Management Facility Recycle Pond, Coffeen Power Plant," Coffeen, IL, July 28, 2022.

[12] Ramboll Americas Engineering Solutions, Inc., "Nature and Extent Report, Coffeen Power Plant, GMF Recycle Pond, IEPA ID No. W1350150004-04," Coffeen, IL, June 12, 2024.

[13] Geosyntec Consultants, Inc., "Groundwater Polishing Evaluation Report Coffeen Power Station - GMF Recycle Pond (EPA ID No. 104)," Coffeen, IL, June 10, 2025.

[14] Ramboll Americas Engineering Solutions, Inc., "Hydrogeologic Site Characterization Report, Coffeen, Power Plant, GMF Recycle Pond," Coffeen, IL, October 25, 2021.

TABLES

Table 1. Proposed Milestone Schedule for Implementing Corrective Action Remedy (Source Control-Groundwater Polishing)

Implementation Phase	**Implementation Task**	**Timeframe* (Preliminary Estimates)**
Source Control Pre-Implementation	Final Closure Plan Submittal	July 2022
	Corrective Action Plan Submittal	June 2025
Source Control Construction	Source Control (Closure) Construction • Complete Implementation of Source Control	4 to 6 years (after approval of closure plan and All Other Closure-Related Permits)
	Timeframe to Complete Source Control Construction[1]	**4 to 6 years** (after receipt of all permits required for closure)
Corrective Action Implementation	Corrective Action Operations (Time to Meet GWPS) • Perform groundwater monitoring and reporting per Corrective Action Groundwater Monitoring Plan	5 years (after completion of Source Control)
	Corrective Action Groundwater Confirmation Monitoring • Perform groundwater monitoring to demonstrate compliance with GWPS for 3 years, per 35 I.A.C. § 845.680(c)	3 years (after Corrective Action Operations and Maintenance)
	Corrective Action Completion • Prepare Corrective Action Completion Report, per 35 I.A.C. § 845.680(E)	3 to 6 months (after Corrective Action Confirmation Monitoring)
	Timeframe to Complete Corrective Action Implementation[1]	**9 years** (after completion of Source Control)

[1] All timeframes are preliminary and may change as the project develops. Timeframes may also be affected by regulatory review and/or permit approval processes, for both 35 I.A.C. § 845 and non-35 I.A.C. § 845 permits.

GWPS = Groundwater Protection Standard(s)

APPENDIX A

CORRECTIVE ACTION ALTERNATIVES ANALYSIS (845.670(E)), INCLUDING CORRECTIVE MEASURES ASSESSMENT (845.660)

Corrective Action Alternatives Analysis for the Gypsum Management Facility Recycling Pond
Coffeen Power Plant
Coffeen, Illinois

June 10, 2025

GRADIENT

www.gradientcorp.com
One Beacon Street, 17th Floor
Boston, MA 02108
617-395-5000

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Abbreviations

bgs	Below Ground Surface
BMP	Best Management Practice
CAA	Closure Alternatives Analysis
CAAA	Corrective Action Alternatives Analysis
CBR	Closure by Removal
CCR	Coal Combustion Residual
CMA	Corrective Measures Assessment
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CPP	Coffeen Power Plant
CY	Cubic Yard
DA	Deep Aquifer
DCU	Deep Confining Unit
GHG	Greenhouse Gas
GMF	Gypsum Management Facility
RP	Recycling Pond
GMP	Groundwater Monitoring Plan
GSP	Gypsum Stack Pond
GWP	Groundwater Polishing
GWPS	Groundwater Protection Standard
IAC	Illinois Administrative Code
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
N_2O	Nitrous Oxide
NID	National Inventory of Dams
NO_x	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
PM	Particulate Matter
SFWA	State Fish and Wildlife Area
Source Control-GWE	Source Control with Groundwater Extraction
Source Control-GWP	Source Control with Groundwater Polishing
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UA	Uppermost Aquifer
UCU	Upper Confining Unit
US DOT	United States Department of Transportation
US EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

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 the Gypsum Management Facility Recycling Pond (GMF RP) 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, 2025a) 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[1]. 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, p. 21419).

In this CAAA, both 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

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[1] Note that the GMF RP is a modern and state-permitted surface impoundment with a composite liner that consists of a 60-mil geomembrane liner with 3 ft of recompacted low permeability soil with internal piping to collect and drain contact water (Prado and Modeer, 2016).

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, pp. 5-18 to 5-19). 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 both the corrective active alternatives evaluated in this CAAA is excavation and removal of all CCR (*i.e.*, closure-by-removal [CBR]) and disposal in an on-Site landfill. Specifically, this approach includes unwatering and dewatering of the impoundment, excavation and removal of CCR, the existing liner system, and any CCR-impacted subsoil into the on-Site landfill for disposal, establishment of a vegetative cover on the final surface of the GMF RP, and a stormwater management system for erosion control. This source control approach would remove all remaining CCR from the impoundment, and reduce to the maximum extent feasible the migration of CCR constituents to groundwater, thus facilitating the achievement of the GWPSs in accordance with IAC Section 845.600.

Two potential corrective actions are evaluated in this CAAA: Source Control with Groundwater Polishing (Source Control-GWP) and Source Control with Groundwater Extraction (Source Control-GWE). Both alternatives consist of source control and residual plume management, and both alternatives were identified as a viable approach in the CMA (Appendix C; Ramboll, 2025a). The residual plume management portions of these corrective action alternatives include groundwater polishing, and a groundwater extraction trench.

Under the Source Control-GWP alternative, active groundwater monitoring would supplement source control to verify and document the attenuation by natural physical and geochemical mechanisms of constituent concentrations in groundwater. Site-specific evaluations demonstrated that groundwater polishing is appropriate at the GMF RP because site conditions are favorable for physical and geochemical attenuation via adsorption (Appendix E; Geosyntec Consultants, Inc., 2025). Under the Source Control-GWE alternative, a groundwater extraction trench would be constructed along the interior toe of the former perimeter dikes, from ground surface to 5 feet (ft) below ground surface (bgs) at the bottom of the uppermost aquifer (UA). The trench would be approximately 1,800 ft long and 2 to 3 ft wide (Appendix B, Ramboll, 2025b). The extraction system would include a collection pipe within the trench, which would pump extracted groundwater to a new on-Site lined settling pond to remove solids. Subsequently, extracted groundwater would be discharged to Coffeen Lake under a National Pollutant Discharge Elimination System (NPDES) permit for the Site. This corrective action alternative would involve incorporating and retrofitting the existing drainage channel and would be constructed perpendicular to the groundwater flow direction at the Site. As part of both corrective action alternatives, an adaptive site management plan would be implemented in order to optimize the selected remedy based on real-time data that are collected.

Table S.1 evaluates the two potentially viable corrective actions evaluated in this CAAA (Source Control-GWP and Source Control-GWE) 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 Source Control-GWP. The expected impacts on workers, nearby communities, and the environment under the Source Control-GWP alternative are lower than those under the Source Control-GWE alternative. Additionally, there is not expected to be a significant difference between the two alternative corrective actions in the time to achieve the GWPSs. Thus, Source Control-GWP is the most appropriate corrective action alternative for the GMF RP.

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-GWE
Magnitude of Reduction of Existing Risks (Section 2.2.1; IAC Section 845.670(e)(1)(A))	Because current conditions do not present a risk to human health or the environment at the GMF RP, there will be no unacceptable risk to human health or the environment for future conditions when the unit has been closed and source control has been implemented. Concentrations of CCR-derived constituents will decline over time and, consequently, potential exposures to CCR-derived constituents in the environment will also decline. The magnitude of the reduction of existing risks is the same for the two potential corrective action alternatives, and both 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 the GMF RP, there will be no unacceptable risk to human health or the environment for future conditions when the unit has been closed and source control has been implemented. Concentrations of CCR-derived constituents will decline over time and, consequently, potential exposures to CCR-derived constituents in the environment will also decline. The magnitude of the reduction of existing risks is the same for the two potential corrective action alternatives, and both 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))	Both alternatives include source control (which is the primary remedial measure) and residual plume management. Source control would remove remaining CCR and stained subsoil from the impoundment, and reduce to the maximum extent feasible, the migration of CCR constituents to groundwater. Under the residual plume management for Source Control-GWP alternative, physical and geochemical attenuation mechanisms would mitigate impacts to downgradient groundwater quality and control the residual plume (Appendix E; Geosyntec, 2025). If necessary, remedy optimizations would be implemented under the adaptive site management program.	Both alternatives include source control (which is the primary remedial measure) and residual plume management. Source control would remove remaining CCR and stained subsoil from the impoundment, and reduce to the maximum extent feasible, the migration of CCR constituents to groundwater. Under the residual plume management for the Source Control-GWE alternative, groundwater extraction trench would remove impacted groundwater and control migration of impacted groundwater. 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	The Source Control-GWE alternative would require construction of a new on-Site settling pond to treat extracted groundwater, prior to discharge *via* a NPDES permitted outfall. The remedy

Evaluation Factor (Report Section; Part 845 Section)	**Source Control-GWP**	**Source Control-GWE**
	under the adaptive site management program.	would also rely on physical and geochemical attenuation processes. 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))	Both corrective action alternatives include source control using CBR with on-Site CCR disposal. This approach would eliminate the risk of a CCR release occurring post-closure under any of the corrective action alternatives.	Both corrective action alternatives include source control using CBR with on-Site CCR disposal. This approach would eliminate the risk of a CCR release occurring post-closure under any of the corrective action 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 operation and maintenance (O&M) efforts would be required under Source Control-GWP, because it would not require the installation, operation, or maintenance of any engineered systems or structures other than maintenance of the monitoring wells. Post-closure care groundwater monitoring would continue for a minimum of 3 years as required by IAC Section 845.740(b). Additionally, corrective action groundwater monitoring would continue for 3 years after GWPS have been achieved. Based on the adaptive site management approach, remedy optimizations might be implemented to ensure achievement of the GWPSs.	Long-term O&M efforts required under Source Control-GWE would include the maintenance of the groundwater collection trench system and discharge of extracted groundwater. Extracted groundwater would be managed and treated by a newly-constructed on-Site settling pond before discharge *via* a NPDES permitted outfall. Post-closure care groundwater monitoring would continue for a minimum of 3 years as required by IAC Section 845.740(b). Additionally, corrective action groundwater monitoring would continue for 3 years after GWPS have been achieved. Based on the adaptive site management approach, remedy optimizations might 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.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. While appropriate controls would be established to prevent accidents and injuries from occurring, the risks of accidents and injuries occurring during source control would be the same for both corrective action alternatives. These source	Source control (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. While appropriate controls would be established to prevent accidents and injuries from occurring, the risks of accidents and injuries occurring during source control would be the same for both corrective action alternatives. These source

Evaluation Factor (Report Section; Part 845 Section)	**Source Control-GWP**	**Source Control-GWE**
	control risks were evaluated in the CAA (Gradient, 2022a). 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-GWP alternative.	control risks were evaluated in the CAA (Gradient, 2022a). Overall, considering both on- and off-Site activities, 8.4×10^{-2} worker injuries and 1.5×10^{-3} worker fatalities would be expected to occur under the Source Control-GWE alternative, which is higher than the Source Control-GWP alternative. An estimated 2.1×10^{-2} injuries and 2.3×10^{-4} fatalities would be expected to occur among community members due to off-Site activities under the Source Control-GWE alternative, which is higher than the Source Control-GWP alternative.
Cross-Media Impacts to Air	Source control (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both corrective action alternatives. Air impacts occurring during source control would be the same for both corrective action alternatives. These source control risks were evaluated in the CAA (Gradient, 2022a). 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.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. Air impacts occurring during source control would be the same for both corrective action alternatives. These source control risks were evaluated in the CAA (Gradient, 2022a). Residual plume management for the Source Control-GWE alternative would have greater air impacts than the Source Control-GWP alternative due to the construction and operation of the extraction trench system.
Cross-Media Impacts to Surface Water and Sediments	Under both corrective action alternatives, the constituent mass flux from groundwater into surface water would decline over time after source control has been completed (Ramboll, 2022). Source control would include removal of free liquids, excavation of remaining CCR, existing liner, and CCR-impacted soils, as well as the establishment of vegetation over the final surface of the GMF RP. This approach would eliminate the mass flux out of the GMF RP.	Under both corrective action alternatives, the constituent mass flux from groundwater into surface water would decline over time after source control has been completed (Ramboll, 2022). Source control would include removal of free liquids, excavation of remaining CCR, existing liner, and soils visibility impacted with CCR, as well as the establishment of vegetation over the final surface of the GMF RP. This approach would eliminate the mass flux out of the GMF RP.

Evaluation Factor (Report Section; Part 845 Section)	**Source Control-GWP**	**Source Control-GWE**
	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.	Under residual plume management for the Source Control-GWE alternative, groundwater collected by the extraction trench would be treated through the on-Site settling pond and discharged to the Coffeen Lake *via* a NPDES-permitted outfall. Surface water and sediment impacts under this alternative would be higher than the Source Control-GWP alternative due to the construction of the extraction trench system. Erosion and sediment runoff may occur due to the close proximity to the wetlands and surface water bodies during construction activities. However, the construction would be restricted inside the unit, and risks of such impacts would be addressed through best management practices (BMPs) in accordance with site land disturbance permits.
Control of Exposure to Any Residual Contamination During Implementation of the Remedy	Source control (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. While appropriate controls would be established to prevent exposures of CCR during source control, the risks of CCR exposure during source control would be the same for both corrective action alternatives. Risks to workers arising from potential contact with residual contamination would be minimal under the Source Control-GWP alternative, which would not involve exposure to any soil or groundwater waste streams.	Source control (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. While appropriate controls would be established to prevent exposures of CCR during source control, the risks of CCR exposure during source control would be the same for both corrective action alternatives. 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-GWE alternative than for the Source Control-GWP alternative, because Source Control-GWE would involve the production, management, and treatment of extracted groundwater, as well as on-Site disposal of excavated spoils generated during extraction trench construction.
Other Identified Impacts	Source control (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action	Source control (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE
	alternatives. Thus, impacts during source control would be the same for both of the corrective action alternatives (see the CAA; Gradient, 2022a). The energy demands of construction equipment and vehicles associated with residual plume management would be minimal because this alternative would not require any significant construction activity. Similarly, traffic and noise impacts associated with residual plume management would also be expected to be lower under the Source Control-GWP alternative than the Source Control-GWE alternative since no significant construction activities would be required under the Source Control-GWP alternative. There would be no impacts to natural resources and habitat under the Source Control-GWP alternative because no additional construction activities would occur after implementation of source.	alternatives. Thus, impacts during source control would be the same for both of the corrective action alternatives (see the CAA; Gradient, 2022a). The energy demands of construction equipment and vehicles associated with residual plume management would be greater under the Source Control-GWE alternative, while the energy demands under the Source Control-GWP would be lower because this alternative would not require any significant construction activity. Similarly, traffic and noise impacts associated with residual plume management would also be expected to be higher under the Source Control-GWE alternative than the Source Control-GWP alternative, due to the construction activities required to construct the extraction trench and settling pond. Under the Source Control-GWE alternative, there would be some negative impacts to natural resources and habitat, including disturbance of some existing habitat atop portions of the construction areas, habitat in the immediate vicinity of these locations by causing alarm and escape behavior in nearby wildlife (*e.g.*, due to noise disturbances). However, the construction would be restricted within the footprint of the GMF RP, and the associated impacts would be low.
Time Until Groundwater Protection Standards Are Achieved (Section 2.2.6; IAC Section 845.670(e)(1)(E))	Groundwater modeling was conducted to evaluate future groundwater quality in the vicinity of the GMF RP under the proposed source control-GWP alternative. Modeling results indicate that groundwater would attain the GWPSs for all constituents within approximately 5 years for all wells after closure (Ramboll, 2022).	The timeframe for achieving GWPS under the Source Control-GWE alternative is expected to be comparable or slightly faster than the Source Control-GWP alternative (Ramboll, 2024). There is not expected to be a significant difference between the Source Control-GWP and Source Control-GWE alternatives in the time to achieve the GWPSs at the Site.

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE
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 (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. Therefore, both corrective action alternatives would be equally and fully protective with regard to exposure to residual CCR. As a result of the source control, there would be no risk of CCR releases post-closure because remaining CCR and impacted soils would be removed. The Source Control-GWP alternative would not involve exposure to any soil or groundwater waste streams associated with residual plume management, thus, there is no potential for exposure of humans and environmental receptors to wastes.	Source control (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. Therefore, both corrective action alternatives would be equally and fully protective with regard to exposure to residual CCR. As a result of the source control, there would be no risk of CCR releases post-closure because remaining CCR and impacted soils would be removed. Potential risks to workers that come in contact with residual contamination of CCR-derived constituents during groundwater extraction and treatment would be managed through the use of rigorous safety protocols and personal protective equipment. Hydrogeological changes would also be expected under the Source Control-GWE alternative, such as lowering the groundwater table in the vicinity of the extraction trench, altering flow patterns in the Uppermost Aquifer (UA), and causing changes in hydraulic gradients. 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 (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. Thus, long-term reliability during source control would be the same for both corrective action alternatives (see the CAA; Gradient, 2022a). Residual plume management under the Source Control-GWP alternative would would rely on physical and geochemical attenuation processes and active monitoring. Site specific evaluations have shown that chemical attenuation is feasible, and remobilization is	Source control (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. Thus, long-term reliability during source control would be the same for both corrective action alternatives (see the CAA; Gradient, 2022a). Residual plume management under the Source Control-GWE alternative would be reliable, provided it is constructed in accordance with standard design specifications, because it is a proven remedy that has been implemented at many sites. Routine and non-routine

Evaluation Factor (Report Section; Part 845 Section)	**Source Control-GWP**	**Source Control-GWE**
	unlikely to impact the time to achieve GWPS as groundwater returns to background conditions (Appendix E; Geosyntec, 2025). If necessary, remedy optimizations would be implemented under the adaptive site management program.	maintenance of the extraction system is required to ensure reliable operation of the extraction trench and pumps, as well as other system components. If necessary, 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-GWE alternative would likely be unnecessary as long as the extraction trench system is maintained and serviced appropriately. 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 (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. Thus, construction difficulties would be the same for both corrective action alternatives (see the CAA; Gradient, 2022a). 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.	Source control (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. Thus, construction difficulties would be the same for both corrective action alternatives (see the CAA; Gradient, 2022a). Residual plume management under the Source Control-GWE alternative would rely on the extraction trench and a settling pond to extract and treat impacted groundwater, as well as physical and geochemical attenuation processes. Shallow groundwater trenches are commonly constructed at similar depths using conventional equipment. Therefore, while some construction is required, the degree of difficulty would be anticipated to be low.
Expected Operational Reliability of the Remedy (Section 2.3.2; IAC Section 845.670 (e)(3)(B))	Source control (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. Thus, the operational reliability of the remedy would be the same for both corrective action alternatives (see the CAA; Gradient, 2022a).	Source control (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. Thus, the operational reliability of the remedy would be the same for both corrective action alternatives (see the CAA; Gradient, 2022a).

Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE
	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. Adaptive site management strategies would be used to implement remedy optimizations, if necessary.	Residual plume management under the Source Control-GWE alternative would have high operational reliability because it is an established and dependable technology, as long as the extraction trench system is maintained and operated appropriately. 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 using a CBR with on-Site disposal approach are the same for both corrective action alternatives and were evaluated in the CAA (Gradient, 2022). Residual plume management under the Source Control-GWP alternative would not need additional permits from other agencies, other than the approval of the Corrective Action Plan.	Specific permits and approvals associated with source control using a CBR with on-Site disposal approach are the same for both corrective action alternatives and were evaluated in the CAA (Gradient, 2022). Residual plume management for the Source Control-GWE alternative would require regulatory approvals. 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 the IEPA for construction stormwater controls and BMPs, a joint water pollution control construction and operating permit would be required. In addition, placement of excavated spoils beneath the GMF GSP final cover system *via* an amendment to the Closure Plan and Construction Permit Application, and operating permit would be required. An Illinois Department of Natural Resources (IDNR) Dam Safety modification permit would be obtained for modifications of the embankment.
Availability of Necessary Equipment and Specialists (Section 2.3.4; IAC Section 845.670 (e)(3)(D))	Source control (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. Thus, equipment and specialist needs would be the same for both corrective action alternatives (see the CAA; Gradient, 2022a). Residual plume management under the Source Control-GWP alternative would	Source control (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. Thus, equipment and specialist needs would be the same for both corrective action alternatives (see the CAA; Gradient, 2022a). Residual plume management under the Source Control-GWE alternative would

Evaluation Factor (Report Section; Part 845 Section)	**Source Control-GWP**	**Source Control-GWE**
	require standard environmental monitoring equipment and groundwater professionals. Specialists such as geologists, hydrogeologists, statisticians (*i.e.*, statistical analysis), and geochemists would be available to collect and evaluate the data.	require specialists to manage the extraction system throughout its construction and operational period. • Construction of the groundwater extraction system (*i.e.*, the trench and settling pond) on the Site is not expected to require specialized contractors or equipment. Shallow collection trenches are routinely constructed by earthwork contractors in central and southern Illinois. • 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. 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).
Available Capacity and Location of Needed Treatment, Storage, and Disposal Services (Section 2.3.5; IAC Section 845.670 (e)(3)(E))	No treatment, storage, or disposal services would be required for the source control- GWP alternative, as GWP would not generate any significant volume of waste or wastewater.	Residual plume management for the Source Control-GWE alternative would require the construction of the extraction trench system, which would generate spoils during the construction phase, and the waste materials would be used as subgrade fill beneath the GMF GSP final cover system during the closure construction of the GMF GSP. Extracted groundwater would be treated at an on-Site settling pond. Treated water from the settling pond would be conveyed to a NPDES permitted outfall.
The Degree to Which Community Concerns Are Addressed by the Remedy (Section 2.4; IAC Section 845.670(e)(4))	The combination of source control (*i.e.*, CBR with on-Site Disposal) with residual plume management would cause groundwater concentrations to decline over time under both of the corrective action alternatives, as suggested by the groundwater modeling (Ramboll, 2022), thus addressing community concerns.	The combination of source control (*i.e.*, CBR with on-Site Disposal) with residual plume management would cause groundwater concentrations to decline over time under both of the corrective action alternatives, as suggested by the groundwater modeling (Ramboll, 2022), thus addressing community concerns.

Evaluation Factor (Report Section; Part 845 Section)	**Source Control-GWP**	**Source Control-GWE**
	A public meeting was held on May 1, 2025, pursuant to requirements under IAC Section 845.660(d). Questions raised by attendees were addressed at the meeting; a written summary of the questions and responses were prepared.	A public meeting was held on May 1, 2025, pursuant to requirements under IAC Section 845.660(d). 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; IAC Section 845.670(d)(4))	There have been no known releases of CCR at the GMF RP. Both potential corrective action alternatives would have source control and residual plume management efforts. The source control would include the complete removal of CCR from the GMF RP and disposal at the on-Site landfill and establishment of vegetation on the final surface of the GMF RP. Therefore, both corrective action alternatives would prevent the release of contaminated material from the GMF RP. 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-derived constituents in groundwater. Site specific evaluations demonstrate that attenuation via sorption onto mineral surfaces should remain stable under post-closure conditions, and remobilization is unlikely to impact the time to achieve GWPS (Appendix E; Geosyntec, 2025). No ecosystems would be disturbed because no construction activities are expected under the Source Control-GWP alternative.	There have been no known releases of CCR at the GMF RP. Both potential corrective action alternatives would have source control and residual plume management efforts. The source control would include the complete removal of CCR from the GMF RP and disposal at the on-Site landfill and establishment of vegetation on the final surface of the GMF RP. Therefore, both corrective action alternatives would prevent the release of contaminated material from the GMF RP. Additionally, residual plume management under the Source Control-GWE alternative would rely on the extraction trench to reduce or prevent migration of impacted groundwater. The construction activities would likely result in some negative impacts to the ecosystem, including disturbance of some existing habitat atop and near the construction areas. However, the construction would be restricted within the footprint of the GMF RP and the associated risks would be low.

Notes:

BMP = Best Management Practice; CAA = Closure Alternatives Analysis; CBR = Closure by Removal; CCR = Coal Combustion Residual; GHG = Greenhouse Gas; GMF GSP = Gypsum Management Facility Gypsum Stack Pond; GMF RP = Gypsum Management Facility Recycling Pond; GWPS = Groundwater Protection Standard; IAC = Illinois Administrative Code; IEPA = Illinois Environmental Protection Agency; NPDES = National Pollutant Discharge Elimination System; O&M = Operations and Maintenance; Source Control-GWE = Source Control with Groundwater Extraction; Source Control-GWP = Source Control with Groundwater Polishing.

1 Introduction

1.1 Site Description and History

1.1.1 Site Location and History

Illinois Power Generating Company's (IPGC) Coffeen Power Plant (CPP) is located about two miles south of the City of Coffeen, Illinois. The plant is an electric power generating facility with coal-fired units 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 CPP operated between 1964 and November 2019 when it was retired (Ramboll, 2021a,b).

1.1.2 CCR Impoundment

The CPP produced and stored coal combustion residuals (CCRs) as a part of its historical operations. There are two gypsum management facility (GMF) units at this facility: (1) the GMF Gypsum Stack Pond (GSP); Vistra ID No. CCR Unit 103, Illinois Environmental Protection Agency [IEPA] ID No. W1350150004-03, and National Inventory of Dams [NID] ID No. IL50579), and (2) the GMF Recycle Pond (RP); Vistra ID No. CCR Unit 104, IEPA ID No. W1350150004-04, and NID ID No. IL50578). The subject of this report will be the GMF RP.

The GMF RP (Figure 1.1) is an 18.3 acre surface impoundment constructed in 2010 and is located immediately south of the GMF GSP (Golder Associates, 2022). The GMF RP, which was intended to act as a polishing pond, received decanted water from the GMF GSP prior to pumping it back to the Coffeen Power Plant for re-use as process water (Ramboll, 2021a,b). However, the GMF GSP was also utilized for the storage of CCR early in its operational period, which lasted from 2010 until 2021 (Ramboll, 2021a,b). Outflow from the GMF RP was pumped back to the CPP for use in the wet scrubber system. The GMF RP has an emergency spillway that discharges to the Unnamed Tributary *via* a National Pollutant Discharge Elimination System (NPDES)-permitted outfall. The GMF RP is a modern, lined, and state permitted[2] CCR surface impoundment (Prado and Modeer, 2016). The basal liner system consisting of a composite 60-mil textured high-density polyethylene (HDPE) geomembrane installed over smooth drum-rolled native soil with internal piping and drains to collect contact water seeping through the liner system (Ramboll, 2021a,b).

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[2] The GMF RP was constructed in accordance with Water Pollution Control Permit 2008-EA-4661 (Ramboll, 2021b).

Figure 1.1 Site Location Map. Adapted from Ramboll (2021a).

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, which flows south into the eastern lobe of Coffeen Lake. The facility is permitted to discharge to Coffeen Lake under NPDES Permit No. IL 0000108 and an emergency spillway is located in the northeast corner of the GMF RP (Ramboll, 2021b).

The GMF RP is located within the Shoal Creek Watershed (Hydrologic Unit Code [HUC] 07140203) and the outer perimeters of the impoundments are located 400 ft and 150 ft west of the Unnamed Tributary, respectively (Ramboll, 2021b). There are several unnamed freshwater ponds and wetlands in the vicinity of the GMF RP. There is an approximately 1.6-acre freshwater emergent wetland located to the southeast of the GMF RP where the Unnamed Tributary enters Coffeen Lake (Ramboll, 2021b).

The 1,100-acre Coffeen Lake was built by damming the McDavid Branch of the East Fork of Shoal Creek to aid with cooling for the facility (Ramboll, 2021a,b). The IEPA classifies Coffeen Lake as a General Use Water (IEPA, 2007), meaning that 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, in 2007, US EPA approved a Total

Maximum Daily Load (TMDL) for phosphorus to address aesthetic quality impairments in Coffeen Lake due to excess algae and total suspended solids (TSS) (IEPA, 2007).

1.1.4 Hydrogeology

The geology underlying the Site in the vicinity of the GMF RP consists of several distinct layers (Ramboll, 2021b).

- **Upper Confining Unit (UCU):** The UCU underlies the GMF RP. It consists of the Loess Unit and the upper portion of the Hagarstown Member, which has low permeability clays and silts with generally greater than 60 percent fines. The UCU was encountered across most of the CPP Site, except near the Unnamed Tributary, where the unit was eroded where it has been excavated for construction.
- **Uppermost Aquifer (UA):** The UA is composed of moderately permeable sands, silty sand, and clayey gravel of the Hagarstown Member and, in some portions of the Site, the upper weathered portion of the Vandalia Member. The UA unit is missing in several locations due to both excavation 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.
- **Deep Aquifer (DA):** The DA is a thin (generally less than 5 ft thick), discontinuous unit composed of sands and silty sands.
- **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 and east toward the Unnamed Tributary. Groundwater predominantly flows east/southeast across the GMF GSP to the Unnamed Tributary; however, the western side of the GMF GSP aligns with the groundwater divide and groundwater in this area flows west toward Coffeen Lake. The GMF RP is located east of the divide, and groundwater flows southeast across the GMF RP. The Unnamed Tributary serves as a regional sink for shallow groundwater discharge and shallow groundwater migration beneath or beyond the tributary is unlikely (Ramboll, 2021a,b). Groundwater flow within the UA is mostly in the horizontal direction because the UA is underlain by the low-permeability LCU (Ramboll, 2021a,b).

During groundwater interaction with surface water, CCR-derived constituents may partition between sediments and the surface water column. It should be noted that many CCR-derived 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 the GMF RP.

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 the GMF RP from 1906 until 1983. Three mines were identified within a 1,000-meter radius of the GMF RP. From north to south, they are the Clover Leaf No. 1 Mine

(Illinois State Geological Survey [ISGS] Mine No. 3001), which operated from 1889 to 1901; the Clover Lead No. 4 Mine (ISGS Mine No. 442), which operated from 1906 to 1924; and the Hillsboro Mine (ISGS Mine No. 871), which operated from 1964 to 1983 (Ramboll, 2021a,b; ISGS and University of Illinois at Urbana-Champaign, 2011). The GMF GSP partially overlies the southernmost extent of the Clover Leaf No. 4 Mine. The GMF RP does not directly overlie any of the former mines.

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 Illinois Power Generating Company (IPGC) (IDNR, 2014). To the north of the CPP, there are walking and hiking trails and bank fishing. Coffeen Lake is also used for 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 meters of the GMF RP (Ramboll, 2021a,b).

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[3] of GWPSs in groundwater associated with the GMF RP have been identified for sulfate and total dissolved solids (TDS; Appendix D, Ramboll, 2024), this report presents a CAAA for the GMF RP 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.

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[3] 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, which was submitted to IEPA on October 25, 2021 as part of IPRG's operating permit application for the AP (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. 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 the GMF RP, a CAAA is required because groundwater monitoring associated with the GMF RP identified exceedances of the GWPSs. Groundwater monitoring was conducted in accordance with the proposed groundwater monitoring plan (GMP) between 2015 and 2023 (TDS; Appendix D, Ramboll, 2024). The groundwater 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, sulfate and TDS were identified as constituents/parameters with exceedances of their corresponding GWPSs (Appendix D, Ramboll, 2024).

Two potentially viable corrective actions for the GMF RP were selected in the CMA for further consideration in this CAAA. The corrective action alternatives that are considered in this CAAA are Source Control with Groundwater Polishing (Source Control-GWP) and Source Control with Groundwater Extraction (Source Control-GWE). Each of these corrective action alternatives are described below in Section 2.1.

2.1 Corrective Action Alternatives Descriptions

For both 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 the GMF RP consists of excavation and removal of all CCR (*i.e.*, closure-by-removal, or CBR) and disposal in an on-Site landfill. Specific elements of this approach include:

- Unwatering and dewatering of the impoundment *via* pumping and passive dewatering methods. Pumped water would be pumped to the existing drainage system to the east of the GMF RP and managed in accordance with the NPDES permit for the facility;
- Excavation of approximately 51,000 cubic yards (CY) of CCRs, subsoils with CCR staining, and existing liner system from the impoundment and disposal in the on-Site landfill.
- Removal of existing embankments and construction of a channel to prevent impoundment of stormwater within the GMF RP, allowing flow through the existing outfall in accordance with the NPDES permit;
- Contouring and grading to manage stormwater;
- Site restoration including construction of a vegetative cover on the final surface and implementing stormwater best management practices (BMPs) to reduce erosion;

These source control activities include the complete removal of remaining CCR, liquid, and stained subsoils from the impoundment thus reducing to the maximum extent feasible the migration of CCR constituents to groundwater and facilitating the achievement of the GWPSs in accordance with IAC Section 845.600.

In addition to source control, the corrective actions evaluated in this CAAA include residual plume management. Two potential corrective actions, identified as viable in the CMA, are evaluated in this CAAA for the GMF RP:

- **Alternative 1:** Source Control with Groundwater Polishing (Source Control-GWP)
- **Alternative 2:** Source Control with Groundwater Extraction (Source Control-GWE)

For both 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 combined with residual plume management based on natural physical and geochemical processes that would reduce groundwater concentrations downgradient of the GMF RP. 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 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 post-closure conditions, and remobilization is unlikely to impact the time to achieve GWPS as groundwater returns to background conditions (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 to achieve the GWPSs 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.
- 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 approximately 8.5 years (102 months) after source control is complete and a corrective action permit has been issued by IEPA, whichever is later (Appendix B, Ramboll, 2025b) including:

- Approximately: 5 years (60 months) of corrective action monitoring (*i.e.*, time to meet GWPSs);
- At least 3 years (36 months) of corrective action confirmation monitoring,[4] and
- Approximately 6 months associated with post-closure reporting.

Although source control (*i.e.*, Closure-by-Removal [CBR]) is a primary component of the corrective action, 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, 2025b).

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[4] It should be noted that post-closure care groundwater monitoring would continue for a minimum of 3 years or until such time as GWPSs are achieved, whichever is longer, as required by IAC Section 845.740(b).

2.1.2 Alternative 2: Source Control-GWE

The second corrective action alternative is Source Control-GWE. This remedy includes source control (CBR with on-Site disposal) with a groundwater extraction trench as the residual plume management approach. This residual plume management approach would include the construction of an extraction trench downgradient of the GMF RP, installation of collection pipe in the trench, backfilling with clean fill, and placement of a compacted clay cap to reduce infiltration (Appendix B; Ramboll, 2025b). The extraction trench would be located within the GMF RP following the removal of the CCR. The trench would extend from the ground surface to a depth of approximately 5 ft below ground surface (bgs), which would penetrate through and extend just below the bottom of the UA (approximately an elevation of 605 ft).[5] The total length of the trench would be about 1,800 ft, occurring along the interior toe of the former perimeter dikes of the GMF RP. This corrective action alternative would also integrate and upgrade the current drainage channel east of the GMF RP. The width of the trench would be about 2 or 3 ft. Construction would involve excavating subgrade soils, installing a collection pipe within the trench, backfilling the trench with a clean granular fill, and placing a clay cap on top of the trench to minimize infiltration into the trench. The installed collection pipe would drain to sump pumps distributed along the trench. Groundwater that is captured would be pumped to a new on-Site lined settling pond and discharged through a NPDES permitted outfall (IEPA, 2023).

Implementation of Source Control-GWE is expected to include various tasks across three phases. These phases include 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;
    - Mobilization of equipment and materials to the Site, and preparation for Site construction, such as installation of stormwater BMPs, construction of a staging area and a level working platform, and/or temporary access roads;
    - The extraction trench would be constructed using conventional trenching methods by excavating subgrade soils, placing collection piping and pumps, and backfilling the trench. Excavated spoils would be used as contouring fill beneath the final GMF GSP cover system;
    - 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. Underground trenches with HDPE piping would be constructed to convey extracted groundwater from the trench to the settling pond and ultimately to an appropriate NPDES outfall. This would require installation of electrical, mechanical, and pneumatic infrastructure to operate the conveyance piping system;
- Site restoration would be completed following the construction of the extraction trench and settling pond.

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[5] All elevations in this report are in the North American Vertical Datum of 1988 (NA_VD88), unless otherwise noted. The actual elevation may be variable based on the thickness of UA at the particular location (Appendix B; Ramboll, 2025b).

- **Phase 3:** Operations, maintenance, and closeout of the extraction trench system. Details pertaining to each of these activities are outlined below.
    - Continuous operation of the extraction trench system;
    - Corrective action O&M would involve routine maintenance of extraction pumps, air compressor, and other system components; non-routine maintenance would include repair or replacement of the system components, 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 at the outfall;
    - 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 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;
    - Corrective action confirmation monitoring would be performed for 3 years after GWPSs have been achieved;
    - 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 11 to 13 years (Appendix B; Ramboll, 2025b) including:

- Approximately 2.5 to 3.5 years (30 to 42 months) of pre-construction activities (Phase 1; assumed to occur concurrently with source control),
- Approximately 4 to 8 months of corrective action construction (Phase 2; assumed to occur concurrently with source control), and
- Approximately 8.5 years (102 months) of O&M and closeout (Phase 3; assumed to start after completion of the source control or a corrective action construction permit application has been issued by IEPA, whichever is longer):
    - It is estimated to include 5 years (60 months) of corrective action monitoring (*i.e.*, time to meet GWPSs), at least 3 years (36 months) of corrective action confirmation monitoring,[6] and 6 months associated with post-closure reporting.

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[6] It should be noted that post-closure care groundwater monitoring would continue for a minimum of 3 years or until such time as GWPSs are achieved, whichever is longer, as required by IAC Section 845.740(b).

Key parameters for the Source Control-GWE corrective action alternative are shown in Table 2.2, below.

Table 2.2 Key Parameters for the Source Control-GWE Corrective Action Alternative[a]

Parameter[b]	Value[c]
Labor Hours	
Total On-Site Labor	5,030 hours
Total Off-Site Labor	0 hours
40% Contingency	2,010 hours
Total Labor Hours:	7,040 hours
Vehicle and Equipment Travel Miles	
Vehicles On-Site	7,040 miles
On-Site Haul Trucks (Unloaded + Loaded)	3,320 miles
Labor Mobilization	36,900 miles
Equipment Mobilization (Unloaded + Loaded)	19,500 miles
Off-Site Haul Trucks (Unloaded + Loaded)	10,400 miles
Material Deliveries (Unloaded + Loaded)	15,600 miles
Total On-Site Vehicle and Equipment Travel Miles:	10,400 miles
Total Off-Site Vehicle and Equipment Travel Miles:	82,400 miles
Total Vehicle and Equipment Travel Miles:	92,700 miles

Notes:
Source Control-GWE = Source Control with Groundwater Extraction.
(a) Although source control (*i.e.*, closure-by-removal [CBR]) is a primary component of the corrective action, the labor time, equipment usage, and mileage linked to source control were previously estimated in the Closure Alternative Analysis (CAA) and are not repeated 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; Ramboll, 2025b.

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 the GMF RP (Appendix A, Gradient, 2022c). Because current conditions do not present a risk to human health or the environment at the GMF RP, there will be no unacceptable risk to human health or the environment for future conditions when the unit has been closed and source control has been implemented. Concentrations of CCR-derived constituents will decline over time and, consequently, potential exposures to CCR-derived 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 two potential corrective action alternatives (IAC Section 845.670(e)(1)(A)), and both corrective action alternatives 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 (CBR with on-Site disposal) would be implemented for both corrective action alternatives, which includes unwatering and dewatering of the impoundment; excavation of CCR, the existing liner system, and soils that are visibly impacted with CCR, disposal of excavated CCR and visibly impacted soils into the on-Site landfill; and establishment of vegetation on the final surface of the GMF RP. This source control approach would completely remove all remaining CCR from the impoundment and reduce to the maximum extent feasible the migration of CCR constituents to groundwater. Because source control would be undertaken at the Site prior to the implementation of any residual plume management, both corrective action alternatives would have removed the potential for remaining CCR to further impact groundwater as all CCR will have been removed from the GMR RP. Both corrective action alternatives would therefore be equally and fully protective with regard to source control. The effectiveness of the corrective action alternatives with respect to residual source control are summarized as follows:

- 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 (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 program, and if viable, incorporated as per IAC Section 845.680(b).
- The Source Control-GWE alternative would be effective at controlling residual contamination and downgradient groundwater impacts and migration through the operation of the extraction trench located within the GMF RP. GWE is a widely used corrective measure that has been effectively implemented at many sites to contain and capture dissolved-phase groundwater plumes. Physical and geochemical attenuation would also help control secondary sources and prevent downgradient migration. 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).

Because both corrective action alternatives include source control and residual plume management, both potential corrective action alternatives would be equally 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. For the Source Control-GWE alternative, extracted groundwater would be managed and treated by a newly constructed on-Site settling pond to remove solids prior to discharge *via* a NPDES-permitted outfall to Coffeen Lake. For both 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))

Both corrective action alternatives include source control by removal of remaining CCR and liquids from the impoundment. Vegetation would be established on the final surface of the GMF RP. This approach would eliminate the risk of a CCR release occurring post-closure under any of the corrective action alternatives, as all CCR will have been removed during source control activities.

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 with both 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. The only long-term management activity required under this alternative would be regular 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 3 years as required by IAC Section 845.740(b). 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-GWE alternative would require the construction of the groundwater extraction trench. 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 would occur during the latter stages of the GMF RP closure. This approach allows for the spoils generated from the extraction trench construction to be disposed beneath the final cover system of the GMF GSP. 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. Extracted groundwater would be managed and treated by a newly-constructed on-Site settling pond before discharge *via* a NPDES outfall to Coffeen Lake. 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 3 years as required by IAC Section 845.740(b). 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. The safety impacts associated with source control, which were evaluated in the CAA (Gradient, 2022a), are the same for both corrective action alternatives. 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.
- The Source Control-GWE alternative would include the construction of an extraction trench system to collect and extract CCR-impacted groundwater downgradient. Potential safety concerns would be related to the construction and O&M of the extraction trench and settling pond.

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, Ramboll estimates that residual plume management for the Source Control-GWE corrective action alternative would require 5,030 on-Site labor hours (Appendix B; Ramboll, 2025b). 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 5.2×10^{-2} worker injuries and 4.6×10^{-4} worker fatalities would occur on-Site under the Source Control-GWE corrective action alternative (Table 2.2). No worker accidents would be expected under the Source Control-GWP alternative. The number of on-Site worker accidents is therefore expected to be higher under the Source Control-GWE alternative.

Table 2.2 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-GWE	5.2×10^{-2}	4.6×10^{-4}

Notes:

Source Control-GWE = Source Control with Groundwater Extraction; Source Control-GWP = Source Control with Groundwater Polishing.

(a) Although source control (*i.e.*, CBR) is a primary component of the corrective action, the worker accidents associated with source control were previously estimated in the Closure Alternative Analysis (CAA) and are not repeated 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-GWE (Tables 2.1). For residual plume management under the Source Control-GWE corrective action alternative, 82,000 total off-Site vehicle and equipment travel miles would be required. No off-Site travel miles would be expected under the Source

Control-GWP alternative (Appendix B; Ramboll, 2025b). 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 2.3 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 3.2×10^{-2} worker injuries and 1.1×10^{-3} worker fatalities would be expected to occur due to off-Site activities under the Source Control-GWE alternative. No worker accidents would be expected under the Source Control-GWP alternative.

Table 2.3 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-GWE	
	Injuries	Fatalities	Injuries	Fatalities
Hauling	0	0	2.2×10^{-3}	1.6×10^{-4}
Labor Mobilization/Demobilization	0	0	2.2×10^{-2}	3.5×10^{-4}
Equipment Mobilization/Demobilization	0	0	4.1×10^{-3}	3.1×10^{-4}
Material Deliveries	0	0	3.3×10^{-3}	2.5×10^{-4}
Total:	0	0	3.2×10^{-2}	1.1×10^{-3}

Notes:

Source Control-GWE = Source Control with Groundwater Extraction; Source Control-GWP = Source Control with Groundwater Polishing.

(a) Although source control (*i.e.*, CBR) is a primary component of the corrective action, the worker accidents associated with source control were previously estimated in the Closure Alternative Analysis (CAA) and are not repeated in this analysis.

Overall, considering accidents occurring both on- and off-Site, no worker injuries and fatalities would be expected to occur for residual plume management under the Source Control and GWP alternative; 8.4×10^{-2} worker injuries and 1.5×10^{-4} worker fatalities would be expected to occur for residual plume management under the Source Control-GWE alternative. Thus, overall risks to workers would be higher under the Source Control-GWE 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), off-Site vehicle accidents could result in an estimated 2.1×10^{-2} injuries and 2.3×10^{-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-GWE alternative (Table 2.4). 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 higher under the Source Control-GWE alternative.

Table 2.4 Expected Number of Community Accidents Under Each Corrective Action Alternative[a]

Off-Site Vehicle Use Category	Source Control-GWP		Source Control-GWE	
	Injuries	Fatalities	Injuries	Fatalities
Hauling	0	0	2.7×10^{-3}	2.0×10^{-5}
Labor Mobilization/Demobilization	0	0	8.9×10^{-3}	1.4×10^{-4}
Equipment Mobilization/Demobilization	0	0	5.1×10^{-3}	3.8×10^{-5}
Material Deliveries	0	0	4.1×10^{-3}	3.0×10^{-5}
Total:	0	0	2.1×10^{-2}	2.3×10^{-4}

Notes:

Source Control-GWE = Source Control with Groundwater Extraction; Source Control-GWP = Source Control with Groundwater Polishing.

(a) Although source control (*i.e.*, CBR) is a primary component of the corrective action, the community accidents associated with source control were previously estimated in the Closure Alternative Analysis (CAA) 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 gas (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 (CBR with on-Site disposal) would be implemented for both potential corrective action alternatives. Air impacts occurring during source control would be the same for both corrective action alternatives. Impacts associated with source control using CBR with on-Site disposal were evaluated in the CAA (Gradient, 2022a). On-Site emissions would be higher for residual plume management under the Source Control-GWE alternative due to the greater amount of on-Site vehicle travel miles required under this corrective action (10,400 total on-Site travel miles under the Source Control-GWE *vs*. no on-Site travel miles under the Source Control-GWP alternative; Section 2.1.1; Table 2.1). Off-Site emissions would similarly be higher for residual plume management under the Source Control-GWE alternative due to the greater amount of off-Site vehicle and equipment travel miles required under this alternative (82,400 total off-Site travel miles under the Source Control-GWE *vs*. no off-Site travel miles under the Source Control-GWP alternative; Section 2.1.1; Table 2.1). In summary, air impacts would be higher for the Source Control-GWE alternative due to greater vehicle travel miles, and lower 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 both action alternatives, the constituent mass flux from groundwater into surface water would decline over time after source control has been completed (Ramboll, 2022). Source control would include removal of free liquids, remaining CCR, existing liner, and stained subsoil, as well as the installation of a vegetative cover over the final surface of the GMF RP. This approach would eliminate any CCR and water retained within the impoundment, and eliminate potential mass flux out of the GMF RP.

Under 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 existing monitoring wells).

Under the Source Control-GWE 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 settling pond. Construction can increase the risk of 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 to a 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 (*i.e.*, CBR with on-Site disposal) would be implemented for both potential corrective action alternatives. While appropriate controls will be established to prevent exposures of CCR during source control, the risks of CCR exposure during source control would be the same for both corrective action alternatives. For each of the other corrective action components potential alternatives, no residual CCR exposures would be expected to occur. However, impacted soils and groundwater can be a source of CCR-derived 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-GWE than for the Source Control-GWP alternative, because the Source Control-GWE would involve the construction of the extraction trench, the production, management, and treatment of extracted groundwater, as well as on-Site disposal of excavated spoils. 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-GWE alternative would be managed through the use of rigorous safety protocols and personal protective equipment.

2.2.5.5 Other Identified Impacts

Source control (*i.e.*, CBR with on-Site disposal) would be implemented for both potential corrective action alternatives. Thus, impacts during source control would be the same for both of the corrective action alternatives (see the CAA; Gradient, 2022a).

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-GWE, while the energy demands under the Source Control-GWP alternative associated with residual plume management are expected to be lower, because the latter alternative would not require any significant construction activity. In addition, energy would be required for the operation of the extraction trench system under the Source Control-GWE alternative, while there is no operational energy required under the Source Control-GWP alternative, because it would rely on physical and geochemical processes.

Similarly, traffic and noise impacts associated with residual plume management are also expected to be higher under the Source Control-GWE alternative than the Source Control-GWP alternative, due to the construction activities required to construct the extraction trench system. Traffic may increase temporarily around the Site under the Source Control-GWE alternative 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 work day (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 are expected to be significantly less than those associated with the Source Control-GWE alternative.

Construction activities can negatively impact natural resources and habitat 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 meters of the GMF RP (Ramboll, 2021a,b). 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-GWE alternative would require construction of an extraction trench and a 1-acre on-Site settling pond, which would occur during the latter phase of the GMF RP closure construction. These impacts would include disturbance of some existing habitat 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). However, the construction would be restricted within the footprint of the GMF RP and the associated impacts would be low.

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).

Groundwater and dissolved constituents move downward through the UCU in the vicinity of the GMF RP until they reach the UA. Further downward migration is limited by the LCU. Within the UA, groundwater flows generally in a southern and eastern direction towards the unnamed tributary. Coffeen Lake is the primary receiving water body in the vicinity of the Site (Ramboll, 2022). Although groundwater elevations may vary seasonally, groundwater flow direction in the UA remains consistent due to the proximity of Coffeen Lake (Ramboll, 2022).

Groundwater elevations near the GMF RP are primarily controlled by surface topography, geologic unit topography and surface water elevations in Coffeen Lake and the Unnamed Tributary (Ramboll, 2022). Water elevations within the surface impoundment have been found to remain relatively consistent and do not fluctuate with groundwater elevations, meaning limited hydraulic connection with the surface impoundment is likely (Ramboll, 2022).

Groundwater modeling was performed in support of the CAA (Ramboll, 2022). The modeling concluded that groundwater concentrations would meet the GWPSs for all of the constituents[7] identified as having

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[7] Sulfate was selected for monitoring contaminant transport in CCR due to its elevated concentrations and its mobile and conservative behavior in groundwater, characterized by minimal sorption or degradation. It would likely take the longest time to meet the GWPS for sulfate. It is not necessary to model all constituents that show GWPS exceedances or have been detected at lower concentrations relative to their GWPSs, because those constituents would likely achieve their GWPSs faster than sulfate (Ramboll, 2022).

potential groundwater exceedances in monitoring wells in the UA within approximately 5 years under the Source Control-GWP alternative (Ramboll, 2022). Considering the short timeframe anticipated for achieving GWPS under the Source Control-GWP alternative without an active remedial action, groundwater modeling related to the extraction trench was not performed for the Source Control-GWE alternative (Appendix B; Ramboll, 2025b). The timeframe for achieving GWPS under the Source Control-GWE alternative is expected to be comparable or slightly faster than the Source Control-GWP alternative (Table 2.5).

Table 2.5 Estimated Timeline and Implementation Schedule Under Each Corrective Action Alternative

Implementation Phase	Implementation Task	Timeframe	
		Source Control-GWP[a]	**Source Control-GWE[b]**
1: Pre-Construction Activities	Agency Coordination, Approvals, and Permitting	NA	18 to 24 months
	Final Design and Bid Process		12 to 18 months
	Total Timeframe to Complete Pre-Construction Activities		30 to 42 months (2.5 to 3.5 years)
2: Corrective Action Construction	Corrective Action Construction	NA	4 to 8 months
	Total Timeframe to Complete Corrective Action Construction		4 to 8 months
3: Corrective Action O&M and Closeout[a]	Corrective Action Operation (Time to Meet GWPS)	60 months (5 years)	60 months (5 years)
	Corrective Action Confirmation Monitoring	36 months	36 months
	Corrective Action Completion Reporting	6 months	6 months
	Total Timeframe to Complete Corrective Action O&M and Closeout	102 months (8.5 years)	102 months (8.5 years)
Total Timeline to Complete Corrective Action (all phases)		102 months (8.5 years)	136 to 152 months (11 to 13 years)

Notes:

Source Control-GWP = Source Control with Groundwater Polishing; Source Control-GWE= Source Control with Groundwater Extraction.

(a) All timelines are assumed to occur after completion of source control (*e.g.*, final closure of the SI) and a corrective action permit has been issued by IEPA, whichever is longer, for the Source Control-GWP Alternative.

(b) Pre-construction and construction activities are assumed to occur concurrently with source control, and corrective action O&M tasks are assumed to occur after completion of source control (*e.g.*, final closure of the SI) and a corrective action construction permit application has been issued by IEPA, whichever is longer, for the Source Control-GWE alternative.

Source: Appendix B; Ramboll, 2025a.

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 will 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 (*i.e.*, CBR with on-Site CCR disposal) will be undertaken at the Site. Thus, both corrective action alternatives would completely eliminate the potential for a sudden CCR release to occur post-closure (due, *e.g.*, to flooding or a dike failure event), as all CCR will have been removed as part of source control. Similarly, due to the source control common to both corrective action alternatives, the two alternatives would both involve removing CCR and soils visibly impacted with CCR and placing them within an on-Site landfill, no future exposure to residual CCR exposures would be expected to occur during the implementation of either of the alternatives. Both corrective action alternatives would therefore be 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-GWE alternative than for the Source Control-GWP alternative, because the Source Control-GWE would involve the production, management, and potential treatment of extracted groundwater. The Source Control-GWP alternative would not involve exposure to either of these soil or groundwater waste streams. Any potential CCR exposures occurring under Source Control-GWE during groundwater extraction and treatment would be managed through the use of rigorous safety protocols, personal protective equipment, and appropriate disposal practice.

Some changes in groundwater flow (*i.e.*, potential controlled discharge into Coffeen Lake) may occur under the Source Control-GWE alternative, due to the operation of the extraction system. Hydrogeological changes would be expected under the Source Control-GWE alternative, such as lowering groundwater table in the vicinity of the extraction trench, altering flow patterns in the UA, and causing changes in hydraulic gradients. 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.

2.2.8 Long-Term Reliability of the Engineering and Institutional Controls (IAC Section 845.670(e)(1)(G))

Source control (*i.e.*, CBR with on-Site disposal) would be implemented for both potential corrective action alternatives. Thus, the long-term reliability during source control would be the same for both corrective action alternatives (CAA, Gradient 2022a). The long-term reliability of the engineering and institutional controls associated with residual plume management of both corrective alternatives 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 attenuation should remain generally stable under post-closure conditions. Remobilization is unlikely to impact the time to achieve GWPS as groundwater returns to background conditions (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 the GMF RP groundwater remediation in response to new Site information and/or the performance of the corrective action alternative.

- GWE is a proven remedy that has been implemented at many sites. Thus, residual plume management under the Source Control-GWE alternative would be expected to be reliable provided it is constructed and operated in accordance with standard design and specifications. Under this alternative, the extraction trench system and settling pond would require engineering design and installation for groundwater extraction and treatment. Routine and non-routine maintenance of the extraction system is required to ensure reliable operation of the extraction trench and pumps, as well as other system components. Active groundwater monitoring would be in place, similar to those required under the Source Control-GWP alternative.
- For both 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 natural 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-GWE would utilize an extraction trench and settling pond to extract and treat impacted groundwater to achieve reductions in groundwater concentrations to below GWPSs. While the extraction system would need ongoing maintenance and potential replacement of system components over time, it is unlikely that the residual plume management remedy under the Source Control-GWE 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.

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 (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. Thus, construction difficulties regarding source control would be the same for both corrective action alternatives. Difficulties associated with implementing CBR with on-Site disposal approach were evaluated in the CAA (Gradient, 2022a). 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-GWE would involve the construction of an extraction trench, settling pond and conveyance system to extract and treat impacted groundwater. The shallow groundwater trench required by this alternative is commonly constructed at similar depths and can be performed using conventional construction equipment. Therefore, while some construction is necessary, the degree of difficulty is expected to be low (Appendix B; Ramboll, 2025b). 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 (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. Thus, the operational reliability of the remedy would be the same for both corrective action alternatives. The reliability associated with implementing CBR with on-Site disposal approach was evaluated in the CAA (Gradient, 2022b). Both 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 natural 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
- Residual plume management under the Source Control-GWE alternative would also have high operational reliability because it is an established and commonly used remedial technique, as long as the extraction trench system is constructed in accordance with appropriate design specifications. In addition, the remedy operates as a mechanical system and would require routine and non-routine maintenance of the extraction system to ensure reliable operation (in addition to those required for groundwater monitoring).

2.3.3 Need to Coordinate with and Obtain Necessary Approvals and Permits from Other Agencies (IAC Section 845.670(e)(3)(C))

Both corrective action alternatives would require regulatory approvals. Specific permits and approvals associated with source control are the same for both corrective action alternatives and are discussed in the CAA (Gradient, 2022a). The specific approvals and permits associated with residual plume management for both corrective action alternatives are discussed below.

- The Source Control-GWP alternative would not need additional permits from other agencies, other than the permits issued by IEPA for source control (*i.e.*, Closure Plan and Construction Permit Application) and approval of the Corrective Action Plan.
- The Source Control-GWE alternative would require approvals and permits. Groundwater extracted from the extraction trench would require a modified NPDES-permit. The NPDES permits would likely require renewals depending on the timeline of corrective action implementation. In addition, permits from the IEPA for construction stormwater controls and BMPs, placement of excavation spoils beneath the GMF GSP final cover system, a joint water pollution control construction and operating permit, as well as IDNR Dam Safety modification permit would be required. These permits and plans typically take 18-24 months to obtain, although some may already be obtained during the GMF RP final closure (Appendix B; Ramboll, 2025b).

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 (*i.e.*, CBR with on-Site CCR disposal) would be implemented for both potential corrective action alternatives. Thus, equipment and specialist needs would be the same for both corrective action alternatives. An assessment of necessary equipment and specialists associated with implementing CBR with on-Site disposal approach was evaluated in the CAA (see the CAA; Gradient, 2022a). Specialized equipment and personnel are essential for field data collection and groundwater sampling for residual plume management under both potential corrective action alternatives. Additionally, the assessment of groundwater concentrations for Site constituents would necessitate laboratory equipment and specialists for both alternatives. The availability of equipment and specialists 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, and geochemists, to conduct statistical analyses, ensuring that natural geochemical processes function as anticipated in 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-GWE alternative would require specialists to manage the extraction system throughout its construction and operational period.
    - Construction of the groundwater to a settling pond on Site is not expected to require specialized contractors or equipment. Collection trenches are routinely constructed by contractors in central and southern Illinois.
    - 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. 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).

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 both alternatives 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-GWE alternative would require the construction of the extraction trench system and a new settling pond on-Site:
    - The construction of the extraction trench would generate spoils, and the waste materials would be disposed of in the GMF GSP final cover system pending a Construction Permit Application Amendment (Appendix B; Ramboll, 2025b). Completing the GWE system construction at the same time as the GMF GSP closure would provide sufficient on-Site capacity for the disposal of generated spoils.
    - The extraction trench system would send extracted groundwater to an on-Site settling pond, which collects 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 Site infrastructure and other surface impoundments at CPP.
    - Discharge from the settling pond would be conveyed to a 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.

2.4 The Degree to Which Community Concerns Are Addressed by the Remedy (IAC Section 845.670(e)(4))

Several nonprofit organizations have raised concerns regarding the potential impacts of the 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; Sierra Club, 2021). The combination of source control (*i.e*., CBR with on-Site CCR disposal) and residual plume management would include a complete removal of CCR from the impoundment and cause groundwater concentrations to decline over time under all of the corrective action alternatives, as suggested by the groundwater modeling (Ramboll, 2022), thus addressing community concerns.

A public meeting was held on May 1, 2025, pursuant to requirements under IAC Section 845.660(d). 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, 2025c). Both potential corrective action alternatives would have source control and residual plume management efforts. The source control would include the complete removal of CCR from the GMF RP and disposal at the on-Site landfill, and establishment of vegetation on the final surface of the GMF RP. Additionally, there is not expected to be a significant difference between the two alternative corrective actions in the time to achieve the GWPSs (Appendix B; Ramboll, 2022, 2025b). Therefore, both corrective action alternatives would prevent the release of contaminated material from the GMF RP.

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 within approximately 5 years under both Source Control-GWP and Source Control-GWE alternatives (Ramboll, 2022). 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 (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 program, 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-GWE alternative would rely on the groundwater extraction trench to reduce or prevent migration of impacted groundwater off-Site. Groundwater quality would also be improved as a result of physical and geochemical attenuation processes. The construction activities would likely to result some negative impacts to the ecosystem, including disturbance of some existing habitat 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). However, the construction would be restricted within the footprint of the GMF RP and the associated risks would be low.

2.6 Summary

This CAAA evaluates both 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 Source Control-GWP. The expected impacts on workers, nearby communities, and the environment under the Source Control-GWP alternative are lower than those under the Source Control-GWE alternative. Additionally, there is not expected to be a significant difference between the two alternative corrective actions in the time to achieve the GWPSs. Thus, Source Control-GWP is the most appropriate corrective action alternative for the GMF RP.

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Appendix A

2022 Human Health and Ecological Risk Assessment

Human Health and Ecological Risk Assessment
Gypsum Management Facility Gypsum Stack Pond and Gypsum Management Facility Recycle Pond
Coffeen Power Plant
Coffeen, Illinois

July 28, 2022

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www.gradientcorp.com
One Beacon Street, 17th Floor
Boston, MA 02108
617-395-5000

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Abbreviations

ADI	Acceptable Daily Intake
BCF	Bioconcentration Factor
BCG	Biota Concentration Guide
CAA	Closure Alternatives Assessment
CCR	Coal Combustion Residuals
CEM	Conceptual Exposure Model
COI	Constituent of Interest
COPC	Constituent of Potential Concern
CPP	Coffeen Power Plant
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
CWS	Community Water Supply Well
DA	Deep Aquifer
DCU	Deep Confining Unit
ESV	Ecological Screening Value
GMF	Gypsum Management Facility
GSP	Gypsum Stack Pond
GWPS	Groundwater Protection Standards
GWQS	Groundwater Quality Standards
HTC	Human Threshold Criteria
IAC	Illinois Administrative Code
ID	Identification
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
NID	National Inventory of Dams
NRWQC	National Recommended Water Quality Criteria
ORNL RAIS	Oak Ridge National Laboratory's Risk Assessment Information System
RfD	Reference Dose
RME	Reasonable Maximum Exposure
RP	Recycle Pond
RSL	Regional Screening Level
SI	Surface Impoundment
SWQC	Surface Water Quality Criteria
SWQS	Surface Water Quality Standards
TEC	Threshold Effect Concentration
UA	Uppermost Aquifer
UCU	Upper Confining Unit
US DOE	United States Department of Energy

US EPA	United States Environmental Protection Agency
USGS	US 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 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, 2021a). The CCR units that are the subjects of this report are two gypsum management facility (GMF) ponds: the GMF gypsum stack pond (GMF GSP, Vistra Identification [ID] Number [No.] 103, Illinois Environmental Protection Agency [IEPA] ID No. W1350150004-03, and National Inventory of Dams [NID] No. IL50579) and the GMF recycle pond (GMF RP, Vistra ID No. 104, IEPA ID No. W1350150004-04, and NID No. IL50578) (Ramboll, 2021a,b). The GMF GSP is a 77-acre lined surface impoundment (SI) and the GMF RP is a 17-acre lined SI; they were used to manage CCR and non-CCR waste streams at the CPP (Ramboll, 2021a,b).

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 the GMF GSP and RP. This risk evaluation was performed to support the Closure Alternatives Assessment (CAA) for the GMF GSP and the GMF RP in accordance with requirements in Title 35 Part 845 of the Illinois Administrative Code (IAC) (IEPA, 2021). 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, 2021), or a relevant surface water quality standard (SWQS) (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, 2014a).

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 the GMF GSP or GMF RP 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 when the GMF GSP and the GMF RP are closed. 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 two miles south of the city of Coffeen and about eight miles southeast of the city of Hillsboro, Illinois. The CPP operated as a coal-fired power plant from 1964 until November 2019 (Ramboll, 2021a). Five CCR units are present on the CPP property: Ash Pond 1, Ash Pond 2, GMF RP, GMF GSP, and Landfill (Ramboll, 2021a). The GMF GSP and the GMF RP are the subjects of this report. The GMF GSP is a 77-acre lined SI, identified by Vistra ID No. 103, IEPA ID No. W1350150004-03, and NID No. IL50579. The GMF RP is a 17-acre lined SI identified by Vistra ID No. 104, IEPA ID No. W1350150004-04, and NID No. IL50578 (Ramboll, 2021a,b). Both units were put into operation in 2010, and stopped receiving waste prior to April 11, 2021 (Ramboll, 2021a).

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 the GMF GSP, flows south into Coffeen Lake (Figure 2.1) (Ramboll, 2021a). 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, 2021a).

Figure 2.1 Site Location Map. Source: Ramboll (2021a).

2.2 Geology/Hydrogeology

The geology underlying the CPP Site in the vicinity of the GMF GSP and the GMF RP primarily consists of unlithified deposits (Ramboll, 2021a,b). The unlithified deposits were categorized into the following hydrostratigraphic units (from the surface downward): the Upper Confining Unit (UCU), composed of Roxana and Peoria Silts (Loess Unit); the Uppermost Aquifer (UA), primarily composed of sandy to gravelly silts and clays of the Hagarstown Member; the Lower Confining Unit (LCU), comprised of the Vandalia Member, the Mulberry Grove Member, and the Smithboro Member; the Deep Aquifer (DA), comprised of sand and sandy silts/clays of the Yarmouth Soil; and the Deep Confining Unit (DCU), comprised of clays, silts, and sands of the Banner Formation (Ramboll, 2021a).

The Hagarstown Member is separated into two units: a gravelly clay till unit on top of a sandy unit (Ramboll, 2021a,b). The sandy unit at the base of the Hagarstown Member was identified as the UA. However, in some locations, the uppermost weathered sandy clay portion of the Vandalia Member was also identified as the UA (Ramboll, 2021a). The UA (*i.e.*, sandy portion of the Hagarstown Member) is generally less than 3 feet (ft) thick but is absent at several locations due to weathering or construction-related excavation (Ramboll, 2021a,b). The UA is not present beneath the entire footprint of the GMF GSP or the GMF RP (Ramboll, 2021a,b). The top of the UA is separated from the overlying CCR materials in the GMF GSP and the GMF RP by the low permeability Loess (UCU) and the gravelly clay till portions of the Hagarstown Member. The bottom of the UA is separated from the DA by low-permeability tills of the LCU (Ramboll, 2021a,b). The UA has moderate permeability with a geometric mean horizontal hydraulic conductivity of 1.4×10^{-3} cm/s near the GMF GSP (Ramboll, 2021a) and a geometric mean horizontal hydraulic conductivity of 1.2×10^{-3} cm/s near the GMF RP (Ramboll, 2021b).

In the vicinity of the GMF RP, groundwater within the UA generally flows southeast towards an unnamed tributary (Ramboll, 2021b). In the vicinity of the GMF GSP, groundwater within the UA flows southeast/east towards the unnamed tributary and southwest/west towards the western branch of Coffeen Lake (Ramboll, 2021a). For the southeastern/eastern flow component, the horizontal hydraulic gradients within the UA range from 0.003 to 0.01 ft/ft (Ramboll, 2021a,b). For the southwestern/western flow component, the average horizontal hydraulic gradient in the UA is about 0.018 ft/ft (Ramboll, 2021a).

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 the GMF GSP and the GMF RP migrates and interacts with surface water and sediment in the adjacent unnamed tributary and Coffeen Lake. The CSM was developed using available hydrogeologic data specific to the GMF GSP and the GMF RP, including information on groundwater flow and surface water characteristics (Ramboll, 2021a).

Due to the presence of a groundwater divide on the Site, groundwater in the UA flows both toward the eastern and western branches of Coffeen Lake (Figure 2.2). On the east side of the groundwater divide, groundwater flows east and southeast into an unnamed tributary that flows south into the eastern branch of Coffeen Lake. On the west side of the divide, groundwater flows west and southwest into the western branch of Coffeen Lake.

All groundwater originating from the GMF RP ultimately flows into the unnamed tributary, whereas a component of groundwater originating from the GMF GSP flows into the unnamed tributary, and the rest flows into the western branch of Coffeen Lake (Figure 2.2). The GMF RP and much of the GMF GSP are located to the east side of the groundwater divide, thus groundwater (and any CCR-related constituents) originating from these SIs may migrate vertically downward through the UCU into the UA and eventually flow into the unnamed tributary (Ramboll, 2021a,b). The western edge of the GMF GSP is on the west side of the groundwater divide; therefore, groundwater (and any CCR-related constituents) originating from this portion of the SI may migrate vertically downward through the UCU into the UA and eventually flow into the western branch of Coffeen Lake. 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 the GMF ponds may mix with surface water in the unnamed tributary to the east and with surface water in the western branch of Coffeen Lake to the west. The dissolved constituents in groundwater may partition between sediments and surface water.

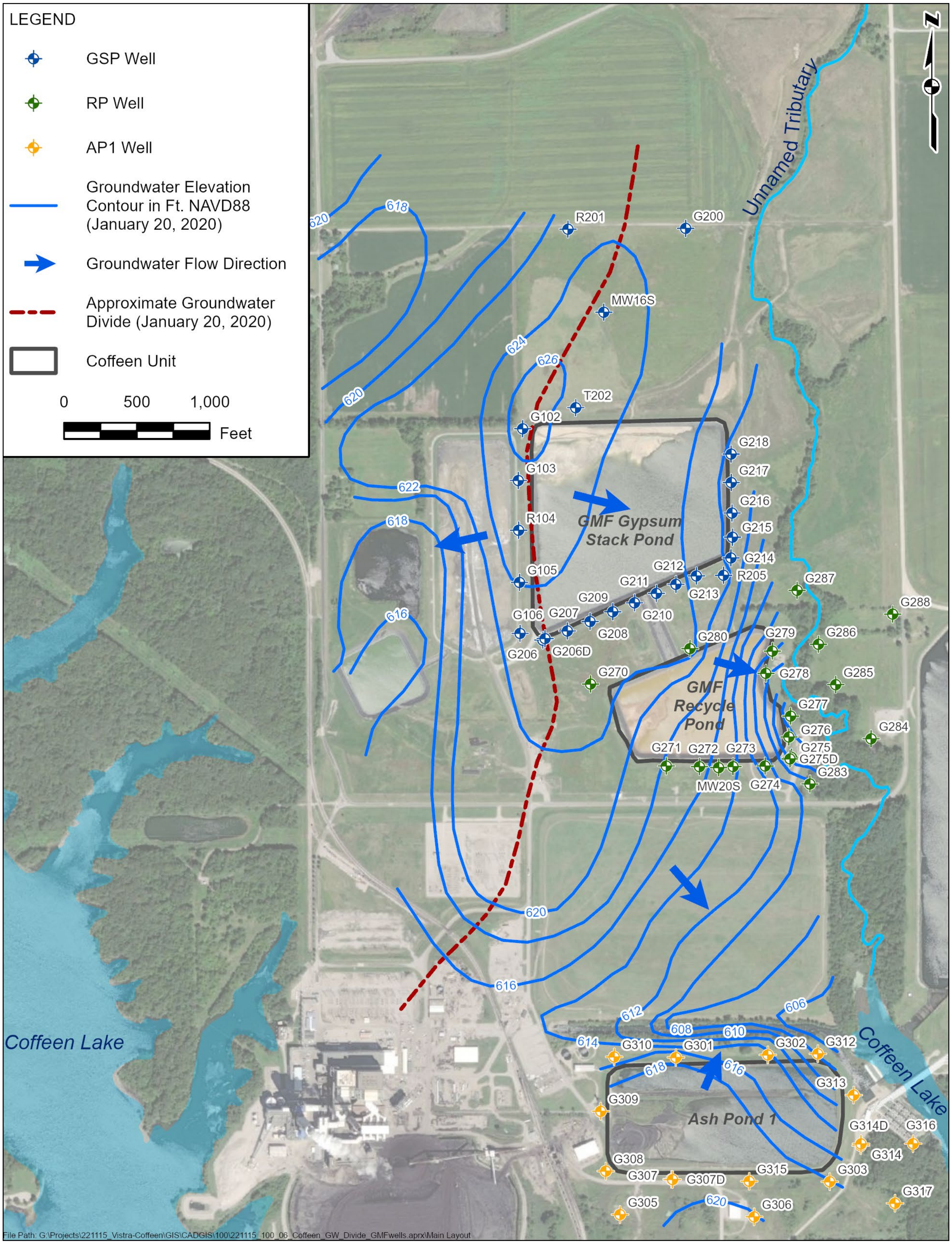

Figure 2.2 Groundwater Flow Direction. Source: Ramboll (2021a).

2.4 Groundwater Monitoring

A total of 43 wells have been used to monitor the groundwater quality near and downgradient of the GMF GSP and the GMF RP; 24 wells are associated with the GMF GSP and 19 wells are associated with the GMF RP. Of the 24 wells associated with the GMF GSP, 23 wells are screened in the UA and 1 well is screened in the DA (Table 2.1). Of the 19 wells associated with the GMF RP, 16 wells are screened in the UA, 2 wells are screened in the LCU, and 1 well is screened in the DA (Table 2.1). The analyses presented in this report conservatively relied on all available data from the 43 wells collected between 2015 and 2021, which is the period subsequent to the promulgation of the Federal CCR Rule. Groundwater samples were analyzed for a suite of total metals, specified in Illinois CCR Rule Part 845.600 (IEPA, 2021).[1] A summary of the groundwater data for the 43 wells used in this risk evaluation is presented in Table 2.2. The GMF GSP and the GMF RP well locations used in this risk evaluation are shown in Figure 2.3. Note that the groundwater data were split into two groups to model surface water concentrations for the unnamed tributary (19 GMF RP and 16 GMF RP wells on the east side of the groundwater divide) and the western branch of Coffeen Lake (8 GMF GSP wells on the west side of the groundwater divide). The use of groundwater data in this risk evaluation does not imply that detected constituents are associated with the GMF GSP or the GMF RP or that they have been identified as potential groundwater exceedances.

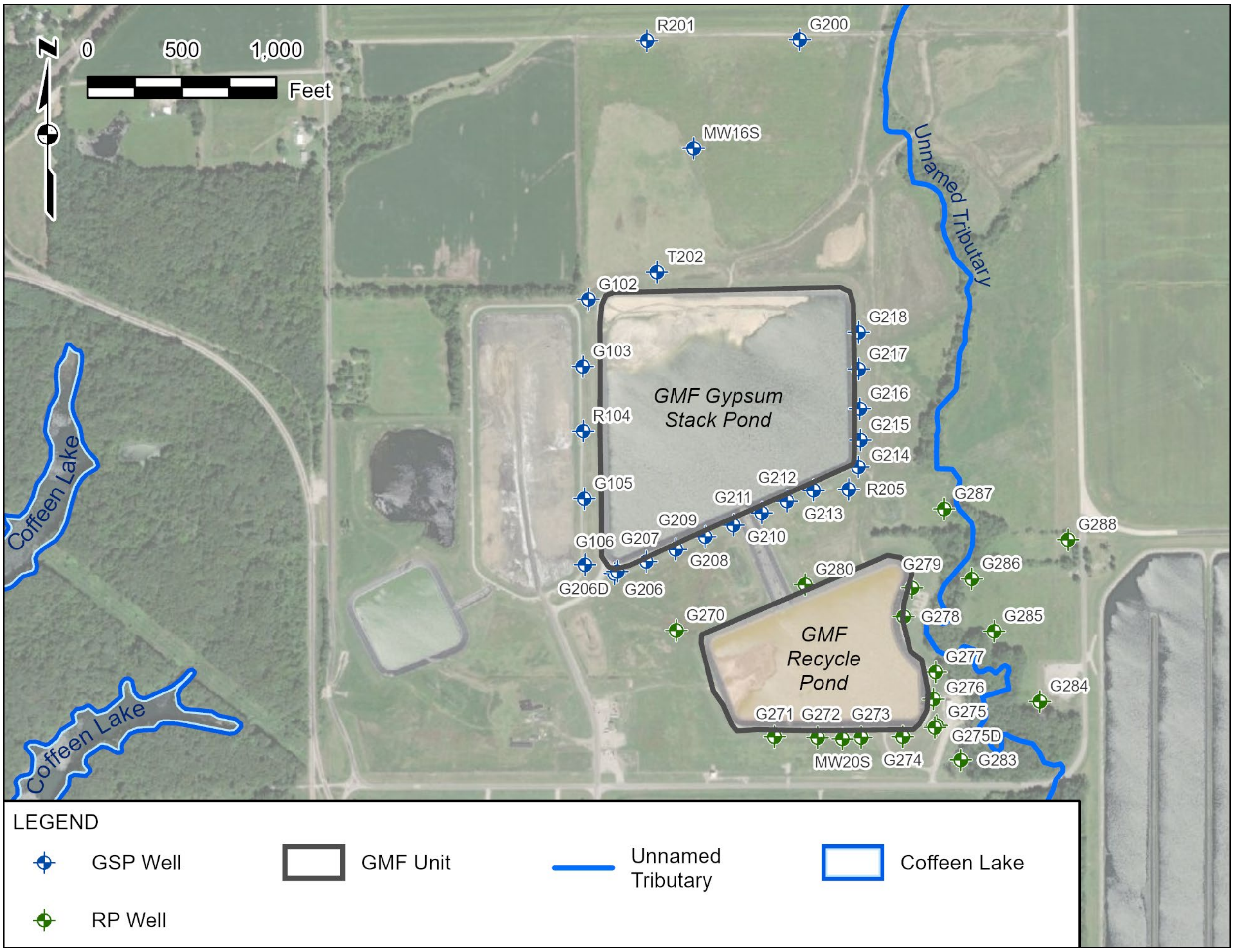

Figure 2.3 Monitoring Well Locations. Source: Ramboll (2021a).

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[1] Samples were analyzed for a longer list of inorganic constituents and general water quality parameters (chloride, fluoride, sulfate, and total dissolved solids), but these constituents were not evaluated in the risk evaluation.

Table 2.1 Groundwater Monitoring Wells Related to the GMF GSP and the GMF RP

Associated GMF Pond	Side of Groundwater Divide	Well	Hydrogeologic Unit	Date Constructed	Screen Top Depth (ft bgs)	Screen Bottom Depth (ft bgs)	Well Depth (ft bgs)
GMF GSP	East	G200	UA	2/25/2008	12.19	16.98	17.36
GMF GSP	East	G207	UA	10/8/2010	18.24	22.77	23.30
GMF GSP	East	G208	UA	10/7/2010	17.53	22.06	22.60
GMF GSP	East	G209	UA	10/7/2010	17.74	22.28	22.81
GMF GSP	East	G210	UA	10/6/2010	19.39	23.93	24.46
GMF GSP	East	G211	UA	10/11/2010	17.34	21.88	22.41
GMF GSP	East	G212	UA	10/11/2010	16.74	21.29	21.81
GMF GSP	East	G213	UA	10/12/2010	16.75	21.29	21.82
GMF GSP	East	G214	UA	10/14/2010	17.75	22.14	22.65
GMF GSP	East	G215	UA	10/13/2010	19.41	23.80	24.31
GMF GSP	East	G216	UA	10/13/2010	20.04	24.42	24.93
GMF GSP	East	G217	UA	10/12/2010	20.49	24.88	25.38
GMF GSP	East	G218	UA	10/12/2010	20.33	24.77	25.27
GMF GSP	East	MW16S	UA	4/25/2006	14.59	19.41	19.76
GMF GSP	East	R205	UA	3/20/2017	11.32	16.01	16.42
GMF GSP	East	T202	UA	10/15/2010	12.27	16.65	17.21
GMF GSP	West	G206D	DA	1/25/2021	49.20	59.00	59.39
GMF GSP	West	G102	UA	4/28/2006	12.02	16.78	17.15
GMF GSP	West	G103	UA	2/15/2010	15.88	20.67	21.09
GMF GSP	West	G105	UA	2/16/2010	16.11	20.90	21.37
GMF GSP	West	G106	UA	2/16/2010	14.37	18.96	19.44
GMF GSP	West	G206	UA	10/14/2010	17.51	21.92	22.42
GMF GSP	West	R104	UA	10/8/2010	14.59	19.32	19.85
GMF GSP	West	R201	UA	10/8/2010	14.59	19.32	19.85
GMF RP	East	G275D	DA	1/14/2021	49.76	59.55	59.89
GMF RP	East	G283	LCU	1/14/2021	8.39	18.17	18.36
GMF RP	East	G285	LCU	1/25/2021	13.68	23.45	23.83
GMF RP	East	G270	UA	2/26/2008	13.13	17.92	18.27
GMF RP	East	G271	UA	9/10/2009	9.96	14.31	14.79
GMF RP	East	G272	UA	9/10/2009	9.11	13.98	14.32
GMF RP	East	G273	UA	9/10/2009	9.08	14.56	15.10

Associated GMF Pond	Side of Groundwater Divide	Well	Hydrogeologic Unit	Date Constructed	Screen Top Depth (ft bgs)	Screen Bottom Depth (ft bgs)	Well Depth (ft bgs)
GMF RP	East	G274	UA	9/16/2009	12.90	17.67	18.06
GMF RP	East	G275	UA	9/16/2009	8.22	12.62	13.19
GMF RP	East	G276	UA	9/16/2009	22.41	27.22	27.65
GMF RP	East	G277	UA	9/14/2009	14.29	18.77	19.24
GMF RP	East	G278	UA	9/11/2009	18.93	23.70	24.06
GMF RP	East	G279	UA	9/10/2009	22.40	26.79	27.30
GMF RP	East	G280	UA	2/26/2008	12.79	17.63	17.98
GMF RP	East	G284	UA	2/3/2021	8.08	12.85	13.23
GMF RP	East	G286	UA	1/18/2021	3.37	8.16	8.50
GMF RP	East	G287	UA	1/20/2021	5.43	10.25	10.59
GMF RP	East	G288	UA	1/19/2021	7.59	12.26	12.75
GMF RP	East	MW20S	UA	5/1/2007	8.41	13.22	13.67

Notes:

Source: Ramboll (2021a).

bgs = Below Ground Surface; DA = Deep Aquifer; ft = Feet; LCU = Lower Confining Unit; UA = Uppermost Aquifer.

Table 2.2 Groundwater Data Summary

Constituent	Samples with Constituent Detected	Samples Analyzed	Minimum Detected Value	Maximum Detected Value	Maximum Laboratory Detection Limit
Total Metals (mg/L)					
Antimony	2	434	0.0040	0.0045	0.0030
Arsenic	158	477	0.0010	0.11	0.0010
Barium	452	452	0.018	0.78	0.0010
Beryllium	9	436	0.0013	0.0067	0.0010
Boron	336	549	0.010	4.6	0.015
Cadmium	8	462	0.0012	0.0041	0.0010
Chromium	65	447	0.0040	0.086	0.0040
Cobalt	46	447	0.0021	0.053	0.0020
Lead	85	477	0.0010	0.082	0.0010
Lithium	25	265	0.011	0.030	0.020
Mercury	8	434	0.00024	0.0014	0.00020
Molybdenum	184	422	0.0010	0.044	0.0010
Selenium	189	451	0.0010	0.020	0.0010
Thallium	9	440	0.0010	0.0035	0.0010
Radionuclides (pCi/L)					
Radium-226 + 228	268	268	0	4.2	5.0
Other (mg/L, unless otherwise noted)					
Chloride	552	552	1.7	440	250
Fluoride	480	530	0.25	0.99	0.25
Sulfate	549	549	9.8	1,800	500
Total Dissolved Solids	555	555	230	3,400	26

Note:
pCi/L = PicoCuries Per Liter.

2.5 Surface Water Monitoring

Geosyntec Consultants collected a total of six surface water samples from Coffeen Lake (south of the GMF GSP and the GMF RP) in August 2021 (Geosyntec Consultants, 2021). The sample locations are shown in Figure 2.4, and the sampling results are summarized in Table 2.3.

Figure 2.4 Surface Water Sampling Locations. Source: Geosyntec Consultants (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	ND	ND	0.005
Iron	5	5	0.23	0.38	0.2
Lithium	0	5	ND	ND	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**:**

ND = Not Detected.

Source: Geosyntec Consultants (2021).

The background sample (BKG-1 on Figure 2.4) was not included in the summary statistics.

Surface water was analyzed for both total and dissolved metals; only the total metals are reported here, because they are generally 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, therefore, was not identified as a 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 the GMF GSP and the GMF RP 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.

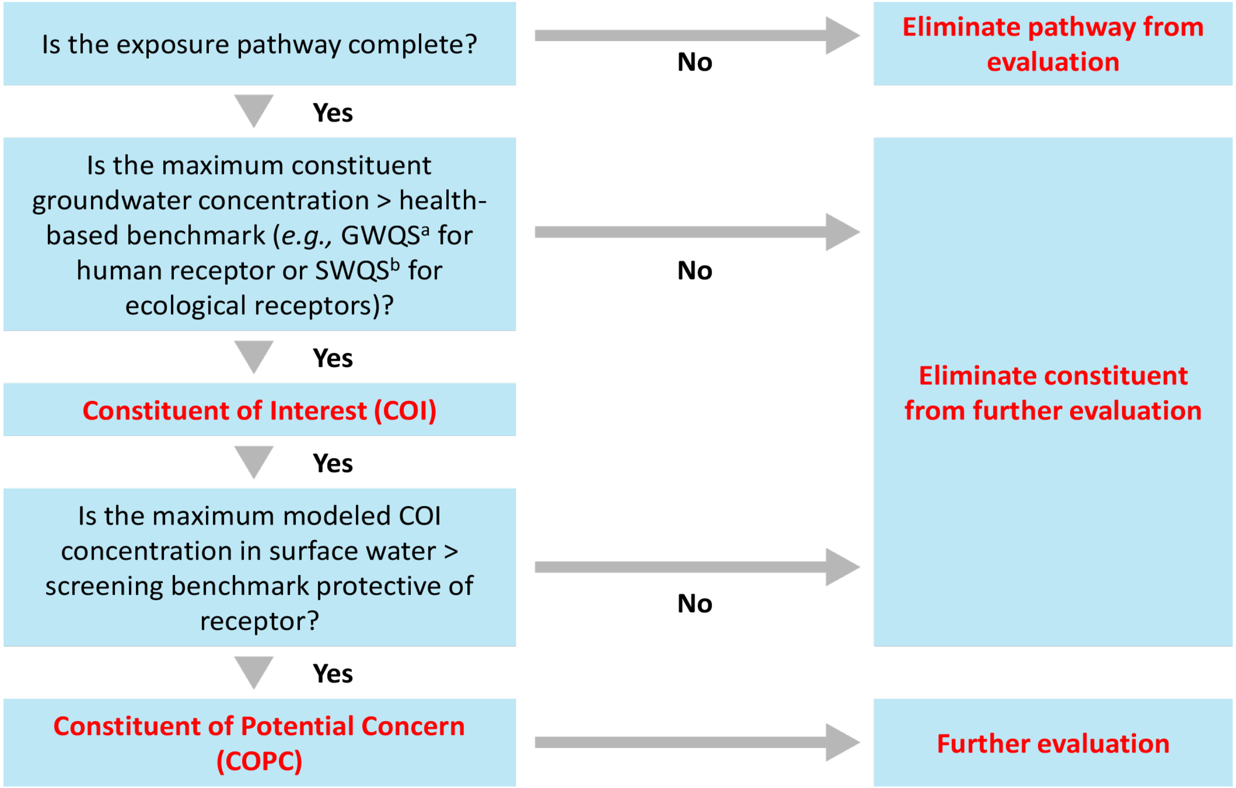

Figure 3.1 Overview of Risk Evaluation Methodology. GWQS = Groundwater Quality Standards; IEPA = Illinois Environmental Protection Agency; SWQS = Surface Water Quality Standards. (a) The IEPA Part 845 groundwater protection standards were used to identify COIs. (b) IEPA SWQS protective of chronic exposures to aquatic organisms were used to identify ecological COIs. In the absence of an 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 were 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 SWQS for ecological receptors. Based on the CSM (Section 2.2), some groundwater underlying the GMF GSP and the GMF RP has the potential to interact with surface water in the unnamed tributary and Coffeen Lake. Therefore, constituents in groundwater potentially related to the GMF GSP and the GMF RP may potentially flow into the unnamed tributary and subsequently 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 wells related to the GMF GSP and the GMF RP. 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 the GMF GSP and the GMF RP 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 the GMF GSP and the GMF RP into groundwater, surface water, sediment, and fish. The following human receptors and exposure pathways were evaluated for inclusion in the Site-specific CEM.

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[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). Although swimming and boating are unlikely to occur in the unnamed tributary due to its shallow depth (flow depth of 2.1 feet) (Golder Associates Inc., 2020), the unnamed tributary was evaluated for recreator exposure due to its potential use by recreational anglers.

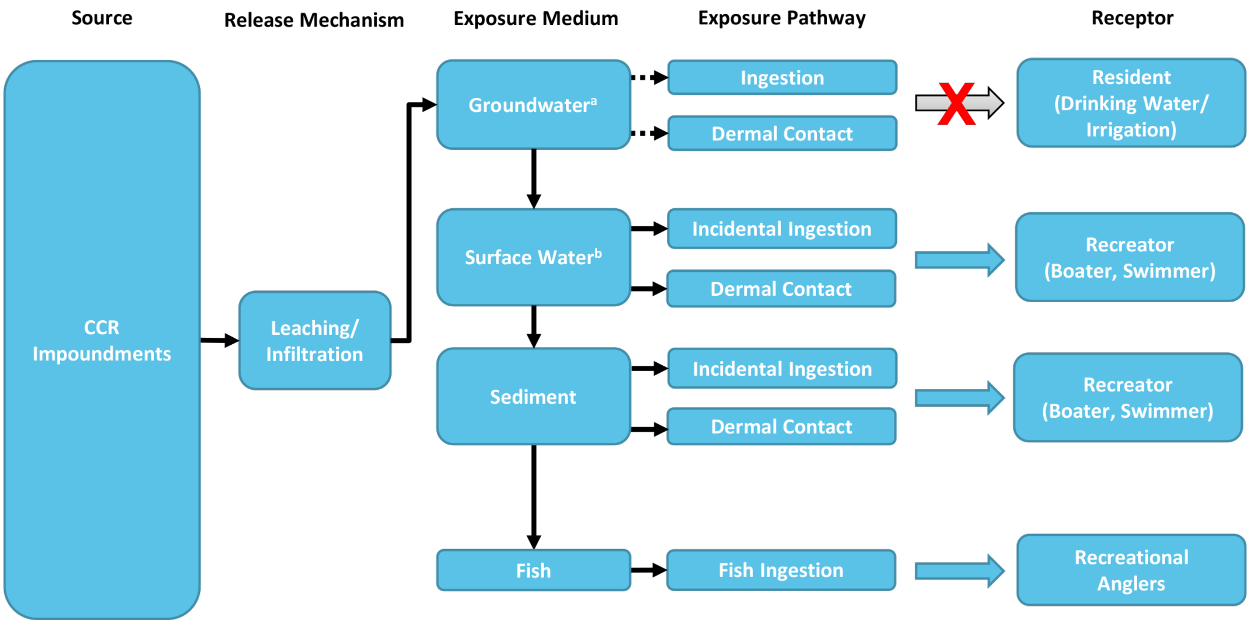

Figure 3.2 Human Conceptual Exposure Model. CCR = Coal Combustion Residuals. Dashed line/Red X = Incomplete or insignificant exposure pathway. (a) Groundwater in the vicinity of the Site is not used as a drinking water or irrigation source. (b) Surface water is not used as a drinking water source.

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 the GMF GSP or the GMF RP. Specifically, there are no users of shallow groundwater from the UA in the vicinity of the GMF GSP or the GMF RP; thus, no receptors can be exposed to any CCR-related constituents in groundwater originating from either of the GMF ponds.

Relying on State databases, Ramboll completed a water well survey in 2021 (Ramboll, 2021a). A total of 18 water wells were identified within a 1,000-meter radius of the GMF ponds during a comprehensive search of the Illinois State Geological Survey's (ISGS) Illinois Water and Related Wells (ILWATER) Map (Ramboll, 2021a,b). These included 12 monitoring wells, 5 farm/domestic wells,[3] and 1 industrial use well (Ramboll, 2021a,b) (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 farm/domestic wells are or can ever be affected by potential CCR-related constituents originating from the GMF GSP/GMF RP.

- **There is no off-Site migration of CCR-related constituents in groundwater**. All groundwater originating from the GMF RP ultimately flows into the unnamed tributary, whereas a component of groundwater originating from the GMF GSP flows into the unnamed tributary, and the rest flows into the western branch of Coffeen Lake. Groundwater from the UA flows southeast/east before flowing into the unnamed tributary, and flows southwest/west before flowing into the western branch of Coffeen Lake (Ramboll, 2021a,b). Three (3) of the 5 farm/domestic wells (*i.e.*, Well IDs 73, 25, and 28) and one industrial well (*i.e.*, 08) located within the 1,000 m buffer area are upgradient of both the GMF GSP and the GMF RP (Figure 3.3). Therefore, there is no plausible mechanism by which those 4 wells (*i.e.*, 73, 08, 25, and 28) could be impacted by any potential constituents in groundwater associated with the GMF GSP and the GMF RP.

  Two (2) water wells (73 and 02) are located on the northeast and southeast side of the unnamed tributary, *i.e.*, the opposite side of the tributary from GMF GSP and the GMF RP (Figure 3.3). The surface water bodies in the vicinity of the GMF ponds are hydraulic boundaries that prevent shallow groundwater from flowing past or underneath them. Furthermore, the surface waters are regional "sinks," which means 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 those two farm/domestic wells (*i.e.*, 73 and 02) from the GMF GSP and the GMF RP (Figure 3.3), there is no plausible mechanism by which the wells could be impacted by any potential constituents in groundwater associated with the GMF GSP and the GMF RP.

  There is one domestic/farm well located southeast of the GMF GSP and the GMF RP (Well ID 32 on Figure 3.3), on the west side of the unnamed tributary. It is likely that this well is not in use and not in existence. The well, which was installed in 1981, is located near the former location of several prior residents (Figure 3.4). However, the property in this area has been purchased by IPGC.

- **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 the GMF GSP is not a complete pathway and was not evaluated further.

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[3] The Ramboll 2021 GMF GSP Hydrogeologic Characterization Report states there are four farm/domestic wells, but Figure 3.3 in that report shows that there are five wells (Ramboll, 2021a).

- **The GMF GSP and the GMF RP have a limited hydraulic connection to underlying groundwater**. The LCU underlying the UA forms a hydraulic barrier between the GMF ponds 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 GMF pond-related impacts to deep groundwater is minimal.

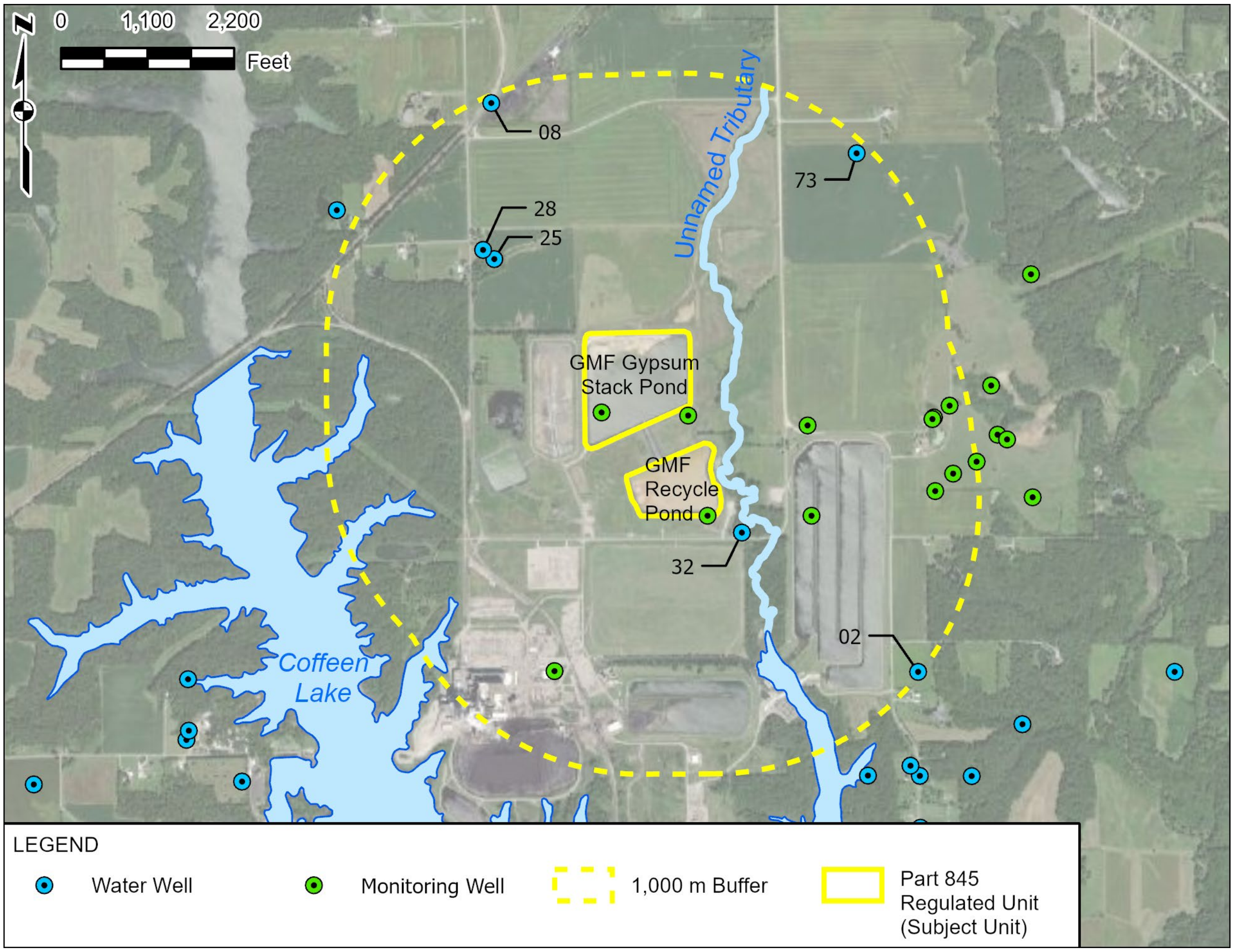

Figure 3.3 Water Wells Within 1,000 Meters of the GMF GSP and the GMF RP. GMF = Gypsum Manufacturing Facility; GSP = Gypsum Stack Pond; RP = Recycle Pond. The industrial well is shown as "08" in the northwest corner of the buffer zone. Sources: Ramboll (2021a,b).

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 Illinois Department of Natural Resources (IDNR) for use as a State Fish and Wildlife Area (Ramboll, 2021a), 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. 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). Although swimming and boating are unlikely to occur in the unnamed tributary due to its shallow depth (flow depth of 2.1 feet) (Golder Associates Inc., 2020), the unnamed tributary was evaluated for recreator exposure due to its potential use by recreational anglers.

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 as well as secondary toxicity *via* bioaccumulation. Figure 3.4 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, 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, fish).

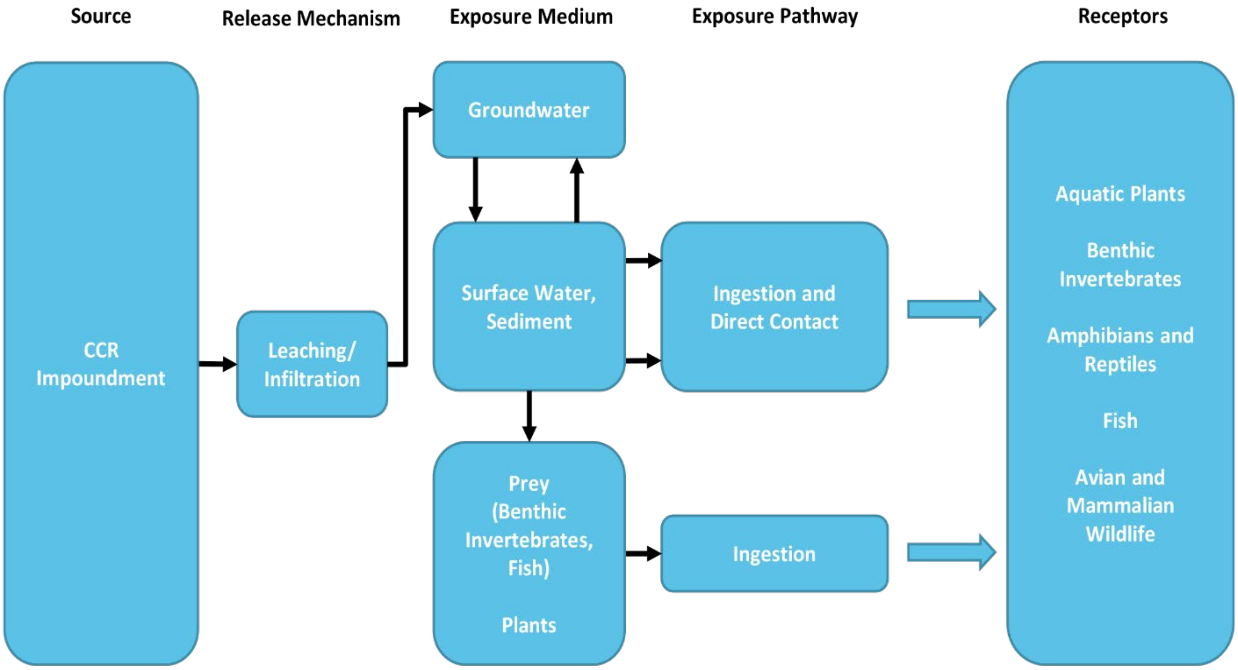

Figure 3.5 Ecological Conceptual Exposure Model. CCR = Coal Combustion Residuals.

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, 2021). Gradient used the maximum detected concentrations from groundwater samples collected from all of the wells associated with the GMF GSP and the GMF RP, regardless of hydrostratigraphic unit. The use of groundwater data in this risk evaluation does not imply that detected constituents are associated with the GMF GSP or the GMF RP or that they have been identified as potential groundwater exceedances. Using this approach, six COIs (arsenic, beryllium, boron, cobalt, lead, and thallium) were identified for the human health risk evaluation *via* the surface water pathway for the unnamed tributary (Table 3.1) and two COIs (beryllium and lead) were identified for the western branch of Coffeen Lake (Table 3.2).

The water quality parameters that exceeded the GWPS included chloride, sulfate, and total dissolved solids; however, these constituents were not included in the risk evaluation because the GWPS are based on aesthetic quality. The US EPA secondary maximum contaminant levels (MCLs) for chloride, sulfate, and total dissolved solids are based on aesthetic quality. The secondary MCLs for chloride and sulfate (250 mg/L) are 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 for the Unnamed Tributary

Constituent[a]	Maximum Concentration	GWPS[b]	Human Health COI[c]
Total Metals (mg/L)			
Antimony	0.0045	0.0060	No
Arsenic	0.11	0.010	Yes
Barium	0.78	2.0	No
Beryllium	0.0042	0.0040	Yes
Boron	4.6	2.0	Yes
Cadmium	0.0041	0.0050	No
Chromium	0.086	0.10	No
Cobalt	0.053	0.0060	Yes
Lead	0.082	0.0075	Yes
Lithium	0.030	0.040	No
Mercury	0.0014	0.0020	No
Molybdenum	0.043	0.10	No
Selenium	0.020	0.050	No
Thallium	0.0035	0.0020	Yes
Radionuclides (pCi/L)			
Radium-226 + 228	4.2	5.0	No
Other (mg/L, unless otherwise noted)			
Chloride	440	200	No[d]
Fluoride	0.73	4.0	No
Sulfate	1,800	400	No[d]
Total Dissolved Solids	3,400	1,200	No[d]

Notes:

COI = Constituent of Interest; GMF = Gypsum Manufacturing Facility; GSP = Gypsum Stack Pond; GWPS = Groundwater Protection Standards; IEPA = Illinois Environmental Protection Agency; MCL = Maximum Contaminant Level; pCi/L = PicoCuries Per Liter; RP = Recycle Pond.

Shaded = Compound identified as a COI.

(a) The constituents are those listed in the Illinois Part 845.600 GWPS (IEPA, 2021). This table presents the maximum concentration from all wells from the GMF GSP and the GMF RP combined.

(b) The Illinois Part 845.600 GWPS (IEPA, 2021) were used to identify COIs.

(c) COIs are constituents for which the maximum concentration exceeds the groundwater standard.

(d) 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.

Table 3.2 Human Health Constituents of Interest for the Western Branch of Coffeen Lake

Constituent[a]	Maximum Concentration	GWPS[b]	Human Health COI[c]
Total Metals (mg/L)			
Antimony	ND	0.0060	No
Arsenic	0.010	0.010	No
Barium	0.17	2.0	No
Beryllium	0.0067	0.0040	Yes
Boron	0.13	2.0	No
Cadmium	0.0012	0.0050	No
Chromium	0.032	0.10	No
Cobalt	0.0058	0.0060	No
Lead	0.0097	0.0075	Yes
Lithium	0.016	0.040	No
Mercury	0.0011	0.0020	No
Molybdenum	0.044	0.10	No
Selenium	0.0091	0.050	No
Thallium	ND	0.0020	No
Radionuclides (pCi/L)			
Radium-226 + 228	2.8	5.0	No
Other (mg/L, unless otherwise noted)			
Chloride	88	200	No[d]
Fluoride	0.99	4.0	No
Sulfate	600	400	No[d]
Total Dissolved Solids	1,300	1,200	No[e]

Notes:

COI = Constituent of Interest; GMF = Gypsum Manufacturing Facility; GSP = Gypsum Stack Pond; GWPS = Groundwater Protection Standards; IEPA = Illinois Environmental Protection Agency; MCL = Maximum Contaminant Level; pCi/L = PicoCuries Per Liter; RP = Recycle Pond.

Shaded = Compound identified as a COI.

(a) The constituents are those listed in the Illinois Part 845.600 GWPS (IEPA, 2021). This table presents the maximum concentration from all wells from the GMF GSP and the GMF RP combined.

(b) The Illinois Part 845.600 GWPS (IEPA, 2021) were used to identify COIs.

(c) COIs are constituents for which the maximum concentration exceeds the groundwater standard.

(d) 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.

(e) Total dissolved solids are not considered a COI because the MCL is based on aesthetic quality.

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) SWQS. IEPA SWQS are health-protective benchmarks for aquatic life exposed to surface water on a long-term basis (*i.e.*, chronic exposure). The SWQS 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).[4]
- 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 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 wells associated with the GMF GSP and the GMF RP, (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. Cadmium, cobalt, lead, mercury, and radium-226+228 were identified as COIs for ecological receptors at the unnamed tributary (Table 3.3), and cadmium was identified as a COI for the western branch of Coffeen Lake (Table 3.4).

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[4] Hardness data are not available for Coffeen Lake or the unnamed tributary 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 3.3 Ecological Constituents of Interest for the Unnamed Tributary

Constituents[a]	Maximum Groundwater Concentration	Ecological Benchmark[b]	Basis	Ecological COI[c]
Total Metals (mg/L)				
Antimony	0.0045	0.19	US EPA R4 ESV	No
Arsenic	0.11	0.19	IEPA SWQC	No
Barium	0.78	5.0	IEPA SWQC	No
Beryllium	0.0042	0.064	US EPA R4 ESV	No
Boron	4.6	7.6	IEPA SWQC	No
Cadmium	0.0041	0.0011	IEPA SWQC	Yes
Chromium	0.086	0.21	IEPA SWQC	No
Cobalt	0.053	0.019	US EPA R4 ESV	Yes
Lead	0.082	0.020	IEPA SWQC	Yes
Lithium	0.030	0.44	US EPA R4 ESV	No
Mercury	0.0014	0.0011	IEPA SWQC	Yes
Molybdenum	0.043	7.2	US EPA R4 ESV	No
Selenium	0.020	1.0	IEPA SWQC	No
Thallium	0.0035	0.0060	US EPA R4 ESV	No
Radionuclides (pCi/L)				
Radium-226 + 228	4.2	3.0	US DOE	Yes
Other (mg/L, unless otherwise noted)				
Chloride	440	500	IEPA SWQC	No
Fluoride	0.73	4.0	IEPA SWQC	No
Sulfate	1,800	NA	NA	No
Total Dissolved Solids	3,400	NA	NA	No

Notes:

COI = Constituent of Interest; ESV = Ecological Screening Value; GWPS = Groundwater Protection Standards; IEPA = Illinois Environmental Protection Agency; SWQC = Surface Water Quality Criteria; NA = Not Available; pCi/L = PicoCuries Per Liter; US DOE = United States Department of Energy; US EPA R4 = United States 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, 2021). This table presents the maximum concentration from all wells from the GMF GSP and the GMF RP combined.

(b) Ecological benchmarks are from the hierarchy of sources discussed in Section 3.3.2: IEPA SWQS (IEPA, 2019); US EPA R4 "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.

Table 3.4 Ecological Constituents of Interest for the Western Branch of Coffeen Lake

Constituents[a]	Maximum Groundwater Concentration	Ecological Benchmark[b]	Basis	Ecological COI[c]
Total Metals (mg/L)				
Antimony	ND	0.19	US EPA R4 ESV	No
Arsenic	0.010	0.19	IEPA SWQC	No
Barium	0.17	5.0	IEPA SWQC	No
Beryllium	0.0067	0.064	US EPA R4 ESV	No
Boron	0.13	7.6	IEPA SWQC	No
Cadmium	0.0012	0.0011	IEPA SWQC	Yes
Chromium	0.032	0.21	IEPA SWQC	No
Cobalt	0.0058	0.019	US EPA R4 ESV	No
Lead	0.0097	0.020	IEPA SWQC	No
Lithium	0.016	0.44	US EPA R4 ESV	No
Mercury	0.0011	0.0011	IEPA SWQC	No
Molybdenum	0.044	7.2	US EPA R4 ESV	No
Selenium	0.0091	1.0	IEPA SWQC	No
Thallium	ND	0.0060	US EPA R4 ESV	No
Radionuclides (pCi/L)				
Radium-226 + 228	2.8	3.0	US DOE	No
Other (mg/L, unless otherwise noted)				
Chloride	88	500	IEPA SWQC	No
Fluoride	0.99	4.0	IEPA SWQC	No
Sulfate	600	0	NA	No
Total Dissolved Solids	1,300	0	NA	No

Notes:

COI = Constituent of Interest; ESV = Ecological Screening Value; GWPS = Groundwater Protection Standards; 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 = United States 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, 2021). This table presents the maximum concentration from all wells from the GMF GSP and the GMF RP combined.

(b) Ecological benchmarks are from the hierarchy of sources discussed in Section 3.3.2: IEPA SWQS (IEPA, 2019); US EPA R4 "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.

3.4 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 the GMF GSP and the GMF RP, Gradient modeled concentrations in surface water and sediment from two water bodies (the unnamed tributary and western branch of Coffeen Lake) for the human and ecological COIs in groundwater. 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 waters. 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) from 2015 to 2021 were conservatively used to model COI concentrations in surface water and sediment.

Groundwater data from the east side of the groundwater divide were used for modeling surface water concentrations in the unnamed tributary. Groundwater data from the west side of the groundwater divide were used for modeling surface water concentrations in the western branch of Coffeen Lake. All of the GMF RP wells (n = 19) and a subset of the GMF GSP wells (n = 16), located on the east side of the divide, were used to model surface water concentrations in the unnamed tributary. Eight (8) of the GMF GSP wells, located on the west side of the divide, were used to model surface water concentrations in the western branch of Coffeen Lake (Figure 2.1). Due to the fact that different sets of wells were used to model surface water concentrations to the east and west, the list of COIs differs on the east and west sides of the groundwater divide. The surface water modeling for the unnamed tributary and the western branch of Coffeen Lake included only the COIs relevant for the east and west sides of the groundwater divide, respectively. The human health and/or ecological COIs on the east side of the divide included arsenic, beryllium, boron, cadmium, cobalt, lead, mercury, thallium, and radium-226+228. The human health and/or ecological COIs on the west side of the divide included beryllium, cadmium, and lead.

The groundwater data were measured as total metals. 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.

The 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 groundwater related to the GMF GSP and the GMF RP 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, 2014a). 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 the unnamed tributary and surface water concentrations are presented in Table 3.5. The COI concentrations in sediment in the unnamed tributary were modeled using the COI-specific sediment-to-water partitioning coefficients and the sediment properties presented in Table 3.6. In the absence of Site-specific information, 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 for the unnamed tributary are presented in Table 3.7. These modeled concentrations reflect conservative contributions from groundwater flow.

The groundwater and surface water properties used in modeling for the western branch of Coffeen Lake are presented in Table 3.8. The sediment properties used in modeling for the western branch of Coffeen Lake are presented in Table 3.9. The modeled surface water and sediment concentrations for the western branch of Coffeen Lake are presented in Table 3.10. A description of the modeling and the detailed results are presented in Appendix A.

Table 3.5 Groundwater and Surface Water Properties Used in Modeling for the Unnamed Tributary

Parameter	Unit	Values	Notes/Source
Groundwater			
COI Concentration	mg/L	Constituent-specific	Maximum detected concentration in groundwater
Cross Section Area for the Uppermost Aquifer[a]	m^2	664	The average thickness of the UA near the GMF ponds (*i.e.*, approximately 3 ft) multiplied by the total length of the GMF ponds near the unnamed tributary (*i.e.*, ~726 m) (Ramboll, 2021b).
Hydraulic Gradient	m/m	0.0075	The average hydraulic gradient determined for the UA towards the unnamed tributary (Ramboll, 2021b).
Hydraulic Conductivity of the Uppermost Aquifer	cm/s	0.0013	The average of the geometric mean horizontal hydraulic conductivities measured for the UA (Ramboll, 2021b).
Surface Water			
Surface Water Flow Rate in the Unnamed Tributary	L/yr	8.04×10^{10}	There are no flow records available for the unnamed tributary that flows from north to south into the eastern branch of Coffeen Lake. According to Golder Associates Inc. (2020), the flow rate was assumed to be 90 cfs.
Total Suspended Solids	mg/L	3.2	Average Coffeen Lake concentration (Hanson, 2020).
Depth of the Water Column	m	0.64	Flow depth of the unnamed tributary (Golder Associates Inc., 2020).
Suspended Sediment to Water Partition Coefficient	mg/L	Constituent-specific	Values based on US EPA (2014a).

Notes:
cfs = Cubic Feet per Second; cm/s = Centimeter Per Second; COI = Constituent of Interest; ft = feet; GMF = Gypsum Management Facility; 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 the unnamed tributary.

Table 3.6 Sediment Properties Used in Modeling for the Unnamed Tributary

Parameter	Unit	Value	Notes/Source
Sediment			
Depth of Upper Benthic Layer	m	0.03	Default (US EPA, 2014a)
Depth of Water Body	m	0.67	Flow depth of the unnamed tributary (Golder Associates Inc., 2020) plus the depth of the upper benthic layer
Bed Sediment Particle Concentration	g/cm^3	1	Default (US EPA, 2014a)
Bed Sediment Porosity	-	0.6	Default (US EPA, 2014a)
TSS Mass Per Unit Area	kg/m^2	0.0038	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 (2014a)

Notes:
TSS = Total Suspended Solids; US EPA = United States Environmental Protection Agency.

Table 3.7 Surface Water and Sediment Modeling Results for the Unnamed Tributary

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				
Arsenic	0.11	2.2E+05	2.9E-06	7.0E-04
Beryllium	0.0042	8.6E+03	1.1E-07	6.4E-05
Boron	4.6	9.4E+06	1.2E-04	7.4E-04
Cadmium	0.0041	8.4E+03	1.1E-07	1.5E-04
Cobalt	0.053	1.1E+05	1.4E-06	1.3E-03
Lead	0.082	1.7E+05	2.2E-06	2.2E-02
Mercury	0.0014	2.9E+03	3.7E-08	1.3E-03
Thallium	0.0035	7.1E+03	9.3E-08	1.7E-06
Radionuclides				
Radium-226 + 228	4.2	8.6E+06	1.1E-04	7.9E-01

Notes:
COI = Constituent of Concern; K_d = Equilibrium Partition Coefficient; pCi/L = PicoCuries Per Liter; pCi/kg = PicoCuries Per Kilogram.

Table 3.8 Groundwater and Surface Water Properties Used in Modeling for the Western Branch of Coffeen Lake

Parameter	Unit	Values	Notes/Source
Groundwater			
COI Concentration	mg/L	Constituent-specific	Maximum detected concentration in groundwater
Cross Section Area for the Uppermost Aquifer[a]	m^2	427	The average thickness of the UA near the GMF GSP (*i.e.*, approximately 3 ft) multiplied by the length of the GMF GSP on the west side of the divide (*i.e.*, about 467 m) (Ramboll, 2021a).
Hydraulic Gradient	m/m	0.018	The average hydraulic gradient for the UA from the GMF GSP towards the western branch of Coffeen Lake (Ramboll, 2021a).
Hydraulic Conductivity of the Uppermost Aquifer	cm/s	0.0014	The geometric mean horizontal hydraulic conductivity measured for the UA near the GMF GSP (Ramboll, 2021a).
Surface Water			
Surface Water Flow Rate in the western branch of Coffeen Lake	L/yr	9.02×10^{11}	There are no flow records available for the western branch of Coffeen Lake. According to the USGS (2022) Streamstats program, the western branch of Coffeen Lake has a two-year flow peak flow prediction of 1,010 cfs.
Total Suspended Solids	mg/L	3.2	Average Coffeen Lake concentration (Hanson, 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 (2014a)

Notes:

cfs = Cubic Feet Per Second; cm/s = Centimeter Per Second; COI = Constituent of Interest; ft = feet; GMF = Gypsum Management Facility; GSP = Gypsum Stack Pond; UA = Uppermost Aquifer; US EPA = United States Environmental Protection Agency; USGS = United States Geological Survey; yr = Year.

(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 3.9 Sediment Properties Used in Modeling for the Western Branch of Coffeen Lake

Parameter	Unit	Value	Notes/Source
Sediment			
Depth of Upper Benthic Layer	m	0.03	Default (US EPA, 2014a)
Depth of Water Body	m	5.73	Depth of water column (5.7 m, depth of Coffeen Lake) (Austen *et al*., 1993) plus depth of upper benthic layer (0.03 m) (US EPA, 2014a)
Bed Sediment Particle Concentration	g/cm^3	1	Default (US EPA, 2014a)
Bed Sediment Porosity	-	0.6	Default (US EPA, 2014a)
TSS Mass per Unit Area	kg/m^2	0.0342	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 (2014a)

Notes:
TSS = Total Suspended Solids; US EPA = United States Environmental Protection Agency.

Table 3.10 Surface Water and Sediment Modeling Results for the Western Branch of Coffeen Lake

COI	Groundwater Concentration (mg/L)	Mass Discharge Rate (mg/year)	Total Water Column Concentration (mg/L)	Concentration Sorbed to Bottom Sediments (mg/kg)
Total Metals				
Beryllium	0.01	2.3E+04	2.6E-08	1.5E-05
Cadmium	0.0012	4.1E+03	4.6E-09	6.2E-06
Lead	0.010	3.3E+04	3.7E-08	3.7E-04

Note:
COI = Constituent of Concern.

3.5 Human Health Risk Evaluation

The section below presents the results of the human health risk evaluation for recreators in Coffeen Lake and the unnamed tributary adjacent to the Site. Risks were assessed using the maximum measured or modeled COIs in surface water.

3.5.1 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 or the unnamed tributary. 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, 2014a) and BCFs reported by Oak Ridge National Laboratory's Risk Assessment Information System (ORNL RAIS) (ORNL, 2020).[5] 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 and water and for fish consumption only.

Screening Risk Evaluation: The maximum modeled and measured COI concentrations in surface water were compared to the calculated Illinois HTC values for the unnamed tributary and the western branch of Coffeen Lake in Tables 3.11 and 3.12, respectively. Surface water samples were collected from Coffeen Lake, but not the unnamed tributary. All surface water concentrations were below their respective

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[5] 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.

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 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 in Coffeen Lake and anglers consuming fish caught in Coffeen Lake or the unnamed tributary.

Table 3.11 Risk Evaluation for Recreators Exposed to Surface Water in the Unnamed Tributary

COI	Modeled Surface Water Concentration[a]	HTC for Water and Fish	HTC for Water Only	HTC for Fish Only	COPC
Total Metals (mg/L)					
Arsenic	2.9E-06	0.022	2.0	0.023	No
Beryllium	1.1E-07	0.021	0.80	0.021	No
Boron	1.2E-04	467	1,400	700	No
Cobalt	1.4E-06	0.0035	2.1	0.0035	No
Lead	2.2E-06	0.015	0.015	0.015	No
Thallium	9.3E-08	0.0017	0.40	0.0017	No

Notes:

COI = Constituent of Interest; COPC = Constituent of Potential Concern; HTC = Human Threshold Criteria.

(a) Surface water samples were not collected from the unnamed tributary.

Table 3.12 Risk Evaluation for Recreators Exposed to Surface Water in the Western Branch of Coffeen Lake

COI	Maximum Surface Water Concentration		HTC for Water and Fish	HTC for Water Only	HTC for Fish Only	COPC	
	Modeled	Measured				Based on Modeled Concentration	Based on Measured Concentration
Total Metals (mg/L)							
Beryllium	2.6E-08	NA	0.021	0.80	0.021	No	NA
Lead	3.7E-08	NA	0.015	0.015	0.015	No	NA

Notes:

COI = Constituent of Interest; COPC = Constituent of Potential Concern; HTC = Human Threshold Criteria.

NA = Not Applicable; COI was not measured in surface water collected from Coffeen Lake.

3.5.2 Recreators Exposed to Sediment

Recreational exposure to sediment may occur during boating activity in Coffeen Lake or while angling in the unnamed tributary; 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, 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 a year (or two weekend days per week for 30 weeks a 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 (US EPA, 2014b). 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 (US EPA, 2011b, 2014b). Since recreational exposures to sediment are assumed to occur for less than four 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, 2014b), 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.

Screening Risk Evaluation: The modeled sediment concentrations at the unnamed tributary and the western branch of Coffeen Lake were well below the recreational sediment screening benchmarks (Tables 3.13 and 3.14, respectively). Therefore, exposure to sediment is not expected to pose an unacceptable risk to recreators while angling in the unnamed tributary or boating in Coffeen Lake.

Table 3.13 Risk Evaluation for Recreators Exposed to Sediment in the Unnamed Tributary

COI	Modeled Sediment Concentration (mg/kg)	Recreator Sediment Screening Benchmark (mg/kg)	COPC
Total Metals (mg/kg)			
Arsenic	7.0E-04	6.8E+01	No
Beryllium	6.4E-05	2.7E+03	No
Boron	7.4E-04	2.7E+05	No
Cobalt	1.3E-03	4.1E+02	No
Lead	2.2E-02	4.0E+02	No
Thallium	1.7E-06	1.4E+01	No

Notes:
COI = Constituent of Interest; COPC = Constituent of Potential Concern.

Table 3.14 Risk Evaluation for Recreators Exposed to Sediment in the Western Branch of Coffeen Lake

COI	Modeled Sediment Concentration (mg/kg)	Recreator Sediment Screening Benchmark (mg/kg)	COPC
Total Metals (mg/kg)			
Beryllium	1.5E-05	2.7E+03	No
Lead	3.7E-04	4.0E+02	No

Notes:
COI = Constituent of Interest; COPC = Constituent of Potential Concern.

3.6 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 (cadmium, cobalt, lead, mercury, and radium-226+228).

3.6.1 Ecological Receptors Exposed to Surface Water

Screening Exposures: The ecological evaluation considered aquatic communities in Coffeen Lake and the unnamed tributary 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 SWQS (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)[6];
- US EPA Region IV (2018) surface water ESVs for hazardous waste sites; and
- 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 modeled COI concentrations in surface water in the unnamed tributary were compared to the benchmarks protective of aquatic life (Table 3.15). The maximum measured COI concentrations in Coffeen Lake, and modeled COI concentrations in the western branch of Coffeen Lake, were compared to the benchmarks protective of aquatic life (Table 3.16). 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 the unnamed tributary or Coffeen Lake.

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[6] Conservatisms associated with using a default hardness value are discussed in Section 3.6.

Table 3.15 Risk Evaluation for Ecological Receptors Exposed to Surface Water in the Unnamed Tributary

COI	Modeled Surface Water Concentration[a]	Ecological Freshwater Benchmark	Basis	COPC
Total Metals (mg/L)				
Cadmium	1.1E-07	0.0011	IEPA SWQC	No
Cobalt	1.4E-06	0.019	US EPA R4 ESV	No
Lead	2.2E-06	0.020	IEPA SWQC	No
Mercury	3.7E-08	0.0011	IEPA SWQC	No
Radionuclides (pCi/L)				
Radium-226 + 228	1.1E-04	3.0	US DOE	No

Notes:

COI = Constituent of Interest; COPC = Constituent of Potential Concern; ESV = Ecological Screening Value; IEPA = Illinois Environmental Protection Agency; pCi/L = PicoCuries Per Liter; SWQC = Surface Water Quality Criteria; US DOE = United States Department of Energy; US EPA R4 = United States Environmental Protection Agency Region IV.

(a) Surface water samples were not collected from the unnamed tributary.

Table 3.16 Risk Evaluation for Ecological Receptors Exposed to Surface Water in the Western Branch of Coffeen Lake

COI	Maximum Surface Water Concentration		Ecological Freshwater Benchmark	Basis	COPC	
	Modeled	Measured			Based on Modeled Concentration	Based on Measured Concentration
Total Metals (mg/L)						
Cadmium	4.6E-09	NA	0.0011	IEPA SWQC	No	NA

Notes:

COI = Constituent of Interest; COPC = Constituent of Potential Concern; IEPA = Illinois Environmental Protection Agency; SWQC = Surface Water Quality Criteria.

NA = Not Applicable; COI was not measured in surface water collected from Coffeen Lake.

3.6.2 Ecological Receptors Exposed to Sediment

Screening Exposures: COIs in impacted groundwater discharging into Coffeen Lake or the unnamed tributary 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 (TECs) 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).[7] The benchmarks used in this evaluation are listed in Table 3.17 for the unnamed tributary, and Table 3.18 for the western branch of Coffeen Lake.

Screening Risk Results: The maximum modeled COI sediment concentrations for the unnamed tributary and the western branch of Coffeen Lake were below their respective sediment screening benchmarks (Tables 3.17 and 3.18, respectively). The modeled sediment concentrations attributed to potential contributions from Site groundwater for all COIs were less than or equal to 1% 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 the unnamed tributary or Coffeen Lake adjacent to the Site.

Table 3.17 Risk Evaluation for Ecological Receptors Exposed to Sediment in the Unnamed Tributary

COI	Modeled Sediment Concentration	ESV[a]	COPC	Percentage of Benchmark
Total Metals (mg/kg)				
Cadmium	1.5E-04	0.99	No	0.01%
Cobalt	1.3E-03	50	No	0.003%
Lead	2.2E-02	35.8	No	0.06%
Mercury	1.3E-03	0.18	No	0.7%
Radionuclides (pCi/kg)				
Radium-226 + 228	7.9E-01	90,000[b]	No	0.001%

Notes:
COI = Constituent of Interest; COPC = Constituent of Potential Concern; ESV = Ecological Screening Value; pCi/g = PicoCuries Per Gram; 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) ESV from US DOE (2019); value converted from 90 pCi/g to 90,000 pCi/kg.

Table 3.18 Risk Evaluation for Ecological Receptors Exposed to Sediment in the Western Branch of Coffeen Lake

COI	Modeled Sediment Concentration	ESV[a]	COPC	Percentage of Benchmark
Total Metals (mg/kg)				
Cadmium	6.2E-06	0.99	No	0.00063%

Notes:
COI = Constituent of Interest; COPC = Constituent of Potential Concern; ESV = Ecological Screening Value; US EPA = United States Environmental Protection Agency.
(a) ESV from US EPA Region IV (2018).

3.6.3 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).

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[7] The BCG for sediment is 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 (US DOE, 2019).

Screening Benchmark: US EPA Region IV (2018) guidance and IEPA SWQS (IEPA, 2019) guidance were used to identify constituents with potential bioaccumulative effects.

Risk Evaluation: With the exception of mercury, the ecological COIs (cadmium, cobalt, lead, and radium-226+228) were not identified as having potential bioaccumulative effects. Therefore, these COIs are not considered to pose an ecological risk *via* bioaccumulation. IEPA (2019) identifies mercury as the only metal with bioaccumulative properties. US EPA Region IV (2018) also identifies mercury (including methyl mercury) as having potential bioaccumulative effects.[8]

The modeled mercury concentration in surface water in the unnamed tributary (3.7×10^{-8} mg/L) was below the mercury surface water ESV for wildlife (1.3×10^{-6} mg/L), and the modeled mercury concentration in sediment at the unnamed tributary (1.3×10^{-3} mg/kg) was below the sediment ESV for wildlife (0.18 mg/kg) (US EPA Region IV, 2018).[9] Both the modeled surface water and sediment concentrations were below benchmarks protective of receptors accounting for bioaccumulative properties. Therefore, in addition to not posing an ecological risk from direct toxicity, mercury does not pose a risk from bioaccumulation exposures.

3.7 Uncertainties and Conservatisms

A number of uncertainties and their potential impacts 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 the GMF GSP and the GMF RP. However, it is possible that not all of the detected constituents are related specifically to the GMF GSP and the GMF RP.
- 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 the GMF GSP and the GMF RP 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 COI concentrations in groundwater. Modeling surface water concentrations using total metal concentrations may overestimate surface water concentrations because dissolved concentrations,

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[8] US EPA Region IV (2018) identifies selenium as having potential bioaccumulative effects. Although selenium was detected in groundwater, it was not considered an ecological COI.

[9] Mercury was not an ecological COI on the west side of the groundwater divide; thus, it was not evaluated for the western branch of Coffeen Lake.

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 sources or other sources unrelated to the GMF GSP and the GMF RP 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 groundwater contributions related to the GMF GSP and the GMF RP are likely to represent only a small fraction of the overall human and ecological exposure to COIs that also have natural sources or sources unrelated to the GMF GSP and the GMF RP.
- Screening benchmarks for human health were developed using exposure inputs based on US EPA's recommended values for reasonable maximum exposure (RME) assessments (US EPA, 2014b). 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 that 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 or the unnamed tributary; therefore, Gradient relied on US EPA's default hardness of 100 mg/L. Use of a higher hardness value would increase the cadmium SWQS 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 SWQS.
- 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 that 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 the GMF GSP and the GMF RP flows into Coffeen Lake and the unnamed tributary 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 anglers who consume locally caught fish from Coffeen Lake or the unnamed tributary, and recreators (boaters) in Coffeen Lake, groups which could be exposed to surface water and sediment. 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 2015 to 2021 were used to estimate exposures. Surface water data collected from Coffeen Lake 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 the GMF GSP or GMF RP 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 or the unnamed tributary 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 or the unnamed tributary adjacent to the Site.
- For anglers consuming locally caught fish, the modeled concentrations of all COIs in surface water 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 or the unnamed tributary.
- 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. 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). Mercury was the only ecological COI identified as having potential bioaccumulative effects. However, the modeled concentrations did not exceed benchmarks protective of bioaccumulative effects. Therefore, mercury is 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 which tend to overestimate exposure and risk. While the risk evaluation was based on the maximum detected COI concentration, 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. Exposure estimates assumed 100% metal bioavailability, which likely results in overestimates of exposure and risks. 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 when the GMF GSP and the GMF RP are closed. 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.

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Appendix A

Surface Water and Sediment Modeling

Gradient modeled surface water concentrations in the unnamed tributary and the western branch of Coffeen Lake and associated sediments based on available groundwater data. First, Gradient estimated the flow rate of constituents of interest (COIs) that may flow into these waterbodies *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 the unnamed tributary and the western branch of Coffeen Lake.

Model Overview

Two separate surface water models were carried out: one for the unnamed tributary, located to the east of a groundwater divide, and one for the western branch of Coffeen Lake, located to the west of a groundwater divide (see Section 2). Groundwater flow into these waterbodies 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 surface water. The groundwater flow entering the surface water is the flow going through a cross-sectional area with a length equal to the length of the surface water bodies adjacent to the GMF ponds (*i.e.*, the GMF Gypsum Stack Pond [GSP] and the GMF Recycle Pond [RP]) with potential CCR-related impacts and a height equal to the average saturated thickness of the UA. It was assumed that all groundwater originating from the GMF RP ultimately flows into the unnamed tributary, whereas a component of groundwater originating from the GMF GSP flows into the unnamed tributary, and the rest flows into the western branch of Coffeen Lake.

Groundwater flow into the unnamed tributary mixes with the surface water in the tributary whereas groundwater flow into the western branch of Coffeen Lake mixes with the surface water in the lake. The COIs entering the unnamed tributary as well as the western branch of Coffeen 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 Flow Rate

The groundwater flow 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 groundwater flowing through the UA was discharged into surface water.

For each groundwater unit, the groundwater flow rate into surface water 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 surface water was then calculated from the following equation:

$$m_c = C_c \times Q \times CF$$

where:

m_c = Mass discharge rate of the COI (mg/year)
C_c = Maximum groundwater concentration of the COI (mg/L)
Q = Groundwater flow rate (m^3/s)
CF = Conversion factors: 1,000 L/m^3; 31,557,600 s/year

The values of the aquifer parameters used for these calculations for the unnamed tributary are provided in Table A.1 and for the western branch of Coffeen Lake are provided in Table A.2. The calculated mass discharge rates were then used as inputs for the surface water and sediment partitioning model.

The cross-sectional area for the UA was approximately 664 m^2 for the unnamed tributary and approximately 427 m^2 for the western branch of Coffeen Lake. The length of the water bodies through which groundwater flows was estimated to be approximately 726 m for the unnamed tributary and about 467 m for the western branch of Coffeen Lake. In both cases, the height of the UA was approximately 3 feet (ft) (*i.e.*, 0.91 m) (Ramboll, 2021a,b).

Towards the unnamed tributary, the average hydraulic gradient within the UA was estimated to be 0.0075 m/m (Ramboll, 2021a,b). Towards the western branch of Coffeen Lake, the mean hydraulic gradient determined for the UA was 0.018 m/m (Ramboll, 2021a).

To model surface water concentrations in the unnamed tributary, we used the average of the geometric mean horizontal hydraulic conductivities (*i.e.*, 0.0013 cm/sec) measured for the UA near the GMF GSP and the GMF RP (Ramboll, 2021a,b). To model surface water concentrations in the western branch of Coffeen Lake, we used the geometric mean horizontal hydraulic conductivity (*i.e.*, 0.0014 cm/sec) determined for the UA near the GMF GSP (Ramboll, 2021a).

Surface Water and Sediment Concentration

Groundwater flowing into the lake will be 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.3.

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 unnamed tributary and the western branch of Coffeen Lake. According to Golder Associates, the flow rate in the unnamed tributary was assumed to be 90 cubic feet per second (cfs) (Golder Associates, Inc., 2020). According to the US Geological Survey (USGS) Streamstats program, the western branch of Coffeen Lake has a two-year flow peak flow prediction of 1,010 cfs (USGS, 2022). The surface water parameters for the unnamed tributary are presented in Table A.4 and the surface water parameters for the western branch of the Coffeen Lake are presented in Table A.5.

The fraction of COI in the water column was calculated for each COI (11 COIs determined for the unnamed tributary and 4 COIs determined for the western branch of Coffeen Lake) using the sediment/water and suspended solids/water partition coefficients (US EPA, 2014, Table J-1). The fraction of COIs 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), set equal to the average Coffeen Lake concentration of 3.2 mg/L (Hanson, 2020)
0.000001 = Units conversion factor
d_w = Depth of the water column (m). The mean depth of the surface water column for the western branch of Coffeen Lake was estimated as 5.7 m (Austen *et al.*, 1993), whereas the flow depth of the unnamed tributary was estimated as 0.6 m (Golder Associates, Inc., 2020).
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) = 5.73 m for the western branch of Coffeen Lake and 0.67 m for the unnamed tributary.
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 for the unnamed tributary are presented in Table A.6 and for the western branch of Coffeen Lake are presented in Table A.7.

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):

$$C_{bstot} = f_{benth} \times C_{wtot} \times \frac{d_z}{d_b}$$

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 contaminant 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 for the unnamed tributary are presented in Table A.8 and for the western branch of Coffeen Lake are presented in Table A.9.

Table A.1 Parameters Used to Estimate Groundwater Flow to the Surface Water of the Unnamed Tributary

Groundwater Unit	Parameter	Name	Value	Unit
Uppermost Aquifer	A	Cross-Sectional Area	664	m^2
Uppermost Aquifer	i	Hydraulic Gradient	0.0075	m/m
Uppermost Aquifer	K	Hydraulic Conductivity	0.0013	cm/s

Note:
Sources: Hydraulic gradient and hydraulic conductivity values from Ramboll (2021a,b).

Table A.2 Parameters Used to Estimate Groundwater Flow to the Surface Water of the Western Branch of Coffeen Lake

Groundwater Unit	Parameter	Name	Value	Unit
Uppermost Aquifer	A	Cross-Sectional Area	427	m^2
Uppermost Aquifer	i	Hydraulic Gradient	0.018	m/m
Uppermost Aquifer	K	Hydraulic Conductivity	0.0014	cm/s

Note:
Source: Hydraulic gradient and hydraulic conductivity values from Ramboll (2021a).

Table A.3 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				
Arsenic	2.4	2.51E+02	3.9	7.94E+03
Boron	0.8	6.31E+00	3.9	7.94E+03
Beryllium	2.8	6.31E+02	4.2	1.58E+04
Cadmium	3.3	2.00E+03	4.9	7.94E+04
Cobalt	3.1	1.26E+03	4.8	6.31E+04
Lead	4.6	3.98E+04	5.7	5.01E+05
Mercury	4.9	7.94E+04	5.3	2.00E+05
Thallium	1.3	2.00E+01	4.1	1.26E+04
Radionuclides				
Radium-226+228	-	7.40E+03	-	7.40E+03

Note:
Source: US EPA (2014).

Table A.4 Surface Water Parameters for the Unnamed Tributary

Parameter	Name	Value	Unit
TSS	Total Suspended Solids	6	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	0.64	m
d_z	Depth of Water Body	0.67	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]	0.00384	kg/m^2
M_S	Sediment Mass per Unit Area[b]	30	kg/m^2

Notes:

L/yr = Liter Per Year.

Source of default values: US EPA (2014).

(a) Determined by multiplying total suspended solids, TSS by the depth of water column, d_w.

(b) Determined by multiplying depth of the upper benthic layer, d_b, by sediment bed particle concentration of 1 g/cc.

Table A.5 Surface Water Parameters for the Western Branch of Coffeen Lake

Parameter	Name	Value	Unit
TSS	Total Suspended Solids	6	mg/L
V_{fx}	Surface Water Flow Rate	9.02×10^{11}	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]	0.0342	kg/m^2
M_S	Sediment Mass per Unit Area[b]	30	kg/m^2

Notes:

L/yr = Liter Per Year.

Source of default values: US EPA (2014).

(a) Determined by multiplying total suspended solids, TSS by the depth of water column, d_w.

(b) Determined by multiplying depth of the upper benthic layer, d_b, by the default sediment bed particle concentration of 1 g/cc.

Table A.6 Calculated Parameters for the Unnamed Tributary

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 $f_{dissolved}$
Arsenic	0.082	0.918	0.955
Beryllium	0.0357	0.9643	0.9132
Boron	0.7639	0.2361	0.9545
Cadmium	0.0155	0.9845	0.6772
Cobalt	0.023	0.977	0.725
Lead	0.002	0.998	0.250
Mercury	0.001	0.999	0.455
Thallium	0.528	0.472	0.930
Radium-226+228	0.003	0.997	0.957

Note:

COI = Constituent of Interest.

Table A.7 Calculated Parameters for the Western Branch of Coffeen Lake

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 $f_{dissolved}$
Beryllium	0.248	0.752	0.913
Cadmium	0.1232	0.8768	0.6772
Lead	0.019	0.981	0.250

Note:
COI = Constituent of Interest.

Table A.8 Surface Water and Sediment Modeling Results for the Unnamed Tributary

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)
Arsenic	0.11	2.2E+05	2.9E-06	7.0E-04
Beryllium	0.0042	8.6E+03	1.1E-07	6.4E-05
Boron	4.6	9.4E+06	1.2E-04	7.4E-04
Cadmium	0.0041	8.4E+03	1.1E-07	1.5E-04
Cobalt	0.053	1.1E+05	1.4E-06	1.3E-03
Lead	0.082	1.7E+05	2.2E-06	2.2E-02
Mercury	0.0014	2.9E+03	3.7E-08	1.3E-03
Thallium	0.0035	7.1E+03	9.3E-08	1.7E-06
Radium-226 + 228	4.2	8.6E+06	1.1E-04	7.9E-01

Notes:
COI = Constituent of Concern; K_d = Equilibrium Partition Coefficient; pCi/kg = PicoCuries Per Kilogram; pCi/L = PicoCuries Per Liter; pCi/year = PicoCuries Per Year.

Table A.9 Surface Water and Sediment Modeling Results for the Western Branch of Coffeen Lake

COI	Groundwater Concentration (mg/L)	Mass Discharge Rate (mg/year)	Total Water Column Concentration (mg/L)	Concentration Sorbed to Bottom Sediments (mg/kg)
Beryllium	0.01	2.3E+04	2.6E-08	1.5E-05
Cadmium	0.0012	4.1E+03	4.6E-09	6.2E-06
Lead	0.010	3.3E+04	3.7E-08	3.7E-04

Notes:
COI = Constituent of Concern; K_d = Equilibrium Partition Coefficient.

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Appendix B

Screening Benchmarks

Table B.1 Calculated Water Quality Standards Protective of Incidental Ingestion and Fish Consumption

Human Health COI	BCF[a] (L/kg-tissue)	Basis	MCL (mg/L)	RfD (mg/kg-day)	ADI[b] (mg/day)	Human Threshold Criteria		
						Water & Fish (mg/L)	Water Only (mg/L)	Fish Only (mg/L)
Arsenic	44	NRWQC (2002)	0.010	0.00030	0.020	0.022	2.0	0.023
Beryllium	19	NRWQC (2002)	0.0040	0.0020	0.0080	0.021	0.80	0.021
Boron	1	(c)	NC	0.20	14	467	1,400	700
Cobalt	300	ORNL (2020)	NC	0.00030	0.021	0.0035	2.1	0.0035
Lead	46	US EPA (2014)	0.015	NC	0.030	0.015	0.015	0.015
Thallium	116	NRWQC (2002)	0.0020	0.000010	0.0040	0.0017	0.40	0.0017

Notes:

ADI = Acceptable Daily Intake; BCF = Bioconcentration Factor; MCL = Maximum Contaminant Level; NC = No Criterion Available; NRWQC = National Recommended Water Quality Criteria; ORNL = Oak Ridge National Laboratory; RAIS = Risk Assessment Information System; RfD = Reference Dose; US EPA = United States Environmental Protection Agency.

(a) BCFs from the following hierarchy of sources:

- NRWQC (US EPA, 2002). National Recommended Water Quality Criteria: 2002. Human Health Criteria Calculation Matrix.
- US EPA (2014a). Human and Ecological Risk Assessment of Coal Combustion Residuals.
- ORNL RAIS (ORNL, 2020). Risk Assessment Information System (RAIS) Toxicity Values and Chemical Parameters.

(b) ADI based on the MCL is calculated as the MCL (mg/L) multiplied by a water ingestion rate of 2 L/day. In the absence of an MCL, the ADI was calculated as the RfD (mg/kg-day) multiplied by the body weight (70 kg).

(c) BCF of 1 was used as a conservative assumption, due to a lack of a published BCF.

Equations from IEPA (2019):

Consumption of Water and Fish

$$\text{HTC} = \frac{\text{ADI}}{\text{W} + (\text{F} \times \text{BCF})}$$

Incidental Consumption of Water Only

$$\text{HTC} = \frac{\text{ADI}}{\text{W}}$$

Consumption of Fish Only

$$\text{HTC} = \frac{\text{ADI}}{\text{F} \times \text{BCF}}$$

Where:

Human Threshold Criteria (HTC)	Chemical-specific	mg/L
Acceptable Daily Intake (ADI)	Chemical-specific	mg/day
Fish Consumption Rate (F)	0.02	kg/day
Bioconcentration Factor (BCF)	Chemical-specific	L/kg-tissue
Water Consumption Rate (W)	0.01	L/day
Body Weight	70	kg

Table B.2 Recreator Exposure to Sediment

COI	Relative Bioavailability (unitless)	Dermal Absorption Fraction (unitless)	Cancer				Cancer SL (mg/kg)	Non-Cancer								Recreator RSL Sediment (mg/kg)	Basis[a]
			TRV		Child + Adult			TRV		Child		Adult		Child	Adult		
			CSF (mg/kg-day)$^{-1}$	Dermal CSF (mg/kg-day)$^{-1}$	Incidental Ingestion SL (mg/kg)	Dermal Contact SL (mg/kg)		RfD (mg/kg-day)	Dermal RfD (mg/kg-day)	Incidental Ingestion SL (mg/kg)	Dermal Contact SL (mg/kg)	Incidental Ingestion SL (mg/kg)	Dermal Contact SL (mg/kg)	Non-Cancer SL (mg/kg)			
Total Metals																	
Arsenic	1	3.0E-02	1.5E+00	1.5E+00	8.1E+01	4.1E+02	6.8E+01	3.0E-04	3.0E-04	4.1E+02	4.4E+03	4.4E+03	8.0E+03	3.8E+02	2.8E+03	6.8E+01	c
Beryllium	1	NA	NC	NC	NC	NC	NC	2.0E-03	1.4E-05	2.7E+03	NA	2.9E+04	NA	2.7E+03	2.9E+04	2.7E+03	nc
Boron	1	NA	NC	NC	NC	NC	NC	2.0E-01	2.0E-01	2.7E+05	NA	2.9E+06	NA	2.7E+05	2.9E+06	2.7E+05	nc
Cobalt	1	NA	NC	NC	NC	NC	NC	3.0E-04	3.0E-04	4.1E+02	NA	4.4E+03	NA	4.1E+02	4.4E+03	4.1E+02	nc
Lead	1	NA	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	4.0E+02	L
Thallium	1	NA	NC	NC	NC	NC	NC	1.0E-05	1.0E-05	1.4E+01	NA	1.5E+02	NA	1.4E+01	1.5E+02	1.4E+01	nc

Notes:

ABS = Dermal Absorption Fraction; COI = Constituent of Interest; CSF = Cancer Slope Factor; NC = No Criterion Available; RfD = Reference Dose; RSL = Regional Screening Level; SL = Screening Level; TRV = Toxicity Reference Value; US EPA = United States Environmental Protection Agency.

(a) Screening benchmark defined as the lower of the Screening Levels for cancer and non-cancer. The basis of the benchmark presented as c = based on cancer endpoint, nc = based on non-cancer endpoint, or L = based on blood lead levels.

Equations for Screening Benchmark and Screening Levels:

$$\text{Screening Benchmark} = \frac{1}{\frac{1}{SL_{ing}} + \frac{1}{SL_{derm}}}$$

$$\text{Non-cancer } SL_{ing} = \frac{THQ * RfD}{Intake} \qquad \text{Cancer } SL_{ing} = \frac{TR}{Intake * CSF}$$

$$\text{Non-cancer } SL_{derm} = \frac{THQ * RfD}{Intake * ABS} \qquad \text{Cancer } SL_{derm} = \frac{TR}{Intake * ABS * CSF}$$

Where:

Target Risk (TR)	1E-05	
Target Hazard Quotient (THQ)	1	
Reference Dose (RfD)	Chemical-specific	mg/kg-day
Dermal Absorption Fraction (ABS)	Chemical-specific	
Cancer Slope Factor (CSF)	Chemical-specific	mg/kg
Incidental Ingestions Screening Level (SL_{ing})	Chemical-specific	mg/kg
Dermal Contact Screening Level (SL_{derm})	Chemical-specific	mg/kg

Sediment – Ingestion (Chemical)

				Non-Cancer		Cancer		
Intake Factor (IF) =		$\frac{IR \times EF \times ED \times CF}{BW \times AT}$	=	7.3E-07	6.8E-08	6.3E-08	2.0E-08	Basis
				Child	Adult	Child	Adult	
	IR	Ingestion Rate (mg/day)		67	33	67	33	One-third of US EPA residential soil ingestion rate (Professional Judgment)
	EF	Sediment Exposure Frequency (days/year)		60	60	60	60	2 days/week between April and October when air temperature >70°F (Professional Judgment)
	ED	Exposure Duration (years)		6	20	6	20	Default value for Resident (US EPA, 2021b)
	CF	Conversion Factor (kg/mg)		0.000001	0.000001	0.000001	0.000001	
	BW	Body Weight (kg)		15	80	15	80	Default value for Resident (US EPA, 2021b)
	AT	Averaging Time (days)		2,190	7,300	25,550	25,550	Default value for Resident (US EPA, 2021b)

Sediment – Dermal Contact (Chemical)

				Non-Cancer		Cancer		
Intake Factor (IF) =		$\frac{SA \times AF \times EF \times ED \times CF}{BW \times AT}$	=	2.2E-06	1.2E-06	1.9E-07	3.6E-07	Basis
				Child	Adult	Child	Adult	
	SA	Surface Area Exposed to Sediment (cm²/day)		1,026	3,026	1,026	3,026	Age-weighted SA for lower legs and feet (US EPA, 2011b)
	AF	Sediment Skin Adherence Factor (mg/cm²)		0.2	0.2	0.2	0.2	Age-weighted AF for children exposed to sediment (US EPA, 2011b)
	EF	Sediment Exposure Frequency (days/year)		60	60	60	60	2 days/week between April and October when air temperature >70°F (Professional Judgment)
	ED	Exposure Duration (years)		6	20	6	20	Default value for Resident (US EPA, 2021b)
	CF	Conversion Factor (kg/mg)		0.000001	0.000001	0.000001	0.000001	
	BW	Body Weight (kg)		15	80	15	80	Default value for Resident (US EPA, 2021b)
	AT	Averaging Time (days)		2,190	7,300	25,550	25,550	Default value for Resident (US EPA, 2021b)

Appendix B

Corrective Action Alternatives Analysis – Supporting Information Report

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

Date
June 10, 2025

Project No.
1940110241-001

CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT

GMF RECYCLE POND
COFFEEN POWER PLANT
IEPA ID NO. W1350150004-04

Bright ideas. Sustainable change.

CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT
IEPA ID NO. W1350150004-04

Project name	**Coffeen Power Plant GMF Recycle Pond**
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

Brian G. Hennings, PG
Project Officer Hydrogeology

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 report has been prepared in accordance with the accepted practice of engineering. The content of this report is not to be used other than for its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

J. Austin Bond, PE
Qualified Professional Engineer

062-075181	IL	11/30/2025
License Number	**State**	**Exp. Date**

JAMES A BOND
062-075181

Affix Seal

CONTENTS

TABLES (WITHIN TEXT)

APPENDICES

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
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
CBR	closure-by-removal
CCR	coal combustion residuals
CCR Rule	40 C.F.R. § 257 Subpart D
CMA	Corrective Measures Assessment
COC	constituent of concern
COF	Coffeen Power Station
CPP	Coffeen Power Plant
CY	cubic yards
GMF GSP	Gypsum Management Facility Gypsum Stack Pond
GMF RP	Gypsum Management Facility Recycle Pond (“the site”)
Gradient	Gradient Corporation
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
IPGC	Illinois Power Generating Company
Kd	soil adsorption coefficient
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
O&M	operations and maintenance
Ramboll	Ramboll Americas Engineering Solutions, Inc.
RS Means	RS Means Heavy Construction Cost Data
SI	surface impoundment
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) Gypsum Management Facility Recycle Pond (GMF RP), which is identified by Illinois Environmental Protection Agency (IEPA) identification (ID) number (No.) W1350150004-04, CCR Unit ID 104, and National Inventory of Dams (NID) No. IL50578. Groundwater corrective action for the GMF RP 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 the GMF RP 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 the GMF RP.

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 were identified as potentially feasible for the GMF RP in the Corrective Measures Assessment (CMA), prepared by Ramboll and attached to the CAAA prepared by Gradient. The remedies identified as potentially feasible included:

- Alternative 1: Source control with groundwater polishing (GWP); and
- Alternative 2: Source control with groundwater extraction (GWE).

Other remedies, including source control with groundwater cutoff wall and source control with in-situ treatment (permeable reactive barrier or in-situ 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**:

- A feasibility-level design drawing (**Appendix A**) was developed to show the approximate extents and typical sections/details of the Alternative 2 remedy (source control with GWE). 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 where groundwater extraction is a component of the potential corrective action.
- 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 within this CAAA-SIR assume that the source control presented in the Final Closure Plan [3] for the GMF RP would also be implemented. Source control is the primary corrective action for the GMF RP and will include removing free liquids from the CCR and completing closure-by-removal (CBR) of the GMF RP by hauling approximately 51,000 cubic yards (CY) of CCR from the GMF RP to the on-site Coffeen Landfill for disposal. Source control will also include removing the existing geomembrane liner from the RP, performing decontamination of the subgrade soils (as and if needed) to remove all remaining CCR from the unit, and performing final site grading to promote surface water drainage and preclude the impoundment of water within the CBR GMF RP.

Groundwater modeling estimates that source control alone would result in GWPS being achieved approximately 5 years after closure completion [4] without implementing other forms of corrective action. The potential remedies evaluated in this CAAA-SIR are intended to work in conjunction with the primary remedy, which is source control.

1.2.3 Criterion for Estimating Time to Achieve GWPS

Times to achieve GWPS for each of the remedial alternative remedies were estimated for the wells within the existing GMF RP compliance monitoring network. This approach was utilized to provide a consistent comparison of the estimated the time to reach GWPS for each remedy, as required by 35 I.A.C. § 845.670(e)(f).

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 GWE,
- **Section 4** includes information used to develop estimates of material quantities, labor hours, and mileage; and
- **Section 5** 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, would include a closure by removal approach for source control, after which GWP would be implemented. GWP is a remedial alternative that relies on natural geochemical processes and may be appropriate as recognized by the United States Environmental Protection Agency (USEPA) in a final policy directive for groundwater remediation [5].

2.1 Supporting Groundwater Modeling and Time to Reach GWPS

The constituents of concern (COCs) exceeding the GWPS at compliance groundwater monitoring wells as of the 2024 Annual Report [6] are sulfate and total dissolved solids (TDS). Sulfate was selected for modeling source control presented in the Final Closure Plan and was identified as a surrogate for the other exceedances[1] of GWPSs, as described in the Groundwater Modeling Report [4]. 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) [4]. 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 [7] and discussed herein.

Groundwater modeling performed to support the closure plan for the GMF RP estimated that GWPS would be met approximately 5 years after the implementation of source control for all wells within the existing GMF RP monitoring well network. This was described in the 2022 modeling report attached to the closure plan that was submitted to IEPA [4].

2.2 Remedy Implementation

Implementation of this portion of the remedy would be initiated after source control (*e.g.,* final closure of the GMF RP) is completed. Implementation 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 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.

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[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 GMF RP. 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.

    - Samples would be collected for COCs required by 35 I.A.C. § 845.600(a)(1). 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).
  - 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 Modeling 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).
    - It should be noted that post-closure care groundwater monitoring required for a 30-year period by 35 I.A.C. § 845.780(c) would continue to occur after corrective action groundwater monitoring is expected to be completed.
  - 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)	60 months
	Corrective Action Confirmation Monitoring	36 months
	Corrective Action Completion	6 months
	Timeframe to Complete Corrective Action Implementation	102 months
	Total Timeline to Complete Corrective Action (after completion of source control)	102 months (9 years)

*All timeframes are assumed to start after source control (*e.g.,* final closure of the SI) is complete and a corrective action permit has been issued by IEPA, whichever is later.

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 the GMF RP 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 [7], groundwater geochemical processes anticipated to occur as downgradient groundwater approaches ambient background conditions are not expected to alter the chemical mechanisms of GWP and 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 outside of permits issued by IEPA for source control (Closure Plan and Construction Permit Application, submitted to IEPA in 2022 [8]).
- 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 would 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 an appreciable volume of waste or wastewater.

3. ALTERNATIVE 2 REMEDY: SOURCE CONTROL WITH GROUNDWATER EXTRACTION

The Alternative 2 remedy, source control with GWE, would include the construction of a downgradient GWE trench that would be located within the GMF RP following CBR of the CCR. The trench would extend from grade surface down to approximately 5 feet below ground surface (bgs) in order to penetrate through and extend just below the bottom of the uppermost aquifer (UA). This would correspond to a typical elevation of 605 feet but would be variable based on actual UA elevations[2]. The total length of the GWE trench would be approximately 1,800 feet, extending along the interior toe of the former perimeter dikes of the GMF RP and incorporating and retrofitting the existing drainage channel east of the GMF RP. The constructed width of the trench is expected to be on the order of 2 to 3 feet. The purpose of the extraction trench would be to provide active removal of the impacted groundwater to accelerate achieving GWPS.

The GWE trench would be constructed by excavation of existing subgrade soils, installation of collection pipe in the trench, backfilling with clean granular fill, and placement of a compacted clay cap over the trench to reduce surface water infiltration. The collection pipe would drain to sumps spaced throughout the trench with an extraction pump within each sump. Extracted groundwater would be collected and routed via pneumatic pumps and air compressors to a new on-site lined settling pond and discharged through Outfall 023, where it would be managed in accordance with the National Pollutant Discharge Elimination System (NPDES) permit for the site [9].

A feasibility-level drawing of the source control with GWE remedy is provided as **Figure 1** in **Appendix A.**

3.1 Remedy Scoping and Groundwater Modeling Results

The location of the extraction trench was selected by reviewing physical constraints around the GMF RP and designating locations on the IPGC property where the 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 regulatory floodplains [10, 11], while limiting adverse impacts or conflicts with the GMF RP final closure construction, future solar redevelopment, and incorporating existing and new site drainage features (*i.e.*, drainage channel allowing stormwater to drain away from the GMF RP after closure).

Assessment of physical constraints resulted in the extraction trench being located within the footprint of the CBR area of the RP, along the northern and eastern perimeter, which is not within regulatory floodplains or known wetlands, provides generally straight and level alignment for the construction of the trench, and would reduce conflicts with the GMF RP final closure. The location of the extraction trench is generally perpendicular to existing groundwater flow patterns. The depth of the extraction trench wall was selected based on interception with the existing groundwater table and the base of the UA. The UA was generally removed within the footprint of the unit as part of initial unit construction activities, so the trench was located around the interior edge of the unit to intercept any portions of the UA that may be remaining. The low surface

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[2] All elevations in this report are referenced to North American Vertical Datum of 1988 (NAVD88), unless otherwise noted.

elevation at the base of the RP CBR berm (approximately 610 feet) limits trench depth to approximately 5 feet bgs to terminate at the expected bottom of the UA.

Groundwater modeling of source control and GWP described in Alternative 1 estimates the time to reach the GWPS for all wells would be approximately 5 years after source control implementation [4]. Given such a short timeframe estimated to reach the GWPS in the absence of an active remedial option, groundwater modeling specific to the GWE remedy was not performed. Time to reach the GWPS for the GWE remedy is expected to be similar or slightly faster than source control with GWP.

3.2 Remedy Implementation

Implementation of the Alternative 2 source control with GWE 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 design subsurface investigations, laboratory soil testing, engineering calculations, design drawings, specifications, and a construction quality assurance plan.
  - Bidding and selection of the groundwater extraction system construction contractor.
- Obtaining permits from other agencies including:
  - A general stormwater permit for construction site activities though IEPA, including construction of stormwater controls and other best management practices (BMPs) such as silt fences and other measures.
  - An amendment to the submitted GMF RP Closure Plan and Construction Permit Application to allow for the disposal of the trench spoils beneath the GMF GSP final cover system.
  - An Illinois Department of Natural Resources (IDNR) Office of Water Resources, Dam Safety modification permit may need to be obtained, for modification 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 would include mobilizing construction equipment to the site, preparing the site for construction activities, construction of the extraction trench (which would include removal or partial replacement of existing subgrade soils), and performing post-construction and site restoration activities. Extraction trench construction is assumed to occur within the latter phases of the GMF RP closure construction, so all spoils generated during extraction trench construction could be placed beneath the final cover system of the adjacent GMF Gypsum Stack Pond (GSP), which would be closed via consolidate-and-cap approach. This would likely mean that the extraction trench would be constructed after CCR has been removed from the CBR portions of the GMF RP, but before the final cover system for the adjacent GMF GSP has been completed. It was assumed that a construction contractor independent from the closure construction contractor would complete installation of the extraction trench.

Information associated with each of these activities is described below.

- The contractor would mobilize equipment and materials to the site, and, if needed, 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 along the extraction trench alignment.
- The 1,800-foot extraction trench would be constructed using conventional construction equipment.
  - Due to the relatively shallow depth of the trench, the use of specialized trenching equipment (*i.e.,* one-pass equipment) was assumed to be unnecessary, and conventional excavation and backfill techniques were assumed to be used. However, specialized methods may be considered during later phases of design.
  - The trench would be excavated along the design alignment on the inner side of the containment berm. Excavation would be conducted to an approximate depth of 5 feet bgs, terminating just below the bottom of the UA. Perforated groundwater collection pipe would be laid on the base of the trench at a 0.5 to 2 percent grade to slope towards the sump locations. The trench would be on the order of 2 to 3 feet wide.
  - Sump locations would be installed along the trench. Sumps would consist of a pit to collect water, a discharge line, a pneumatic pump to pump water to the discharge line, and an air compressor.
  - The trench would be backfilled would clean granular material and capped with low-permeability clay and topsoil at the surface, or a more erosion-resistant material (i.e., a turf-reinforced mat or gravel), if needed to prevent stormwater erosion and infiltration of the trench.
  - Excavated soils (*e.g.*, spoils) from trench excavation would be placed into off-road dump trucks and hauled to the GMF GSP for use as subgrade fill beneath the final cover system. The material would be moisture-conditioned by spreading it in thin lifts and compacting in accordance with the subgrade fill specifications for the GMF GSP final closure.
- An approximately 1 acre, geomembrane-lined settling pond for management of extracted groundwater would be constructed using conventional construction equipment. The temporary wastewater treatment plant that is being constructed on-site to allow existing contact stormwater in the GMF GSP and adjacent GMF RP to be treated prior to discharge, is not expected to operate post-closure and therefore was assumed unavailable for treating extracted groundwater.
  - The location of the settling pond would be sited to limit adverse impacts or conflicts with the GMF RP final closure construction, 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 was assumed to 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 would be installed in the settling pond to reduce the potential for releases of extracted groundwater.
  - Underground trenches with high-density polyethylene (HDPE) piping would be excavated to convey extracted groundwater from the extraction trench to the settling pond and from the settling pond to Outfall 023. 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 extraction trench. This would include minor regrading and seeding of disturbed areas.
  - 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.

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 trench extraction system would require routine scheduled inspections and associated maintenance including, but not limited to, totalizer data collection and maintenance of extraction pumps, as well as other system components.
  - Non-routine maintenance that may occur during extended operation of the extraction trench may include tasks such as repair or replacement of the extraction 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 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).
    - It should be noted that post-closure care groundwater monitoring required for a 30-year period by 35 I.A.C. § 845.780(c) would continue to occur after corrective action groundwater monitoring is expected to be completed.
  - 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 GWE remedy is provided in **Table B** below.

Table B. Feasibility-Level Implementation Schedule – Alternative 2: Source Control with GWE

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	12 to 18 months
	Timeframe to Complete Corrective Pre-Construction Activities	30 to 42 months after CAP Approval
2: Corrective Action Construction	Corrective Action Construction	4 to 8 months
	Timeframe to Complete Corrective Action Construction	4 to 8 months after completion of pre-construction activities
3: Corrective Action O&M and Closeout	Corrective Action Monitoring (Time to Meet GWPS)	60 months*
	Corrective Action Confirmation Monitoring	36 months*
	Corrective Action Completion	6 months*
	Timeframe to Complete Corrective Action O&M and Closeout	102 months* after completion of O&M and closeout activities
	Total Timeline to Complete Corrective Action	136 to 152 months (11 to 13 years)
	Timeline to Complete Corrective Action (after completion of source control)	102 months* (9 years*)

*Denotes a timeframe that is assumed to start after source control (*e.g.,* final closure of the SI) is complete and a corrective action construction permit application has been issued by IEPA, whichever is longer.

It should be noted that Phases 1 and 2 were assumed to occur concurrently with closure construction, to allow spoils to be disposed of beneath the GMF GSP final cover system. Therefore, the start of Phase 3 (Corrective Action O&M and closeout) was assumed to begin at the completion of source control (final closure of the GMF RP). In the event that Phases 1 and 2 could not be completed concurrently with source control due to a delay in receiving permits or construction-related conflicts, the total schedule would likely increase.

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. The settling pond would need to be sited to avoid conflict with planned solar redevelopment, other site infrastructure, and closure activities related to the GMF RP and other surface impoundments 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 GWE trench would be sent to the settling pond via the pneumatic extraction pumps and transfer piping. Treated water would be discharged via NPDES Outfall 023 to Coffeen Lake. All groundwater would be discharged in accordance with site-specific NPDES permit requirements [9].

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 the GMF RP 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 during the relatively short design life, although the remedy 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)
  - Shallow groundwater extraction trenches are commonly constructed to similar elevations using conventional construction equipment by regional contractors. Therefore, the degree of difficulty is expected to be low.
- Expected Operational Reliability of the Remedy - 35 I.A.C. § 845.670(e)(3)(B)
  - The extraction trench is expected to have high operational reliability if it is constructed in accordance with the design and specifications.
  - However, the extraction trench system is a mechanical system that would require routine maintenance in order 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 stormwater controls and BMPs, placement of excavation spoils beneath the GMF GSP final cover system, in addition to a joint water pollution control construction and operating permit and 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.
    - While some of these permits may also be obtained for the GMF RP and/or GMF GSP final closure, the schedule for approval of both the final closure plan and the eventual CAP are uncertain at this time; therefore, it has been assumed that separate permit applications for both the closure and corrective action construction would be submitted.
- Availability of Necessary Equipment and Specialists - 35 I.A.C. § 845.670(e)(3)(D)
  - Construction of the GWE system is not expected to require specialized contractors or equipment, as similar shallow collection trenches (*i.e.,* French drains) are routinely constructed by earthwork contractors in Central and Southern Illinois.
  - 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 GWE system construction would be limited to spoils; these would be disposed of on-site in the GMF GSP, during closure construction, as compacted contouring fill beneath the final cover system. Completing the GWE system construction at the same time as the GMF GSP closure would provide sufficient on-site capacity for the disposal of generated spoils.
  - The GWE system would send extracted groundwater to an on-site settling pond to settle solids extracted during groundwater recovery via the pneumatic extraction 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. MATERIAL QUANTITY, LABOR, AND MILEAGE ESTIMATES

Estimates of material quantities, total labor hours, and mileage were prepared for Alternative 2 source control with GWE, 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 operations and maintenance of a physical remedy.

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) [12] 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 GWE active remedy, 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 B** for each alternative.

5. 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] Golder Associates USA, Inc., "Final Closure Plan for the Gypsum Mangement Facility Recycle Pond," Coffeen, IL, July 28, 2022.

[4] Ramboll, "Groundwater Modeling Report GMF Gypsum Stack Pond and GMF Recycle Pond," Ramboll, Coffeen, Illinois, July 28, 2022.

[5] 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.

[6] Ramboll Americas Engineering Solutions, "2024 35 I.A.C. S 845 Annual Groundwater Monitoring and Corrective Action Report, GMF Recycle Pond, Coffeen Power Station, IEPA ID No. W1350150004-04," Coffeen, IL, 2025.

[7] Geosyntec Consultants, Inc., "Groundwater Polishing Evaluation Report Coffeen Power Station - GMF Recycle Pond (EPA ID No. 104)," Coffeen, IL, 2024.

[8] Golder Associates USA, Inc., "Part 845 Construction Permit Application for Gypsum Management Facility Recycle Pond," July 28, 2022.

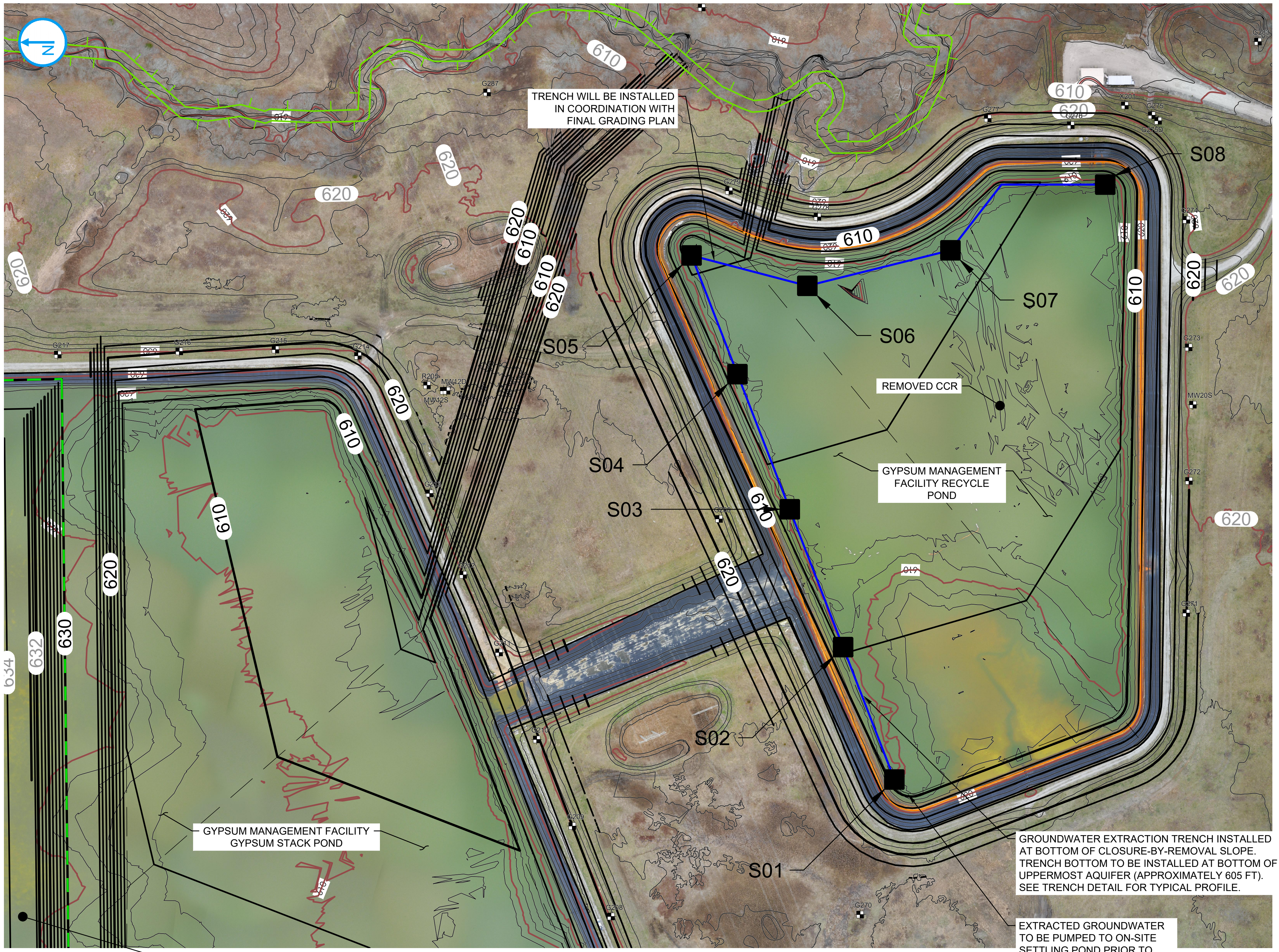
[9] Illinois Environmental Protection Agency, "NPDES Permit No. IL0000108," Illinois Environmental Protection Agency, Coffeen, Illinois, 2023.

[10] U.S. Fish and Wildlife Service,, "National Wetlands Inventory, Surface Waters and Wetlands," [Online]. Available: https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/.

[11] National Flood Insurance Program, *Flood Hazard Boundary Map, Montgomery County, Illinois, Unincorporated Areas,* Federal Emergency Management Agency, 1981.

[12] Gordian, RS Means Data version 8.7, Springfield, IL: Gordian, 2023.

APPENDIX A
FEASIBILITY-LEVEL DESIGN DRAWING FOR ALTERNATIVE 2 REMEDY



TRENCH WILL BE INSTALLED IN COORDINATION WITH FINAL GRADING PLAN

REMOVED CCR

GYPSUM MANAGEMENT FACILITY RECYCLE POND

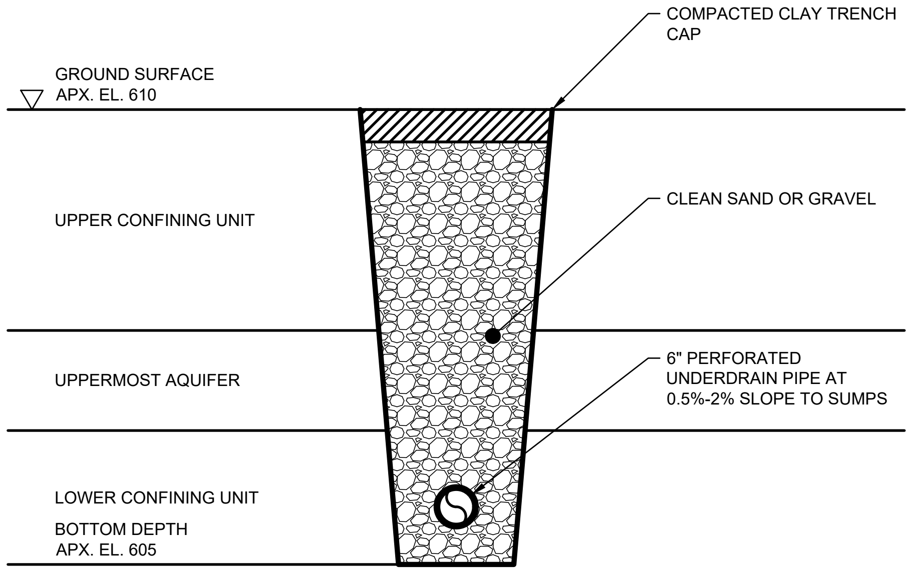
GYPSUM MANAGEMENT FACILITY GYPSUM STACK POND

GROUNDWATER EXTRACTION TRENCH INSTALLED AT BOTTOM OF CLOSURE-BY-REMOVAL SLOPE. TRENCH BOTTOM TO BE INSTALLED AT BOTTOM OF UPPERMOST AQUIFER (APPROXIMATELY 605 FT). SEE TRENCH DETAIL FOR TYPICAL PROFILE.

EXTRACTED GROUNDWATER TO BE PUMPED TO ON-SITE SETTLING POND PRIOR TO DISCHARGE

SPOILS FROM TRENCH EXCAVATION TO BE PLACED IN GSP FOR USE AS SUBGRADE FILL BENEATH FINAL COVER SYSTEM

SITE PLAN



TRENCH DETAIL

NOT TO SCALE

NOTE:

1. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 12/3/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 12/3/2020 & 12/4/2020.
2. POST-CLOSURE GRADING REPRESENTED PER COFFEEN POWER PLANT GYPSUM MANAGEMENT FACILITY CONSTRUCTION PERMIT APPLICATION DRAWINGS COMPLETED BY GOLDER, JULY 2022.
3. WETLANDS REPRESENTED AS PER ILLINOIS NATIONAL WETLANDS INVENTORY.

PROJECT: 1940075591 DATED: 5/19/2025 DESIGNER: LEMMONEN C:\DCS\ACCDocs\Ramboll Gruppen AS\RUS-1940103584-002 Vistra Energy COF\Project Files\4 Delivery\40 WIP\401 Civil\Drawings\03_CAAA-SIR\COF-GMF-RP CAAA-SIR.dwg

━	GROUNDWATER EXTRACTION TRENCH
■	SUMP PUMP
━	CLOSURE BY REMOVAL AREA
┴┴┴┴	WETLANDS BOUNDARY (SEE NOTE 3)

GROUNDWATER EXTRACTION TRENCH
FEASABILITY-LEVEL DESIGN

GMF RP
Coffeen Power Plant 134 CIPS Lane Coffeen, IL 62017

FIGURE 1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

APPENDIX B
MATERIAL QUANTITY, LABOR, AND MILEAGE ESTIMATES FOR ALTERNATIVE 2 REMEDY

ILLINOIS POWER GENERATING COMPANY - COFFEEN POWER PLANT - GYPSUM MANAGEMENT FACILITY RECYCLE POND
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 2 - SOURCE CONTROL WITH GROUNDWATER EXTRACTION TRENCH[1]

ITEM NO.	ENGINEERING AND CONSTRUCTION SUPPORT TASKS	Units	Quantity	Crew	Output	Labor Hours	Equipment Hours	Notes
1	Engineering Support and CQA During Construction	LS	1	Eng	60	1,440	0	Assumed labor and equipment hours based on Ramboll project experience.
	ENGINEERING, PRE-CONSTRUCTION, AND CONSTRUCTION SUPPORT TASKS 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	-	-	-	-	422	130	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	5,000	2 Clab	2500	32	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 2,000 ft of temporary access road.
	Construct Staging Area & Temporary Roads	SY	5,000	B14	615	390	130	015523500100: Temporary, roads, gravel fill, 8" gravel depth, excluding surfacing. Assumes 0.5 acre staging area and approximately 2,000 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	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.
	SITE PREPARATION ESTIMATED SUBTOTAL					**987**	**270**	
ITEM NO.	**GROUNDWATER EXTRACTION TRENCH CONSTRUCTION**	**Units**	**Quantity**	**Crew**	**Daily Output**	**Labor Hours**	**Equipment Hours**	**Notes**
6	Installation of Groundwater Extraction Trench	-	-	-	-	496	181	Groundwater extraction trench and components
	Trench Excavation	CY	840	B13D	376	36	18	312316131358: Excavating, trench; 4' to 6' deep, 1/2 C.Y. excavator w/ trench box (1 C.Y. excavator). Volume estimate based on 2.5 ft wide by 5 ft deep trench over 1,800 LF.
	Install 6" HDPE Collection Pipe	LF	1,800	B14	300	288	96	334116302110: Perforated PVC, 6" diameter for underdrains along trench alignment.
	Install Sump Pits	EA	8	Q1	1.8	71	0	221429132010: Wet-pit-mounted, vertical sump pump, single stage, 25 GPM, 1 HP, 1-1/2" discharge.
	Backfill with Granular Trench Backfill	LCY	840	B10R	100	101	67	312316133060: Backfill trench, F.E. loader, wheel mtd., 1 C.Y. bucket, 200' haul. Trench cap volume is included with general granular trench backfill.
7	Groundwater Extraction Trench Mechanical Installation	-	-	-	-	656	220	Groundwater extraction system mechanical and electrical components
	Excavate Utility Trench for Lines to Compressors and Extraction Pumps	LF	2,000	B54	860	19	19	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.
	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	1,500	B10R	100	180	120	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	1,500	B22A	320	188	75	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	85	B10R	100	10	7	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, 1,500 ft long.
8	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	CY	3,300	B12D	2080	25	13	312316420300: Excavating, bulk bank measure, hydraulic, crawler mtd., 3 C.Y. cap (300 CY/hr).
	Hauling and Placement of Settling Pond Material	CY	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	CY	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	SY	5,000	B63B	1850	86	22	310519531100: Reservoir liners, membrane lining, 40 mil, LLDPE.
9	Extracted Water Discharge Management	-	-	-	-	475	192	Based on approximate 3,000 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	3,000	B54	860	28	28	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	3,000	B22A	320	375	150	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	170	B10R	100	20	14	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 long.
10	Trench Spoils Management	-	-	-	-	42	29	Quantity based on average area of trench excavation 2.5 ft wide by 5 ft deep over 1,800 ft extraction trench alignment, plus dewatering basin spoils (1 acre large by 2 feet deep).
	Loading	CY - as excavated	840	B12C	1320	10	5	312316420260: Excavating, bulk bank measure, hydraulic, crawler mtd, 2 C.Y. cap (165 CY/hr).
	Hauling and Placement within Consolidated GSP CIP Footprint	CY - as excavated	840	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.
	Spreading/Drying Moisture Conditioning	CY - as excavated	840	B10B	1000	10	7	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	840	B10B	1000	10	7	312323170020: Spread dumped material, no compaction, by dozer. Daily output edited to match excavation based on experience.
	Compaction of Material	CY - in place	840	B10F	2600	4	3	312323235060: Compaction; Riding, vibrating roller, 12" lifts, 2 passes. RS Means Crew is B10Y; altered to B10F based on experience.
	GROUNDWATER EXTRACTION TRENCH CONSTRUCTION					**1,895**	**711**	
ITEM NO.	**SITE RESTORATION**	**Units**	**Quantity**	**Crew**	**Daily Output**	**Labor Hours**	**Equipment Hours**	**Notes**
11	Infrastructure Restoration	-	-	-	-	86	9	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	21.8	B66	700	0.2	0.2	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 and temporary roads (~1 acre total) excluding settling pond.
	Fertilizer	MSF	43.5	B66	700	0.5	0.5	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 and temporary roads (~1 acre total) and new settling pond (1 acre).
	Grassland Mix	MSF	43.5	B66	52	7	7	329219142300: Seeding athletic fields, seeding fescue, tall, 5.5 lb. per M.S.F., tractor spreader. Quantity all disturbed areas including staging area and temporary roads (~1 acre total) and new settling pond (1 acre).
	Mulch	MSF	43.5	B65	530	1	1	329113160350: Mulching, Hay, 1" deep, power mulcher, large.
	SITE RESTORATION ESTIMATED SUBTOTAL					**86**	**9**	
ITEM NO.	**Corrective Action Operation and Maintenance**	**Units**	**Quantity**	**Crew**	**Daily Output**	**Labor Hours**	**Equipment Hours**	**Notes**
12	Groundwater Extraction Trench Operation & Maintenance	-	-	-	-	800	-	Routine operation and maintenance of groundwater extraction trench
	Field Maintenance	Event	20	TM	-	800	0	Assumes quarterly maintenance on pneumatic pumps and air compressors over 5 years of operation. Each maintenance event assumes 2 staff for 3 days to check, clean, and service all mechanical parts. Assumes all labor, equipment, mobilization over 3 days.
	CORRECTIVE ACTION OPERATION AND MAINTENANCE SUBTOTAL					**800**	**0**	

			Total Labor Hours	Total Equipment Hours
ENGINEERING AND CONSTRUCTION SUBTOTAL			**4,408**	**990**
CORRECTIVE ACTION OPERATION AND MAINTENANCE SUBTOTAL			**800**	**-**
ENGINEER'S ESTIMATE OF TOTAL CONSTRUCTION AND ENGINEERING HOURS			**4,400**	**1,000**

NOTES:
1. Alternative 2: Source Control with groundwater extraction trench is estimated to take approximately 5 years to achieve groundwater protection standards (GWPS-35 I.A.C Section 845.600) at all perimeter wells associated with the Gypsum Recycle Pond (RP) following RP closure by removal (CBR).
2. RS Means refers to the 2023 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
CIP = closure in place
CY = Cubic Yard
    Loose: Material swelled when removed from compacted state
DMM = Deep mixing method
GSP = Gypsum Stack Pond
EA = Each
GWPS = groundwater protection standards
IRM = interim remedial measure
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 - GYPSUM MANAGEMENT FACILITY RECYCLE POND
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 2 - SOURCE CONTROL WITH 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								
2,8	2 Clab	Laborer x2	16	None	0	2	64	0
3	A2	Laborer x2 Truck Driver x1	24	Flatbed Truck, Gas, 1.5 ton	8	3	108	36
11	B1	Labor Foremanx1 Laborer x2	24	None	0	3	77	0
5	B6	Laborer x 2 Operator (light) x 1	24	Backhoe Loader, 48 H.P.	8	3	180	60
8,10	B10B	Operator x1 Laborer x0.5	12	Dozer, 200 H.P.	8	1.5	60	40
8,10	B10F	Operator (med) x1 Laborer x0.5	12	Tandem Roller, 10, Ton	8	1.5	19	13
6,7,9	B10R	Operator (med) x 1 Laborer x 0.5	12	Frontend loader, W.M., 1 C.Y.	8	1.5	311	208
8	B11L	Operator (med) x 1 Laborer x 1	16	Grader, 30,000lb	8	2	19	10
9	B12C	Operator (crane) x 1 Laborer x 1	16	Hydraulic excavator, 2 C.Y.	8	2	10	5
8	B12D	Operator (crane) x 1 Laborer x 1	16	Hydraulic excavator, 3.5 C.Y.	8	2	25	13
6	B13D	Operator (crane) x 1 Laborer x 1	16	Hydraulic excavator, 1 C.Y. Trench Box	8	2	36	18
2,6	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	678	226
7,9	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	563	225
8,10	B34G	Truck Driver x1	8	Dump Truck, Off Hwy., 50 ton	8	1	16	16
7,9	B54	Operator (light) x1	8	Trencher, Chain, 40 H.P.	8	1	47	47
3	B62	Laborer x2 Operator x 1	24	Loader, Skid Steer, 30 H.P.	8	3	133	44
8	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	7	7
6	Q1	Plumber x1 Plumber Apprentice x1	16	None	0	2	71	0
4	R1B	Electrician x1 Electrician Apprentice x2	24	None	0	3	144	0
9	R30	Electrician Foreman x0.25 Electrician x1 Laborer (Semi-Skilled) x2	26	None	0	3.25	312	0
1	Eng	Engineering Staff x1.2	10	Rental Vehicle x1	0	1.2	1,440	0
				Construction Subtotals			4,400	1,000
Corrective Action Operation & Maintenance								
12	TM	Maintenance Crew x2	20	Service Truck x2 Hand Tools	0	2	800	0
				O&M Subtotals			800	0
						Totals	**5,200**	**1,000**

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 - GYPSUM MANAGEMENT FACILITY RECYCLE POND
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 2 - SOURCE CONTROL WITH GROUNDWATER EXTRACTION TRENCH

Construction Mileage and Labor Estimates - Alternative 2: Groundwater Extraction Trench

Item	Quantity	Assumptions
Labor Total Hours	4,408	Per projected Construction total in cost estimate (does not include contingency)
Duration of Onsite Construction Days	117	Total Days
Average Daily Crew Size	3.3	Assumes multiple crew sizes and a 10 hour work day Assumes 1 Ramboll personnel daily for construction oversight
Daily Labor Mobilization Miles	27,256	Includes light and medium commercial vehicles Average of 70 miles round trip per day, as proposed in construction permit for GMF RP Closure
Vehicles Miles Onsite	5,841	Includes light and medium commercial vehicles 1 mile per day round trip from gate to parking 5 miles per day for onsite miles 9 miles per day local trips (Town of Coffeen) No contingency Included
Equipment Mobilization Miles - Unloaded	9,734	Average of 500 miles round trip for equipment hauling (from Chicago, IL) Average 1 load of equipment per working week
Equipment Mobilization Miles - Loaded	9,734	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	1,662	34 CY Off Road Dump Truck 1 mile round trip per load
Onsite Haul Truck Miles - Loaded	1,662	34 CY Off Road Dump Truck 1 mile round trip per load
Offsite Haul Truck Miles - Unloaded	5,208	Assumes 16 CY loads of gravel are delivered to the site from a regional supplier located within 100 miles of the site
Offsite Haul Truck Miles - Loaded	5,208	Assumes truck is returning to the regional supplier located within 50 miles of the site
Material Delivery Miles - Unloaded	7,788	Misc. construction materials (erosion controls, piping, geotextile) Assumes 200 mile round trip, average 2 trips per working week
Material Delivery Miles - Loaded	7,788	Misc. construction materials (erosion controls, piping, geotextile) Assumes 200 mile round trip, average 2 trips per working week

OMM Mileage and Labor Estimates - Alternative 2: Groundwater Extraction Trench

Item	Quantity	Assumptions
Labor Total Hours	800	Per projected CM total in cost estimate (does not include contingency)
Duration of Onsite OMM Days	40	Total Days
Average Daily Crew Size	2	Assumes multiple crew sizes and a 10 hour work day
Daily Labor Mobilization Miles	9,600	Includes mob/demob from Chicago (260 miles round trip) and local daily commute mileage (40 round trip miles per day).
Vehicles Miles Onsite	1,200	Includes light and medium commercial vehicles 1 mile per day round trip from gate to parking 5 miles per day for onsite miles 9 miles per day local trips (Town of Coffeen) No contingency Included
Equipment Mobilization Miles - Unloaded	0	Normal work vehicles only for this alternative & phase No heavy equipment to mobilize
Equipment Mobilization Miles - Loaded	0	Normal work vehicles only for this alternative & phase No heavy equipment to mobilize
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
MNA = monitored natural attenuation

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

GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS
IEPA ID: W135015004-04

RAMBOLL Bright ideas. Sustainable change.

35 I.A.C. § 845 CORRECTIVE MEASURES ASSESSMENT COFFEEN POWER PLANT GMF RECYCLE POND

Project name	**Coffeen Power Plant GMF Recycle Pond**
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

TABLES

FIGURES

ATTACHMENTS

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
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
E002	Event 2; quarter 3, 2023
E003	Event 3; quarter 4, 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)
HCR	Hydrogeologic Site Characterization Report
HDPE	high-density polyethylene
ID	identification
IEPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
IPGC	Illinois Power Generating Company
ITRC	National Research Council, Interstate Technology & Regulatory Council
IX	ion exchange
LCU	lower confining unit
NID	National Inventory of Dams
No.	number
NPDES	National Pollutant Discharge Elimination System
NRT/OBG	Natural Resource Technology, an OBG Company
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 Gypsum Management Facility (GMF) Recycle Pond (GMF RP) at the Coffeen Power Plant (CPP), also referred to as CCR unit identification (ID) number (No.) 104, Illinois Environmental Protection Agency (IEPA) ID No. W1350150004-04, and National Inventory of Dams (NID) No. IL50578. This report addresses content requirements specific to 35 I.A.C. § 845.660 (Assessment of Corrective Measures) for exceedances of sulfate, total dissolved solids (TDS), and arsenic at the GMF RP.

1.1 Source Control and Residual Plume Management

IPGC intends to initiate significant source control and residual plume management efforts as part of the GMF RP closure, as documented in the Construction Permit Application that was submitted to IEPA in July of 2022 (IPGC, 2022). The GMF RP will be closed by removal.

The source control will include removal of ponded water, followed by dewatering the CCR and excavating approximately 51,000 cubic yards of CCR and disposing in the on-site CCR landfill. The geomembrane liner system will be removed and disposed. Up to 1 foot of subsoil beneath the geomembrane may also be removed and disposed of in the on-site CCR landfill if CCR is visually observed during liner removal. To prevent impoundment of water in the GMF RP footprint after CCR removal, existing earthen embankments will be removed on the eastern side of the GMF RP and a channel will be excavated to allow stormwater to flow into the existing drainage to the east. The final ground surface will be sloped to drain towards the new channel to allow post-closure, non-contact stormwater to gravity flow into the existing drainage. The proposed source control is predicted to allow the groundwater protection standards (GWPS) to be achieved within approximately 5 years after the completion of closure (Ramboll, 2022). These source control activities will serve as the primary groundwater corrective measure at the GMF RP. 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 plumes that remain after completion of source control.

Attachment A includes summary figures from the Construction Permit Application that show the proposed final source control and primary corrective action.

1.2 Adaptive Site Management

Adaptive site management strategies will be employed as an integral part of ongoing corrective action at the GMF RP. The adaptive site management approach will allow timely incorporation of new site information over the closure and post-closure life cycle of the GMF RP to ensure the achievement of the 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 prediction, 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 the GMF RP 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 the GMF RP. 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 the GMF RP. 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 the GMF RP.

3. Ongoing groundwater monitoring at the GMF RP 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 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, Illinois. The GMF RP 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**), to the west, east, and south, and is bordered by agricultural land to the north. **Figure 2-2** is a site map showing the location of Ash Pond No. 1 (AP1), Ash Pond No. 2 (AP2), the GMF Gypsum Stack Pond (GMF GSP), the GMF RP (35 I.A.C. § 845 regulated CCR Unit and subject of this CMA), and the Landfill. The GMF RP area will hereinafter be referred to as the Site.

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 high-density polyethylene (HDPE) liner with 3 feet of recompacted soil with a hydraulic conductivity of 1 x 10^{-7} centimeters per second (cm/s), with internal piping and drains to collect contact water. Construction of the unit required installation of a groundwater underdrain system to reduced 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.

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, the GMF RP has been well characterized and detailed in the Hydrogeologic Site Characterization Report (HCR; Ramboll, 2021), which was prepared to comply with the requirements specified in 35 I.A.C. § 845.620 and expands upon the Hydrogeologic Monitoring Plan (Natural Resource Technology/O'Brien & Gere Engineers, Inc. [NRT/OBG], 2017). The conceptual site model (CSM) is presented below.

In addition to the CCR present at the GMF RP, 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. Construction of the GMF RP required the excavation and removal of this layer within the unit footprint and the UCU has been eroded east of the GMF RP, near the Unnamed Tributary.
- **Uppermost Aquifer:** The uppermost aquifer (UA) is the Hagarstown Member which is classified as primarily sandy to gravelly silts and clays with thin beds of sands. Similar to the Loess Unit and upper Hagarstown, the lower Hagarstown Member was excavated to facilitate construction of the GMF RP and the lower Hagarstown is also absent in some locations near the Unnamed Tributary. Hydraulic conductivities near the GMF RP ranged from 7.8 x 10^{-4} to 1.7 x 10^{-3} cm/s (geometric mean of 1.2 x 10^{-3} 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 within this unit. Hydraulic conductivities in the vicinity of the GMF RP ranged from 2.7×10^{-4} to 4.5×10^{-3} cm/s (geometric mean of 1.2×10^{-3} cm/s). The elevated hydraulic conductivity values are likely not representative of the primary LCU lithology, but instead reflect the isolated and discontinuous sandy lenses in which the wells are screened.
- **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. Where present, the DA has been identified as a PMP due to presence of downward gradients in the overlying LCU and the relatively greater hydraulic conductivities measured in the DA. Field hydraulic conductivity testing was not performed on DA monitoring well G275D, located near the GMF GSP, however, historical hydraulic conductivity in the ranged from 1.3×10^{-4} to 1.7×10^{-3} 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 CPP. No monitoring wells are screened only within the DCU, and no field hydraulic conductivity tests were conducted for the DCU.

Groundwater elevations at CPP, including within the UA, are primarily controlled by surface topography, geologic unit topography, and water levels within Coffeen Lake and the Unnamed Tributary. Groundwater flows east to southeast across the GMF RP toward the Unnamed Tributary. Based on the elevations of the tributary and groundwater elevations measured east of the tributary, the tributary is a hydraulic barrier and prevents groundwater migration east of the 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 (**Figure 2-3**). Phreatic surfaces or water elevations within the SIs are generally consistent and have not been observed to fluctuate with groundwater elevations indicating limited hydraulic connection with the SIs. Groundwater elevations and contours for the quarter 2 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 construction permit application for the GMF RP 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 nine wells screened in the UA (two background and seven compliance), two compliance wells screened in the LCU, one compliance well screened in the DA, one temporary water level only well, and one temporary water level only surface water staff gage. The groundwater samples collected from the 12 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 groundwater monitoring 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):

- Sulfate in UA well G273 and LCU well G285
- TDS in LCU well G285

Subsequent compliance sampling events for Quarter 3 and Quarter 4 2023 (Event 2 [E002] and Event 3 [E003]) were completed in August and November 2023 and groundwater samples were evaluated for exceedances of the GWPS as described in 35 I.A.C. § 845.600 (Ramboll, 2024a; Ramboll, 2024b). The following additional exceedance was identified during the E003 monitoring event:

- TDS in UA well G279
- Arsenic DA well G275D

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 a source other than the GMF RP was the cause of the arsenic GWPS exceedances in DA well G275D (Geosyntec Consultants, Inc., 2024). No response has been received from IEPA at the time of this CMA submission, therefore the CMA will address the identified GWPS exceedances summarized above. The arsenic GWPS exceedance in the DA is addressed in this CMA; however, the time to attain GWPS will require further evaluation if the ASD is not approved by IEPA.

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 the GMF RP during the E001 groundwater monitoring (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 surface impoundments (SI) 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 (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 CMA). 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 the GMF RP, 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 the GMF RP. 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 the GMF RP 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 action, which will be the source control activities described in **Section 1.1** (source removal of CCR and disposal in the on-site CCR landfill). The source control is expected to reduce downgradient concentrations in the UA to less than the GWPS via naturally occurring physical and chemical processes in approximately 5 years. 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 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 will be initiated for the GMF RP, 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, 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 significant planned source control effort at the site, which will consist of a hybrid consolidate-and-cap approach with a final 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, 2015b). 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, 2015b):

Both physical and chemical processes can contribute to the reduction of the small amount of residual mass remaining after closure of the GMF RP, 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 (IX).

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, IX, 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, 2015b) 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.

- Management of extracted groundwater, which may include modification to the existing 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 lateral 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 groundwater polishing with a limited cutoff wall and groundwater extraction in specific areas may provide advantages over independent use of these potential corrective technologies. Cutoff walls can be used in combination with groundwater extraction or as part of a PRB system (as the "funnel" in a funnel-and-gate system; **Section 4.4**).

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 sulfate (and TDS) 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 could be accomplished 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 IX 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; 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 placed 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 ZVI 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 sulfate, TDS, and arsenic at the downgradient waste boundary of the GMF RP 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 CAP; and
- Institutional requirements, such as State or local permit requirement or other environmental or public health requirements that may substantially affect implementation of the CAP.

Table 5-1 presents the qualitative CMA evaluation of each corrective technology relative to these requirements, as well as their ability to address the sulfate, TDS, and arsenic 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 the GMF RP.

5.2 Groundwater Corrective Technology Assessment

Source control, consisting of closure-by-removal, will be the primary groundwater corrective measure for the GMF RP. Closure is expected to be completed by November 2026 and each of the potential groundwater corrective measure technologies would supplement the positive impact of the closure activities. The following sections evaluate groundwater corrective measure technologies that, when combined with site closure, may be viable to address the sulfate, TDS, and arsenic GWPS exceedances. Technologies that are not viable for addressing the GWPS exceedances at the GMF RP will be eliminated from further evaluation and viable technologies will be advanced for further evaluation as part of the 35 I.A.C. § 845.600 CAAA process.

5.2.1 Source Control with Groundwater Polishing

Source control corrective measures (**Section 1.1**) will eliminate the mass loading to the groundwater system and the groundwater polishing process could decrease the timeframe for attainment of GWPS in the UA, as discussed below.

Groundwater polishing by natural geochemical processes is a widely accepted component of groundwater remediation and is routinely approved by the IEPA 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 degradation; the geochemical processes require further evaluation.

Naturally occurring geochemical processes are ongoing at the GMF RP and will continue to affect groundwater constituent concentrations during and after GMF RP closure. 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. 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 prior to, or concurrently with, site closure activities.

No potential safety impacts or exposure to human health or environmental receptors are expected to result from the groundwater polishing processes. Timeframes to achieve GWPS are dependent on site-specific conditions but are expected to be relatively short based on the groundwater modeling. Selecting groundwater polishing as a corrective measure for the GMF RP will require approval of the closure and CAP permits by the IEPA.

Monitoring the groundwater polishing to track progress toward achievement of the GWPS, in conjunction with source control at the GMF RP, would require 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. System design could begin immediately after approval of the CAP permit. Additional investigations to characterize site conditions and installation of the final monitoring system could be performed concurrently with the source control (unit closure) activities, which are currently expected to be completed in 2026.

Groundwater polishing processes will continue before and after source control implementation and may be a viable corrective measure for the sulfate, TDS and arsenic exceedances at the GMF RP. Therefore, these processes are being advanced to the CAAA for further evaluation.

5.2.2 Source Control with Groundwater Extraction

Source control will eliminate the mass loading to the groundwater system and implementing a groundwater extraction system may reduce the time required to attain the GWPS. However, attainment of the GWPS may be similar to the approximately 5 years predicted by the groundwater modeling.

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. However, the heterogeneous, varied natures of the UA, LCU and DA may result in variable performance of pumping wells.

Extracted groundwater would require management, possibly including treatment, which may require specialized equipment and/or contractors. There could be some impacts associated with constructing and operating a groundwater extraction system, including altering of the groundwater flow system and some limited exposure to extracted groundwater.

Additional data collection and analyses would be required to design an extraction system. 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 not reduce the time to attain GWPS in the UA or LCU, relative to the post-closure timeframe predicted by the groundwater model for groundwater polishing, due to the low permeability UCU and the implementation timeframe for groundwater extraction. Time to attain GWPS for arsenic in the DA would require further evaluation if the ASD is not accepted by IEPA. Implementing a groundwater extraction system at the GMF RP would require IEPA approval of the CAP permit, and extracted groundwater could likely be discharged under the existing NPDES permit.

Groundwater extraction could be a viable corrective measure for the sulfate, TDS, and arsenic exceedances at the GMF RP. 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 will reduce the mass loading to the groundwater system and implementing groundwater corrective measures may reduce the time required to attain the GWPS. A 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. The variable natures and low permeability of the LCU and DA would limit the performance of a cutoff wall, which would typically be designed with hydraulic conductivity of 1×10^{-7} cm/s.

Constructing a cutoff wall could alter the flow system, redirecting contaminants to areas where they are not currently present. Specialized construction contractor(s) may be required, depending upon the construction method, which could delay implementation.

Additional data collection and analyses would be required to design a cutoff wall. Construction could be completed within 1 to 2 years. Time of implementation is approximately 4 to 5 years, including characterization, design, permitting and construction. Construction could possibly be accelerated by combining with site closure activities. 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. Time to attain GWPS for arsenic in the DA would require further evaluation if the ASD is not accepted by IEPA.

A cutoff wall at the GMF RP would require IEPA approval of the CAP permit. 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 sulfate, TDS, and arsenic exceedances at the GMF RP. Site conditions, including the relatively shallow and thin UA, do not suggest that a cutoff wall would provide a significant benefit to an extraction system or enhance the time required to meet GWPS. Therefore, the cutoff wall is not being advanced to the CAAA for further evaluation.

5.2.4 Source Control with In-Situ Chemical Treatment

Source control will reduce the 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 sulfate (and TDS) 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, discontinuous nature of the UA, LCU and DA. Depending upon the location of the PRB system, construction may affect existing berms at the GMF RP and periodic change-outs of IX resin media may be required.

No potential safety impacts or exposure to human health or environmental receptors are expected to result from a PRB.

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 and on ultimate 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 acceptance, in-situ chemical treatment is not a viable corrective measure for the sulfate, TDS, and arsenic exceedances at the GMF RP 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; and
- Source control and with groundwater extraction.

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TABLES

TABLE 5-1. DRAFT CORRECTIVE MEASURE ASSESSMENT MATRIX
GMF RECYCLE POND
COFEEN POWER PLANT
COFFEEN, ILLINOIS

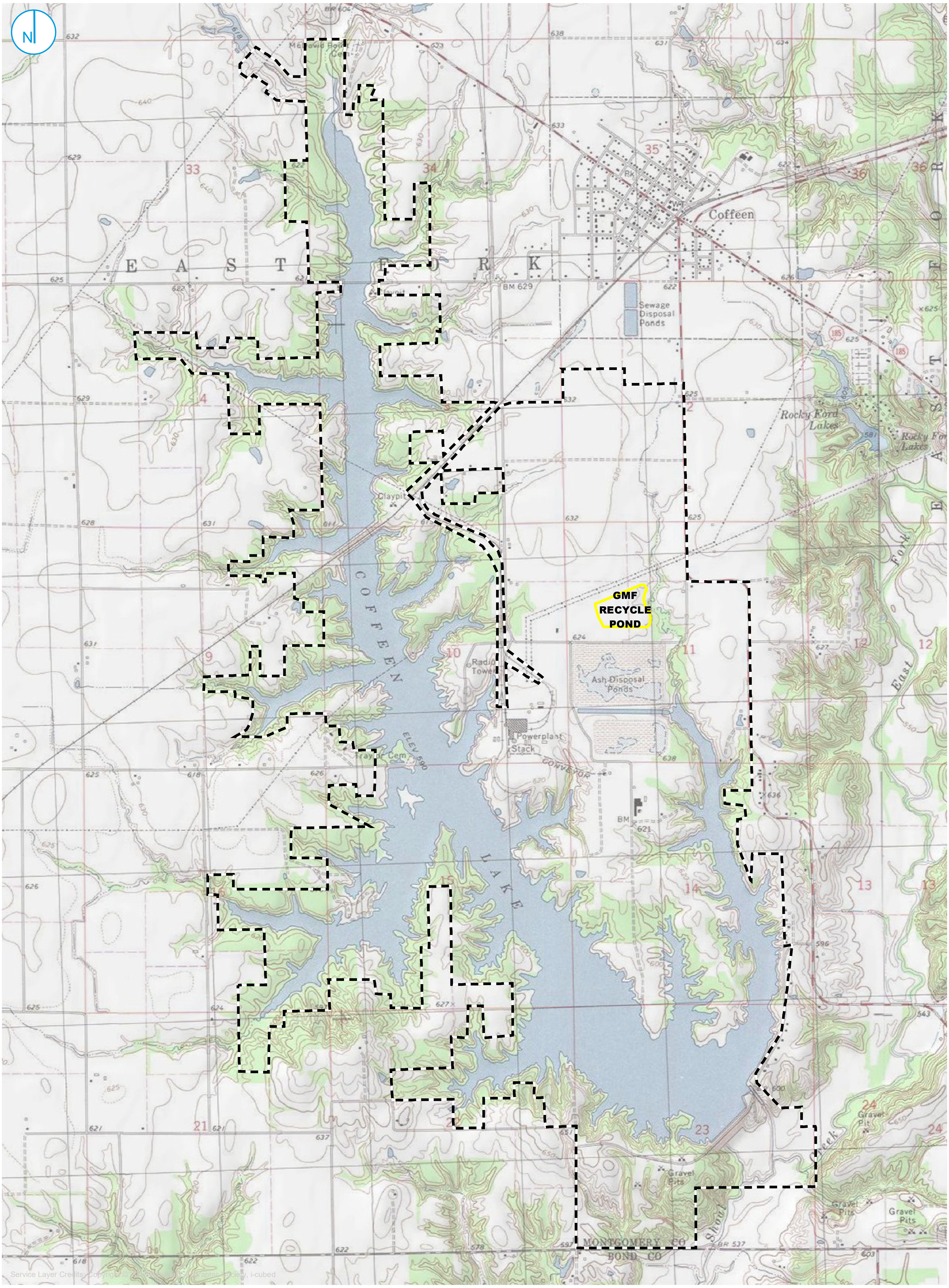
Remedy	**Evaluation Factors**						
	Performance	**Reliability**	**Ease of Implementation**	**Potential Impacts of Remedy (safety impacts, cross-media impacts, control of exposure to any residual contamination)**	**Time Required to Begin and Implement Remedy[1]**	**Time to Attain Groundwater Protection 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 (closure-by-removal), which is expected to be completed prior to 2026. Site conditions are favorable for physical degradation of sulfate (and TDS) and arsenic, while geochemical degradation may be limited under normal aquifer conditions.	Ongoing analysis will evaluate whether geochemical mechanisms have low reversibility, the aquifer has sufficient capacity, and the hydrogeology is favorable for sulfate (and TDS) and arsenic dilution/dispersion.	Long-term monitoring would be required. Implementing would not require extensive specialized equipment or contractors	None identified.	Approximately 90 days after CAP permit approval.	Less than the 5 years post-closure predicted by the groundwater model.	IEPA approval of the closure and CAP permits is required.
Source Control with Groundwater Extraction	Widely accepted, routinely approved technology; variable performance anticipated due to the heterogeneous, varied nature of uppermost aquifer.	Reliable if properly designed, constructed and maintained. However, the heterogeneous, varied nature of uppermost aquifer may present reliability challenges for pumping wells.	Design challenges due to heterogenous, varied nature of uppermost aquifer. Specialized contractors may be needed for construction of the groundwater extraction system. The extraction system would require ongoing routine operation and maintenance activities and extracted groundwater would require management, possibly including treatment, which may also require specialized equipment/contractors and higher maintenance costs.	Alters groundwater flow system and there is the some limited potential for contact exposure to extracted groundwater.	Design, permitting and construction is expected to take 3 to 4 years after CAP permit approval.	Dependent on site-specific conditions not yet fully characterized. May be similar to the 5 years predicted by the groundwater model due to the low permeability Upper Confining Unit.	IEPA approval of the closure and CAP permits is required. Extracted groundwater could likely be discharged under the NPDES permit.
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.	Design, permitting and construction is expected to take 4 to 5 years after CAP approval. Implementation could 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, may not significantly improve attainment of the GWPS due to the low permeability Upper Confining Unit.	IEPA approval of the closure and CAP permits is required.
Source Control with In-Situ Chemical Treatment	In-situ treatment using IX resins not well established for sulfate, TDS or arsenic, therefore performance is unknown.	Unknown reliability for sulfate, TDS or arsenic.	Design challenges related to reactive material delivery and due to heterogenous, discontinuous nature of uppermost aquifer. Could require periodic change-outs of resin media.	None identified.	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, arsenic and TDS 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.

Notes:
[1] Time required to begin and implement remedy includes design, permitting, and construction.
CAP - Corrective Action Plan
GWPS - Groundwater Protection Standard
IEPA - Illinois Environmental Protection Agency
IX - Ion Exchange
NPDES - National Pollutant Discharge Elimination System
TDS - Total Dissolved Solids

FIGURES

PROJECT: 169000XXXX | DATED: 10/13/2021 | DESIGNER: STOLZSD

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Coffeen\GMF_RP\GMP\Figure 1-1_Site Location Map RP.mxd



▭ REGULATED UNIT (SUBJECT UNIT)

▭ PROPERTY BOUNDARY

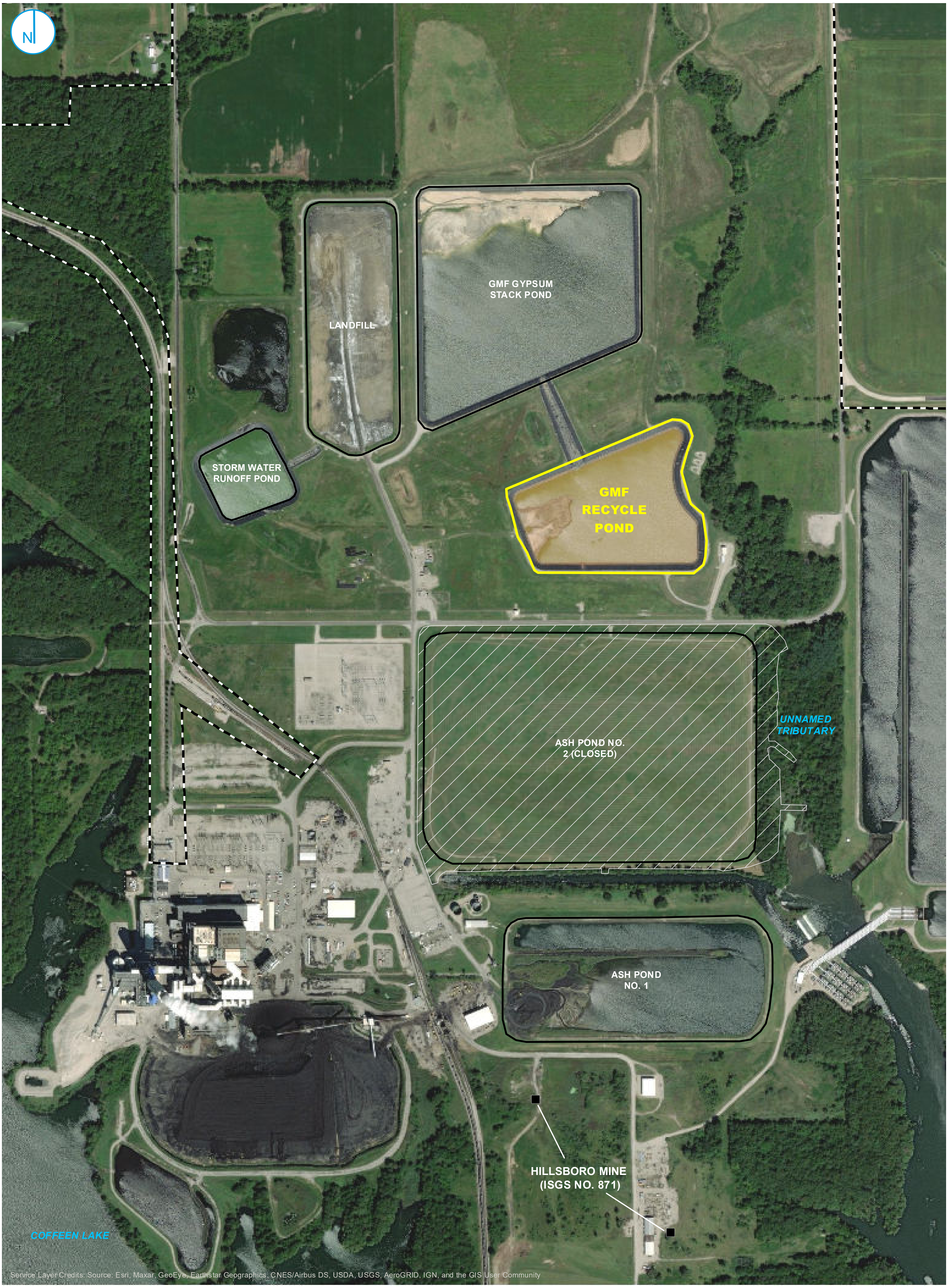
0 1,000 2,000 Feet

SITE LOCATION MAP

FIGURE 2-1

35 I.A.C. § 845 CORRECTIVE MEASURES ASSESSMENT
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.



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

■ COAL MINE SHAFT

▭ 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
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

✚	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

FIGURE 2-3

35 I.A.C. § 845 CORRECTIVE
MEASURES ASSESSMENT
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Coffeen\GMF_RP\GMP\Figure 2-1_Proposed Monitoring Well Network.mxd

PROJECT: 169000XXXX | DATED: 10/15/2021 | DESIGNER: STOLZSD

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

🟧	BACKGROUND WELL
🟦	COMPLIANCE WELL
🟩	SOURCE SAMPLE LOCATION
◒	STAFF GAGE
▭	REGULATED UNIT (SUBJECT UNIT)
▭	SITE FEATURE
▨	LIMITS OF FINAL COVER
⬚	PROPERTY BOUNDARY

0 150 300 Feet

MONITORING WELL LOCATION MAP

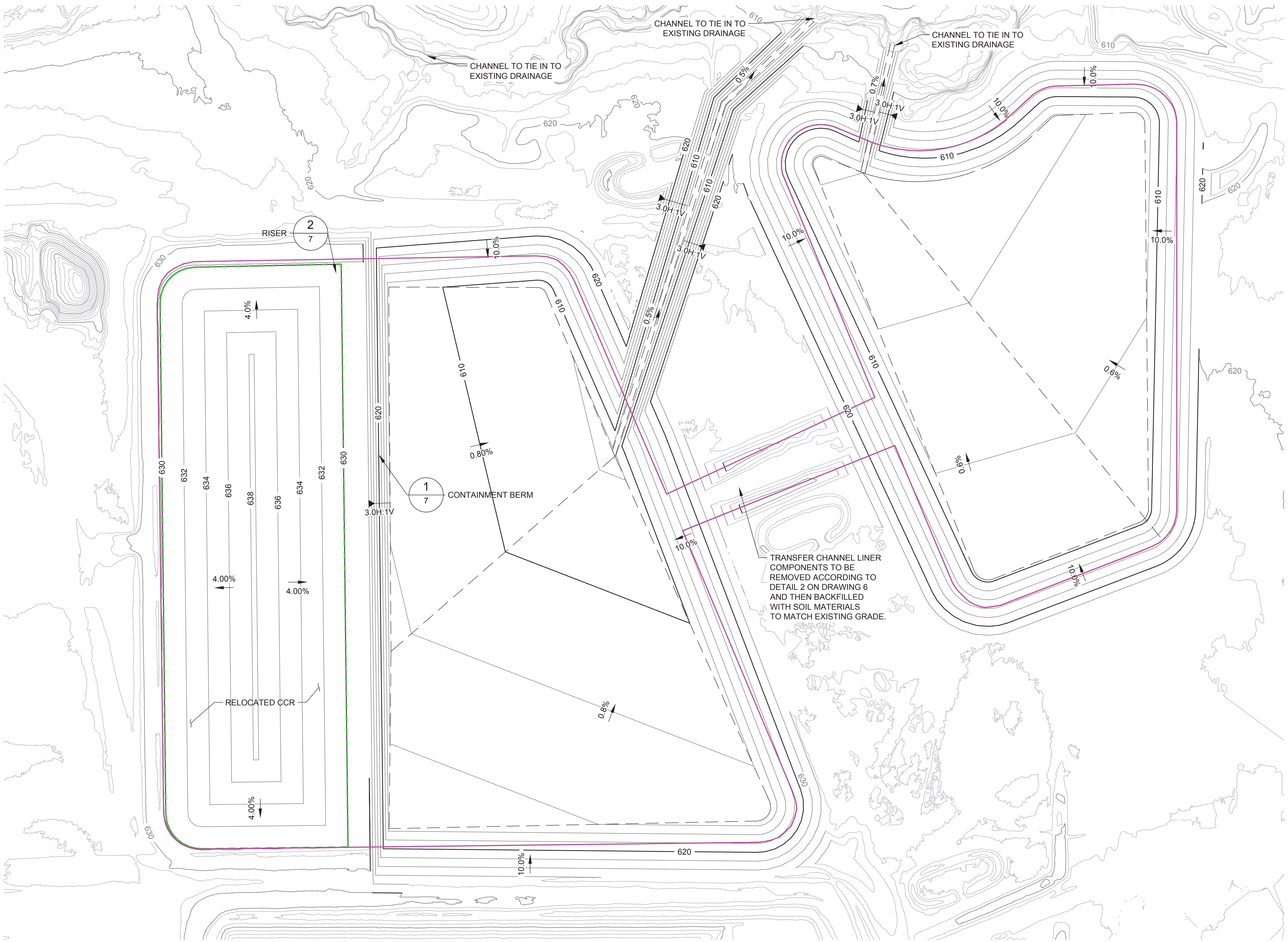
35 I.A.C. § 845 CORRECTIVE MEASURES ASSESSMENT
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 2-4

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

ATTACHMENT A
Selected Construction Permit Application Plans

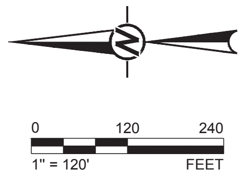


LEGEND

600	GMF CLOSURE IN PLACE GRADES (SEE NOTES 1, 2, AND 3)
600	EXISTING GROUND CONTOURS (SEE NOTE 4)
🟩	LIMIT OF RELOCATED CCR WASTE
▬	LIMITS OF LINER SYSTEM (SEE NOTE 5)

NOTE(S)

1. THE CLOSURE-IN-PLACE CONCEPT FOR THE GYPSUM MANAGEMENT FACILITY (GMF) GYPSUM STACK POND (GSP) INVOLVES REMOVAL OF PONDED WATER, CONSTRUCTION OF A STRUCTURAL BERM (WITH COMPOSITE LINER ON THE UPSTREAM SLOPE), REMOVAL AND RELOCATION OF GYPSUM AND 1 FT (MAX.) OF CLAY LINER SOUTH OF THE BERM TO WITHIN THE CONSOLIDATED FOOTPRINT, PLACEMENT OF SOIL COVER ON GSP FLOOR SOUTH OF THE BERM FOR DRAINAGE, REMOVAL OF PERIMETER EMBANKMENT SOUTH OF RELOCATED WASTE, AND FINAL COVER CONSTRUCTION. EXISTING LINER COMPONENTS TO BE REMOVED SOUTH OF THE BERM ARE SPECIFIED IN DETAIL 1 ON DRAWING 7.
2. THE GMF RECYCLE POND CLOSURE WILL BE BY REMOVAL.
3. GMF GSP CLOSURE IN PLACE GRADES INCLUDE RELOCATED CCR WASTE, WASTE CONTAINMENT BERM, SOIL FILL FOR DRAINAGE ON GSP FLOOR, AND EXCAVATION GRADING FOR REMOVAL OF GSP PERIMETER EMBANKMENT SOUTH OF THE CONTAINMENT BERM. GMF RECYCLE POND GRADES ARE SOIL FILL FOR DRAINAGE ON RECYCLE POND FLOOR AND EXCAVATION GRADING FOR REMOVAL OF RECYCLE POND PERIMETER EMBANKMENT.
4. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 12/3/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 12/3/2020 & 12/4/2020.
5. LIMITS OF THE LINER SYSTEM ARE APPROXIMATE BASED ON GYPSUM MANAGEMENT FACILITY (GMF) GYPSUM STACK POND (GSP) AND RECYCLE POND (RP) BASE GRADES DEVELOPED FROM CONSTRUCTION RECORD DRAWINGS DATED 1/5/2011.



REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-07-28	ISSUED FOR PERMIT APPLICATION	DVS	AGD	MWD	MNH

SEAL

MARK N. HADDOCK
062-058223
7/28/22

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
COFFEEN POWER PLANT

CONSULTANT
WSP GOLDER

701 EMERSON ROAD, SUITE 250
CREVE COEUR, MO 63141
UNITED STATES
(313) 984 8800

PROJECT
GYPSUM MANAGEMENT FACILITY
CONSTRUCTION PERMIT APPLICATION

TITLE
GYPSUM REGRADING AND CONTAINMENT PLAN

PROJECT NO.	REV.	DRAWING
21465046	A	3

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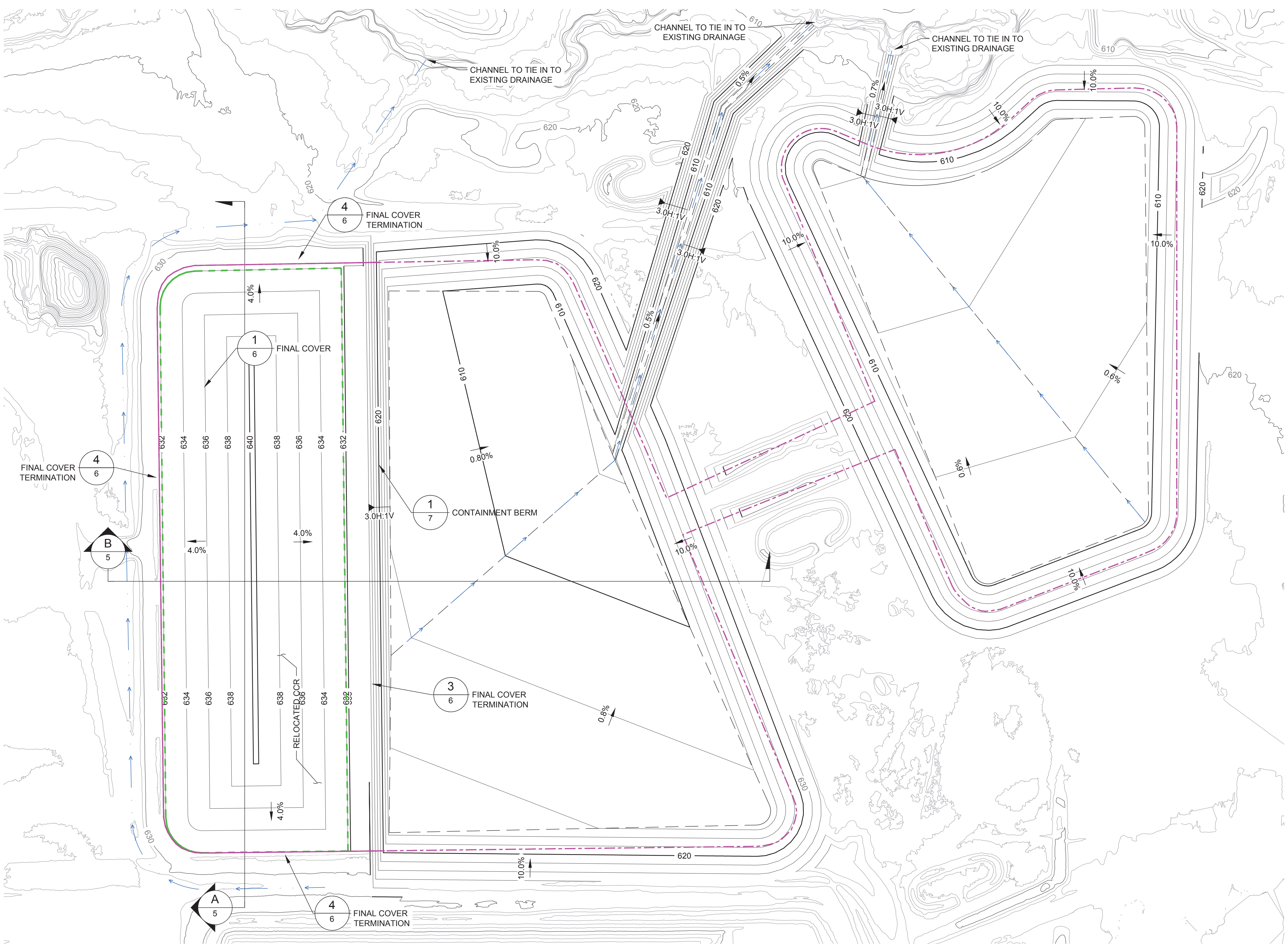

LEGEND

- 600 GMF CLOSURE IN PLACE GRADES (SEE NOTES 1 AND 2)
- 600 EXISTING GROUND CONTOURS (SEE NOTE 4)
- LIMIT OF RELOCATED CCR WASTE
- → PROPOSED STORM WATER FLOW PATH
- EXISTING LINER TO REMAIN IN PLACE (SEE NOTE 5)
- EXISTING LINER TO BE REMOVED (SEE NOTE 5)

NOTE(S)

1. THE CLOSURE-IN-PLACE CONCEPT FOR THE GYPSUM MANAGEMENT FACILITY (GMF) GYPSUM STACK POND (GSP) INVOLVES REMOVAL OF PONDED WATER, CONSTRUCTION OF A STRUCTURAL BERM (WITH COMPOSITE LINER ON THE UPSTREAM SLOPE), REMOVAL AND RELOCATION OF GYPSUM AND 1 FT (MAX.) OF CLAY LINER SOUTH OF THE BERM TO WITHIN THE CONSOLIDATED FOOTPRINT, PLACEMENT OF SOIL COVER ON GSP FLOOR SOUTH OF THE BERM FOR DRAINAGE, REMOVAL OF PERIMETER EMBANKMENT SOUTH OF RELOCATED WASTE, AND FINAL COVER CONSTRUCTION. EXISTING LINER COMPONENTS TO BE REMOVED SOUTH OF THE BERM ARE SPECIFIED IN DETAIL 1 ON DRAWING 7.
2. THE GMF RECYCLE POND CLOSURE WILL BE BY REMOVAL.
3. GMF GSP CLOSURE IN PLACE GRADES INCLUDE RELOCATED CCR WASTE, WASTE CONTAINMENT BERM, SOIL FILL FOR DRAINAGE ON GSP FLOOR, AND EXCAVATION GRADING FOR REMOVAL OF GSP PERIMETER EMBANKMENT SOUTH OF THE CONTAINMENT BERM. GMF RECYCLE POND GRADES ARE SOIL FILL FOR DRAINAGE ON RECYCLE POND FLOOR AND EXCAVATION GRADING FOR REMOVAL OF RECYCLE POND PERIMETER EMBANKMENT.
4. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 12/3/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 12/3/2020 & 12/4/2020.
5. THE PROPOSED STORMWATER DRAINAGE CONCEPT IS TO SHED WATER INTO EXISTING DRAINAGE CHANNEL EAST OF THE FACILITY. STORMWATER COLLECTED WITHIN THE GMF GSP AND RECYCLE POND WILL BE DIRECTED INTO AN OPEN CHANNEL THAT BREACHES CONSTRUCTED BERMS TO CONNECT TO THE EXISTING DRAINAGE.
6. LIMITS OF THE LINER SYSTEM ARE APPROXIMATE BASED ON GYPSUM MANAGEMENT FACILITY (GMF) BASE GRADES DEVELOPED FROM CONSTRUCTION RECORD DRAWINGS DATED 1/5/2011.

0 120 240
1" = 120' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-07-28	ISSUED FOR PERMIT APPLICATION	DVS	AGD	MWD	MNH

SEAL
MARK N. HADDOCK
062-058223
7/28/22

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
COFFEEN POWER PLANT

CONSULTANT
WSP GOLDER
701 EMERSON ROAD, SUITE 250
CREVE COEUR, MO 63141
UNITED STATES
(313) 984 8800

PROJECT
GYPSUM MANAGEMENT FACILITY
CONSTRUCTION PERMIT APPLICATION

TITLE
FINAL COVER AND STORMWATER PLAN

PROJECT NO. 21465046
REV. A
DRAWING 4

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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, GMF RECYCLE POND, IEPA ID NO. W1350150004-04

RAMBOLL Bright ideas. Sustainable change.

NATURE AND EXTENT REPORT
COFFEEN POWER PLANT, GMF RECYCLE POND, IEPA ID NO. W1350150004-04

Project name	**Coffeen Power Plant GMF Recycle Pond**
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 OConnor

Alison O'Connor, PhD
Geochemist

Nathaniel R Keller

Nathaniel R. Keller
Senior Technical Manager

Brian G. Hennings, PG
Project Officer, Hydrogeology

CONTENTS

TABLES (ATTACHED)

FIGURES (ATTACHED)

APPENDICES

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
ASD	Alternative Source Demonstration
bgs	below ground surface
CCR	coal combustion residuals
cm/s	centimeters per second
CPP	Coffeen Power Plant
CSM	conceptual site model
DA	deep aquifer
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
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) Gypsum Management Facility (GMF) Recycle Pond (RP) during June 2023 for the Quarter 2, 2023 compliance sampling event (Event 1 [E001]) were evaluated for 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:
  - Sulfate at G273
- Detected Lower Confining Unit (LCU) Exceedances:
  - Sulfate at G285
  - Total dissolved solids (TDS) at G285

As a result of the identified E001 exceedances, a Corrective Measures Assessment 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 December 2023 and groundwater samples were evaluated for exceedances of the GWPS as described in 35 I.A.C. § 845.600. Exceedances identified during the E002 event were consistent with those listed above. In addition to the exceedances listed above, the following statistical exceedances were identified in the following hydrostratigraphic units and wells during the E003 Event:

- Detected UA Exceedance:
  - TDS at G279
- Detected Deep Aquifer (DA) Exceedance:
  - Arsenic at G275D

Pursuant to 35 I.A.C. § 845.650I, an Alternative Source Demonstration (ASD) was submitted to Illinois Environmental Protection Agency (IEPA) on May 7, 2024 that presented evidence demonstrating that a source other than the GMF RP was the cause of the arsenic exceedance at DA monitoring well G275D [2]. Concurrence from the IEPA is pending, and the extent of arsenic is not discussed in this report.

As required by 35 I.A.C. § 845.650(d)(1), this report characterizes the nature and extent of sulfate and TDS and relevant site conditions to determine how they may affect the corrective measures ultimately selected for the GMF RP and documents the additional measures taken in accordance with 35 I.A.C. § 845.650(d).

Statistical exceedances of sulfate greater than the GWPS were encountered within the UA only at G273. The lateral extents of sulfate exceedances are defined to the east by monitoring well G275, to the west by monitoring well G271, and to the north by background monitoring wells G270 and G280. Statistical exceedances of TDS greater than the GWPS were encountered within the UA only at G279. The lateral extents of TDS exceedances are defined to the south by G277, to the west by background monitoring well G280, and to the east by monitoring well G284 (located east of the Unnamed Tributary). Vertically, the extents of sulfate and TDS greater than the GWPS is limited by the presence of low permeability tills [2].

Statistical exceedances of sulfate and TDS greater than the GWPS encountered in the LCU at monitoring well G285 are defined to the south by G283, but wells screened within the LCU are not present to the east of this location. The extent of elevated sulfate (and TDS) is limited by the lower hydraulic conductivity observed in the materials of the LCU and limited continuity of sand lenses, in addition to flow directions which are expected to be primarily toward the Unnamed Tributary based on elevations measured in SG-04. The Unnamed Tributary appears to be a local receiving body for groundwater and likely prevents or reduces groundwater migration east of the Unnamed Tributary. However, the presence of statistical exceedances of sulfate and TDS greater than the GWPS in LCU compliance well G285 indicates that migration may occur (potentially when water elevations in the Unnamed Tributary are high) and allow transport of sulfate and TDS in groundwater a short distance east of the Unnamed Tributary.

Conditions within UA groundwater are predicted to favor amorphous iron oxide stability at most locations, which indicates that a portion of the sulfate concentrations in the groundwater system may be attenuated via surface complexation reactions. However, batch attenuation testing results indicate that chemical attenuation of sulfate, and therefore TDS, downgradient of the GMF RP could be minimal. Chemical attenuation of sulfate in the LCU and DA is also anticipated to be limited, as amorphous iron oxides are predicted to be less stable in the LCU, with the potential for dissolution and precipitation reactions with other iron-bearing species such as siderite.

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 with detected statistical exceedances of the GWPS that are attributable to the CPP GMF RP.

The groundwater data and analysis in this report includes results from historical sampling (initiated in 2015) through E003, which was completed on December 7, 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 [3, 4, 5]. The statistical determination presented in the report identified the following exceedances of the GWPS at compliance groundwater wells in the following hydrostratigraphic units:

- Detected UA Exceedances:
  - Sulfate at G273
  - TDS at G279
- Detected LCU Exceedances:
  - Sulfate at G285
  - TDS at G285
- Detected DA Exceedances:
  - Arsenic at G275D

Pursuant to 35 I.A.C. § 845.650I, an ASD was submitted to IEPA on May 7, 2024 [2] that presented evidence demonstrating that a source other than the GMF RP was the cause of the arsenic exceedance at DA monitoring well G275D. Concurrence from the IEPA is pending, and the extent of arsenic is not discussed in this report. If IEPA does not concur, additional activities will be required to understand distribution and mechanisms controlling the occurrence of arsenic in the DA. This Nature and Extent Report discusses in detail the extent of the sulfate and TDS statistical exceedances as well as a geochemical conceptual site model (GCSM) describing the nature of these 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: GMF RP (35 I.A.C. § 845 regulated CCR Unit and subject of this report), Ash Pond Number (No.) 1 (AP1), Ash Pond No. 2 (AP2), GMF Gypsum Stack Pond (GSP), and Landfill (LF). The GMF RP is located in Section 11, Township 7 North and Range 3 West. The GMF RP is located northeast of the CPP and situated in a predominantly agricultural area (**Figure 2-2**). The GMF RP 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 GMF RP is bordered by other CCR units and agricultural land to the north. The GMF GSP is located north and immediately adjacent to the GMF RP; therefore, the geology and hydrogeology are similar and results from the 35 I.A.C. § 845 investigations from both units are included and discussed in this report, and in the Nature and Extent report prepared for the GMF GSP. The combined area including the GMF RP and GMF GSP will hereinafter be referred to as the site and data from both units will be utilized in portions of **Sections 2.3** and **2.5**.

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.

- **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 (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 x 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 601 feet[1] 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. Illinois Power Generating Company (IPGC) ceased placement of waste in the GMF RP prior to April 11, 2021. Review of historical aerial imagery of the GMF RP (observations summarized in **Figure 2-3**) illustrate the extent of CCR deposition through time as well as potential CCR variability (based on observed differences in color). Proposed geotechnical and geochemical sample locations for CCR materials could not be safely accessed during the 2021 investigation. X201 collects representative source water from the southeast corner of the GMF RP **(Figure 2-4**) (Hydrogeologic Site Characterization Report [HCR] [6]). The unit contains gypsum scrubber waste and the base of CCR at the GMF RP is shown in **Figure 2-5**.

  Water that may come into contact with CCR within the footprint of the GMF RP becomes CCR source water. CCR source water samples are collected from the southeast corner of the GMF

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[1] All elevations in this report are referenced to North American Vertical Datum of 1988 (NAVD88) unless otherwise noted.

RP (X201). Results from the source water samples are used to provide information for groundwater transport modeling[2].

- **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 HDPE liner with 3 feet of recompacted soil with a hydraulic conductivity of 1 x 10^{-7} cm/s with internal piping and drains to collect contact water. Construction of the unit required excavation to an elevation of approximately 603 feet 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. IPGC ceased placement of waste in the GMF GSP prior to April 11, 2021.
- **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 the 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.
- **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.
- **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, the GMF RP has been well characterized and detailed in the HCR [6].

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[2] Per Federal Register 80 (21302), which promulgated the final 40 C.F.R. § 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, X201 collects representative CCR source water from the southeast corner of the GMF RP.

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 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 the CCR Unit. 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 absent in several locations due to weathering and in other locations due to excavation during construction of the CCR Unit. The UA exhibits a moderate hydraulic conductivity and is the most likely unit to indicate potential impacts from the GMF RP. Based on the geologic information, the top of UA occurs at an elevation of 606 to 609 feet near the GMF RP (**Figure 2-6**) and was removed below the footprint of the unit (**Figure 2-7**). The base of the UA and the material on which the GMF RP liner was placed is the top of the LCU, which contains the low permeability Vandalia Member, Mulberry Grove Member, and Smithboro Till.

2.3.3 Potential Migration Pathways

Potential migration pathways (PMPs) 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 G283 and G285 are considered LCU PMP monitoring well locations and monitor the potential migration of impacts through the LCU where the UA is absent. Monitoring well G285 additionally monitors the potential for off-site impacts due to the direction of groundwater flow locally coming from the east to the west, towards the Unnamed Tributary. Monitoring well G275D is considered a DA PMP monitoring location and monitors the potential for migration of impacts from the GMF RP through the UA and LCU.

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 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. [7] and Kolata [8]. 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) [9]. 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 [10].

2.3.5 Water Table Elevation and Groundwater Flow Direction

A transducer was installed at X201 during the 2021 investigation to monitor pond water levels in the GMF RP. Phreatic surface elevations in the GMF RP showed minimal variation, with elevations from approximately 617 to 619 feet (**Table 2-1**). As indicated in **Section 2.3.2**, the UA was removed below the footprint of the GMF RP (**Figure 2-7**) and the IEPA-approved GMF RP composite liner system exceeds the design criteria for a composite liner for new CCR landfills established by Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257.70(b). The material on which the GMF RP liner was placed is the top of the LCU, which is comprised of the low permeability Vandalia Member, Mulberry Grove Member, and Smithboro Till.

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 across the GMF RP (**Figure 2-8** and **Table 2-1**) toward the Unnamed Tributary. Based on the elevations of the tributary and groundwater elevations measured east of the tributary (**Appendix A** 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 the GMF RP ranged from approximately 603 to 624 feet (**Figure 2-8** and **Table 2-1**). 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 2-8** and **Appendix A**). Monitoring wells G283 and G285 were screened across the LCU closest to the GMF RP, where the UA was eroded. Groundwater elevations in G283 and G285 ranged from about 602 to 610 feet during 2023 (**Table 2-1**).

DA (PMP) groundwater elevations are generally lower than those in the UA and LCU (PMP) and ranged from approximately 576 to 618 feet in 2023 (**Figure 2-8** and **Table 2-1**). Monitoring well G275D is nearest the GMF RP 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 2-9**).

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 the GMF RP are presented in **Table 2-2** and well locations are shown on **Figure 2-8**. Vertical hydraulic gradients for other nested well locations at the CPP, discussed below, are presented in **Appendix B**. 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.

- 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.
- 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 DA
  - Well nest G275/G275D, located near the southeast corner of the GMF RP, has consistently downward gradients, with an average vertical gradient of 0.71 ft/ft. Vertical gradients observed at this well nest have generally decreased in downward strength since observation began in 2021.
  - Well nest G206/G206D, located near the southwest corner of the GMF GSP, has consistently downward gradients, with an average vertical gradient of 0.72 ft/ft. Vertical gradients observed at this well nest have generally decreased in downward strength since observation began in 2021.
- 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 northwest of AP1, where consistent upward gradients were measured between the UA and upper LCU. However, overall, 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 2-8**). 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 are variable, but flow directions are generally consistent in the UA.

Groundwater near the GMF RP may periodically flow into 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 [11]. 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 [12].

2.3.6 Hydraulic Conductivities

2.3.6.1 Field Hydraulic Conductivities

Field hydraulic conductivity tests were performed by Hanson in 2021 as part of characterization efforts to complete 35 I.A.C. § 845 requirements. Individual field hydraulic conductivity test results conducted at the GMF RP are summarized in **Table 2-3** [6] and historical results are included in **Appendix C** [12], and tested well locations are included on **Figure 2-8**. The results of the tests are summarized as follows:

- **UA:** Hydraulic conductivities near the GMF RP ranged from 7.8 x 10^{-4} to 1.7 x 10^{-3} cm/s. Tests had a geometric mean value of 1.2 x 10^{-3} cm/s. This is generally consistent with, although higher than, tests conducted prior to 2017 as part of CCR Rule characterization efforts that indicated hydraulic conductivities varied from 1.7 x 10^{-5} to 2.1 x 10^{-3} cm/s with a geometric mean of 2.9 x 10^{-4} cm/s.
- **LCU:** Hydraulic conductivities near the GMF RP ranged from 2.7 x 10^{-4} to 4.5 x 10^{-3} cm/s. Tests had a geometric mean of 1.2 x 10^{-3} cm/s. Monitoring wells with the highest hydraulic conductivities were located near the GMF RP and wells with the lowest hydraulic conductivities were located near AP1. Prior to 2017, field hydraulic conductivity tests completed in the LCU for monitoring well and temporary piezometers (G45D, G46D, T408, and T409) indicate horizontal conductivities from 4.0 x 10^{-8} and 3.4 x 10^{-5}. The elevated hydraulic conductivity values (10^{-4} to 10^{-3} cm/s) in wells near the GMF RP relative to other areas of the CPP are likely not representative of the primary LCU lithology, but instead reflect the isolated and discontinuous sandy lenses in which the wells are screened.
- **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 resulted in hydraulic conductivity values ranging 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. Field hydraulic conductivity testing was not performed on DA monitoring well G275D, located near the GMF RP.
- 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 [6] and historically [12]. The 2021 results are summarized in **Table 2-4** and historical results are provided in **Appendix C**; all results are discussed below.

- **CCR:** No geotechnical samples of CCR were collected from within the GMF RP.
- **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. No laboratory vertical hydraulic conductivity tests were completed on UCU materials near the GMF RP.
    - Geotechnical tests conducted prior to 2017 indicated UCU vertical hydraulic conductivity values ranging 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, 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. No LCU samples collected near the GMF RP were analyzed for vertical hydraulic conductivity.
    - 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 ranging 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 x 10-9 and 4.5 x 10-6 cm/s were reported.
- **Bedrock**: No bedrock samples were analyzed for vertical hydraulic conductivity.

2.4 Groundwater Monitoring

The monitoring system for the GMF RP is shown on **Figure 2-2** and consists of two background monitoring wells (G270 and G280), ten compliance monitoring wells (G271, G273, G275, G275D, G276, G277, G279, G283, G284, and G285), one temporary water level only surface water staff gage (SG-04, which was destroyed in October 2023), and one water level only location (X201) primarily used to monitor water levels within the SI and can be used to characterize source water within the SI [13]. The monitoring wells are screened within the UA (G270, G271, G273, G275, G275D, G276, G277, G279, G280, and G284), LCU (G283 and G285), and DA (G275D) along the perimeter of the GMF RP. Source samples are collected from the X201 at the southeast corner of the GMF RP (**Figure 2-2**).

2.5 Hydrogeologic Conceptual Site Model

The HCR [6] and information provided above forms the foundation of the GMF RP hydrogeological setting. The GMF RP and GMF GSP overlie 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.

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 the groundwater modeling [14] 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 Yarmouth Soil (*i.e.*, DA) and Lierle Clay (*i.e.*, DCU) were not included in the model, for consistency with the original model [15].

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. 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. During construction of the LF, GMF GSP, and the GMF RP, the Loess Unit and portions of the Hagarstown Member (including the UA) were excavated, therefore CCR within the lined GMF RP does not overlie the UA, but rather the LCU, which is separated from the base of CCR in the GMF RP by a composite liner system that exceeds the design criteria for a composite liner for new CCR landfills established by 40 C.F.R. § 257.70(b). 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 the GMF RP can be separated into three distinct groupings that exhibit similar geologic and hydraulic characteristics. Compliance 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, G271, G273, G275, G277, G280, and G284. UA monitoring wells G276 and G279 are screened slightly deeper than the other UA wells (approximately 30 feet bgs) because they are located on top of the berm.
- LCU wells: shallow wells (generally 20 to 25 feet bgs) east of the GMF RP installed where the UCU and UA have been eroded (G283 and G285). LCU wells are screened in moderate permeability (generally about 10^{-4} cm/s) sand lenses within the low permeability till.
- DA wells: deep well (approximately 60 feet bgs) screened in low to moderate permeability materials (generally about 10^{-5} cm/s) located southwest of the GMF RP (G275D).

3. OCCURRENCE AND DISTRIBUTION OF GROUNDWATER EXCEEDANCES (EXTENT)

Results from groundwater samples collected from the GMF RP 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 [3, 4, 5]. Exceedances for which an ASD was not completed include the following parameters and wells by hydrostratigraphic unit:

- UA (**Figure 3-1**)
  - Sulfate at G273
  - TDS at G279
- LCU (**Figure 3-2**)
  - Sulfate at G285
  - TDS at G285

The extents of exceedances discussed below were defined using existing monitoring wells, including wells present on-site (**Table 3-1**) 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 [16, 17, 18]. Solids samples were collected to characterize the geochemical properties and potential effect on geochemistry of the groundwater system for use in ASDs and evaluation of potential remedies. Soil borings were advanced adjacent to G270, G275D, G284, and G288 near the RP, and G200 and G215 which are adjacent to the GSP but are representative of conditions within the same HSUs. Solids samples were collected and analyzed for the following (not all analyses completed for each sample):

- EPA 6020A for Total Metals;
- Bulk Mineralogy by Reitveld x-ray diffraction Analysis;
- Cation Exchange Capacity Analysis;
- Total Organic Carbon Analysis; and,
- Sulfur contents.

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 Sulfate

Statistical exceedances of sulfate in the UA are located only in monitoring well G273, south of the GMF RP. Concentrations of sulfate in G273 range from 333 to 940 milligrams per liter (mg/L) (**Table 3-3**). Sulfate statistical exceedances are defined laterally within the UA by monitoring wells G271 to the west and G275 to the east (**Figure 3-1)**. The lateral extent of downgradient sulfate statistical exceedances are additionally constrained to the east by the Unnamed Tributary which appears to be a local groundwater receiving body that may prevent or reduce groundwater migration east of the Unnamed Tributary.

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 at the CPP indicate hydraulic conductivities from 5.5 x 10^{-8} to 3.7 x 10^{-7} cm/s. This is very low relative to the horizontal hydraulic conductivity measured within the UA (geometric mean of 1.4 x 10^{-3} cm/s). The significant contrast in permeability (greater than two orders of magnitude) indicates groundwater will preferentially migrate horizontally toward the Unnamed Tributary and the elevated sulfate concentrations will not extend into the underlying hydrostratigraphic units where the UA is present. The extent of sulfate GWPS statistical exceedances are additionally vertically defined by DA monitoring well G275D.

3.2.2 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. Concentrations of TDS in UA wells G279 range from 560 to 6,260 mg/L (**Table 3-3**). TDS statistical exceedances are defined laterally within the UA to the west, upgradient, by background monitoring well G280, to the south by well G277, and to the east by G286 (historical samples indicate TDS concentrations less than 400 mg/L) (**Figures 2-2** and **3-1**). The extent of downgradient TDS statistical exceedances are additionally constrained to the east by the Unnamed Tributary as a local groundwater receiving body that may prevent or reduce groundwater migration east of the Unnamed Tributary.

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 5.5 x 10^{-8} to 3.7 x 10^{-7} cm/s. This is very low relative to the horizontal hydraulic conductivity measured within the UA (geometric mean of 2.0 x 10^{-3} cm/s). The significant contrast in permeability (greater than two orders of magnitude) indicates groundwater will preferentially migrate horizontally toward the Unnamed Tributary. In locations where the UA is not present, vertical migration may occur (*i.e.,* G285) but the extent is limited due to the low hydraulic conductivity.

3.3 Extents in the Lower Confining Unit/Potential Migration Pathway

3.3.1 Sulfate

Statistical exceedances of sulfate in the LCU are located only in monitoring well G285, east of the GMF RP and Unnamed Tributary. Concentrations of sulfate in G285, which has had GWPS (400 mg/L) statistical exceedances, ranged from 490 to 780 mg/L (**Table 3-3**). Sulfate exceedances are defined within the LCU to the south by monitoring well G283 (**Figure 3-2)**. The lateral extent of sulfate statistical exceedances at G285 are not expected to extend a significant distance to the north or east due to observed groundwater flow directions toward the unnamed tributary and not expected to extend a significant distance to the east due to the absence of continuous sandy transmissive zones in the LCU materials.

Downward migration of sulfate in the LCU is limited due to the low hydraulic conductivities which range from 5.5 x 10^{-8} to 3.7 x 10^{-7} cm/s. There are no monitoring wells screened within the DA adjacent to G285, however, DA monitoring well G275D, located closer to the GMF RP, does not exhibit a sulfate statistical exceedance (**Figure 2-9**).

3.3.2 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 the sulfate statistical exceedances at G285. Concentrations of TDS at G285 range from 1,400 to 1,700 mg/L (**Table 3-3**). Similar to sulfate, TDS statistical exceedances are defined within the LCU to the south by monitoring well G283 (**Figure 3-2)**. The lateral extent of TDS statistical exceedances at G285 are not expected to extend a significant distance to the north due to observed groundwater flow directions and not expected to extend a significant distance to the east due to the absence of continuous sandy transmissive zones in the LCU materials. There is no monitoring well east of G285 in the LCU to define the eastern extent of TDS in the LCU.

Similar to sulfate, downward migration of TDS in the LCU is limited due to the low hydraulic conductivities from 5.5 x 10^{-8} to 3.7 x 10^{-7} cm/s. There are no monitoring wells screened within the DA adjacent to G285, however, DA monitoring well G275D does not exhibit a statistical TDS exceedance (**Figure 2-9**).

4. GEOCHEMICAL CONCEPTUAL SITE MODEL (NATURE)

A GCSM was developed to describe the conditions of the groundwater in the vicinity of CPP GMF RP and is summarized here (full analysis presented in **Appendix D**). 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 GMF RP 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 GMF RP include sulfate and TDS.

CCR materials are the primary source of constituent loading to the CCR porewater, which is considered to represent the mobile phase constituents capable of migrating into the underlying materials and potentially downgradient in groundwater. The presence of CCR porewater is relatively minor in the GMF RP due to the limited presence of solid CCR, and porewater samples could not be collected. As an alternative, GMF RP surface water was collected from location X201 to represent CCR source water. The CCR source water is therefore representative of the mobile phase constituents capable of migrating into the underlying materials and potentially downgradient in groundwater. The GMF RP CCR source water is therefore the primary indicator of the sulfate concentration available to potentially migrate to the groundwater and is considered as the primary source term for environmental investigation and fate and transport modeling. The observed sulfate statistical exceedances were identified in groundwater to the east of the GMF RP, where the groundwater signature is generally consistent with influence from the CCR source water. TDS is a measure of inorganic and organic substances in solution. TDS trends are generally consistent with those of sulfate in the GMF RP groundwater system.

Conditions within UA groundwater are predicted to favor amorphous iron oxide stability at most locations, which indicates that 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, amorphous iron oxides are predicted to be less stable in the LCU, with the potential for dissolution and precipitation reactions with other iron-bearing species such as siderite. Crystalline iron oxides were not identified in the mineralogical analysis. In addition, batch attenuation testing with solids from the site could not determine a partitioning coefficient for sulfate. These results indicate that chemical attenuation of sulfate, and therefore TDS, downgradient of the GMF RP could be minimal.

5. COMBINED GEOCHEMICAL AND HYDROGEOLOGIC CONCEPTUAL SITE MODELS

5.1 Sulfate and TDS Conceptual Site Model

The CSM describing current conditions at the GMF RP combining the hydrogeologic and geochemical CSMs for sulfate and TDS is as follows. Water contained in the GMF RP is hydraulically separated from the underlying unlithified glacial deposits by a 60-mil HDPE liner that was installed during construction of the GSP in 2010. In addition, the UA was removed from beneath the footprint of the GMF RP during its construction. Based on groundwater elevations measured at wells screened in the UA adjacent to the GMF RP and surface water elevations of the Unnamed Tributary, groundwater flow in the UA is in the direction of the Unnamed Tributary both from the west and east sides. The observed flow directions and potentiometric surfaces drawn from site monitoring wells indicate flow toward the unnamed Tributary; however, the presence of statistical GWPS exceedances of sulfate and TDS in LCU compliance well G285 indicates that there is potential transport of sulfate and TDS in groundwater to the east of the Unnamed Tributary. Additional investigation data is being collected from monitoring wells G219 and G220 that were installed in 2024 downgradient of the GMF GSP and to the west and east of the Unnamed Tributary, respectively. Findings from the installation and sampling of these additional wells will provide additional hydrogeologic information that may further inform the nature and extent of GWPS exceedances in G285.

Although the RP is a lined unit, the presence of sulfate exceedances at G273 and G285, and TDS exceedances at G279 and G285 on the eastern boundary and downgradient suggests that leakage from the RP may be causing elevated sulfate (and TDS) concentrations in this area. The CCR and the liner of the RP will be removed during closure which will provide source control in the future. Conditions within UA groundwater are predicted to favor amorphous iron oxide stability at most locations with less stability in the LCU, which indicates that a portion of the sulfate concentrations in the groundwater system may be attenuated via surface complexation reactions at higher rates in the UA compared to LCU. 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, and therefore TDS, downgradient of the GMF RP could be minimal.

6. CONCLUSIONS AND FUTURE ACTIVITIES

In accordance with 35 I.A.C. § 845.650(d)(1), the nature and extent of statistical GWPS exceedances of 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 the GMF RP.

The lateral extents of statistical exceedances in the UA are illustrated in **Figure 3-1**. As discussed in **Sections 3.2.1** and **3.2.2**, sulfate and TDS exceedances are defined laterally by monitoring wells and the downgradient extents are constrained by the Unnamed Tributary as a local groundwater receiving body that may prevent or reduce groundwater migration east of the Unnamed Tributary as well as observed flow directions. Sulfate and TDS exceedances are not expected to extend a significant distance to the north or west due to observed groundwater flow direction within the UA around the GMF RP. Sulfate and TDS exceedances are constrained vertically by the underlying Vandalia Till.

The lateral extents of exceedances in the LCU are illustrated in **Figure 3-2**. As discussed in **Sections 3.3.1** and **3.3.2**, sulfate and TDS exceedances are defined to the south by monitoring well G283. The lateral extent of sulfate (and TDS) exceedances at G285 are not expected to extend a significant distance to the north due to observed groundwater flow directions and are not expected to extend a significant distance to the east due the low hydraulic conductivity material, absence of continuous sandy transmissive zones in the LCU materials, and the presence of the Unnamed Tributary which is a local groundwater receiving body that likely prevents or reduces groundwater migration east of the Unnamed Tributary.

Sulfate was selected for modeling source control presented in the Final Closure Plan and was identified as a surrogate for TDS, as described in the Groundwater Modeling Report [19]. 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), which is a conservative estimate for predicting contaminant transport times in the model. The GCSM results indicate sulfate attenuation downgradient is expected to be minimal. Additional geochemical modeling will be completed to evaluate how sorption to solid phases may affect sulfate mobility and therefore the time for sulfate (and TDS) to reach the GWPS.

7. REFERENCES

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TABLES

Table 2-1. Summary of Groundwater Elevations

Nature and Extent Report
Coffeen Power Plant
GMF Recycle Pond
Coffeen, IL

Well ID	Well Type	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G270	Background	05/30/2023	5.06	620.79
G271	Compliance	05/30/2023	9.28	616.28
G273	Compliance	05/30/2023	10.41	612.60
G275	Compliance	05/30/2023	13.38	604.88
G275D	Compliance	06/08/2023	[41.89]	[578.42]
G276	Compliance	05/30/2023	26.60	605.39
G277	Compliance	05/30/2023	18.21	604.87
G279	Compliance	05/30/2023	22.73	609.31
G280	Background	05/30/2023	3.96	621.38
G283	Compliance	05/30/2023	5.60	605.14
G284	Compliance	05/30/2023	12.43	605.98
G285	Compliance	05/30/2023	6.71	606.80
X201	Water Level	05/30/2023	38.15	580.32
SG-04	Water Level	05/30/2023	6.41	593.11

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
GMF Recycle Pond
Coffeen, IL

Well ID	Well Type	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G270	Background	08/14/2023	[8.52]	[617.34]
G271	Compliance	08/08/2023	11.20	614.37
G273	Compliance	08/08/2023	11.56	611.46
G275	Compliance	08/08/2023	Dry	
G275D	Compliance	08/08/2023	31.27	589.04
G276	Compliance	08/08/2023	27.75	604.25
G277	Compliance	08/08/2023	19.76	603.32
G279	Compliance	08/08/2023	23.69	608.35
G280	Background	08/08/2023	5.80	619.55
G283	Compliance	08/15/2023	[7.45]	[603.30]
G284	Compliance	08/15/2023	[12.28]	[606.14]
G285	Compliance	08/08/2023	8.25	605.26
X201	Water Level	08/08/2023	37.76	580.71

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
GMF Recycle Pond
Coffeen, IL

Well ID	Well Type	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
G270	Background	11/13/2023	10.90	614.96
G271	Compliance	11/13/2023	13.00	612.57
G273	Compliance	11/13/2023	12.71	610.31
G275	Compliance	11/13/2023	Dry	
G275D	Compliance	11/13/2023	Not Measured	
G276	Compliance	11/13/2023	28.59	603.41
G277	Compliance	11/13/2023	Dry	
G279	Compliance	11/13/2023	23.39	608.65
G280	Background	11/13/2023	8.91	616.44
G283	Compliance	11/13/2023	7.22	603.53
G284	Compliance	11/13/2023	Dry	
G285	Compliance	11/13/2023	9.38	604.14
X201	Water Level	11/13/2023	34.00	584.47
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
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

Table 2-2. Vertical Hydraulic Gradients

Nature and Extent Report
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

Table 2-2. Vertical Hydraulic Gradients

Nature and Extent Report
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

Table 2-3. 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

Table 2-4. Geotechnical Data Summary

Nature and Extent Report
GMF Recycle Pond
Coffeen Power Plant
Coffeen, IL

Sample ID	Field Location ID	Top of Sample (ft bgs)	Bottom of Sample (ft bgs)	Moisture Content (%)	Dry Density (pcf)	Specific Gravity	Calculated Porosity [1] (%)	Vertical Hydraulic Conductivity (cm/s)	LL	PL	PI	USCS	Gravel (%)	Sand (%)	Fines (%)
Loess Unit															
G275D/Comp 1	G275D	4	9.5	18.3	110.8	2.66	33.2	--	33	16	17	CL	0	37	63
G284/Comp 1	G284	4	9.9	15.5	110.4	2.56	30.9	--	30	14	16	CL	0	45	55
G288/Comp 1	G288	3.3	6	20.2	104.6	2.55	34.3	--	40	19	21	CL	0	30	70
G288/Comp 2	G288	6	11.2	16.4	111.6	2.54	29.6	--	27	14	15	CL	0	44	56
Hagarstown Member															
G275D/Comp 2	G275D	9.5	10.9	20.4	102.5	2.57	36.1	--	32	17	15	CL	0	47	53
G275D, ST7	G275D	12	14	15.8	115.9	--	--	1.6E-04	--	--	--	SC	--	--	--
G284/Comp 2	G284	10	14	12.7	122.2	2.63	25.5	--	18	12	6	SM	0	58	42
G288/Comp 3	G288	11.2	12	15.7	112.0	2.56	29.9	--	16	11	5	ML	0	55	55
Vandalia Member															
G275D/Comp 3	G275D	16	46	13.2	121.6	2.64	26.2	--	39	15	24	CL	0	23	77
Smithboro Member															
G275D/Comp 4	G275D	46	52	13.3	122.0	2.64	25.9	--	30	15	15	CL	0	31	69
Yarmouth Soil															
G275D/Comp 5	G275D	52	54	10.2	--	2.59	--	--	NP	NP	NP	SP-SM	0	90	10
Lierle Clay															
G275D/Comp 6	G275D	54	64	20.6	106.3	2.66	36.0	--	39	16	23	CL	0	17	83

[O:KLT, QC: FPO][U: FPO, QC:KLT 8/9/21][U:KLT 8/13/21, C:EDP 8/30/21]

Notes:

[1] Porosity calculated as relationship of bulk density (p_b) to particle density (p_d) ($n = 100[1- (p_b/p_d)]$)

-- = not analyzed
% = Percent
bgs = below ground surface
cm/s = centimeters per second
ft = foot/feet
GMF = Gypsum Management Facility
LL = Liquid limit
NP = Non Plastic
pcf = pounds per cubic foot
PI = Plasticity Index
PL = Plastic Limit

USCS = Unified Soil Classification System
CL = Lean Clay
ML = Silt
SC = Clayey Sand
SM = Silty Sand
SP-SM = Poorly Graded-Sand with silt

Table 3-1. Monitoring Well Construction Details

Nature and Extent Report
Coffeen Power Plant
GMF Recycle Pond
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	2008-02-26	--	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
G271	UA	2009-09-10	--	625.34	Top of Disk	622.89	9.96	14.31	612.93	608.58	14.79	606.90	4.4	2	39.0650072	-89.3955874
G272	UA	2009-09-10	--	623.51	Top of Disk	620.72	9.11	13.98	611.61	606.74	14.32	606.40	4.9	2	39.0649894	-89.3947851
G273	UA	2009-09-10	--	622.66	Top of Disk	620.17	9.08	14.56	611.09	605.61	15.1	604.20	5.5	2	39.0649852	-89.3939733
G274	UA	2009-09-16	--	623.79	Top of Disk	621.67	12.9	17.67	608.77	604.00	18.06	603.60	4.8	2	39.064991	-89.393198
G275	UA	2009-09-16	--	618.26	Top of Disk	616.14	8.22	12.62	607.92	603.52	13.19	603.00	4.4	2	39.0651507	-89.3925614
G275D	DA	2021-01-14	620.31	620.23	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	2009-09-16	--	631.51	Top of Disk	629.14	22.41	27.22	606.73	601.92	27.65	601.10	4.8	2	39.0655345	-89.3926172
G277	UA	2009-09-14	--	623.08	Top of Disk	620.79	14.29	18.77	606.50	602.02	19.24	600.80	4.5	2	39.0659274	-89.3925718
G279	UA	2009-09-10	--	632.04	Top of Disk	629.19	22.4	26.79	606.79	602.40	27.3	601.20	4.4	2	39.0671555	-89.3929983
G280	UA	2008-02-26	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
G283	LCU	2021-01-14	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	2021-02-03	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	2021-01-25	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	2021-01-18	613.13	613.30	Top of PVC	609.97	3.37	8.16	606.60	601.81	8.5	600.00	4.8	2	39.067277	-89.391883
G287	UA	2021-01-20	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	2021-01-19	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
MW20S	UA	2007-05-01	622.90	622.86	Top of PVC	620.26	8.41	13.22	611.85	607.04	13.67	604.30	4.8	2	39.0649676	-89.3943221

Notes:

All elevation data are presented relative to the North American Vertical Datum of 1988 (NAVD88), GEOID 12A
-- = not measured/recorded
bgs = below ground surface
DA = Deep Aquifer
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
GMF Recycle Pond
Coffeen, IL

Location	Parameter	Unit	Groundwater Protection Standard	2023 Q2 LCL	2023 Q3 LCL	2023 Q4 LCL
G275D	Arsenic, total	mg/L	0.010	0.00205	0.00218	0.0144
G273	Sulfate, total	mg/L	400	410	410	400
G285	Sulfate, total	mg/L	400	535	541	571
G279	Total Dissolved Solids	mg/L	1,200	1,080	--	2,400
G285	Total Dissolved Solids	mg/L	1,200	1,430	1,450	1,460

Notes:
-- = data not available (well reported dry during compliance sampling event)
LCL = Lower Confidence Level
mg/L = milligrams per liter

Table 3-3. Summary of Groundwater Data

Nature and Extent Report
Coffeen Power Plant
GMF Recycle Pond
Coffeen, IL

HSU	Location	Parameter	Unit	Sample Count	Non-Detect Result Count	Percent Non-Detect Results	First Sample	Last Sample	Minimum	Median	Mean	Maximum
DA	G275D	Arsenic, total	mg/L	8	0	0	03/30/2021	12/07/2023	0.00330	0.00910	0.0116	0.0237
DA	G275D	Sulfate, total	mg/L	8	0	0	03/30/2021	12/07/2023	99.0	225	197	270
DA	G275D	Total Dissolved Solids	mg/L	8	0	0	03/30/2021	12/07/2023	840	990	974	1,100
LCU	G283	Arsenic, total	mg/L	11	5	45	03/31/2021	11/20/2023	<0.0004	0.00100	0.000982	0.00160
LCU	G283	Sulfate, total	mg/L	11	0	0	03/31/2021	11/20/2023	230	250	246	270
LCU	G283	Total Dissolved Solids	mg/L	11	0	0	03/31/2021	11/20/2023	770	820	830	930
LCU	G285	Arsenic, total	mg/L	11	5	45	03/30/2021	11/20/2023	<0.0004	0.00100	0.000952	0.00140
LCU	G285	Sulfate, total	mg/L	11	0	0	03/30/2021	11/20/2023	490	580	590	708
LCU	G285	Total Dissolved Solids	mg/L	11	0	0	03/30/2021	11/20/2023	1,400	1,500	1,545	1,700
UA	G270	Arsenic, total	mg/L	38	35	92	01/20/2015	11/17/2023	<0.0004	0.00100	0.000941	0.00110
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	G271	Arsenic, total	mg/L	31	27	87	01/21/2015	11/17/2023	0.000500	0.00100	0.000976	0.00200
UA	G271	Sulfate, total	mg/L	32	0	0	01/21/2015	11/17/2023	170	375	371	610
UA	G271	Total Dissolved Solids	mg/L	32	0	0	01/21/2015	11/17/2023	594	870	869	1,100
UA	G272	Arsenic, total	mg/L	17	17	100	01/21/2015	11/17/2023	<0.0004	<0.001	<0.001	<0.001
UA	G272	Sulfate, total	mg/L	17	0	0	01/21/2015	11/17/2023	270	370	369	470
UA	G272	Total Dissolved Solids	mg/L	17	0	0	01/21/2015	11/17/2023	660	880	867	1,100
UA	G273	Arsenic, total	mg/L	31	25	81	01/21/2015	11/17/2023	0.000400	0.00100	0.00107	0.00450
UA	G273	Sulfate, total	mg/L	32	0	0	01/21/2015	11/17/2023	333	440	469	940
UA	G273	Total Dissolved Solids	mg/L	32	0	0	01/21/2015	11/17/2023	820	1,050	1,042	1,300
UA	G274	Arsenic, total	mg/L	17	10	59	01/21/2015	11/17/2023	0.000500	0.00100	0.00102	0.00170
UA	G274	Sulfate, total	mg/L	17	0	0	01/21/2015	11/17/2023	150	286	267	390
UA	G274	Total Dissolved Solids	mg/L	17	0	0	01/21/2015	11/17/2023	490	770	711	890
UA	G275	Arsenic, total	mg/L	12	9	75	01/21/2015	06/08/2023	<0.00069	0.00100	0.00125	0.00430
UA	G275	Sulfate, total	mg/L	12	0	0	01/21/2015	06/08/2023	320	540	563	940
UA	G275	Total Dissolved Solids	mg/L	12	0	0	01/21/2015	06/08/2023	790	1,100	1,184	1,500
UA	G276	Arsenic, total	mg/L	30	27	90	01/21/2015	11/17/2023	<0.0004	0.00100	0.00107	0.00570
UA	G276	Sulfate, total	mg/L	31	0	0	01/21/2015	11/17/2023	180	250	319	2,610
UA	G276	Total Dissolved Solids	mg/L	31	0	0	01/21/2015	11/17/2023	660	820	938	4,260
UA	G277	Arsenic, total	mg/L	10	5	50	10/14/2020	06/01/2023	<0.00069	0.00100	0.000938	0.00130
UA	G277	Sulfate, total	mg/L	10	0	0	10/14/2020	06/01/2023	67.0	470	416	610
UA	G277	Total Dissolved Solids	mg/L	10	0	0	10/14/2020	06/01/2023	480	1,250	1,197	1,600
UA	G279	Arsenic, total	mg/L	31	23	74	01/21/2015	11/17/2023	<0.00069	0.00100	0.00113	0.00300
UA	G279	Sulfate, total	mg/L	32	0	0	01/21/2015	11/17/2023	110	590	855	3,390
UA	G279	Total Dissolved Solids	mg/L	32	0	0	01/21/2015	11/17/2023	560	1,350	1,942	6,260
UA	G280	Arsenic, total	mg/L	39	30	77	01/21/2015	11/20/2023	<0.0004	0.00100	0.00125	0.00660
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	G284	Arsenic, total	mg/L	10	9	90	03/30/2021	08/15/2023	<0.0004	0.00100	0.000940	<0.00022
UA	G284	Sulfate, total	mg/L	10	0	0	03/30/2021	08/15/2023	60.0	68.0	80.1	174
UA	G284	Total Dissolved Solids	mg/L	10	0	0	03/30/2021	08/15/2023	410	490	500	656
UA	G286	Arsenic, total	mg/L	8	8	100	03/31/2021	07/27/2021	<0.00022	<0.00022	<0.00022	<0.00022
UA	G286	Sulfate, total	mg/L	8	0	0	03/31/2021	07/27/2021	11.0	13.5	13.5	16.0

Table 3-3. Summary of Groundwater Data

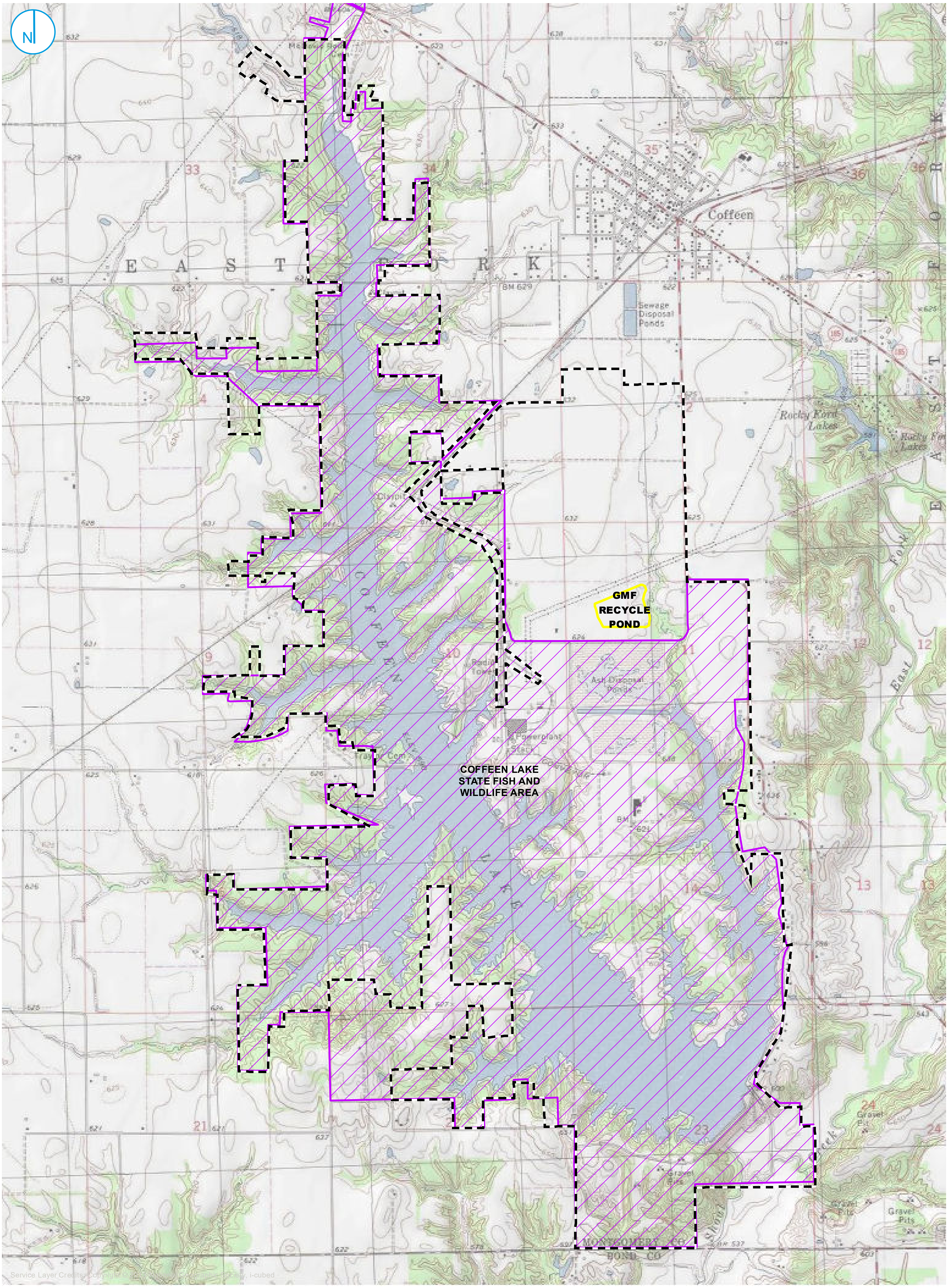
Nature and Extent Report
Coffeen Power Plant
GMF Recycle Pond
Coffeen, IL

HSU	Location	Parameter	Unit	Sample Count	Non-Detect Result Count	Percent Non-Detect Results	First Sample	Last Sample	Minimum	Median	Mean	Maximum
UA	G286	Total Dissolved Solids	mg/L	8	0	0	03/31/2021	07/27/2021	230	300	300	370
UA	G287	Arsenic, total	mg/L	8	8	100	03/29/2021	07/27/2021	<0.00022	<0.00022	<0.00022	<0.00022
UA	G287	Sulfate, total	mg/L	8	0	0	03/29/2021	07/27/2021	41.0	43.5	44.4	50.0
UA	G287	Total Dissolved Solids	mg/L	8	0	0	03/29/2021	07/27/2021	350	445	436	490
UA	G288	Arsenic, total	mg/L	8	0	0	03/30/2021	07/27/2021	0.00110	0.00375	0.00348	0.00560
UA	G288	Sulfate, total	mg/L	8	0	0	03/30/2021	07/27/2021	29.0	42.0	200	770
UA	G288	Total Dissolved Solids	mg/L	8	0	0	03/30/2021	07/27/2021	310	370	490	1,400
UA	MW20S	Arsenic, total	mg/L	1	0	0	10/07/2015	10/07/2015	0.00490	0.00490	0.00490	0.00490
UA	MW20S	Sulfate, total	mg/L	1	0	0	10/07/2015	10/07/2015	89.0	89.0	89.0	89.0
UA	MW20S	Total Dissolved Solids	mg/L	1	0	0	10/07/2015	10/07/2015	460	460	460	460

Notes:

< = less than the method detection limit
DA = Deep Aquifer
HSU = Hydrostratigraphic Unit
LCU = Lower Confining Unit
UA = Uppermost Aquifer

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 2-1

NATURE AND EXTENT REPORT
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

PROJECT: 169000XXXX | DATED: 6/4/2024 | DESIGNER: GALARNMC

Y:\Mapping\Projects\22\2285\MXD\Nature_and_Extent\COF\Nature_and_Extent_Report\104\Figure 2-2. Monitoring Well Location Map.mxd

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

- ⊞ COMPLIANCE MONITORING WELL
- ⊞ BACKGROUND MONITORING WELL
- ⊞ MONITORING WELL
- ● CCR SOURCEWATER SAMPLE
- ◓ STAFF GAGE, RIVER
- ■ COAL MINE SHAFT
- ▭ 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.

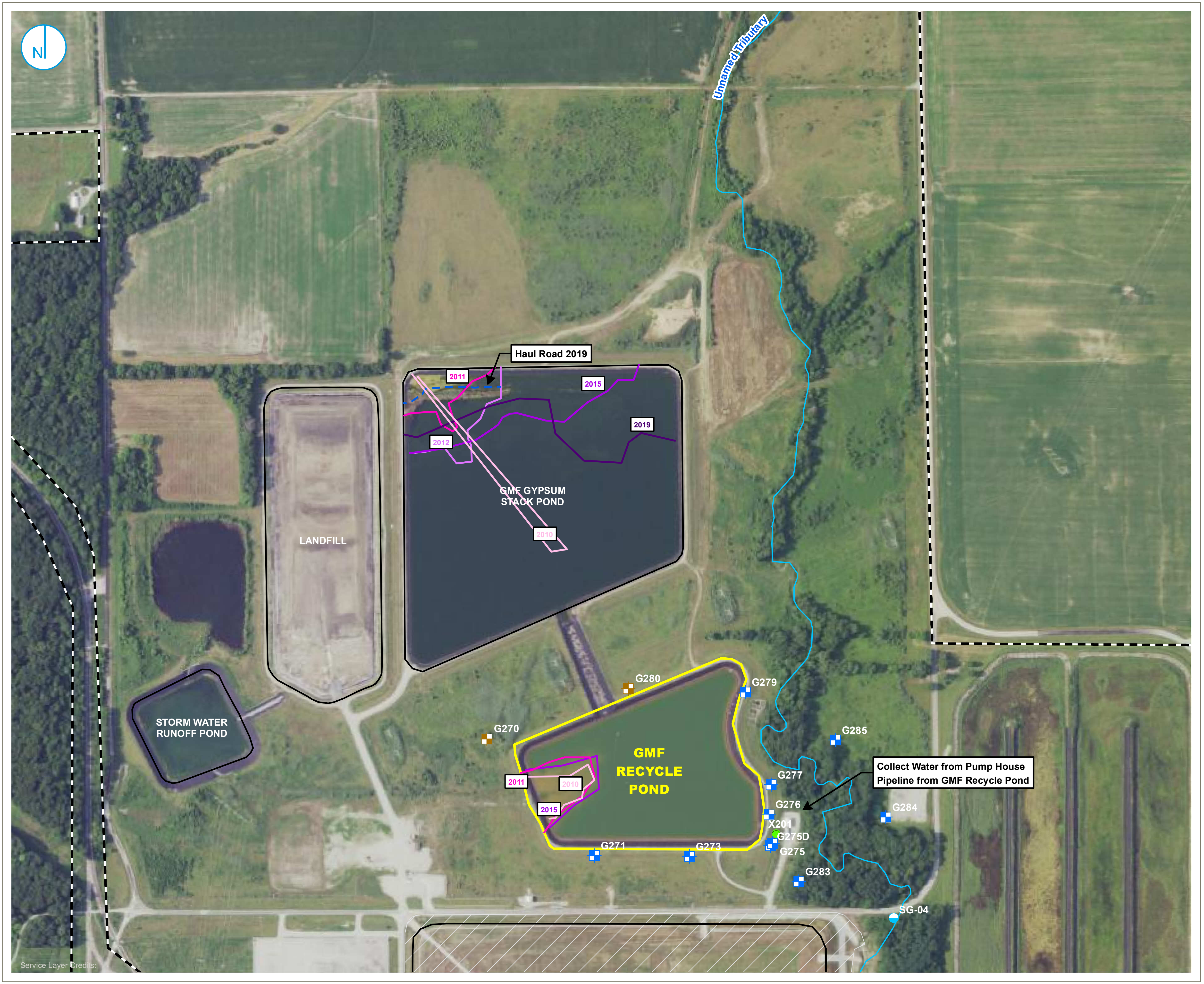
MONITORING WELL LOCATION MAP

NATURE AND EXTENT REPORT
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 2-2

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



Y:\Mapping\Projects\22\2285\MXD\Nature_and_Extent\COF\Nature_and_Extent_Report\104\Figure 2-3. CCR Observations.mxd

PROJECT: 169000XXXX | DATED: 5/10/2024 | DESIGNER: GALARNMC

⊞	COMPLIANCE MONITORING WELL
⊞	BACKGROUND MONITORING WELL
◒	STAFF GAGE, RIVER
●	CCR SOURCEWATER SAMPLE
—	APPROXIMATE LIMITS OF ASH BASED ON 2010 AERIAL
—	APPROXIMATE LIMITS OF ASH BASED ON 2011 AERIAL
—	APPROXIMATE LIMITS OF ASH BASED ON 2012 AERIAL
—	APPROXIMATE LIMITS OF ASH BASED ON 2015 AERIAL
—	APPROXIMATE LIMITS OF ASH BASED ON 2019 AERIAL
- - -	HAUL ROAD 2019
◯	SURFACE WATER FEATURE
☐	REGULATED UNIT (SUBJECT UNIT)
☐	SITE FEATURE
▨	LIMITS OF FINAL COVER
⬚	PROPERTY BOUNDARY

NOTE:
STAFF GAGE SG-04 WAS IDENTIFIED AS DESTROYED DURING OCTOBER 2023.

0 225 450
Feet

CCR OBSERVATIONS

NATURE AND EXTENT REPORT
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

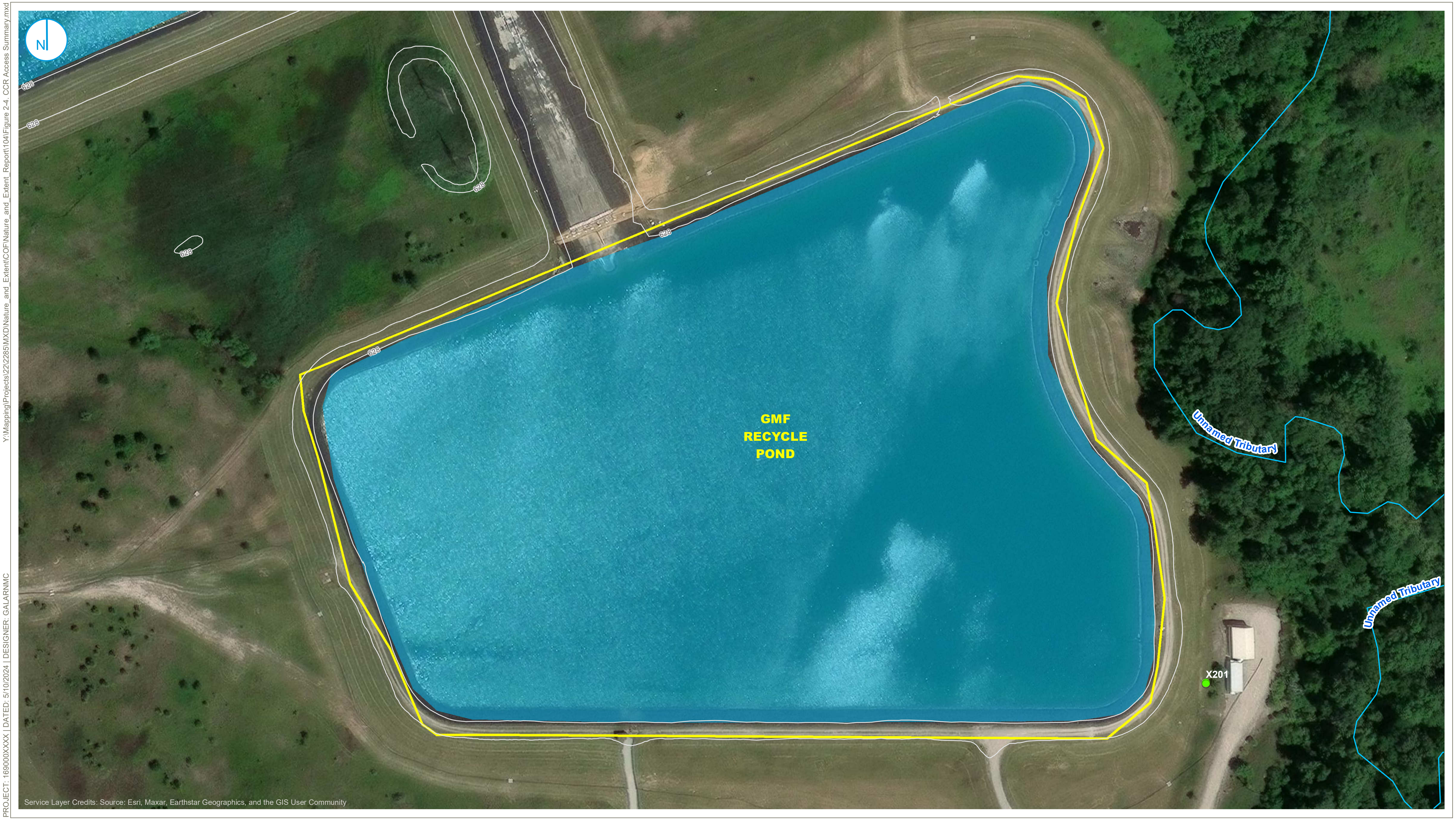
FIGURE 2-3

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

Y:\Mapping\Projects\22\2285\MXD\Nature_and_Extent\COF\Nature_and_Extent_Report\104\Figure 2-4. CCR Access Summary.mxd

PROJECT: 169000XXXX | DATED: 5/10/2024 | DESIGNER: GALARNMC



Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

● CCR SOURCEWATER SAMPLE

— 628-FT ELEVATION CONTOUR (NAVD88)

▬ ELEVATION BELOW 628

☐ REGULATED UNIT (SUBJECT UNIT)

⬚ PROPERTY BOUNDARY

0 75 150 Feet

CCR ACCESS SUMMARY

NATURE AND EXTENT REPORT
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 2-4

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

Y:\Mapping\Projects\22\2285\MXD\Nature_and_Extent\COF\Nature_and_Extent_Report\104\Figure 2-5. Base of CCR.mxd

PROJECT: 169000XXXX | DATED: 5/10/2024 | DESIGNER: GALARNMC

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

10-FT BOTTOM OF ASH ELEVATION CONTOUR (NAVD88)

2-FT BOTTOM OF ASH ELEVATION CONTOUR (NAVD88)

SURFACE WATER FEATURE

🟨 REGULATED UNIT (SUBJECT UNIT)

0 75 150 Feet

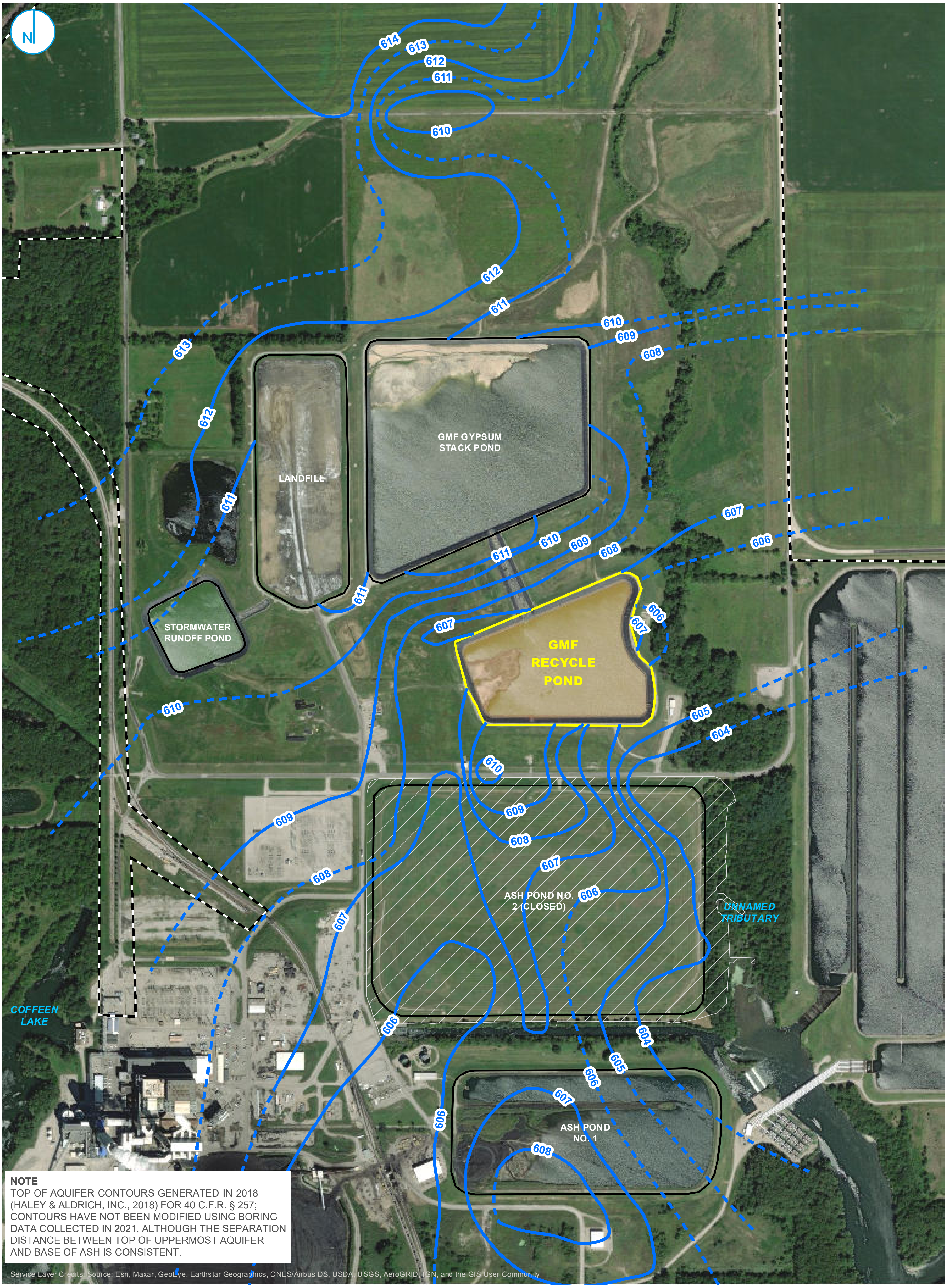
BASE OF CCR

NATURE AND EXTENT REPORT
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 2-5

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



NOTE
TOP OF AQUIFER CONTOURS GENERATED IN 2018 (HALEY & ALDRICH, INC., 2018) FOR 40 C.F.R. § 257; CONTOURS HAVE NOT BEEN MODIFIED USING BORING DATA COLLECTED IN 2021, ALTHOUGH THE SEPARATION DISTANCE BETWEEN TOP OF UPPERMOST AQUIFER AND BASE OF ASH IS CONSISTENT.

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

- ━ HAGARSTOWN MEMBER ELEVATION CONTOUR (1-FT INTERVAL, NAVD88)
- ╍ INFERRED HAGARSTOWN MEMBER ELEVATION CONTOUR
- 🟨 PART 845 REGULATED UNIT (SUBJECT UNIT)
- ☐ SITE FEATURE
- ▨ LIMITS OF FINAL COVER
- ⬚ PROPERTY BOUNDARY

0 275 550 Feet

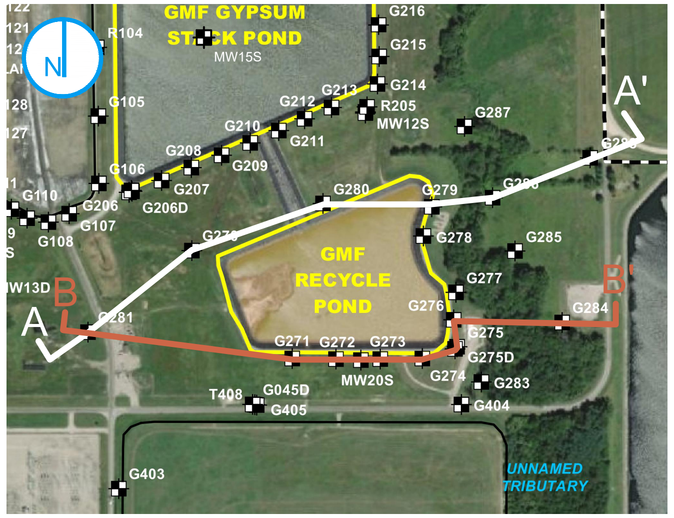
TOP OF UPPERMOST AQUIFER

FIGURE 2-6

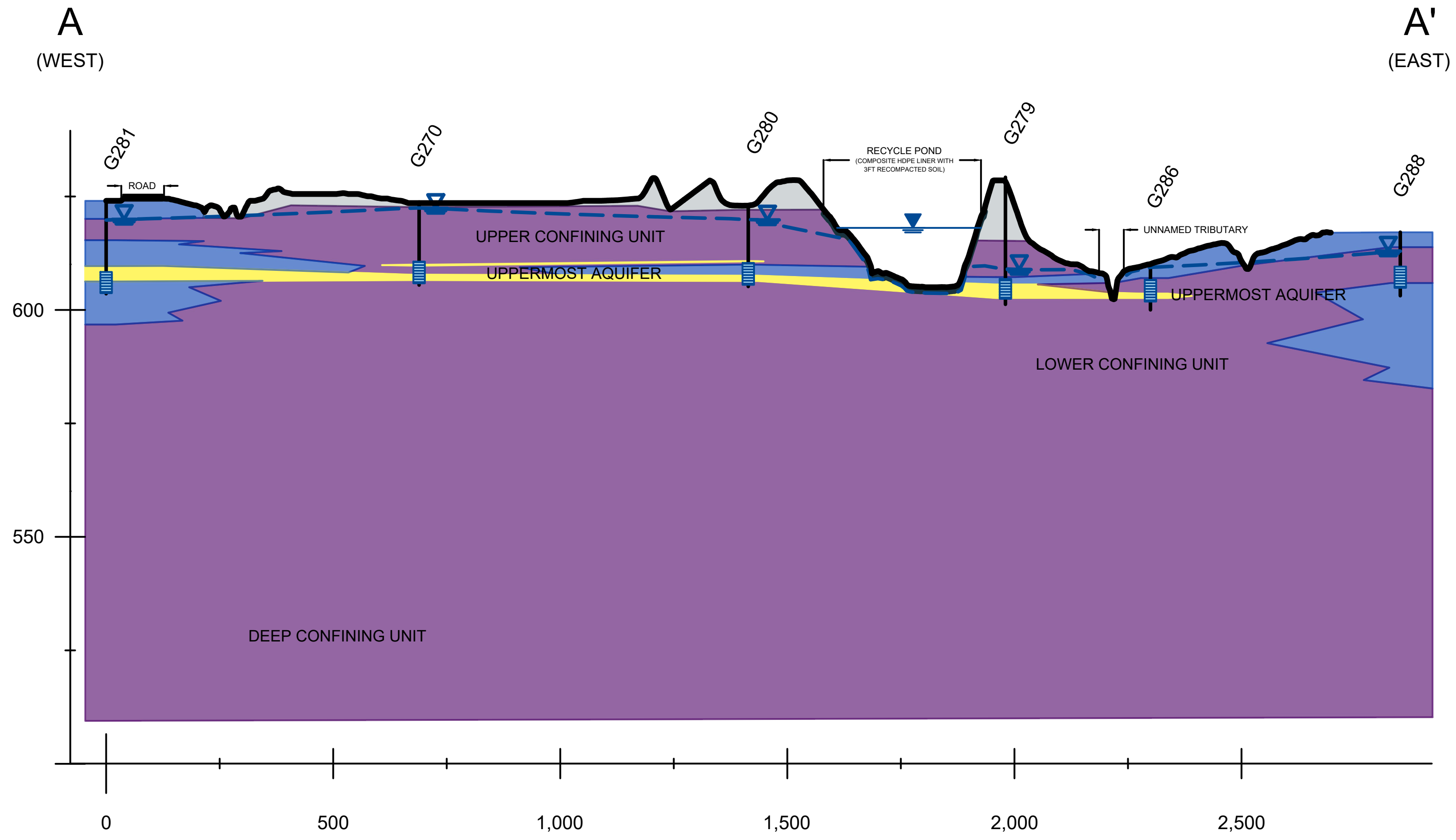
NATURE AND EXTENT REPORT
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

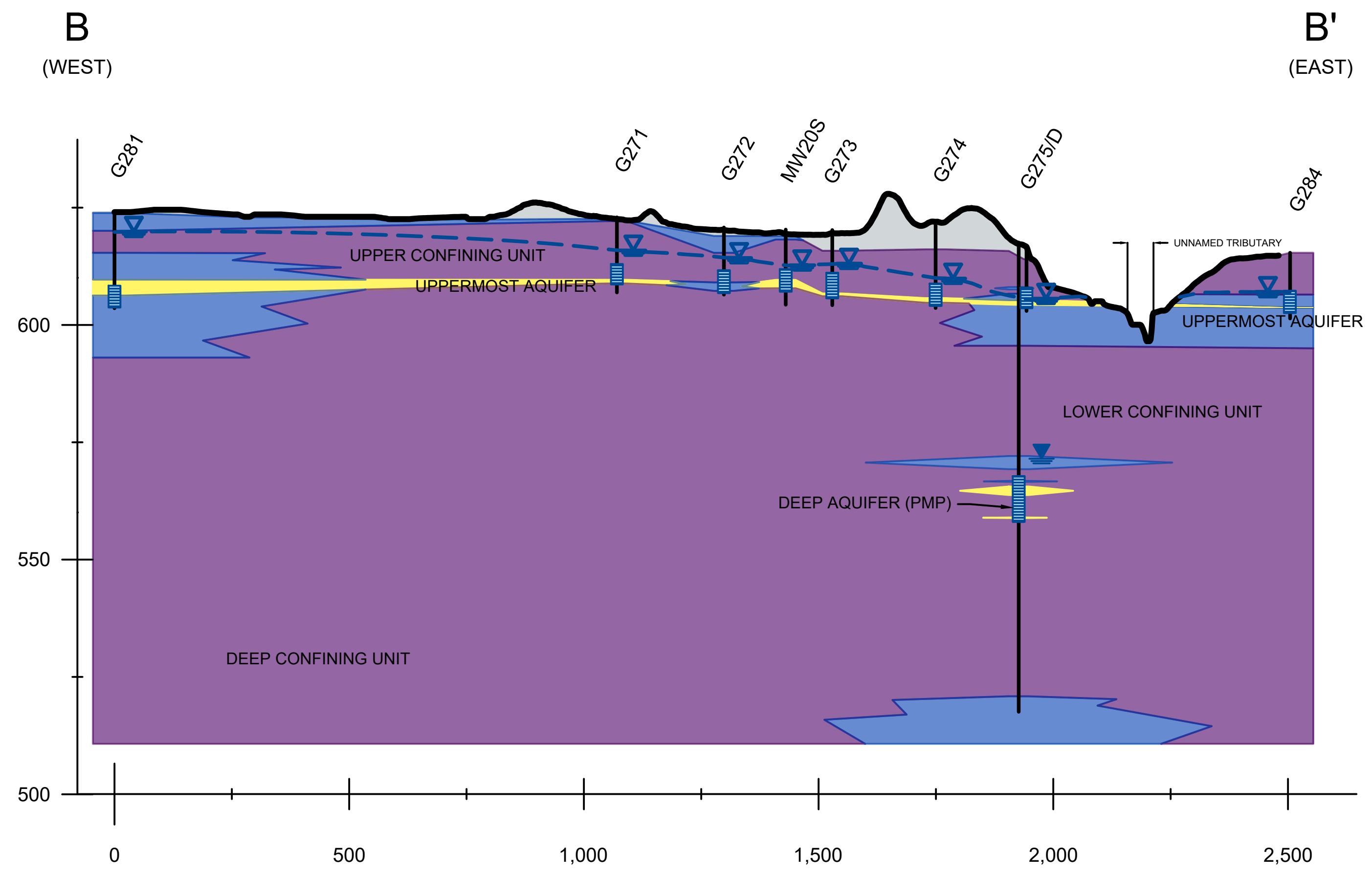
RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

\\ramboll.sharepoint.com@SSL\DavWWWRoot\sites\vistra\Shared Documents\CCR GW\Deliverables\Part 845 Operating Permits\Sites\Coffeen\Hydrogeo Report\Figures\EVS\Working Files\CAD\Cross Sections\Coffeen-GMF-RP-Cross Sections.dwg
PROJECT: 1940100806 DATED: 10/8/2021 DESIGNER: ENGELHSA



NOTES
1. This profile was developed by interpolation between widely spaced boreholes. Only at the borehole location should it be considered as an approximately accurate representation and then only to the degree implied by the notes on the borehole logs.
2. Scale is approximate.
3. Vertical scale is exaggerated 10X.
4. Groundwater elevations measured on July 26, 2021.

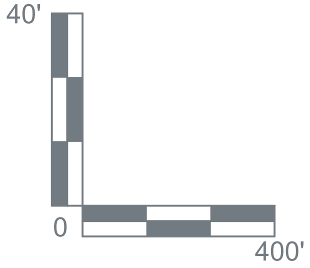




LEGEND

▢	FILL
🟪	CLAY (CL/CH)
🟦	SILT (ML)
🟨	SAND (SP/SM/SW)

▤	WELL SCREEN INTERVAL
- -	UPPERMOST AQUIFER POTENTIOMETRIC SURFACE
▽	UPPERMOST AQUIFER GROUNDWATER ELEVATION
▼	BEDROCK GROUNDWATER / OTHER GROUNDWATER / SURFACE WATER ELEVATION(S)
~	SURFACE WATER



GEOLOGIC CROSS SECTIONS
A-A' & B-B'

NATURE AND EXTENT EPORT
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

FIGURE 2-7

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

▣	COMPLIANCE MONITORING WELL
▣	BACKGROUND MONITORING WELL
▣	PORE WATER 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. ELEVATION CONTOURS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

UPPERMOST AQUIFER POTENTIOMETRIC SURFACE MAP MAY 30, 2023 (E001)

FIGURE 2-8

NATURE AND EXTENT REPORT
GMF RECYCLE POND

COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

PROJECT: 169000XXXX | DATED: 6/3/2024 | DESIGNER: GALARNMC

Y:\Mapping\Projects\22\2285\MXD\Nature_and_Extent\COF\Nature_and_Extent_Report\104\Figure 2-9. COF 104 Pot Surface DA 20230808.mxd

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

- ⊞ 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 2-9

NATURE AND EXTENT REPORT
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

● TOTAL SULFATE EXCEEDANCE

● TOTAL DISSOLVED SOLIDS 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
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

🟠 TOTAL SULFATE EXCEEDANCE
🟢 TOTAL DISSOLVED SOLIDS EXCEEDANCE
• 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
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

APPENDICES

APPENDIX A
Site-Wide Groundwater Elevations

Appendix A. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
GMF Recycle Pond
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

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

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

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

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

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 A. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
GMF Recycle Pond
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

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 A. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
GMF Recycle Pond
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

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

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

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 A. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
GMF Recycle Pond
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

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

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

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

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

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

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 A. Site-Wide Groundwater Elevations
Nature and Extent Report
Coffeen Power Plant
GMF Recycle Pond
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

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 A. Site-Wide Groundwater Elevations
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Coffeen Power Plant
GMF Recycle Pond
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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

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

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

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GMF Recycle Pond
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

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 A. Site-Wide Groundwater Elevations

Nature and Extent Report
Coffeen Power Plant
GMF Recycle Pond
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
Supplemental Vertical Hydraulic Gradients

Appendix B. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 1
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 B. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 1
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 B. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 1
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

Appendix B. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 1
Coffeen, IL

Date	T409 Groundwater Elevation (ft NAVD88)	G46D Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	LCU (upper)	LCU (lower)				
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 B. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 1
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 B. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report

Coffeen Power Plant

Ash Pond No. 1

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 B. Supplemental 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

Appendix B. Supplemental 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

Appendix B. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
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

Appendix B. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report
Coffeen Power Plant
Ash Pond No. 2
Coffeen, IL

Date	T409 Groundwater Elevation (ft NAVD88)	G46D Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	LCU (upper)	LCU (lower)				
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

Appendix B. Supplemental Vertical Hydraulic Gradients

Nature and Extent Report
Coffeen Power Plant
GMF Gypsum Stack Pond
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
Historical Field and Laboratory Hydraulic Conductivities

Appendix C. Historical Field and Laboratory Hydraulic Conductivities

Nature and Extent Report
GMF Recycle Pond
Coffeen Power Plant
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 C. Historical Field and Laboratory Hydraulic Conductivities
Nature and Extent Report
GMF Recycle Pond
Coffeen Power Plant
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**	

APPENDIX D
Geochemical Conceptual Site Model

Geosyntec consultants

engineers | scientists | innovators

Geochemical Conceptual Site Model

Coffeen Power Plant – Gypsum Management Facility Recycle Pond

(CCR Unit #104)

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

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ACRONYMS AND ABBREVIATIONS

ASD	alternative source demonstration
CEC	cation exchange capacity
CCR	coal combustion residuals
COCs	constituents of concern
CPP	Coffeen Power Plant
DA	deep aquifer
DCU	deep confining unit
GCSM	geochemical conceptual site model
GMF	Gypsum Management Facility
GSP	Gypsum Stack Pond
GWPS	groundwater protection standards
HSU	hydrostratigraphic unit
I.A.C.	Illinois Administrative Code
IEPA	Illinois Environmental Protection Agency
LCU	lower confining unit
meq/100g	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
RP	Recycle Pond
SU	standard units
TDS	total dissolved solids
TOC	total organic carbon
UA	uppermost aquifer
UCU	upper confining unit
XRD	X-Ray diffraction

1. EXECUTIVE SUMMARY

A geochemical conceptual site model (GCSM) has been developed to describe subsurface conditions at the Coffeen Power Plant Gypsum Management Facility (GMF) Recycle Pond (RP) coal combustion residuals unit (Unit #104). A GCSM describes the geochemical processes that contribute to the mobilization, distribution, and attenuation of constituents of concern (COCs) in the subsurface environment. This report describes the GCSM for parameters that have exceeded the groundwater protection standard (GWPS) in GMF RP groundwater and which will be addressed in the corrective action plan. The exceedances detected at the GMF RP are sulfate and total dissolved solids (TDS). Exceedances of COCs are present in two hydrostratigraphic units at the Site: the uppermost aquifer (UA), comprised predominantly of sandy to gravelly silts with thin sand beds, and the lower confining unit (LCU), comprised primarily of sandy to silty till, with discontinuous sand lenses that have been identified as potential migration pathways (PMPs).

The coal combustion residuals (CCR) materials are the primary source of constituent loading to the CCR porewater, which is considered to represent the mobile phase constituents capable of migrating into the underlying materials and potentially downgradient in groundwater. The presence of CCR porewater is relatively minor in the GMF RP due to the limited presence of solid CCR, and porewater samples could not be collected. As an alternative, GMF RP surface water was collected from location X201 to represent CCR source water. The CCR source water is therefore representative of the mobile phase constituents capable of migrating into the underlying materials and potentially downgradient in groundwater. The GMF RP CCR source water is therefore the primary indicator of the sulfate concentration available to potentially migrate to the groundwater and is considered as the primary source term for environmental investigation and fate and transport modeling. The observed sulfate exceedances were identified in groundwater to the east of the GMF RP, where the groundwater signature is generally consistent with influence from the CCR source water. TDS is a measure of inorganic and organic substances in solution. TDS trends are generally consistent with those of sulfate in the GMF RP groundwater system.

Conditions within groundwater from the UA are predicted to favor amorphous iron oxide stability at most locations, which indicates that a portion of the 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. However, amorphous iron oxides are predicted to be less stable in the LCU, with the potential for dissolution and precipitation reactions with other iron-bearing species such as siderite. Crystalline iron oxides were not identified in the mineralogical analysis and a site-specific partition coefficient for sulfate could not be calculated from the results of batch attenuation testing completed with solids from the Site. These results indicate that chemical attenuation of sulfate, and therefore TDS, downgradient of the GMF RP is expected to be limited.

2. INTRODUCTION

This report documents the development of a geochemical conceptual site model (GCSM) to describe subsurface conditions at the Coffeen Power Plant (CPP) Gypsum Management Facility (GMF) Recycle Pond (RP) coal combustion residuals (CCR) unit (Unit #104). A GCSM describes the environmental media and geochemical processes that contribute to the mobilization, distribution, and attenuation of constituents of concern (COCs) in the subsurface 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 the RP. The document has been prepared as an appendix to the CPP GMF RP Nature and Extent (N&E) Report prepared by Ramboll Americas Engineering Solutions, Inc. (Ramboll).

Sulfate and total dissolved solids (TDS) are the only constituents with statistical exceedances above the GWPS at the RP for the second, third, and fourth quarters of 2023 monitoring events (Q2 2023, Q3, 2023, and Q4 2023) completed under Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845.630. For the 2023 events discussed above, sulfate and TDS exceedances were detected in samples from the lower confining unit (LCU) at compliance monitoring well G285; a sulfate exceedance was detected in samples from the uppermost aquifer (UA) at compliance monitoring well G273; and a TDS exceedance was detected in samples from the UA at compliance monitoring well G279.

An exceedance of arsenic was detected at deep aquifer (DA) compliance monitoring well G275D during the fourth quarter 2023 sampling event (Ramboll 2024). An alternative source demonstration (ASD), as allowed by 35 I.A.C. § 845.650(e), was completed for the arsenic exceedance (Geosyntec 2024). Therefore, arsenic is not included as a COC in this GCSM.

3. SITE BACKGROUND

3.1 Site Overview

An overview of site characteristics and hydrogeology is presented in the CPP GMF RP N&E Report. A site layout figure is provided in Attachment A.[1] The CPP property is located approximately two miles south of the city of Coffeen, Illinois, and bordered by lobes of Coffeen Lake to the west, east, and south, and by agricultural land to the north. The Coffeen GMF RP impoundment is located to the south of the GMF Gypsum Stack Pond (GSP) CCR unit (Unit # 103). An unnamed tributary runs north to south to the east of the GMF GSP and RP.

The GMF RP is an 18.3-acre lined surface impoundment that received decanted water from the GMF GSP from 2010 to 2021 to act as a polishing pond. Outflow from the GMF RP was pumped back to the CPP for use in the wet scrubber system, and the GMF RP also has an emergency spillway that discharges to the unnamed tributary via a National Pollutant Discharge Elimination System permitted outfall. The GMF RP was constructed in accordance with Illinois Environmental Protection Agency (IEPA) Water Pollution Control Permit No. 2008-EA-4661 and is constructed with a composite high-density polyethylene (HDPE) liner with three feet of recompacted soil and a groundwater underdrain system.

A Hydrogeologic Site Characterization Report (Ramboll 2021a) previously described the hydrostratigraphic units (HSUs) present in the vicinity of the CPP GMF RP, which consist of an Upper Confining Unit (UCU), UA, LCU, DA, and Deep Confining Unit (DCU). The UCU consists of the silty or clayey silt of the Loess Unit and the upper clayey portion of the Hagerstown 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 COF.

Vertical gradients measured near CPP indicate downward flow from the UA to the LCU and DA. Vertical gradients at the G275/G725D well nest, located near the southeast corner of the GMF RP, were consistently strongly downward with an average vertical gradient of 0.71 feet per foot (CPP GMF RP N&E Report). Both the DA and the LCU have been identified as PMPs due to the presence of these downward gradients.

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 the GMF RP. The proposed groundwater monitoring network is described

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[1] This figure is also provided as Figure 2-1 of the CPP GMF RP N&E Report.

in the Groundwater Monitoring Plan (Ramboll 2021b) and shown in Attachment B.[2] Well construction information is provided in Attachment C.[3]

Groundwater flow is generally east to southeast in the vicinity of the GMF RP in the direction of the unnamed tributary. 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 GMF RP N&E Report.

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[2] This figure is also provided as Figure 2-2 of the CPP GMF RP N&E Report.
[3] This table is also provided as Table 3-1 of the CPP GMF RP 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 are provided in Section 4.2 and 4.3, respectively, with discussion of how groundwater both upgradient and downgradient of the GMF RP 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

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 might 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 each contributor species. 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 removing the individual constituents that contribute to TDS from aqueous phases.

4.2 Site Solids Characterization

Solid phase data for the CCR source material within the GMF RP has not been collected due to safety concerns and limited abundance of solid phase CCR. As noted in Section 3.1, the GMF RP served as a polishing pond for the GMF GSP and did not receive any other inputs of CCR solids. Therefore, analysis of CCR solids from two locations within the GMF GSP in 2021 are considered representative of the CCR solids that would be expected to influence CCR source water composition at the GMF RP and are discussed throughout the following sections.

Solids from HSUs across the monitoring network were characterized using various analytical techniques, the results of which are presented in Tables 1 and 2, to characterize their geochemical properties and to understand their effect on the geochemistry of the groundwater system.[4] Solids were collected from three locations adjacent to the following existing wells in the GMF RP monitoring network and one additional location adjacent to the GMF RP, specifically:

- G270, located upgradient of the GMF RP to the northwest. Solids were collected within the UA and are considered representative of background conditions for the GMF RP.
- G275D, located downgradient of the GMF RP to the south. Solids were collected within the UCU, UA, and LCU.
- G284, located downgradient of the GMF RP to the southeast. Solids were collected within the UCU and UA.
- G288, located side-gradient of the GMF RP to the east. Solids were collected within the UCU and UA.

The monitoring well locations are shown on Attachment B. Boring logs for these locations are provided in Attachment D.

Samples from two additional locations across the Site were analyzed as part of investigations at the CPP GMF GSP but are representative of conditions within the same HSUs beneath the GMF RP. These solids were collected adjacent to existing wells in the GMF GSP monitoring network, specifically:

- G200, located upgradient of the GMF GSP to the north. Solids were collected within the UA and are considered representative of background conditions for the GMF RP.
- G215, located at the downgradient edge of the GSP to the east. Solids were collected within the UA.

The monitoring well locations for G200 and G215 and the boring logs for these locations are provided in Attachment D.

4.2.1 Bulk Characterization

Bulk characterization analytical data is presented on Table 1 and the analytical data is provided in Attachment E. Total organic carbon (TOC) represents only the carbon component of organic matter within a solid material. Non-detect to 1.12 percent by dry weight [% wt]) abundances of

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[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 the CPP GMF RP were not submitted for analysis via this technique.

TOC were reported in the vicinity of the GMF RP within the UA, with similarly low abundances in the LCU (1.09 % wt), and UCU solids (0.06 to 0.16 % wt).[5]

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 all tend to possess high negative surface charges at circumneutral pH and therefore tend to contribute to higher CEC values. CEC values in UA solids (7.93 to 15 milliequivalents per 100 g of sample [meq/100g]) are similar to those in UCU solids (9.60 to 22.95 meq/100g) and LCU solids (9.25 meq/100g).

Total sulfide was only detected in one out of three samples submitted (0.08 wt% at background location SB-200), consistent with the low total sulfur concentrations (less than 950 milligrams per kilogram [mg/kg]) in all samples. 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. Of three samples submitted for AVS analysis, AVS was only detected at SB-200 (0.17 milligrams per kilogram [mg/kg]). The low abundance of total sulfides and AVS indicates sulfides have a limited abundance in the Site solids and sulfur is primarily present within other mineral phases. Sulfate was only detected in solids from within the UA at the G275D boring location (20 mg/kg) as well as in solid samples from the UCU (12 to 50 mg/kg) and LCU (48 mg/kg) (Table 1). Note that sulfate concentrations in GMF GSP solids were 15,000 to 19,000 mg/kg (Table 1); the higher concentrations in the CCR solid materials compared to the aquifer lithology is consistent with the predominance of gypsum in the CCR.

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 1 and the analytical data is provided in Attachment E.

Total aluminum was only measured at three locations within the UA (SB-200, SB-215, and G270), with concentrations ranging between 9,600 to 22,000 mg/kg. Total iron concentrations are greater in UA solids in background locations (16,000 to 22,000 mg/kg) compared to compliance locations (4,200 to 9,900 mg/kg). Iron concentrations in UCU and LCU solids (3,800 to 16,000 mg/kg) were similar to those detected in UA compliance well locations. The abundance of iron within the bulk solids matrix of the UA indicates the potential presence of iron-bearing minerals within the system. The presence of iron-bearing minerals was confirmed via X-Ray diffraction (XRD) as discussed in Section 4.2.2.

Total manganese concentrations follow a similar pattern to iron in the UA, with concentrations greater in background location UA solids (1,200 mg/kg) than compliance well location UA solids (130 to 550 mg/kg). Total manganese concentrations similar to the UA were reported in the LCU

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[5] While the analytical laboratory reports provided in Attachment E provide TOC as mg/kg, the results have been converted to % wt for ease of interpretation.

solids (240 mg/kg), whereas lower concentrations were detected in UCU solids (16 to 110 mg/kg) (Table 1).

4.2.2 Mineralogical Analysis

XRD with Rietveld refinement was conducted for identification of minerals in three solid samples collected from the UA adjacent to G200, G215 and G270. 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 detected by XRD is ignored in the percent calculation.

The XRD data are presented in Table 2 and the analytical data is provided in Attachment F. Solids from the SB-200 and SB-215 in the UA were predominantly composed of quartz, ranging from 53.1 to 60.6% of the minerals present. Feldspar minerals including albite (8.0 to 9.1%) and microcline (6.2 to 9.8%), and the carbonate minerals dolomite (12.9 to 18.2 %) and calcite (non-detect to 4.5%) were detected as additional primary crystalline mineral phases.

While crystalline forms of iron oxides were not detected in Site solids, ankerite, an iron-bearing carbonate mineral, was detected in all Site solids at abundances from 4.3 to 5.2%. The abundance of ankerite compared to the abundance of total iron in Site solids indicates that the total iron within Site solids is largely associated with minerals other than crystalline iron oxides and that iron oxides, if present, are likely present as non-crystalline or amorphous phases. No crystalline manganese oxide or aluminum oxide minerals were detected in Site solids.

4.3 Aqueous Geochemistry

Groundwater from wells across the UA, LCU, and DA in the vicinity of the GMF RP were analyzed for a range of geochemical parameters, as presented in Figures 1–7. For clarity in interpretation, UA well locations are shown with square symbology, LCU well locations are shown with diamond symbology and DA locations are shown with triangular symbology. Background locations G270 and G280, both of which are screened in the UA, are shown with hollow symbology. The groundwater data used in the site evaluation is summarized in Attachment G.

A limited set of aqueous phase samples representative of GMF RP CCR source water has been collected in the recent past from the X201 location, which is included in the monitoring network only to gauge pond water levels.

The CCR materials are the primary source of constituent loading to the CCR porewater, which is considered to represent the mobile phase constituents capable of migrating into the underlying materials and potentially downgradient in groundwater. The presence of CCR porewater is relatively minor in the GMF RP to the limited presence solid CCR, and porewater samples could not be collected. As an alternative, GMF RP surface water was collected from location X201 to represent CCR source water. The RP CCR source water is the primary indicator of constituents available to the groundwater and is considered as the primary source term for environmental investigation and fate and transport modeling. The CCR source water data collected from the X201 location and used in the Site evaluation is also summarized in Attachment G.

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.

GMF RP CCR source water pH values ranged between 4.4 to 7.2 SU (Figure 1). In wells across the groundwater monitoring network, pH values appear to be stable and are circumneutral, consistent with the buffering capacity associated with the presence of carbonate mineral species detected within UA solids (Table 2). Compliance UA groundwater pH values largely range between 6.5 to 7.5 SU, which overlaps with the range detected for background UA groundwater with pH values 6.0 to 7.5 SU. LCU groundwater near the GMF RP, represented by G283 and G285, has a range of pH values between 6.7 to 7.7 SU. DA groundwater near the GMF RP, represented by G275D, has a range of pH values between 7.0 to 7.5 SU. Within UA compliance wells, pH values are highest in G271, located to the south/southeast of the GMF RP, and lowest in G79, northeast of the GMF RP. This spatial distribution of pH may relate to an increasing influence of GMF RP porewater at this location.

Groundwater across the Site has a range of redox conditions, with UA monitoring network wells having almost exclusively positive (oxidizing) ORP values at both background and compliance well locations (Figure 2). ORP values in the DA near the GMF RP are almost exclusively negative (more reducing), while LCU ORP values are both positive and negative values (at the G285 and G283 locations, respectively). GMF RP CCR source water at the X201 location is relatively more oxidizing than groundwater in the UA compliance network. This is likely due to the shallow construction of the GMF RP and its high surface area.

4.3.2 Exceedance Parameters

Total sulfate concentrations within GMF RP porewater at X201 ranged between 5,500 to 17,000 mg/L[6], above the GWPS of 400 mg/L (Figure 3a). When measured, dissolved sulfate was similar (14,000 to 18,000 mg/L) (Figure 3b). These elevated concentrations are consistent with the nature of the CCR material within the unit (gypsum) and the high sulfate concentrations detected for GMF GSP solids (Table 1).

Sulfate in UA background wells G270 (48 to 58 mg/L) and G280 (43 to 113 mg/L)[7] rarely exceed the sulfate GWPS (Figure 3a). Sulfate concentrations are generally stable through time across the monitoring network, with sulfate concentrations consistently above the GWPS only at G273 in the UA and G285 in the LCU (Figure 3a). Sulfate concentrations at G279 have shown an increasing

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[6] For the 31 March 2021 porewater sample at X201, the detected sulfate concentration was anomalously low at 1,600 mg/L and has been excluded from the presented range.

[7] For the 9 November 2022 groundwater sample at G280, the detected sulfate concentration was anomalously high at 910 mg/L and has been excluded from the presented range.

trend since mid-2022, resulting in a statistical exceedance of the GWPS in Q4 2023. Sulfate concentrations within the DA near the GMF RP have remained relatively low (99 to 270 mg/L). When measured, dissolved sulfate represents the majority of total sulfate at all locations and within all HSUs (Figure 3b).

UA background wells G270 (360 to 510 mg/L) and G280 (400 to 608 mg/L) have lower TDS concentrations relative to UA compliance wells (440 to 1,600 mg/L; excluding G279) and LCU and DA compliance wells (770 to 1,000 mg/L; excluding G285; Figure 4). TDS concentrations at wells with exceedances, G279 within the UA (560 to 6,260 mg/L) and G285 within the LCU (1,400 to 1,700 mg/L), are higher than the other compliance wells. GMF RP CCR source water at X201 has TDS concentrations well above those detected in the compliance monitoring network (3,100 to 17,000 mg/L). Sulfate and TDS concentrations are significantly positively linearly correlated for wells in the compliance monitoring network (R^2= 0.92, Figure 5), indicating that sulfate is a major contributor to TDS across the GMF RP monitoring network. This includes both G279 and G285, where a statistically significant exceedance of sulfate was identified.

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).

Using conditions detected at compliance well G273 on 5 June 2023 to represent groundwater within the UA (Table 3), amorphous ferrihydrite (represented as $Fe(OH)_3$(ppd) on the diagram) is predicted to be stable under groundwater conditions at most UA locations (Figure 6a).[8] However, most locations are poised on the redox boundary between dissolved iron and amorphous iron oxides, suggesting the potential for dynamic iron precipitation and dissolution conditions. Ankerite, which is an analogous iron-bearing carbonate species to siderite, was identified via XRD but is not expected to be thermodynamically stable within the UA based upon the detected pH and redox conditions. Dissolution of ankerite 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 unstable, at some locations within the UA.

Using conditions detected at well G285 on 8 June 2023 to represent groundwater within the LCU and DA (Table 3), the dissolved ferrous sulfate ion pair is predicted to be stable under groundwater conditions at many LCU and DA locations (Figure 6b). Given the high sulfate concentrations at G285, an additional Eh-pH diagram was generated using conditions at well G283 on 8 June 2023 to represent groundwater within the LCU and DA at other locations. Amorphous ferrihydrite is predicted to be unstable under these conditions, with many sample observations poised on the

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[8] Field ORP measurements were converted to Eh by adding +200 millivolts to correct for the Ag/AgCl electrode.

redox boundary with siderite (Figure 6c). This is consistent with the observation of ankerite via XRD in solids near the GMF RP and indicates the potential for a dynamic equilibrium between amorphous iron oxides and iron carbonate minerals.

The manganese Eh-pH diagrams for the UA and LCU/DA show that solid phase manganese minerals, including manganese oxides, are not predicted to be stable under conditions across the Site in the UA, LCU, or DA (Figures 7a, 7b, and 7c).

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 available across the Site for the Q2, Q3, and Q4 2023 sampling events. A comparison of the total and dissolved iron and manganese data for these events is provided in Table 4.

Total iron concentrations ranged from 0.029 mg/L at downgradient UA compliance well G276 to 0.97 mg/L at UA background well G280. Iron was higher in the LCU and DA HSUs relative to the UA compliance locations, ranging from 0.326 mg/L at sidegradient compliance well G285 to 7.39 mg/L at downgradient DA compliance well G275D. The total iron concentration in GMF RP CCR source water was 0.068 mg/L (Table 4).

Where detected, dissolved iron concentrations followed similar patterns of relative concentrations to those detected for total iron, with concentrations ranging from 0.0016 mg/L at downgradient UA compliance well G277 to 2.9 mg/L at downgradient LCU well G283. The dissolved iron concentration as a percentage of the total iron value was less than 35%, except for at G283. These observations are consistent with Eh-pH modeling results indicating geochemical conditions favoring the stability of amorphous ferrihydrite at UA locations, and dissolved iron species at LCU and DA locations.

Total manganese concentrations in GMF RP CCR source water ranged from 45 to 53.3 mg/L (Table 4). Total manganese concentrations in groundwater ranged from below reporting limits to 0.85 mg/L at background UA well G270 (Table 4). Dissolved manganese concentrations ranged from below reporting limits to 0.835 mg/L at downgradient DA well G275D. Dissolved manganese represents the majority of total manganese concentrations at most locations. This is consistent with the predicted mobilization of manganese to the aqueous phase based on the Pourbaix diagrams (Figures 6a & 6b).

4.3.5 Major Ion Distribution and Groundwater Signatures

Piper diagrams were constructed using data from the GMF RP to visualize major ion distributions in groundwater (Figure 8). Piper diagrams are a common tool for assessing geochemical similarities or differences between aqueous samples. The cation composition of the GMF RP CCR source water is dominated by magnesium, with a major anion composition that is sulfate-dominated. Background UA wells G270 and G280 compositions have lower contributions of sulfate, greater contributions of carbonate alkalinity (consistent with the presence of carbonate minerals in the solids detected at G270), and major cation distributions of relatively equal contributions of both monovalent and divalent cations (Table 2). Groundwater from DA compliance well G275D and sidegradient UA compliance well G284 cluster with these background wells, consistent with the low total sulfate concentrations detected at these locations. Groundwaters from the UA compliance network cluster along a continuum between background locations and GMF RP CCR source water, consistent with the higher concentrations of sulfate detected at these locations. This is particularly notable for G279, which clusters near GMF RP CCR source water from X201, and the fourth quarter sample from G275, which appears to be driven by an anomalously high sulfate value (Figure 3a). These results provide further evidence for the influence of GMF RP CCR source water on compliance wells located to the east of 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. A draft memorandum discussing batch attenuation testing at the CPP GMF Recycle Pond was included as an appendix to the *Groundwater Modeling Report (*Ramboll 2022) and is provided as Attachment H to this document.

5.1 Batch Attenuation Testing

Batch attenuation testing was conducted for sulfate to evaluate the potential for sorption and to generate site-specific distribution coefficients between the solid and aqueous phase. In 2021, Geosyntec conducted a field investigation at the GMF GSP which included completion of two soil borings ranging in depth from 18 to 28 feet below ground surface. One groundwater sample (G215) and one soil sample (SB-215) were used for batch attenuation testing at five soil:solution ratios (Table 6), each ran in duplicate. One set of microcosms was amended (i.e., spiked) with sodium sulfate (Na_2SO4) to achieve target concentrations of sulfate (Table 5). After the end of the test, the samples were filtered through a 0.45-micron (µm) filter prior to analysis for dissolved concentrations of sulfate. Analysis of the dissolved phase is important to adequately measure the portioning of mass between the solid and liquid fractions of the experiment.

5.2 Partition Coefficient Results

The mass of sulfate in the water versus in the solids of each sample was plotted according to three sorption models: linear, Langmuir, and Freundlich. Data obtained from the batch attenuation tests was used to calculate attenuation distribution coefficients (K_d) for each sorption model. The calculated linear, Langmuir, and Freundlich distribution coefficients (K_d, K_L, and K_F, respectively) and $1/n$ values are shown in Table 7. The linear and Langmuir isotherms for sulfate are provided in Figure 9.

A sulfate partition coefficient was not determined for any isotherm for the sulfate amended microcosms. The linear isotherm yielded a partition coefficient of 0.1 L/kg but had a very poor goodness-of-fit, and the Langmuir isotherm yielded a negative coefficient. A Freundlich isotherm could not be calculated because the data were not conducive to log transformation.

6. GEOCHEMICAL CONCEPTUAL SITE MODEL

6.1 Source and Mobilization Mechanisms

Sulfate is concentrated in flue gas desulfurization wastewater, as gypsum is the main solid component formed in the blowdown and the majority of sulfate mineral phases are soluble under environmental conditions such that sulfate associated with flue gas desulfurization wastewater is leachable (Koralegedara et al., 2019). The likely primary source of sulfate to the UA is GMF RP CCR CCR source water. Sulfate was identified in the CCR CCR source water at concentrations up to 17,000 mg/L. Groundwater conditions at the wells with sulfate exceedances, which are located east of the GMF RP, are consistent with the influence from CCR source water. Detected concentrations of sulfate are a major contributor to the exceedances of TDS identified at G279 and G285.

6.2 Potential and Observed Attenuation Mechanisms

Sulfate exceedances are currently limited to the UA and LCU. 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 iron oxides and oxyhydroxides associated with solids if the pH is low resulting in positive surface charge. Modeling of pH and redox conditions support the presence of iron oxides in amorphous phases across the Site in the UA at some locations, although they may be poised to undergo dynamic conditions. This indicates that attenuation of sulfate via sorption mechanisms is possible in the UA, though it will be dependent on speciation, redox conditions, and pH in this HSU. 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. Chemical attenuation of sulfate in the LCU and DA is also anticipated to be limited, as amorphous iron oxides are predicted to be less stable in the LCU, with the potential for dissolution and precipitation reactions with other iron-bearing species such as siderite. Any attenuation of sulfate would likely contribute to a reduction of TDS in the groundwater.

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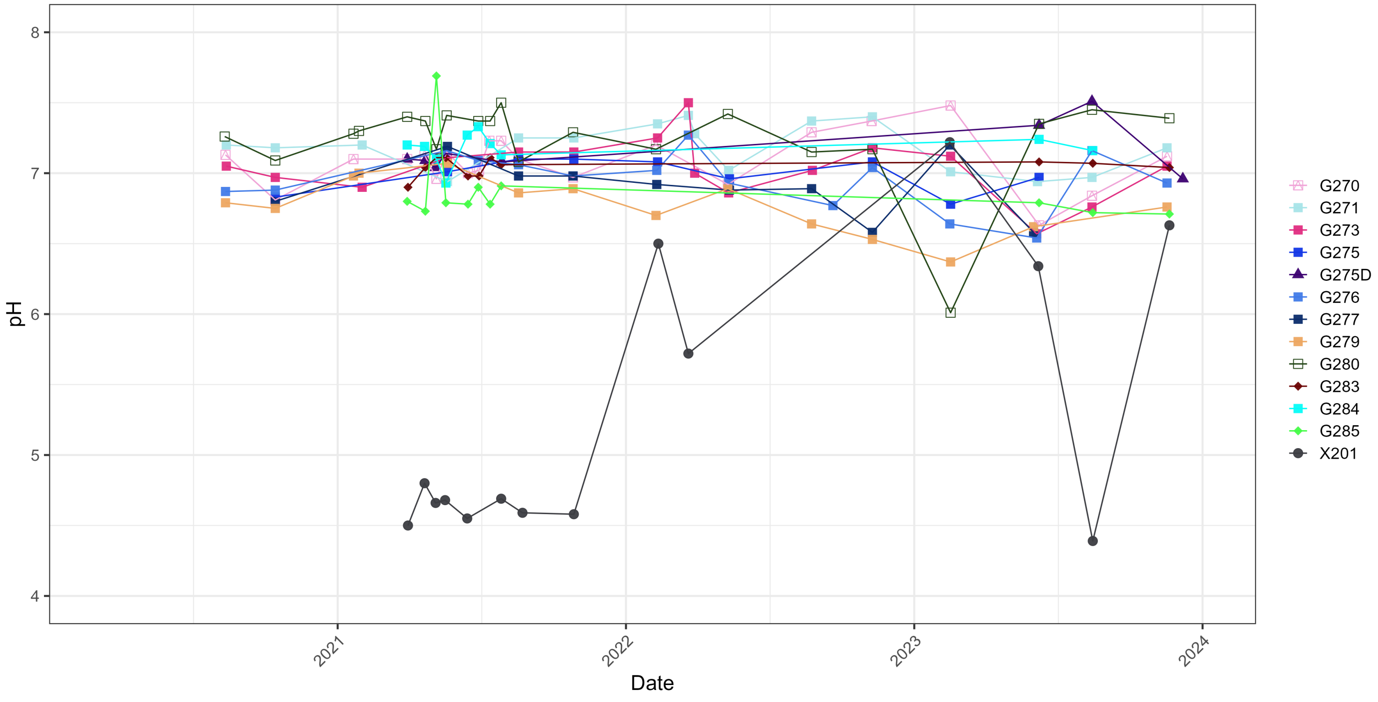
FIGURES

pH across Recycle Pond Monitoring Network



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Notes:
Background wells shown with open symbols.

pH Time Series

Coffeen Power Plant – Gypsum Management Facility
Recycle Pond

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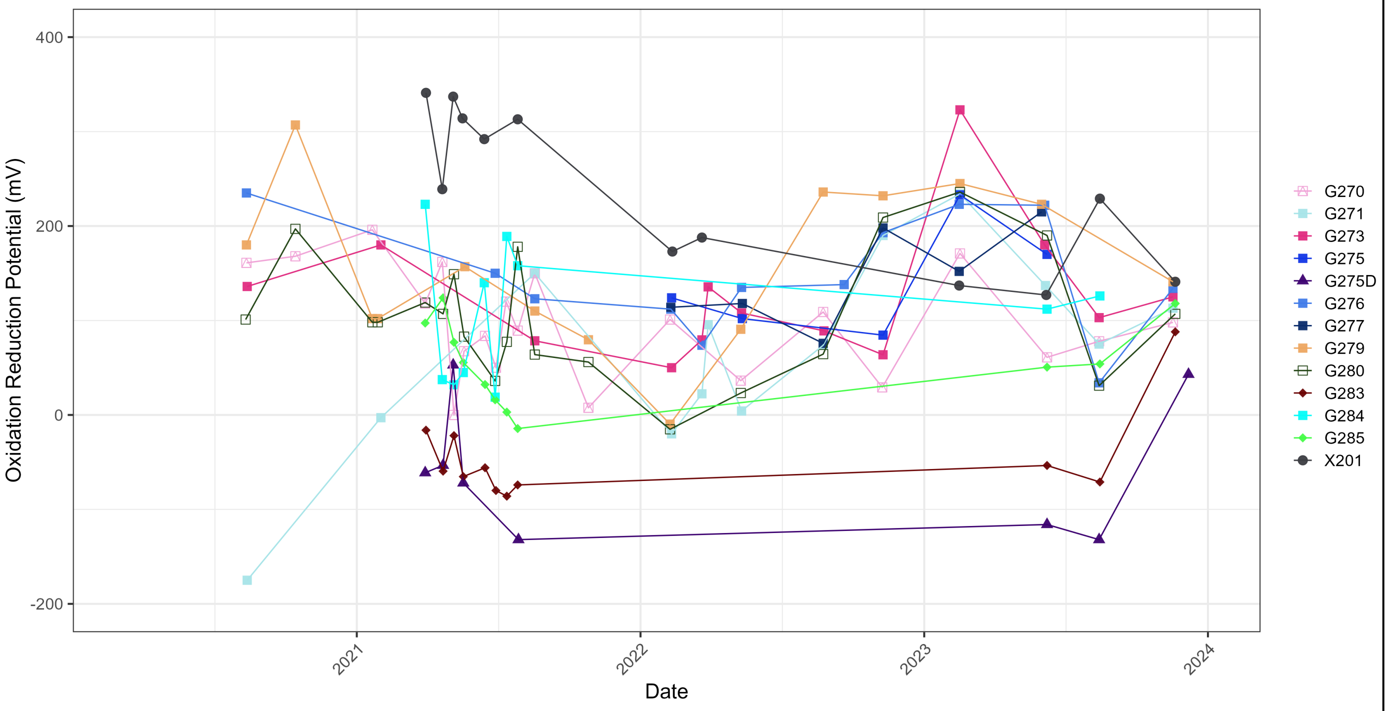
Columbus, Ohio

May 2024

Figure

1

ORP across Recycle Pond Monitoring Network



Notes:
mV: millivolts
Background wells shown with open symbols.

ORP Time Series

Coffeen Power Plant – Gypsum Management Facility
Recycle Pond

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Figure

2

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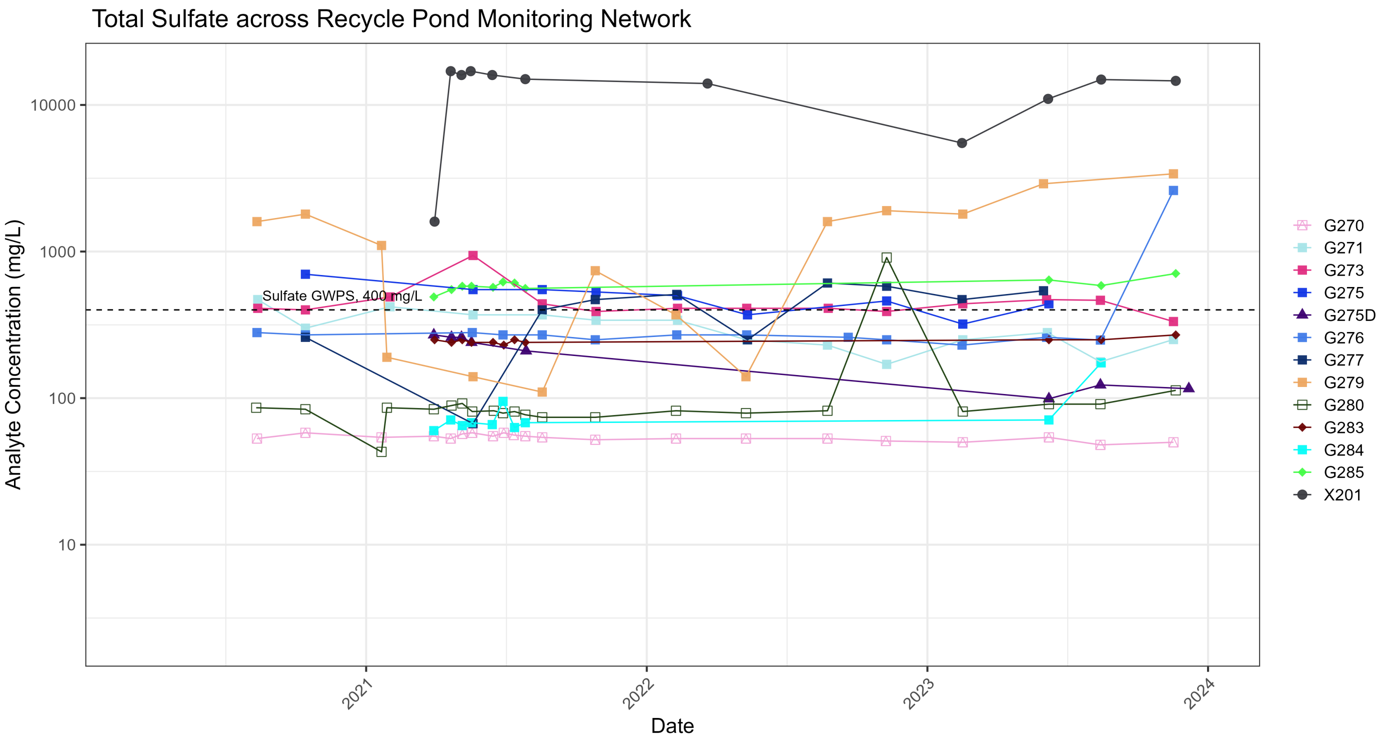

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Notes:
mg/L: milligrams per liter
GWPS: Groundwater Protection Standard
Background wells shown with open symbols.

Total Sulfate Concentration Time Series

Coffeen Power Plant – Gypsum Management Facility
Recycle Pond

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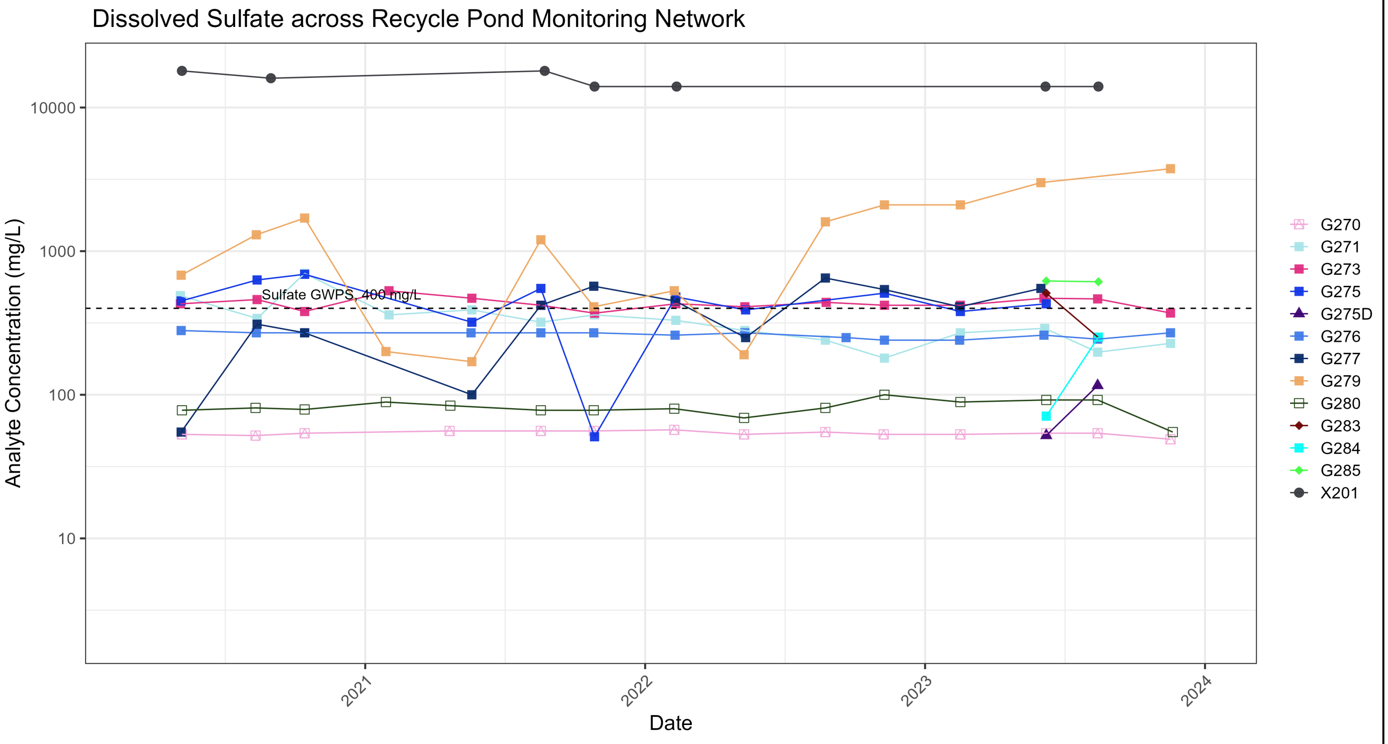
May 2024

Figure
3a



Notes:
mg/L: milligrams per liter
GWPS: Groundwater Protection Standard
Background wells shown with open symbols.

Dissolved Sulfate Concentration Time Series

Coffeen Power Plant – Gypsum Management Facility
Recycle Pond

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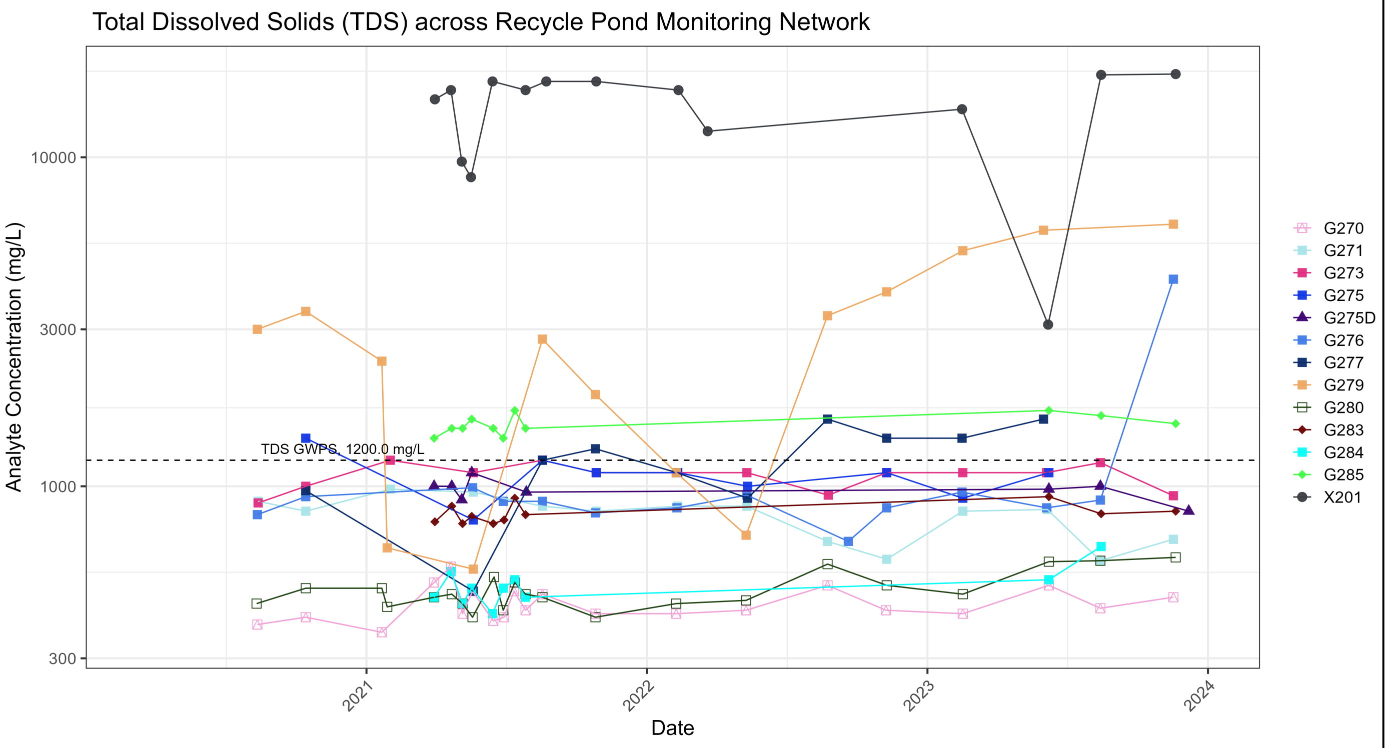
Figure
3b

Columbus, Ohio

May 2024



Notes:
mg/L: milligrams per liter
GWPS: Groundwater Protection Standard
Background wells shown with open symbols.

TDS Concentration Time Series

Coffeen Power Plant – Gypsum Management Facility
Recycle Pond

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Figure
4

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May 2024

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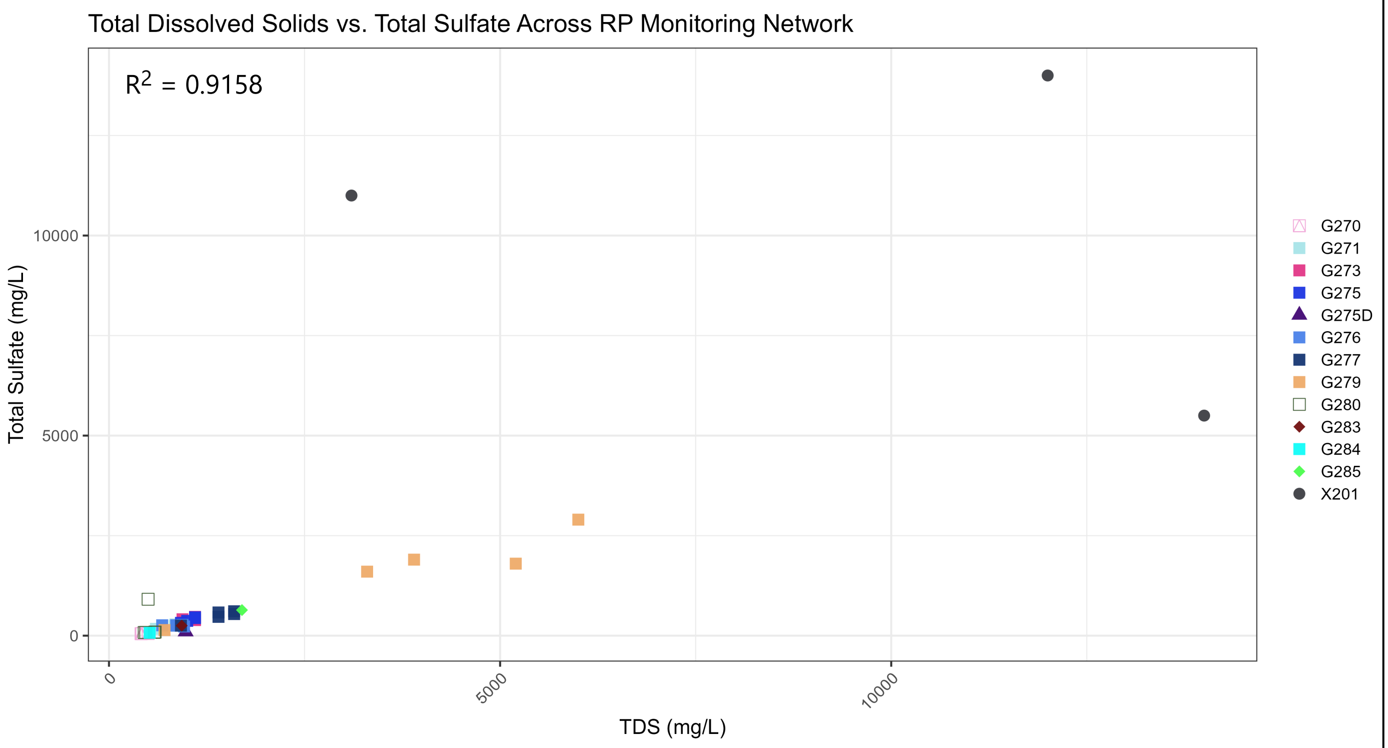

Vistra - Groundwater Compliance - Documents\General\GCSM\Coffeen\Figures

Notes:
mg/L: milligrams per liter
Background wells shown with open symbols.
Regression was run using only groundwater results.

TDS Concentration vs Sulfate Concentration

Coffeen Power Plant – Gypsum Management Facility
Recycle Pond

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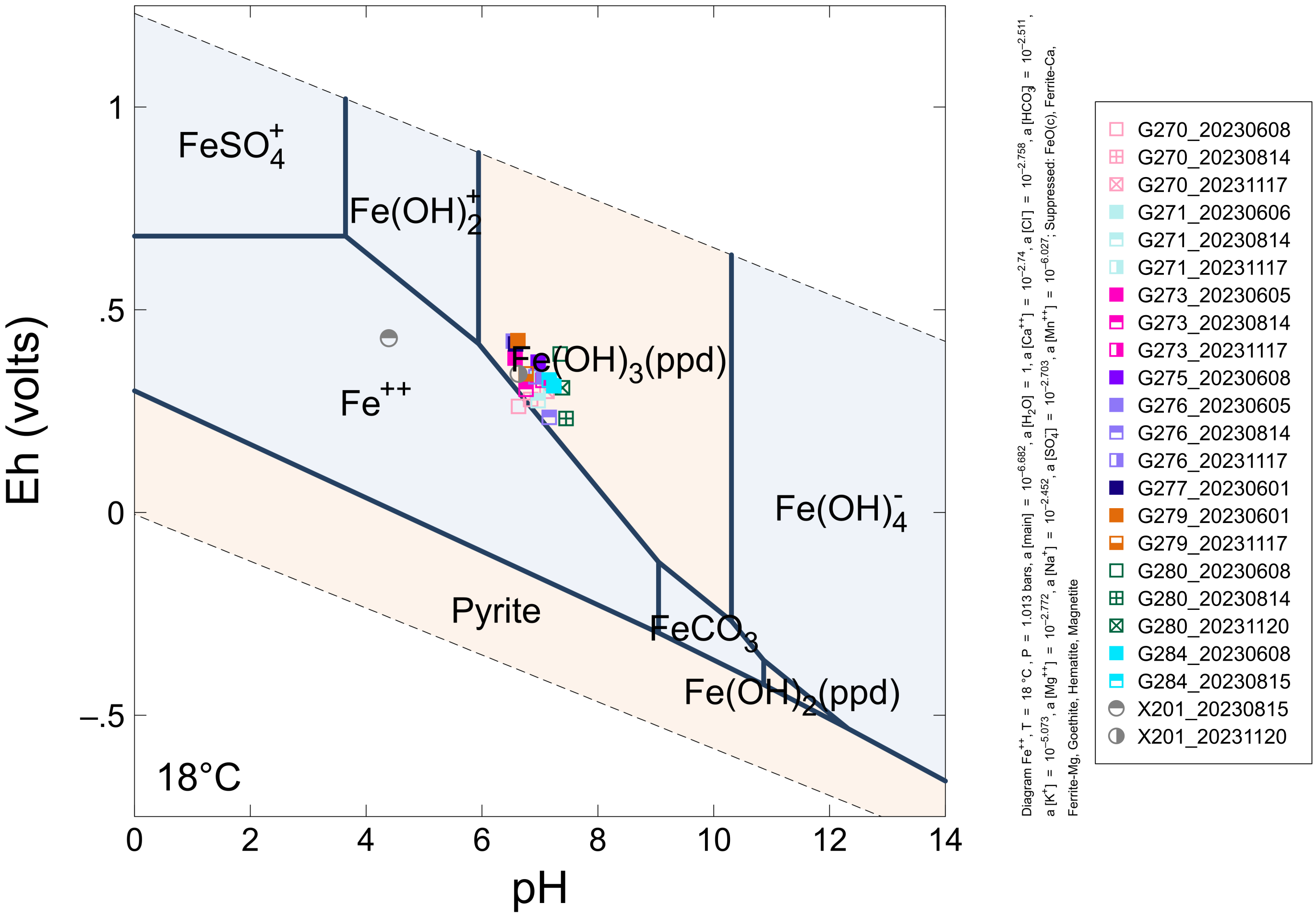
Figure
5



Notes:
1. Diagram was generated using conditions detected at well G273 on 6/5/23
2. Well G273 is screened in the uppermost aquifer.
3. Available Q2, Q3, and Q4 data points are displayed.
4. Crystalline iron oxide, ferrite-Ca, ferrite-Mg, goethite, hematite, and magnetite were suppressed during model generation.

Iron Pourbaix Diagram – G273 Conditions

Coffeen Power Plant – Gypsum Management Facility Recycle Pond

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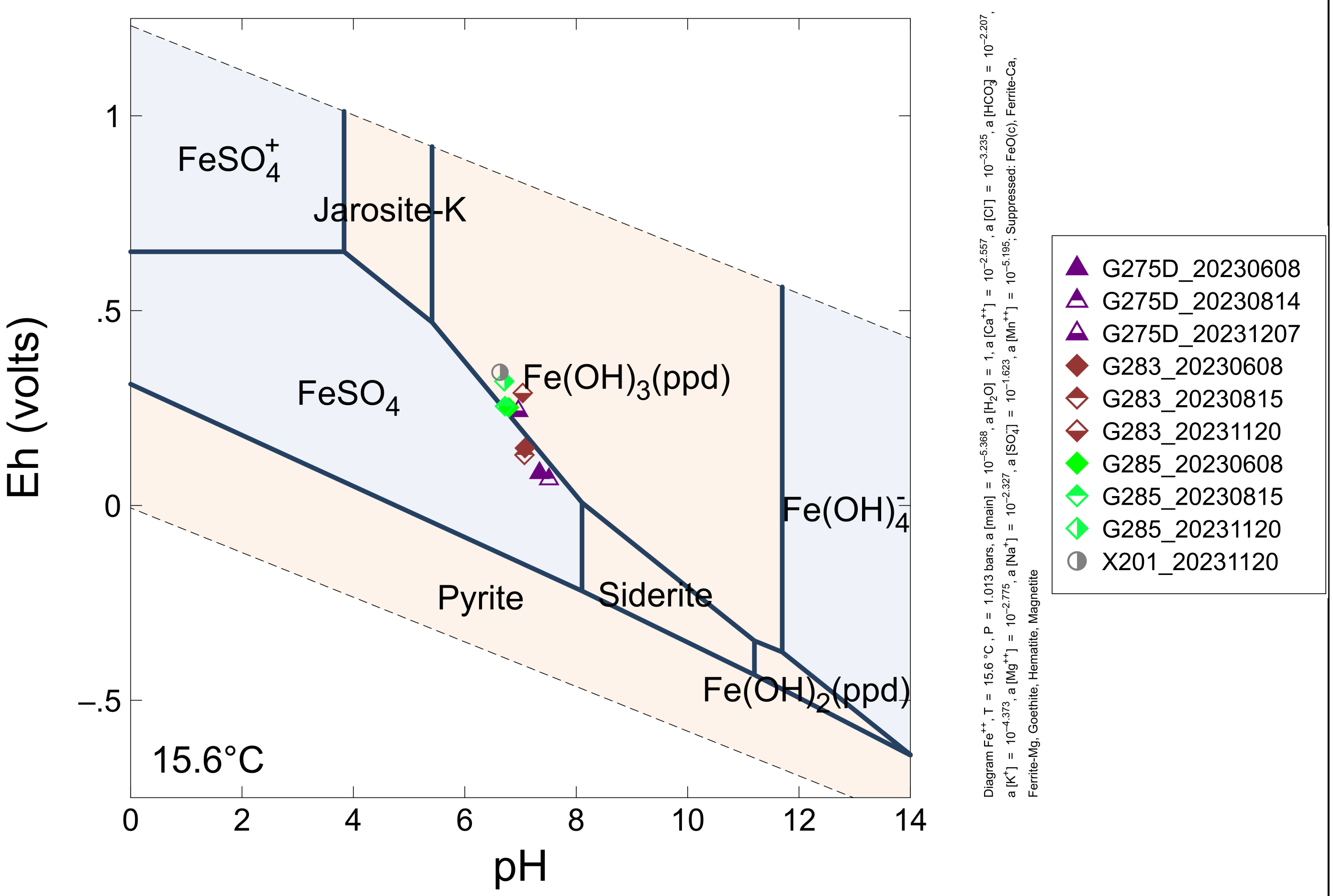
Figure
6a

Columbus, Ohio

May 2024



Notes:

1. Diagram was generated using conditions detected at well G285 on 6/8/23.
2. Well G285 is screened in the lower confining unit.
3. The three most recent available pH and ORP data points for each location are displayed.
4. Crystalline iron oxide, ferrite-Ca, ferrite-Mg, goethite, hematite, and magnetite were suppressed during model generation.

Iron Pourbaix Diagram – G285 Conditions

Coffeen Power Plant – Gypsum Management Facility
Recycle Pond

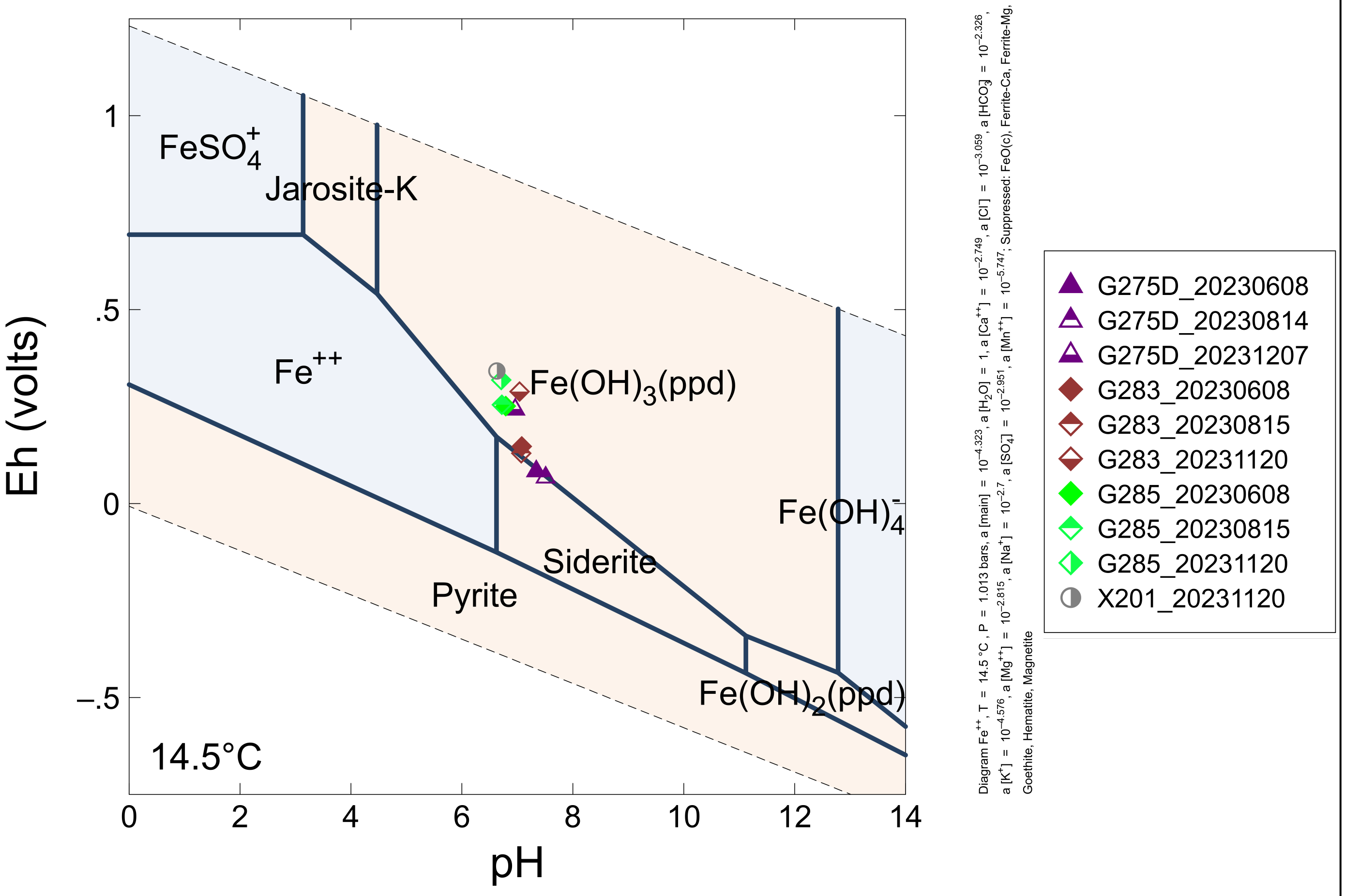
Geosyntec consultants

Figure

6b

Columbus, Ohio

May 2024



Notes:

1. Diagram was generated using conditions detected at well G283 on 6/8/23.
2. The three most recent available pH and ORP data points for each location are displayed.
3. Crystalline iron oxide, ferrite-Ca, ferrite-Mg, goethite, hematite, and magnetite were suppressed during model generation.

Iron Pourbaix Diagram – G283 Conditions

Coffeen Power Plant – Gypsum Management Facility Recycle Pond

Geosyntec consultants

Figure

6c

Columbus, Ohio

May 2024

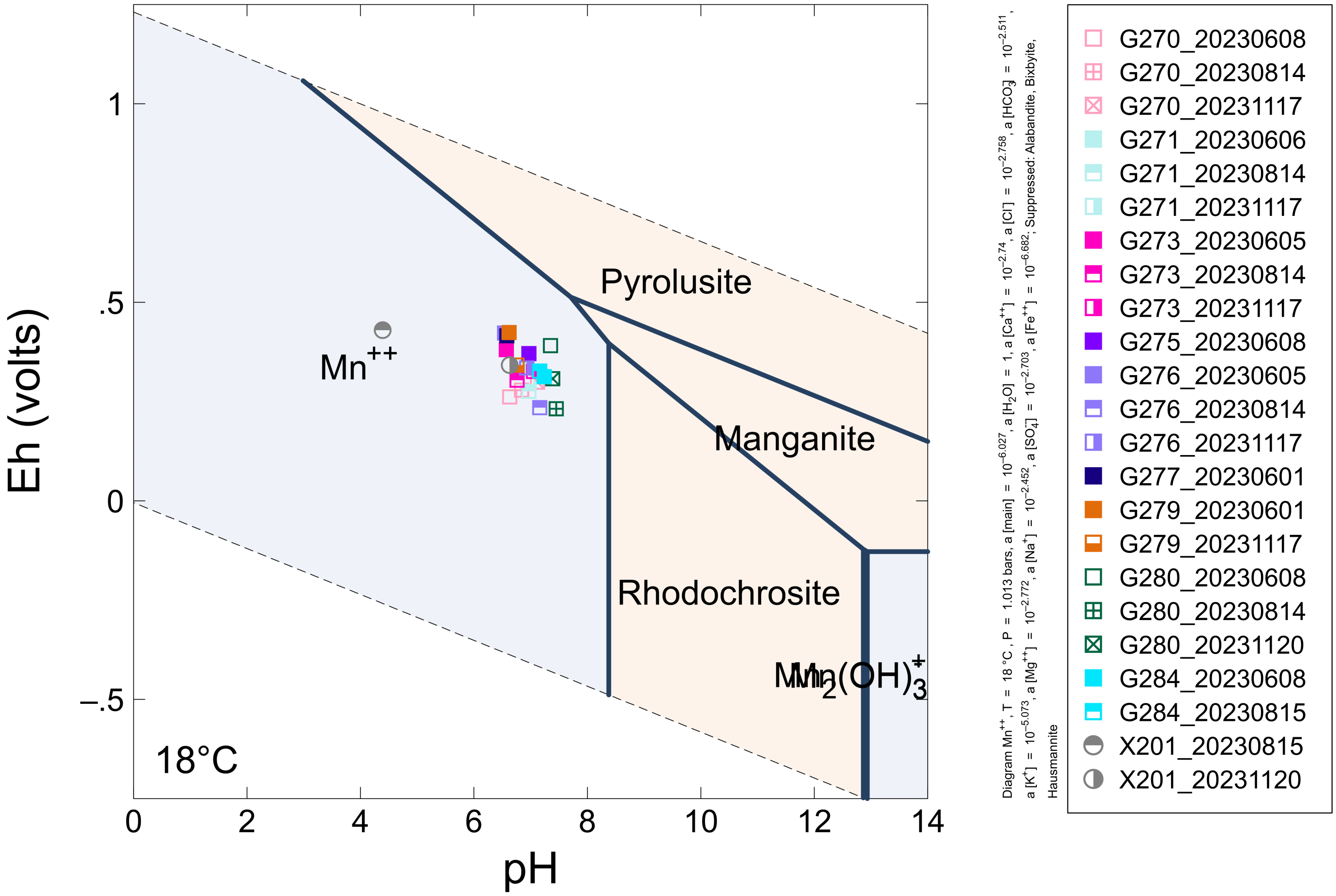


Diagram Mn^{++}, T = 18 °C , P = 1.013 bars, a [main] = $10^{-6.027}$, a [H_2O] = 1, a [Ca^{++}] = $10^{-2.74}$, a [Cl^-] = $10^{-2.758}$, a [HCO_3^-] = $10^{-2.511}$, a [K^+] = $10^{-5.073}$, a [Mg^{++}] = $10^{-2.772}$, a [Na^+] = $10^{-2.452}$, a [SO_4^{--}] = $10^{-2.703}$, a [Fe^{++}] = $10^{-6.682}$; Suppressed: Alabandite, Bixbyite, Hausmannite

Notes:

1. Diagram was generated using conditions detected at well G273 on 6/5/23. Well
2. G273 is screened in the uppermost aquifer.
3. Available Q2, Q3, and Q4 data points are displayed.
4. Alabandite, bixbyite, and hausmannite were suppressed during model generation.

Manganese Pourbaix Diagram – G273 Conditions

Coffeen Power Plant – Gypsum Management Facility
Recycle Pond

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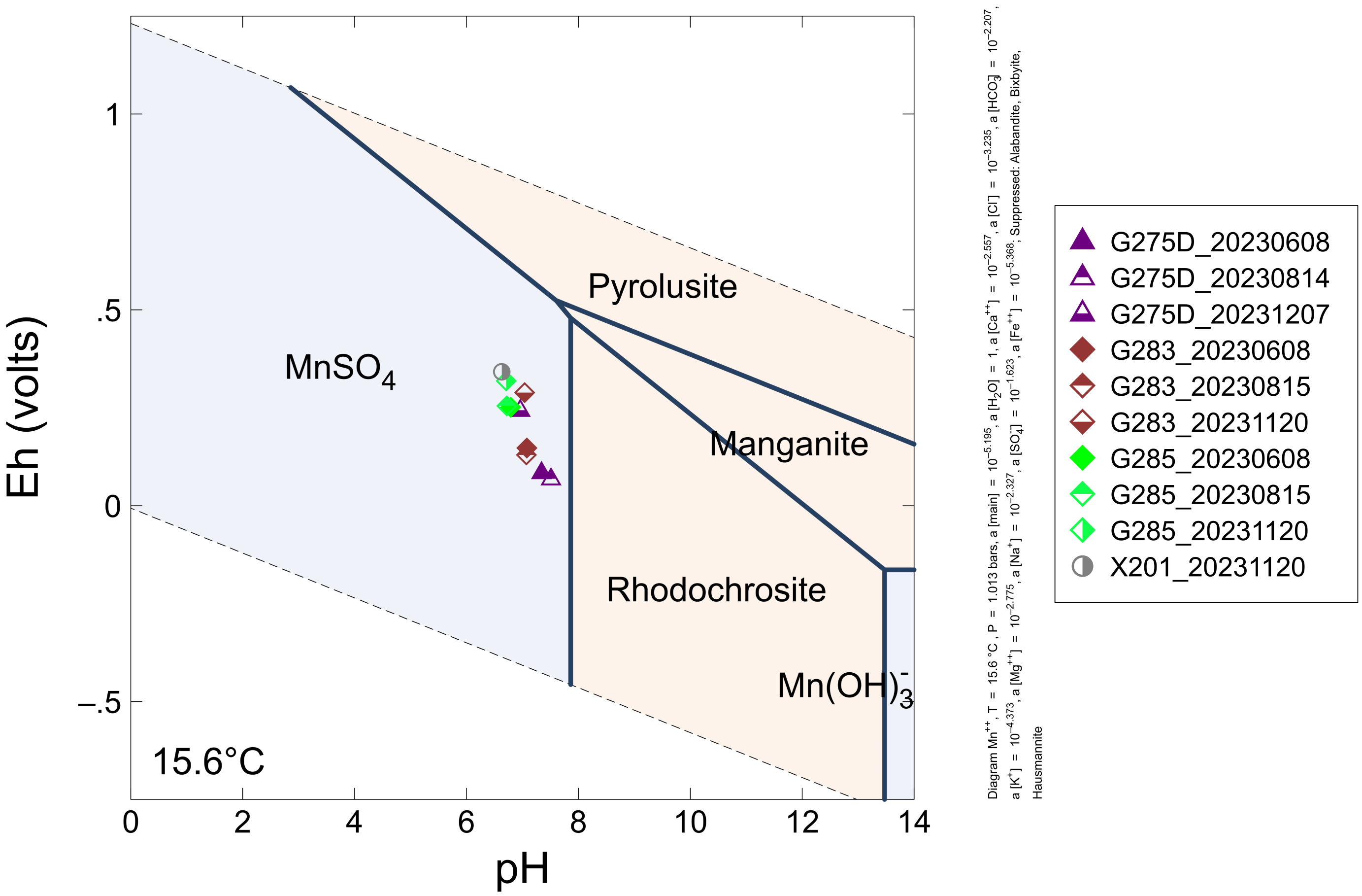
Figure
7a

Columbus, Ohio | May 2024



Notes:

1. Diagram was generated using conditions detected at well G285 on 6/8/23.
2. Well G285 is screened in the lower confining unit.
3. The three most recent available pH and ORP data points for each location are displayed.
4. Alabandite, bixbyite, and hausmannite were suppressed during model generation.

Manganese Pourbaix Diagram – G285 Conditions

Coffeen Power Plant – Gypsum Management Facility
Recycle Pond

Geosyntec
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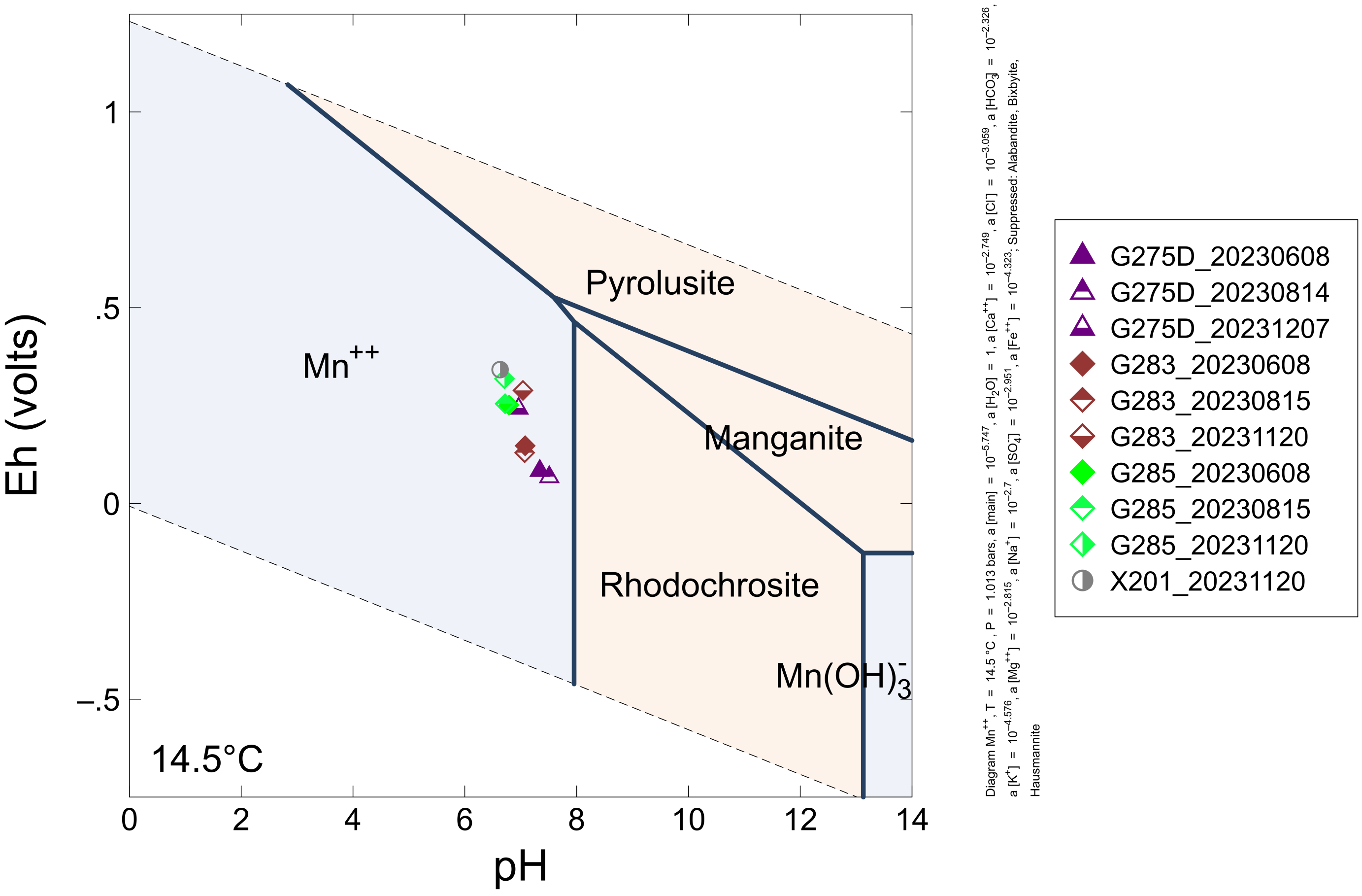
Figure
7b

Columbus, Ohio

May 2024



Notes:

1. Diagram was generated using conditions detected at well G283 on 6/8/23.
2. The three most recent available pH and ORP data points for each location are displayed.
3. Alabandite, bixbyite, and hausmannite were suppressed during model generation.

Manganese Pourbaix Diagram – G283 Conditions

Coffeen Power Plant – Gypsum Management Facility
Recycle Pond

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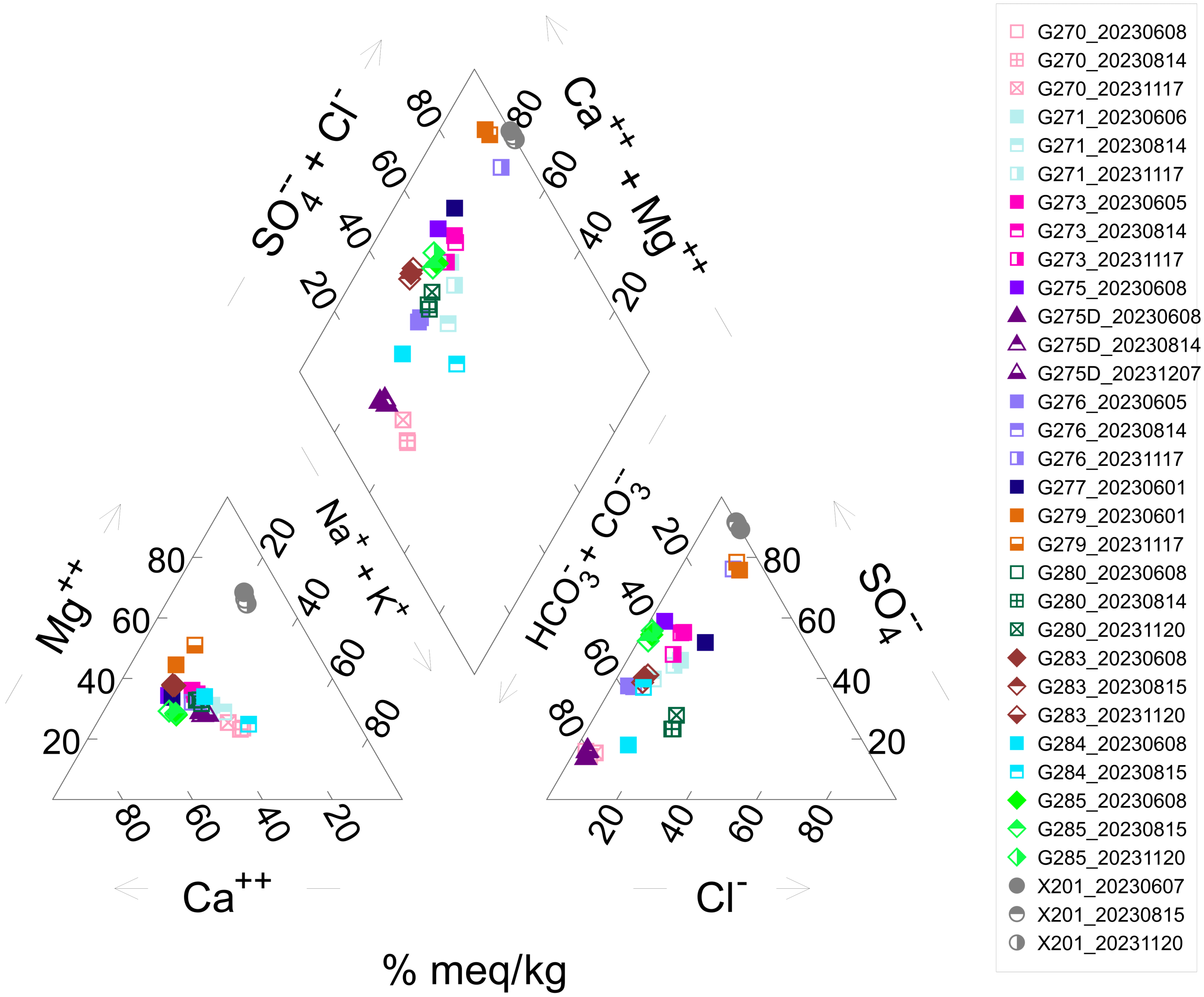
Figure
7c

Columbus, Ohio

May 2024



Notes:

1. Available Q2, Q3, and Q4 data points are displayed.

% meq/kg: percent milliequivalents per kilogram

Piper Diagram

Coffeen Power Plant – Gypsum Management Facility Recycle Pond

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Figure **8**

Columbus, Ohio

May 2024

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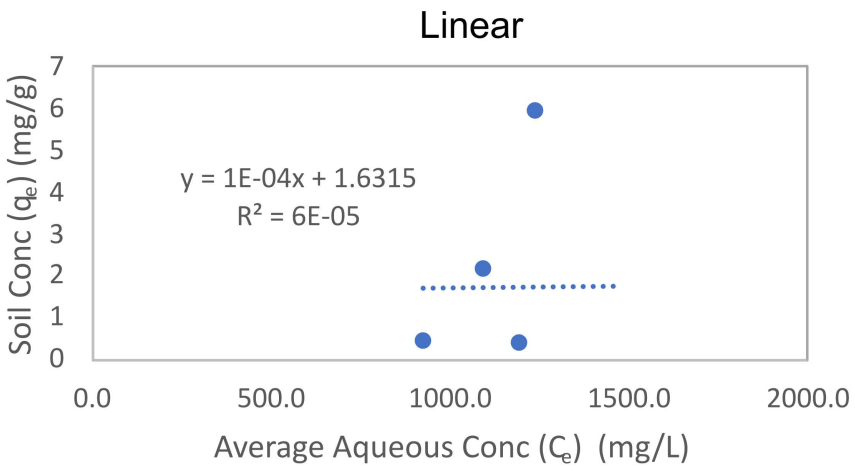
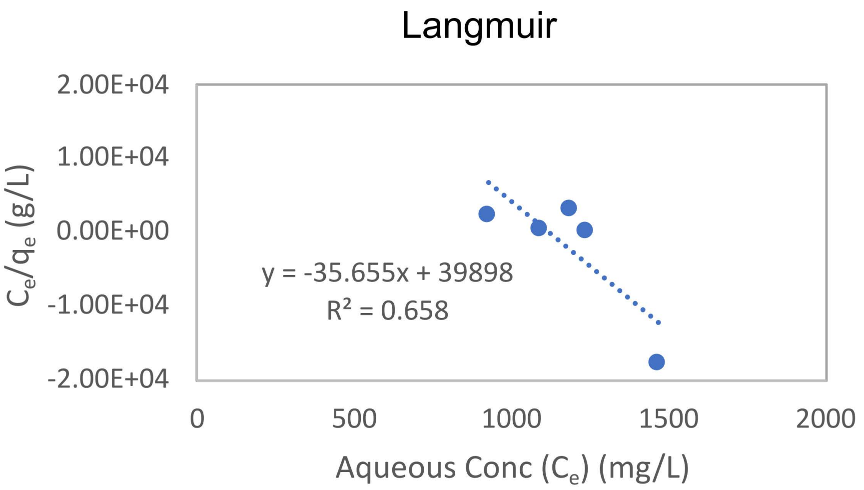


Linear



Langmuir

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

G215 Sulfate Partition Coefficients
Coffeen Power Plant - GMF Recycle Pond

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Columbus, OH
May 2024

Figure
9

TABLES

Table 1. Bulk Characterization of Site Solids
Geochemical Conceptual Site Model
Coffeen Power Plant - GMF Recycle Pond

Field Boring Location	**SB-200**	**SB-215**	**G270**	**G275D**			**G284**		**G288**			**GSP Gypsum 1**	**GSP Gypsum 2**
Sample Depth (ft bgs)	**(14-15, 15-18)**	**(23-24, 24-24.5)**	**(12-16)**	**(4-9.5)**	**(9.5 -10.9)**	**(16-46)**	**(4-8.9)**	**(10-14)**	**(3.3-6)**	**(6-11.2)**	**(11.2-12)**	**0-0**	**0-0**
Sampled Aquifer Unit	**UA**	**UA**	**UA**	**UCU**	**UA**	**LCU**	**UCU**	**UA**	**UCU**	**UCU**	**UA**	**CCR**	**CCR**
Analyte	**Concentration**	**Concentration**	**Concentration**	**Concentration**	**Concentration**	**Concentration**	**Concentration**	**Concentration**	**Concentration**	**Concentration**	**Concentration**	**Concentration**	**Concentration**
Aluminum	21000	22000	9600	--	--	--	--	--	--	--	--	--	--
Antimony	< 0.8	< 0.8	<0.8	< 2.9	< 3	< 3	< 3	< 3	< 2.8	< 3	< 3	<1.5	<3
Arsenic	3.1	7.9	12	4.3	2.1	2.6	< 1	< 1	1.8	1.2	1.8	<0.51	<1
Barium	205	219	210	47	63	53	18	48	47	32	43	6.6	13
Beryllium	0.42	0.45	0.48	< 0.95	< 1	< 1	< 1	< 1	< 0.94	< 1	< 1	<0.51	<1
Bismuth	< 0.09	< 0.09	0.18	--	--	--	--	--	--	--	--	--	--
Boron	--	--	5	< 9.5	< 10	< 10	< 10	< 10	< 9.4	< 10	< 10	13	<10
Cadmium	0.17	0.17	0.12	<0.95	< 1	< 1	< 1	< 1	< 0.94	< 1	< 1	<0.51	<0.51
Calcium	59000	63000	5000	--	--	--	--	--	--	--	--	--	--
Chloride	--	--	--	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	25	260
Chromium	144	124	16	14	11	9.1	7.6	4.7	5.5	5.4	6.3	<2	<4
Cobalt	4	4	10	6.3	4.2	4.3	2	5.9	1.9	2.4	3.3	<1	<2
Copper	10	8	12	--	--	--	--	--	--	--	--	--	--
Fluoride	--	--	--	< 2.5	< 2.5	< 2.5	3	< 2.5	3.2	< 2.5	< 2.5	13	7.6
Iron	16000	16000	22000	16000	9900	8200	4700	4200	3800	9500	8000	--	--
Lead	10	11	12	13	7.2	6.7	3.4	9.7	5	5.8	6.5	0.67	<1
Lithium	8.8	7.1	11	6.7	12	7.7	5	5	4.7	5	5	<2.6	<5
Magnesium	26000	25000	4700	--	--	--	--	--	--	--	--	--	--
Manganese	403	364	1200	110	190	240	16	130	39	62	550	--	--
Mercury	--	--	--	< 0.19	< 0.2	< 0.2	< 0.2	< 0.2	< 0.19	< 0.2	< 0.2	<0.1	--
Molybdenum	1.5	1.1	0.8	< 0.95	< 1	1	< 1	< 1	< 0.94	< 1	< 1	1.2	<1
Nickel	14	10	20	--	--	--	--	--	--	--	--	--	--
Phosphorus	320	320	--	--	--	--	--	--	--	--	--	--	--
Potassium	11000	12000	1400									--	--
Selenium	0.7	< 0.7	<0.7	0.96	< 1	< 1	< 1	< 1	< 0.94	< 1	< 1	<0.51	<1
Silver	< 0.5	< 0.5	< 0.05	--	--	--	--	--	--	--	--	--	--
Sodium	5200	4900	110	--	--	--	--	--	--	--	--	--	--
Strontium	102	90	10	--	--	--	--	--	--	--	--	--	--
Sulfate	--	--	-	50	20	48	23	< 10	17	12	< 10	19000	15000
Tin	< 6	< 6	0.16	--	--	--	--	--	--	--	--	--	--
Titanium	955	374	< 0.5	--	--	--	--	--	--	--	--	--	--
Thallium	0.18	0.2	230	< 0.95	< 1	< 1	< 1	< 1	< 0.94	< 1	< 1	<0.51	<1
Uranium	0.65	0.52	1.46	--	--	--	--	--	--	--	--	--	--
Vanadium	20	19	22	--	--	--	--	--	--	--	--	--	--
Yttrium	8.76	8.52	9.4	--	--	--	--	--	--	--	--	--	--
Zinc	31	30	50	--	--	--	--	--	--	--	--	--	--
Carbon (%)	3.17%	2.84%	--	--	--	--	--	--	--	--	--	--	--
Sulfur	950	60	< 50	24	66	640	26	< 10	15	18	17	--	--
Sulfide (%)	0.08%	< 0.04%	< 0.04	--	--	--	--	--	--	--	--	--	--
TOC (%)	0.531	0.566	0.138	0.0603	1.12	1.09	0.0806	0.102	0.155	0.105	1.11	--	--
Cation Exchange Capacity (meq/100g)	--	--	--	22.95	7.93	9.25	15.6	15	9.6	12.1	14.7	--	--
AVS (mg/kg)	0.17	< 0.19	< 0.19	--	--	--	--	--	--	--	--	--	--

Notes

Sample depth is shown in feet below ground surface (ft bgs)

All results shown in mg/kg (milligrams per kilogram) unless otherwise noted

UA - uppermost aquifer

UCU - upper confining unit

LCU - lower confining unit

TOC - total organic carbon

AVS - acid volatile sulfide

Table 2. XRD Analysis of Site Solids
Geochemical Conceptual Site Model
Coffeen Power Plant - GMF Recycle Pond

Field Boring Location			**SB-200**	**SB-215**	**G270**
Sample Depth (ft bgs)			**(14-15, 15-18)**	**(23-24, 24-24.5)**	**(12-16)**
Sampled Aquifer Unit			**UA**	**UA**	**UA**
Mineral/compound	**Formula**	**Mineral type**	**(wt %)**	**(wt %)**	**(wt %)**
Quartz	SiO_2	Silicate	53.1	58.3	60.6
Microcline	$KAlSi_3O_8$	Feldspar	6.4	6.2	9.8
Albite	$NaAlSi_3O_8$	Feldspar	8.0	9.0	9.1
Calcite	$CaCO_3$	Carbonate	3.3	4.5	-
Dolomite	$CaMg(CO_3)_2$	Carbonate	18.2	12.9	0.6
Ankerite	$CaFe(CO3)_2$	Carbonate	5.2	4.3	0.5
Diopside	$CaMgSi_2O_6$	Pyroxene	3.8	4.1	1.3
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$	Amphibole	-	-	3.3
Pyrite	FeS_2	Sulfide	-	-	0.2
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	Mica	-	-	2.4
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	Mica	-	-	9.0
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$	Phyllosilicate/clay	2.1	0.8	1.4
Stilpnomelane	$K(Fe^{2+},Mg,Fe^{3+})_8(Si,Al)_{12}(O,OH)_{27}\cdot n(H_2O)$	Sheet silicate	-	-	2.0
Clay minerals total			2.1	0.8	3.4

Notes

Dashes indicate mineral was not identified by lab

Sample depth is shown in feet below ground surface (ft bgs)

wt %: percentage by weight

Table 3. Eh-pH Diagram Inputs
Geochemical Conceptual Site Model
Coffeen Power Plant - GMF Recycle Pond

Well ID		**G273**	**G285**	**G283**
Sample Date		**6/5/2023**	**6/8/2023**	**6/8/2023**
Aquifer Unit		**UA**	**LCU**	**LCU**
Input Parameter	**Unit**			
Temperature	°C	18	15.6	14.5
pH	SU	6.57	6.79	7.08
Calcium	mg/L	160	270	140
Chloride	mg/L	73	25	36
Bicarbonate Alkalinity	mg/L	360	640	410
Magnesium	mg/L	83	90	68
Sodium	mg/L	95	130	53
Potassium	mg/L	0.39	2	1.2
Sulfate	mg/L	470	640	250
Total Manganese	mg/L	0.11	0.83	0.19
Total Iron	mg/L	0.14	0.61	5.3

Notes

°C - degrees Celsius
mg/L - milligrams per liter
SU - standard units
UA - uppermost aquifer
LCU - lower confining unit

Table 4 - RP Total and Dissolved Aqueous Iron and Manganese Results
Geochemical Conceptual Site Model
Coffeen Power Plant - GMF Recycle Pond

Well ID	Well Characterization	Sampled Aquifer Unit	Date	Iron, dissolved (mg/L)	Iron, total (mg/L)	Manganese, dissolved (mg/L)	Manganese, total (mg/L)
G270	Background	UA	2023/06/08	0.044	0.68	0.079	0.85
			2023/08/14	0.019	0.147	0.157	0.244
			2023/11/17	< 0.0115	0.119	0.0675	0.197
G271	Compliance	UA	2023/06/06	0.032	0.19	0.022	0.024
			2023/08/14	0.0261	0.273	0.0126	0.0191
			2023/11/17	< 0.0115	0.6	0.0089	0.0297
G273	Compliance	UA	2023/06/05	0.031	0.14	0.096	0.11
			2023/08/14	< 0.0175	0.0679	< 0.0008	0.111
			2023/11/17	0.019	0.31	0.0625	0.117
G275	Compliance	UA	2023/06/08	0.0087	0.59	0.026	0.036
G275D	Compliance	DA	2023/06/08	1	5.7	0.73	0.72
			2023/08/14	2.85	7.39	0.835	0.67
G276	Compliance	UA	2023/06/05	0.01	0.029	0.00023	< 0.00085
			2023/08/14	< 0.0175	0.178	< 0.0008	0.0118
			2023/11/17	< 0.0115	1.02	< 0.0042	0.0193
G277	Compliance	UA	2023/06/01	0.0016	0.18	0.0097	0.012
G279	Compliance	UA	2023/06/01	0.0037	0.074	0.16	0.18
			2023/11/17	< 0.0115	0.209	0.623	0.368
G280	Background	UA	2023/06/08	0.0061	0.97	0.0014	0.043
			2023/08/14	< 0.0175	0.264	0.0032	0.0159
			2023/11/20	< 0.0115	0.31	0.0123	0.0452
G283	Compliance	LCU	2023/06/08	2.9	5.3	0.18	0.19
			2023/08/15	2.32	2.66	0.177	0.177
G284	Compliance	UA	2023/06/08	0.029	0.88	0.0022	0.034
			2023/08/15	0.0115	0.0329	0.0008	0.0017
G285	Compliance	LCU	2023/06/08	0.1	0.61	0.8	0.83
			2023/08/15	0.075	0.326	0.865	0.937
X201	Source	RP Porewater	2023/06/07	0.01	0.068	46	45
			2023/08/15	0.02	-	56.2	53.3

Notes

Dashes indicate sample was not analyzed for analyte

Non-detect results are shown as less than the method detection limit.

mg/L: milligrams per liter

UA: uppermost aquifer

LCU: lower confining unit

DA: deep aquifer

Table 5 - Microcosm Amendment and Target Concentrations
Geochemical Conceptual Site Model
Coffeen Power Plant - GMF Recycle Pond

Groundwater Sample ID	Soil Sample ID	Compound	Amendment	Target Concentration (mg/L)
G215	SB-215 (19-24.5 ft bgs)	Sulfate	3.41 g of Na_2SO_4	1500

Notes:

ft bgs - feet below ground surface
mg/L - milligrams per liter
Na_2SO_4 - sodium sulfate

Table 6 - Batch Attenuation Testing Results,
G215 Geochemical Conceptual Site Model
Coffeen Power Plant - GMF Recycle Pond

Groundwater Sample ID	Geologic Material Sample ID	Treatment	Soil: Water Ratio	Date	Day	Replicate	Dissolved Sulfate	pH	ORP
							mg/L	SU	mV
G215	**--**	Groundwater Only Control	--	25-Jan-22	0	G215-1a (SO_4^{2-})	1,589	6.98	83
						G215-2a (SO_4^{2-})	1,826	6.99	79
						Average Concentration (mg/L)	**1,708**	**6.99**	**81**
				7-Feb-22	7	G215-1 (SO_4^{2-})	1,617	6.8	26
						G215-2 (SO_4^{2-})	1,478	6.81	13
						Average Concentration (mg/L)	**1,548**	**6.81**	**20**
	G215 SB-215 Geologic Material	2:1 Soil:Water Ratio	2:1.5	31-Jan-22	0				
				7-Feb-22	7	SB-215-(19-24.5) :G215 2:1-1 (SO_4^{2-})	1,321	6.92	57
						SB-215-(19-24.5) :G215 2:1-2 (SO_4^{2-})	1,302	6.94	103
						Average Concentration (mg/L)	**1,311**	**6.93**	**80**
		1:1 Soil:Water Ratio	1:1.3	31-Jan-22	0				
				7-Feb-22	7	SB-215-(19-24.5) :G215 1:1-1 (SO_4^{2-})	1,727	6.89	85
						SB-215-(19-24.5) :G215 1:1-2 (SO_4^{2-})	860	6.91	91
						Average Concentration (mg/L)	**1,294**	**6.90**	**88**
		1:5 Soil:Water Ratio	1:5.8	31-Jan-22	0				
				7-Feb-22	7	SB-215-(19-24.5) :G215 1:5-1 (SO_4^{2-})	1,326	6.92	29
						SB-215-(19-24.5) :G215 1:5-2 (SO_4^{2-})	1,516	6.87	15
						Average Concentration (mg/L)	**1,421**	**6.90**	**22**
		1:10 Soil:Water Ratio	1:11.5	31-Jan-22	0				
				7-Feb-22	7	SB-215-(19-24.5) :G215 1:10-1 (SO_4^{2-})	1,570	6.87	23
						SB-215-(19-24.5) :G215 1:10-2 (SO_4^{2-})	1,551	6.85	30
						Average Concentration (mg/L)	**1,560**	**6.86**	**27**
		1:20 Soil:Water Ratio	1:27.2	31-Jan-22	0				
				7-Feb-22	7	SB-215-(19-24.5) :G215 1:20-1 (SO_4^{2-})	1,511	6.83	32
						SB-215-(19-24.5) :G215 1:20-2 (SO_4^{2-})	1,588	6.84	79
						Average Concentration (mg/L)	**1,550**	**6.84**	**56**

Notes:

mg/L - milligrams per liter
mV - millivolts
SU - Standard Units
ORP - oxidation/reduction potential

Table 7 - Partition Coefficient Results, G215 Geochemical Conceptual Site Model Coffeen Power Plant - GMF Recycle Pond

Analyte	Amendment	Isotherm	Variable	Value
Sulfate	**Sodium Sulfate**	**Linear**	**R^2**	0.0
			K_D (L/kg)	0.10
		Langmuir	**R^2**	0.66
			q_m (mg/g)	-0.028
			K_L (L/kg)	-8.94E+02
		Freundlich	**R^2**	--
			1/n	--
			K_F (L/kg)	--

Notes:

The Freundlich isotherm was not calculated for boron or sulfate because the data were not conducive to log transformation

K_D - linear partition coefficient

K_L - Langmuir partition coefficient

K_F - Freundlich partition coefficient

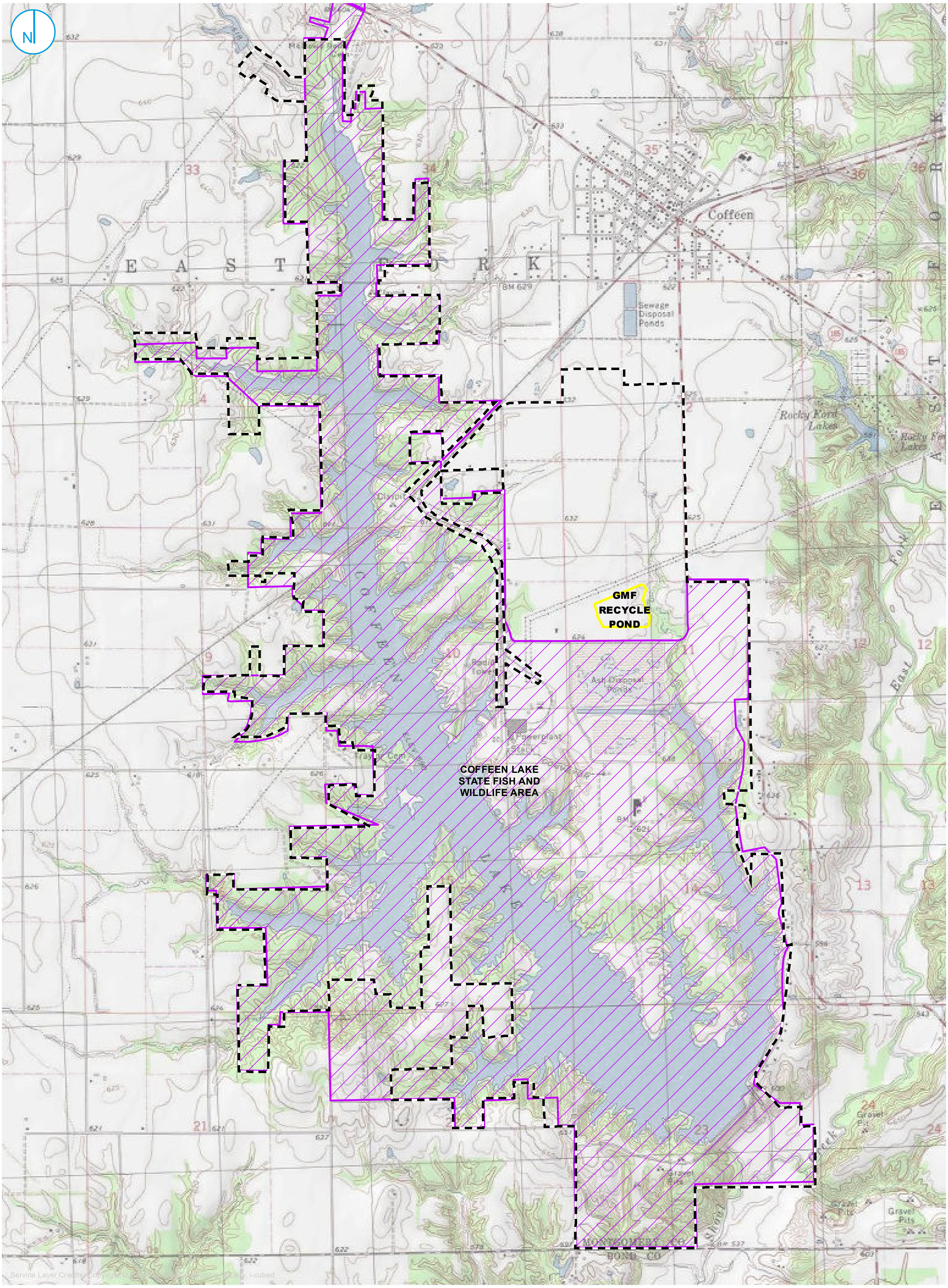
q_m - inverse of the slope of the linearized Langmuir isotherm

n - non-linearity constant of the Freundlich isotherm

L/kg - liters per kilogram

Attachment A

Site Layout Figure



🟨 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 2-1

NATURE AND EXTENT REPORT
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

Attachment B

Proposed Part 845 Groundwater Monitoring Network

▚	COMPLIANCE MONITORING WELL	▭	REGULATED UNIT (SUBJECT UNIT)
▚	BACKGROUND MONITORING WELL	▭	SITE FEATURE
▚	MONITORING WELL	▨	LIMITS OF FINAL COVER
●	CCR SOURCEWATER SAMPLE	⬚	PROPERTY BOUNDARY
◒	STAFF GAGE, RIVER		
■	COAL MINE SHAFT		

0 275 550 Feet

MONITORING WELL LOCATION MAP

FIGURE 2-2

NATURE AND EXTENT REPORT
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

Attachment C

Monitoring Well Construction Information

Table 3-1. Monitoring Well Construction Details

Nature and Extent Report
Coffeen Power Plant
GMF Recycle Pond
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	2008-02-26	--	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
G271	UA	2009-09-10	--	625.34	Top of Disk	622.89	9.96	14.31	612.93	608.58	14.79	606.90	4.4	2	39.0650072	-89.3955874
G272	UA	2009-09-10	--	623.51	Top of Disk	620.72	9.11	13.98	611.61	606.74	14.32	606.40	4.9	2	39.0649894	-89.3947851
G273	UA	2009-09-10	--	622.66	Top of Disk	620.17	9.08	14.56	611.09	605.61	15.1	604.20	5.5	2	39.0649852	-89.3939733
G274	UA	2009-09-16	--	623.79	Top of Disk	621.67	12.9	17.67	608.77	604.00	18.06	603.60	4.8	2	39.064991	-89.393198
G275	UA	2009-09-16	--	618.26	Top of Disk	616.14	8.22	12.62	607.92	603.52	13.19	603.00	4.4	2	39.0651507	-89.3925614
G275D	DA	2021-01-14	620.31	620.23	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	2009-09-16	--	631.51	Top of Disk	629.14	22.41	27.22	606.73	601.92	27.65	601.10	4.8	2	39.0655345	-89.3926172
G277	UA	2009-09-14	--	623.08	Top of Disk	620.79	14.29	18.77	606.50	602.02	19.24	600.80	4.5	2	39.0659274	-89.3925718
G279	UA	2009-09-10	--	632.04	Top of Disk	629.19	22.4	26.79	606.79	602.40	27.3	601.20	4.4	2	39.0671555	-89.3929983
G280	UA	2008-02-26	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
G283	LCU	2021-01-14	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	2021-02-03	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	2021-01-25	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	2021-01-18	613.13	613.30	Top of PVC	609.97	3.37	8.16	606.60	601.81	8.5	600.00	4.8	2	39.067277	-89.391883
G287	UA	2021-01-20	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	2021-01-19	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
MW20S	UA	2007-05-01	622.90	622.86	Top of PVC	620.26	8.41	13.22	611.85	607.04	13.67	604.30	4.8	2	39.0649676	-89.3943221

Notes:

All elevation data are presented relative to the North American Vertical Datum of 1988 (NAVD88), GEOID 12A
-- = not measured/recorded
bgs = below ground surface
DA = Deep Aquifer
ft = foot or feet
HSU = Hydrostratigraphic Unit
LCU = Lower Confining Unit
PVC = polyvinyl chloride
UA = Uppermost Aquifer

Attachment D
Boring Logs for Solids Collection Locations

Legend

▭ Pond Boundary

⌖ Well Locations

Notes:
1. GMF Recycle Pond boundaries are approximate.
2. Well locations provided by Coffeen Power Plant.
GMF: Gypsum Management Facility

Relevant Well Locations

134 Cips Lane
Coffeen, Illinois

Geosyntec consultants

Columbus, Ohio | May 2024

Figure

D-1

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FIELD BORING LOG

HANSON

CLIENT: AEG Coffeen Power Station	**CONTRACTOR:** Testing Service Corp.		
Site: CCB Management Facility	**Rig mfg/model:** CME-650 Track Drill	**BOREHOLE ID:** G200	
Location: Coffeen, Illinois	**Drilling Method:** 3¼" HSA w/SS & CME samplers	**Well ID:** G200	
Project: 05S3004A		**Surface Elev:** 624.20 ft. MSL	
DATES: Start: 2/25/2008	**FIELD STAFF: Driller:** B. Williamson	**Completion:** 18.00 ft. BGS	
Finish: 2/25/2008	**Helper:** R. Keedy	**Station:** 877,930.59N	
WEATHER: Overcast, cold	**Eng/Geo:** .	2,515,649.96E	

TOPOGRAPHIC MAP INFORMATION:

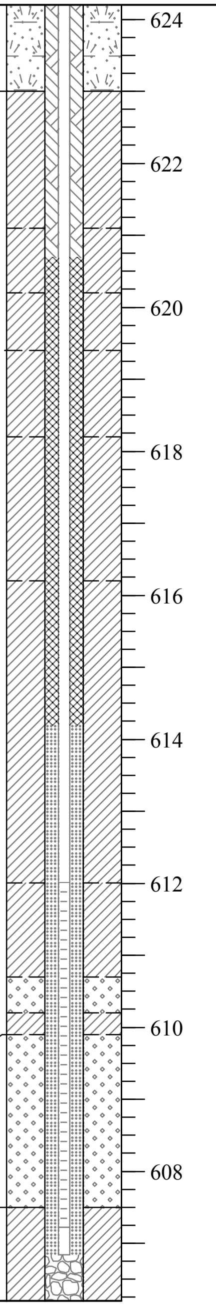
Quadrangle: Coffeen, IL
Township: East Fork
Section 2, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:

▼ = 13.50 - While drilling
▼ = 2.75 - 3/12/08
▽ =

SAMPLE			TESTING			
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type
	24/24 *100%*	SS	*3-2* *3-3* N=5			
1A				31		1.36 B
2A				26		1.94 BSh
	19/24 *79%*	SS	*3-3* *6-6* N=9			
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
	22/24 *92%*	SS	*1-3* *2-3* N=5			
6A				22		1.01
	24/24 *100%*	SS	*3-3* *5-6* N=8			
7A				15		0.50 B
7B				18		
8A				24		0.27 B
	19/24 *79%*	SS	*0-3* *5-8* N=8			
8B				17		
9A				13		
	24/24 *100%*	SS	*8-15* *30-50* N=45			
9B				8		

Depth ft. BGS	Lithologic Description
	Very dark grayish brown (10YR3/2), moist, firm, friable, clayey SILT
2	Dark gray (10YR4/1) with 5% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY
▼	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
	Very dark gray (10YR3/1), moist, firm, silty CLAY, slight trace sand
6	Dark gray (10YR4/1) with 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, trace coarse sand
8	Dark gray (10YR4/1) with 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, sand and slight trace gravel
12	Yellowish brown (10YR5/8), moist, soft, sandy CLAY
▼	Gray (10YR5/1), wet, soft, fine- to coarse-grained SAND
14	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	Gray (10YR5/1), moist, hard, silty CLAY, trace sand and gravel
18	**End of Boring = 18.0 ft. BGS**



Remarks

NOTE(S):

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: .

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			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
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 | Borehole Detail | Elevation ft. MSL | Remarks

Depth: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20
Elevation: 630, 628, 626, 624, 622, 620, 618, 616, 614, 612

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.

FILL - Dark grayish brown (10YR4/2), moist, firm, silty CLAY with trace sand and gravel.

FILL - Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand.

Very dark gray (10YR3/1), moist, firm, silty CLAY with trace sand, trace roots.

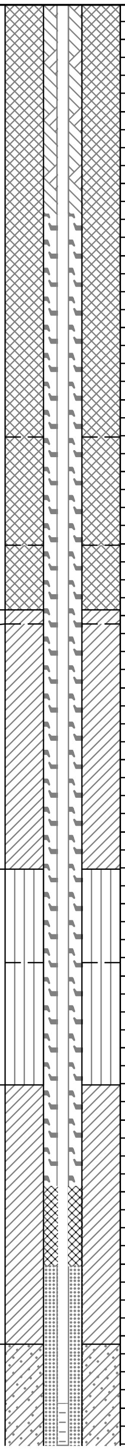
Dark gray (10YR4/1) with 30% dark yellowish brown (10YR4/6) moist, firm, silty CLAY with trace sand.

Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with trace sand.

Dark gray (10YR4/1), moist, firm, clayey SILT with trace sand.

Dark gray (10YR4/1) with 30% Dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and gravel.

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

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: .

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

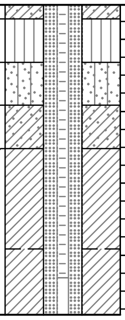
TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▼ = Dry - While drilling
▼ = Dry - Upon completion
▽ = 22.52 - 10/14/10

SAMPLE			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
11A	20/24 *83%*	SS	*2-4* *4-4* N=8	17		
12A	24/24 *100%*	SS	*7-11* *17-19* N=28	11		
12B	0/4 *0%*	BD		9		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	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.		
▽	Grayish brown (10YR5/2), slightly moist, very firm, very silty CLAY with sand and gravel.	608	
24	Dark gray (10YR4/1), slightly moist, hard, very silty CLAY with sand and gravel.		

Borehole Detail



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: 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
▽ =

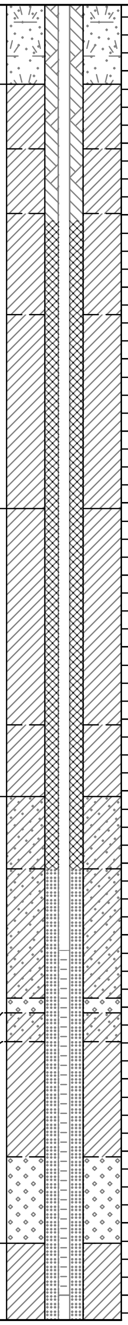
SAMPLE Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Qp* (tsf) Failure Type
	20/24 *83%*	SS	*2-2 2-4* N=4			
1A				24		
2A	19/24 *79%*	SS	*3-4 5-9* N=9	22		2.33 B
2B				20		5.04 Sh
3A	20/24 *83%*	SS	*14-5 7-8* N=12	17		2.52 Sh
4A	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: 2, 4, 6, 8, 10, 12, 14, 16, 18

Lithologic Description:

- Dark grayish brown (10YR4/2), moist, firm, clayey SILT
- Dark grayish brown (10YR4/2), moist, firm, silty CLAY
- Dark grayish brown (10YR4/2) with 5% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, slight trace sand
- Gray (10YR5/1) with 70% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, slight trace sand and gravel
- Dark gray (10YR4/1) with 5% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, trace sand, slight trace gravel
- Gray (10YR5/1) with 10% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, trace sand, slight trace gravel
- Gray (10YR5/1) with 60% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY, trace sand, slight trace gravel
- Gray (10YR5/1), moist, soft, sandy CLAY
- Gray (10YR5/1), moist, soft, sandy CLAY, trace gravel
- Gray (10YR5/1), moist, soft, fine- to coarse-grained SAND, trace gravel
- Dark yellowish brown (10YR4/4), moist, soft, sandy CLAY
- 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
- Gray (10YR5/1), moist, hard, silty CLAY, trace sand and gravel

Borehole Detail



Elevation ft. MSL: 622, 620, 618, 616, 614, 612, 610, 608, 606

Remarks

End of Boring = 18.27 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.	**CONTRACTOR:** Roberts		
Site: Coffeen Part 845 Groundwater	**Rig mfg/model:** CME-75 Track Rig	**BOREHOLE ID:** G275D	
Location: Coffeen, Illinois	**Drilling Method:** 4.25" HSA w/SS sampler	**Well ID:** G275	
Project: 20E0111A		**Surface Elev:** 617.52 ft. MSL	
DATES: Start: 1/28/2021	**FIELD STAFF: Driller:** Matt	**Completion:** 99.70 ft. BGS	
Finish: 2/3/2021	**Helper:** Corey	**Station:** 874,285.30N	
WEATHER: Clear, cold (20s)	**Eng/Geo:** C. Colin Winter	2,516,366.50E	

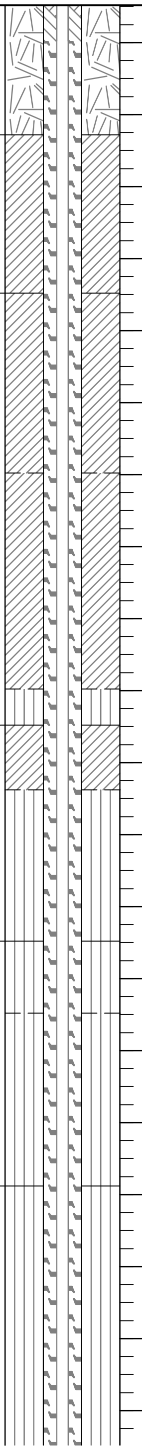
TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▽ = 10.90 - 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
1A	21/24 *88%*	SS	*3-4 5-10* N=9				
2A	22/24 *92%*	SS	*3-4 6-9* N=10				2
3A	19/24 *79%*	SS	*2-4 6-8* N=10				4
4A	23/24 *96%*	SS	*2-5 5-6* N=10				6
5A	24/24 *100%*	SS	*2-3 5-6* N=8				8
5B							
6A	24/24 *100%*	SS	*0-1 2-2* N=3				10
6B							
7A	18/24 *75%*	SH					12
8A	14/14 *100%*	SS	*26-43 50/2"*				14
9A	24/24 *100%*	SS	*5-12 18-22* N=30				16
10A	24/24 *100%*	SS	*4-11 13-20* N=24				18
							20

Lithologic Description
Dark yellowish brown (10YR4/4), moist, stiff, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel, trace roots. [FILL]
Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, moist, very stiff, lean CLAY, with some silt, few very fine- to fine-grained sand, trace small gravel.
Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, very stiff, lean CLAY, with some silt, few very fine- to fine-grained sand, trace small gravel.
Gray (10YR5/1) with 20% yellowish brown (10YR5/6) and 5% yellowish red (5YR4/6) mottles, moist, very stiff, lean CLAY, with some silt, few very fine- to fine-grained sand, trace small gravel.
Dark yellowish brown (10YR3/6), moist, stiff, SILT, with some very fine- to medium-grained sand, few clay and small gravel.
Gray (10YR6/1) with 10% dark yellowish brown (10YR3/6) mottles, moist, stiff, lean CLAY, with some silt, little very fine- to fine-grained sand, few small gravel.
▽ Dark yellowish brown (10YR3/6), wet, loose, SILT, with some very fine- to fine-grained sand, few clay and small gravel.
Gray (10YR6/1) with 20% yellowish brown (10YR5/6) mottles, moist, hard, SILT, with some very fine- to fine-grained sand, few clay and small gravel.
Grayish brown (10YR5/2) with 10% yellowish brown (10YR5/6) mottles, moist, hard, SILT, with some very fine- to fine-grained sand, few clay and small gravel.
Brown (10YR5/3) with 10% yellowish brown (10YR5/6) mottles, moist, hard, SILT, with some clay and very fine- to fine-grained sand, few small gravel.

Borehole Detail



Elevation ft. MSL

Remarks

NOTE(S): G275 installed in adjacent blind drill borehole.

FIELD BORING LOG

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/28/2021
Finish: 2/3/2021
WEATHER: Clear, cold (20s)

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

HANSON

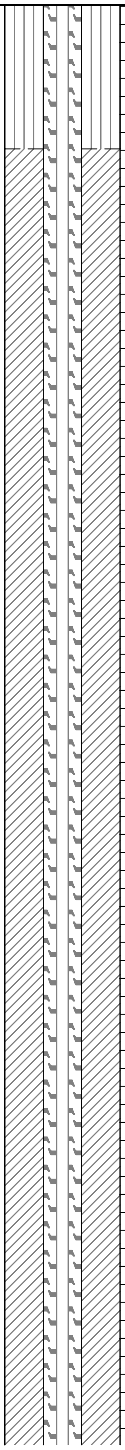
BOREHOLE ID: G275D
Well ID: G275
Surface Elev: 617.52 ft. MSL
Completion: 99.70 ft. BGS
Station: 874,285.30N
2,516,366.50E

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

WATER LEVEL INFORMATION:
∇ = 10.90 - 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
11A	24/24 *100%*	SS	*3-9 13-22* N=22			
12A	24/24 *100%*	SS	*7-14 20-24* N=34			
13A	24/24 *100%*	SS	*6-11 15-21* N=26			
14A	18/24 *75%*	SS	*4-8 12-10* N=20			
15A	24/24 *100%*	SS	*5-7 13-17* N=20			
16A	23/24 *96%*	SS	*4-7 12-16* N=19			
17A	2/24 *8%*	SS	*4-10 13-17* N=23			
18A	21/24 *88%*	SH				
19A	24/24 *100%*	SS	*3-6 10-14* N=16			
20A	4/24 *17%*	SS	*3-8 11-17* N=19			

Depth ft. BGS	Lithologic Description	Remarks
to 22	Brown (10YR5/3) with 10% yellowish brown (10YR5/6) mottles, moist, hard, SILT, with some clay and very fine- to fine-grained sand, few small gravel. *[Continued from previous page]*	
22	Dark gray (10YR4/1) with frequent dark yellowish brown (10YR3/6) oxidation along fractures, moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel.	Vertical fractures with oxidation from 22 to 24 ft, no oxidation below 24 ft. Occasional thin SILT and SAND lenses from 25.3 to 25.8 ft. Trace wood fragments below 28 ft.



Depth ft. BGS: 22, 24, 26, 28, 30, 32, 34, 36, 38, 40

NOTE(S): G275 installed in adjacent blind drill borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/28/2021
Finish: 2/3/2021
WEATHER: Clear, cold (20s)

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

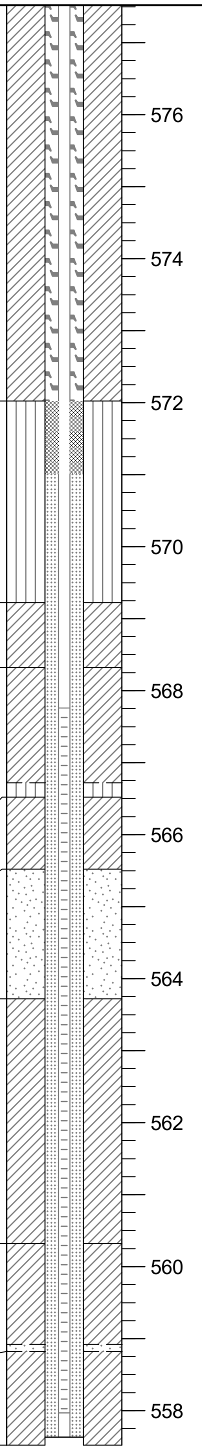
BOREHOLE ID: G275D
Well ID: G275
Surface Elev: 617.52 ft. MSL
Completion: 99.70 ft. BGS
Station: 874,285.30N
2,516,366.50E

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

WATER LEVEL INFORMATION:
▽ = 10.90 - 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
21A	24/24 *100%*	SS	*4-8* *11-15* N=19			
22A	24/24 *100%*	SS	*7-8* *11-17* N=19			
23A	24/24 *100%*	SS	*5-8* *13-40* N=21			
24A	23/24 *96%*	SS	*22-45* *35-23* N=80			
25A	24/24 *100%*	SS	*7-9* *14-21* N=23			
26A	24/24 *100%*	SS	*3-8* *15-15* N=23			
27A	17/24 *71%*	SS	*12-27* *13-15* N=40			
28A	24/24 *100%*	SS	*4-9* *11-13* N=20			
29A	24/24 *100%*	SS	*5-9* *13-12* N=22			
30A	24/24 *100%*	SS	*3-4* *7-14* N=11			

Depth ft. BGS	Lithologic Description	Remarks
42 44	Dark gray (10YR4/1) with frequent dark yellowish brown (10YR3/6) oxidation along fractures, moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel. *[Continued from previous page]*	0.5" lignite fragment seam at 42.8 ft.
46 48	Dark gray (10YR4/1), moist, hard, SILT, with some to little clay and very fine- to fine-grained sand, few small to medium gravel.	
	Dark gray (10YR4/1), moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel.	
50	Very dark gray (10YR3/1), moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel, trace wood fragments.	
	Dark gray (10YR3/1), moist, SILT, with some very fine-grained sand seams.	Methane deposit encountered at approx. 51 ft.
52	Dark gray (10YR4/1) with 15% dark grayish brown (10YR4/2) mottles, moist, stiff, lean CLAY, with some silt, trace very fine-grained sand, small gravel and wood fragments.	
	Gray (10YR5/1), moist, dense, very fine- to medium-grained SAND, with some silt, trace small gravel.	
54 56	Very dark grayish brown (10YR3/2), moist, hard, lean CLAY, with some silt, trace very fine-grained sand and organics.	
58	Very dark grayish brown (10YR3/2) with 10% dark yellowish brown (10YR4/6) mottles, moist, hard, lean CLAY, with some silt, trace very fine-grained sand and organics.	
	Very dark grayish brown (10YR3/2), wet, SAND, with some silt.	
60	Gray (GLEY15/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel.	



NOTE(S): G275 installed in adjacent blind drill borehole.

FIELD BORING LOG

HANSON

CLIENT:	Illinois Power Generating Co.	**CONTRACTOR:**	Roberts
Site:	Coffeen Part 845 Groundwater	**Rig mfg/model:**	CME-75 Track Rig
Location:	Coffeen, Illinois	**Drilling Method:**	4.25" HSA w/SS sampler
Project:	20E0111A		
DATES: Start:	1/28/2021	**FIELD STAFF: Driller:**	Matt
Finish:	2/3/2021	**Helper:**	Corey
WEATHER:	Clear, cold (20s)	**Eng/Geo:**	C. Colin Winter

BOREHOLE ID: G275D
Well ID: G275
Surface Elev: 617.52 ft. MSL
Completion: 99.70 ft. BGS
Station: 874,285.30N
2,516,366.50E

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

WATER LEVEL INFORMATION:
▽ = 10.90 - 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	Elevation ft. MSL	Remarks
31A	24/24 *100%*	SS	*0-4* *5-7* N=9						
32A	24/24 *100%*	SS	*4-6* *8-11* N=14						
33A	24/24 *100%*	SH					64		
34A	24/24 *100%*	SS	*5-10* *22-41* N=32						
35A	24/24 *100%*	SS	*12-24* *33-45* N=57						
36A	23/24 *96%*	SS	*6-14* *25-30* N=39						
37A	24/24 *100%*	SS	*8-18* *24-32* N=42						
38A	24/24 *100%*	SS	*7-16* *25-29* N=41						
39A	24/24 *100%*	SS	*7-15* *20-21* N=35						
40A	19/24 *79%*	SS	*3-5* *7-10* N=12						

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
60–62	Gray (GLEY15/) with 30% dark yellowish brown (10YR4/6) mottles, moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel.	556	
62–67.5	Greenish gray (GLEY15/1) with 15% very dark gray (10YR3/1) mottles, moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel.	554, 552, 550	
67.5–73	Yellowish brown (10YR5/4) with occasional thin greenish gray (GLEY15/1) seams, moist, hard, lean CLAY, with some silt, few small gravel, trace very fine-grained sand.	548, 546	Trace medium gravel at 70 ft.
73–79.3	Yellowish brown (10YR5/4) with 15% gray (10YR6/1) mottles, moist, hard, lean CLAY, with some silt, few small gravel, trace very fine-grained sand.	544, 542, 540	
79.3–80	Greenish gray (GLEY15/1) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace very	538	

Depth scale: 62, 64, 66, 68, 70, 72, 74, 76, 78, 80

NOTE(S): G275 installed in adjacent blind drill borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/28/2021
Finish: 2/3/2021
WEATHER: Clear, cold (20s)

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: G275D
Well ID: G275
Surface Elev: 617.52 ft. MSL
Completion: 99.70 ft. BGS
Station: 874,285.30N
2,516,366.50E

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

WATER LEVEL INFORMATION:
▽ = 10.90 - During Drilling
▼ =
▼ =

Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) *Qp (tsf)* Failure Type
41A	22/24 *92%*	SS	*1-5* *7-11* N=12			
42A	24/24 *100%*	SS	*4-14* *19-20* N=33			
43A	8/24 *33%*	SS	*6-20* *22-23* N=42			
44A	24/24 *100%*	SS	*7-8* *16-17* N=24			
45A	24/24 *100%*	SS	*5-13* *16-21* N=29			
46A	24/24 *100%*	SS	*4-8* *15-9* N=23			
47A						
47B	24/24 *100%*	SS	*5-6* *8-10* N=14			
48A	24/24 *100%*	SS	*2-4* *7-8* N=11			
49A	24/24 *100%*	SS	*2-6* *7-11* N=13			
50A	18/20 *90%*	SS	*3-15* *28-50/2"* N=43			

Lithologic Description

fine-grained sand.
Greenish gray (GLEY15/1) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace very fine-grained sand.
[Continued from previous page]

Very dark gray (10YR3/1), moist, stiff, lean CLAY, with some silt, trace very fine-grained sand.

Greenish gray (GLEY15/1) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace very fine-grained sand.

Greenish gray (GLEY15/1) with 20% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace very fine-grained sand and small gravel.

Greenish gray (GLEY15/1) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace very fine-grained sand and small gravel.

Brown (10YR4/3) with 5% dark yellowish brown (10YR4/6) mottles, moist, hard, lean CLAY, with some silt, trace very fine-grained sand and small gravel.

Brown (10YR4/3) with 5% dark yellowish brown (10YR4/6) mottles, moist, hard, lean CLAY, with some silt, few small gravel, trace very fine-grained sand, medium gravel and black (10YR2/1) organics.

Brown (10YR4/3) with 5% dark yellowish brown (10YR4/6) mottles, moist, hard, lean CLAY, with some silt, few small gravel and wood fragments, trace very fine-grained sand, medium gravel and black (10YR2/1) organics.

Very dark grayish brown (10YR3/2), moist, stiff, fat CLAY, with some silt.

Dark grayish brown (10YR4/2), moist, stiff, fat CLAY, with some silt.

Greenish gray (GLEY15/1) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, little to trace very fine-grained sand, trace small gravel.

Greenish gray (GLEY15/1) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt and very

NOTE(S): G275 installed in adjacent blind drill borehole.

FIELD BORING LOG

HANSON

CLIENT:	Illinois Power Generating Co.	**CONTRACTOR:**	Roberts		
Site:	Coffeen Part 845 Groundwater	**Rig mfg/model:**	CME-75 Track Rig	**BOREHOLE ID:**	G275D
Location:	Coffeen, Illinois	**Drilling Method:**	4.25" HSA w/SS sampler	**Well ID:**	G275
Project:	20E0111A			**Surface Elev:**	617.52 ft. MSL
DATES: Start:	1/28/2021	**FIELD STAFF: Driller:**	Matt	**Completion:**	99.70 ft. BGS
Finish:	2/3/2021	**Helper:**	Corey	**Station:**	874,285.30N
WEATHER:	Clear, cold (20s)	**Eng/Geo:**	C. Colin Winter		2,516,366.50E

TOPOGRAPHIC MAP INFORMATION:

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

WATER LEVEL INFORMATION:

∇ = 10.90 - During Drilling
∇ =
$\blacktriangledown$ =

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
								fine-grained sand, trace small gravel.			
								End of boring = 99.7 feet			

NOTE(S): G275 installed in adjacent blind drill borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/20/2021
Finish: 1/20/2021
WEATHER: Clear, 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: G284
Well ID: G284
Surface Elev: 615.33 ft. MSL
Completion: 14.00 ft. BGS
Station: 874,423.60N
2,516,922.90E

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

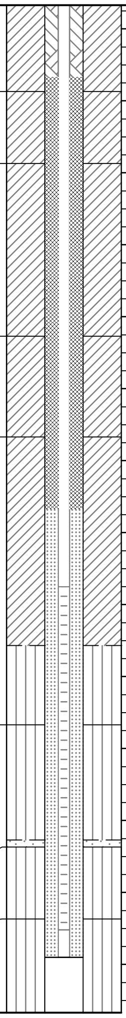
WATER LEVEL INFORMATION:
∇ = 11.60 - During Drilling
∇ =
▼ =

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
1A	18/24 *75%*	SS	*0-2* *2-5* N=4			
2A	22/24 *92%*	SS	*1-2* *3-4* N=5			
3A	20/24 *83%*	SS	*0-3* *4-4* N=7			
4A	22/24 *92%*	SS	*2-3* *4-6* N=7			
5A 5B	24/24 *100%*	SS	*2-3* *4-4* N=7			
6A	20/24 *83%*	SS	*1-2* *3-3* N=5			
7A	23/24 *96%*	SS	*7-22* *27-48* N=49			

Depth ft. BGS	Lithologic Description
	Very dark gray (10YR3/1), moist, very stiff, lean CLAY, some silt, few roots.
2	Gray (10YR6/1) with 20% yellowish brown (10YR5/6) mottles, moist, very stiff, lean CLAY, with some silt, trace very fine-grained sand.
4	Dark gray (10YR4/1) with 10% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace very fine-grained sand.
6	Gray (10YR6/1) with 10% yellowish brown (10YR5/6) moist, very stiff, lean CLAY, with some very fine-grained sand and silt, few small gravel.
8	Gray (10YR6/1) with 30% yellowish brown (10YR5/6) moist, very stiff, lean CLAY, with some very fine-grained sand and silt, few small gravel.
10	Yellowish brown (10YR5/4), moist, loose, SILT, with some very fine- to fine-grained sand, few clay and small gravel.
∇	Yellowish brown (10YR5/4) with 20% yellowish brown (10YR5/6) mottles, moist, loose, SILT, with some very fine- to fine-grained sand, few clay and small gravel.
12	Yellowish brown (10YR5/4), wet, SAND, with some silt.
	Yellowish brown (10YR5/4) with 20% yellowish brown (10YR5/6) mottles, wet, loose, SILT, with few very fine- to medium-grained sand, little clay, few small gravel.
14	Light yellowish brown (10YR6/4) with 10% yellowish brown (10YR5/6) mottles, moist, hard, SILT, trace very fine-grained sand.

End of boring = 14.0 feet

Borehole Detail



Elevation ft. MSL: 614, 612, 610, 608, 606, 604, 602

Remarks

NOTE(S): G284 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/21/2021
Finish: 1/21/2021
WEATHER: Clear, 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: G288
Well ID: G288
Surface Elev: 617.08 ft. MSL
Completion: 14.00 ft. BGS
Station: 875,279.60N
2,517,071.40E

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/ft³)	Qu (tsf) *Qp (tsf)* Failure Type
1A	18/24 *75%*	SS	*1-2* *2-3* N=4			
2A 2B	20/24 *83%*	SS	*1-1* *2-3* N=3			
3A	20/24 *83%*	SS	*2-3* *4-4* N=7			
4A	24/24 *100%*	SS	*1-2* *4-4* N=6			
5A	24/24 *100%*	SS	*0-2* *2-3* N=4			
6A 6B	21/24 *88%*	SS	*1-2* *3-5* N=5			
7A	22/24 *92%*	SS	*5-12* *19-19* N=31			

Depth ft. BGS: 2, 4, 6, 8, 10, 12, 14 — Elevation ft. MSL: 616, 614, 612, 610, 608, 606, 604

Lithologic Description

Brown (10YR4/3), moist, medium stiff, SILT, with some clay, trace roots.

Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace small gravel.

Dark gray (10YR4/1) with 10% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, little very fine- to fine-grained sand, trace small gravel.

Gray (10YR6/1) with 20% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt and very fine- to fine-grained sand, trace small gravel.

Light yellowish brown (10YR6/4), moist, stiff, lean CLAY, with some silt and very fine- to fine-grained sand, trace small gravel.

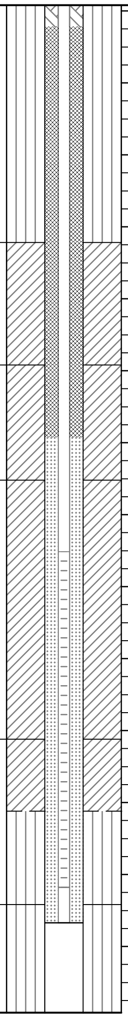
▽

Gray (10YR6/1), wet, medium stiff, SILT, with some very fine- to fine-grained sand, few small to medium gravel, occasional thin sand seams.

Gray (10YR6/1) with 25% dark yellowish brown (10YR4/6) mottles, moist, hard, SILT, with some very fine- to fine-grained sand, few clay, trace small gravel.

End of boring = 14.0 feet

Borehole Detail



Remarks

NOTE(S): G288 installed in borehole.

Attachment E
Site Solids Bulk Characterization Analytical Data

PDC Laboratories, Inc.
PROFESSIONAL • DEPENDABLE • COMMITTED

February 23, 2021

Rhonald Hasenyager
Hanson Professional Services, Inc.
1525 South Sixth Street
Springfield, IL 62703-2886

RE: HANSON VISTRA SOIL

Dear Rhonald Hasenyager:

Please find enclosed the analytical results for the **6** sample(s) the laboratory received on **1/22/21 2:00 pm** and logged in under work order **EA03939**. All testing is performed according to our current TNI accreditations 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 Director of Client Services, Lisa Grant, with any feedback you have about your experience with our laboratory at 309-683-1764 or lgrant@pdclab.com.

Sincerely,

Gail g Schindler

Gail Schindler
Project Manager
(309) 692-9688 x1716
gschindler@pdclab.com

NELAP ACCREDITED TNI LABORATORY

SAMPLE RECEIPT CHECK LIST

Items not applicable will be marked as in compliance

Work Order EA03939

YES	Samples received within temperature compliance when applicable
YES	COC present upon sample receipt
YES	COC completed & legible
YES	Sampler name & signature present
YES	Unique sample IDs assigned
YES	Sample collection location recorded
YES	Date & time collected recorded on COC
YES	Relinquished by client signature on COC
YES	COC & labels match
YES	Sample labels are legible
YES	Appropriate bottle(s) received
YES	Sufficient sample volume received
YES	Sample containers recieved undamaged
NO	Zero headspace, <6 mm present in VOA vials
NO	Trip blank(s) received
YES	All non-field analyses received within holding times
NO	Short hold time analysis
YES	Current PDC COC submitted
NO	Case narrative provided

ANALYTICAL RESULTS

Sample: EA03939-01
Name: G284-S1
Matrix: Soil - Composite

Sampled: 01/20/21 15:30
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - A & L Great Lakes Laboratory									
Cation Exchange Capacity - subcontracted	15.6	meq/100g			1	1			Subcontracted

Sample: EA03939-02
Name: G284-S2
Matrix: Soil - Composite

Sampled: 01/20/21 15:45
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - A & L Great Lakes Laboratory									
Cation Exchange Capacity - subcontracted	15	meq/100g			1	1			Subcontracted

Sample: EA03939-03
Name: G284-S3
Matrix: Soil - Composite

Sampled: 01/20/21 15:55
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - A & L Great Lakes Laboratory									
Cation Exchange Capacity - subcontracted	6.2	meq/100g			1	1			Subcontracted

Sample: EA03939-04
Name: G288-S1
Matrix: Soil - Composite

Sampled: 01/21/21 08:00
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - A & L Great Lakes Laboratory									
Cation Exchange Capacity - subcontracted	9.6	meq/100g			1	1			Subcontracted

ANALYTICAL RESULTS

Sample: EA03939-05
Name: G288-S2
Matrix: Soil - Composite

Sampled: 01/21/21 08:15
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - A & L Great Lakes Laboratory									
Cation Exchange Capacity - subcontracted	12.1	meq/100g			1	1			Subcontracted

Sample: EA03939-06
Name: G288-S3
Matrix: Soil - Composite

Sampled: 01/21/21 08:30
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - A & L Great Lakes Laboratory									
Cation Exchange Capacity - subcontracted	14.7	meq/100g			1	1			Subcontracted

ANALYTICAL RESULTS

Sample: EA03939-01
Name: G284-S1
Matrix: Soil - Composite

Sampled: 01/20/21 15:30
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Lloyd Kahn - Eurofins Eaton Analytical, Inc. - Lancaster, PA									
Total Organic Carbon (TOC)	806 H	mg/kg			1.99	597	02/04/21 19:07		SM 5310C 2000

Sample: EA03939-02
Name: G284-S2
Matrix: Soil - Composite

Sampled: 01/20/21 15:45
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Lloyd Kahn - Eurofins Eaton Analytical, Inc. - Lancaster, PA									
Total Organic Carbon (TOC)	1020 J	mg/kg			4.05	1220	02/03/21 23:18		SM 5310C 2000

ANALYTICAL RESULTS

Sample: EA03939-03
Name: G284-S3
Matrix: Soil - Composite

Sampled: 01/20/21 15:55
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Lloyd Kahn - Eurofins Eaton Analytical, Inc. - Lancaster, PA									
Total Organic Carbon (TOC)	656 J	mg/kg			2.78	834	02/03/21 23:56		SM 5310C 2000

Sample: EA03939-04
Name: G288-S1
Matrix: Soil - Composite

Sampled: 01/21/21 08:00
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Lloyd Kahn - Eurofins Eaton Analytical, Inc. - Lancaster, PA									
Total Organic Carbon (TOC)	1550	mg/kg			4.17	1250	02/04/21 00:09		SM 5310C 2000

Sample: EA03939-05
Name: G288-S2
Matrix: Soil - Composite

Sampled: 01/21/21 08:15
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Lloyd Kahn - Eurofins Eaton Analytical, Inc. - Lancaster, PA									
Total Organic Carbon (TOC)	1050	mg/kg			3.09	927	02/04/21 00:22		SM 5310C 2000

Sample: EA03939-06
Name: G288-S3
Matrix: Soil - Composite

Sampled: 01/21/21 08:30
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Lloyd Kahn - Eurofins Eaton Analytical, Inc. - Lancaster, PA									
Total Organic Carbon (TOC)	11100	mg/kg			2.79	837	02/04/21 00:34		SM 5310C 2000

ANALYTICAL RESULTS

ANALYTICAL RESULTS

Sample: EA03939-01
Name: G284-S1
Matrix: Soil - Composite

Sampled: 01/20/21 15:30
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - Pace Analytical - Mt Juliet, Tn									
Radium 226 - subcontracted	0.72	pCi/g dry wt			1		02/11/21 09:57		Subcontracted
Radium 228 - subcontracted	0.666	pCi/g dry wt			1		02/08/21 09:30		Subcontracted

Sample: EA03939-02
Name: G284-S2
Matrix: Soil - Composite

Sampled: 01/20/21 15:45
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - Pace Analytical - Mt Juliet, Tn									
Radium 226 - subcontracted	0.499	pCi/g dry wt			1		02/11/21 09:57		Subcontracted
Radium 228 - subcontracted	-0.0666	pCi/g dry wt	U		1		02/08/21 09:30		Subcontracted

Sample: EA03939-03
Name: G284-S3
Matrix: Soil - Composite

Sampled: 01/20/21 15:55
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - Pace Analytical - Mt Juliet, Tn									
Radium 226 - subcontracted	0.615	pCi/g dry wt			1		02/11/21 09:57		Subcontracted
Radium 228 - subcontracted	-0.0718	pCi/g dry wt	U		1		02/08/21 09:30		Subcontracted

Sample: EA03939-04
Name: G288-S1
Matrix: Soil - Composite

Sampled: 01/21/21 08:00
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - Pace Analytical - Mt Juliet, Tn									
Radium 226 - subcontracted	0.45	pCi/g dry wt			1		02/11/21 10:01		Subcontracted
Radium 228 - subcontracted	-0.17	pCi/g dry wt	U		1		02/08/21 09:30		Subcontracted

ANALYTICAL RESULTS

Sample: EA03939-05
Name: G288-S2
Matrix: Soil - Composite

Sampled: 01/21/21 08:15
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - Pace Analytical - Mt Juliet, Tn									
Radium 226 - subcontracted	0.424	pCi/g dry wt			1		02/11/21 10:01		Subcontracted
Radium 228 - subcontracted	0.567	pCi/g dry wt	J		1		02/08/21 09:30		Subcontracted

Sample: EA03939-06
Name: G288-S3
Matrix: Soil - Composite

Sampled: 01/21/21 08:30
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - Pace Analytical - Mt Juliet, Tn									
Radium 226 - subcontracted	0.277	pCi/g dry wt			1		02/11/21 10:01		Subcontracted
Radium 228 - subcontracted	0.684	pCi/g dry wt			1		02/08/21 09:30		Subcontracted

ANALYTICAL RESULTS

ANALYTICAL RESULTS

Sample: EA03939-01
Name: G284-S1
Matrix: Soil - Composite

Sampled: 01/20/21 15:30
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	< 10	mg/kg		01/25/21 14:12	1	10	01/25/21 14:12	CRD	EPA 9056A
Sulfate	23	mg/kg		01/25/21 14:12	1	10	01/25/21 14:12	CRD	EPA 9056A
General Chemistry - PIA									
Fluoride	3.0	mg/kg		01/27/21 15:02	1	2.5	01/27/21 15:02	TTH	SM 4500F C 1997
Total Nitrogen	250	mg/kg dry		01/27/21 13:18	1	60	01/28/21 13:06	CRS1	(calc)
Metals by ICP-MS - PIA									
Iron as Fe2O3	6700	mg/kg		01/26/21 14:39	10	43	01/28/21 11:46	JMW	calculated
Manganese as MnO2	26	mg/kg		01/26/21 14:39	10	1.6	01/28/21 11:46	JMW	calculated
Nutrients - PIA									
Nitrate/Nitrite-N	0.59	mg/kg		01/27/21 13:18	1	0.20	01/27/21 13:18	CJP	EPA 353.2 REV 2
Total Kjeldahl Nitrogen (TKN)	210	mg/kg		01/26/21 08:28	1	50	01/28/21 13:06	CRS1	EPA 351.2 REV 2*
Total Metals - PIA									
Antimony	< 3.0	mg/kg		01/26/21 14:39	10	3.0	01/28/21 11:46	JMW	EPA 6020A
Arsenic	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:46	JMW	EPA 6020A
Barium	18	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:46	JMW	EPA 6020A
Beryllium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:46	JMW	EPA 6020A
Boron	< 10	mg/kg		01/26/21 14:39	10	10	01/29/21 07:54	JMW	EPA 6020A*
Cadmium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:46	JMW	EPA 6020A
Chromium	7.6	mg/kg		01/26/21 14:39	10	4.0	01/28/21 11:46	JMW	EPA 6020A
Cobalt	< 2.0	mg/kg		01/26/21 14:39	10	2.0	01/28/21 11:46	JMW	EPA 6020A
Iron	4700	mg/kg		01/26/21 14:39	10	30	01/28/21 11:46	JMW	EPA 6020A*
Lead	3.4	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:46	JMW	EPA 6020A
Manganese	16	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:46	JMW	EPA 6020A
Molybdenum	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:46	JMW	EPA 6020A
Selenium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:46	JMW	EPA 6020A
Thallium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/29/21 07:54	JMW	EPA 6020A
Mercury	< 0.20	mg/kg		01/26/21 14:39	10	0.20	01/28/21 11:46	JMW	EPA 6020A
Lithium	< 5.0	mg/kg		01/26/21 14:39	1	5.0	01/28/21 12:59	AMB	EPA 6010B*
Sulfur	26	mg/kg		01/26/21 14:39	1	10	01/27/21 13:56	TJJ	EPA 6010B*

ANALYTICAL RESULTS

Sample: EA03939-02
Name: G284-S2
Matrix: Soil - Composite

Sampled: 01/20/21 15:45
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	< 10	mg/kg		01/25/21 15:42	1	10	01/25/21 15:42	CRD	EPA 9056A
Fluoride	< 2.5	mg/kg		01/25/21 15:42	1	2.5	01/25/21 15:42	CRD	EPA 9056A
Sulfate	< 10	mg/kg		01/25/21 15:42	1	10	01/25/21 15:42	CRD	EPA 9056A
General Chemistry - PIA									
Total Nitrogen	140	mg/kg dry		01/27/21 13:19	1	60	01/28/21 13:07	CRS1	(calc)
Metals by ICP-MS - PIA									
Iron as Fe2O3	6000	mg/kg		01/26/21 14:39	10	43	01/28/21 11:50	JMW	calculated
Manganese as MnO2	200	mg/kg		01/26/21 14:39	10	1.6	01/28/21 11:50	JMW	calculated
Nutrients - PIA									
Nitrate/Nitrite-N	0.92	mg/kg		01/27/21 13:19	1	0.20	01/27/21 13:19	CJP	EPA 353.2 REV 2
Total Kjeldahl Nitrogen (TKN)	110	mg/kg		01/26/21 08:28	1	50	01/28/21 13:07	CRS1	EPA 351.2 REV 2*
Total Metals - PIA									
Antimony	< 3.0	mg/kg		01/26/21 14:39	10	3.0	01/28/21 11:50	JMW	EPA 6020A
Arsenic	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:50	JMW	EPA 6020A
Barium	48	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:50	JMW	EPA 6020A
Beryllium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:50	JMW	EPA 6020A
Boron	< 10	mg/kg		01/26/21 14:39	10	10	01/29/21 07:58	JMW	EPA 6020A*
Cadmium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:50	JMW	EPA 6020A
Chromium	4.7	mg/kg		01/26/21 14:39	10	4.0	01/28/21 11:50	JMW	EPA 6020A
Cobalt	5.9	mg/kg		01/26/21 14:39	10	2.0	01/28/21 11:50	JMW	EPA 6020A
Iron	4200	mg/kg		01/26/21 14:39	10	30	01/28/21 11:50	JMW	EPA 6020A*
Lead	9.7	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:50	JMW	EPA 6020A
Manganese	130	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:50	JMW	EPA 6020A
Molybdenum	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:50	JMW	EPA 6020A
Selenium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 11:50	JMW	EPA 6020A
Thallium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/29/21 07:58	JMW	EPA 6020A
Mercury	< 0.20	mg/kg		01/26/21 14:39	10	0.20	01/28/21 11:50	JMW	EPA 6020A
Lithium	< 5.0	mg/kg		01/26/21 14:39	1	5.0	01/28/21 13:01	AMB	EPA 6010B*
Sulfur	< 10	mg/kg		01/26/21 14:39	1	10	01/27/21 13:58	TJJ	EPA 6010B*

ANALYTICAL RESULTS

Sample: EA03939-03
Name: G284-S3
Matrix: Soil - Composite

Sampled: 01/20/21 15:55
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	< 10	mg/kg		01/25/21 16:19	1	10	01/25/21 16:19	CRD	EPA 9056A
Sulfate	10	mg/kg		01/25/21 16:19	1	10	01/25/21 16:19	CRD	EPA 9056A
General Chemistry - PIA									
Fluoride	< 2.5	mg/kg	Q3	01/27/21 14:58	1	2.5	01/27/21 14:58	TTH	SM 4500F C 1997
Total Nitrogen	100	mg/kg dry		01/27/21 13:20	1	58	01/28/21 13:08	CRS1	(calc)
Metals by ICP-MS - PIA									
Iron as Fe2O3	5900	mg/kg		01/26/21 14:39	10	41	01/28/21 11:54	JMW	calculated
Manganese as MnO2	400	mg/kg		01/26/21 14:39	10	1.5	01/28/21 11:54	JMW	calculated
Nutrients - PIA									
Nitrate/Nitrite-N	< 0.20	mg/kg		01/27/21 13:20	1	0.20	01/27/21 13:20	CJP	EPA 353.2 REV 2
Total Kjeldahl Nitrogen (TKN)	86	mg/kg		01/26/21 08:28	1	50	01/28/21 13:08	CRS1	EPA 351.2 REV 2*
Total Metals - PIA									
Antimony	< 2.8	mg/kg		01/26/21 14:39	10	2.8	01/28/21 11:54	JMW	EPA 6020A
Arsenic	1.9	mg/kg		01/26/21 14:39	10	0.95	01/28/21 11:54	JMW	EPA 6020A
Barium	26	mg/kg		01/26/21 14:39	10	0.95	01/28/21 11:54	JMW	EPA 6020A
Beryllium	< 0.95	mg/kg		01/26/21 14:39	10	0.95	01/28/21 11:54	JMW	EPA 6020A
Boron	< 9.5	mg/kg		01/26/21 14:39	10	9.5	01/29/21 08:02	JMW	EPA 6020A*
Cadmium	< 0.95	mg/kg		01/26/21 14:39	10	0.95	01/28/21 11:54	JMW	EPA 6020A
Chromium	5.5	mg/kg		01/26/21 14:39	10	3.8	01/28/21 11:54	JMW	EPA 6020A
Cobalt	< 1.9	mg/kg		01/26/21 14:39	10	1.9	01/28/21 11:54	JMW	EPA 6020A
Iron	4200	mg/kg		01/26/21 14:39	10	28	01/28/21 11:54	JMW	EPA 6020A*
Lead	5.1	mg/kg		01/26/21 14:39	10	0.95	01/28/21 11:54	JMW	EPA 6020A
Manganese	260	mg/kg		01/26/21 14:39	10	0.95	01/28/21 11:54	JMW	EPA 6020A
Molybdenum	< 0.95	mg/kg		01/26/21 14:39	10	0.95	01/28/21 11:54	JMW	EPA 6020A
Selenium	< 0.95	mg/kg		01/26/21 14:39	10	0.95	01/28/21 11:54	JMW	EPA 6020A
Thallium	< 0.95	mg/kg		01/26/21 14:39	10	0.95	01/29/21 08:02	JMW	EPA 6020A
Mercury	< 0.19	mg/kg		01/26/21 14:39	10	0.19	01/28/21 11:54	JMW	EPA 6020A
Lithium	< 4.7	mg/kg		01/26/21 14:39	1	4.7	01/28/21 13:03	AMB	EPA 6010B*
Sulfur	9.6	mg/kg		01/26/21 14:39	1	9.5	01/27/21 14:00	TJJ	EPA 6010B*

ANALYTICAL RESULTS

Sample: EA03939-04
Name: G288-S1
Matrix: Soil - Composite

Sampled: 01/21/21 08:00
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	< 10	mg/kg		01/25/21 16:55	1	10	01/25/21 16:55	CRD	EPA 9056A
Fluoride	3.2	mg/kg		01/25/21 16:55	1	2.5	01/25/21 16:55	CRD	EPA 9056A
Sulfate	17	mg/kg		01/25/21 16:55	1	10	01/25/21 16:55	CRD	EPA 9056A
General Chemistry - PIA									
Total Nitrogen	350	mg/kg dry		01/27/21 13:20	1	64	01/28/21 13:09	CRS1	(calc)
Metals by ICP-MS - PIA									
Iron as Fe2O3	5500	mg/kg		01/26/21 14:39	10	40	01/28/21 11:57	JMW	calculated
Manganese as MnO2	61	mg/kg		01/26/21 14:39	10	1.5	01/28/21 11:57	JMW	calculated
Nutrients - PIA									
Nitrate/Nitrite-N	0.78	mg/kg		01/27/21 13:20	1	0.20	01/27/21 13:20	CJP	EPA 353.2 REV 2
Total Kjeldahl Nitrogen (TKN)	280	mg/kg		01/26/21 08:28	1	50	01/28/21 13:09	CRS1	EPA 351.2 REV 2*
Total Metals - PIA									
Antimony	< 2.8	mg/kg		01/26/21 14:39	10	2.8	01/28/21 11:57	JMW	EPA 6020A
Arsenic	1.8	mg/kg		01/26/21 14:39	10	0.94	01/28/21 11:57	JMW	EPA 6020A
Barium	47	mg/kg		01/26/21 14:39	10	0.94	01/28/21 11:57	JMW	EPA 6020A
Beryllium	< 0.94	mg/kg		01/26/21 14:39	10	0.94	01/28/21 11:57	JMW	EPA 6020A
Boron	< 9.4	mg/kg		01/26/21 14:39	10	9.4	01/29/21 08:06	JMW	EPA 6020A*
Cadmium	< 0.94	mg/kg		01/26/21 14:39	10	0.94	01/28/21 11:57	JMW	EPA 6020A
Chromium	5.5	mg/kg		01/26/21 14:39	10	3.8	01/28/21 11:57	JMW	EPA 6020A
Cobalt	< 1.9	mg/kg		01/26/21 14:39	10	1.9	01/28/21 11:57	JMW	EPA 6020A
Iron	3800	mg/kg		01/26/21 14:39	10	28	01/28/21 11:57	JMW	EPA 6020A*
Lead	5.0	mg/kg		01/26/21 14:39	10	0.94	01/28/21 11:57	JMW	EPA 6020A
Manganese	39	mg/kg		01/26/21 14:39	10	0.94	01/28/21 11:57	JMW	EPA 6020A
Molybdenum	< 0.94	mg/kg		01/26/21 14:39	10	0.94	01/28/21 11:57	JMW	EPA 6020A
Selenium	< 0.94	mg/kg		01/26/21 14:39	10	0.94	01/28/21 11:57	JMW	EPA 6020A
Thallium	< 0.94	mg/kg		01/26/21 14:39	10	0.94	01/29/21 08:06	JMW	EPA 6020A
Mercury	< 0.19	mg/kg		01/26/21 14:39	10	0.19	01/28/21 11:57	JMW	EPA 6020A
Lithium	< 4.7	mg/kg		01/26/21 14:39	1	4.7	01/28/21 13:12	AMB	EPA 6010B*
Sulfur	15	mg/kg		01/26/21 14:39	1	9.4	01/27/21 14:07	TJJ	EPA 6010B*

ANALYTICAL RESULTS

Sample: EA03939-05
Name: G288-S2
Matrix: Soil - Composite

Sampled: 01/21/21 08:15
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	< 10	mg/kg		01/25/21 17:31	1	10	01/25/21 17:31	CRD	EPA 9056A
Sulfate	12	mg/kg		01/25/21 17:31	1	10	01/25/21 17:31	CRD	EPA 9056A
General Chemistry - PIA									
Fluoride	< 2.5	mg/kg		01/27/21 14:53	1	2.5	01/27/21 14:53	TTH	SM 4500F C 1997
Total Nitrogen	160	mg/kg dry		01/27/21 13:21	1	64	01/28/21 13:09	CRS1	(calc)
Metals by ICP-MS - PIA									
Iron as Fe2O3	14000	mg/kg		01/26/21 14:39	10	43	01/28/21 12:01	JMW	calculated
Manganese as MnO2	98	mg/kg		01/26/21 14:39	10	1.6	01/28/21 12:01	JMW	calculated
Nutrients - PIA									
Nitrate/Nitrite-N	0.34	mg/kg		01/27/21 13:21	1	0.20	01/27/21 13:21	CJP	EPA 353.2 REV 2
Total Kjeldahl Nitrogen (TKN)	120	mg/kg		01/26/21 08:28	1	50	01/28/21 13:09	CRS1	EPA 351.2 REV 2*
Total Metals - PIA									
Antimony	< 3.0	mg/kg		01/26/21 14:39	10	3.0	01/28/21 12:01	JMW	EPA 6020A
Arsenic	1.2	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:01	JMW	EPA 6020A
Barium	32	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:01	JMW	EPA 6020A
Beryllium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:01	JMW	EPA 6020A
Boron	< 10	mg/kg		01/26/21 14:39	10	10	01/29/21 08:09	JMW	EPA 6020A*
Cadmium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:01	JMW	EPA 6020A
Chromium	5.4	mg/kg		01/26/21 14:39	10	4.0	01/28/21 12:01	JMW	EPA 6020A
Cobalt	2.4	mg/kg		01/26/21 14:39	10	2.0	01/28/21 12:01	JMW	EPA 6020A
Iron	9500	mg/kg		01/26/21 14:39	10	30	01/28/21 12:01	JMW	EPA 6020A*
Lead	5.8	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:01	JMW	EPA 6020A
Manganese	62	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:01	JMW	EPA 6020A
Molybdenum	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:01	JMW	EPA 6020A
Selenium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:01	JMW	EPA 6020A
Thallium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/29/21 08:09	JMW	EPA 6020A
Mercury	< 0.20	mg/kg		01/26/21 14:39	10	0.20	01/28/21 12:01	JMW	EPA 6020A
Lithium	< 5.0	mg/kg		01/26/21 14:39	1	5.0	01/28/21 13:14	AMB	EPA 6010B*
Sulfur	18	mg/kg		01/26/21 14:39	1	10	01/27/21 14:09	TJJ	EPA 6010B*

ANALYTICAL RESULTS

Sample: EA03939-06
Name: G288-S3
Matrix: Soil - Composite

Sampled: 01/21/21 08:30
Received: 01/22/21 14:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	< 10	mg/kg		01/25/21 18:07	1	10	01/25/21 18:07	CRD	EPA 9056A
Fluoride	< 2.5	mg/kg		01/25/21 18:07	1	2.5	01/25/21 18:07	CRD	EPA 9056A
Sulfate	< 10	mg/kg		01/25/21 18:07	1	10	01/25/21 18:07	CRD	EPA 9056A
General Chemistry - PIA									
Total Nitrogen	360	mg/kg dry		01/27/21 13:22	1	58	01/28/21 13:10	CRS1	(calc)
Metals by ICP-MS - PIA									
Iron as Fe2O3	12000	mg/kg		01/26/21 14:39	10	43	01/28/21 12:05	JMW	calculated
Manganese as MnO2	870	mg/kg		01/26/21 14:39	10	1.6	01/28/21 12:05	JMW	calculated
Nutrients - PIA									
Nitrate/Nitrite-N	0.42	mg/kg		01/27/21 13:22	1	0.20	01/27/21 13:22	CJP	EPA 353.2 REV 2
Total Kjeldahl Nitrogen (TKN)	310	mg/kg		01/26/21 08:28	1	50	01/28/21 13:10	CRS1	EPA 351.2 REV 2*
Total Metals - PIA									
Antimony	< 3.0	mg/kg		01/26/21 14:39	10	3.0	01/28/21 12:05	JMW	EPA 6020A
Arsenic	1.8	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:05	JMW	EPA 6020A
Barium	43	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:05	JMW	EPA 6020A
Beryllium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:05	JMW	EPA 6020A
Boron	< 10	mg/kg		01/26/21 14:39	10	10	01/29/21 08:13	JMW	EPA 6020A*
Cadmium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:05	JMW	EPA 6020A
Chromium	6.3	mg/kg		01/26/21 14:39	10	4.0	01/28/21 12:05	JMW	EPA 6020A
Cobalt	3.3	mg/kg		01/26/21 14:39	10	2.0	01/28/21 12:05	JMW	EPA 6020A
Iron	8000	mg/kg		01/26/21 14:39	10	30	01/28/21 12:05	JMW	EPA 6020A*
Lead	6.5	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:05	JMW	EPA 6020A
Manganese	550	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:05	JMW	EPA 6020A
Molybdenum	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:05	JMW	EPA 6020A
Selenium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/28/21 12:05	JMW	EPA 6020A
Thallium	< 1.0	mg/kg		01/26/21 14:39	10	1.0	01/29/21 08:13	JMW	EPA 6020A
Mercury	< 0.20	mg/kg		01/26/21 14:39	10	0.20	01/28/21 12:05	JMW	EPA 6020A
Lithium	< 5.0	mg/kg		01/26/21 14:39	1	5.0	01/28/21 13:16	AMB	EPA 6010B*
Sulfur	17	mg/kg		01/26/21 14:39	1	10	01/27/21 14:11	TJJ	EPA 6010B*

NOTES

Specifications regarding method revisions and method modifications used for analysis are available upon request. Please contact your project manager.

* Not a TNI accredited analyte

Memos

TOC, CEC and Radium 226/228 subcontracted - report attached

Certifications

CHI - McHenry, IL - 4314-A W. Crystal Lake Road, McHenry, IL 60050
TNI Accreditation for Drinking Water and Wastewater Fields of Testing through IL EPA Accreditation No. 100279
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17556

PIA - Peoria, IL - 2231 W. Altorfer Drive, Peoria, IL 61615
TNI Accreditation for Drinking Water, Wastewater, Solid and Hazardous Material Fields of Testing through IL EPA Accreditation No. 100230
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17553
Drinking Water Certifications/Accreditations: Iowa (240); Kansas (E-10338); Missouri (870)
Wastewater Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)
Solid and Hazardous Material Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)

SPMO - Springfield, MO - 1805 W Sunset Street, Springfield, MO 65807
USEPA DMR-QA Program

STL - Hazelwood, MO - 944 Anglum Rd, Hazelwood, MO 63042
TNI Accreditation for Wastewater, Solid and Hazardous Material Fields of Testing through KS KDHE Certification No. E-10389
TNI Accreditation for Wastewater, Solid and Hazardous Material Fields of Testing through IL EPA Accreditation No. - 200080
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory, Registry No. 171050
Missouri Department of Natural Resources - Certificate of Approval for Microbiological Laboratory Service - No. 1050

Qualifiers

Q3	Matrix Spike/Matrix Spike Duplicate both failed % recovery acceptance limits. The associated blank spike recovery was acceptable.

Gail g Schindler

Certified by: Gail Schindler, Project Manager

Report Number
F21026-0048
Account Number
67045

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2231 W ALTORFER DR
PEORIA, IL 61615-1807

For: EA03939

Purchase Order: 12450

Date Received: 1/26/2021
Date Reported: 1/28/2021 **Page:** 1 **of** 1

Attn: JANET CLUTTERS

SOIL TEST REPORT

Sample ID	Lab Number	Organic Matter %	Phosphorus		Potassium K lb/A	Magnesium Mg lb/A	Calcium Ca lb/A	Sodium Na lb/A	Soil pH	Buffer pH	CEC meq/100g	Percent Cation Saturation				
			Bray-1 Equiv lb/A	Bray P2 lb/A								% K	% Mg	% Ca	% H	% Na
G284-S1	13309	0.6	4		112	1250	1700		5.3	6.5	15.6	0.9	33.4	27.2	38.5	
G284-S2	13310	0.7	4		152	1830	2800		6.9		15.0	1.3	50.7	46.5	1.5	
G284-S3	13311	0.5	6		78	680	1300		7.6		6.2	1.6	45.8	52.6		
G288-S1	13312	1.2	16		110	490	2500		6.6	6.9	9.6	1.5	21.2	64.9	12.5	
G288-S2	13313	0.8	4		148	1300	2600		7.6		12.1	1.6	44.7	53.7		
G288-S3	13314	0.4	4		94	1340	3600		8.0		14.7	0.8	38.0	61.2		

Sample ID	Sulfur S lb/A	Zinc Zn lb/A	Manganese Mn lb/A	Iron Fe lb/A	Copper Cu lb/A	Boron B lb/A	Soluble Salts (1:2) mmhos/cm	Nitrate NO_3-N lb/A	Ammonium NH_4-N lb/A	Bicarb-P P lb/A				Comments
														lb/A = ppm x 2

National Center for Testing & Innovation

ANALYTICAL REPORT

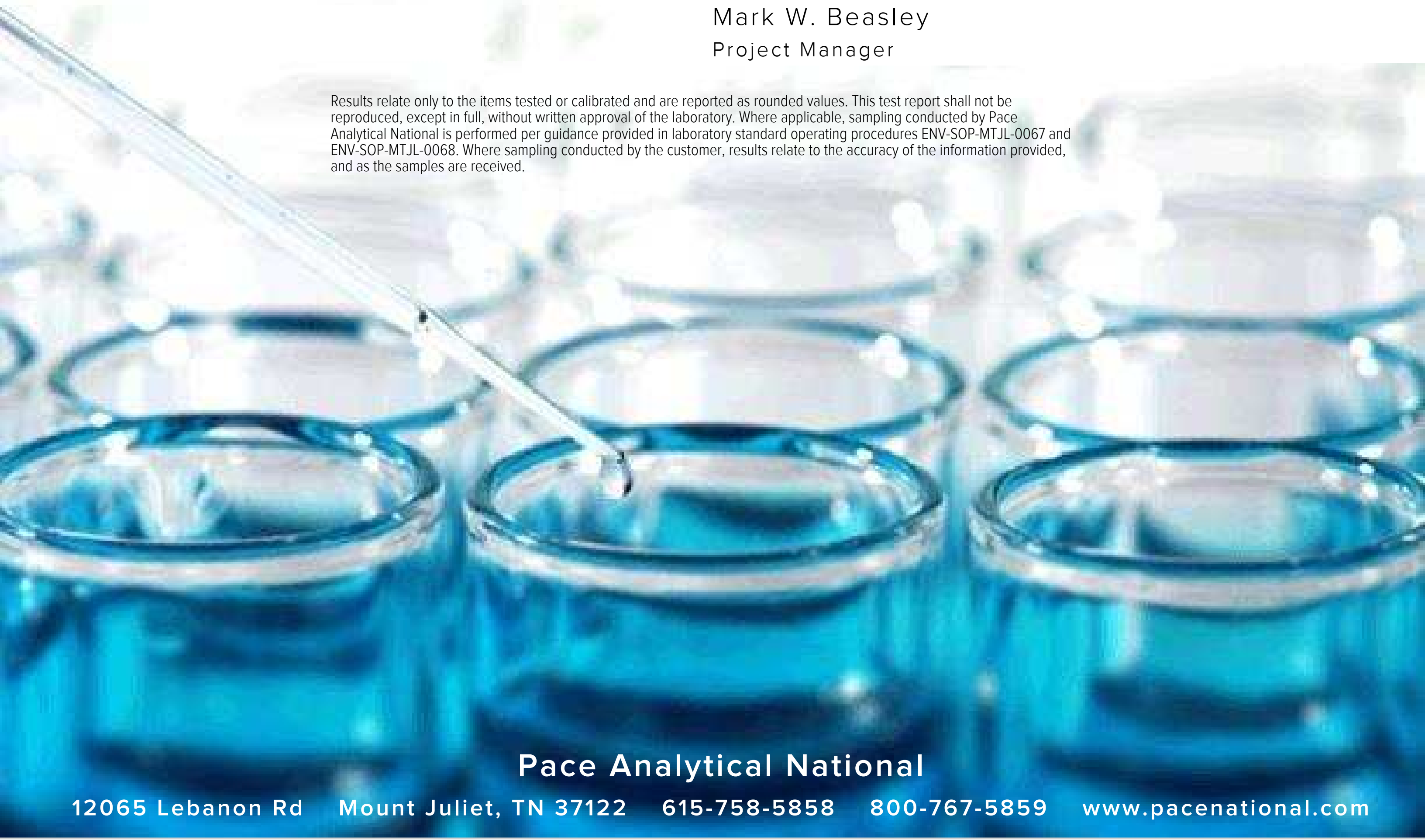
February 12, 2021

PDC Laboratory, Inc.

Sample Delivery Group:	L1310837
Samples Received:	01/27/2021
Project Number:	EA03939
Description:	
Report To:	Gail Schindler 2231 W. Altorfer Drive Peoria, IL 61615

Entire Report Reviewed By:

Mark W. Beasley
Project Manager



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1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Collected by	Collected date/time	Received date/time
	01/20/21 15:30	01/27/21 09:00

EA03939-01 L1310837-01 Solids and Chemical Materials

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 9320	WG1613494	1	02/01/21 14:02	02/08/21 09:30	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1614846	1	02/08/21 09:33	02/11/21 09:57	RGT	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1614846	1	02/08/21 09:33	02/11/21 09:57	RGT	Mt. Juliet, TN

Collected by	Collected date/time	Received date/time
	01/20/21 15:45	01/27/21 09:00

EA03939-02 L1310837-02 Solids and Chemical Materials

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 9320	WG1613494	1	02/01/21 14:02	02/08/21 09:30	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1614846	1	02/08/21 09:33	02/11/21 09:57	RGT	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1614846	1	02/08/21 09:33	02/11/21 09:57	RGT	Mt. Juliet, TN

Collected by	Collected date/time	Received date/time
	01/20/21 15:55	01/27/21 09:00

EA03939-03 L1310837-03 Solids and Chemical Materials

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 9320	WG1613494	1	02/01/21 14:02	02/08/21 09:30	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1614846	1	02/08/21 09:33	02/11/21 09:57	RGT	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1614846	1	02/08/21 09:33	02/11/21 09:57	RGT	Mt. Juliet, TN

Collected by	Collected date/time	Received date/time
	01/21/21 08:00	01/27/21 09:00

EA03939-04 L1310837-04 Solids and Chemical Materials

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 9320	WG1613494	1	02/01/21 14:02	02/08/21 09:30	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1614846	1	02/08/21 09:33	02/11/21 10:01	RGT	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1614846	1	02/08/21 09:33	02/11/21 10:01	RGT	Mt. Juliet, TN

Collected by	Collected date/time	Received date/time
	01/21/21 08:15	01/27/21 09:00

EA03939-05 L1310837-05 Solids and Chemical Materials

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 9320	WG1613494	1	02/01/21 14:02	02/08/21 09:30	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1614846	1	02/08/21 09:33	02/11/21 10:01	RGT	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1614846	1	02/08/21 09:33	02/11/21 10:01	RGT	Mt. Juliet, TN

Collected by	Collected date/time	Received date/time
	01/21/21 08:30	01/27/21 09:00

EA03939-06 L1310837-06 Solids and Chemical Materials

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 9320	WG1613494	1	02/01/21 14:02	02/08/21 09:30	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1614846	1	02/08/21 09:33	02/11/21 10:01	RGT	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1614846	1	02/08/21 09:33	02/11/21 10:01	RGT	Mt. Juliet, TN

CASE NARRATIVE

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All radiochemical sample results for solids are reported on a dry weight basis with the exception of tritium, carbon-14 and radon, unless wet weight was requested by the client. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

Mark W. Beasley
Project Manager

Radiochemistry by Method 9320

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	0.666		0.296	0.542	02/08/2021 09:30	WG1613494
(T) Barium	*91.6*			*62.0-143*	*02/08/2021 09:30*	WG1613494
(T) Yttrium	*96.7*			*79.0-136*	*02/08/2021 09:30*	WG1613494

Radiochemistry by Method Calculation

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
Combined Radium	1.39		0.455	0.598	02/11/2021 09:57	WG1614846

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
RADIUM-226	0.720		0.159	0.0559	02/11/2021 09:57	WG1614846
(T) Barium-133	*94.5*			*30.0-143*	*02/11/2021 09:57*	WG1614846

Radiochemistry by Method 9320

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/l		+ / -	pCi/l	date / time	
RADIUM-228	-0.0666	U	0.303	0.573	02/08/2021 09:30	WG1613494
(T) Barium	*94.4*			*62.0-143*	*02/08/2021 09:30*	WG1613494
(T) Yttrium	*96.5*			*79.0-136*	*02/08/2021 09:30*	WG1613494

Radiochemistry by Method Calculation

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/g		+ / -	pCi/g	date / time	
Combined Radium	0.499	J	0.430	0.634	02/11/2021 09:57	WG1614846

Radiochemistry by Method SM7500Ra B M

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/g		+ / -	pCi/g	date / time	
RADIUM-226	0.499		0.127	0.0605	02/11/2021 09:57	WG1614846
(T) Barium-133	*100*			*30.0-143*	*02/11/2021 09:57*	WG1614846

Radiochemistry by Method 9320

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/l		+ / -	pCi/l	date / time	
RADIUM-228	-0.0718	U	0.320	0.611	02/08/2021 09:30	WG1613494
(T) Barium	*85.2*			*62.0-143*	*02/08/2021 09:30*	WG1613494
(T) Yttrium	*102*			*79.0-136*	*02/08/2021 09:30*	WG1613494

Radiochemistry by Method Calculation

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/g		+ / -	pCi/g	date / time	
Combined Radium	0.615	J	0.473	0.682	02/11/2021 09:57	WG1614846

Radiochemistry by Method SM7500Ra B M

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/g		+ / -	pCi/g	date / time	
RADIUM-226	0.615		0.153	0.071	02/11/2021 09:57	WG1614846
(T) Barium-133	*101*			*30.0-143*	*02/11/2021 09:57*	WG1614846

Radiochemistry by Method 9320

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/l		+ / -	pCi/l	date / time	
RADIUM-228	-0.170	U	0.313	0.599	02/08/2021 09:30	WG1613494
(T) Barium	*86.0*			*62.0-143*	*02/08/2021 09:30*	WG1613494
(T) Yttrium	*97.9*			*79.0-136*	*02/08/2021 09:30*	WG1613494

Radiochemistry by Method Calculation

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/g		+ / -	pCi/g	date / time	
Combined Radium	0.450	J	0.438	0.654	02/11/2021 10:01	WG1614846

Radiochemistry by Method SM7500Ra B M

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/g		+ / -	pCi/g	date / time	
RADIUM-226	0.450		0.125	0.0547	02/11/2021 10:01	WG1614846
(T) Barium-133	*98.2*			*30.0-143*	*02/11/2021 10:01*	WG1614846

Radiochemistry by Method 9320

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	0.567	J	0.318	0.586	02/08/2021 09:30	WG1613494
(T) Barium	*96.3*			*62.0-143*	*02/08/2021 09:30*	WG1613494
(T) Yttrium	*98.6*			*79.0-136*	*02/08/2021 09:30*	WG1613494

Radiochemistry by Method Calculation

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
Combined Radium	0.990		0.448	0.651	02/11/2021 10:01	WG1614846

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/g	Qualifier	Uncertainty + / -	MDA pCi/g	Analysis Date date / time	Batch
RADIUM-226	0.424		0.130	0.0651	02/11/2021 10:01	WG1614846
(T) Barium-133	*100*			*30.0-143*	*02/11/2021 10:01*	WG1614846

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method 9320

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/l		+ / -	pCi/l	date / time	
RADIUM-228	0.684		0.306	0.56	02/08/2021 09:30	WG1613494
(T) Barium	*93.0*			*62.0-143*	*02/08/2021 09:30*	WG1613494
(T) Yttrium	*102*			*79.0-136*	*02/08/2021 09:30*	WG1613494

Radiochemistry by Method Calculation

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/g		+ / -	pCi/g	date / time	
Combined Radium	0.962		0.411	0.638	02/11/2021 10:01	WG1614846

Radiochemistry by Method SM7500Ra B M

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/g		+ / -	pCi/g	date / time	
RADIUM-226	0.277		0.105	0.0779	02/11/2021 10:01	WG1614846
(T) Barium-133	*105*			*30.0-143*	*02/11/2021 10:01*	WG1614846

Method Blank (MB)

(MB) R3621132-1 02/08/21 09:30

Analyte	MB Result pCi/l	MB Qualifier	MB MDA pCi/l
Radium-228	-0.154	U	0.465
(T) Barium	*93.6*		
(T) Yttrium	*98.0*		

L1310837-02 Original Sample (OS) • Duplicate (DUP)

(OS) L1310837-02 02/08/21 09:30 • (DUP) R3621132-4 02/08/21 09:30

Analyte	Original Result pCi/l	DUP Result pCi/l	Dilution	DUP RPD %	DUP RER	DUP Qualifier	DUP RPD Limits %	DUP RER Limit
Radium-228	-0.0666	-0.0207	1	0.000	0.113	U	20	3
(T) Barium	*94.4*	*86.6*						
(T) Yttrium	*96.5*	*98.2*						

Laboratory Control Sample (LCS)

(LCS) R3621132-2 02/08/21 09:30

Analyte	Spike Amount pCi/l	LCS Result pCi/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Radium-228	5.00	5.44	109	80.0-120	
(T) Barium			*97.0*		
(T) Yttrium			*95.2*		

L1310837-01 Original Sample (OS) • Matrix Spike (MS)

(OS) L1310837-01 02/08/21 09:30 • (MS) R3621132-3 02/08/21 09:30

Analyte	Spike Amount pCi/l	Original Result pCi/l	MS Result pCi/l	MS Rec. %	Dilution	Rec. Limits %	MS Qualifier
Radium-228	4.84	0.666	6.78	126	1	70.0-130	
(T) Barium		*91.6*		*88.3*			
(T) Yttrium		*96.7*		*105*			

Method Blank (MB)

(MB) R3621772-1 02/11/21 09:57

Analyte	MB Result pCi/g	MB Qualifier	MB MDA pCi/g
Radium-226	0.00798	U	0.0460
(T) Barium-133	*90.1*		

L1310837-06 Original Sample (OS) • Duplicate (DUP)

(OS) L1310837-06 02/11/21 10:01 • (DUP) R3621772-4 02/11/21 09:57

Analyte	Original Result pCi/g	DUP Result pCi/g	Dilution	DUP RPD %	DUP RER	DUP Qualifier	DUP RPD Limits %	DUP RER Limit
Radium-226	0.277	0.391	1	34.1	0.685		20	3
(T) Barium-133	*105*	*92.0*						

Laboratory Control Sample (LCS)

(LCS) R3621772-2 02/11/21 09:57

Analyte	Spike Amount pCi/g	LCS Result pCi/g	LCS Rec. %	Rec. Limits %	LCS Qualifier
Radium-226	5.02	5.26	105	60.0-144	
(T) Barium-133			*102*		

L1310837-01 Original Sample (OS) • Matrix Spike (MS)

(OS) L1310837-01 02/11/21 09:57 • (MS) R3621772-3 02/11/21 09:57

Analyte	Spike Amount pCi/g	Original Result pCi/g	MS Result pCi/g	MS Rec. %	Dilution	Rec. Limits %	MS Qualifier
Radium-226	5.00	0.720	6.75	121	1	65.0-135	
(T) Barium-133		*94.5*		*88.8*			

GLOSSARY OF TERMS

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDA	Minimum Detectable Activity.
Rec.	Recovery.
RER	Replicate Error Ratio.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(T)	Tracer - A radioisotope of known concentration added to a solution of chemically equivalent radioisotopes at a known concentration to assist in monitoring the yield of the chemical separation.
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state “ND” (Not Detected) or “BDL” (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
J	The identification of the analyte is acceptable; the reported value is an estimate.
U	Below Detectable Limits: Indicates that the analyte was not detected.

ACCREDITATIONS & LOCATIONS

Pace National is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our one location design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be YOUR LAB OF CHOICE.

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace National.

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Alaska	17-026	Nevada	TN000032021-1
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California	2932	New Mexico [1]	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina [1]	DW21704
Georgia	NELAP	North Carolina [3]	41
Georgia [1]	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LAO00356
Kentucky [1,6]	KY90010	South Carolina	84004002
Kentucky [2]	16	South Dakota	n/a
Louisiana	AI30792	Tennessee [1,4]	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas [5]	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

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ANSI National Accreditation Board	L2239

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Texas	T104704328-20-18

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

EA03939

H097

L1310837

SENDING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(800) 752-6651

RECEIVING LABORATORY

Pace Analytical - Mt Juliet, Tn
12065 Lebanon Rd
Mt Juliet, TN 37122
(615) 758-5858

Sample: **EA03939-01**
Name: G284-S1
Sampled: 01/20/21 15:30
Matrix: Soil
Preservative: Cool <6

-01

Analysis	Due	Expires	Comments
01-Radium 226/228 combined	02/02/21 16:00	07/19/21 15:30	

Sample: **EA03939-02**
Name: G284-S2
Sampled: 01/20/21 15:45
Matrix: Soil
Preservative: Cool <6

-02

Analysis	Due	Expires	Comments
01-Radium 226/228 combined	02/02/21 16:00	07/19/21 15:45	

Sample: **EA03939-03**
Name: G284-S3
Sampled: 01/20/21 15:55
Matrix: Soil
Preservative: Cool <6

-03

Analysis	Due	Expires	Comments
01-Radium 226/228 combined	02/02/21 16:00	07/19/21 15:55	

Sample: **EA03939-04**
Name: G288-S1
Sampled: 01/21/21 08:00
Matrix: Soil
Preservative: Cool <6

-04

Analysis	Due	Expires	Comments
01-Radium 226/228 combined	02/02/21 16:00	07/20/21 08:00	

Sample: **EA03939-05**
Name: G288-S2

RAD SCREEN: <0.5 mR/hr

Sampled: 01/21/21 08:15
Matrix: Soil
Preservative: Cool <6

-05

Analysis	Due	Expires	Comments
		07/20/21 08:15	

Sample Receipt Checklist

COC Seal Present/Intact: Y [✓ N]
COC Signed/Accurate: [✓ Y] N
Bottles arrive intact: [✓ Y] N
Correct bottles used: [✓ Y] N
Sufficient volume sent: [✓ Y] N
RAD Screen <0.5 mR/hr: [✓ Y] N

If Applicable
VOA Zero Headspace: Y N
Pres.Correct/Check: Y N

<500 CPM

MPAB 9.6-.2=9.4

6 total

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

EA03939

L1310837

SENDING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(800) 752-6651

RECEIVING LABORATORY

Pace Analytical - Mt Juliet, Tn
12065 Lebanon Rd
Mt Juliet, TN 37122
(615) 758-5858

Sample: EA03939-06
Name: G288-S3

Sampled: 01/21/21 08:30
Matrix: Soil
Preservative: Cool <6

-06

Analysis	Due	Expires	Comments
01-Radium 226/228 combined	02/02/21 16:00	07/20/21 08:30	

Please email results to Gail Schindler at gschindler@pdclab.com

Date Shipped: 1-25-21 Total # of Containers: 6 Sample Origin (State): IL PO #: 11508

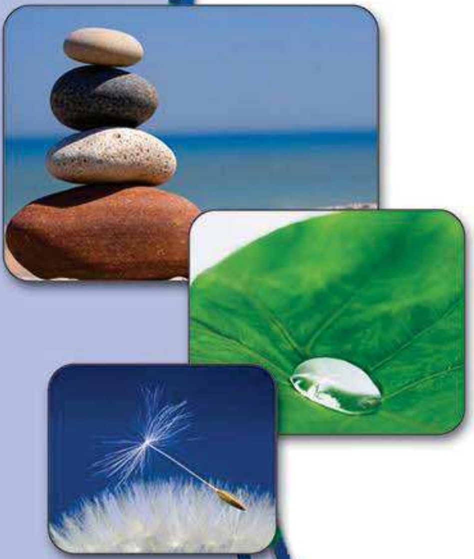
Turn-Around Time Requested ☑ NORMAL ☐ RUSH Date Results Needed: ____________

1-25-21 11:00			
Relinquished By	Date/Time	Received By	Date/Time
			1-27-21 845
Relinquished By	Date/Time	Received By	Date/Time

Sample Temperature Upon Receipt ____ °C
Sample(s) Received on Ice Y or N
Proper Bottles Received in Good Condition Y or N
Bottles Filled with Adequate Volume Y or N
Samples Received Within Hold Time Y or N
Date/Time Taken From Sample Bottle Y or N

RAD SCREEN: <0.5 mR/hr

eurofins | Environment Testing America



ANALYTICAL REPORT

Eurofins Lancaster Laboratories Env, LLC
2425 New Holland Pike
Lancaster, PA 17601
Tel: (717)656-2300

Laboratory Job ID: 410-27780-1
Client Project/Site: EA03939

For:
PDC Laboratories, Inc.
2231 W. Altorfer Drive
Peoria, Illinois 61615

Attn: Gail Schindler

Marrissa Williams

Authorized for release by:
2/10/2021 2:27:43 PM

Marrissa Williams, Project Manager
(717)556-7246
Marrissa.Williams@eurofinset.com

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.

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Results relate only to the items tested and the sample(s) as received by the laboratory.

Analytical test results meet all requirements of the associated regulatory program (e.g., NELAC (TNI), DoD, and ISO 17025) unless otherwise noted under the individual analysis. Data qualifiers are applied to note exceptions. Noncompliant quality control (QC) is further explained in narrative comments.

· QC results that exceed the upper limits and are associated with non-detect samples are qualified but further narration is not required since the bias is high and does not change a non-detect result. Further narration is also not required with QC blank detection when the associated sample concentration is non-detect or more than ten times the level in the blank.

· Matrix QC may not be reported if insufficient sample or site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD is performed, unless otherwise specified in the method.

· Surrogate and/or isotope dilution analyte recoveries (if applicable) which are outside of the QC window are confirmed unless attributed to a dilution or otherwise noted in the narrative.

Regulated compliance samples (e.g. SDWA, NPDES) must comply with the associated agency requirements/permits.

Measurement uncertainty values, as applicable, are available upon request.

Test results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. Times are local to the area of activity. Parameters listed in the 40 CFR Part 136 Table II as "analyze immediately" and tested in the laboratory are not performed within 15 minutes of collection.

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Marrissa Williams

Marrissa Williams
Project Manager
2/10/2021 2:27:43 PM

Table of Contents

Definitions/Glossary

Client: PDC Laboratories, Inc.
Project/Site: EA03939

Job ID: 410-27780-1

Qualifiers

General Chemistry

Qualifier	Qualifier Description
H	Sample was prepped or analyzed beyond the specified holding time
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
1C	Result is from the primary column on a dual-column method.
2C	Result is from the confirmation column on a dual-column method.
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

Case Narrative

Job ID: 410-27780-1

Laboratory: Eurofins Lancaster Laboratories Env, LLC

Narrative

Job Narrative
410-27780-1

Receipt

The samples were received on 1/28/2021 10:13 AM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperature of the cooler at receipt time was -1.1°C

General Chemistry

Method Lloyd_Kahn: Reanalysis of the following sample was performed outside of the analytical holding time due to the initial analysis exceeding the calibration range. : EA03939-01 G284-S1 (410-27780-1).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Detection Summary

Client: PDC Laboratories, Inc.
Project/Site: EA03939

Job ID: 410-27780-1

Client Sample ID: EA03939-01 G284-S1 — Lab Sample ID: 410-27780-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Total Organic Carbon	806	H	597	199	mg/Kg	1.99		Lloyd Kahn	Total/NA

Client Sample ID: EA03939-02 G284-S2 — Lab Sample ID: 410-27780-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Total Organic Carbon	1020	J	1220	405	mg/Kg	4.05		Lloyd Kahn	Total/NA

Client Sample ID: EA03939-03 G284-S3 — Lab Sample ID: 410-27780-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Total Organic Carbon	656	J	834	278	mg/Kg	2.78		Lloyd Kahn	Total/NA

Client Sample ID: EA03939-04 G288-S1 — Lab Sample ID: 410-27780-4

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Total Organic Carbon	1550		1250	417	mg/Kg	4.17		Lloyd Kahn	Total/NA

Client Sample ID: EA03939-05 G288-S2 — Lab Sample ID: 410-27780-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Total Organic Carbon	1050		927	309	mg/Kg	3.09		Lloyd Kahn	Total/NA

Client Sample ID: EA03939-06 G288-S3 — Lab Sample ID: 410-27780-6

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Total Organic Carbon	11100		837	279	mg/Kg	2.79		Lloyd Kahn	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample Results

Client: PDC Laboratories, Inc.
Project/Site: EA03939

Job ID: 410-27780-1

Client Sample ID: EA03939-01 G284-S1

Lab Sample ID: 410-27780-1

Date Collected: 01/20/21 15:30
Date Received: 01/28/21 10:13

Matrix: Solid

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon	806	H	597	199	mg/Kg			02/04/21 19:07	1.99
Percent Moisture	18.9		1.0	1.0	%			01/28/21 20:42	1
Percent Solids	81.1		1.0	1.0	%			01/28/21 20:42	1

Client Sample ID: EA03939-02 G284-S2

Lab Sample ID: 410-27780-2

Date Collected: 01/20/21 15:45
Date Received: 01/28/21 10:13

Matrix: Solid

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon	1020	J	1220	405	mg/Kg			02/03/21 23:18	4.05
Percent Moisture	16.6		1.0	1.0	%			01/28/21 20:42	1
Percent Solids	83.4		1.0	1.0	%			01/28/21 20:42	1

Client Sample ID: EA03939-03 G284-S3

Lab Sample ID: 410-27780-3

Date Collected: 01/20/21 15:55
Date Received: 01/28/21 10:13

Matrix: Solid

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon	656	J	834	278	mg/Kg			02/03/21 23:56	2.78
Percent Moisture	14.9		1.0	1.0	%			01/28/21 20:42	1
Percent Solids	85.1		1.0	1.0	%			01/28/21 20:42	1

Client Sample ID: EA03939-04 G288-S1

Lab Sample ID: 410-27780-4

Date Collected: 01/21/21 08:00
Date Received: 01/28/21 10:13

Matrix: Solid

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon	1550		1250	417	mg/Kg			02/04/21 00:09	4.17
Percent Moisture	17.2		1.0	1.0	%			01/28/21 20:42	1
Percent Solids	82.8		1.0	1.0	%			01/28/21 20:42	1

Client Sample ID: EA03939-05 G288-S2

Lab Sample ID: 410-27780-5

Date Collected: 01/21/21 08:15
Date Received: 01/28/21 10:13

Matrix: Solid

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon	1050		927	309	mg/Kg			02/04/21 00:22	3.09
Percent Moisture	17.9		1.0	1.0	%			01/28/21 20:42	1
Percent Solids	82.1		1.0	1.0	%			01/28/21 20:42	1

Client Sample ID: EA03939-06 G288-S3

Lab Sample ID: 410-27780-6

Date Collected: 01/21/21 08:30
Date Received: 01/28/21 10:13

Matrix: Solid

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon	11100		837	279	mg/Kg			02/04/21 00:34	2.79
Percent Moisture	12.7		1.0	1.0	%			01/28/21 20:42	1

Client Sample Results

Client: PDC Laboratories, Inc.
Project/Site: EA03939

Job ID: 410-27780-1

Client Sample ID: EA03939-06 G288-S3
Date Collected: 01/21/21 08:30
Date Received: 01/28/21 10:13

Lab Sample ID: 410-27780-6
Matrix: Solid

General Chemistry (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	87.3		1.0	1.0	%			01/28/21 20:42	1

Method: Lloyd Kahn - Organic Carbon, Total (TOC)

Lab Sample ID: MB 410-91050/3
Matrix: Solid
Analysis Batch: 91050

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon	ND		300	100	mg/Kg			02/03/21 18:52	1

Lab Sample ID: LCS 410-91050/4
Matrix: Solid
Analysis Batch: 91050

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Total Organic Carbon	4300	4097		mg/Kg		95	47 - 143

Lab Sample ID: MB 410-91563/3
Matrix: Solid
Analysis Batch: 91563

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon	ND		300	100	mg/Kg			02/04/21 17:51	1

Lab Sample ID: LCS 410-91563/4
Matrix: Solid
Analysis Batch: 91563

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Total Organic Carbon	4300	4159		mg/Kg		97	47 - 143

QC Association Summary

General Chemistry

Analysis Batch: 89236

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-27780-1	EA03939-01 G284-S1	Total/NA	Solid	Moisture	
410-27780-2	EA03939-02 G284-S2	Total/NA	Solid	Moisture	
410-27780-3	EA03939-03 G284-S3	Total/NA	Solid	Moisture	
410-27780-4	EA03939-04 G288-S1	Total/NA	Solid	Moisture	
410-27780-5	EA03939-05 G288-S2	Total/NA	Solid	Moisture	
410-27780-6	EA03939-06 G288-S3	Total/NA	Solid	Moisture	

Analysis Batch: 91050

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-27780-2	EA03939-02 G284-S2	Total/NA	Solid	Lloyd Kahn	
410-27780-3	EA03939-03 G284-S3	Total/NA	Solid	Lloyd Kahn	
410-27780-4	EA03939-04 G288-S1	Total/NA	Solid	Lloyd Kahn	
410-27780-5	EA03939-05 G288-S2	Total/NA	Solid	Lloyd Kahn	
410-27780-6	EA03939-06 G288-S3	Total/NA	Solid	Lloyd Kahn	
MB 410-91050/3	Method Blank	Total/NA	Solid	Lloyd Kahn	
LCS 410-91050/4	Lab Control Sample	Total/NA	Solid	Lloyd Kahn	

Analysis Batch: 91563

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-27780-1	EA03939-01 G284-S1	Total/NA	Solid	Lloyd Kahn	
MB 410-91563/3	Method Blank	Total/NA	Solid	Lloyd Kahn	
LCS 410-91563/4	Lab Control Sample	Total/NA	Solid	Lloyd Kahn	

Lab Chronicle

Client: PDC Laboratories, Inc.
Project/Site: EA03939

Job ID: 410-27780-1

Client Sample ID: EA03939-01 G284-S1

Lab Sample ID: 410-27780-1
Date Collected: 01/20/21 15:30
Matrix: Solid
Date Received: 01/28/21 10:13

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Lloyd Kahn		1.99	91563	02/04/21 19:07	KGQ6	ELLE
Total/NA	Analysis	Moisture		1	89236	01/28/21 20:42	PTG7	ELLE

Client Sample ID: EA03939-02 G284-S2

Lab Sample ID: 410-27780-2
Date Collected: 01/20/21 15:45
Matrix: Solid
Date Received: 01/28/21 10:13

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Lloyd Kahn		4.05	91050	02/03/21 23:18	NKL9	ELLE
Total/NA	Analysis	Moisture		1	89236	01/28/21 20:42	PTG7	ELLE

Client Sample ID: EA03939-03 G284-S3

Lab Sample ID: 410-27780-3
Date Collected: 01/20/21 15:55
Matrix: Solid
Date Received: 01/28/21 10:13

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Lloyd Kahn		2.78	91050	02/03/21 23:56	NKL9	ELLE
Total/NA	Analysis	Moisture		1	89236	01/28/21 20:42	PTG7	ELLE

Client Sample ID: EA03939-04 G288-S1

Lab Sample ID: 410-27780-4
Date Collected: 01/21/21 08:00
Matrix: Solid
Date Received: 01/28/21 10:13

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Lloyd Kahn		4.17	91050	02/04/21 00:09	NKL9	ELLE
Total/NA	Analysis	Moisture		1	89236	01/28/21 20:42	PTG7	ELLE

Client Sample ID: EA03939-05 G288-S2

Lab Sample ID: 410-27780-5
Date Collected: 01/21/21 08:15
Matrix: Solid
Date Received: 01/28/21 10:13

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Lloyd Kahn		3.09	91050	02/04/21 00:22	NKL9	ELLE
Total/NA	Analysis	Moisture		1	89236	01/28/21 20:42	PTG7	ELLE

Client Sample ID: EA03939-06 G288-S3

Lab Sample ID: 410-27780-6
Date Collected: 01/21/21 08:30
Matrix: Solid
Date Received: 01/28/21 10:13

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Lloyd Kahn		2.79	91050	02/04/21 00:34	NKL9	ELLE
Total/NA	Analysis	Moisture		1	89236	01/28/21 20:42	PTG7	ELLE

Laboratory References:

ELLE = Eurofins Lancaster Laboratories Env, LLC, 2425 New Holland Pike, Lancaster, PA 17601, TEL (717)656-2300

Accreditation/Certification Summary

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Laboratory: Eurofins Lancaster Laboratories Env, LLC

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	Identification Number	Expiration Date
A2LA	Dept. of Defense ELAP	1.01	11-30-22
Alaska	State	PA00009	06-30-21
Alaska (UST)	State	17-027	01-31-21 *
Arizona	State	AZ0780	03-12-21
Arkansas DEQ	State	19-053-0	08-09-21
California	State	2792	02-01-22
Colorado	State	PA00009	06-30-21
Connecticut	State	PH-0746	06-30-21
DE Haz. Subst. Cleanup Act (HSCA)	State	019-006 (PA cert)	01-31-22
Delaware (DW)	State	N/A	02-01-22
Florida	NELAP	E87997	07-01-21
Hawaii	State	N/A	01-31-22
Iowa	State	361	03-02-22
Kansas	NELAP	E-10151	10-31-21
Kentucky (DW)	State	KY90088	01-01-22
Kentucky (WW)	State	KY90088	12-31-21
Louisiana	NELAP	02055	06-30-21
Maine	State	2019012	03-12-21
Maryland	State	100	06-30-21
Massachusetts	State	M-PA009	06-30-21
Minnesota	NELAP	042-999-487	12-31-21
Missouri	State	450	01-31-22
Montana (DW)	State	0098	01-01-22
Montana (UST)	State	0098	01-01-22
Nebraska	State	NE-OS-32-17	01-31-20 *
Nevada	State	PA000092019-3	07-31-21
New Hampshire	NELAP	273019	01-10-22
New Jersey	NELAP	PA011	06-30-21
New York	NELAP	10670	04-01-21
North Carolina (DW)	State	42705	07-31-21
North Carolina (WW/SW)	State	521	12-31-21
North Dakota	State	R-205	01-31-20 *
Oklahoma	NELAP	R-205	08-31-21
Oregon	NELAP	PA200001-018	09-12-21
PALA	Canada	1978	05-08-21
Pennsylvania	NELAP	36-00037	01-31-22
Texas	NELAP	T104704194-20-38	08-31-21
Utah	NELAP	PA000092019-16	02-28-21
Vermont	State	VT - 36037	10-29-21
Virginia	NELAP	10561	06-14-21
Washington	State	C457	04-11-21
West Virginia DEP	State	055	06-30-21
Wyoming	State	8TMS-L	01-31-22
Wyoming (UST)	A2LA	1.01	11-30-22

* Accreditation/Certification renewal pending - accreditation/certification considered valid.

Method Summary

Client: PDC Laboratories, Inc.
Project/Site: EA03939

Job ID: 410-27780-1

Method	Method Description	Protocol	Laboratory
Lloyd Kahn	Organic Carbon, Total (TOC)	EPA	ELLE
Moisture	Percent Moisture	EPA	ELLE

Protocol References:

EPA = US Environmental Protection Agency

Laboratory References:

ELLE = Eurofins Lancaster Laboratories Env, LLC, 2425 New Holland Pike, Lancaster, PA 17601, TEL (717)656-2300

Sample Summary

Client: PDC Laboratories, Inc.
Project/Site: EA03939

Job ID: 410-27780-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received	Asset ID
410-27780-1	EA03939-01 G284-S1	Solid	01/20/21 15:30	01/28/21 10:13	
410-27780-2	EA03939-02 G284-S2	Solid	01/20/21 15:45	01/28/21 10:13	
410-27780-3	EA03939-03 G284-S3	Solid	01/20/21 15:55	01/28/21 10:13	
410-27780-4	EA03939-04 G288-S1	Solid	01/21/21 08:00	01/28/21 10:13	
410-27780-5	EA03939-05 G288-S2	Solid	01/21/21 08:15	01/28/21 10:13	
410-27780-6	EA03939-06 G288-S3	Solid	01/21/21 08:30	01/28/21 10:13	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

EA03939

410-27780 Chain of Custody

SENDING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(800) 752-6651

RECEIVING LABORATORY

Eurofins Eaton Analytical, Inc. - Lancaster, PA
2425 New Holland Pike
Lancaster, PA 17601
(717) 656-2300

Sample: **EA03939-01**
Name: G284-S1
Sampled: 01/20/21 15:30
Matrix: Soil
Preservative: H2SO4, cool <6

Analysis	Due	Expires	Comments
01-TOC-STL	02/02/21 16:00	02/17/21 15:30	

Sample: **EA03939-02**
Name: G284-S2
Sampled: 01/20/21 15:45
Matrix: Soil
Preservative: H2SO4, cool <6

Analysis	Due	Expires	Comments
01-TOC-STL	02/02/21 16:00	02/17/21 15:45	

Sample: **EA03939-03**
Name: G284-S3
Sampled: 01/20/21 15:55
Matrix: Soil
Preservative: H2SO4, cool <6

Analysis	Due	Expires	Comments
01-TOC-STL	02/02/21 16:00	02/17/21 15:55	

Sample: **EA03939-04**
Name: G288-S1
Sampled: 01/21/21 08:00
Matrix: Soil
Preservative: H2SO4, cool <6

Analysis	Due	Expires	Comments
01-TOC-STL	02/02/21 16:00	02/18/21 08:00	

Sample: **EA03939-05**
Name: G288-S2
Sampled: 01/21/21 08:15
Matrix: Soil
Preservative: H2SO4, cool <6

Analysis	Due	Expires	Comments
01-TOC-STL	02/02/21 16:00	02/18/21 08:15	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

EA03939

SENDING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(800) 752-6651

RECEIVING LABORATORY

Eurofins Eaton Analytical, Inc. - Lancaster, PA
2425 New Holland Pike
Lancaster, PA 17601
(717) 656-2300

Sample: **EA03939-06**
Name: G288-S3

Sampled: 01/21/21 08:30
Matrix: Soil
Preservative: H2SO4, cool <6

Analysis	Due	Expires	Comments
01-TOC-STL	02/02/21 16:00	02/18/21 08:30	

Please email results to Gail Schindler at gschindler@pdclab.com

Date Shipped: 1/26/21 Total # of Containers: 6 Sample Origin (State): IL PO #: 11506

Turn-Around Time Requested ☒ NORMAL ☐ RUSH Date Results Needed: ______________

Relinquished By	Date/Time	Received By	Date/Time
E. M	1/26/21 1204		
		Julissa R.	1/28/21 10:13

Sample Temperature Upon Receipt ____ °C
Sample(s) Received on Ice Y or N
Proper Bottles Received in Good Condition Y or N
Bottles Filled with Adequate Volume Y or N
Samples Received Within Hold Time Y or N
Date/Time Taken From Sample Bottle Y or N

Tmm

Login Sample Receipt Checklist

Client: PDC Laboratories, Inc. Job Number: 410-27780-1

Login Number: 27780 **List Source: Eurofins Lancaster Laboratories Env**
List Number: 1
Creator: Rivera, Tatiana

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal is intact.	N/A	
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 (</=6C, not frozen).	True	
Cooler Temperature is recorded.	True	
WV: Container Temperature is acceptable (</=6C, not frozen).	N/A	
WV: Container Temperature is recorded.	N/A	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	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	
There is sufficient vol. for all requested analyses.	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	N/A	
Is the Field Sampler's name present on COC?	False	Received project as a subcontract.
Sample Preservation Verified.	N/A	
Residual Chlorine Checked.	N/A	
Sample custody seals are intact.	N/A	

PDC LABORATORIES, INC.
WWW.PDCLAB.COM

REGULATORY PROGRAM (CIRCLE):	NPDES
MORBCA	RCRA
CCDD	TACO: RES OR IND/COMM

CHAIN OF CUSTODY RECORD

STATE WHERE SAMPLE COLLECTED IL

ALL HIGHLIGHTED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

①
CLIENT: **HANSON PROFESSIONAL SERVICES**
ADDRESS: **1525 S 6TH STREET**
CITY STATE ZIP: **SPRINGFIELD IL 62703-6801**
CONTACT PERSON: **MR RHON HASENYAGER**

PROJECT NUMBER: **COFFEEN GMF**
PROJECT LOCATION:
PURCHASE ORDER #:
PHONE NUMBER:
E-MAIL:
DATE SHIPPED:
SAMPLER (PLEASE PRINT): COLIN WINTER
SAMPLER'S SIGNATURE:

MATRIX TYPES:
WW- WASTEWATER
DW- DRINKING WATER
GW- GROUND WATER
WWSL- SLUDGE
NAS- NON AQUEOUS SOLID
LCHT-LEACHATE
OIL-OIL
SO-SOIL
SOL-SOLID

③ ANALYSIS REQUESTED

④ (FOR LAB USE ONLY)
LOGIN # EA03939-06
LOGGED BY: DCW
CLIENT: HANSON PROFESSIONAL SERVICES
PROJECT: HANSON VISTRA COFFEEN GMF SOIL
PRJ. MGR.: GJ SCHINDLER

② SAMPLE DESCRIPTION (UNIQUE DESCRIPTION AS IT WILL APPEAR ON THE ANALYTICAL REPORT)	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	BOTTLE COUNT	PRES CODE CLIENT PROVIDED	SB, AS, BA, BE, B, CD, CA, CR,	CO, FE, PB, LI, MG, MN, MO, K	SE, NA, S, TL, CL, F, SO4, TN	FE OXIDE, MN OXIDE	RAD 226/228	TOC	CEC	REMARKS
G284-S1	1/20/21	3:30pm		X	So	2									
G284-S2	1/20/21	3:45pm		X	So	3									
G284-S3	1/20/21	3:55pm		X	So	2									
G288-S1	1/21/20	8AM		X	So	3									
G288-S2	1/21/20	8:15AM		X	So	3									
G288-S3	1/21/20	8:30AM		X	So	1									

CHEMICAL PRESERVATION CODES:	1 – HCL	2 – H2SO4	3 – HNO3	4 – NAOH	5 – NA2S2O3	6 – UNPRESERVED	7 – OTHER

⑤
TURNAROUND TIME REQUESTED (PLEASE CIRCLE) NORMAL RUSH
(RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
RUSH RESULTS VIA (PLEASE CIRCLE) EMAIL PHONE
EMAIL IF DIFFERENT FROM ABOVE:
PHONE # IF DIFFERENT FROM ABOVE:
DATE RESULTS NEEDED

⑥
I understand that by initialing this box I give the lab permission to proceed with analysis, even though it may not meet all sample conformance requirements as defined in the receiving facility's Sample Acceptance Policy and the data will be qualified. Qualified data may NOT be acceptable to report to all regulatory authorities.
PROCEED WITH ANALYSIS AND QUALIFY RESULTS: (INITIALS) ________________

⑦

RELINQUISHED BY: (SIGNATURE)	DATE 1/22/21 TIME 10:30AM	RECEIVED BY: (SIGNATURE)	DATE 1-22-21 TIME 10:30
RELINQUISHED BY: (SIGNATURE)	DATE 1-22-21 TIME 14:00	RECEIVED BY: (SIGNATURE)	DATE TIME
RELINQUISHED BY: (SIGNATURE)	DATE TIME	RECEIVED BY: (SIGNATURE) Gail Schindler	DATE 1-22-21 TIME 1400

⑧ COMMENTS: (FOR LAB USE ONLY)
____
____
SAMPLE TEMPERATURE UPON RECEIPT 4.7 °C
CHILL PROCESS STARTED PRIOR TO RECEIPT [✓ Y] OR N
SAMPLE(S) RECEIVED ON ICE [✓ Y] OR N
SAMPLE ACCEPTANCE NONCONFORMANT REPORT IS NEEDED Y OR [✓ N]
DATE AND TIME TAKEN FROM SAMPLE BOTTLE ________________

PRIMA ENVIRONMENTAL INC.
Questions Answered.

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 GMF MNA
PRIMA ID: Sirem 08312021-Coffeen GMF

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 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-200-(14-15, 15-18)	0.17
SB-215-(23-24, 24-24.5)	< 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	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.

PRIMA ENVIRONMENTAL INC.
Questions Answered.

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 AM

Client/Company: SiREM - AVS 0831 2021

Project: Coffeen GMF

	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: jars in tact, but no tape around lids. Lid for SB-215(23-24,24-24.5) was loose.			
Do sample IDs on containers match IDs on COC?	☒	☐	☐
If no, explain:			

Other Comments:
store in glove box

PRIMA ENVIRONMENTAL INC.
Mathews Parkway, Suite 300 El Dorado Hills, CA 95762
(916) 939-7300; (916) 939-7398 Fax
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CHAIN of CUSTODY

Page 1 of 1

Project Manager: Michael Healey
Project Name: Coffeen GMF 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-200-(14-15,15-18)	30-Aug-21	2:30	S	1	X										
✓ SB-215-(23-24,24-24.5)	30-Aug-21	2:45	S	1	X										

Special Instructions	Relinquished by:		Received by:
	Company SiREM	Date 30Aug21	Company
	Printed Name Rachel Hallman	Time 3:00 pm.	Printed Name
	Signature Rachel Hallman		Signature
	Relinquished by:		**Received by:**
	Company	Date 8/31/21	Company PRIMA
	Printed Name	Time 10:40	Printed Name Molly Scott
	Signature		Signature Molly Scott

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

16-November-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: **CA19059-AUG21**
Reference: Project Name: Coffeen GMF 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-200-(14-15,15-18)**	**6: SB-215-(23-24,24-24.5)**
Sample Date & Time					30-Aug-21 14:30	30-Aug-21 14:45
Ag [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	< 0.5	< 0.5
Al [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	21000	22000
As [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	3.1	7.9
Ba [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	205	219
Be [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	0.42	0.45
Bi [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	< 0.09	< 0.09
Ca [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	59000	63000
Cd [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	0.17	0.17
Co [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	4	4
Cr [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	144	124
Cu [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	10	8.0
Fe [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	16000	16000
K [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	11000	12000
Li [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	8.8	7.1
Mg [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	26000	25000
Mn [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	403	364
Mo [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	1.5	1.1
Na [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	5200	4900
Ni [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	14	10
P [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	320	320
Pb [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	10	11
Sb [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	< 0.8	< 0.8
Se [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	< 0.7	< 0.7
Sn [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	< 6	< 6
Sr [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	102	90

Analysis	**1: Analysis Start Date**	**2: Analysis Start Time**	**3: Analysis Completed Date**	**4: Analysis Completed Time**	**5: SB-200-(14-15,15-18)**	**6: SB-215-(23-24,24-24.5)**
Ti [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	955	374
Tl [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	0.18	0.20
U [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	0.65	0.52
V [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	20	19
Y [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	8.76	8.52
Zn [µg/g]	29-Sep-21	13:16	16-Nov-21	08:46	31	30
C [%]	14-Sep-21	19:33	15-Sep-21	09:28	3.17	2.84
S [%]	14-Sep-21	19:33	15-Sep-21	09:28	0.095	0.006
TOC [%]	15-Sep-21	09:51	16-Sep-21	15:24	0.531	0.566
Sulphide [%]	16-Sep-21	17:28	17-Sep-21	09:35	0.08	< 0.04

Catharine Arnold

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
CATHARINE ARNOLD
CHEMIST

Catharine Arnold, B.Sc., C.Chem
Project Specialist,
Environment, Health & Safety

Attachment F
X-Ray Diffraction Analytical Data

SGS

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*Environmental Services*
Project Number/ LIMS No.	*Custom XRD/MI4508-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

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

Huyun Zhou

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.

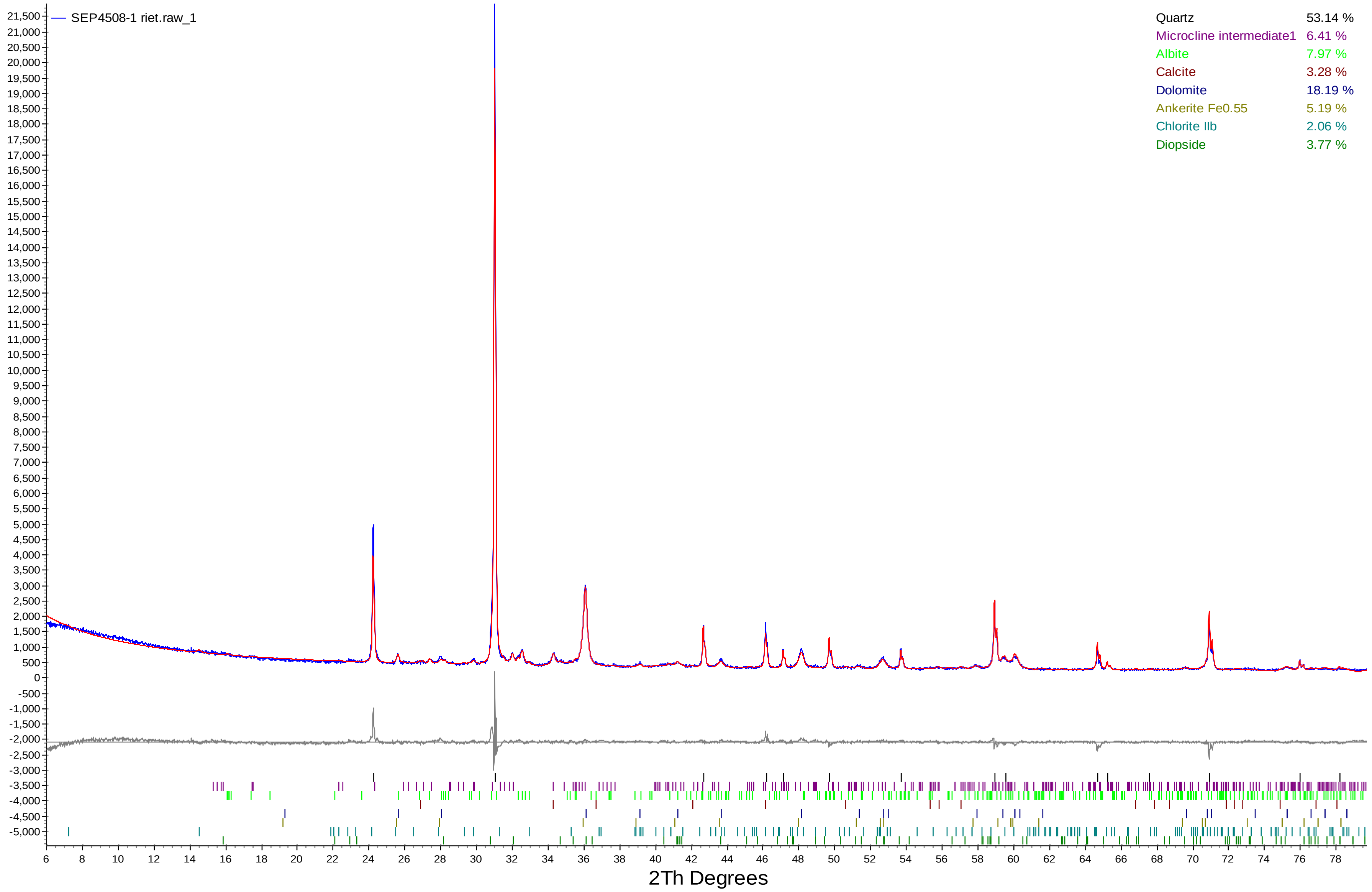
Summary of Rietveld Quantitative Analysis X-Ray Diffraction Results

Mineral/Compound	**SB-200-(14-15,15-18)** **SEP4508-01** (wt %)	**SB-215-(23-24,24-24.5)** **SEP4508-02** (wt %)
Quartz	53.1	58.3
Microcline	6.4	6.2
Albite	8.0	9.0
Calcite	3.3	4.5
Dolomite	18.2	12.9
Ankerite	5.2	4.3
Chlorite	2.1	0.8
Diopside	3.8	4.1
TOTAL	100	100

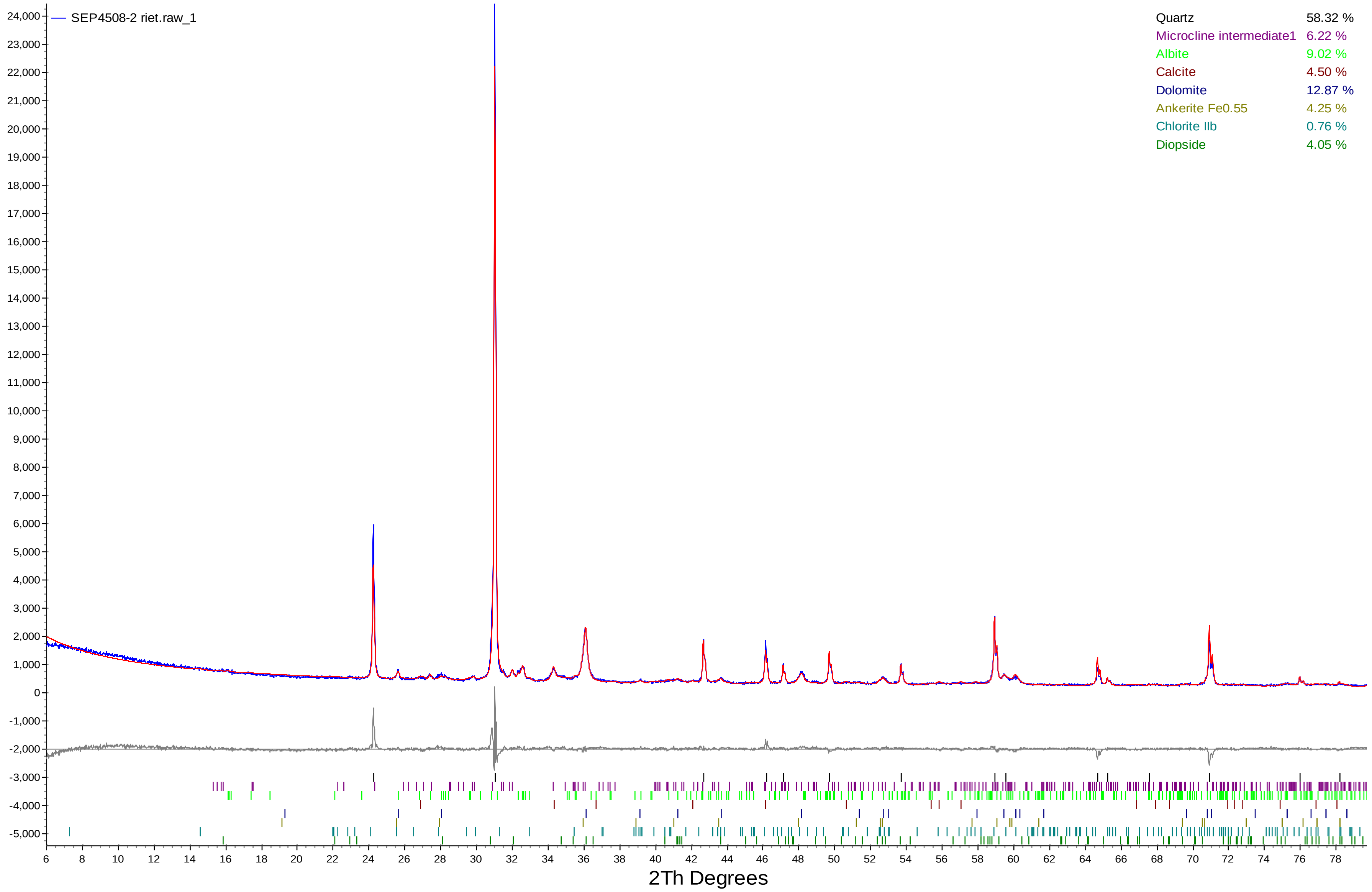
The weight percent quantities indicated have been normalized to a sum of 100%. The quantity of amorphous material has not been determined.

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	$CaMgSi_2O_6$

SB-200-(14-15,15-18)



SB-215-(23-24,24-24.5)



Attachment G

Site Evaluation Aqueous Phase Data

Attachment G. Site Evaluation Aqueous Phase Data
Geochemical Conceptual Site Model
Coffeen GMF Recycle Pond
Coffeen Power Plant
Coffeen, IL

HSU	Location	Well Type	Date	Parameter	Unit	Result
DA	G275D	C	2021/03/30	pH (field)	SU	7.1
DA	G275D	C	2021/04/22	pH (field)	SU	7.1
DA	G275D	C	2021/05/05	pH (field)	SU	7.0
DA	G275D	C	2021/05/18	pH (field)	SU	7.1
DA	G275D	C	2021/07/28	pH (field)	SU	7.1
DA	G275D	C	2023/06/08	pH (field)	SU	7.3
DA	G275D	C	2023/08/14	pH (field)	SU	7.5
DA	G275D	C	2023/12/07	pH (field)	SU	7.0
DA	G275D	C	2021/03/30	Oxidation Reduction Potential	mV	-61.2
DA	G275D	C	2021/04/22	Oxidation Reduction Potential	mV	-53.3
DA	G275D	C	2021/05/05	Oxidation Reduction Potential	mV	52.9
DA	G275D	C	2021/05/18	Oxidation Reduction Potential	mV	-72.0
DA	G275D	C	2021/07/28	Oxidation Reduction Potential	mV	-132
DA	G275D	C	2023/06/08	Oxidation Reduction Potential	mV	-116
DA	G275D	C	2023/08/14	Oxidation Reduction Potential	mV	-132
DA	G275D	C	2023/12/07	Oxidation Reduction Potential	mV	43.0
DA	G275D	C	2021/03/30	Eh	V	0.13
DA	G275D	C	2021/04/22	Eh	V	0.14
DA	G275D	C	2021/05/05	Eh	V	0.25
DA	G275D	C	2021/05/18	Eh	V	0.12
DA	G275D	C	2021/07/28	Eh	V	0.059
DA	G275D	C	2023/06/08	Eh	V	0.078
DA	G275D	C	2023/08/14	Eh	V	0.063
DA	G275D	C	2023/12/07	Eh	V	0.24
DA	G275D	C	2021/03/30	Alkalinity, bicarbonate	mg/L CaCO3	620
DA	G275D	C	2021/04/22	Alkalinity, bicarbonate	mg/L CaCO3	600
DA	G275D	C	2021/05/05	Alkalinity, bicarbonate	mg/L CaCO3	590
DA	G275D	C	2021/05/18	Alkalinity, bicarbonate	mg/L CaCO3	600
DA	G275D	C	2021/07/28	Alkalinity, bicarbonate	mg/L CaCO3	640
DA	G275D	C	2023/06/08	Alkalinity, bicarbonate	mg/L CaCO3	750
DA	G275D	C	2023/08/14	Alkalinity, bicarbonate	mg/L CaCO3	770
DA	G275D	C	2023/12/07	Alkalinity, bicarbonate	mg/L CaCO3	742
DA	G275D	C	2021/03/30	Arsenic, total	mg/L	0.00530
DA	G275D	C	2021/04/22	Arsenic, total	mg/L	0.00330
DA	G275D	C	2021/05/05	Arsenic, total	mg/L	0.00740
DA	G275D	C	2021/05/18	Arsenic, total	mg/L	0.00930
DA	G275D	C	2021/07/28	Arsenic, total	mg/L	0.00890
DA	G275D	C	2023/06/08	Arsenic, total	mg/L	0.0170
DA	G275D	C	2023/08/14	Arsenic, total	mg/L	0.0237
DA	G275D	C	2023/12/07	Arsenic, total	mg/L	0.0182
DA	G275D	C	2021/03/30	Barium, total	mg/L	0.430
DA	G275D	C	2021/04/22	Barium, total	mg/L	0.360
DA	G275D	C	2021/05/05	Barium, total	mg/L	0.340
DA	G275D	C	2021/05/18	Barium, total	mg/L	0.310
DA	G275D	C	2021/07/28	Barium, total	mg/L	0.330
DA	G275D	C	2023/06/08	Barium, total	mg/L	0.450
DA	G275D	C	2023/08/14	Barium, total	mg/L	0.506
DA	G275D	C	2023/12/07	Barium, total	mg/L	0.676
DA	G275D	C	2021/03/30	Calcium, total	mg/L	170
DA	G275D	C	2021/04/22	Calcium, total	mg/L	170
DA	G275D	C	2021/05/05	Calcium, total	mg/L	160
DA	G275D	C	2021/05/18	Calcium, total	mg/L	170
DA	G275D	C	2021/07/28	Calcium, total	mg/L	170
DA	G275D	C	2023/06/08	Calcium, total	mg/L	150
DA	G275D	C	2023/08/14	Calcium, total	mg/L	157

DA	G275D	C	2023/12/07	Calcium, total	mg/L	155
DA	G275D	C	2021/03/30	Chloride, total	mg/L	32.0
DA	G275D	C	2021/04/22	Chloride, total	mg/L	34.0
DA	G275D	C	2021/05/05	Chloride, total	mg/L	51.0
DA	G275D	C	2021/05/18	Chloride, total	mg/L	39.0
DA	G275D	C	2021/07/28	Chloride, total	mg/L	38.0
DA	G275D	C	2023/06/08	Chloride, total	mg/L	23.0
DA	G275D	C	2023/08/14	Chloride, total	mg/L	20.0
DA	G275D	C	2023/12/07	Chloride, total	mg/L	19.0
DA	G275D	C	2023/06/08	Ferrous Iron, dissolved	mg/L	1.10
DA	G275D	C	2023/06/08	Iron, dissolved	mg/L	1.00
DA	G275D	C	2023/08/14	Iron, dissolved	mg/L	2.85
DA	G275D	C	2021/03/30	Magnesium, total	mg/L	73.0
DA	G275D	C	2021/04/22	Magnesium, total	mg/L	70.0
DA	G275D	C	2021/05/05	Magnesium, total	mg/L	68.0
DA	G275D	C	2021/05/18	Magnesium, total	mg/L	66.0
DA	G275D	C	2021/07/28	Magnesium, total	mg/L	66.0
DA	G275D	C	2023/06/08	Magnesium, total	mg/L	61.0
DA	G275D	C	2023/08/14	Magnesium, total	mg/L	61.8
DA	G275D	C	2023/12/07	Magnesium, total	mg/L	63.4
DA	G275D	C	2023/06/08	Manganese, dissolved	mg/L	0.730
DA	G275D	C	2023/08/14	Manganese, dissolved	mg/L	0.835
DA	G275D	C	2023/08/14	Phosphate, dissolved	mg/L	0.292
DA	G275D	C	2021/03/30	Potassium, total	mg/L	5.40
DA	G275D	C	2021/04/22	Potassium, total	mg/L	5.50
DA	G275D	C	2021/05/05	Potassium, total	mg/L	5.00
DA	G275D	C	2021/05/18	Potassium, total	mg/L	4.70
DA	G275D	C	2021/07/28	Potassium, total	mg/L	4.00
DA	G275D	C	2023/06/08	Potassium, total	mg/L	2.50
DA	G275D	C	2023/08/14	Potassium, total	mg/L	3.00
DA	G275D	C	2023/12/07	Potassium, total	mg/L	3.14
DA	G275D	C	2023/06/08	Silicon, dissolved	mg/L	8.10
DA	G275D	C	2023/08/14	Silicon, dissolved	mg/L	7.29
DA	G275D	C	2021/03/30	Sodium, total	mg/L	96.0
DA	G275D	C	2021/04/22	Sodium, total	mg/L	100
DA	G275D	C	2021/05/05	Sodium, total	mg/L	110
DA	G275D	C	2021/05/18	Sodium, total	mg/L	110
DA	G275D	C	2021/07/28	Sodium, total	mg/L	110
DA	G275D	C	2023/06/08	Sodium, total	mg/L	110
DA	G275D	C	2023/08/14	Sodium, total	mg/L	119
DA	G275D	C	2023/12/07	Sodium, total	mg/L	128
DA	G275D	C	2021/03/30	Sulfate, total	mg/L	270
DA	G275D	C	2021/04/22	Sulfate, total	mg/L	260
DA	G275D	C	2021/05/05	Sulfate, total	mg/L	260
DA	G275D	C	2021/05/18	Sulfate, total	mg/L	240
DA	G275D	C	2021/07/28	Sulfate, total	mg/L	210
DA	G275D	C	2023/06/08	Sulfate, total	mg/L	99.0
DA	G275D	C	2023/08/14	Sulfate, total	mg/L	123
DA	G275D	C	2023/12/07	Sulfate, total	mg/L	116
DA	G275D	C	2021/03/30	Temperature (Celsius)	degrees C	18.1
DA	G275D	C	2021/04/22	Temperature (Celsius)	degrees C	14.6
DA	G275D	C	2021/05/05	Temperature (Celsius)	degrees C	18.3
DA	G275D	C	2021/05/18	Temperature (Celsius)	degrees C	17.5
DA	G275D	C	2021/07/28	Temperature (Celsius)	degrees C	21.4
DA	G275D	C	2023/06/08	Temperature (Celsius)	degrees C	17.0
DA	G275D	C	2023/08/14	Temperature (Celsius)	degrees C	15.6
DA	G275D	C	2023/12/07	Temperature (Celsius)	degrees C	12.9
DA	G275D	C	2021/03/30	Total Dissolved Solids	mg/L	1,000
DA	G275D	C	2021/04/22	Total Dissolved Solids	mg/L	1,000
DA	G275D	C	2021/05/05	Total Dissolved Solids	mg/L	910
DA	G275D	C	2021/05/18	Total Dissolved Solids	mg/L	1,100
DA	G275D	C	2021/07/28	Total Dissolved Solids	mg/L	960

DA	G275D	C	2023/06/08	Total Dissolved Solids	mg/L	980
DA	G275D	C	2023/08/14	Total Dissolved Solids	mg/L	1,000
DA	G275D	C	2023/12/07	Total Dissolved Solids	mg/L	840
LCU	G283	C	2021/03/31	pH (field)	SU	6.9
LCU	G283	C	2021/04/22	pH (field)	SU	7.0
LCU	G283	C	2021/05/06	pH (field)	SU	7.1
LCU	G283	C	2021/05/18	pH (field)	SU	7.1
LCU	G283	C	2021/06/15	pH (field)	SU	7.0
LCU	G283	C	2021/06/29	pH (field)	SU	7.0
LCU	G283	C	2021/07/13	pH (field)	SU	7.1
LCU	G283	C	2021/07/27	pH (field)	SU	7.1
LCU	G283	C	2023/06/08	pH (field)	SU	7.1
LCU	G283	C	2023/08/15	pH (field)	SU	7.1
LCU	G283	C	2023/11/20	pH (field)	SU	7.0
LCU	G283	C	2021/03/31	Oxidation Reduction Potential	mV	-16.1
LCU	G283	C	2021/04/22	Oxidation Reduction Potential	mV	-59.5
LCU	G283	C	2021/05/06	Oxidation Reduction Potential	mV	-21.9
LCU	G283	C	2021/05/18	Oxidation Reduction Potential	mV	-65.3
LCU	G283	C	2021/06/15	Oxidation Reduction Potential	mV	-55.9
LCU	G283	C	2021/06/29	Oxidation Reduction Potential	mV	-80.0
LCU	G283	C	2021/07/13	Oxidation Reduction Potential	mV	-86.0
LCU	G283	C	2021/07/27	Oxidation Reduction Potential	mV	-74.1
LCU	G283	C	2023/06/08	Oxidation Reduction Potential	mV	-53.5
LCU	G283	C	2023/08/15	Oxidation Reduction Potential	mV	-71.0
LCU	G283	C	2023/11/20	Oxidation Reduction Potential	mV	88.0
LCU	G283	C	2021/03/31	Eh	V	0.18
LCU	G283	C	2021/04/22	Eh	V	0.14
LCU	G283	C	2021/05/06	Eh	V	0.18
LCU	G283	C	2021/05/18	Eh	V	0.13
LCU	G283	C	2021/06/15	Eh	V	0.14
LCU	G283	C	2021/06/29	Eh	V	0.11
LCU	G283	C	2021/07/13	Eh	V	0.11
LCU	G283	C	2021/07/27	Eh	V	0.12
LCU	G283	C	2023/06/08	Eh	V	0.14
LCU	G283	C	2023/08/15	Eh	V	0.12
LCU	G283	C	2023/11/20	Eh	V	0.29
LCU	G283	C	2021/03/31	Alkalinity, bicarbonate	mg/L CaCO3	450
LCU	G283	C	2021/04/22	Alkalinity, bicarbonate	mg/L CaCO3	420
LCU	G283	C	2021/05/06	Alkalinity, bicarbonate	mg/L CaCO3	400
LCU	G283	C	2021/05/18	Alkalinity, bicarbonate	mg/L CaCO3	420
LCU	G283	C	2021/06/15	Alkalinity, bicarbonate	mg/L CaCO3	440
LCU	G283	C	2021/06/29	Alkalinity, bicarbonate	mg/L CaCO3	400
LCU	G283	C	2021/07/13	Alkalinity, bicarbonate	mg/L CaCO3	410
LCU	G283	C	2021/07/27	Alkalinity, bicarbonate	mg/L CaCO3	420
LCU	G283	C	2023/06/08	Alkalinity, bicarbonate	mg/L CaCO3	410
LCU	G283	C	2023/08/15	Alkalinity, bicarbonate	mg/L CaCO3	438
LCU	G283	C	2023/11/20	Alkalinity, bicarbonate	mg/L CaCO3	422
LCU	G283	C	2021/03/31	Arsenic, total	mg/L	0.00160
LCU	G283	C	2021/04/22	Arsenic, total	mg/L	<0.00022
LCU	G283	C	2021/05/06	Arsenic, total	mg/L	0.00100
LCU	G283	C	2021/05/18	Arsenic, total	mg/L	0.00120
LCU	G283	C	2021/06/15	Arsenic, total	mg/L	0.00100
LCU	G283	C	2021/06/29	Arsenic, total	mg/L	<0.00022
LCU	G283	C	2021/07/13	Arsenic, total	mg/L	<0.00022
LCU	G283	C	2021/07/27	Arsenic, total	mg/L	<0.00022
LCU	G283	C	2023/06/08	Arsenic, total	mg/L	0.00110
LCU	G283	C	2023/08/15	Arsenic, total	mg/L	<0.0004
LCU	G283	C	2023/11/20	Arsenic, total	mg/L	0.000500
LCU	G283	C	2021/03/31	Barium, total	mg/L	0.160
LCU	G283	C	2021/04/22	Barium, total	mg/L	0.160
LCU	G283	C	2021/05/06	Barium, total	mg/L	0.170
LCU	G283	C	2021/05/18	Barium, total	mg/L	0.160

LCU	G283	C	2021/06/15	Barium, total	mg/L	0.170
LCU	G283	C	2021/06/29	Barium, total	mg/L	0.170
LCU	G283	C	2021/07/13	Barium, total	mg/L	0.170
LCU	G283	C	2021/07/27	Barium, total	mg/L	0.160
LCU	G283	C	2023/06/08	Barium, total	mg/L	0.160
LCU	G283	C	2023/08/15	Barium, total	mg/L	0.174
LCU	G283	C	2023/11/20	Barium, total	mg/L	0.184
LCU	G283	C	2021/03/31	Calcium, total	mg/L	140
LCU	G283	C	2021/04/22	Calcium, total	mg/L	140
LCU	G283	C	2021/05/06	Calcium, total	mg/L	150
LCU	G283	C	2021/05/18	Calcium, total	mg/L	140
LCU	G283	C	2021/06/15	Calcium, total	mg/L	140
LCU	G283	C	2021/06/29	Calcium, total	mg/L	140
LCU	G283	C	2021/07/13	Calcium, total	mg/L	130
LCU	G283	C	2021/07/27	Calcium, total	mg/L	140
LCU	G283	C	2023/06/08	Calcium, total	mg/L	140
LCU	G283	C	2023/08/15	Calcium, total	mg/L	140
LCU	G283	C	2023/11/20	Calcium, total	mg/L	170
LCU	G283	C	2021/03/31	Chloride, total	mg/L	36.0
LCU	G283	C	2021/04/22	Chloride, total	mg/L	41.0
LCU	G283	C	2021/05/06	Chloride, total	mg/L	38.0
LCU	G283	C	2021/05/18	Chloride, total	mg/L	40.0
LCU	G283	C	2021/06/15	Chloride, total	mg/L	38.0
LCU	G283	C	2021/06/29	Chloride, total	mg/L	42.0
LCU	G283	C	2021/07/13	Chloride, total	mg/L	41.0
LCU	G283	C	2021/07/27	Chloride, total	mg/L	39.0
LCU	G283	C	2023/06/08	Chloride, total	mg/L	36.0
LCU	G283	C	2023/08/15	Chloride, total	mg/L	39.0
LCU	G283	C	2023/11/20	Chloride, total	mg/L	41.0
LCU	G283	C	2023/06/08	Ferrous Iron, dissolved	mg/L	2.00
LCU	G283	C	2023/06/08	Iron, dissolved	mg/L	2.90
LCU	G283	C	2023/08/15	Iron, dissolved	mg/L	2.32
LCU	G283	C	2021/03/31	Magnesium, total	mg/L	73.0
LCU	G283	C	2021/04/22	Magnesium, total	mg/L	72.0
LCU	G283	C	2021/05/06	Magnesium, total	mg/L	73.0
LCU	G283	C	2021/05/18	Magnesium, total	mg/L	68.0
LCU	G283	C	2021/06/15	Magnesium, total	mg/L	66.0
LCU	G283	C	2021/06/29	Magnesium, total	mg/L	73.0
LCU	G283	C	2021/07/13	Magnesium, total	mg/L	68.0
LCU	G283	C	2021/07/27	Magnesium, total	mg/L	71.0
LCU	G283	C	2023/06/08	Magnesium, total	mg/L	68.0
LCU	G283	C	2023/08/15	Magnesium, total	mg/L	68.9
LCU	G283	C	2023/11/20	Magnesium, total	mg/L	83.6
LCU	G283	C	2023/06/08	Manganese, dissolved	mg/L	0.180
LCU	G283	C	2023/08/15	Manganese, dissolved	mg/L	0.177
LCU	G283	C	2023/08/15	Phosphate, dissolved	mg/L	0.286
LCU	G283	C	2021/03/31	Potassium, total	mg/L	1.80
LCU	G283	C	2021/04/22	Potassium, total	mg/L	1.30
LCU	G283	C	2021/05/06	Potassium, total	mg/L	1.30
LCU	G283	C	2021/05/18	Potassium, total	mg/L	1.30
LCU	G283	C	2021/06/15	Potassium, total	mg/L	1.20
LCU	G283	C	2021/06/29	Potassium, total	mg/L	1.20
LCU	G283	C	2021/07/13	Potassium, total	mg/L	1.20
LCU	G283	C	2021/07/27	Potassium, total	mg/L	1.20
LCU	G283	C	2023/06/08	Potassium, total	mg/L	1.20
LCU	G283	C	2023/08/15	Potassium, total	mg/L	1.31
LCU	G283	C	2023/11/20	Potassium, total	mg/L	1.57
LCU	G283	C	2023/06/08	Silicon, dissolved	mg/L	9.80
LCU	G283	C	2023/08/15	Silicon, dissolved	mg/L	8.47
LCU	G283	C	2021/03/31	Sodium, total	mg/L	54.0
LCU	G283	C	2021/04/22	Sodium, total	mg/L	55.0
LCU	G283	C	2021/05/06	Sodium, total	mg/L	52.0

LCU	G283	C	2021/05/18	Sodium, total	mg/L	56.0
LCU	G283	C	2021/06/15	Sodium, total	mg/L	51.0
LCU	G283	C	2021/06/29	Sodium, total	mg/L	54.0
LCU	G283	C	2021/07/13	Sodium, total	mg/L	53.0
LCU	G283	C	2021/07/27	Sodium, total	mg/L	55.0
LCU	G283	C	2023/06/08	Sodium, total	mg/L	53.0
LCU	G283	C	2023/08/15	Sodium, total	mg/L	55.4
LCU	G283	C	2023/11/20	Sodium, total	mg/L	63.6
LCU	G283	C	2021/03/31	Sulfate, total	mg/L	250
LCU	G283	C	2021/04/22	Sulfate, total	mg/L	240
LCU	G283	C	2021/05/06	Sulfate, total	mg/L	250
LCU	G283	C	2021/05/18	Sulfate, total	mg/L	240
LCU	G283	C	2021/06/15	Sulfate, total	mg/L	240
LCU	G283	C	2021/06/29	Sulfate, total	mg/L	230
LCU	G283	C	2021/07/13	Sulfate, total	mg/L	250
LCU	G283	C	2021/07/27	Sulfate, total	mg/L	240
LCU	G283	C	2023/06/08	Sulfate, total	mg/L	250
LCU	G283	C	2023/08/15	Sulfate, total	mg/L	250
LCU	G283	C	2023/11/20	Sulfate, total	mg/L	270
LCU	G283	C	2021/03/31	Temperature (Celsius)	degrees C	10.4
LCU	G283	C	2021/04/22	Temperature (Celsius)	degrees C	11.9
LCU	G283	C	2021/05/06	Temperature (Celsius)	degrees C	12.2
LCU	G283	C	2021/05/18	Temperature (Celsius)	degrees C	12.9
LCU	G283	C	2021/06/15	Temperature (Celsius)	degrees C	15.6
LCU	G283	C	2021/06/29	Temperature (Celsius)	degrees C	17.8
LCU	G283	C	2021/07/13	Temperature (Celsius)	degrees C	16.3
LCU	G283	C	2021/07/27	Temperature (Celsius)	degrees C	17.0
LCU	G283	C	2023/06/08	Temperature (Celsius)	degrees C	14.5
LCU	G283	C	2023/08/15	Temperature (Celsius)	degrees C	14.8
LCU	G283	C	2023/11/20	Temperature (Celsius)	degrees C	12.6
LCU	G283	C	2021/03/31	Total Dissolved Solids	mg/L	780
LCU	G283	C	2021/04/22	Total Dissolved Solids	mg/L	870
LCU	G283	C	2021/05/06	Total Dissolved Solids	mg/L	770
LCU	G283	C	2021/05/18	Total Dissolved Solids	mg/L	810
LCU	G283	C	2021/06/15	Total Dissolved Solids	mg/L	770
LCU	G283	C	2021/06/29	Total Dissolved Solids	mg/L	790
LCU	G283	C	2021/07/13	Total Dissolved Solids	mg/L	920
LCU	G283	C	2021/07/27	Total Dissolved Solids	mg/L	820
LCU	G283	C	2023/06/08	Total Dissolved Solids	mg/L	930
LCU	G283	C	2023/08/15	Total Dissolved Solids	mg/L	825
LCU	G283	C	2023/11/20	Total Dissolved Solids	mg/L	840
LCU	G285	C	2021/03/30	pH (field)	SU	6.8
LCU	G285	C	2021/04/22	pH (field)	SU	6.7
LCU	G285	C	2021/05/06	pH (field)	SU	7.7
LCU	G285	C	2021/05/18	pH (field)	SU	6.8
LCU	G285	C	2021/06/15	pH (field)	SU	6.8
LCU	G285	C	2021/06/28	pH (field)	SU	6.9
LCU	G285	C	2021/07/13	pH (field)	SU	6.8
LCU	G285	C	2021/07/27	pH (field)	SU	6.9
LCU	G285	C	2023/06/08	pH (field)	SU	6.8
LCU	G285	C	2023/08/15	pH (field)	SU	6.7
LCU	G285	C	2023/11/20	pH (field)	SU	6.7
LCU	G285	C	2021/03/30	Oxidation Reduction Potential	mV	97.3
LCU	G285	C	2021/04/22	Oxidation Reduction Potential	mV	124
LCU	G285	C	2021/05/06	Oxidation Reduction Potential	mV	76.9
LCU	G285	C	2021/05/18	Oxidation Reduction Potential	mV	55.5
LCU	G285	C	2021/06/15	Oxidation Reduction Potential	mV	32.2
LCU	G285	C	2021/06/28	Oxidation Reduction Potential	mV	16.0
LCU	G285	C	2021/07/13	Oxidation Reduction Potential	mV	3.00
LCU	G285	C	2021/07/27	Oxidation Reduction Potential	mV	-14.4
LCU	G285	C	2023/06/08	Oxidation Reduction Potential	mV	50.6
LCU	G285	C	2023/08/15	Oxidation Reduction Potential	mV	54.0

LCU	G285	C	2023/11/20	Oxidation Reduction Potential	mV	118
LCU	G285	C	2021/03/30	Eh	V	0.29
LCU	G285	C	2021/04/22	Eh	V	0.32
LCU	G285	C	2021/05/06	Eh	V	0.27
LCU	G285	C	2021/05/18	Eh	V	0.25
LCU	G285	C	2021/06/15	Eh	V	0.23
LCU	G285	C	2021/06/28	Eh	V	0.21
LCU	G285	C	2021/07/13	Eh	V	0.20
LCU	G285	C	2021/07/27	Eh	V	0.18
LCU	G285	C	2023/06/08	Eh	V	0.25
LCU	G285	C	2023/08/15	Eh	V	0.25
LCU	G285	C	2023/11/20	Eh	V	0.32
LCU	G285	C	2021/03/30	Alkalinity, bicarbonate	mg/L CaCO3	590
LCU	G285	C	2021/04/22	Alkalinity, bicarbonate	mg/L CaCO3	600
LCU	G285	C	2021/05/06	Alkalinity, bicarbonate	mg/L CaCO3	610
LCU	G285	C	2021/05/18	Alkalinity, bicarbonate	mg/L CaCO3	640
LCU	G285	C	2021/06/15	Alkalinity, bicarbonate	mg/L CaCO3	600
LCU	G285	C	2021/06/28	Alkalinity, bicarbonate	mg/L CaCO3	610
LCU	G285	C	2021/07/13	Alkalinity, bicarbonate	mg/L CaCO3	650
LCU	G285	C	2021/07/27	Alkalinity, bicarbonate	mg/L CaCO3	650
LCU	G285	C	2023/06/08	Alkalinity, bicarbonate	mg/L CaCO3	640
LCU	G285	C	2023/08/15	Alkalinity, bicarbonate	mg/L CaCO3	638
LCU	G285	C	2023/11/20	Alkalinity, bicarbonate	mg/L CaCO3	678
LCU	G285	C	2021/03/30	Arsenic, total	mg/L	<0.00022
LCU	G285	C	2021/04/22	Arsenic, total	mg/L	<0.00022
LCU	G285	C	2021/05/06	Arsenic, total	mg/L	<0.00022
LCU	G285	C	2021/05/18	Arsenic, total	mg/L	0.00120
LCU	G285	C	2021/06/15	Arsenic, total	mg/L	0.00110
LCU	G285	C	2021/06/28	Arsenic, total	mg/L	<0.0002
LCU	G285	C	2021/07/13	Arsenic, total	mg/L	0.00140
LCU	G285	C	2021/07/27	Arsenic, total	mg/L	0.00100
LCU	G285	C	2023/06/08	Arsenic, total	mg/L	0.000770
LCU	G285	C	2023/08/15	Arsenic, total	mg/L	<0.0004
LCU	G285	C	2023/11/20	Arsenic, total	mg/L	0.000600
LCU	G285	C	2021/03/30	Barium, total	mg/L	0.0940
LCU	G285	C	2021/04/22	Barium, total	mg/L	0.0910
LCU	G285	C	2021/05/06	Barium, total	mg/L	0.0880
LCU	G285	C	2021/05/18	Barium, total	mg/L	0.0760
LCU	G285	C	2021/06/15	Barium, total	mg/L	0.0760
LCU	G285	C	2021/06/28	Barium, total	mg/L	0.0730
LCU	G285	C	2021/07/13	Barium, total	mg/L	0.0700
LCU	G285	C	2021/07/27	Barium, total	mg/L	0.0650
LCU	G285	C	2023/06/08	Barium, total	mg/L	0.0430
LCU	G285	C	2023/08/15	Barium, total	mg/L	0.0455
LCU	G285	C	2023/11/20	Barium, total	mg/L	0.0452
LCU	G285	C	2021/03/30	Calcium, total	mg/L	210
LCU	G285	C	2021/04/22	Calcium, total	mg/L	240
LCU	G285	C	2021/05/06	Calcium, total	mg/L	260
LCU	G285	C	2021/05/18	Calcium, total	mg/L	250
LCU	G285	C	2021/06/15	Calcium, total	mg/L	280
LCU	G285	C	2021/06/28	Calcium, total	mg/L	250
LCU	G285	C	2021/07/13	Calcium, total	mg/L	250
LCU	G285	C	2021/07/27	Calcium, total	mg/L	270
LCU	G285	C	2023/06/08	Calcium, total	mg/L	270
LCU	G285	C	2023/08/15	Calcium, total	mg/L	272
LCU	G285	C	2023/11/20	Calcium, total	mg/L	313
LCU	G285	C	2021/03/30	Chloride, total	mg/L	80.0
LCU	G285	C	2021/04/22	Chloride, total	mg/L	78.0
LCU	G285	C	2021/05/06	Chloride, total	mg/L	65.0
LCU	G285	C	2021/05/18	Chloride, total	mg/L	63.0
LCU	G285	C	2021/06/15	Chloride, total	mg/L	57.0
LCU	G285	C	2021/06/28	Chloride, total	mg/L	56.0

LCU	G285	C	2021/07/13	Chloride, total	mg/L	60.0
LCU	G285	C	2021/07/27	Chloride, total	mg/L	47.0
LCU	G285	C	2023/06/08	Chloride, total	mg/L	25.0
LCU	G285	C	2023/08/15	Chloride, total	mg/L	24.0
LCU	G285	C	2023/11/20	Chloride, total	mg/L	22.0
LCU	G285	C	2023/06/08	Ferrous Iron, dissolved	mg/L	0.170
LCU	G285	C	2023/06/08	Iron, dissolved	mg/L	0.100
LCU	G285	C	2023/08/15	Iron, dissolved	mg/L	0.0750
LCU	G285	C	2021/03/30	Magnesium, total	mg/L	61.0
LCU	G285	C	2021/04/22	Magnesium, total	mg/L	75.0
LCU	G285	C	2021/05/06	Magnesium, total	mg/L	78.0
LCU	G285	C	2021/05/18	Magnesium, total	mg/L	78.0
LCU	G285	C	2021/06/15	Magnesium, total	mg/L	87.0
LCU	G285	C	2021/06/28	Magnesium, total	mg/L	82.0
LCU	G285	C	2021/07/13	Magnesium, total	mg/L	84.0
LCU	G285	C	2021/07/27	Magnesium, total	mg/L	88.0
LCU	G285	C	2023/06/08	Magnesium, total	mg/L	90.0
LCU	G285	C	2023/08/15	Magnesium, total	mg/L	92.5
LCU	G285	C	2023/11/20	Magnesium, total	mg/L	106
LCU	G285	C	2023/06/08	Manganese, dissolved	mg/L	0.800
LCU	G285	C	2023/08/15	Manganese, dissolved	mg/L	0.865
LCU	G285	C	2023/08/15	Phosphate, dissolved	mg/L	<0.005
LCU	G285	C	2021/03/30	Potassium, total	mg/L	4.70
LCU	G285	C	2021/04/22	Potassium, total	mg/L	4.40
LCU	G285	C	2021/05/06	Potassium, total	mg/L	3.70
LCU	G285	C	2021/05/18	Potassium, total	mg/L	3.60
LCU	G285	C	2021/06/15	Potassium, total	mg/L	3.40
LCU	G285	C	2021/06/28	Potassium, total	mg/L	3.10
LCU	G285	C	2021/07/13	Potassium, total	mg/L	3.00
LCU	G285	C	2021/07/27	Potassium, total	mg/L	3.10
LCU	G285	C	2023/06/08	Potassium, total	mg/L	2.00
LCU	G285	C	2023/08/15	Potassium, total	mg/L	2.38
LCU	G285	C	2023/11/20	Potassium, total	mg/L	2.52
LCU	G285	C	2023/06/08	Silicon, dissolved	mg/L	5.10
LCU	G285	C	2023/08/15	Silicon, dissolved	mg/L	4.61
LCU	G285	C	2021/03/30	Sodium, total	mg/L	190
LCU	G285	C	2021/04/22	Sodium, total	mg/L	200
LCU	G285	C	2021/05/06	Sodium, total	mg/L	180
LCU	G285	C	2021/05/18	Sodium, total	mg/L	170
LCU	G285	C	2021/06/15	Sodium, total	mg/L	160
LCU	G285	C	2021/06/28	Sodium, total	mg/L	150
LCU	G285	C	2021/07/13	Sodium, total	mg/L	140
LCU	G285	C	2021/07/27	Sodium, total	mg/L	140
LCU	G285	C	2023/06/08	Sodium, total	mg/L	130
LCU	G285	C	2023/08/15	Sodium, total	mg/L	128
LCU	G285	C	2023/11/20	Sodium, total	mg/L	128
LCU	G285	C	2021/03/30	Sulfate, total	mg/L	490
LCU	G285	C	2021/04/22	Sulfate, total	mg/L	550
LCU	G285	C	2021/05/06	Sulfate, total	mg/L	580
LCU	G285	C	2021/05/18	Sulfate, total	mg/L	580
LCU	G285	C	2021/06/15	Sulfate, total	mg/L	570
LCU	G285	C	2021/06/28	Sulfate, total	mg/L	620
LCU	G285	C	2021/07/13	Sulfate, total	mg/L	610
LCU	G285	C	2021/07/27	Sulfate, total	mg/L	560
LCU	G285	C	2023/06/08	Sulfate, total	mg/L	640
LCU	G285	C	2023/08/15	Sulfate, total	mg/L	586
LCU	G285	C	2023/11/20	Sulfate, total	mg/L	708
LCU	G285	C	2021/03/30	Temperature (Celsius)	degrees C	12.6
LCU	G285	C	2021/04/22	Temperature (Celsius)	degrees C	12.2
LCU	G285	C	2021/05/06	Temperature (Celsius)	degrees C	13.0
LCU	G285	C	2021/05/18	Temperature (Celsius)	degrees C	14.5
LCU	G285	C	2021/06/15	Temperature (Celsius)	degrees C	16.7

LCU	G285	C	2021/06/28	Temperature (Celsius)	degrees C	17.4
LCU	G285	C	2021/07/13	Temperature (Celsius)	degrees C	16.6
LCU	G285	C	2021/07/27	Temperature (Celsius)	degrees C	17.8
LCU	G285	C	2023/06/08	Temperature (Celsius)	degrees C	15.6
LCU	G285	C	2023/08/15	Temperature (Celsius)	degrees C	14.3
LCU	G285	C	2023/11/20	Temperature (Celsius)	degrees C	12.0
LCU	G285	C	2021/03/30	Total Dissolved Solids	mg/L	1,400
LCU	G285	C	2021/04/22	Total Dissolved Solids	mg/L	1,500
LCU	G285	C	2021/05/06	Total Dissolved Solids	mg/L	1,500
LCU	G285	C	2021/05/18	Total Dissolved Solids	mg/L	1,600
LCU	G285	C	2021/06/15	Total Dissolved Solids	mg/L	1,500
LCU	G285	C	2021/06/28	Total Dissolved Solids	mg/L	1,400
LCU	G285	C	2021/07/13	Total Dissolved Solids	mg/L	1,700
LCU	G285	C	2021/07/27	Total Dissolved Solids	mg/L	1,500
LCU	G285	C	2023/06/08	Total Dissolved Solids	mg/L	1,700
LCU	G285	C	2023/08/15	Total Dissolved Solids	mg/L	1,640
LCU	G285	C	2023/11/20	Total Dissolved Solids	mg/L	1,550
UA	G270	B	2010/07/27	pH (field)	SU	7.3
UA	G270	B	2010/11/15	pH (field)	SU	7.7
UA	G270	B	2011/01/28	pH (field)	SU	7.1
UA	G270	B	2011/05/03	pH (field)	SU	7.0
UA	G270	B	2011/07/27	pH (field)	SU	7.0
UA	G270	B	2011/11/11	pH (field)	SU	7.5
UA	G270	B	2012/01/26	pH (field)	SU	7.4
UA	G270	B	2012/05/22	pH (field)	SU	7.2
UA	G270	B	2012/07/24	pH (field)	SU	7.1
UA	G270	B	2012/11/14	pH (field)	SU	7.4
UA	G270	B	2013/01/30	pH (field)	SU	7.1
UA	G270	B	2013/05/20	pH (field)	SU	7.1
UA	G270	B	2013/07/22	pH (field)	SU	7.0
UA	G270	B	2013/10/14	pH (field)	SU	7.2
UA	G270	B	2014/02/19	pH (field)	SU	7.3
UA	G270	B	2014/05/13	pH (field)	SU	6.9
UA	G270	B	2014/08/11	pH (field)	SU	7.4
UA	G270	B	2014/10/14	pH (field)	SU	7.4
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	2008/03/11	Alkalinity, bicarbonate	mg/L CaCO3	450
UA	G270	B	2008/04/21	Alkalinity, bicarbonate	mg/L CaCO3	440
UA	G270	B	2008/06/11	Alkalinity, bicarbonate	mg/L CaCO3	440
UA	G270	B	2008/08/13	Alkalinity, bicarbonate	mg/L CaCO3	440
UA	G270	B	2008/10/14	Alkalinity, bicarbonate	mg/L CaCO3	420
UA	G270	B	2008/12/02	Alkalinity, bicarbonate	mg/L CaCO3	440
UA	G270	B	2010/02/11	Alkalinity, bicarbonate	mg/L CaCO3	400
UA	G270	B	2011/01/28	Alkalinity, bicarbonate	mg/L CaCO3	330
UA	G270	B	2012/01/26	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G270	B	2013/01/30	Alkalinity, bicarbonate	mg/L CaCO3	240
UA	G270	B	2014/02/19	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G270	B	2014/08/11	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G270	B	2014/10/14	Alkalinity, bicarbonate	mg/L CaCO3	280
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	2008/03/11	Arsenic, total	mg/L	<0.005
UA	G270	B	2008/04/21	Arsenic, total	mg/L	0.00160
UA	G270	B	2008/06/11	Arsenic, total	mg/L	0.00120
UA	G270	B	2008/08/13	Arsenic, total	mg/L	<0.001
UA	G270	B	2008/10/14	Arsenic, total	mg/L	<0.001
UA	G270	B	2008/12/02	Arsenic, total	mg/L	<0.001
UA	G270	B	2009/09/21	Arsenic, total	mg/L	<0.001
UA	G270	B	2009/11/10	Arsenic, total	mg/L	<0.001

UA	G270	B	2010/01/28	Arsenic, total	mg/L	<0.001
UA	G270	B	2010/07/27	Arsenic, total	mg/L	<0.001
UA	G270	B	2010/11/15	Arsenic, total	mg/L	0.00110
UA	G270	B	2011/01/28	Arsenic, total	mg/L	<0.001
UA	G270	B	2011/05/03	Arsenic, total	mg/L	<0.001
UA	G270	B	2011/07/27	Arsenic, total	mg/L	<0.001
UA	G270	B	2011/11/11	Arsenic, total	mg/L	<0.001
UA	G270	B	2012/01/26	Arsenic, total	mg/L	<0.001
UA	G270	B	2012/05/22	Arsenic, total	mg/L	<0.001
UA	G270	B	2012/07/24	Arsenic, total	mg/L	<0.001
UA	G270	B	2012/11/14	Arsenic, total	mg/L	<0.001
UA	G270	B	2013/01/30	Arsenic, total	mg/L	<0.001
UA	G270	B	2013/05/20	Arsenic, total	mg/L	<0.001
UA	G270	B	2013/07/22	Arsenic, total	mg/L	<0.001
UA	G270	B	2013/10/14	Arsenic, total	mg/L	<0.001
UA	G270	B	2014/02/19	Arsenic, total	mg/L	<0.001
UA	G270	B	2014/05/13	Arsenic, total	mg/L	0.00130
UA	G270	B	2014/08/11	Arsenic, total	mg/L	0.00340
UA	G270	B	2014/10/14	Arsenic, total	mg/L	0.0110
UA	G270	B	2015/01/20	Arsenic, total	mg/L	<0.001
UA	G270	B	2015/04/13	Arsenic, total	mg/L	<0.001
UA	G270	B	2015/07/22	Arsenic, total	mg/L	<0.001
UA	G270	B	2015/10/05	Arsenic, total	mg/L	<0.001
UA	G270	B	2015/11/20	Arsenic, total	mg/L	0.00100
UA	G270	B	2016/02/10	Arsenic, total	mg/L	<0.00013
UA	G270	B	2016/05/12	Arsenic, total	mg/L	<0.00013
UA	G270	B	2016/08/01	Arsenic, total	mg/L	<0.00013
UA	G270	B	2016/11/16	Arsenic, total	mg/L	<0.00013
UA	G270	B	2017/02/10	Arsenic, total	mg/L	<0.00013
UA	G270	B	2017/05/16	Arsenic, total	mg/L	<0.00013
UA	G270	B	2017/07/12	Arsenic, total	mg/L	<0.00013
UA	G270	B	2018/05/11	Arsenic, total	mg/L	<0.00072
UA	G270	B	2018/08/03	Arsenic, total	mg/L	<0.0009
UA	G270	B	2019/01/21	Arsenic, total	mg/L	<0.0009
UA	G270	B	2019/08/15	Arsenic, total	mg/L	<0.0009
UA	G270	B	2020/01/24	Arsenic, total	mg/L	<0.0009
UA	G270	B	2020/08/12	Arsenic, total	mg/L	<0.00022
UA	G270	B	2020/10/14	Arsenic, total	mg/L	<0.001
UA	G270	B	2021/01/21	Arsenic, total	mg/L	<0.00022
UA	G270	B	2021/03/30	Arsenic, total	mg/L	<0.00022
UA	G270	B	2021/04/21	Arsenic, total	mg/L	<0.00022
UA	G270	B	2021/05/06	Arsenic, total	mg/L	<0.00022
UA	G270	B	2021/05/19	Arsenic, total	mg/L	<0.00022
UA	G270	B	2021/06/15	Arsenic, total	mg/L	<0.00022
UA	G270	B	2021/06/29	Arsenic, total	mg/L	<0.00022
UA	G270	B	2021/07/12	Arsenic, total	mg/L	<0.00022
UA	G270	B	2021/07/27	Arsenic, total	mg/L	<0.00022
UA	G270	B	2021/08/18	Arsenic, total	mg/L	<0.00022
UA	G270	B	2021/10/26	Arsenic, total	mg/L	<0.001
UA	G270	B	2022/02/08	Arsenic, total	mg/L	<0.00069
UA	G270	B	2022/05/10	Arsenic, total	mg/L	<0.00069
UA	G270	B	2022/08/24	Arsenic, total	mg/L	<0.00069
UA	G270	B	2022/11/08	Arsenic, total	mg/L	<0.00069
UA	G270	B	2023/02/16	Arsenic, total	mg/L	<0.00069
UA	G270	B	2023/06/08	Arsenic, total	mg/L	0.00110
UA	G270	B	2023/08/14	Arsenic, total	mg/L	<0.0004
UA	G270	B	2023/11/17	Arsenic, total	mg/L	0.000500
UA	G270	B	2008/03/11	Barium, total	mg/L	0.0760
UA	G270	B	2008/04/21	Barium, total	mg/L	0.0760
UA	G270	B	2008/06/11	Barium, total	mg/L	0.0720
UA	G270	B	2008/08/13	Barium, total	mg/L	0.0690
UA	G270	B	2008/10/14	Barium, total	mg/L	0.0680

UA	G270	B	2008/12/02	Barium, total	mg/L	0.0680
UA	G270	B	2010/02/11	Barium, total	mg/L	0.0560
UA	G270	B	2011/01/28	Barium, total	mg/L	0.0640
UA	G270	B	2012/01/26	Barium, total	mg/L	0.0490
UA	G270	B	2013/01/30	Barium, total	mg/L	0.0620
UA	G270	B	2014/02/19	Barium, total	mg/L	0.0410
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	2008/03/11	Calcium, total	mg/L	77.0
UA	G270	B	2008/04/21	Calcium, total	mg/L	72.0
UA	G270	B	2008/06/11	Calcium, total	mg/L	70.0
UA	G270	B	2008/08/13	Calcium, total	mg/L	67.0
UA	G270	B	2008/10/14	Calcium, total	mg/L	71.0
UA	G270	B	2008/12/02	Calcium, total	mg/L	69.0
UA	G270	B	2009/09/21	Calcium, total	mg/L	77.0
UA	G270	B	2009/11/10	Calcium, total	mg/L	75.0
UA	G270	B	2010/01/28	Calcium, total	mg/L	74.0
UA	G270	B	2010/07/27	Calcium, total	mg/L	58.0
UA	G270	B	2010/11/15	Calcium, total	mg/L	60.0
UA	G270	B	2011/01/28	Calcium, total	mg/L	80.0
UA	G270	B	2011/05/03	Calcium, total	mg/L	<100
UA	G270	B	2011/07/27	Calcium, total	mg/L	59.0
UA	G270	B	2011/11/11	Calcium, total	mg/L	61.0
UA	G270	B	2012/01/26	Calcium, total	mg/L	64.0
UA	G270	B	2012/05/22	Calcium, total	mg/L	67.0
UA	G270	B	2012/07/24	Calcium, total	mg/L	73.0
UA	G270	B	2012/11/14	Calcium, total	mg/L	65.0

UA	G270	B	2013/01/30	Calcium, total	mg/L	65.0
UA	G270	B	2013/05/20	Calcium, total	mg/L	72.0
UA	G270	B	2013/07/22	Calcium, total	mg/L	70.0
UA	G270	B	2013/10/14	Calcium, total	mg/L	81.0
UA	G270	B	2014/02/19	Calcium, total	mg/L	67.0
UA	G270	B	2014/05/13	Calcium, total	mg/L	68.0
UA	G270	B	2014/08/11	Calcium, total	mg/L	62.0
UA	G270	B	2014/10/14	Calcium, total	mg/L	67.0
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	2008/03/11	Chloride, total	mg/L	9.50
UA	G270	B	2008/04/21	Chloride, total	mg/L	11.0
UA	G270	B	2008/06/11	Chloride, total	mg/L	<10
UA	G270	B	2008/08/13	Chloride, total	mg/L	8.90
UA	G270	B	2008/10/14	Chloride, total	mg/L	9.40
UA	G270	B	2008/12/02	Chloride, total	mg/L	9.60
UA	G270	B	2009/09/21	Chloride, total	mg/L	9.40
UA	G270	B	2009/11/10	Chloride, total	mg/L	11.0
UA	G270	B	2010/01/28	Chloride, total	mg/L	19.0
UA	G270	B	2010/07/27	Chloride, total	mg/L	40.0
UA	G270	B	2010/11/15	Chloride, total	mg/L	40.0
UA	G270	B	2011/01/28	Chloride, total	mg/L	45.0
UA	G270	B	2011/05/03	Chloride, total	mg/L	57.0
UA	G270	B	2011/07/27	Chloride, total	mg/L	57.0
UA	G270	B	2011/11/11	Chloride, total	mg/L	64.0
UA	G270	B	2012/01/26	Chloride, total	mg/L	73.0
UA	G270	B	2012/05/22	Chloride, total	mg/L	83.0

UA	G270	B	2012/07/24	Chloride, total	mg/L	66.0
UA	G270	B	2012/11/14	Chloride, total	mg/L	76.0
UA	G270	B	2013/01/30	Chloride, total	mg/L	91.0
UA	G270	B	2013/05/20	Chloride, total	mg/L	85.0
UA	G270	B	2013/07/22	Chloride, total	mg/L	79.0
UA	G270	B	2013/10/14	Chloride, total	mg/L	72.0
UA	G270	B	2014/02/19	Chloride, total	mg/L	56.0
UA	G270	B	2014/05/13	Chloride, total	mg/L	30.0
UA	G270	B	2014/08/11	Chloride, total	mg/L	34.0
UA	G270	B	2014/10/14	Chloride, total	mg/L	21.0
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	2023/06/08	Ferrous Iron, dissolved	mg/L	0.260
UA	G270	B	2008/03/11	Iron, dissolved	mg/L	<0.5
UA	G270	B	2008/04/21	Iron, dissolved	mg/L	0.530
UA	G270	B	2008/06/11	Iron, dissolved	mg/L	0.860
UA	G270	B	2008/08/13	Iron, dissolved	mg/L	0.730
UA	G270	B	2008/10/14	Iron, dissolved	mg/L	0.800
UA	G270	B	2008/12/02	Iron, dissolved	mg/L	0.700
UA	G270	B	2009/09/21	Iron, dissolved	mg/L	0.560
UA	G270	B	2009/11/10	Iron, dissolved	mg/L	0.370
UA	G270	B	2010/01/28	Iron, dissolved	mg/L	<0.1
UA	G270	B	2010/07/27	Iron, dissolved	mg/L	0.0460
UA	G270	B	2010/11/15	Iron, dissolved	mg/L	0.0530
UA	G270	B	2011/01/28	Iron, dissolved	mg/L	0.0340

UA	G270	B	2011/05/03	Iron, dissolved	mg/L	0.0120
UA	G270	B	2011/07/27	Iron, dissolved	mg/L	0.0150
UA	G270	B	2011/11/11	Iron, dissolved	mg/L	0.0320
UA	G270	B	2012/01/26	Iron, dissolved	mg/L	<0.01
UA	G270	B	2012/05/22	Iron, dissolved	mg/L	0.0140
UA	G270	B	2012/07/24	Iron, dissolved	mg/L	0.0180
UA	G270	B	2012/11/14	Iron, dissolved	mg/L	0.0440
UA	G270	B	2013/01/30	Iron, dissolved	mg/L	<0.01
UA	G270	B	2013/05/20	Iron, dissolved	mg/L	<0.01
UA	G270	B	2013/07/22	Iron, dissolved	mg/L	0.0460
UA	G270	B	2013/10/14	Iron, dissolved	mg/L	0.0620
UA	G270	B	2014/02/19	Iron, dissolved	mg/L	<0.01
UA	G270	B	2014/05/13	Iron, dissolved	mg/L	<0.01
UA	G270	B	2014/08/11	Iron, dissolved	mg/L	0.0300
UA	G270	B	2014/10/14	Iron, dissolved	mg/L	0.0300
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	2008/03/11	Magnesium, total	mg/L	39.0
UA	G270	B	2008/04/21	Magnesium, total	mg/L	34.0
UA	G270	B	2008/06/11	Magnesium, total	mg/L	33.0
UA	G270	B	2008/08/13	Magnesium, total	mg/L	31.0
UA	G270	B	2008/10/14	Magnesium, total	mg/L	34.0
UA	G270	B	2008/12/02	Magnesium, total	mg/L	32.0
UA	G270	B	2010/02/11	Magnesium, total	mg/L	30.0
UA	G270	B	2011/01/28	Magnesium, total	mg/L	37.0
UA	G270	B	2012/01/26	Magnesium, total	mg/L	29.0
UA	G270	B	2013/01/30	Magnesium, total	mg/L	29.0
UA	G270	B	2014/02/19	Magnesium, total	mg/L	27.0

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	2008/03/11	Manganese, dissolved	mg/L	0.190
UA	G270	B	2008/04/21	Manganese, dissolved	mg/L	0.210
UA	G270	B	2008/06/11	Manganese, dissolved	mg/L	0.210
UA	G270	B	2008/08/13	Manganese, dissolved	mg/L	0.260
UA	G270	B	2008/10/14	Manganese, dissolved	mg/L	0.220
UA	G270	B	2008/12/02	Manganese, dissolved	mg/L	0.220
UA	G270	B	2009/09/21	Manganese, dissolved	mg/L	0.260
UA	G270	B	2009/11/10	Manganese, dissolved	mg/L	0.230
UA	G270	B	2010/01/28	Manganese, dissolved	mg/L	0.140
UA	G270	B	2010/07/27	Manganese, dissolved	mg/L	0.0620
UA	G270	B	2010/11/15	Manganese, dissolved	mg/L	0.0690
UA	G270	B	2011/01/28	Manganese, dissolved	mg/L	0.0320
UA	G270	B	2011/05/03	Manganese, dissolved	mg/L	0.0230
UA	G270	B	2011/07/27	Manganese, dissolved	mg/L	0.0460
UA	G270	B	2011/11/11	Manganese, dissolved	mg/L	0.0500
UA	G270	B	2012/01/26	Manganese, dissolved	mg/L	0.00940
UA	G270	B	2012/05/22	Manganese, dissolved	mg/L	0.0400
UA	G270	B	2012/07/24	Manganese, dissolved	mg/L	0.0450
UA	G270	B	2012/11/14	Manganese, dissolved	mg/L	0.0170
UA	G270	B	2013/01/30	Manganese, dissolved	mg/L	0.0110
UA	G270	B	2013/05/20	Manganese, dissolved	mg/L	0.0250
UA	G270	B	2013/07/22	Manganese, dissolved	mg/L	0.0450
UA	G270	B	2013/10/14	Manganese, dissolved	mg/L	0.0410
UA	G270	B	2014/02/19	Manganese, dissolved	mg/L	0.00290
UA	G270	B	2014/05/13	Manganese, dissolved	mg/L	0.0160
UA	G270	B	2014/08/11	Manganese, dissolved	mg/L	0.0400
UA	G270	B	2014/10/14	Manganese, dissolved	mg/L	0.0400
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	2008/03/11	Potassium, total	mg/L	<2.5
UA	G270	B	2008/04/21	Potassium, total	mg/L	1.30
UA	G270	B	2008/06/11	Potassium, total	mg/L	1.50
UA	G270	B	2008/08/13	Potassium, total	mg/L	1.10
UA	G270	B	2008/10/14	Potassium, total	mg/L	1.10
UA	G270	B	2008/12/02	Potassium, total	mg/L	1.20
UA	G270	B	2010/02/11	Potassium, total	mg/L	0.780
UA	G270	B	2011/01/28	Potassium, total	mg/L	0.980
UA	G270	B	2012/01/26	Potassium, total	mg/L	0.680
UA	G270	B	2013/01/30	Potassium, total	mg/L	0.590
UA	G270	B	2014/02/19	Potassium, total	mg/L	0.570
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	2008/03/11	Sodium, total	mg/L	63.0
UA	G270	B	2008/04/21	Sodium, total	mg/L	65.0
UA	G270	B	2008/06/11	Sodium, total	mg/L	64.0
UA	G270	B	2008/08/13	Sodium, total	mg/L	72.0
UA	G270	B	2008/10/14	Sodium, total	mg/L	76.0
UA	G270	B	2008/12/02	Sodium, total	mg/L	71.0
UA	G270	B	2010/02/11	Sodium, total	mg/L	84.0
UA	G270	B	2011/01/28	Sodium, total	mg/L	74.0
UA	G270	B	2012/01/26	Sodium, total	mg/L	78.0

UA	G270	B	2013/01/30	Sodium, total	mg/L	78.0
UA	G270	B	2014/02/19	Sodium, total	mg/L	77.0
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	2008/03/11	Sulfate, total	mg/L	2.30
UA	G270	B	2008/04/21	Sulfate, total	mg/L	2.40
UA	G270	B	2008/06/11	Sulfate, total	mg/L	2.80
UA	G270	B	2008/08/13	Sulfate, total	mg/L	4.20
UA	G270	B	2008/10/14	Sulfate, total	mg/L	4.70
UA	G270	B	2008/12/02	Sulfate, total	mg/L	4.40
UA	G270	B	2009/09/21	Sulfate, total	mg/L	3.20
UA	G270	B	2009/11/10	Sulfate, total	mg/L	5.10
UA	G270	B	2010/01/28	Sulfate, total	mg/L	8.20
UA	G270	B	2010/07/27	Sulfate, total	mg/L	9.10
UA	G270	B	2010/11/15	Sulfate, total	mg/L	7.60
UA	G270	B	2011/01/28	Sulfate, total	mg/L	9.60
UA	G270	B	2011/05/03	Sulfate, total	mg/L	13.0
UA	G270	B	2011/07/27	Sulfate, total	mg/L	18.0
UA	G270	B	2011/11/11	Sulfate, total	mg/L	23.0
UA	G270	B	2012/01/26	Sulfate, total	mg/L	40.0
UA	G270	B	2012/05/22	Sulfate, total	mg/L	57.0
UA	G270	B	2012/07/24	Sulfate, total	mg/L	43.0
UA	G270	B	2012/11/14	Sulfate, total	mg/L	77.0
UA	G270	B	2013/01/30	Sulfate, total	mg/L	96.0
UA	G270	B	2013/05/20	Sulfate, total	mg/L	120
UA	G270	B	2013/07/22	Sulfate, total	mg/L	120
UA	G270	B	2013/10/14	Sulfate, total	mg/L	85.0
UA	G270	B	2014/02/19	Sulfate, total	mg/L	140
UA	G270	B	2014/05/13	Sulfate, total	mg/L	140
UA	G270	B	2014/08/11	Sulfate, total	mg/L	130
UA	G270	B	2014/10/14	Sulfate, total	mg/L	140
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	2008/03/11	Total Dissolved Solids	mg/L	440
UA	G270	B	2008/04/21	Total Dissolved Solids	mg/L	420
UA	G270	B	2008/06/11	Total Dissolved Solids	mg/L	430
UA	G270	B	2008/08/13	Total Dissolved Solids	mg/L	440
UA	G270	B	2008/10/14	Total Dissolved Solids	mg/L	440
UA	G270	B	2008/12/02	Total Dissolved Solids	mg/L	400
UA	G270	B	2009/09/21	Total Dissolved Solids	mg/L	430
UA	G270	B	2009/11/10	Total Dissolved Solids	mg/L	450
UA	G270	B	2010/01/28	Total Dissolved Solids	mg/L	430
UA	G270	B	2010/02/11	Total Dissolved Solids	mg/L	460
UA	G270	B	2010/07/27	Total Dissolved Solids	mg/L	480
UA	G270	B	2010/11/15	Total Dissolved Solids	mg/L	490
UA	G270	B	2011/01/28	Total Dissolved Solids	mg/L	470
UA	G270	B	2011/05/03	Total Dissolved Solids	mg/L	430
UA	G270	B	2011/07/27	Total Dissolved Solids	mg/L	480
UA	G270	B	2011/11/11	Total Dissolved Solids	mg/L	440
UA	G270	B	2012/01/26	Total Dissolved Solids	mg/L	420
UA	G270	B	2012/05/22	Total Dissolved Solids	mg/L	460
UA	G270	B	2012/07/24	Total Dissolved Solids	mg/L	480
UA	G270	B	2012/11/14	Total Dissolved Solids	mg/L	500
UA	G270	B	2013/01/30	Total Dissolved Solids	mg/L	540
UA	G270	B	2013/05/20	Total Dissolved Solids	mg/L	480
UA	G270	B	2013/07/22	Total Dissolved Solids	mg/L	500
UA	G270	B	2013/10/14	Total Dissolved Solids	mg/L	520
UA	G270	B	2014/02/19	Total Dissolved Solids	mg/L	500
UA	G270	B	2014/05/13	Total Dissolved Solids	mg/L	500
UA	G270	B	2014/08/11	Total Dissolved Solids	mg/L	500
UA	G270	B	2014/10/14	Total Dissolved Solids	mg/L	500
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	2010/07/27	pH (field)	SU	7.3
UA	G280	B	2010/11/16	pH (field)	SU	7.9
UA	G280	B	2011/01/28	pH (field)	SU	7.3
UA	G280	B	2011/05/04	pH (field)	SU	7.2
UA	G280	B	2011/07/27	pH (field)	SU	7.2
UA	G280	B	2011/11/11	pH (field)	SU	7.8
UA	G280	B	2012/01/30	pH (field)	SU	7.3
UA	G280	B	2012/05/22	pH (field)	SU	7.5
UA	G280	B	2012/07/24	pH (field)	SU	7.1
UA	G280	B	2012/11/14	pH (field)	SU	7.7
UA	G280	B	2013/01/31	pH (field)	SU	7.5
UA	G280	B	2013/05/20	pH (field)	SU	7.3
UA	G280	B	2013/07/22	pH (field)	SU	7.3
UA	G280	B	2013/10/14	pH (field)	SU	7.4
UA	G280	B	2014/02/19	pH (field)	SU	7.7
UA	G280	B	2014/05/13	pH (field)	SU	7.2
UA	G280	B	2014/08/12	pH (field)	SU	7.6
UA	G280	B	2014/10/14	pH (field)	SU	7.5
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	2008/03/11	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G280	B	2008/04/21	Alkalinity, bicarbonate	mg/L CaCO3	270
UA	G280	B	2008/06/11	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G280	B	2008/08/13	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G280	B	2008/10/13	Alkalinity, bicarbonate	mg/L CaCO3	250
UA	G280	B	2008/12/03	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G280	B	2010/02/11	Alkalinity, bicarbonate	mg/L CaCO3	230
UA	G280	B	2011/01/28	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G280	B	2012/01/30	Alkalinity, bicarbonate	mg/L CaCO3	250
UA	G280	B	2013/01/31	Alkalinity, bicarbonate	mg/L CaCO3	220
UA	G280	B	2014/02/19	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G280	B	2014/08/12	Alkalinity, bicarbonate	mg/L CaCO3	270
UA	G280	B	2014/10/14	Alkalinity, bicarbonate	mg/L CaCO3	280
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	2008/03/11	Arsenic, total	mg/L	<0.01
UA	G280	B	2008/04/21	Arsenic, total	mg/L	<0.001
UA	G280	B	2008/06/11	Arsenic, total	mg/L	<0.001
UA	G280	B	2008/08/13	Arsenic, total	mg/L	<0.001
UA	G280	B	2008/10/13	Arsenic, total	mg/L	<0.001
UA	G280	B	2008/12/03	Arsenic, total	mg/L	<0.001
UA	G280	B	2009/09/21	Arsenic, total	mg/L	<0.001
UA	G280	B	2009/11/12	Arsenic, total	mg/L	<0.001
UA	G280	B	2010/01/28	Arsenic, total	mg/L	<0.001
UA	G280	B	2010/07/27	Arsenic, total	mg/L	<0.001
UA	G280	B	2010/11/16	Arsenic, total	mg/L	<0.001
UA	G280	B	2011/01/28	Arsenic, total	mg/L	0.00120
UA	G280	B	2011/05/04	Arsenic, total	mg/L	<0.001
UA	G280	B	2011/07/27	Arsenic, total	mg/L	<0.001
UA	G280	B	2011/11/11	Arsenic, total	mg/L	<0.001
UA	G280	B	2012/01/30	Arsenic, total	mg/L	<0.001
UA	G280	B	2012/05/22	Arsenic, total	mg/L	<0.001
UA	G280	B	2012/07/24	Arsenic, total	mg/L	<0.001
UA	G280	B	2012/11/14	Arsenic, total	mg/L	0.00210
UA	G280	B	2013/01/31	Arsenic, total	mg/L	<0.001
UA	G280	B	2013/05/20	Arsenic, total	mg/L	<0.001
UA	G280	B	2013/07/22	Arsenic, total	mg/L	<0.001

UA	G280	B	2013/10/14	Arsenic, total	mg/L	<0.001
UA	G280	B	2014/02/19	Arsenic, total	mg/L	<0.001
UA	G280	B	2014/05/13	Arsenic, total	mg/L	0.00140
UA	G280	B	2014/08/12	Arsenic, total	mg/L	<0.001
UA	G280	B	2014/10/14	Arsenic, total	mg/L	0.00120
UA	G280	B	2015/01/21	Arsenic, total	mg/L	<0.001
UA	G280	B	2015/04/13	Arsenic, total	mg/L	<0.001
UA	G280	B	2015/07/23	Arsenic, total	mg/L	<0.001
UA	G280	B	2015/10/08	Arsenic, total	mg/L	<0.001
UA	G280	B	2015/11/24	Arsenic, total	mg/L	0.00660
UA	G280	B	2016/02/10	Arsenic, total	mg/L	<0.00013
UA	G280	B	2016/05/10	Arsenic, total	mg/L	<0.00013
UA	G280	B	2016/08/03	Arsenic, total	mg/L	<0.00013
UA	G280	B	2016/11/20	Arsenic, total	mg/L	<0.00013
UA	G280	B	2017/02/15	Arsenic, total	mg/L	0.00170
UA	G280	B	2017/05/20	Arsenic, total	mg/L	<0.00013
UA	G280	B	2017/07/18	Arsenic, total	mg/L	<0.00013
UA	G280	B	2018/05/16	Arsenic, total	mg/L	0.00110
UA	G280	B	2018/08/10	Arsenic, total	mg/L	<0.0009
UA	G280	B	2019/01/22	Arsenic, total	mg/L	0.00350
UA	G280	B	2019/08/26	Arsenic, total	mg/L	<0.0009
UA	G280	B	2020/01/23	Arsenic, total	mg/L	<0.0009
UA	G280	B	2020/08/11	Arsenic, total	mg/L	0.00340
UA	G280	B	2020/10/14	Arsenic, total	mg/L	<0.001
UA	G280	B	2021/01/21	Arsenic, total	mg/L	<0.001
UA	G280	B	2021/01/28	Arsenic, total	mg/L	<0.00022
UA	G280	B	2021/03/30	Arsenic, total	mg/L	<0.00022
UA	G280	B	2021/04/22	Arsenic, total	mg/L	<0.00022
UA	G280	B	2021/05/06	Arsenic, total	mg/L	<0.00022
UA	G280	B	2021/05/19	Arsenic, total	mg/L	<0.00022
UA	G280	B	2021/06/16	Arsenic, total	mg/L	<0.00022
UA	G280	B	2021/06/28	Arsenic, total	mg/L	<0.0002
UA	G280	B	2021/07/13	Arsenic, total	mg/L	<0.00022
UA	G280	B	2021/07/27	Arsenic, total	mg/L	<0.00022
UA	G280	B	2021/08/18	Arsenic, total	mg/L	<0.00022
UA	G280	B	2021/10/26	Arsenic, total	mg/L	<0.001
UA	G280	B	2022/02/08	Arsenic, total	mg/L	<0.0002
UA	G280	B	2022/05/10	Arsenic, total	mg/L	<0.00069
UA	G280	B	2022/08/24	Arsenic, total	mg/L	<0.00069
UA	G280	B	2022/11/09	Arsenic, total	mg/L	0.000900
UA	G280	B	2023/02/16	Arsenic, total	mg/L	0.00140
UA	G280	B	2023/06/08	Arsenic, total	mg/L	0.000770
UA	G280	B	2023/08/14	Arsenic, total	mg/L	<0.0004
UA	G280	B	2023/11/20	Arsenic, total	mg/L	0.000500
UA	G280	B	2008/03/11	Barium, total	mg/L	0.0490
UA	G280	B	2008/04/21	Barium, total	mg/L	0.0580
UA	G280	B	2008/06/11	Barium, total	mg/L	0.0520
UA	G280	B	2008/08/13	Barium, total	mg/L	0.0530
UA	G280	B	2008/10/13	Barium, total	mg/L	0.0500
UA	G280	B	2008/12/03	Barium, total	mg/L	0.110
UA	G280	B	2010/02/11	Barium, total	mg/L	0.0390
UA	G280	B	2011/01/28	Barium, total	mg/L	0.0820
UA	G280	B	2012/01/30	Barium, total	mg/L	0.0470
UA	G280	B	2013/01/31	Barium, total	mg/L	0.0360
UA	G280	B	2014/02/19	Barium, total	mg/L	0.0410
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	2008/03/11	Calcium, total	mg/L	63.0
UA	G280	B	2008/04/21	Calcium, total	mg/L	59.0
UA	G280	B	2008/06/11	Calcium, total	mg/L	66.0
UA	G280	B	2008/08/13	Calcium, total	mg/L	63.0
UA	G280	B	2008/10/13	Calcium, total	mg/L	69.0
UA	G280	B	2008/12/03	Calcium, total	mg/L	120
UA	G280	B	2009/09/21	Calcium, total	mg/L	59.0
UA	G280	B	2009/11/12	Calcium, total	mg/L	61.0
UA	G280	B	2010/01/28	Calcium, total	mg/L	60.0
UA	G280	B	2010/07/27	Calcium, total	mg/L	60.0
UA	G280	B	2010/11/16	Calcium, total	mg/L	58.0
UA	G280	B	2011/01/28	Calcium, total	mg/L	100
UA	G280	B	2011/05/04	Calcium, total	mg/L	<100
UA	G280	B	2011/07/27	Calcium, total	mg/L	63.0
UA	G280	B	2011/11/11	Calcium, total	mg/L	60.0
UA	G280	B	2012/01/30	Calcium, total	mg/L	81.0
UA	G280	B	2012/05/22	Calcium, total	mg/L	65.0
UA	G280	B	2012/07/24	Calcium, total	mg/L	72.0
UA	G280	B	2012/11/14	Calcium, total	mg/L	63.0
UA	G280	B	2013/01/31	Calcium, total	mg/L	63.0
UA	G280	B	2013/05/20	Calcium, total	mg/L	67.0
UA	G280	B	2013/07/22	Calcium, total	mg/L	73.0
UA	G280	B	2013/10/14	Calcium, total	mg/L	72.0
UA	G280	B	2014/02/19	Calcium, total	mg/L	69.0
UA	G280	B	2014/05/13	Calcium, total	mg/L	73.0
UA	G280	B	2014/08/12	Calcium, total	mg/L	75.0
UA	G280	B	2014/10/14	Calcium, total	mg/L	76.0
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	2008/03/11	Chloride, total	mg/L	47.0
UA	G280	B	2008/04/21	Chloride, total	mg/L	51.0
UA	G280	B	2008/06/11	Chloride, total	mg/L	43.0
UA	G280	B	2008/08/13	Chloride, total	mg/L	44.0
UA	G280	B	2008/10/13	Chloride, total	mg/L	45.0
UA	G280	B	2008/12/03	Chloride, total	mg/L	110
UA	G280	B	2009/09/21	Chloride, total	mg/L	40.0
UA	G280	B	2009/11/12	Chloride, total	mg/L	40.0
UA	G280	B	2010/01/28	Chloride, total	mg/L	41.0
UA	G280	B	2010/07/27	Chloride, total	mg/L	60.0
UA	G280	B	2010/11/16	Chloride, total	mg/L	35.0
UA	G280	B	2011/01/28	Chloride, total	mg/L	57.0
UA	G280	B	2011/05/04	Chloride, total	mg/L	87.0
UA	G280	B	2011/07/27	Chloride, total	mg/L	45.0
UA	G280	B	2011/11/11	Chloride, total	mg/L	51.0
UA	G280	B	2012/01/30	Chloride, total	mg/L	54.0
UA	G280	B	2012/05/22	Chloride, total	mg/L	67.0
UA	G280	B	2012/07/24	Chloride, total	mg/L	48.0
UA	G280	B	2012/11/14	Chloride, total	mg/L	46.0
UA	G280	B	2013/01/31	Chloride, total	mg/L	46.0
UA	G280	B	2013/05/20	Chloride, total	mg/L	59.0
UA	G280	B	2013/07/22	Chloride, total	mg/L	52.0
UA	G280	B	2013/10/14	Chloride, total	mg/L	51.0
UA	G280	B	2014/02/19	Chloride, total	mg/L	56.0
UA	G280	B	2014/05/13	Chloride, total	mg/L	55.0
UA	G280	B	2014/08/12	Chloride, total	mg/L	55.0
UA	G280	B	2014/10/14	Chloride, total	mg/L	60.0
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	2023/06/08	Ferrous Iron, dissolved	mg/L	<0.02
UA	G280	B	2008/03/11	Iron, dissolved	mg/L	<1
UA	G280	B	2008/04/21	Iron, dissolved	mg/L	<0.1
UA	G280	B	2008/06/11	Iron, dissolved	mg/L	<0.1
UA	G280	B	2008/08/13	Iron, dissolved	mg/L	<0.1
UA	G280	B	2008/10/13	Iron, dissolved	mg/L	<0.1
UA	G280	B	2008/12/03	Iron, dissolved	mg/L	<0.1
UA	G280	B	2009/09/21	Iron, dissolved	mg/L	<0.1
UA	G280	B	2009/11/12	Iron, dissolved	mg/L	<0.1
UA	G280	B	2010/01/28	Iron, dissolved	mg/L	<0.1
UA	G280	B	2010/07/27	Iron, dissolved	mg/L	<0.01
UA	G280	B	2010/11/16	Iron, dissolved	mg/L	<0.01
UA	G280	B	2011/01/28	Iron, dissolved	mg/L	0.0230
UA	G280	B	2011/05/04	Iron, dissolved	mg/L	<0.01
UA	G280	B	2011/07/27	Iron, dissolved	mg/L	<0.01
UA	G280	B	2011/11/11	Iron, dissolved	mg/L	0.0140
UA	G280	B	2012/01/30	Iron, dissolved	mg/L	0.0230
UA	G280	B	2012/05/22	Iron, dissolved	mg/L	<0.01
UA	G280	B	2012/07/24	Iron, dissolved	mg/L	<0.01
UA	G280	B	2012/11/14	Iron, dissolved	mg/L	<0.01
UA	G280	B	2013/01/31	Iron, dissolved	mg/L	<0.01
UA	G280	B	2013/05/20	Iron, dissolved	mg/L	<0.01
UA	G280	B	2013/07/22	Iron, dissolved	mg/L	<0.01

UA	G280	B	2013/10/14	Iron, dissolved	mg/L	<0.01
UA	G280	B	2014/02/19	Iron, dissolved	mg/L	0.0270
UA	G280	B	2014/05/13	Iron, dissolved	mg/L	<0.01
UA	G280	B	2014/08/12	Iron, dissolved	mg/L	<0.01
UA	G280	B	2014/10/14	Iron, dissolved	mg/L	0.0120
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	2008/03/11	Magnesium, total	mg/L	35.0
UA	G280	B	2008/04/21	Magnesium, total	mg/L	32.0
UA	G280	B	2008/06/11	Magnesium, total	mg/L	33.0
UA	G280	B	2008/08/13	Magnesium, total	mg/L	32.0
UA	G280	B	2008/10/13	Magnesium, total	mg/L	36.0
UA	G280	B	2008/12/03	Magnesium, total	mg/L	55.0
UA	G280	B	2010/02/11	Magnesium, total	mg/L	30.0
UA	G280	B	2011/01/28	Magnesium, total	mg/L	47.0
UA	G280	B	2012/01/30	Magnesium, total	mg/L	31.0
UA	G280	B	2013/01/31	Magnesium, total	mg/L	31.0
UA	G280	B	2014/02/19	Magnesium, total	mg/L	34.0
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	2008/03/11	Manganese, dissolved	mg/L	0.110
UA	G280	B	2008/04/21	Manganese, dissolved	mg/L	0.180
UA	G280	B	2008/06/11	Manganese, dissolved	mg/L	0.130
UA	G280	B	2008/08/13	Manganese, dissolved	mg/L	0.130
UA	G280	B	2008/10/13	Manganese, dissolved	mg/L	0.0780
UA	G280	B	2008/12/03	Manganese, dissolved	mg/L	0.240
UA	G280	B	2009/09/21	Manganese, dissolved	mg/L	0.0120
UA	G280	B	2009/11/12	Manganese, dissolved	mg/L	0.0190
UA	G280	B	2010/01/28	Manganese, dissolved	mg/L	0.00690
UA	G280	B	2010/07/27	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2010/11/16	Manganese, dissolved	mg/L	0.0180
UA	G280	B	2011/01/28	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2011/05/04	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2011/07/27	Manganese, dissolved	mg/L	0.0150
UA	G280	B	2011/11/11	Manganese, dissolved	mg/L	0.00330
UA	G280	B	2012/01/30	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2012/05/22	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2012/07/24	Manganese, dissolved	mg/L	0.00730
UA	G280	B	2012/11/14	Manganese, dissolved	mg/L	0.00810
UA	G280	B	2013/01/31	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2013/05/20	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2013/07/22	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2013/10/14	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2014/02/19	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2014/05/13	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2014/08/12	Manganese, dissolved	mg/L	<0.001
UA	G280	B	2014/10/14	Manganese, dissolved	mg/L	<0.001
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	2008/03/11	Potassium, total	mg/L	<5
UA	G280	B	2008/04/21	Potassium, total	mg/L	1.20
UA	G280	B	2008/06/11	Potassium, total	mg/L	1.00
UA	G280	B	2008/08/13	Potassium, total	mg/L	1.20
UA	G280	B	2008/10/13	Potassium, total	mg/L	0.850
UA	G280	B	2008/12/03	Potassium, total	mg/L	0.870
UA	G280	B	2010/02/11	Potassium, total	mg/L	0.640
UA	G280	B	2011/01/28	Potassium, total	mg/L	0.870
UA	G280	B	2012/01/30	Potassium, total	mg/L	0.610
UA	G280	B	2013/01/31	Potassium, total	mg/L	0.730
UA	G280	B	2014/02/19	Potassium, total	mg/L	0.430
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	2008/03/11	Sodium, total	mg/L	48.0
UA	G280	B	2008/04/21	Sodium, total	mg/L	49.0
UA	G280	B	2008/06/11	Sodium, total	mg/L	50.0
UA	G280	B	2008/08/13	Sodium, total	mg/L	50.0
UA	G280	B	2008/10/13	Sodium, total	mg/L	54.0
UA	G280	B	2008/12/03	Sodium, total	mg/L	97.0
UA	G280	B	2010/02/11	Sodium, total	mg/L	58.0
UA	G280	B	2011/01/28	Sodium, total	mg/L	82.0
UA	G280	B	2012/01/30	Sodium, total	mg/L	91.0
UA	G280	B	2013/01/31	Sodium, total	mg/L	47.0
UA	G280	B	2014/02/19	Sodium, total	mg/L	50.0
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	2008/03/11	Sulfate, total	mg/L	60.0
UA	G280	B	2008/04/21	Sulfate, total	mg/L	58.0
UA	G280	B	2008/06/11	Sulfate, total	mg/L	62.0
UA	G280	B	2008/08/13	Sulfate, total	mg/L	59.0
UA	G280	B	2008/10/13	Sulfate, total	mg/L	60.0
UA	G280	B	2008/12/03	Sulfate, total	mg/L	230
UA	G280	B	2009/09/21	Sulfate, total	mg/L	43.0
UA	G280	B	2009/11/12	Sulfate, total	mg/L	42.0
UA	G280	B	2010/01/28	Sulfate, total	mg/L	47.0
UA	G280	B	2010/07/27	Sulfate, total	mg/L	80.0
UA	G280	B	2010/11/16	Sulfate, total	mg/L	43.0
UA	G280	B	2011/01/28	Sulfate, total	mg/L	76.0
UA	G280	B	2011/05/04	Sulfate, total	mg/L	98.0
UA	G280	B	2011/07/27	Sulfate, total	mg/L	54.0
UA	G280	B	2011/11/11	Sulfate, total	mg/L	59.0
UA	G280	B	2012/01/30	Sulfate, total	mg/L	68.0
UA	G280	B	2012/05/22	Sulfate, total	mg/L	93.0
UA	G280	B	2012/07/24	Sulfate, total	mg/L	51.0
UA	G280	B	2012/11/14	Sulfate, total	mg/L	48.0
UA	G280	B	2013/01/31	Sulfate, total	mg/L	54.0
UA	G280	B	2013/05/20	Sulfate, total	mg/L	71.0
UA	G280	B	2013/07/22	Sulfate, total	mg/L	67.0
UA	G280	B	2013/10/14	Sulfate, total	mg/L	65.0
UA	G280	B	2014/02/19	Sulfate, total	mg/L	74.0
UA	G280	B	2014/05/13	Sulfate, total	mg/L	78.0
UA	G280	B	2014/08/12	Sulfate, total	mg/L	76.0
UA	G280	B	2014/10/14	Sulfate, total	mg/L	83.0
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	2008/03/11	Total Dissolved Solids	mg/L	420
UA	G280	B	2008/04/21	Total Dissolved Solids	mg/L	400
UA	G280	B	2008/06/11	Total Dissolved Solids	mg/L	430
UA	G280	B	2008/08/13	Total Dissolved Solids	mg/L	410
UA	G280	B	2008/10/13	Total Dissolved Solids	mg/L	450
UA	G280	B	2008/12/03	Total Dissolved Solids	mg/L	760
UA	G280	B	2009/09/21	Total Dissolved Solids	mg/L	380
UA	G280	B	2009/11/12	Total Dissolved Solids	mg/L	370
UA	G280	B	2010/01/28	Total Dissolved Solids	mg/L	400
UA	G280	B	2010/02/11	Total Dissolved Solids	mg/L	440
UA	G280	B	2010/07/27	Total Dissolved Solids	mg/L	520
UA	G280	B	2010/11/16	Total Dissolved Solids	mg/L	370
UA	G280	B	2011/01/28	Total Dissolved Solids	mg/L	500
UA	G280	B	2011/05/04	Total Dissolved Solids	mg/L	560
UA	G280	B	2011/07/27	Total Dissolved Solids	mg/L	420
UA	G280	B	2011/11/11	Total Dissolved Solids	mg/L	390
UA	G280	B	2012/01/30	Total Dissolved Solids	mg/L	440
UA	G280	B	2012/05/22	Total Dissolved Solids	mg/L	470
UA	G280	B	2012/07/24	Total Dissolved Solids	mg/L	360

UA	G280	B	2012/11/14	Total Dissolved Solids	mg/L	440
UA	G280	B	2013/01/31	Total Dissolved Solids	mg/L	380
UA	G280	B	2013/05/20	Total Dissolved Solids	mg/L	410
UA	G280	B	2013/07/22	Total Dissolved Solids	mg/L	400
UA	G280	B	2013/10/14	Total Dissolved Solids	mg/L	480
UA	G280	B	2014/02/19	Total Dissolved Solids	mg/L	440
UA	G280	B	2014/05/13	Total Dissolved Solids	mg/L	440
UA	G280	B	2014/08/12	Total Dissolved Solids	mg/L	490
UA	G280	B	2014/10/14	Total Dissolved Solids	mg/L	480
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	G271	C	2010/07/27	pH (field)	SU	7.2
UA	G271	C	2010/07/28	pH (field)	SU	7.2
UA	G271	C	2010/09/20	pH (field)	SU	7.8
UA	G271	C	2010/11/16	pH (field)	SU	7.8
UA	G271	C	2011/01/28	pH (field)	SU	7.3
UA	G271	C	2011/05/04	pH (field)	SU	7.3
UA	G271	C	2011/07/27	pH (field)	SU	7.4
UA	G271	C	2011/11/14	pH (field)	SU	7.3
UA	G271	C	2012/01/26	pH (field)	SU	7.6
UA	G271	C	2012/05/22	pH (field)	SU	7.4
UA	G271	C	2012/07/24	pH (field)	SU	7.2
UA	G271	C	2012/11/14	pH (field)	SU	7.4
UA	G271	C	2013/01/31	pH (field)	SU	7.4

UA	G271	C	2013/05/20	pH (field)	SU	7.3
UA	G271	C	2013/07/22	pH (field)	SU	7.1
UA	G271	C	2013/10/14	pH (field)	SU	7.1
UA	G271	C	2014/02/19	pH (field)	SU	7.3
UA	G271	C	2014/05/13	pH (field)	SU	6.8
UA	G271	C	2014/08/11	pH (field)	SU	7.5
UA	G271	C	2014/10/14	pH (field)	SU	7.4
UA	G271	C	2015/01/21	pH (field)	SU	7.5
UA	G271	C	2015/04/10	pH (field)	SU	7.3
UA	G271	C	2015/07/22	pH (field)	SU	7.2
UA	G271	C	2015/10/08	pH (field)	SU	7.0
UA	G271	C	2015/11/23	pH (field)	SU	7.3
UA	G271	C	2016/02/16	pH (field)	SU	7.5
UA	G271	C	2016/05/12	pH (field)	SU	7.2
UA	G271	C	2016/08/05	pH (field)	SU	7.2
UA	G271	C	2016/11/21	pH (field)	SU	7.2
UA	G271	C	2017/02/11	pH (field)	SU	7.2
UA	G271	C	2017/05/20	pH (field)	SU	7.1
UA	G271	C	2017/07/17	pH (field)	SU	7.1
UA	G271	C	2017/11/04	pH (field)	SU	7.3
UA	G271	C	2018/05/16	pH (field)	SU	7.3
UA	G271	C	2018/08/10	pH (field)	SU	7.1
UA	G271	C	2019/01/22	pH (field)	SU	7.2
UA	G271	C	2019/08/26	pH (field)	SU	7.2
UA	G271	C	2020/01/22	pH (field)	SU	7.2
UA	G271	C	2020/08/13	pH (field)	SU	7.2
UA	G271	C	2020/10/14	pH (field)	SU	7.2
UA	G271	C	2021/02/01	pH (field)	SU	7.2
UA	G271	C	2021/05/20	pH (field)	SU	6.9
UA	G271	C	2021/08/18	pH (field)	SU	7.2
UA	G271	C	2021/10/27	pH (field)	SU	7.2
UA	G271	C	2022/02/10	pH (field)	SU	7.3
UA	G271	C	2022/03/21	pH (field)	SU	7.4
UA	G271	C	2022/03/29	pH (field)	SU	7.3
UA	G271	C	2022/05/11	pH (field)	SU	7.0
UA	G271	C	2022/08/24	pH (field)	SU	7.4
UA	G271	C	2022/11/09	pH (field)	SU	7.4
UA	G271	C	2023/02/16	pH (field)	SU	7.0
UA	G271	C	2023/06/06	pH (field)	SU	6.9
UA	G271	C	2023/08/14	pH (field)	SU	7.0
UA	G271	C	2023/11/17	pH (field)	SU	7.2
UA	G271	C	2015/11/23	Oxidation Reduction Potential	mV	123
UA	G271	C	2016/02/16	Oxidation Reduction Potential	mV	165
UA	G271	C	2016/05/12	Oxidation Reduction Potential	mV	205
UA	G271	C	2016/08/05	Oxidation Reduction Potential	mV	191
UA	G271	C	2016/11/21	Oxidation Reduction Potential	mV	154
UA	G271	C	2017/02/11	Oxidation Reduction Potential	mV	145
UA	G271	C	2017/05/20	Oxidation Reduction Potential	mV	152
UA	G271	C	2017/07/17	Oxidation Reduction Potential	mV	189
UA	G271	C	2017/11/04	Oxidation Reduction Potential	mV	170
UA	G271	C	2018/05/16	Oxidation Reduction Potential	mV	174
UA	G271	C	2018/08/10	Oxidation Reduction Potential	mV	117
UA	G271	C	2019/01/22	Oxidation Reduction Potential	mV	180
UA	G271	C	2019/08/26	Oxidation Reduction Potential	mV	183
UA	G271	C	2020/01/22	Oxidation Reduction Potential	mV	190
UA	G271	C	2020/08/13	Oxidation Reduction Potential	mV	-175
UA	G271	C	2021/02/01	Oxidation Reduction Potential	mV	-2.90
UA	G271	C	2021/08/18	Oxidation Reduction Potential	mV	150
UA	G271	C	2022/02/10	Oxidation Reduction Potential	mV	-20.0
UA	G271	C	2022/03/21	Oxidation Reduction Potential	mV	22.4
UA	G271	C	2022/03/29	Oxidation Reduction Potential	mV	95.6
UA	G271	C	2022/05/11	Oxidation Reduction Potential	mV	4.20

UA	G271	C	2022/08/24	Oxidation Reduction Potential	mV	73.8
UA	G271	C	2022/11/09	Oxidation Reduction Potential	mV	190
UA	G271	C	2023/02/16	Oxidation Reduction Potential	mV	234
UA	G271	C	2023/06/06	Oxidation Reduction Potential	mV	137
UA	G271	C	2023/08/14	Oxidation Reduction Potential	mV	75.0
UA	G271	C	2023/11/17	Oxidation Reduction Potential	mV	113
UA	G271	C	2015/11/23	Eh	V	0.32
UA	G271	C	2016/02/16	Eh	V	0.36
UA	G271	C	2016/05/12	Eh	V	0.40
UA	G271	C	2016/08/05	Eh	V	0.38
UA	G271	C	2016/11/21	Eh	V	0.35
UA	G271	C	2017/02/11	Eh	V	0.34
UA	G271	C	2017/05/20	Eh	V	0.35
UA	G271	C	2017/07/17	Eh	V	0.38
UA	G271	C	2017/11/04	Eh	V	0.37
UA	G271	C	2018/05/16	Eh	V	0.37
UA	G271	C	2018/08/10	Eh	V	0.31
UA	G271	C	2019/01/22	Eh	V	0.38
UA	G271	C	2019/08/26	Eh	V	0.38
UA	G271	C	2020/01/22	Eh	V	0.39
UA	G271	C	2020/08/13	Eh	V	0.015
UA	G271	C	2021/02/01	Eh	V	0.20
UA	G271	C	2021/08/18	Eh	V	0.34
UA	G271	C	2022/02/10	Eh	V	0.18
UA	G271	C	2022/03/21	Eh	V	0.22
UA	G271	C	2022/03/29	Eh	V	0.29
UA	G271	C	2022/05/11	Eh	V	0.20
UA	G271	C	2022/08/24	Eh	V	0.26
UA	G271	C	2022/11/09	Eh	V	0.38
UA	G271	C	2023/02/16	Eh	V	0.43
UA	G271	C	2023/06/06	Eh	V	0.33
UA	G271	C	2023/08/14	Eh	V	0.27
UA	G271	C	2023/11/17	Eh	V	0.31
UA	G271	C	2009/09/22	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G271	C	2009/11/09	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G271	C	2010/01/19	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G271	C	2010/03/08	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G271	C	2010/07/27	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G271	C	2011/01/28	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G271	C	2012/01/26	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G271	C	2013/01/31	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G271	C	2014/02/19	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G271	C	2014/08/11	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G271	C	2014/10/14	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G271	C	2015/01/21	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G271	C	2015/04/10	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G271	C	2017/07/17	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G271	C	2020/01/22	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G271	C	2021/02/01	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G271	C	2022/03/29	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G271	C	2022/08/24	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G271	C	2023/02/16	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G271	C	2023/06/06	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G271	C	2023/08/14	Alkalinity, bicarbonate	mg/L CaCO3	281
UA	G271	C	2023/11/17	Alkalinity, bicarbonate	mg/L CaCO3	299
UA	G271	C	2022/08/24	Alkalinity, carbonate	mg/L CaCO3	10.0
UA	G271	C	2009/09/22	Arsenic, total	mg/L	0.00300
UA	G271	C	2009/11/09	Arsenic, total	mg/L	0.00490
UA	G271	C	2010/01/19	Arsenic, total	mg/L	<0.001
UA	G271	C	2010/03/08	Arsenic, total	mg/L	<0.001
UA	G271	C	2010/07/27	Arsenic, total	mg/L	<0.001
UA	G271	C	2010/11/16	Arsenic, total	mg/L	<0.001

UA	G271	C	2011/01/28	Arsenic, total	mg/L	0.00150
UA	G271	C	2011/05/04	Arsenic, total	mg/L	<0.001
UA	G271	C	2011/07/27	Arsenic, total	mg/L	<0.001
UA	G271	C	2011/11/14	Arsenic, total	mg/L	0.00130
UA	G271	C	2012/01/26	Arsenic, total	mg/L	0.00130
UA	G271	C	2012/05/22	Arsenic, total	mg/L	<0.001
UA	G271	C	2012/07/24	Arsenic, total	mg/L	<0.001
UA	G271	C	2012/11/14	Arsenic, total	mg/L	0.00140
UA	G271	C	2013/01/31	Arsenic, total	mg/L	0.00310
UA	G271	C	2013/05/20	Arsenic, total	mg/L	<0.001
UA	G271	C	2013/07/22	Arsenic, total	mg/L	<0.001
UA	G271	C	2013/10/14	Arsenic, total	mg/L	<0.001
UA	G271	C	2014/02/19	Arsenic, total	mg/L	0.00280
UA	G271	C	2014/05/13	Arsenic, total	mg/L	0.00170
UA	G271	C	2014/08/11	Arsenic, total	mg/L	0.00270
UA	G271	C	2014/10/14	Arsenic, total	mg/L	0.00190
UA	G271	C	2015/01/21	Arsenic, total	mg/L	<0.001
UA	G271	C	2015/04/10	Arsenic, total	mg/L	<0.001
UA	G271	C	2015/07/22	Arsenic, total	mg/L	<0.001
UA	G271	C	2015/10/08	Arsenic, total	mg/L	<0.001
UA	G271	C	2015/11/23	Arsenic, total	mg/L	<0.00013
UA	G271	C	2016/02/16	Arsenic, total	mg/L	<0.00013
UA	G271	C	2016/05/12	Arsenic, total	mg/L	<0.00013
UA	G271	C	2016/08/05	Arsenic, total	mg/L	<0.00013
UA	G271	C	2016/11/21	Arsenic, total	mg/L	<0.00013
UA	G271	C	2017/02/11	Arsenic, total	mg/L	<0.00013
UA	G271	C	2017/05/20	Arsenic, total	mg/L	0.00170
UA	G271	C	2017/07/17	Arsenic, total	mg/L	<0.00013
UA	G271	C	2018/05/16	Arsenic, total	mg/L	<0.0009
UA	G271	C	2018/08/10	Arsenic, total	mg/L	<0.0009
UA	G271	C	2019/01/22	Arsenic, total	mg/L	<0.0009
UA	G271	C	2019/08/26	Arsenic, total	mg/L	0.00200
UA	G271	C	2020/01/22	Arsenic, total	mg/L	<0.0009
UA	G271	C	2020/08/13	Arsenic, total	mg/L	<0.00022
UA	G271	C	2020/10/14	Arsenic, total	mg/L	<0.001
UA	G271	C	2021/02/01	Arsenic, total	mg/L	<0.00022
UA	G271	C	2021/05/20	Arsenic, total	mg/L	<0.001
UA	G271	C	2021/08/18	Arsenic, total	mg/L	<0.00022
UA	G271	C	2021/10/27	Arsenic, total	mg/L	<0.001
UA	G271	C	2022/02/10	Arsenic, total	mg/L	<0.00069
UA	G271	C	2022/05/11	Arsenic, total	mg/L	<0.00069
UA	G271	C	2022/08/24	Arsenic, total	mg/L	<0.00069
UA	G271	C	2022/11/09	Arsenic, total	mg/L	<0.00069
UA	G271	C	2023/02/16	Arsenic, total	mg/L	<0.00069
UA	G271	C	2023/06/06	Arsenic, total	mg/L	<0.00069
UA	G271	C	2023/08/14	Arsenic, total	mg/L	0.000500
UA	G271	C	2023/11/17	Arsenic, total	mg/L	0.000600
UA	G271	C	2009/09/22	Barium, total	mg/L	0.0800
UA	G271	C	2009/11/09	Barium, total	mg/L	0.110
UA	G271	C	2010/01/19	Barium, total	mg/L	0.0550
UA	G271	C	2010/03/08	Barium, total	mg/L	0.0550
UA	G271	C	2010/07/27	Barium, total	mg/L	0.0410
UA	G271	C	2011/01/28	Barium, total	mg/L	0.0500
UA	G271	C	2012/01/26	Barium, total	mg/L	0.0340
UA	G271	C	2013/01/31	Barium, total	mg/L	0.0630
UA	G271	C	2014/02/19	Barium, total	mg/L	0.0620
UA	G271	C	2015/04/10	Barium, total	mg/L	0.0290
UA	G271	C	2015/07/22	Barium, total	mg/L	0.0280
UA	G271	C	2015/10/08	Barium, total	mg/L	0.0300
UA	G271	C	2015/11/23	Barium, total	mg/L	0.0310
UA	G271	C	2016/02/16	Barium, total	mg/L	0.0280
UA	G271	C	2016/05/12	Barium, total	mg/L	0.0280

UA	G271	C	2016/08/05	Barium, total	mg/L	0.0320
UA	G271	C	2016/11/21	Barium, total	mg/L	0.0310
UA	G271	C	2017/02/11	Barium, total	mg/L	0.0270
UA	G271	C	2017/05/20	Barium, total	mg/L	0.0290
UA	G271	C	2017/07/17	Barium, total	mg/L	0.0280
UA	G271	C	2018/05/16	Barium, total	mg/L	0.0210
UA	G271	C	2018/08/10	Barium, total	mg/L	0.0240
UA	G271	C	2019/01/22	Barium, total	mg/L	0.0230
UA	G271	C	2019/08/26	Barium, total	mg/L	0.0420
UA	G271	C	2020/01/22	Barium, total	mg/L	0.0240
UA	G271	C	2020/08/13	Barium, total	mg/L	0.0250
UA	G271	C	2020/10/14	Barium, total	mg/L	0.0250
UA	G271	C	2021/02/01	Barium, total	mg/L	0.0210
UA	G271	C	2021/05/20	Barium, total	mg/L	0.0180
UA	G271	C	2021/08/18	Barium, total	mg/L	0.0190
UA	G271	C	2021/10/27	Barium, total	mg/L	0.0210
UA	G271	C	2022/02/10	Barium, total	mg/L	0.0190
UA	G271	C	2022/05/11	Barium, total	mg/L	0.0190
UA	G271	C	2022/08/24	Barium, total	mg/L	0.0200
UA	G271	C	2022/11/09	Barium, total	mg/L	0.0200
UA	G271	C	2023/02/16	Barium, total	mg/L	0.0210
UA	G271	C	2023/06/06	Barium, total	mg/L	0.0210
UA	G271	C	2023/08/14	Barium, total	mg/L	0.0254
UA	G271	C	2023/11/17	Barium, total	mg/L	0.0350
UA	G271	C	2009/09/22	Calcium, total	mg/L	110
UA	G271	C	2009/11/09	Calcium, total	mg/L	140
UA	G271	C	2010/01/19	Calcium, total	mg/L	110
UA	G271	C	2010/03/08	Calcium, total	mg/L	120
UA	G271	C	2010/07/27	Calcium, total	mg/L	120
UA	G271	C	2010/11/16	Calcium, total	mg/L	110
UA	G271	C	2011/01/28	Calcium, total	mg/L	110
UA	G271	C	2011/05/04	Calcium, total	mg/L	<100
UA	G271	C	2011/07/27	Calcium, total	mg/L	96.0
UA	G271	C	2011/11/14	Calcium, total	mg/L	110
UA	G271	C	2012/01/26	Calcium, total	mg/L	110
UA	G271	C	2012/05/22	Calcium, total	mg/L	110
UA	G271	C	2012/07/24	Calcium, total	mg/L	110
UA	G271	C	2012/11/14	Calcium, total	mg/L	130
UA	G271	C	2013/01/31	Calcium, total	mg/L	150
UA	G271	C	2013/05/20	Calcium, total	mg/L	120
UA	G271	C	2013/07/22	Calcium, total	mg/L	99.0
UA	G271	C	2013/10/14	Calcium, total	mg/L	120
UA	G271	C	2014/02/19	Calcium, total	mg/L	150
UA	G271	C	2014/05/13	Calcium, total	mg/L	140
UA	G271	C	2014/08/11	Calcium, total	mg/L	140
UA	G271	C	2014/10/14	Calcium, total	mg/L	150
UA	G271	C	2015/01/21	Calcium, total	mg/L	120
UA	G271	C	2015/04/10	Calcium, total	mg/L	130
UA	G271	C	2015/11/23	Calcium, total	mg/L	130
UA	G271	C	2016/02/16	Calcium, total	mg/L	130
UA	G271	C	2016/05/12	Calcium, total	mg/L	170
UA	G271	C	2016/08/05	Calcium, total	mg/L	110
UA	G271	C	2016/11/21	Calcium, total	mg/L	110
UA	G271	C	2017/02/11	Calcium, total	mg/L	100
UA	G271	C	2017/05/20	Calcium, total	mg/L	110
UA	G271	C	2017/07/17	Calcium, total	mg/L	110
UA	G271	C	2017/11/04	Calcium, total	mg/L	100
UA	G271	C	2018/05/16	Calcium, total	mg/L	76.0
UA	G271	C	2018/08/10	Calcium, total	mg/L	86.0
UA	G271	C	2019/01/22	Calcium, total	mg/L	100
UA	G271	C	2019/08/26	Calcium, total	mg/L	100
UA	G271	C	2020/01/22	Calcium, total	mg/L	180

UA	G271	C	2020/08/13	Calcium, total	mg/L	150
UA	G271	C	2021/02/01	Calcium, total	mg/L	150
UA	G271	C	2021/08/18	Calcium, total	mg/L	100
UA	G271	C	2022/02/10	Calcium, total	mg/L	120
UA	G271	C	2022/08/24	Calcium, total	mg/L	110
UA	G271	C	2023/02/16	Calcium, total	mg/L	120
UA	G271	C	2023/06/06	Calcium, total	mg/L	110
UA	G271	C	2023/08/14	Calcium, total	mg/L	80.9
UA	G271	C	2023/11/17	Calcium, total	mg/L	90.6
UA	G271	C	2009/09/22	Chloride, total	mg/L	37.0
UA	G271	C	2009/11/09	Chloride, total	mg/L	34.0
UA	G271	C	2010/01/19	Chloride, total	mg/L	33.0
UA	G271	C	2010/03/08	Chloride, total	mg/L	36.0
UA	G271	C	2010/07/27	Chloride, total	mg/L	40.0
UA	G271	C	2010/11/16	Chloride, total	mg/L	44.0
UA	G271	C	2011/01/28	Chloride, total	mg/L	44.0
UA	G271	C	2011/05/04	Chloride, total	mg/L	53.0
UA	G271	C	2011/07/27	Chloride, total	mg/L	49.0
UA	G271	C	2011/11/14	Chloride, total	mg/L	50.0
UA	G271	C	2012/01/26	Chloride, total	mg/L	44.0
UA	G271	C	2012/05/22	Chloride, total	mg/L	5.10
UA	G271	C	2012/07/24	Chloride, total	mg/L	45.0
UA	G271	C	2012/11/14	Chloride, total	mg/L	50.0
UA	G271	C	2013/01/31	Chloride, total	mg/L	58.0
UA	G271	C	2013/05/20	Chloride, total	mg/L	47.0
UA	G271	C	2013/07/22	Chloride, total	mg/L	49.0
UA	G271	C	2013/10/14	Chloride, total	mg/L	47.0
UA	G271	C	2014/02/19	Chloride, total	mg/L	51.0
UA	G271	C	2014/05/13	Chloride, total	mg/L	47.0
UA	G271	C	2014/08/11	Chloride, total	mg/L	42.0
UA	G271	C	2014/10/14	Chloride, total	mg/L	45.0
UA	G271	C	2015/01/21	Chloride, total	mg/L	39.0
UA	G271	C	2015/04/10	Chloride, total	mg/L	45.0
UA	G271	C	2015/07/22	Chloride, total	mg/L	35.0
UA	G271	C	2015/10/08	Chloride, total	mg/L	38.0
UA	G271	C	2015/11/23	Chloride, total	mg/L	38.0
UA	G271	C	2016/02/16	Chloride, total	mg/L	38.0
UA	G271	C	2016/05/12	Chloride, total	mg/L	39.0
UA	G271	C	2016/08/05	Chloride, total	mg/L	37.0
UA	G271	C	2016/11/21	Chloride, total	mg/L	29.0
UA	G271	C	2017/02/11	Chloride, total	mg/L	30.0
UA	G271	C	2017/05/20	Chloride, total	mg/L	28.0
UA	G271	C	2017/07/17	Chloride, total	mg/L	29.0
UA	G271	C	2017/11/04	Chloride, total	mg/L	24.0
UA	G271	C	2018/05/16	Chloride, total	mg/L	38.0
UA	G271	C	2018/08/10	Chloride, total	mg/L	32.0
UA	G271	C	2019/01/22	Chloride, total	mg/L	21.0
UA	G271	C	2019/08/26	Chloride, total	mg/L	21.0
UA	G271	C	2020/01/22	Chloride, total	mg/L	51.0
UA	G271	C	2020/08/13	Chloride, total	mg/L	44.0
UA	G271	C	2020/10/14	Chloride, total	mg/L	23.0
UA	G271	C	2021/02/01	Chloride, total	mg/L	60.0
UA	G271	C	2021/05/20	Chloride, total	mg/L	58.0
UA	G271	C	2021/08/18	Chloride, total	mg/L	49.0
UA	G271	C	2021/10/27	Chloride, total	mg/L	47.0
UA	G271	C	2022/02/10	Chloride, total	mg/L	58.0
UA	G271	C	2022/05/11	Chloride, total	mg/L	43.0
UA	G271	C	2022/08/24	Chloride, total	mg/L	64.0
UA	G271	C	2022/11/09	Chloride, total	mg/L	62.0
UA	G271	C	2023/02/16	Chloride, total	mg/L	59.0
UA	G271	C	2023/06/06	Chloride, total	mg/L	69.0
UA	G271	C	2023/08/14	Chloride, total	mg/L	35.0

UA	G271	C	2023/11/17	Chloride, total	mg/L	60.0
UA	G271	C	2023/06/06	Ferrous Iron, dissolved	mg/L	0.150
UA	G271	C	2009/11/10	Iron, dissolved	mg/L	<0.1
UA	G271	C	2010/01/19	Iron, dissolved	mg/L	<0.1
UA	G271	C	2010/03/08	Iron, dissolved	mg/L	<0.2
UA	G271	C	2010/07/27	Iron, dissolved	mg/L	0.0120
UA	G271	C	2010/09/20	Iron, dissolved	mg/L	<0.01
UA	G271	C	2010/11/16	Iron, dissolved	mg/L	<0.01
UA	G271	C	2011/01/28	Iron, dissolved	mg/L	<0.01
UA	G271	C	2011/05/04	Iron, dissolved	mg/L	<0.01
UA	G271	C	2011/07/27	Iron, dissolved	mg/L	<0.01
UA	G271	C	2011/11/14	Iron, dissolved	mg/L	<0.01
UA	G271	C	2012/01/26	Iron, dissolved	mg/L	<0.01
UA	G271	C	2012/05/22	Iron, dissolved	mg/L	<0.01
UA	G271	C	2012/07/24	Iron, dissolved	mg/L	<0.01
UA	G271	C	2012/11/14	Iron, dissolved	mg/L	<0.01
UA	G271	C	2013/01/31	Iron, dissolved	mg/L	0.0260
UA	G271	C	2013/05/20	Iron, dissolved	mg/L	<0.01
UA	G271	C	2013/07/22	Iron, dissolved	mg/L	0.0110
UA	G271	C	2013/10/14	Iron, dissolved	mg/L	<0.01
UA	G271	C	2014/02/19	Iron, dissolved	mg/L	<0.01
UA	G271	C	2014/05/13	Iron, dissolved	mg/L	0.0200
UA	G271	C	2014/08/11	Iron, dissolved	mg/L	<0.01
UA	G271	C	2014/10/14	Iron, dissolved	mg/L	<0.01
UA	G271	C	2015/01/21	Iron, dissolved	mg/L	<0.01
UA	G271	C	2015/04/10	Iron, dissolved	mg/L	<0.01
UA	G271	C	2015/07/22	Iron, dissolved	mg/L	<0.01
UA	G271	C	2015/10/08	Iron, dissolved	mg/L	<0.01
UA	G271	C	2016/02/16	Iron, dissolved	mg/L	<0.01
UA	G271	C	2016/05/12	Iron, dissolved	mg/L	<0.01
UA	G271	C	2016/07/27	Iron, dissolved	mg/L	0.0130
UA	G271	C	2016/11/21	Iron, dissolved	mg/L	<0.01
UA	G271	C	2017/02/08	Iron, dissolved	mg/L	<0.01
UA	G271	C	2017/05/18	Iron, dissolved	mg/L	<0.01
UA	G271	C	2017/07/25	Iron, dissolved	mg/L	<0.01
UA	G271	C	2017/11/04	Iron, dissolved	mg/L	<0.01
UA	G271	C	2018/01/29	Iron, dissolved	mg/L	0.0400
UA	G271	C	2018/05/16	Iron, dissolved	mg/L	<0.01
UA	G271	C	2018/08/10	Iron, dissolved	mg/L	<0.01
UA	G271	C	2018/11/05	Iron, dissolved	mg/L	<0.1
UA	G271	C	2019/01/22	Iron, dissolved	mg/L	0.0240
UA	G271	C	2019/05/03	Iron, dissolved	mg/L	<0.01
UA	G271	C	2019/08/26	Iron, dissolved	mg/L	0.0110
UA	G271	C	2019/10/22	Iron, dissolved	mg/L	<0.01
UA	G271	C	2020/01/22	Iron, dissolved	mg/L	<0.01
UA	G271	C	2020/05/05	Iron, dissolved	mg/L	<0.01
UA	G271	C	2020/08/13	Iron, dissolved	mg/L	0.0500
UA	G271	C	2020/10/14	Iron, dissolved	mg/L	0.0170
UA	G271	C	2021/02/01	Iron, dissolved	mg/L	0.140
UA	G271	C	2021/05/20	Iron, dissolved	mg/L	0.0750
UA	G271	C	2021/08/18	Iron, dissolved	mg/L	0.120
UA	G271	C	2021/10/27	Iron, dissolved	mg/L	<0.01
UA	G271	C	2022/02/10	Iron, dissolved	mg/L	0.200
UA	G271	C	2022/05/11	Iron, dissolved	mg/L	0.120
UA	G271	C	2022/08/24	Iron, dissolved	mg/L	0.00290
UA	G271	C	2022/11/09	Iron, dissolved	mg/L	0.0120
UA	G271	C	2023/02/16	Iron, dissolved	mg/L	<0.00072
UA	G271	C	2023/06/06	Iron, dissolved	mg/L	0.0320
UA	G271	C	2023/08/14	Iron, dissolved	mg/L	0.0261
UA	G271	C	2023/11/17	Iron, dissolved	mg/L	<0.0115
UA	G271	C	2009/09/22	Magnesium, total	mg/L	51.0
UA	G271	C	2009/11/09	Magnesium, total	mg/L	68.0

UA	G271	C	2010/01/19	Magnesium, total	mg/L	56.0
UA	G271	C	2010/03/08	Magnesium, total	mg/L	62.0
UA	G271	C	2010/07/27	Magnesium, total	mg/L	56.0
UA	G271	C	2011/01/28	Magnesium, total	mg/L	58.0
UA	G271	C	2012/01/26	Magnesium, total	mg/L	53.0
UA	G271	C	2013/01/31	Magnesium, total	mg/L	69.0
UA	G271	C	2014/02/19	Magnesium, total	mg/L	67.0
UA	G271	C	2015/04/10	Magnesium, total	mg/L	66.0
UA	G271	C	2017/07/17	Magnesium, total	mg/L	59.0
UA	G271	C	2020/01/22	Magnesium, total	mg/L	91.0
UA	G271	C	2021/02/01	Magnesium, total	mg/L	68.0
UA	G271	C	2022/02/10	Magnesium, total	mg/L	56.0
UA	G271	C	2022/08/24	Magnesium, total	mg/L	53.0
UA	G271	C	2023/02/16	Magnesium, total	mg/L	49.0
UA	G271	C	2023/06/06	Magnesium, total	mg/L	56.0
UA	G271	C	2023/08/14	Magnesium, total	mg/L	38.6
UA	G271	C	2023/11/17	Magnesium, total	mg/L	43.9
UA	G271	C	2009/11/10	Manganese, dissolved	mg/L	0.110
UA	G271	C	2010/01/19	Manganese, dissolved	mg/L	0.00700
UA	G271	C	2010/03/08	Manganese, dissolved	mg/L	<0.0025
UA	G271	C	2010/07/27	Manganese, dissolved	mg/L	0.0160
UA	G271	C	2010/09/20	Manganese, dissolved	mg/L	0.00150
UA	G271	C	2010/11/16	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2011/01/28	Manganese, dissolved	mg/L	0.00130
UA	G271	C	2011/05/04	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2011/07/27	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2011/11/14	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2012/01/26	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2012/05/22	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2012/07/24	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2012/11/14	Manganese, dissolved	mg/L	0.00210
UA	G271	C	2013/01/31	Manganese, dissolved	mg/L	0.0240
UA	G271	C	2013/05/20	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2013/07/22	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2013/10/14	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2014/02/19	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2014/05/13	Manganese, dissolved	mg/L	0.220
UA	G271	C	2014/08/11	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2014/10/14	Manganese, dissolved	mg/L	0.00210
UA	G271	C	2015/01/21	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2015/04/10	Manganese, dissolved	mg/L	<0.002
UA	G271	C	2015/07/22	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2015/10/08	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2016/02/16	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2016/05/12	Manganese, dissolved	mg/L	<0.002
UA	G271	C	2016/07/27	Manganese, dissolved	mg/L	0.00760
UA	G271	C	2016/11/21	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2017/02/08	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2017/05/18	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2017/07/25	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2017/11/04	Manganese, dissolved	mg/L	0.00170
UA	G271	C	2018/01/29	Manganese, dissolved	mg/L	0.00440
UA	G271	C	2018/05/16	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2018/08/10	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2018/11/05	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2019/01/22	Manganese, dissolved	mg/L	0.00220
UA	G271	C	2019/05/03	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2019/08/26	Manganese, dissolved	mg/L	0.0120
UA	G271	C	2019/10/22	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2020/01/22	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2020/05/05	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2020/08/13	Manganese, dissolved	mg/L	0.0450

UA	G271	C	2020/10/14	Manganese, dissolved	mg/L	0.00750
UA	G271	C	2021/02/01	Manganese, dissolved	mg/L	0.0170
UA	G271	C	2021/05/20	Manganese, dissolved	mg/L	0.00600
UA	G271	C	2021/08/18	Manganese, dissolved	mg/L	0.00940
UA	G271	C	2021/10/27	Manganese, dissolved	mg/L	<0.001
UA	G271	C	2022/02/10	Manganese, dissolved	mg/L	0.0160
UA	G271	C	2022/05/11	Manganese, dissolved	mg/L	0.0710
UA	G271	C	2022/08/24	Manganese, dissolved	mg/L	0.00220
UA	G271	C	2022/11/09	Manganese, dissolved	mg/L	0.00340
UA	G271	C	2023/02/16	Manganese, dissolved	mg/L	<0.00023
UA	G271	C	2023/06/06	Manganese, dissolved	mg/L	0.0220
UA	G271	C	2023/08/14	Manganese, dissolved	mg/L	0.0126
UA	G271	C	2023/11/17	Manganese, dissolved	mg/L	0.00890
UA	G271	C	2023/08/14	Phosphate, dissolved	mg/L	0.0400
UA	G271	C	2009/09/22	Potassium, total	mg/L	2.60
UA	G271	C	2009/11/09	Potassium, total	mg/L	3.00
UA	G271	C	2010/01/19	Potassium, total	mg/L	1.60
UA	G271	C	2010/03/08	Potassium, total	mg/L	1.10
UA	G271	C	2010/07/27	Potassium, total	mg/L	0.730
UA	G271	C	2011/01/28	Potassium, total	mg/L	0.800
UA	G271	C	2012/01/26	Potassium, total	mg/L	0.730
UA	G271	C	2013/01/31	Potassium, total	mg/L	1.70
UA	G271	C	2014/02/19	Potassium, total	mg/L	1.50
UA	G271	C	2015/04/10	Potassium, total	mg/L	0.390
UA	G271	C	2017/07/17	Potassium, total	mg/L	0.390
UA	G271	C	2020/01/22	Potassium, total	mg/L	0.430
UA	G271	C	2021/02/01	Potassium, total	mg/L	0.420
UA	G271	C	2022/02/10	Potassium, total	mg/L	0.390
UA	G271	C	2022/08/24	Potassium, total	mg/L	0.390
UA	G271	C	2023/02/16	Potassium, total	mg/L	0.290
UA	G271	C	2023/06/06	Potassium, total	mg/L	0.270
UA	G271	C	2023/08/14	Potassium, total	mg/L	0.369
UA	G271	C	2023/11/17	Potassium, total	mg/L	0.445
UA	G271	C	2023/06/06	Silicon, dissolved	mg/L	8.30
UA	G271	C	2023/08/14	Silicon, dissolved	mg/L	7.60
UA	G271	C	2009/09/22	Sodium, total	mg/L	67.0
UA	G271	C	2009/11/09	Sodium, total	mg/L	69.0
UA	G271	C	2010/01/19	Sodium, total	mg/L	68.0
UA	G271	C	2010/03/08	Sodium, total	mg/L	70.0
UA	G271	C	2010/07/27	Sodium, total	mg/L	71.0
UA	G271	C	2011/01/28	Sodium, total	mg/L	75.0
UA	G271	C	2012/01/26	Sodium, total	mg/L	67.0
UA	G271	C	2013/01/31	Sodium, total	mg/L	77.0
UA	G271	C	2014/02/19	Sodium, total	mg/L	80.0
UA	G271	C	2015/04/10	Sodium, total	mg/L	100
UA	G271	C	2017/07/17	Sodium, total	mg/L	120
UA	G271	C	2020/01/22	Sodium, total	mg/L	100
UA	G271	C	2021/02/01	Sodium, total	mg/L	81.0
UA	G271	C	2022/02/10	Sodium, total	mg/L	86.0
UA	G271	C	2022/08/24	Sodium, total	mg/L	87.0
UA	G271	C	2023/02/16	Sodium, total	mg/L	77.0
UA	G271	C	2023/06/06	Sodium, total	mg/L	78.0
UA	G271	C	2023/08/14	Sodium, total	mg/L	87.4
UA	G271	C	2023/11/17	Sodium, total	mg/L	80.0
UA	G271	C	2009/09/22	Sulfate, total	mg/L	230
UA	G271	C	2009/11/09	Sulfate, total	mg/L	290
UA	G271	C	2010/01/19	Sulfate, total	mg/L	320
UA	G271	C	2010/03/08	Sulfate, total	mg/L	300
UA	G271	C	2010/07/27	Sulfate, total	mg/L	350
UA	G271	C	2010/11/16	Sulfate, total	mg/L	280
UA	G271	C	2011/01/28	Sulfate, total	mg/L	270
UA	G271	C	2011/05/04	Sulfate, total	mg/L	240

UA	G271	C	2011/07/27	Sulfate, total	mg/L	240
UA	G271	C	2011/11/14	Sulfate, total	mg/L	250
UA	G271	C	2012/01/26	Sulfate, total	mg/L	240
UA	G271	C	2012/05/22	Sulfate, total	mg/L	240
UA	G271	C	2012/07/24	Sulfate, total	mg/L	280
UA	G271	C	2012/11/14	Sulfate, total	mg/L	300
UA	G271	C	2013/01/31	Sulfate, total	mg/L	380
UA	G271	C	2013/05/20	Sulfate, total	mg/L	350
UA	G271	C	2013/07/22	Sulfate, total	mg/L	360
UA	G271	C	2013/10/14	Sulfate, total	mg/L	390
UA	G271	C	2014/02/19	Sulfate, total	mg/L	420
UA	G271	C	2014/05/13	Sulfate, total	mg/L	440
UA	G271	C	2014/08/11	Sulfate, total	mg/L	500
UA	G271	C	2014/10/14	Sulfate, total	mg/L	480
UA	G271	C	2015/01/21	Sulfate, total	mg/L	490
UA	G271	C	2015/04/10	Sulfate, total	mg/L	440
UA	G271	C	2015/07/22	Sulfate, total	mg/L	350
UA	G271	C	2015/10/08	Sulfate, total	mg/L	400
UA	G271	C	2015/11/23	Sulfate, total	mg/L	420
UA	G271	C	2016/02/16	Sulfate, total	mg/L	440
UA	G271	C	2016/05/12	Sulfate, total	mg/L	540
UA	G271	C	2016/08/05	Sulfate, total	mg/L	440
UA	G271	C	2016/11/21	Sulfate, total	mg/L	400
UA	G271	C	2017/02/11	Sulfate, total	mg/L	430
UA	G271	C	2017/05/20	Sulfate, total	mg/L	390
UA	G271	C	2017/07/17	Sulfate, total	mg/L	380
UA	G271	C	2017/11/04	Sulfate, total	mg/L	360
UA	G271	C	2018/05/16	Sulfate, total	mg/L	330
UA	G271	C	2018/08/10	Sulfate, total	mg/L	470
UA	G271	C	2019/01/22	Sulfate, total	mg/L	420
UA	G271	C	2019/08/26	Sulfate, total	mg/L	340
UA	G271	C	2020/01/22	Sulfate, total	mg/L	610
UA	G271	C	2020/08/13	Sulfate, total	mg/L	470
UA	G271	C	2020/10/14	Sulfate, total	mg/L	300
UA	G271	C	2021/02/01	Sulfate, total	mg/L	420
UA	G271	C	2021/05/20	Sulfate, total	mg/L	370
UA	G271	C	2021/08/18	Sulfate, total	mg/L	370
UA	G271	C	2021/10/27	Sulfate, total	mg/L	340
UA	G271	C	2022/02/10	Sulfate, total	mg/L	340
UA	G271	C	2022/05/11	Sulfate, total	mg/L	250
UA	G271	C	2022/08/24	Sulfate, total	mg/L	230
UA	G271	C	2022/11/09	Sulfate, total	mg/L	170
UA	G271	C	2023/02/16	Sulfate, total	mg/L	250
UA	G271	C	2023/06/06	Sulfate, total	mg/L	280
UA	G271	C	2023/08/14	Sulfate, total	mg/L	177
UA	G271	C	2023/11/17	Sulfate, total	mg/L	251
UA	G271	C	2015/11/23	Temperature (Celsius)	degrees C	16.7
UA	G271	C	2016/02/16	Temperature (Celsius)	degrees C	10.6
UA	G271	C	2016/05/12	Temperature (Celsius)	degrees C	16.1
UA	G271	C	2016/08/05	Temperature (Celsius)	degrees C	19.2
UA	G271	C	2016/11/21	Temperature (Celsius)	degrees C	15.0
UA	G271	C	2017/02/11	Temperature (Celsius)	degrees C	15.0
UA	G271	C	2017/05/20	Temperature (Celsius)	degrees C	15.7
UA	G271	C	2017/07/17	Temperature (Celsius)	degrees C	20.7
UA	G271	C	2017/11/04	Temperature (Celsius)	degrees C	13.4
UA	G271	C	2018/05/16	Temperature (Celsius)	degrees C	13.2
UA	G271	C	2018/08/10	Temperature (Celsius)	degrees C	15.4
UA	G271	C	2019/01/22	Temperature (Celsius)	degrees C	11.4
UA	G271	C	2019/08/26	Temperature (Celsius)	degrees C	17.3
UA	G271	C	2020/01/22	Temperature (Celsius)	degrees C	12.8
UA	G271	C	2020/08/13	Temperature (Celsius)	degrees C	22.9
UA	G271	C	2021/02/01	Temperature (Celsius)	degrees C	11.1

UA	G271	C	2021/08/18	Temperature (Celsius)	degrees C	19.0
UA	G271	C	2022/02/10	Temperature (Celsius)	degrees C	10.8
UA	G271	C	2022/03/21	Temperature (Celsius)	degrees C	15.7
UA	G271	C	2022/03/29	Temperature (Celsius)	degrees C	11.1
UA	G271	C	2022/05/11	Temperature (Celsius)	degrees C	19.4
UA	G271	C	2022/08/24	Temperature (Celsius)	degrees C	21.3
UA	G271	C	2022/11/09	Temperature (Celsius)	degrees C	17.4
UA	G271	C	2023/02/16	Temperature (Celsius)	degrees C	9.40
UA	G271	C	2023/06/06	Temperature (Celsius)	degrees C	17.1
UA	G271	C	2023/08/14	Temperature (Celsius)	degrees C	17.2
UA	G271	C	2023/11/17	Temperature (Celsius)	degrees C	16.3
UA	G271	C	2009/09/22	Total Dissolved Solids	mg/L	770
UA	G271	C	2009/11/09	Total Dissolved Solids	mg/L	770
UA	G271	C	2010/01/19	Total Dissolved Solids	mg/L	860
UA	G271	C	2010/03/08	Total Dissolved Solids	mg/L	880
UA	G271	C	2010/07/27	Total Dissolved Solids	mg/L	840
UA	G271	C	2010/11/16	Total Dissolved Solids	mg/L	830
UA	G271	C	2011/01/28	Total Dissolved Solids	mg/L	730
UA	G271	C	2011/05/04	Total Dissolved Solids	mg/L	750
UA	G271	C	2011/07/27	Total Dissolved Solids	mg/L	800
UA	G271	C	2011/11/14	Total Dissolved Solids	mg/L	710
UA	G271	C	2012/01/26	Total Dissolved Solids	mg/L	750
UA	G271	C	2012/05/22	Total Dissolved Solids	mg/L	710
UA	G271	C	2012/07/24	Total Dissolved Solids	mg/L	770
UA	G271	C	2012/11/14	Total Dissolved Solids	mg/L	940
UA	G271	C	2013/01/31	Total Dissolved Solids	mg/L	880
UA	G271	C	2013/05/20	Total Dissolved Solids	mg/L	790
UA	G271	C	2013/07/22	Total Dissolved Solids	mg/L	800
UA	G271	C	2013/10/14	Total Dissolved Solids	mg/L	840
UA	G271	C	2014/02/19	Total Dissolved Solids	mg/L	840
UA	G271	C	2014/05/13	Total Dissolved Solids	mg/L	670
UA	G271	C	2014/08/11	Total Dissolved Solids	mg/L	1,000
UA	G271	C	2014/10/14	Total Dissolved Solids	mg/L	940
UA	G271	C	2015/01/21	Total Dissolved Solids	mg/L	870
UA	G271	C	2015/04/10	Total Dissolved Solids	mg/L	1,000
UA	G271	C	2015/07/22	Total Dissolved Solids	mg/L	1,000
UA	G271	C	2015/10/08	Total Dissolved Solids	mg/L	1,000
UA	G271	C	2015/11/23	Total Dissolved Solids	mg/L	860
UA	G271	C	2016/02/16	Total Dissolved Solids	mg/L	1,000
UA	G271	C	2016/05/12	Total Dissolved Solids	mg/L	940
UA	G271	C	2016/08/05	Total Dissolved Solids	mg/L	840
UA	G271	C	2016/11/21	Total Dissolved Solids	mg/L	910
UA	G271	C	2017/02/11	Total Dissolved Solids	mg/L	1,100
UA	G271	C	2017/05/20	Total Dissolved Solids	mg/L	870
UA	G271	C	2017/07/17	Total Dissolved Solids	mg/L	950
UA	G271	C	2017/11/04	Total Dissolved Solids	mg/L	820
UA	G271	C	2018/05/16	Total Dissolved Solids	mg/L	820
UA	G271	C	2018/08/10	Total Dissolved Solids	mg/L	880
UA	G271	C	2019/01/22	Total Dissolved Solids	mg/L	770
UA	G271	C	2019/08/26	Total Dissolved Solids	mg/L	690
UA	G271	C	2020/01/22	Total Dissolved Solids	mg/L	1,100
UA	G271	C	2020/08/13	Total Dissolved Solids	mg/L	900
UA	G271	C	2020/10/14	Total Dissolved Solids	mg/L	840
UA	G271	C	2021/02/01	Total Dissolved Solids	mg/L	980
UA	G271	C	2021/05/20	Total Dissolved Solids	mg/L	960
UA	G271	C	2021/08/18	Total Dissolved Solids	mg/L	870
UA	G271	C	2021/10/27	Total Dissolved Solids	mg/L	840
UA	G271	C	2022/02/10	Total Dissolved Solids	mg/L	870
UA	G271	C	2022/05/11	Total Dissolved Solids	mg/L	870
UA	G271	C	2022/08/24	Total Dissolved Solids	mg/L	680
UA	G271	C	2022/11/09	Total Dissolved Solids	mg/L	600
UA	G271	C	2023/02/16	Total Dissolved Solids	mg/L	840

UA	G271	C	2023/06/06	Total Dissolved Solids	mg/L	850
UA	G271	C	2023/08/14	Total Dissolved Solids	mg/L	594
UA	G271	C	2023/11/17	Total Dissolved Solids	mg/L	690
UA	G273	C	2010/07/27	pH (field)	SU	7.0
UA	G273	C	2010/07/28	pH (field)	SU	7.0
UA	G273	C	2010/09/20	pH (field)	SU	7.7
UA	G273	C	2010/11/16	pH (field)	SU	7.8
UA	G273	C	2011/01/31	pH (field)	SU	7.1
UA	G273	C	2011/05/03	pH (field)	SU	7.1
UA	G273	C	2011/07/27	pH (field)	SU	7.3
UA	G273	C	2011/11/14	pH (field)	SU	7.2
UA	G273	C	2012/01/26	pH (field)	SU	7.2
UA	G273	C	2012/05/22	pH (field)	SU	7.2
UA	G273	C	2012/07/24	pH (field)	SU	7.1
UA	G273	C	2012/11/14	pH (field)	SU	7.4
UA	G273	C	2013/01/31	pH (field)	SU	7.0
UA	G273	C	2013/05/20	pH (field)	SU	7.1
UA	G273	C	2013/07/22	pH (field)	SU	7.0
UA	G273	C	2013/10/14	pH (field)	SU	7.1
UA	G273	C	2014/02/19	pH (field)	SU	7.4
UA	G273	C	2014/05/13	pH (field)	SU	7.8
UA	G273	C	2014/08/11	pH (field)	SU	7.3
UA	G273	C	2014/10/14	pH (field)	SU	7.3
UA	G273	C	2015/01/21	pH (field)	SU	7.3
UA	G273	C	2015/04/13	pH (field)	SU	7.0
UA	G273	C	2015/07/23	pH (field)	SU	7.2
UA	G273	C	2015/10/08	pH (field)	SU	7.4
UA	G273	C	2015/11/24	pH (field)	SU	7.1
UA	G273	C	2016/02/16	pH (field)	SU	7.2
UA	G273	C	2016/05/12	pH (field)	SU	7.0
UA	G273	C	2016/08/05	pH (field)	SU	7.1
UA	G273	C	2016/11/21	pH (field)	SU	7.3
UA	G273	C	2017/02/15	pH (field)	SU	6.9
UA	G273	C	2017/05/20	pH (field)	SU	7.1
UA	G273	C	2017/07/17	pH (field)	SU	7.3
UA	G273	C	2017/11/04	pH (field)	SU	7.0
UA	G273	C	2018/05/16	pH (field)	SU	7.2
UA	G273	C	2018/08/10	pH (field)	SU	7.1
UA	G273	C	2019/01/22	pH (field)	SU	7.1
UA	G273	C	2019/08/26	pH (field)	SU	7.0
UA	G273	C	2020/01/22	pH (field)	SU	7.1
UA	G273	C	2020/08/13	pH (field)	SU	7.0
UA	G273	C	2020/10/14	pH (field)	SU	7.0
UA	G273	C	2021/02/01	pH (field)	SU	6.9
UA	G273	C	2021/05/20	pH (field)	SU	7.1
UA	G273	C	2021/08/18	pH (field)	SU	7.2
UA	G273	C	2021/10/27	pH (field)	SU	7.2
UA	G273	C	2022/02/10	pH (field)	SU	7.2
UA	G273	C	2022/03/21	pH (field)	SU	7.5
UA	G273	C	2022/03/29	pH (field)	SU	7.0
UA	G273	C	2022/05/11	pH (field)	SU	6.9
UA	G273	C	2022/08/25	pH (field)	SU	7.0
UA	G273	C	2022/11/09	pH (field)	SU	7.2
UA	G273	C	2023/02/16	pH (field)	SU	7.1
UA	G273	C	2023/06/05	pH (field)	SU	6.6
UA	G273	C	2023/08/14	pH (field)	SU	6.8
UA	G273	C	2023/11/17	pH (field)	SU	7.0
UA	G273	C	2015/11/24	Oxidation Reduction Potential	mV	105
UA	G273	C	2016/02/16	Oxidation Reduction Potential	mV	156
UA	G273	C	2016/05/12	Oxidation Reduction Potential	mV	177
UA	G273	C	2016/08/05	Oxidation Reduction Potential	mV	172
UA	G273	C	2016/11/21	Oxidation Reduction Potential	mV	150

UA	G273	C	2017/02/15	Oxidation Reduction Potential	mV	96.0
UA	G273	C	2017/05/20	Oxidation Reduction Potential	mV	60.0
UA	G273	C	2017/07/17	Oxidation Reduction Potential	mV	142
UA	G273	C	2017/11/04	Oxidation Reduction Potential	mV	141
UA	G273	C	2018/05/16	Oxidation Reduction Potential	mV	168
UA	G273	C	2018/08/10	Oxidation Reduction Potential	mV	161
UA	G273	C	2019/01/22	Oxidation Reduction Potential	mV	173
UA	G273	C	2019/08/26	Oxidation Reduction Potential	mV	161
UA	G273	C	2020/01/22	Oxidation Reduction Potential	mV	109
UA	G273	C	2020/08/13	Oxidation Reduction Potential	mV	136
UA	G273	C	2021/02/01	Oxidation Reduction Potential	mV	180
UA	G273	C	2021/08/18	Oxidation Reduction Potential	mV	78.5
UA	G273	C	2022/02/10	Oxidation Reduction Potential	mV	50.0
UA	G273	C	2022/03/21	Oxidation Reduction Potential	mV	79.5
UA	G273	C	2022/03/29	Oxidation Reduction Potential	mV	136
UA	G273	C	2022/05/11	Oxidation Reduction Potential	mV	108
UA	G273	C	2022/08/25	Oxidation Reduction Potential	mV	89.0
UA	G273	C	2022/11/09	Oxidation Reduction Potential	mV	63.7
UA	G273	C	2023/02/16	Oxidation Reduction Potential	mV	323
UA	G273	C	2023/06/05	Oxidation Reduction Potential	mV	180
UA	G273	C	2023/08/14	Oxidation Reduction Potential	mV	103
UA	G273	C	2023/11/17	Oxidation Reduction Potential	mV	125
UA	G273	C	2015/11/24	Eh	V	0.30
UA	G273	C	2016/02/16	Eh	V	0.35
UA	G273	C	2016/05/12	Eh	V	0.37
UA	G273	C	2016/08/05	Eh	V	0.37
UA	G273	C	2016/11/21	Eh	V	0.35
UA	G273	C	2017/02/15	Eh	V	0.29
UA	G273	C	2017/05/20	Eh	V	0.26
UA	G273	C	2017/07/17	Eh	V	0.33
UA	G273	C	2017/11/04	Eh	V	0.34
UA	G273	C	2018/05/16	Eh	V	0.36
UA	G273	C	2018/08/10	Eh	V	0.36
UA	G273	C	2019/01/22	Eh	V	0.37
UA	G273	C	2019/08/26	Eh	V	0.36
UA	G273	C	2020/01/22	Eh	V	0.31
UA	G273	C	2020/08/13	Eh	V	0.33
UA	G273	C	2021/02/01	Eh	V	0.38
UA	G273	C	2021/08/18	Eh	V	0.27
UA	G273	C	2022/02/10	Eh	V	0.25
UA	G273	C	2022/03/21	Eh	V	0.27
UA	G273	C	2022/03/29	Eh	V	0.33
UA	G273	C	2022/05/11	Eh	V	0.30
UA	G273	C	2022/08/25	Eh	V	0.28
UA	G273	C	2022/11/09	Eh	V	0.26
UA	G273	C	2023/02/16	Eh	V	0.52
UA	G273	C	2023/06/05	Eh	V	0.37
UA	G273	C	2023/08/14	Eh	V	0.30
UA	G273	C	2023/11/17	Eh	V	0.32
UA	G273	C	2009/09/23	Alkalinity, bicarbonate	mg/L CaCO3	330
UA	G273	C	2009/11/10	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G273	C	2010/01/21	Alkalinity, bicarbonate	mg/L CaCO3	320
UA	G273	C	2010/03/04	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G273	C	2010/07/27	Alkalinity, bicarbonate	mg/L CaCO3	320
UA	G273	C	2011/01/31	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G273	C	2012/01/26	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G273	C	2013/01/31	Alkalinity, bicarbonate	mg/L CaCO3	370
UA	G273	C	2014/02/19	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G273	C	2014/08/11	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G273	C	2014/10/14	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G273	C	2015/01/21	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G273	C	2015/04/13	Alkalinity, bicarbonate	mg/L CaCO3	360

UA	G273	C	2017/07/17	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G273	C	2020/01/22	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G273	C	2021/02/01	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G273	C	2022/03/29	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G273	C	2022/08/25	Alkalinity, bicarbonate	mg/L CaCO3	1,100
UA	G273	C	2023/02/16	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G273	C	2023/06/05	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G273	C	2023/08/14	Alkalinity, bicarbonate	mg/L CaCO3	366
UA	G273	C	2023/11/17	Alkalinity, bicarbonate	mg/L CaCO3	353
UA	G273	C	2022/08/25	Alkalinity, carbonate	mg/L CaCO3	10.0
UA	G273	C	2009/09/23	Arsenic, total	mg/L	<0.001
UA	G273	C	2009/11/10	Arsenic, total	mg/L	<0.001
UA	G273	C	2010/01/21	Arsenic, total	mg/L	<0.001
UA	G273	C	2010/03/04	Arsenic, total	mg/L	<0.001
UA	G273	C	2010/07/27	Arsenic, total	mg/L	<0.001
UA	G273	C	2010/11/16	Arsenic, total	mg/L	<0.001
UA	G273	C	2011/01/31	Arsenic, total	mg/L	<0.001
UA	G273	C	2011/05/03	Arsenic, total	mg/L	<0.001
UA	G273	C	2011/07/27	Arsenic, total	mg/L	<0.001
UA	G273	C	2011/11/14	Arsenic, total	mg/L	0.00130
UA	G273	C	2012/01/26	Arsenic, total	mg/L	<0.001
UA	G273	C	2012/05/22	Arsenic, total	mg/L	<0.001
UA	G273	C	2012/07/24	Arsenic, total	mg/L	<0.001
UA	G273	C	2012/11/14	Arsenic, total	mg/L	0.00340
UA	G273	C	2013/01/31	Arsenic, total	mg/L	<0.001
UA	G273	C	2013/05/20	Arsenic, total	mg/L	<0.001
UA	G273	C	2013/07/22	Arsenic, total	mg/L	<0.001
UA	G273	C	2013/10/14	Arsenic, total	mg/L	<0.001
UA	G273	C	2014/02/19	Arsenic, total	mg/L	<0.001
UA	G273	C	2014/05/13	Arsenic, total	mg/L	<0.001
UA	G273	C	2014/08/11	Arsenic, total	mg/L	<0.001
UA	G273	C	2014/10/14	Arsenic, total	mg/L	0.00110
UA	G273	C	2015/01/21	Arsenic, total	mg/L	<0.001
UA	G273	C	2015/04/13	Arsenic, total	mg/L	<0.001
UA	G273	C	2015/07/23	Arsenic, total	mg/L	<0.001
UA	G273	C	2015/10/08	Arsenic, total	mg/L	<0.001
UA	G273	C	2015/11/24	Arsenic, total	mg/L	<0.00013
UA	G273	C	2016/02/16	Arsenic, total	mg/L	<0.00013
UA	G273	C	2016/05/12	Arsenic, total	mg/L	0.00450
UA	G273	C	2016/08/05	Arsenic, total	mg/L	<0.00013
UA	G273	C	2016/11/21	Arsenic, total	mg/L	<0.00013
UA	G273	C	2017/02/15	Arsenic, total	mg/L	<0.00013
UA	G273	C	2017/05/20	Arsenic, total	mg/L	<0.00013
UA	G273	C	2017/07/17	Arsenic, total	mg/L	<0.00013
UA	G273	C	2018/05/16	Arsenic, total	mg/L	<0.0009
UA	G273	C	2018/08/10	Arsenic, total	mg/L	<0.0009
UA	G273	C	2019/01/22	Arsenic, total	mg/L	0.00150
UA	G273	C	2019/08/26	Arsenic, total	mg/L	<0.0009
UA	G273	C	2020/01/22	Arsenic, total	mg/L	0.00110
UA	G273	C	2020/08/13	Arsenic, total	mg/L	<0.00022
UA	G273	C	2020/10/14	Arsenic, total	mg/L	<0.001
UA	G273	C	2021/02/01	Arsenic, total	mg/L	<0.00022
UA	G273	C	2021/05/20	Arsenic, total	mg/L	<0.001
UA	G273	C	2021/08/18	Arsenic, total	mg/L	<0.00022
UA	G273	C	2021/10/27	Arsenic, total	mg/L	<0.001
UA	G273	C	2022/02/10	Arsenic, total	mg/L	<0.00069
UA	G273	C	2022/05/11	Arsenic, total	mg/L	<0.00069
UA	G273	C	2022/08/25	Arsenic, total	mg/L	<0.00069
UA	G273	C	2022/11/09	Arsenic, total	mg/L	<0.00069
UA	G273	C	2023/02/16	Arsenic, total	mg/L	0.00120
UA	G273	C	2023/06/05	Arsenic, total	mg/L	<0.00069
UA	G273	C	2023/08/14	Arsenic, total	mg/L	0.000400

UA	G273	C	2023/11/17	Arsenic, total	mg/L	0.000700
UA	G273	C	2009/09/23	Barium, total	mg/L	0.0940
UA	G273	C	2009/11/10	Barium, total	mg/L	0.0900
UA	G273	C	2010/01/21	Barium, total	mg/L	0.0850
UA	G273	C	2010/03/04	Barium, total	mg/L	0.0790
UA	G273	C	2010/07/27	Barium, total	mg/L	0.0480
UA	G273	C	2011/01/31	Barium, total	mg/L	0.0500
UA	G273	C	2012/01/26	Barium, total	mg/L	0.0430
UA	G273	C	2013/01/31	Barium, total	mg/L	0.0460
UA	G273	C	2014/02/19	Barium, total	mg/L	0.0390
UA	G273	C	2015/04/13	Barium, total	mg/L	0.0280
UA	G273	C	2015/07/23	Barium, total	mg/L	0.0440
UA	G273	C	2015/10/08	Barium, total	mg/L	0.0390
UA	G273	C	2015/11/24	Barium, total	mg/L	0.0490
UA	G273	C	2016/02/16	Barium, total	mg/L	0.0310
UA	G273	C	2016/05/12	Barium, total	mg/L	0.0310
UA	G273	C	2016/08/05	Barium, total	mg/L	0.0320
UA	G273	C	2016/11/21	Barium, total	mg/L	0.0360
UA	G273	C	2017/02/15	Barium, total	mg/L	0.0330
UA	G273	C	2017/05/20	Barium, total	mg/L	0.0320
UA	G273	C	2017/07/17	Barium, total	mg/L	0.0350
UA	G273	C	2018/05/16	Barium, total	mg/L	0.0320
UA	G273	C	2018/08/10	Barium, total	mg/L	0.0270
UA	G273	C	2019/01/22	Barium, total	mg/L	0.0490
UA	G273	C	2019/08/26	Barium, total	mg/L	0.0270
UA	G273	C	2020/01/22	Barium, total	mg/L	0.0300
UA	G273	C	2020/08/13	Barium, total	mg/L	0.0270
UA	G273	C	2020/10/14	Barium, total	mg/L	0.0290
UA	G273	C	2021/02/01	Barium, total	mg/L	0.0290
UA	G273	C	2021/05/20	Barium, total	mg/L	0.0280
UA	G273	C	2021/08/18	Barium, total	mg/L	0.0280
UA	G273	C	2021/10/27	Barium, total	mg/L	0.0280
UA	G273	C	2022/02/10	Barium, total	mg/L	0.0290
UA	G273	C	2022/05/11	Barium, total	mg/L	0.0290
UA	G273	C	2022/08/25	Barium, total	mg/L	0.0290
UA	G273	C	2022/11/09	Barium, total	mg/L	0.0260
UA	G273	C	2023/02/16	Barium, total	mg/L	0.0300
UA	G273	C	2023/06/05	Barium, total	mg/L	0.0320
UA	G273	C	2023/08/14	Barium, total	mg/L	0.0347
UA	G273	C	2023/11/17	Barium, total	mg/L	0.0410
UA	G273	C	2009/09/23	Calcium, total	mg/L	120
UA	G273	C	2009/11/10	Calcium, total	mg/L	140
UA	G273	C	2010/01/21	Calcium, total	mg/L	150
UA	G273	C	2010/03/04	Calcium, total	mg/L	190
UA	G273	C	2010/07/27	Calcium, total	mg/L	160
UA	G273	C	2010/11/16	Calcium, total	mg/L	130
UA	G273	C	2011/01/31	Calcium, total	mg/L	170
UA	G273	C	2011/05/03	Calcium, total	mg/L	160
UA	G273	C	2011/07/27	Calcium, total	mg/L	150
UA	G273	C	2011/11/14	Calcium, total	mg/L	150
UA	G273	C	2012/01/26	Calcium, total	mg/L	180
UA	G273	C	2012/05/22	Calcium, total	mg/L	160
UA	G273	C	2012/07/24	Calcium, total	mg/L	140
UA	G273	C	2012/11/14	Calcium, total	mg/L	160
UA	G273	C	2013/01/31	Calcium, total	mg/L	180
UA	G273	C	2013/05/20	Calcium, total	mg/L	180
UA	G273	C	2013/07/22	Calcium, total	mg/L	160
UA	G273	C	2013/10/14	Calcium, total	mg/L	140
UA	G273	C	2014/02/19	Calcium, total	mg/L	150
UA	G273	C	2014/05/13	Calcium, total	mg/L	160
UA	G273	C	2014/08/11	Calcium, total	mg/L	140
UA	G273	C	2014/10/14	Calcium, total	mg/L	150

UA	G273	C	2015/01/21	Calcium, total	mg/L	150
UA	G273	C	2015/04/13	Calcium, total	mg/L	200
UA	G273	C	2015/11/24	Calcium, total	mg/L	140
UA	G273	C	2016/02/16	Calcium, total	mg/L	150
UA	G273	C	2016/05/12	Calcium, total	mg/L	170
UA	G273	C	2016/08/05	Calcium, total	mg/L	120
UA	G273	C	2016/11/21	Calcium, total	mg/L	140
UA	G273	C	2017/02/15	Calcium, total	mg/L	140
UA	G273	C	2017/05/20	Calcium, total	mg/L	130
UA	G273	C	2017/07/17	Calcium, total	mg/L	140
UA	G273	C	2017/11/04	Calcium, total	mg/L	120
UA	G273	C	2018/05/16	Calcium, total	mg/L	160
UA	G273	C	2018/08/10	Calcium, total	mg/L	140
UA	G273	C	2019/01/22	Calcium, total	mg/L	170
UA	G273	C	2019/08/26	Calcium, total	mg/L	150
UA	G273	C	2020/01/22	Calcium, total	mg/L	170
UA	G273	C	2020/08/13	Calcium, total	mg/L	150
UA	G273	C	2021/02/01	Calcium, total	mg/L	160
UA	G273	C	2021/08/18	Calcium, total	mg/L	150
UA	G273	C	2022/02/10	Calcium, total	mg/L	160
UA	G273	C	2022/08/25	Calcium, total	mg/L	160
UA	G273	C	2023/02/16	Calcium, total	mg/L	150
UA	G273	C	2023/06/05	Calcium, total	mg/L	160
UA	G273	C	2023/08/14	Calcium, total	mg/L	164
UA	G273	C	2023/11/17	Calcium, total	mg/L	131
UA	G273	C	2009/09/23	Chloride, total	mg/L	35.0
UA	G273	C	2009/11/10	Chloride, total	mg/L	28.0
UA	G273	C	2010/01/21	Chloride, total	mg/L	30.0
UA	G273	C	2010/03/04	Chloride, total	mg/L	25.0
UA	G273	C	2010/07/27	Chloride, total	mg/L	30.0
UA	G273	C	2010/11/16	Chloride, total	mg/L	27.0
UA	G273	C	2011/01/31	Chloride, total	mg/L	33.0
UA	G273	C	2011/05/03	Chloride, total	mg/L	59.0
UA	G273	C	2011/07/27	Chloride, total	mg/L	29.0
UA	G273	C	2011/11/14	Chloride, total	mg/L	29.0
UA	G273	C	2012/01/26	Chloride, total	mg/L	27.0
UA	G273	C	2012/05/22	Chloride, total	mg/L	27.0
UA	G273	C	2012/07/24	Chloride, total	mg/L	32.0
UA	G273	C	2012/11/14	Chloride, total	mg/L	33.0
UA	G273	C	2013/01/31	Chloride, total	mg/L	37.0
UA	G273	C	2013/05/20	Chloride, total	mg/L	4.00
UA	G273	C	2013/07/22	Chloride, total	mg/L	35.0
UA	G273	C	2013/10/14	Chloride, total	mg/L	37.0
UA	G273	C	2014/02/19	Chloride, total	mg/L	38.0
UA	G273	C	2014/05/13	Chloride, total	mg/L	47.0
UA	G273	C	2014/08/11	Chloride, total	mg/L	37.0
UA	G273	C	2014/10/14	Chloride, total	mg/L	37.0
UA	G273	C	2015/01/21	Chloride, total	mg/L	46.0
UA	G273	C	2015/04/13	Chloride, total	mg/L	41.0
UA	G273	C	2015/07/23	Chloride, total	mg/L	39.0
UA	G273	C	2015/10/08	Chloride, total	mg/L	46.0
UA	G273	C	2015/11/24	Chloride, total	mg/L	41.0
UA	G273	C	2016/02/16	Chloride, total	mg/L	45.0
UA	G273	C	2016/05/12	Chloride, total	mg/L	44.0
UA	G273	C	2016/08/05	Chloride, total	mg/L	46.0
UA	G273	C	2016/11/21	Chloride, total	mg/L	48.0
UA	G273	C	2017/02/15	Chloride, total	mg/L	47.0
UA	G273	C	2017/05/20	Chloride, total	mg/L	51.0
UA	G273	C	2017/07/17	Chloride, total	mg/L	48.0
UA	G273	C	2017/11/04	Chloride, total	mg/L	50.0
UA	G273	C	2018/05/16	Chloride, total	mg/L	50.0
UA	G273	C	2018/08/10	Chloride, total	mg/L	53.0

UA	G273	C	2019/01/22	Chloride, total	mg/L	54.0
UA	G273	C	2019/08/26	Chloride, total	mg/L	59.0
UA	G273	C	2020/01/22	Chloride, total	mg/L	59.0
UA	G273	C	2020/08/13	Chloride, total	mg/L	64.0
UA	G273	C	2020/10/14	Chloride, total	mg/L	61.0
UA	G273	C	2021/02/01	Chloride, total	mg/L	82.0
UA	G273	C	2021/05/20	Chloride, total	mg/L	64.0
UA	G273	C	2021/08/18	Chloride, total	mg/L	66.0
UA	G273	C	2021/10/27	Chloride, total	mg/L	62.0
UA	G273	C	2022/02/10	Chloride, total	mg/L	69.0
UA	G273	C	2022/05/11	Chloride, total	mg/L	67.0
UA	G273	C	2022/08/25	Chloride, total	mg/L	74.0
UA	G273	C	2022/11/09	Chloride, total	mg/L	68.0
UA	G273	C	2023/02/16	Chloride, total	mg/L	77.0
UA	G273	C	2023/06/05	Chloride, total	mg/L	73.0
UA	G273	C	2023/08/14	Chloride, total	mg/L	68.0
UA	G273	C	2023/11/17	Chloride, total	mg/L	63.0
UA	G273	C	2023/06/05	Ferrous Iron, dissolved	mg/L	0.220
UA	G273	C	2009/11/10	Iron, dissolved	mg/L	<0.1
UA	G273	C	2010/01/21	Iron, dissolved	mg/L	<0.1
UA	G273	C	2010/03/04	Iron, dissolved	mg/L	<0.2
UA	G273	C	2010/07/27	Iron, dissolved	mg/L	<0.01
UA	G273	C	2010/09/20	Iron, dissolved	mg/L	<0.01
UA	G273	C	2010/11/16	Iron, dissolved	mg/L	<0.01
UA	G273	C	2011/01/31	Iron, dissolved	mg/L	<0.01
UA	G273	C	2011/05/03	Iron, dissolved	mg/L	<0.01
UA	G273	C	2011/07/27	Iron, dissolved	mg/L	<0.01
UA	G273	C	2011/11/14	Iron, dissolved	mg/L	<0.01
UA	G273	C	2012/01/26	Iron, dissolved	mg/L	<0.01
UA	G273	C	2012/05/22	Iron, dissolved	mg/L	<0.01
UA	G273	C	2012/07/24	Iron, dissolved	mg/L	<0.01
UA	G273	C	2012/11/14	Iron, dissolved	mg/L	<0.01
UA	G273	C	2013/01/31	Iron, dissolved	mg/L	<0.01
UA	G273	C	2013/05/20	Iron, dissolved	mg/L	<0.01
UA	G273	C	2013/07/22	Iron, dissolved	mg/L	<0.01
UA	G273	C	2013/10/14	Iron, dissolved	mg/L	<0.01
UA	G273	C	2014/02/19	Iron, dissolved	mg/L	<0.01
UA	G273	C	2014/05/13	Iron, dissolved	mg/L	<0.01
UA	G273	C	2014/08/11	Iron, dissolved	mg/L	<0.01
UA	G273	C	2014/10/14	Iron, dissolved	mg/L	<0.01
UA	G273	C	2015/01/21	Iron, dissolved	mg/L	<0.01
UA	G273	C	2015/04/13	Iron, dissolved	mg/L	0.0290
UA	G273	C	2015/07/23	Iron, dissolved	mg/L	<0.01
UA	G273	C	2015/10/08	Iron, dissolved	mg/L	<0.01
UA	G273	C	2016/02/16	Iron, dissolved	mg/L	<0.01
UA	G273	C	2016/05/12	Iron, dissolved	mg/L	<0.01
UA	G273	C	2016/07/27	Iron, dissolved	mg/L	<0.01
UA	G273	C	2016/11/21	Iron, dissolved	mg/L	0.0240
UA	G273	C	2017/02/08	Iron, dissolved	mg/L	<0.01
UA	G273	C	2017/05/18	Iron, dissolved	mg/L	<0.01
UA	G273	C	2017/07/25	Iron, dissolved	mg/L	<0.01
UA	G273	C	2017/11/04	Iron, dissolved	mg/L	0.0230
UA	G273	C	2018/01/29	Iron, dissolved	mg/L	0.120
UA	G273	C	2018/05/16	Iron, dissolved	mg/L	0.0150
UA	G273	C	2018/08/10	Iron, dissolved	mg/L	<0.01
UA	G273	C	2018/11/05	Iron, dissolved	mg/L	<0.1
UA	G273	C	2019/01/22	Iron, dissolved	mg/L	0.0180
UA	G273	C	2019/05/03	Iron, dissolved	mg/L	<0.01
UA	G273	C	2019/08/26	Iron, dissolved	mg/L	0.0120
UA	G273	C	2019/10/22	Iron, dissolved	mg/L	<0.01
UA	G273	C	2020/01/22	Iron, dissolved	mg/L	0.0160
UA	G273	C	2020/05/05	Iron, dissolved	mg/L	<0.01

UA	G273	C	2020/08/13	Iron, dissolved	mg/L	<0.01
UA	G273	C	2020/10/14	Iron, dissolved	mg/L	<0.01
UA	G273	C	2021/02/01	Iron, dissolved	mg/L	0.0150
UA	G273	C	2021/05/20	Iron, dissolved	mg/L	0.0130
UA	G273	C	2021/08/18	Iron, dissolved	mg/L	0.0120
UA	G273	C	2021/10/27	Iron, dissolved	mg/L	0.0190
UA	G273	C	2022/02/10	Iron, dissolved	mg/L	0.0570
UA	G273	C	2022/05/11	Iron, dissolved	mg/L	0.00400
UA	G273	C	2022/08/25	Iron, dissolved	mg/L	0.0140
UA	G273	C	2022/11/09	Iron, dissolved	mg/L	0.0220
UA	G273	C	2023/02/16	Iron, dissolved	mg/L	<0.00072
UA	G273	C	2023/06/05	Iron, dissolved	mg/L	0.0310
UA	G273	C	2023/08/14	Iron, dissolved	mg/L	<0.0175
UA	G273	C	2023/11/17	Iron, dissolved	mg/L	0.0190
UA	G273	C	2009/09/23	Magnesium, total	mg/L	63.0
UA	G273	C	2009/11/10	Magnesium, total	mg/L	72.0
UA	G273	C	2010/01/21	Magnesium, total	mg/L	75.0
UA	G273	C	2010/03/04	Magnesium, total	mg/L	95.0
UA	G273	C	2010/07/27	Magnesium, total	mg/L	79.0
UA	G273	C	2011/01/31	Magnesium, total	mg/L	89.0
UA	G273	C	2012/01/26	Magnesium, total	mg/L	92.0
UA	G273	C	2013/01/31	Magnesium, total	mg/L	93.0
UA	G273	C	2014/02/19	Magnesium, total	mg/L	88.0
UA	G273	C	2015/04/13	Magnesium, total	mg/L	100
UA	G273	C	2017/07/17	Magnesium, total	mg/L	63.0
UA	G273	C	2020/01/22	Magnesium, total	mg/L	90.0
UA	G273	C	2021/02/01	Magnesium, total	mg/L	83.0
UA	G273	C	2022/02/10	Magnesium, total	mg/L	77.0
UA	G273	C	2022/08/25	Magnesium, total	mg/L	82.0
UA	G273	C	2023/02/16	Magnesium, total	mg/L	76.0
UA	G273	C	2023/06/05	Magnesium, total	mg/L	83.0
UA	G273	C	2023/08/14	Magnesium, total	mg/L	82.0
UA	G273	C	2023/11/17	Magnesium, total	mg/L	67.2
UA	G273	C	2009/11/10	Manganese, dissolved	mg/L	0.0970
UA	G273	C	2010/01/21	Manganese, dissolved	mg/L	0.0630
UA	G273	C	2010/03/04	Manganese, dissolved	mg/L	0.0550
UA	G273	C	2010/07/27	Manganese, dissolved	mg/L	0.0480
UA	G273	C	2010/09/20	Manganese, dissolved	mg/L	0.0520
UA	G273	C	2010/11/16	Manganese, dissolved	mg/L	0.0580
UA	G273	C	2011/01/31	Manganese, dissolved	mg/L	0.0470
UA	G273	C	2011/05/03	Manganese, dissolved	mg/L	0.0420
UA	G273	C	2011/07/27	Manganese, dissolved	mg/L	0.0290
UA	G273	C	2011/11/14	Manganese, dissolved	mg/L	0.0410
UA	G273	C	2012/01/26	Manganese, dissolved	mg/L	0.0330
UA	G273	C	2012/05/22	Manganese, dissolved	mg/L	0.0280
UA	G273	C	2012/07/24	Manganese, dissolved	mg/L	0.0220
UA	G273	C	2012/11/14	Manganese, dissolved	mg/L	0.0260
UA	G273	C	2013/01/31	Manganese, dissolved	mg/L	0.0300
UA	G273	C	2013/05/20	Manganese, dissolved	mg/L	0.0130
UA	G273	C	2013/07/22	Manganese, dissolved	mg/L	0.0220
UA	G273	C	2013/10/14	Manganese, dissolved	mg/L	0.0150
UA	G273	C	2014/02/19	Manganese, dissolved	mg/L	0.0150
UA	G273	C	2014/05/13	Manganese, dissolved	mg/L	0.330
UA	G273	C	2014/08/11	Manganese, dissolved	mg/L	0.0100
UA	G273	C	2014/10/14	Manganese, dissolved	mg/L	0.0130
UA	G273	C	2015/01/21	Manganese, dissolved	mg/L	0.0180
UA	G273	C	2015/04/13	Manganese, dissolved	mg/L	0.0190
UA	G273	C	2015/07/23	Manganese, dissolved	mg/L	0.00110
UA	G273	C	2015/10/08	Manganese, dissolved	mg/L	0.0140
UA	G273	C	2016/02/16	Manganese, dissolved	mg/L	0.0100
UA	G273	C	2016/05/12	Manganese, dissolved	mg/L	0.0120
UA	G273	C	2016/07/27	Manganese, dissolved	mg/L	0.0210

UA	G273	C	2016/11/21	Manganese, dissolved	mg/L	0.0220
UA	G273	C	2017/02/08	Manganese, dissolved	mg/L	0.0180
UA	G273	C	2017/05/18	Manganese, dissolved	mg/L	0.00830
UA	G273	C	2017/07/25	Manganese, dissolved	mg/L	<0.001
UA	G273	C	2017/11/04	Manganese, dissolved	mg/L	0.0200
UA	G273	C	2018/01/29	Manganese, dissolved	mg/L	0.0280
UA	G273	C	2018/05/16	Manganese, dissolved	mg/L	0.0130
UA	G273	C	2018/08/10	Manganese, dissolved	mg/L	0.00800
UA	G273	C	2018/11/05	Manganese, dissolved	mg/L	0.0130
UA	G273	C	2019/01/22	Manganese, dissolved	mg/L	0.0180
UA	G273	C	2019/05/03	Manganese, dissolved	mg/L	0.0170
UA	G273	C	2019/08/26	Manganese, dissolved	mg/L	0.0270
UA	G273	C	2019/10/22	Manganese, dissolved	mg/L	0.0210
UA	G273	C	2020/01/22	Manganese, dissolved	mg/L	0.0250
UA	G273	C	2020/05/05	Manganese, dissolved	mg/L	0.0240
UA	G273	C	2020/08/13	Manganese, dissolved	mg/L	0.0290
UA	G273	C	2020/10/14	Manganese, dissolved	mg/L	0.0240
UA	G273	C	2021/02/01	Manganese, dissolved	mg/L	0.0360
UA	G273	C	2021/05/20	Manganese, dissolved	mg/L	0.0400
UA	G273	C	2021/08/18	Manganese, dissolved	mg/L	0.0380
UA	G273	C	2021/10/27	Manganese, dissolved	mg/L	0.0470
UA	G273	C	2022/02/10	Manganese, dissolved	mg/L	0.0440
UA	G273	C	2022/05/11	Manganese, dissolved	mg/L	0.0390
UA	G273	C	2022/08/25	Manganese, dissolved	mg/L	0.0490
UA	G273	C	2022/11/09	Manganese, dissolved	mg/L	0.0680
UA	G273	C	2023/02/16	Manganese, dissolved	mg/L	<0.00023
UA	G273	C	2023/06/05	Manganese, dissolved	mg/L	0.0960
UA	G273	C	2023/08/14	Manganese, dissolved	mg/L	<0.0008
UA	G273	C	2023/11/17	Manganese, dissolved	mg/L	0.0625
UA	G273	C	2023/08/14	Phosphate, dissolved	mg/L	<0.005
UA	G273	C	2009/09/23	Potassium, total	mg/L	0.790
UA	G273	C	2009/11/10	Potassium, total	mg/L	0.760
UA	G273	C	2010/01/21	Potassium, total	mg/L	0.530
UA	G273	C	2010/03/04	Potassium, total	mg/L	0.580
UA	G273	C	2010/07/27	Potassium, total	mg/L	0.520
UA	G273	C	2011/01/31	Potassium, total	mg/L	0.460
UA	G273	C	2012/01/26	Potassium, total	mg/L	0.450
UA	G273	C	2013/01/31	Potassium, total	mg/L	0.400
UA	G273	C	2014/02/19	Potassium, total	mg/L	0.450
UA	G273	C	2015/04/13	Potassium, total	mg/L	0.300
UA	G273	C	2017/07/17	Potassium, total	mg/L	0.490
UA	G273	C	2020/01/22	Potassium, total	mg/L	0.400
UA	G273	C	2021/02/01	Potassium, total	mg/L	0.380
UA	G273	C	2022/02/10	Potassium, total	mg/L	0.440
UA	G273	C	2022/08/25	Potassium, total	mg/L	0.470
UA	G273	C	2023/02/16	Potassium, total	mg/L	0.460
UA	G273	C	2023/06/05	Potassium, total	mg/L	0.390
UA	G273	C	2023/08/14	Potassium, total	mg/L	0.557
UA	G273	C	2023/11/17	Potassium, total	mg/L	0.539
UA	G273	C	2023/06/05	Silicon, dissolved	mg/L	8.50
UA	G273	C	2023/08/14	Silicon, dissolved	mg/L	7.95
UA	G273	C	2009/09/23	Sodium, total	mg/L	91.0
UA	G273	C	2009/11/10	Sodium, total	mg/L	99.0
UA	G273	C	2010/01/21	Sodium, total	mg/L	93.0
UA	G273	C	2010/03/04	Sodium, total	mg/L	100
UA	G273	C	2010/07/27	Sodium, total	mg/L	90.0
UA	G273	C	2011/01/31	Sodium, total	mg/L	94.0
UA	G273	C	2012/01/26	Sodium, total	mg/L	96.0
UA	G273	C	2013/01/31	Sodium, total	mg/L	96.0
UA	G273	C	2014/02/19	Sodium, total	mg/L	92.0
UA	G273	C	2015/04/13	Sodium, total	mg/L	95.0
UA	G273	C	2017/07/17	Sodium, total	mg/L	85.0

UA	G273	C	2020/01/22	Sodium, total	mg/L	100
UA	G273	C	2021/02/01	Sodium, total	mg/L	94.0
UA	G273	C	2022/02/10	Sodium, total	mg/L	99.0
UA	G273	C	2022/08/25	Sodium, total	mg/L	100
UA	G273	C	2023/02/16	Sodium, total	mg/L	97.0
UA	G273	C	2023/06/05	Sodium, total	mg/L	95.0
UA	G273	C	2023/08/14	Sodium, total	mg/L	104
UA	G273	C	2023/11/17	Sodium, total	mg/L	87.0
UA	G273	C	2009/09/23	Sulfate, total	mg/L	340
UA	G273	C	2009/11/10	Sulfate, total	mg/L	400
UA	G273	C	2010/01/21	Sulfate, total	mg/L	560
UA	G273	C	2010/03/04	Sulfate, total	mg/L	570
UA	G273	C	2010/07/27	Sulfate, total	mg/L	490
UA	G273	C	2010/11/16	Sulfate, total	mg/L	420
UA	G273	C	2011/01/31	Sulfate, total	mg/L	520
UA	G273	C	2011/05/03	Sulfate, total	mg/L	640
UA	G273	C	2011/07/27	Sulfate, total	mg/L	510
UA	G273	C	2011/11/14	Sulfate, total	mg/L	510
UA	G273	C	2012/01/26	Sulfate, total	mg/L	750
UA	G273	C	2012/05/22	Sulfate, total	mg/L	470
UA	G273	C	2012/07/24	Sulfate, total	mg/L	360
UA	G273	C	2012/11/14	Sulfate, total	mg/L	630
UA	G273	C	2013/01/31	Sulfate, total	mg/L	740
UA	G273	C	2013/05/20	Sulfate, total	mg/L	670
UA	G273	C	2013/07/22	Sulfate, total	mg/L	510
UA	G273	C	2013/10/14	Sulfate, total	mg/L	450
UA	G273	C	2014/02/19	Sulfate, total	mg/L	570
UA	G273	C	2014/05/13	Sulfate, total	mg/L	620
UA	G273	C	2014/08/11	Sulfate, total	mg/L	530
UA	G273	C	2014/10/14	Sulfate, total	mg/L	500
UA	G273	C	2015/01/21	Sulfate, total	mg/L	650
UA	G273	C	2015/04/13	Sulfate, total	mg/L	690
UA	G273	C	2015/07/23	Sulfate, total	mg/L	390
UA	G273	C	2015/10/08	Sulfate, total	mg/L	450
UA	G273	C	2015/11/24	Sulfate, total	mg/L	420
UA	G273	C	2016/02/16	Sulfate, total	mg/L	550
UA	G273	C	2016/05/12	Sulfate, total	mg/L	520
UA	G273	C	2016/08/05	Sulfate, total	mg/L	400
UA	G273	C	2016/11/21	Sulfate, total	mg/L	440
UA	G273	C	2017/02/15	Sulfate, total	mg/L	470
UA	G273	C	2017/05/20	Sulfate, total	mg/L	390
UA	G273	C	2017/07/17	Sulfate, total	mg/L	360
UA	G273	C	2017/11/04	Sulfate, total	mg/L	380
UA	G273	C	2018/05/16	Sulfate, total	mg/L	490
UA	G273	C	2018/08/10	Sulfate, total	mg/L	460
UA	G273	C	2019/01/22	Sulfate, total	mg/L	590
UA	G273	C	2019/08/26	Sulfate, total	mg/L	440
UA	G273	C	2020/01/22	Sulfate, total	mg/L	510
UA	G273	C	2020/08/13	Sulfate, total	mg/L	410
UA	G273	C	2020/10/14	Sulfate, total	mg/L	400
UA	G273	C	2021/02/01	Sulfate, total	mg/L	490
UA	G273	C	2021/05/20	Sulfate, total	mg/L	940
UA	G273	C	2021/08/18	Sulfate, total	mg/L	440
UA	G273	C	2021/10/27	Sulfate, total	mg/L	390
UA	G273	C	2022/02/10	Sulfate, total	mg/L	410
UA	G273	C	2022/05/11	Sulfate, total	mg/L	410
UA	G273	C	2022/08/25	Sulfate, total	mg/L	410
UA	G273	C	2022/11/09	Sulfate, total	mg/L	390
UA	G273	C	2023/02/16	Sulfate, total	mg/L	440
UA	G273	C	2023/06/05	Sulfate, total	mg/L	470
UA	G273	C	2023/08/14	Sulfate, total	mg/L	465
UA	G273	C	2023/11/17	Sulfate, total	mg/L	333

UA	G273	C	2015/11/24	Temperature (Celsius)	degrees C	16.7
UA	G273	C	2016/02/16	Temperature (Celsius)	degrees C	10.9
UA	G273	C	2016/05/12	Temperature (Celsius)	degrees C	16.0
UA	G273	C	2016/08/05	Temperature (Celsius)	degrees C	18.2
UA	G273	C	2016/11/21	Temperature (Celsius)	degrees C	14.3
UA	G273	C	2017/02/15	Temperature (Celsius)	degrees C	15.6
UA	G273	C	2017/05/20	Temperature (Celsius)	degrees C	15.0
UA	G273	C	2017/07/17	Temperature (Celsius)	degrees C	21.7
UA	G273	C	2017/11/04	Temperature (Celsius)	degrees C	12.6
UA	G273	C	2018/05/16	Temperature (Celsius)	degrees C	14.3
UA	G273	C	2018/08/10	Temperature (Celsius)	degrees C	15.2
UA	G273	C	2019/01/22	Temperature (Celsius)	degrees C	11.9
UA	G273	C	2019/08/26	Temperature (Celsius)	degrees C	16.9
UA	G273	C	2020/01/22	Temperature (Celsius)	degrees C	12.6
UA	G273	C	2020/08/13	Temperature (Celsius)	degrees C	17.6
UA	G273	C	2021/02/01	Temperature (Celsius)	degrees C	11.8
UA	G273	C	2021/08/18	Temperature (Celsius)	degrees C	18.8
UA	G273	C	2022/02/10	Temperature (Celsius)	degrees C	12.0
UA	G273	C	2022/03/21	Temperature (Celsius)	degrees C	17.1
UA	G273	C	2022/03/29	Temperature (Celsius)	degrees C	11.8
UA	G273	C	2022/05/11	Temperature (Celsius)	degrees C	19.6
UA	G273	C	2022/08/25	Temperature (Celsius)	degrees C	18.7
UA	G273	C	2022/11/09	Temperature (Celsius)	degrees C	17.9
UA	G273	C	2023/02/16	Temperature (Celsius)	degrees C	9.30
UA	G273	C	2023/06/05	Temperature (Celsius)	degrees C	18.0
UA	G273	C	2023/08/14	Temperature (Celsius)	degrees C	16.6
UA	G273	C	2023/11/17	Temperature (Celsius)	degrees C	16.4
UA	G273	C	2009/09/23	Total Dissolved Solids	mg/L	890
UA	G273	C	2009/11/10	Total Dissolved Solids	mg/L	980
UA	G273	C	2010/01/21	Total Dissolved Solids	mg/L	1,200
UA	G273	C	2010/03/04	Total Dissolved Solids	mg/L	1,300
UA	G273	C	2010/07/27	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2010/11/16	Total Dissolved Solids	mg/L	960
UA	G273	C	2011/01/31	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2011/05/03	Total Dissolved Solids	mg/L	1,200
UA	G273	C	2011/07/27	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2011/11/14	Total Dissolved Solids	mg/L	990
UA	G273	C	2012/01/26	Total Dissolved Solids	mg/L	1,300
UA	G273	C	2012/05/22	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2012/07/24	Total Dissolved Solids	mg/L	910
UA	G273	C	2012/11/14	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2013/01/31	Total Dissolved Solids	mg/L	1,300
UA	G273	C	2013/05/20	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2013/07/22	Total Dissolved Solids	mg/L	980
UA	G273	C	2013/10/14	Total Dissolved Solids	mg/L	900
UA	G273	C	2014/02/19	Total Dissolved Solids	mg/L	1,200
UA	G273	C	2014/05/13	Total Dissolved Solids	mg/L	910
UA	G273	C	2014/08/11	Total Dissolved Solids	mg/L	1,000
UA	G273	C	2014/10/14	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2015/01/21	Total Dissolved Solids	mg/L	1,200
UA	G273	C	2015/04/13	Total Dissolved Solids	mg/L	1,300
UA	G273	C	2015/07/23	Total Dissolved Solids	mg/L	1,200
UA	G273	C	2015/10/08	Total Dissolved Solids	mg/L	930
UA	G273	C	2015/11/24	Total Dissolved Solids	mg/L	890
UA	G273	C	2016/02/16	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2016/05/12	Total Dissolved Solids	mg/L	980
UA	G273	C	2016/08/05	Total Dissolved Solids	mg/L	840
UA	G273	C	2016/11/21	Total Dissolved Solids	mg/L	900
UA	G273	C	2017/02/15	Total Dissolved Solids	mg/L	990
UA	G273	C	2017/05/20	Total Dissolved Solids	mg/L	890
UA	G273	C	2017/07/17	Total Dissolved Solids	mg/L	920
UA	G273	C	2017/11/04	Total Dissolved Solids	mg/L	820

UA	G273	C	2018/05/16	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2018/08/10	Total Dissolved Solids	mg/L	940
UA	G273	C	2019/01/22	Total Dissolved Solids	mg/L	1,300
UA	G273	C	2019/08/26	Total Dissolved Solids	mg/L	1,000
UA	G273	C	2020/01/22	Total Dissolved Solids	mg/L	1,000
UA	G273	C	2020/08/13	Total Dissolved Solids	mg/L	890
UA	G273	C	2020/10/14	Total Dissolved Solids	mg/L	1,000
UA	G273	C	2021/02/01	Total Dissolved Solids	mg/L	1,200
UA	G273	C	2021/05/20	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2021/08/18	Total Dissolved Solids	mg/L	1,200
UA	G273	C	2021/10/27	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2022/02/10	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2022/05/11	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2022/08/25	Total Dissolved Solids	mg/L	940
UA	G273	C	2022/11/09	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2023/02/16	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2023/06/05	Total Dissolved Solids	mg/L	1,100
UA	G273	C	2023/08/14	Total Dissolved Solids	mg/L	1,180
UA	G273	C	2023/11/17	Total Dissolved Solids	mg/L	936
UA	G275	C	2010/07/26	pH (field)	SU	7.2
UA	G275	C	2010/07/28	pH (field)	SU	7.2
UA	G275	C	2010/09/20	pH (field)	SU	7.6
UA	G275	C	2010/11/16	pH (field)	SU	7.5
UA	G275	C	2011/01/31	pH (field)	SU	7.0
UA	G275	C	2011/05/03	pH (field)	SU	6.8
UA	G275	C	2011/07/27	pH (field)	SU	6.7
UA	G275	C	2011/11/14	pH (field)	SU	6.9
UA	G275	C	2012/01/31	pH (field)	SU	6.9
UA	G275	C	2012/05/22	pH (field)	SU	6.9
UA	G275	C	2012/07/24	pH (field)	SU	6.8
UA	G275	C	2012/11/14	pH (field)	SU	7.0
UA	G275	C	2013/05/20	pH (field)	SU	6.8
UA	G275	C	2013/07/22	pH (field)	SU	6.7
UA	G275	C	2014/05/13	pH (field)	SU	7.7
UA	G275	C	2014/08/11	pH (field)	SU	7.1
UA	G275	C	2014/10/14	pH (field)	SU	6.8
UA	G275	C	2015/01/21	pH (field)	SU	7.0
UA	G275	C	2015/04/13	pH (field)	SU	6.7
UA	G275	C	2015/07/23	pH (field)	SU	7.1
UA	G275	C	2020/10/14	pH (field)	SU	6.8
UA	G275	C	2021/05/20	pH (field)	SU	7.0
UA	G275	C	2021/08/18	pH (field)	SU	7.1
UA	G275	C	2021/10/27	pH (field)	SU	7.1
UA	G275	C	2022/02/10	pH (field)	SU	7.1
UA	G275	C	2022/05/12	pH (field)	SU	7.0
UA	G275	C	2022/11/09	pH (field)	SU	7.1
UA	G275	C	2023/02/16	pH (field)	SU	6.8
UA	G275	C	2023/06/08	pH (field)	SU	7.0
UA	G275	C	2022/02/10	Oxidation Reduction Potential	mV	124
UA	G275	C	2022/05/12	Oxidation Reduction Potential	mV	102
UA	G275	C	2022/11/09	Oxidation Reduction Potential	mV	84.5
UA	G275	C	2023/02/16	Oxidation Reduction Potential	mV	233
UA	G275	C	2023/06/08	Oxidation Reduction Potential	mV	170
UA	G275	C	2022/02/10	Eh	V	0.32
UA	G275	C	2022/05/12	Eh	V	0.30
UA	G275	C	2022/11/09	Eh	V	0.28
UA	G275	C	2023/02/16	Eh	V	0.43
UA	G275	C	2023/06/08	Eh	V	0.36
UA	G275	C	2009/09/22	Alkalinity, bicarbonate	mg/L CaCO3	440
UA	G275	C	2009/11/11	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G275	C	2010/01/21	Alkalinity, bicarbonate	mg/L CaCO3	240
UA	G275	C	2010/03/08	Alkalinity, bicarbonate	mg/L CaCO3	250

UA	G275	C	2010/07/26	Alkalinity, bicarbonate	mg/L CaCO3	420
UA	G275	C	2011/01/31	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G275	C	2012/01/31	Alkalinity, bicarbonate	mg/L CaCO3	390
UA	G275	C	2014/08/11	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G275	C	2014/10/14	Alkalinity, bicarbonate	mg/L CaCO3	440
UA	G275	C	2015/01/21	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G275	C	2015/04/13	Alkalinity, bicarbonate	mg/L CaCO3	400
UA	G275	C	2023/06/08	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G275	C	2009/09/22	Arsenic, total	mg/L	<0.005
UA	G275	C	2009/11/11	Arsenic, total	mg/L	<0.001
UA	G275	C	2010/01/21	Arsenic, total	mg/L	<0.001
UA	G275	C	2010/03/08	Arsenic, total	mg/L	<0.001
UA	G275	C	2010/07/26	Arsenic, total	mg/L	<0.001
UA	G275	C	2010/11/16	Arsenic, total	mg/L	0.00280
UA	G275	C	2011/01/31	Arsenic, total	mg/L	0.00150
UA	G275	C	2011/05/03	Arsenic, total	mg/L	<0.001
UA	G275	C	2011/07/27	Arsenic, total	mg/L	<0.001
UA	G275	C	2011/11/14	Arsenic, total	mg/L	0.00410
UA	G275	C	2012/01/31	Arsenic, total	mg/L	0.00110
UA	G275	C	2012/05/22	Arsenic, total	mg/L	0.00170
UA	G275	C	2012/07/24	Arsenic, total	mg/L	0.00180
UA	G275	C	2012/11/14	Arsenic, total	mg/L	0.00250
UA	G275	C	2013/05/20	Arsenic, total	mg/L	0.00250
UA	G275	C	2013/07/22	Arsenic, total	mg/L	<0.001
UA	G275	C	2014/05/13	Arsenic, total	mg/L	0.00190
UA	G275	C	2014/08/11	Arsenic, total	mg/L	0.00430
UA	G275	C	2014/10/14	Arsenic, total	mg/L	0.00110
UA	G275	C	2015/01/21	Arsenic, total	mg/L	0.00430
UA	G275	C	2015/04/13	Arsenic, total	mg/L	<0.001
UA	G275	C	2015/07/23	Arsenic, total	mg/L	<0.001
UA	G275	C	2020/10/14	Arsenic, total	mg/L	<0.001
UA	G275	C	2021/05/20	Arsenic, total	mg/L	<0.001
UA	G275	C	2021/08/18	Arsenic, total	mg/L	<0.001
UA	G275	C	2021/10/27	Arsenic, total	mg/L	<0.001
UA	G275	C	2022/02/10	Arsenic, total	mg/L	<0.001
UA	G275	C	2022/05/12	Arsenic, total	mg/L	<0.00069
UA	G275	C	2022/11/09	Arsenic, total	mg/L	0.00120
UA	G275	C	2023/02/16	Arsenic, total	mg/L	0.00110
UA	G275	C	2023/06/08	Arsenic, total	mg/L	<0.00069
UA	G275	C	2009/09/22	Barium, total	mg/L	0.120
UA	G275	C	2009/11/11	Barium, total	mg/L	0.0320
UA	G275	C	2010/01/21	Barium, total	mg/L	0.0320
UA	G275	C	2010/03/08	Barium, total	mg/L	0.0350
UA	G275	C	2010/07/26	Barium, total	mg/L	0.0380
UA	G275	C	2011/01/31	Barium, total	mg/L	0.0460
UA	G275	C	2012/01/31	Barium, total	mg/L	0.0390
UA	G275	C	2015/04/13	Barium, total	mg/L	0.0560
UA	G275	C	2015/07/23	Barium, total	mg/L	0.0350
UA	G275	C	2020/10/14	Barium, total	mg/L	0.0320
UA	G275	C	2021/05/20	Barium, total	mg/L	0.0250
UA	G275	C	2021/08/18	Barium, total	mg/L	0.0270
UA	G275	C	2021/10/27	Barium, total	mg/L	0.0240
UA	G275	C	2022/02/10	Barium, total	mg/L	0.0530
UA	G275	C	2022/05/12	Barium, total	mg/L	0.0270
UA	G275	C	2022/11/09	Barium, total	mg/L	0.0290
UA	G275	C	2023/02/16	Barium, total	mg/L	0.0300
UA	G275	C	2023/06/08	Barium, total	mg/L	0.0240
UA	G275	C	2009/09/22	Calcium, total	mg/L	300
UA	G275	C	2009/11/11	Calcium, total	mg/L	140
UA	G275	C	2010/01/21	Calcium, total	mg/L	120
UA	G275	C	2010/03/08	Calcium, total	mg/L	160
UA	G275	C	2010/07/26	Calcium, total	mg/L	180

UA	G275	C	2010/11/16	Calcium, total	mg/L	260
UA	G275	C	2011/01/31	Calcium, total	mg/L	230
UA	G275	C	2011/05/03	Calcium, total	mg/L	240
UA	G275	C	2011/07/27	Calcium, total	mg/L	200
UA	G275	C	2011/11/14	Calcium, total	mg/L	260
UA	G275	C	2012/01/31	Calcium, total	mg/L	310
UA	G275	C	2012/05/22	Calcium, total	mg/L	240
UA	G275	C	2012/07/24	Calcium, total	mg/L	260
UA	G275	C	2012/11/14	Calcium, total	mg/L	270
UA	G275	C	2013/05/20	Calcium, total	mg/L	250
UA	G275	C	2013/07/22	Calcium, total	mg/L	210
UA	G275	C	2014/05/13	Calcium, total	mg/L	210
UA	G275	C	2014/08/11	Calcium, total	mg/L	240
UA	G275	C	2014/10/14	Calcium, total	mg/L	200
UA	G275	C	2015/01/21	Calcium, total	mg/L	230
UA	G275	C	2015/04/13	Calcium, total	mg/L	180
UA	G275	C	2023/06/08	Calcium, total	mg/L	160
UA	G275	C	2009/09/22	Chloride, total	mg/L	14.0
UA	G275	C	2009/11/11	Chloride, total	mg/L	12.0
UA	G275	C	2010/01/21	Chloride, total	mg/L	13.0
UA	G275	C	2010/03/08	Chloride, total	mg/L	23.0
UA	G275	C	2010/07/26	Chloride, total	mg/L	9.90
UA	G275	C	2010/11/16	Chloride, total	mg/L	9.70
UA	G275	C	2011/01/31	Chloride, total	mg/L	11.0
UA	G275	C	2011/05/03	Chloride, total	mg/L	13.0
UA	G275	C	2011/07/27	Chloride, total	mg/L	9.20
UA	G275	C	2011/11/14	Chloride, total	mg/L	17.0
UA	G275	C	2012/01/31	Chloride, total	mg/L	15.0
UA	G275	C	2012/05/22	Chloride, total	mg/L	11.0
UA	G275	C	2012/07/24	Chloride, total	mg/L	13.0
UA	G275	C	2012/11/14	Chloride, total	mg/L	19.0
UA	G275	C	2013/05/20	Chloride, total	mg/L	24.0
UA	G275	C	2013/07/22	Chloride, total	mg/L	19.0
UA	G275	C	2014/05/13	Chloride, total	mg/L	20.0
UA	G275	C	2014/08/11	Chloride, total	mg/L	20.0
UA	G275	C	2014/10/14	Chloride, total	mg/L	16.0
UA	G275	C	2015/01/21	Chloride, total	mg/L	20.0
UA	G275	C	2015/04/13	Chloride, total	mg/L	22.0
UA	G275	C	2015/07/23	Chloride, total	mg/L	30.0
UA	G275	C	2020/10/14	Chloride, total	mg/L	27.0
UA	G275	C	2021/05/20	Chloride, total	mg/L	18.0
UA	G275	C	2021/08/18	Chloride, total	mg/L	23.0
UA	G275	C	2021/10/27	Chloride, total	mg/L	18.0
UA	G275	C	2022/02/10	Chloride, total	mg/L	22.0
UA	G275	C	2022/05/12	Chloride, total	mg/L	20.0
UA	G275	C	2022/11/09	Chloride, total	mg/L	32.0
UA	G275	C	2023/02/16	Chloride, total	mg/L	19.0
UA	G275	C	2023/06/08	Chloride, total	mg/L	24.0
UA	G275	C	2023/06/08	Ferrous Iron, dissolved	mg/L	0.100
UA	G275	C	2009/11/11	Iron, dissolved	mg/L	<0.1
UA	G275	C	2010/01/21	Iron, dissolved	mg/L	<0.1
UA	G275	C	2010/03/08	Iron, dissolved	mg/L	<0.2
UA	G275	C	2010/07/26	Iron, dissolved	mg/L	0.0110
UA	G275	C	2010/09/20	Iron, dissolved	mg/L	<0.01
UA	G275	C	2010/11/16	Iron, dissolved	mg/L	<0.01
UA	G275	C	2011/01/31	Iron, dissolved	mg/L	0.0250
UA	G275	C	2011/05/03	Iron, dissolved	mg/L	<0.01
UA	G275	C	2011/07/27	Iron, dissolved	mg/L	0.0350
UA	G275	C	2011/11/14	Iron, dissolved	mg/L	0.0190
UA	G275	C	2012/01/31	Iron, dissolved	mg/L	0.0260
UA	G275	C	2012/05/22	Iron, dissolved	mg/L	<0.01
UA	G275	C	2012/07/24	Iron, dissolved	mg/L	0.0130

UA	G275	C	2012/11/14	Iron, dissolved	mg/L	0.0280
UA	G275	C	2013/05/20	Iron, dissolved	mg/L	<0.01
UA	G275	C	2013/07/22	Iron, dissolved	mg/L	0.0140
UA	G275	C	2014/05/13	Iron, dissolved	mg/L	0.0220
UA	G275	C	2014/08/11	Iron, dissolved	mg/L	<0.01
UA	G275	C	2014/10/14	Iron, dissolved	mg/L	0.0110
UA	G275	C	2015/01/21	Iron, dissolved	mg/L	<0.01
UA	G275	C	2015/04/13	Iron, dissolved	mg/L	<0.01
UA	G275	C	2015/07/23	Iron, dissolved	mg/L	0.0120
UA	G275	C	2016/02/09	Iron, dissolved	mg/L	0.0270
UA	G275	C	2016/05/12	Iron, dissolved	mg/L	<0.01
UA	G275	C	2016/07/27	Iron, dissolved	mg/L	0.0380
UA	G275	C	2016/11/21	Iron, dissolved	mg/L	0.0700
UA	G275	C	2017/02/14	Iron, dissolved	mg/L	<0.01
UA	G275	C	2017/05/18	Iron, dissolved	mg/L	<0.01
UA	G275	C	2017/07/25	Iron, dissolved	mg/L	0.0600
UA	G275	C	2017/11/03	Iron, dissolved	mg/L	0.0880
UA	G275	C	2018/05/16	Iron, dissolved	mg/L	0.0230
UA	G275	C	2018/08/10	Iron, dissolved	mg/L	<0.01
UA	G275	C	2018/11/05	Iron, dissolved	mg/L	<0.1
UA	G275	C	2019/01/22	Iron, dissolved	mg/L	0.0530
UA	G275	C	2019/05/03	Iron, dissolved	mg/L	0.0140
UA	G275	C	2019/08/26	Iron, dissolved	mg/L	0.0250
UA	G275	C	2019/10/22	Iron, dissolved	mg/L	0.0270
UA	G275	C	2020/01/23	Iron, dissolved	mg/L	<0.01
UA	G275	C	2020/05/06	Iron, dissolved	mg/L	<0.01
UA	G275	C	2020/08/13	Iron, dissolved	mg/L	<0.01
UA	G275	C	2020/10/14	Iron, dissolved	mg/L	<0.01
UA	G275	C	2021/05/20	Iron, dissolved	mg/L	<0.01
UA	G275	C	2021/08/18	Iron, dissolved	mg/L	<0.01
UA	G275	C	2021/10/27	Iron, dissolved	mg/L	<0.01
UA	G275	C	2022/02/10	Iron, dissolved	mg/L	<0.01
UA	G275	C	2022/05/12	Iron, dissolved	mg/L	0.00350
UA	G275	C	2022/11/09	Iron, dissolved	mg/L	0.0110
UA	G275	C	2023/02/16	Iron, dissolved	mg/L	0.00950
UA	G275	C	2023/06/08	Iron, dissolved	mg/L	0.00870
UA	G275	C	2009/09/22	Magnesium, total	mg/L	140
UA	G275	C	2009/11/11	Magnesium, total	mg/L	67.0
UA	G275	C	2010/01/21	Magnesium, total	mg/L	60.0
UA	G275	C	2010/03/08	Magnesium, total	mg/L	76.0
UA	G275	C	2010/07/26	Magnesium, total	mg/L	81.0
UA	G275	C	2011/01/31	Magnesium, total	mg/L	110
UA	G275	C	2012/01/31	Magnesium, total	mg/L	97.0
UA	G275	C	2015/04/13	Magnesium, total	mg/L	75.0
UA	G275	C	2023/06/08	Magnesium, total	mg/L	67.0
UA	G275	C	2009/11/11	Manganese, dissolved	mg/L	0.0320
UA	G275	C	2010/01/21	Manganese, dissolved	mg/L	0.0230
UA	G275	C	2010/03/08	Manganese, dissolved	mg/L	0.0290
UA	G275	C	2010/07/26	Manganese, dissolved	mg/L	0.0190
UA	G275	C	2010/09/20	Manganese, dissolved	mg/L	0.0260
UA	G275	C	2010/11/16	Manganese, dissolved	mg/L	0.160
UA	G275	C	2011/01/31	Manganese, dissolved	mg/L	0.0160
UA	G275	C	2011/05/03	Manganese, dissolved	mg/L	0.0400
UA	G275	C	2011/07/27	Manganese, dissolved	mg/L	0.0300
UA	G275	C	2011/11/14	Manganese, dissolved	mg/L	0.0900
UA	G275	C	2012/01/31	Manganese, dissolved	mg/L	0.00810
UA	G275	C	2012/05/22	Manganese, dissolved	mg/L	0.0100
UA	G275	C	2012/07/24	Manganese, dissolved	mg/L	0.0900
UA	G275	C	2012/11/14	Manganese, dissolved	mg/L	0.280
UA	G275	C	2013/05/20	Manganese, dissolved	mg/L	<0.001
UA	G275	C	2013/07/22	Manganese, dissolved	mg/L	0.00170
UA	G275	C	2014/05/13	Manganese, dissolved	mg/L	0.340

UA	G275	C	2014/08/11	Manganese, dissolved	mg/L	<0.001
UA	G275	C	2014/10/14	Manganese, dissolved	mg/L	0.00300
UA	G275	C	2015/01/21	Manganese, dissolved	mg/L	0.0250
UA	G275	C	2015/04/13	Manganese, dissolved	mg/L	0.00240
UA	G275	C	2015/07/23	Manganese, dissolved	mg/L	0.0120
UA	G275	C	2016/02/09	Manganese, dissolved	mg/L	0.00640
UA	G275	C	2016/05/12	Manganese, dissolved	mg/L	0.00360
UA	G275	C	2016/07/27	Manganese, dissolved	mg/L	0.680
UA	G275	C	2016/11/21	Manganese, dissolved	mg/L	0.0480
UA	G275	C	2017/02/14	Manganese, dissolved	mg/L	0.0100
UA	G275	C	2017/05/18	Manganese, dissolved	mg/L	0.0170
UA	G275	C	2017/07/25	Manganese, dissolved	mg/L	0.0460
UA	G275	C	2017/11/03	Manganese, dissolved	mg/L	0.0210
UA	G275	C	2018/05/16	Manganese, dissolved	mg/L	0.00870
UA	G275	C	2018/08/10	Manganese, dissolved	mg/L	0.00370
UA	G275	C	2018/11/05	Manganese, dissolved	mg/L	0.0580
UA	G275	C	2019/01/22	Manganese, dissolved	mg/L	0.0180
UA	G275	C	2019/05/03	Manganese, dissolved	mg/L	0.00140
UA	G275	C	2019/08/26	Manganese, dissolved	mg/L	0.0130
UA	G275	C	2019/10/22	Manganese, dissolved	mg/L	0.0160
UA	G275	C	2020/01/23	Manganese, dissolved	mg/L	0.0140
UA	G275	C	2020/05/06	Manganese, dissolved	mg/L	0.0150
UA	G275	C	2020/08/13	Manganese, dissolved	mg/L	0.0480
UA	G275	C	2020/10/14	Manganese, dissolved	mg/L	0.0120
UA	G275	C	2021/05/20	Manganese, dissolved	mg/L	<0.001
UA	G275	C	2021/08/18	Manganese, dissolved	mg/L	0.00320
UA	G275	C	2021/10/27	Manganese, dissolved	mg/L	0.00630
UA	G275	C	2022/02/10	Manganese, dissolved	mg/L	<0.001
UA	G275	C	2022/05/12	Manganese, dissolved	mg/L	0.00150
UA	G275	C	2022/11/09	Manganese, dissolved	mg/L	0.140
UA	G275	C	2023/02/16	Manganese, dissolved	mg/L	0.0690
UA	G275	C	2023/06/08	Manganese, dissolved	mg/L	0.0260
UA	G275	C	2009/09/22	Potassium, total	mg/L	1.80
UA	G275	C	2009/11/11	Potassium, total	mg/L	<0.5
UA	G275	C	2010/01/21	Potassium, total	mg/L	<0.5
UA	G275	C	2010/03/08	Potassium, total	mg/L	<0.5
UA	G275	C	2010/07/26	Potassium, total	mg/L	0.240
UA	G275	C	2011/01/31	Potassium, total	mg/L	0.890
UA	G275	C	2012/01/31	Potassium, total	mg/L	0.490
UA	G275	C	2015/04/13	Potassium, total	mg/L	1.80
UA	G275	C	2023/06/08	Potassium, total	mg/L	0.410
UA	G275	C	2023/06/08	Silicon, dissolved	mg/L	8.80
UA	G275	C	2009/09/22	Sodium, total	mg/L	87.0
UA	G275	C	2009/11/11	Sodium, total	mg/L	68.0
UA	G275	C	2010/01/21	Sodium, total	mg/L	50.0
UA	G275	C	2010/03/08	Sodium, total	mg/L	58.0
UA	G275	C	2010/07/26	Sodium, total	mg/L	64.0
UA	G275	C	2011/01/31	Sodium, total	mg/L	65.0
UA	G275	C	2012/01/31	Sodium, total	mg/L	96.0
UA	G275	C	2015/04/13	Sodium, total	mg/L	79.0
UA	G275	C	2023/06/08	Sodium, total	mg/L	59.0
UA	G275	C	2009/09/22	Sulfate, total	mg/L	990
UA	G275	C	2009/11/11	Sulfate, total	mg/L	350
UA	G275	C	2010/01/21	Sulfate, total	mg/L	390
UA	G275	C	2010/03/08	Sulfate, total	mg/L	460
UA	G275	C	2010/07/26	Sulfate, total	mg/L	550
UA	G275	C	2010/11/16	Sulfate, total	mg/L	970
UA	G275	C	2011/01/31	Sulfate, total	mg/L	840
UA	G275	C	2011/05/03	Sulfate, total	mg/L	790
UA	G275	C	2011/07/27	Sulfate, total	mg/L	720
UA	G275	C	2011/11/14	Sulfate, total	mg/L	820
UA	G275	C	2012/01/31	Sulfate, total	mg/L	370

UA	G275	C	2012/05/22	Sulfate, total	mg/L	670
UA	G275	C	2012/07/24	Sulfate, total	mg/L	900
UA	G275	C	2012/11/14	Sulfate, total	mg/L	950
UA	G275	C	2013/05/20	Sulfate, total	mg/L	840
UA	G275	C	2013/07/22	Sulfate, total	mg/L	700
UA	G275	C	2014/05/13	Sulfate, total	mg/L	750
UA	G275	C	2014/08/11	Sulfate, total	mg/L	880
UA	G275	C	2014/10/14	Sulfate, total	mg/L	500
UA	G275	C	2015/01/21	Sulfate, total	mg/L	940
UA	G275	C	2015/04/13	Sulfate, total	mg/L	650
UA	G275	C	2015/07/23	Sulfate, total	mg/L	750
UA	G275	C	2020/10/14	Sulfate, total	mg/L	700
UA	G275	C	2021/05/20	Sulfate, total	mg/L	550
UA	G275	C	2021/08/18	Sulfate, total	mg/L	550
UA	G275	C	2021/10/27	Sulfate, total	mg/L	530
UA	G275	C	2022/02/10	Sulfate, total	mg/L	500
UA	G275	C	2022/05/12	Sulfate, total	mg/L	370
UA	G275	C	2022/11/09	Sulfate, total	mg/L	460
UA	G275	C	2023/02/16	Sulfate, total	mg/L	320
UA	G275	C	2023/06/08	Sulfate, total	mg/L	440
UA	G275	C	2022/02/10	Temperature (Celsius)	degrees C	10.6
UA	G275	C	2022/05/12	Temperature (Celsius)	degrees C	17.9
UA	G275	C	2022/11/09	Temperature (Celsius)	degrees C	18.3
UA	G275	C	2023/02/16	Temperature (Celsius)	degrees C	9.90
UA	G275	C	2023/06/08	Temperature (Celsius)	degrees C	16.7
UA	G275	C	2009/09/22	Total Dissolved Solids	mg/L	2,000
UA	G275	C	2009/11/11	Total Dissolved Solids	mg/L	910
UA	G275	C	2010/01/21	Total Dissolved Solids	mg/L	870
UA	G275	C	2010/03/08	Total Dissolved Solids	mg/L	1,100
UA	G275	C	2010/07/26	Total Dissolved Solids	mg/L	1,200
UA	G275	C	2010/11/16	Total Dissolved Solids	mg/L	1,700
UA	G275	C	2011/01/31	Total Dissolved Solids	mg/L	1,500
UA	G275	C	2011/05/03	Total Dissolved Solids	mg/L	1,600
UA	G275	C	2011/07/27	Total Dissolved Solids	mg/L	1,300
UA	G275	C	2011/11/14	Total Dissolved Solids	mg/L	1,500
UA	G275	C	2012/01/31	Total Dissolved Solids	mg/L	1,300
UA	G275	C	2012/05/22	Total Dissolved Solids	mg/L	1,500
UA	G275	C	2012/07/24	Total Dissolved Solids	mg/L	1,600
UA	G275	C	2012/11/14	Total Dissolved Solids	mg/L	1,600
UA	G275	C	2013/05/20	Total Dissolved Solids	mg/L	1,400
UA	G275	C	2013/07/22	Total Dissolved Solids	mg/L	1,400
UA	G275	C	2014/05/13	Total Dissolved Solids	mg/L	370
UA	G275	C	2014/08/11	Total Dissolved Solids	mg/L	1,500
UA	G275	C	2014/10/14	Total Dissolved Solids	mg/L	840
UA	G275	C	2015/01/21	Total Dissolved Solids	mg/L	1,500
UA	G275	C	2015/04/13	Total Dissolved Solids	mg/L	1,500
UA	G275	C	2015/07/23	Total Dissolved Solids	mg/L	1,500
UA	G275	C	2020/10/14	Total Dissolved Solids	mg/L	1,400
UA	G275	C	2021/05/20	Total Dissolved Solids	mg/L	790
UA	G275	C	2021/08/18	Total Dissolved Solids	mg/L	1,200
UA	G275	C	2021/10/27	Total Dissolved Solids	mg/L	1,100
UA	G275	C	2022/02/10	Total Dissolved Solids	mg/L	1,100
UA	G275	C	2022/05/12	Total Dissolved Solids	mg/L	1,000
UA	G275	C	2022/11/09	Total Dissolved Solids	mg/L	1,100
UA	G275	C	2023/02/16	Total Dissolved Solids	mg/L	920
UA	G275	C	2023/06/08	Total Dissolved Solids	mg/L	1,100
UA	G276	C	2010/07/26	pH (field)	SU	7.0
UA	G276	C	2010/07/28	pH (field)	SU	7.0
UA	G276	C	2010/09/20	pH (field)	SU	7.7
UA	G276	C	2010/11/16	pH (field)	SU	7.8
UA	G276	C	2011/01/31	pH (field)	SU	7.3
UA	G276	C	2011/05/03	pH (field)	SU	7.2

UA	G276	C	2011/07/27	pH (field)	SU	7.2
UA	G276	C	2011/11/14	pH (field)	SU	7.4
UA	G276	C	2012/01/31	pH (field)	SU	7.3
UA	G276	C	2012/05/22	pH (field)	SU	7.3
UA	G276	C	2012/07/24	pH (field)	SU	7.2
UA	G276	C	2012/11/14	pH (field)	SU	7.5
UA	G276	C	2013/01/31	pH (field)	SU	7.2
UA	G276	C	2013/05/20	pH (field)	SU	7.2
UA	G276	C	2013/07/22	pH (field)	SU	7.2
UA	G276	C	2014/05/13	pH (field)	SU	7.1
UA	G276	C	2014/08/12	pH (field)	SU	7.3
UA	G276	C	2014/10/14	pH (field)	SU	6.8
UA	G276	C	2015/01/21	pH (field)	SU	7.4
UA	G276	C	2015/04/13	pH (field)	SU	6.9
UA	G276	C	2015/07/23	pH (field)	SU	7.4
UA	G276	C	2015/11/24	pH (field)	SU	7.3
UA	G276	C	2016/02/16	pH (field)	SU	7.2
UA	G276	C	2016/05/12	pH (field)	SU	7.1
UA	G276	C	2016/08/03	pH (field)	SU	7.2
UA	G276	C	2016/11/21	pH (field)	SU	7.1
UA	G276	C	2017/02/17	pH (field)	SU	7.2
UA	G276	C	2017/05/20	pH (field)	SU	7.0
UA	G276	C	2017/07/18	pH (field)	SU	7.2
UA	G276	C	2017/11/04	pH (field)	SU	7.1
UA	G276	C	2018/05/16	pH (field)	SU	7.1
UA	G276	C	2018/08/10	pH (field)	SU	7.1
UA	G276	C	2019/01/22	pH (field)	SU	7.1
UA	G276	C	2019/08/26	pH (field)	SU	7.2
UA	G276	C	2020/01/23	pH (field)	SU	7.0
UA	G276	C	2020/08/12	pH (field)	SU	6.9
UA	G276	C	2020/10/14	pH (field)	SU	6.9
UA	G276	C	2021/05/19	pH (field)	SU	7.2
UA	G276	C	2021/06/28	pH (field)	SU	7.1
UA	G276	C	2021/08/18	pH (field)	SU	7.1
UA	G276	C	2021/10/26	pH (field)	SU	7.0
UA	G276	C	2022/02/09	pH (field)	SU	7.0
UA	G276	C	2022/03/21	pH (field)	SU	7.3
UA	G276	C	2022/05/11	pH (field)	SU	6.9
UA	G276	C	2022/09/20	pH (field)	SU	6.8
UA	G276	C	2022/11/09	pH (field)	SU	7.0
UA	G276	C	2023/02/15	pH (field)	SU	6.6
UA	G276	C	2023/06/05	pH (field)	SU	6.5
UA	G276	C	2023/08/14	pH (field)	SU	7.2
UA	G276	C	2023/11/17	pH (field)	SU	6.9
UA	G276	C	2015/11/24	Oxidation Reduction Potential	mV	112
UA	G276	C	2016/02/16	Oxidation Reduction Potential	mV	148
UA	G276	C	2016/05/12	Oxidation Reduction Potential	mV	186
UA	G276	C	2016/08/03	Oxidation Reduction Potential	mV	118
UA	G276	C	2016/11/21	Oxidation Reduction Potential	mV	96.0
UA	G276	C	2017/02/17	Oxidation Reduction Potential	mV	99.0
UA	G276	C	2017/05/20	Oxidation Reduction Potential	mV	98.0
UA	G276	C	2017/07/18	Oxidation Reduction Potential	mV	98.0
UA	G276	C	2017/11/04	Oxidation Reduction Potential	mV	105
UA	G276	C	2018/05/16	Oxidation Reduction Potential	mV	122
UA	G276	C	2018/08/10	Oxidation Reduction Potential	mV	110
UA	G276	C	2019/01/22	Oxidation Reduction Potential	mV	114
UA	G276	C	2019/08/26	Oxidation Reduction Potential	mV	104
UA	G276	C	2020/01/23	Oxidation Reduction Potential	mV	198
UA	G276	C	2020/08/12	Oxidation Reduction Potential	mV	235
UA	G276	C	2021/06/28	Oxidation Reduction Potential	mV	150
UA	G276	C	2021/08/18	Oxidation Reduction Potential	mV	123
UA	G276	C	2022/02/09	Oxidation Reduction Potential	mV	112

UA	G276	C	2022/03/21	Oxidation Reduction Potential	mV	73.8
UA	G276	C	2022/05/11	Oxidation Reduction Potential	mV	135
UA	G276	C	2022/09/20	Oxidation Reduction Potential	mV	138
UA	G276	C	2022/11/09	Oxidation Reduction Potential	mV	193
UA	G276	C	2023/02/15	Oxidation Reduction Potential	mV	223
UA	G276	C	2023/06/05	Oxidation Reduction Potential	mV	222
UA	G276	C	2023/08/14	Oxidation Reduction Potential	mV	34.0
UA	G276	C	2023/11/17	Oxidation Reduction Potential	mV	134
UA	G276	C	2015/11/24	Eh	V	0.31
UA	G276	C	2016/02/16	Eh	V	0.35
UA	G276	C	2016/05/12	Eh	V	0.38
UA	G276	C	2016/08/03	Eh	V	0.31
UA	G276	C	2016/11/21	Eh	V	0.29
UA	G276	C	2017/02/17	Eh	V	0.29
UA	G276	C	2017/05/20	Eh	V	0.29
UA	G276	C	2017/07/18	Eh	V	0.29
UA	G276	C	2017/11/04	Eh	V	0.30
UA	G276	C	2018/05/16	Eh	V	0.32
UA	G276	C	2018/08/10	Eh	V	0.31
UA	G276	C	2019/01/22	Eh	V	0.31
UA	G276	C	2019/08/26	Eh	V	0.30
UA	G276	C	2020/01/23	Eh	V	0.40
UA	G276	C	2020/08/12	Eh	V	0.43
UA	G276	C	2021/06/28	Eh	V	0.34
UA	G276	C	2021/08/18	Eh	V	0.32
UA	G276	C	2022/02/09	Eh	V	0.31
UA	G276	C	2022/03/21	Eh	V	0.27
UA	G276	C	2022/05/11	Eh	V	0.33
UA	G276	C	2022/09/20	Eh	V	0.33
UA	G276	C	2022/11/09	Eh	V	0.38
UA	G276	C	2023/02/15	Eh	V	0.42
UA	G276	C	2023/06/05	Eh	V	0.41
UA	G276	C	2023/08/14	Eh	V	0.23
UA	G276	C	2023/11/17	Eh	V	0.33
UA	G276	C	2009/09/23	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G276	C	2009/11/11	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G276	C	2010/01/21	Alkalinity, bicarbonate	mg/L CaCO3	320
UA	G276	C	2010/03/09	Alkalinity, bicarbonate	mg/L CaCO3	310
UA	G276	C	2010/07/26	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G276	C	2011/01/31	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G276	C	2012/01/31	Alkalinity, bicarbonate	mg/L CaCO3	330
UA	G276	C	2013/01/31	Alkalinity, bicarbonate	mg/L CaCO3	240
UA	G276	C	2014/08/12	Alkalinity, bicarbonate	mg/L CaCO3	400
UA	G276	C	2014/10/14	Alkalinity, bicarbonate	mg/L CaCO3	400
UA	G276	C	2015/01/21	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G276	C	2015/04/13	Alkalinity, bicarbonate	mg/L CaCO3	400
UA	G276	C	2017/07/18	Alkalinity, bicarbonate	mg/L CaCO3	470
UA	G276	C	2020/01/23	Alkalinity, bicarbonate	mg/L CaCO3	500
UA	G276	C	2022/02/09	Alkalinity, bicarbonate	mg/L CaCO3	460
UA	G276	C	2022/09/20	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G276	C	2023/02/15	Alkalinity, bicarbonate	mg/L CaCO3	490
UA	G276	C	2023/06/05	Alkalinity, bicarbonate	mg/L CaCO3	510
UA	G276	C	2023/08/14	Alkalinity, bicarbonate	mg/L CaCO3	481
UA	G276	C	2023/11/17	Alkalinity, bicarbonate	mg/L CaCO3	377
UA	G276	C	2022/09/20	Alkalinity, carbonate	mg/L CaCO3	10.0
UA	G276	C	2009/09/23	Arsenic, total	mg/L	<0.005
UA	G276	C	2009/11/11	Arsenic, total	mg/L	<0.001
UA	G276	C	2010/01/21	Arsenic, total	mg/L	<0.001
UA	G276	C	2010/03/10	Arsenic, total	mg/L	<0.001
UA	G276	C	2010/07/26	Arsenic, total	mg/L	<0.001
UA	G276	C	2010/11/16	Arsenic, total	mg/L	<0.001
UA	G276	C	2011/01/31	Arsenic, total	mg/L	0.00260

UA	G276	C	2011/05/03	Arsenic, total	mg/L	<0.001
UA	G276	C	2011/07/27	Arsenic, total	mg/L	<0.001
UA	G276	C	2011/11/14	Arsenic, total	mg/L	0.00130
UA	G276	C	2012/01/31	Arsenic, total	mg/L	<0.001
UA	G276	C	2012/05/22	Arsenic, total	mg/L	0.00110
UA	G276	C	2012/07/24	Arsenic, total	mg/L	<0.001
UA	G276	C	2012/11/14	Arsenic, total	mg/L	0.00150
UA	G276	C	2013/01/31	Arsenic, total	mg/L	<0.001
UA	G276	C	2013/05/20	Arsenic, total	mg/L	<0.001
UA	G276	C	2013/07/22	Arsenic, total	mg/L	<0.001
UA	G276	C	2014/05/13	Arsenic, total	mg/L	0.00130
UA	G276	C	2014/08/12	Arsenic, total	mg/L	0.00130
UA	G276	C	2014/10/14	Arsenic, total	mg/L	<0.001
UA	G276	C	2015/01/21	Arsenic, total	mg/L	<0.001
UA	G276	C	2015/04/13	Arsenic, total	mg/L	0.00570
UA	G276	C	2015/07/23	Arsenic, total	mg/L	<0.001
UA	G276	C	2015/11/24	Arsenic, total	mg/L	<0.00013
UA	G276	C	2016/02/16	Arsenic, total	mg/L	<0.00013
UA	G276	C	2016/05/12	Arsenic, total	mg/L	<0.00013
UA	G276	C	2016/08/03	Arsenic, total	mg/L	<0.00013
UA	G276	C	2016/11/21	Arsenic, total	mg/L	<0.00013
UA	G276	C	2017/02/17	Arsenic, total	mg/L	<0.00013
UA	G276	C	2017/05/20	Arsenic, total	mg/L	<0.00013
UA	G276	C	2017/07/18	Arsenic, total	mg/L	<0.00013
UA	G276	C	2018/05/16	Arsenic, total	mg/L	<0.0009
UA	G276	C	2018/08/10	Arsenic, total	mg/L	<0.0009
UA	G276	C	2019/01/22	Arsenic, total	mg/L	<0.0009
UA	G276	C	2019/08/26	Arsenic, total	mg/L	<0.0009
UA	G276	C	2020/01/23	Arsenic, total	mg/L	<0.0009
UA	G276	C	2020/08/12	Arsenic, total	mg/L	<0.00022
UA	G276	C	2020/10/14	Arsenic, total	mg/L	<0.001
UA	G276	C	2021/05/19	Arsenic, total	mg/L	<0.001
UA	G276	C	2021/06/28	Arsenic, total	mg/L	<0.0002
UA	G276	C	2021/08/18	Arsenic, total	mg/L	<0.00022
UA	G276	C	2021/10/26	Arsenic, total	mg/L	<0.001
UA	G276	C	2022/02/09	Arsenic, total	mg/L	<0.00069
UA	G276	C	2022/05/11	Arsenic, total	mg/L	<0.00069
UA	G276	C	2022/09/20	Arsenic, total	mg/L	<0.00069
UA	G276	C	2022/11/09	Arsenic, total	mg/L	0.000770
UA	G276	C	2023/02/15	Arsenic, total	mg/L	<0.00069
UA	G276	C	2023/06/05	Arsenic, total	mg/L	<0.00069
UA	G276	C	2023/08/14	Arsenic, total	mg/L	<0.0004
UA	G276	C	2023/11/17	Arsenic, total	mg/L	0.000500
UA	G276	C	2009/09/23	Barium, total	mg/L	0.160
UA	G276	C	2009/11/11	Barium, total	mg/L	0.0790
UA	G276	C	2010/01/21	Barium, total	mg/L	0.0750
UA	G276	C	2010/03/10	Barium, total	mg/L	0.0830
UA	G276	C	2010/07/26	Barium, total	mg/L	0.0630
UA	G276	C	2011/01/31	Barium, total	mg/L	0.0780
UA	G276	C	2012/01/31	Barium, total	mg/L	0.0750
UA	G276	C	2013/01/31	Barium, total	mg/L	0.0810
UA	G276	C	2015/04/13	Barium, total	mg/L	0.340
UA	G276	C	2015/07/23	Barium, total	mg/L	0.0960
UA	G276	C	2015/11/24	Barium, total	mg/L	0.0770
UA	G276	C	2016/02/16	Barium, total	mg/L	0.0900
UA	G276	C	2016/05/12	Barium, total	mg/L	0.0780
UA	G276	C	2016/08/03	Barium, total	mg/L	0.0850
UA	G276	C	2016/11/21	Barium, total	mg/L	0.0810
UA	G276	C	2017/02/17	Barium, total	mg/L	0.0820
UA	G276	C	2017/05/20	Barium, total	mg/L	0.0810
UA	G276	C	2017/07/18	Barium, total	mg/L	0.0840
UA	G276	C	2018/05/16	Barium, total	mg/L	0.0730

UA	G276	C	2018/08/10	Barium, total	mg/L	0.0690
UA	G276	C	2019/01/22	Barium, total	mg/L	0.0760
UA	G276	C	2019/08/26	Barium, total	mg/L	0.0660
UA	G276	C	2020/01/23	Barium, total	mg/L	0.0630
UA	G276	C	2020/08/12	Barium, total	mg/L	0.0530
UA	G276	C	2020/10/14	Barium, total	mg/L	0.0530
UA	G276	C	2021/05/19	Barium, total	mg/L	0.0530
UA	G276	C	2021/06/28	Barium, total	mg/L	0.0500
UA	G276	C	2021/08/18	Barium, total	mg/L	0.0460
UA	G276	C	2021/10/26	Barium, total	mg/L	0.0460
UA	G276	C	2022/02/09	Barium, total	mg/L	0.0480
UA	G276	C	2022/05/11	Barium, total	mg/L	0.0500
UA	G276	C	2022/09/20	Barium, total	mg/L	0.0560
UA	G276	C	2022/11/09	Barium, total	mg/L	0.0450
UA	G276	C	2023/02/15	Barium, total	mg/L	0.0460
UA	G276	C	2023/06/05	Barium, total	mg/L	0.0460
UA	G276	C	2023/08/14	Barium, total	mg/L	0.0553
UA	G276	C	2023/11/17	Barium, total	mg/L	0.0683
UA	G276	C	2009/09/23	Calcium, total	mg/L	94.0
UA	G276	C	2009/11/11	Calcium, total	mg/L	91.0
UA	G276	C	2010/01/21	Calcium, total	mg/L	91.0
UA	G276	C	2010/03/10	Calcium, total	mg/L	110
UA	G276	C	2010/07/26	Calcium, total	mg/L	93.0
UA	G276	C	2010/11/16	Calcium, total	mg/L	96.0
UA	G276	C	2011/01/31	Calcium, total	mg/L	96.0
UA	G276	C	2011/05/03	Calcium, total	mg/L	<100
UA	G276	C	2011/07/27	Calcium, total	mg/L	96.0
UA	G276	C	2011/11/14	Calcium, total	mg/L	94.0
UA	G276	C	2012/01/31	Calcium, total	mg/L	130
UA	G276	C	2012/05/22	Calcium, total	mg/L	97.0
UA	G276	C	2012/07/24	Calcium, total	mg/L	100
UA	G276	C	2012/11/14	Calcium, total	mg/L	100
UA	G276	C	2013/01/31	Calcium, total	mg/L	110
UA	G276	C	2013/05/20	Calcium, total	mg/L	99.0
UA	G276	C	2013/07/22	Calcium, total	mg/L	100
UA	G276	C	2014/05/13	Calcium, total	mg/L	130
UA	G276	C	2014/08/12	Calcium, total	mg/L	120
UA	G276	C	2014/10/14	Calcium, total	mg/L	100
UA	G276	C	2015/01/21	Calcium, total	mg/L	100
UA	G276	C	2015/04/13	Calcium, total	mg/L	170
UA	G276	C	2015/11/24	Calcium, total	mg/L	120
UA	G276	C	2016/02/16	Calcium, total	mg/L	120
UA	G276	C	2016/05/12	Calcium, total	mg/L	130
UA	G276	C	2016/08/03	Calcium, total	mg/L	110
UA	G276	C	2016/11/21	Calcium, total	mg/L	120
UA	G276	C	2017/02/17	Calcium, total	mg/L	110
UA	G276	C	2017/05/20	Calcium, total	mg/L	110
UA	G276	C	2017/07/18	Calcium, total	mg/L	130
UA	G276	C	2017/11/04	Calcium, total	mg/L	120
UA	G276	C	2018/05/16	Calcium, total	mg/L	110
UA	G276	C	2018/08/10	Calcium, total	mg/L	120
UA	G276	C	2019/01/22	Calcium, total	mg/L	120
UA	G276	C	2019/08/26	Calcium, total	mg/L	140
UA	G276	C	2020/01/23	Calcium, total	mg/L	140
UA	G276	C	2020/08/12	Calcium, total	mg/L	140
UA	G276	C	2021/06/28	Calcium, total	mg/L	140
UA	G276	C	2021/08/18	Calcium, total	mg/L	140
UA	G276	C	2022/02/09	Calcium, total	mg/L	140
UA	G276	C	2022/09/20	Calcium, total	mg/L	140
UA	G276	C	2023/02/15	Calcium, total	mg/L	140
UA	G276	C	2023/06/05	Calcium, total	mg/L	130
UA	G276	C	2023/08/14	Calcium, total	mg/L	139

UA	G276	C	2023/11/17	Calcium, total	mg/L	146
UA	G276	C	2009/09/23	Chloride, total	mg/L	38.0
UA	G276	C	2009/11/11	Chloride, total	mg/L	40.0
UA	G276	C	2010/01/21	Chloride, total	mg/L	36.0
UA	G276	C	2010/03/09	Chloride, total	mg/L	38.0
UA	G276	C	2010/07/26	Chloride, total	mg/L	40.0
UA	G276	C	2010/11/16	Chloride, total	mg/L	35.0
UA	G276	C	2011/01/31	Chloride, total	mg/L	36.0
UA	G276	C	2011/05/03	Chloride, total	mg/L	36.0
UA	G276	C	2011/07/27	Chloride, total	mg/L	37.0
UA	G276	C	2011/11/14	Chloride, total	mg/L	35.0
UA	G276	C	2012/01/31	Chloride, total	mg/L	32.0
UA	G276	C	2012/05/22	Chloride, total	mg/L	38.0
UA	G276	C	2012/07/24	Chloride, total	mg/L	38.0
UA	G276	C	2012/11/14	Chloride, total	mg/L	36.0
UA	G276	C	2013/01/31	Chloride, total	mg/L	35.0
UA	G276	C	2013/05/20	Chloride, total	mg/L	3.80
UA	G276	C	2013/07/22	Chloride, total	mg/L	32.0
UA	G276	C	2014/05/13	Chloride, total	mg/L	31.0
UA	G276	C	2014/08/12	Chloride, total	mg/L	29.0
UA	G276	C	2014/10/14	Chloride, total	mg/L	28.0
UA	G276	C	2015/01/21	Chloride, total	mg/L	30.0
UA	G276	C	2015/04/13	Chloride, total	mg/L	34.0
UA	G276	C	2015/07/23	Chloride, total	mg/L	26.0
UA	G276	C	2015/11/24	Chloride, total	mg/L	28.0
UA	G276	C	2016/02/16	Chloride, total	mg/L	23.0
UA	G276	C	2016/05/12	Chloride, total	mg/L	22.0
UA	G276	C	2016/08/03	Chloride, total	mg/L	23.0
UA	G276	C	2016/11/21	Chloride, total	mg/L	23.0
UA	G276	C	2017/02/17	Chloride, total	mg/L	23.0
UA	G276	C	2017/05/20	Chloride, total	mg/L	22.0
UA	G276	C	2017/07/18	Chloride, total	mg/L	23.0
UA	G276	C	2017/11/04	Chloride, total	mg/L	20.0
UA	G276	C	2018/05/16	Chloride, total	mg/L	24.0
UA	G276	C	2018/08/10	Chloride, total	mg/L	24.0
UA	G276	C	2019/01/22	Chloride, total	mg/L	26.0
UA	G276	C	2019/08/26	Chloride, total	mg/L	21.0
UA	G276	C	2020/01/23	Chloride, total	mg/L	25.0
UA	G276	C	2020/08/12	Chloride, total	mg/L	23.0
UA	G276	C	2020/10/14	Chloride, total	mg/L	24.0
UA	G276	C	2021/05/19	Chloride, total	mg/L	22.0
UA	G276	C	2021/06/28	Chloride, total	mg/L	29.0
UA	G276	C	2021/08/18	Chloride, total	mg/L	22.0
UA	G276	C	2021/10/26	Chloride, total	mg/L	21.0
UA	G276	C	2022/02/09	Chloride, total	mg/L	23.0
UA	G276	C	2022/05/11	Chloride, total	mg/L	22.0
UA	G276	C	2022/09/20	Chloride, total	mg/L	23.0
UA	G276	C	2022/11/09	Chloride, total	mg/L	21.0
UA	G276	C	2023/02/15	Chloride, total	mg/L	25.0
UA	G276	C	2023/06/05	Chloride, total	mg/L	24.0
UA	G276	C	2023/08/14	Chloride, total	mg/L	31.0
UA	G276	C	2023/11/17	Chloride, total	mg/L	387
UA	G276	C	2023/06/05	Ferrous Iron, dissolved	mg/L	0.160
UA	G276	C	2009/11/11	Iron, dissolved	mg/L	<0.1
UA	G276	C	2010/01/21	Iron, dissolved	mg/L	<0.1
UA	G276	C	2010/03/10	Iron, dissolved	mg/L	<0.2
UA	G276	C	2010/07/26	Iron, dissolved	mg/L	0.0140
UA	G276	C	2010/09/20	Iron, dissolved	mg/L	<0.01
UA	G276	C	2010/11/16	Iron, dissolved	mg/L	0.0340
UA	G276	C	2011/01/31	Iron, dissolved	mg/L	0.0270
UA	G276	C	2011/05/03	Iron, dissolved	mg/L	<0.01
UA	G276	C	2011/07/27	Iron, dissolved	mg/L	<0.01

UA	G276	C	2011/11/14	Iron, dissolved	mg/L	<0.01
UA	G276	C	2012/01/31	Iron, dissolved	mg/L	<0.01
UA	G276	C	2012/05/22	Iron, dissolved	mg/L	0.0410
UA	G276	C	2012/07/24	Iron, dissolved	mg/L	<0.01
UA	G276	C	2012/11/14	Iron, dissolved	mg/L	<0.01
UA	G276	C	2013/01/31	Iron, dissolved	mg/L	<0.01
UA	G276	C	2013/05/20	Iron, dissolved	mg/L	<0.01
UA	G276	C	2013/07/22	Iron, dissolved	mg/L	<0.01
UA	G276	C	2014/05/13	Iron, dissolved	mg/L	<0.01
UA	G276	C	2014/08/12	Iron, dissolved	mg/L	<0.01
UA	G276	C	2014/10/14	Iron, dissolved	mg/L	<0.01
UA	G276	C	2015/01/21	Iron, dissolved	mg/L	<0.01
UA	G276	C	2015/04/13	Iron, dissolved	mg/L	<0.01
UA	G276	C	2015/07/23	Iron, dissolved	mg/L	<0.01
UA	G276	C	2016/02/17	Iron, dissolved	mg/L	<0.01
UA	G276	C	2016/05/12	Iron, dissolved	mg/L	<0.01
UA	G276	C	2016/08/03	Iron, dissolved	mg/L	0.100
UA	G276	C	2016/11/21	Iron, dissolved	mg/L	<0.01
UA	G276	C	2017/02/14	Iron, dissolved	mg/L	<0.01
UA	G276	C	2017/05/18	Iron, dissolved	mg/L	<0.01
UA	G276	C	2017/07/25	Iron, dissolved	mg/L	<0.01
UA	G276	C	2017/11/04	Iron, dissolved	mg/L	0.0400
UA	G276	C	2018/01/29	Iron, dissolved	mg/L	0.0130
UA	G276	C	2018/05/16	Iron, dissolved	mg/L	0.0490
UA	G276	C	2018/08/10	Iron, dissolved	mg/L	<0.01
UA	G276	C	2018/11/05	Iron, dissolved	mg/L	<0.1
UA	G276	C	2019/01/22	Iron, dissolved	mg/L	<0.01
UA	G276	C	2019/05/03	Iron, dissolved	mg/L	<0.01
UA	G276	C	2019/08/26	Iron, dissolved	mg/L	<0.01
UA	G276	C	2019/10/22	Iron, dissolved	mg/L	<0.01
UA	G276	C	2020/01/23	Iron, dissolved	mg/L	<0.01
UA	G276	C	2020/05/06	Iron, dissolved	mg/L	<0.01
UA	G276	C	2020/08/12	Iron, dissolved	mg/L	<0.01
UA	G276	C	2020/10/14	Iron, dissolved	mg/L	0.0120
UA	G276	C	2021/05/19	Iron, dissolved	mg/L	<0.01
UA	G276	C	2021/08/18	Iron, dissolved	mg/L	<0.01
UA	G276	C	2021/10/26	Iron, dissolved	mg/L	<0.01
UA	G276	C	2022/02/09	Iron, dissolved	mg/L	<0.01
UA	G276	C	2022/05/11	Iron, dissolved	mg/L	0.00610
UA	G276	C	2022/09/20	Iron, dissolved	mg/L	0.00170
UA	G276	C	2022/11/09	Iron, dissolved	mg/L	0.0120
UA	G276	C	2023/02/15	Iron, dissolved	mg/L	<0.00072
UA	G276	C	2023/06/05	Iron, dissolved	mg/L	0.0100
UA	G276	C	2023/08/14	Iron, dissolved	mg/L	<0.0175
UA	G276	C	2023/11/17	Iron, dissolved	mg/L	<0.0115
UA	G276	C	2009/09/23	Magnesium, total	mg/L	41.0
UA	G276	C	2009/11/11	Magnesium, total	mg/L	43.0
UA	G276	C	2010/01/21	Magnesium, total	mg/L	44.0
UA	G276	C	2010/03/10	Magnesium, total	mg/L	49.0
UA	G276	C	2010/07/26	Magnesium, total	mg/L	43.0
UA	G276	C	2011/01/31	Magnesium, total	mg/L	47.0
UA	G276	C	2012/01/31	Magnesium, total	mg/L	46.0
UA	G276	C	2013/01/31	Magnesium, total	mg/L	53.0
UA	G276	C	2015/04/13	Magnesium, total	mg/L	77.0
UA	G276	C	2017/07/18	Magnesium, total	mg/L	58.0
UA	G276	C	2020/01/23	Magnesium, total	mg/L	67.0
UA	G276	C	2022/02/09	Magnesium, total	mg/L	66.0
UA	G276	C	2022/09/20	Magnesium, total	mg/L	67.0
UA	G276	C	2023/02/15	Magnesium, total	mg/L	59.0
UA	G276	C	2023/06/05	Magnesium, total	mg/L	63.0
UA	G276	C	2023/08/14	Magnesium, total	mg/L	64.2
UA	G276	C	2023/11/17	Magnesium, total	mg/L	64.4

UA	G276	C	2009/11/11	Manganese, dissolved	mg/L	0.0300
UA	G276	C	2010/01/21	Manganese, dissolved	mg/L	0.00930
UA	G276	C	2010/03/10	Manganese, dissolved	mg/L	0.0100
UA	G276	C	2010/07/26	Manganese, dissolved	mg/L	0.00540
UA	G276	C	2010/09/20	Manganese, dissolved	mg/L	0.00500
UA	G276	C	2010/11/16	Manganese, dissolved	mg/L	0.00180
UA	G276	C	2011/01/31	Manganese, dissolved	mg/L	0.00410
UA	G276	C	2011/05/03	Manganese, dissolved	mg/L	0.00160
UA	G276	C	2011/07/27	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2011/11/14	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2012/01/31	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2012/05/22	Manganese, dissolved	mg/L	0.00140
UA	G276	C	2012/07/24	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2012/11/14	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2013/01/31	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2013/05/20	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2013/07/22	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2014/05/13	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2014/08/12	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2014/10/14	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2015/01/21	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2015/04/13	Manganese, dissolved	mg/L	<0.002
UA	G276	C	2015/07/23	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2016/02/17	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2016/05/12	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2016/08/03	Manganese, dissolved	mg/L	0.00110
UA	G276	C	2016/11/21	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2017/02/14	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2017/05/18	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2017/07/25	Manganese, dissolved	mg/L	0.00150
UA	G276	C	2017/11/04	Manganese, dissolved	mg/L	0.00170
UA	G276	C	2018/01/29	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2018/05/16	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2018/08/10	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2018/11/05	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2019/01/22	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2019/05/03	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2019/08/26	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2019/10/22	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2020/01/23	Manganese, dissolved	mg/L	0.00110
UA	G276	C	2020/05/06	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2020/08/12	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2020/10/14	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2021/05/19	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2021/08/18	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2021/10/26	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2022/02/09	Manganese, dissolved	mg/L	<0.001
UA	G276	C	2022/05/11	Manganese, dissolved	mg/L	0.000850
UA	G276	C	2022/09/20	Manganese, dissolved	mg/L	<0.00023
UA	G276	C	2022/11/09	Manganese, dissolved	mg/L	<0.00023
UA	G276	C	2023/02/15	Manganese, dissolved	mg/L	<0.00023
UA	G276	C	2023/06/05	Manganese, dissolved	mg/L	<0.00023
UA	G276	C	2023/08/14	Manganese, dissolved	mg/L	<0.0008
UA	G276	C	2023/11/17	Manganese, dissolved	mg/L	0.00420
UA	G276	C	2023/08/14	Phosphate, dissolved	mg/L	<0.005
UA	G276	C	2009/09/23	Potassium, total	mg/L	3.80
UA	G276	C	2009/11/11	Potassium, total	mg/L	2.20
UA	G276	C	2010/01/21	Potassium, total	mg/L	1.20
UA	G276	C	2010/03/10	Potassium, total	mg/L	1.40
UA	G276	C	2010/07/26	Potassium, total	mg/L	0.860
UA	G276	C	2011/01/31	Potassium, total	mg/L	1.40
UA	G276	C	2012/01/31	Potassium, total	mg/L	1.30

UA	G276	C	2013/01/31	Potassium, total	mg/L	1.10
UA	G276	C	2015/04/13	Potassium, total	mg/L	3.10
UA	G276	C	2017/07/18	Potassium, total	mg/L	0.500
UA	G276	C	2020/01/23	Potassium, total	mg/L	0.450
UA	G276	C	2022/02/09	Potassium, total	mg/L	0.550
UA	G276	C	2022/09/20	Potassium, total	mg/L	0.560
UA	G276	C	2023/02/15	Potassium, total	mg/L	0.470
UA	G276	C	2023/06/05	Potassium, total	mg/L	0.420
UA	G276	C	2023/08/14	Potassium, total	mg/L	0.966
UA	G276	C	2023/11/17	Potassium, total	mg/L	0.875
UA	G276	C	2023/06/05	Silicon, dissolved	mg/L	10.0
UA	G276	C	2023/08/14	Silicon, dissolved	mg/L	8.80
UA	G276	C	2009/09/23	Sodium, total	mg/L	110
UA	G276	C	2009/11/11	Sodium, total	mg/L	83.0
UA	G276	C	2010/01/21	Sodium, total	mg/L	74.0
UA	G276	C	2010/03/10	Sodium, total	mg/L	80.0
UA	G276	C	2010/07/26	Sodium, total	mg/L	72.0
UA	G276	C	2011/01/31	Sodium, total	mg/L	76.0
UA	G276	C	2012/01/31	Sodium, total	mg/L	110
UA	G276	C	2013/01/31	Sodium, total	mg/L	81.0
UA	G276	C	2015/04/13	Sodium, total	mg/L	86.0
UA	G276	C	2017/07/18	Sodium, total	mg/L	85.0
UA	G276	C	2020/01/23	Sodium, total	mg/L	96.0
UA	G276	C	2022/02/09	Sodium, total	mg/L	96.0
UA	G276	C	2022/09/20	Sodium, total	mg/L	93.0
UA	G276	C	2023/02/15	Sodium, total	mg/L	84.0
UA	G276	C	2023/06/05	Sodium, total	mg/L	93.0
UA	G276	C	2023/08/14	Sodium, total	mg/L	96.4
UA	G276	C	2023/11/17	Sodium, total	mg/L	90.3
UA	G276	C	2009/09/23	Sulfate, total	mg/L	170
UA	G276	C	2009/11/11	Sulfate, total	mg/L	170
UA	G276	C	2010/01/21	Sulfate, total	mg/L	190
UA	G276	C	2010/03/09	Sulfate, total	mg/L	180
UA	G276	C	2010/07/26	Sulfate, total	mg/L	230
UA	G276	C	2010/11/16	Sulfate, total	mg/L	200
UA	G276	C	2011/01/31	Sulfate, total	mg/L	200
UA	G276	C	2011/05/03	Sulfate, total	mg/L	200
UA	G276	C	2011/07/27	Sulfate, total	mg/L	170
UA	G276	C	2011/11/14	Sulfate, total	mg/L	180
UA	G276	C	2012/01/31	Sulfate, total	mg/L	190
UA	G276	C	2012/05/22	Sulfate, total	mg/L	160
UA	G276	C	2012/07/24	Sulfate, total	mg/L	190
UA	G276	C	2012/11/14	Sulfate, total	mg/L	190
UA	G276	C	2013/01/31	Sulfate, total	mg/L	250
UA	G276	C	2013/05/20	Sulfate, total	mg/L	180
UA	G276	C	2013/07/22	Sulfate, total	mg/L	220
UA	G276	C	2014/05/13	Sulfate, total	mg/L	230
UA	G276	C	2014/08/12	Sulfate, total	mg/L	220
UA	G276	C	2014/10/14	Sulfate, total	mg/L	220
UA	G276	C	2015/01/21	Sulfate, total	mg/L	260
UA	G276	C	2015/04/13	Sulfate, total	mg/L	310
UA	G276	C	2015/07/23	Sulfate, total	mg/L	180
UA	G276	C	2015/11/24	Sulfate, total	mg/L	190
UA	G276	C	2016/02/16	Sulfate, total	mg/L	230
UA	G276	C	2016/05/12	Sulfate, total	mg/L	230
UA	G276	C	2016/08/03	Sulfate, total	mg/L	190
UA	G276	C	2016/11/21	Sulfate, total	mg/L	210
UA	G276	C	2017/02/17	Sulfate, total	mg/L	200
UA	G276	C	2017/05/20	Sulfate, total	mg/L	220
UA	G276	C	2017/07/18	Sulfate, total	mg/L	220
UA	G276	C	2017/11/04	Sulfate, total	mg/L	210
UA	G276	C	2018/05/16	Sulfate, total	mg/L	220

UA	G276	C	2018/08/10	Sulfate, total	mg/L	230
UA	G276	C	2019/01/22	Sulfate, total	mg/L	240
UA	G276	C	2019/08/26	Sulfate, total	mg/L	260
UA	G276	C	2020/01/23	Sulfate, total	mg/L	270
UA	G276	C	2020/08/12	Sulfate, total	mg/L	280
UA	G276	C	2020/10/14	Sulfate, total	mg/L	270
UA	G276	C	2021/05/19	Sulfate, total	mg/L	280
UA	G276	C	2021/06/28	Sulfate, total	mg/L	270
UA	G276	C	2021/08/18	Sulfate, total	mg/L	270
UA	G276	C	2021/10/26	Sulfate, total	mg/L	250
UA	G276	C	2022/02/09	Sulfate, total	mg/L	270
UA	G276	C	2022/05/11	Sulfate, total	mg/L	270
UA	G276	C	2022/09/20	Sulfate, total	mg/L	260
UA	G276	C	2022/11/09	Sulfate, total	mg/L	250
UA	G276	C	2023/02/15	Sulfate, total	mg/L	230
UA	G276	C	2023/06/05	Sulfate, total	mg/L	260
UA	G276	C	2023/08/14	Sulfate, total	mg/L	249
UA	G276	C	2023/11/17	Sulfate, total	mg/L	2,610
UA	G276	C	2015/11/24	Temperature (Celsius)	degrees C	15.9
UA	G276	C	2016/02/16	Temperature (Celsius)	degrees C	10.8
UA	G276	C	2016/05/12	Temperature (Celsius)	degrees C	17.6
UA	G276	C	2016/08/03	Temperature (Celsius)	degrees C	18.2
UA	G276	C	2016/11/21	Temperature (Celsius)	degrees C	14.0
UA	G276	C	2017/02/17	Temperature (Celsius)	degrees C	14.6
UA	G276	C	2017/05/20	Temperature (Celsius)	degrees C	15.7
UA	G276	C	2017/07/18	Temperature (Celsius)	degrees C	19.6
UA	G276	C	2017/11/04	Temperature (Celsius)	degrees C	12.9
UA	G276	C	2018/05/16	Temperature (Celsius)	degrees C	14.8
UA	G276	C	2018/08/10	Temperature (Celsius)	degrees C	15.2
UA	G276	C	2019/01/22	Temperature (Celsius)	degrees C	12.0
UA	G276	C	2019/08/26	Temperature (Celsius)	degrees C	17.2
UA	G276	C	2020/01/23	Temperature (Celsius)	degrees C	12.1
UA	G276	C	2020/08/12	Temperature (Celsius)	degrees C	22.2
UA	G276	C	2021/06/28	Temperature (Celsius)	degrees C	17.2
UA	G276	C	2021/08/18	Temperature (Celsius)	degrees C	20.0
UA	G276	C	2022/02/09	Temperature (Celsius)	degrees C	12.8
UA	G276	C	2022/03/21	Temperature (Celsius)	degrees C	17.3
UA	G276	C	2022/05/11	Temperature (Celsius)	degrees C	18.8
UA	G276	C	2022/09/20	Temperature (Celsius)	degrees C	19.4
UA	G276	C	2022/11/09	Temperature (Celsius)	degrees C	22.6
UA	G276	C	2023/02/15	Temperature (Celsius)	degrees C	14.4
UA	G276	C	2023/06/05	Temperature (Celsius)	degrees C	19.0
UA	G276	C	2023/08/14	Temperature (Celsius)	degrees C	16.2
UA	G276	C	2023/11/17	Temperature (Celsius)	degrees C	15.0
UA	G276	C	2009/09/23	Total Dissolved Solids	mg/L	620
UA	G276	C	2009/11/11	Total Dissolved Solids	mg/L	670
UA	G276	C	2010/01/21	Total Dissolved Solids	mg/L	660
UA	G276	C	2010/03/09	Total Dissolved Solids	mg/L	650
UA	G276	C	2010/07/26	Total Dissolved Solids	mg/L	710
UA	G276	C	2010/11/16	Total Dissolved Solids	mg/L	670
UA	G276	C	2011/01/31	Total Dissolved Solids	mg/L	710
UA	G276	C	2011/05/03	Total Dissolved Solids	mg/L	650
UA	G276	C	2011/07/27	Total Dissolved Solids	mg/L	670
UA	G276	C	2011/11/14	Total Dissolved Solids	mg/L	620
UA	G276	C	2012/01/31	Total Dissolved Solids	mg/L	650
UA	G276	C	2012/05/22	Total Dissolved Solids	mg/L	660
UA	G276	C	2012/07/24	Total Dissolved Solids	mg/L	680
UA	G276	C	2012/11/14	Total Dissolved Solids	mg/L	680
UA	G276	C	2013/01/31	Total Dissolved Solids	mg/L	680
UA	G276	C	2013/05/20	Total Dissolved Solids	mg/L	640
UA	G276	C	2013/07/22	Total Dissolved Solids	mg/L	670
UA	G276	C	2014/05/13	Total Dissolved Solids	mg/L	700

UA	G276	C	2014/08/12	Total Dissolved Solids	mg/L	640
UA	G276	C	2014/10/14	Total Dissolved Solids	mg/L	700
UA	G276	C	2015/01/21	Total Dissolved Solids	mg/L	700
UA	G276	C	2015/04/13	Total Dissolved Solids	mg/L	780
UA	G276	C	2015/07/23	Total Dissolved Solids	mg/L	800
UA	G276	C	2015/11/24	Total Dissolved Solids	mg/L	710
UA	G276	C	2016/02/16	Total Dissolved Solids	mg/L	760
UA	G276	C	2016/05/12	Total Dissolved Solids	mg/L	660
UA	G276	C	2016/08/03	Total Dissolved Solids	mg/L	680
UA	G276	C	2016/11/21	Total Dissolved Solids	mg/L	720
UA	G276	C	2017/02/17	Total Dissolved Solids	mg/L	680
UA	G276	C	2017/05/20	Total Dissolved Solids	mg/L	750
UA	G276	C	2017/07/18	Total Dissolved Solids	mg/L	780
UA	G276	C	2017/11/04	Total Dissolved Solids	mg/L	720
UA	G276	C	2018/05/16	Total Dissolved Solids	mg/L	740
UA	G276	C	2018/08/10	Total Dissolved Solids	mg/L	760
UA	G276	C	2019/01/22	Total Dissolved Solids	mg/L	860
UA	G276	C	2019/08/26	Total Dissolved Solids	mg/L	880
UA	G276	C	2020/01/23	Total Dissolved Solids	mg/L	1,400
UA	G276	C	2020/08/12	Total Dissolved Solids	mg/L	820
UA	G276	C	2020/10/14	Total Dissolved Solids	mg/L	930
UA	G276	C	2021/05/19	Total Dissolved Solids	mg/L	990
UA	G276	C	2021/06/28	Total Dissolved Solids	mg/L	900
UA	G276	C	2021/08/18	Total Dissolved Solids	mg/L	900
UA	G276	C	2021/10/26	Total Dissolved Solids	mg/L	830
UA	G276	C	2022/02/09	Total Dissolved Solids	mg/L	860
UA	G276	C	2022/05/11	Total Dissolved Solids	mg/L	940
UA	G276	C	2022/09/20	Total Dissolved Solids	mg/L	680
UA	G276	C	2022/11/09	Total Dissolved Solids	mg/L	860
UA	G276	C	2023/02/15	Total Dissolved Solids	mg/L	960
UA	G276	C	2023/06/05	Total Dissolved Solids	mg/L	860
UA	G276	C	2023/08/14	Total Dissolved Solids	mg/L	908
UA	G276	C	2023/11/17	Total Dissolved Solids	mg/L	4,260
UA	G277	C	2010/07/26	pH (field)	SU	7.3
UA	G277	C	2010/07/28	pH (field)	SU	7.3
UA	G277	C	2010/09/20	pH (field)	SU	7.4
UA	G277	C	2010/11/16	pH (field)	SU	7.7
UA	G277	C	2011/01/31	pH (field)	SU	7.0
UA	G277	C	2011/05/03	pH (field)	SU	6.8
UA	G277	C	2011/07/27	pH (field)	SU	6.8
UA	G277	C	2011/11/14	pH (field)	SU	7.0
UA	G277	C	2012/01/31	pH (field)	SU	7.0
UA	G277	C	2012/05/22	pH (field)	SU	6.9
UA	G277	C	2012/07/25	pH (field)	SU	6.7
UA	G277	C	2012/11/14	pH (field)	SU	6.8
UA	G277	C	2013/05/20	pH (field)	SU	6.9
UA	G277	C	2013/07/22	pH (field)	SU	6.8
UA	G277	C	2014/05/13	pH (field)	SU	6.8
UA	G277	C	2014/10/15	pH (field)	SU	6.5
UA	G277	C	2014/10/16	pH (field)	SU	6.5
UA	G277	C	2020/10/14	pH (field)	SU	6.8
UA	G277	C	2021/05/20	pH (field)	SU	7.2
UA	G277	C	2021/08/18	pH (field)	SU	7.0
UA	G277	C	2021/10/26	pH (field)	SU	7.0
UA	G277	C	2022/02/09	pH (field)	SU	6.9
UA	G277	C	2022/05/12	pH (field)	SU	6.9
UA	G277	C	2022/08/24	pH (field)	SU	6.9
UA	G277	C	2022/11/09	pH (field)	SU	6.6
UA	G277	C	2023/02/15	pH (field)	SU	7.2
UA	G277	C	2023/06/01	pH (field)	SU	6.6
UA	G277	C	2022/02/09	Oxidation Reduction Potential	mV	114
UA	G277	C	2022/05/12	Oxidation Reduction Potential	mV	118

UA	G277	C	2022/08/24	Oxidation Reduction Potential	mV	75.8
UA	G277	C	2022/11/09	Oxidation Reduction Potential	mV	198
UA	G277	C	2023/02/15	Oxidation Reduction Potential	mV	152
UA	G277	C	2023/06/01	Oxidation Reduction Potential	mV	215
UA	G277	C	2022/02/09	Eh	V	0.31
UA	G277	C	2022/05/12	Eh	V	0.31
UA	G277	C	2022/08/24	Eh	V	0.27
UA	G277	C	2022/11/09	Eh	V	0.39
UA	G277	C	2023/02/15	Eh	V	0.35
UA	G277	C	2023/06/01	Eh	V	0.41
UA	G277	C	2009/09/23	Alkalinity, bicarbonate	mg/L CaCO3	220
UA	G277	C	2009/11/11	Alkalinity, bicarbonate	mg/L CaCO3	270
UA	G277	C	2010/01/19	Alkalinity, bicarbonate	mg/L CaCO3	320
UA	G277	C	2010/03/08	Alkalinity, bicarbonate	mg/L CaCO3	330
UA	G277	C	2010/07/26	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G277	C	2011/01/31	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G277	C	2012/01/31	Alkalinity, bicarbonate	mg/L CaCO3	420
UA	G277	C	2014/10/15	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G277	C	2023/06/01	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G277	C	2009/09/23	Arsenic, total	mg/L	0.0270
UA	G277	C	2009/11/11	Arsenic, total	mg/L	0.0200
UA	G277	C	2010/01/19	Arsenic, total	mg/L	0.00190
UA	G277	C	2010/03/08	Arsenic, total	mg/L	<0.001
UA	G277	C	2010/07/26	Arsenic, total	mg/L	0.00180
UA	G277	C	2010/11/16	Arsenic, total	mg/L	<0.001
UA	G277	C	2011/01/31	Arsenic, total	mg/L	0.00150
UA	G277	C	2011/05/03	Arsenic, total	mg/L	<0.001
UA	G277	C	2011/07/27	Arsenic, total	mg/L	<0.001
UA	G277	C	2011/11/14	Arsenic, total	mg/L	0.00390
UA	G277	C	2012/01/31	Arsenic, total	mg/L	0.00300
UA	G277	C	2012/05/22	Arsenic, total	mg/L	<0.001
UA	G277	C	2012/07/25	Arsenic, total	mg/L	0.00110
UA	G277	C	2012/11/14	Arsenic, total	mg/L	<0.001
UA	G277	C	2013/05/20	Arsenic, total	mg/L	<0.001
UA	G277	C	2013/07/22	Arsenic, total	mg/L	<0.001
UA	G277	C	2014/05/13	Arsenic, total	mg/L	0.00210
UA	G277	C	2014/10/15	Arsenic, total	mg/L	0.00230
UA	G277	C	2020/10/14	Arsenic, total	mg/L	<0.001
UA	G277	C	2021/05/20	Arsenic, total	mg/L	0.00130
UA	G277	C	2021/08/18	Arsenic, total	mg/L	<0.001
UA	G277	C	2021/10/26	Arsenic, total	mg/L	<0.001
UA	G277	C	2022/02/09	Arsenic, total	mg/L	<0.001
UA	G277	C	2022/05/12	Arsenic, total	mg/L	0.000720
UA	G277	C	2022/08/24	Arsenic, total	mg/L	<0.00069
UA	G277	C	2022/11/09	Arsenic, total	mg/L	0.000840
UA	G277	C	2023/02/15	Arsenic, total	mg/L	0.000830
UA	G277	C	2023/06/01	Arsenic, total	mg/L	0.00100
UA	G277	C	2009/09/23	Barium, total	mg/L	0.610
UA	G277	C	2009/11/11	Barium, total	mg/L	0.220
UA	G277	C	2010/01/19	Barium, total	mg/L	0.0930
UA	G277	C	2010/03/08	Barium, total	mg/L	0.0750
UA	G277	C	2010/07/26	Barium, total	mg/L	0.0850
UA	G277	C	2011/01/31	Barium, total	mg/L	0.0850
UA	G277	C	2012/01/31	Barium, total	mg/L	0.120
UA	G277	C	2020/10/14	Barium, total	mg/L	0.120
UA	G277	C	2021/05/20	Barium, total	mg/L	0.100
UA	G277	C	2021/08/18	Barium, total	mg/L	0.140
UA	G277	C	2021/10/26	Barium, total	mg/L	0.130
UA	G277	C	2022/02/09	Barium, total	mg/L	0.120
UA	G277	C	2022/05/12	Barium, total	mg/L	0.0940
UA	G277	C	2022/08/24	Barium, total	mg/L	0.0990
UA	G277	C	2022/11/09	Barium, total	mg/L	0.0430

UA	G277	C	2023/02/15	Barium, total	mg/L	0.0990
UA	G277	C	2023/06/01	Barium, total	mg/L	0.0940
UA	G277	C	2009/09/23	Calcium, total	mg/L	190
UA	G277	C	2009/11/11	Calcium, total	mg/L	110
UA	G277	C	2010/01/19	Calcium, total	mg/L	92.0
UA	G277	C	2010/03/08	Calcium, total	mg/L	93.0
UA	G277	C	2010/07/26	Calcium, total	mg/L	85.0
UA	G277	C	2010/11/16	Calcium, total	mg/L	86.0
UA	G277	C	2011/01/31	Calcium, total	mg/L	97.0
UA	G277	C	2011/05/03	Calcium, total	mg/L	<100
UA	G277	C	2011/07/27	Calcium, total	mg/L	110
UA	G277	C	2011/11/14	Calcium, total	mg/L	110
UA	G277	C	2012/01/31	Calcium, total	mg/L	160
UA	G277	C	2012/05/22	Calcium, total	mg/L	110
UA	G277	C	2012/07/25	Calcium, total	mg/L	110
UA	G277	C	2012/11/14	Calcium, total	mg/L	120
UA	G277	C	2013/05/20	Calcium, total	mg/L	110
UA	G277	C	2013/07/22	Calcium, total	mg/L	93.0
UA	G277	C	2014/05/13	Calcium, total	mg/L	130
UA	G277	C	2014/10/15	Calcium, total	mg/L	84.0
UA	G277	C	2023/06/01	Calcium, total	mg/L	240
UA	G277	C	2009/09/23	Chloride, total	mg/L	41.0
UA	G277	C	2009/11/11	Chloride, total	mg/L	43.0
UA	G277	C	2010/01/19	Chloride, total	mg/L	39.0
UA	G277	C	2010/03/08	Chloride, total	mg/L	43.0
UA	G277	C	2010/07/26	Chloride, total	mg/L	46.0
UA	G277	C	2011/01/31	Chloride, total	mg/L	40.0
UA	G277	C	2011/05/03	Chloride, total	mg/L	42.0
UA	G277	C	2011/07/27	Chloride, total	mg/L	49.0
UA	G277	C	2011/11/14	Chloride, total	mg/L	36.0
UA	G277	C	2012/01/31	Chloride, total	mg/L	37.0
UA	G277	C	2012/05/22	Chloride, total	mg/L	30.0
UA	G277	C	2012/07/24	Chloride, total	mg/L	34.0
UA	G277	C	2012/11/14	Chloride, total	mg/L	11.0
UA	G277	C	2013/05/20	Chloride, total	mg/L	3.30
UA	G277	C	2013/07/22	Chloride, total	mg/L	18.0
UA	G277	C	2014/05/13	Chloride, total	mg/L	30.0
UA	G277	C	2014/10/15	Chloride, total	mg/L	3.60
UA	G277	C	2020/10/14	Chloride, total	mg/L	68.0
UA	G277	C	2021/05/20	Chloride, total	mg/L	15.0
UA	G277	C	2021/08/18	Chloride, total	mg/L	91.0
UA	G277	C	2021/10/26	Chloride, total	mg/L	89.0
UA	G277	C	2022/02/09	Chloride, total	mg/L	120
UA	G277	C	2022/05/12	Chloride, total	mg/L	52.0
UA	G277	C	2022/08/24	Chloride, total	mg/L	120
UA	G277	C	2022/11/09	Chloride, total	mg/L	110
UA	G277	C	2023/02/15	Chloride, total	mg/L	120
UA	G277	C	2023/06/01	Chloride, total	mg/L	150
UA	G277	C	2023/06/01	Ferrous Iron, dissolved	mg/L	<0.02
UA	G277	C	2009/11/11	Iron, dissolved	mg/L	39.0
UA	G277	C	2010/01/19	Iron, dissolved	mg/L	<0.1
UA	G277	C	2010/03/09	Iron, dissolved	mg/L	<0.2
UA	G277	C	2010/07/26	Iron, dissolved	mg/L	0.0160
UA	G277	C	2010/09/20	Iron, dissolved	mg/L	0.0280
UA	G277	C	2010/11/16	Iron, dissolved	mg/L	<0.01
UA	G277	C	2011/01/31	Iron, dissolved	mg/L	<0.01
UA	G277	C	2011/05/03	Iron, dissolved	mg/L	<0.01
UA	G277	C	2011/07/27	Iron, dissolved	mg/L	<0.01
UA	G277	C	2011/11/14	Iron, dissolved	mg/L	0.0160
UA	G277	C	2012/05/22	Iron, dissolved	mg/L	<0.01
UA	G277	C	2012/07/25	Iron, dissolved	mg/L	<0.01
UA	G277	C	2013/05/20	Iron, dissolved	mg/L	<0.01

UA	G277	C	2013/07/22	Iron, dissolved	mg/L	<0.01
UA	G277	C	2014/05/13	Iron, dissolved	mg/L	<0.01
UA	G277	C	2014/10/16	Iron, dissolved	mg/L	<0.01
UA	G277	C	2016/05/12	Iron, dissolved	mg/L	<0.01
UA	G277	C	2016/08/03	Iron, dissolved	mg/L	0.0220
UA	G277	C	2020/01/23	Iron, dissolved	mg/L	<0.01
UA	G277	C	2020/05/06	Iron, dissolved	mg/L	<0.01
UA	G277	C	2020/08/13	Iron, dissolved	mg/L	<0.01
UA	G277	C	2020/10/14	Iron, dissolved	mg/L	<0.01
UA	G277	C	2021/05/20	Iron, dissolved	mg/L	<0.01
UA	G277	C	2021/08/18	Iron, dissolved	mg/L	<0.01
UA	G277	C	2021/10/26	Iron, dissolved	mg/L	<0.01
UA	G277	C	2022/02/09	Iron, dissolved	mg/L	<0.01
UA	G277	C	2022/05/12	Iron, dissolved	mg/L	<0.00072
UA	G277	C	2022/08/24	Iron, dissolved	mg/L	0.0170
UA	G277	C	2022/11/09	Iron, dissolved	mg/L	0.00550
UA	G277	C	2023/02/15	Iron, dissolved	mg/L	0.00100
UA	G277	C	2023/06/01	Iron, dissolved	mg/L	0.00160
UA	G277	C	2009/09/23	Magnesium, total	mg/L	91.0
UA	G277	C	2009/11/11	Magnesium, total	mg/L	53.0
UA	G277	C	2010/01/19	Magnesium, total	mg/L	39.0
UA	G277	C	2010/03/08	Magnesium, total	mg/L	40.0
UA	G277	C	2010/07/26	Magnesium, total	mg/L	37.0
UA	G277	C	2011/01/31	Magnesium, total	mg/L	43.0
UA	G277	C	2012/01/31	Magnesium, total	mg/L	49.0
UA	G277	C	2023/06/01	Magnesium, total	mg/L	100
UA	G277	C	2009/11/11	Manganese, dissolved	mg/L	1.60
UA	G277	C	2010/01/19	Manganese, dissolved	mg/L	0.0200
UA	G277	C	2010/03/09	Manganese, dissolved	mg/L	0.00370
UA	G277	C	2010/07/26	Manganese, dissolved	mg/L	0.00300
UA	G277	C	2010/09/20	Manganese, dissolved	mg/L	0.00550
UA	G277	C	2010/11/16	Manganese, dissolved	mg/L	0.00210
UA	G277	C	2011/01/31	Manganese, dissolved	mg/L	0.00310
UA	G277	C	2011/05/03	Manganese, dissolved	mg/L	<0.001
UA	G277	C	2011/07/27	Manganese, dissolved	mg/L	<0.001
UA	G277	C	2011/11/14	Manganese, dissolved	mg/L	0.00540
UA	G277	C	2012/05/22	Manganese, dissolved	mg/L	0.00520
UA	G277	C	2012/07/25	Manganese, dissolved	mg/L	0.0130
UA	G277	C	2013/05/20	Manganese, dissolved	mg/L	<0.001
UA	G277	C	2013/07/22	Manganese, dissolved	mg/L	<0.001
UA	G277	C	2014/05/13	Manganese, dissolved	mg/L	<0.001
UA	G277	C	2014/10/16	Manganese, dissolved	mg/L	0.00300
UA	G277	C	2016/05/12	Manganese, dissolved	mg/L	0.00170
UA	G277	C	2016/08/03	Manganese, dissolved	mg/L	0.340
UA	G277	C	2020/01/23	Manganese, dissolved	mg/L	0.00120
UA	G277	C	2020/05/06	Manganese, dissolved	mg/L	0.00120
UA	G277	C	2020/08/13	Manganese, dissolved	mg/L	0.00890
UA	G277	C	2020/10/14	Manganese, dissolved	mg/L	0.0250
UA	G277	C	2021/05/20	Manganese, dissolved	mg/L	<0.001
UA	G277	C	2021/08/18	Manganese, dissolved	mg/L	<0.001
UA	G277	C	2021/10/26	Manganese, dissolved	mg/L	0.00840
UA	G277	C	2022/02/09	Manganese, dissolved	mg/L	0.0160
UA	G277	C	2022/05/12	Manganese, dissolved	mg/L	0.0200
UA	G277	C	2022/08/24	Manganese, dissolved	mg/L	0.0150
UA	G277	C	2022/11/09	Manganese, dissolved	mg/L	0.0930
UA	G277	C	2023/02/15	Manganese, dissolved	mg/L	0.000320
UA	G277	C	2023/06/01	Manganese, dissolved	mg/L	0.00970
UA	G277	C	2009/09/23	Potassium, total	mg/L	7.90
UA	G277	C	2009/11/11	Potassium, total	mg/L	5.00
UA	G277	C	2010/01/19	Potassium, total	mg/L	2.20
UA	G277	C	2010/03/08	Potassium, total	mg/L	1.40
UA	G277	C	2010/07/26	Potassium, total	mg/L	2.20

UA	G277	C	2011/01/31	Potassium, total	mg/L	0.960
UA	G277	C	2012/01/31	Potassium, total	mg/L	2.60
UA	G277	C	2023/06/01	Potassium, total	mg/L	0.790
UA	G277	C	2023/06/01	Silicon, dissolved	mg/L	9.50
UA	G277	C	2009/09/23	Sodium, total	mg/L	66.0
UA	G277	C	2009/11/11	Sodium, total	mg/L	52.0
UA	G277	C	2010/01/19	Sodium, total	mg/L	55.0
UA	G277	C	2010/03/08	Sodium, total	mg/L	55.0
UA	G277	C	2010/07/26	Sodium, total	mg/L	52.0
UA	G277	C	2011/01/31	Sodium, total	mg/L	55.0
UA	G277	C	2012/01/31	Sodium, total	mg/L	76.0
UA	G277	C	2023/06/01	Sodium, total	mg/L	97.0
UA	G277	C	2009/09/23	Sulfate, total	mg/L	79.0
UA	G277	C	2009/11/11	Sulfate, total	mg/L	49.0
UA	G277	C	2010/01/19	Sulfate, total	mg/L	63.0
UA	G277	C	2010/03/08	Sulfate, total	mg/L	49.0
UA	G277	C	2010/07/26	Sulfate, total	mg/L	58.0
UA	G277	C	2011/01/31	Sulfate, total	mg/L	52.0
UA	G277	C	2011/05/03	Sulfate, total	mg/L	56.0
UA	G277	C	2011/07/27	Sulfate, total	mg/L	61.0
UA	G277	C	2011/11/14	Sulfate, total	mg/L	51.0
UA	G277	C	2012/01/31	Sulfate, total	mg/L	45.0
UA	G277	C	2012/05/22	Sulfate, total	mg/L	49.0
UA	G277	C	2012/07/24	Sulfate, total	mg/L	52.0
UA	G277	C	2012/11/14	Sulfate, total	mg/L	42.0
UA	G277	C	2013/05/20	Sulfate, total	mg/L	5.70
UA	G277	C	2013/07/22	Sulfate, total	mg/L	45.0
UA	G277	C	2014/05/13	Sulfate, total	mg/L	60.0
UA	G277	C	2014/10/15	Sulfate, total	mg/L	18.0
UA	G277	C	2020/10/14	Sulfate, total	mg/L	260
UA	G277	C	2021/05/20	Sulfate, total	mg/L	67.0
UA	G277	C	2021/08/18	Sulfate, total	mg/L	400
UA	G277	C	2021/10/26	Sulfate, total	mg/L	470
UA	G277	C	2022/02/09	Sulfate, total	mg/L	510
UA	G277	C	2022/05/12	Sulfate, total	mg/L	250
UA	G277	C	2022/08/24	Sulfate, total	mg/L	610
UA	G277	C	2022/11/09	Sulfate, total	mg/L	580
UA	G277	C	2023/02/15	Sulfate, total	mg/L	470
UA	G277	C	2023/06/01	Sulfate, total	mg/L	540
UA	G277	C	2022/02/09	Temperature (Celsius)	degrees C	11.3
UA	G277	C	2022/05/12	Temperature (Celsius)	degrees C	16.6
UA	G277	C	2022/08/24	Temperature (Celsius)	degrees C	19.2
UA	G277	C	2022/11/09	Temperature (Celsius)	degrees C	19.1
UA	G277	C	2023/02/15	Temperature (Celsius)	degrees C	16.2
UA	G277	C	2023/06/01	Temperature (Celsius)	degrees C	16.5
UA	G277	C	2009/09/24	Total Dissolved Solids	mg/L	430
UA	G277	C	2009/11/11	Total Dissolved Solids	mg/L	680
UA	G277	C	2010/01/20	Total Dissolved Solids	mg/L	550
UA	G277	C	2010/03/08	Total Dissolved Solids	mg/L	540
UA	G277	C	2010/07/26	Total Dissolved Solids	mg/L	790
UA	G277	C	2011/01/31	Total Dissolved Solids	mg/L	610
UA	G277	C	2011/05/03	Total Dissolved Solids	mg/L	600
UA	G277	C	2011/07/27	Total Dissolved Solids	mg/L	650
UA	G277	C	2011/11/14	Total Dissolved Solids	mg/L	580
UA	G277	C	2012/05/22	Total Dissolved Solids	mg/L	580
UA	G277	C	2012/07/24	Total Dissolved Solids	mg/L	580
UA	G277	C	2013/05/20	Total Dissolved Solids	mg/L	520
UA	G277	C	2013/07/22	Total Dissolved Solids	mg/L	500
UA	G277	C	2014/05/13	Total Dissolved Solids	mg/L	560
UA	G277	C	2014/10/16	Total Dissolved Solids	mg/L	360
UA	G277	C	2020/10/14	Total Dissolved Solids	mg/L	970
UA	G277	C	2021/05/20	Total Dissolved Solids	mg/L	480

UA	G277	C	2021/08/18	Total Dissolved Solids	mg/L	1,200
UA	G277	C	2021/10/26	Total Dissolved Solids	mg/L	1,300
UA	G277	C	2022/02/09	Total Dissolved Solids	mg/L	1,100
UA	G277	C	2022/05/12	Total Dissolved Solids	mg/L	920
UA	G277	C	2022/08/24	Total Dissolved Solids	mg/L	1,600
UA	G277	C	2022/11/09	Total Dissolved Solids	mg/L	1,400
UA	G277	C	2023/02/15	Total Dissolved Solids	mg/L	1,400
UA	G277	C	2023/06/01	Total Dissolved Solids	mg/L	1,600
UA	G279	C	2010/07/26	pH (field)	SU	7.2
UA	G279	C	2010/07/28	pH (field)	SU	7.2
UA	G279	C	2010/09/20	pH (field)	SU	7.5
UA	G279	C	2010/11/16	pH (field)	SU	7.7
UA	G279	C	2011/01/28	pH (field)	SU	7.7
UA	G279	C	2011/05/04	pH (field)	SU	6.9
UA	G279	C	2011/07/27	pH (field)	SU	7.2
UA	G279	C	2011/11/14	pH (field)	SU	7.3
UA	G279	C	2012/01/30	pH (field)	SU	7.1
UA	G279	C	2012/05/22	pH (field)	SU	7.1
UA	G279	C	2012/07/24	pH (field)	SU	7.0
UA	G279	C	2012/11/14	pH (field)	SU	7.2
UA	G279	C	2013/01/31	pH (field)	SU	7.0
UA	G279	C	2013/05/20	pH (field)	SU	7.1
UA	G279	C	2013/07/22	pH (field)	SU	7.0
UA	G279	C	2013/10/14	pH (field)	SU	7.1
UA	G279	C	2014/02/19	pH (field)	SU	7.4
UA	G279	C	2014/05/13	pH (field)	SU	7.0
UA	G279	C	2014/08/12	pH (field)	SU	7.2
UA	G279	C	2014/10/14	pH (field)	SU	7.1
UA	G279	C	2015/01/21	pH (field)	SU	7.1
UA	G279	C	2015/04/13	pH (field)	SU	6.6
UA	G279	C	2015/07/23	pH (field)	SU	7.1
UA	G279	C	2015/10/08	pH (field)	SU	7.0
UA	G279	C	2015/11/24	pH (field)	SU	7.2
UA	G279	C	2016/02/16	pH (field)	SU	7.2
UA	G279	C	2016/05/13	pH (field)	SU	6.9
UA	G279	C	2016/08/03	pH (field)	SU	7.1
UA	G279	C	2016/11/22	pH (field)	SU	7.2
UA	G279	C	2017/02/15	pH (field)	SU	7.1
UA	G279	C	2017/05/20	pH (field)	SU	7.0
UA	G279	C	2017/07/18	pH (field)	SU	7.3
UA	G279	C	2017/11/04	pH (field)	SU	7.2
UA	G279	C	2018/05/16	pH (field)	SU	7.1
UA	G279	C	2018/08/10	pH (field)	SU	7.1
UA	G279	C	2019/01/23	pH (field)	SU	7.0
UA	G279	C	2019/08/26	pH (field)	SU	7.0
UA	G279	C	2020/01/23	pH (field)	SU	7.0
UA	G279	C	2020/08/12	pH (field)	SU	6.8
UA	G279	C	2020/10/14	pH (field)	SU	6.8
UA	G279	C	2021/01/21	pH (field)	SU	7.0
UA	G279	C	2021/01/28	pH (field)	SU	7.0
UA	G279	C	2021/05/20	pH (field)	SU	7.1
UA	G279	C	2021/08/18	pH (field)	SU	6.9
UA	G279	C	2021/10/26	pH (field)	SU	6.9
UA	G279	C	2022/02/08	pH (field)	SU	6.7
UA	G279	C	2022/05/10	pH (field)	SU	6.9
UA	G279	C	2022/08/24	pH (field)	SU	6.6
UA	G279	C	2022/11/09	pH (field)	SU	6.5
UA	G279	C	2023/02/16	pH (field)	SU	6.4
UA	G279	C	2023/06/01	pH (field)	SU	6.6
UA	G279	C	2023/11/17	pH (field)	SU	6.8
UA	G279	C	2015/11/24	Oxidation Reduction Potential	mV	71.0
UA	G279	C	2016/02/16	Oxidation Reduction Potential	mV	147

UA	G279	C	2016/05/13	Oxidation Reduction Potential	mV	127
UA	G279	C	2016/08/03	Oxidation Reduction Potential	mV	-63.0
UA	G279	C	2016/11/22	Oxidation Reduction Potential	mV	-76.0
UA	G279	C	2017/02/15	Oxidation Reduction Potential	mV	-70.0
UA	G279	C	2017/05/20	Oxidation Reduction Potential	mV	-62.0
UA	G279	C	2017/07/18	Oxidation Reduction Potential	mV	-65.0
UA	G279	C	2017/11/04	Oxidation Reduction Potential	mV	-61.0
UA	G279	C	2018/05/16	Oxidation Reduction Potential	mV	-57.0
UA	G279	C	2018/08/10	Oxidation Reduction Potential	mV	-70.0
UA	G279	C	2019/01/23	Oxidation Reduction Potential	mV	-64.0
UA	G279	C	2019/08/26	Oxidation Reduction Potential	mV	-69.0
UA	G279	C	2020/01/23	Oxidation Reduction Potential	mV	342
UA	G279	C	2020/08/12	Oxidation Reduction Potential	mV	180
UA	G279	C	2020/10/14	Oxidation Reduction Potential	mV	307
UA	G279	C	2021/01/21	Oxidation Reduction Potential	mV	102
UA	G279	C	2021/01/28	Oxidation Reduction Potential	mV	102
UA	G279	C	2021/05/20	Oxidation Reduction Potential	mV	157
UA	G279	C	2021/08/18	Oxidation Reduction Potential	mV	110
UA	G279	C	2021/10/26	Oxidation Reduction Potential	mV	79.6
UA	G279	C	2022/02/08	Oxidation Reduction Potential	mV	-9.70
UA	G279	C	2022/05/10	Oxidation Reduction Potential	mV	90.7
UA	G279	C	2022/08/24	Oxidation Reduction Potential	mV	236
UA	G279	C	2022/11/09	Oxidation Reduction Potential	mV	232
UA	G279	C	2023/02/16	Oxidation Reduction Potential	mV	245
UA	G279	C	2023/06/01	Oxidation Reduction Potential	mV	223
UA	G279	C	2023/11/17	Oxidation Reduction Potential	mV	141
UA	G279	C	2015/11/24	Eh	V	0.27
UA	G279	C	2016/02/16	Eh	V	0.35
UA	G279	C	2016/05/13	Eh	V	0.32
UA	G279	C	2016/08/03	Eh	V	0.13
UA	G279	C	2016/11/22	Eh	V	0.12
UA	G279	C	2017/02/15	Eh	V	0.13
UA	G279	C	2017/05/20	Eh	V	0.13
UA	G279	C	2017/07/18	Eh	V	0.13
UA	G279	C	2017/11/04	Eh	V	0.14
UA	G279	C	2018/05/16	Eh	V	0.14
UA	G279	C	2018/08/10	Eh	V	0.12
UA	G279	C	2019/01/23	Eh	V	0.13
UA	G279	C	2019/08/26	Eh	V	0.12
UA	G279	C	2020/01/23	Eh	V	0.54
UA	G279	C	2020/08/12	Eh	V	0.37
UA	G279	C	2020/10/14	Eh	V	0.50
UA	G279	C	2021/01/21	Eh	V	0.30
UA	G279	C	2021/01/28	Eh	V	0.30
UA	G279	C	2021/05/20	Eh	V	0.35
UA	G279	C	2021/08/18	Eh	V	0.30
UA	G279	C	2022/02/08	Eh	V	0.19
UA	G279	C	2022/05/10	Eh	V	0.28
UA	G279	C	2022/08/24	Eh	V	0.43
UA	G279	C	2022/11/09	Eh	V	0.42
UA	G279	C	2023/02/16	Eh	V	0.44
UA	G279	C	2023/06/01	Eh	V	0.42
UA	G279	C	2023/11/17	Eh	V	0.34
UA	G279	C	2009/09/23	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G279	C	2009/11/09	Alkalinity, bicarbonate	mg/L CaCO3	330
UA	G279	C	2010/01/27	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G279	C	2010/03/04	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G279	C	2010/07/26	Alkalinity, bicarbonate	mg/L CaCO3	430
UA	G279	C	2011/01/28	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G279	C	2012/01/30	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G279	C	2013/01/31	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G279	C	2014/02/19	Alkalinity, bicarbonate	mg/L CaCO3	370

UA	G279	C	2014/08/12	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G279	C	2014/10/14	Alkalinity, bicarbonate	mg/L CaCO3	400
UA	G279	C	2015/01/21	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G279	C	2015/04/13	Alkalinity, bicarbonate	mg/L CaCO3	460
UA	G279	C	2017/07/18	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G279	C	2020/01/23	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G279	C	2021/01/28	Alkalinity, bicarbonate	mg/L CaCO3	310
UA	G279	C	2022/02/08	Alkalinity, bicarbonate	mg/L CaCO3	400
UA	G279	C	2022/08/24	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G279	C	2023/02/16	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G279	C	2023/06/01	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G279	C	2023/11/17	Alkalinity, bicarbonate	mg/L CaCO3	357
UA	G279	C	2022/08/24	Alkalinity, carbonate	mg/L CaCO3	10.0
UA	G279	C	2009/09/23	Arsenic, total	mg/L	0.00640
UA	G279	C	2009/11/09	Arsenic, total	mg/L	<0.001
UA	G279	C	2010/01/27	Arsenic, total	mg/L	<0.001
UA	G279	C	2010/03/04	Arsenic, total	mg/L	<0.001
UA	G279	C	2010/07/26	Arsenic, total	mg/L	<0.001
UA	G279	C	2010/11/16	Arsenic, total	mg/L	<0.001
UA	G279	C	2011/01/28	Arsenic, total	mg/L	0.00260
UA	G279	C	2011/05/04	Arsenic, total	mg/L	<0.001
UA	G279	C	2011/07/27	Arsenic, total	mg/L	<0.001
UA	G279	C	2011/11/14	Arsenic, total	mg/L	<0.001
UA	G279	C	2012/01/30	Arsenic, total	mg/L	<0.001
UA	G279	C	2012/05/22	Arsenic, total	mg/L	<0.001
UA	G279	C	2012/07/24	Arsenic, total	mg/L	<0.001
UA	G279	C	2012/11/14	Arsenic, total	mg/L	0.00180
UA	G279	C	2013/01/31	Arsenic, total	mg/L	<0.001
UA	G279	C	2013/05/20	Arsenic, total	mg/L	0.00120
UA	G279	C	2013/07/22	Arsenic, total	mg/L	<0.001
UA	G279	C	2013/10/14	Arsenic, total	mg/L	<0.001
UA	G279	C	2014/02/19	Arsenic, total	mg/L	<0.001
UA	G279	C	2014/05/13	Arsenic, total	mg/L	<0.001
UA	G279	C	2014/08/12	Arsenic, total	mg/L	<0.001
UA	G279	C	2014/10/14	Arsenic, total	mg/L	<0.001
UA	G279	C	2015/01/21	Arsenic, total	mg/L	<0.001
UA	G279	C	2015/04/13	Arsenic, total	mg/L	0.00130
UA	G279	C	2015/07/23	Arsenic, total	mg/L	0.00200
UA	G279	C	2015/10/08	Arsenic, total	mg/L	0.00150
UA	G279	C	2015/11/24	Arsenic, total	mg/L	<0.00013
UA	G279	C	2016/02/16	Arsenic, total	mg/L	<0.00013
UA	G279	C	2016/05/13	Arsenic, total	mg/L	<0.00013
UA	G279	C	2016/08/03	Arsenic, total	mg/L	<0.00013
UA	G279	C	2016/11/22	Arsenic, total	mg/L	<0.00013
UA	G279	C	2017/02/15	Arsenic, total	mg/L	<0.00013
UA	G279	C	2017/05/20	Arsenic, total	mg/L	<0.00013
UA	G279	C	2017/07/18	Arsenic, total	mg/L	<0.00013
UA	G279	C	2018/05/16	Arsenic, total	mg/L	<0.0009
UA	G279	C	2018/08/10	Arsenic, total	mg/L	<0.0009
UA	G279	C	2019/01/23	Arsenic, total	mg/L	0.00300
UA	G279	C	2019/08/26	Arsenic, total	mg/L	<0.0009
UA	G279	C	2020/01/23	Arsenic, total	mg/L	<0.0009
UA	G279	C	2020/08/12	Arsenic, total	mg/L	<0.00022
UA	G279	C	2020/10/14	Arsenic, total	mg/L	<0.001
UA	G279	C	2021/01/21	Arsenic, total	mg/L	<0.001
UA	G279	C	2021/01/28	Arsenic, total	mg/L	<0.00022
UA	G279	C	2021/05/20	Arsenic, total	mg/L	<0.001
UA	G279	C	2021/08/18	Arsenic, total	mg/L	<0.00022
UA	G279	C	2021/10/26	Arsenic, total	mg/L	<0.001
UA	G279	C	2022/02/08	Arsenic, total	mg/L	<0.00069
UA	G279	C	2022/05/10	Arsenic, total	mg/L	<0.00069
UA	G279	C	2022/08/24	Arsenic, total	mg/L	<0.00069

UA	G279	C	2022/11/09	Arsenic, total	mg/L	0.00110
UA	G279	C	2023/02/16	Arsenic, total	mg/L	0.00200
UA	G279	C	2023/06/01	Arsenic, total	mg/L	0.00110
UA	G279	C	2023/11/17	Arsenic, total	mg/L	0.000700
UA	G279	C	2009/09/23	Barium, total	mg/L	0.0950
UA	G279	C	2009/11/09	Barium, total	mg/L	0.0650
UA	G279	C	2010/01/27	Barium, total	mg/L	0.0670
UA	G279	C	2010/03/04	Barium, total	mg/L	0.0650
UA	G279	C	2010/07/26	Barium, total	mg/L	0.0620
UA	G279	C	2011/01/28	Barium, total	mg/L	0.0980
UA	G279	C	2012/01/30	Barium, total	mg/L	0.0500
UA	G279	C	2013/01/31	Barium, total	mg/L	0.0600
UA	G279	C	2014/02/19	Barium, total	mg/L	0.0580
UA	G279	C	2015/04/13	Barium, total	mg/L	0.0290
UA	G279	C	2015/07/23	Barium, total	mg/L	0.110
UA	G279	C	2015/10/08	Barium, total	mg/L	0.0960
UA	G279	C	2015/11/24	Barium, total	mg/L	0.0530
UA	G279	C	2016/02/16	Barium, total	mg/L	0.0720
UA	G279	C	2016/05/13	Barium, total	mg/L	0.0540
UA	G279	C	2016/08/03	Barium, total	mg/L	0.0690
UA	G279	C	2016/11/22	Barium, total	mg/L	0.0570
UA	G279	C	2017/02/15	Barium, total	mg/L	0.0530
UA	G279	C	2017/05/20	Barium, total	mg/L	0.0890
UA	G279	C	2017/07/18	Barium, total	mg/L	0.0540
UA	G279	C	2018/05/16	Barium, total	mg/L	0.0520
UA	G279	C	2018/08/10	Barium, total	mg/L	0.0440
UA	G279	C	2019/01/23	Barium, total	mg/L	0.0830
UA	G279	C	2019/08/26	Barium, total	mg/L	0.0500
UA	G279	C	2020/01/23	Barium, total	mg/L	0.0620
UA	G279	C	2020/08/12	Barium, total	mg/L	0.0320
UA	G279	C	2020/10/14	Barium, total	mg/L	0.0310
UA	G279	C	2021/01/21	Barium, total	mg/L	0.0480
UA	G279	C	2021/01/28	Barium, total	mg/L	0.0430
UA	G279	C	2021/05/20	Barium, total	mg/L	0.0500
UA	G279	C	2021/08/18	Barium, total	mg/L	0.0380
UA	G279	C	2021/10/26	Barium, total	mg/L	0.0620
UA	G279	C	2022/02/08	Barium, total	mg/L	0.0560
UA	G279	C	2022/05/10	Barium, total	mg/L	0.0560
UA	G279	C	2022/08/24	Barium, total	mg/L	0.0460
UA	G279	C	2022/11/09	Barium, total	mg/L	0.0280
UA	G279	C	2023/02/16	Barium, total	mg/L	0.0390
UA	G279	C	2023/06/01	Barium, total	mg/L	0.0430
UA	G279	C	2023/11/17	Barium, total	mg/L	0.0460
UA	G279	C	2009/09/23	Calcium, total	mg/L	90.0
UA	G279	C	2009/11/09	Calcium, total	mg/L	81.0
UA	G279	C	2010/01/27	Calcium, total	mg/L	80.0
UA	G279	C	2010/03/04	Calcium, total	mg/L	85.0
UA	G279	C	2010/07/26	Calcium, total	mg/L	91.0
UA	G279	C	2010/11/16	Calcium, total	mg/L	89.0
UA	G279	C	2011/01/28	Calcium, total	mg/L	100
UA	G279	C	2011/05/04	Calcium, total	mg/L	130
UA	G279	C	2011/07/27	Calcium, total	mg/L	83.0
UA	G279	C	2011/11/14	Calcium, total	mg/L	84.0
UA	G279	C	2012/01/30	Calcium, total	mg/L	120
UA	G279	C	2012/05/22	Calcium, total	mg/L	69.0
UA	G279	C	2012/07/24	Calcium, total	mg/L	98.0
UA	G279	C	2012/11/14	Calcium, total	mg/L	97.0
UA	G279	C	2013/01/31	Calcium, total	mg/L	120
UA	G279	C	2013/05/20	Calcium, total	mg/L	87.0
UA	G279	C	2013/07/22	Calcium, total	mg/L	88.0
UA	G279	C	2013/10/14	Calcium, total	mg/L	97.0
UA	G279	C	2014/02/19	Calcium, total	mg/L	86.0

UA	G279	C	2014/05/13	Calcium, total	mg/L	94.0
UA	G279	C	2014/08/12	Calcium, total	mg/L	97.0
UA	G279	C	2014/10/14	Calcium, total	mg/L	92.0
UA	G279	C	2015/01/21	Calcium, total	mg/L	100
UA	G279	C	2015/04/13	Calcium, total	mg/L	170
UA	G279	C	2015/11/24	Calcium, total	mg/L	140
UA	G279	C	2016/02/16	Calcium, total	mg/L	180
UA	G279	C	2016/05/13	Calcium, total	mg/L	120
UA	G279	C	2016/08/03	Calcium, total	mg/L	210
UA	G279	C	2016/11/22	Calcium, total	mg/L	170
UA	G279	C	2017/02/15	Calcium, total	mg/L	210
UA	G279	C	2017/05/20	Calcium, total	mg/L	150
UA	G279	C	2017/07/18	Calcium, total	mg/L	240
UA	G279	C	2017/11/04	Calcium, total	mg/L	220
UA	G279	C	2018/05/16	Calcium, total	mg/L	180
UA	G279	C	2018/08/10	Calcium, total	mg/L	250
UA	G279	C	2019/01/23	Calcium, total	mg/L	120
UA	G279	C	2019/08/26	Calcium, total	mg/L	120
UA	G279	C	2020/01/23	Calcium, total	mg/L	190
UA	G279	C	2020/08/12	Calcium, total	mg/L	480
UA	G279	C	2020/10/14	Calcium, total	mg/L	490
UA	G279	C	2021/01/21	Calcium, total	mg/L	350
UA	G279	C	2021/01/28	Calcium, total	mg/L	100
UA	G279	C	2021/05/20	Calcium, total	mg/L	120
UA	G279	C	2021/08/18	Calcium, total	mg/L	360
UA	G279	C	2021/10/26	Calcium, total	mg/L	250
UA	G279	C	2022/02/08	Calcium, total	mg/L	190
UA	G279	C	2022/05/10	Calcium, total	mg/L	130
UA	G279	C	2022/08/24	Calcium, total	mg/L	450
UA	G279	C	2022/11/09	Calcium, total	mg/L	460
UA	G279	C	2023/02/16	Calcium, total	mg/L	450
UA	G279	C	2023/06/01	Calcium, total	mg/L	710
UA	G279	C	2023/11/17	Calcium, total	mg/L	530
UA	G279	C	2009/09/23	Chloride, total	mg/L	59.0
UA	G279	C	2009/11/09	Chloride, total	mg/L	50.0
UA	G279	C	2010/01/27	Chloride, total	mg/L	54.0
UA	G279	C	2010/03/04	Chloride, total	mg/L	57.0
UA	G279	C	2010/07/26	Chloride, total	mg/L	64.0
UA	G279	C	2010/11/16	Chloride, total	mg/L	52.0
UA	G279	C	2011/01/28	Chloride, total	mg/L	50.0
UA	G279	C	2011/05/04	Chloride, total	mg/L	49.0
UA	G279	C	2011/07/27	Chloride, total	mg/L	51.0
UA	G279	C	2011/11/14	Chloride, total	mg/L	53.0
UA	G279	C	2012/01/30	Chloride, total	mg/L	51.0
UA	G279	C	2012/05/22	Chloride, total	mg/L	54.0
UA	G279	C	2012/07/24	Chloride, total	mg/L	71.0
UA	G279	C	2012/11/14	Chloride, total	mg/L	62.0
UA	G279	C	2013/01/31	Chloride, total	mg/L	60.0
UA	G279	C	2013/05/20	Chloride, total	mg/L	56.0
UA	G279	C	2013/07/22	Chloride, total	mg/L	55.0
UA	G279	C	2013/10/14	Chloride, total	mg/L	55.0
UA	G279	C	2014/02/19	Chloride, total	mg/L	54.0
UA	G279	C	2014/05/13	Chloride, total	mg/L	50.0
UA	G279	C	2014/08/12	Chloride, total	mg/L	56.0
UA	G279	C	2014/10/14	Chloride, total	mg/L	63.0
UA	G279	C	2015/01/21	Chloride, total	mg/L	74.0
UA	G279	C	2015/04/13	Chloride, total	mg/L	46.0
UA	G279	C	2015/07/23	Chloride, total	mg/L	96.0
UA	G279	C	2015/10/08	Chloride, total	mg/L	120
UA	G279	C	2015/11/24	Chloride, total	mg/L	61.0
UA	G279	C	2016/02/16	Chloride, total	mg/L	130
UA	G279	C	2016/05/13	Chloride, total	mg/L	18.0

UA	G279	C	2016/08/03	Chloride, total	mg/L	110
UA	G279	C	2016/11/22	Chloride, total	mg/L	130
UA	G279	C	2017/02/15	Chloride, total	mg/L	120
UA	G279	C	2017/05/20	Chloride, total	mg/L	57.0
UA	G279	C	2017/07/18	Chloride, total	mg/L	130
UA	G279	C	2017/11/04	Chloride, total	mg/L	170
UA	G279	C	2018/05/16	Chloride, total	mg/L	76.0
UA	G279	C	2018/08/10	Chloride, total	mg/L	160
UA	G279	C	2019/01/23	Chloride, total	mg/L	7.30
UA	G279	C	2019/08/26	Chloride, total	mg/L	4.70
UA	G279	C	2020/01/23	Chloride, total	mg/L	72.0
UA	G279	C	2020/08/12	Chloride, total	mg/L	410
UA	G279	C	2020/10/14	Chloride, total	mg/L	420
UA	G279	C	2021/01/21	Chloride, total	mg/L	260
UA	G279	C	2021/01/28	Chloride, total	mg/L	5.80
UA	G279	C	2021/05/20	Chloride, total	mg/L	3.30
UA	G279	C	2021/08/18	Chloride, total	mg/L	270
UA	G279	C	2021/10/26	Chloride, total	mg/L	190
UA	G279	C	2022/02/08	Chloride, total	mg/L	76.0
UA	G279	C	2022/05/10	Chloride, total	mg/L	6.80
UA	G279	C	2022/08/24	Chloride, total	mg/L	370
UA	G279	C	2022/11/09	Chloride, total	mg/L	480
UA	G279	C	2023/02/16	Chloride, total	mg/L	320
UA	G279	C	2023/06/01	Chloride, total	mg/L	490
UA	G279	C	2023/11/17	Chloride, total	mg/L	485
UA	G279	C	2023/06/01	Ferrous Iron, dissolved	mg/L	<0.02
UA	G279	C	2009/11/09	Iron, dissolved	mg/L	<0.1
UA	G279	C	2010/01/27	Iron, dissolved	mg/L	<0.1
UA	G279	C	2010/03/04	Iron, dissolved	mg/L	<0.2
UA	G279	C	2010/07/26	Iron, dissolved	mg/L	0.0110
UA	G279	C	2010/09/20	Iron, dissolved	mg/L	<0.01
UA	G279	C	2010/11/16	Iron, dissolved	mg/L	<0.01
UA	G279	C	2011/01/28	Iron, dissolved	mg/L	0.0160
UA	G279	C	2011/05/04	Iron, dissolved	mg/L	<0.01
UA	G279	C	2011/07/27	Iron, dissolved	mg/L	<0.01
UA	G279	C	2011/11/14	Iron, dissolved	mg/L	<0.01
UA	G279	C	2012/01/30	Iron, dissolved	mg/L	<0.01
UA	G279	C	2012/05/22	Iron, dissolved	mg/L	<0.01
UA	G279	C	2012/07/24	Iron, dissolved	mg/L	<0.01
UA	G279	C	2012/11/14	Iron, dissolved	mg/L	<0.01
UA	G279	C	2013/01/31	Iron, dissolved	mg/L	<0.01
UA	G279	C	2013/05/20	Iron, dissolved	mg/L	<0.01
UA	G279	C	2013/07/22	Iron, dissolved	mg/L	0.0130
UA	G279	C	2013/10/14	Iron, dissolved	mg/L	0.110
UA	G279	C	2014/02/19	Iron, dissolved	mg/L	<0.01
UA	G279	C	2014/05/13	Iron, dissolved	mg/L	0.0150
UA	G279	C	2014/08/12	Iron, dissolved	mg/L	<0.01
UA	G279	C	2014/10/14	Iron, dissolved	mg/L	<0.01
UA	G279	C	2015/01/21	Iron, dissolved	mg/L	<0.01
UA	G279	C	2015/04/13	Iron, dissolved	mg/L	<0.01
UA	G279	C	2015/07/23	Iron, dissolved	mg/L	<0.01
UA	G279	C	2015/10/08	Iron, dissolved	mg/L	<0.01
UA	G279	C	2016/02/16	Iron, dissolved	mg/L	<0.01
UA	G279	C	2016/05/13	Iron, dissolved	mg/L	<0.01
UA	G279	C	2016/08/03	Iron, dissolved	mg/L	<0.01
UA	G279	C	2016/11/22	Iron, dissolved	mg/L	<0.01
UA	G279	C	2017/02/14	Iron, dissolved	mg/L	<0.01
UA	G279	C	2017/05/19	Iron, dissolved	mg/L	<0.01
UA	G279	C	2017/07/25	Iron, dissolved	mg/L	<0.01
UA	G279	C	2017/11/04	Iron, dissolved	mg/L	0.0930
UA	G279	C	2018/01/30	Iron, dissolved	mg/L	0.0600
UA	G279	C	2018/05/16	Iron, dissolved	mg/L	<0.01

UA	G279	C	2018/08/10	Iron, dissolved	mg/L	0.0160
UA	G279	C	2018/11/06	Iron, dissolved	mg/L	<0.01
UA	G279	C	2019/01/23	Iron, dissolved	mg/L	<0.01
UA	G279	C	2019/05/01	Iron, dissolved	mg/L	<0.01
UA	G279	C	2019/08/26	Iron, dissolved	mg/L	<0.01
UA	G279	C	2019/10/22	Iron, dissolved	mg/L	0.0120
UA	G279	C	2020/01/23	Iron, dissolved	mg/L	<0.01
UA	G279	C	2020/05/06	Iron, dissolved	mg/L	<0.01
UA	G279	C	2020/08/12	Iron, dissolved	mg/L	<0.01
UA	G279	C	2020/10/14	Iron, dissolved	mg/L	<0.01
UA	G279	C	2021/01/21	Iron, dissolved	mg/L	<0.01
UA	G279	C	2021/01/28	Iron, dissolved	mg/L	0.0150
UA	G279	C	2021/05/20	Iron, dissolved	mg/L	<0.01
UA	G279	C	2021/08/18	Iron, dissolved	mg/L	<0.01
UA	G279	C	2021/10/26	Iron, dissolved	mg/L	<0.01
UA	G279	C	2022/02/08	Iron, dissolved	mg/L	<0.01
UA	G279	C	2022/05/10	Iron, dissolved	mg/L	0.000770
UA	G279	C	2022/08/24	Iron, dissolved	mg/L	0.00470
UA	G279	C	2022/11/09	Iron, dissolved	mg/L	0.0200
UA	G279	C	2023/02/16	Iron, dissolved	mg/L	0.00580
UA	G279	C	2023/06/01	Iron, dissolved	mg/L	0.00370
UA	G279	C	2023/11/17	Iron, dissolved	mg/L	<0.0115
UA	G279	C	2009/09/23	Magnesium, total	mg/L	50.0
UA	G279	C	2009/11/09	Magnesium, total	mg/L	47.0
UA	G279	C	2010/01/27	Magnesium, total	mg/L	49.0
UA	G279	C	2010/03/04	Magnesium, total	mg/L	50.0
UA	G279	C	2010/07/26	Magnesium, total	mg/L	48.0
UA	G279	C	2011/01/28	Magnesium, total	mg/L	54.0
UA	G279	C	2012/01/30	Magnesium, total	mg/L	49.0
UA	G279	C	2013/01/31	Magnesium, total	mg/L	65.0
UA	G279	C	2014/02/19	Magnesium, total	mg/L	46.0
UA	G279	C	2015/04/13	Magnesium, total	mg/L	80.0
UA	G279	C	2017/07/18	Magnesium, total	mg/L	120
UA	G279	C	2020/01/23	Magnesium, total	mg/L	88.0
UA	G279	C	2021/01/28	Magnesium, total	mg/L	43.0
UA	G279	C	2022/02/08	Magnesium, total	mg/L	86.0
UA	G279	C	2022/08/24	Magnesium, total	mg/L	290
UA	G279	C	2023/02/16	Magnesium, total	mg/L	280
UA	G279	C	2023/06/01	Magnesium, total	mg/L	450
UA	G279	C	2023/11/17	Magnesium, total	mg/L	484
UA	G279	C	2009/11/09	Manganese, dissolved	mg/L	0.260
UA	G279	C	2010/01/27	Manganese, dissolved	mg/L	0.0940
UA	G279	C	2010/03/04	Manganese, dissolved	mg/L	0.0590
UA	G279	C	2010/07/26	Manganese, dissolved	mg/L	0.0190
UA	G279	C	2010/09/20	Manganese, dissolved	mg/L	0.0140
UA	G279	C	2010/11/16	Manganese, dissolved	mg/L	0.00880
UA	G279	C	2011/01/28	Manganese, dissolved	mg/L	0.0140
UA	G279	C	2011/05/04	Manganese, dissolved	mg/L	0.00330
UA	G279	C	2011/07/27	Manganese, dissolved	mg/L	0.00710
UA	G279	C	2011/11/14	Manganese, dissolved	mg/L	0.00350
UA	G279	C	2012/01/30	Manganese, dissolved	mg/L	0.00490
UA	G279	C	2012/05/22	Manganese, dissolved	mg/L	0.0420
UA	G279	C	2012/07/24	Manganese, dissolved	mg/L	0.00200
UA	G279	C	2012/11/14	Manganese, dissolved	mg/L	0.0190
UA	G279	C	2013/01/31	Manganese, dissolved	mg/L	0.00190
UA	G279	C	2013/05/20	Manganese, dissolved	mg/L	0.00110
UA	G279	C	2013/07/22	Manganese, dissolved	mg/L	0.00780
UA	G279	C	2013/10/14	Manganese, dissolved	mg/L	0.0780
UA	G279	C	2014/02/19	Manganese, dissolved	mg/L	0.0290
UA	G279	C	2014/05/13	Manganese, dissolved	mg/L	0.0340
UA	G279	C	2014/08/12	Manganese, dissolved	mg/L	0.0240
UA	G279	C	2014/10/14	Manganese, dissolved	mg/L	0.0260

UA	G279	C	2015/01/21	Manganese, dissolved	mg/L	0.0170
UA	G279	C	2015/04/13	Manganese, dissolved	mg/L	0.00330
UA	G279	C	2015/07/23	Manganese, dissolved	mg/L	0.0130
UA	G279	C	2015/10/08	Manganese, dissolved	mg/L	0.0320
UA	G279	C	2016/02/16	Manganese, dissolved	mg/L	0.0110
UA	G279	C	2016/05/13	Manganese, dissolved	mg/L	0.00610
UA	G279	C	2016/08/03	Manganese, dissolved	mg/L	0.00330
UA	G279	C	2016/11/22	Manganese, dissolved	mg/L	0.00450
UA	G279	C	2017/02/14	Manganese, dissolved	mg/L	<0.001
UA	G279	C	2017/05/19	Manganese, dissolved	mg/L	0.00500
UA	G279	C	2017/07/25	Manganese, dissolved	mg/L	0.00860
UA	G279	C	2017/11/04	Manganese, dissolved	mg/L	0.0240
UA	G279	C	2018/01/30	Manganese, dissolved	mg/L	0.0210
UA	G279	C	2018/03/05	Manganese, dissolved	mg/L	0.00660
UA	G279	C	2018/11/06	Manganese, dissolved	mg/L	0.00400
UA	G279	C	2019/05/01	Manganese, dissolved	mg/L	<0.001
UA	G279	C	2019/08/26	Manganese, dissolved	mg/L	<0.001
UA	G279	C	2020/01/23	Manganese, dissolved	mg/L	<0.001
UA	G279	C	2020/10/14	Manganese, dissolved	mg/L	0.0450
UA	G279	C	2021/01/21	Manganese, dissolved	mg/L	0.0290
UA	G279	C	2021/01/28	Manganese, dissolved	mg/L	<0.001
UA	G279	C	2021/05/20	Manganese, dissolved	mg/L	<0.001
UA	G279	C	2021/08/18	Manganese, dissolved	mg/L	0.0290
UA	G279	C	2021/10/26	Manganese, dissolved	mg/L	0.0120
UA	G279	C	2022/02/08	Manganese, dissolved	mg/L	0.00900
UA	G279	C	2022/05/10	Manganese, dissolved	mg/L	<0.00023
UA	G279	C	2022/08/24	Manganese, dissolved	mg/L	0.0550
UA	G279	C	2022/11/09	Manganese, dissolved	mg/L	0.0990
UA	G279	C	2023/02/16	Manganese, dissolved	mg/L	0.0460
UA	G279	C	2023/06/01	Manganese, dissolved	mg/L	0.160
UA	G279	C	2023/11/17	Manganese, dissolved	mg/L	0.623
UA	G279	C	2009/09/23	Potassium, total	mg/L	2.30
UA	G279	C	2009/11/09	Potassium, total	mg/L	1.00
UA	G279	C	2010/01/27	Potassium, total	mg/L	0.780
UA	G279	C	2010/03/04	Potassium, total	mg/L	0.590
UA	G279	C	2010/07/26	Potassium, total	mg/L	0.570
UA	G279	C	2011/01/28	Potassium, total	mg/L	1.40
UA	G279	C	2012/01/30	Potassium, total	mg/L	0.600
UA	G279	C	2013/01/31	Potassium, total	mg/L	0.680
UA	G279	C	2014/02/19	Potassium, total	mg/L	0.290
UA	G279	C	2015/04/13	Potassium, total	mg/L	0.650
UA	G279	C	2017/07/18	Potassium, total	mg/L	0.360
UA	G279	C	2020/01/23	Potassium, total	mg/L	0.330
UA	G279	C	2021/01/28	Potassium, total	mg/L	0.380
UA	G279	C	2022/02/08	Potassium, total	mg/L	0.320
UA	G279	C	2022/08/24	Potassium, total	mg/L	0.950
UA	G279	C	2023/02/16	Potassium, total	mg/L	0.520
UA	G279	C	2023/06/01	Potassium, total	mg/L	2.50
UA	G279	C	2023/11/17	Potassium, total	mg/L	4.73
UA	G279	C	2023/06/01	Silicon, dissolved	mg/L	9.90
UA	G279	C	2009/09/23	Sodium, total	mg/L	80.0
UA	G279	C	2009/11/09	Sodium, total	mg/L	84.0
UA	G279	C	2010/01/27	Sodium, total	mg/L	84.0
UA	G279	C	2010/03/04	Sodium, total	mg/L	83.0
UA	G279	C	2010/07/26	Sodium, total	mg/L	81.0
UA	G279	C	2011/01/28	Sodium, total	mg/L	75.0
UA	G279	C	2012/01/30	Sodium, total	mg/L	140
UA	G279	C	2013/01/31	Sodium, total	mg/L	110
UA	G279	C	2014/02/19	Sodium, total	mg/L	72.0
UA	G279	C	2015/04/13	Sodium, total	mg/L	110
UA	G279	C	2017/07/18	Sodium, total	mg/L	120
UA	G279	C	2020/01/23	Sodium, total	mg/L	78.0

UA	G279	C	2021/01/28	Sodium, total	mg/L	50.0
UA	G279	C	2022/02/08	Sodium, total	mg/L	81.0
UA	G279	C	2022/08/24	Sodium, total	mg/L	190
UA	G279	C	2023/02/16	Sodium, total	mg/L	170
UA	G279	C	2023/06/01	Sodium, total	mg/L	250
UA	G279	C	2023/11/17	Sodium, total	mg/L	272
UA	G279	C	2009/09/23	Sulfate, total	mg/L	99.0
UA	G279	C	2009/11/09	Sulfate, total	mg/L	92.0
UA	G279	C	2010/01/27	Sulfate, total	mg/L	88.0
UA	G279	C	2010/03/04	Sulfate, total	mg/L	83.0
UA	G279	C	2010/07/26	Sulfate, total	mg/L	88.0
UA	G279	C	2010/11/16	Sulfate, total	mg/L	96.0
UA	G279	C	2011/01/28	Sulfate, total	mg/L	93.0
UA	G279	C	2011/05/04	Sulfate, total	mg/L	100
UA	G279	C	2011/07/27	Sulfate, total	mg/L	95.0
UA	G279	C	2011/11/14	Sulfate, total	mg/L	95.0
UA	G279	C	2012/01/30	Sulfate, total	mg/L	160
UA	G279	C	2012/05/22	Sulfate, total	mg/L	96.0
UA	G279	C	2012/07/24	Sulfate, total	mg/L	130
UA	G279	C	2012/11/14	Sulfate, total	mg/L	140
UA	G279	C	2013/01/31	Sulfate, total	mg/L	390
UA	G279	C	2013/05/20	Sulfate, total	mg/L	180
UA	G279	C	2013/07/22	Sulfate, total	mg/L	140
UA	G279	C	2013/10/14	Sulfate, total	mg/L	120
UA	G279	C	2014/02/19	Sulfate, total	mg/L	110
UA	G279	C	2014/05/13	Sulfate, total	mg/L	110
UA	G279	C	2014/08/12	Sulfate, total	mg/L	120
UA	G279	C	2014/10/14	Sulfate, total	mg/L	140
UA	G279	C	2015/01/21	Sulfate, total	mg/L	230
UA	G279	C	2015/04/13	Sulfate, total	mg/L	470
UA	G279	C	2015/07/23	Sulfate, total	mg/L	470
UA	G279	C	2015/10/08	Sulfate, total	mg/L	810
UA	G279	C	2015/11/24	Sulfate, total	mg/L	520
UA	G279	C	2016/02/16	Sulfate, total	mg/L	610
UA	G279	C	2016/05/13	Sulfate, total	mg/L	230
UA	G279	C	2016/08/03	Sulfate, total	mg/L	570
UA	G279	C	2016/11/22	Sulfate, total	mg/L	720
UA	G279	C	2017/02/15	Sulfate, total	mg/L	700
UA	G279	C	2017/05/20	Sulfate, total	mg/L	370
UA	G279	C	2017/07/18	Sulfate, total	mg/L	730
UA	G279	C	2017/11/04	Sulfate, total	mg/L	870
UA	G279	C	2018/05/16	Sulfate, total	mg/L	540
UA	G279	C	2018/08/10	Sulfate, total	mg/L	940
UA	G279	C	2019/01/23	Sulfate, total	mg/L	240
UA	G279	C	2019/08/26	Sulfate, total	mg/L	170
UA	G279	C	2020/01/23	Sulfate, total	mg/L	400
UA	G279	C	2020/08/12	Sulfate, total	mg/L	1,600
UA	G279	C	2020/10/14	Sulfate, total	mg/L	1,800
UA	G279	C	2021/01/21	Sulfate, total	mg/L	1,100
UA	G279	C	2021/01/28	Sulfate, total	mg/L	190
UA	G279	C	2021/05/20	Sulfate, total	mg/L	140
UA	G279	C	2021/08/18	Sulfate, total	mg/L	110
UA	G279	C	2021/10/26	Sulfate, total	mg/L	740
UA	G279	C	2022/02/08	Sulfate, total	mg/L	370
UA	G279	C	2022/05/10	Sulfate, total	mg/L	140
UA	G279	C	2022/08/24	Sulfate, total	mg/L	1,600
UA	G279	C	2022/11/09	Sulfate, total	mg/L	1,900
UA	G279	C	2023/02/16	Sulfate, total	mg/L	1,800
UA	G279	C	2023/06/01	Sulfate, total	mg/L	2,900
UA	G279	C	2023/11/17	Sulfate, total	mg/L	3,390
UA	G279	C	2015/11/24	Temperature (Celsius)	degrees C	16.4
UA	G279	C	2016/02/16	Temperature (Celsius)	degrees C	10.7

UA	G279	C	2016/05/13	Temperature (Celsius)	degrees C	16.8
UA	G279	C	2016/08/03	Temperature (Celsius)	degrees C	19.6
UA	G279	C	2016/11/22	Temperature (Celsius)	degrees C	13.2
UA	G279	C	2017/02/15	Temperature (Celsius)	degrees C	14.3
UA	G279	C	2017/05/20	Temperature (Celsius)	degrees C	15.3
UA	G279	C	2017/07/18	Temperature (Celsius)	degrees C	18.7
UA	G279	C	2017/11/04	Temperature (Celsius)	degrees C	13.2
UA	G279	C	2018/05/16	Temperature (Celsius)	degrees C	14.4
UA	G279	C	2018/08/10	Temperature (Celsius)	degrees C	15.8
UA	G279	C	2019/01/23	Temperature (Celsius)	degrees C	11.8
UA	G279	C	2019/08/26	Temperature (Celsius)	degrees C	17.5
UA	G279	C	2020/01/23	Temperature (Celsius)	degrees C	12.4
UA	G279	C	2020/08/12	Temperature (Celsius)	degrees C	19.6
UA	G279	C	2020/10/14	Temperature (Celsius)	degrees C	17.2
UA	G279	C	2021/01/21	Temperature (Celsius)	degrees C	13.4
UA	G279	C	2021/01/28	Temperature (Celsius)	degrees C	13.4
UA	G279	C	2021/05/20	Temperature (Celsius)	degrees C	18.1
UA	G279	C	2021/08/18	Temperature (Celsius)	degrees C	19.8
UA	G279	C	2022/02/08	Temperature (Celsius)	degrees C	13.8
UA	G279	C	2022/05/10	Temperature (Celsius)	degrees C	19.8
UA	G279	C	2022/08/24	Temperature (Celsius)	degrees C	18.5
UA	G279	C	2022/11/09	Temperature (Celsius)	degrees C	19.6
UA	G279	C	2023/02/16	Temperature (Celsius)	degrees C	11.1
UA	G279	C	2023/06/01	Temperature (Celsius)	degrees C	18.3
UA	G279	C	2023/11/17	Temperature (Celsius)	degrees C	16.8
UA	G279	C	2009/09/23	Total Dissolved Solids	mg/L	620
UA	G279	C	2009/11/09	Total Dissolved Solids	mg/L	620
UA	G279	C	2010/01/27	Total Dissolved Solids	mg/L	630
UA	G279	C	2010/03/04	Total Dissolved Solids	mg/L	610
UA	G279	C	2010/07/26	Total Dissolved Solids	mg/L	670
UA	G279	C	2010/11/16	Total Dissolved Solids	mg/L	600
UA	G279	C	2011/01/28	Total Dissolved Solids	mg/L	600
UA	G279	C	2011/05/04	Total Dissolved Solids	mg/L	630
UA	G279	C	2011/07/27	Total Dissolved Solids	mg/L	600
UA	G279	C	2011/11/14	Total Dissolved Solids	mg/L	580
UA	G279	C	2012/01/30	Total Dissolved Solids	mg/L	630
UA	G279	C	2012/05/22	Total Dissolved Solids	mg/L	590
UA	G279	C	2012/07/24	Total Dissolved Solids	mg/L	660
UA	G279	C	2012/11/14	Total Dissolved Solids	mg/L	750
UA	G279	C	2013/01/31	Total Dissolved Solids	mg/L	1,200
UA	G279	C	2013/05/20	Total Dissolved Solids	mg/L	600
UA	G279	C	2013/07/22	Total Dissolved Solids	mg/L	560
UA	G279	C	2013/10/14	Total Dissolved Solids	mg/L	640
UA	G279	C	2014/02/19	Total Dissolved Solids	mg/L	600
UA	G279	C	2014/05/13	Total Dissolved Solids	mg/L	1,200
UA	G279	C	2014/08/12	Total Dissolved Solids	mg/L	600
UA	G279	C	2014/10/14	Total Dissolved Solids	mg/L	650
UA	G279	C	2015/01/21	Total Dissolved Solids	mg/L	810
UA	G279	C	2015/04/13	Total Dissolved Solids	mg/L	800
UA	G279	C	2015/07/23	Total Dissolved Solids	mg/L	1,200
UA	G279	C	2015/10/08	Total Dissolved Solids	mg/L	1,700
UA	G279	C	2015/11/24	Total Dissolved Solids	mg/L	1,100
UA	G279	C	2016/02/16	Total Dissolved Solids	mg/L	1,400
UA	G279	C	2016/05/13	Total Dissolved Solids	mg/L	600
UA	G279	C	2016/08/03	Total Dissolved Solids	mg/L	1,300
UA	G279	C	2016/11/22	Total Dissolved Solids	mg/L	1,300
UA	G279	C	2017/02/15	Total Dissolved Solids	mg/L	1,500
UA	G279	C	2017/05/20	Total Dissolved Solids	mg/L	940
UA	G279	C	2017/07/18	Total Dissolved Solids	mg/L	1,600
UA	G279	C	2017/11/04	Total Dissolved Solids	mg/L	1,600
UA	G279	C	2018/05/16	Total Dissolved Solids	mg/L	1,200
UA	G279	C	2018/08/10	Total Dissolved Solids	mg/L	1,800

UA	G279	C	2019/01/23	Total Dissolved Solids	mg/L	740
UA	G279	C	2019/08/26	Total Dissolved Solids	mg/L	560
UA	G279	C	2020/01/23	Total Dissolved Solids	mg/L	830
UA	G279	C	2020/08/12	Total Dissolved Solids	mg/L	3,000
UA	G279	C	2020/10/14	Total Dissolved Solids	mg/L	3,400
UA	G279	C	2021/01/21	Total Dissolved Solids	mg/L	2,400
UA	G279	C	2021/01/28	Total Dissolved Solids	mg/L	650
UA	G279	C	2021/05/20	Total Dissolved Solids	mg/L	560
UA	G279	C	2021/08/18	Total Dissolved Solids	mg/L	2,800
UA	G279	C	2021/10/26	Total Dissolved Solids	mg/L	1,900
UA	G279	C	2022/02/08	Total Dissolved Solids	mg/L	1,100
UA	G279	C	2022/05/10	Total Dissolved Solids	mg/L	710
UA	G279	C	2022/08/24	Total Dissolved Solids	mg/L	3,300
UA	G279	C	2022/11/09	Total Dissolved Solids	mg/L	3,900
UA	G279	C	2023/02/16	Total Dissolved Solids	mg/L	5,200
UA	G279	C	2023/06/01	Total Dissolved Solids	mg/L	6,000
UA	G279	C	2023/11/17	Total Dissolved Solids	mg/L	6,260
UA	G284	C	2021/03/30	pH (field)	SU	7.2
UA	G284	C	2021/04/21	pH (field)	SU	7.2
UA	G284	C	2021/05/06	pH (field)	SU	7.1
UA	G284	C	2021/05/18	pH (field)	SU	6.9
UA	G284	C	2021/06/14	pH (field)	SU	7.3
UA	G284	C	2021/06/28	pH (field)	SU	7.3
UA	G284	C	2021/07/13	pH (field)	SU	7.2
UA	G284	C	2021/07/27	pH (field)	SU	7.1
UA	G284	C	2023/06/08	pH (field)	SU	7.2
UA	G284	C	2023/08/15	pH (field)	SU	7.2
UA	G284	C	2021/03/30	Oxidation Reduction Potential	mV	223
UA	G284	C	2021/04/21	Oxidation Reduction Potential	mV	37.4
UA	G284	C	2021/05/06	Oxidation Reduction Potential	mV	31.9
UA	G284	C	2021/05/18	Oxidation Reduction Potential	mV	44.9
UA	G284	C	2021/06/14	Oxidation Reduction Potential	mV	140
UA	G284	C	2021/06/28	Oxidation Reduction Potential	mV	18.8
UA	G284	C	2021/07/13	Oxidation Reduction Potential	mV	189
UA	G284	C	2021/07/27	Oxidation Reduction Potential	mV	158
UA	G284	C	2023/06/08	Oxidation Reduction Potential	mV	112
UA	G284	C	2023/08/15	Oxidation Reduction Potential	mV	126
UA	G284	C	2021/03/30	Eh	V	0.42
UA	G284	C	2021/04/21	Eh	V	0.24
UA	G284	C	2021/05/06	Eh	V	0.23
UA	G284	C	2021/05/18	Eh	V	0.24
UA	G284	C	2021/06/14	Eh	V	0.33
UA	G284	C	2021/06/28	Eh	V	0.21
UA	G284	C	2021/07/13	Eh	V	0.38
UA	G284	C	2021/07/27	Eh	V	0.35
UA	G284	C	2023/06/08	Eh	V	0.31
UA	G284	C	2023/08/15	Eh	V	0.32
UA	G284	C	2021/03/30	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G284	C	2021/04/21	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G284	C	2021/05/06	Alkalinity, bicarbonate	mg/L CaCO3	160
UA	G284	C	2021/05/18	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G284	C	2021/06/14	Alkalinity, bicarbonate	mg/L CaCO3	320
UA	G284	C	2021/06/28	Alkalinity, bicarbonate	mg/L CaCO3	310
UA	G284	C	2021/07/13	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G284	C	2021/07/27	Alkalinity, bicarbonate	mg/L CaCO3	310
UA	G284	C	2023/06/08	Alkalinity, bicarbonate	mg/L CaCO3	340
UA	G284	C	2023/08/15	Alkalinity, bicarbonate	mg/L CaCO3	322
UA	G284	C	2021/03/30	Arsenic, total	mg/L	<0.00022
UA	G284	C	2021/04/21	Arsenic, total	mg/L	<0.00022
UA	G284	C	2021/05/06	Arsenic, total	mg/L	<0.00022
UA	G284	C	2021/05/18	Arsenic, total	mg/L	<0.00022
UA	G284	C	2021/06/14	Arsenic, total	mg/L	<0.00022

UA	G284	C	2021/06/28	Arsenic, total	mg/L	<0.0002
UA	G284	C	2021/07/13	Arsenic, total	mg/L	<0.00022
UA	G284	C	2021/07/27	Arsenic, total	mg/L	<0.00022
UA	G284	C	2023/06/08	Arsenic, total	mg/L	0.00100
UA	G284	C	2023/08/15	Arsenic, total	mg/L	<0.0004
UA	G284	C	2021/03/30	Barium, total	mg/L	0.0600
UA	G284	C	2021/04/21	Barium, total	mg/L	0.0670
UA	G284	C	2021/05/06	Barium, total	mg/L	0.0640
UA	G284	C	2021/05/18	Barium, total	mg/L	0.0640
UA	G284	C	2021/06/14	Barium, total	mg/L	0.0680
UA	G284	C	2021/06/28	Barium, total	mg/L	0.0630
UA	G284	C	2021/07/13	Barium, total	mg/L	0.0650
UA	G284	C	2021/07/27	Barium, total	mg/L	0.0650
UA	G284	C	2023/06/08	Barium, total	mg/L	0.0690
UA	G284	C	2023/08/15	Barium, total	mg/L	0.0875
UA	G284	C	2021/03/30	Calcium, total	mg/L	70.0
UA	G284	C	2021/04/21	Calcium, total	mg/L	75.0
UA	G284	C	2021/05/06	Calcium, total	mg/L	76.0
UA	G284	C	2021/05/18	Calcium, total	mg/L	76.0
UA	G284	C	2021/06/14	Calcium, total	mg/L	78.0
UA	G284	C	2021/06/28	Calcium, total	mg/L	69.0
UA	G284	C	2021/07/13	Calcium, total	mg/L	68.0
UA	G284	C	2021/07/27	Calcium, total	mg/L	74.0
UA	G284	C	2023/06/08	Calcium, total	mg/L	73.0
UA	G284	C	2023/08/15	Calcium, total	mg/L	72.5
UA	G284	C	2021/03/30	Chloride, total	mg/L	41.0
UA	G284	C	2021/04/21	Chloride, total	mg/L	45.0
UA	G284	C	2021/05/06	Chloride, total	mg/L	38.0
UA	G284	C	2021/05/18	Chloride, total	mg/L	42.0
UA	G284	C	2021/06/14	Chloride, total	mg/L	40.0
UA	G284	C	2021/06/28	Chloride, total	mg/L	64.0
UA	G284	C	2021/07/13	Chloride, total	mg/L	48.0
UA	G284	C	2021/07/27	Chloride, total	mg/L	44.0
UA	G284	C	2023/06/08	Chloride, total	mg/L	42.0
UA	G284	C	2023/08/15	Chloride, total	mg/L	32.0
UA	G284	C	2023/06/08	Ferrous Iron, dissolved	mg/L	0.0580
UA	G284	C	2023/06/08	Iron, dissolved	mg/L	0.0290
UA	G284	C	2023/08/15	Iron, dissolved	mg/L	<0.0115
UA	G284	C	2021/03/30	Magnesium, total	mg/L	39.0
UA	G284	C	2021/04/21	Magnesium, total	mg/L	41.0
UA	G284	C	2021/05/06	Magnesium, total	mg/L	40.0
UA	G284	C	2021/05/18	Magnesium, total	mg/L	38.0
UA	G284	C	2021/06/14	Magnesium, total	mg/L	40.0
UA	G284	C	2021/06/28	Magnesium, total	mg/L	38.0
UA	G284	C	2021/07/13	Magnesium, total	mg/L	37.0
UA	G284	C	2021/07/27	Magnesium, total	mg/L	41.0
UA	G284	C	2023/06/08	Magnesium, total	mg/L	38.0
UA	G284	C	2023/08/15	Magnesium, total	mg/L	34.6
UA	G284	C	2023/06/08	Manganese, dissolved	mg/L	0.00220
UA	G284	C	2023/08/15	Manganese, dissolved	mg/L	<0.0008
UA	G284	C	2023/08/15	Phosphate, dissolved	mg/L	0.0210
UA	G284	C	2021/03/30	Potassium, total	mg/L	0.360
UA	G284	C	2021/04/21	Potassium, total	mg/L	0.300
UA	G284	C	2021/05/06	Potassium, total	mg/L	0.280
UA	G284	C	2021/05/18	Potassium, total	mg/L	0.360
UA	G284	C	2021/06/14	Potassium, total	mg/L	0.300
UA	G284	C	2021/06/28	Potassium, total	mg/L	0.270
UA	G284	C	2021/07/13	Potassium, total	mg/L	0.270
UA	G284	C	2021/07/27	Potassium, total	mg/L	0.320
UA	G284	C	2023/06/08	Potassium, total	mg/L	0.340
UA	G284	C	2023/08/15	Potassium, total	mg/L	0.572
UA	G284	C	2023/06/08	Silicon, dissolved	mg/L	9.90

UA	G284	C	2023/08/15	Silicon, dissolved	mg/L	8.83
UA	G284	C	2021/03/30	Sodium, total	mg/L	52.0
UA	G284	C	2021/04/21	Sodium, total	mg/L	55.0
UA	G284	C	2021/05/06	Sodium, total	mg/L	51.0
UA	G284	C	2021/05/18	Sodium, total	mg/L	57.0
UA	G284	C	2021/06/14	Sodium, total	mg/L	53.0
UA	G284	C	2021/06/28	Sodium, total	mg/L	50.0
UA	G284	C	2021/07/13	Sodium, total	mg/L	53.0
UA	G284	C	2021/07/27	Sodium, total	mg/L	56.0
UA	G284	C	2023/06/08	Sodium, total	mg/L	56.0
UA	G284	C	2023/08/15	Sodium, total	mg/L	115
UA	G284	C	2021/03/30	Sulfate, total	mg/L	60.0
UA	G284	C	2021/04/21	Sulfate, total	mg/L	71.0
UA	G284	C	2021/05/06	Sulfate, total	mg/L	65.0
UA	G284	C	2021/05/18	Sulfate, total	mg/L	68.0
UA	G284	C	2021/06/14	Sulfate, total	mg/L	66.0
UA	G284	C	2021/06/28	Sulfate, total	mg/L	95.0
UA	G284	C	2021/07/13	Sulfate, total	mg/L	63.0
UA	G284	C	2021/07/27	Sulfate, total	mg/L	68.0
UA	G284	C	2023/06/08	Sulfate, total	mg/L	71.0
UA	G284	C	2023/08/15	Sulfate, total	mg/L	174
UA	G284	C	2021/03/30	Temperature (Celsius)	degrees C	12.2
UA	G284	C	2021/04/21	Temperature (Celsius)	degrees C	11.4
UA	G284	C	2021/05/06	Temperature (Celsius)	degrees C	11.8
UA	G284	C	2021/05/18	Temperature (Celsius)	degrees C	13.3
UA	G284	C	2021/06/14	Temperature (Celsius)	degrees C	17.0
UA	G284	C	2021/06/28	Temperature (Celsius)	degrees C	17.4
UA	G284	C	2021/07/13	Temperature (Celsius)	degrees C	16.5
UA	G284	C	2021/07/27	Temperature (Celsius)	degrees C	18.8
UA	G284	C	2023/06/08	Temperature (Celsius)	degrees C	16.7
UA	G284	C	2023/08/15	Temperature (Celsius)	degrees C	17.0
UA	G284	C	2021/03/30	Total Dissolved Solids	mg/L	460
UA	G284	C	2021/04/21	Total Dissolved Solids	mg/L	550
UA	G284	C	2021/05/06	Total Dissolved Solids	mg/L	440
UA	G284	C	2021/05/18	Total Dissolved Solids	mg/L	490
UA	G284	C	2021/06/14	Total Dissolved Solids	mg/L	410
UA	G284	C	2021/06/28	Total Dissolved Solids	mg/L	490
UA	G284	C	2021/07/13	Total Dissolved Solids	mg/L	520
UA	G284	C	2021/07/27	Total Dissolved Solids	mg/L	460
UA	G284	C	2023/06/08	Total Dissolved Solids	mg/L	520
UA	G284	C	2023/08/15	Total Dissolved Solids	mg/L	656
UA	G272	WLOA	2010/07/27	pH (field)	SU	7.2
UA	G272	WLOA	2010/07/28	pH (field)	SU	7.2
UA	G272	WLOA	2010/09/20	pH (field)	SU	7.8
UA	G272	WLOA	2010/11/16	pH (field)	SU	7.8
UA	G272	WLOA	2011/01/31	pH (field)	SU	7.5
UA	G272	WLOA	2011/05/04	pH (field)	SU	7.3
UA	G272	WLOA	2011/07/27	pH (field)	SU	7.5
UA	G272	WLOA	2011/11/14	pH (field)	SU	7.5
UA	G272	WLOA	2012/01/26	pH (field)	SU	7.7
UA	G272	WLOA	2012/05/22	pH (field)	SU	7.4
UA	G272	WLOA	2012/07/24	pH (field)	SU	7.2
UA	G272	WLOA	2012/11/14	pH (field)	SU	7.5
UA	G272	WLOA	2013/01/31	pH (field)	SU	7.3
UA	G272	WLOA	2013/05/20	pH (field)	SU	7.4
UA	G272	WLOA	2013/07/22	pH (field)	SU	7.3
UA	G272	WLOA	2013/10/14	pH (field)	SU	7.4
UA	G272	WLOA	2014/02/19	pH (field)	SU	7.8
UA	G272	WLOA	2014/05/13	pH (field)	SU	7.8
UA	G272	WLOA	2014/08/11	pH (field)	SU	7.6
UA	G272	WLOA	2014/10/14	pH (field)	SU	7.4
UA	G272	WLOA	2015/01/21	pH (field)	SU	7.6

UA	G272	WLOA	2015/04/10	pH (field)	SU	7.2
UA	G272	WLOA	2015/07/23	pH (field)	SU	7.2
UA	G272	WLOA	2015/10/08	pH (field)	SU	7.2
UA	G272	WLOA	2020/10/14	pH (field)	SU	7.4
UA	G272	WLOA	2021/02/01	pH (field)	SU	7.5
UA	G272	WLOA	2021/05/20	pH (field)	SU	7.4
UA	G272	WLOA	2021/08/18	pH (field)	SU	7.3
UA	G272	WLOA	2021/10/27	pH (field)	SU	7.3
UA	G272	WLOA	2022/02/10	pH (field)	SU	7.6
UA	G272	WLOA	2022/05/11	pH (field)	SU	7.1
UA	G272	WLOA	2022/08/24	pH (field)	SU	7.3
UA	G272	WLOA	2022/11/09	pH (field)	SU	7.4
UA	G272	WLOA	2023/02/16	pH (field)	SU	7.8
UA	G272	WLOA	2023/06/08	pH (field)	SU	7.1
UA	G272	WLOA	2023/08/14	pH (field)	SU	6.9
UA	G272	WLOA	2023/11/17	pH (field)	SU	7.2
UA	G272	WLOA	2022/02/10	Oxidation Reduction Potential	mV	88.0
UA	G272	WLOA	2022/05/11	Oxidation Reduction Potential	mV	96.1
UA	G272	WLOA	2022/08/24	Oxidation Reduction Potential	mV	115
UA	G272	WLOA	2022/11/09	Oxidation Reduction Potential	mV	171
UA	G272	WLOA	2023/02/16	Oxidation Reduction Potential	mV	147
UA	G272	WLOA	2023/06/08	Oxidation Reduction Potential	mV	100
UA	G272	WLOA	2023/08/14	Oxidation Reduction Potential	mV	90.0
UA	G272	WLOA	2023/11/17	Oxidation Reduction Potential	mV	120
UA	G272	WLOA	2022/02/10	Eh	V	0.29
UA	G272	WLOA	2022/05/11	Eh	V	0.29
UA	G272	WLOA	2022/08/24	Eh	V	0.31
UA	G272	WLOA	2022/11/09	Eh	V	0.36
UA	G272	WLOA	2023/02/16	Eh	V	0.35
UA	G272	WLOA	2023/06/08	Eh	V	0.29
UA	G272	WLOA	2023/08/14	Eh	V	0.28
UA	G272	WLOA	2023/11/17	Eh	V	0.32
UA	G272	WLOA	2009/09/22	Alkalinity, bicarbonate	mg/L CaCO3	270
UA	G272	WLOA	2009/11/10	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G272	WLOA	2010/01/19	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G272	WLOA	2010/03/04	Alkalinity, bicarbonate	mg/L CaCO3	270
UA	G272	WLOA	2010/07/27	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G272	WLOA	2011/01/31	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G272	WLOA	2012/01/26	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G272	WLOA	2013/01/31	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G272	WLOA	2014/02/19	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G272	WLOA	2014/08/11	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G272	WLOA	2014/10/14	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G272	WLOA	2015/01/21	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G272	WLOA	2015/04/10	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G272	WLOA	2009/09/22	Arsenic, total	mg/L	0.00120
UA	G272	WLOA	2009/11/10	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2010/01/19	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2010/03/04	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2010/07/27	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2010/11/16	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2011/01/31	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2011/05/04	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2011/07/27	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2011/11/14	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2012/01/26	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2012/05/22	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2012/07/24	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2012/11/14	Arsenic, total	mg/L	0.00110
UA	G272	WLOA	2013/01/31	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2013/05/20	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2013/07/22	Arsenic, total	mg/L	<0.001

UA	G272	WLOA	2013/10/14	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2014/02/19	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2014/05/13	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2014/08/11	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2014/10/14	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2015/01/21	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2015/04/10	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2015/07/23	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2015/10/08	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2020/10/14	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2021/02/01	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2021/05/20	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2021/08/18	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2021/10/27	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2022/02/10	Arsenic, total	mg/L	<0.001
UA	G272	WLOA	2022/05/11	Arsenic, total	mg/L	<0.00069
UA	G272	WLOA	2022/08/24	Arsenic, total	mg/L	<0.00069
UA	G272	WLOA	2022/11/09	Arsenic, total	mg/L	<0.00069
UA	G272	WLOA	2023/02/16	Arsenic, total	mg/L	<0.00069
UA	G272	WLOA	2023/06/08	Arsenic, total	mg/L	<0.00069
UA	G272	WLOA	2023/08/14	Arsenic, total	mg/L	<0.0004
UA	G272	WLOA	2023/11/17	Arsenic, total	mg/L	<0.0004
UA	G272	WLOA	2009/09/22	Barium, total	mg/L	0.0790
UA	G272	WLOA	2009/11/10	Barium, total	mg/L	0.0730
UA	G272	WLOA	2010/01/19	Barium, total	mg/L	0.0680
UA	G272	WLOA	2010/03/04	Barium, total	mg/L	0.0610
UA	G272	WLOA	2010/07/27	Barium, total	mg/L	0.0620
UA	G272	WLOA	2011/01/31	Barium, total	mg/L	0.0700
UA	G272	WLOA	2012/01/26	Barium, total	mg/L	0.0680
UA	G272	WLOA	2013/01/31	Barium, total	mg/L	0.0720
UA	G272	WLOA	2014/02/19	Barium, total	mg/L	0.0600
UA	G272	WLOA	2015/04/10	Barium, total	mg/L	0.0590
UA	G272	WLOA	2015/07/23	Barium, total	mg/L	0.0600
UA	G272	WLOA	2015/10/08	Barium, total	mg/L	0.0580
UA	G272	WLOA	2020/10/14	Barium, total	mg/L	0.0550
UA	G272	WLOA	2021/02/01	Barium, total	mg/L	0.0490
UA	G272	WLOA	2021/05/20	Barium, total	mg/L	0.0540
UA	G272	WLOA	2021/08/18	Barium, total	mg/L	0.0480
UA	G272	WLOA	2021/10/27	Barium, total	mg/L	0.0450
UA	G272	WLOA	2022/02/10	Barium, total	mg/L	0.0330
UA	G272	WLOA	2022/05/11	Barium, total	mg/L	0.0510
UA	G272	WLOA	2022/08/24	Barium, total	mg/L	0.0460
UA	G272	WLOA	2022/11/09	Barium, total	mg/L	0.0420
UA	G272	WLOA	2023/02/16	Barium, total	mg/L	0.0540
UA	G272	WLOA	2023/06/08	Barium, total	mg/L	0.0500
UA	G272	WLOA	2023/08/14	Barium, total	mg/L	0.0569
UA	G272	WLOA	2023/11/17	Barium, total	mg/L	0.0619
UA	G272	WLOA	2009/09/22	Calcium, total	mg/L	84.0
UA	G272	WLOA	2009/11/10	Calcium, total	mg/L	88.0
UA	G272	WLOA	2010/01/19	Calcium, total	mg/L	85.0
UA	G272	WLOA	2010/03/04	Calcium, total	mg/L	93.0
UA	G272	WLOA	2010/07/27	Calcium, total	mg/L	92.0
UA	G272	WLOA	2010/11/16	Calcium, total	mg/L	84.0
UA	G272	WLOA	2011/01/31	Calcium, total	mg/L	98.0
UA	G272	WLOA	2011/05/04	Calcium, total	mg/L	<100
UA	G272	WLOA	2011/07/27	Calcium, total	mg/L	99.0
UA	G272	WLOA	2011/11/14	Calcium, total	mg/L	98.0
UA	G272	WLOA	2012/01/26	Calcium, total	mg/L	98.0
UA	G272	WLOA	2012/05/22	Calcium, total	mg/L	82.0
UA	G272	WLOA	2012/07/24	Calcium, total	mg/L	100
UA	G272	WLOA	2012/11/14	Calcium, total	mg/L	110
UA	G272	WLOA	2013/01/31	Calcium, total	mg/L	110

UA	G272	WLOA	2013/05/20	Calcium, total	mg/L	98.0
UA	G272	WLOA	2013/07/22	Calcium, total	mg/L	100
UA	G272	WLOA	2013/10/14	Calcium, total	mg/L	100
UA	G272	WLOA	2014/02/19	Calcium, total	mg/L	110
UA	G272	WLOA	2014/05/13	Calcium, total	mg/L	93.0
UA	G272	WLOA	2014/08/11	Calcium, total	mg/L	110
UA	G272	WLOA	2014/10/14	Calcium, total	mg/L	110
UA	G272	WLOA	2015/01/21	Calcium, total	mg/L	99.0
UA	G272	WLOA	2015/04/10	Calcium, total	mg/L	110
UA	G272	WLOA	2009/09/22	Chloride, total	mg/L	53.0
UA	G272	WLOA	2009/11/10	Chloride, total	mg/L	46.0
UA	G272	WLOA	2010/01/19	Chloride, total	mg/L	45.0
UA	G272	WLOA	2010/03/04	Chloride, total	mg/L	44.0
UA	G272	WLOA	2010/07/27	Chloride, total	mg/L	44.0
UA	G272	WLOA	2010/11/16	Chloride, total	mg/L	42.0
UA	G272	WLOA	2011/01/31	Chloride, total	mg/L	43.0
UA	G272	WLOA	2011/05/04	Chloride, total	mg/L	42.0
UA	G272	WLOA	2011/07/27	Chloride, total	mg/L	<100
UA	G272	WLOA	2011/11/14	Chloride, total	mg/L	41.0
UA	G272	WLOA	2012/01/26	Chloride, total	mg/L	43.0
UA	G272	WLOA	2012/05/22	Chloride, total	mg/L	42.0
UA	G272	WLOA	2012/07/24	Chloride, total	mg/L	43.0
UA	G272	WLOA	2012/11/14	Chloride, total	mg/L	40.0
UA	G272	WLOA	2013/01/31	Chloride, total	mg/L	44.0
UA	G272	WLOA	2013/05/20	Chloride, total	mg/L	37.0
UA	G272	WLOA	2013/07/22	Chloride, total	mg/L	35.0
UA	G272	WLOA	2013/10/14	Chloride, total	mg/L	32.0
UA	G272	WLOA	2014/02/19	Chloride, total	mg/L	40.0
UA	G272	WLOA	2014/05/13	Chloride, total	mg/L	36.0
UA	G272	WLOA	2014/08/11	Chloride, total	mg/L	34.0
UA	G272	WLOA	2014/10/14	Chloride, total	mg/L	37.0
UA	G272	WLOA	2015/01/21	Chloride, total	mg/L	31.0
UA	G272	WLOA	2015/04/10	Chloride, total	mg/L	37.0
UA	G272	WLOA	2015/07/23	Chloride, total	mg/L	29.0
UA	G272	WLOA	2015/10/08	Chloride, total	mg/L	33.0
UA	G272	WLOA	2020/10/14	Chloride, total	mg/L	22.0
UA	G272	WLOA	2021/02/01	Chloride, total	mg/L	30.0
UA	G272	WLOA	2021/05/20	Chloride, total	mg/L	28.0
UA	G272	WLOA	2021/08/18	Chloride, total	mg/L	31.0
UA	G272	WLOA	2021/10/27	Chloride, total	mg/L	32.0
UA	G272	WLOA	2022/02/10	Chloride, total	mg/L	32.0
UA	G272	WLOA	2022/05/11	Chloride, total	mg/L	38.0
UA	G272	WLOA	2022/08/24	Chloride, total	mg/L	38.0
UA	G272	WLOA	2022/11/09	Chloride, total	mg/L	40.0
UA	G272	WLOA	2023/02/16	Chloride, total	mg/L	38.0
UA	G272	WLOA	2023/06/08	Chloride, total	mg/L	54.0
UA	G272	WLOA	2023/08/14	Chloride, total	mg/L	41.0
UA	G272	WLOA	2023/11/17	Chloride, total	mg/L	44.0
UA	G272	WLOA	2009/11/10	Iron, dissolved	mg/L	<0.1
UA	G272	WLOA	2010/01/19	Iron, dissolved	mg/L	<0.1
UA	G272	WLOA	2010/03/04	Iron, dissolved	mg/L	<0.2
UA	G272	WLOA	2010/07/27	Iron, dissolved	mg/L	0.0130
UA	G272	WLOA	2010/09/20	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2010/11/16	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2011/01/31	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2011/05/04	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2011/07/27	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2011/11/14	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2012/01/26	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2012/05/22	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2012/07/24	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2012/11/14	Iron, dissolved	mg/L	<0.01

UA	G272	WLOA	2013/01/31	Iron, dissolved	mg/L	0.0140
UA	G272	WLOA	2013/05/20	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2013/07/22	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2013/10/14	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2014/02/19	Iron, dissolved	mg/L	0.0130
UA	G272	WLOA	2014/05/13	Iron, dissolved	mg/L	0.0150
UA	G272	WLOA	2014/08/11	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2014/10/14	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2015/01/21	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2015/04/10	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2015/07/23	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2015/10/08	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2016/02/09	Iron, dissolved	mg/L	0.0340
UA	G272	WLOA	2016/05/12	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2016/07/27	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2016/11/21	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2017/02/08	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2017/05/18	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2017/07/25	Iron, dissolved	mg/L	0.0140
UA	G272	WLOA	2017/11/03	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2018/01/29	Iron, dissolved	mg/L	0.0510
UA	G272	WLOA	2018/05/16	Iron, dissolved	mg/L	0.0170
UA	G272	WLOA	2019/06/21	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2019/09/25	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2019/10/22	Iron, dissolved	mg/L	0.0110
UA	G272	WLOA	2020/01/23	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2020/05/05	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2020/08/13	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2020/10/14	Iron, dissolved	mg/L	0.0140
UA	G272	WLOA	2021/02/01	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2021/05/20	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2021/08/18	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2021/10/27	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2022/02/10	Iron, dissolved	mg/L	<0.01
UA	G272	WLOA	2022/05/11	Iron, dissolved	mg/L	0.00900
UA	G272	WLOA	2022/08/24	Iron, dissolved	mg/L	0.00230
UA	G272	WLOA	2022/11/09	Iron, dissolved	mg/L	0.00100
UA	G272	WLOA	2023/02/16	Iron, dissolved	mg/L	0.0170
UA	G272	WLOA	2023/06/08	Iron, dissolved	mg/L	0.0150
UA	G272	WLOA	2023/08/14	Iron, dissolved	mg/L	0.0210
UA	G272	WLOA	2023/11/17	Iron, dissolved	mg/L	<0.0115
UA	G272	WLOA	2009/09/22	Magnesium, total	mg/L	40.0
UA	G272	WLOA	2009/11/10	Magnesium, total	mg/L	43.0
UA	G272	WLOA	2010/01/19	Magnesium, total	mg/L	42.0
UA	G272	WLOA	2010/03/04	Magnesium, total	mg/L	45.0
UA	G272	WLOA	2010/07/27	Magnesium, total	mg/L	42.0
UA	G272	WLOA	2011/01/31	Magnesium, total	mg/L	50.0
UA	G272	WLOA	2012/01/26	Magnesium, total	mg/L	49.0
UA	G272	WLOA	2013/01/31	Magnesium, total	mg/L	54.0
UA	G272	WLOA	2014/02/19	Magnesium, total	mg/L	50.0
UA	G272	WLOA	2015/04/10	Magnesium, total	mg/L	52.0
UA	G272	WLOA	2009/11/10	Manganese, dissolved	mg/L	0.0560
UA	G272	WLOA	2010/01/19	Manganese, dissolved	mg/L	0.00600
UA	G272	WLOA	2010/03/04	Manganese, dissolved	mg/L	<0.0025
UA	G272	WLOA	2010/07/27	Manganese, dissolved	mg/L	0.00190
UA	G272	WLOA	2010/09/20	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2010/11/16	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2011/01/31	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2011/05/04	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2011/07/27	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2011/11/14	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2012/01/26	Manganese, dissolved	mg/L	<0.001

UA	G272	WLOA	2012/05/22	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2012/07/24	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2012/11/14	Manganese, dissolved	mg/L	0.00120
UA	G272	WLOA	2013/01/31	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2013/05/20	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2013/07/22	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2013/10/14	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2014/02/19	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2014/05/13	Manganese, dissolved	mg/L	0.230
UA	G272	WLOA	2014/08/11	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2014/10/14	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2015/01/21	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2015/04/10	Manganese, dissolved	mg/L	<0.002
UA	G272	WLOA	2015/07/23	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2015/10/08	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2016/02/09	Manganese, dissolved	mg/L	0.00130
UA	G272	WLOA	2016/05/12	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2016/07/27	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2016/11/21	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2017/02/08	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2017/05/18	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2017/07/25	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2017/11/03	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2018/01/29	Manganese, dissolved	mg/L	0.00260
UA	G272	WLOA	2018/05/16	Manganese, dissolved	mg/L	0.00160
UA	G272	WLOA	2019/06/21	Manganese, dissolved	mg/L	0.0120
UA	G272	WLOA	2019/09/25	Manganese, dissolved	mg/L	0.0140
UA	G272	WLOA	2019/10/22	Manganese, dissolved	mg/L	0.0120
UA	G272	WLOA	2020/01/23	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2020/05/05	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2020/08/13	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2020/10/14	Manganese, dissolved	mg/L	0.00320
UA	G272	WLOA	2021/02/01	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2021/05/20	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2021/08/18	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2021/10/27	Manganese, dissolved	mg/L	<0.001
UA	G272	WLOA	2022/02/10	Manganese, dissolved	mg/L	0.00100
UA	G272	WLOA	2022/05/11	Manganese, dissolved	mg/L	<0.00023
UA	G272	WLOA	2022/08/24	Manganese, dissolved	mg/L	<0.00023
UA	G272	WLOA	2022/11/09	Manganese, dissolved	mg/L	<0.00023
UA	G272	WLOA	2023/02/16	Manganese, dissolved	mg/L	0.0560
UA	G272	WLOA	2023/06/08	Manganese, dissolved	mg/L	0.00430
UA	G272	WLOA	2023/08/14	Manganese, dissolved	mg/L	0.00590
UA	G272	WLOA	2023/11/17	Manganese, dissolved	mg/L	<0.0008
UA	G272	WLOA	2009/09/22	Potassium, total	mg/L	1.20
UA	G272	WLOA	2009/11/10	Potassium, total	mg/L	1.00
UA	G272	WLOA	2010/01/19	Potassium, total	mg/L	0.800
UA	G272	WLOA	2010/03/04	Potassium, total	mg/L	0.550
UA	G272	WLOA	2010/07/27	Potassium, total	mg/L	0.610
UA	G272	WLOA	2011/01/31	Potassium, total	mg/L	0.660
UA	G272	WLOA	2012/01/26	Potassium, total	mg/L	0.460
UA	G272	WLOA	2013/01/31	Potassium, total	mg/L	0.630
UA	G272	WLOA	2014/02/19	Potassium, total	mg/L	0.390
UA	G272	WLOA	2015/04/10	Potassium, total	mg/L	0.380
UA	G272	WLOA	2009/09/22	Sodium, total	mg/L	68.0
UA	G272	WLOA	2009/11/10	Sodium, total	mg/L	78.0
UA	G272	WLOA	2010/01/19	Sodium, total	mg/L	72.0
UA	G272	WLOA	2010/03/04	Sodium, total	mg/L	77.0
UA	G272	WLOA	2010/07/27	Sodium, total	mg/L	75.0
UA	G272	WLOA	2011/01/31	Sodium, total	mg/L	80.0
UA	G272	WLOA	2012/01/26	Sodium, total	mg/L	82.0
UA	G272	WLOA	2013/01/31	Sodium, total	mg/L	87.0

UA	G272	WLOA	2014/02/19	Sodium, total	mg/L	81.0
UA	G272	WLOA	2015/04/10	Sodium, total	mg/L	86.0
UA	G272	WLOA	2009/09/22	Sulfate, total	mg/L	120
UA	G272	WLOA	2009/11/10	Sulfate, total	mg/L	130
UA	G272	WLOA	2010/01/19	Sulfate, total	mg/L	160
UA	G272	WLOA	2010/03/04	Sulfate, total	mg/L	160
UA	G272	WLOA	2010/07/27	Sulfate, total	mg/L	210
UA	G272	WLOA	2010/11/16	Sulfate, total	mg/L	200
UA	G272	WLOA	2011/01/31	Sulfate, total	mg/L	230
UA	G272	WLOA	2011/05/04	Sulfate, total	mg/L	210
UA	G272	WLOA	2011/07/27	Sulfate, total	mg/L	250
UA	G272	WLOA	2011/11/14	Sulfate, total	mg/L	230
UA	G272	WLOA	2012/01/26	Sulfate, total	mg/L	240
UA	G272	WLOA	2012/05/22	Sulfate, total	mg/L	190
UA	G272	WLOA	2012/07/24	Sulfate, total	mg/L	220
UA	G272	WLOA	2012/11/14	Sulfate, total	mg/L	220
UA	G272	WLOA	2013/01/31	Sulfate, total	mg/L	330
UA	G272	WLOA	2013/05/20	Sulfate, total	mg/L	280
UA	G272	WLOA	2013/07/22	Sulfate, total	mg/L	260
UA	G272	WLOA	2013/10/14	Sulfate, total	mg/L	300
UA	G272	WLOA	2014/02/19	Sulfate, total	mg/L	340
UA	G272	WLOA	2014/05/13	Sulfate, total	mg/L	310
UA	G272	WLOA	2014/08/11	Sulfate, total	mg/L	330
UA	G272	WLOA	2014/10/14	Sulfate, total	mg/L	310
UA	G272	WLOA	2015/01/21	Sulfate, total	mg/L	380
UA	G272	WLOA	2015/04/10	Sulfate, total	mg/L	340
UA	G272	WLOA	2015/07/23	Sulfate, total	mg/L	270
UA	G272	WLOA	2015/10/08	Sulfate, total	mg/L	340
UA	G272	WLOA	2020/10/14	Sulfate, total	mg/L	300
UA	G272	WLOA	2021/02/01	Sulfate, total	mg/L	370
UA	G272	WLOA	2021/05/20	Sulfate, total	mg/L	300
UA	G272	WLOA	2021/08/18	Sulfate, total	mg/L	370
UA	G272	WLOA	2021/10/27	Sulfate, total	mg/L	390
UA	G272	WLOA	2022/02/10	Sulfate, total	mg/L	370
UA	G272	WLOA	2022/05/11	Sulfate, total	mg/L	380
UA	G272	WLOA	2022/08/24	Sulfate, total	mg/L	420
UA	G272	WLOA	2022/11/09	Sulfate, total	mg/L	390
UA	G272	WLOA	2023/02/16	Sulfate, total	mg/L	360
UA	G272	WLOA	2023/06/08	Sulfate, total	mg/L	470
UA	G272	WLOA	2023/08/14	Sulfate, total	mg/L	416
UA	G272	WLOA	2023/11/17	Sulfate, total	mg/L	411
UA	G272	WLOA	2022/02/10	Temperature (Celsius)	degrees C	10.2
UA	G272	WLOA	2022/05/11	Temperature (Celsius)	degrees C	16.5
UA	G272	WLOA	2022/08/24	Temperature (Celsius)	degrees C	21.5
UA	G272	WLOA	2022/11/09	Temperature (Celsius)	degrees C	17.8
UA	G272	WLOA	2023/02/16	Temperature (Celsius)	degrees C	9.20
UA	G272	WLOA	2023/06/08	Temperature (Celsius)	degrees C	17.2
UA	G272	WLOA	2023/08/14	Temperature (Celsius)	degrees C	18.0
UA	G272	WLOA	2023/11/17	Temperature (Celsius)	degrees C	14.8
UA	G272	WLOA	2009/09/22	Total Dissolved Solids	mg/L	570
UA	G272	WLOA	2009/11/10	Total Dissolved Solids	mg/L	610
UA	G272	WLOA	2010/01/19	Total Dissolved Solids	mg/L	610
UA	G272	WLOA	2010/03/04	Total Dissolved Solids	mg/L	630
UA	G272	WLOA	2010/07/27	Total Dissolved Solids	mg/L	690
UA	G272	WLOA	2010/11/16	Total Dissolved Solids	mg/L	670
UA	G272	WLOA	2011/01/31	Total Dissolved Solids	mg/L	660
UA	G272	WLOA	2011/05/04	Total Dissolved Solids	mg/L	690
UA	G272	WLOA	2011/07/27	Total Dissolved Solids	mg/L	740
UA	G272	WLOA	2011/11/14	Total Dissolved Solids	mg/L	670
UA	G272	WLOA	2012/01/26	Total Dissolved Solids	mg/L	660
UA	G272	WLOA	2012/05/22	Total Dissolved Solids	mg/L	750
UA	G272	WLOA	2012/07/24	Total Dissolved Solids	mg/L	710

UA	G272	WLOA	2012/11/14	Total Dissolved Solids	mg/L	780
UA	G272	WLOA	2013/01/31	Total Dissolved Solids	mg/L	760
UA	G272	WLOA	2013/05/20	Total Dissolved Solids	mg/L	680
UA	G272	WLOA	2013/07/22	Total Dissolved Solids	mg/L	680
UA	G272	WLOA	2013/10/14	Total Dissolved Solids	mg/L	740
UA	G272	WLOA	2014/02/19	Total Dissolved Solids	mg/L	720
UA	G272	WLOA	2014/05/13	Total Dissolved Solids	mg/L	620
UA	G272	WLOA	2014/08/11	Total Dissolved Solids	mg/L	740
UA	G272	WLOA	2014/10/14	Total Dissolved Solids	mg/L	840
UA	G272	WLOA	2015/01/21	Total Dissolved Solids	mg/L	790
UA	G272	WLOA	2015/04/10	Total Dissolved Solids	mg/L	800
UA	G272	WLOA	2015/07/23	Total Dissolved Solids	mg/L	840
UA	G272	WLOA	2015/10/08	Total Dissolved Solids	mg/L	660
UA	G272	WLOA	2020/10/14	Total Dissolved Solids	mg/L	790
UA	G272	WLOA	2021/02/01	Total Dissolved Solids	mg/L	830
UA	G272	WLOA	2021/05/20	Total Dissolved Solids	mg/L	730
UA	G272	WLOA	2021/08/18	Total Dissolved Solids	mg/L	930
UA	G272	WLOA	2021/10/27	Total Dissolved Solids	mg/L	880
UA	G272	WLOA	2022/02/10	Total Dissolved Solids	mg/L	740
UA	G272	WLOA	2022/05/11	Total Dissolved Solids	mg/L	1,000
UA	G272	WLOA	2022/08/24	Total Dissolved Solids	mg/L	1,000
UA	G272	WLOA	2022/11/09	Total Dissolved Solids	mg/L	880
UA	G272	WLOA	2023/02/16	Total Dissolved Solids	mg/L	880
UA	G272	WLOA	2023/06/08	Total Dissolved Solids	mg/L	1,100
UA	G272	WLOA	2023/08/14	Total Dissolved Solids	mg/L	960
UA	G272	WLOA	2023/11/17	Total Dissolved Solids	mg/L	926
UA	G274	WLOA	2010/07/27	pH (field)	SU	6.9
UA	G274	WLOA	2010/07/28	pH (field)	SU	6.9
UA	G274	WLOA	2010/09/20	pH (field)	SU	7.8
UA	G274	WLOA	2010/11/16	pH (field)	SU	7.9
UA	G274	WLOA	2011/01/31	pH (field)	SU	7.1
UA	G274	WLOA	2011/05/03	pH (field)	SU	7.1
UA	G274	WLOA	2011/07/27	pH (field)	SU	7.3
UA	G274	WLOA	2011/11/14	pH (field)	SU	7.3
UA	G274	WLOA	2012/01/26	pH (field)	SU	7.3
UA	G274	WLOA	2012/05/22	pH (field)	SU	7.2
UA	G274	WLOA	2012/07/24	pH (field)	SU	7.1
UA	G274	WLOA	2012/11/14	pH (field)	SU	7.3
UA	G274	WLOA	2013/01/31	pH (field)	SU	7.1
UA	G274	WLOA	2013/05/20	pH (field)	SU	7.2
UA	G274	WLOA	2013/07/22	pH (field)	SU	7.0
UA	G274	WLOA	2013/10/14	pH (field)	SU	7.1
UA	G274	WLOA	2014/02/19	pH (field)	SU	7.5
UA	G274	WLOA	2014/05/13	pH (field)	SU	7.6
UA	G274	WLOA	2014/08/11	pH (field)	SU	7.4
UA	G274	WLOA	2014/10/14	pH (field)	SU	7.2
UA	G274	WLOA	2015/01/21	pH (field)	SU	7.3
UA	G274	WLOA	2015/04/13	pH (field)	SU	6.8
UA	G274	WLOA	2015/07/23	pH (field)	SU	7.3
UA	G274	WLOA	2015/10/08	pH (field)	SU	7.2
UA	G274	WLOA	2020/10/14	pH (field)	SU	6.7
UA	G274	WLOA	2021/02/01	pH (field)	SU	7.3
UA	G274	WLOA	2021/05/19	pH (field)	SU	7.3
UA	G274	WLOA	2021/08/18	pH (field)	SU	7.3
UA	G274	WLOA	2021/10/26	pH (field)	SU	7.3
UA	G274	WLOA	2022/02/10	pH (field)	SU	7.3
UA	G274	WLOA	2022/05/11	pH (field)	SU	6.9
UA	G274	WLOA	2022/08/23	pH (field)	SU	7.2
UA	G274	WLOA	2022/11/09	pH (field)	SU	7.2
UA	G274	WLOA	2023/02/16	pH (field)	SU	7.2
UA	G274	WLOA	2023/06/08	pH (field)	SU	7.0
UA	G274	WLOA	2023/08/14	pH (field)	SU	7.5

UA	G274	WLOA	2023/11/17	pH (field)	SU	7.1
UA	G274	WLOA	2022/02/10	Oxidation Reduction Potential	mV	104
UA	G274	WLOA	2022/05/11	Oxidation Reduction Potential	mV	118
UA	G274	WLOA	2022/08/23	Oxidation Reduction Potential	mV	-91.9
UA	G274	WLOA	2022/11/09	Oxidation Reduction Potential	mV	-64.0
UA	G274	WLOA	2023/02/16	Oxidation Reduction Potential	mV	222
UA	G274	WLOA	2023/06/08	Oxidation Reduction Potential	mV	45.0
UA	G274	WLOA	2023/08/14	Oxidation Reduction Potential	mV	-1.00
UA	G274	WLOA	2023/11/17	Oxidation Reduction Potential	mV	126
UA	G274	WLOA	2022/02/10	Eh	V	0.30
UA	G274	WLOA	2022/05/11	Eh	V	0.31
UA	G274	WLOA	2022/08/23	Eh	V	0.10
UA	G274	WLOA	2022/11/09	Eh	V	0.13
UA	G274	WLOA	2023/02/16	Eh	V	0.42
UA	G274	WLOA	2023/06/08	Eh	V	0.24
UA	G274	WLOA	2023/08/14	Eh	V	0.19
UA	G274	WLOA	2023/11/17	Eh	V	0.32
UA	G274	WLOA	2009/09/24	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G274	WLOA	2009/11/11	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G274	WLOA	2010/01/27	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G274	WLOA	2010/03/08	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G274	WLOA	2010/07/27	Alkalinity, bicarbonate	mg/L CaCO3	330
UA	G274	WLOA	2011/01/31	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G274	WLOA	2012/01/26	Alkalinity, bicarbonate	mg/L CaCO3	310
UA	G274	WLOA	2013/01/31	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G274	WLOA	2014/02/19	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G274	WLOA	2014/08/11	Alkalinity, bicarbonate	mg/L CaCO3	320
UA	G274	WLOA	2014/10/14	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G274	WLOA	2015/01/21	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G274	WLOA	2015/04/13	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G274	WLOA	2009/09/24	Arsenic, total	mg/L	0.00240
UA	G274	WLOA	2009/11/11	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2010/01/27	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2010/03/08	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2010/07/27	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2010/11/16	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2011/01/31	Arsenic, total	mg/L	0.00230
UA	G274	WLOA	2011/05/03	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2011/07/27	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2011/11/14	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2012/01/26	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2012/05/22	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2012/07/24	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2012/11/14	Arsenic, total	mg/L	0.00220
UA	G274	WLOA	2013/01/31	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2013/05/20	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2013/07/22	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2013/10/14	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2014/02/19	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2014/05/13	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2014/08/11	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2014/10/14	Arsenic, total	mg/L	0.00400
UA	G274	WLOA	2015/01/21	Arsenic, total	mg/L	0.00110
UA	G274	WLOA	2015/04/13	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2015/07/23	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2015/10/08	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2020/10/14	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2021/02/01	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2021/05/19	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2021/08/18	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2021/10/26	Arsenic, total	mg/L	<0.001
UA	G274	WLOA	2022/02/10	Arsenic, total	mg/L	<0.001

UA	G274	WLOA	2022/05/11	Arsenic, total	mg/L	<0.00069
UA	G274	WLOA	2022/08/23	Arsenic, total	mg/L	0.00150
UA	G274	WLOA	2022/11/09	Arsenic, total	mg/L	0.00170
UA	G274	WLOA	2023/02/16	Arsenic, total	mg/L	0.00130
UA	G274	WLOA	2023/06/08	Arsenic, total	mg/L	0.000860
UA	G274	WLOA	2023/08/14	Arsenic, total	mg/L	0.000500
UA	G274	WLOA	2023/11/17	Arsenic, total	mg/L	0.000700
UA	G274	WLOA	2009/09/24	Barium, total	mg/L	0.120
UA	G274	WLOA	2009/11/11	Barium, total	mg/L	0.0920
UA	G274	WLOA	2010/01/27	Barium, total	mg/L	0.0900
UA	G274	WLOA	2010/03/08	Barium, total	mg/L	0.0910
UA	G274	WLOA	2010/07/27	Barium, total	mg/L	0.0800
UA	G274	WLOA	2011/01/31	Barium, total	mg/L	0.0770
UA	G274	WLOA	2012/01/26	Barium, total	mg/L	0.0680
UA	G274	WLOA	2013/01/31	Barium, total	mg/L	0.0590
UA	G274	WLOA	2014/02/19	Barium, total	mg/L	0.0630
UA	G274	WLOA	2015/04/13	Barium, total	mg/L	0.0520
UA	G274	WLOA	2015/07/23	Barium, total	mg/L	0.0680
UA	G274	WLOA	2015/10/08	Barium, total	mg/L	0.0610
UA	G274	WLOA	2020/10/14	Barium, total	mg/L	0.0680
UA	G274	WLOA	2021/02/01	Barium, total	mg/L	0.0830
UA	G274	WLOA	2021/05/19	Barium, total	mg/L	0.0610
UA	G274	WLOA	2021/08/18	Barium, total	mg/L	0.0780
UA	G274	WLOA	2021/10/26	Barium, total	mg/L	0.0980
UA	G274	WLOA	2022/02/10	Barium, total	mg/L	0.0830
UA	G274	WLOA	2022/05/11	Barium, total	mg/L	0.0500
UA	G274	WLOA	2022/08/23	Barium, total	mg/L	0.0930
UA	G274	WLOA	2022/11/09	Barium, total	mg/L	0.0660
UA	G274	WLOA	2023/02/16	Barium, total	mg/L	0.0880
UA	G274	WLOA	2023/06/08	Barium, total	mg/L	0.0740
UA	G274	WLOA	2023/08/14	Barium, total	mg/L	0.0846
UA	G274	WLOA	2023/11/17	Barium, total	mg/L	0.0932
UA	G274	WLOA	2009/09/24	Calcium, total	mg/L	100
UA	G274	WLOA	2009/11/11	Calcium, total	mg/L	100
UA	G274	WLOA	2010/01/27	Calcium, total	mg/L	100
UA	G274	WLOA	2010/03/08	Calcium, total	mg/L	110
UA	G274	WLOA	2010/07/27	Calcium, total	mg/L	110
UA	G274	WLOA	2010/11/16	Calcium, total	mg/L	120
UA	G274	WLOA	2011/01/31	Calcium, total	mg/L	110
UA	G274	WLOA	2011/05/03	Calcium, total	mg/L	120
UA	G274	WLOA	2011/07/27	Calcium, total	mg/L	120
UA	G274	WLOA	2011/11/14	Calcium, total	mg/L	120
UA	G274	WLOA	2012/01/26	Calcium, total	mg/L	110
UA	G274	WLOA	2012/05/22	Calcium, total	mg/L	120
UA	G274	WLOA	2012/07/24	Calcium, total	mg/L	120
UA	G274	WLOA	2012/11/14	Calcium, total	mg/L	120
UA	G274	WLOA	2013/01/31	Calcium, total	mg/L	130
UA	G274	WLOA	2013/05/20	Calcium, total	mg/L	120
UA	G274	WLOA	2013/07/22	Calcium, total	mg/L	110
UA	G274	WLOA	2013/10/14	Calcium, total	mg/L	110
UA	G274	WLOA	2014/02/19	Calcium, total	mg/L	110
UA	G274	WLOA	2014/05/13	Calcium, total	mg/L	98.0
UA	G274	WLOA	2014/08/11	Calcium, total	mg/L	120
UA	G274	WLOA	2014/10/14	Calcium, total	mg/L	100
UA	G274	WLOA	2015/01/21	Calcium, total	mg/L	110
UA	G274	WLOA	2015/04/13	Calcium, total	mg/L	110
UA	G274	WLOA	2009/09/24	Chloride, total	mg/L	55.0
UA	G274	WLOA	2009/11/11	Chloride, total	mg/L	54.0
UA	G274	WLOA	2010/01/27	Chloride, total	mg/L	50.0
UA	G274	WLOA	2010/03/08	Chloride, total	mg/L	49.0
UA	G274	WLOA	2010/07/27	Chloride, total	mg/L	44.0
UA	G274	WLOA	2010/11/16	Chloride, total	mg/L	38.0

UA	G274	WLOA	2011/01/31	Chloride, total	mg/L	39.0
UA	G274	WLOA	2011/05/03	Chloride, total	mg/L	36.0
UA	G274	WLOA	2011/07/27	Chloride, total	mg/L	37.0
UA	G274	WLOA	2011/11/14	Chloride, total	mg/L	37.0
UA	G274	WLOA	2012/01/26	Chloride, total	mg/L	34.0
UA	G274	WLOA	2012/05/22	Chloride, total	mg/L	36.0
UA	G274	WLOA	2012/07/24	Chloride, total	mg/L	40.0
UA	G274	WLOA	2012/11/14	Chloride, total	mg/L	37.0
UA	G274	WLOA	2013/01/31	Chloride, total	mg/L	36.0
UA	G274	WLOA	2013/05/20	Chloride, total	mg/L	3.60
UA	G274	WLOA	2013/07/22	Chloride, total	mg/L	32.0
UA	G274	WLOA	2013/10/14	Chloride, total	mg/L	31.0
UA	G274	WLOA	2014/02/19	Chloride, total	mg/L	32.0
UA	G274	WLOA	2014/05/13	Chloride, total	mg/L	27.0
UA	G274	WLOA	2014/08/11	Chloride, total	mg/L	25.0
UA	G274	WLOA	2014/10/14	Chloride, total	mg/L	23.0
UA	G274	WLOA	2015/01/21	Chloride, total	mg/L	19.0
UA	G274	WLOA	2015/04/13	Chloride, total	mg/L	24.0
UA	G274	WLOA	2015/07/23	Chloride, total	mg/L	24.0
UA	G274	WLOA	2015/10/08	Chloride, total	mg/L	22.0
UA	G274	WLOA	2020/10/14	Chloride, total	mg/L	16.0
UA	G274	WLOA	2021/02/01	Chloride, total	mg/L	10.0
UA	G274	WLOA	2021/05/19	Chloride, total	mg/L	15.0
UA	G274	WLOA	2021/08/18	Chloride, total	mg/L	13.0
UA	G274	WLOA	2021/10/26	Chloride, total	mg/L	7.70
UA	G274	WLOA	2022/02/10	Chloride, total	mg/L	9.40
UA	G274	WLOA	2022/05/11	Chloride, total	mg/L	12.0
UA	G274	WLOA	2022/08/23	Chloride, total	mg/L	12.0
UA	G274	WLOA	2022/11/09	Chloride, total	mg/L	16.0
UA	G274	WLOA	2023/02/16	Chloride, total	mg/L	8.80
UA	G274	WLOA	2023/06/08	Chloride, total	mg/L	14.0
UA	G274	WLOA	2023/08/14	Chloride, total	mg/L	11.0
UA	G274	WLOA	2023/11/17	Chloride, total	mg/L	13.0
UA	G274	WLOA	2009/11/11	Iron, dissolved	mg/L	<0.1
UA	G274	WLOA	2010/01/27	Iron, dissolved	mg/L	<0.1
UA	G274	WLOA	2010/03/08	Iron, dissolved	mg/L	<0.2
UA	G274	WLOA	2010/07/27	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2010/09/20	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2010/11/16	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2011/01/31	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2011/05/03	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2011/07/27	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2011/11/14	Iron, dissolved	mg/L	0.0120
UA	G274	WLOA	2012/01/26	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2012/05/22	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2012/07/24	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2012/11/14	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2013/01/31	Iron, dissolved	mg/L	0.0140
UA	G274	WLOA	2013/05/20	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2013/07/22	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2013/10/14	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2014/02/19	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2014/05/13	Iron, dissolved	mg/L	0.0140
UA	G274	WLOA	2014/08/11	Iron, dissolved	mg/L	0.0110
UA	G274	WLOA	2014/10/14	Iron, dissolved	mg/L	0.0120
UA	G274	WLOA	2015/01/21	Iron, dissolved	mg/L	0.0260
UA	G274	WLOA	2015/04/13	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2015/07/23	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2015/10/08	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2016/02/09	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2016/05/12	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2016/07/27	Iron, dissolved	mg/L	0.130

UA	G274	WLOA	2016/11/21	Iron, dissolved	mg/L	0.0250
UA	G274	WLOA	2017/02/14	Iron, dissolved	mg/L	0.0340
UA	G274	WLOA	2017/05/18	Iron, dissolved	mg/L	3.10
UA	G274	WLOA	2017/07/25	Iron, dissolved	mg/L	2.10
UA	G274	WLOA	2017/11/03	Iron, dissolved	mg/L	3.90
UA	G274	WLOA	2018/01/29	Iron, dissolved	mg/L	5.40
UA	G274	WLOA	2018/05/16	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2018/08/10	Iron, dissolved	mg/L	0.0140
UA	G274	WLOA	2018/11/05	Iron, dissolved	mg/L	<0.1
UA	G274	WLOA	2019/01/22	Iron, dissolved	mg/L	0.0520
UA	G274	WLOA	2019/05/03	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2019/08/26	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2019/10/22	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2020/01/23	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2020/05/05	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2020/08/13	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2020/10/14	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2021/02/01	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2021/05/19	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2021/08/18	Iron, dissolved	mg/L	0.0340
UA	G274	WLOA	2021/10/26	Iron, dissolved	mg/L	0.0160
UA	G274	WLOA	2022/02/10	Iron, dissolved	mg/L	<0.01
UA	G274	WLOA	2022/05/11	Iron, dissolved	mg/L	<0.00072
UA	G274	WLOA	2022/08/23	Iron, dissolved	mg/L	0.0570
UA	G274	WLOA	2022/11/09	Iron, dissolved	mg/L	0.0530
UA	G274	WLOA	2023/02/16	Iron, dissolved	mg/L	0.00590
UA	G274	WLOA	2023/06/08	Iron, dissolved	mg/L	0.120
UA	G274	WLOA	2023/08/14	Iron, dissolved	mg/L	<0.0175
UA	G274	WLOA	2023/11/17	Iron, dissolved	mg/L	0.0120
UA	G274	WLOA	2009/09/24	Magnesium, total	mg/L	55.0
UA	G274	WLOA	2009/11/11	Magnesium, total	mg/L	54.0
UA	G274	WLOA	2010/01/27	Magnesium, total	mg/L	55.0
UA	G274	WLOA	2010/03/08	Magnesium, total	mg/L	58.0
UA	G274	WLOA	2010/07/27	Magnesium, total	mg/L	54.0
UA	G274	WLOA	2011/01/31	Magnesium, total	mg/L	58.0
UA	G274	WLOA	2012/01/26	Magnesium, total	mg/L	59.0
UA	G274	WLOA	2013/01/31	Magnesium, total	mg/L	63.0
UA	G274	WLOA	2014/02/19	Magnesium, total	mg/L	47.0
UA	G274	WLOA	2015/04/13	Magnesium, total	mg/L	56.0
UA	G274	WLOA	2009/11/11	Manganese, dissolved	mg/L	0.00700
UA	G274	WLOA	2010/01/27	Manganese, dissolved	mg/L	0.00390
UA	G274	WLOA	2010/03/08	Manganese, dissolved	mg/L	0.00560
UA	G274	WLOA	2010/07/27	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2010/09/20	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2010/11/16	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2011/01/31	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2011/05/03	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2011/07/27	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2011/11/14	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2012/01/26	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2012/05/22	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2012/07/24	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2012/11/14	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2013/01/31	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2013/05/20	Manganese, dissolved	mg/L	0.00730
UA	G274	WLOA	2013/07/22	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2013/10/14	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2014/02/19	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2014/05/13	Manganese, dissolved	mg/L	0.00590
UA	G274	WLOA	2014/08/11	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2014/10/14	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2015/01/21	Manganese, dissolved	mg/L	0.00360

UA	G274	WLOA	2015/04/13	Manganese, dissolved	mg/L	<0.002
UA	G274	WLOA	2015/07/23	Manganese, dissolved	mg/L	0.00150
UA	G274	WLOA	2015/10/08	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2016/02/09	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2016/05/12	Manganese, dissolved	mg/L	0.0460
UA	G274	WLOA	2016/07/27	Manganese, dissolved	mg/L	0.140
UA	G274	WLOA	2016/11/21	Manganese, dissolved	mg/L	0.140
UA	G274	WLOA	2017/02/14	Manganese, dissolved	mg/L	0.310
UA	G274	WLOA	2017/05/18	Manganese, dissolved	mg/L	0.140
UA	G274	WLOA	2017/07/25	Manganese, dissolved	mg/L	0.0890
UA	G274	WLOA	2017/11/03	Manganese, dissolved	mg/L	0.0740
UA	G274	WLOA	2018/01/29	Manganese, dissolved	mg/L	0.140
UA	G274	WLOA	2018/05/16	Manganese, dissolved	mg/L	0.00270
UA	G274	WLOA	2018/08/10	Manganese, dissolved	mg/L	0.00480
UA	G274	WLOA	2018/11/05	Manganese, dissolved	mg/L	0.00950
UA	G274	WLOA	2019/01/22	Manganese, dissolved	mg/L	0.00430
UA	G274	WLOA	2019/05/03	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2019/08/26	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2019/10/22	Manganese, dissolved	mg/L	0.0290
UA	G274	WLOA	2020/01/23	Manganese, dissolved	mg/L	0.0130
UA	G274	WLOA	2020/05/05	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2020/08/13	Manganese, dissolved	mg/L	0.0220
UA	G274	WLOA	2020/10/14	Manganese, dissolved	mg/L	0.0380
UA	G274	WLOA	2021/02/01	Manganese, dissolved	mg/L	0.00220
UA	G274	WLOA	2021/05/19	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2021/08/18	Manganese, dissolved	mg/L	0.0210
UA	G274	WLOA	2021/10/26	Manganese, dissolved	mg/L	0.00410
UA	G274	WLOA	2022/02/10	Manganese, dissolved	mg/L	<0.001
UA	G274	WLOA	2022/05/11	Manganese, dissolved	mg/L	0.0140
UA	G274	WLOA	2022/08/23	Manganese, dissolved	mg/L	0.0970
UA	G274	WLOA	2022/11/09	Manganese, dissolved	mg/L	0.150
UA	G274	WLOA	2023/02/16	Manganese, dissolved	mg/L	<0.00023
UA	G274	WLOA	2023/06/08	Manganese, dissolved	mg/L	0.0470
UA	G274	WLOA	2023/08/14	Manganese, dissolved	mg/L	0.0157
UA	G274	WLOA	2023/11/17	Manganese, dissolved	mg/L	0.0276
UA	G274	WLOA	2009/09/24	Potassium, total	mg/L	1.20
UA	G274	WLOA	2009/11/11	Potassium, total	mg/L	<0.5
UA	G274	WLOA	2010/01/27	Potassium, total	mg/L	<0.5
UA	G274	WLOA	2010/03/08	Potassium, total	mg/L	<0.5
UA	G274	WLOA	2010/07/27	Potassium, total	mg/L	0.360
UA	G274	WLOA	2011/01/31	Potassium, total	mg/L	0.390
UA	G274	WLOA	2012/01/26	Potassium, total	mg/L	0.370
UA	G274	WLOA	2013/01/31	Potassium, total	mg/L	0.480
UA	G274	WLOA	2014/02/19	Potassium, total	mg/L	0.480
UA	G274	WLOA	2015/04/13	Potassium, total	mg/L	0.500
UA	G274	WLOA	2009/09/24	Sodium, total	mg/L	96.0
UA	G274	WLOA	2009/11/11	Sodium, total	mg/L	100
UA	G274	WLOA	2010/01/27	Sodium, total	mg/L	100
UA	G274	WLOA	2010/03/08	Sodium, total	mg/L	100
UA	G274	WLOA	2010/07/27	Sodium, total	mg/L	97.0
UA	G274	WLOA	2011/01/31	Sodium, total	mg/L	100
UA	G274	WLOA	2012/01/26	Sodium, total	mg/L	100
UA	G274	WLOA	2013/01/31	Sodium, total	mg/L	110
UA	G274	WLOA	2014/02/19	Sodium, total	mg/L	78.0
UA	G274	WLOA	2015/04/13	Sodium, total	mg/L	89.0
UA	G274	WLOA	2009/09/24	Sulfate, total	mg/L	230
UA	G274	WLOA	2009/11/11	Sulfate, total	mg/L	250
UA	G274	WLOA	2010/01/27	Sulfate, total	mg/L	260
UA	G274	WLOA	2010/03/08	Sulfate, total	mg/L	270
UA	G274	WLOA	2010/07/27	Sulfate, total	mg/L	320
UA	G274	WLOA	2010/11/16	Sulfate, total	mg/L	360
UA	G274	WLOA	2011/01/31	Sulfate, total	mg/L	370

UA	G274	WLOA	2011/05/03	Sulfate, total	mg/L	400
UA	G274	WLOA	2011/07/27	Sulfate, total	mg/L	370
UA	G274	WLOA	2011/11/14	Sulfate, total	mg/L	370
UA	G274	WLOA	2012/01/26	Sulfate, total	mg/L	370
UA	G274	WLOA	2012/05/22	Sulfate, total	mg/L	330
UA	G274	WLOA	2012/07/24	Sulfate, total	mg/L	300
UA	G274	WLOA	2012/11/14	Sulfate, total	mg/L	420
UA	G274	WLOA	2013/01/31	Sulfate, total	mg/L	460
UA	G274	WLOA	2013/05/20	Sulfate, total	mg/L	350
UA	G274	WLOA	2013/07/22	Sulfate, total	mg/L	330
UA	G274	WLOA	2013/10/14	Sulfate, total	mg/L	380
UA	G274	WLOA	2014/02/19	Sulfate, total	mg/L	300
UA	G274	WLOA	2014/05/13	Sulfate, total	mg/L	370
UA	G274	WLOA	2014/08/11	Sulfate, total	mg/L	400
UA	G274	WLOA	2014/10/14	Sulfate, total	mg/L	320
UA	G274	WLOA	2015/01/21	Sulfate, total	mg/L	260
UA	G274	WLOA	2015/04/13	Sulfate, total	mg/L	390
UA	G274	WLOA	2015/07/23	Sulfate, total	mg/L	320
UA	G274	WLOA	2015/10/08	Sulfate, total	mg/L	320
UA	G274	WLOA	2020/10/14	Sulfate, total	mg/L	290
UA	G274	WLOA	2021/02/01	Sulfate, total	mg/L	180
UA	G274	WLOA	2021/05/19	Sulfate, total	mg/L	290
UA	G274	WLOA	2021/08/18	Sulfate, total	mg/L	240
UA	G274	WLOA	2021/10/26	Sulfate, total	mg/L	150
UA	G274	WLOA	2022/02/10	Sulfate, total	mg/L	190
UA	G274	WLOA	2022/05/11	Sulfate, total	mg/L	270
UA	G274	WLOA	2022/08/23	Sulfate, total	mg/L	250
UA	G274	WLOA	2022/11/09	Sulfate, total	mg/L	310
UA	G274	WLOA	2023/02/16	Sulfate, total	mg/L	160
UA	G274	WLOA	2023/06/08	Sulfate, total	mg/L	310
UA	G274	WLOA	2023/08/14	Sulfate, total	mg/L	286
UA	G274	WLOA	2023/11/17	Sulfate, total	mg/L	330
UA	G274	WLOA	2022/02/10	Temperature (Celsius)	degrees C	12.1
UA	G274	WLOA	2022/05/11	Temperature (Celsius)	degrees C	18.4
UA	G274	WLOA	2022/08/23	Temperature (Celsius)	degrees C	19.9
UA	G274	WLOA	2022/11/09	Temperature (Celsius)	degrees C	17.8
UA	G274	WLOA	2023/02/16	Temperature (Celsius)	degrees C	11.1
UA	G274	WLOA	2023/06/08	Temperature (Celsius)	degrees C	16.8
UA	G274	WLOA	2023/08/14	Temperature (Celsius)	degrees C	15.6
UA	G274	WLOA	2023/11/17	Temperature (Celsius)	degrees C	15.6
UA	G274	WLOA	2009/09/24	Total Dissolved Solids	mg/L	830
UA	G274	WLOA	2009/11/11	Total Dissolved Solids	mg/L	820
UA	G274	WLOA	2010/01/27	Total Dissolved Solids	mg/L	850
UA	G274	WLOA	2010/03/08	Total Dissolved Solids	mg/L	870
UA	G274	WLOA	2010/07/27	Total Dissolved Solids	mg/L	900
UA	G274	WLOA	2010/11/16	Total Dissolved Solids	mg/L	940
UA	G274	WLOA	2011/01/31	Total Dissolved Solids	mg/L	950
UA	G274	WLOA	2011/05/03	Total Dissolved Solids	mg/L	980
UA	G274	WLOA	2011/07/27	Total Dissolved Solids	mg/L	980
UA	G274	WLOA	2011/11/14	Total Dissolved Solids	mg/L	900
UA	G274	WLOA	2012/01/26	Total Dissolved Solids	mg/L	880
UA	G274	WLOA	2012/05/22	Total Dissolved Solids	mg/L	920
UA	G274	WLOA	2012/07/24	Total Dissolved Solids	mg/L	880
UA	G274	WLOA	2012/11/14	Total Dissolved Solids	mg/L	910
UA	G274	WLOA	2013/01/31	Total Dissolved Solids	mg/L	870
UA	G274	WLOA	2013/05/20	Total Dissolved Solids	mg/L	800
UA	G274	WLOA	2013/07/22	Total Dissolved Solids	mg/L	820
UA	G274	WLOA	2013/10/14	Total Dissolved Solids	mg/L	840
UA	G274	WLOA	2014/02/19	Total Dissolved Solids	mg/L	810
UA	G274	WLOA	2014/05/13	Total Dissolved Solids	mg/L	750
UA	G274	WLOA	2014/08/11	Total Dissolved Solids	mg/L	880
UA	G274	WLOA	2014/10/14	Total Dissolved Solids	mg/L	770

UA	G274	WLOA	2015/01/21	Total Dissolved Solids	mg/L	770
UA	G274	WLOA	2015/04/13	Total Dissolved Solids	mg/L	770
UA	G274	WLOA	2015/07/23	Total Dissolved Solids	mg/L	890
UA	G274	WLOA	2015/10/08	Total Dissolved Solids	mg/L	770
UA	G274	WLOA	2020/10/14	Total Dissolved Solids	mg/L	760
UA	G274	WLOA	2021/02/01	Total Dissolved Solids	mg/L	500
UA	G274	WLOA	2021/05/19	Total Dissolved Solids	mg/L	850
UA	G274	WLOA	2021/08/18	Total Dissolved Solids	mg/L	630
UA	G274	WLOA	2021/10/26	Total Dissolved Solids	mg/L	520
UA	G274	WLOA	2022/02/10	Total Dissolved Solids	mg/L	490
UA	G274	WLOA	2022/05/11	Total Dissolved Solids	mg/L	780
UA	G274	WLOA	2022/08/23	Total Dissolved Solids	mg/L	880
UA	G274	WLOA	2022/11/09	Total Dissolved Solids	mg/L	780
UA	G274	WLOA	2023/02/16	Total Dissolved Solids	mg/L	580
UA	G274	WLOA	2023/06/08	Total Dissolved Solids	mg/L	600
UA	G274	WLOA	2023/08/14	Total Dissolved Solids	mg/L	780
UA	G274	WLOA	2023/11/17	Total Dissolved Solids	mg/L	744
UA	G286	WLOA	2021/03/31	pH (field)	SU	7.0
UA	G286	WLOA	2021/04/22	pH (field)	SU	6.7
UA	G286	WLOA	2021/05/06	pH (field)	SU	7.1
UA	G286	WLOA	2021/05/18	pH (field)	SU	7.1
UA	G286	WLOA	2021/06/15	pH (field)	SU	7.1
UA	G286	WLOA	2021/06/28	pH (field)	SU	7.2
UA	G286	WLOA	2021/07/13	pH (field)	SU	7.0
UA	G286	WLOA	2021/07/27	pH (field)	SU	7.2
UA	G286	WLOA	2021/03/31	Oxidation Reduction Potential	mV	128
UA	G286	WLOA	2021/04/22	Oxidation Reduction Potential	mV	138
UA	G286	WLOA	2021/05/06	Oxidation Reduction Potential	mV	89.5
UA	G286	WLOA	2021/05/18	Oxidation Reduction Potential	mV	79.7
UA	G286	WLOA	2021/06/15	Oxidation Reduction Potential	mV	99.8
UA	G286	WLOA	2021/06/28	Oxidation Reduction Potential	mV	38.4
UA	G286	WLOA	2021/07/13	Oxidation Reduction Potential	mV	130
UA	G286	WLOA	2021/07/27	Oxidation Reduction Potential	mV	92.7
UA	G286	WLOA	2021/03/31	Eh	V	0.33
UA	G286	WLOA	2021/04/22	Eh	V	0.34
UA	G286	WLOA	2021/05/06	Eh	V	0.28
UA	G286	WLOA	2021/05/18	Eh	V	0.28
UA	G286	WLOA	2021/06/15	Eh	V	0.29
UA	G286	WLOA	2021/06/28	Eh	V	0.23
UA	G286	WLOA	2021/07/13	Eh	V	0.32
UA	G286	WLOA	2021/07/27	Eh	V	0.28
UA	G286	WLOA	2021/03/31	Alkalinity, bicarbonate	mg/L CaCO3	310
UA	G286	WLOA	2021/04/22	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G286	WLOA	2021/05/06	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G286	WLOA	2021/05/18	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G286	WLOA	2021/06/15	Alkalinity, bicarbonate	mg/L CaCO3	320
UA	G286	WLOA	2021/06/28	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G286	WLOA	2021/07/13	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G286	WLOA	2021/07/27	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G286	WLOA	2021/03/31	Arsenic, total	mg/L	<0.00022
UA	G286	WLOA	2021/04/22	Arsenic, total	mg/L	<0.00022
UA	G286	WLOA	2021/05/06	Arsenic, total	mg/L	<0.00022
UA	G286	WLOA	2021/05/18	Arsenic, total	mg/L	<0.00022
UA	G286	WLOA	2021/06/15	Arsenic, total	mg/L	<0.00022
UA	G286	WLOA	2021/06/28	Arsenic, total	mg/L	<0.00022
UA	G286	WLOA	2021/07/13	Arsenic, total	mg/L	<0.00022
UA	G286	WLOA	2021/07/27	Arsenic, total	mg/L	<0.00022
UA	G286	WLOA	2021/03/31	Barium, total	mg/L	0.0360
UA	G286	WLOA	2021/04/22	Barium, total	mg/L	0.0420
UA	G286	WLOA	2021/05/06	Barium, total	mg/L	0.0340
UA	G286	WLOA	2021/05/18	Barium, total	mg/L	0.0320
UA	G286	WLOA	2021/06/15	Barium, total	mg/L	0.0370

UA	G286	WLOA	2021/06/28	Barium, total	mg/L	0.0400
UA	G286	WLOA	2021/07/13	Barium, total	mg/L	0.0410
UA	G286	WLOA	2021/07/27	Barium, total	mg/L	0.0460
UA	G286	WLOA	2021/03/31	Calcium, total	mg/L	71.0
UA	G286	WLOA	2021/04/22	Calcium, total	mg/L	60.0
UA	G286	WLOA	2021/05/06	Calcium, total	mg/L	66.0
UA	G286	WLOA	2021/05/18	Calcium, total	mg/L	66.0
UA	G286	WLOA	2021/06/15	Calcium, total	mg/L	73.0
UA	G286	WLOA	2021/06/28	Calcium, total	mg/L	70.0
UA	G286	WLOA	2021/07/13	Calcium, total	mg/L	70.0
UA	G286	WLOA	2021/07/27	Calcium, total	mg/L	75.0
UA	G286	WLOA	2021/03/31	Chloride, total	mg/L	3.10
UA	G286	WLOA	2021/04/22	Chloride, total	mg/L	3.20
UA	G286	WLOA	2021/05/06	Chloride, total	mg/L	2.10
UA	G286	WLOA	2021/05/18	Chloride, total	mg/L	1.70
UA	G286	WLOA	2021/06/15	Chloride, total	mg/L	2.70
UA	G286	WLOA	2021/06/28	Chloride, total	mg/L	2.30
UA	G286	WLOA	2021/07/13	Chloride, total	mg/L	2.60
UA	G286	WLOA	2021/07/27	Chloride, total	mg/L	2.70
UA	G286	WLOA	2021/03/31	Magnesium, total	mg/L	32.0
UA	G286	WLOA	2021/04/22	Magnesium, total	mg/L	30.0
UA	G286	WLOA	2021/05/06	Magnesium, total	mg/L	33.0
UA	G286	WLOA	2021/05/18	Magnesium, total	mg/L	31.0
UA	G286	WLOA	2021/06/15	Magnesium, total	mg/L	35.0
UA	G286	WLOA	2021/06/28	Magnesium, total	mg/L	36.0
UA	G286	WLOA	2021/07/13	Magnesium, total	mg/L	37.0
UA	G286	WLOA	2021/07/27	Magnesium, total	mg/L	36.0
UA	G286	WLOA	2021/03/31	Potassium, total	mg/L	0.270
UA	G286	WLOA	2021/04/22	Potassium, total	mg/L	0.450
UA	G286	WLOA	2021/05/06	Potassium, total	mg/L	0.200
UA	G286	WLOA	2021/05/18	Potassium, total	mg/L	0.290
UA	G286	WLOA	2021/06/15	Potassium, total	mg/L	0.250
UA	G286	WLOA	2021/06/28	Potassium, total	mg/L	0.150
UA	G286	WLOA	2021/07/13	Potassium, total	mg/L	0.200
UA	G286	WLOA	2021/07/27	Potassium, total	mg/L	0.280
UA	G286	WLOA	2021/03/31	Sodium, total	mg/L	4.90
UA	G286	WLOA	2021/04/22	Sodium, total	mg/L	5.20
UA	G286	WLOA	2021/05/06	Sodium, total	mg/L	4.70
UA	G286	WLOA	2021/05/18	Sodium, total	mg/L	4.50
UA	G286	WLOA	2021/06/15	Sodium, total	mg/L	4.00
UA	G286	WLOA	2021/06/28	Sodium, total	mg/L	4.70
UA	G286	WLOA	2021/07/13	Sodium, total	mg/L	4.90
UA	G286	WLOA	2021/07/27	Sodium, total	mg/L	5.10
UA	G286	WLOA	2021/03/31	Sulfate, total	mg/L	16.0
UA	G286	WLOA	2021/04/22	Sulfate, total	mg/L	12.0
UA	G286	WLOA	2021/05/06	Sulfate, total	mg/L	13.0
UA	G286	WLOA	2021/05/18	Sulfate, total	mg/L	11.0
UA	G286	WLOA	2021/06/15	Sulfate, total	mg/L	11.0
UA	G286	WLOA	2021/06/28	Sulfate, total	mg/L	14.0
UA	G286	WLOA	2021/07/13	Sulfate, total	mg/L	16.0
UA	G286	WLOA	2021/07/27	Sulfate, total	mg/L	15.0
UA	G286	WLOA	2021/03/31	Temperature (Celsius)	degrees C	9.60
UA	G286	WLOA	2021/04/22	Temperature (Celsius)	degrees C	11.2
UA	G286	WLOA	2021/05/06	Temperature (Celsius)	degrees C	16.0
UA	G286	WLOA	2021/05/18	Temperature (Celsius)	degrees C	13.4
UA	G286	WLOA	2021/06/15	Temperature (Celsius)	degrees C	19.7
UA	G286	WLOA	2021/06/28	Temperature (Celsius)	degrees C	19.8
UA	G286	WLOA	2021/07/13	Temperature (Celsius)	degrees C	19.5
UA	G286	WLOA	2021/07/27	Temperature (Celsius)	degrees C	20.0
UA	G286	WLOA	2021/03/31	Total Dissolved Solids	mg/L	320
UA	G286	WLOA	2021/04/22	Total Dissolved Solids	mg/L	270
UA	G286	WLOA	2021/05/06	Total Dissolved Solids	mg/L	300

UA	G286	WLOA	2021/05/18	Total Dissolved Solids	mg/L	270
UA	G286	WLOA	2021/06/15	Total Dissolved Solids	mg/L	300
UA	G286	WLOA	2021/06/28	Total Dissolved Solids	mg/L	230
UA	G286	WLOA	2021/07/13	Total Dissolved Solids	mg/L	370
UA	G286	WLOA	2021/07/27	Total Dissolved Solids	mg/L	340
UA	G287	WLOA	2021/03/29	pH (field)	SU	7.3
UA	G287	WLOA	2021/04/22	pH (field)	SU	7.1
UA	G287	WLOA	2021/05/06	pH (field)	SU	7.2
UA	G287	WLOA	2021/05/18	pH (field)	SU	7.2
UA	G287	WLOA	2021/06/14	pH (field)	SU	7.1
UA	G287	WLOA	2021/06/28	pH (field)	SU	7.3
UA	G287	WLOA	2021/07/13	pH (field)	SU	7.3
UA	G287	WLOA	2021/07/27	pH (field)	SU	7.3
UA	G287	WLOA	2021/03/29	Oxidation Reduction Potential	mV	59.6
UA	G287	WLOA	2021/04/22	Oxidation Reduction Potential	mV	128
UA	G287	WLOA	2021/05/06	Oxidation Reduction Potential	mV	147
UA	G287	WLOA	2021/05/18	Oxidation Reduction Potential	mV	75.0
UA	G287	WLOA	2021/06/14	Oxidation Reduction Potential	mV	102
UA	G287	WLOA	2021/06/28	Oxidation Reduction Potential	mV	30.6
UA	G287	WLOA	2021/07/13	Oxidation Reduction Potential	mV	125
UA	G287	WLOA	2021/07/27	Oxidation Reduction Potential	mV	117
UA	G287	WLOA	2021/03/29	Eh	V	0.26
UA	G287	WLOA	2021/04/22	Eh	V	0.33
UA	G287	WLOA	2021/05/06	Eh	V	0.34
UA	G287	WLOA	2021/05/18	Eh	V	0.27
UA	G287	WLOA	2021/06/14	Eh	V	0.30
UA	G287	WLOA	2021/06/28	Eh	V	0.22
UA	G287	WLOA	2021/07/13	Eh	V	0.32
UA	G287	WLOA	2021/07/27	Eh	V	0.31
UA	G287	WLOA	2021/03/29	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G287	WLOA	2021/04/22	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G287	WLOA	2021/05/06	Alkalinity, bicarbonate	mg/L CaCO3	360
UA	G287	WLOA	2021/05/18	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G287	WLOA	2021/06/14	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G287	WLOA	2021/06/28	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G287	WLOA	2021/07/13	Alkalinity, bicarbonate	mg/L CaCO3	350
UA	G287	WLOA	2021/07/27	Alkalinity, bicarbonate	mg/L CaCO3	380
UA	G287	WLOA	2021/03/29	Arsenic, total	mg/L	<0.00022
UA	G287	WLOA	2021/04/22	Arsenic, total	mg/L	<0.00022
UA	G287	WLOA	2021/05/06	Arsenic, total	mg/L	<0.00022
UA	G287	WLOA	2021/05/18	Arsenic, total	mg/L	<0.00022
UA	G287	WLOA	2021/06/14	Arsenic, total	mg/L	<0.00022
UA	G287	WLOA	2021/06/28	Arsenic, total	mg/L	<0.0002
UA	G287	WLOA	2021/07/13	Arsenic, total	mg/L	<0.00022
UA	G287	WLOA	2021/07/27	Arsenic, total	mg/L	<0.00022
UA	G287	WLOA	2021/03/29	Barium, total	mg/L	0.0560
UA	G287	WLOA	2021/04/22	Barium, total	mg/L	0.0620
UA	G287	WLOA	2021/05/06	Barium, total	mg/L	0.0600
UA	G287	WLOA	2021/05/18	Barium, total	mg/L	0.0570
UA	G287	WLOA	2021/06/14	Barium, total	mg/L	0.0690
UA	G287	WLOA	2021/06/28	Barium, total	mg/L	0.0660
UA	G287	WLOA	2021/07/13	Barium, total	mg/L	0.0640
UA	G287	WLOA	2021/07/27	Barium, total	mg/L	0.0670
UA	G287	WLOA	2021/03/29	Calcium, total	mg/L	73.0
UA	G287	WLOA	2021/04/22	Calcium, total	mg/L	79.0
UA	G287	WLOA	2021/05/06	Calcium, total	mg/L	79.0
UA	G287	WLOA	2021/05/18	Calcium, total	mg/L	77.0
UA	G287	WLOA	2021/06/14	Calcium, total	mg/L	85.0
UA	G287	WLOA	2021/06/28	Calcium, total	mg/L	77.0
UA	G287	WLOA	2021/07/13	Calcium, total	mg/L	73.0
UA	G287	WLOA	2021/07/27	Calcium, total	mg/L	81.0
UA	G287	WLOA	2021/03/29	Chloride, total	mg/L	23.0

UA	G287	WLOA	2021/04/22	Chloride, total	mg/L	27.0
UA	G287	WLOA	2021/05/06	Chloride, total	mg/L	23.0
UA	G287	WLOA	2021/05/18	Chloride, total	mg/L	24.0
UA	G287	WLOA	2021/06/14	Chloride, total	mg/L	22.0
UA	G287	WLOA	2021/06/28	Chloride, total	mg/L	28.0
UA	G287	WLOA	2021/07/13	Chloride, total	mg/L	35.0
UA	G287	WLOA	2021/07/27	Chloride, total	mg/L	24.0
UA	G287	WLOA	2021/03/29	Magnesium, total	mg/L	39.0
UA	G287	WLOA	2021/04/22	Magnesium, total	mg/L	40.0
UA	G287	WLOA	2021/05/06	Magnesium, total	mg/L	41.0
UA	G287	WLOA	2021/05/18	Magnesium, total	mg/L	38.0
UA	G287	WLOA	2021/06/14	Magnesium, total	mg/L	41.0
UA	G287	WLOA	2021/06/28	Magnesium, total	mg/L	40.0
UA	G287	WLOA	2021/07/13	Magnesium, total	mg/L	38.0
UA	G287	WLOA	2021/07/27	Magnesium, total	mg/L	40.0
UA	G287	WLOA	2021/03/29	Potassium, total	mg/L	0.300
UA	G287	WLOA	2021/04/22	Potassium, total	mg/L	0.690
UA	G287	WLOA	2021/05/06	Potassium, total	mg/L	0.240
UA	G287	WLOA	2021/05/18	Potassium, total	mg/L	0.260
UA	G287	WLOA	2021/06/14	Potassium, total	mg/L	0.620
UA	G287	WLOA	2021/06/28	Potassium, total	mg/L	0.330
UA	G287	WLOA	2021/07/13	Potassium, total	mg/L	0.290
UA	G287	WLOA	2021/07/27	Potassium, total	mg/L	0.410
UA	G287	WLOA	2021/03/29	Sodium, total	mg/L	51.0
UA	G287	WLOA	2021/04/22	Sodium, total	mg/L	58.0
UA	G287	WLOA	2021/05/06	Sodium, total	mg/L	49.0
UA	G287	WLOA	2021/05/18	Sodium, total	mg/L	52.0
UA	G287	WLOA	2021/06/14	Sodium, total	mg/L	52.0
UA	G287	WLOA	2021/06/28	Sodium, total	mg/L	52.0
UA	G287	WLOA	2021/07/13	Sodium, total	mg/L	51.0
UA	G287	WLOA	2021/07/27	Sodium, total	mg/L	54.0
UA	G287	WLOA	2021/03/29	Sulfate, total	mg/L	44.0
UA	G287	WLOA	2021/04/22	Sulfate, total	mg/L	46.0
UA	G287	WLOA	2021/05/06	Sulfate, total	mg/L	43.0
UA	G287	WLOA	2021/05/18	Sulfate, total	mg/L	41.0
UA	G287	WLOA	2021/06/14	Sulfate, total	mg/L	43.0
UA	G287	WLOA	2021/06/28	Sulfate, total	mg/L	50.0
UA	G287	WLOA	2021/07/13	Sulfate, total	mg/L	45.0
UA	G287	WLOA	2021/07/27	Sulfate, total	mg/L	43.0
UA	G287	WLOA	2021/03/29	Temperature (Celsius)	degrees C	11.1
UA	G287	WLOA	2021/04/22	Temperature (Celsius)	degrees C	11.6
UA	G287	WLOA	2021/05/06	Temperature (Celsius)	degrees C	11.9
UA	G287	WLOA	2021/05/18	Temperature (Celsius)	degrees C	12.9
UA	G287	WLOA	2021/06/14	Temperature (Celsius)	degrees C	17.9
UA	G287	WLOA	2021/06/28	Temperature (Celsius)	degrees C	19.3
UA	G287	WLOA	2021/07/13	Temperature (Celsius)	degrees C	18.2
UA	G287	WLOA	2021/07/27	Temperature (Celsius)	degrees C	19.3
UA	G287	WLOA	2021/03/29	Total Dissolved Solids	mg/L	410
UA	G287	WLOA	2021/04/22	Total Dissolved Solids	mg/L	490
UA	G287	WLOA	2021/05/06	Total Dissolved Solids	mg/L	420
UA	G287	WLOA	2021/05/18	Total Dissolved Solids	mg/L	450
UA	G287	WLOA	2021/06/14	Total Dissolved Solids	mg/L	440
UA	G287	WLOA	2021/06/28	Total Dissolved Solids	mg/L	350
UA	G287	WLOA	2021/07/13	Total Dissolved Solids	mg/L	480
UA	G287	WLOA	2021/07/27	Total Dissolved Solids	mg/L	450
UA	G288	WLOA	2021/03/30	pH (field)	SU	7.0
UA	G288	WLOA	2021/04/21	pH (field)	SU	7.1
UA	G288	WLOA	2021/05/06	pH (field)	SU	7.1
UA	G288	WLOA	2021/05/18	pH (field)	SU	7.2
UA	G288	WLOA	2021/06/15	pH (field)	SU	7.1
UA	G288	WLOA	2021/06/28	pH (field)	SU	7.3
UA	G288	WLOA	2021/07/13	pH (field)	SU	7.2

UA	G288	WLOA	2021/07/27	pH (field)	SU	7.5
UA	G288	WLOA	2021/03/30	Oxidation Reduction Potential	mV	40.3
UA	G288	WLOA	2021/04/21	Oxidation Reduction Potential	mV	-21.0
UA	G288	WLOA	2021/05/06	Oxidation Reduction Potential	mV	-10.9
UA	G288	WLOA	2021/05/18	Oxidation Reduction Potential	mV	-74.3
UA	G288	WLOA	2021/06/15	Oxidation Reduction Potential	mV	-122
UA	G288	WLOA	2021/06/28	Oxidation Reduction Potential	mV	-96.7
UA	G288	WLOA	2021/07/13	Oxidation Reduction Potential	mV	-94.9
UA	G288	WLOA	2021/07/27	Oxidation Reduction Potential	mV	-113
UA	G288	WLOA	2021/03/30	Eh	V	0.24
UA	G288	WLOA	2021/05/06	Eh	V	0.19
UA	G288	WLOA	2021/05/18	Eh	V	0.12
UA	G288	WLOA	2021/06/15	Eh	V	0.073
UA	G288	WLOA	2021/06/28	Eh	V	0.097
UA	G288	WLOA	2021/07/13	Eh	V	0.099
UA	G288	WLOA	2021/07/27	Eh	V	0.080
UA	G288	WLOA	2021/03/30	Alkalinity, bicarbonate	mg/L CaCO3	260
UA	G288	WLOA	2021/04/21	Alkalinity, bicarbonate	mg/L CaCO3	240
UA	G288	WLOA	2021/05/06	Alkalinity, bicarbonate	mg/L CaCO3	250
UA	G288	WLOA	2021/05/18	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G288	WLOA	2021/06/15	Alkalinity, bicarbonate	mg/L CaCO3	280
UA	G288	WLOA	2021/06/28	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G288	WLOA	2021/07/13	Alkalinity, bicarbonate	mg/L CaCO3	290
UA	G288	WLOA	2021/07/27	Alkalinity, bicarbonate	mg/L CaCO3	300
UA	G288	WLOA	2021/03/30	Arsenic, total	mg/L	0.00110
UA	G288	WLOA	2021/04/21	Arsenic, total	mg/L	0.00120
UA	G288	WLOA	2021/05/06	Arsenic, total	mg/L	0.00300
UA	G288	WLOA	2021/05/18	Arsenic, total	mg/L	0.00560
UA	G288	WLOA	2021/06/15	Arsenic, total	mg/L	0.00470
UA	G288	WLOA	2021/06/28	Arsenic, total	mg/L	0.00400
UA	G288	WLOA	2021/07/13	Arsenic, total	mg/L	0.00350
UA	G288	WLOA	2021/07/27	Arsenic, total	mg/L	0.00470
UA	G288	WLOA	2021/03/30	Barium, total	mg/L	0.0460
UA	G288	WLOA	2021/04/21	Barium, total	mg/L	0.0370
UA	G288	WLOA	2021/05/06	Barium, total	mg/L	0.0620
UA	G288	WLOA	2021/05/18	Barium, total	mg/L	0.0730
UA	G288	WLOA	2021/06/15	Barium, total	mg/L	0.0740
UA	G288	WLOA	2021/06/28	Barium, total	mg/L	0.0760
UA	G288	WLOA	2021/07/13	Barium, total	mg/L	0.0780
UA	G288	WLOA	2021/07/27	Barium, total	mg/L	0.0810
UA	G288	WLOA	2021/03/30	Calcium, total	mg/L	69.0
UA	G288	WLOA	2021/04/21	Calcium, total	mg/L	170
UA	G288	WLOA	2021/05/06	Calcium, total	mg/L	72.0
UA	G288	WLOA	2021/05/18	Calcium, total	mg/L	75.0
UA	G288	WLOA	2021/06/15	Calcium, total	mg/L	79.0
UA	G288	WLOA	2021/06/28	Calcium, total	mg/L	74.0
UA	G288	WLOA	2021/07/13	Calcium, total	mg/L	71.0
UA	G288	WLOA	2021/07/27	Calcium, total	mg/L	80.0
UA	G288	WLOA	2021/03/30	Chloride, total	mg/L	18.0
UA	G288	WLOA	2021/04/21	Chloride, total	mg/L	31.0
UA	G288	WLOA	2021/05/06	Chloride, total	mg/L	28.0
UA	G288	WLOA	2021/05/18	Chloride, total	mg/L	25.0
UA	G288	WLOA	2021/06/15	Chloride, total	mg/L	31.0
UA	G288	WLOA	2021/06/28	Chloride, total	mg/L	38.0
UA	G288	WLOA	2021/07/13	Chloride, total	mg/L	51.0
UA	G288	WLOA	2021/07/27	Chloride, total	mg/L	32.0
UA	G288	WLOA	2021/03/30	Magnesium, total	mg/L	32.0
UA	G288	WLOA	2021/04/21	Magnesium, total	mg/L	75.0
UA	G288	WLOA	2021/05/06	Magnesium, total	mg/L	30.0
UA	G288	WLOA	2021/05/18	Magnesium, total	mg/L	31.0
UA	G288	WLOA	2021/06/15	Magnesium, total	mg/L	33.0
UA	G288	WLOA	2021/06/28	Magnesium, total	mg/L	33.0

UA	G288	WLOA	2021/07/13	Magnesium, total	mg/L	31.0
UA	G288	WLOA	2021/07/27	Magnesium, total	mg/L	34.0
UA	G288	WLOA	2021/03/30	Potassium, total	mg/L	0.430
UA	G288	WLOA	2021/04/21	Potassium, total	mg/L	1.40
UA	G288	WLOA	2021/05/06	Potassium, total	mg/L	0.470
UA	G288	WLOA	2021/05/18	Potassium, total	mg/L	0.550
UA	G288	WLOA	2021/06/15	Potassium, total	mg/L	0.440
UA	G288	WLOA	2021/06/28	Potassium, total	mg/L	0.420
UA	G288	WLOA	2021/07/13	Potassium, total	mg/L	0.390
UA	G288	WLOA	2021/07/27	Potassium, total	mg/L	0.470
UA	G288	WLOA	2021/03/30	Sodium, total	mg/L	30.0
UA	G288	WLOA	2021/04/21	Sodium, total	mg/L	160
UA	G288	WLOA	2021/05/06	Sodium, total	mg/L	31.0
UA	G288	WLOA	2021/05/18	Sodium, total	mg/L	36.0
UA	G288	WLOA	2021/06/15	Sodium, total	mg/L	35.0
UA	G288	WLOA	2021/06/28	Sodium, total	mg/L	35.0
UA	G288	WLOA	2021/07/13	Sodium, total	mg/L	34.0
UA	G288	WLOA	2021/07/27	Sodium, total	mg/L	36.0
UA	G288	WLOA	2021/03/30	Sulfate, total	mg/L	600
UA	G288	WLOA	2021/04/21	Sulfate, total	mg/L	770
UA	G288	WLOA	2021/05/06	Sulfate, total	mg/L	41.0
UA	G288	WLOA	2021/05/18	Sulfate, total	mg/L	29.0
UA	G288	WLOA	2021/06/15	Sulfate, total	mg/L	37.0
UA	G288	WLOA	2021/06/28	Sulfate, total	mg/L	42.0
UA	G288	WLOA	2021/07/13	Sulfate, total	mg/L	43.0
UA	G288	WLOA	2021/07/27	Sulfate, total	mg/L	42.0
UA	G288	WLOA	2021/03/30	Temperature (Celsius)	degrees C	12.3
UA	G288	WLOA	2021/05/06	Temperature (Celsius)	degrees C	13.3
UA	G288	WLOA	2021/05/18	Temperature (Celsius)	degrees C	13.2
UA	G288	WLOA	2021/06/15	Temperature (Celsius)	degrees C	15.2
UA	G288	WLOA	2021/06/28	Temperature (Celsius)	degrees C	17.6
UA	G288	WLOA	2021/07/13	Temperature (Celsius)	degrees C	17.3
UA	G288	WLOA	2021/07/27	Temperature (Celsius)	degrees C	19.1
UA	G288	WLOA	2021/03/30	Total Dissolved Solids	mg/L	310
UA	G288	WLOA	2021/04/21	Total Dissolved Solids	mg/L	1,400
UA	G288	WLOA	2021/05/06	Total Dissolved Solids	mg/L	350
UA	G288	WLOA	2021/05/18	Total Dissolved Solids	mg/L	390
UA	G288	WLOA	2021/06/15	Total Dissolved Solids	mg/L	330
UA	G288	WLOA	2021/06/28	Total Dissolved Solids	mg/L	340
UA	G288	WLOA	2021/07/13	Total Dissolved Solids	mg/L	390
UA	G288	WLOA	2021/07/27	Total Dissolved Solids	mg/L	410
UA	MW20S	WLOA	2015/10/07	pH (field)	SU	8.0
UA	MW20S	WLOA	2015/10/07	Arsenic, total	mg/L	0.00490
UA	MW20S	WLOA	2015/10/07	Barium, total	mg/L	0.200
UA	MW20S	WLOA	2015/10/07	Chloride, total	mg/L	17.0
UA	MW20S	WLOA	2015/10/07	Iron, dissolved	mg/L	<0.01
UA	MW20S	WLOA	2015/10/07	Manganese, dissolved	mg/L	0.300
UA	MW20S	WLOA	2015/10/07	Sulfate, total	mg/L	89.0
UA	MW20S	WLOA	2015/10/07	Total Dissolved Solids	mg/L	460

Notes:

< = results is less than detection limit
B = Background
C = Compliance
HSU = Hydrostratigraphic Unit
DA = Deep Aquifer
LCU = Lower Confining Unit
UA = Uppermost Aquifer
mg/L = milligrams per liter
SU = standard units
V = volts

Attachment H

Memorandum – Evaluation of Partition Coefficients – Coffeen GMF Recycle Pond

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 GMF Recycle Pond CCR Unit 104, Coffeen Power Plant, Coffeen, Illinois

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INTRODUCTION

The Illinois Power Generation Company (IPGC) currently operates the Coffeen Power Plant (CPP) in Coffeen, Illinois. The coal combustion residuals (CCR) Unit referred to as the Gypsum Management Facility (GMP) Recycle Pond (RP) (Vistra identification [ID] number [No.] 104; Illinois Environmental Protection Agency [IEPA] ID No. W1350150004-04; National Inventory of Dams [NID] No. IL50578) is a 17-acre pond that receives blowdown from the air emission scrubber. The pond was in operation starting in 2010 until April 11, 2021, when IPGC ceased receipt of waste to the GMF RP. Geosyntec Consultants (Geosyntec) is assisting IPGC with Part 845 compliance at the Site.

IPGC is currently preparing a Construction Permit application for the GMF RP 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) as outlined 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 the GMF RP, including boron, sulfate, and total dissolved solids (TDS). 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 the GMF RP which included completion of two (2) soil/rock borings ranging in depth from 18 to 28 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**.

One groundwater sample (G215) and one soil sample (SB-215) 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. One set of microcosms was amended (i.e., spiked) with sodium sulfate (Na_2SO_4) and another with boric acid (H_3BO_3) to achieve target concentrations of sulfate and boron, respectively (**Table 2**).

An initial sample of the stock solution for each experimental design was collected on Day 0, and a control sample (i.e., only amended G215 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 partition 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 partition 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 partition 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 partition coefficients (K_d, K_L, and K_F, respectively) and $1/n$ values are shown in **Table 5**.

SUMMARY OF RESULTS

The partition coefficient values for each amendment (denoted as G215-SO_4 when amended with sodium sulfate and G215-B when amended with boric acid) are presented in **Table 5**. Figures which show the linear, Langmuir, and Freundlich isotherms for boron and sulfate are provided in **Appendix A**. Measurements of soil boron concentrations in SB-215 are pending; a surrogate value of 0 mg/kg was used, consistent with soil boron concentrations from other areas at the CPP.

A boron partition coefficient was not determined for any isotherm for the boron amended microcosms. Both the linear and linearized Langmuir isotherms yielded negative partition coefficients, and the linearized Freundlich could not be calculated as the data were not conducive to log transformation. Other studies have reported low partition coefficients for boron ranging from 0.19 to 1.3 L/kg, depending on pH conditions and the amount of sorbent present (EPRI, 2005; Strenge & Peterson, 1989).

A sulfate partition coefficient was not determined for any isotherm for the sulfate amended microcosms. The linear isotherm yielded a partition coefficient of 0.1 L/kg but had a very poor goodness-of-fit, and the Langmuir isotherm yielded a negative coefficient. As in the boron-amended microcosms, the Freundlich isotherm could not be calculated because the data were not conducive to log transformation 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

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TABLES

Table 1 - Batch Attenuation Testing Data Summary
Coffeen GMF RP

Groundwater Sample ID	**Soil Sample ID**	**Soil: Water Ratio**
G215	SB-215 (19-24.5 ft bgs) Sodium Sulfate Amendment	2:1.5
		1:1.3
		1:5.8
		1:11.5
		1:27.2
G215	SB-215 (19-24.5 ft bgs) Boric Acid Amendment	2:1.5
		1:1.3
		1:5.8
		1:11.5
		1:28.1

Notes:

ft bgs = feet below ground surface

Table 2 - Microcosm Amendment and Target Concentrations
Coffeen GMF RP

Groundwater Sample ID	Soil Sample ID	Compound	Amendment	Target Concentration (mg/L)
G215	SB-215 (19-24.5 ft bgs)	Boron	31.93 mL of a 2 g/L H_3BO_3	6
		Sulfate	3.41 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
Coffeen GMF RP - Sodium Sulfate Amendment

Groundwater Sample ID	Geologic Material Sample ID	Treatment	Date	Day	Replicate	Dissolved Sulfate	pH	ORP
						mg/L	SU	mV
G215	--	Groundwater Only Control	25-Jan-22	0	G215-1a (SO_4^{2-})	1,589	6.98	83
					G215-2a (SO_4^{2-})	1,826	6.99	79
					Average Concentration (mg/L)	**1,708**	**6.99**	**81**
			7-Feb-22	7	G215-1 (SO_4^{2-})	1,617	6.8	26
					G215-2 (SO_4^{2-})	1,478	6.81	13
					Average Concentration (mg/L)	**1,548**	**6.81**	**20**
	G215 SB-215 Geologic Material	2:1 Soil:Water Ratio	31-Jan-22	0				
			7-Feb-22	7	SB-215-(19-24.5) :G215 2:1-1 (SO_4^{2-})	1,321	6.92	57
					SB-215-(19-24.5) :G215 2:1-2 (SO_4^{2-})	1,302	6.94	103
					Average Concentration (mg/L)	**1,311**	**6.93**	**80**
		1:1 Soil:Water Ratio	31-Jan-22	0				
			7-Feb-22	7	SB-215-(19-24.5) :G215 1:1-1 (SO_4^{2-})	1,727	6.89	85
					SB-215-(19-24.5) :G215 1:1-2 (SO_4^{2-})	860	6.91	91
					Average Concentration (mg/L)	**1,294**	**6.90**	**88**
		1:5 Soil:Water Ratio	31-Jan-22	0				
			7-Feb-22	7	SB-215-(19-24.5) :G215 1:5-1 (SO_4^{2-})	1,326	6.92	29
					SB-215-(19-24.5) :G215 1:5-2 (SO_4^{2-})	1,516	6.87	15
					Average Concentration (mg/L)	**1,421**	**6.90**	**22**
		1:10 Soil:Water Ratio	31-Jan-22	0				
			7-Feb-22	7	SB-215-(19-24.5) :G215 1:10-1 (SO_4^{2-})	1,570	6.87	23
					SB-215-(19-24.5) :G215 1:10-2 (SO_4^{2-})	1,551	6.85	30
					Average Concentration (mg/L)	**1,560**	**6.86**	**27**
		1:20 Soil:Water Ratio	31-Jan-22	0				
			7-Feb-22	7	SB-215-(19-24.5) :G215 1:20-1 (SO_4^{2-})	1,511	6.83	32
					SB-215-(19-24.5) :G215 1:20-2 (SO_4^{2-})	1,588	6.84	79
					Average Concentration (mg/L)	**1,550**	**6.84**	**56**

Notes:

mg/L - milligrams per liter

mV - millivolts

SU - Standard Units

ORP - oxidation/reduction potential

Table 4 - Batch Attenuation Testing Results
Coffeen GMF RP - Boric Acid Amendment

Groundwater Sample ID	Geologic Material Sample ID	Treatment	Date	Day	Replicate	Dissolved Boron	pH	ORP
						mg/L	SU	mV
G215	--	Groundwater Only Control	25-Jan-22	0	G215-1a (B)	4.6	6.88	90
					G215-2a (B)	4.7	6.85	72
					Average Concentration (mg/L)	**4.7**	**6.87**	**81**
			7-Feb-22	7	G215-1 (B)	5.3	6.9	57
					G215-2 (B)	5.4	7.03	13
					Average Concentration (mg/L)	**5.4**	**6.97**	**35**
	G215 SB-215 Geologic Material	2:1 Soil:Water Ratio	31-Jan-22	0				
			7-Feb-22	7	SB-215-(19-24.5) :G215 2:1-1 (B)	3.4	6.91	9
					SB-215-(19-24.5) :G215 2:1-2 (B)	3.4	7.05	11
					Average Concentration (mg/L)	**3.4**	**6.98**	**10**
		1:1 Soil:Water Ratio	31-Jan-22	0				
			7-Feb-22	7	SB-215-(19-24.5) :G215 1:1-1 (B)	4.3	6.98	15
					SB-215-(19-24.5) :G215 1:1-2 (B)	4.3	7.06	31
					Average Concentration (mg/L)	**4.3**	**7.02**	**23**
		1:5 Soil:Water Ratio	31-Jan-22	0				
			7-Feb-22	7	SB-215-(19-24.5) :G215 1:5-1 (B)	5.0	6.96	49
					SB-215-(19-24.5) :G215 1:5-2 (B)	5.2	7.00	19
					Average Concentration (mg/L)	**5.1**	**6.98**	**34**
		1:10 Soil:Water Ratio	31-Jan-22	0				
			7-Feb-22	7	SB-215-(19-24.5) :G215 1:10-1 (B)	5.5	6.95	20
					SB-215-(19-24.5) :G215 1:10-2 (B)	5.3	6.95	29
					Average Concentration (mg/L)	**5.4**	**6.95**	**25**
		1:20 Soil:Water Ratio	31-Jan-22	0				
			7-Feb-22	7	SB-215-(19-24.5) :G215 1:20-1 (B)	5.6	6.93	174
					SB-215-(19-24.5) :G215 1:20-2 (B)	5.5	6.84	102
					Average Concentration (mg/L)	**5.5**	**6.89**	**138**

Notes:

mg/L - milligrams per liter
mV - millivolts
SU - Standard Units
ORP - oxidation/reduction potential

Table 5 - Partition Coefficient Results
Coffeen GMF RP

Analyte	Amendment	Isotherm	Variable	Value
Boron	**Boric Acid**	**Linear**	**R^2**	0.518
			K_D (L/kg)	-8.45
		Langmuir	**R^2**	0.47
			q_m (mg/g)	0.000
			K_L (L/kg)	-1.87E+05
		Freundlich	**R^2**	--
			1/n	--
			K_F (L/kg)	--
Sulfate	**Sodium Sulfate**	**Linear**	**R^2**	0.0
			K_D (L/kg)	0.10
		Langmuir	**R^2**	0.66
			q_m (mg/g)	-0.028
			K_L (L/kg)	-8.94E+02
		Freundlich	**R^2**	--
			1/n	--
			K_F (L/kg)	--

Notes:

The Freundlich isotherm was not calculated for boron or sulfate because the data were not conducive to log transformation

K_D - linear partition coefficient

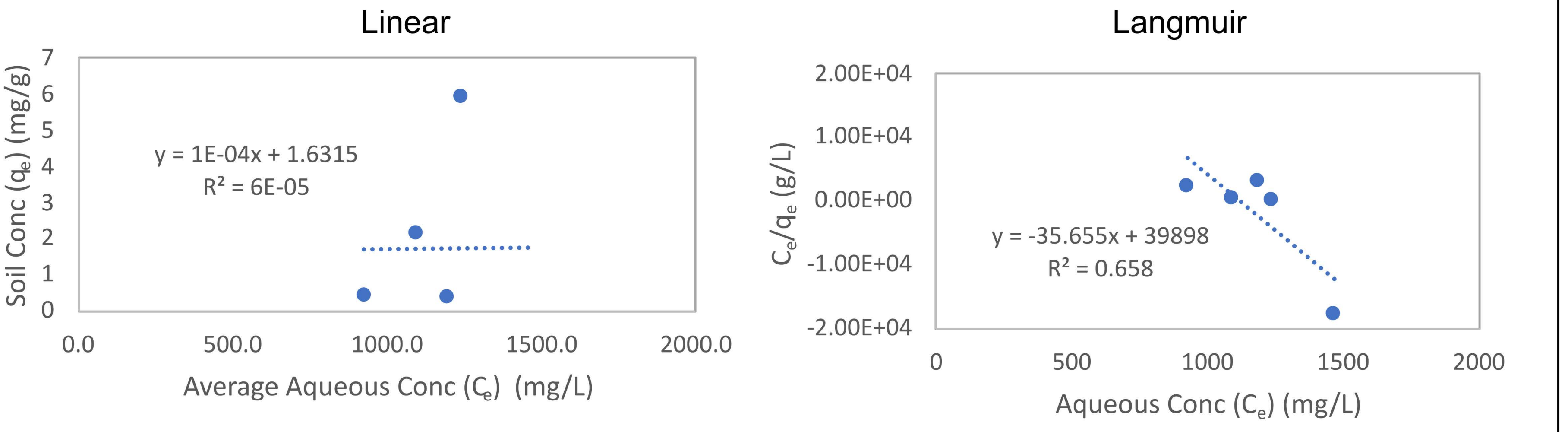
K_L - Langmuir partition coefficient

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:

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

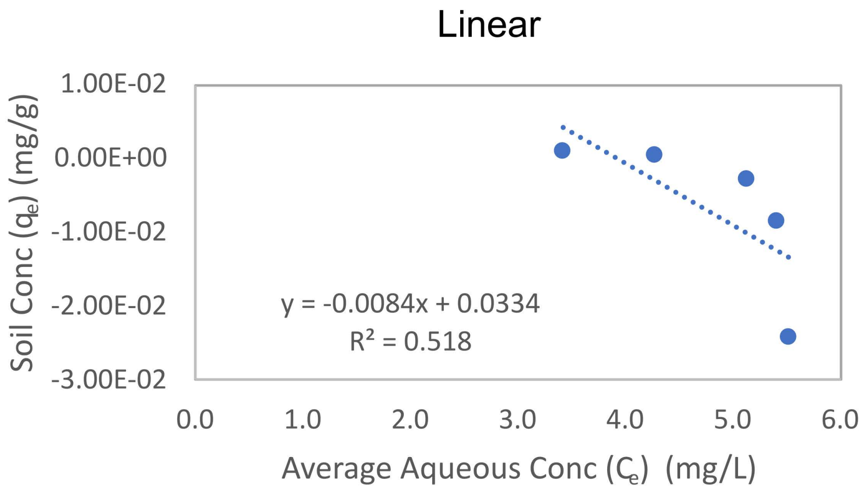
G215-SO_4 Sulfate Partitioning Coefficients
Coffeen Power Plant GMF RP
Coffeen, Illinois

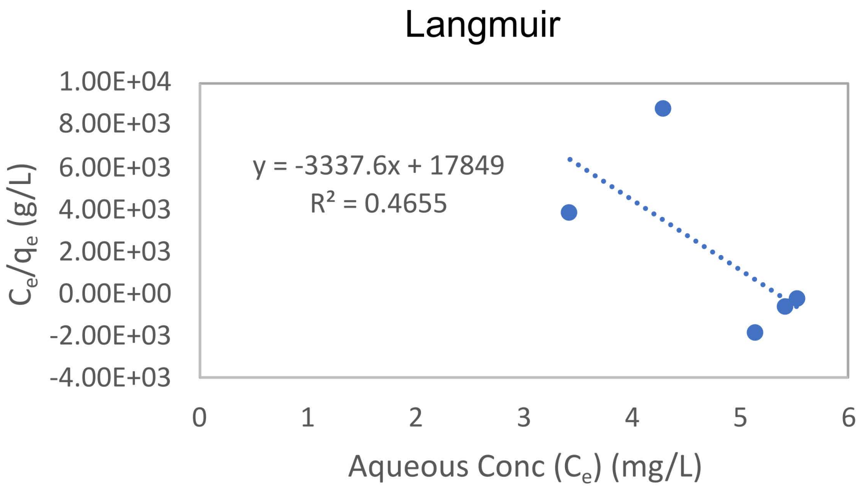
Geosyntec consultants

Columbus, OH

May 2022

Figure
1





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

G215-B Boron Partitioning Coefficients
Coffeen Power Plant GMF RP
Coffeen, Illinois

Geosyntec consultants

Columbus, OH

May 2022

Figure

2

Appendix E

Groundwater Polishing Evaluation Report

Geosyntec consultants

engineers | scientists | innovators

Groundwater Polishing Evaluation Report

Coffeen Power Plant – Gypsum Management Facility Recycle Pond

(IEPA ID No. W1350150004-04)

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 2025

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ACRONYMS AND ABBREVIATIONS

%	percent
CAAA	Corrective Action Alternatives 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
GMF	Gypsum Management Facility
GSP	Gypsum Stack Pond
GWPS	Groundwater protection standard
IEPA	Illinois Environmental Protection Agency
LCU	Lowermost confining unit
mg/kg	milligrams per kilogram
NPDES	National Pollutant Discharge Elimination System
redox	oxidation-reduction
RP	Recycle Pond
SEP	Sequential extraction procedure
TDS	Total dissolved solids
UA	Uppermost aquifer
UCU	Uppermost confining unit
USEPA	United States Environmental Protection Agency
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 Gypsum Management Facility (GMF) Recycle Pond (RP) Unit. The constituents of concern (COCs) addressed in this document are 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 GMF RP.

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 sulfate is feasible under current conditions through sorption to iron and aluminum oxide solids and barite precipitation. Modeling indicates that sulfate attenuation via sorption onto mineral surfaces should remain stable under post-closure conditions, as iron and aluminum oxide mineral phases are predicted to experience minor (if any) dissolution with background groundwater interaction.

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[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 Gypsum Management Facility Recycle Pond. 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.

Additionally, barite precipitation was predicted in all future scenarios. Remobilization of sulfate is unlikely to affect the estimated time to reach the GWPS based on modeling results. It is anticipated that attenuation of sulfate will contribute to a reduction in TDS concentrations. 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 Gypsum Management Facility (GMF) Recycle Pond (RP) Unit. The purpose of the CAAA is to holistically evaluate potentially viable corrective actions to remediate groundwater and achieve compliance with 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 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 GMF RP.[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 Report [Ramboll, 2022]). 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 GMF RP 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 to groundwater polishing under current conditions and after source control implementation.

The groundwater flow and transport model (Ramboll, 2022) 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 sulfate before and after source control as a means of contextualizing the times estimated in the flow and transport model. This analysis also provides an initial

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[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.

foundation for understanding groundwater chemistry to inform adaptive site management as a key component of the Corrective Action Groundwater Monitoring Plan[4].

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[4] The Corrective Action Groundwater Monitoring Plan serves as Appendix B to the Corrective Action Plan.

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 Coffeen GMF RP impoundment is located to the south of the GMF Gypsum Stack Pond (GSP) coal combustion residuals (CCR) unit. An Unnamed Tributary runs north to south to the east of the GMF GSP and RP. The GMF RP is an 18.3-acre lined surface impoundment that received decanted water from the GMF GSP from 2010 to 2021 to act as a polishing pond. Outflow from the GMF RP was pumped back to the CPP for use in the wet scrubber system, and the GMF RP also has an emergency spillway that discharges to the Unnamed Tributary via a National Pollutant Discharge Elimination System (NPDES) permitted outfall. The GMF RP was also utilized for the storage of CCR early in its operational period. The GMF RP was constructed in accordance with Illinois Environmental Protection Agency (IEPA) Water Pollution Control Permit No. 2008-EA-4661 and is constructed with a composite high-density polyethylene (HDPE) liner over three feet of recompacted soil with an underlying leachate collection system/leak detection 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 GMF RP unit. The proposed groundwater monitoring network is shown in **Attachment A**. The monitoring network consists of 10 downgradient compliance monitoring wells (G271, G273, G275, G275D, G276, G277, G279, G283, G284 and G285) and 2 upgradient background wells (G270 and G280).

The geology underlying the Site in the vicinity of GMF RP consists of five distinct hydrostratigraphic units (Ramboll, 2021):

- **Upper Confining Unit (UCU):** The UCU 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 percent (%) fines. The UCU was encountered across most of the CPP subsurface.
- **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.
- **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 feet thick), discontinuous unit composed of sands and silty sands.

- **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 and east toward the Unnamed Tributary, the eastern lobe of Coffeen Lake, and the discharge flume. Groundwater flow in the vicinity of the GMF RP is generally to the east to southeast, in the direction of the Unnamed Tributary. 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 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 GMF RP were observed from 2023 Q2 through 2023 Q4 (Ramboll, 2024):

- Sulfate – Observed at monitoring wells G273, G279, and G285.
- TDS – Observed at monitoring wells G279 and G285.

Monitoring wells G273 and G279 are screened within the UA, whereas monitoring well G285 is screened within the LCU.

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 GWPS.

2.3 Geochemical Conceptual Site Model

A Geochemical Conceptual Site Model (GCSM)[5] was developed for Coffeen GMF RP 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.

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[5] 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.

The primary source of sulfate to groundwater of the UA and LCU within the monitoring network is GMF RP CCR porewater. This finding is based on sulfate concentrations within the source and relationships to hydrogeological patterns at the Site.

Limited variability in pH or oxidation-reduction (redox) conditions have been observed between upgradient (background) and downgradient locations, with pH values in the UA and LCU observed to be generally stable and circumneutral. Redox conditions within the UA are relatively oxidizing at both background and compliance locations, while within the LCU redox conditions are observed to range between relatively oxidizing to relatively reducing.

Sulfate in the groundwater system may be attenuated via adsorption and surface complexation reactions within portions of the UA and LCU. Sulfate sorption to iron oxyhydroxide phases is potentially occurring within the subsurface near GMF RP due to the ubiquitous nature of these materials. Groundwater conditions from the UA are predicted to favor amorphous iron oxide stability, though dynamic equilibrium conditions between amorphous iron oxides and ferrous iron may occur and would impact the stability of sorbent phases. Groundwater conditions from the LCU are predicted to favor dissolved ferrous iron at many LCU locations, such that there may be a dynamic equilibrium between this species and amorphous iron oxides and iron carbonate minerals, as supported by the detected presence of iron-bearing carbonate minerals (ankerite) in some site solids. Crystalline iron oxides were not identified in analyzed aquifer solids samples, so iron oxides present in site solids are likely present at quantities below the analytical detection limits or in non-crystalline or amorphous phases.

The GCSM findings suggest the potential for chemical attenuation of sulfate based on modeling of pH and groundwater redox conditions that are potentially favorable for the stability of amorphous iron-bearing phases, particularly within the UA. Attenuation of sulfate to oxide materials is determined by their thermodynamic stability, which is dependent on speciation, redox conditions, and pH. Sulfate is a major contributor to TDS concentrations at RP monitoring wells, so attenuation of sulfate is expected to contribute somewhat to a reduction in TDS in the groundwater.

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 (Ramboll, 2022), which is based on hydraulic properties of the aquifer and does not take into account chemical interactions of sulfate within the hydrologic unit.

3.1 Methods

Geochemical modeling was done in PHREEQC Version 3 (USGS 2021) using a modified MINTEQ v4 thermodynamic database (as described in relevant sections below). The geochemical modeling of groundwater polishing under current conditions and conditions after source control is completed includes speciation and reaction modeling (USEPA 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 mechanisms that may occur at time scales relevant to groundwater flow, including adsorption and certain mineral dissolution/precipitation reactions (i.e., iron and aluminum (hydr)oxides, carbonates, and some sulfates) as identified in the GCSM[6]. The model

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[6] 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.

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 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**. Data used in the model and discussed below are provided in the Nature and Extent Report[7].

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 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 GMF RP samples, model input concentrations for crystalline iron oxide for GMF RP were derived using site-specific total metals and mineralogy (X-ray diffraction [XRD]) datasets, and input concentrations for ferrihydrite were taken from a SEP dataset compiled from analogous geological systems, as described in greater detail in **Attachment C**. Gibbsite input concentrations for GMF RP 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 gibbsite 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 and dolomite are present in site aquifer solids (that were analyzed for mineralogy) in excess, and model input concentration were based on site-specific XRD results.

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[7] 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).

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 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[8].

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 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 both 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 3** 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**.

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[8] 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 Sulfate

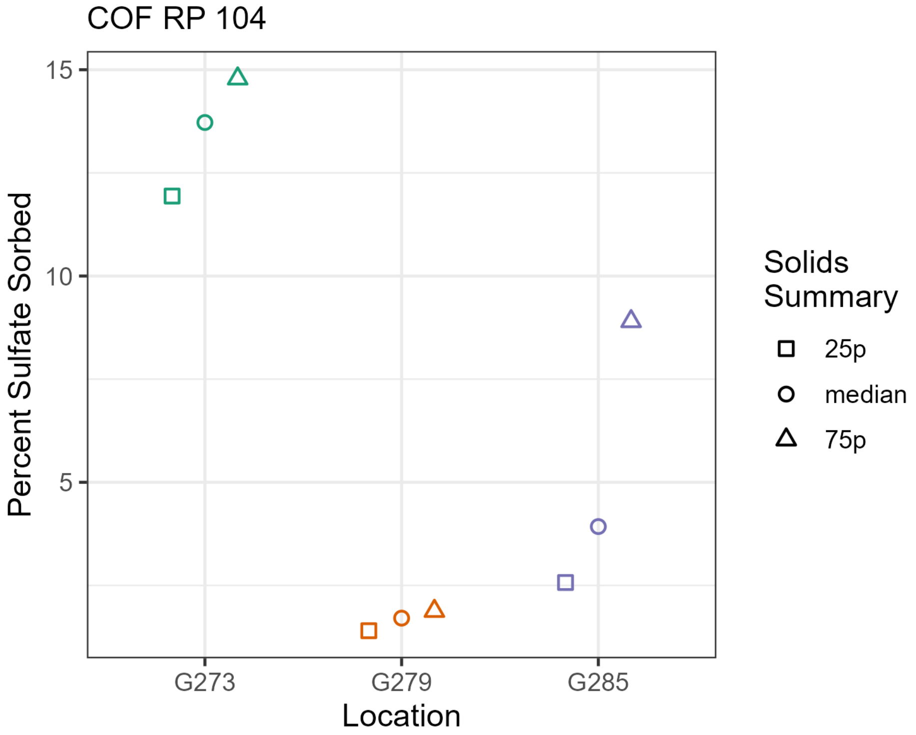


Figure 2: Modeled Sulfate Behavior

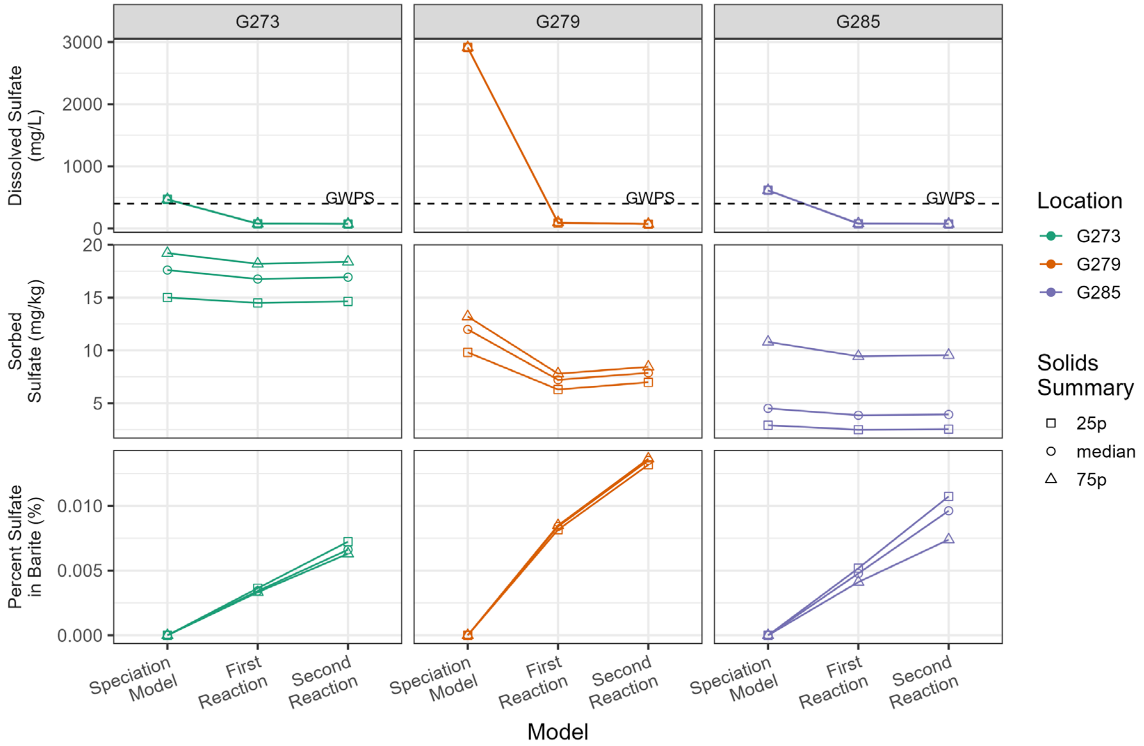
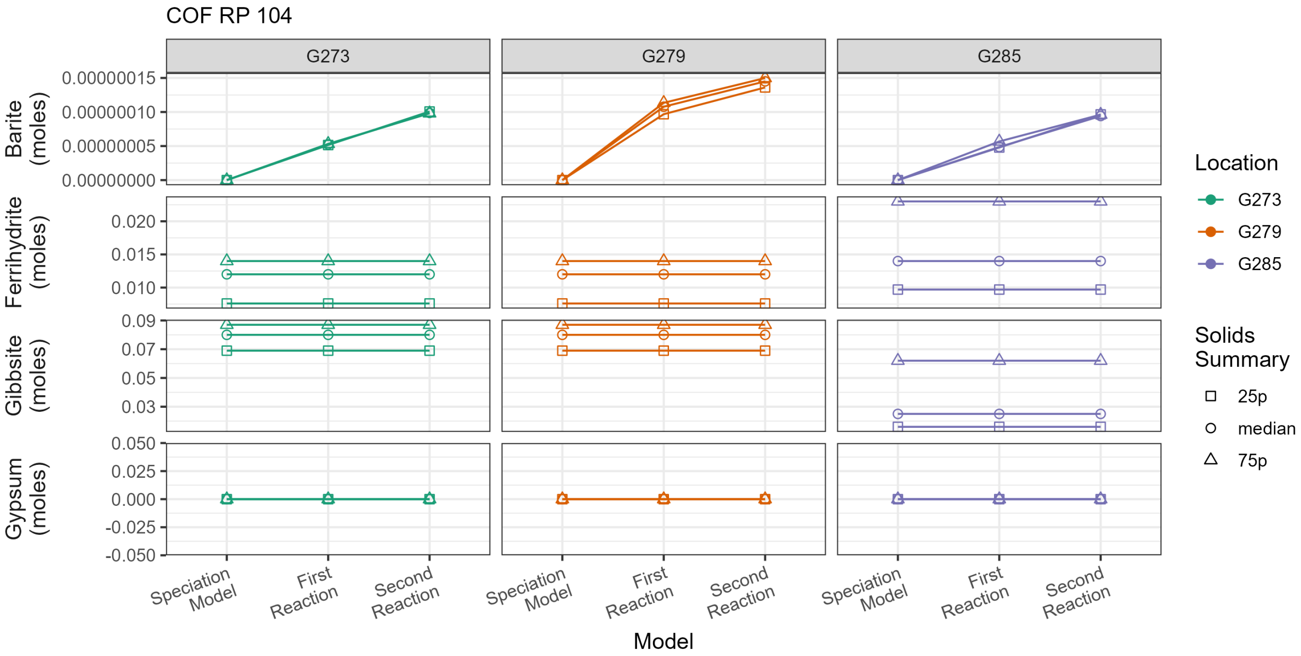


Figure 3: Modeled Sorbing Phase Behavior



3.2.2 Speciation Modeling

Results of speciation modeling indicate that some chemical attenuation of sulfate is likely to occur for all wells, although minor (less than 10% aqueous sulfate sorbed) amounts of attenuation are predicted for groundwater at locations G279 and G285 (**Figure 1**). Sulfate sorption to aquifer solids is predicted to be comparable across the UA and LCU based on speciation modeling results. More attenuation is predicted for UA location G273 compared to other wells with exceedances, with results indicating between 12 to 15% of aqueous sulfate sorption. Sensitivity assessments demonstrate the 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 6% (applicable to location G285) of aqueous sulfate sorbed under current conditions. These results suggest that some sulfate sorption is predicted under current geochemical conditions, although sorption is variable depending on location and the absolute amount of sorbed sulfate is somewhat sensitive to the amount of sorbent.

3.2.3 Reaction modeling

Reaction modeling of conditions following source control demonstrate that aqueous sulfate concentrations decrease with background groundwater interaction (**Figure 2**). Aqueous sulfate concentrations are predicted to decrease with each iterative reaction, although the relative decrease in concentration between the first reaction and second reaction is a much smaller magnitude decrease (**Figure 2**). Some degree of sulfate desorption is predicted with background groundwater interaction after the first iterative reaction; however, the impact of this desorption on aqueous sulfate concentrations is offset by background groundwater containing less aqueous sulfate. All modeled wells are predicted to achieve the sulfate GWPS following the first iterative reaction, indicating that mobilization of currently attenuated sulfate is unlikely to affect the modeled time to reach the GWPS.

Sulfate is 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 3**). Barite precipitation is predicted in all post-source control scenarios, which provides an additional attenuation mechanism for aqueous sulfate (**Figure 3**). The predicted stability of sorbing mineral phases and precipitation of barite under post-source control conditions demonstrates the continued feasibility of sulfate chemical attenuation in groundwater downgradient of GMF RP.

These results suggest that chemical attenuation of sulfate should remain feasible following source control efforts. 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. Sulfate is a major contributor to TDS concentrations at RP monitoring wells, so chemical attenuation of sulfate is also expected to contribute to a reduction in TDS.

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 sulfate attenuation as groundwater quality returns to background conditions.

Geochemical modeling of current GMF RP geochemical conditions demonstrates chemical attenuation of sulfate via sorption to aquifer solids, particularly iron and aluminum oxides, and precipitation of barite. Modeling of anticipated post-source control conditions predicts some desorption of sulfate from solids that will be offset by interaction with background groundwater containing low aqueous sulfate concentrations, resulting in net aqueous sulfate concentration decreases at all wells with exceedances. Barite precipitation is predicted under post-source control 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, the dominant contributor to TDS concentrations, will also contribute to a reduction in TDS.

Results of the geochemical modeling suggest that mobilization of currently attenuated sulfate is unlikely to affect the modeled time to reach the GWPS. The results will inform corrective action groundwater monitoring and adaptive site management, critical components of every corrective action considered in the CAAA.

5. REFERENCES

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TABLES

Table 1. Summary of Geochemical Model Inputs
Groundwater Polishing Evaluation Report
Coffeen Power Plant - Gypsum Management Facility Recycle Pond

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 Modeling Response of Sorbing Phases
Groundwater Polishing Evaluation Report
Coffeen Power Plant - Gypsum Management Facility Recycle Pond

Parameter	Hydrostratigraphic Unit	Location	Summary Type	First Reaction Change		Second Reaction Change	
				mg/kg	%	mg/kg	%
Barite	LCU	G285	25p	0.00201	NA	0.00406	101.52
			median	0.00204	NA	0.00396	93.65
			75p	0.00239	NA	0.00404	69.43
	UA	G273	25p	0.00285	NA	0.00557	95.59
			median	0.0029	NA	0.00545	88.04
			75p	0.00294	NA	0.00542	84.21
		G279	25p	0.00535	NA	0.00752	40.61
			median	0.00596	NA	0.00801	34.53
			75p	0.00627	NA	0.00828	32.08
Ferrihydrite	LCU	G285	25p	187	<0.01	187	<0.01
			median	270	<0.01	270	<0.01
			75p	443	<0.01	443	<0.01
	UA	G273	25p	192	<0.01	192	<0.01
			median	304	<0.01	304	<0.01
			75p	354	<0.01	354	<0.01
		G279	25p	192	<0.01	192	<0.01
			median	304	<0.01	304	<0.01
			75p	354	<0.01	354	<0.01
Gibbsite	LCU	G285	25p	225	<0.01	225	<0.01
			median	351	<0.01	351	<0.01
			75p	871	<0.01	871	<0.01
	UA	G273	25p	1270	<0.01	1270	<0.01
			median	1480	<0.01	1480	<0.01
			75p	1610	<0.01	1610	<0.01
		G279	25p	1270	<0.01	1270	<0.01
			median	1480	<0.01	1480	<0.01
			75p	1610	<0.01	1610	<0.01

Notes:

% = percent

25p = 25th percentile

75p = 75th percentile

mg/kg = milligram/kilogram

LCU = Lower Confining Unit

UA = Uppermost Aquifer

NA = not applicable

ATTACHMENT A
Operating Permit Network Map and Potentiometric Surface - August 2023

⊞	COMPLIANCE MONITORING WELL
⊞	BACKGROUND WELL
⊞	PORE WATER 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
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

ATTACHMENT B

PHREEQC Input Files and Thermodynamic Database

25th Percentile Metal Oxides/No Charge Balance

```
SELECTED_OUTPUT 1
-file COF_845_104_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 #G285 (C - LCU)
redox pe
units mg/l
density 1
pH 6.755
pe 4.645
temp 14.95
S(6) 613 as SO4
B 0.1065
Li 0.0038
As 0.000485
C(4) 383 as CO3
Cl 24.5
F 0.327
Ca 271
Mg 91.25
Na 129
K 2.19
Ba 0.04425
Si 4.855
P 0.01825
Mn 0.8325
Fe 0.0875
Al 0.009125
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.0011
Co 0.00295
Pb 0.00028
Mo 0.0035
Se 0.000335
end

SOLUTION 2 #G273 (C - UA)
redox pe
units mg/l
density 1
```

```
pH 6.665
pe 6.125
temp 17.3
S(6) 467.5 as SO4
B 0.0454
Li 0.0046
As 0.0003725
C(4) 217.5 as CO3
Cl 70.5
F 0.292
Ca 162
Mg 82.5
Na 99.5
K 0.4735
Ba 0.03335
Si 8.225
P 0.003225
Mn 0.0482
Fe 0.019875
Al 0.004675
Sb 0.0006075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.00017
Pb 0.000205
Mo 0.00078
Se 0.000335
end

SOLUTION 3 #G279 (C - UA)
redox pe
units mg/l
density 1
pH 6.62
pe 7.5
temp 18.3
S(6) 2900 as SO4
B 4
Li 0.017
As 0.0011
C(4) 204 as CO3
Cl 490
F 0.322
Ca 710
Mg 450
Na 250
K 2.5
Ba 0.043
Si 9.9
P 0.00395
Mn 0.16
Fe 0.0037
Al 0.0041
```

```
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00024
Pb 0.00011
Mo 0.00074
Se 0.0068
end

EQUILIBRIUM_PHASES 1 #G285 (C - LCU) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.016
Ferrihydrite 0 0.0097
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 #G273 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.069
Ferrihydrite 0 0.0076
Calcite 0 1
Dolomite(ordered) 0 3

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 #G279 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.069
Ferrihydrite 0 0.0076
Calcite 0 1
Dolomite(ordered) 0 3

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
```

```
SOLUTION 4 #average background
redox pe
units mg/l
density 1
pH 7.095
pe 4.95
temp 15.3
S(6) 72.5
B 0.0093
Li 0.0027
As 0.000485
C(4) 182.5
Cl 41.5 charge
F 0.3245
Ca 68.45
Mg 30.3
Na 69.4
K 0.625
Ba 0.05105
Si 7.365
P 0.00775
Mn 0.0411
Fe 0.013875
Al 0.013
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.0003
Pb 0.000405
Mo 0.000885
Se 0.000335

SAVE solution 4

end

#FIRST REACTION

#G285 (C - LCU) - First Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G285 (C - LCU) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G273 (C - UA) - First Reaction
USE SOLUTION 4
```

```
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G273 (C - UA) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G279 (C - UA) - First Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G279 (C - UA) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end
```

25th Percentile Metal Oxides/Charge Balance on Chloride

```
SELECTED_OUTPUT 1
-file COF_845_104_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 #G285 (C - LCU)
redox pe
units mg/l
density 1
pH 6.755
pe 4.645
temp 14.95
S(6) 613 as SO4
B 0.1065
Li 0.0038
As 0.000485
C(4) 383 as CO3
Cl 24.5 charge
F 0.327
Ca 271
Mg 91.25
Na 129
K 2.19
Ba 0.04425
Si 4.855
P 0.01825
Mn 0.8325
Fe 0.0875
Al 0.009125
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.0011
Co 0.00295
Pb 0.00028
Mo 0.0035
Se 0.000335
end

SOLUTION 2 #G273 (C - UA)
redox pe
units mg/l
density 1
```

```
pH 6.665
pe 6.125
temp 17.3
S(6) 467.5 as SO4
B 0.0454
Li 0.0046
As 0.0003725
C(4) 217.5 as CO3
Cl 70.5 charge
F 0.292
Ca 162
Mg 82.5
Na 99.5
K 0.4735
Ba 0.03335
Si 8.225
P 0.003225
Mn 0.0482
Fe 0.019875
Al 0.004675
Sb 0.0006075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.00017
Pb 0.000205
Mo 0.00078
Se 0.000335
end

SOLUTION 3 #G279 (C - UA)
redox pe
units mg/l
density 1
pH 6.62
pe 7.5
temp 18.3
S(6) 2900 as SO4
B 4
Li 0.017
As 0.0011
C(4) 204 as CO3
Cl 490 charge
F 0.322
Ca 710
Mg 450
Na 250
K 2.5
Ba 0.043
Si 9.9
P 0.00395
Mn 0.16
Fe 0.0037
Al 0.0041
```

```
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00024
Pb 0.00011
Mo 0.00074
Se 0.0068
end

EQUILIBRIUM_PHASES 1 #G285 (C - LCU) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.016
Ferrihydrite 0 0.0097
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 #G273 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.069
Ferrihydrite 0 0.0076
Calcite 0 1
Dolomite(ordered) 0 3

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 #G279 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.069
Ferrihydrite 0 0.0076
Calcite 0 1
Dolomite(ordered) 0 3

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
```

```
SOLUTION 4 #average background
redox pe
units mg/l
density 1
pH 7.095
pe 4.95
temp 15.3
S(6) 72.5
B 0.0093
Li 0.0027
As 0.000485
C(4) 182.5
Cl 41.5 charge
F 0.3245
Ca 68.45
Mg 30.3
Na 69.4
K 0.625
Ba 0.05105
Si 7.365
P 0.00775
Mn 0.0411
Fe 0.013875
Al 0.013
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.0003
Pb 0.000405
Mo 0.000885
Se 0.000335

SAVE solution 4

end

#FIRST REACTION

#G285 (C - LCU) - First Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G285 (C - LCU) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G273 (C - UA) - First Reaction
USE SOLUTION 4
```

```
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G273 (C - UA) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G279 (C - UA) - First Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G279 (C - UA) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end
```

75th Percentile Metal Oxides/No Charge Balance

```
SELECTED_OUTPUT 1
-file COF_845_104_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 #G285 (C - LCU)
redox pe
units mg/l
density 1
pH 6.755
pe 4.645
temp 14.95
S(6) 613 as SO4
B 0.1065
Li 0.0038
As 0.000485
C(4) 383 as CO3
Cl 24.5
F 0.327
Ca 271
Mg 91.25
Na 129
K 2.19
Ba 0.04425
Si 4.855
P 0.01825
Mn 0.8325
Fe 0.0875
Al 0.009125
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.0011
Co 0.00295
Pb 0.00028
Mo 0.0035
Se 0.000335
end

SOLUTION 2 #G273 (C - UA)
redox pe
units mg/l
density 1
```

```
pH 6.665
pe 6.125
temp 17.3
S(6) 467.5 as SO4
B 0.0454
Li 0.0046
As 0.0003725
C(4) 217.5 as CO3
Cl 70.5
F 0.292
Ca 162
Mg 82.5
Na 99.5
K 0.4735
Ba 0.03335
Si 8.225
P 0.003225
Mn 0.0482
Fe 0.019875
Al 0.004675
Sb 0.0006075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.00017
Pb 0.000205
Mo 0.00078
Se 0.000335
end

SOLUTION 3 #G279 (C - UA)
redox pe
units mg/l
density 1
pH 6.62
pe 7.5
temp 18.3
S(6) 2900 as SO4
B 4
Li 0.017
As 0.0011
C(4) 204 as CO3
Cl 490
F 0.322
Ca 710
Mg 450
Na 250
K 2.5
Ba 0.043
Si 9.9
P 0.00395
Mn 0.16
Fe 0.0037
Al 0.0041
```

```
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00024
Pb 0.00011
Mo 0.00074
Se 0.0068
end

EQUILIBRIUM_PHASES 1 #G285 (C - LCU) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.062
Ferrihydrite 0 0.023
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 #G273 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.087
Ferrihydrite 0 0.014
Calcite 0 1
Dolomite(ordered) 0 3

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 #G279 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.087
Ferrihydrite 0 0.014
Calcite 0 1
Dolomite(ordered) 0 3

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
```

```
SOLUTION 4 #average background
redox pe
units mg/l
density 1
pH 7.095
pe 4.95
temp 15.3
S(6) 72.5
B 0.0093
Li 0.0027
As 0.000485
C(4) 182.5
Cl 41.5 charge
F 0.3245
Ca 68.45
Mg 30.3
Na 69.4
K 0.625
Ba 0.05105
Si 7.365
P 0.00775
Mn 0.0411
Fe 0.013875
Al 0.013
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.0003
Pb 0.000405
Mo 0.000885
Se 0.000335

SAVE solution 4

end

#FIRST REACTION

#G285 (C - LCU) - First Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G285 (C - LCU) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G273 (C - UA) - First Reaction
USE SOLUTION 4
```

```
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G273 (C - UA) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G279 (C - UA) - First Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G279 (C - UA) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end
```

75th Percentile Metal Oxides/Charge Balance on Chloride

```
SELECTED_OUTPUT 1
-file COF_845_104_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 #G285 (C - LCU)
redox pe
units mg/l
density 1
pH 6.755
pe 4.645
temp 14.95
S(6) 613 as SO4
B 0.1065
Li 0.0038
As 0.000485
C(4) 383 as CO3
Cl 24.5 charge
F 0.327
Ca 271
Mg 91.25
Na 129
K 2.19
Ba 0.04425
Si 4.855
P 0.01825
Mn 0.8325
Fe 0.0875
Al 0.009125
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.0011
Co 0.00295
Pb 0.00028
Mo 0.0035
Se 0.000335
end

SOLUTION 2 #G273 (C - UA)
redox pe
units mg/l
density 1
```

```
pH 6.665
pe 6.125
temp 17.3
S(6) 467.5 as SO4
B 0.0454
Li 0.0046
As 0.0003725
C(4) 217.5 as CO3
Cl 70.5 charge
F 0.292
Ca 162
Mg 82.5
Na 99.5
K 0.4735
Ba 0.03335
Si 8.225
P 0.003225
Mn 0.0482
Fe 0.019875
Al 0.004675
Sb 0.0006075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.00017
Pb 0.000205
Mo 0.00078
Se 0.000335
end

SOLUTION 3 #G279 (C - UA)
redox pe
units mg/l
density 1
pH 6.62
pe 7.5
temp 18.3
S(6) 2900 as SO4
B 4
Li 0.017
As 0.0011
C(4) 204 as CO3
Cl 490 charge
F 0.322
Ca 710
Mg 450
Na 250
K 2.5
Ba 0.043
Si 9.9
P 0.00395
Mn 0.16
Fe 0.0037
Al 0.0041
```

```
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00024
Pb 0.00011
Mo 0.00074
Se 0.0068
end

EQUILIBRIUM_PHASES 1 #G285 (C - LCU) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.062
Ferrihydrite 0 0.023
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 #G273 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.087
Ferrihydrite 0 0.014
Calcite 0 1
Dolomite(ordered) 0 3

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 #G279 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.087
Ferrihydrite 0 0.014
Calcite 0 1
Dolomite(ordered) 0 3

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
```

```
SOLUTION 4 #average background
redox pe
units mg/l
density 1
pH 7.095
pe 4.95
temp 15.3
S(6) 72.5
B 0.0093
Li 0.0027
As 0.000485
C(4) 182.5
Cl 41.5 charge
F 0.3245
Ca 68.45
Mg 30.3
Na 69.4
K 0.625
Ba 0.05105
Si 7.365
P 0.00775
Mn 0.0411
Fe 0.013875
Al 0.013
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.0003
Pb 0.000405
Mo 0.000885
Se 0.000335

SAVE solution 4

end

#FIRST REACTION

#G285 (C - LCU) - First Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G285 (C - LCU) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G273 (C - UA) - First Reaction
USE SOLUTION 4
```

```
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G273 (C - UA) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G279 (C - UA) - First Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G279 (C - UA) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end
```

Median Metal Oxides/No Charge Balance

```
SELECTED_OUTPUT 1
-file COF_845_104_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 #G285 (C - LCU)
redox pe
units mg/l
density 1
pH 6.755
pe 4.645
temp 14.95
S(6) 613 as SO4
B 0.1065
Li 0.0038
As 0.000485
C(4) 383 as CO3
Cl 24.5
F 0.327
Ca 271
Mg 91.25
Na 129
K 2.19
Ba 0.04425
Si 4.855
P 0.01825
Mn 0.8325
Fe 0.0875
Al 0.009125
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.0011
Co 0.00295
Pb 0.00028
Mo 0.0035
Se 0.000335
end

SOLUTION 2 #G273 (C - UA)
redox pe
units mg/l
density 1
```

```
pH 6.665
pe 6.125
temp 17.3
S(6) 467.5 as SO4
B 0.0454
Li 0.0046
As 0.0003725
C(4) 217.5 as CO3
Cl 70.5
F 0.292
Ca 162
Mg 82.5
Na 99.5
K 0.4735
Ba 0.03335
Si 8.225
P 0.003225
Mn 0.0482
Fe 0.019875
Al 0.004675
Sb 0.0006075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.00017
Pb 0.000205
Mo 0.00078
Se 0.000335
end

SOLUTION 3 #G279 (C - UA)
redox pe
units mg/l
density 1
pH 6.62
pe 7.5
temp 18.3
S(6) 2900 as SO4
B 4
Li 0.017
As 0.0011
C(4) 204 as CO3
Cl 490
F 0.322
Ca 710
Mg 450
Na 250
K 2.5
Ba 0.043
Si 9.9
P 0.00395
Mn 0.16
Fe 0.0037
Al 0.0041
```

```
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00024
Pb 0.00011
Mo 0.00074
Se 0.0068
end

EQUILIBRIUM_PHASES 1 #G285 (C - LCU) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.025
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 #G273 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.08
Ferrihydrite 0 0.012
Calcite 0 1
Dolomite(ordered) 0 3

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 #G279 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.08
Ferrihydrite 0 0.012
Calcite 0 1
Dolomite(ordered) 0 3

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
```

```
SOLUTION 4 #average background
redox pe
units mg/l
density 1
pH 7.095
pe 4.95
temp 15.3
S(6) 72.5
B 0.0093
Li 0.0027
As 0.000485
C(4) 182.5
Cl 41.5 charge
F 0.3245
Ca 68.45
Mg 30.3
Na 69.4
K 0.625
Ba 0.05105
Si 7.365
P 0.00775
Mn 0.0411
Fe 0.013875
Al 0.013
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.0003
Pb 0.000405
Mo 0.000885
Se 0.000335

SAVE solution 4

end

#FIRST REACTION

#G285 (C - LCU) - First Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G285 (C - LCU) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G273 (C - UA) - First Reaction
USE SOLUTION 4
```

```
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G273 (C - UA) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G279 (C - UA) - First Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G279 (C - UA) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end
```

Median Metal Oxides/Charge Balance on Chloride

```
SELECTED_OUTPUT 1
-file COF_845_104_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 #G285 (C - LCU)
redox pe
units mg/l
density 1
pH 6.755
pe 4.645
temp 14.95
S(6) 613 as SO4
B 0.1065
Li 0.0038
As 0.000485
C(4) 383 as CO3
Cl 24.5 charge
F 0.327
Ca 271
Mg 91.25
Na 129
K 2.19
Ba 0.04425
Si 4.855
P 0.01825
Mn 0.8325
Fe 0.0875
Al 0.009125
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.0011
Co 0.00295
Pb 0.00028
Mo 0.0035
Se 0.000335
end

SOLUTION 2 #G273 (C - UA)
redox pe
units mg/l
density 1
```

```
pH 6.665
pe 6.125
temp 17.3
S(6) 467.5 as SO4
B 0.0454
Li 0.0046
As 0.0003725
C(4) 217.5 as CO3
Cl 70.5 charge
F 0.292
Ca 162
Mg 82.5
Na 99.5
K 0.4735
Ba 0.03335
Si 8.225
P 0.003225
Mn 0.0482
Fe 0.019875
Al 0.004675
Sb 0.0006075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.00017
Pb 0.000205
Mo 0.00078
Se 0.000335
end

SOLUTION 3 #G279 (C - UA)
redox pe
units mg/l
density 1
pH 6.62
pe 7.5
temp 18.3
S(6) 2900 as SO4
B 4
Li 0.017
As 0.0011
C(4) 204 as CO3
Cl 490 charge
F 0.322
Ca 710
Mg 450
Na 250
K 2.5
Ba 0.043
Si 9.9
P 0.00395
Mn 0.16
Fe 0.0037
Al 0.0041
```

```
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00024
Pb 0.00011
Mo 0.00074
Se 0.0068
end

EQUILIBRIUM_PHASES 1 #G285 (C - LCU) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.025
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 #G273 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.08
Ferrihydrite 0 0.012
Calcite 0 1
Dolomite(ordered) 0 3

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 #G279 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.08
Ferrihydrite 0 0.012
Calcite 0 1
Dolomite(ordered) 0 3

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
```

```
SOLUTION 4 #average background
redox pe
units mg/l
density 1
pH 7.095
pe 4.95
temp 15.3
S(6) 72.5
B 0.0093
Li 0.0027
As 0.000485
C(4) 182.5
Cl 41.5 charge
F 0.3245
Ca 68.45
Mg 30.3
Na 69.4
K 0.625
Ba 0.05105
Si 7.365
P 0.00775
Mn 0.0411
Fe 0.013875
Al 0.013
Sb 0.0003075
Be 0.0001975
Cd 0.000235
Cr 0.00135
Co 0.0003
Pb 0.000405
Mo 0.000885
Se 0.000335

SAVE solution 4

end

#FIRST REACTION

#G285 (C - LCU) - First Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G285 (C - LCU) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#G273 (C - UA) - First Reaction
USE SOLUTION 4
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USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G273 (C - UA) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#G279 (C - UA) - First Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#G279 (C - UA) - Second Reaction
USE SOLUTION 4
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end
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Database

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#$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
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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
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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
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```
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
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```
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
```

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# 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
```

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-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:
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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
```

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-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
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```
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
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```
#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 Gypsum Management Facility Recycle Pond (RP) 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 (35 I.A.C.) § 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 RP samples. The dataset constraints necessitated alternative means of deriving oxide inputs.

Because SEP analyses were not completed on any Coffeen RP 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 (applicable to crystalline iron oxides) or amorphous metal oxides (iron and aluminum) compiled from SEP datasets consisting of samples collected from similar geologic systems at various power generating facilities across Illinois. Monitoring wells within the Coffeen RP uppermost aquifer (UA) and lower confining unit (LCU) were modeled, so hydrostratigraphic unit-specific solid phase inputs were incorporated to account for geologic variability across units. Much of the Coffeen RP UA consists of the Hagarstown Member, so the analogous dataset for the UA is comprised of samples collected from various power generating

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[1] The Nature and Extent Report was previously submitted to IEPA in April 2024, and provided with relevant updates as Appendix D of the CAAA to which this report is attached.

facilities across Illinois specifically within the Hagarstown Member. The RP LCU consists of geologic formations which was not sampled at other Illinois power generating facilities; therefore, the LCU analogous dataset is comprised of numerous samples collected from multiple geologic units at power generating facilities across Illinois. The geologic similarity (regional geology, similar lithologies and depositional environments, similar mineral assemblages) between the samples comprising these datasets and the Coffeen RP subsurface make these datasets appropriate for estimating the amount and distribution of sorbing solid phases in the absence of a complete site-specific dataset.

SEP data for iron and aluminum is available for 25 solid phase samples across six distinct hydrostratigraphic units (LCU analogous dataset), of which 3 solid phase samples are specifically from the Hagarstown Member (UA analogous dataset).

Total solid-phase iron was measured in six RP UA solids samples at concentrations ranging from 4,200 milligrams per kilogram (mg/kg) to 22,000 mg/kg. Total solid-phase iron was measured for one LCU solid sample (8,200 mg/kg). Three RP 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, but no iron oxide minerals were detected. The UA in the vicinity of the RP was therefore determined to not contain crystalline iron oxide material. No RP LCU solid samples were analyzed for mineralogy. The crystalline iron component for the LCU was determined by applying a proportion of 0.005 (representative of 0.5 weight % - the method detection limit for most crystalline mineral phases in X-ray diffraction analysis) to the total iron value from the LCU sample.

The amorphous ferrihydrite components for both hydrostratigraphic units were based on the 25th percentile of amorphous ferrihydrite distribution in each applicable analogous compiled SEP dataset.

The gibbsite component of the models was determined using the average mass of aluminum associated with the oxide fraction from each 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

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[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.

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:

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 (Ramboll 2021).

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 and dolomite are common carbonate minerals and were 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. Therefore, the mass fractions reported in the X-ray diffraction are used as model inputs for the UA. No RP LCU solid samples were analyzed using X-ray diffraction, so calcite and dolomite mass fractions from adjacent Ash Pond 1 LCU samples are used as model inputs for the RP LCU. 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 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 I.A.C. § 845.600[3]: Although these parameters are not subject to corrective action at Coffeen RP, 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[4] 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:

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[3] 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.

[4] https://static.horiba.com/fileadmin/Horiba/Products/Process_and_Environmental/Water_Pollution/Instruction_Manuals/U-50/U-50_Manual.pdf

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:

$$\frac{mg\ CO_3^{2-}}{L} = \frac{mg\ CaCO_3}{L} \times \frac{mole\ CaCO_3}{100.1\ mg\ CaCO_3} \times \frac{1\ mole\ CO_3^{2-}}{1\ mole\ CaCO_3} \times \frac{60\ mg\ CO_3^{2-}}{mole\ CO_3^{2-}}$$

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.

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ATTACHMENT D
Complete Geochemical Modeling Outputs

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
GMF Recycle Pond
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	pH	pe	charge	pct_err	S(6)
G285	C - LCU	Initial Soln	TRUE	25p	6.75	4.64	5.43e-16	1.19e-12	0.00639
G273	C - UA	Initial Soln	TRUE	25p	6.66	6.12	-4.80e-18	-1.45e-14	0.00487
G279	C - UA	Initial Soln	TRUE	25p	6.62	7.50	-1.79e-17	-1.51e-14	0.0303
G285	C - LCU	Speciation Model	TRUE	25p	6.75	4.64	5.48e-16	1.20e-12	0.00639
G273	C - UA	Speciation Model	TRUE	25p	6.66	6.12	4.74e-18	1.43e-14	0.00487
G279	C - UA	Speciation Model	TRUE	25p	6.62	7.50	1.20e-10	1.01e-07	0.0303
G285	C - LCU	First Reaction	TRUE	25p	7.42	1.41	9.65e-06	0.0484	0.000779
G285	C - LCU	Second Reaction	TRUE	25p	7.51	1.22	2.36e-06	0.0125	0.000752
G273	C - UA	First Reaction	TRUE	25p	7.45	2.96	-9.40e-05	-4.80e-01	0.000778
G273	C - UA	Second Reaction	TRUE	25p	7.52	2.75	-2.36e-06	-1.26e-02	0.000748
G279	C - UA	First Reaction	TRUE	25p	7.46	4.03	-2.58e-04	-1.31e+00	0.000909
G279	C - UA	Second Reaction	TRUE	25p	7.52	3.62	-5.37e-06	-2.88e-02	0.000725
G285	C - LCU	Initial Soln	TRUE	75p	6.75	4.64	5.43e-16	1.19e-12	0.00639
G273	C - UA	Initial Soln	TRUE	75p	6.66	6.12	-4.80e-18	-1.45e-14	0.00487
G279	C - UA	Initial Soln	TRUE	75p	6.62	7.50	-1.79e-17	-1.51e-14	0.0303
G285	C - LCU	Speciation Model	TRUE	75p	6.75	4.64	5.48e-16	1.20e-12	0.00639
G273	C - UA	Speciation Model	TRUE	75p	6.66	6.12	4.74e-18	1.43e-14	0.00487
G279	C - UA	Speciation Model	TRUE	75p	6.62	7.50	1.20e-10	1.01e-07	0.0303
G285	C - LCU	First Reaction	TRUE	75p	7.34	1.59	-3.76e-05	-1.78e-01	0.000834
G285	C - LCU	Second Reaction	TRUE	75p	7.45	1.32	-2.24e-06	-1.15e-02	0.000749
G273	C - UA	First Reaction	TRUE	75p	7.40	3.08	-9.19e-05	-4.55e-01	0.000799
G273	C - UA	Second Reaction	TRUE	75p	7.49	2.83	-5.22e-06	-2.75e-02	0.000747
G279	C - UA	First Reaction	TRUE	75p	7.41	4.22	-2.72e-04	-1.33e+00	0.000993
G279	C - UA	Second Reaction	TRUE	75p	7.50	3.76	-1.03e-05	-5.42e-02	0.000727
G285	C - LCU	Initial Soln	TRUE	median	6.75	4.64	5.43e-16	1.19e-12	0.00639
G273	C - UA	Initial Soln	TRUE	median	6.66	6.12	-4.80e-18	-1.45e-14	0.00487
G279	C - UA	Initial Soln	TRUE	median	6.62	7.50	-1.79e-17	-1.51e-14	0.0303
G285	C - LCU	Speciation Model	TRUE	median	6.75	4.64	5.48e-16	1.20e-12	0.00639
G273	C - UA	Speciation Model	TRUE	median	6.66	6.12	4.74e-18	1.43e-14	0.00487
G279	C - UA	Speciation Model	TRUE	median	6.62	7.50	1.20e-10	1.01e-07	0.0303
G285	C - LCU	First Reaction	TRUE	median	7.39	1.48	8.17e-06	0.0401	0.000793
G285	C - LCU	Second Reaction	TRUE	median	7.49	1.25	1.74e-06	0.00910	0.000751
G273	C - UA	First Reaction	TRUE	median	7.41	3.05	-8.99e-05	-4.49e-01	0.000793
G273	C - UA	Second Reaction	TRUE	median	7.50	2.81	-4.19e-06	-2.21e-02	0.000747
G279	C - UA	First Reaction	TRUE	median	7.42	4.16	-2.61e-04	-1.29e+00	0.000964
G279	C - UA	Second Reaction	TRUE	median	7.51	3.71	-8.38e-06	-4.45e-02	0.000726
G285	C - LCU	Initial Soln	FALSE	25p	6.75	4.64	0.00859	23.5	0.00639
G273	C - UA	Initial Soln	FALSE	25p	6.66	6.12	0.00498	17.7	0.00487
G279	C - UA	Initial Soln	FALSE	25p	6.62	7.50	0.00682	6.11	0.0303
G285	C - LCU	Speciation Model	FALSE	25p	6.75	4.64	0.00859	23.5	0.00639
G273	C - UA	Speciation Model	FALSE	25p	6.66	6.12	0.00498	17.7	0.00487
G279	C - UA	Speciation Model	FALSE	25p	6.62	7.50	0.00682	6.11	0.0303
G285	C - LCU	First Reaction	FALSE	25p	7.42	1.41	9.78e-06	0.0490	0.000779
G285	C - LCU	Second Reaction	FALSE	25p	7.51	1.21	2.36e-06	0.0125	0.000752

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
GMF Recycle Pond
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	pH	pe	charge	pct_err	S(6)
G273	C - UA	First Reaction	FALSE	25p	7.45	2.96	-8.41e-05	-4.30e-01	0.000776
G273	C - UA	Second Reaction	FALSE	25p	7.52	2.75	-2.28e-06	-1.22e-02	0.000748
G279	C - UA	First Reaction	FALSE	25p	7.46	4.03	-2.52e-04	-1.28e+00	0.000907
G279	C - UA	Second Reaction	FALSE	25p	7.52	3.62	-5.30e-06	-2.84e-02	0.000725
G285	C - LCU	Initial Soln	FALSE	75p	6.75	4.64	0.00859	23.5	0.00639
G273	C - UA	Initial Soln	FALSE	75p	6.66	6.12	0.00498	17.7	0.00487
G279	C - UA	Initial Soln	FALSE	75p	6.62	7.50	0.00682	6.11	0.0303
G285	C - LCU	Speciation Model	FALSE	75p	6.75	4.64	0.00859	23.5	0.00639
G273	C - UA	Speciation Model	FALSE	75p	6.66	6.12	0.00498	17.7	0.00487
G279	C - UA	Speciation Model	FALSE	75p	6.62	7.50	0.00682	6.11	0.0303
G285	C - LCU	First Reaction	FALSE	75p	7.34	1.59	-3.08e-05	-1.46e-01	0.000831
G285	C - LCU	Second Reaction	FALSE	75p	7.45	1.32	-2.17e-06	-1.11e-02	0.000748
G273	C - UA	First Reaction	FALSE	75p	7.40	3.08	-8.09e-05	-4.00e-01	0.000797
G273	C - UA	Second Reaction	FALSE	75p	7.49	2.83	-5.10e-06	-2.68e-02	0.000747
G279	C - UA	First Reaction	FALSE	75p	7.41	4.22	-2.65e-04	-1.30e+00	0.000991
G279	C - UA	Second Reaction	FALSE	75p	7.50	3.76	-1.02e-05	-5.38e-02	0.000727
G285	C - LCU	Initial Soln	FALSE	median	6.75	4.64	0.00859	23.5	0.00639
G273	C - UA	Initial Soln	FALSE	median	6.66	6.12	0.00498	17.7	0.00487
G279	C - UA	Initial Soln	FALSE	median	6.62	7.50	0.00682	6.11	0.0303
G285	C - LCU	Speciation Model	FALSE	median	6.75	4.64	0.00859	23.5	0.00639
G273	C - UA	Speciation Model	FALSE	median	6.66	6.12	0.00498	17.7	0.00487
G279	C - UA	Speciation Model	FALSE	median	6.62	7.50	0.00682	6.11	0.0303
G285	C - LCU	First Reaction	FALSE	median	7.39	1.48	8.86e-06	0.0435	0.000792
G285	C - LCU	Second Reaction	FALSE	median	7.49	1.25	1.74e-06	0.00910	0.000751
G273	C - UA	First Reaction	FALSE	median	7.41	3.05	-7.94e-05	-3.97e-01	0.000791
G273	C - UA	Second Reaction	FALSE	median	7.50	2.81	-4.08e-06	-2.16e-02	0.000747
G279	C - UA	First Reaction	FALSE	median	7.42	4.16	-2.55e-04	-1.26e+00	0.000962
G279	C - UA	Second Reaction	FALSE	median	7.51	3.71	-8.30e-06	-4.41e-02	0.000726

Location	Location Description	Model	Charge Balance	Solids Summary	B	Li	As	C(4)	Cl
G285	C - LCU	Initial Soln	TRUE	25p	9.87e-06	5.48e-07	6.48e-09	0.00639	0.00927
G273	C - UA	Initial Soln	TRUE	25p	4.20e-06	6.63e-07	4.98e-09	0.00363	0.00696
G279	C - UA	Initial Soln	TRUE	25p	0.000372	2.46e-06	1.48e-08	0.00342	0.0207
G285	C - LCU	Speciation Model	TRUE	25p	9.87e-06	5.48e-07	6.48e-09	0.00639	0.00927
G273	C - UA	Speciation Model	TRUE	25p	4.20e-06	6.63e-07	4.98e-09	0.00363	0.00696
G279	C - UA	Speciation Model	TRUE	25p	0.000372	2.46e-06	1.48e-08	0.00342	0.0207
G285	C - LCU	First Reaction	TRUE	25p	9.50e-06	3.89e-07	1.38e-09	0.00431	0.00484
G285	C - LCU	Second Reaction	TRUE	25p	8.48e-06	3.89e-07	1.27e-09	0.00369	0.00484
G273	C - UA	First Reaction	TRUE	25p	5.61e-06	3.89e-07	2.58e-09	0.00414	0.00484
G273	C - UA	Second Reaction	TRUE	25p	5.76e-06	3.89e-07	2.60e-09	0.00359	0.00484
G279	C - UA	First Reaction	TRUE	25p	0.000149	3.89e-07	2.44e-09	0.00407	0.00484
G279	C - UA	Second Reaction	TRUE	25p	0.000120	3.89e-07	2.61e-09	0.00360	0.00484
G285	C - LCU	Initial Soln	TRUE	75p	9.87e-06	5.48e-07	6.48e-09	0.00639	0.00927
G273	C - UA	Initial Soln	TRUE	75p	4.20e-06	6.63e-07	4.98e-09	0.00363	0.00696
G279	C - UA	Initial Soln	TRUE	75p	0.000372	2.46e-06	1.48e-08	0.00342	0.0207
G285	C - LCU	Speciation Model	TRUE	75p	9.87e-06	5.48e-07	6.48e-09	0.00639	0.00927
G273	C - UA	Speciation Model	TRUE	75p	4.20e-06	6.63e-07	4.98e-09	0.00363	0.00696
G279	C - UA	Speciation Model	TRUE	75p	0.000372	2.46e-06	1.48e-08	0.00342	0.0207
G285	C - LCU	First Reaction	TRUE	75p	1.03e-05	3.89e-07	1.70e-09	0.00498	0.00484
G285	C - LCU	Second Reaction	TRUE	75p	1.05e-05	3.89e-07	1.15e-09	0.00412	0.00484
G273	C - UA	First Reaction	TRUE	75p	5.46e-06	3.89e-07	2.71e-09	0.00449	0.00484
G273	C - UA	Second Reaction	TRUE	75p	5.69e-06	3.89e-07	2.14e-09	0.00379	0.00484
G279	C - UA	First Reaction	TRUE	75p	0.000155	3.89e-07	2.47e-09	0.00437	0.00484
G279	C - UA	Second Reaction	TRUE	75p	0.000128	3.89e-07	2.11e-09	0.00377	0.00484
G285	C - LCU	Initial Soln	TRUE	median	9.87e-06	5.48e-07	6.48e-09	0.00639	0.00927
G273	C - UA	Initial Soln	TRUE	median	4.20e-06	6.63e-07	4.98e-09	0.00363	0.00696
G279	C - UA	Initial Soln	TRUE	median	0.000372	2.46e-06	1.48e-08	0.00342	0.0207
G285	C - LCU	Speciation Model	TRUE	median	9.87e-06	5.48e-07	6.48e-09	0.00639	0.00927
G273	C - UA	Speciation Model	TRUE	median	4.20e-06	6.63e-07	4.98e-09	0.00363	0.00696
G279	C - UA	Speciation Model	TRUE	median	0.000372	2.46e-06	1.48e-08	0.00342	0.0207
G285	C - LCU	First Reaction	TRUE	median	9.87e-06	3.89e-07	1.46e-09	0.00456	0.00484
G285	C - LCU	Second Reaction	TRUE	median	9.41e-06	3.89e-07	1.14e-09	0.00384	0.00484
G273	C - UA	First Reaction	TRUE	median	5.50e-06	3.89e-07	2.64e-09	0.00439	0.00484
G273	C - UA	Second Reaction	TRUE	median	5.71e-06	3.89e-07	2.20e-09	0.00373	0.00484
G279	C - UA	First Reaction	TRUE	median	0.000153	3.89e-07	2.43e-09	0.00428	0.00484
G279	C - UA	Second Reaction	TRUE	median	0.000125	3.89e-07	2.18e-09	0.00372	0.00484
G285	C - LCU	Initial Soln	FALSE	25p	9.87e-06	5.48e-07	6.48e-09	0.00639	0.000692
G273	C - UA	Initial Soln	FALSE	25p	4.20e-06	6.63e-07	4.98e-09	0.00363	0.00199
G279	C - UA	Initial Soln	FALSE	25p	0.000372	2.46e-06	1.48e-08	0.00342	0.0139
G285	C - LCU	Speciation Model	FALSE	25p	9.87e-06	5.48e-07	6.48e-09	0.00639	0.000692
G273	C - UA	Speciation Model	FALSE	25p	4.20e-06	6.63e-07	4.98e-09	0.00363	0.00199
G279	C - UA	Speciation Model	FALSE	25p	0.000372	2.46e-06	1.48e-08	0.00342	0.0139
G285	C - LCU	First Reaction	FALSE	25p	9.33e-06	3.89e-07	1.46e-09	0.00431	0.00484
G285	C - LCU	Second Reaction	FALSE	25p	8.34e-06	3.89e-07	1.34e-09	0.00369	0.00484

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Location	Location Description	Model	Charge Balance	Solids Summary	B	Li	As	C(4)	Cl
G273	C - UA	First Reaction	FALSE	25p	5.54e-06	3.89e-07	2.66e-09	0.00414	0.00484
G273	C - UA	Second Reaction	FALSE	25p	5.69e-06	3.89e-07	2.69e-09	0.00359	0.00484
G279	C - UA	First Reaction	FALSE	25p	0.000149	3.89e-07	2.50e-09	0.00407	0.00484
G279	C - UA	Second Reaction	FALSE	25p	0.000120	3.89e-07	2.68e-09	0.00360	0.00484
G285	C - LCU	Initial Soln	FALSE	75p	9.87e-06	5.48e-07	6.48e-09	0.00639	0.000692
G273	C - UA	Initial Soln	FALSE	75p	4.20e-06	6.63e-07	4.98e-09	0.00363	0.00199
G279	C - UA	Initial Soln	FALSE	75p	0.000372	2.46e-06	1.48e-08	0.00342	0.0139
G285	C - LCU	Speciation Model	FALSE	75p	9.87e-06	5.48e-07	6.48e-09	0.00639	0.000692
G273	C - UA	Speciation Model	FALSE	75p	4.20e-06	6.63e-07	4.98e-09	0.00363	0.00199
G279	C - UA	Speciation Model	FALSE	75p	0.000372	2.46e-06	1.48e-08	0.00342	0.0139
G285	C - LCU	First Reaction	FALSE	75p	1.01e-05	3.89e-07	1.80e-09	0.00498	0.00484
G285	C - LCU	Second Reaction	FALSE	75p	1.03e-05	3.89e-07	1.22e-09	0.00412	0.00484
G273	C - UA	First Reaction	FALSE	75p	5.39e-06	3.89e-07	2.79e-09	0.00449	0.00484
G273	C - UA	Second Reaction	FALSE	75p	5.62e-06	3.89e-07	2.22e-09	0.00379	0.00484
G279	C - UA	First Reaction	FALSE	75p	0.000154	3.89e-07	2.53e-09	0.00437	0.00484
G279	C - UA	Second Reaction	FALSE	75p	0.000127	3.89e-07	2.16e-09	0.00377	0.00484
G285	C - LCU	Initial Soln	FALSE	median	9.87e-06	5.48e-07	6.48e-09	0.00639	0.000692
G273	C - UA	Initial Soln	FALSE	median	4.20e-06	6.63e-07	4.98e-09	0.00363	0.00199
G279	C - UA	Initial Soln	FALSE	median	0.000372	2.46e-06	1.48e-08	0.00342	0.0139
G285	C - LCU	Speciation Model	FALSE	median	9.87e-06	5.48e-07	6.48e-09	0.00639	0.000692
G273	C - UA	Speciation Model	FALSE	median	4.20e-06	6.63e-07	4.98e-09	0.00363	0.00199
G279	C - UA	Speciation Model	FALSE	median	0.000372	2.46e-06	1.48e-08	0.00342	0.0139
G285	C - LCU	First Reaction	FALSE	median	9.70e-06	3.89e-07	1.54e-09	0.00456	0.00484
G285	C - LCU	Second Reaction	FALSE	median	9.25e-06	3.89e-07	1.21e-09	0.00384	0.00484
G273	C - UA	First Reaction	FALSE	median	5.43e-06	3.89e-07	2.72e-09	0.00439	0.00484
G273	C - UA	Second Reaction	FALSE	median	5.64e-06	3.89e-07	2.28e-09	0.00373	0.00484
G279	C - UA	First Reaction	FALSE	median	0.000152	3.89e-07	2.49e-09	0.00428	0.00484
G279	C - UA	Second Reaction	FALSE	median	0.000125	3.89e-07	2.24e-09	0.00372	0.00484

Location	Location Description	Model	Charge Balance	Solids Summary	F	Ca	Mg	Na	K
G285	C - LCU	Initial Soln	TRUE	25p	1.72e-05	0.00677	0.00376	0.00562	5.61e-05
G273	C - UA	Initial Soln	TRUE	25p	1.54e-05	0.00405	0.00340	0.00433	1.21e-05
G279	C - UA	Initial Soln	TRUE	25p	1.70e-05	0.0178	0.0186	0.0109	6.43e-05
G285	C - LCU	Speciation Model	TRUE	25p	1.72e-05	0.00677	0.00376	0.00562	5.61e-05
G273	C - UA	Speciation Model	TRUE	25p	1.54e-05	0.00405	0.00340	0.00433	1.21e-05
G279	C - UA	Speciation Model	TRUE	25p	1.70e-05	0.0178	0.0186	0.0109	6.43e-05
G285	C - LCU	First Reaction	TRUE	25p	1.72e-05	0.00184	0.00184	0.00302	1.60e-05
G285	C - LCU	Second Reaction	TRUE	25p	1.71e-05	0.00170	0.00170	0.00302	1.60e-05
G273	C - UA	First Reaction	TRUE	25p	1.76e-05	0.00178	0.00178	0.00302	1.60e-05
G273	C - UA	Second Reaction	TRUE	25p	1.71e-05	0.00167	0.00168	0.00302	1.60e-05
G279	C - UA	First Reaction	TRUE	25p	1.71e-05	0.00179	0.00179	0.00302	1.60e-05
G279	C - UA	Second Reaction	TRUE	25p	1.71e-05	0.00166	0.00167	0.00302	1.60e-05
G285	C - LCU	Initial Soln	TRUE	75p	1.72e-05	0.00677	0.00376	0.00562	5.61e-05
G273	C - UA	Initial Soln	TRUE	75p	1.54e-05	0.00405	0.00340	0.00433	1.21e-05
G279	C - UA	Initial Soln	TRUE	75p	1.70e-05	0.0178	0.0186	0.0109	6.43e-05
G285	C - LCU	Speciation Model	TRUE	75p	1.72e-05	0.00677	0.00376	0.00562	5.61e-05
G273	C - UA	Speciation Model	TRUE	75p	1.54e-05	0.00405	0.00340	0.00433	1.21e-05
G279	C - UA	Speciation Model	TRUE	75p	1.70e-05	0.0178	0.0186	0.0109	6.43e-05
G285	C - LCU	First Reaction	TRUE	75p	1.74e-05	0.00200	0.00199	0.00302	1.60e-05
G285	C - LCU	Second Reaction	TRUE	75p	1.71e-05	0.00178	0.00179	0.00302	1.60e-05
G273	C - UA	First Reaction	TRUE	75p	1.78e-05	0.00187	0.00187	0.00302	1.60e-05
G273	C - UA	Second Reaction	TRUE	75p	1.71e-05	0.00171	0.00172	0.00302	1.60e-05
G279	C - UA	First Reaction	TRUE	75p	1.71e-05	0.00190	0.00189	0.00302	1.60e-05
G279	C - UA	Second Reaction	TRUE	75p	1.71e-05	0.00170	0.00170	0.00302	1.60e-05
G285	C - LCU	Initial Soln	TRUE	median	1.72e-05	0.00677	0.00376	0.00562	5.61e-05
G273	C - UA	Initial Soln	TRUE	median	1.54e-05	0.00405	0.00340	0.00433	1.21e-05
G279	C - UA	Initial Soln	TRUE	median	1.70e-05	0.0178	0.0186	0.0109	6.43e-05
G285	C - LCU	Speciation Model	TRUE	median	1.72e-05	0.00677	0.00376	0.00562	5.61e-05
G273	C - UA	Speciation Model	TRUE	median	1.54e-05	0.00405	0.00340	0.00433	1.21e-05
G279	C - UA	Speciation Model	TRUE	median	1.70e-05	0.0178	0.0186	0.0109	6.43e-05
G285	C - LCU	First Reaction	TRUE	median	1.72e-05	0.00190	0.00190	0.00302	1.60e-05
G285	C - LCU	Second Reaction	TRUE	median	1.71e-05	0.00173	0.00173	0.00302	1.60e-05
G273	C - UA	First Reaction	TRUE	median	1.77e-05	0.00184	0.00184	0.00302	1.60e-05
G273	C - UA	Second Reaction	TRUE	median	1.71e-05	0.00170	0.00170	0.00302	1.60e-05
G279	C - UA	First Reaction	TRUE	median	1.71e-05	0.00187	0.00186	0.00302	1.60e-05
G279	C - UA	Second Reaction	TRUE	median	1.71e-05	0.00169	0.00169	0.00302	1.60e-05
G285	C - LCU	Initial Soln	FALSE	25p	1.72e-05	0.00677	0.00376	0.00562	5.61e-05
G273	C - UA	Initial Soln	FALSE	25p	1.54e-05	0.00405	0.00340	0.00433	1.21e-05
G279	C - UA	Initial Soln	FALSE	25p	1.70e-05	0.0178	0.0186	0.0109	6.43e-05
G285	C - LCU	Speciation Model	FALSE	25p	1.72e-05	0.00677	0.00376	0.00562	5.61e-05
G273	C - UA	Speciation Model	FALSE	25p	1.54e-05	0.00405	0.00340	0.00433	1.21e-05
G279	C - UA	Speciation Model	FALSE	25p	1.70e-05	0.0178	0.0186	0.0109	6.43e-05
G285	C - LCU	First Reaction	FALSE	25p	1.72e-05	0.00184	0.00184	0.00302	1.60e-05
G285	C - LCU	Second Reaction	FALSE	25p	1.71e-05	0.00170	0.00170	0.00302	1.60e-05

Location	Location Description	Model	Charge Balance	Solids Summary	F	Ca	Mg	Na	K
G273	C - UA	First Reaction	FALSE	25p	1.76e-05	0.00178	0.00178	0.00302	1.60e-05
G273	C - UA	Second Reaction	FALSE	25p	1.71e-05	0.00167	0.00167	0.00302	1.60e-05
G279	C - UA	First Reaction	FALSE	25p	1.71e-05	0.00179	0.00179	0.00302	1.60e-05
G279	C - UA	Second Reaction	FALSE	25p	1.71e-05	0.00166	0.00167	0.00302	1.60e-05
G285	C - LCU	Initial Soln	FALSE	75p	1.72e-05	0.00677	0.00376	0.00562	5.61e-05
G273	C - UA	Initial Soln	FALSE	75p	1.54e-05	0.00405	0.00340	0.00433	1.21e-05
G279	C - UA	Initial Soln	FALSE	75p	1.70e-05	0.0178	0.0186	0.0109	6.43e-05
G285	C - LCU	Speciation Model	FALSE	75p	1.72e-05	0.00677	0.00376	0.00562	5.61e-05
G273	C - UA	Speciation Model	FALSE	75p	1.54e-05	0.00405	0.00340	0.00433	1.21e-05
G279	C - UA	Speciation Model	FALSE	75p	1.70e-05	0.0178	0.0186	0.0109	6.43e-05
G285	C - LCU	First Reaction	FALSE	75p	1.74e-05	0.00200	0.00199	0.00302	1.60e-05
G285	C - LCU	Second Reaction	FALSE	75p	1.71e-05	0.00178	0.00179	0.00302	1.60e-05
G273	C - UA	First Reaction	FALSE	75p	1.78e-05	0.00187	0.00187	0.00302	1.60e-05
G273	C - UA	Second Reaction	FALSE	75p	1.71e-05	0.00171	0.00172	0.00302	1.60e-05
G279	C - UA	First Reaction	FALSE	75p	1.71e-05	0.00190	0.00189	0.00302	1.60e-05
G279	C - UA	Second Reaction	FALSE	75p	1.71e-05	0.00170	0.00170	0.00302	1.60e-05
G285	C - LCU	Initial Soln	FALSE	median	1.72e-05	0.00677	0.00376	0.00562	5.61e-05
G273	C - UA	Initial Soln	FALSE	median	1.54e-05	0.00405	0.00340	0.00433	1.21e-05
G279	C - UA	Initial Soln	FALSE	median	1.70e-05	0.0178	0.0186	0.0109	6.43e-05
G285	C - LCU	Speciation Model	FALSE	median	1.72e-05	0.00677	0.00376	0.00562	5.61e-05
G273	C - UA	Speciation Model	FALSE	median	1.54e-05	0.00405	0.00340	0.00433	1.21e-05
G279	C - UA	Speciation Model	FALSE	median	1.70e-05	0.0178	0.0186	0.0109	6.43e-05
G285	C - LCU	First Reaction	FALSE	median	1.72e-05	0.00190	0.00190	0.00302	1.60e-05
G285	C - LCU	Second Reaction	FALSE	median	1.71e-05	0.00173	0.00173	0.00302	1.60e-05
G273	C - UA	First Reaction	FALSE	median	1.77e-05	0.00184	0.00184	0.00302	1.60e-05
G273	C - UA	Second Reaction	FALSE	median	1.71e-05	0.00170	0.00170	0.00302	1.60e-05
G279	C - UA	First Reaction	FALSE	median	1.71e-05	0.00187	0.00186	0.00302	1.60e-05
G279	C - UA	Second Reaction	FALSE	median	1.71e-05	0.00169	0.00169	0.00302	1.60e-05

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Location	Location Description	Model	Charge Balance	Solids Summary	Ba	Si	P	Mn	Fe
G285	C - LCU	Initial Soln	TRUE	25p	3.23e-07	8.09e-05	5.90e-07	1.52e-05	1.57e-06
G273	C - UA	Initial Soln	TRUE	25p	2.43e-07	0.000137	1.04e-07	8.78e-07	3.56e-07
G279	C - UA	Initial Soln	TRUE	25p	3.15e-07	0.000166	1.28e-07	2.93e-06	6.66e-08
G285	C - LCU	Speciation Model	TRUE	25p	3.23e-07	8.09e-05	5.90e-07	1.52e-05	1.57e-06
G273	C - UA	Speciation Model	TRUE	25p	2.43e-07	0.000137	1.04e-07	8.78e-07	3.56e-07
G279	C - UA	Speciation Model	TRUE	25p	3.15e-07	0.000166	1.28e-07	2.93e-06	6.66e-08
G285	C - LCU	First Reaction	TRUE	25p	3.23e-07	2.64e-05	5.39e-07	1.93e-06	3.24e-07
G285	C - LCU	Second Reaction	TRUE	25p	3.23e-07	2.91e-05	5.78e-07	9.85e-07	2.71e-07
G273	C - UA	First Reaction	TRUE	25p	3.19e-07	5.00e-05	2.24e-07	5.37e-07	1.21e-08
G273	C - UA	Second Reaction	TRUE	25p	3.22e-07	5.30e-05	2.55e-07	5.94e-07	1.09e-08
G279	C - UA	First Reaction	TRUE	25p	2.74e-07	5.22e-05	1.41e-07	5.17e-07	5.12e-09
G279	C - UA	Second Reaction	TRUE	25p	3.32e-07	5.63e-05	1.66e-07	6.03e-07	4.83e-09
G285	C - LCU	Initial Soln	TRUE	75p	3.23e-07	8.09e-05	5.90e-07	1.52e-05	1.57e-06
G273	C - UA	Initial Soln	TRUE	75p	2.43e-07	0.000137	1.04e-07	8.78e-07	3.56e-07
G279	C - UA	Initial Soln	TRUE	75p	3.15e-07	0.000166	1.28e-07	2.93e-06	6.66e-08
G285	C - LCU	Speciation Model	TRUE	75p	3.23e-07	8.09e-05	5.90e-07	1.52e-05	1.57e-06
G273	C - UA	Speciation Model	TRUE	75p	2.43e-07	0.000137	1.04e-07	8.78e-07	3.56e-07
G279	C - UA	Speciation Model	TRUE	75p	3.15e-07	0.000166	1.28e-07	2.93e-06	6.66e-08
G285	C - LCU	First Reaction	TRUE	75p	3.13e-07	2.70e-05	5.52e-07	3.75e-06	3.82e-07
G285	C - LCU	Second Reaction	TRUE	75p	3.32e-07	2.27e-05	5.02e-07	2.08e-06	3.24e-07
G273	C - UA	First Reaction	TRUE	75p	3.17e-07	5.02e-05	2.16e-07	5.36e-07	1.30e-08
G273	C - UA	Second Reaction	TRUE	75p	3.27e-07	4.48e-05	2.16e-07	5.74e-07	1.13e-08
G279	C - UA	First Reaction	TRUE	75p	2.57e-07	5.20e-05	1.33e-07	5.03e-07	5.50e-09
G279	C - UA	Second Reaction	TRUE	75p	3.35e-07	4.75e-05	1.38e-07	5.82e-07	4.93e-09
G285	C - LCU	Initial Soln	TRUE	median	3.23e-07	8.09e-05	5.90e-07	1.52e-05	1.57e-06
G273	C - UA	Initial Soln	TRUE	median	2.43e-07	0.000137	1.04e-07	8.78e-07	3.56e-07
G279	C - UA	Initial Soln	TRUE	median	3.15e-07	0.000166	1.28e-07	2.93e-06	6.66e-08
G285	C - LCU	Speciation Model	TRUE	median	3.23e-07	8.09e-05	5.90e-07	1.52e-05	1.57e-06
G273	C - UA	Speciation Model	TRUE	median	2.43e-07	0.000137	1.04e-07	8.78e-07	3.56e-07
G279	C - UA	Speciation Model	TRUE	median	3.15e-07	0.000166	1.28e-07	2.93e-06	6.66e-08
G285	C - LCU	First Reaction	TRUE	median	3.22e-07	2.58e-05	5.35e-07	2.42e-06	3.46e-07
G285	C - LCU	Second Reaction	TRUE	median	3.26e-07	2.50e-05	5.28e-07	1.20e-06	2.91e-07
G273	C - UA	First Reaction	TRUE	median	3.18e-07	4.96e-05	2.16e-07	5.37e-07	1.27e-08
G273	C - UA	Second Reaction	TRUE	median	3.25e-07	4.61e-05	2.23e-07	5.81e-07	1.12e-08
G279	C - UA	First Reaction	TRUE	median	2.63e-07	5.15e-05	1.34e-07	5.09e-07	5.40e-09
G279	C - UA	Second Reaction	TRUE	median	3.34e-07	4.89e-05	1.43e-07	5.90e-07	4.90e-09
G285	C - LCU	Initial Soln	FALSE	25p	3.23e-07	8.09e-05	5.90e-07	1.52e-05	1.57e-06
G273	C - UA	Initial Soln	FALSE	25p	2.43e-07	0.000137	1.04e-07	8.78e-07	3.56e-07
G279	C - UA	Initial Soln	FALSE	25p	3.15e-07	0.000166	1.28e-07	2.93e-06	6.66e-08
G285	C - LCU	Speciation Model	FALSE	25p	3.23e-07	8.09e-05	5.90e-07	1.52e-05	1.57e-06
G273	C - UA	Speciation Model	FALSE	25p	2.43e-07	0.000137	1.04e-07	8.78e-07	3.56e-07
G279	C - UA	Speciation Model	FALSE	25p	3.15e-07	0.000166	1.28e-07	2.93e-06	6.66e-08
G285	C - LCU	First Reaction	FALSE	25p	3.23e-07	2.63e-05	5.44e-07	1.98e-06	3.28e-07
G285	C - LCU	Second Reaction	FALSE	25p	3.23e-07	2.90e-05	5.84e-07	9.95e-07	2.75e-07

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Location	Location Description	Model	Charge Balance	Solids Summary	Ba	Si	P	Mn	Fe
G273	C - UA	First Reaction	FALSE	25p	3.20e-07	4.98e-05	2.25e-07	5.42e-07	1.21e-08
G273	C - UA	Second Reaction	FALSE	25p	3.22e-07	5.29e-05	2.57e-07	5.97e-07	1.09e-08
G279	C - UA	First Reaction	FALSE	25p	2.75e-07	5.21e-05	1.42e-07	5.18e-07	5.12e-09
G279	C - UA	Second Reaction	FALSE	25p	3.32e-07	5.63e-05	1.66e-07	6.03e-07	4.83e-09
G285	C - LCU	Initial Soln	FALSE	75p	3.23e-07	8.09e-05	5.90e-07	1.52e-05	1.57e-06
G273	C - UA	Initial Soln	FALSE	75p	2.43e-07	0.000137	1.04e-07	8.78e-07	3.56e-07
G279	C - UA	Initial Soln	FALSE	75p	3.15e-07	0.000166	1.28e-07	2.93e-06	6.66e-08
G285	C - LCU	Speciation Model	FALSE	75p	3.23e-07	8.09e-05	5.90e-07	1.52e-05	1.57e-06
G273	C - UA	Speciation Model	FALSE	75p	2.43e-07	0.000137	1.04e-07	8.78e-07	3.56e-07
G279	C - UA	Speciation Model	FALSE	75p	3.15e-07	0.000166	1.28e-07	2.93e-06	6.66e-08
G285	C - LCU	First Reaction	FALSE	75p	3.14e-07	2.69e-05	5.57e-07	3.87e-06	3.88e-07
G285	C - LCU	Second Reaction	FALSE	75p	3.32e-07	2.27e-05	5.07e-07	2.14e-06	3.29e-07
G273	C - UA	First Reaction	FALSE	75p	3.18e-07	5.00e-05	2.17e-07	5.42e-07	1.29e-08
G273	C - UA	Second Reaction	FALSE	75p	3.27e-07	4.47e-05	2.17e-07	5.77e-07	1.13e-08
G279	C - UA	First Reaction	FALSE	75p	2.58e-07	5.19e-05	1.34e-07	5.04e-07	5.50e-09
G279	C - UA	Second Reaction	FALSE	75p	3.34e-07	4.74e-05	1.38e-07	5.82e-07	4.93e-09
G285	C - LCU	Initial Soln	FALSE	median	3.23e-07	8.09e-05	5.90e-07	1.52e-05	1.57e-06
G273	C - UA	Initial Soln	FALSE	median	2.43e-07	0.000137	1.04e-07	8.78e-07	3.56e-07
G279	C - UA	Initial Soln	FALSE	median	3.15e-07	0.000166	1.28e-07	2.93e-06	6.66e-08
G285	C - LCU	Speciation Model	FALSE	median	3.23e-07	8.09e-05	5.90e-07	1.52e-05	1.57e-06
G273	C - UA	Speciation Model	FALSE	median	2.43e-07	0.000137	1.04e-07	8.78e-07	3.56e-07
G279	C - UA	Speciation Model	FALSE	median	3.15e-07	0.000166	1.28e-07	2.93e-06	6.66e-08
G285	C - LCU	First Reaction	FALSE	median	3.22e-07	2.57e-05	5.40e-07	2.49e-06	3.51e-07
G285	C - LCU	Second Reaction	FALSE	median	3.26e-07	2.50e-05	5.33e-07	1.22e-06	2.96e-07
G273	C - UA	First Reaction	FALSE	median	3.19e-07	4.95e-05	2.18e-07	5.43e-07	1.27e-08
G273	C - UA	Second Reaction	FALSE	median	3.25e-07	4.60e-05	2.24e-07	5.84e-07	1.12e-08
G279	C - UA	First Reaction	FALSE	median	2.63e-07	5.14e-05	1.35e-07	5.10e-07	5.40e-09
G279	C - UA	Second Reaction	FALSE	median	3.34e-07	4.89e-05	1.43e-07	5.90e-07	4.90e-09

Location	Location Description	Model	Charge Balance	Solids Summary	Al	Sb	Be	Cd	Cr
G285	C - LCU	Initial Soln	TRUE	25p	3.39e-07	2.53e-09	2.19e-08	2.09e-09	2.12e-08
G273	C - UA	Initial Soln	TRUE	25p	1.73e-07	5.00e-09	2.19e-08	2.09e-09	2.60e-08
G279	C - UA	Initial Soln	TRUE	25p	1.53e-07	1.77e-09	3.29e-08	3.31e-09	2.71e-08
G285	C - LCU	Speciation Model	TRUE	25p	3.39e-07	2.53e-09	2.19e-08	2.09e-09	2.12e-08
G273	C - UA	Speciation Model	TRUE	25p	1.73e-07	5.00e-09	2.19e-08	2.09e-09	2.60e-08
G279	C - UA	Speciation Model	TRUE	25p	1.53e-07	1.77e-09	3.29e-08	3.31e-09	2.71e-08
G285	C - LCU	First Reaction	TRUE	25p	5.52e-08	2.53e-09	4.18e-09	8.02e-10	3.38e-09
G285	C - LCU	Second Reaction	TRUE	25p	6.39e-08	2.53e-09	3.61e-09	7.18e-10	3.05e-09
G273	C - UA	First Reaction	TRUE	25p	5.77e-08	2.53e-09	3.96e-09	9.16e-10	4.61e-09
G273	C - UA	Second Reaction	TRUE	25p	6.57e-08	2.53e-09	3.52e-09	8.50e-10	4.35e-09
G279	C - UA	First Reaction	TRUE	25p	5.85e-08	2.53e-09	5.96e-09	1.49e-10	2.44e-09
G279	C - UA	Second Reaction	TRUE	25p	6.57e-08	2.53e-09	5.33e-09	1.26e-10	2.19e-09
G285	C - LCU	Initial Soln	TRUE	75p	3.39e-07	2.53e-09	2.19e-08	2.09e-09	2.12e-08
G273	C - UA	Initial Soln	TRUE	75p	1.73e-07	5.00e-09	2.19e-08	2.09e-09	2.60e-08
G279	C - UA	Initial Soln	TRUE	75p	1.53e-07	1.77e-09	3.29e-08	3.31e-09	2.71e-08
G285	C - LCU	Speciation Model	TRUE	75p	3.39e-07	2.53e-09	2.19e-08	2.09e-09	2.12e-08
G273	C - UA	Speciation Model	TRUE	75p	1.73e-07	5.00e-09	2.19e-08	2.09e-09	2.60e-08
G279	C - UA	Speciation Model	TRUE	75p	1.53e-07	1.77e-09	3.29e-08	3.31e-09	2.71e-08
G285	C - LCU	First Reaction	TRUE	75p	4.88e-08	2.53e-09	4.98e-09	9.00e-10	3.90e-09
G285	C - LCU	Second Reaction	TRUE	75p	5.78e-08	2.53e-09	4.00e-09	7.88e-10	3.29e-09
G273	C - UA	First Reaction	TRUE	75p	5.35e-08	2.53e-09	4.33e-09	9.63e-10	4.87e-09
G273	C - UA	Second Reaction	TRUE	75p	6.24e-08	2.53e-09	3.68e-09	8.73e-10	4.40e-09
G279	C - UA	First Reaction	TRUE	75p	5.45e-08	2.53e-09	6.51e-09	1.62e-10	2.67e-09
G279	C - UA	Second Reaction	TRUE	75p	6.28e-08	2.53e-09	5.55e-09	1.33e-10	2.26e-09
G285	C - LCU	Initial Soln	TRUE	median	3.39e-07	2.53e-09	2.19e-08	2.09e-09	2.12e-08
G273	C - UA	Initial Soln	TRUE	median	1.73e-07	5.00e-09	2.19e-08	2.09e-09	2.60e-08
G279	C - UA	Initial Soln	TRUE	median	1.53e-07	1.77e-09	3.29e-08	3.31e-09	2.71e-08
G285	C - LCU	Speciation Model	TRUE	median	3.39e-07	2.53e-09	2.19e-08	2.09e-09	2.12e-08
G273	C - UA	Speciation Model	TRUE	median	1.73e-07	5.00e-09	2.19e-08	2.09e-09	2.60e-08
G279	C - UA	Speciation Model	TRUE	median	1.53e-07	1.77e-09	3.29e-08	3.31e-09	2.71e-08
G285	C - LCU	First Reaction	TRUE	median	5.25e-08	2.53e-09	4.46e-09	8.38e-10	3.56e-09
G285	C - LCU	Second Reaction	TRUE	median	6.16e-08	2.53e-09	3.74e-09	7.40e-10	3.12e-09
G273	C - UA	First Reaction	TRUE	median	5.46e-08	2.53e-09	4.22e-09	9.49e-10	4.79e-09
G273	C - UA	Second Reaction	TRUE	median	6.33e-08	2.53e-09	3.63e-09	8.66e-10	4.38e-09
G279	C - UA	First Reaction	TRUE	median	5.56e-08	2.53e-09	6.35e-09	1.58e-10	2.60e-09
G279	C - UA	Second Reaction	TRUE	median	6.37e-08	2.53e-09	5.48e-09	1.31e-10	2.23e-09
G285	C - LCU	Initial Soln	FALSE	25p	3.39e-07	2.53e-09	2.19e-08	2.09e-09	2.12e-08
G273	C - UA	Initial Soln	FALSE	25p	1.73e-07	5.00e-09	2.19e-08	2.09e-09	2.60e-08
G279	C - UA	Initial Soln	FALSE	25p	1.53e-07	1.77e-09	3.29e-08	3.31e-09	2.71e-08
G285	C - LCU	Speciation Model	FALSE	25p	3.39e-07	2.53e-09	2.19e-08	2.09e-09	2.12e-08
G273	C - UA	Speciation Model	FALSE	25p	1.73e-07	5.00e-09	2.19e-08	2.09e-09	2.60e-08
G279	C - UA	Speciation Model	FALSE	25p	1.53e-07	1.77e-09	3.29e-08	3.31e-09	2.71e-08
G285	C - LCU	First Reaction	FALSE	25p	5.53e-08	2.53e-09	4.16e-09	1.08e-09	3.46e-09
G285	C - LCU	Second Reaction	FALSE	25p	6.39e-08	2.53e-09	3.59e-09	9.62e-10	3.13e-09

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Location	Location Description	Model	Charge Balance	Solids Summary	Al	Sb	Be	Cd	Cr
G273	C - UA	First Reaction	FALSE	25p	5.77e-08	2.53e-09	3.95e-09	1.11e-09	4.69e-09
G273	C - UA	Second Reaction	FALSE	25p	6.57e-08	2.53e-09	3.51e-09	1.03e-09	4.44e-09
G279	C - UA	First Reaction	FALSE	25p	5.85e-08	2.53e-09	5.96e-09	1.69e-10	2.47e-09
G279	C - UA	Second Reaction	FALSE	25p	6.57e-08	2.53e-09	5.32e-09	1.42e-10	2.21e-09
G285	C - LCU	Initial Soln	FALSE	75p	3.39e-07	2.53e-09	2.19e-08	2.09e-09	2.12e-08
G273	C - UA	Initial Soln	FALSE	75p	1.73e-07	5.00e-09	2.19e-08	2.09e-09	2.60e-08
G279	C - UA	Initial Soln	FALSE	75p	1.53e-07	1.77e-09	3.29e-08	3.31e-09	2.71e-08
G285	C - LCU	Speciation Model	FALSE	75p	3.39e-07	2.53e-09	2.19e-08	2.09e-09	2.12e-08
G273	C - UA	Speciation Model	FALSE	75p	1.73e-07	5.00e-09	2.19e-08	2.09e-09	2.60e-08
G279	C - UA	Speciation Model	FALSE	75p	1.53e-07	1.77e-09	3.29e-08	3.31e-09	2.71e-08
G285	C - LCU	First Reaction	FALSE	75p	4.89e-08	2.53e-09	4.96e-09	1.21e-09	3.99e-09
G285	C - LCU	Second Reaction	FALSE	75p	5.78e-08	2.53e-09	3.98e-09	1.06e-09	3.37e-09
G273	C - UA	First Reaction	FALSE	75p	5.36e-08	2.53e-09	4.32e-09	1.16e-09	4.96e-09
G273	C - UA	Second Reaction	FALSE	75p	6.24e-08	2.53e-09	3.67e-09	1.05e-09	4.48e-09
G279	C - UA	First Reaction	FALSE	75p	5.46e-08	2.53e-09	6.51e-09	1.83e-10	2.70e-09
G279	C - UA	Second Reaction	FALSE	75p	6.29e-08	2.53e-09	5.54e-09	1.50e-10	2.29e-09
G285	C - LCU	Initial Soln	FALSE	median	3.39e-07	2.53e-09	2.19e-08	2.09e-09	2.12e-08
G273	C - UA	Initial Soln	FALSE	median	1.73e-07	5.00e-09	2.19e-08	2.09e-09	2.60e-08
G279	C - UA	Initial Soln	FALSE	median	1.53e-07	1.77e-09	3.29e-08	3.31e-09	2.71e-08
G285	C - LCU	Speciation Model	FALSE	median	3.39e-07	2.53e-09	2.19e-08	2.09e-09	2.12e-08
G273	C - UA	Speciation Model	FALSE	median	1.73e-07	5.00e-09	2.19e-08	2.09e-09	2.60e-08
G279	C - UA	Speciation Model	FALSE	median	1.53e-07	1.77e-09	3.29e-08	3.31e-09	2.71e-08
G285	C - LCU	First Reaction	FALSE	median	5.26e-08	2.53e-09	4.44e-09	1.13e-09	3.64e-09
G285	C - LCU	Second Reaction	FALSE	median	6.16e-08	2.53e-09	3.73e-09	9.95e-10	3.20e-09
G273	C - UA	First Reaction	FALSE	median	5.47e-08	2.53e-09	4.21e-09	1.15e-09	4.87e-09
G273	C - UA	Second Reaction	FALSE	median	6.34e-08	2.53e-09	3.62e-09	1.05e-09	4.46e-09
G279	C - UA	First Reaction	FALSE	median	5.56e-08	2.53e-09	6.34e-09	1.79e-10	2.63e-09
G279	C - UA	Second Reaction	FALSE	median	6.37e-08	2.53e-09	5.47e-09	1.47e-10	2.26e-09

Location	Location Description	Model	Charge Balance	Solids Summary	Co	Pb	Mo	Se	Hfo_s
G285	C - LCU	Initial Soln	TRUE	25p	5.01e-08	1.35e-09	3.65e-08	4.25e-09	0
G273	C - UA	Initial Soln	TRUE	25p	2.89e-09	9.90e-10	8.14e-09	4.25e-09	0
G279	C - UA	Initial Soln	TRUE	25p	4.09e-09	5.34e-10	7.75e-09	8.66e-08	0
G285	C - LCU	Speciation Model	TRUE	25p	5.01e-08	1.35e-09	3.65e-08	4.25e-09	4.85e-05
G273	C - UA	Speciation Model	TRUE	25p	2.89e-09	9.90e-10	8.14e-09	4.25e-09	3.80e-05
G279	C - UA	Speciation Model	TRUE	25p	4.09e-09	5.34e-10	7.75e-09	8.66e-08	3.80e-05
G285	C - LCU	First Reaction	TRUE	25p	2.00e-08	1.29e-09	1.41e-08	1.92e-09	4.85e-05
G285	C - LCU	Second Reaction	TRUE	25p	1.74e-08	1.18e-09	1.00e-08	1.97e-09	4.85e-05
G273	C - UA	First Reaction	TRUE	25p	1.34e-09	1.54e-09	1.05e-08	3.43e-09	3.80e-05
G273	C - UA	Second Reaction	TRUE	25p	1.22e-09	1.47e-09	9.43e-09	3.56e-09	3.80e-05
G279	C - UA	First Reaction	TRUE	25p	2.11e-10	1.13e-10	9.56e-09	3.74e-08	3.80e-05
G279	C - UA	Second Reaction	TRUE	25p	1.75e-10	9.48e-11	9.38e-09	3.61e-08	3.80e-05
G285	C - LCU	Initial Soln	TRUE	75p	5.01e-08	1.35e-09	3.65e-08	4.25e-09	0
G273	C - UA	Initial Soln	TRUE	75p	2.89e-09	9.90e-10	8.14e-09	4.25e-09	0
G279	C - UA	Initial Soln	TRUE	75p	4.09e-09	5.34e-10	7.75e-09	8.66e-08	0
G285	C - LCU	Speciation Model	TRUE	75p	5.01e-08	1.35e-09	3.65e-08	4.25e-09	0.000115
G273	C - UA	Speciation Model	TRUE	75p	2.89e-09	9.90e-10	8.14e-09	4.25e-09	7.00e-05
G279	C - UA	Speciation Model	TRUE	75p	4.09e-09	5.34e-10	7.75e-09	8.66e-08	7.00e-05
G285	C - LCU	First Reaction	TRUE	75p	2.30e-08	1.47e-09	1.90e-08	2.10e-09	0.000115
G285	C - LCU	Second Reaction	TRUE	75p	1.96e-08	1.33e-09	1.16e-08	1.70e-09	0.000115
G273	C - UA	First Reaction	TRUE	75p	1.42e-09	1.58e-09	1.14e-08	3.48e-09	7.00e-05
G273	C - UA	Second Reaction	TRUE	75p	1.26e-09	1.48e-09	9.55e-09	3.09e-09	7.00e-05
G279	C - UA	First Reaction	TRUE	75p	2.30e-10	1.19e-10	9.70e-09	3.91e-08	7.00e-05
G279	C - UA	Second Reaction	TRUE	75p	1.86e-10	9.94e-11	9.36e-09	3.40e-08	7.00e-05
G285	C - LCU	Initial Soln	TRUE	median	5.01e-08	1.35e-09	3.65e-08	4.25e-09	0
G273	C - UA	Initial Soln	TRUE	median	2.89e-09	9.90e-10	8.14e-09	4.25e-09	0
G279	C - UA	Initial Soln	TRUE	median	4.09e-09	5.34e-10	7.75e-09	8.66e-08	0
G285	C - LCU	Speciation Model	TRUE	median	5.01e-08	1.35e-09	3.65e-08	4.25e-09	7.00e-05
G273	C - UA	Speciation Model	TRUE	median	2.89e-09	9.90e-10	8.14e-09	4.25e-09	6.00e-05
G279	C - UA	Speciation Model	TRUE	median	4.09e-09	5.34e-10	7.75e-09	8.66e-08	6.00e-05
G285	C - LCU	First Reaction	TRUE	median	2.11e-08	1.35e-09	1.58e-08	1.95e-09	7.00e-05
G285	C - LCU	Second Reaction	TRUE	median	1.82e-08	1.22e-09	1.05e-08	1.77e-09	7.00e-05
G273	C - UA	First Reaction	TRUE	median	1.40e-09	1.56e-09	1.11e-08	3.44e-09	6.00e-05
G273	C - UA	Second Reaction	TRUE	median	1.25e-09	1.48e-09	9.51e-09	3.16e-09	6.00e-05
G279	C - UA	First Reaction	TRUE	median	2.24e-10	1.17e-10	9.65e-09	3.84e-08	6.00e-05
G279	C - UA	Second Reaction	TRUE	median	1.82e-10	9.76e-11	9.37e-09	3.43e-08	6.00e-05
G285	C - LCU	Initial Soln	FALSE	25p	5.01e-08	1.35e-09	3.65e-08	4.25e-09	0
G273	C - UA	Initial Soln	FALSE	25p	2.89e-09	9.90e-10	8.14e-09	4.25e-09	0
G279	C - UA	Initial Soln	FALSE	25p	4.09e-09	5.34e-10	7.75e-09	8.66e-08	0
G285	C - LCU	Speciation Model	FALSE	25p	5.01e-08	1.35e-09	3.65e-08	4.25e-09	4.85e-05
G273	C - UA	Speciation Model	FALSE	25p	2.89e-09	9.90e-10	8.14e-09	4.25e-09	3.80e-05
G279	C - UA	Speciation Model	FALSE	25p	4.09e-09	5.34e-10	7.75e-09	8.66e-08	3.80e-05
G285	C - LCU	First Reaction	FALSE	25p	2.08e-08	1.33e-09	1.44e-08	1.96e-09	4.85e-05
G285	C - LCU	Second Reaction	FALSE	25p	1.81e-08	1.21e-09	1.01e-08	2.00e-09	4.85e-05

Attachment D. PHREEQC modeling output

Groundwater Polishing Report
GMF Recycle Pond
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	Co	Pb	Mo	Se	Hfo_s
G273	C - UA	First Reaction	FALSE	25p	1.37e-09	1.58e-09	1.06e-08	3.46e-09	3.80e-05
G273	C - UA	Second Reaction	FALSE	25p	1.25e-09	1.51e-09	9.44e-09	3.60e-09	3.80e-05
G279	C - UA	First Reaction	FALSE	25p	2.17e-10	1.17e-10	9.57e-09	3.78e-08	3.80e-05
G279	C - UA	Second Reaction	FALSE	25p	1.80e-10	9.83e-11	9.39e-09	3.65e-08	3.80e-05
G285	C - LCU	Initial Soln	FALSE	75p	5.01e-08	1.35e-09	3.65e-08	4.25e-09	0
G273	C - UA	Initial Soln	FALSE	75p	2.89e-09	9.90e-10	8.14e-09	4.25e-09	0
G279	C - UA	Initial Soln	FALSE	75p	4.09e-09	5.34e-10	7.75e-09	8.66e-08	0
G285	C - LCU	Speciation Model	FALSE	75p	5.01e-08	1.35e-09	3.65e-08	4.25e-09	0.000115
G273	C - UA	Speciation Model	FALSE	75p	2.89e-09	9.90e-10	8.14e-09	4.25e-09	7.00e-05
G279	C - UA	Speciation Model	FALSE	75p	4.09e-09	5.34e-10	7.75e-09	8.66e-08	7.00e-05
G285	C - LCU	First Reaction	FALSE	75p	2.39e-08	1.51e-09	1.95e-08	2.14e-09	0.000115
G285	C - LCU	Second Reaction	FALSE	75p	2.04e-08	1.37e-09	1.17e-08	1.73e-09	0.000115
G273	C - UA	First Reaction	FALSE	75p	1.46e-09	1.62e-09	1.15e-08	3.52e-09	7.00e-05
G273	C - UA	Second Reaction	FALSE	75p	1.29e-09	1.52e-09	9.56e-09	3.13e-09	7.00e-05
G279	C - UA	First Reaction	FALSE	75p	2.37e-10	1.23e-10	9.72e-09	3.95e-08	7.00e-05
G279	C - UA	Second Reaction	FALSE	75p	1.91e-10	1.03e-10	9.36e-09	3.44e-08	7.00e-05
G285	C - LCU	Initial Soln	FALSE	median	5.01e-08	1.35e-09	3.65e-08	4.25e-09	0
G273	C - UA	Initial Soln	FALSE	median	2.89e-09	9.90e-10	8.14e-09	4.25e-09	0
G279	C - UA	Initial Soln	FALSE	median	4.09e-09	5.34e-10	7.75e-09	8.66e-08	0
G285	C - LCU	Speciation Model	FALSE	median	5.01e-08	1.35e-09	3.65e-08	4.25e-09	7.00e-05
G273	C - UA	Speciation Model	FALSE	median	2.89e-09	9.90e-10	8.14e-09	4.25e-09	6.00e-05
G279	C - UA	Speciation Model	FALSE	median	4.09e-09	5.34e-10	7.75e-09	8.66e-08	6.00e-05
G285	C - LCU	First Reaction	FALSE	median	2.20e-08	1.39e-09	1.62e-08	1.98e-09	7.00e-05
G285	C - LCU	Second Reaction	FALSE	median	1.89e-08	1.26e-09	1.05e-08	1.80e-09	7.00e-05
G273	C - UA	First Reaction	FALSE	median	1.43e-09	1.61e-09	1.12e-08	3.48e-09	6.00e-05
G273	C - UA	Second Reaction	FALSE	median	1.28e-09	1.52e-09	9.52e-09	3.20e-09	6.00e-05
G279	C - UA	First Reaction	FALSE	median	2.31e-10	1.21e-10	9.68e-09	3.88e-08	6.00e-05
G279	C - UA	Second Reaction	FALSE	median	1.87e-10	1.01e-10	9.37e-09	3.47e-08	6.00e-05

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
GMF Recycle Pond
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
G285	C - LCU	Initial Soln	TRUE	25p	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	25p	0.00194	0.000528	9.75e-05	0.000111	1.23e-05
G273	C - UA	Speciation Model	TRUE	25p	0.00152	0.00228	8.77e-05	0.000103	1.35e-05
G279	C - UA	Speciation Model	TRUE	25p	0.00152	0.00228	8.02e-05	0.000113	3.72e-05
G285	C - LCU	First Reaction	TRUE	25p	0.00194	0.000528	0.000272	0.000119	1.86e-06
G285	C - LCU	Second Reaction	TRUE	25p	0.00194	0.000528	0.000295	0.000114	1.69e-06
G273	C - UA	First Reaction	TRUE	25p	0.00152	0.00228	0.000193	9.12e-05	1.00e-06
G273	C - UA	Second Reaction	TRUE	25p	0.00152	0.00228	0.000202	8.72e-05	8.58e-07
G279	C - UA	First Reaction	TRUE	25p	0.00152	0.00228	0.000181	7.68e-05	1.32e-06
G279	C - UA	Second Reaction	TRUE	25p	0.00152	0.00228	0.000187	7.43e-05	9.09e-07
G285	C - LCU	Initial Soln	TRUE	75p	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	75p	0.00460	0.00205	0.000231	0.000263	2.92e-05
G273	C - UA	Speciation Model	TRUE	75p	0.00280	0.00287	0.000162	0.000190	2.49e-05
G279	C - UA	Speciation Model	TRUE	75p	0.00280	0.00287	0.000148	0.000208	6.85e-05
G285	C - LCU	First Reaction	TRUE	75p	0.00460	0.00205	0.000565	0.000282	4.51e-06
G285	C - LCU	Second Reaction	TRUE	75p	0.00460	0.00205	0.000685	0.000277	4.67e-06
G273	C - UA	First Reaction	TRUE	75p	0.00280	0.00287	0.000338	0.000170	1.95e-06
G273	C - UA	Second Reaction	TRUE	75p	0.00280	0.00287	0.000383	0.000164	1.90e-06
G279	C - UA	First Reaction	TRUE	75p	0.00280	0.00287	0.000320	0.000142	2.79e-06
G279	C - UA	Second Reaction	TRUE	75p	0.00280	0.00287	0.000356	0.000139	2.05e-06
G285	C - LCU	Initial Soln	TRUE	median	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	median	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	median	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	median	0.00280	0.000825	0.000141	0.000160	1.78e-05
G273	C - UA	Speciation Model	TRUE	median	0.00240	0.00264	0.000138	0.000163	2.13e-05
G279	C - UA	Speciation Model	TRUE	median	0.00240	0.00264	0.000127	0.000178	5.87e-05
G285	C - LCU	First Reaction	TRUE	median	0.00280	0.000825	0.000376	0.000172	2.74e-06
G285	C - LCU	Second Reaction	TRUE	median	0.00280	0.000825	0.000430	0.000166	2.72e-06
G273	C - UA	First Reaction	TRUE	median	0.00240	0.00264	0.000295	0.000145	1.66e-06
G273	C - UA	Second Reaction	TRUE	median	0.00240	0.00264	0.000328	0.000140	1.58e-06
G279	C - UA	First Reaction	TRUE	median	0.00240	0.00264	0.000279	0.000122	2.32e-06
G279	C - UA	Second Reaction	TRUE	median	0.00240	0.00264	0.000304	0.000118	1.69e-06
G285	C - LCU	Initial Soln	FALSE	25p	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	25p	0.00194	0.000528	9.71e-05	0.000110	1.26e-05
G273	C - UA	Speciation Model	FALSE	25p	0.00152	0.00228	8.75e-05	0.000102	1.38e-05
G279	C - UA	Speciation Model	FALSE	25p	0.00152	0.00228	8.01e-05	0.000112	3.75e-05
G285	C - LCU	First Reaction	FALSE	25p	0.00194	0.000528	0.000272	0.000119	1.86e-06
G285	C - LCU	Second Reaction	FALSE	25p	0.00194	0.000528	0.000295	0.000114	1.69e-06

Attachment D. PHREEQC modeling output
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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
G273	C - UA	First Reaction	FALSE	25p	0.00152	0.00228	0.000193	9.13e-05	1.00e-06
G273	C - UA	Second Reaction	FALSE	25p	0.00152	0.00228	0.000202	8.73e-05	8.58e-07
G279	C - UA	First Reaction	FALSE	25p	0.00152	0.00228	0.000182	7.68e-05	1.32e-06
G279	C - UA	Second Reaction	FALSE	25p	0.00152	0.00228	0.000187	7.43e-05	9.10e-07
G285	C - LCU	Initial Soln	FALSE	75p	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	75p	0.00460	0.00205	0.000230	0.000260	2.99e-05
G273	C - UA	Speciation Model	FALSE	75p	0.00280	0.00287	0.000161	0.000189	2.54e-05
G279	C - UA	Speciation Model	FALSE	75p	0.00280	0.00287	0.000148	0.000207	6.90e-05
G285	C - LCU	First Reaction	FALSE	75p	0.00460	0.00205	0.000566	0.000283	4.49e-06
G285	C - LCU	Second Reaction	FALSE	75p	0.00460	0.00205	0.000686	0.000278	4.66e-06
G273	C - UA	First Reaction	FALSE	75p	0.00280	0.00287	0.000338	0.000170	1.95e-06
G273	C - UA	Second Reaction	FALSE	75p	0.00280	0.00287	0.000383	0.000164	1.90e-06
G279	C - UA	First Reaction	FALSE	75p	0.00280	0.00287	0.000321	0.000142	2.79e-06
G279	C - UA	Second Reaction	FALSE	75p	0.00280	0.00287	0.000357	0.000139	2.05e-06
G285	C - LCU	Initial Soln	FALSE	median	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	median	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	median	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	median	0.00280	0.000825	0.000140	0.000158	1.82e-05
G273	C - UA	Speciation Model	FALSE	median	0.00240	0.00264	0.000138	0.000162	2.18e-05
G279	C - UA	Speciation Model	FALSE	median	0.00240	0.00264	0.000127	0.000177	5.92e-05
G285	C - LCU	First Reaction	FALSE	median	0.00280	0.000825	0.000376	0.000172	2.73e-06
G285	C - LCU	Second Reaction	FALSE	median	0.00280	0.000825	0.000430	0.000166	2.71e-06
G273	C - UA	First Reaction	FALSE	median	0.00240	0.00264	0.000295	0.000145	1.66e-06
G273	C - UA	Second Reaction	FALSE	median	0.00240	0.00264	0.000328	0.000140	1.58e-06
G279	C - UA	First Reaction	FALSE	median	0.00240	0.00264	0.000279	0.000122	2.31e-06
G279	C - UA	Second Reaction	FALSE	median	0.00240	0.00264	0.000305	0.000118	1.69e-06

Attachment D. PHREEQC modeling output

Groundwater Polishing Report
GMF Recycle Pond
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	m_Hfo_wSO4-	m_Hfo_wOSi(OH)3	m_Hfo_wOSiO(OH)2-	m_Hfo_wHCO3	m_Hfo_wCO3-
G285	C - LCU	Initial Soln	TRUE	25p	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	25p	7.02e-06	0.000152	8.21e-05	0.00103	0.000154
G273	C - UA	Speciation Model	TRUE	25p	7.97e-06	0.000230	0.000121	0.000659	9.51e-05
G279	C - UA	Speciation Model	TRUE	25p	2.62e-05	0.000259	0.000114	0.000560	6.77e-05
G285	C - LCU	First Reaction	TRUE	25p	4.08e-07	0.000137	0.000193	0.000570	0.000222
G285	C - LCU	Second Reaction	TRUE	25p	3.28e-07	0.000163	0.000260	0.000441	0.000194
G273	C - UA	First Reaction	TRUE	25p	2.38e-07	0.000184	0.000240	0.000368	0.000132
G273	C - UA	Second Reaction	TRUE	25p	1.86e-07	0.000203	0.000290	0.000283	0.000111
G279	C - UA	First Reaction	TRUE	25p	2.81e-07	0.000180	0.000263	0.000334	0.000134
G279	C - UA	Second Reaction	TRUE	25p	1.82e-07	0.000200	0.000310	0.000263	0.000112
G285	C - LCU	Initial Soln	TRUE	75p	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	75p	1.66e-05	0.000359	0.000195	0.00244	0.000364
G273	C - UA	Speciation Model	TRUE	75p	1.47e-05	0.000424	0.000222	0.00121	0.000175
G279	C - UA	Speciation Model	TRUE	75p	4.83e-05	0.000478	0.000210	0.00103	0.000125
G285	C - LCU	First Reaction	TRUE	75p	1.13e-06	0.000291	0.000359	0.00162	0.000552
G285	C - LCU	Second Reaction	TRUE	75p	9.47e-07	0.000297	0.000453	0.00130	0.000545
G273	C - UA	First Reaction	TRUE	75p	4.93e-07	0.000323	0.000396	0.000771	0.000260
G273	C - UA	Second Reaction	TRUE	75p	4.08e-07	0.000326	0.000470	0.000605	0.000240
G279	C - UA	First Reaction	TRUE	75p	6.23e-07	0.000317	0.000440	0.000694	0.000265
G279	C - UA	Second Reaction	TRUE	75p	3.99e-07	0.000322	0.000511	0.000556	0.000243
G285	C - LCU	Initial Soln	TRUE	median	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	median	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	median	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	median	1.01e-05	0.000219	0.000119	0.00149	0.000222
G273	C - UA	Speciation Model	TRUE	median	1.26e-05	0.000364	0.000191	0.00104	0.000150
G279	C - UA	Speciation Model	TRUE	median	4.14e-05	0.000409	0.000180	0.000884	0.000107
G285	C - LCU	First Reaction	TRUE	median	6.29e-07	0.000185	0.000249	0.000892	0.000331
G285	C - LCU	Second Reaction	TRUE	median	5.26e-07	0.000205	0.000327	0.000699	0.000307
G273	C - UA	First Reaction	TRUE	median	4.11e-07	0.000279	0.000348	0.000640	0.000220
G273	C - UA	Second Reaction	TRUE	median	3.37e-07	0.000287	0.000416	0.000500	0.000199
G279	C - UA	First Reaction	TRUE	median	5.08e-07	0.000274	0.000386	0.000577	0.000224
G279	C - UA	Second Reaction	TRUE	median	3.29e-07	0.000284	0.000450	0.000460	0.000201
G285	C - LCU	Initial Soln	FALSE	25p	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	25p	7.15e-06	0.000151	8.22e-05	0.00103	0.000155
G273	C - UA	Speciation Model	FALSE	25p	8.10e-06	0.000230	0.000121	0.000660	9.57e-05
G279	C - UA	Speciation Model	FALSE	25p	2.64e-05	0.000259	0.000114	0.000560	6.79e-05
G285	C - LCU	First Reaction	FALSE	25p	4.07e-07	0.000137	0.000193	0.000571	0.000222
G285	C - LCU	Second Reaction	FALSE	25p	3.28e-07	0.000163	0.000260	0.000441	0.000193

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
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Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	m_Hfo_wSO4-	m_Hfo_wOSi(OH)3	m_Hfo_wOSiO(OH) 2-	m_Hfo_wHCO3	m_Hfo_wCO3-
G273	C - UA	First Reaction	FALSE	25p	2.38e-07	0.000183	0.000239	0.000368	0.000132
G273	C - UA	Second Reaction	FALSE	25p	1.86e-07	0.000203	0.000289	0.000283	0.000111
G279	C - UA	First Reaction	FALSE	25p	2.80e-07	0.000180	0.000263	0.000334	0.000134
G279	C - UA	Second Reaction	FALSE	25p	1.82e-07	0.000200	0.000309	0.000263	0.000112
G285	C - LCU	Initial Soln	FALSE	75p	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	75p	1.70e-05	0.000357	0.000195	0.00244	0.000367
G273	C - UA	Speciation Model	FALSE	75p	1.49e-05	0.000423	0.000223	0.00122	0.000176
G279	C - UA	Speciation Model	FALSE	75p	4.86e-05	0.000477	0.000210	0.00103	0.000125
G285	C - LCU	First Reaction	FALSE	75p	1.13e-06	0.000290	0.000358	0.00162	0.000551
G285	C - LCU	Second Reaction	FALSE	75p	9.46e-07	0.000296	0.000451	0.00130	0.000545
G273	C - UA	First Reaction	FALSE	75p	4.92e-07	0.000322	0.000395	0.000770	0.000260
G273	C - UA	Second Reaction	FALSE	75p	4.08e-07	0.000326	0.000470	0.000605	0.000240
G279	C - UA	First Reaction	FALSE	75p	6.22e-07	0.000317	0.000440	0.000694	0.000265
G279	C - UA	Second Reaction	FALSE	75p	3.99e-07	0.000322	0.000510	0.000556	0.000243
G285	C - LCU	Initial Soln	FALSE	median	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	median	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	median	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	median	1.03e-05	0.000217	0.000119	0.00149	0.000223
G273	C - UA	Speciation Model	FALSE	median	1.28e-05	0.000362	0.000191	0.00104	0.000151
G279	C - UA	Speciation Model	FALSE	median	4.16e-05	0.000409	0.000180	0.000885	0.000107
G285	C - LCU	First Reaction	FALSE	median	6.28e-07	0.000185	0.000248	0.000892	0.000331
G285	C - LCU	Second Reaction	FALSE	median	5.25e-07	0.000205	0.000326	0.000699	0.000307
G273	C - UA	First Reaction	FALSE	median	4.11e-07	0.000278	0.000348	0.000640	0.000220
G273	C - UA	Second Reaction	FALSE	median	3.37e-07	0.000287	0.000416	0.000500	0.000199
G279	C - UA	First Reaction	FALSE	median	5.07e-07	0.000274	0.000386	0.000577	0.000224
G279	C - UA	Second Reaction	FALSE	median	3.29e-07	0.000284	0.000450	0.000461	0.000201

Attachment D. PHREEQC modeling output
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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
G285	C - LCU	Initial Soln	TRUE	25p	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	25p	1.22e-05	3.33e-05	1.54e-06	3.96e-08	2.66e-07
G273	C - UA	Speciation Model	TRUE	25p	2.80e-06	7.90e-06	3.79e-07	2.08e-08	1.44e-07
G279	C - UA	Speciation Model	TRUE	25p	1.61e-06	5.44e-06	3.11e-07	1.82e-08	1.50e-07
G285	C - LCU	First Reaction	TRUE	25p	2.26e-05	2.37e-05	4.21e-07	4.29e-08	1.10e-07
G285	C - LCU	Second Reaction	TRUE	25p	2.39e-05	2.22e-05	3.49e-07	3.49e-08	7.96e-08
G273	C - UA	First Reaction	TRUE	25p	5.15e-06	5.84e-06	1.12e-07	1.96e-08	5.47e-08
G273	C - UA	Second Reaction	TRUE	25p	5.39e-06	5.60e-06	9.87e-08	1.52e-08	3.88e-08
G279	C - UA	First Reaction	TRUE	25p	3.68e-06	3.73e-06	6.44e-08	3.34e-08	8.33e-08
G279	C - UA	Second Reaction	TRUE	25p	3.84e-06	3.67e-06	5.95e-08	2.74e-08	6.42e-08
G285	C - LCU	Initial Soln	TRUE	75p	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	75p	2.89e-05	7.88e-05	3.65e-06	9.40e-08	6.30e-07
G273	C - UA	Speciation Model	TRUE	75p	5.15e-06	1.45e-05	6.97e-07	3.83e-08	2.66e-07
G279	C - UA	Speciation Model	TRUE	75p	2.97e-06	1.00e-05	5.74e-07	3.34e-08	2.77e-07
G285	C - LCU	First Reaction	TRUE	75p	5.00e-05	5.99e-05	1.22e-06	1.13e-07	3.32e-07
G285	C - LCU	Second Reaction	TRUE	75p	5.58e-05	5.41e-05	8.92e-07	1.03e-07	2.45e-07
G273	C - UA	First Reaction	TRUE	75p	9.15e-06	1.11e-05	2.27e-07	4.05e-08	1.20e-07
G273	C - UA	Second Reaction	TRUE	75p	1.00e-05	1.03e-05	1.79e-07	3.43e-08	8.64e-08
G279	C - UA	First Reaction	TRUE	75p	6.56e-06	7.00e-06	1.27e-07	6.70e-08	1.75e-07
G279	C - UA	Second Reaction	TRUE	75p	7.09e-06	6.61e-06	1.05e-07	6.01e-08	1.38e-07
G285	C - LCU	Initial Soln	TRUE	median	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	median	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	median	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	median	1.76e-05	4.80e-05	2.22e-06	5.72e-08	3.83e-07
G273	C - UA	Speciation Model	TRUE	median	4.42e-06	1.25e-05	5.98e-07	3.28e-08	2.28e-07
G279	C - UA	Speciation Model	TRUE	median	2.55e-06	8.59e-06	4.92e-07	2.87e-08	2.37e-07
G285	C - LCU	First Reaction	TRUE	median	3.19e-05	3.50e-05	6.53e-07	6.55e-08	1.77e-07
G285	C - LCU	Second Reaction	TRUE	median	3.46e-05	3.21e-05	5.05e-07	5.65e-08	1.29e-07
G273	C - UA	First Reaction	TRUE	median	7.94e-06	9.39e-06	1.89e-07	3.39e-08	9.85e-08
G273	C - UA	Second Reaction	TRUE	median	8.60e-06	8.79e-06	1.52e-07	2.82e-08	7.06e-08
G279	C - UA	First Reaction	TRUE	median	5.68e-06	5.96e-06	1.06e-07	5.65e-08	1.45e-07
G279	C - UA	Second Reaction	TRUE	median	6.09e-06	5.68e-06	8.99e-08	4.96e-08	1.14e-07
G285	C - LCU	Initial Soln	FALSE	25p	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	25p	1.23e-05	3.35e-05	1.54e-06	3.94e-08	2.62e-07
G273	C - UA	Speciation Model	FALSE	25p	2.83e-06	7.95e-06	3.79e-07	2.07e-08	1.43e-07
G279	C - UA	Speciation Model	FALSE	25p	1.62e-06	5.45e-06	3.11e-07	1.81e-08	1.49e-07
G285	C - LCU	First Reaction	FALSE	25p	2.28e-05	2.39e-05	4.25e-07	4.20e-08	1.08e-07
G285	C - LCU	Second Reaction	FALSE	25p	2.40e-05	2.24e-05	3.53e-07	3.42e-08	7.80e-08

Attachment D. PHREEQC modeling output
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Coffeen Power Plant
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Location	Location Description	Model	Charge Balance	Solids Summary	m_Hfo_wPO4-2	m_Hfo_wHPO4-	m_Hfo_wH2PO4	m_Hfo_sCO3-	m_Hfo_sHCO3
G273	C - UA	First Reaction	FALSE	25p	5.19e-06	5.88e-06	1.13e-07	1.93e-08	5.38e-08
G273	C - UA	Second Reaction	FALSE	25p	5.43e-06	5.64e-06	9.95e-08	1.50e-08	3.81e-08
G279	C - UA	First Reaction	FALSE	25p	3.69e-06	3.74e-06	6.45e-08	3.32e-08	8.26e-08
G279	C - UA	Second Reaction	FALSE	25p	3.85e-06	3.68e-06	5.96e-08	2.71e-08	6.37e-08
G285	C - LCU	Initial Soln	FALSE	75p	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	75p	2.93e-05	7.94e-05	3.66e-06	9.33e-08	6.21e-07
G273	C - UA	Speciation Model	FALSE	75p	5.21e-06	1.46e-05	6.99e-07	3.82e-08	2.63e-07
G279	C - UA	Speciation Model	FALSE	75p	2.99e-06	1.00e-05	5.73e-07	3.33e-08	2.75e-07
G285	C - LCU	First Reaction	FALSE	75p	5.04e-05	6.04e-05	1.23e-06	1.11e-07	3.26e-07
G285	C - LCU	Second Reaction	FALSE	75p	5.62e-05	5.46e-05	9.01e-07	1.01e-07	2.40e-07
G273	C - UA	First Reaction	FALSE	75p	9.22e-06	1.11e-05	2.28e-07	3.99e-08	1.18e-07
G273	C - UA	Second Reaction	FALSE	75p	1.01e-05	1.03e-05	1.80e-07	3.38e-08	8.51e-08
G279	C - UA	First Reaction	FALSE	75p	6.58e-06	7.02e-06	1.27e-07	6.65e-08	1.74e-07
G279	C - UA	Second Reaction	FALSE	75p	7.11e-06	6.63e-06	1.05e-07	5.97e-08	1.37e-07
G285	C - LCU	Initial Soln	FALSE	median	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	median	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	median	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	median	1.78e-05	4.83e-05	2.23e-06	5.68e-08	3.78e-07
G273	C - UA	Speciation Model	FALSE	median	4.46e-06	1.25e-05	5.99e-07	3.27e-08	2.26e-07
G279	C - UA	Speciation Model	FALSE	median	2.56e-06	8.61e-06	4.92e-07	2.85e-08	2.35e-07
G285	C - LCU	First Reaction	FALSE	median	3.21e-05	3.53e-05	6.59e-07	6.42e-08	1.73e-07
G285	C - LCU	Second Reaction	FALSE	median	3.49e-05	3.24e-05	5.10e-07	5.53e-08	1.26e-07
G273	C - UA	First Reaction	FALSE	median	8.00e-06	9.46e-06	1.90e-07	3.34e-08	9.70e-08
G273	C - UA	Second Reaction	FALSE	median	8.66e-06	8.85e-06	1.54e-07	2.77e-08	6.95e-08
G279	C - UA	First Reaction	FALSE	median	5.70e-06	5.98e-06	1.06e-07	5.60e-08	1.44e-07
G279	C - UA	Second Reaction	FALSE	median	6.10e-06	5.69e-06	9.02e-08	4.93e-08	1.13e-07

Attachment D. PHREEQC modeling output
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Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	m_Hfo_sHPO4-	m_Hfo_sH2BO3	m_Hfo_sH2PO4	m_Hfo_sOSi(OH)3	m_Hfo_sOSiO(OH) 2-
G285	C - LCU	Initial Soln	TRUE	25p	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	25p	8.58e-09	1.04e-12	3.98e-10	3.91e-08	2.12e-08
G273	C - UA	Speciation Model	TRUE	25p	1.73e-09	3.37e-13	8.28e-11	5.03e-08	2.64e-08
G279	C - UA	Speciation Model	TRUE	25p	1.46e-09	3.40e-11	8.35e-11	6.95e-08	3.05e-08
G285	C - LCU	First Reaction	TRUE	25p	4.58e-09	2.06e-12	8.14e-11	2.64e-08	3.73e-08
G285	C - LCU	Second Reaction	TRUE	25p	4.00e-09	1.85e-12	6.30e-11	2.95e-08	4.69e-08
G273	C - UA	First Reaction	TRUE	25p	8.67e-10	6.62e-13	1.67e-11	2.73e-08	3.56e-08
G273	C - UA	Second Reaction	TRUE	25p	7.67e-10	6.52e-13	1.35e-11	2.78e-08	3.97e-08
G279	C - UA	First Reaction	TRUE	25p	9.31e-10	2.78e-11	1.60e-11	4.50e-08	6.56e-08
G279	C - UA	Second Reaction	TRUE	25p	8.95e-10	2.25e-11	1.45e-11	4.88e-08	7.56e-08
G285	C - LCU	Initial Soln	TRUE	75p	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	75p	2.03e-08	2.47e-12	9.43e-10	9.27e-08	5.03e-08
G273	C - UA	Speciation Model	TRUE	75p	3.18e-09	6.21e-13	1.52e-10	9.27e-08	4.86e-08
G279	C - UA	Speciation Model	TRUE	75p	2.69e-09	6.27e-11	1.54e-10	1.28e-07	5.62e-08
G285	C - LCU	First Reaction	TRUE	75p	1.23e-08	4.91e-12	2.49e-10	5.95e-08	7.34e-08
G285	C - LCU	Second Reaction	TRUE	75p	1.02e-08	5.56e-12	1.68e-10	5.59e-08	8.53e-08
G273	C - UA	First Reaction	TRUE	75p	1.72e-09	1.18e-12	3.53e-11	5.03e-08	6.17e-08
G273	C - UA	Second Reaction	TRUE	75p	1.47e-09	1.28e-12	2.55e-11	4.66e-08	6.72e-08
G279	C - UA	First Reaction	TRUE	75p	1.77e-09	5.16e-11	3.20e-11	8.02e-08	1.11e-07
G279	C - UA	Second Reaction	TRUE	75p	1.64e-09	4.62e-11	2.59e-11	7.98e-08	1.27e-07
G285	C - LCU	Initial Soln	TRUE	median	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	median	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	median	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	median	1.24e-08	1.50e-12	5.74e-10	5.64e-08	3.06e-08
G273	C - UA	Speciation Model	TRUE	median	2.72e-09	5.32e-13	1.31e-10	7.95e-08	4.16e-08
G279	C - UA	Speciation Model	TRUE	median	2.30e-09	5.38e-11	1.32e-10	1.10e-07	4.82e-08
G285	C - LCU	First Reaction	TRUE	median	6.93e-09	3.03e-12	1.29e-10	3.66e-08	4.93e-08
G285	C - LCU	Second Reaction	TRUE	median	5.90e-09	3.06e-12	9.29e-11	3.77e-08	6.01e-08
G273	C - UA	First Reaction	TRUE	median	1.45e-09	1.03e-12	2.90e-11	4.29e-08	5.36e-08
G273	C - UA	Second Reaction	TRUE	median	1.24e-09	1.08e-12	2.15e-11	4.06e-08	5.88e-08
G279	C - UA	First Reaction	TRUE	median	1.50e-09	4.41e-11	2.67e-11	6.90e-08	9.73e-08
G279	C - UA	Second Reaction	TRUE	median	1.40e-09	3.85e-11	2.22e-11	7.01e-08	1.11e-07
G285	C - LCU	Initial Soln	FALSE	25p	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	25p	8.52e-09	1.02e-12	3.92e-10	3.83e-08	2.09e-08
G273	C - UA	Speciation Model	FALSE	25p	1.72e-09	3.33e-13	8.21e-11	4.97e-08	2.62e-08
G279	C - UA	Speciation Model	FALSE	25p	1.45e-09	3.37e-11	8.29e-11	6.89e-08	3.03e-08
G285	C - LCU	First Reaction	FALSE	25p	4.53e-09	1.98e-12	8.06e-11	2.59e-08	3.65e-08
G285	C - LCU	Second Reaction	FALSE	25p	3.95e-09	1.78e-12	6.24e-11	2.88e-08	4.59e-08

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
GMF Recycle Pond
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	m_Hfo_sHPO4-	m_Hfo_sH2BO3	m_Hfo_sH2PO4	m_Hfo_sOSi(OH)3	m_Hfo_sOSiO(OH)2-
G273	C - UA	First Reaction	FALSE	25p	8.60e-10	6.44e-13	1.65e-11	2.68e-08	3.50e-08
G273	C - UA	Second Reaction	FALSE	25p	7.60e-10	6.34e-13	1.34e-11	2.74e-08	3.90e-08
G279	C - UA	First Reaction	FALSE	25p	9.26e-10	2.75e-11	1.60e-11	4.46e-08	6.50e-08
G279	C - UA	Second Reaction	FALSE	25p	8.90e-10	2.23e-11	1.44e-11	4.84e-08	7.49e-08
G285	C - LCU	Initial Soln	FALSE	75p	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	75p	2.02e-08	2.42e-12	9.31e-10	9.09e-08	4.96e-08
G273	C - UA	Speciation Model	FALSE	75p	3.17e-09	6.13e-13	1.51e-10	9.16e-08	4.82e-08
G279	C - UA	Speciation Model	FALSE	75p	2.67e-09	6.21e-11	1.53e-10	1.27e-07	5.58e-08
G285	C - LCU	First Reaction	FALSE	75p	1.21e-08	4.74e-12	2.47e-10	5.82e-08	7.18e-08
G285	C - LCU	Second Reaction	FALSE	75p	1.01e-08	5.36e-12	1.66e-10	5.47e-08	8.34e-08
G273	C - UA	First Reaction	FALSE	75p	1.71e-09	1.15e-12	3.50e-11	4.95e-08	6.07e-08
G273	C - UA	Second Reaction	FALSE	75p	1.45e-09	1.24e-12	2.53e-11	4.58e-08	6.60e-08
G279	C - UA	First Reaction	FALSE	75p	1.76e-09	5.11e-11	3.18e-11	7.95e-08	1.10e-07
G279	C - UA	Second Reaction	FALSE	75p	1.63e-09	4.58e-11	2.58e-11	7.91e-08	1.25e-07
G285	C - LCU	Initial Soln	FALSE	median	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	median	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	median	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	median	1.23e-08	1.47e-12	5.66e-10	5.53e-08	3.02e-08
G273	C - UA	Speciation Model	FALSE	median	2.72e-09	5.26e-13	1.30e-10	7.85e-08	4.13e-08
G279	C - UA	Speciation Model	FALSE	median	2.29e-09	5.33e-11	1.31e-10	1.09e-07	4.79e-08
G285	C - LCU	First Reaction	FALSE	median	6.86e-09	2.92e-12	1.28e-10	3.58e-08	4.82e-08
G285	C - LCU	Second Reaction	FALSE	median	5.84e-09	2.94e-12	9.20e-11	3.69e-08	5.87e-08
G273	C - UA	First Reaction	FALSE	median	1.43e-09	1.00e-12	2.88e-11	4.22e-08	5.27e-08
G273	C - UA	Second Reaction	FALSE	median	1.23e-09	1.05e-12	2.13e-11	3.99e-08	5.78e-08
G279	C - UA	First Reaction	FALSE	median	1.49e-09	4.37e-11	2.66e-11	6.83e-08	9.64e-08
G279	C - UA	Second Reaction	FALSE	median	1.39e-09	3.82e-11	2.21e-11	6.94e-08	1.10e-07

Attachment D. PHREEQC modeling output

Groundwater Polishing Report
GMF Recycle Pond
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
G285	C - LCU	Initial Soln	TRUE	25p	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	25p	3.17e-09	1.81e-09	4.25e-14	0.000149	5.83e-05
G273	C - UA	Speciation Model	TRUE	25p	2.95e-09	1.74e-09	2.34e-13	0.000639	0.000135
G279	C - UA	Speciation Model	TRUE	25p	9.97e-09	7.03e-09	1.33e-13	0.000368	0.00157
G285	C - LCU	First Reaction	TRUE	25p	3.60e-10	7.89e-11	3.52e-15	0.000142	4.97e-05
G285	C - LCU	Second Reaction	TRUE	25p	3.05e-10	5.93e-11	2.82e-15	0.000145	4.21e-05
G273	C - UA	First Reaction	TRUE	25p	1.49e-10	3.54e-11	1.48e-14	0.000636	0.000130
G273	C - UA	Second Reaction	TRUE	25p	1.18e-10	2.55e-11	1.19e-14	0.000643	0.000125
G279	C - UA	First Reaction	TRUE	25p	3.30e-10	7.00e-11	6.61e-15	0.000276	0.00142
G279	C - UA	Second Reaction	TRUE	25p	2.22e-10	4.43e-11	5.72e-15	0.000306	0.00130
G285	C - LCU	Initial Soln	TRUE	75p	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	75p	7.53e-09	4.30e-09	1.65e-13	0.000579	0.000226
G273	C - UA	Speciation Model	TRUE	75p	5.44e-09	3.21e-09	2.95e-13	0.000806	0.000170
G279	C - UA	Speciation Model	TRUE	75p	1.84e-08	1.29e-08	1.67e-13	0.000464	0.00198
G285	C - LCU	First Reaction	TRUE	75p	9.23e-10	2.31e-10	1.70e-14	0.000540	0.000217
G285	C - LCU	Second Reaction	TRUE	75p	8.81e-10	1.78e-10	1.24e-14	0.000547	0.000207
G273	C - UA	First Reaction	TRUE	75p	3.05e-10	7.68e-11	2.13e-14	0.000798	0.000165
G273	C - UA	Second Reaction	TRUE	75p	2.72e-10	5.82e-11	1.63e-14	0.000807	0.000160
G279	C - UA	First Reaction	TRUE	75p	7.06e-10	1.57e-10	9.38e-15	0.000340	0.00182
G279	C - UA	Second Reaction	TRUE	75p	5.07e-10	9.88e-11	7.38e-15	0.000369	0.00170
G285	C - LCU	Initial Soln	TRUE	median	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	median	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	median	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	median	4.58e-09	2.61e-09	6.65e-14	0.000233	9.12e-05
G273	C - UA	Speciation Model	TRUE	median	4.66e-09	2.75e-09	2.72e-13	0.000741	0.000156
G279	C - UA	Speciation Model	TRUE	median	1.57e-08	1.11e-08	1.54e-13	0.000427	0.00182
G285	C - LCU	First Reaction	TRUE	median	5.43e-10	1.25e-10	5.97e-15	0.000220	8.21e-05
G285	C - LCU	Second Reaction	TRUE	median	4.99e-10	9.67e-11	4.60e-15	0.000224	7.36e-05
G273	C - UA	First Reaction	TRUE	median	2.56e-10	6.33e-11	1.88e-14	0.000735	0.000152
G273	C - UA	Second Reaction	TRUE	median	2.23e-10	4.76e-11	1.46e-14	0.000743	0.000147
G279	C - UA	First Reaction	TRUE	median	5.83e-10	1.28e-10	8.35e-15	0.000315	0.00167
G279	C - UA	Second Reaction	TRUE	median	4.17e-10	8.12e-11	6.76e-15	0.000344	0.00154
G285	C - LCU	Initial Soln	FALSE	25p	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	25p	3.21e-09	1.82e-09	4.24e-14	0.000149	5.73e-05
G273	C - UA	Speciation Model	FALSE	25p	2.99e-09	1.75e-09	2.34e-13	0.000638	0.000133
G279	C - UA	Speciation Model	FALSE	25p	9.98e-09	7.02e-09	1.32e-13	0.000366	0.00157
G285	C - LCU	First Reaction	FALSE	25p	3.52e-10	7.72e-11	3.52e-15	0.000142	4.88e-05
G285	C - LCU	Second Reaction	FALSE	25p	2.98e-10	5.80e-11	2.82e-15	0.000146	4.13e-05

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
G273	C - UA	First Reaction	FALSE	25p	1.47e-10	3.47e-11	1.48e-14	0.000637	0.000128
G273	C - UA	Second Reaction	FALSE	25p	1.16e-10	2.51e-11	1.19e-14	0.000644	0.000123
G279	C - UA	First Reaction	FALSE	25p	3.27e-10	6.93e-11	6.61e-15	0.000276	0.00142
G279	C - UA	Second Reaction	FALSE	25p	2.20e-10	4.40e-11	5.73e-15	0.000306	0.00130
G285	C - LCU	Initial Soln	FALSE	75p	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	75p	7.61e-09	4.32e-09	1.64e-13	0.000576	0.000222
G273	C - UA	Speciation Model	FALSE	75p	5.50e-09	3.23e-09	2.95e-13	0.000804	0.000167
G279	C - UA	Speciation Model	FALSE	75p	1.84e-08	1.29e-08	1.67e-13	0.000462	0.00198
G285	C - LCU	First Reaction	FALSE	75p	9.01e-10	2.26e-10	1.70e-14	0.000541	0.000213
G285	C - LCU	Second Reaction	FALSE	75p	8.61e-10	1.75e-10	1.24e-14	0.000548	0.000203
G273	C - UA	First Reaction	FALSE	75p	3.00e-10	7.56e-11	2.12e-14	0.000799	0.000163
G273	C - UA	Second Reaction	FALSE	75p	2.67e-10	5.73e-11	1.62e-14	0.000808	0.000158
G279	C - UA	First Reaction	FALSE	75p	7.00e-10	1.56e-10	9.37e-15	0.000340	0.00182
G279	C - UA	Second Reaction	FALSE	75p	5.03e-10	9.80e-11	7.39e-15	0.000369	0.00170
G285	C - LCU	Initial Soln	FALSE	median	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	median	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	median	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	median	4.63e-09	2.63e-09	6.63e-14	0.000232	8.95e-05
G273	C - UA	Speciation Model	FALSE	median	4.72e-09	2.77e-09	2.71e-13	0.000739	0.000154
G279	C - UA	Speciation Model	FALSE	median	1.58e-08	1.11e-08	1.54e-13	0.000425	0.00182
G285	C - LCU	First Reaction	FALSE	median	5.31e-10	1.22e-10	5.97e-15	0.000220	8.06e-05
G285	C - LCU	Second Reaction	FALSE	median	4.88e-10	9.47e-11	4.60e-15	0.000225	7.22e-05
G273	C - UA	First Reaction	FALSE	median	2.52e-10	6.22e-11	1.88e-14	0.000736	0.000149
G273	C - UA	Second Reaction	FALSE	median	2.19e-10	4.68e-11	1.46e-14	0.000744	0.000145
G279	C - UA	First Reaction	FALSE	median	5.78e-10	1.27e-10	8.34e-15	0.000315	0.00167
G279	C - UA	Second Reaction	FALSE	median	4.14e-10	8.06e-11	6.76e-15	0.000345	0.00154

Attachment D. PHREEQC modeling output
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GMF Recycle Pond
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	m_Hao_H3BO4-	Ferrihydrite	d_Ferrihydrite	Gibbsite	d_Gibbsite
G285	C - LCU	Initial Soln	TRUE	25p	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	25p	9.58e-13	0.00970	0	0.0160	0
G273	C - UA	Speciation Model	TRUE	25p	1.72e-12	0.00760	0	0.0690	0
G279	C - UA	Speciation Model	TRUE	25p	2.04e-11	0.00760	0	0.0690	0
G285	C - LCU	First Reaction	TRUE	25p	9.37e-12	0.00970	2.24e-07	0.0160	4.27e-07
G285	C - LCU	Second Reaction	TRUE	25p	1.02e-11	0.00970	2.25e-07	0.0160	4.18e-07
G273	C - UA	First Reaction	TRUE	25p	2.61e-11	0.00760	2.25e-07	0.0690	4.24e-07
G273	C - UA	Second Reaction	TRUE	25p	3.15e-11	0.00760	2.25e-07	0.0690	4.16e-07
G279	C - UA	First Reaction	TRUE	25p	2.77e-10	0.00760	2.25e-07	0.0690	4.24e-07
G279	C - UA	Second Reaction	TRUE	25p	3.25e-10	0.00760	2.25e-07	0.0690	4.16e-07
G285	C - LCU	Initial Soln	TRUE	75p	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	75p	3.71e-12	0.0230	0	0.0620	0
G273	C - UA	Speciation Model	TRUE	75p	2.17e-12	0.0140	0	0.0870	0
G279	C - UA	Speciation Model	TRUE	75p	2.57e-11	0.0140	0	0.0870	0
G285	C - LCU	First Reaction	TRUE	75p	3.22e-11	0.0230	2.23e-07	0.0620	4.33e-07
G285	C - LCU	Second Reaction	TRUE	75p	4.27e-11	0.0230	2.25e-07	0.0620	4.24e-07
G273	C - UA	First Reaction	TRUE	75p	2.90e-11	0.0140	2.24e-07	0.0870	4.29e-07
G273	C - UA	Second Reaction	TRUE	75p	3.72e-11	0.0140	2.25e-07	0.0870	4.20e-07
G279	C - UA	First Reaction	TRUE	75p	3.09e-10	0.0140	2.24e-07	0.0870	4.27e-07
G279	C - UA	Second Reaction	TRUE	75p	3.97e-10	0.0140	2.25e-07	0.0870	4.19e-07
G285	C - LCU	Initial Soln	TRUE	median	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	median	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	median	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	median	1.50e-12	0.0140	0	0.0250	0
G273	C - UA	Speciation Model	TRUE	median	1.99e-12	0.0120	0	0.0800	0
G279	C - UA	Speciation Model	TRUE	median	2.36e-11	0.0120	0	0.0800	0
G285	C - LCU	First Reaction	TRUE	median	1.41e-11	0.0140	2.24e-07	0.0250	4.29e-07
G285	C - LCU	Second Reaction	TRUE	median	1.68e-11	0.0140	2.25e-07	0.0250	4.20e-07
G273	C - UA	First Reaction	TRUE	median	2.76e-11	0.0120	2.24e-07	0.0800	4.27e-07
G273	C - UA	Second Reaction	TRUE	median	3.49e-11	0.0120	2.25e-07	0.0800	4.19e-07
G279	C - UA	First Reaction	TRUE	median	2.94e-10	0.0120	2.24e-07	0.0800	4.26e-07
G279	C - UA	Second Reaction	TRUE	median	3.68e-10	0.0120	2.25e-07	0.0800	4.18e-07
G285	C - LCU	Initial Soln	FALSE	25p	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	25p	9.39e-13	0.00970	0	0.0160	0
G273	C - UA	Speciation Model	FALSE	25p	1.69e-12	0.00760	0	0.0690	0
G279	C - UA	Speciation Model	FALSE	25p	2.03e-11	0.00760	0	0.0690	0
G285	C - LCU	First Reaction	FALSE	25p	9.22e-12	0.00970	2.24e-07	0.0160	4.27e-07
G285	C - LCU	Second Reaction	FALSE	25p	9.98e-12	0.00970	2.25e-07	0.0160	4.18e-07

Attachment D. PHREEQC modeling output
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Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	m_Hao_H3BO4-	Ferrihydrite	d_Ferrihydrite	Gibbsite	d_Gibbsite
G273	C - UA	First Reaction	FALSE	25p	2.59e-11	0.00760	2.25e-07	0.0690	4.24e-07
G273	C - UA	Second Reaction	FALSE	25p	3.11e-11	0.00760	2.25e-07	0.0690	4.16e-07
G279	C - UA	First Reaction	FALSE	25p	2.77e-10	0.00760	2.25e-07	0.0690	4.24e-07
G279	C - UA	Second Reaction	FALSE	25p	3.25e-10	0.00760	2.25e-07	0.0690	4.16e-07
G285	C - LCU	Initial Soln	FALSE	75p	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	75p	3.64e-12	0.0230	0	0.0620	0
G273	C - UA	Speciation Model	FALSE	75p	2.13e-12	0.0140	0	0.0870	0
G279	C - UA	Speciation Model	FALSE	75p	2.56e-11	0.0140	0	0.0870	0
G285	C - LCU	First Reaction	FALSE	75p	3.18e-11	0.0230	2.23e-07	0.0620	4.33e-07
G285	C - LCU	Second Reaction	FALSE	75p	4.20e-11	0.0230	2.25e-07	0.0620	4.24e-07
G273	C - UA	First Reaction	FALSE	75p	2.87e-11	0.0140	2.24e-07	0.0870	4.28e-07
G273	C - UA	Second Reaction	FALSE	75p	3.68e-11	0.0140	2.25e-07	0.0870	4.20e-07
G279	C - UA	First Reaction	FALSE	75p	3.09e-10	0.0140	2.24e-07	0.0870	4.27e-07
G279	C - UA	Second Reaction	FALSE	75p	3.97e-10	0.0140	2.25e-07	0.0870	4.19e-07
G285	C - LCU	Initial Soln	FALSE	median	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	median	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	median	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	median	1.47e-12	0.0140	0	0.0250	0
G273	C - UA	Speciation Model	FALSE	median	1.96e-12	0.0120	0	0.0800	0
G279	C - UA	Speciation Model	FALSE	median	2.35e-11	0.0120	0	0.0800	0
G285	C - LCU	First Reaction	FALSE	median	1.39e-11	0.0140	2.24e-07	0.0250	4.29e-07
G285	C - LCU	Second Reaction	FALSE	median	1.65e-11	0.0140	2.25e-07	0.0250	4.20e-07
G273	C - UA	First Reaction	FALSE	median	2.74e-11	0.0120	2.24e-07	0.0800	4.27e-07
G273	C - UA	Second Reaction	FALSE	median	3.45e-11	0.0120	2.25e-07	0.0800	4.19e-07
G279	C - UA	First Reaction	FALSE	median	2.94e-10	0.0120	2.24e-07	0.0800	4.26e-07
G279	C - UA	Second Reaction	FALSE	median	3.68e-10	0.0120	2.25e-07	0.0800	4.18e-07

Location	Location Description	Model	Charge Balance	Solids Summary	Barite	d_Barite	Calcite	d_Calcite	Dolomite (ordered)
G285	C - LCU	Initial Soln	TRUE	25p	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	25p	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	25p	0	0	1.00	0	2.00
G273	C - UA	Speciation Model	TRUE	25p	0	0	1.00	0	3.00
G279	C - UA	Speciation Model	TRUE	25p	0	0	1.00	0	3.00
G285	C - LCU	First Reaction	TRUE	25p	4.79e-08	4.79e-08	1.00	0.000592	2.00
G285	C - LCU	Second Reaction	TRUE	25p	9.65e-08	4.86e-08	1.00	0.000511	2.00
G273	C - UA	First Reaction	TRUE	25p	5.15e-08	5.15e-08	1.00	0.000684	3.00
G273	C - UA	Second Reaction	TRUE	25p	1.01e-07	4.92e-08	1.00	0.000510	3.00
G279	C - UA	First Reaction	TRUE	25p	9.68e-08	9.68e-08	1.00	0.000687	3.00
G279	C - UA	Second Reaction	TRUE	25p	1.36e-07	3.93e-08	1.00	0.000554	3.00
G285	C - LCU	Initial Soln	TRUE	75p	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	75p	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	75p	0	0	1.00	0	2.00
G273	C - UA	Speciation Model	TRUE	75p	0	0	1.00	0	3.00
G279	C - UA	Speciation Model	TRUE	75p	0	0	1.00	0	3.00
G285	C - LCU	First Reaction	TRUE	75p	5.67e-08	5.67e-08	1.00	0.000710	2.00
G285	C - LCU	Second Reaction	TRUE	75p	9.61e-08	3.94e-08	1.00	0.000579	2.00
G273	C - UA	First Reaction	TRUE	75p	5.32e-08	5.32e-08	1.00	0.000753	3.00
G273	C - UA	Second Reaction	TRUE	75p	9.81e-08	4.48e-08	1.00	0.000546	3.00
G279	C - UA	First Reaction	TRUE	75p	1.13e-07	1.13e-07	1.00	0.000740	3.00
G279	C - UA	Second Reaction	TRUE	75p	1.50e-07	3.64e-08	1.00	0.000581	3.00
G285	C - LCU	Initial Soln	TRUE	median	0	0	0	0	0
G273	C - UA	Initial Soln	TRUE	median	0	0	0	0	0
G279	C - UA	Initial Soln	TRUE	median	0	0	0	0	0
G285	C - LCU	Speciation Model	TRUE	median	0	0	1.00	0	2.00
G273	C - UA	Speciation Model	TRUE	median	0	0	1.00	0	3.00
G279	C - UA	Speciation Model	TRUE	median	0	0	1.00	0	3.00
G285	C - LCU	First Reaction	TRUE	median	4.86e-08	4.86e-08	1.00	0.000629	2.00
G285	C - LCU	Second Reaction	TRUE	median	9.41e-08	4.55e-08	1.00	0.000533	2.00
G273	C - UA	First Reaction	TRUE	median	5.25e-08	5.25e-08	1.00	0.000731	3.00
G273	C - UA	Second Reaction	TRUE	median	9.86e-08	4.62e-08	1.00	0.000535	3.00
G279	C - UA	First Reaction	TRUE	median	1.08e-07	1.08e-07	1.00	0.000723	3.00
G279	C - UA	Second Reaction	TRUE	median	1.45e-07	3.72e-08	1.00	0.000573	3.00
G285	C - LCU	Initial Soln	FALSE	25p	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	25p	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	25p	0	0	1.00	0	2.00
G273	C - UA	Speciation Model	FALSE	25p	0	0	1.00	0	3.00
G279	C - UA	Speciation Model	FALSE	25p	0	0	1.00	0	3.00
G285	C - LCU	First Reaction	FALSE	25p	4.78e-08	4.78e-08	1.00	0.000590	2.00
G285	C - LCU	Second Reaction	FALSE	25p	9.64e-08	4.86e-08	1.00	0.000510	2.00

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Location	Location Description	Model	Charge Balance	Solids Summary	Barite	d_Barite	Calcite	d_Calcite	Dolomite (ordered)
G273	C - UA	First Reaction	FALSE	25p	5.08e-08	5.08e-08	1.00	0.000676	3.00
G273	C - UA	Second Reaction	FALSE	25p	1.00e-07	4.93e-08	1.00	0.000510	3.00
G279	C - UA	First Reaction	FALSE	25p	9.62e-08	9.62e-08	1.00	0.000684	3.00
G279	C - UA	Second Reaction	FALSE	25p	1.36e-07	3.93e-08	1.00	0.000554	3.00
G285	C - LCU	Initial Soln	FALSE	75p	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	75p	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	75p	0	0	1.00	0	2.00
G273	C - UA	Speciation Model	FALSE	75p	0	0	1.00	0	3.00
G279	C - UA	Speciation Model	FALSE	75p	0	0	1.00	0	3.00
G285	C - LCU	First Reaction	FALSE	75p	5.59e-08	5.59e-08	1.00	0.000702	2.00
G285	C - LCU	Second Reaction	FALSE	75p	9.53e-08	3.94e-08	1.00	0.000579	2.00
G273	C - UA	First Reaction	FALSE	75p	5.25e-08	5.25e-08	1.00	0.000743	3.00
G273	C - UA	Second Reaction	FALSE	75p	9.73e-08	4.49e-08	1.00	0.000545	3.00
G279	C - UA	First Reaction	FALSE	75p	1.13e-07	1.13e-07	1.00	0.000737	3.00
G279	C - UA	Second Reaction	FALSE	75p	1.49e-07	3.64e-08	1.00	0.000581	3.00
G285	C - LCU	Initial Soln	FALSE	median	0	0	0	0	0
G273	C - UA	Initial Soln	FALSE	median	0	0	0	0	0
G279	C - UA	Initial Soln	FALSE	median	0	0	0	0	0
G285	C - LCU	Speciation Model	FALSE	median	0	0	1.00	0	2.00
G273	C - UA	Speciation Model	FALSE	median	0	0	1.00	0	3.00
G279	C - UA	Speciation Model	FALSE	median	0	0	1.00	0	3.00
G285	C - LCU	First Reaction	FALSE	median	4.84e-08	4.84e-08	1.00	0.000626	2.00
G285	C - LCU	Second Reaction	FALSE	median	9.39e-08	4.55e-08	1.00	0.000533	2.00
G273	C - UA	First Reaction	FALSE	median	5.17e-08	5.17e-08	1.00	0.000722	3.00
G273	C - UA	Second Reaction	FALSE	median	9.79e-08	4.62e-08	1.00	0.000534	3.00
G279	C - UA	First Reaction	FALSE	median	1.07e-07	1.07e-07	1.00	0.000720	3.00
G279	C - UA	Second Reaction	FALSE	median	1.44e-07	3.72e-08	1.00	0.000573	3.00

Location	Location Description	Model	Charge Balance	Solids Summary	d_Dolomite (ordered)	Gypsum	d_Gypsum	si_Ferrihydrite	si_Gibbsite
G285	C - LCU	Initial Soln	TRUE	25p	0	0	0	1.46	0.953
G273	C - UA	Initial Soln	TRUE	25p	0	0	0	1.19	0.710
G279	C - UA	Initial Soln	TRUE	25p	0	0	0	0.439	0.646
G285	C - LCU	Speciation Model	TRUE	25p	0	0	0	1.46	0.953
G273	C - UA	Speciation Model	TRUE	25p	0	0	0	1.19	0.710
G279	C - UA	Speciation Model	TRUE	25p	0	0	0	0.439	0.646
G285	C - LCU	First Reaction	TRUE	25p	-7.33e-04	0	0	0	0
G285	C - LCU	Second Reaction	TRUE	25p	-5.02e-04	0	0	0	0
G273	C - UA	First Reaction	TRUE	25p	-7.64e-04	0	0	0	0
G273	C - UA	Second Reaction	TRUE	25p	-4.76e-04	0	0	0	0
G279	C - UA	First Reaction	TRUE	25p	-7.77e-04	0	0	0	0
G279	C - UA	Second Reaction	TRUE	25p	-5.10e-04	0	0	0	0
G285	C - LCU	Initial Soln	TRUE	75p	0	0	0	1.46	0.953
G273	C - UA	Initial Soln	TRUE	75p	0	0	0	1.19	0.710
G279	C - UA	Initial Soln	TRUE	75p	0	0	0	0.439	0.646
G285	C - LCU	Speciation Model	TRUE	75p	0	0	0	1.46	0.953
G273	C - UA	Speciation Model	TRUE	75p	0	0	0	1.19	0.710
G279	C - UA	Speciation Model	TRUE	75p	0	0	0	0.439	0.646
G285	C - LCU	First Reaction	TRUE	75p	-1.01e-03	0	0	0	0
G285	C - LCU	Second Reaction	TRUE	75p	-6.61e-04	0	0	0	0
G273	C - UA	First Reaction	TRUE	75p	-9.21e-04	0	0	0	0
G273	C - UA	Second Reaction	TRUE	75p	-5.55e-04	0	0	0	0
G279	C - UA	First Reaction	TRUE	75p	-9.34e-04	0	0	0	0
G279	C - UA	Second Reaction	TRUE	75p	-5.75e-04	0	0	0	0
G285	C - LCU	Initial Soln	TRUE	median	0	0	0	1.46	0.953
G273	C - UA	Initial Soln	TRUE	median	0	0	0	1.19	0.710
G279	C - UA	Initial Soln	TRUE	median	0	0	0	0.439	0.646
G285	C - LCU	Speciation Model	TRUE	median	0	0	0	1.46	0.953
G273	C - UA	Speciation Model	TRUE	median	0	0	0	1.19	0.710
G279	C - UA	Speciation Model	TRUE	median	0	0	0	0.439	0.646
G285	C - LCU	First Reaction	TRUE	median	-8.30e-04	0	0	0	0
G285	C - LCU	Second Reaction	TRUE	median	-5.56e-04	0	0	0	0
G273	C - UA	First Reaction	TRUE	median	-8.74e-04	0	0	0	0
G273	C - UA	Second Reaction	TRUE	median	-5.31e-04	0	0	0	0
G279	C - UA	First Reaction	TRUE	median	-8.87e-04	0	0	0	0
G279	C - UA	Second Reaction	TRUE	median	-5.55e-04	0	0	0	0
G285	C - LCU	Initial Soln	FALSE	25p	0	0	0	1.47	0.955
G273	C - UA	Initial Soln	FALSE	25p	0	0	0	1.19	0.712
G279	C - UA	Initial Soln	FALSE	25p	0	0	0	0.440	0.647
G285	C - LCU	Speciation Model	FALSE	25p	0	0	0	1.47	0.955
G273	C - UA	Speciation Model	FALSE	25p	0	0	0	1.19	0.712
G279	C - UA	Speciation Model	FALSE	25p	0	0	0	0.440	0.647
G285	C - LCU	First Reaction	FALSE	25p	-7.30e-04	0	0	0	0
G285	C - LCU	Second Reaction	FALSE	25p	-5.02e-04	0	0	0	0

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
GMF Recycle Pond
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	d_Dolomite (ordered)	Gypsum	d_Gypsum	si_Ferrihydrite	si_Gibbsite
G273	C - UA	First Reaction	FALSE	25p	-7.56e-04	0	0	0	0
G273	C - UA	Second Reaction	FALSE	25p	-4.75e-04	0	0	0	0
G279	C - UA	First Reaction	FALSE	25p	-7.74e-04	0	0	0	0
G279	C - UA	Second Reaction	FALSE	25p	-5.10e-04	0	0	0	0
G285	C - LCU	Initial Soln	FALSE	75p	0	0	0	1.47	0.955
G273	C - UA	Initial Soln	FALSE	75p	0	0	0	1.19	0.712
G279	C - UA	Initial Soln	FALSE	75p	0	0	0	0.440	0.647
G285	C - LCU	Speciation Model	FALSE	75p	0	0	0	1.47	0.955
G273	C - UA	Speciation Model	FALSE	75p	0	0	0	1.19	0.712
G279	C - UA	Speciation Model	FALSE	75p	0	0	0	0.440	0.647
G285	C - LCU	First Reaction	FALSE	75p	-1.00e-03	0	0	0	0
G285	C - LCU	Second Reaction	FALSE	75p	-6.61e-04	0	0	0	0
G273	C - UA	First Reaction	FALSE	75p	-9.12e-04	0	0	0	0
G273	C - UA	Second Reaction	FALSE	75p	-5.54e-04	0	0	0	0
G279	C - UA	First Reaction	FALSE	75p	-9.31e-04	0	0	0	0
G279	C - UA	Second Reaction	FALSE	75p	-5.75e-04	0	0	0	0
G285	C - LCU	Initial Soln	FALSE	median	0	0	0	1.47	0.955
G273	C - UA	Initial Soln	FALSE	median	0	0	0	1.19	0.712
G279	C - UA	Initial Soln	FALSE	median	0	0	0	0.440	0.647
G285	C - LCU	Speciation Model	FALSE	median	0	0	0	1.47	0.955
G273	C - UA	Speciation Model	FALSE	median	0	0	0	1.19	0.712
G279	C - UA	Speciation Model	FALSE	median	0	0	0	0.440	0.647
G285	C - LCU	First Reaction	FALSE	median	-8.26e-04	0	0	0	0
G285	C - LCU	Second Reaction	FALSE	median	-5.55e-04	0	0	0	0
G273	C - UA	First Reaction	FALSE	median	-8.65e-04	0	0	0	0
G273	C - UA	Second Reaction	FALSE	median	-5.30e-04	0	0	0	0
G279	C - UA	First Reaction	FALSE	median	-8.84e-04	0	0	0	0
G279	C - UA	Second Reaction	FALSE	median	-5.55e-04	0	0	0	0

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
GMF Recycle Pond
Coffeen Power Plant
Coffeen, IL

Location	Location Description	Model	Charge Balance	Solids Summary	si_Barite	si_Calcite	si_Dolomite (ordered)	si_Gypsum
G285	C - LCU	Initial Soln	TRUE	25p	0.679	-2.25e-01	-7.01e-01	-6.01e-01
G273	C - UA	Initial Soln	TRUE	25p	0.493	-7.24e-01	-1.49e+00	-8.50e-01
G279	C - UA	Initial Soln	TRUE	25p	0.973	-4.57e-01	-8.28e-01	0.0756
G285	C - LCU	Speciation Model	TRUE	25p	0.679	-2.25e-01	-7.01e-01	-6.01e-01
G273	C - UA	Speciation Model	TRUE	25p	0.493	-7.24e-01	-1.49e+00	-8.50e-01
G279	C - UA	Speciation Model	TRUE	25p	0.973	-4.57e-01	-8.28e-01	0.0756
G285	C - LCU	First Reaction	TRUE	25p	0	0	0	-1.77e+00
G285	C - LCU	Second Reaction	TRUE	25p	0	0	0	-1.81e+00
G273	C - UA	First Reaction	TRUE	25p	0	0	0	-1.78e+00
G273	C - UA	Second Reaction	TRUE	25p	0	0	0	-1.81e+00
G279	C - UA	First Reaction	TRUE	25p	0	0	0	-1.72e+00
G279	C - UA	Second Reaction	TRUE	25p	0	0	0	-1.83e+00
G285	C - LCU	Initial Soln	TRUE	75p	0.679	-2.25e-01	-7.01e-01	-6.01e-01
G273	C - UA	Initial Soln	TRUE	75p	0.493	-7.24e-01	-1.49e+00	-8.50e-01
G279	C - UA	Initial Soln	TRUE	75p	0.973	-4.57e-01	-8.28e-01	0.0756
G285	C - LCU	Speciation Model	TRUE	75p	0.679	-2.25e-01	-7.01e-01	-6.01e-01
G273	C - UA	Speciation Model	TRUE	75p	0.493	-7.24e-01	-1.49e+00	-8.50e-01
G279	C - UA	Speciation Model	TRUE	75p	0.973	-4.57e-01	-8.28e-01	0.0756
G285	C - LCU	First Reaction	TRUE	75p	0	0	0	-1.73e+00
G285	C - LCU	Second Reaction	TRUE	75p	0	0	0	-1.80e+00
G273	C - UA	First Reaction	TRUE	75p	0	0	0	-1.76e+00
G273	C - UA	Second Reaction	TRUE	75p	0	0	0	-1.81e+00
G279	C - UA	First Reaction	TRUE	75p	0	0	0	-1.67e+00
G279	C - UA	Second Reaction	TRUE	75p	0	0	0	-1.82e+00
G285	C - LCU	Initial Soln	TRUE	median	0.679	-2.25e-01	-7.01e-01	-6.01e-01
G273	C - UA	Initial Soln	TRUE	median	0.493	-7.24e-01	-1.49e+00	-8.50e-01
G279	C - UA	Initial Soln	TRUE	median	0.973	-4.57e-01	-8.28e-01	0.0756
G285	C - LCU	Speciation Model	TRUE	median	0.679	-2.25e-01	-7.01e-01	-6.01e-01
G273	C - UA	Speciation Model	TRUE	median	0.493	-7.24e-01	-1.49e+00	-8.50e-01
G279	C - UA	Speciation Model	TRUE	median	0.973	-4.57e-01	-8.28e-01	0.0756
G285	C - LCU	First Reaction	TRUE	median	0	0	0	-1.76e+00
G285	C - LCU	Second Reaction	TRUE	median	0	0	0	-1.80e+00
G273	C - UA	First Reaction	TRUE	median	0	0	0	-1.77e+00
G273	C - UA	Second Reaction	TRUE	median	0	0	0	-1.81e+00
G279	C - UA	First Reaction	TRUE	median	0	0	0	-1.68e+00
G279	C - UA	Second Reaction	TRUE	median	0	0	0	-1.82e+00
G285	C - LCU	Initial Soln	FALSE	25p	0.701	-2.12e-01	-6.74e-01	-5.83e-01
G273	C - UA	Initial Soln	FALSE	25p	0.509	-7.15e-01	-1.47e+00	-8.36e-01
G279	C - UA	Initial Soln	FALSE	25p	0.979	-4.54e-01	-8.21e-01	0.0800
G285	C - LCU	Speciation Model	FALSE	25p	0.701	-2.12e-01	-6.74e-01	-5.83e-01
G273	C - UA	Speciation Model	FALSE	25p	0.509	-7.15e-01	-1.47e+00	-8.36e-01
G279	C - UA	Speciation Model	FALSE	25p	0.979	-4.54e-01	-8.21e-01	0.0800
G285	C - LCU	First Reaction	FALSE	25p	0	0	0	-1.77e+00
G285	C - LCU	Second Reaction	FALSE	25p	0	0	0	-1.81e+00

Attachment D. PHREEQC modeling output

Groundwater Polishing Report
GMF Recycle Pond
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Location	Location Description	Model	Charge Balance	Solids Summary	si_Barite	si_Calcite	si_Dolomite (ordered)	si_Gypsum
G273	C - UA	First Reaction	FALSE	25p	0	0	0	-1.78e+00
G273	C - UA	Second Reaction	FALSE	25p	0	0	0	-1.81e+00
G279	C - UA	First Reaction	FALSE	25p	0	0	0	-1.72e+00
G279	C - UA	Second Reaction	FALSE	25p	0	0	0	-1.83e+00
G285	C - LCU	Initial Soln	FALSE	75p	0.701	-2.12e-01	-6.74e-01	-5.83e-01
G273	C - UA	Initial Soln	FALSE	75p	0.509	-7.15e-01	-1.47e+00	-8.36e-01
G279	C - UA	Initial Soln	FALSE	75p	0.979	-4.54e-01	-8.21e-01	0.0800
G285	C - LCU	Speciation Model	FALSE	75p	0.701	-2.12e-01	-6.74e-01	-5.83e-01
G273	C - UA	Speciation Model	FALSE	75p	0.509	-7.15e-01	-1.47e+00	-8.36e-01
G279	C - UA	Speciation Model	FALSE	75p	0.979	-4.54e-01	-8.21e-01	0.0800
G285	C - LCU	First Reaction	FALSE	75p	0	0	0	-1.73e+00
G285	C - LCU	Second Reaction	FALSE	75p	0	0	0	-1.80e+00
G273	C - UA	First Reaction	FALSE	75p	0	0	0	-1.76e+00
G273	C - UA	Second Reaction	FALSE	75p	0	0	0	-1.81e+00
G279	C - UA	First Reaction	FALSE	75p	0	0	0	-1.67e+00
G279	C - UA	Second Reaction	FALSE	75p	0	0	0	-1.82e+00
G285	C - LCU	Initial Soln	FALSE	median	0.701	-2.12e-01	-6.74e-01	-5.83e-01
G273	C - UA	Initial Soln	FALSE	median	0.509	-7.15e-01	-1.47e+00	-8.36e-01
G279	C - UA	Initial Soln	FALSE	median	0.979	-4.54e-01	-8.21e-01	0.0800
G285	C - LCU	Speciation Model	FALSE	median	0.701	-2.12e-01	-6.74e-01	-5.83e-01
G273	C - UA	Speciation Model	FALSE	median	0.509	-7.15e-01	-1.47e+00	-8.36e-01
G279	C - UA	Speciation Model	FALSE	median	0.979	-4.54e-01	-8.21e-01	0.0800
G285	C - LCU	First Reaction	FALSE	median	0	0	0	-1.76e+00
G285	C - LCU	Second Reaction	FALSE	median	0	0	0	-1.80e+00
G273	C - UA	First Reaction	FALSE	median	0	0	0	-1.77e+00
G273	C - UA	Second Reaction	FALSE	median	0	0	0	-1.81e+00
G279	C - UA	First Reaction	FALSE	median	0	0	0	-1.68e+00
G279	C - UA	Second Reaction	FALSE	median	0	0	0	-1.82e+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
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, GMF RECYCLE POND, IEPA ID NO W1350150004-04

RAMBOLL Bright ideas. Sustainable change.

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN COFFEEN POWER PLANT, GMF RECYCLE POND, IEPA ID NO W1350150004-04

Project name	**Coffeen Power Plant GMF Recycle Pond**
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	**Sung-Woo Lee, PhD**
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

TABLES (ATTACHED)

FIGURES (ATTACHED)

APPENDICES

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
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 Coffee 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 Gypsum Management Facility Recycle Pond (GMF RP), CCR identification (ID) No. 104, Illinois Environmental Protection Agency (IEPA) ID No. W1350150004-04, and National Inventory of Dams (NID) No. IL50578. The GMF RP is a 17-acre, lined SI put into operation in 2010 and used to manage blowdown from the air emission scrubbers at the CPP. The GMF RP was built in accordance with Water Pollution Control Permit 2008-EA-4661. IPGC ceased receipt of waste to the GMF RP prior to April 11, 2021. 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 the GMF RP 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 to the Corrective Action Plan for the CPP GMF RP. The Corrective Action Plan proposes source control with groundwater polishing, as presented as the remedy for the GMF RP. 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 the GMF RP. 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 the GMF RP[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] The presence of exceedances at the waste boundary will continue to be evaluated under the Operating permit GMP previously submitted to IEPA [3].

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 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 the GMF RP, Ash Pond No. 1 (AP1), Ash Pond No. 2 (AP2), the Gypsum Management Facility Gypsum Stack Pond (GMF GSP), 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. The GMF RP is located between the two lobes of Coffeen Lake (identified as “Coffeen Lake” and “Unnamed Tributary” on **Figure 1-2**). To the east and west are the two lobes of Coffeen Lake, AP2 to the south, and the GMF GSP to the north (**Figure 1-3**). Beyond the lake and other CCR units is agricultural land.

The GMF RP is a 17-acre, lined SI put into operation in 2010 and used to manage blowdown from the air emission scrubbers at the CPP. The GMF RP was built in accordance with Water Pollution Control Permit 2008-EA-4661 and features a composite 60-millimeter high density polyethylene liner with 3 feet of recompacted soil with a hydraulic conductivity of 1 x 10^{-7} centimeters per second, with internal piping and drains to collect contact water. Construction of the unit required excavation to approximately 601 feet and installation of a groundwater underdrain system to eliminate inward pressure on the liner prior to placement of CCR. The GMF GSP underdrain underdrain is a passive, gravity drained system. IPGC ceased receipt of waste to the GMF RP prior to April 11, 2021. 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 the GMF RP at the CPP.

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 GMF RP has been well characterized as detailed in the Hydrogeologic Site Characterization Report (HCR) [1] included in the Operating Permit Application[2] and in the Nature and Extent Report [2].[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 the GMF RP 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.

---

[2] The HCR was previously included as Attachment H of the Coffeen GMF RP Operating Permit Application, submitted to IEPA on October 25, 2021.

[3] The Nature and Extent Report was previously submitted to IEPA [2] 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.

- **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 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):** 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 primarily east to southeast across the GMF RP toward the 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 the GMF RP began in the second quarter of 2023 [3]. 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 a compliance groundwater monitoring wells were identified [4]:

- Sulfate at wells G273 and G285

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[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 GMF RP. 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.

- Total Dissolved Solids (TDS) at well G285

Alternative Source Demonstrations (ASDs) were not completed for the GWPS exceedances listed above. Subsequent compliance sampling events (following E001) were evaluated for exceedances of the GWPS as described in 35 I.A.C. § 845.600 [5, 6, 7, 8, 9, 10]. Exceedances identified during the subsequent events were consistent with that listed above. In addition to the exceedance listed above, the following exceedances were identified:

- Arsenic at well G275D
- Chloride at well G279
- Sulfate at wells G277 and G279
- TDS at wells G277 and G279

Pursuant to 35 I.A.C. § 845.650(e), an Alternative Source Demonstration (ASD) presented evidence demonstrating that sources other than the GMF RP were the cause of the arsenic GWPS exceedance at G275D [11]. The IEPA provided a written response that it did not concur with the ASD [12]. The non-concurrence was not appealed.

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 the GMF RP and was submitted to IEPA on June 12, 2024 [13]. 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

Solid phase data were collected and evaluated from the following six locations during monitoring well installation to further assess the nature, degree, and extent of potential groundwater impacts in accordance with 35 I.A.C. § 845.650.

- UA monitoring wells G270, G284, and G288 near the GMF RP
- UA monitoring wells G200 and G215 near the GMF GSP, which are representative of conditions within the same hydrostratigraphic unit near the GMF RP
- DA at monitoring well G275D near the GMF RP

Soil lithology was logged continuously at the above locations. Soil samples were collected from the above locations and were analyzed for one or more of the following: total metals by 7-step sequential extraction procedure, sulfur content, bulk mineralogy by Reitveld x-ray diffraction, bulk elemental composition by x-ray fluorescence, total organic carbon and loss on ignition, and cation exchange capacity. An evaluation of the data is provided in the Nature and Extent Report.[5]

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[5] The Nature and Extent Report was previously submitted to IEPA [2] 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 the GMF RP 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 nine 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.
- **Non-Unit Exceedance**: wells with GWPS exceedances inconsistent with the CSM.

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 [14][6].

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 [15]. 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[6]:

- 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

[6] 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 [21, 22].

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 [14] 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 the GMF RP 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. [16]
- "Groundwater Remedy Completion Strategy: Moving Forward with the End in Mind," USEPA, Office of Solid Waste and Emergency Response, 2014. [17]
- "Adaptive Site Management – A Framework for Implementing Adaptive Management at Contaminated Sediment Superfund Sites," USEPA, Office of Superfund Remediation and Technology Innovation, 2022. [18]
- "Environmental Cleanup Best Management Practices: Effective Use of the Project Life Cycle Conceptual Site Model," USEPA, Office of Solid Waste and Emergency Response, 2011. [19]

Evaluation of corrective action remedy effectiveness will occur in three phases (**Figure 3-1**): remedy progress evaluation, stability evaluation, and attainment evaluation [16].

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 the COF GMF RP includes the following COC parameters[7]:

- Chloride, 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 [17]. 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.

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[7] Arsenic at G275D will be monitored as a non-unit exceedance.

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 [17], 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 [17]. 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[8] was used to compare the anticipated time to reach the GWPS for the different corrective actions considered at the GMF RP.

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

[8] The Groundwater Modeling Report is referenced in the CAAA 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 [16, 17]. 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 [16]. All trend analyses are performed in accordance with the Multi-Site StAP (**Appendix B**) and the USEPA Unified Guidance for groundwater statistics [20].

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 two types 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 Non-Unit Exceedances

The ASDs submitted for arsenic at well G275D present a CSM demonstrating that the source of arsenic is the native aquifer material and not the RP. Data collected during corrective action monitoring will be evaluated for consistency with the CSM presented in the ASDs. If new data do not support the CSM, the exceedance will be evaluated in the adaptive management framework as part of the Five-Year Annual Groundwater Monitoring and Corrective Action Report.

3.1.5 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 [17]).

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[9]. Additional data collected may also suggest ways to optimize the monitoring network or performance metrics [17].

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 [17, 19] 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 the remedy progress phase may be considered complete, and the monitoring program may move to the Stability Evaluation phase (see **Section 3.2**).

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. Before assessing if compliance with the GWPS has been attained (**Section 3.3**), any transient effects of treatment on the groundwater (e.g., rebounding concentrations) should be allowed to dissipate [16]. Stability is evaluated to assess 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.

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[9] 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."

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

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[3] Ramboll Americas Engineering Solutions, Inc., "Groundwater Monitoring Plan, GMF Recycle Pond, Coffeen Power Plant, Coffeen, Illinois," October 25, 2021.

[4] Ramboll Americas Engineering Solutions, Inc., "35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances, Quarter 2, 2023: GMF Recycle Pond, Coffeen Power Plant, Coffeen, Illinois," October 16, 2023.

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[6] Ramboll Americas Engineering Solutions, Inc., "35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances Quarter 4, 2023: GMF Recycle Pond, Coffeen Power Plant, Coffeen, Illinois.," March 10, 2024.

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TABLES

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

Corrective Action Groundwater Monitoring Plan
Coffeen Power Plant
GMF Recycle Pond
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
GMF Recycle Pond
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	Figure 1-4 (X201)
NA	Staff gauge/ piezometer to monitor head of neighboring surface water body	NA
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
GMF Recycle Pond
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 10/23/24; C: LDC 11/7/24][U: KLT 2/10/25, C: CJC 6/2/25]

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
GMF Recycle Pond
Coffeen, IL

Well ID	Monitored Unit	Corrective Action Monitoring Well System		
		Inside Plume	Plume Definition	Non-Unit Exceedance
G273	UA	X		
G274	UA		X	
G275D	DA		X	X
G277	UA	X		
G279	UA	X		
G283	LCU		X	
G284	LCU		X	
G285	LCU	X		
G286	LCU		X	

[O: CJC 08/02/2024; C: KLT 4/3/25]

Notes:
DA = Deep Aquifer
UA = uppermost aquifer
LCU = Lower Confining Unit

Table 2-2. Monitoring Well Locations and Construction Details

Corrective Action Groundwater Monitoring Plan
Coffeen Power Plant
GMF Recycle Pond
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)
G273	UA	9/10/2009	622.5	622.7	Top of Casing	620.5	9.1	14.6	611.4	605.9	17.3	603.2	5.5	2	39.064991	-89.393979
G274	UA	9/16/2009	623.5	623.7	Top of Casing	622.3	12.9	17.7	609.4	604.6	19.4	602.8	4.8	2	39.064997	-89.393204
G275D	DA	1/14/2021	620.0	620.1	Top of Casing	617.4	49.8	59.6	567.6	557.8	62.7	554.7	9.8	2	39.065121	-89.392601
G277	UA	9/14/2009	623.2	623.2	Top of Casing	621.0	14.3	18.8	606.7	602.3	21.4	599.6	4.5	2	39.065935	-89.392575
G279	UA	9/10/2009	632.0	632.0	Top of Casing	629.5	22.4	26.8	607.1	602.7	29.9	599.6	4.4	2	39.067163	-89.393003
G283	LCU	1/14/2021	610.6	610.8	Top of Casing	608.2	8.4	18.2	599.9	590.1	20.9	587.3	9.8	2	39.064645	-89.392125
G284	UA	2/3/2021	617.8	618.0	Top of Casing	615.2	8.1	12.9	607.1	602.4	16.0	599.2	4.8	2	39.065488	-89.390637
G285	LCU	1/25/2021	613.2	613.4	Top of Casing	610.4	13.7	23.5	596.8	587.0	26.8	583.7	9.8	2	39.066513	-89.391480
G286	UA	1/18/2021	612.9	613.0	Top of Casing	609.9	3.4	8.2	606.5	601.7	11.6	598.2	4.8	2	39.067277	-89.391889

[O: CJC 10/23/2024; C: AOC 10/30/2024][U: KLT 2/10/25, C: CJC 04/02/2025]

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
GMF Recycle Pond
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]											
Chloride	9251 or EPA 300	9	1	0	0	1	11	plastic	100 mL	Cool to 6 °C	28 days
Sulfate	9036 or EPA 300	9	1	0	0	1	11	plastic	50 mL	Cool to 6 °C	28 days
Total Dissolved Solids	SM 2540 C	9	1	0	0	1	11	plastic	200 mL	Cool to 6 °C	7 days
Non-Unit Exceedance Parameter											
Arsenic	6020 [7]	9	1	0	0	1	11	plastic	600 mL	HNO_3 to pH<2	6 months
Inorganic Parameters											
Alkalinity, bicarbonate	SM 2320 B	9	1	0	0	1	11	plastic	500 mL	Cool to 6 °C	14 days
Alkalinity, carbonate	SM 2320 B	9	1	0	0	1	11	plastic	500 mL	Cool to 6 °C	14 days
Calcium	6020 [7]	9	1	0	0	1	11	plastic	600 mL	HNO_3 to pH<2	6 months
Fluoride	9214 or EPA 300	9	1	0	0	1	11	plastic	300 mL	Cool to 6 °C	28 days
Magnesium	6020 [7]	9	1	0	0	1	11	plastic	600 mL	HNO_3 to pH<2	6 months
Sodium	6020 [7]	9	1	0	0	1	11	plastic	600 mL	HNO_3 to pH<2	6 months
Potassium	6020 [7]	9	1	0	0	1	11	plastic	600 mL	HNO_3 to pH<2	6 months
Field Parameters											
pH	SM 4500-H+ B	9	NA	NA	NA	NA	9	flow-through cell	NA	none	immediately
Dissolved Oxygen [8]	SM 4500-O/405.1	9	NA	NA	NA	NA	9	flow-through cell	NA	none	immediately
Temperature [8]	SM 2550	9	NA	NA	NA	NA	9	flow-through cell	NA	none	immediately
Oxidation/Reduction Potential [8]	SM 2580 B	9	NA	NA	NA	NA	9	flow-through cell	NA	none	immediately
Specific Conductance [8]	SM 2510 B	9	NA	NA	NA	NA	9	flow-through cell	NA	none	immediately
Turbidity [9]	SM 2130 B	9	NA	NA	NA	NA	9	flow-through cell or hand-held turbidity meter	NA	none	immediately

[O: CJC 10/23/2024, C: AOC 10/30/2024][U: KLT 2/10/25, C: CJC 04/02/2025]

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

GMF Recycle Pond

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	
Non-Unit Exceedance	Compare data points or summary statistics to site-specific GWPS	**AND**	--		--	--	ongoing data collection will be used to validate CSM, indicating that the exceedance is not coming from the unit and from other source

[O: CJC 10/23/2024; C: AOC 10/30/2024]

Notes:

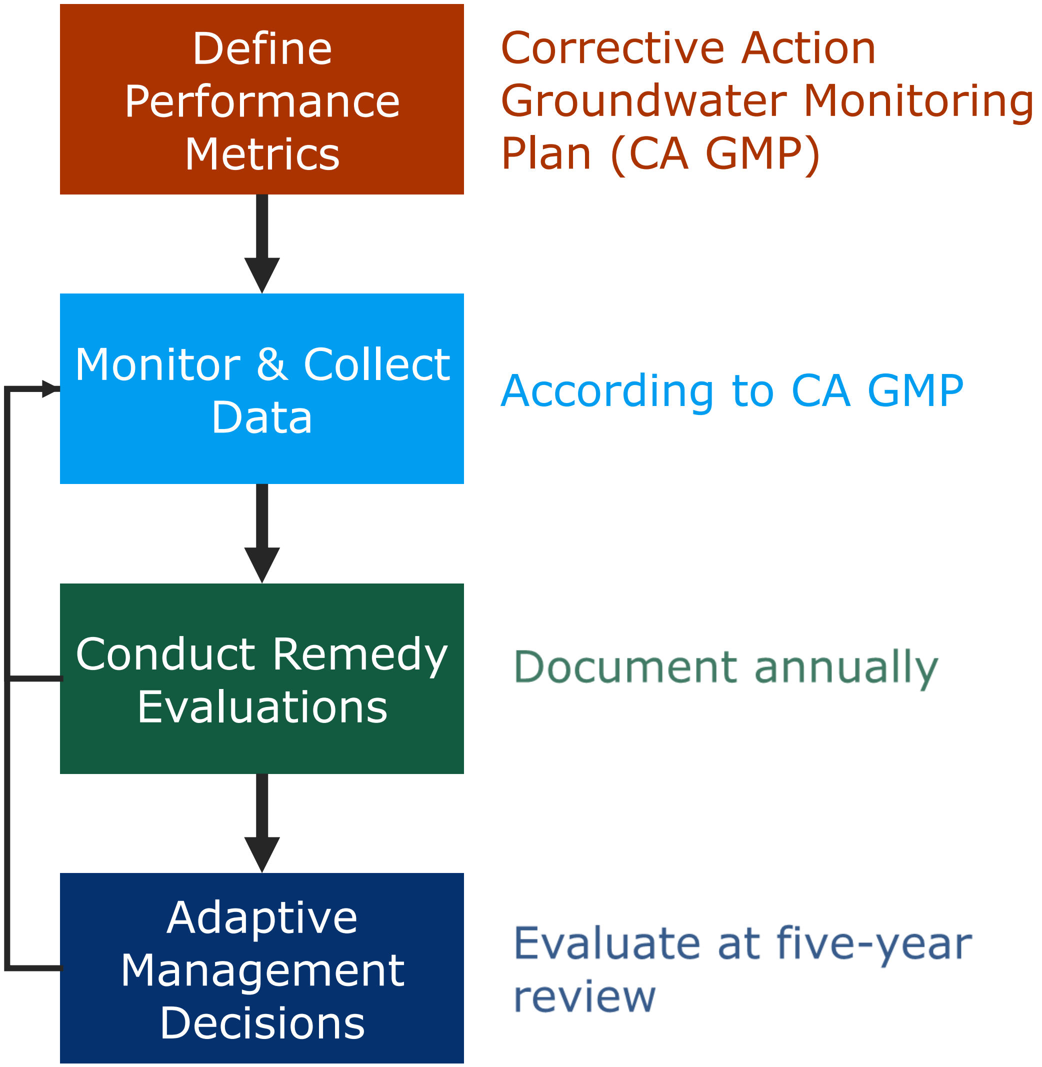
1. Only applies to wells included in the flow and transport model
2. To be documented in Annual Monitoring and Corrective Action Reports

-- = No relevant trigger criteria

COC = constituent of concern

GWPS = groundwater protection standard

FIGURES



Define Performance Metrics

Corrective Action Groundwater Monitoring Plan (CA GMP)

Monitor & Collect Data

According to CA GMP

Conduct Remedy Evaluations

Document annually

Adaptive Management Decisions

Evaluate at five-year review

DRAFTED BY: AO

2/7/2025

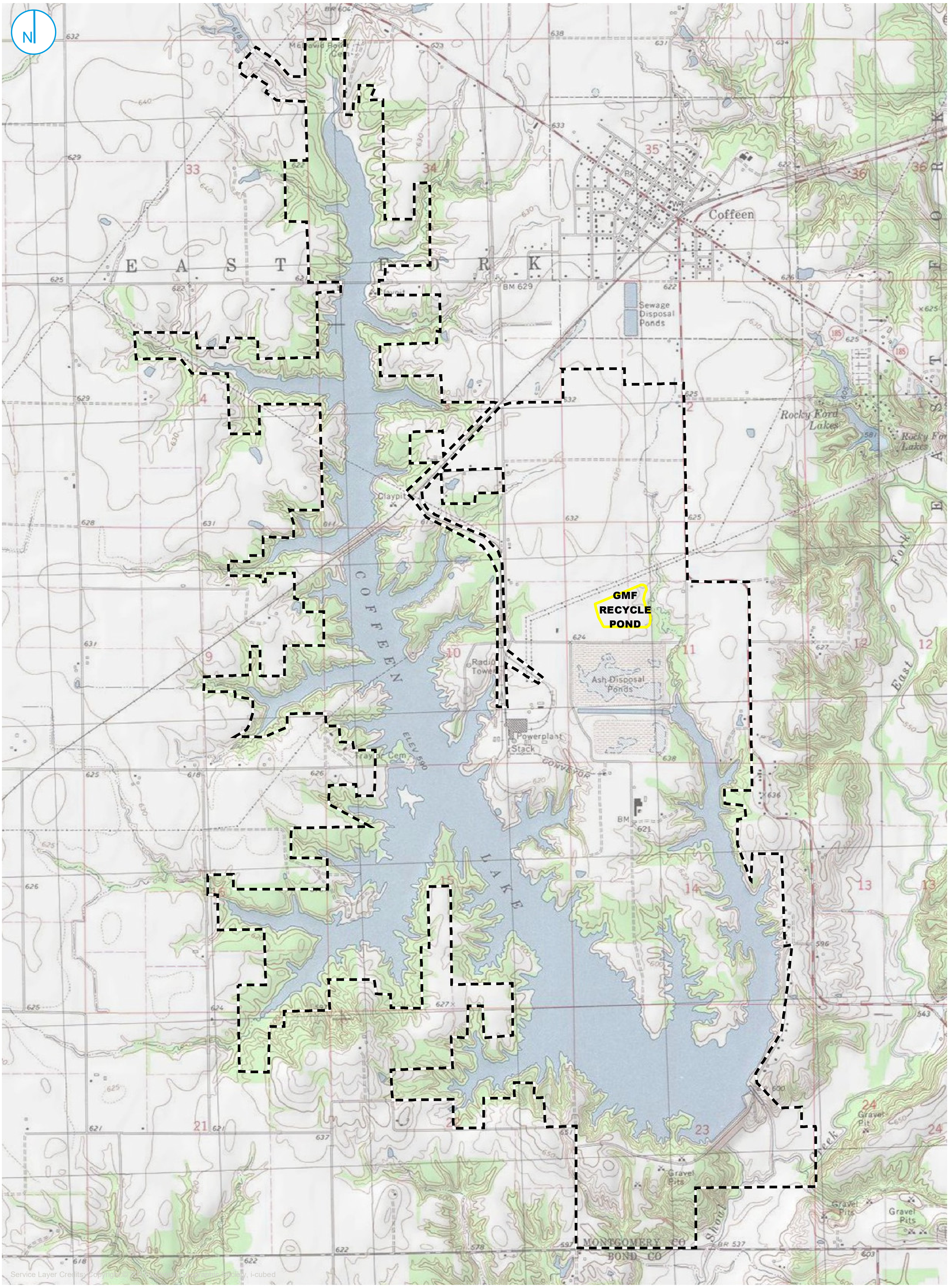
CORRECTIVE ACTION MONITORING OUTLINE

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN
COFFEEN POWER PLANT
GMF RECYCLE POND
COFFEEN, ILLINOIS

Figure 1-1

PROJECT: 169000XXXX | DATED: 10/13/2021 | DESIGNER: STOLZSD

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Coffeen\GMF_RP\GMP\Figure 1-1_Site Location Map RP.mxd



▭ REGULATED UNIT (SUBJECT UNIT)

- - - PROPERTY BOUNDARY

SITE LOCATION MAP

FIGURE 1-2

0 1,000 2,000
Feet

CORRECTIVE ACTION
GROUNDWATER MONITORING PLAN
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

PROJECT: 169000XXXX | DATED: 2/26/2025 | DESIGNER: GALARNMC

Y:\Mapping\Projects\22\2285\MXD\GMP\Coffeen\GMF_RP_104\845_CorrectiveAction\COF_104_CA_GMP.aprx\Figure 1-3. Site Map

🟨 REGULATED UNIT (SUBJECT UNIT)

☐ SITE FEATURE

▨ LIMITS OF FINAL COVER

⬚ PROPERTY BOUNDARY

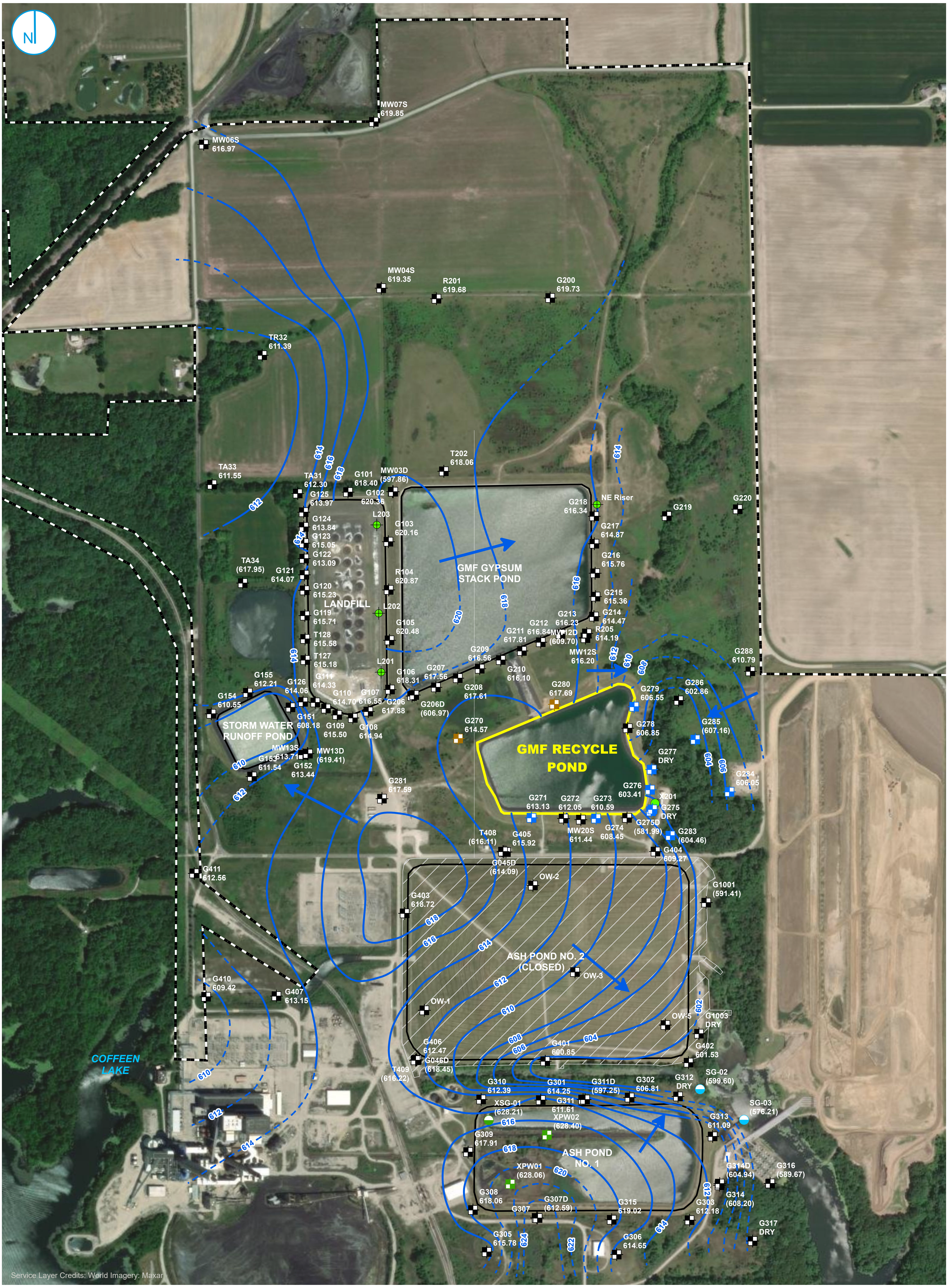
0 325 650 Feet

SITE MAP

FIGURE 1-3

CORRECTIVE ACTION
GROUNDWATER MONITORING PLAN
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.



✚	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

FIGURE 1-4

CORRECTIVE ACTION
GROUNDWATER MONITORING PLAN
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

- MONITORING WELL
- REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- PROPERTY BOUNDARY

- XXX INSIDE PLUME MONITORING WELL
- XXX PLUME DEFINITION MONITORING WELL
- XXX NON-UNIT EXCEEDANCE MONITORING WELL

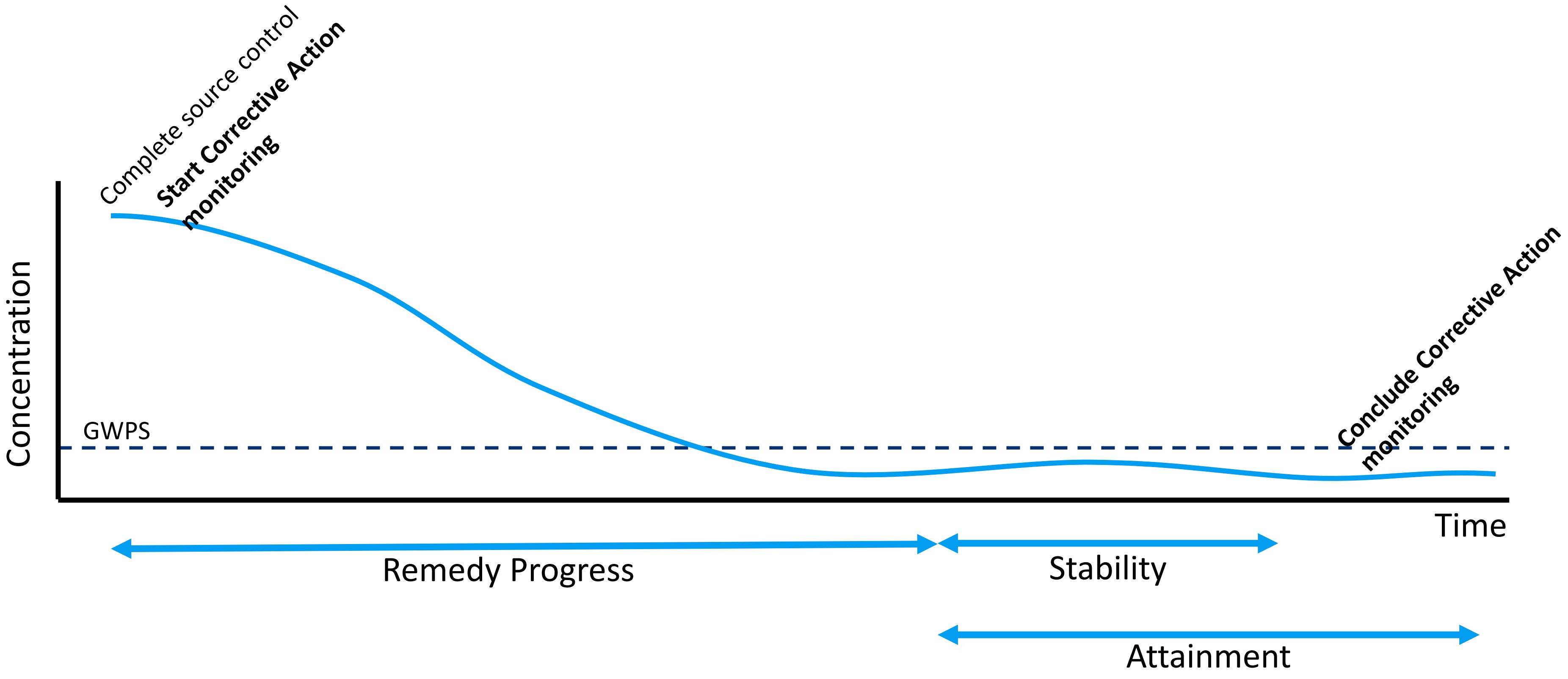
0 150 300 Feet

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

FIGURE 2-1

CORRECTIVE ACTION
GROUNDWATER MONITORING PLAN
GMF RECYCLE POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.



RAMBOLL

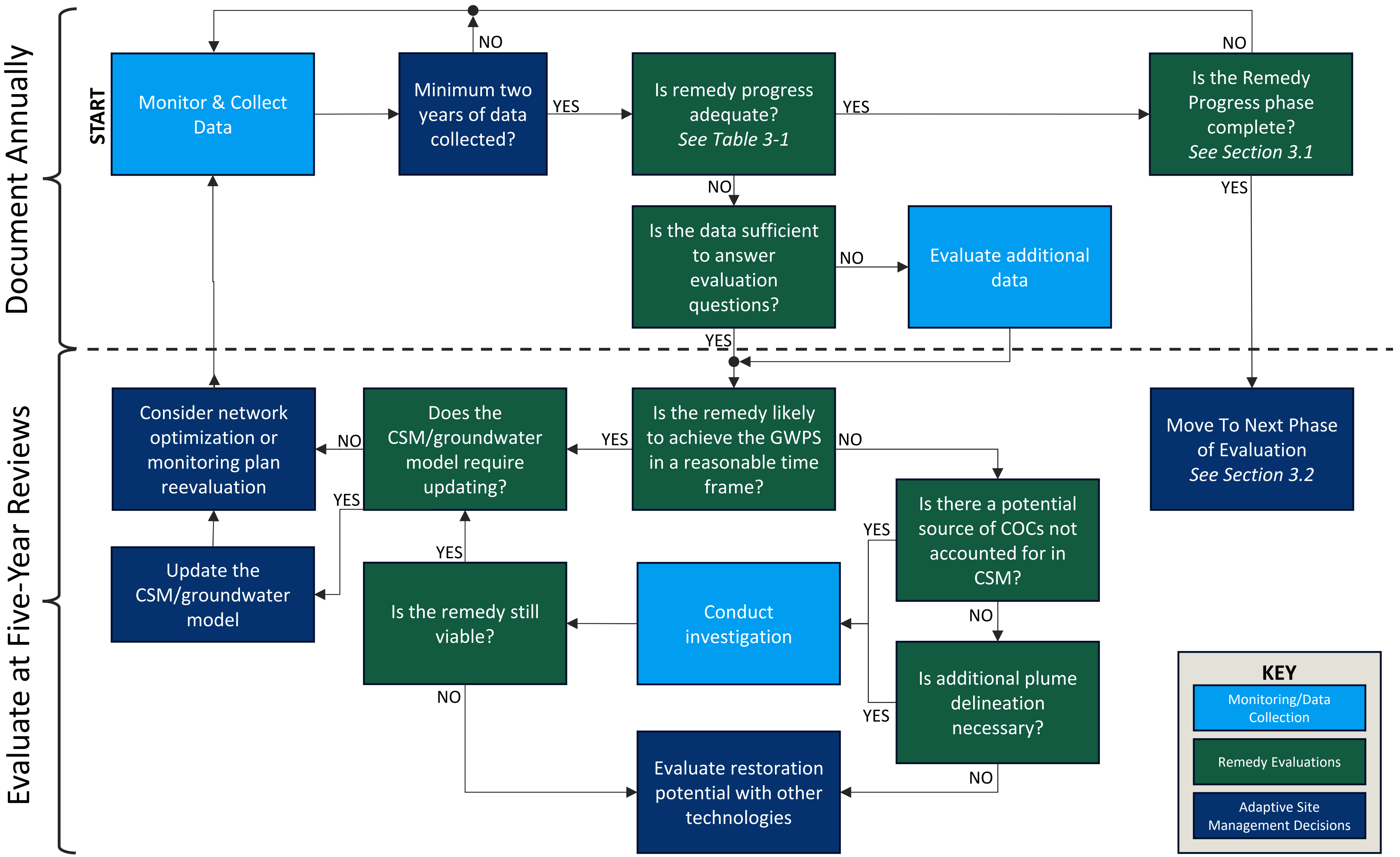
DRAFTED BY: AO

2/7/2025

CORRECTIVE ACTION MONITORING TIMELINE

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN
COFFEEN POWER PLANT
GMF RECYCLE POND
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 | 2/7/2025

ADAPTIVE SITE MANAGEMENT DECISION-MAKING FLOW CHART

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN
COFFEEN POWER PLANT
GMF RECYCLE POND
COFFEEN, ILLINOIS

Figure 3-2

APPENDICES

APPENDIX A
BORING LOGS AND WELL CONSTRUCTION FORMS

BORING LOGS

FIELD BORING LOG

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			TESTING			
Number	Recov / Total (in) *% Recovery*	Type	*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 | Borehole Detail | Elevation ft. MSL | Remarks

FILL -Dark yellowish brown (10YR4/6), moist, firm, silty CLAY with slight trace sand.

FILL - Gray (10YR5/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with slight trace sand and gravel.

Brownish yellow (10YR6/8) with 40% gray (10YR5/1) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.

Gray (10YR6/1) with 10% brownish yellow(10YR6/6) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.

Gray (10YR5/1), moist, firm, silty CLAY with sand and trace gravel.

Yellowish brown (10YR5/8) with 30% gray (10YR6/1) mottles, moist, soft, sandy CLAY with silty and slight trace gravel.

Brownish yellow (10YR6/8) with 10% gray (10YR6/1) mottles, very moist, soft, sandy CLAY with silt and slight trace gravel.

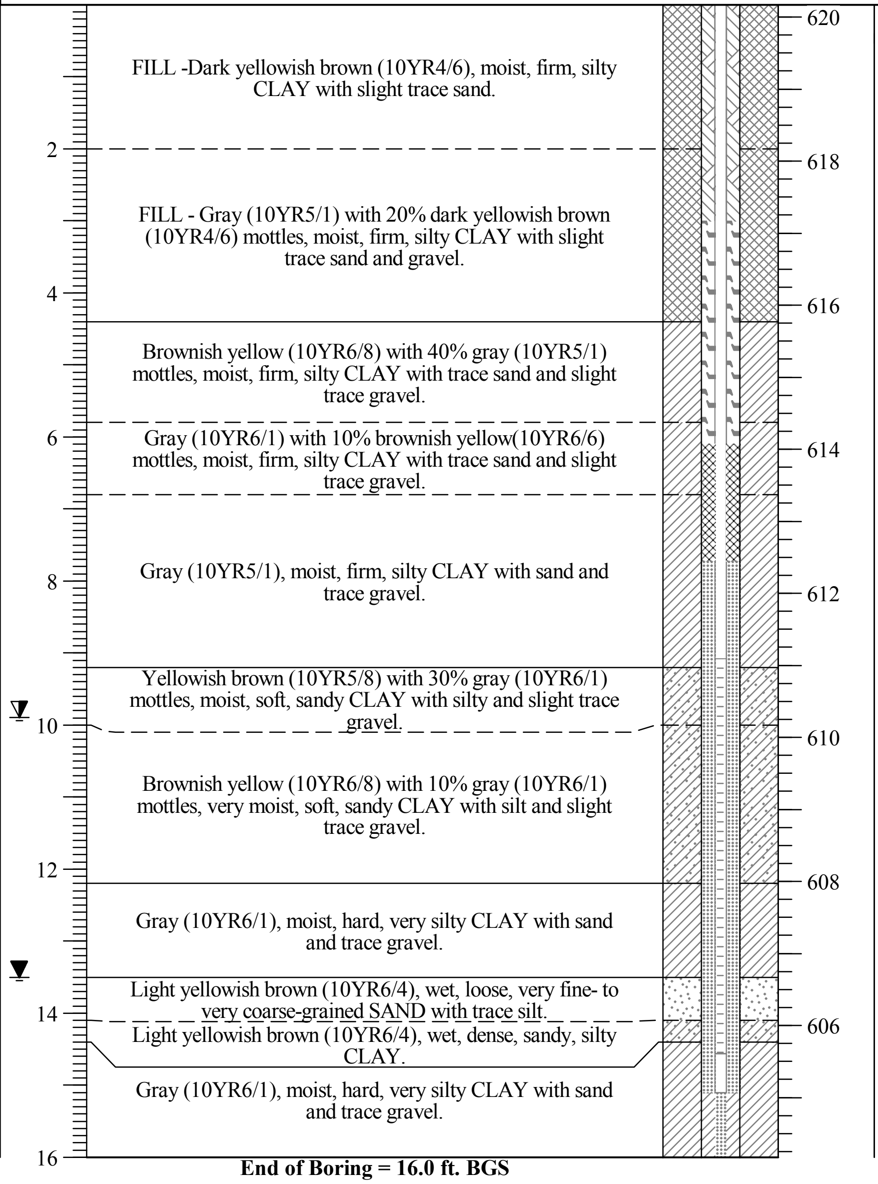
Gray (10YR6/1), moist, hard, very silty CLAY with sand and trace gravel.

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.

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

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

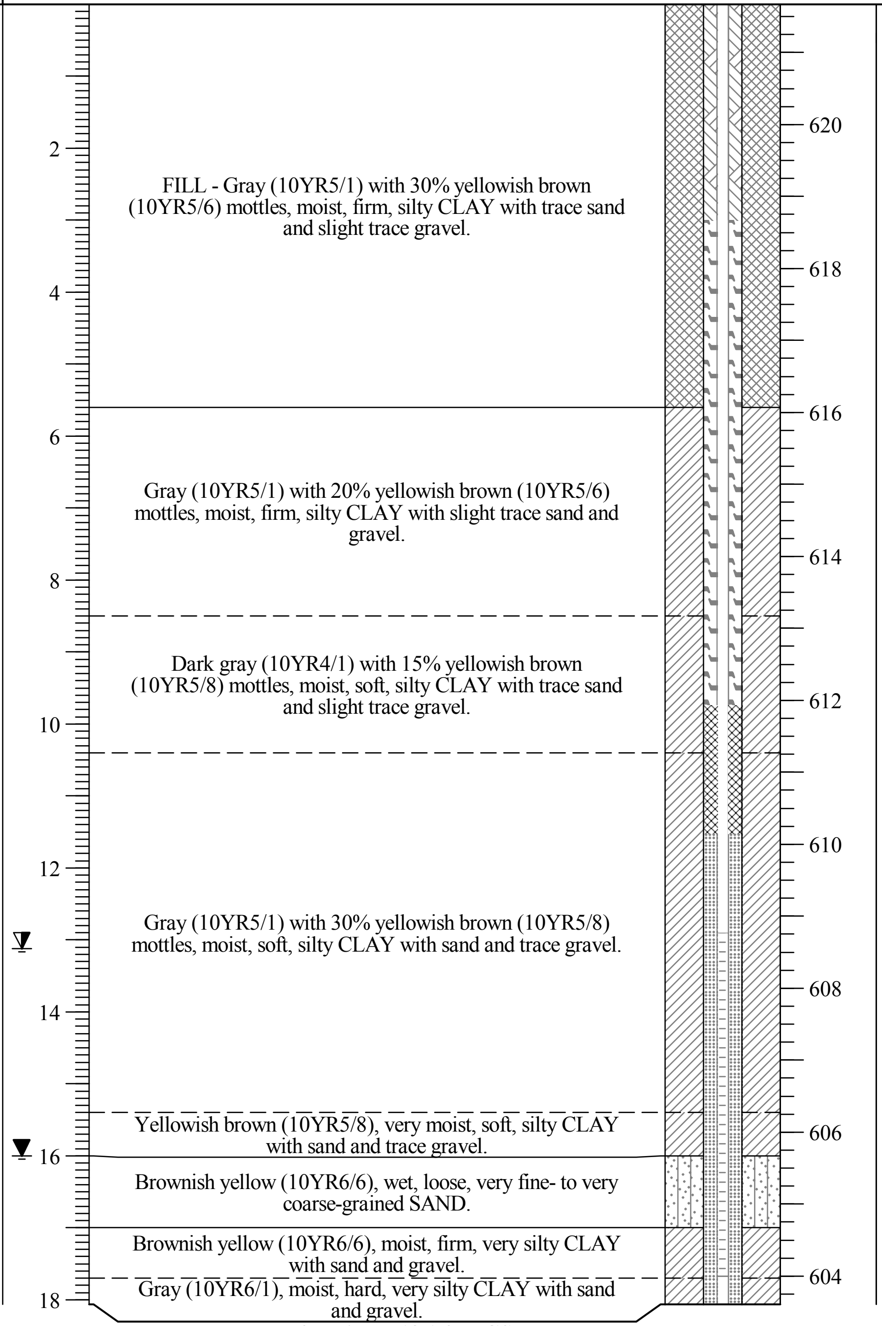
BOREHOLE ID: G274
Well ID: G274
Surface Elev: 621.67 ft. MSL
Completion: 18.06 ft. BGS
Station: 874,239.25N
2,516,195.60E

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			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
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 | Borehole Detail | Elevation ft. MSL | Remarks



FILL - Gray (10YR5/1) with 30% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.

Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY with slight trace sand and gravel.

Dark gray (10YR4/1) with 15% yellowish brown (10YR5/8) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.

Gray (10YR5/1) with 30% yellowish brown (10YR5/8) mottles, moist, soft, silty CLAY with sand and trace gravel.

Yellowish brown (10YR5/8), very moist, soft, silty CLAY with sand and trace gravel.

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.

Gray (10YR6/1), moist, hard, very silty CLAY with sand and gravel.

End of Boring = 18.1 ft. BGS

NOTE(S):

FIELD BORING LOG

CLIENT:	Illinois Power Generating Co.	**CONTRACTOR:**	Roberts		
Site:	Coffeen Part 845 Groundwater	**Rig mfg/model:**	CME-75 Track Rig	**BOREHOLE ID:**	G275D
Location:	Coffeen, Illinois	**Drilling Method:**	4.25" HSA w/SS sampler	**Well ID:**	G275
Project:	20E0111A			**Surface Elev:**	617.52 ft. MSL
DATES: Start:	1/28/2021	**FIELD STAFF: Driller:**	Matt	**Completion:**	99.70 ft. BGS
Finish:	2/3/2021	**Helper:**	Corey	**Station:**	874,285.30N
WEATHER:	Clear, cold (20s)	**Eng/Geo:**	C. Colin Winter		2,516,366.50E

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

WATER LEVEL INFORMATION:
▽ = 10.90 - 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
1A	21/24 *88%*	SS	*3-4 5-10* N=9				
2A	22/24 *92%*	SS	*3-4 6-9* N=10				
3A	19/24 *79%*	SS	*2-4 6-8* N=10				
4A	23/24 *96%*	SS	*2-5 5-6* N=10				
5A	24/24 *100%*	SS	*2-3 5-6* N=8				
5B							
6A	24/24 *100%*	SS	*0-1 2-2* N=3				
6B							
7A	18/24 *75%*	SH					
8A	14/14 *100%*	SS	*26-43 50/2"*				
9A	24/24 *100%*	SS	*5-12 18-22* N=30				
10A	24/24 *100%*	SS	*4-11 13-20* N=24				

Depth ft. BGS — Lithologic Description — Borehole Detail — Elevation ft. MSL — Remarks

Dark yellowish brown (10YR4/4), moist, stiff, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel, trace roots. [FILL]

Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, moist, very stiff, lean CLAY, with some silt, few very fine- to fine-grained sand, trace small gravel.

Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, very stiff, lean CLAY, with some silt, few very fine- to fine-grained sand, trace small gravel.

Gray (10YR5/1) with 20% yellowish brown (10YR5/6) and 5% yellowish red (5YR4/6) mottles, moist, very stiff, lean CLAY, with some silt, few very fine- to fine-grained sand, trace small gravel.

Dark yellowish brown (10YR3/6), moist, stiff, SILT, with some very fine- to medium-grained sand, few clay and small gravel.

Gray (10YR6/1) with 10% dark yellowish brown (10YR3/6) mottles, moist, stiff, lean CLAY, with some silt, little very fine- to fine-grained sand, few small gravel.

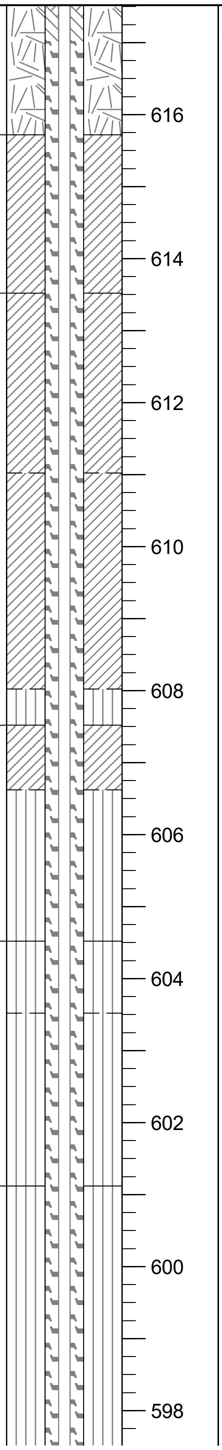
▽

Dark yellowish brown (10YR3/6), wet, loose, SILT, with some very fine- to fine-grained sand, few clay and small gravel.

Gray (10YR6/1) with 20% yellowish brown (10YR5/6) mottles, moist, hard, SILT, with some very fine- to fine-grained sand, few clay and small gravel.

Grayish brown (10YR5/2) with 10% yellowish brown (10YR5/6) mottles, moist, hard, SILT, with some very fine- to fine-grained sand, few clay and small gravel.

Brown (10YR5/3) with 10% yellowish brown (10YR5/6) mottles, moist, hard, SILT, with some clay and very fine- to fine-grained sand, few small gravel.



NOTE(S): G275 installed in adjacent blind drill borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/28/2021
Finish: 2/3/2021
WEATHER: Clear, cold (20s)

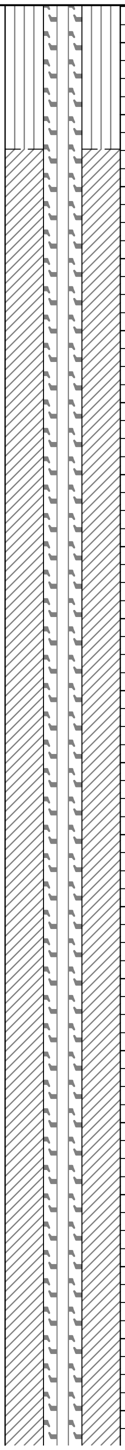
CONTRACTOR: Roberts
Rig mfg/model: CME-75 Track Rig
Drilling Method: 4.25" HSA w/SS sampler
FIELD STAFF: Driller: Matt
Helper: Corey
Eng/Geo: C. Colin Winter

BOREHOLE ID: G275D
Well ID: G275
Surface Elev: 617.52 ft. MSL
Completion: 99.70 ft. BGS
Station: 874,285.30N
2,516,366.50E

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

WATER LEVEL INFORMATION:
$\underline{\nabla}$ = 10.90 - During Drilling
$\underline{\blacktriangledown}$ =
$\underline{\blacktriangledown}$ =

SAMPLE			TESTING			
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) *Qp (tsf)* Failure Type
11A	24/24 *100%*	SS	*3-9* *13-22* N=22			
12A	24/24 *100%*	SS	*7-14* *20-24* N=34			
13A	24/24 *100%*	SS	*6-11* *15-21* N=26			
14A	18/24 *75%*	SS	*4-8* *12-10* N=20			
15A	24/24 *100%*	SS	*5-7* *13-17* N=20			
16A	23/24 *96%*	SS	*4-7* *12-16* N=19			
17A	2/24 *8%*	SS	*4-10* *13-17* N=23			
18A	21/24 *88%*	SH				
19A	24/24 *100%*	SS	*3-6* *10-14* N=16			
20A	4/24 *17%*	SS	*3-8* *11-17* N=19			



Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Brown (10YR5/3) with 10% yellowish brown (10YR5/6) mottles, moist, hard, SILT, with some clay and very fine- to fine-grained sand, few small gravel. *[Continued from previous page]*	596	
22			Vertical fractures with oxidation from 22 to 24 ft, no oxidation below 24 ft.
		594	
24			
		592	Occasional thin SILT and SAND lenses from 25.3 to 25.8 ft.
26			
		590	
28			Trace wood fragments below 28 ft.
		588	
30			
	Dark gray (10YR4/1) with frequent dark yellowish brown (10YR3/6) oxidation along fractures, moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel.	586	
32			
		584	
34			
		582	
36			
		580	
38			
		578	
40			

NOTE(S): G275 installed in adjacent blind drill borehole.

FIELD BORING LOG

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/28/2021
Finish: 2/3/2021
WEATHER: Clear, cold (20s)

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

HANSON

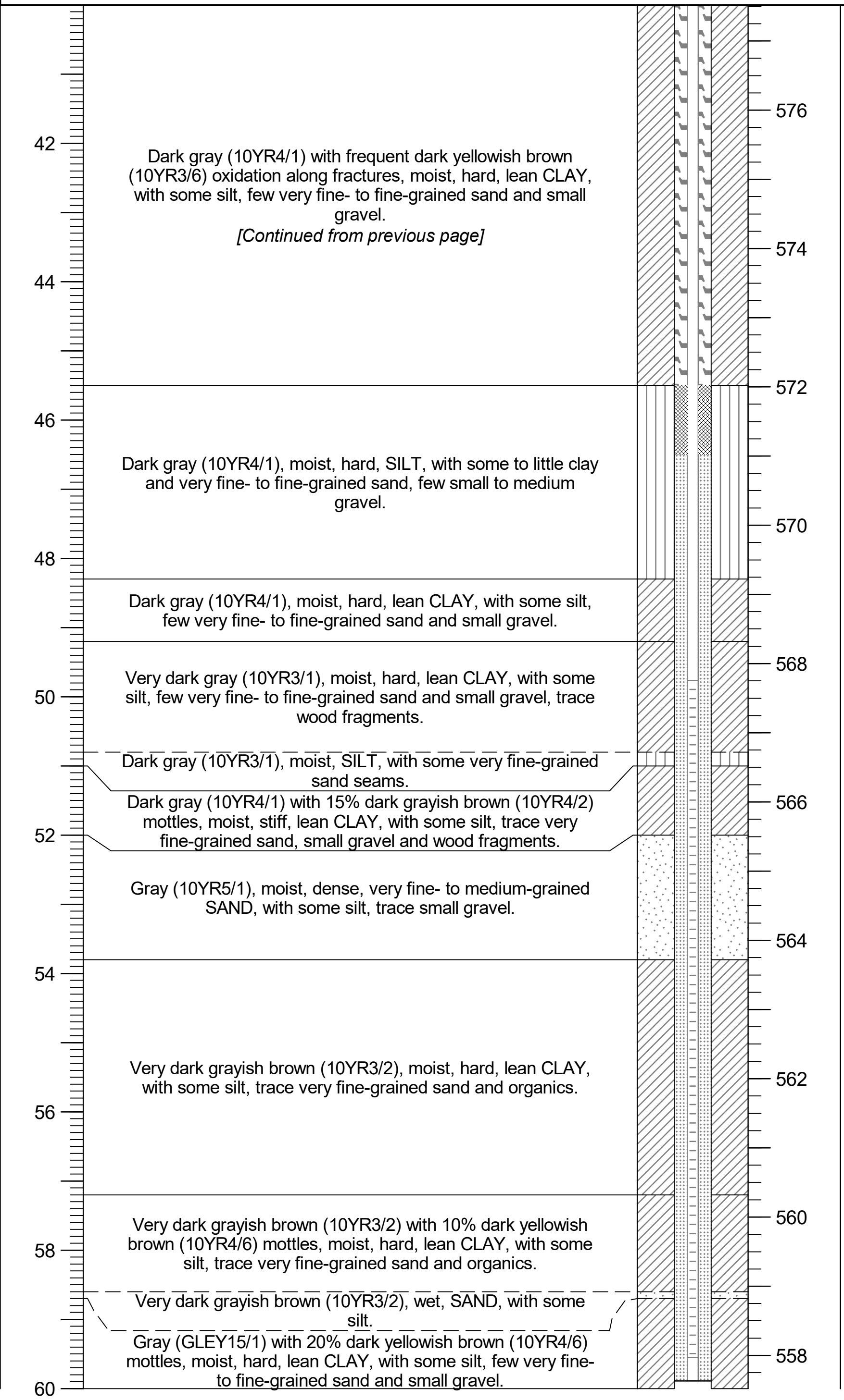
BOREHOLE ID: G275D
Well ID: G275
Surface Elev: 617.52 ft. MSL
Completion: 99.70 ft. BGS
Station: 874,285.30N
2,516,366.50E

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

WATER LEVEL INFORMATION:
▽ = 10.90 - 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
21A	24/24 *100%*	SS	*4-8* *11-15* N=19			
22A	24/24 *100%*	SS	*7-8* *11-17* N=19			
23A	24/24 *100%*	SS	*5-8* *13-40* N=21			
24A	23/24 *96%*	SS	*22-45* *35-23* N=80			
25A	24/24 *100%*	SS	*7-9* *14-21* N=23			
26A	24/24 *100%*	SS	*3-8* *15-15* N=23			
27A	17/24 *71%*	SS	*12-27* *13-15* N=40			
28A	24/24 *100%*	SS	*4-9* *11-13* N=20			
29A	24/24 *100%*	SS	*5-9* *13-12* N=22			
30A	24/24 *100%*	SS	*3-4* *7-14* N=11			

Lithologic Description	Remarks
Dark gray (10YR4/1) with frequent dark yellowish brown (10YR3/6) oxidation along fractures, moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel. *[Continued from previous page]*	0.5" lignite fragment seam at 42.8 ft.
Dark gray (10YR4/1), moist, hard, SILT, with some to little clay and very fine- to fine-grained sand, few small to medium gravel.	
Dark gray (10YR4/1), moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel.	
Very dark gray (10YR3/1), moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel, trace wood fragments.	
Dark gray (10YR3/1), moist, SILT, with some very fine-grained sand seams.	Methane deposit encountered at approx. 51 ft.
Dark gray (10YR4/1) with 15% dark grayish brown (10YR4/2) mottles, moist, stiff, lean CLAY, with some silt, trace very fine-grained sand, small gravel and wood fragments.	
Gray (10YR5/1), moist, dense, very fine- to medium-grained SAND, with some silt, trace small gravel.	
Very dark grayish brown (10YR3/2), moist, hard, lean CLAY, with some silt, trace very fine-grained sand and organics.	
Very dark grayish brown (10YR3/2) with 10% dark yellowish brown (10YR4/6) mottles, moist, hard, lean CLAY, with some silt, trace very fine-grained sand and organics.	
Very dark grayish brown (10YR3/2), wet, SAND, with some silt.	
Gray (GLEY15/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel.	



NOTE(S): G275 installed in adjacent blind drill borehole.

FIELD BORING LOG

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/28/2021
Finish: 2/3/2021
WEATHER: Clear, cold (20s)

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: G275D
Well ID: G275
Surface Elev: 617.52 ft. MSL
Completion: 99.70 ft. BGS
Station: 874,285.30N
2,516,366.50E

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

WATER LEVEL INFORMATION:
▽ = 10.90 - 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
31A	24/24 *100%*	SS	*0-4* *5-7* N=9					Gray (GLEY15/) with 30% dark yellowish brown (10YR4/6) mottles, moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel.			
										556	
							62				
32A	24/24 *100%*	SS	*4-6* *8-11* N=14								
										554	
33A							64				
	24/24 *100%*	SH						Greenish gray (GLEY15/1) with 15% very dark gray (10YR3/1) mottles, moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand and small gravel.			
										552	
							66				
34A	24/24 *100%*	SS	*5-10* *22-41* N=32								
										550	
							68				
35A	24/24 *100%*	SS	*12-24* *33-45* N=57								
										548	
							70	Yellowish brown (10YR5/4) with occasional thin greenish gray (GLEY15/1) seams, moist, hard, lean CLAY, with some silt, few small gravel, trace very fine-grained sand.			Trace medium gravel at 70 ft.
36A	23/24 *96%*	SS	*6-14* *25-30* N=39								
										546	
							72				
37A	24/24 *100%*	SS	*8-18* *24-32* N=42								
										544	
							74				
38A	24/24 *100%*	SS	*7-16* *25-29* N=41								
										542	
							76	Yellowish brown (10YR5/4) with 15% gray (10YR6/1) mottles, moist, hard, lean CLAY, with some silt, few small gravel, trace very fine-grained sand.			
39A	24/24 *100%*	SS	*7-15* *20-21* N=35								
										540	
							78				
40A	19/24 *79%*	SS	*3-5* *7-10* N=12					Greenish gray (GLEY15/1) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace very		538	
							80				

NOTE(S): G275 installed in adjacent blind drill borehole.

FIELD BORING LOG

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/28/2021
Finish: 2/3/2021
WEATHER: Clear, cold (20s)

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: G275D
Well ID: G275
Surface Elev: 617.52 ft. MSL
Completion: 99.70 ft. BGS
Station: 874,285.30N
2,516,366.50E

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

WATER LEVEL INFORMATION:
▽ = 10.90 - 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
41A	22/24 *92%*	SS	*1-5* *7-11* N=12			
42A	24/24 *100%*	SS	*4-14* *19-20* N=33			
43A	8/24 *33%*	SS	*6-20* *22-23* N=42			
44A	24/24 *100%*	SS	*7-8* *16-17* N=24			
45A	24/24 *100%*	SS	*5-13* *16-21* N=29			
46A	24/24 *100%*	SS	*4-8* *15-9* N=23			
47A						
47B	24/24 *100%*	SS	*5-6* *8-10* N=14			
48A	24/24 *100%*	SS	*2-4* *7-8* N=11			
49A	24/24 *100%*	SS	*2-6* *7-11* N=13			
50A	18/20 *90%*	SS	*3-15* *28-50/2"* N=43			

Depth ft. BGS: 82, 84, 86, 88, 90, 92, 94, 96, 98

Lithologic Description

fine-grained sand.
Greenish gray (GLEY15/1) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace very fine-grained sand.
[Continued from previous page]

Very dark gray (10YR3/1), moist, stiff, lean CLAY, with some silt, trace very fine-grained sand.

Greenish gray (GLEY15/1) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace very fine-grained sand.

Greenish gray (GLEY15/1) with 20% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace very fine-grained sand and small gravel.

Greenish gray (GLEY15/1) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace very fine-grained sand and small gravel.

Brown (10YR4/3) with 5% dark yellowish brown (10YR4/6) mottles, moist, hard, lean CLAY, with some silt, trace very fine-grained sand and small gravel.

Brown (10YR4/3) with 5% dark yellowish brown (10YR4/6) mottles, moist, hard, lean CLAY, with some silt, few small gravel, trace very fine-grained sand, medium gravel and black (10YR2/1) organics.

Brown (10YR4/3) with 5% dark yellowish brown (10YR4/6) mottles, moist, hard, lean CLAY, with some silt, few small gravel and wood fragments, trace very fine-grained sand, medium gravel and black (10YR2/1) organics.

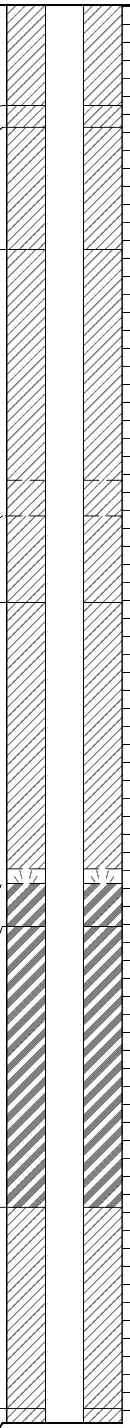
Very dark grayish brown (10YR3/2), moist, stiff, fat CLAY, with some silt.

Dark grayish brown (10YR4/2), moist, stiff, fat CLAY, with some silt.

Greenish gray (GLEY15/1) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, little to trace very fine-grained sand, trace small gravel.

Greenish gray (GLEY15/1) with 5% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt and very

Borehole Detail



Elevation ft. MSL: 536, 534, 532, 530, 528, 526, 524, 522, 520, 518

Remarks

NOTE(S): G275 installed in adjacent blind drill borehole.

FIELD BORING LOG

CLIENT: Illinois Power Generating Co.	**CONTRACTOR:** Roberts		
Site: Coffeen Part 845 Groundwater	**Rig mfg/model:** CME-75 Track Rig	**BOREHOLE ID:**	G275D
Location: Coffeen, Illinois	**Drilling Method:** 4.25" HSA w/SS sampler	**Well ID:**	G275
Project: 20E0111A		**Surface Elev:**	617.52 ft. MSL
DATES: Start: 1/28/2021	**FIELD STAFF: Driller:** Matt	**Completion:**	99.70 ft. BGS
Finish: 2/3/2021	**Helper:** Corey	**Station:**	874,285.30N
WEATHER: Clear, cold (20s)	**Eng/Geo:** C. Colin Winter		2,516,366.50E

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

WATER LEVEL INFORMATION:
∇ = 10.90 - 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
								fine-grained sand, trace small gravel. **End of boring = 99.7 feet**			

NOTE(S): G275 installed in adjacent blind drill borehole.

FIELD BORING LOG

HANSON

CLIENT:	AEG Coffeen Power Station	**CONTRACTOR:**	Layne-Western Co		
Site:	CCB Management Facility	**Rig mfg/model:**	CME-750 ATV Drill	**BOREHOLE ID:**	G277
Location:	Coffeen, Illinois	**Drilling Method:**	4¼" HSA w/SS & CME samplers	**Well ID:**	G277
Project:	05S3004A			**Surface Elev:**	620.79 ft. MSL
DATES: Start:	9/14/2009	**FIELD STAFF: Driller:**	G. Mills	**Completion:**	20.00 ft. BGS
Finish:	9/14/2009	**Helper:**	J. Twellman	**Station:**	874,581.80N
WEATHER:	Sunny, mild (70'S)	**Eng/Geo:**	R. Hasenyager		2,516,370.51E

TOPOGRAPHIC MAP INFORMATION:

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

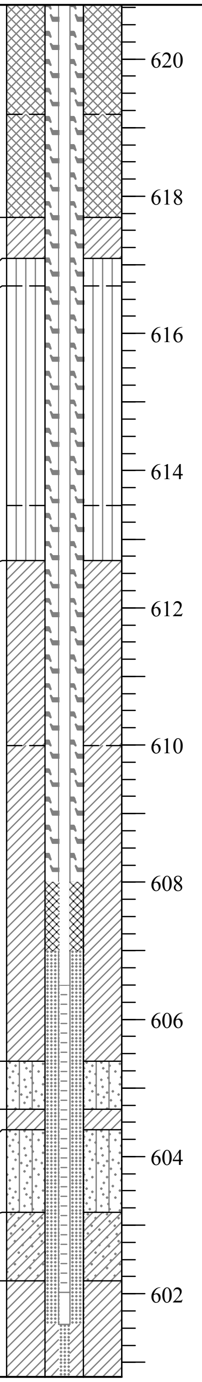
WATER LEVEL INFORMATION:

▼ = 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	17/24 *71%*	SS	*4-7 9-11* N=16	11		
3B				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		
10						

Depth ft. BGS	Lithologic Description
	FILL - Yellowish brown (10YR5/4) with 10% yellowish brown (10YR5/8) mottles, very moist, soft, silty CLAY with slight trace sand and gravel.
2	FILL - Yellowish brown (10YR5/4) with 20% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with slight trace sand and gravel.
	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.
6	Light brownish gray (10YR6/2) with 25% yellowish brown (10YR5/8) mottles, moist, firm, clayey SILT with slight trace sand.
8	Gray (10YR6/1) with 50% very dark grayish brown (10YR3/2) mottles, moist, hard, clayey SILT with slight trace sand and gravel.
10	Gray (10YR5/1) with 10% yellowish brown (10YR5/6) mottles, moist, hard, very silty CLAY with sand and slight trace gravel.
12–14	Yellowish brown (10YR5/8) with 30% gray (10YR6/1) mottles, moist, hard, silty CLAY with sand and trace gravel.
16	Gray (10YR6/1), moist, slightly dense, silty, very fine- to very coarse-grained SAND.
▼	Gray (10YR6/1) with 30% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and trace gravel.
	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.
	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**

Borehole Detail / Elevation ft. MSL / Remarks



NOTE(S):

FIELD BORING LOG

HANSON

CLIENT:	AEG Coffeen Power Station	**CONTRACTOR:**	Layne-Western Co		
Site:	CCB Management Facility	**Rig mfg/model:**	CME-750 ATV Drill	**BOREHOLE ID:**	G279
Location:	Coffeen, Illinois	**Drilling Method:**	4¼" HSA w/SS & CME samplers	**Well ID:**	G279
Project:	05S3004A			**Surface Elev:**	629.19 ft. MSL
DATES: Start:	9/10/2009	**FIELD STAFF: Driller:**	G. Mills	**Completion:**	28.00 ft. BGS
Finish:	9/10/2009	**Helper:**	J. Twellman	**Station:**	875,028.06N
WEATHER:	Sunny, warm (80's)	**Eng/Geo:**	R. Hasenyager		2,516,245.60E

TOPOGRAPHIC MAP INFORMATION:

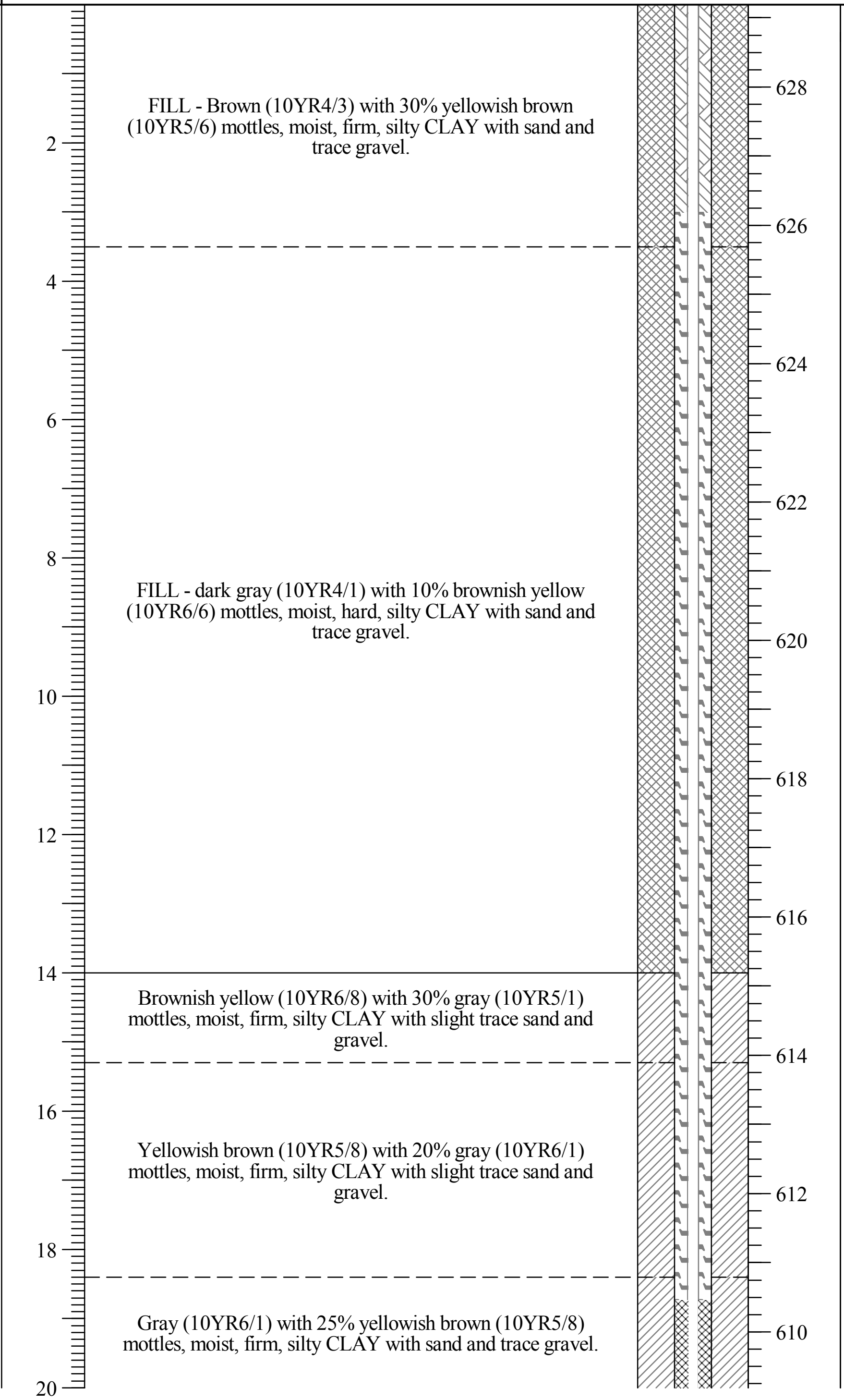
Quadrangle: Coffeen, IL
Township: East Fork
Section 11, **Tier** 7N; **Range** 3W

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
0 – 3.5	FILL - Brown (10YR4/3) with 30% yellowish brown (10YR5/6) mottles, moist, firm, silty CLAY with sand and trace gravel.
3.5 – 14	FILL - dark gray (10YR4/1) with 10% brownish yellow (10YR6/6) mottles, moist, hard, silty CLAY with sand and trace gravel.
14 – 15.3	Brownish yellow (10YR6/8) with 30% gray (10YR5/1) mottles, moist, firm, silty CLAY with slight trace sand and gravel.
15.3 – 18.4	Yellowish brown (10YR5/8) with 20% gray (10YR6/1) mottles, moist, firm, silty CLAY with slight trace sand and gravel.
18.4 – 20	Gray (10YR6/1) with 25% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and trace gravel.



NOTE(S):

FIELD BORING LOG

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

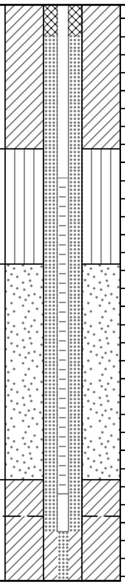
BOREHOLE ID: G279
Well ID: G279
Surface Elev: 629.19 ft. MSL
Completion: 28.00 ft. BGS
Station: 875,028.06N
2,516,245.60E

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			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	Borehole Detail	Elevation ft. MSL	Remarks
11A	23/24 *96%*	SS	*2-4* *5-7* N=9	18				Gray (10YR6/1) with 25% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with sand and trace gravel. *[Continued from previous page]*		608	
12A	19/24 *79%*	SS	*4-9* *8-9* N=17	13			22	Yellowish brown (10YR5/8), moist, firm, clayey SILT and very fine-grained SAND with slight trace gravel.		606	
12B				12			▼ 24				
13A	17/24 *71%*	SS	*1-5* *5-7* N=10	18			▽	Light brownish gray (10YR6/2), wet, loose, very fine- to coarse-grained SAND.		604	
14A				16			26	Brownish yellow (10YR6/6), moist, hard, very silty CLAY with sand and trace gravel.			
14B	24/24 *100%*	SS	*10-10* *18-18* N=28	14			28	Gray (10YR6/1), moist, hard, very silty CLAY with sand and trace gravel.		602	

End of Boring = 28.0 ft. BGS



NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/18/2021
Finish: 1/18/2021
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: G283
Well ID: G283
Surface Elev: 608.30 ft. MSL
Completion: 18.00 ft. BGS
Station: 874,113.00N
2,516,503.00E

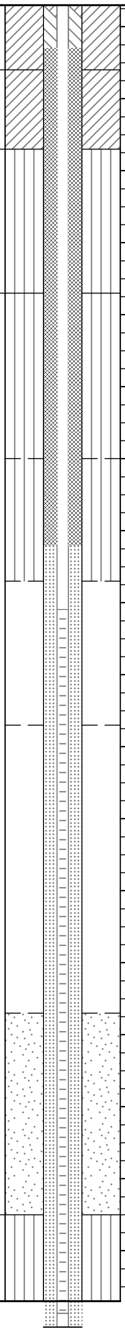
TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▽ = 14.00 - During Drilling
▽ =
▼ =

SAMPLE			TESTING			
Number	Recov / Total (in) % Recovery	Type	Blows / 6 in N - Value **RQD**	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A 1B	19/24 79%	SS	1-2 4-3 N=6			
2A	23/24 96%	SS	8-15 24-31 N=39			
3A	20/23 87%	SS	5-27 35-50/5" N=62			
4A	18/18 100%	SS	15-31 50/5.5"			
5A	19/22 86%	SS	9-29 38-50/4" N=67			
6A	21/24 88%	SS	12-24 25-30 N=49			
7A	24/24 100%	SS	14-22 32-38 N=54			
8A	22/24 92%	SS	6-17 12-12 N=29			
9A 9B	24/24 100%	SS	0-8 16-19 N=24			

Depth ft. BGS	Lithologic Description	Remarks
	Very dark grayish brown (10YR3/2), moist, stiff, lean CLAY, with some silt, little very fine- to fine-grained sand, trace roots.	
2	Yellowish brown (10YR5/4), moist, stiff, lean CLAY, with some silt, little very fine- to fine-grained sand, few small gravel.	
4	Gray (10YR6/1) with 30% yellowish brown (10YR5/6) mottles, moist, hard, SILT, with some very fine- to fine-grained sand, little small gravel, trace clay.	
6	Yellowish brown (10YR5/6) with 30% gray (10YR6/1) mottles and frequent yellowish red (5YR4/6) oxidation along fracture faces, moist, hard SILT, with some very fine- to fine-grained sand, little small gravel, trace clay.	
8	Gray (10YR5/1), moist, hard, SILT, with some very fine- to fine-grained sand, little small gravel, trace clay.	
10	Gray (10YR5/1), moist, hard, SILT, with some to little very fine- to fine-grained sand, little small gravel, trace clay.	
12 ▽ 14	Gray (10YR5/1), moist, hard, SILT, with some to little very fine- to fine-grained sand, little to few small gravel, trace clay.	0.5" very fine-grained SAND seam at 13.6 ft.
16	Dark gray (10YR4/1), wet, medium dense, very fine- to medium-grained SAND, with some silt, few small gravel, occasional thin clayey seams.	
18	Gray (10YR5/1), moist, very stiff, SILT, with some to ltitle very fine-grained sand.	

End of boring = 18.0 feet


Borehole Detail

Elevation ft. MSL: 608, 606, 604, 602, 600, 598, 596, 594, 592

NOTE(S): G283 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/20/2021
Finish: 1/20/2021
WEATHER: Clear, 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: G284
Well ID: G284
Surface Elev: 615.33 ft. MSL
Completion: 14.00 ft. BGS
Station: 874,423.60N
2,516,922.90E

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

WATER LEVEL INFORMATION:
∇ = 11.60 - 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
1A	18/24 *75%*	SS	*0-2* *2-5* N=4			
2A	22/24 *92%*	SS	*1-2* *3-4* N=5			
3A	20/24 *83%*	SS	*0-3* *4-4* N=7			
4A	22/24 *92%*	SS	*2-3* *4-6* N=7			
5A 5B	24/24 *100%*	SS	*2-3* *4-4* N=7			
6A	20/24 *83%*	SS	*1-2* *3-3* N=5			
7A	23/24 *96%*	SS	*7-22* *27-48* N=49			

Depth ft. BGS: 2, 4, 6, 8, 10, 12, 14

Lithologic Description

Very dark gray (10YR3/1), moist, very stiff, lean CLAY, some silt, few roots.

Gray (10YR6/1) with 20% yellowish brown (10YR5/6) mottles, moist, very stiff, lean CLAY, with some silt, trace very fine-grained sand.

Dark gray (10YR4/1) with 10% yellowish brown (10YR5/6) mottles, moist, stiff, lean CLAY, with some silt, trace very fine-grained sand.

Gray (10YR6/1) with 10% yellowish brown (10YR5/6) moist, very stiff, lean CLAY, with some very fine-grained sand and silt, few small gravel.

Gray (10YR6/1) with 30% yellowish brown (10YR5/6) moist, very stiff, lean CLAY, with some very fine-grained sand and silt, few small gravel.

Yellowish brown (10YR5/4), moist, loose, SILT, with some very fine- to fine-grained sand, few clay and small gravel.

Yellowish brown (10YR5/4) with 20% yellowish brown (10YR5/6) mottles, moist, loose, SILT, with some very fine- to fine-grained sand, few clay and small gravel.

∇

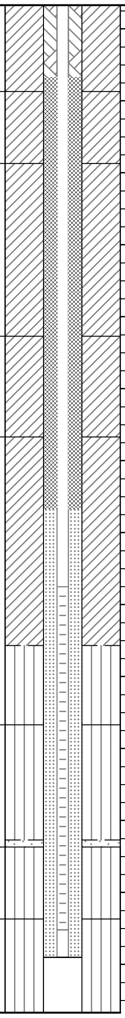
Yellowish brown (10YR5/4), wet, SAND, with some silt.

Yellowish brown (10YR5/4) with 20% yellowish brown (10YR5/6) mottles, wet, loose, SILT, with few very fine- to medium-grained sand, little clay, few small gravel.

Light yellowish brown (10YR6/4) with 10% yellowish brown (10YR5/6) mottles, moist, hard, SILT, trace very fine-grained sand.

End of boring = 14.0 feet

Borehole Detail



Elevation ft. MSL: 614, 612, 610, 608, 606, 604, 602

Remarks

NOTE(S): G284 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/19/2021
Finish: 1/19/2021
WEATHER: Clear, cold (20s)

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: G285
Well ID: G285
Surface Elev: 610.54 ft. MSL
Completion: 26.00 ft. BGS
Station: 874,795.00N
2,516,680.40E

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

WATER LEVEL INFORMATION:
▽ = Dry 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
1A	20/24 *83%*	SS	*0-2* *3-3* N=5			
2A	18/24 *75%*	SS	*1-3* *4-6* N=7			
3A	22/24 *92%*	SS	*2-5* *8-9* N=13			
4A	22/24 *92%*	SS	*3-8* *12-15* N=20			
5A	21/24 *88%*	SS	*4-11* *16-18* N=27			
6A	23/24 *96%*	SS	*3-8* *13-17* N=21			
7A	23/24 *96%*	SS	*4-9* *12-17* N=21			
8A	23/24 *96%*	SS	*5-14* *21-33* N=35			
9A	23/24 *96%*	SS	*5-7* *10-15* N=17			
10A	4/24 *17%*	SS	*4-6* *12-14* N=18			

Depth ft. BGS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Lithologic Description

Yellowish brown (10YR5/4), moist, stiff, lean CLAY, with some silt, few fine-grained sand.

Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, very stiff, lean CLAY, with some silt, few very fine-grained sand, trace small gravel.

Yellowish brown (10YR5/6) with 20% gray (10YR5/1) mottles, moist, very stiff, lean CLAY, with some silt, few very fine-grained sand, trace small gravel.

Gray (10YR5/1) with 15% yellowish brown (10YR5/6) mottles, hard, lean CLAY, with some silt, few very fine-grained sand and small gravel.

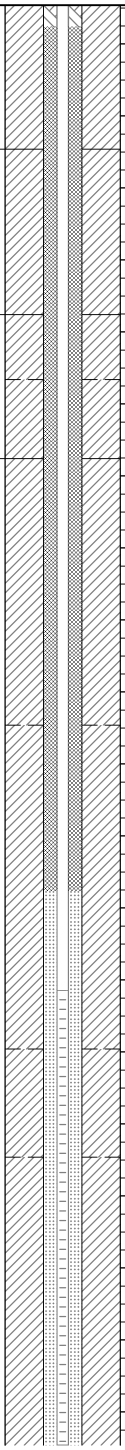
Yellowish brown (10YR5/6) with 20% gray (10YR5/1) mottles, hard, lean CLAY, with some silt, few very fine-grained sand and small gravel.

Grayish brown (10YR5/2) with 15% yellowish brown (10YR5/6) mottles, hard, lean CLAY, with some silt, few very fine-grained sand and small gravel.

Grayish brown (10YR5/2) with 15% yellowish brown (10YR5/6) mottles and 15% dark reddish brown (5YR3/4) oxidation along vertical fracture, hard, lean CLAY, with some silt, few very fine-grained sand and small gravel.

Dark gray (10YR4/1), moist, hard, lean CLAY, with some silt, few very fine-grained sand and small gravel.

Borehole Detail



Elevation ft. MSL: 610, 608, 606, 604, 602, 600, 598, 596, 594, 592

Remarks

Sampler pushing gravel in Run 10.

NOTE(S): G285 installed in borehole.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/19/2021
Finish: 1/19/2021
WEATHER: Clear, cold (20s)

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

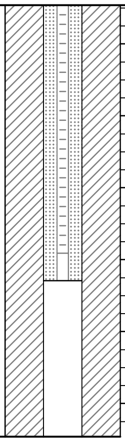
BOREHOLE ID: G285
Well ID: G285
Surface Elev: 610.54 ft. MSL
Completion: 26.00 ft. BGS
Station: 874,795.00N
2,516,680.40E

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

WATER LEVEL INFORMATION:
▽ = Dry 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	Elevation ft. MSL	Remarks
11A	24/24 *100%*	SS	*4-7* *9-11* N=16					Dark gray (10YR4/1), moist, hard, lean CLAY, with some silt, few very fine-grained sand and small gravel. *[Continued from previous page]*	590	
12A	3/24 *13%*	SS	*4-7* *8-13* N=15				22		588	Sampler pushing gravel in Run 12.
13A	23/24 *96%*	SS	*3-5* *7-11* N=12				24		586	
							26	**End of boring = 26.0 feet**		

Borehole Detail



NOTE(S): G285 installed in borehole.

FIELD BORING LOG

CLIENT: Illinois Power Generating Co.
Site: Coffeen Part 845 Groundwater
Location: Coffeen, Illinois
Project: 20E0111A
DATES: Start: 1/19/2021
Finish: 1/19/2021
WEATHER: Clear, 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

HANSON

BOREHOLE ID: G286
Well ID: G286
Surface Elev: 609.97 ft. MSL
Completion: 10.00 ft. BGS
Station: 875,072.20N
2,516,561.80E

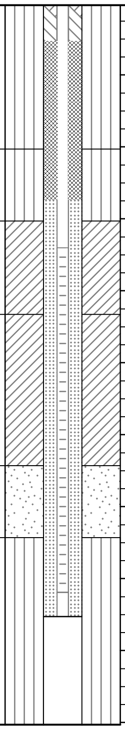
TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Coffeen, IL
Township: East Fork Township
Section 11, **Tier** 7N; **Range** 3W

WATER LEVEL INFORMATION:
▽ = 6.40 - 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
1A	24/24 *100%*	SS	*0-0* *2-2* N=2			
2A						
2B	19/24 *79%*	SS	*0-2* *5-7* N=7			
3A	19/24 *79%*	SS	*4-7* *5-4* N=12			
4A 4B	20/24 *83%*	SS	*2-3* *3-4* N=6			
5A	20/24 *83%*	SS	*2-5* *7-15* N=12			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark grayish brown (10YR4/2), moist, medium stiff, SILT, with some clay, trace very fine-grained sand and small gravel.	
2	Brown (10YR5/3), moist, stiff, SILT, with some clay, few very fine- to fine-grained sand, trace small gravel.	608
	Grayish brown (10YR5/2), moist, hard, lean CLAY, with some silt, few very fine- to fine-grained sand, trace small gravel.	
4	Dark grayish brown (10YR4/2) with 20% grayish brown (10YR5/2) mottles, moist, very stiff, lean CLAY, with some very fine- to medium-grained sand, little silt, few small gravel.	606
6 ▽	Gray (10YR5/1) with 10% dark yellowish brown (10YR3/6) mottles, wet, loose, SAND, with some silt and small to medium gravel, trace clay.	604
8	Gray (10YR5/1), moist, hard, SILT, with some very fine- to fine-grained sand, few small gravel.	602
10	**End of boring = 10.0 feet**	600

Borehole Detail



Remarks

NOTE(S): G286 installed in borehole.

WELL CONSTRUCTION FORMS

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Montgomery Well #: G273

Site Name: CCB Management Facility Borehole #: G273

State Plane Coordinate: X 2,515,975.5 Y 874,235.2 (or) Latitude: 39° 3' 53.900" Longitude: -89° 23' 38.300"

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 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

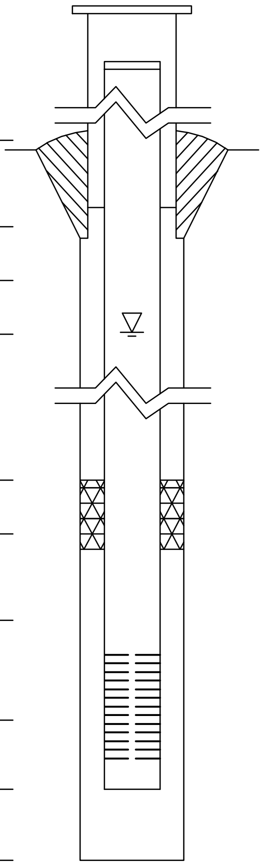
Type of Sand Pack: Quartz sand

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

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

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:

Well Completion Form (revised 02/06/02)

**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~~ Plant ~~Plane~~ 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

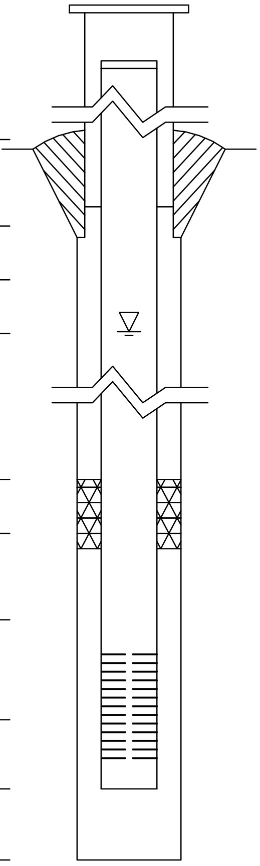
Type of Sand Pack: Quartz sand

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

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

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:

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency

Well Completion Report

Site #:
County: Montgomery
Well #: G275D

Site Name: Coffeen Part 845 Groundwater
Borehole #: G275D

State Plane Coordinate: X 2,516,366.5 Y 874,285.3 (or) Latitude: Longitude:

Surveyed By: Michael J. Graminski
IL Registration #: 035-003919

Drilling Contractor: Roberts
Driller: Matt

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

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

Logged By: Colin Winter
Date Started: 1/28/2021 Date Finished: 2/3/2021

Report Form Completed By: Colin Winter
Date: 5/3/2021

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

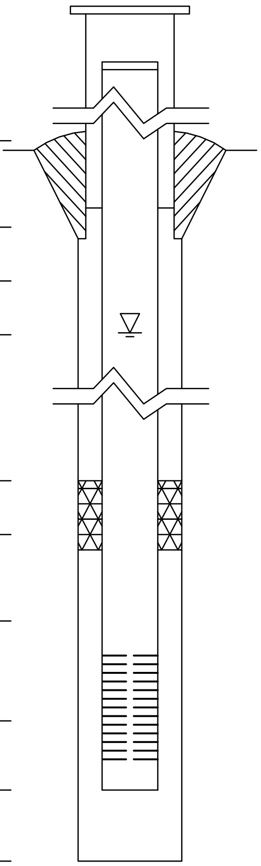
Type of Sand Pack: Quartz sand

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.)
620.69	-3.17	Top of Protective Casing
620.31	-2.79	Top of Riser Pipe
617.52	0.00	Ground Surface
617.02	0.50	Top of Annular Sealant
		Static Water Level (After Completion)
572.02	45.50	Top of Seal
571.02	46.50	Top of Sand Pack
567.76	49.76	Top of Screen
557.97	59.55	Bottom of Screen
557.63	59.89	Bottom of Well
517.82	99.70	Bottom of Borehole

* Referenced to a National Geodetic Datum

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)	52.55
Bottom of Screen to End Cap	(feet)	0.34
Screen Length (1st slot to last slot)	(feet)	9.79
Total Length of Casing	(feet)	62.68
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

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:

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

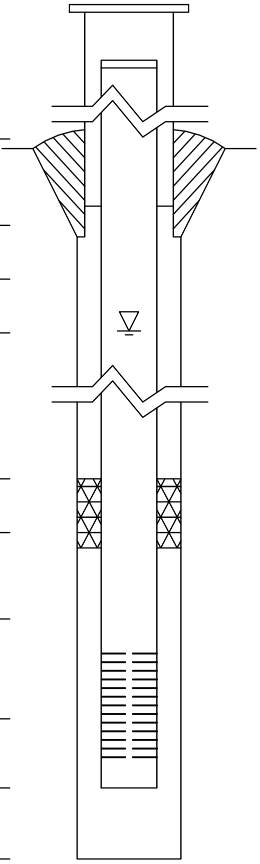
Type of Sand Pack: Quartz sand

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

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

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:

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency

Well Completion Report

Site #:
County: Montgomery
Well #: G279
Site Name: CCB Management Facility
Borehole #: G279
State Plane Coordinate: X 2,516,245.6 Y 875,028.1 (or) Latitude: 39° 4' 1.800" Longitude: -89° 23' 34.800"

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 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

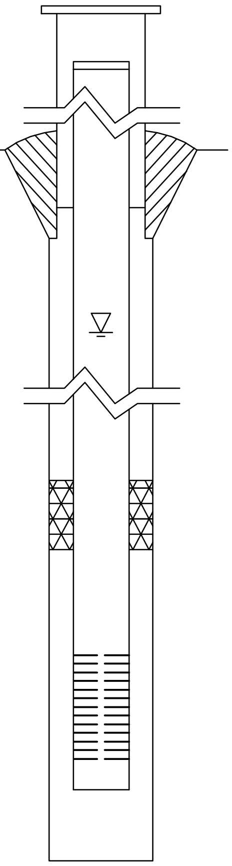
Type of Sand Pack: Quartz sand

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
601.89	27.3	
601.19	28.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

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

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:

Illinois Environmental Protection Agency

Well Completion Report

Site #:

County: Montgomery

Well #: G283

Site Name: Coffeen Part 845 Groundwater

Borehole #: G283

State Plane Coordinate: X 2,516,503.0 Y 874,113.0 (or) Latitude: Longitude:

Surveyed By: Michael J. Graminski

IL Registration #: 035-003919

Drilling Contractor: Roberts

Driller: Matt

Consulting Firm: Hanson Professional Services Inc.

Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger

Drilling Fluid (Type): None

Logged By: Colin Winter

Date Started: 1/18/2021 Date Finished: 1/18/2021

Report Form Completed By: Colin Winter

Date: 5/3/2021

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:

Setting Time:

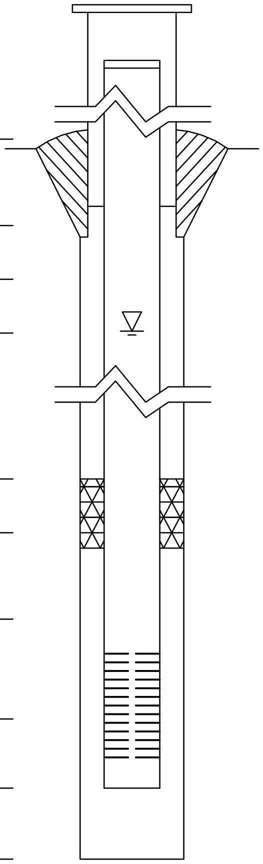
Type of Sand Pack: Quartz Sand

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.)
611.07	-2.77	Top of Protective Casing
610.75	-2.45	Top of Riser Pipe
608.30	0.00	Ground Surface
607.70	0.60	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
600.80	7.50	Top of Sand Pack
599.91	8.39	Top of Screen
590.13	18.17	Bottom of Screen
589.94	18.36	Bottom of Well
589.94	18.36	Bottom of Borehole

* Referenced to a National Geodetic Datum

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)	10.84
Bottom of Screen to End Cap	(feet)	0.38
Screen Length (1st slot to last slot)	(feet)	9.78
Total Length of Casing	(feet)	21.00
Screen Slot Size **	(inches)	0.010

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:

Well Completion Form (revised 02/06/02)

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency

Well Completion Report

Site #:
County: Montgomery
Well #: G284
Site Name: Coffeen Part 845 Groundwater
Borehole #: G284
State Plane Coordinate: X 2,516,922.9 Y 874,423.6 (or) Latitude: ______ ______ ______ Longitude: ______ ______ ______

Surveyed By: Michael J. Graminski
IL Registration #: 035-003919
Drilling Contractor: Roberts
Driller: Matt
Consulting Firm: Hanson Professional Services Inc.
Geologist: Rhonald W. Hasenyager, LPG #196-000246
Drilling Method: Hollow stem auger
Drilling Fluid (Type): None
Logged By: Colin Winter
Date Started: 1/20/2021
Date Finished: 1/20/2021
Report Form Completed By: Colin Winter
Date: 5/3/2021

ANNULAR SPACE DETAILS

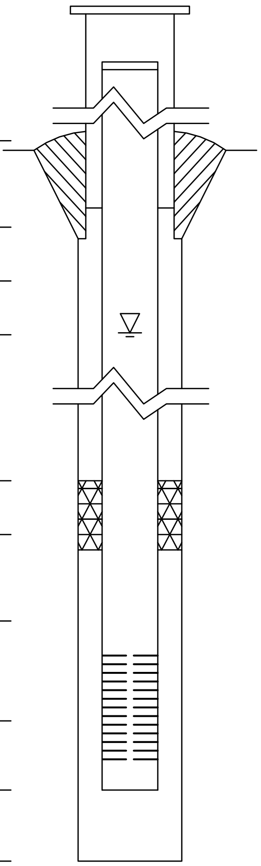
Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips
Installation Method: Gravity
Setting Time: >24 hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)
Installation Method:
Setting Time:

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.)
618.66	-3.33	Top of Protective Casing
618.42	-3.09	Top of Riser Pipe
615.33	0.00	Ground Surface
614.33	1.00	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
608.33	7.00	Top of Sand Pack
607.25	8.08	Top of Screen
602.48	12.85	Bottom of Screen
602.10	13.23	Bottom of Well
601.33	14.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

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)	11.17
Bottom of Screen to End Cap	(feet)	0.38
Screen Length (1st slot to last slot)	(feet)	4.77
Total Length of Casing	(feet)	16.32
Screen Slot Size **	(inches)	0.010

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:

Well Completion Form (revised 02/06/02)

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency **Well Completion Report**

Site #: ______ County: Montgomery Well #: G285

Site Name: Coffeen Part 845 Groundwater Borehole #: G285

State Plane Coordinate: X 2,516,680.4 Y 874,795.0 (or) Latitude: ______ Longitude: ______

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Roberts Driller: Matt

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

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

Logged By: Colin Winter Date Started: 1/19/2021 Date Finished: 1/19/2021

Report Form Completed By: Colin Winter Date: 5/3/2021

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: ______

Setting Time: ______

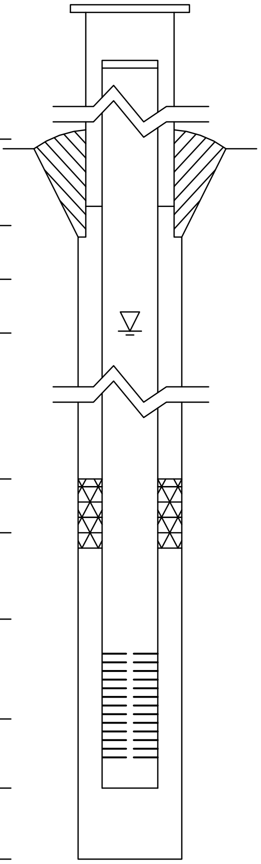
Type of Sand Pack: Quartz Sand

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.)
613.90	-3.36	Top of Protective Casing
613.52	-2.98	Top of Riser Pipe
610.54	0.00	Ground Surface
610.24	0.30	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
598.24	12.30	Top of Sand Pack
596.86	13.68	Top of Screen
587.09	23.45	Bottom of Screen
586.71	23.83	Bottom of Well
584.54	26.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

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)	16.66
Bottom of Screen to End Cap	(feet)	0.38
Screen Length (1st slot to last slot)	(feet)	9.77
Total Length of Casing	(feet)	26.81
Screen Slot Size **	(inches)	0.010

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:

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency
Well Completion Report

Site #:
County: Montgomery
Well #: G286

Site Name: Coffeen Part 845 Groundwater
Borehole #: G286

State Plane Coordinate: X 2,516,561.8 Y 875,072.2 (or) Latitude: ___ ___ ___ Longitude: ___ ___ ___

Surveyed By: Michael J. Graminski
IL Registration #: 035-002901

Drilling Contractor: Roberts
Driller: Matt

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

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

Logged By: Colin Winter
Date Started: 1/19/2021 Date Finished: 1/19/2021

Report Form Completed By: Colin Winter
Date: 5/3/2021

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:

Setting Time:

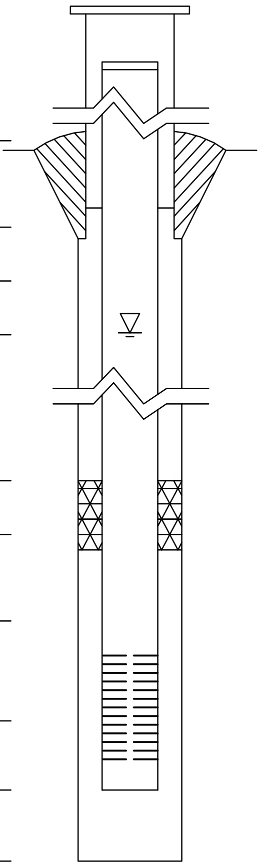
Type of Sand Pack: Quartz Sand

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.)
613.57	-3.60	Top of Protective Casing
613.13	-3.16	Top of Riser Pipe
609.97	0.00	Ground Surface
609.47	0.50	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
607.27	2.70	Top of Sand Pack
606.60	3.37	Top of Screen
601.81	8.16	Bottom of Screen
601.47	8.50	Bottom of Well
599.97	10.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

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)	6.53
Bottom of Screen to End Cap	(feet)	0.34
Screen Length (1st slot to last slot)	(feet)	4.79
Total Length of Casing	(feet)	11.66
Screen Slot Size **	(inches)	0.010

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:

Well Completion Form (revised 02/06/02)

**Hand-Slotted Well Screens Are Unacceptable

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 Banoff

Rachel A. Banoff
Environmental Engineer

Alison OConnor

Alison O'Connor
Senior Lead Consultant

Eric J. Tlachac

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

ERIC J. TLACHAC
062-063091

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

BRIAN G. HENNINGS
196.001482

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 Banoff

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

FIGURES (IN TEXT)

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

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[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.

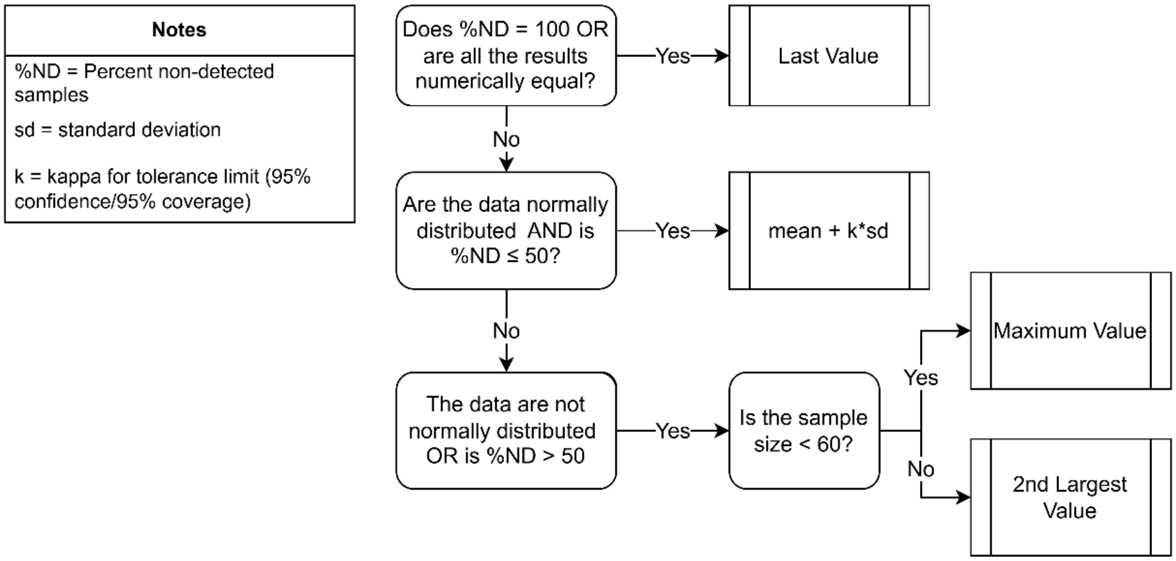

Figure 1. Flow chart illustrating the statistical methods used for calculating background under Compliance Monitoring.

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.

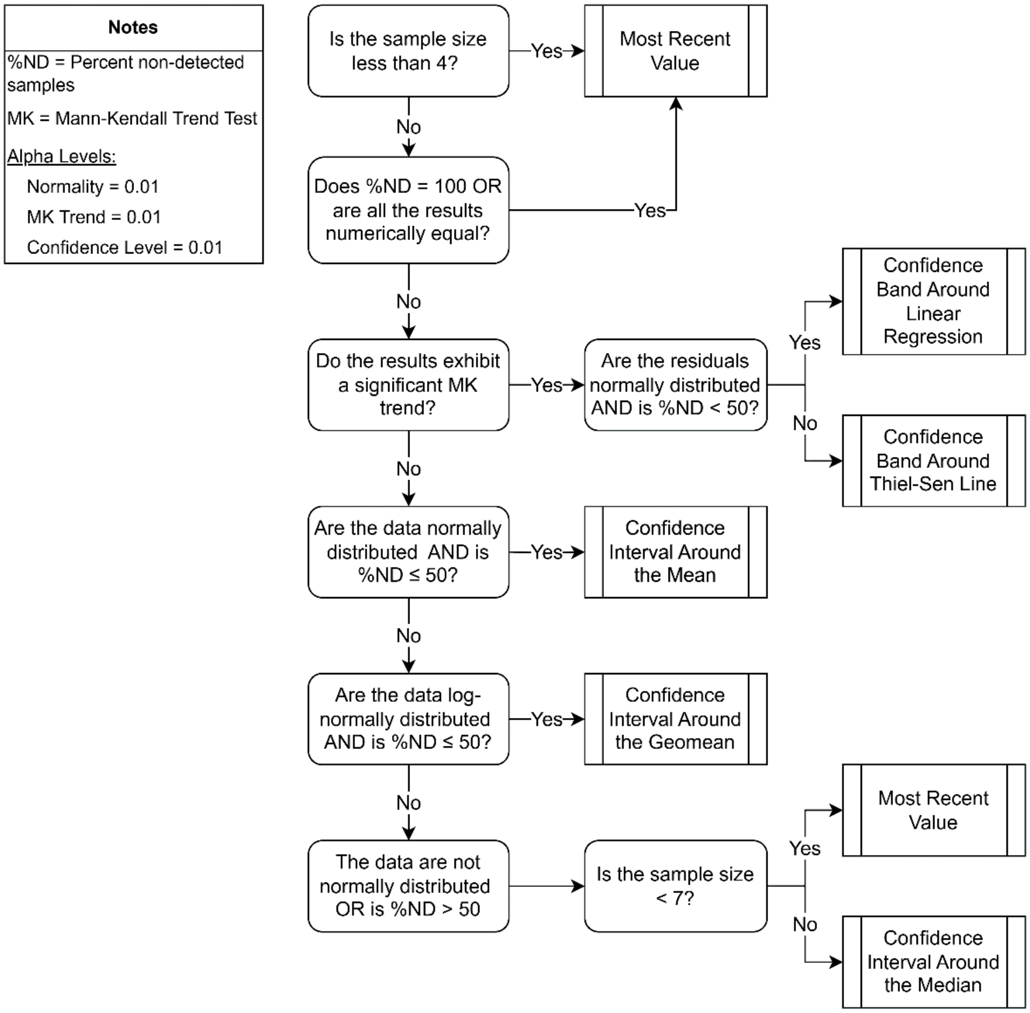

Figure 2. Flow chart illustrating the statistical methods used for calculating confidence intervals in Compliance Monitoring.

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:

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

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

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

$F_{1-2\alpha,2,\mathrm{n}-2}$ = upper $(1\text{-}2\alpha)^{\text{th}}$ 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 $N = n(n-1)/2$ 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:

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

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:

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

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 α^th^ 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

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