Intended for

Illinois Power Resources Generating, LLC
7800 Cilco Lane
Bartonville, Illinois, 61607

Date

March 28, 2025

Project No.

1940110241-003

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CORRECTIVE ACTION PLAN

ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

IEPA ID NO. W1438050005-01

RAMBOLL Bright ideas. Sustainable change.

CORRECTIVE ACTION PLAN
EDWARDS POWER PLANT, ASH POND, IEPA ID NO. W1438050005-01

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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
amp	amperage
AP	Ash Pond, also referred to as Site
BCU	bedrock confining unit
CA	Corrective Action
CA GMP	Corrective Action Groundwater Monitoring Plan
CAAA	Corrective Action Alternatives Analysis
CAAA-SIR	Corrective Action Alternatives Analysis Supporting Information Report
CAP	Corrective Action Plan
CBR	closure-by-removal
CCR	coal combustion residuals
CIP	closure-in-place
CMA	Corrective Measures Assessment
COC	constituent of concern
COI	constituent of interest
CP	Construction Permit
CY	cubic yards
EPP	Edwards Power Plant
EQ	equalization
gpm	gallons per minute
Gradient	Gradient Corporation
GWE	Groundwater Extraction
GWP	Groundwater Polishing
GWPS	groundwater protection standards
HCR	Hydrogeologic Site Characterization Report
ID	identification
IEPA	Illinois Environmental Protection Agency
IPRG	Illinois Power Resources Generating, LLC
ISGS	Illinois State Geological Survey
NAVD88	North American Vertical Datum of 1988
NID	National Inventory of Dams
No.	number
OMM	Operations, Maintenance, and Monitoring
OP	Operating Permit
PMP	potential migration pathway
psf	Pound per square foot
psi	Pound per square inch
Ramboll	Ramboll Americas Engineering Solutions, Inc.
SFA	Safety Factor Assessment
TDS	total dissolved solids
UA	uppermost aquifer
UCF	Upper Cahokia Formation
USEPA	United States Environmental Protection Agency
VAC	volt alternating current

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1. INTRODUCTION

1.1 Plant and Site Information

Illinois Power Resources Generating, LLC (IPRG) is the owner of the inactive coal-fired Edwards Power Plant (EPP), also referred to as the Edwards Power Station, in Bartonville, Peoria County, Illinois. IGPC intends to complete groundwater corrective action (CA) at the coal combustion residuals (CCR) surface impoundment (SI) Ash Pond (AP), which is identified by Illinois Environmental Protection Agency (IEPA) identification (ID) number (No.) W1438050005-01, CCR Unit ID No. 301, and National Inventory of Dams (NID) No. IL50710. This Corrective Action Plan (CAP) has been prepared for the AP at the EPP 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].

1.2 Organization of the Corrective Action Plan

This CAP is organized in the following manner:

- **Section 1** includes an introduction to the AP, 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 CA process, including the results of the Corrective Measures Assessment (CMA) and Corrective Action Alternatives Analysis (CAAA);
- **Section 3** provides the CAP requirements, the selected remedy, an evaluation of effectiveness and an implementation schedule, as required by 35 I.A.C. § 845.670; and
- **Section 4** includes reference documents used in the development of this CAP.

This CAP was prepared as an attachment to Construction Permit application for the AP as required by 35 I.A.C. § 845.220(a) and (c).

1.3 Permit Status

In addition to the Construction Permit (CP) application for CA, to which this CAP is an appendix, the following 35 I.A.C. § 845 permit applications have previously been submitted to IEPA by IPRG for the AP:

- An OP application, as required by 35 I.A.C. § 845.230, was submitted on October 25, 2021 [2].
- A CP application for closure of the AP, as required by 35 I.A.C. § 845.220, including a CCR Surface Impoundment Final Closure Plan, as required by 35 I.A.C. § 845.720, was submitted on June 29, 2022 [3].
  - The Final Closure Plan selected hybrid closure-in-place (CIP) with consolidation as the most appropriate closure method for the AP.

As of the date of this CAP, IPRG's OP and CP applications for the AP are pending with IEPA.

1.4 Selected Corrective Action Remedy

Groundwater Extraction (GWE), combined with the source control presented within the Final Closure Plan [4], has been identified as the most appropriate remedy for the AP, based on the

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Corrective Action Alternatives Analysis (CAAA) provided in **Appendix A**. Potential remedies evaluated in the CAAA included Source Control with Groundwater Polishing (GWP), Source Control with GWE, and Source Control with Phytoremediation.

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 [5] is also attached to the CAAA. This report presents results from geochemical modeling of exceedance[1] parameters addressed at AP by the CAP. Geochemical modeling evaluated GWP as a component of the proposed CA. The results of the GWP evaluation also contextualized estimates of the modeled times to meet groundwater protection standards (GWPS) by evaluating potential changes in constituent of concern (COC) attenuation as groundwater quality returns to background conditions.

1.4.1 Narrative Description of Selected Corrective Action Remedy

CA will consist of the source control, as outlined in the Final Closure Plan for the AP [4], and the operation of a GWE system, which will be located at the downgradient boundary of the AP and will intercept CCR-impacted groundwater from native soil units, prior to it flowing offsite. This will control the source to reduce, to the maximum extent feasible, further releases of constituents listed in 845.600 in accordance with 845.670(d)(3).

The proposed source control portion of the remedy (*e.g.,* closure) exceeds the minimum Closure Performance Standards listed in 35 I.A.C. § 845.750. 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 [USEPA], 2015a, p. 21342):

> *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 AP will be closed using a hybrid consolidate-and-cap approach. This will include completely removing approximately 1,130,000 cubic yards (CY) of CCR [3] from the closure-by-removal (CBR) area and relocating the waste material to the south end and other low areas of the SI (the CIP area). Additionally, approximately 210,000 CY of CCR will be relocated from the rail loop embankment into the CIP footprint. The excavation and consolidation will reduce the total CCR footprint from approximately 102 acres to approximately 69 acres, providing a 33 acre, or approximately 32 percent (%), reduction in the consolidated and closed final footprint of the AP. Additional closure activities will include construction of an earthen separation berm at the perimeter of the relocation area of the AP to contain the relocated ash, installing a system to

[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 IPRG's operating permit application for the EPP AP. That operating permit application, including the proposed groundwater monitoring program, remains under review by the IEPA and, therefore, IPRG has not identified any actual exceedances.

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address residual saturation, and installing an engineered low permeability geomembrane cover system.

The consolidated CCR will be covered with an alternate geomembrane final cover system having performance that exceeds the 35 I.A.C. § 845.750(c)(2) minimum final cover requirements. The proposed source control is predicted to reduce water flux out of the AP by 94% relative to pre-closure conditions (**Appendix A**).

The GWE system will be installed concurrent with closure construction and will consist of two groundwater extraction trenches. The groundwater extraction trenches will collect CCR-impacted groundwater from the potential migration pathway (PMP) and Upper Aquifer (UA).

The system will be continuously operated during the CA period, outside of routine shutdowns for system maintenance and/or power outages. Groundwater CA performance will be monitored in accordance with the Corrective Action Groundwater Monitoring Plan (CA GMP). The system operation will cease when concentrations in monitoring wells upgradient of the GWE do not exceed the GWPS and a determination has been made that COCs will not rebound above the GWPS after the system is removed from operation. Monitoring and adaptive site management practices presented in the corrective action groundwater monitoring plan describe how stability in groundwater data will be evaluated before assessing if compliance with the GWPS has been attained to allow any transient effects of treatment on the groundwater (e.g., rebounding concentrations) to dissipate.

Estimated timelines for GWE system operations and times to reach the GWPS will be periodically reviewed and updated based on observed CA performance via an adaptive site management strategy. These periodic, updated estimates will be communicated to IEPA and the public within annual CA monitoring reports, in accordance with the CA GMP.

CA will be considered complete when a demonstration that GWPS compliance beyond the waste boundary has been achieved for at least three years after remedy operations have ceased and a CA completion report and certification have been submitted to IEPA in accordance with 35 I.A.C. § 845.680(e).

1.4.1.1 Narrative Discussion of Remedy Design and Function

The GWE system remedy includes the construction of two GWE trenches. Permit-level engineering drawings depicting the proposed remedy are provided in **Appendix B**. Each trench is described below:

North Trench:

- The north trench will be approximately 1,600-feet long and 3 feet wide and will run north to south along the northwest side of the AP, generally intersecting groundwater downgradient of the west side of the CCR consolidation area.
- The north trench will extend from the post-construction surface grade (approximate elevation of 440 feet[2]) through the PMP and UA, and terminate approximately 1 to 2 feet below the top of competent bedrock (bedrock expected to be at an approximate elevation range of 411 to 421 feet). The depth of the north trench ranges from approximately 21 to 31 feet deep (to bottom of key).

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

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South Trench:

- The south trench will be approximately 800-feet long and 3 feet wide and will run north to south along the southwest side of the AP generally intersecting groundwater down gradient of the southwest side of the CCR consolidation area. The trench will be constructed from the crest of the existing embankment after removal of the rail line, ballast and ash embankment section.
- The south trench will extend from the post-construction crest elevation after removal of the rail line, ballast, and ash embankment section (approximately elevation 450 feet) through the PMP and UA and terminate approximately 1 to 2 feet below the top of competent bedrock (expected to be at an approximate elevation of 401.5 feet). The depth of the south trench will be approximately 50 feet deep.

Construction of the selected remedy will include the following tasks:

- A Pre-Design Investigation (PDI) along the trench alignments will be required to verify the bedrock elevation and trench depth. The results of the PDI will be incorporated into the final trench design documents.
- Site utilities will be modified and/or abandoned, as necessary to provide construction access.

Specific construction activities for the north trench are described below.

- Groundwater fate and transport modeling estimates an initial extraction flow rate of approximately 20 gallons per minute (gpm), which decreases to 6 gpm as operation of the GWE trench captures groundwater downgradient of the CCR unit.
- Perforated groundwater collection pipe will be laid in the trench base at an approximate 0.5 to 2% grade to slope towards the collection sumps.
- A total of three collection sumps are anticipated to be installed at 300 to 500 foot centers along the north trench alignment. Sumps will consist of a pit to hold extracted water, a pneumatic pump, and a discharge pipe that will carry extracted water to an equalization (EQ) tank into a nearby compressor shed.
- Site utilities will be modified and/or abandoned, as necessary to provide construction access. This may require raising existing high-voltage power lines that cross the northern trench alignment, in order to provide a safe working distance between the energized lines and construction equipment. Additionally, previously abandoned portions of a sewer force main within the trench alignment may need to be removed to allow for trench construction.

Specific construction activities for the south trench are described below.

- The contractor will establish a 40-foot-wide level work platform at an elevation of 450 feet along the crest of the AP embankment at the south trench alignment to allow construction of the trench by the specialty trench contractor.
- Groundwater fate and transport modeling estimates an initial extraction flow rate of approximately 19 gpm, which decreases to 8 gpm as operation of the GWE trench captures groundwater downgradient of the CCR unit.
- Geotechnical monitoring will be performed during construction of the work platform and south trench to evaluate the AP embankment for signs of distress during construction. A geotechnical monitoring plan will be incorporated into the final design documents.

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- Methane is known to be present in aquifers throughout Illinois, due to both natural and anthropogenic processes (coal mining), and has been encountered at depth during drilling along the AP embankment in the vicinity of the south trench alignment [6]. A detailed methane monitoring plan will be developed and implemented during onsite construction activities where the potential to encounter methane has been previously identified.
- Perforated groundwater collection pipe will be laid in the trench base at an approximate 0.5 to 2% grade to slope towards the collection sumps.
- A total of two collection sumps are anticipated to be installed at 200 to 500 foot centers along the south trench alignment. Sumps will consist of a pit to hold extracted water, a pneumatic pump and a discharge pipe that will carry extracted water to an EQ tank into a nearby compressor shed.

Electrical infrastructure to support the GWE system will be installed prior to delivery and placement of the GWE system. System infrastructure will include:

- Electrical infrastructure to support the GWE system will include a 480-volt alternating current (VAC), 400-amperage (amp) power service, including supporting transformers and other infrastructure to power each compressor shed.

A groundwater extraction system enclosure will be placed within the limits of a central gravel pad. The system enclosure will consist of the following equipment:

- An air compressor, air receiver tank, EQ tank, and transfer pump to supply compressed air to nearby pneumatic pumps and to transfer liquids from the EQ tank to the water treatment process; and
- A compressor air manifold consisting of control valves and pulse counters, and a collection sump discharge piping manifold consisting of control valves and flow meters to totalize extracted water from each collection sump will be installed in the compressor shed as well as other miscellaneous electrical controls that allow for continuous automated operation, data collection, and remote telemetry.

Additionally, preliminary geotechnical assessments performed to confirm that installation of the south trench is not expected to adversely impact the structural integrity of the AP perimeter dikes.

1.4.2 Narrative Description of Proposed Remedy Operations

- The GWE system will be operated in accordance with this CAP, and other applicable permits and regulations. Operations, monitoring, and maintenance (OMM) will be conducted on the GWE system on a routine basis. OMM will consist of system wide data collection to track groundwater recovery and discharge rates, sediment removal (as needed), and to optimize trench extraction rates as needed under an adaptive site management strategy. Waste streams associated with the GWE system and their management include: accumulated sediment/solids that collect at the bottom of the EQ tanks, which will be intermittently removed, dried, and disposed of at a non-hazardous landfill, as needed based on accumulation rates.
- The conveyance piping will be flushed on an as-needed basis if solids accumulation is observed on the inner wall of the conveyance pipe during routine OMM inspections. Flush water will be managed in accordance with applicable permits that will be obtained at a later date.

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Routine equipment maintenance will be conducted per recommendations provided by manufacturers of the various components of the GWE system. Additionally, faulty equipment will be replaced as needed to keep the GWE system operating within design specifications. Equipment maintenance and/or replacements may require temporary shutdown of the GWE system.

1.4.3 Narrative Description of Proposed Groundwater Monitoring

CA groundwater monitoring will be conducted in accordance with the CA GMP during remedy operation to evaluate the effectiveness of the CA 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. Information associated with each of these activities is described below.

- Regular groundwater monitoring will be conducted utilizing a CA 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 CA is intended to address. Sampling to evaluate CA effectiveness will begin the quarter after the CA 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 CA at the AP. The adaptive site management approach will allow timely incorporation of new site information to ensure the achievement of the GWPS. The effectiveness of the remedy at each phase is evaluated using performance metrics designed to assess the goals of that phase. Performance metrics answer questions designed to evaluate multiple aspects of remedy effectiveness with the ultimate goal of holistically guiding management decisions [7]. The goals and performance metrics of each phase of remedy evaluation are presented in Section 3 of the CA GMP included in the CP application.
- Documentation of remedy progress metrics will be provided in the Annual Groundwater Monitoring and CA Report beginning after the second year of data collection: a minimum of eight data points is required to complete meaningful statistical analysis required for evaluation of the remedy progress metrics, which will be available after two years of quarterly sampling. Per USEPA guidance [7], a thorough review of CA progress and remedy effectiveness will be conducted every five years. A Five-Year Annual Groundwater Monitoring and CA Report will evaluate the comprehensive data set and, if triggered by the results of the remedy progress evaluation metrics, evaluate whether adaptive management actions are needed. The five-year time frame allows adaptive management decisions to be based on a robust data sufficient to complete meaningful statistical analysis while remaining responsive to changing site conditions [7].
- CA Confirmation Monitoring and Completion

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- Per 35 I.A.C. § 845.680(c), CA 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 CA confirmation monitoring period, a CA Completion Report and Certification will be prepared and submitted to IEPA, in accordance with 35 I.A.C. § 845.680(e).

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2. CORRECTIVE ACTION OVERVIEW

This CAP is based on the tiered assessment and analysis of alternative remedial technologies and remedies that was completed via the CMA and CAAA (**Appendix A**). The objective of these assessments were to determine the optimal alternative for the AP that, when coupled within the source control proposed in the Final Closure Plan [4], 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 [4] for the AP will also be implemented. Final design and construction of the proposed GWE trenches and associated appurtenant structures and infrastructure will be closely coordinated with the AP closure construction. It is expected that CA construction will occur concurrently with closure construction. Construction will be sequenced such that: a) CCR and any underlying comingled soils are removed from the CCR relocation area, and backfilling and regrading the area is completed prior to initiating construction of the north GWE trench; and b) the existing rail loop, ballast and ash embankment are removed prior to initiating construction of the south GWE trench. It is anticipated that construction of the trenches will occur prior to installation of the final cover system. This sequencing is necessary to facilitate construction of the trenches without adversely impacting the closure construction, and vice versa, and to allow placement of trench spoils beneath the cover system.

Source control alone, without other supplemental corrective action, has been estimated via groundwater modeling to reduce the hydraulic flux out of the AP by 94%, relative to pre-closure conditions. Groundwater modeling performed to support the Final Closure Plan estimates that source control activities are expected to result in GWPS being achieved in greater than 100 years after closure completion, without implementing other forms of CA [4].

The remedy presented in this CAP is supplemental to a system to address residual saturation, completion of source control via closure, and placing the CCR above the groundwater table and UA, which when combined are the primary remedial action that will be performed at the site.

2.2 Corrective Measures Assessment

The CMA [8] was performed for the AP and submitted to the IEPA on June 6, 2024, after the exceedances of the GWPSs were identified. The CMA considered a total of five corrective measures for the AP, including:

- Source Control with GWP
- Source Control with GWE
- Source Control with Groundwater Cutoff Wall
- Source Control with In-Situ Chemical Treatment
- Source Control with Phytoremediation

Based on the CMA, three corrective measures, including Source Control-GWP, Source Control-GWE, and Source Control-Phytoremediation, were identified as potentially viable corrective measures for the AP and were included for further evaluation, design advancement, and

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comparative assessment within the CAAA for the AP. The other corrective measures were determined by the CMA to be unlikely to be viable for the AP 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 AP was prepared by Gradient based on a Corrective Action Alternatives Analysis Supporting Information Report (CAAA-SIR) prepared by Ramboll. The CAAA-SIR included additional evaluation, design advancement, and comparative assessment of the Source Control-GWP, Source Control-GWE, and Source Control-Phytoremediation corrective measures identified as potentially viable for the AP by the CMA. The evaluation included the completion of feasibility-level design activities for each alternative; this 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 the 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-GWE was identified as the most appropriate CA for the AP and was selected for further design development as part of this CAP.

It should be noted that the permit-level engineering assessments, groundwater modeling, and other information contained within this CAP were developed to a higher level of design and detail than those assessments performed in the CAAA; therefore, information on items such as permitting, remedy scope, estimated time to reach GWPS, implementation schedule, etc. may differ between this CAP and the included CAAA-SIR and CAAA. Information for the Source Control-GWE contained within the CAP should be considered to supersede information contained within the CAAA and CAAA-SIR.

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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 disused within the CMA and CAAA documents that have been prepared to support the CAP. Therefore, the demonstrations will also refer to those documents.

3.1 General Requirements

35 I.A.C. § 845.670(c): The corrective action plan must meet the following requirements:

(1) Be based on the results of the corrective measures assessment conducted under 35 I.A.C. § 845.660;

(2) Identify a selected remedy that at a minimum, meets the standards listed in subsection (d);

(3) Contain the corrective action alternatives analysis specified in subsection (e); and

(4) Contain proposed schedules for implementation, including an analysis of the factors in subsection (f).

This CAP is based on the results of the CMA and CAAA, which are included within **Appendix A**. The proposed schedule for implementing source control with GWE is provided in **Table 1**.

3.2 Remedy Selection

Section 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 AP pose no risk to human health or the environment (**Appendix A**). Concentrations of CCR-derived constituents are anticipated to decline once the AP is closed and the GWE remedy is in place as presented in the CAAA [9] (**Appendix A**). The GWE system will provide hydraulic control and intercept migration of groundwater as CCR-derived constituent concentrations decline below the GWPS.

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

Groundwater modeling indicates source control with GWE (Appendix B of the CAAA-SIR which is attached in Appendix A), which is selected as the remedy of this CAP, will result in attainment of the GWPS within the current monitoring system within 37 years of final closure completion.

(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 AP will be closed using a hybrid consolidate and CIP approach which will act as the main source control mechanism to prevent further releases of CCR-derived constituents. The GWE system will intercept potential off-site migration of CCR-derived constituents in groundwater until the GWPS are achieved.

The main source of CCR-derived constituent release occurred as a result of surface water infiltration. The GWE system was designed to intercept CCR-impacted groundwater from native soil units prior to it flowing offsite. If the remedy is found to be unsuccessful in meeting

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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 AP.

(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 closure plan [4].

3.3 Schedule for Implementation

GWE is effective as an engineered corrective action as it intercepts downgradient groundwater, supports attainment of the GWPS, and has been demonstrated as a reliable and applicable ex-situ remedial technology by the USEPA **[10]**. GWE will be implemented as the final CA. GWE will continue to operate as the CA following source control until (1) GWPS have been met and (2) it has been determined that potential rebound above GWPS is not expected after operation of the GWE system is ceased. Monitoring and adaptive site management practices presented in the corrective action groundwater monitoring plan will be used to determine when operation of the GWE will cease after the GWPS has been met. The corrective action groundwater monitoring plan describes how stability in groundwater data will be evaluated before assessing if compliance with the GWPS has been attained to allow any transient effects of treatment on the groundwater (e.g., rebounding concentrations) to dissipate.

The GWE remedy was evaluated to determine if it can be successfully implemented to achieve GWPS compliance in a timely manner. Timeframes to attain GWPS in the CA monitoring network wells are estimated in **Table A**:

Table A. Estimated Timeframes to Attain GWPS in Groundwater Monitoring Wells

Description	2 years**	5 years**	10 years**	20 years**	37 years**
Percentage of wells predicted to attain GWPS*	20%	20%	60%	80%	100 %

*: 10 wells were used for this estimate as presented in the 2025 Groundwater Modeling Technical Memorandum.
**: Years counted starting from completion of CA.

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-GWE remedy at the AP is included in **Table 1**. The schedule will result in completion of remedial activities within a reasonable

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timeframe considering the factors specified 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 [11], which was submitted to the IEPA on June 4, 2024 and is included with relevant updates as Appendix D to the CAAA report (**Appendix A**), details exceedances of the GWPS. Groundwater modeling and geochemical analysis were performed by Ramboll as part of the CAAA-SIR to design the remedy, and the modeling considered the nature and extent of contamination.

35 I.A.C. § 845.670(f)(2): Reasonable probabilities of remedial technologies achieving compliance with the GWPS established by 35 I.A.C. § 845.600 and other objectives of the remedy;

Several remedies were evaluated in the CAAA and it was determined that the selected remedy (Source Control–GWE) is expected to achieve compliance with 35 I.A.C. § 845.600. Groundwater modeling was performed to evaluate future groundwater quality in the vicinity of the AP impoundment. The results of the modeling indicate that groundwater will attain the GWPS for all constituents within approximately 37 years after closure.

As discussed in the CMA, source control via consolidate-and-cap approach and GWE are proven methods for addressing groundwater contamination [8]. The proposed consolidate-and-cap approach is consistent with the requirements of Title 40 of the Code of Federal Regulations (40 C.F.R.) Section 257 and 35 I.A.C. § 845. The proposed cover has been demonstrated to be compliant by equivalency in the Final Closure Plan [4].

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

The selected remedy includes CIP and GWE. The CCR will be managed within the footprint of the existing CCR Unit as proposed in the Final Closure Plan [4]. The GWE system is not expected to result in the management of CCR. Therefore, the treatment and disposal capacity of CCR is not an applicable consideration for the selected remedy.

35 I.A.C. § 845.670(f)(4): Potential risks to human health and the environment from exposure to contamination before completion of the remedy;

A Human Health and Ecological Risk Assessment was completed and included as an attachment to the CAAA [9] (**Appendix A**). The overall conclusion is that groundwater from the AP impoundment and potential groundwater contributions to surface water pose no unacceptable risks to human health or the environment. Groundwater data collected from 2015 to 2021 were used to estimate exposures, and data from the one available surface water sample was also evaluated. For groundwater constituents retained as constituents of interest (COIs), surface water and sediment concentrations were modeled using the maximum detected groundwater concentration. 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.

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35 I.A.C. § 845.670(f)(5): Resource value of the aquifer, including:

The resource value of the aquifer is discussed in the Hydrogeologic Site Characterization Report (HCR) [12], which is included as Attachment B.3 in the CP application [3]. The principal aquifer in the region is the sand and gravel outwash deposits of the Banner and Henry Formations in the Illinois Valley. Well logs indicate that high-capacity wells with yields up to 1,000 gpm have been developed in this aquifer. These high yield formations have not been observed in the vicinity of the Ash Pond. Groundwater wells in the adjacent uplands are either shallow wells in thin sand and gravel lenses which occur within the Glasford Formation diamicton or drilled into the underlying bedrock. The aquifer in the vicinity of the Ash Pond is limited to thin (generally less than four feet), moderate permeability sand, silty sand, and clayey gravel material within the Lower Cahokia Formation, bedrock, and/or weathered shale bedrock, where present. In locations where higher permeability materials and coarser grained material are absent, the aquifer is interpreted as the interface between the Lower Cahokia Formation and shale bedrock. 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 AP impoundment and potential groundwater contributions to surface water pose no unacceptable risks to human health or the environment. No changes in future residential, commercial, or ecological use are expected. In the absence of changes to current and future uses there is no applicable scheduling consideration.

35 I.A.C. § 845.670(f)(5)(B): Proximity and withdrawal rate of users;

A water well inventory was completed in 2021 utilizing federal and state databases to assess nearby pumping wells, drinking water receptors, and other uses of water in the vicinity of the AP. Based on records obtained from the Illinois State Geological Survey (ISGS) ILWATER Map [13], there are 14 wells located outside of the EPP property within 1,000 meters of the AP. These included seven engineering test wells, three industrial-commercial wells, three farm/domestic wells, and one monitoring well. Three of the 14 identified offsite water wells are downgradient of the AP, two of which are identified as water wells, and one is identified as plugged and abandoned. No potable wells were identified downgradient of the AP. Primary uses are industrial applications, monitoring, and engineering test wells.

Additional evaluation of these receptors was completed as part of a supplemental site investigation [14] to determine the status and use of wells at locations identified in the most recent survey. The evaluation resulted in confirmation of seven potential water wells within 1,000 meters of the AP boundary. Based on the analysis only 3 wells are present within 1,000-meters of the AP, two are non-potable supplies and the third well is located upgradient of the AP and will not be impacted by a potential release from the AP.

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

Per 35 I.A.C. § 620.210, groundwater within the UA at the AP meets the definition of Class I – Potable Resource Groundwater [12]. The Human Health and Ecological Risk Assessment [9]

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concluded that groundwater from the AP impoundment and potential groundwater contributions to surface water pose no unacceptable risks to human health or the environment.

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

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 AP. Section 3.5 of the Human Health and Ecological Risk Assessment [9] included as Appendix A of the CAAA indicated there are no current unacceptable risks to ecological receptors at the AP.

- Ecological receptors exposed to surface water include aquatic plants, amphibians, reptiles, and fish. The risk evaluation showed that none of the COIs in surface water exceeded protective screening benchmarks.
- Ecological receptors exposed to sediment include benthic invertebrates. The modeled sediment COIs did not exceed the conservative screening benchmarks, therefore, none of the COIs evaluated in sediment are expected to pose an unacceptable risk to ecological receptors.
- Ecological receptors were also evaluated for exposure to bioaccumulative COIs. This evaluation considered higher trophic-level wildlife with direct exposure to surface water and sediment and secondary exposure through the consumption of dietary items (*e.g.*, plants, invertebrates, small mammals, fish). Based on US EPA Region 4 Ecological Risk Assessment Supplemental Guidance (March 2018 Update) [15], only mercury was identified as a bioaccumulative COI. 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 COCs 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. In the absence of any unacceptable risks to ecological receptors there is no applicable scheduling consideration.

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

In addition to the CCR present at AP, there are three principal layers of unlithified material present above the bedrock, which are categorized into the hydrostratigraphic units described below (from surface downward) based on stratigraphic relationships and common hydrogeologic characteristics:

- Upper Cahokia Formation (UCF)/PMP: Low permeability clays and silts of the UCF are present at the surface. This unit is considered a PMP at elevations similar to the base of the AP, and in places where thin discontinuous sand lenses occur within the UCF adjacent to the AP.
- UA: Thin (generally less than 4 feet), moderate permeability sand, silty sand, and clayey gravel material within the Lower Cahokia Formation, bedrock, and/or weathered shale bedrock, where present. In locations where higher permeability materials and coarser grained material are absent, the UA is interpreted as the interface between the Lower Cahokia Formation and shale bedrock.

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- Bedrock Confining Unit (BCU): Thick, very low permeability shales and siltstones of the Carbondale and Modesto Formations. This unit was encountered at elevations ranging from approximately 400 to 422 feet[3] with higher bedrock elevations occurring beneath the northern portion of the AP.

The effects of nature and extent of contamination on schedule were considered by incorporating the geometry, hydraulic, and geochemical properties of these units into the groundwater modeling and groundwater polishing reports, attached to the CAAA-SIR and CAAA respectively included in **Attachment A**, which estimate the time to reach the GWPS for remedial alternatives.

The GWE remedy will intercept groundwater migrating through the UA and PMP and reduce off-site migration.

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

As discussed in subsection 670(f)(5)(B) above, there are 3 water wells within 1,000 meters of the AP [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 and the GWE remedy will reduce off-site migration of AP CCR-derived constituents.

3.3.1 Other Relevant Factors

35 I.A.C. § 845.670(f)(6): Other relevant factors.

No additional factors were identified for consideration.

3.4 Necessity of Interim Measures

35 I.A.C § 845.680(a)(3) states the owner or operator must take any interim measures necessary to reduce the constituents leaching from the CCR surface impoundment, and/or potential exposures to human or ecological receptors. As indicated in the HHERA and discussed above, there are no currently unacceptable risks to human or ecological receptors. Due to the low permeability clay in the Cahokia Formation foundation soils surrounding the AP, migration of porewater and movement of groundwater outside the AP are limited. Therefore, no interim measures are required. Further, all subsections of this requirement are discussed as follows.

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

As described in the CAAA-SIR, remedy construction is estimated to be complete within 6 years of approval of the CP, which is relatively short compared to the estimated time to reach the GWPS.

35 I.A.C. § 845.680(a)(3)(B): Actual or potential exposure of nearby populations or environmental receptors to any of the constituents listed in 35 I.A.C. § 845.600.

There are no current unacceptable risks to human or ecological receptors at the site (**Appendix A**). Because there are no receptors within the footprint of impacted groundwater, the resource value of the UA is limited in the vicinity of the Ash Pond, and it is not a source of drinking water near the Ash Pond [12, 14]. Additionally, the Illinois River surface water is not used as a source of drinking water in the area.

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

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35 I.A.C. § 845.680(a)(3)(C): Actual or potential contamination of sensitive ecosystems or current or potential drinking water supplies.

The nature and extent of exceedances have been evaluated in the Nature and Extent Report [11]. 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. The Illinois River surface water adjacent to the AP is not used as a source of drinking water in the area. Additionally, an ecological risk assessment was completed [9] and no unacceptable risks were identified for ecological receptors exposed to surface water and sediment.

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

No interim measure is expected to prevent further degradation of the groundwater more expeditiously than implementation of the selected remedy.

35 I.A.C. § 845.680(a)(3)(E): Weather conditions that may cause any of the constituents listed in 35 I.A.C. § 845.600 to migrate or be released.

There are no unacceptable risks presented by the AP under current conditions from weather-related phenomena.

35 I.A.C. § 845.680(a)(3)(F): Potential for exposure to any of the constituents listed in 35 I.A.C. § 845.600 as a result of accident or failure of a container or handling system.

There are no container or handling systems that pose a risk to receptors in the interim.

35 I.A.C. § 845.680(a)(3)(G): *Other situations that may pose threats to human health and the environment.*

No other situations have been identified where AP CCR leachate poses threats to human health and the environment.

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4. REFERENCES

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[10] USEPA, "Federal Remediation Technologies Roundtable, Technology Screening Matrix - Groundwater Pump and Treat," [Online]. Available: https://www.frtr.gov/matrix/Groundwater-Pump-and-Treat/. [Accessed 3 December 2024].

[11] Ramboll Americas Engineering Solutions, Inc., "Nature and Extent Report, Edwards Power Plant, Ash Pond, IEPA ID No. W1438050005-01," Ramboll Americas Engineering Solutions, Inc., Bartonville, Illinois, June 4, 2024.

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[14] Ramboll Americas Engineering Solutions, Inc., "2023 Supplemental Site Investigation Report, Ash Pond, Edwards Power Plant," Ramboll Americas Engineering Solutions, Inc., Bartonville, Illinois, December 1, 2023.

[15] USEPA, "Region 4 Ecological Risk Assessment Supplemental Guidance," 2018.

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

Implementation Phase	Implementation Task	Timeframe (Preliminary Estimates)
1: Pre-Construction	Agency Coordination, Approvals, and Permitting	18 to 24 months
	Final Design and Bid Process	24 to 36 months
	Timeframe to Complete Corrective Action Pre-Construction Activities	42 to 60 months
2: Corrective Action Construction	Corrective Action Construction	9 to 18 months
	Timeframe to Complete Corrective Action Construction	9 to 18 months
3: Corrective Action O&M and Closure	Corrective Action Monitoring and O&M	444 months (37 years)
	Corrective Action Groundwater Compliance Monitoring	36 months
	Corrective Action Completion	6 months
	Timeframe to Complete Corrective Action O&M and Closure	486 months (40.5 years)
Total Timeline to Complete Corrective Action (after approval of Corrective Action Plan)		537 to 564 months (45 to 47 years)

[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.

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

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Corrective Action Alternatives Analysis for the Ash Pond at the Edwards Power Plant, Bartonville, Illinois

March 28, 2025

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Abbreviations

AP	Ash Pond
BMP	Best Management Practice
BCU	Bedrock Confining Unit
bgs	Below Ground Surface
CAA	Closure Alternatives Analysis
CAAA	Corrective Action Alternatives Analysis
CBR	Closure-by-Removal
CCR	Coal Combustion Residual
CIP	Closure-in-Place
CMA	Corrective Measures Assessment
EPP	Edwards Power Plant
GHG	Greenhouse Gas
GWE	Groundwater Extraction
GWP	Groundwater Polishing
GWPS	Groundwater Protection Standard
HUC	Hydrologic Unit Code
IAC	Illinois Administrative Code
ID No.	Identification Number
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
IPRG	Illinois Power Resources Generating, LLC
LCF	Lower Cahokia Formation
LLDPE	Linear Low-density Polyethylene
msl	Mean Sea Level
NAVD88	North American Vertical Datum of 1988
NID	National Inventory of Dams
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
PMP	Potential Migration Pathway
SFWA	State Fish and Wildlife Area
Source Control-GWP	Source Control with Groundwater Polishing
Source Control-GWE	Source Control with Groundwater Extraction
Source Control-Phytoremediation	Source Control with Phytoremediation
UA	Uppermost Aquifer
UCF	Upper Cahokia Formation
US DOT	United States Department of Transportation
US EPA	United States Environmental Protection Agency

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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 Ash Pond (AP) at the Edwards Power Plant (EPP) pursuant to the requirements under IAC Section 845.670. The goal of performing a CAAA is to holistically evaluate the potentially viable corrective actions identified in the Corrective Measures Assessment (CMA) (Appendix C; Ramboll, 2024a) in order to remediate groundwater and achieve compliance with the groundwater protection standards (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 would 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 (NRC, 2013):

- Highly heterogeneous subsurface environments;
- Large source zones;
- Multiple, recalcitrant constituents; and
- Long timeframes over which releases occurred.

Each of these characteristics are common at CCR sites. Surface impoundments are often tens to hundreds of acres in size and many have operated for decades, leading to large source zones and prolonged releases. Furthermore, CCR impoundments are often located in alluvial geologic settings where sands are interbedded with silts and clays. This results in a heterogeneous environment where constituent mass may persist for many years in low-permeability deposits. Finally, the constituents that are most common at CCR sites include metals and inorganics that do not naturally biodegrade. The combination of these factors results in a complex groundwater environment where remediation, even under the best of circumstances, may take many years to achieve GWPSs. It is for these reasons that the United States Environmental Protection Agency (US EPA) refused to specify what is a reasonable *versus* an unreasonable timeframe for groundwater corrective actions at CCR sites, stating that it "was truly unable to establish an outer limit on the necessary timeframes – including even a presumptive outer bound" (US EPA, 2015a).

In this CAAA, all corrective actions that have been evaluated consist of source control with residual plume management. Source control is generally considered to be one of the more effective remedial action approaches. Source control involves removing the hydraulic head from an impoundment (*i.e.*, unwatering and dewatering) and preventing further downward migration of constituents. US EPA has found that "releases from surface impoundments [to groundwater] drop dramatically after closure" (US EPA, 2014). US EPA has also stated that source control is the most effective means of ensuring the timely attainment of remediation objectives (US EPA, 2015b). As a result, the implementation of source control often has a substantial and immediate effect on groundwater quality improvements.

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The specific source control method that is the central component of all the corrective action alternatives evaluated in this CAAA is closure-in-place (CIP) using a consolidate-and-cap approach. Specifically, this approach includes the removal of free liquids, excavation of CCR from the high points and northwestern sections of the AP and consolidation into the southern portion and other low areas of the AP, and the installation of a low-permeability final geomembrane cover system. The excavation and consolidation would decrease the total CCR footprint from approximately 102 acres to 69 acres, a reduction of about 32%, in the final consolidated and closed footprint of the AP. The final cover system consisting of a 40-milliliter (mil) linear low-density polyethylene (LLDPE) geomembrane layer, a geocomposite drainage layer, and 24 inches (in) of protective soil cover would be installed over the closed portion of the AP. These activities are designed to control, minimize, or eliminate, post-closure infiltration of liquids into the impounded CCR. An earthen separation berm would be constructed at the perimeter of the consolidated AP to contain the relocated CCRs. As demonstrated by the groundwater modeling in support of the Closure Alternatives Analysis (CAA) (Gradient, 2022), this source control approach would result in a reduction of the migration of water into the AP by 97% compared to pre-closure conditions. Additionally, source control would result in a reduction of hydraulic flux out of the AP by 94% compared to pre-closure conditions (Ramboll, 2022), demonstrating that source control will control, minimize, or eliminate post-closure releases of leachate.

Three potential corrective actions are evaluated in this CAAA: Source Control with Groundwater Polishing (Source Control-GWP), Source Control with Groundwater Extraction (Source Control-GWE) and Source Control with Phytoremediation (Source Control-Phytoremediation). All alternatives consist of source control and residual plume management, and all alternatives were identified as a viable approach in the CMA (Appendix C; Ramboll, 2024a). The residual plume management portions of these corrective action alternatives include groundwater polishing (GWP), groundwater extraction (GWE), and phytoremediation.

Under the Source Control-GWP alternative, constituent concentrations in groundwater would be actively monitored to ensure the improvement of downgradient groundwater quality resulting from physical and geochemical attenuation mechanisms. Site-specific evaluations demonstrated that GWP is appropriate at the AP because Site conditions are favorable for natural attenuation of inorganic contaminants *via* adsorption (Appendix E; Life Cycle Geo, LLC, 2025). Under the Source Control-GWE alternative, two groundwater extraction trenches (GWE) would be constructed within the footprint of the AP to remove impacted groundwater in the Upper Cahokia Formation (UCF)/Potential Migration Pathway (PMP) and Uppermost Aquifer (UA) and prevent off-Site migration of CCR constituents. One extraction trench (*i.e.,* North Trench) would be 1,700 feet (ft) long and 3 ft wide; the other (*i.e*., South Trench) would be 800 ft long and 3 ft wide. Perforated collection pipes would be installed along the trenches. The trenches would be backfilled with clean granular fill and capped with compacted clay to reduce surface water infiltration. The collection pipes would drain to sumps spaced throughout the trenches to extract groundwater. Extracted groundwater would be collected and sent to a new on-Site lined settling pond constructed within the excavated area of the AP and discharged from either a new or existing outfall managed under the National Pollutant Discharge Elimination System (NPDES) permit for the Site. Under the Source Control-Phytoremediation, two tree segments along the west side of the AP would be planted to prevent the westerly off-Site groundwater migration from the AP. Each tree segment would consist of a grid of tree plantings, and each planting would contain one tree and a well system to passively draw groundwater upward to the root zone and allow phytoremediation to occur. Each tree structure would consist of a borehole advanced into the UA and backfilled with tree cuttings and porous material to allow groundwater from the UA and PMP to rise to the potentiometric surface elevation. A surface liner would be installed to reduce precipitation infiltration to facilitate downward root growth for groundwater intake. As part of all three 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.

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Table S.1 evaluates all corrective actions alternatives (Source Control-GWP, Source Control-GWE, and Source Control-Phytoremediation) 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-GWE. The expected time to meet GWPS in all monitoring wells is expected to be shorter under the Source Control-GWE alternative (approximately 37 years) than under the Source Control-GWP alternative (over 100 years) and the Source Control-Phytoremediation alternative (approximately 48 to 77 years), assuming all corrective action alternatives start after completion of source control. In addition, Source Control-GWE has higher operational reliability over the long-term than the Source Control-Phytoremediation alternative. Thus, Source Control-GWE is the most appropriate corrective action alternative for the AP.

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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	Source Control-Phytoremediation
Magnitude of Reduction of Existing Risks/Be Protective of Human Health and the Environment (Section 2.2.1; IAC Section 845.670(e)(1)(A)/ IAC Section 845.670(d)(1))	Because current conditions do not present a risk to human health or the environment at the AP, there will be no unacceptable risks to human health or the environment for future conditions when the unit has been closed and source control/residual plume management has been implemented. Concentrations of CCR-related constituents will decline over time and, consequently, potential exposures to CCR-related constituents in the environment will also decline. The magnitude of the reduction of existing risks is the same for all three potential corrective action alternatives, and each corrective action alternative is equally protective of human health and the environment.	Because current conditions do not present a risk to human health or the environment at the AP, there will be no unacceptable risks to human health or the environment for future conditions when the unit has been closed and source control/residual plume management has been implemented. Concentrations of CCR-related constituents will decline over time and, consequently, potential exposures to CCR-related constituents in the environment will also decline. The magnitude of the reduction of existing risks is the same for all three potential corrective action alternatives, and each corrective action alternative is equally protective of human health and the environment.	Because current conditions do not present a risk to human health or the environment at the AP, there will be no unacceptable risks to human health or the environment for future conditions when the unit has been closed and source control/residual plume management has been implemented. Concentrations of CCR-related constituents will decline over time and, consequently, potential exposures to CCR-related constituents in the environment will also decline. The magnitude of the reduction of existing risks is the same for all three potential corrective action alternatives, and each corrective action alternative is equally protective of human health and the environment.
Effectiveness of the Remedy in Controlling the Source (Section 2.2.2; IAC Section 845.670(e)(2))			
Extent to Which Containment Practices Will Reduce Further Releases/Control the Sources of Releases to Reduce or Eliminate, to the Maximum Extent Feasible (IAC Section 845.670(e)(2)(A)/ IAC Section 845.670(d)(3))	All three alternatives include source control (which is the primary remedial measure) and residual plume management. Modeling results (see the CAA; Gradient, 2022; Ramboll, 2022) indicate that source control would result in a reduction of hydraulic flux into AP by 97%, and	All three alternatives include source control (which is the primary remedial measure), and residual plume management. Modeling results (see the CAA; Gradient, 2022; Ramboll, 2022) indicate that source control would result in a reduction of hydraulic flux into AP by 97%, and	All three alternatives include source control (which is the primary remedial measure), and residual plume management. Modeling results (see the CAA; Gradient, 2022; Ramboll, 2022) indicate that source control would result in a reduction of hydraulic flux into AP by 97%, and

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
	flux out of the AP by 94% compared to pre-closure conditions. Source control is thus effective at controlling releases. 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. If necessary, remedy optimizations would be implemented under the adaptive site management program.	flux out of the AP by 94% compared to pre-closure conditions. Source control is thus effective at controlling releases. Under the residual plume management for Source Control-GWE alternative, groundwater extraction trenches would remove impacted groundwater and control off-Site migration of impacted groundwater. If necessary, remedy optimizations would be implemented under the adaptive site management program.	flux out of the AP by 94% compared to pre-closure conditions. Source control is thus effective at controlling releases. Under the residual plume management for Source Control-Phytoremediation alternative, tree wells would remove impacted groundwater and control the westerly off-Site migration. If necessary, remedy optimizations would be implemented under the adaptive site management program.
Extent to Which Treatment Technologies May Be Used (IAC Section 845.670(e)(2)(B))	Source Control-GWP would rely on physical and geochemical attenuation processes. If necessary, remedy optimizations would be implemented under the adaptive site management program.	For the Source Control-GWE alternative, it would require construction of a new on-Site settling pond to treat extracted groundwater prior to discharge *via* an NPDES permitted outfall. If necessary, remedy optimizations would be implemented under the adaptive site management program.	For the Source Control-Phytoremediation alternative, trees would passively treat groundwater by uptaking impacted groundwater. If necessary, remedy optimizations would be implemented under the adaptive site management program.
Likelihood of Future Releases of CCR (Section 2.2.3; IAC Section 845.670(e)(1)(B))	All three corrective action alternatives include source control using CIP with a consolidate-and-cap approach. Free liquids would be removed; a new cover system would be installed over the AP, which would include a 40-mil LLDPE geomembrane layer, a geocomposite drainage layer, 24 in of protective soil cover, as well as new stormwater	All three corrective action alternatives include source control using CIP with a consolidate-and-cap approach. Free liquids would be removed; a new cover system would be installed over the AP, which would include a 40-mil LLDPE geomembrane layer, a geocomposite drainage layer, 24 in of protective soil cover, as well as new stormwater	All three corrective action alternatives include source control using CIP with a consolidate-and-cap approach. Free liquids would be removed; a new cover system would be installed over the AP, which would include a 40-mil LLDPE geomembrane layer, a geocomposite drainage layer, 24 in of protective soil cover, as well as new stormwater

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
	control structures. Relative to current conditions, this cover system would provide increased protection against berm and surface erosion, precipitation infiltration, and other adverse effects that could potentially trigger a release of CCR (Appendix B; Ramboll, 2025a). There would be minimal risk of accidental CCR releases occurring post-closure for all of the corrective action alternatives.	control structures. Relative to current conditions, this cover system would provide increased protection against berm and surface erosion, precipitation infiltration, and other adverse effects that could potentially trigger a release of CCR (Appendix B; Ramboll, 2025a). There would be minimal risk of accidental CCR releases occurring post-closure for all of the corrective action alternatives.	control structures. Relative to current conditions, this cover system would provide increased protection against berm and surface erosion, precipitation infiltration, and other adverse effects that could potentially trigger a release of CCR (Appendix B; Ramboll, 2025a). There would be minimal risk of accidental CCR releases occurring post-closure for all 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 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 well network. Post-closure care groundwater monitoring would continue for a minimum of 30 years as required by IAC Section 845.780(c). Additionally, corrective action groundwater monitoring would continue for 3 years after GWPS have been achieved. Based on the adaptive site management approach, remedy optimizations may be implemented to ensure achievement of the GWPSs.	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* an NPDES permitted outfall. Post-closure care groundwater monitoring would continue for a minimum of 30 years as required by IAC Section 845.780(c). Additionally, corrective action groundwater monitoring would continue for 3 years after GWPS have been achieved. Based on the adaptive site management approach, remedy optimizations may be implemented to ensure achievement of the GWPSs.	Long-term O&M efforts required under Source Control-Phytoremediation would include regular inspection and maintenance of the phytoremediation system, including inspections and maintenance of water delivery systems, maintenance to irrigation systems, maintenance and pruning of the trees, mowing and clearing other vegetation around the tress, collection of tree tissue samples, harvesting tree waste, and maintenance of phytoremediation installation components, *etc.* Post-closure care groundwater monitoring would continue for a minimum of 30 years as required by IAC Section 845.780(c). Additionally, corrective action groundwater monitoring would continue for 3 years after GWPS have been achieved. Based on the adaptive site

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
			management approach, remedy optimizations may be implemented to ensure achievement of the GWPSs.
Short-Term Risks to the Community or the Environment During Implementation of Remedy (Section 2.2.5; IAC Section 845.670(e)(1)(D))			
Safety Impacts	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all 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 all corrective action alternatives. These source control risks were evaluated in the CAA (Gradient, 2022). 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.	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all 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 all corrective action alternatives. These source control risks were evaluated in the CAA (Gradient, 2022). Overall, considering worker accidents occurring during residual plume management both on- and off-Site, 0.71 worker injuries and 1.1×10^{-2} worker fatalities would be expected to occur under the Source Control-GWE alternative, which is the highest among the three alternatives. In total, an estimated 0.18 injuries and 2.5×10^{-3} fatalities would be expected to occur among community	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all 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 all corrective action alternatives. These source control risks were evaluated in the CAA (Gradient, 2022). Overall, considering worker accidents occurring during residual plume management both on- and off-Site, 0.50 worker injuries and 7.7×10^{-3} worker fatalities would be expected to occur under the Source Control-Phytoremediation alternative. In total, an estimated 0.13 injuries and 1.8×10^{-3} fatalities would be expected to occur among community members due to off-Site activities

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
		members due to off-Site activities under the Source Control-GWE alternative, which is the highest among the three alternatives.	under the Source Control-Phytoremediation alternative.
Cross-Media Impacts to Air	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all three potential corrective action alternatives. Air impacts occurring during source control would be the same for all three corrective action alternatives. These source control risks were evaluated in the CAA (Gradient, 2022). Cross-media impacts to air can include air pollutants and GHG emissions, which are proportional to the potential impact of each alternative on other emissions from construction vehicles and equipment. Residual plume management for the Source Control-GWP alternative would be expected to have minimal air impacts because it would not require the construction of any engineered systems or structures.	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all three potential corrective action alternatives. Air impacts occurring during source control would be the same for all three corrective action alternatives. These source control risks were evaluated in the CAA (Gradient, 2022). Cross-media impacts to air can include air pollutants and GHG emissions, which are proportional to the potential impact of each alternative on other emissions from construction vehicles and equipment. Residual plume management for the Source Control-GWE alternative would have the greatest air impacts among all three alternatives due to the highest vehicle and equipment miles required for construction, operation, and maintenance of the extraction trench system.	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all three potential corrective action alternatives. Air impacts occurring during source control would be the same for all three corrective action alternatives. These source control risks were evaluated in the CAA (Gradient, 2022). Cross-media impacts to air can include air pollutants and GHG emissions, which are proportional to the potential impact of each alternative on other emissions from construction vehicles and equipment. Residual plume management for the Source Control-Phytoremediation alternative would have greater air impacts than the Source Control-GWP due to the installation of the tree segments.
Cross-Media Impacts to Surface Water and Sediments	Groundwater modeling performed in support of the CAA (Gradient, 2022) predicted that source control (*i.e.*, CIP using a consolidate-and-cap approach) would result in a	Groundwater modeling performed in support of the CAA (Gradient, 2022) predicted that source control (*i.e.*, CIP using a consolidate-and-cap approach) would result in a	Groundwater modeling performed in support of the CAA (Gradient, 2022) predicted that source control (*i.e.*, CIP using a consolidate-and-cap approach) would result in a

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
	reduction of hydraulic flux in and out of the AP by 97% and 94%, respectively, compared to pre-closure conditions (Ramboll, 2022). 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.	reduction of hydraulic flux in and out of the AP by 97% and 94%, respectively, compared to pre-closure conditions (Ramboll, 2022). Under residual plume management for the Source Control-GWE alternative, extracted groundwater would be treated at the on-Site settling pond and discharged *via* an NPDES-permitted outfall. Surface water and sediment impacts associated with residual plume management would be higher than the those of Source Control-GWP alternative due to the construction of the extraction trench system and the settling pond. Erosion and sediment runoff may occur due to the close proximity to the wetlands and surface water bodies during construction activities.	reduction of hydraulic flux in and out of the AP by 97% and 94%, respectively, compared to pre-closure conditions (Ramboll, 2022). Under residual plume management for the Source Control-Phytoremediation alternative, limited construction activities would be required to install the tree well systems, including staging of a work platform and equipment, hollow stem auger drilling for the tree well system, and other installation items. Surface water and sediment impacts associated with residual plume management would be higher than the those of the Source Control-GWP alternative. Erosion and sediment runoff may occur due to the close proximity to the wetlands and surface water bodies during construction activities.
Control of Exposure to Any Residual Contamination During Implementation of the Remedy	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all three 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 activities would be the same for all corrective action alternatives.	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all three 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 activities would be the same for all corrective action alternatives.	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all three 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 activities would be the same for all corrective action alternatives.

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
	Risks to workers arising from potential contact with residual contamination during construction activities associated with residual plume management would be minimal under the Source Control-GWP alternative, which would not involve exposure to any soil or groundwater waste streams.	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 under the Source Control-GWP and Source Control-Phytoremediation alternatives; 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.	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-Phytoremediation alternative than under the Source Control-GWP alternative, but lower than Source Control-GWE alternative; Source Control-Phytoremediation would only involve disposal of spoils generated during construction, but not involve the management of impacted groundwater.
Other Identified Impacts	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, impacts during source control would be the same for all of the corrective action alternatives (see the CAA; Gradient, 2022). The energy demands of construction equipment and vehicles associated with residual plume management under the Source Control-GWP would be minimal because this alternative would not require any significant construction activity.	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, impacts during source control would be the same for all of the corrective action alternatives (see the CAA; Gradient, 2022). The energy demands of construction equipment and vehicles associated with residual plume management would be greatest under the Source Control/GWE alternative due to the activities that would be required to construct the GWE system.	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, impacts during source control would be the same for all of the corrective action alternatives (see the CAA; Gradient, 2022). The energy demands of construction equipment and vehicles associated with residual plume management under the Source Control-Phytoremediation would be less compared to the Source Control-GWE alternative, but greater than the Source Control-GWP alternative.

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
	Similarly, traffic and noise impacts associated with residual plume management would be expected to be lower for the Source Control-GWP alternative compared to Source Control-GWE and Source Control-Phytoremediation since no significant construction activities would be required. There would be no impacts to natural resources and habitats under the Source Control-GWP alternative because no additional construction activities would occur after implementation of the source control.	Similarly, traffic and noise impacts associated with residual plume management would 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 system and settling pond under the Source Control-GWE alternative. Under the Source Control-GWE alternative, there would be some negative impacts to natural resources and habitats, including disturbances of some existing habitats atop portions of the construction areas and potential impacts to aquatic and wetland species in the discontinuous wetland areas in the immediate vicinity of the AP due to potential sediment runoff during construction.	Similarly, traffic and noise impacts associated with residual plume management would be expected to be higher under the Source Control-Phytoremediation alternative than the Source Control-GWP alternative, due to the construction activities related to installation of tree segments under the Source Control-Phytoremediation alternative. Under the Source Control-Phytoremediation alternative, there would be some negative impacts to natural resources and habitats, including disturbances of some existing habitats atop portions of the construction areas and potential impacts to aquatic and wetland species in the discontinuous wetland areas in the immediate vicinity of the AP due to potential sediment runoff during construction.
Time Until Groundwater Protection Standards Are Achieved/Attain the Groundwater Protection Standards Specified in Section 845.600 (Section 2.2.6; IAC Section 845.670(e)(1)(E); IAC Section 845.670(d)(2))	Groundwater modeling performed in support of the CAA (Gradient, 2022) predicted that source control (*i.e.*, CIP using a consolidate-and-cap approach) would result in a reduction of hydraulic flux in and out of the AP by 97% and 94%, respectively, compared to pre-closure conditions (Ramboll, 2022). Additional modeling was conducted to evaluate future groundwater	Groundwater modeling performed in support of the CAA (Gradient, 2022) predicted that source control (*i.e.*, CIP using a consolidate-and-cap approach) would result in a reduction of hydraulic flux in and out of the AP by 97% and 94%, respectively, compared to pre-closure conditions (Ramboll, 2022). Additional modeling was conducted to evaluate future groundwater	Groundwater modeling performed in support of the CAA (Gradient, 2022) predicted that source control (*i.e.*, CIP using a consolidate-and-cap approach) would result in a reduction of hydraulic flux in and out of the AP by 97% and 94%, respectively, compared to pre-closure conditions (Ramboll, 2022). Additional modeling was conducted to evaluate future groundwater

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
	quality in the vicinity of the AP under each of the proposed corrective action alternatives. The results indicate that groundwater would attain the GWPSs for all constituents identified as having potential exceedances in the monitoring well network within over 100 years under the Source Control-GWP alternative (Ramboll, 2025b).	quality in the vicinity of the AP under each of the proposed corrective action alternatives. The results indicate that groundwater would attain the GWPSs for all constituents identified as having potential exceedances in the monitoring well network within approximately 37 years after source control has been completed under the Source Control-GWE alternative. Current modeling indicates that an additional 13 years of system operation may be required to prevent concentrations from rebounding above the GWPSs, thus the total corrective action operation and maintenance (O&M) period would likely be 50 years for the Source Control-GWE alternative (Ramboll, 2025b). However, additional modeling would be performed, and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to determine the exact required duration of additional system operation.	quality in the vicinity of the AP under each of the proposed corrective action alternatives. The results indicate that groundwater would attain the GWPSs for all constituents identified as having potential exceedances in the monitoring well network within approximately 48 to 77 years after source control has been completed under the Source Control-Phytoremediation alternative. Current modeling indicates that an additional 22 to 73 years of system operation may be required to prevent concentrations from rebounding above the GWPSs, thus the total corrective action O&M period would likely be 70 to 150 years for the Source Control-Phytoremediation alternative (Ramboll, 2025b). However, additional modeling would be performed, and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to determine the exact required duration of additional system operation.
Potential for Exposure of Humans and Environmental Receptors to Remaining Wastes, Considering the Potential Threat to Human Health and the Environment Associated with Excavation, Transportation,	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives, thus, potential exposures to CCR remaining in AP	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives, thus, potential exposures to CCR remaining in AP	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives, thus, potential exposures to CCR remaining in AP

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
Re-disposal, Containment, or Changes in Groundwater Flow (Section 2.2.7; IAC Section 845.670(e)(1)(F))	would be the same under all alternatives. Once source control activities have been completed, this corrective action alternative is expected to limit exposure of humans and environmental receptors to CCR remaining in AP. Furthermore, as a result of the source control, there would be minimal risks of CCR releases post-closure. The Source Control-GWP alternative would not involve exposure to the soil or groundwater waste streams and, thus, there is no potential for exposure of humans and environmental receptors to wastes.	would be the same under all alternatives. Once source control activities have been completed, this corrective action alternative is expected to limit exposure of humans and environmental receptors to CCR remaining in AP. Furthermore, as a result of the source control, there would be minimal risks of CCR releases post-closure. Potential risks to workers that come in contact with residual contamination of CCR-related constituents during groundwater extraction and treatment, as well as on-Site disposal of construction spoils would be managed through the use of rigorous safety protocols and personal protective equipment. Some changes in groundwater flow (*i.e.*, potential controlled discharge into Illinois River) may occur under the Source Control-GWE alternative, due to the operation of the GWE system. Hydrogeological changes would also be expected under this alternative, such as lowering groundwater table in the vicinity of the extraction trenches, altering flow patterns in the UA, and causing changes in hydraulic gradients. However, changes to groundwater	would be the same under all alternatives. Once source control activities have been completed, this corrective action alternative is expected to limit exposure of humans and environmental receptors to CCR remaining in AP. Furthermore, as a result of the source control, there would be minimal risks of CCR releases post-closure. Potential risks to workers in contact with residual contamination during disposal of spoils generated from tree well/boring installation would be managed through the use of rigorous safety protocols and personal protective equipment. Local hydraulic gradients and groundwater flow direction may change under the residual plume managed for the Source Control-Phytoremediation alternative, because tree installations west of the AP would uptake groundwater in the UA/PMP and work as pumps. 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.

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
		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.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, long-term reliability during source control would be the same for all corrective action alternatives (see the CAA; Gradient, 2022). Residual plume management under the Source Control-GWP alternative would be reliable because it is a proven process that would rely on physical and geochemical attenuation processes and active monitoring. Site specific evaluations have shown that chemical attenuation is feasible, and remobilization is unlikely to impact the time to achieve GWPSs as groundwater returns to background conditions (Appendix E; Life Cycle Geo, LLC, 2025). If necessary, remedy optimizations would be implemented under the adaptive site management program.	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, long-term reliability during source control would be the same for all corrective action alternatives (see the CAA; Gradient, 2022). Residual plume management under the Source Control-GWE alternative would be reliable, as long as the extraction trench and pumps are maintained and operated appropriately, because it is a proven remedy that has been implemented at many sites. Routine and non-routine maintenance of the GWE 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.	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, long-term reliability during source control would be the same for all corrective action alternatives (see the CAA; Gradient, 2022). Residual plume management under the Source Control-Phytoremediation alternative would be reliable provided it is constructed in accordance with standard design and specifications. The effectiveness of the phytoremediation installations would depend on the trees' ability to grow under Site conditions. Significant variability exists in the time needed to reach GWPSs (48 to 77 years) and the total remedy O&M duration (70 to 150 years) that would potentially be required to prevent concentrations from rebounding above the GWPSs, which suggests the uncertainty in the system's overall operational reliability. In addition, the lack of large-scale case studies for boron or other CCR-

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
			constituents adds extra uncertainty to its long-term reliability (Appendix B; Ramboll, 2025a). As a combination of mechanical and biological systems, routine and ongoing maintenance would be required to ensure reliable operation over the long-term.
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 the alternative 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 and treatment system are maintained appropriately. Adaptive site management strategies would be used to implement remedy optimizations, if necessary, to ensure that remedial goals are achieved.	Tree replacement is expected during the time horizon of the residual plume management under the Source Control-Phytoremediation alternative. Depending on the performance and lifespan of the trees, it is estimated that trees may be replaced one to five times, assuming a 30- to 50-year tree lifespan. An annual tree replacement rate is estimated to be 10% (approximately 60 trees) during the first 5 years, and then 5% afterwards. Ongoing maintenance and inspections would be required to monitor tree performance.
Degree of Difficulty Associated with Constructing the Remedy (Section 2.3.1; IAC Section 845.670 (e)(3)(A))	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, construction difficulties would be the same for all corrective action alternatives. Difficulties associated with implementing CIP using a consolidate-and-cap approach were	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, construction difficulties would be the same for all corrective action alternatives. Difficulties associated with implementing CIP using a consolidate-and-cap approach were	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, construction difficulties would be the same for all corrective action alternatives. Difficulties associated with implementing CIP using a consolidate-and-cap approach were

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
	evaluated in the CAA (see the CAA; Gradient, 2022). 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.	evaluated in the CAA (see the CAA; Gradient, 2022). Residual plume management under the Source Control-GWE would involve the construction of two extraction trenches, a settling pond, and a conveyance system to extract and treat impacted groundwater. It may have the following challenges during construction of the extraction trenches (Appendix B; Ramboll, 2025): ▪ Shallow groundwater trenches are commonly constructed at similar depths using specialized and conventional equipment. ▪ Constructing the South Trench would necessitate significant modifications to the AP embankment to create a suitable working platform for construction equipment. This would require the use of excavation shoring and/or other approach to ensure dike stability during construction. Geotechnical design involving three-dimensional analysis would be utilized for the construction. The modifications would likely require a geotechnical monitoring program to assess the	evaluated in the CAA (see the CAA; Gradient, 2022). Residual plume management under the Source Control-Phytoremediation would utilize a tree well system to uptake and control impacted groundwater. It may have the following challenges during installation of the tree segments (Appendix B; Ramboll, 2025): ▪ This approach would require a hollow stem auger drill rig for installing the tree well systems, along with general construction equipment to install a working pad for the southern tree segment. Local Site geology is not expected to pose significant challenges during any earthwork or tree well borings. ▪ Constructing the South Trench would necessitate significant modifications to the AP embankment to create a suitable working platform for construction equipment. This would require the use of excavation shoring and/or other approach to ensure dike stability during construction. Geotechnical design involving three-dimensional analysis

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
		embankment for any signs of distress during construction. If distress is detected, construction may need to be temporarily paused to evaluate and address the issue. ▪ High-voltage power lines crossing the North Trench alignment may need to be raised to ensure a safe working distance from construction equipment. ▪ Additionally, naturally occurring methane at the Site necessitates a methane monitoring and response plan, which may lead to periodic safety shutdowns during construction to allow methane levels to decrease to safe levels.	would be utilized for the construction. The modifications would likely require a geotechnical monitoring program to assess the embankment for any signs of distress during construction. If distress is detected, construction may need to be temporarily paused to evaluate and address the issue. ▪ High-voltage power lines crossing the North Trench alignment may need to be raised to ensure a safe working distance from construction equipment. ▪ Additionally, naturally occurring methane at the Site necessitates a methane monitoring and response plan, which may lead to periodic safety shutdowns during construction to allow methane levels to decrease to safe levels.
Expected Operational Reliability of the Remedy (Section 2.3.2; IAC Section 845.670 (e)(3)(B))	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, the operational reliability of the remedy would be the same for all corrective action alternatives. The reliability	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, the operational reliability of the remedy would be the same for all corrective action alternatives. The reliability	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, the operational reliability of the remedy would be the same for all corrective action alternatives. The reliability

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
	associated with implementing CIP using a consolidate-and-cap approach was evaluated in the CAA (see the CAA; Gradient, 2022). 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.	associated with implementing CIP using a consolidate-and-cap approach was evaluated in the CAA (see the CAA; Gradient, 2022). Residual plume management under the Source Control-GWE alternative would have high operational reliability because it is an established technology, as long as the extraction trench and treatment system are maintained and operated appropriately. Adaptive site management strategies would be used to implement remedy optimizations, if necessary.	associated with implementing CIP using a consolidate-and-cap approach was evaluated in the CAA (see the CAA; Gradient, 2022). Residual plume management under the Source Control-Phytoremediation alternative would also have high operational reliability, as long as the phytoremediation installations are constructed in accordance with the design and specifications. The effectiveness of the phytoremediation installations would depend on the trees' ability to grow under Site conditions. Significant variability exists in the time needed to reach GWPSs (48 to 77 years) and the total remedy O&M duration (70 to 150 years) that would potentially be required to prevent concentrations from rebounding above the GWPSs, which suggests the uncertainty in the system's overall operational reliability. In addition, the lack of large-scale case studies for boron or other CCR-constituents adds extra uncertainty to its long-term reliability (Appendix B; Ramboll, 2025a). As a combination of mechanical and biological systems, routine and ongoing maintenance would be required to ensure reliable operation over the long-term.

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
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 consolidate-and-cap approach was evaluated in the CAA (Gradient, 2022). Residual plume management for Source Control-GWP would require regulatory approval, but no additional permits would be needed.	Specific permits and approvals associated with source control using a consolidate-and-cap approach was evaluated in the CAA (Gradient, 2022). Residual plume management for the Source Control-GWE alternative would require regulatory approval. 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, placement of excavated spoils beneath the AP final cover system *via* an amendment to the AP Closure Plan and Construction Permit Application, and operation would be required. An Illinois Department of Natural Resources (IDNR) Dam Safety modification permit would be obtained for modifications of the embankment.	Specific permits and approvals associated with source control using a consolidate-and-cap approach was evaluated in the CAA (Gradient, 2022). Residual plume management for the Source Control-Phytoremediation alternative would require regulatory approval. A general stormwater permit through IEPA would be required for construction activities, including construction stormwater controls and other BMPs such as installation of silt fences and other measures. An IDNR Dam Safety Modification Permit would be required for modification of the embankment. These permits and plans typically take 18-24 months to obtain, although some may already be obtained during the AP final closure.
Availability of Necessary Equipment and Specialists (Section 2.3.4; IAC Section 845.670 (e)(3)(D))	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, equipment and specialist needs would be the same for all corrective action alternatives. An assessment of necessary	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, equipment and specialist needs would be the same for all corrective action alternatives. An assessment of necessary	Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, equipment and specialist needs would be the same for all corrective action alternatives. An assessment of necessary

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
	equipment and specialists associated with implementing CIP using a consolidate-and-cap approach was evaluated in the CAA (see the CAA; Gradient, 2022). Residual plume management under the Source Control-GWP alternative would 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.	equipment and specialists associated with implementing CIP using a consolidate-and-cap approach was evaluated in the CAA (see the CAA; Gradient, 2022). Residual plume management under the Source Control-GWE alternative would require specialists to manage the GWE system throughout its construction and operational period. 1. Construction of the groundwater extraction system (*i.e.*, the trenches and settling pond) on the Site would require a specialized contractor, and specialized and often custom-built equipment including one-pass construction equipment. Additionally, geotechnical specialists would be needed to design the working platform and monitor the AP embankment for signs of distress during the trench installation. The availability of contractors with such equipment may be limited. Specialists including design engineers, construction managers and contractor staff experienced in trench construction and similar geologic environments would be required as well. In addition, specialists	equipment and specialists associated with implementing CIP using a consolidate-and-cap approach was evaluated in the CAA (see the CAA; Gradient, 2022). Residual plume management under the Source Control-Phytoremediation alternative would require specialists to construct and manage the phytoremediation installations throughout its construction and operational period. 1. Specialists in phytoremediation design would be needed during the design and construction of the remedy. The construction of the tree well systems would require a widely available hollow stem auger drill rig, and the drilling crew would not need specialized skills beyond typical capabilities. Additionally, geotechnical specialists would be required for the design and construction of the working platform and to monitor the embankment for signs of distress during construction. These types of equipment and specialists have been utilized in the past for other similar types of

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
		and equipment may have backlogs from similar specialty ground improvement projects in the area. 2. 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 Source Control-GWP alternative, these activities are already being conducted as part of routine groundwater monitoring.	phytoremediation design and construction projects. 2. 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 Source Control-GWP alternative, these activities are already being conducted as part of routine groundwater monitoring.
Available Capacity and Location of Needed Treatment, Storage, and Disposal Services/Comply with Standards for Management of Wastes as Specified in Section 845.680(d) (Section 2.3.5; IAC Section 845.670 (e)(3)(D)/ IAC section 845.670(d)(5))	No treatment, storage, or disposal services would be required with the residual plume management under the Source Control-GWP alternative, as GWP would not generate any significant volume of waste or wastewater.	Residual plume management for the Source Control-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 AP final cover system. Extracted groundwater would be treated at an on-Site settling pond. Discharge from the settling pond would be conveyed to an NPDES permitted outfall.	Residual plume management for the Source Control-GWE alternative would generate spoils during the tree well/boring installations, which would be disposed of on-Site in the AP during closure construction. Organic waste would be produced annually throughout the phytoremediation process, including replaced trees and seasonal debris. Periodic sampling of the waste would determine whether it can be chipped for on-Site mulch/compost or may need off-Site disposal. Waste Management Peoria City, a nearby landfill 18 miles away, would handle off-Site disposal, if necessary.

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
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.*, CIP using a consolidate-and-cap approach) with residual plume management would cause groundwater concentrations to decline over time under all of the corrective action alternatives, as suggested by the groundwater modeling (Ramboll, 2025b). A public meeting will be held on April 30, 2025, pursuant to requirements under IAC Section 845.710(e). Questions raised by attendees will be answered at the meeting; subsequently, a written summary of all questions and responses will be made available to interested parties.	The combination of source control (*i.e.*, CIP using a consolidate-and-cap approach) with residual plume management would cause groundwater concentrations to decline over time under all of the corrective action alternatives, as suggested by the groundwater modeling (Ramboll, 2025b). A public meeting will be held on April 30, 2025, pursuant to requirements under IAC Section 845.710(e). Questions raised by attendees will be answered at the meeting; subsequently, a written summary of all questions and responses will be made available to interested parties.	The combination of source control (*i.e.*, CIP using a consolidate-and-cap approach) with residual plume management would cause groundwater concentrations to decline over time under all of the corrective action alternatives, as suggested by the groundwater modeling (Ramboll, 2025b). A public meeting will be held on April 30, 2025, pursuant to requirements under IAC Section 845.710(e). Questions raised by attendees will be answered at the meeting; subsequently, a written summary of all questions and responses will be made available to interested parties.
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 AP. All potential corrective action alternatives would have source control with residual plume management efforts. The source control would include a consolidate-and-cap approach with free liquids removal to limit the infiltration of precipitation into the impounded CCR. 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	There have been no known releases of CCR at the AP. All potential corrective action alternatives would have source control with residual plume management efforts. The source control would include a consolidate-and-cap approach with free liquids removal to limit the infiltration of precipitation into the impounded CCR. Additionally, residual plume management under the Source Control-GWE alternative would rely on the GWE trenches to reduce or prevent migration of impacted groundwater off-Site.	There have been no known releases of CCR at the AP. All potential corrective action alternatives would have source control with residual plume management efforts. The source control would include a consolidate-and-cap approach with free liquids removal to limit the infiltration of precipitation into the impounded CCR. Additionally, residual plume management under the Source Control-Phytoremediation alternative would remove the CCR-constituents in groundwater and control off-Site migration through

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Evaluation Factor (Report Section; Part 845 Section)	Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
	residual concentrations of CCR-related constituents in groundwater. Attenuation via sorption onto mineral surfaces should remain stable under post-closure conditions, and remobilization is unlikely to impact the time to achieve GWPS (Appendix E; Life Cycle Geo, LLC, 2025). No ecosystems would be disturbed because no construction activities are expected under the Source Control-GWP alternative.	The construction activities would likely result in some negative impacts to the ecosystem, including disturbances of some existing habitats near the construction areas. Short-term impacts could also occur to sensitive aquatic and wetland species in the discontinuous wetland areas in the immediate vicinity of the AP.	the phytoremediation installations (*i.e.*, approximately 550 tree well systems). The construction activities would likely result in some negative impacts to the ecosystem, including disturbances of some existing habitats near the construction areas. Short-term impacts could also occur to sensitive aquatic and wetland species in the discontinuous wetland areas in the immediate vicinity of the AP.

Notes:

AP = Ash Pond; BMP = Best Management Practice; CAA = Closure Alternatives Analysis; CCR = Coal Combustion Residual; CIP = Closure-in-Place; GHG = Greenhouse Gas; GWE = Groundwater Extraction Trench; GWP = Groundwater Polishing; GWPS = Groundwater Protection Standard; LLDPE = Linear Low Density Polyethylene; IAC = Illinois Administrative Code; IEPA = Illinois Environmental Protection Agency; NPDES = National Pollutant Discharge Elimination System; PMP = Potential Migration Pathway; Source Control-GWE = Source Control with Groundwater Extraction Trench; Source Control-GWP = Source Control with Groundwater Polishing; Source Control-Phytoremediation = Source Control with Phytoremediation; UA = Uppermost Aquifer.

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1 Introduction

1.1 Site Description and History

1.1.1 Site Location and History

Edwards Power Plant (EPP) is an electric power generating facility owned by Illinois Power Resources Generating, LLC (IPRG). The facility is located between Mapleton and Bartonville in Peoria County and is situated along the Illinois River (Ramboll, 2021). The facility began operating in 1960 and was retired in 2022 (Ramboll, 2021; Vistra Corp, 2021).

1.1.2 CCR Impoundment

A part of its operations, Edwards Power Plant produced and stored CCRs. The Edwards Ash Pond ("the Ash Pond," AP) (Vistra identification number [ID No.] CCR Unit 301, Illinois Environmental Protection Agency [IEPA] ID No. W1438050005-01, and National Inventory of Dams [NID] ID No. IL50710), which is the only CCR-containing impoundment at this Site, is the subject of this report.

The AP (Figure 1.1) is a 102-acre[1] unlined surface impoundment that was constructed in 1960 for the management of sluiced bottom ash, fly ash, and other non-CCR wastes generated historically by the facility (Ramboll, 2025c; AECOM, 2016; Ramboll, 2021). The AP has been in continuous operation since 1960 and after retirement in 2022, the AP no longer receives sluice ash (Gradient, 2022).

There are three sub-basins that are hydraulically connected within the AP: the Process Water Pond (the "North Cell"), the Fly Ash Pond, and the Clarification Pond (the "South Cell"; AECOM, 2016; Figure 1.1). The Process Water Pond and the Fly Ash Pond received CCR and other waste streams from the facility. Serpentine channels located within the Fly Ash Pond were used to settle out the majority of the CCR prior to discharging decanted water into the Clarification Pond, which serves as the settling basin for the unit. The Clarification Pond discharged to the Illinois River *via* a National Pollutant Discharge Elimination System (NPDES)-permitted outfall (AECOM, 2016; Ramboll, 2021).

In 2004, a rail loop was constructed to the south of the Clarification Pond which included installation of embankments for the rail loop with ash, as a permissible beneficial use. The footprint of the AP was reduced at that time, and the CCR material located south of the rail loop was capped with soil (AECOM, 2016).

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[1] Previous reports have noted that the pond was approximately 91 acres (AECOM, 2016; Ramboll, 2021), although the official surveyed size is 102 acres (Ramboll, 2025c).

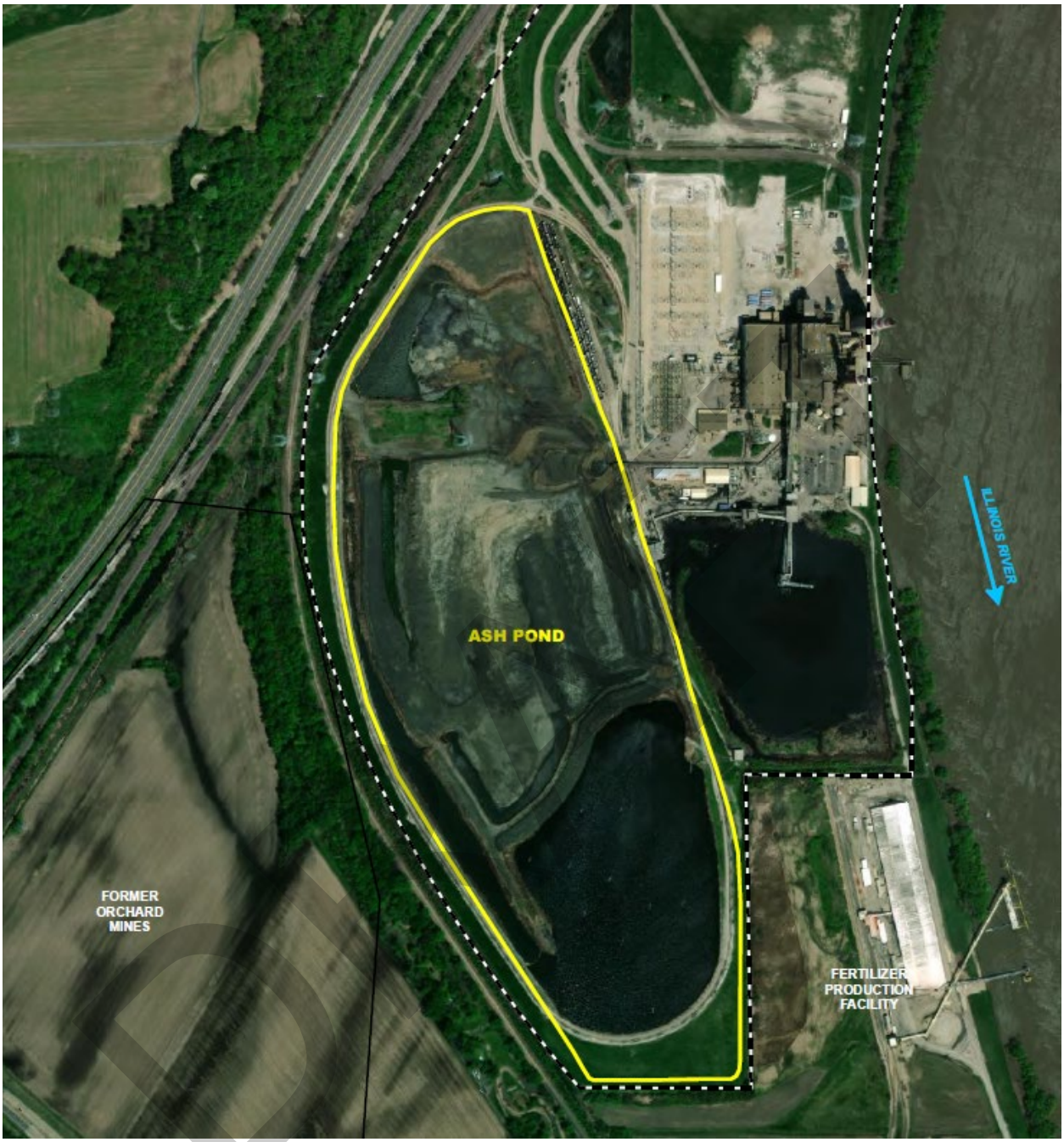

Figure 1.1 Site Location Map. Source: Ramboll (2021).

1.1.3 Surface Water Hydrology

The Clarification Pond associated with the AP (Figure 1.1) discharged decanted water to the Illinois River *via* an NPDES-permitted outfall. The Illinois River is located approximately more than 800 ft east of the outer border of the AP within the Pekin Lake-Illinois River sub watershed (Hydrologic Unit Code [HUC] 071300030304; Ramboll, 2021). The segment of the Illinois River adjacent to the Site (Section IL_D-05) is listed on the 2018 Illinois Section 303(d) List as being impaired for fish consumption due to mercury and

polychlorinated biphenyls (IEPA, 2016, 2019). Two lakes, Pekin Lake and Worley Lake, are located about 0.5 miles east of the AP on the opposite side of the Illinois River (Ramboll, 2021).

1.1.4 Hydrogeology

The geology underlying the Site in the vicinity of the AP consists of several distinct hydrostratigraphic units (Ramboll, 2021):

- **Upper Cahokia Formation (UCF)/Potential Migration Pathway (PMP):** Low permeability clays and silts consist of the Upper Cahokia Formation. This unit also includes discontinuous lenses of sand, sandy clay to clayey sand, and sandy silt. The saturated and unconfined sandy lenses within the UCF have been identified as PMP. The thickness of the UCF ranges between 5 and 40 ft in the vicinity of the AP.
- **Uppermost Aquifer (UA):** The UA contains thin layers (generally less than 4 ft) of moderately permeable sand, silty sand, and clayey gravel within the Lower Cahokia Formation (LCF) and saturated portions of the UCF. More permeable materials are generally located in the southern portion of the Site. The bottom of the UA (*i.e.*, LCF) overlies the shale bedrock.
- **Bedrock Confining Unit (BCU):** This confining layer consists of thick and low permeability shales and siltstones of the Carbondale and Modesto Formations.

Groundwater within the UA flows predominantly to the west in the central portion of the AP towards a former channel of the Illinois River, and to the south/southeast in the southern end of the AP. There is a minor component in the northernmost portion of the AP where groundwater in the UA and PMP flows to the north and northwest (Ramboll, 2021). Groundwater flow occurs primarily in the more permeable zones within the LCF in the UA (Ramboll, 2021).

During groundwater interaction with surface water, CCR-related constituents may partition between sediments and the surface water column. It should be noted that many CCR-related constituents occur naturally in sediments and surface water (and can also arise from other industrial sources). As a result, their presence in the sediments and/or surface water of the Illinois River does not necessarily signify contributions from the AP. There is little seasonal variation in groundwater flow direction in the UA regardless of surface water levels of the Illinois River (Ramboll, 2021).

1.1.5 Site Vicinity

The Edwards Power Plant Site is bordered by a salt processing facility to the north, a railroad right-of-way and Highway 42 to the west, agricultural fields to the south, and the Illinois River and a fertilizer production facility to the east (Ramboll, 2021; Figure 1.1). Coal mining operations occurred in the vicinity of the Site from 1890 until 1940. The mine located closest to the AP was the Orchard Mine (Mine ID No. 828), which operated from 1890 until 1909 and extended laterally (within uncertainty bounds) to the western edge of the AP. The Petri Mine (Mine ID No. 6673) operated from 1919 until 1933 and was located approximately 0.1 miles northwest of the AP. The Hollis Mine (Mine ID No. 3021) operated from 1933 until 1940 and was located approximately 0.6 miles north of the AP (Ramboll, 2021).

Although the area surrounding the Site is predominantly agricultural and industrial, there are a few scenic and recreational areas located within a few miles of the Site. These include the Illinois River, Worley Lake, the Pekin Lake State Fish and Wildlife Area (SFWA), and the Powerton Lake SFWA. Pekin Lake SFWA is located east of the Site on the opposite bank of the Illinois River. Powerton Lake SFWA is located

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approximately 3 miles downstream of the Site on the opposite bank of the Illinois River. There are some small, discontinuous wetland areas in the immediate vicinity of the AP (US FWS, 2021). Based on a review of the Illinois Department of Natural Resources (IDNR) Historic Preservation Division database and the Illinois State Archaeological Survey database, there are no historic sites located within 1,000 meters of the AP (Ramboll, 2021).

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 groundwater protection standard (GWPSs) have been identified. Because exceedances[2] of GWPSs in groundwater associated with the AP have been identified for boron and sulfate (Appendix D; Ramboll, 2024a), this report presents a CAAA for the AP 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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[2] 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, 2022). 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 AP, a CAAA is required because groundwater monitoring associated with the AP identified exceedances of the GWPSs. Groundwater monitoring was conducted in accordance with the proposed groundwater monitoring plan between 2015 and 2023 (Appendix D; Ramboll, 2024b). The groundwater samples collected from groundwater compliance monitoring wells were used to evaluate compliance with the groundwater quality standards listed in IAC Section 845.600(a). As of the date of this report, boron and sulfate were identified as constituents/parameters with exceedances of their corresponding GWPSs (Appendix D; Ramboll, 2024b).

Three potentially viable corrective actions for the AP were selected in the CMA for further consideration in this CAAA. Each of these corrective action alternatives include source control (closure-in-place [CIP] using a consolidate-and-cap approach). The corrective actions alternatives that are considered in this CAAA are Source Control with Groundwater Polishing (Source Control-GWP), Source Control with Groundwater Extraction (Source Control-GWE), and Source Control with Phytoremediation (Source Control-Phytoremediation). The corrective actions are described below in Section 2.1.

2.1 Corrective Action Alternative Descriptions

For all three corrective actions evaluated in this CAAA, source control is the primary remedy. US EPA has stated that source control is the most effective means of ensuring the timely attainment of remediation objectives (US EPA, 2015b). The source control for the AP consists of CIP using a consolidate-and-cap approach. Specific elements of this approach include:

- Free liquids would be removed from the AP *via* unwatering and dewatering, as described above, and managed in accordance with the NPDES permit for the facility (845.750(b)(1) and

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845.750(b)(2)). The methods by which free liquids will be removed may include drilled sumps, engineered trenches, and/or horizontal wells. Collected flows would be pumped to a temporary storage system and discharged to an outfall in accordance with the NPDES permit for the Site;

- Excavation of approximately 1.13 million cubic yards of CCRs from the high points and northwestern area of the AP and consolidation into a 69-acre CIP area in the south end and other low areas of the AP. All CCR and up to 1 ft of underlying soils would be removed from the designated closure-by-removal (CBR) area;
- Removal of approximately 210,000 cubic yards of soils and other existing structures from the rail loop embankment located on the perimeter berm of the AP for placement into the CIP footprint;
- Construction of a new earthen containment berm to separate the 33-acre excavated portion of the AP from the consolidate-and-cap portion of the AP;
- Contouring and grading of the northwestern portion to manage stormwater;
- Installation of stormwater control infrastructure. Stormwater would be managed using an existing drainage ditch on the western side of the CCR surface impoundment, which discharges to the Illinois River *via* the EPP's NPDES permit; and
- Construction of a final cover system consisting of a 40-mil linear low-density polyethylene (LLDPE) geomembrane layer, a geocomposite drainage layer, and 24 in of protective soil cover suitable for supporting vegetative growth. A possible future solar redevelopment has been planned atop the cover system.

These source control activities include removal of free liquids, excavation and consolidation of CCR , and a reduction of the final impoundment footprint from 102 acres to approximately 69 acres (IngenAE, LLC, 2022a). A low-permeability final geomembrane cover system consisting of a 40-mil linear low-density polyethylene (LLDPE) geomembrane layer, a geocomposite drainage layer, and 24 in of protective soil cover would be installed over the closed portion of the AP. These measures (installation of a geosynthetic cap and consolidation of CCR) will control 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. As demonstrated by the groundwater modeling in support of the Closure Alternatives Analysis (CAA; Gradient, 2022), this source control approach would result in a reduction of the migration of water into the AP by 97% compared to pre-closure conditions. Additionally, source control would result in a reduction of hydraulic flux out of the AP by 94% compared to pre-closure conditions. Due to the reduction in the hydraulic flux out of the AP, the mass flux out of the AP will also be controlled or minimized as much as feasible as a result of CIP (Ramboll, 2022), demonstrating that source control will control, minimize, or eliminate post-closure release of leachate.

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

- **Alternative 1:** Source Control with Groundwater Polishing (Source Control-GWP);
- **Alternative 2:** Source Control with Groundwater Extraction (Source Control-GWE);
- **Alternative 3:** Source Control with Phytoremediation (Source Control-Phytoremediation).

For all three potential corrective action alternatives, adaptive site management strategies would be integrated into residual plume management. This approach ensures the timely incorporation of new Site information throughout the corrective action process in order to optimize the remediation and expedite

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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 (CIP using a consolidate-and-cap approach) combined with residual plume management based on natural physical and geochemical processes that would reduce groundwater concentrations downgradient of the AP. 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; Life Cycle Geo, LLC, 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, 2015).

Components of residual plume management for the Source Control-GWP alternative include:

- Groundwater concentrations would be reduced in the downgradient plume as a result of physical and geochemical attenuation processes. Site-specific evaluations have shown that GWP would reduce the groundwater concentrations and mobility of inorganic contaminants, especially after the implementation of source control. 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; Life Cycle Geo, LLC, 2025).
- Corrective action groundwater monitoring using a groundwater monitoring system designed in accordance IAC Section 845.680(c), which would be installed within the plume that lies beyond the facility boundary.
- Adaptive site management strategies for this alternative would include geochemical modeling. Groundwater monitoring results would be evaluated and compared to the model-predicted concentrations. In situations in which observed groundwater concentrations deviate significantly from modeled conditions, alternative methods or techniques would be evaluated, and if viable, incorporated as per IAC Section 845.680(b).
- Corrective action confirmation groundwater sampling would be performed for 3 years after GWPSs have been achieved.
- 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).

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The overall corrective action implementation duration for this alternative is over 100 years after completion of source control has been completed (Appendix B; Ramboll, 2025a), including:

- Over 100 years of corrective action monitoring (*i.e.*, time to meet GWPSs),
- At least 3 years (36 months) of corrective action confirmation monitoring,[3] and
- Approximately 6 months associated with post-closure reporting.

Although source control (*i.e.*, closure-in-place [CIP]) is a primary component of the corrective action, the labor time, equipment usage, and mileage linked to source control were previously estimated in the Closure Alternative Analysis (CAA) (Gradient, 2022) and are not repeated in this analysis. There is no labor and mileage incurred with the residual plume management under the Source Control and GWP alternative, because no construction would be required under this alternative. Mileage and labor associated with corrective action monitoring was not included in this analysis (Appendix B; Ramboll, 2025a).

2.1.2 Alternative 2: Source Control-GWE

The second corrective action alternative is Source Control-GWE. This remedy includes source control (*i.e.*, CIP using a consolidate-and-cap approach) with groundwater extraction trenches as the residual plume management approach. The residual plume management approach would include the construction of two extraction trenches, the North and the South Trenches, to capture impacted groundwater from the UCF/PMP and UA and control westerly off-Site migration of impacted groundwater. The North Trench would be located along the inboard CCR excavation slope. It would be 1,700 ft long, 3 ft wide, and would extend to an elevation of 411 to 416 ft above mean sea level (msl) or about 24 to 29 ft below ground surface (bgs).[4] The South Trench would be located on the crest of the existing embankment after removal of the rail line, ballast, and CCR. It would be 800 ft long, 3 ft wide, and would extend to an elevation of 401.5 ft above msl or about 39 ft below bgs. Perforated collection pipes would be installed along the trenches. The trenches would be backfilled with clean granular fill and capped with compacted clay to reduce surface water infiltration. Groundwater that is captured would be pumped to a new on-Site lined settling pond located within the excavated area of the AP before discharge to either the Illinois River or the drainage channel adjacent to the AP *via* a new or existing outfall, and would be managed in accordance with the NPDES permits for the Site.

Implementation of residual plume management for Source Control-GWE is expected to include various tasks across three major phases: pre-construction activities (Phase 1); corrective action construction (Phase 2); and corrective action operations, maintenance, and closeout (Phase 3). The activities associated with each of these phases are summarized below:

- **Phase 1:** Pre-construction activities including obtaining permits from agencies and completing Site investigations and engineering designs.
- **Phase 2:** Construction of the extraction trenches, settling pond, and minor Site restoration of disturbed areas.
    - Mobilization of equipment and materials to the Site, and preparation for Site construction including stormwater best management practices (BMPs), modification for Site utilities, and specialty geotechnical techniques for trenching activities. A detailed methane monitoring plan

[3] It should be noted that post-closure care groundwater monitoring will continue for a minimum of 30 years as required by IAC Section. 845.780(c).
[4] All elevations in this report are in the North American Vertical Datum of 1988 (NAVD88), unless otherwise noted.

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would be developed and implemented during the on-Site construction to address the presence of methane in aquifers at the AP;

- The extraction trenches would be constructed using specialized trenching equipment due to the relatively deep depth. This method utilizes a specialized one-pass trencher to excavate subgrade soils, install collection piping and sumps, and backfill the trench with granular material, all in a single operation. Alternative construction methods may be evaluated in later design phases. The trenches would be backfilled with clean granular material and capped with low-permeability clay and topsoil;
- Excavated spoils would be placed at the AP to use as subgrade fill beneath the final cover system;
- The 1-acre, geomembrane-lined collection pond would be constructed to manage extracted groundwater using conventional construction equipment. An additional transfer pump may be necessary for discharge of extracted groundwater to the collection pond; and,
- Site restoration would be completed following the construction of the GWE system and settling pond.

- **Phase 3:** Operations, Maintenance (O&M), and Closeout of the GWE system. Details pertaining to each of these activities are outlined below.
  - Operation of the GWE system;
  - Corrective Action O&M would involve routine maintenance of extraction pumps, air compressor, flow totalizers, 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 appropriate modified NPDES permit;
  - Adaptive site management strategies would be employed to track remediation progress and incorporate new Site information to assure the achievement of the GWPSs;
  - Corrective action monitoring would be performed using a corrective action groundwater monitoring network designed in accordance with IAC Section 845.680(c), which would be installed within the plume that lies beyond the facility boundary;
  - GWPSs are expected to be achieved in approximately 37 years after source control is completed. Current modeling indicates that the GWE trenches may be required to continue operating for an additional 13 years to prevent concentrations from rebounding above the GWPSs; however, additional modeling would be performed and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation. Therefore, the total operational time period for the horizontal GWE system may be about 50 years under current estimates. Corrective action monitoring would continue during this time and include a 3-year corrective action confirmation monitoring period; and
  - Following the completion of the corrective action confirmation monitoring period, a report and certification for Corrective Action Completion would be prepared and submitted to IEPA as per IAC Section 845.680(e).

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The overall corrective action implementation duration is approximately 58 to 60 years (693 to 720 months), including (Appendix B; Ramboll, 2025a):

- Approximately 4 to 5 years (42 to 60 months) of pre-construction activities (Phase 1; assumed to occur concurrently with source control);
- Approximately 9 to 18 months of corrective action construction (Phase 2; assumed to occur concurrently with source control); and
- Approximately 53.5 years (642 months) of O&M and closeout (Phase 3; assumed to start after the completion of source control):
    - Phase 3 is estimated to include 37 years (444 months) of corrective action monitoring (*i.e.*, time to meet GWPSs), 13 years (156 months) of additional operation to prevent groundwater concentrations from rebounding above the GWPSs,[5] at least 3 years (36 months) of corrective action confirmation monitoring,[6] and 6 months associated with post-closure reporting.

Key parameters for the Source Control-GWE corrective action alternative are shown in Table 2.1, below.

Table 2.1 Key Parameters for the Source Control-GWE Corrective Action Alternative[a]

Parameter[b]	Value[c]
Labor Hours	
Total On-Site Labor	32,600 hours
Total Off-Site Labor	0 hours
40% Contingency	13,000 hours
Total Labor Hours:	45,600 hours
Vehicle and Equipment Travel Miles	
Vehicles On-Site	89,100 miles
On-Site Haul Trucks (Unloaded + Loaded)	968 miles
Labor Mobilization	560,000 miles
Equipment Mobilization (Unloaded + Loaded)	27,200 miles
Off-Site Haul Trucks (Unloaded + Loaded)	125,000 miles
Material Deliveries (Unloaded + Loaded)	24,000 miles
Total On-Site Vehicle and Equipment Travel Miles:	90,100 miles
Total Off-Site Vehicle and Equipment Travel Miles:	736,000 miles
Total Vehicle and Equipment Travel Miles:	826,000 miles

Notes:
Source Control-GWE = Source Control with Groundwater Extraction.
(a) Although source control (*i.e.*, closure-in-place [CIP]) 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 O&M phases for this alternative.
(c) Values reported in this table were rounded to reflect 3 significant figures.
Source: Appendix B; Ramboll, 2025a.

[5] Current modeling indicates that an additional 13 years of system operation may be required to prevent concentrations from rebounding above the GWPSs; however, additional modeling would be performed, and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation.
[6] It should be noted that post-closure care groundwater monitoring would continue for a minimum of 30 years or until such time as GWPSs are achieved, whichever is longer, as required by IAC Section 845.780(c).

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2.1.3 Alternative 3: Source Control-Phytoremediation

The third corrective action alternative is Source Control-Phytoremediation. This remedy includes source control (*i.e.*, CIP using a consolidate-and-cap approach) combined with phytoremediation as the residual plume management approach. This residual plume management approach would include the installation of two segments of trees on the west side of the AP to control off-Site migration of impacted groundwater. Each tree segment would consist of a grid of tree plantings, and each planting would contain one tree and a well system to passively draw groundwater upward to the root zone and allow phytoremediation to occur. Each tree structure would consist of a borehole advanced into the UA and backfilled with tree cuttings and porous material to allow groundwater from the UA and PMP to rise to the potentiometric surface elevation. A surface liner would be installed to reduce precipitation inflow to facilitate downward root growth for groundwater intake. The two separate tree segments would address exceedances in the northern and southern areas of the AP, respectively. The northern tree segment would be located along the berm within the excavation area and would be 1,700 ft long. The southern tree segment would be along the exterior toe of the former perimeter dike of the AP and would be 1,900 ft long. The two segments would include a total of about 550 trees, with 200 trees in the northern section and 350 trees in the southern section.

Implementation of residual plume management for Source Control-Phytoremediation is expected to include various tasks across three major phases: pre-construction activities (Phase 1); corrective action construction (Phase 2); and corrective action operations, maintenance, and closeout (Phase 3). The activities associated with each of these phases are summarized below:

- **Phase 1:** Pre-construction activities including obtaining permits from agencies, and completing Site investigations and engineering designs.
- **Phase 2:** Construction of the phytoremediation system (tree well systems), and Site restoration of disturbed areas.
    - Mobilization of equipment and materials to the Site and preparation for Site construction, which would include implementing stormwater BMPs around the construction area, modification of Site utilities, and the construction of a work platform;
    - Geotechnical monitoring would be performed to evaluate the AP embankment for signs of distress during construction;
    - The phytoremediation system would be constructed using a hollow stem auger drill rig to allow enough space for a tree cutting, appropriate backfill, and additional items associated with the installation. The upper portion of each borehole, located above the groundwater table, would be backfilled with mixture of porous material, organic moisture-wicking material, and nutrient amendments;
    - A detailed methane monitoring plan would be developed and implemented to account for methane presence in aquifers at the AP; and
    - Site restoration would be completed following the phytoremediation installations.
- **Phase 3:** Operations, Maintenance, and Closeout of the phytoremediation system. Details pertaining to each of these activities are outlined below.
    - Corrective Action O&M would involve routine and non-routine maintenance of the phytoremediation system including inspections and maintenance of water delivery systems and/or the delivery of irrigation water, maintenance to irrigation systems, maintenance and pruning of the trees, mowing and clearing other vegetation around the tress, collection of tree

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tissue samples, harvesting tree waste, and maintenance of phytoremediation installation components;

- 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;
- GWPSs are expected to be achieved in 48 to 77 years after source control is completed. Current modeling indicates that operation of the phytoremediation system may be required for an additional 22 to 73 years to prevent concentrations from rebounding above the GWPS; however, additional modeling would be performed, and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation. Therefore, the total operational time period for the phytoremediation system may range from 70 years with ideal tree performance to 150 years with sub-optimal performance. Corrective action monitoring would continue during this time and would include an additional 3 years of corrective action confirmation after corrective action operation has ceased; and
- Following the completion of the corrective action confirmation monitoring period, a report and certification for Corrective Action Completion would be prepared and submitted to IEPA as per IAC Section 845.680(e).

The overall corrective action implementation duration is approximately 78 to 161 years (939 to 1,932 months), including:

- Approximately 4 to 6 years (48 to 72 months) of pre-construction activities (Phase 1; assumed to occur concurrently with source control),
- Approximately 9 to 18 months of corrective action construction (Phase 2; assumed to occur concurrently with source control), and
- Approximately 74 to 154 years (882 to 1,842 months) of corrective action O&M and closeout (Phase 3).
    - Phase 3 is estimated to include 48 to 77 years (576 to 924 months) of corrective action O&M (*i.e.*, time to meet GWPSs), 22 to 73 years (156 to 876 months) of additional operation to prevent concentrations from rebounding above the GWPSs,[7] at least 3 years (36 months) of corrective action confirmation monitoring, [8] and 6 months associated with post-closure reporting (Appendix B).

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[7] Current modeling indicates that an additional 22 to 73 years of system operation may be required to prevent concentrations from rebounding above the GWPSs; however, additional modeling would be performed, and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation.

[8] It should be noted that post-closure care groundwater monitoring would continue for a minimum of 30 years or until such time as GWPSs are achieved, whichever is longer, as required by IAC Section 845.780(c).

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-Phytoremediation Corrective Action Alternative[a]

Parameter[b]	Value[c]
Labor Hours	
Total On-Site Labor	22,800 hours
Total Off-Site Labor	0 hours
40% Contingency	9,130 hours
Total Labor Hours:	32,000 hours
Vehicle and Equipment Travel Miles	
Vehicles On-Site	68,600 miles
On-Site Haul Trucks (Unloaded + Loaded)	1,510 miles
Labor Mobilization	402,000 miles
Equipment Mobilization (Unloaded + Loaded)	66,200 miles
Off-Site Haul Trucks (Unloaded + Loaded)	34,300 miles
Material Deliveries (Unloaded + Loaded)	17,300 miles
Total On-Site Vehicle and Equipment Travel Miles:	70,100 miles
Total Off-Site Vehicle and Equipment Travel Miles:	520,000 miles
Total Vehicle and Equipment Travel Miles:	590,000 miles

Notes:
Source Control-Phytoremediation = Source Control with Phytoremediation.
(a) Although source control (*i.e.*, closure-in-place [CIP]) 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 O&M phases for this alternative.
(c) Values reported in this table were rounded to reflect 3 significant figures.
Source: Appendix B; Ramboll, 2025a.

2.2 Long- and Short-Term Effectiveness and Protectiveness of Corrective Action Alternative (IAC Section 845.670(e)(1))

2.2.1 Magnitude of Reduction of Existing Risks/Be Protective of Human Health and the Environment (IAC Section 845.670(e)(1)(A)/IAC Section 845.670(d)(1))

There are no current unacceptable risks to human or ecological receptors at this Site associated with the AP (Appendix A; Gradient, 2022). Because current conditions do not present a risk to human health or the environment at the AP, there will be no unacceptable risk to human health or the environment for future conditions when the unit has been closed and source control/residual plume management has been implemented. Concentrations of CCR-related constituents will decline over time and, consequently, potential exposures to CCR-related constituents in the environment will also decline. As a result of this, the magnitude of the reduction of existing risks is the same for all corrective action alternatives (IAC Section 845.670(e)(1)(A)), and all corrective action alternatives are equally protective of human health and the environment (IAC Section 84.670(d)(1)).

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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 (*i.e.*, CIP using a consolidate-and-cap approach) which includes the removal of free liquids, excavation of CCR in the northern portions of the AP and consolidation into the southern portion of the AP, and the installation of a low-permeability final cover system designed to limit the infiltration of precipitation into the impounded CCR, would be implemented for all corrective action alternatives. As demonstrated by the groundwater modeling in support of the Closure Alternatives Analysis (CAA; Gradient, 2022), this source control approach would result in a reduction of the migration of water into the AP by 97% compared to pre-closure conditions. Additionally, source control would result in a reduction of hydraulic flux out of the AP by 94% compared to pre-closure conditions (Ramboll, 2022). Because source control would be undertaken at the Site prior to the implementation of any residual plume management, all three corrective action alternatives would remove the potential for CCR within the impoundment to impact groundwater. All three corrective action alternatives would be equally and fully protective with regard to source control. The effectiveness of residual plume management for each of the corrective action alternatives with respect to residual source control is summarized below.

- Under the Source Control-GWP alternative, the attenuation of dissolved constituent concentrations remaining after source control would be achieved through natural physical and geochemical processes. Site-specific evaluations have shown that GWP would reduce the groundwater concentrations and mobility of inorganic contaminants, especially after the implementation of source control. 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; Life Cycle Geo, LLC, 2025). In cases in which observed groundwater concentrations deviate significantly from modeled conditions, alternative methods or techniques would be evaluated under the adaptive site management, and if viable, incorporated as per IAC Section 845.680(b).
- Under the Source Control-GWE alternative, residual source control would be achieved by extracting impacted groundwater and preventing off-Site migration through installation of two extraction trenches along the western side of the AP. GWE is a widely used corrective measure that has been effectively implemented at many sites to contain and capture dissolved-phase groundwater plumes. In cases in which observed groundwater concentrations deviate significantly from modeled conditions, alternative methods or techniques to achieve the GWPSs would be evaluated under the adaptive site management plan, and if viable, incorporated as per IAC Section 845.680(b).
- Under the Source Control-Phytoremediation alternative, residual source control would be achieved by removing impacted groundwater and controlling the westerly off-Site migration through the installation of two tree segments on the west side of the AP. Phytoremediation is a commonly used corrective measure that has been effectively implemented at many sites to remove constituents from groundwater. In cases in which observed groundwater concentrations deviate significantly from modeled conditions, alternative methods or techniques to achieve the GWPSs would be evaluated under the adaptive site management plan, and if viable, incorporated as per IAC Section 845.680(b).

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Because all three corrective action alternatives include source control, and residual plume management, each 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 under this alternative. For the Source Control-GWE alternative, extracted groundwater would be managed and treated by a newly constructed on-Site settling pond, although other methods for treated extracted groundwater may be evaluated at later phases of design (Appendix B; Ramboll, 2025a). For the Source Control-Phytoremediation alternative, tree plantings would passively treat groundwater by uptaking impacted groundwater. No additional treatment technologies are planned for this alternative. For all corrective action alternatives, remedy optimizations would be implemented, if necessary, under the adaptive site management program.

2.2.3 Likelihood of Future Releases of CCR (IAC Section 845.670(e)(1)(B))

All three corrective action alternatives include source control using CIP with a consolidate-and-cap approach. Free liquids would be removed; a new cover system would be installed over the AP, which would include a 40-mil LLDPE geomembrane layer, a geocomposite drainage layer, 24 in of protective soil cover, and new stormwater control structures. Relative to current conditions, this cover system would provide increased protection against berm and surface erosion, precipitation infiltration, and other adverse effects that could potentially trigger a release of CCR. There would be minimal risk of accidental CCR releases occurring post-closure for all of the corrective action alternatives.

2.2.4 Type and Degree of Long-Term Management, Including Monitoring, Operation, and Maintenance (IAC Section 845.670(e)(1)(C))

The type and degree of long-term residual groundwater plume management associated with each corrective action alternative is summarized below.

- Residual plume management for the Source Control-GWP alternative would not require the installation, operation, or maintenance of any engineered systems or structures, other than maintenance of the monitoring well network. The only long-term management activity required under this alternative would be corrective action groundwater monitoring and routine maintenance of the monitoring wells, which would continue for at least 3 years after GWPSs have been achieved for all wells, in accordance with IAC Section 845.680(c)(2). Post-closure care groundwater monitoring would continue for a minimum of 30 years as required by IAC Section 845.780(c). Based on the adaptive site management approach, remedy optimization (additional methods or techniques) may be implemented to ensure the achievement of the GWPSs.
- Residual plume management for the Source Control-GWE would require the construction of two groundwater extraction trenches. 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 trenches would occur concurrently with AP closure activities. This approach would allow for the spoils generated from the extraction trenches to be disposed beneath the final cover system of the AP. Corrective action O&M would require regular inspection and maintenance of the extraction trench system. Extracted groundwater would be managed and treated by a newly-constructed on-Site collection pond before discharge *via* an NPDES outfall to the Illinois River.

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Additionally, corrective action groundwater sampling and routine maintenance of the monitoring well network would continue for at least 3 years after GWPSs have been achieved at all wells, in accordance with IAC Section 845.680(c)(2). Post-closure care groundwater monitoring would continue for a minimum of 30 years as required by IAC Section 845.780(c). Based on the adaptive site management approach, remedy optimization (additional methods or techniques) may be implemented to ensure the achievement of the GWPSs.

- Residual plume management for the Source Control-Phytoremediation would require the construction of two tree segments. Multiple tasks would be completed over three phases: pre-construction activities (Phase 1), corrective action construction (Phase 2), corrective action O&M, and closeout (Phase 3). Once pre-construction activities are completed, the installation of tree segments would occur concurrently with AP closure activities to allow spoils generated from boring of tree wells to be disposed beneath the final cover system of the AP. Corrective action O&M would require regular inspection and maintenance of the phytoremediation system, including inspections and maintenance of water delivery systems and/or the delivery of irrigation water, maintenance to irrigation systems, maintenance and pruning of the trees, mowing and clearing other vegetation around the trees, collection of tree tissue samples, harvesting tree waste, and maintenance of phytoremediation installation components, *etc.* Additionally, corrective action groundwater sampling and routine maintenance of the monitoring well network would continue for at least 3 years after GWPSs have been achieved at all wells, in accordance with IAC Section 845.680(c)(2). Post-closure care groundwater monitoring would continue for a minimum of 30 years as required by IAC Section 845.780(c). Based on the adaptive site management approach, remedy optimization (additional methods or techniques) may be implemented to ensure the achievement of the GWPSs.

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 (*i.e.*, CIP using a consolidate-and-cap approach), which were evaluated in the CAA (Gradient, 2022), are the same for all 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 two groundwater extraction trenches and a settling pond to collect, extract and treat CCR-impacted groundwater. Potential safety concerns would be related to construction and O&M of the extraction trenches and settling pond.
- The Source Control-Phytoremediation alternative would include the installation of two tree segments to extract impacted groundwater and control off-Site migration of CCR-impacted

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groundwater. Potential safety concerns would be related to the installation and O&M of the tree segments.

Worker Risks

On-Site accidents include injuries and deaths arising from the use of heavy equipment and/or earthmoving operations during Site activities. Off-Site accidents include injuries and deaths due to vehicle accidents during labor and equipment mobilization/demobilization, as well as materials/supplies hauling and deliveries.

As discussed in section 2.1.1, there are no construction activities or operational requirements associated with residual plume management for the Source Control-GWP alternative. As shown in Tables 2.1-2.2, Ramboll estimates that residual plume management for the Source Control-GWE corrective action alternative would require 32,600 on-Site labor hours, and residual plume management for the Source Control-Phytoremediation corrective action alternative would require 22,800 on-Site labor hours (Appendix B; Ramboll, 2025a). 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, approximately 0.34 worker injuries and 3.0×10^{-3} worker fatalities would occur on-Site under the Source Control-GWE corrective action alternative; and approximately 0.24 worker injuries and 2.1×10^{-3} worker fatalities would occur on-Site under the Source Control-Phytoremediation corrective action alternative (Table 2.3). No worker accidents would be expected under the Source Control-GWP alternative. The number of on-Site worker accidents is therefore expected to be highest under the Source Control-GWE alternative and lowest under the Source Control-GWP alternative.

Table 2.3 Expected Number of On-Site Worker Accidents Under Each Corrective Action Alternative[a,b]

Corrective Action Alternative	Injuries	Fatalities
Source Control-GWP	0	0
Source Control-GWE	0.34	3.0×10^{-3}
Source Control-Phytoremediation	0.24	2.1×10^{-3}

Notes:
Source Control-GWE = Source Control with Groundwater Extraction; Source Control-GWP = Source Control with Groundwater Polishing; Source Control-Phytoremediation = Source Control with Phytoremediation.
(a) Although source control (*i.e.*, closure-in-place [CIP]) is a primary component of the corrective action, the worker accidents associated with source control were previously 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.
Source: Appendix B; Ramboll, 2025a.

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 alternative compared to the Source Control-Phytoremediation alternative (Tables 2.1-2.2). For residual plume management under the Source Control-GWE corrective action alternative, 736,000 total off-Site vehicle and equipment travel miles would be required. In contrast, residual plume management under the Source Control-Phytoremediation alternative, 520,000 total off-Site vehicle and equipment travel miles would be required and no off-Site travel miles would be expected under the Source Control and GWP alternative (Appendix B; Ramboll, 2025a). The United States Department of Transportation (US DOT) provides estimates of the expected number of fatalities and injuries "per vehicle mile driven" for drivers and passengers of large

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trucks and passenger vehicles (US DOT, 2023a). Table 2.4 shows the expected number of off-Site accidents under each corrective action alternative due to all categories of off-Site vehicle usage. For these calculations, it was assumed that labor mobilization/demobilization would rely upon passenger vehicles (cars or light trucks, including pickups, vans, and sport utility vehicles) and that hauling, equipment mobilization/demobilization, and material deliveries would rely upon large trucks. Based on US DOT's accident statistics and the mileage estimates in Appendix B, an estimated 0.37 worker injuries and 8.1×10^{-3} worker fatalities would be expected to occur due to off-Site activities under the Source Control-GWE alternative; and an estimated 0.26 worker injuries and 5.7×10^{-3} worker fatalities would be expected to occur due to off-Site activities under the Source Control-Phytoremediation alternative. No worker accidents would be expected under the Source Control-GWP alternative.

Table 2.4 Expected Number of Off-Site Worker Accidents Related to Off-Site Car and Truck Use Under Each Corrective Action Alternative[a]

Off-Site Vehicle Use Category	Source Control-GWP		Source Control-GWE		Source Control-Phytoremediation	
	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Hauling	0	0	0.026	2.0×10^{-3}	7.2×10^{-3}	5.4×10^{-4}
Labor Mobilization/Demobilization	0	0	0.33	5.3×10^{-3}	0.24	3.8×10^{-3}
Equipment Mobilization/Demobilization	0	0	5.7×10^{-3}	4.3×10^{-4}	0.014	1.0×10^{-3}
Material Deliveries	0	0	5.1×10^{-3}	3.8×10^{-4}	3.6×10^{-3}	2.7×10^{-4}
Total:	0	0	0.37	8.1×10^{-3}	0.26	5.7×10^{-3}

Notes:
Source Control-GWE = Source Control with Groundwater Extraction Trench; Source Control-GWP = Source Control with Groundwater Polishing; Source Control-Phytoremediation = Source Control with Phytoremediation.
(a) Although source control (*i.e.*, closure-in-place [CIP]) is a primary component of the corrective action, the worker accidents associated with source control were previously 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 worker fatalities would be expected to occur for residual plume management under the Source Control and GWP alternative; 0.71 worker injuries and 0.011 worker fatalities would be expected to under the Source Control-GWE alternative; and 0.50 worker injuries and 7.7×10^{-3} worker fatalities would be expected to occur under the Source Control-Phytoremediation alternative. Thus, overall risks to workers would be highest under the Source Control-GWE.

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 (2023b) and the off-Site travel mileages reported in Appendix B (and summarized in Tables 2.1-2.2), off-Site vehicle accidents could result in an estimated 1.8×10^{-2} injuries and 2.5×10^{-3} 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) under the Source Control-GWE alternative (Table 2.5). Under the Source Control-Phytoremediation alternative, off-Site vehicle accidents could result in an estimated 0.13 community injuries and 1.8×10^{-3} community fatalities. No community risks are expected under the Source Control-GWP alternative. Therefore, off-Site impacts on nearby residents, including injuries or fatalities, would be the highest under the Source Control-GWE alternative, and lowest under the Source Control-GWP alternative.

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Table 2.5 Expected Number of Community Accidents Under Each Corrective Action Alternative[a]

Off-Site Vehicle Use Category	Source Control-GWP		Source Control-GWE		Source Control-Phytoremediation	
	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Hauling	0	0	3.3×10^{-2}	2.4×10^{-4}	9.0×10^{-3}	6.6×10^{-5}
Labor Mobilization/Demobilization	0	0	0.14	2.2×10^{-3}	9.7×10^{-2}	1.6×10^{-3}
Equipment Mobilization/Demobilization	0	0	7.2×10^{-3}	5.3×10^{-5}	1.7×10^{-2}	1.3×10^{-5}
Material Deliveries	0	0	6.3×10^{-3}	4.6×10^{-5}	4.5×10^{-3}	3.3×10^{-5}
Total:	0	0	0.18	2.5×10^{-3}	0.13	1.8×10^{-3}

Notes:
Source Control-GWE = Source Control with Groundwater Extraction Trench; Source Control-GWP = Source Control with Groundwater Polishing; Source Control-Phytoremediation = Source Control with Phytoremediation.
(a) Although source control (*i.e.*, closure-in-place [CIP]) is a primary component of the corrective action, the worker accidents associated with source control were previously 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 (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all three potential corrective action alternatives. Air impacts occurring during source control would be the same for all corrective action alternatives. Impacts associated with CIP using a consolidate-and-cap approach were evaluated in the CAA (Gradient, 2022). On-Site emissions would be highest under the Source Control-GWE alternative due to the greatest amount of on-Site vehicle travel miles required under this corrective action alternative (90,100 total on-Site travel miles under the Source Control-GWE alternative *versus* 70,100 total on-Site travel miles under the Source Control-Phytoremediation alternative and no on-Site travel miles under the source Control-GWP alternative; Section 2.1.1; Tables 2.1-2.2). Off-Site emissions would similarly be highest under the Source Control-GWE alternative due to the greatest amount of off-Site vehicle and equipment travel miles required under this alternative (736,000 total off-Site travel miles under the Source Control-GWE alternative *versus* 520,000 total off-Site travel miles under the Source Control-Phytoremediation alternative and no off-Site travel miles under the Source Control-GWP alternative). In summary, air impacts would be highest for the Source Control-GWE alternative due to greatest vehicle travel miles, and lowest for the Source Control-GWP alternative, because no construction activities would be expected under this alternative.

2.2.5.3 Cross-Media Impacts to Surface Water and Sediments

Under all three corrective action alternatives, 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, consolidation of CCR in the AP and the installation of a low-permeability geomembrane final cover system to limit the precipitation infiltration into the CCR unit. This approach would minimize the amount of water retained within the impoundment, which further reduces the hydraulic flux through the CCR. As demonstrated by the groundwater modeling in support of the Closure

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Alternatives Analysis (CAA; Gradient, 2022), this source control approach would result in a reduction of the migration of water into the AP by 97% compared to pre-closure conditions. Additionally, source control would result in a reduction of hydraulic flux out of the AP by 94% compared to pre-closure conditions. Due to the reduction in the hydraulic flux out of the AP, the mass flux out of the AP will also be controlled or minimized as much as feasible as a result of CIP (Ramboll, 2022).

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 monitoring wells).

Under the Source Control-GWE alternative, surface water and sediment impacts associated with residual plume management would be higher than the those of Source Control-GWP alternative due to the construction of the extraction trenches and the settling pond. Construction can have short-term negative impacts on surface water and sediment quality immediately adjacent to a site due to erosion and sediment runoff. Extracted groundwater would be discharged to either the Illinois River or the drainage channel adjacent to the AP *via* a new or existing outfall. Any associated impacts would be addressed through BMPs in accordance with Site land disturbance permits.

Under the Source Control-Phytoremediation alternative, surface water and sediment impacts associated with residual plume management would be higher than the those of Source Control-GWP alternative, because it would require some construction, which is limited to staging of a work platform and equipment, hollow stem auger drilling for the tree well system, and other installation items related to the phytoremediation system. Construction can have short-term negative impacts on surface water and sediment quality immediately adjacent to a site due to erosion and sediment runoff. 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.*, CIP using a consolidate-and-cap approach) would be implemented for all three 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 all corrective action alternatives. For each of the other corrective action components for the three potential alternatives, no residual CCR exposures would be expected to occur. However, impacted soils and groundwater can be a source of CCR-related constituent exposure for workers. Risks to workers arising from potential contact with residual contamination during construction, operation, and maintenance activities associated with residual plume management would be higher for the Source Control-GWE alternative than for the Source Control-GWP and Source Control-Phytoremediation alternatives because the Source Control-GWE would involve both the production, management, and treatment of extracted groundwater, as well as on-Site disposal of excavated spoils generated during extraction trench construction. The Source Control-Phytoremediation alternative would not involve the management of impacted groundwater; exposure would be limited to disposal of spoils generated during phytoremediation installations. The Source Control-GWP alternative would not involve exposure to either of these soil or groundwater waste streams associated with residual plume management. Any potential CCR-exposures during the Source Control-GWE or the Source Control-Phytoremediation alternatives would be managed through the use of rigorous safety protocols and personal protective equipment.

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2.2.5.5 Other Identified Impacts

Source control (*i.e.*, CIP using a consolidate-and-cap approach) would be implemented for all three corrective action alternatives. Thus, impacts during source control would be the same for all of the corrective action alternatives (see the CAA; Gradient, 2022).

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 alternative, while the energy demands under the Source Control-GWP and Source Control-Phytoremediation alternatives associated with residual plume management are expected to be lower. The Source Control-GWP would not require any significant construction activity and the Source Control-Phytoremediation is expected to require relatively limited construction activity. In addition, energy would be required for the O&M of the extraction trench system under the Source Control-GWE and the tree wells under Source Control-Phytoremediation alternatives; there is no operational energy required under the Source Control-GWP alternative because the Source Control-GWP alternative would rely on natural physical and geochemical processes.

Traffic and noise impacts associated with residual plume management are also expected to be higher under the Source Control-GWE and Source Control-Phytoremediation alternatives than the Source Control-GWP alternative; construction activities would be required to construct the extraction trench system and settling pond under the Source Control-GWE alternative and to install tree segments under the Source Control-Phytoremediation alternative. Traffic may increase temporarily around the Site under the Source Control-GWE and Source Control-Phytoremediation alternatives due to the daily arrival and departure of the workforce, equipment mobilization/demobilization, and material deliveries. However, these impacts would be expected to largely occur at the beginning and end of each workday (for the arrival/departure of the work force), at the beginning and end of the construction period (for equipment mobilization/ demobilization), and at specific times throughout the construction period (for material deliveries). Traffic and noise impacts associated with residual plume management from the Source Control-GWP alternative is expected to be significantly less than those associated with the Source Control-GWE and Source Control-Phytoremediation alternatives.

Construction activities can negatively impact natural resources and habitats near the Site, as well as scenic and recreational value. According to the IDNR Natural Heritage, Historic Preservation Division, and the Illinois State Archaeological Survey databases, no natural areas, protected areas, or historic sites were identified 1,000 meters from the AP (Ramboll, 2021). There would be no impacts associated with residual plume management under the Source Control-GWP alternative because no additional construction activities are expected to occur. The Source Control-GWE alternative would require construction of two extraction trenches and an on-Site settling pond and the Source Control-Phytoremediation would involve installation of tree well systems, both of which would occur during the later phase of the AP closure construction. The AP is separated spatially from the Illinois River; construction activities at the AP are unlikely to have a significant negative impact on aquatic species found in the Illinois River (due to, *e.g.*, erosion and sediment runoff). However, construction activities could cause disturbance of some existing habitats atop portions of the construction areas, and habitats in the immediate vicinity of these locations by causing alarm and

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escape behavior in nearby wildlife (*e.g.*, due to noise disturbances). In addition, it is also possible that limited negative short-term impacts could occur to sensitive aquatic and wetland species in the discontinuous wetland areas in the immediate vicinity of the AP due to potential sediment runoff during construction (see Section 1.1.3).

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 within the UA flows predominantly to the west in the central portion of the AP towards a former channel of the Illinois River, and to the south/southeast in the southern end of the AP. There is a minor component in the northernmost portion of the AP where groundwater in the UA and PMP flows to the north and northwest (Ramboll, 2021). Groundwater flow occurs primarily in the more permeable zones within the LCF in the UA (Ramboll, 2021).

Groundwater modeling was performed in support of the CAA (Gradient, 2022). The modeling predicted that source control would result in a reduction of the migration of water into AP by 97% compared to pre-closure conditions. Additionally, source control would result in a reduction of hydraulic flux out of AP by 94% compared to pre-closure conditions (Ramboll, 2022). Additional modeling was conducted for each of the corrective action alternatives to evaluate future groundwater quality in the vicinity of the AP as a result of residual plume management (Appendix B; Ramboll, 2025b), and the results of the modeling indicate that it would take more than 100 years to achieve the GWPSs for all of the constituents[9] identified as having potential groundwater exceedances in AP groundwater monitoring wells under the Source Control-GWP once source control has been completed. Under the Source Control-GWE alternative, approximately 37 years would be required to achieve GWPSs once source control is completed. Current modeling indicates that an additional 13 years of system operation may be required to prevent concentrations from rebounding above the GWPSs (Appendix B; Ramboll, 2025a); however, additional modeling would be performed, and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation for the Source Control-GWE alternative. Under the Source Control-Phytoremediation alternative, approximately 48 to 77 years would be required to achieve GWPSs once source control is completed. Current modeling indicates that an additional 22 to 73 years of system operation may be required to prevent concentrations from rebounding above the GWPSs (Appendix B; Ramboll, 2025a); however, additional modeling would be performed, and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation for the Source Control-Phytoremediation alternative. The timeframe for achieving GWPS under the Source Control-GWE is predicted to be shorter than the timeframe for achieving the GWPS under the Source Control-GWP and Source Control-Phytoremediation alternatives.

[9] Boron was selected as a surrogate for the contaminant fate and transport simulations to evaluate the effectiveness of each of the corrective action alternatives. Boron has similar groundwater transport characteristics as the other constituents that have been detected with potential GWPS exceedances (*i.e.*, sulfate). Therefore, subsurface transport during closure conditions would be similar for all these constituents. Boron has been detected in AP groundwater at the highest concentrations relative to its GWPS and it will likely take the longest time to meet the GWPS. 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 will likely achieve their GWPSs more quickly (Appendix B; Ramboll, 2025b).

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Table 2.6 Estimated Timeline and Implementation Schedule Under Each Corrective Action Alternative

Implementation Phase	Implementation Task	Timeframe		
		Source Control-GWP	Source Control-GWE	Source Control-Phytoremediation
1: Pre-Construction Activities[a] (Concurrent with Source Control)	Agency Coordination, Approvals, and Permitting	NA	18 to 24 months	18 to 24 months
	Pilot Study		NA	6 to 12 months
	Final Design and Bid Process		24 to 36 months	24 to 36 months
	Total Timeframe to Complete Pre-Construction Activities		42 to 60 months	48 to 72 months
2: Corrective Action Construction[a] (Concurrent with Source Control)	Corrective Action Construction	NA	9 to 18 months	9 to 18 months
	Total Timeframe to Complete Corrective Action Construction Activities		9 to 18 months	9 to 18 months
3: Corrective Action O&M and Closeout[b] (After Completion of Source Control)	Corrective Action Monitoring (Time to Meet GWPS)	Over 100 years	444 months (37 years)	576 to 924 months (48 to 77 years)
	Potential Additional Corrective Action Operation (After GWPS Have Been Achieved)[c]	NA	156 (13 years)	264 to 876 months (22 to 73 years)
	Corrective Action Confirmation Monitoring	36 months	36 months	36 months
	Corrective Action Completion Reporting	6 months	6 months	6 months
	Total Timeframe to Complete Corrective Action O&M and Closeout	Over 100 years	642 months (53.5 years)	882 to 1,842 months (74 to 154 years)
Total Timeline to Complete Corrective Action (All Phases)		Over 100 years	693 to 720 months (58 to 60 years)	939 to 1,932 months (78 to 161 years)

Notes:
O&M = Operations and Maintenance; Source Control-GWE = Source Control with Groundwater Extraction; Source Control-GWP = Source Control with Groundwater Polishing; Source Control-Phytoremediation= Source Control with Phytoremediation.
(a) Pre-construction Activities (Phase 1) and Corrective Action Construction (Phase 2) are assumed to occur concurrently with the source control (*i.e.*, closure-in-place or CIP) activities, to allow waste materials to be placed underneath the Ash Pond (AP) final cover system under the Source Control-GWE and Source Control-Phytoremediation alternatives.
(b) Corrective Action O&M and Closeout (Phase 3) is assumed to start after the source control (*i.e.*, closure-in-place or CIP) is complete.
(c) For Source Control-GWE and Source Control-Phytoremediation alternatives, current modeling indicates that additional system operation may be required to prevent concentrations from rebounding above the GWPSs (Appendix B; Ramboll, 2025a); additional modeling would be performed and data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation.
Source: Appendix B; Ramboll, 2025a.

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2.2.7 Potential for Exposure of Humans and Environmental Receptors to Remaining Wastes, Considering the Potential Threat to Human Health and the Environment Associated with Excavation, Transportation, Re-disposal, Containment, or Changes in Groundwater Flow (IAC Section 845.670(e)(1)(F))

Section 2.2.1 describes the magnitude of reduction of existing risks under each corrective action alternative. Section 2.2.2 describes the effectiveness of the remedy in controlling the source, including the extent to which containment practices would reduce further releases. Section 2.2.3 describes the likelihood of future releases of CCR occurring under each corrective action alternative, and Section 2.2.5 describes the short-term risks to workers, the community, and the environment during implementation of the remedy, including safety impacts and control of exposure to any residual contamination. In summary, source control measures (*i.e.*, CIP using a consolidate-and-cap approach) would be undertaken at the Site. Thus, potential exposures to CCR remaining in the AP would be the same under all three alternatives. Similarly, due to the source control common to all of the corrective action alternatives, a new geomembrane cover system would be placed over the AP, and no residual CCR exposures would be expected to occur during the implementation of any of the alternatives. All 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 and Source Control-Phytoremediation alternatives because the Source Control-GWE would involve the production, management, and potential treatment of extracted groundwater, as well as on-Site disposal of excavated spoils generated during extraction trench construction. The Source Control-Phytoremediation alternative would involve management of spoils generated by tree well/boring installation. 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 of extracted groundwater) may occur under the Source Control-GWE alternative, due to the operation of the GWE system. Hydrogeological changes would be expected under the Source Control-GWE alternative, such as lowering groundwater table in the vicinity of the extraction trenches, altering flow patterns in the UA, and causing changes in hydraulic gradients. Under the Source Control-Phytoremediation alternative, tree installations west of the AP would be designed to uptake groundwater in the UA/PMP and work as pumps, which would change local hydraulic gradients and groundwater flow direction. 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.*, CIP using a consolidate-and-cap approach) would be implemented for all potential corrective action alternatives. Thus, the long-term reliability during source control would be the same for each corrective action alternative (Gradient, 2022). The long-term reliability of the engineering and

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institutional controls associated with residual plume management of all corrective alternatives are summarized below.

- Residual plume management under the Source Control-GWP alternative would be reliable, because it would rely on natural physical and geochemical processes, rather than the installation, operation, and maintenance of engineered systems or structures. Site specific evaluations have shown that chemical attenuation is feasible, and remobilization is unlikely to impact the time to achieve GWPS as groundwater returns to background conditions (Appendix E; Life Cycle Geo, LLC, 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 AP 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 in accordance with standard design and specifications. Under this alternative, the extraction trenches and settling pond would require engineering design and installation for groundwater extraction and treatment. Routine and non-routine maintenance of the GWE system is required to ensure reliable operation of the extraction trench and pumps, as well as other system components. GWPSs are expected to be achieved in approximately 37 years after source control is completed. Current modeling indicates that the GWE trenches may be required to operate for an additional 13 years to prevent concentrations from rebounding above the GWPSs.[10] Active groundwater monitoring would be in place, similar to those required under the Source Control-GWP alternative.
- Residual plume management under the Source Control-Phytoremediation alternative would be expected to be reliable, provided it is constructed in accordance with standard design and specifications. The effectiveness of the phytoremediation installations would depend on the trees' ability to grow under Site conditions and would require the root systems to achieve target uptake rates of approximately 40 gallons per day per tree. Sensitivity analyses show significant variability in the time needed to reach GWPSs (48 to 77 years) and the total remedy duration (70 to 150 years) to prevent concentrations from rebounding above the GWPSs.[11] This suggests that the overall operational reliability of this remedy is uncertain. In addition, although phytoremediation can address low concentrations of boron and other inorganics, the lack of large-scale case studies for boron or other CCR-constituents adds extra uncertainty to its long-term reliability (Appendix B; Ramboll, 2025a). As a combination of mechanical and biological systems, routine and ongoing maintenance would be required to ensure reliable operation over the long-term.
- For all corrective action alternatives, remedy optimizations would be implemented if necessary under the adaptive site management program.

[10] Current modeling indicates that an additional 13 years of system operation may be required to prevent concentrations from rebounding above the GWPSs under the Source Control-GWE alternative; however, additional modeling would be performed, and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation.

[11] Current modeling indicates that an additional 22 to 73 years of system operation may be required to prevent concentrations from rebounding above the GWPSs under the Source Control-Phytoremediation alternative; however, additional modeling would be performed, and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation.

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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 physical 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 two extraction trenches and a settling pond to extract and treat impacted groundwater to achieve reductions in groundwater concentrations to below GWPSs. While the GWE 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.
- Source Control-Phytoremediation would utilize tree well system installations to control migration of CCR-constituents in groundwater. Tree replacement is expected during the time horizon of the remedy. Depending on the performance and lifespan of the trees, it is estimated that trees may be replaced one to five times, assuming a 30- to 50-year tree lifespan. An annual tree replacement rate is estimated to be 10% (approximately 60 trees) during the first 5 years, and then 5% afterwards. Ongoing maintenance and inspections would be required to monitor tree performance. 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.*, CIP using a consolidate-and-cap approach) would be implemented for all three corrective action alternatives. Thus, construction difficulties regarding source control would be the same for all corrective action alternatives. Difficulties associated with implementing CIP using a consolidate-and-cap approach were evaluated in the CAA (Gradient, 2022). 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. This alternative would only require the construction and use of monitoring wells designed in accordance with IAC Section 845.680(c). Therefore, there would be minimal difficulty in constructing the Source Control-GWP remedy.

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- Residual plume management under the Source Control-GWE alternative would involve the construction of two extraction trenches, a settling pond and conveyance system to extract and treat impacted groundwater. It may have the following challenges during construction of the extraction trenches (Appendix B; Ramboll, 2025a):
    - The construction of the groundwater trenches required by this alternative is commonly constructed at similar depths and would be performed using specialized and conventional construction equipment.
    - Constructing the South Trench would necessitate significant modifications to the AP embankment to create a suitable working platform for construction equipment. This would require the use of excavation shoring and/or other approaches to ensure dike stability during construction because the modifications would be intrusive and may temporarily increase the risk of dike instability relative to current conditions. Geotechnical designs involving three-dimensional analysis would be utilized for the construction. The modifications would likely require a geotechnical monitoring program to assess the embankment for any signs of distress during construction. If distress is detected, construction may need to be temporarily paused to evaluate and address the issue.
    - High-voltage power lines crossing the North Trench alignment may need to be raised to ensure a safe working distance from construction equipment.
    - Additionally, naturally occurring methane at the Site necessitates a methane monitoring and response plan, which may lead to periodic safety shutdowns during construction to allow methane levels to decrease to safe levels.
    - Groundwater monitoring would be conducted using a groundwater monitoring network designed in accordance with IAC Section 845.680(c).
- Residual plume management under the Source Control-Phytoremediation alternative would utilize a tree well system to uptake and control impacted groundwater. It may have the following challenges during construction of the tree segments (Appendix B; Ramboll, 2025a):
    - This approach would require a hollow stem auger drill rig for installing the tree well systems, along with general construction equipment such as excavation and grading machinery, to install a working pad for the southern tree segment. Local Site geology is not expected to pose significant challenges during any earthwork or tree well borings.
    - Constructing the southern tree segment would necessitate significant modifications to the AP embankment to create a suitable working platform for construction equipment. This would require the use of excavation shoring and/or other approaches to ensure dike stability during construction because the modifications would be intrusive and may temporarily increase the risk of dike instability relative to current conditions. Geotechnical designs involving three-dimensional analysis would be utilized for the construction. The modifications would likely require a geotechnical monitoring program to assess the embankment for any signs of distress during construction. If distress is detected, construction may need to be temporarily paused to evaluate and address the issue.
    - High-voltage power lines crossing the northern tree segment may need to be raised to ensure a safe working distance from construction equipment.
    - Additionally, naturally occurring methane at the Site necessitates a methane monitoring and response plan, which may lead to periodic safety shutdowns during construction to allow methane levels to decrease to safe levels.

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- 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.*, CIP using a consolidate-and-cap approach) would be implemented for all three corrective action alternatives. Thus, the operational reliability of the remedy would be the same for all corrective action alternatives. The reliability associated with implementing CIP using a consolidate-and-cap approach was evaluated in the CAA (Gradient, 2022). All three corrective action alternatives would likely be highly reliable with respect to operational controls associated with residual plume management; specific details for each corrective action alternative are discussed below.

- Residual plume management under the Source Control-GWP alternative would have high operational reliability because it would rely on 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 the design and specifications. The remedy would operate as a mechanical system and would require routine and non-routine maintenance of the GWE system to ensure reliable operation (in addition to those required for groundwater monitoring); and
- Residual plume management under the Source Control-Phytoremediation alternative would also have high operational reliability as long as the phytoremediation installations are constructed in accordance with the design and specifications. The effectiveness of the phytoremediation installations would depend on the trees' ability to grow under Site conditions, and would require the root systems to achieve target uptake rates of approximately 40 gallons per day per tree. Sensitivity analyses show significant variability in the time needed to reach GWPSs (48 to 77 years) and the total remedy duration (70 to 150 years) to prevent concentrations from rebounding above the GWPSs. This suggests that the overall operational reliability of this remedy is uncertain. In addition, although phytoremediation can address low concentrations of boron and other inorganics, the lack of large-scale case studies for boron or other CCR-constituents adds extra uncertainty to its long-term reliability (Appendix B; Ramboll, 2025a). As a combination of mechanical and biological systems, routine and ongoing maintenance would be required to ensure reliable operation over the long-term.

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

All three corrective action alternatives would require regulatory approvals. Specific permits and approvals associated with source control (*i.e.*, CIP using a consolidate-and-cap-approach) are the same for all corrective action alternatives and are discussed in the CAA (Gradient, 2022). The specific approvals and permits associated with residual plume management for all corrective action alternatives are discussed below.

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- 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 eventual Corrective Action Plan.
- The Source Control-GWE alternative would require approvals and permits and Site-specific NPDES permits. Groundwater extracted from the GWE trenches would require a modified NPDES permit. The NPDES permit would likely require renewals depending on the timeline of corrective action implementation. In addition, permits from the IEPA for construction of stormwater controls and BMPs, a joint water pollution control, an amendment to the AP Closure Plan and Construction Permit Application for placement of excavated spoils beneath the AP final cover system, and an IDNR Dam Safety Modification Permit for modification of the embankment would be required. These permits and plans typically take 18-24 months to obtain, although some may already be obtained during the AP final closure.
- The Source Control-Phytoremediation alternative would require a general stormwater permit through IEPA for construction activities, including construction stormwater controls and other BMPs such as installation of silt fences and other measures. An IDNR Dam Safety Modification Permit would be required for modification of the embankment. These permits and plans typically take 18-24 months to obtain, although some may already be obtained during the AP final closure.

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.*, CIP using a consolidate-and-cap approach) would be implemented for all three corrective action alternatives. Thus, equipment and specialist needs would be the same for all corrective action alternatives. An assessment of necessary equipment and specialists associated with implementing CIP using a consolidate-and-cap approach was evaluated in the CAA (see the CAA; Gradient, 2022). Specialized equipment and personnel are essential for field data collection and groundwater sampling for residual plume management under each potential corrective action alternative. Additionally, the assessment of groundwater concentrations for Site constituents would necessitate laboratory equipment and specialists for each alternative. The availability of equipment and specialists associated with residual plume management for each corrective action alternative is summarized below.

- Residual plume management under the Source Control-GWP alternative would require groundwater professionals, such as geologists, hydrogeologists, statisticians (*i.e.*, statistical analysis), and geochemists to evaluate all monitoring data, ensuring that physical and geochemical processes function as anticipated for this alternative. The equipment and specialists needed for Site groundwater monitoring and analysis are currently engaged in these tasks as part of the routine groundwater monitoring program outlined in accordance with IAC Section 845.220(c)(4).
- Residual plume management under the Source Control-GWE alternative would require specialists to manage the GWE system throughout its construction and operational period.
    - Construction of the groundwater extraction system (*i.e.*, the trenches and settling pond) on the Site would require a specialized contractor. The contractor would most likely need specialized and often custom-built equipment including one-pass construction equipment. Additionally, geotechnical specialists would be needed to design the working platform and monitor the AP embankment for signs of distress during the trench installation. The availability of contractors with such equipment may be limited. Specialists including design engineers, construction managers, and contractor staff experienced in trench construction and similar geologic environments would be required as well. In addition, specialists and equipment may have

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backlogs from similar specialty ground improvement projects in the area, such as electric utility, dam/levee, and other market sectors.

- 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 Source Control-GWP alternative, these activities are already being conducted as part of routine groundwater monitoring in accordance with IAC Section 845.220(c)(4).

- Residual plume management under the Source Control-Phytoremediation alternative would require specialists to construct and manage the phytoremediation installations throughout its construction and operational period.
  - Specialists in phytoremediation design would be needed during the design and construction of the remedy. The construction of the tree well systems would require a widely available hollow stem auger drill rig, and the drilling crew would not need specialized skills beyond typical capabilities. Additionally, geotechnical specialists would be required for the design and construction of the working platform and to monitor the embankment for signs of distress during construction. These types of equipment and specialists have been utilized in the past for other similar types of phytoremediation design and construction projects (Appendix B)
  - 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 Source Control-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)(D)/IAC Section 845.670(d)(5))

The available capacity and location of needed treatment, storage, and disposal services associated with residual plume management under each corrective action alternative is summarized below. All the practices employed in each alternative would comply with standards for the management of wastes as specified in IAC Section 845.670(e)(3)(D) 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 trenches would generate spoils, and the waste materials would be used as subgrade fill beneath the AP final cover system during the closure construction. Completing the extraction trench construction at the same time as the AP 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

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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, nearby solar redevelopment, wetlands, and floodplains.

- Discharge from the settling pond would be conveyed to an NPDES permitted outfall. Renewal of the NPDES permits may be necessary to continue operations, depending on the timeline of the corrective action implementation in relation to the source control completion.

- Residual plume management for the Source Control-GWE alternative would generate spoils during the tree well/boring installations, which would be disposed of on-Site in the AP during closure construction. Simultaneously completing the phytoremediation installations with the AP closure would ensure sufficient on-Site capacity for disposing of generated spoils. Organic waste would be produced annually throughout the phytoremediation process, including replaced trees and seasonal debris. Periodic sampling of the waste would determine whether it can be chipped for on-Site mulch/compost or may need off-Site disposal. Waste Management Peoria City, a nearby landfill located 18 miles away, would have sufficient capacity to handle off-Site disposal, if necessary.

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

Several nonprofits raised concerns regarding the potential impacts of the AP on groundwater and surface water quality including Earthjustice, the Prairie Rivers Network, the League of Women Voters, and the Sierra Club (Earthjustice *et al*., 2018; LWVGP, 2021; Sierra Club, 2014; Sierra Club and CIHCA, 2014; UCS, 2018). The combination of source control (*i.e*., CIP using a consolidate-and-cap approach) with residual plume management would 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 will be held on April 30, 2025, pursuant to requirements under IAC Section 845.710(e). Questions raised by attendees will be answered at the meeting; subsequently, a written summary of all questions and responses will be made available to interested parties.

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). All three potential corrective action alternatives include source control (*i.e.*, CIP using a consolidate-and-cap approach) and residual plume management efforts. Source Control for AP would include excavation of CCR from the high points and northwestern section area, consolidation into the southern end and low areas of the AP, and the installation of a low-permeability final geomembrane cover system designed to limit the infiltration of precipitation into the impounded CCR. Groundwater modeling was performed in support of the Closure Plan (IngenAE, LLC, 2022b), and concluded that this source control approach would result in a reduction of the migration of water into the AP by 97% compared to pre-closure conditions. Additionally, source control would result in a reduction of hydraulic flux out of the AP by 94% compared to pre-closure conditions (Ramboll, 2022). Therefore, source control will prevent further releases of CCR constituents from AP into the environment.

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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 predicted that it would take more than 100 years after source control has been completed to achieve the GWPSs in all monitoring wells under the Source Control-GWP alternative. Under the Source Control-GWE alternative, GWPSs would be achieved in approximately 37 years after source control has been completed. Under the Source Control-Phytoremediation alternative, GWPSs would be achieved in approximately 48 to 77 years after source control has been completed (see Section 2.2.6; Appendix B; Ramboll, 2025b). Current modeling indicates that an additional 13 years may be required to prevent concentrations from rebounding above the GWPSs under the Source Control-GWE alternative and 22 to 73 years of system operation may be required to prevent concentrations from rebounding above the GWPSs under the Source Control-Phytoremediation alternative (see Section 2.2.6; Appendix B; Ramboll, 2025b). However, additional modeling would be performed, and additional data would be collected as part of the Corrective Action Groundwater Monitoring Plan to evaluate and assess the exact required duration of additional system operation. Specific considerations for residual plume management for each alternative are provided below.

- Residual plume management under the Source Control-GWP alternative would address impacted groundwater by relying on 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. Contaminant levels in groundwater are anticipated to drop below the GWPS at all compliance monitoring wells following the migration of background groundwater during the post-closure phase (Appendix E; Life Cycle Geo, LLC, 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 GWE trenches 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 could cause disturbances of some existing habitats atop portions of the construction areas, and habitats in the immediate vicinity of these locations by causing alarm and escape behavior in nearby wildlife (*e.g.*, due to noise disturbances). In addition, it is also possible that limited negative short-term impacts could occur to sensitive aquatic and wetland species in the discontinuous wetland areas in the immediate vicinity of the AP (see Section 1.1.3).
- Residual plume management under the Source Control-Phytoremediation alternative would rely on the phytoremediation installations (*i.e.*, approximately 550 trees) to remove the CCR-constituents in groundwater and control off-Site migration through the. Groundwater quality would also be improved as a result of physical and geochemical attenuation processes. The construction activities could cause disturbances of some existing habitats atop portions of the construction areas, and habitats in the immediate vicinity of these locations by causing alarm and escape behavior in nearby wildlife (*e.g.*, due to noise disturbances). In addition, it is also possible that limited negative short-term impacts could occur to sensitive aquatic and wetland species in the discontinuous wetland areas in the immediate vicinity of the AP (see Section 1.1.3).

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2.6 Summary

This CAAA evaluates all 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-GWE. The expected time to meet GWPS in all monitoring wells is expected to be shorter under the Source Control-GWE alternative (approximately 37 years) than under the Source Control-GWP alternative (more than 100 years) and the Source Control-Phytoremediation alternative (approximately 48 to 77 years). In addition, Source Control-GWE has higher operational reliability over the long-term than the Source Control-Phytoremediation alternative. Thus, Source Control-GWE is the most appropriate corrective action alternative for the AP.

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Appendix A

Human Health and Ecological Risk Assessment

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Human Health and Ecological Risk Assessment
Ash Pond
Edwards Power Plant
Bartonville, Illinois

June 30, 2022

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Abbreviations

ADI	Acceptable Daily Intake
AP	Ash Pond
BCF	Bioconcentration Factor
BCG	Biota Concentration Guide
BCU	Bedrock Confining Unit
CAA	Closure Alternatives Assessment
CCR	Coal Combustion Residual
CEM	Conceptual Exposure Model
COI	Constituent of Interest
COPC	Constituent of Potential Concern
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
EPP	Edwards Power Plant
ESV	Ecological Screening Value
GWPS	Groundwater Protection Standard
GWQS	Groundwater Quality Standards
HTC	Human Threshold Criteria
IAC	Illinois Administrative Code
IEPA	Illinois Environmental Protection Agency
ILWATER	Illinois Water and Related Wells
IPRG	Illinois Power Resources Generating, LLC
ISGS	Illinois State Geological Survey
MCL	Maximum Contaminant Level
NOEC	No Observed Effect Concentration
NPDES	National Pollutant Discharge Elimination System
NRWQC	National Recommended Water Quality Criteria
ORNL RAIS	Oak Ridge National Laboratory's Risk Assessment Information System
PMP	Potential Migration Pathway
PRG	Preliminary Remediation Goal
RfD	Reference Dose
RME	Reasonable Maximum Exposure
RSL	Regional Screening Level
SWQS	Surface Water Quality Standards
TEC	Threshold Effect Concentration
UA	Uppermost Aquifer
UCF	Upper Cahokia Formation
US DOE	United States Department of Energy
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey

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1 Introduction

The Edwards Power Plant (EPP or "the Site") is an electric power-generating facility with coal-fired units located in Peoria County, Illinois, between Mapleton and Bartonville. The facility is owned by Illinois Power Resources Generating, LLC (IPRG), and began operations in 1960. The EPP has one surface impoundment for storage of coal combustion residuals (CCR) known as the Ash Pond (AP), which covers approximately 91 acres (Ramboll, 2021). The EPP Ash Pond (Illinois Environmental Protection Agency [IEPA] ID No. W1438050005-01) is planned to commence closure by the end of 2022 and is the subject of this report.

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 potentially impacted by the AP. This risk evaluation was performed to support the Closure Alternatives Assessment (CAA) for the AP in accordance with requirements in Title 35 Part 845 of the Illinois Administrative Code (IAC) (IEPA, 2021a). Human and ecological risks were evaluated for Site-specific constituents of interest (COIs). The conceptual site model (CSM) assumed that Site-related COIs in groundwater may migrate to the Illinois River and affect surface water and sediment in the vicinity of the Site.

Consistent with United States Environmental Protection Agency (US EPA) guidance (US EPA, 1989), this report used a tiered approach to evaluate potential risks, which included the following steps:

1. Identify complete exposure pathways and develop a conceptual exposure model (CEM).
2. Identify Site-related COIs: Constituents detected in groundwater were considered COIs if their maximum detected concentration over the period from 2015 to 2021 exceeded a groundwater protection standard (GWPS), identified in Part 845.600 (IEPA, 2021a), or relevant surface water quality standards (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, Gradient considered evaluation criteria detailed in IEPA guidance documents (*e.g.*, IEPA, 2013, 2019), incorporating principles and assumptions consistent with the Federal CCR Rule (US EPA, 2015a) and US EPA's "Human and Ecological Risk Assessment of Coal Combustion Residuals" (US EPA, 2014).

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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 and ecological receptors resulting from CCR exposures associated with the AP 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 swimming or boating in the Illinois River adjacent to the Site.
- No unacceptable risks were identified for recreators exposed to sediment in the Illinois River 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 AP is 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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2 Site Overview

2.1 Site Description

The EPP is located in Peoria County, Illinois, between Mapleton and Bartonville, in a predominantly agricultural area. The EPP is bordered by a salt processing facility to the north, railroad right-of-way and former Orchard Mines to the west, the Illinois River and fertilizer production facility to the east, and agricultural land to the south (Figure 2.1) (Ramboll, 2021). The Illinois River flows adjacent to the facility from north to south (Figure 2.1). The AP discharges to the Illinois River under a National Pollutant Discharge Elimination System (NPDES) permit (Ramboll, 2021).

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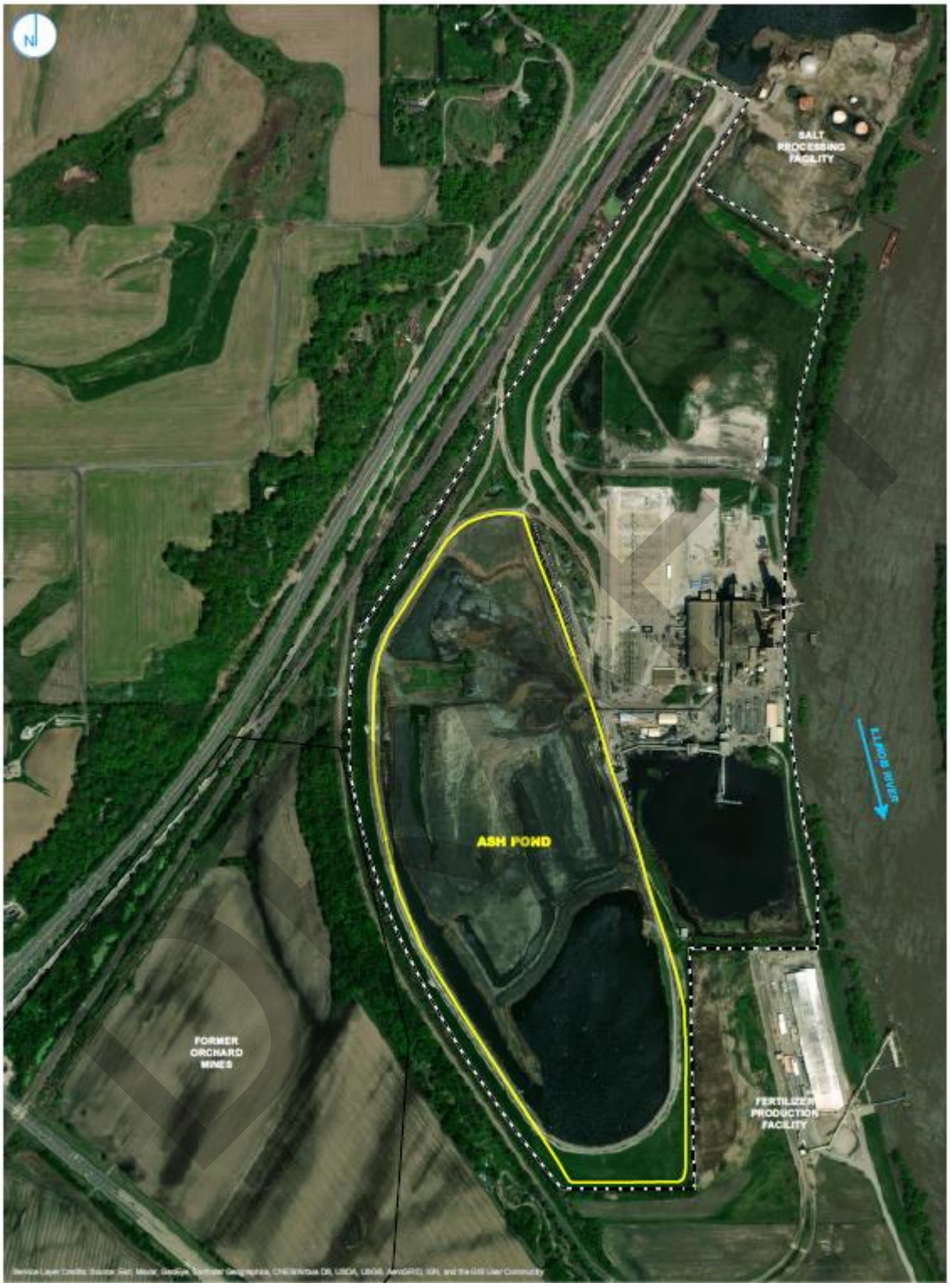

Figure 2.1 Site Location Map. Source: Ramboll (2021).

2.2 Geology/Hydrogeology

The geology underlying the Site in the vicinity of the AP primarily consists of unlithified deposits of the Cahokia Formation, underlain by a thick shale bedrock (Ramboll, 2021). The uppermost aquifer (UA) has been identified as the Lower Cahokia Formation (LCF) and saturated portions of the Upper Cahokia Formation (UCF) (Ramboll, 2021). The underlying shale has been identified as a bedrock confining unit (BCU) (Ramboll, 2021).

The UCF consists of low-permeability clays and silts, as well as discontinuous lenses of sand, sandy clay to clayey sand, and sandy silt. The saturated and unconfined sandy lenses within the UCF have been identified as Potential Migration Pathways. The thickness of the UCF ranges between 5 and 40 feet (ft) in the vicinity of the AP (Ramboll, 2021). The LCF consists of coarse materials of sand and gravel directly overlying the bedrock. The UA includes the LCF and, where saturated, portions of the UCF (Ramboll, 2021). The UA is primarily composed of moderately permeable sands and clayey gravels with a geometric mean horizontal hydraulic conductivity of 1.6×10^{-4} centimeters per second (cm/s) (Ramboll, 2021). Horizontal hydraulic gradients calculated for the UA range from 0.001 to 0.004 ft/ft (Ramboll, 2021). The bottom of the UA (*i.e.*, LCF) overlies the shale BCU. This confining layer consists of very low-permeability shales and siltstones with interbedded sandstone. The BCU has a geometric mean horizontal hydraulic conductivity of 3.2×10^{-6} cm/s (Ramboll, 2021), approximately two orders of magnitude lower than the overlying UA.

The alluvial soils of the UA are limited to areas immediately adjacent to and underlying the Illinois River and are located in north-south orientation parallel to the river (Ramboll, 2022a). In the area immediately underlying the AP, a thick layer of low-permeability clays associated with the UCF has been observed (Ramboll, 2022a). This clay layer restricts the migration of groundwater from the saturated deposits underlying the AP into the surrounding areas. West of the AP, the elevation of the ground surface increases and, correspondingly, the elevation of the shale BCU also increases. Based on regional information, alluvial soils are not expected to occur in the areas west of US Highway 24 (Ramboll, 2022a).

Groundwater flow within the UA occurs in both a northward and southward direction along the orientation of the UA, parallel to the river (Figure 2.2). The Illinois River recharges groundwater (*i.e.*, surface water flows into groundwater) throughout much of the area surrounding the EPP. Due to the hydraulic influence of the AP, a groundwater mound (*i.e.*, piezometric maximum) is located underneath the AP. This mound facilitates groundwater flow in both a northward and southward direction (Figure 2.2). Moreover, the groundwater mound associated with the AP may have resulted in a localized area in which groundwater flows in an easterly direction to the Illinois River. This easterly groundwater flow component and potential groundwater interaction with surface water in the Illinois River is expected to be eliminated after pond closure when the hydraulic head in the AP is removed. Because the shale BCU is elevated in the areas west of the AP and alluvial soils are not expected to occur west of the AP past US Highway 24, there is expected to be only a limited groundwater flow component from areas underlying the AP toward the west.

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Figure 2.2 Groundwater Elevation in Uppermost Aquifer – February 2021. Source: Ramboll (2021).

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 AP migrates and potentially interacts with surface water and sediment in the adjacent Illinois River. The CSM was developed using available hydrogeologic data specific to the AP (Ramboll, 2021), including information on groundwater flow and surface water characteristics.

CCR-related constituents from the AP may migrate vertically downward and into groundwater. Once in groundwater, these constituents may migrate northward and southward consistent with the primary groundwater flow directions. Based on groundwater modeling and groundwater monitoring conducted at the Site, and because of the low-permeability clays underlying the AP, no CCR-related constituents from

the AP have migrated off of the EPP property to the north or the south in excess of their GWPS (Figure 2.3). Some CCR-constituents may migrate eastward to the Illinois River, as a result of the groundwater mound caused by the AP. As a result, dissolved constituents in groundwater may partition between river sediments and Illinois River surface water.

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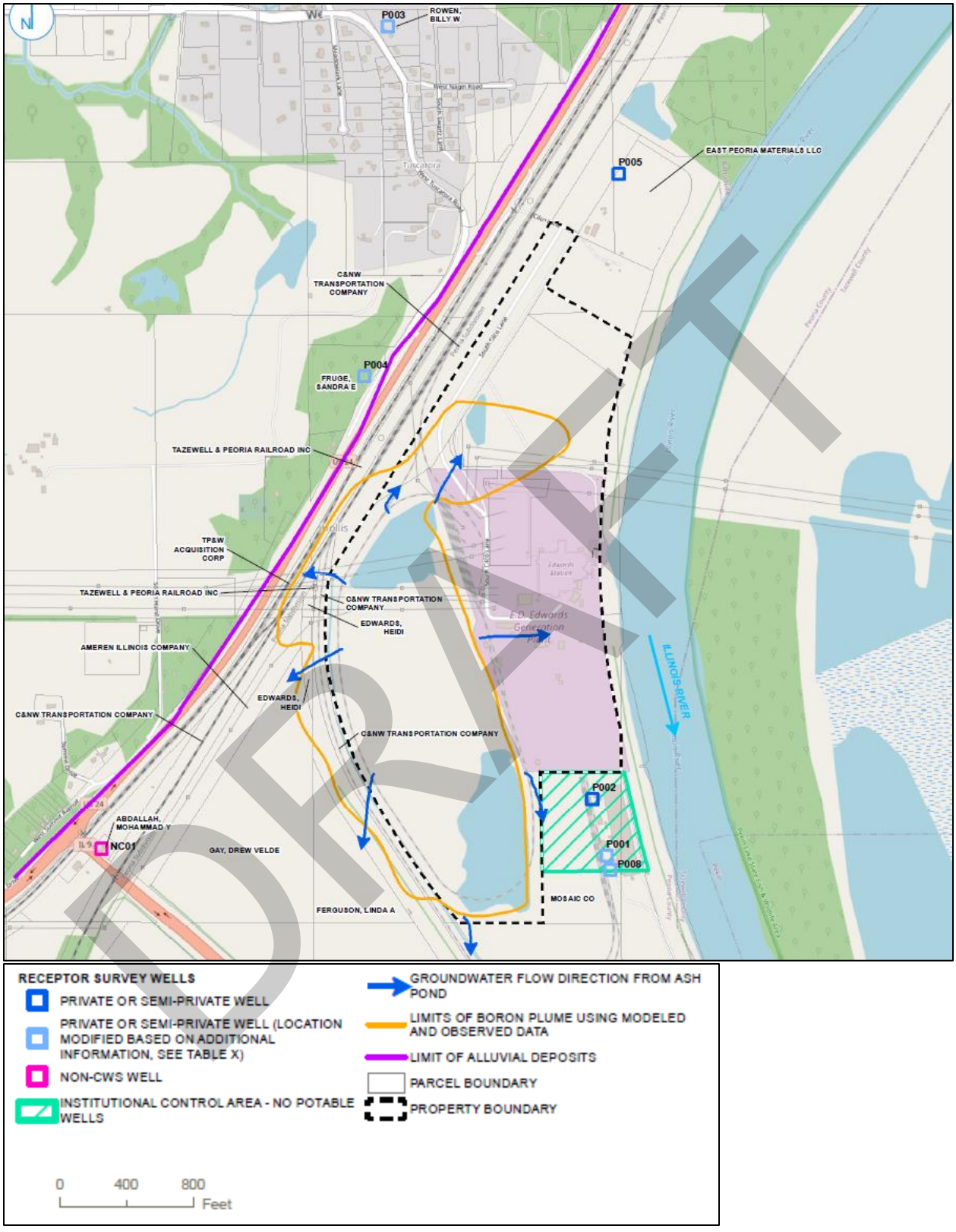

Figure 2.3 Modeled and Observed Extent of Boron in Groundwater and Water Wells Identified in Receptor Survey. Source: Ramboll (2022b).

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2.4 Groundwater Monitoring

A total of 28 wells have been used to monitor the groundwater quality near and downgradient of the AP. Of these, 18 wells are screened in the UA, 8 are screened in the UCF, and 3 are screened in the BCU (Table 2.1) (Ramboll, 2021). The analyses presented in this report relied on all available data from the 28 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, 2021a).[1] A summary of the groundwater data used in this risk evaluation is presented in Table 2.2. The AP well locations are shown in Figure 2.4. Note that there are additional wells located within the boundary of the AP and screened in pore water, that were not used in this risk analysis because they are not reflective of groundwater. The use of groundwater data in this risk evaluation does not imply that any detected constituents are associated with the AP or that they have been identified as potential groundwater exceedances.

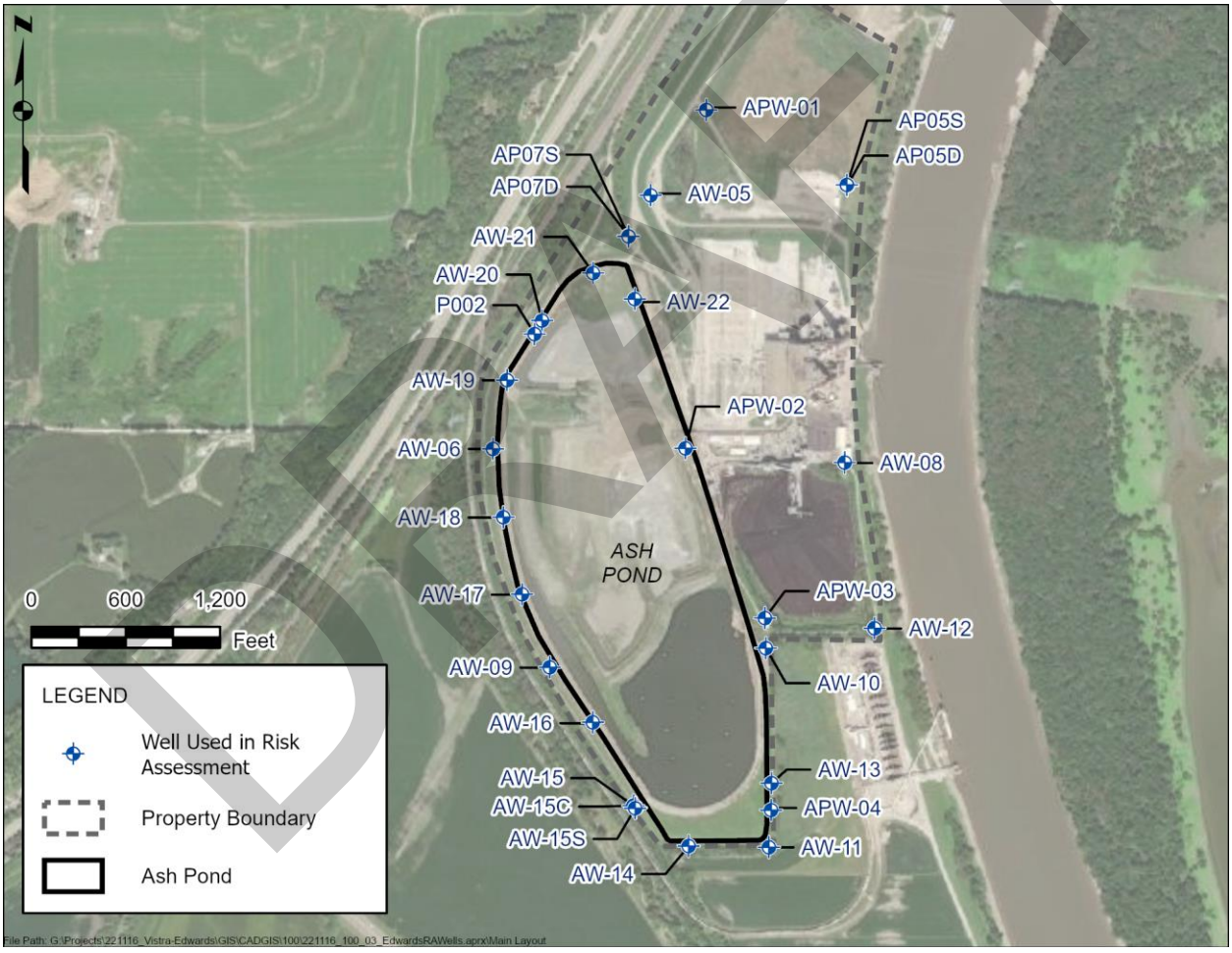

Figure 2.4 Monitoring Well Locations. Source: Ramboll (2021).

[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 Edwards Ash Pond

Well	Hydrogeologic Unit	Date Constructed	Screen Top Depth (ft bgs)	Screen Bottom Depth (ft bgs)	Well Depth (ft bgs)
AP05S	UA	11/29/2016	32.87	37.64	38.06
AP05D	BCU	12/05/2016	47.09	56.69	57.17
AP06[a]	UCF	11/30/2016	19.93	24.72	25.00
AP07S	UCF	12/02/2016	29.95	34.74	35.00
AP07D	BCU	12/08/2016	55.01	64.59	65.00
APW-01	UCF	07/27/2010	7.60	18.00	18.00
APW-02	UCF	07/20/2010	39.60	50.00	50.00
APW-03	UCF	07/19/2010	19.60	30.00	30.00
APW-04	UCF	07/27/2010	9.60	20.00	20.00
AW-05	UA	07/22/2015	15.87	20.47	21.10
AW-06	UA	08/03/2015	36.60	41.09	41.69
AW-08	UA	07/21/2015	47.55	57.19	57.70
AW-09	UA	08/03/2015	47.14	51.62	52.23
AW-10	UA	07/23/2015	27.62	32.23	32.74
AW-11	UA	07/28/2015	24.21	28.81	29.31
AW-12	UA	01/07/2021	26.00	31.00	31.00
AW-13	UA	01/09/2021	25.00	30.00	30.00
AW-14	UA	01/08/2021	24.00	29.00	29.00
AW-15	UA	01/08/2021	33.00	38.00	38.00
AW-15C	BCU	01/08/2021	43.00	48.00	48.00
AW-15S	UCF	01/08/2021	8.00	18.00	18.00
AW-16	UA	01/08/2021	55.00	60.00	60.00
AW-17	UA	01/08/2021	51.00	56.00	56.00
AW-18	UA	01/09/2021	46.00	51.00	51.00
AW-19	UA	01/09/2021	35.00	40.00	40.00
AW-20	UA	01/10/2021	36.50	41.50	41.50
AW-21	UA	01/10/2021	32.00	37.00	37.00
AW-22	UA	01/08/2021	44.00	49.00	49.00
P002	UCF	--	30.60	35.60	35.90

Notes:
Source: Ramboll (2021).
-- = Data Unavailable; BCU = Bedrock Confining Unit; bgs = Below Ground Surface; ft = Feet; UA = Uppermost Aquifer; UCF = Upper Cahokia Formation.

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Table 2.2 Groundwater Data Summary

Constituent	Samples with Constituent Detected	Samples Analyzed	Minimum Detected Value	Maximum Detected Value	Maximum Detection Limit
Total Metals (mg/L)					
Antimony	4	229	0.003	0.0045	0.003
Arsenic	228	253	0.001	0.097	0.02
Barium	253	253	0.062	8.6	0.02
Beryllium	29	253	0.00085	0.017	0.001
Boron	260	260	0.047	12	0.4
Cadmium	14	229	0.0011	0.004	0.001
Chromium	93	253	0.004	0.59	0.004
Cobalt	141	253	0.002	0.29	0.002
Lead	109	253	0.001	0.27	0.001
Lithium	179	253	0.011	0.85	0.02
Mercury	8	229	0.00021	0.0018	0.0002
Molybdenum	211	253	0.001	0.046	0.002
Selenium	57	253	0.001	0.019	0.004
Thallium	5	229	0.0012	0.0026	0.001
Radionuclides (pCi/L)					
Radium-226+228	252	252	0	23	1.93
Other (mg/L)					
Chloride	260	260	5.2	830	250
Fluoride	128	260	0.25	10.2	2.5
Sulfate	181	260	1	570	250
Total Dissolved Solids	260	260	390	2,600	34

Notes:
Source: Ramboll (2021).
pCi/L = PicoCuries Per Liter.

2.5 Surface Water Sampling

One surface water sample was collected from the Illinois River in 2017, as part of the Antidegradation Alternatives Analysis (Foth Infrastructure & Environment, LLC, 2017). The sample was collected from the "River Inlet," located approximately 1,000 feet north (upstream) of the AP outfall to the river (Figure 2.5, Table 2.3) (Foth Infrastructure & Environment, LLC, 2017). It should be noted that although this sample location is due east of the northern end of the AP, it was not collected specifically to examine the potential impact of the AP on the Illinois River. Data from this sample are included in this report for completeness; however, due to the lack of upstream and downstream samples, results from this sample are insufficient to evaluate the potential impact of the AP on the surface water quality conditions in the Illinois River. Instead, the potential impact of groundwater flowing from the UA to the Illinois River was modeled to predict potential surface water effects resulting from the AP (Section 3.3.3). These model-predicted surface water concentrations were used in this evaluation to assess potential risk to surface water receptors.

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Figure 2.5 Surface Water Sampling Location. Source: Foth Infrastructure & Environment, LLC (2017, Figure 1).

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Table 2.3 Surface Water Data Summary

Constituent	Detected Concentration (mg/L)
Total Metals	
Arsenic	0.0025
Barium	0.080
Boron	0.097
Cadmium	0.00023
Chromium	0.0073
Copper	0.0063
Iron	4.2
Lead	0.0049
Manganese	0.11
Mercury	0.000015
Nickel	0.0060
Selenium	0.0012
Silver	0.000028
Zinc	0.033
Other	
Chloride	100
Fluoride	0.23
Sulfate	65
Total Dissolved Solids	534

Notes:
Source: Foth Infrastructure & Environment, LLC (2017).
Sample collected from the River Inlet location on February 13, 2017.

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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 AP have the potential to pose adverse health effects to human and ecological receptors. The risk evaluation is consistent with the principles of risk assessment established by US EPA and has considered evaluation criteria detailed in Illinois guidance documents (*e.g.*, IEPA, 2013, 2019).

The general risk evaluation approach is summarized in Figure 3.1 and discussed below.

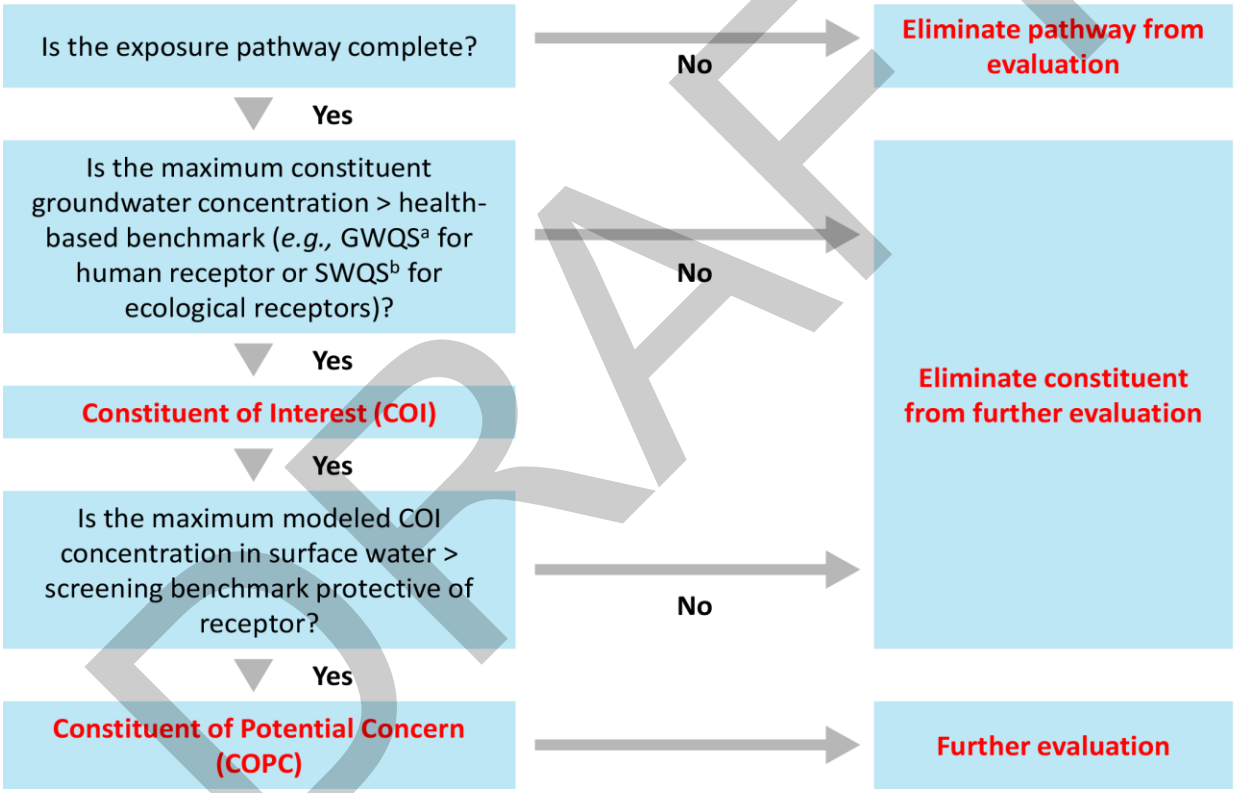

Figure 3.1 Overview of Risk Evaluation Methodology. GWQS = Groundwater Quality Standard; IEPA = Illinois Environmental Protection Agency; SWQS = Surface Water Quality Standard.
(a) The IEPA Part 845 GWPS were used to identify COIs.
(b) IEPA SWQS protective of chronic exposures to aquatic organisms were used to identify ecological COIs. In the absence of SWQS, US EPA Region IV Ecological Screening Values (ESV) were used.

The first step in the risk evaluation was to develop the CEMs and identify complete exposure pathways. All potential receptors and exposure pathways based on groundwater use and surface water use in the vicinity of the Site were considered. Exposure pathways that are incomplete were excluded from the evaluation.

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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), groundwater flows in both a northward and southward direction along the orientation of the LCF/UA, parallel to the river. In the area immediately underlying the AP, a thick layer of low-permeability clays associated with the UCF has been observed (Ramboll, 2022a). This clay layer restricts groundwater migration from the saturated deposits underlying the AP to the surrounding areas. A groundwater mound associated with operation of the AP may cause a localized zone where groundwater flows in an easterly direction into the Illinois River. This easterly groundwater flow component and potential groundwater interaction with surface water in the Illinois River is expected to be eliminated after pond closure when the hydraulic head in the AP is removed. There is expected to be only a limited groundwater flow component from areas underlying the AP toward the west.

One surface water sample was collected from the Illinois River adjacent to the Site; however, sediment samples have not been collected from the river. 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 AP-related wells. The measured and modeled COI concentrations in surface water and sediment were compared to conservative, generic risk-based screening benchmarks for human health and ecological receptors. These generic screening benchmarks rely on default assumptions with limited consideration of site-specific characteristics. Human health benchmarks are receptor-specific values calculated for each pathway and environmental medium that are designed to be protective of human health. Ecological benchmarks are medium-specific values designed to be protective of all potential ecological receptors exposed to surface water. Ecological and human health screening benchmarks are inherently conservative because they are intended to screen out chemicals that are of no concern with a high level of confidence. Therefore, a measured or modeled COI concentration exceeding a screening benchmark does not indicate an unacceptable risk; it only indicates 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 AP 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.

[2] As discussed further in Section 3.3.2, groundwater quality standards 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.

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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 the 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 AP into groundwater, surface water, sediment, and fish. The following human receptors and exposure pathways were evaluated for inclusion in the Site-specific CEM:

- Residents – exposure to groundwater/surface water as drinking water
- Residents – exposure to groundwater/surface water used for irrigation
- Recreators in the river near 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. 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.

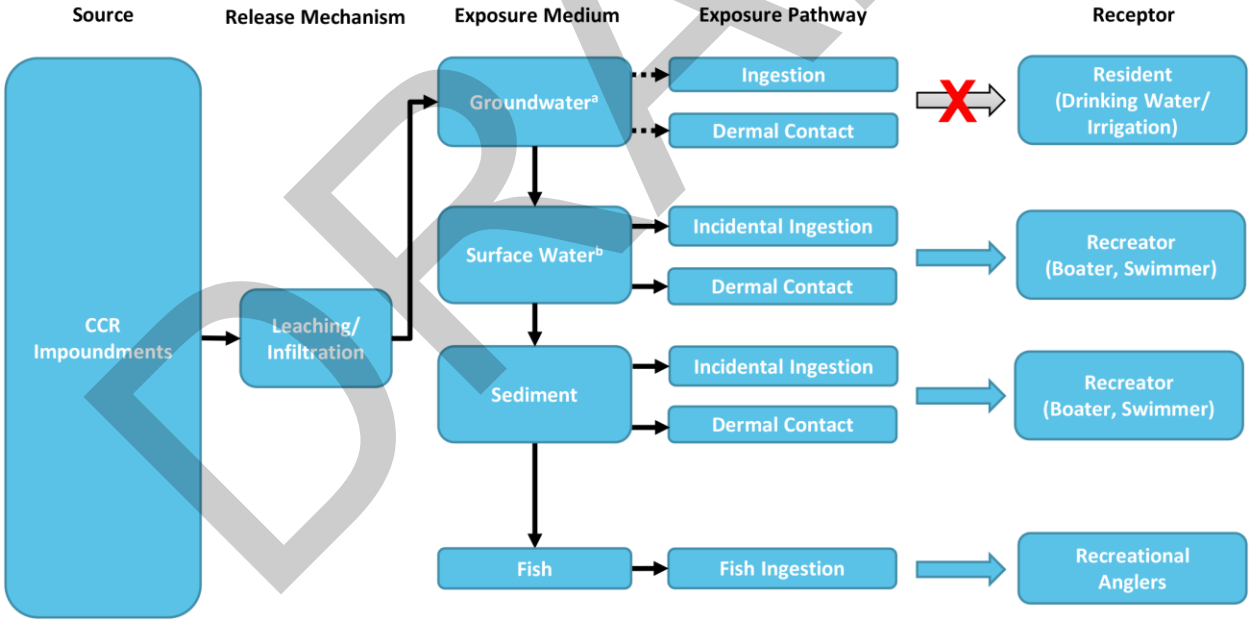

Figure 3.2 Human Conceptual Exposure Model. CCR = Coal Combustion Residual. Dashed line/Red X = Incomplete or Insignificant Exposure Pathway.
(a) Groundwater in the vicinity of the Site is not used as a drinking water or irrigation source.
(b) Surface water is not used as a drinking water source.

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3.2.1.1 Groundwater or Surface Water as a Drinking Water/Irrigation Source

Groundwater as a source of drinking water and/or irrigation water is not a complete exposure pathway for CCR-related constituents originating from the AP. Based on groundwater modeling and groundwater monitoring conducted at the Site, and because of the low-permeability clays underlying the AP, no CCR-related constituents from the AP have migrated off of the EPP property to the north or the south in excess of their GWPS (Figure 2.3). Additionally, a summary of the evidence, presented below, supports the conclusion that there are no residential uses of groundwater that could be impacted as a result of the AP. Furthermore, Illinois River surface water is not used as a source of drinking water in the area.

- **There are no groundwater users near the EPP in areas where groundwater could be impacted due to the AP.** Relying on federal and state databases, Ramboll completed a potable water well survey in 2021 (Ramboll, 2021). A total of 7 wells were identified proximate to the EPP during a comprehensive search of the Illinois State Geological Survey's (ISGS) Illinois Water and Related Wells (ILWATER) Map (ISGS, 2020; Ramboll, 2021) (Figure 2.3). All of these wells are either in areas where groundwater is not expected to be impacted by the AP or are industrial wells that are not used for domestic purposes (Ramboll, 2021). Specific information pertaining to each well identified in the receptor survey is provided below.

    - Well P004: This is a residential well located on the bluff above the Illinois River, north of the AP. The well is 65 feet deep and screened in the shale bedrock (ISGS, 1978). The shale bedrock is a hydrostratigraphic unit that has a limited hydraulic connection to the UCF and LCF soil deposits located on the EPP property. Based on topographic maps, the ground surface elevation at the well is approximately 480 ft msl (based on NAVD88)[3] (USGS, 2017). Thus, the bottom of P004 is located at an elevation of approximately 415 ft msl (570 ft minus 65 ft). The well log indicates that the bedrock was encountered at a depth of 30 feet (ISGS, 1978), which is at an elevation of 450 ft msl (480 ft minus 30 ft). Additionally, the well log indicates that groundwater was encountered at a depth of 37 feet below the top casing (which is 36 feet below ground surface [ft bgs]; ISGS, 1978). Thus, the groundwater elevation at P004 is 444 ft msl (480 ft minus 36 ft). Because the groundwater elevation is below the depth of the bedrock, the unlithified soils at P004 are unsaturated (*i.e.*, there is no alluvial aquifer at P004). Additionally, the measured groundwater elevation at P004 (444 ft msl) is higher than the measured groundwater elevations at AW-05 and APW-01 (approximately 435 ft msl; Figure 2.2), which are the closest monitoring wells to P004, and are screened in unlithified soils of the UCF and LCF. Thus, it is impossible for any groundwater impacts associated with the AP to impact groundwater quality at well P004.

    - Well P003: This is a residential well located to the north of the EPP. The well is 43 feet deep and screened in clay (ISGS, 1969). Based on topographic maps, the ground surface elevation at the well is approximately 570 ft msl (based on NAVD88) (USGS, 2017); thus, the bottom of P003 is located at an elevation of approximately 527 ft msl (570 ft minus 43 ft). Because groundwater underlying the AP is located at an elevation of approximately 430 to 440 ft msl (Figure 2.2; *i.e.*, 87 to 97 ft lower than P003), it is impossible for any groundwater impacts associated with the AP to impact groundwater quality at P003.

    - Well P005: This is a well located on an industrial property, owned by East Peoria Materials LLC, north of the EPP. The well was installed to a depth of 60 ft bgs into bedrock (ISGS, 1987). After the well was drilled, the driller's notes indicated that it did not yield sufficient

[3] NAVD88 is the North American Vertical Datum of 1988.

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water ("no water"; ISGS, 1987); thus, Gradient believes this well is not likely to be active, if it even still exists.

- Well P001: This is an industrial well located on the Mosaic Company property, formerly owned by Cargill Marine and Terminal and Cargo Carriers. The well was installed to a depth of 20 ft bgs into clay (ISGS, 2001). As a result of prior recognized environmental conditions on the property, land-use restrictions have been implemented that prevent anyone from installing, operating, or maintaining a potable water supply well (Eastep, 2003). Thus, it is not expected that this well is used for domestic purposes.
- Well P002: This is an industrial well located on the Mosaic Company property, formerly owned by Cargill Marine and Terminal and Cargo Carriers. The well was installed to a depth of 30 ft bgs into clay (ISGS, 1968). As a result of prior recognized environmental conditions on the property, land-use restrictions have been implemented that prevent anyone from installing, operating, or maintaining a potable water supply well (Eastep, 2003). Thus, it is not expected that this well is used for domestic purposes.
- Well P008: This is an industrial well located on the Mosaic Company property, formerly owned by Cargill Marine and Terminal and Cargo Carriers. The well was installed to a depth of 300 ft bgs into shale bedrock (ISGS, 2017). As a result of prior recognized environmental conditions on the property, land-use restrictions have been implemented that prevent anyone from installing, operating, or maintaining a potable water supply well (Eastep, 2003). Thus, it is not expected that this well is used for domestic purposes.
- NC-01: This is a non-community water source well associated with the Freedom Gas Station (Hahn, 2020). Peoria County Health Department indicated that the well is not a potable well (Hahn, 2020). Moreover, the well is side-gradient from the AP and unlikely to be affected by any AP-related impacts.

- **The Illinois River is not used as a public water supply adjacent to the Site.** The Illinois River is classified as a "General Use Water." IEPA supports the use of the Illinois River for aquatic life and primary contact recreation, but it is not designated for public and food processing water supplies (IEPA, 2018). The Illinois River is used as a public water supply in the city of Peoria, IL; however, this location is approximately 9 miles upstream of the Site (ISWS, 2022). The segment of the Illinois River adjacent to the Site (Assessment Unit ID: IL D-05) is listed on the 2018 Illinois Section 303(d) List as being impaired for fish consumption, due to mercury and polychlorinated biphenyls (US EPA, 2018; IEPA, 2021b). Therefore, surface water adjacent to the Site is not used as a source of drinking water, and this exposure pathway was not evaluated further.
- **The AP has a limited hydraulic connection to underlying bedrock groundwater resources**. The shale bedrock aquitard underlying the UA forms a hydraulic barrier between the AP and deeper groundwater resources. Due to very low hydraulic conductivity of the shale bedrock aquitard, downward migration of shallow groundwater to the underlying aquifers is expected to be limited. Therefore, the likelihood of AP-related impacts to the deep groundwater resources is minimal.

3.2.1.2 Recreational Exposures

The Illinois River flows from north to south past the Site. Recreational exposure to surface water and sediment may occur during activities such as swimming, boating, or fishing in the river. Exposure estimates for swimmers provide a health-protective means to evaluate exposure during other recreational activities. Recreational anglers may also consume locally caught fish from the Illinois River.

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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 3.3 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)

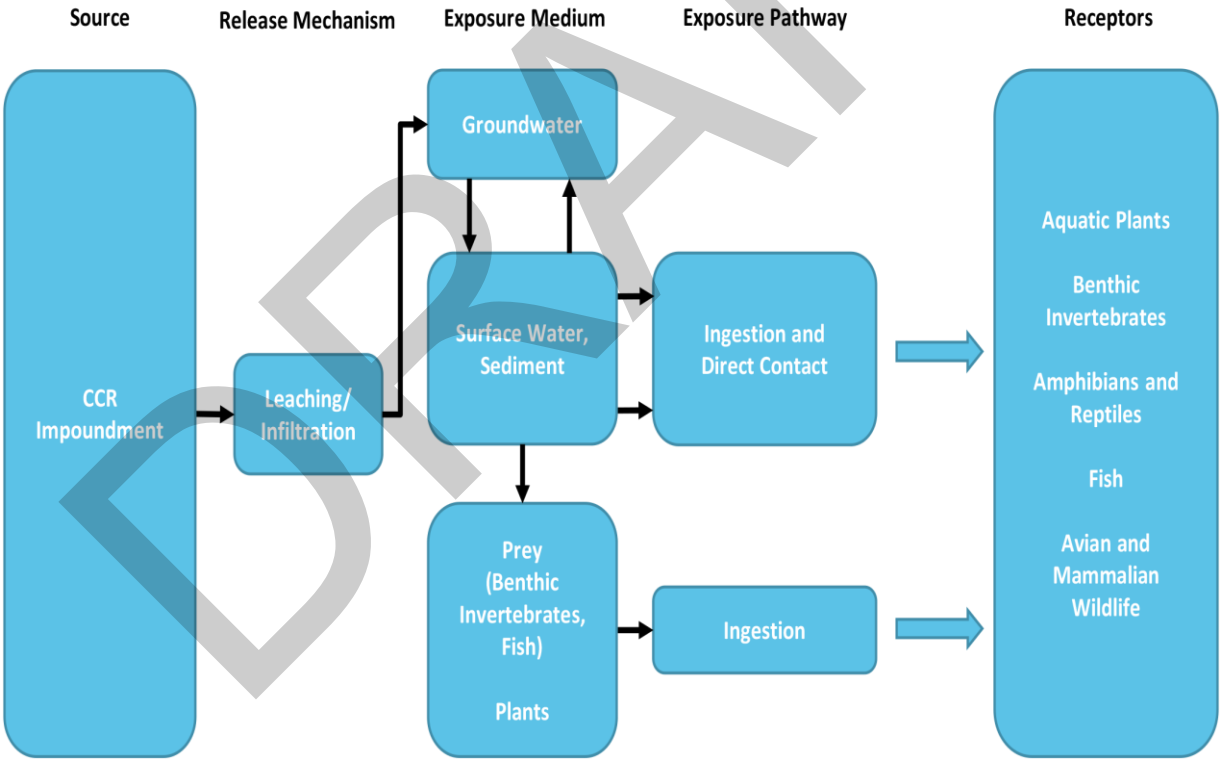

Figure 3.3 Ecological Conceptual Exposure Model. CCR = Coal Combustion Residual.

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3.3 Identification of Constituents of Interest

Risks were evaluated for COIs. A constituent was considered a COI if the maximum detected constituent concentration in groundwater exceeded a health-based benchmark. According to US EPA risk assessment guidance (US EPA, 1989), this screening step is designed to reduce the number of constituents carried through the risk evaluation that are anticipated to have a minimal contribution to the overall risk. Identified COIs are the constituents that are most likely to pose a risk concern in the surface water adjacent to the Site.

3.3.1 Human Health Constituents of Interest

For the human health risk evaluation, COIs were conservatively identified as constituents with maximum concentrations in groundwater above the GWPS listed in the Illinois CCR Rule Part 845.600 (IEPA, 2021a). Gradient used the maximum detected concentrations from groundwater samples collected from all of the AP-associated wells, regardless of hydrostratigraphic unit. The use of groundwater data in this risk evaluation does not imply that detected constituents are associated with the AP or that they have been identified as potential groundwater exceedances. Using this approach, 11 COIs (arsenic, barium, beryllium, boron, chromium, cobalt, lead, lithium, thallium, radium-226+228, and fluoride) were identified for the human health risk evaluation *via* the surface water pathway (Table 3.1).

The water quality parameters that exceeded the GWPS included 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.

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Table 3.1 Human Health Constituents of Interest

Constituent[a]	Maximum Concentration	GWPS[b]	Human Health COI[c]
Total Metals (mg/L)			
Antimony	0.0045	0.006	No
Arsenic	0.097	0.01	Yes
Barium	8.6	2	Yes
Beryllium	0.017	0.004	Yes
Boron	12	2	Yes
Cadmium	0.004	0.005	No
Chromium	0.59	0.1	Yes
Cobalt	0.29	0.006	Yes
Lead	0.27	0.0075	Yes
Lithium	0.85	0.04	Yes
Mercury	0.0018	0.002	No
Molybdenum	0.046	0.1	No
Selenium	0.019	0.05	No
Thallium	0.0026	0.002	Yes
Radionuclides (pCi/L)			
Radium-226+228	23	5	Yes
Other (mg/L, unless otherwise noted)			
Chloride	830	200	No[d]
Fluoride	10.2	4	Yes
Sulfate	570	400	No[d]
Total Dissolved Solids	2,600	1,200	No[e]

Notes:
COI = Constituent of Interest; GWPS = Groundwater Protection Standard; MCL = Maximum Contaminant Level; pCi/L = PicoCuries Per Liter.
Shaded = Compound identified as a COI.
(a) The constituents are those listed in the IL Part 845.600 GWPS (IEPA, 2021a).
(b) The IL Part 845.600 GWPS (IEPA, 2021a) 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.

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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 a United States Department of Energy (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 AP-associated wells, (regardless of hydrostratigraphic unit) without considering spatial or temporal representativeness for ecological receptor exposures. The use of the maximum constituent concentrations in this evaluation is designed to conservatively identify COIs that warrant further investigation. Barium, boron, cadmium, chromium, cobalt, lead, lithium, mercury, radium-226+228, chloride, and fluoride were identified as COIs for ecological receptors (Table 3.2).

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[4] Hardness data are not available for the Illinois River adjacent to the Site; therefore, the US EPA (2022) default hardness of 100 mg/L was used. Use of a higher hardness value would result in less stringent screening values, thus, use of the US EPA default hardness is conservative.

Table 3.2 Ecological Constituents of Interest

Constituent[a]	Maximum Groundwater Concentration	Ecological Benchmark[b]	Basis	Ecological COI[c]
Total Metals (mg/L)				
Antimony	0.0045	0.19	US EPA R4 ESV	No
Arsenic	0.097	0.19	IEPA SWQC	No
Barium	8.6	5	IEPA SWQC	Yes
Beryllium	0.017	0.064	US EPA R4 ESV	No
Boron	12	7.6	IEPA SWQC	Yes
Cadmium	0.004	0.0011	IEPA SWQC	Yes
Chromium	0.59	0.21	IEPA SWQC	Yes
Cobalt	0.29	0.019	US EPA R4 ESV	Yes
Lead	0.27	0.020	IEPA SWQC	Yes
Lithium	0.85	0.44	US EPA R4 ESV	Yes
Mercury	0.0018	0.0011	IEPA SWQC	Yes
Molybdenum	0.046	7.2	US EPA R4 ESV	No
Selenium	0.019	1	IEPA SWQC	No
Thallium	0.0026	0.006	US EPA R4 ESV	No
Radionuclides (pCi/L)				
Radium-226+228	23	3	US DOE	Yes
Other (mg/L, unless otherwise noted)				
Chloride	830	500	IEPA SWQC	Yes
Fluoride	10.2	4	IEPA SWQC	Yes
Sulfate	570	NA	NA	No
Total Dissolved Solids	2,600	NA	NA	No

Notes:
AP = Ash Pond; COI = Constituent of Interest; ESV = Ecological Screening Value; GWPS = Groundwater Protection Standard; IEPA = Illinois Environmental Protection Agency; NA = Not Available; pCi/L = PicoCuries Per Liter; SWQC = Surface Water Quality Criteria; US DOE = United States Department of Energy; US EPA R4 = US Environmental Protection Agency Region IV.
Shaded = Compound identified as a COI.
(a) The constituents are those listed in the IL Part 845.600 GWPS (IEPA, 2021a) that were detected in at least one groundwater sample from the 28 wells related to the Edwards AP.
(b) Ecological benchmarks are from the hierarchy of sources discussed in Section 3.3.2: IEPA SWQC (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.

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3.3.3 Surface Water and Sediment Modeling

One surface water sample was collected from the Illinois River adjacent to the Site; however, as discussed in Section 2.5, this sample is insufficient to evaluate the potential impact of the AP on the Illinois River. Therefore, to estimate the potential contribution to surface water (and sediment) from groundwater specifically associated with the AP, Gradient modeled concentrations in the Illinois River surface water and sediment from groundwater that may flow to the Illinois River for the detected human and ecological COIs (arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, lead, lithium, mercury, thallium, radium-226+228, chloride, and fluoride). The constituents detected in groundwater above a ecological or health-based benchmark are most likely to pose a risk concern in the adjacent surface water. Gradient modeled human health and ecological COI concentrations in the surface water and sediment using a mass balance calculation based on the surface water and groundwater mixing. The model assumes a well-mixed groundwater-surface water location.

The maximum detected concentrations in groundwater (regardless of well location) from 2015 to 2021 were conservatively used to model COI concentrations in surface water and sediment. The groundwater data were measured as total metals. Use of the total metal 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 to 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 AP-related groundwater and does not account for background concentrations in surface water or sediment.

For this evaluation, Gradient adapted a simplified and conservative form of US EPA's indirect exposure assessment methodology (US EPA, 1998) that was used in US EPA's coal combustion waste risk assessment (US EPA, 2014). The model is a mass-balance calculation based on surface water and groundwater mixing and the concept that the dissolved and sorbed concentrations can be related through an equilibrium partition 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, Gradient 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).

The aquifer and surface water properties used to estimate the volume of groundwater flowing to the Illinois River and surface water concentrations are presented in Table 3.3. The COI concentrations in sediment were modeled using the COI-specific sediment-to-water partitioning coefficients and the sediment properties presented in Table 3.4. In the absence of Site-specific information for the Illinois River, Gradient used default assumptions (*e.g.*, depth of the upper benthic layer and bed sediment porosity) to model sediment concentrations. The modeled surface water and sediment concentrations are presented in Table 3.5. These modeled concentrations reflect conservative contributions from groundwater. A description of the modeling and the detailed results are presented in Appendix A.

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Table 3.3 Groundwater and Surface Water Properties Used in Modeling

Parameter	Unit	Value	Notes/Source
Groundwater			
COI Concentration	mg/L	Constituent specific	Maximum detected concentration in groundwater.
Cross Section Area for the UA[a]	m^2	1,277	The length of the groundwater discharge zone was assumed to be equal to the length of the AP (*i.e.*, approximately 1,047 m). The thickness of the discharge zone was assumed to be equal to the maximum thickness of the UA (1.22 m) (Ramboll, 2021).
Hydraulic Gradient	m/m	0.004	Maximum average horizontal hydraulic gradient determined for the UA (Ramboll, 2021).
Hydraulic Conductivity of the UA	cm/s	0.00017	Geometric mean horizontal hydraulic conductivity for all UA wells (Ramboll, 2021).
Surface Water			
Surface Water Flow Rate	L/yr	5.3×10^{12}	Representative low flow (10th percentile) discharge rate for the Illinois River at USGS Kingston Mines, Illinois, gauging station (USGS 05568500) (USGS, 2022).
Total Suspended Solids (TSS)	mg/L	105	TSS data from Illinois River inlet (Foth Infrastructure & Environment, LLC, 2017).
Depth of the Water Column	m	2.74	Illinois River bathymetry data (Bist LLC, 2022).
Suspended Sediment to Water Partition Coefficient	mg/L	Constituent specific	Values based on US EPA (2014).

Notes:
AP = Ash Pond; COI = Constituent of Interest; L/yr = Liter Per Year; UA = Uppermost Aquifer; US EPA = United States Environmental Protection Agency; USGS = United States Geological Survey.
(a) The cross-sectional area represents the area through which groundwater flows from the UA to the Illinois River.

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Table 3.4 Sediment Properties Used in Modeling

Parameter	Unit	Value	Notes/Source
Sediment			
Depth of Upper Benthic Layer	m	0.03	Default (US EPA, 2014).
Depth of Water Body	m	2.77	Depth of water column (2.74 m, as indicated by Illinois River bathymetry data (Bist LLC, 2022) plus depth of upper benthic layer (0.03 m) (US EPA, 2014).
Bed Sediment Particle Concentration	g/cm^3	1	Default (US EPA, 2014).
Bed Sediment Porosity	-	0.6	Default (US EPA, 2014).
TSS Mass per Unit Area	kg/m^2	0.29	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 Partitioning Coefficients	mg/L	Constituent specific	Values based on US EPA (2014).

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

Table 3.5 Surface Water and Sediment Modeling Results

COI	Groundwater Concentration (mg/L or pCi/L)	Mass Discharge Rate (mg/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	0.097	2.7E+04	5.1E-09	6.9E-07
Barium	8.6	2.4E+06	4.5E-07	6.9E-05
Beryllium	0.017	4.7E+03	8.9E-10	2.1E-07
Boron	12	3.3E+06	6.3E-07	2.2E-06
Cadmium	0.0040	1.1E+03	2.1E-10	4.5E-08
Chromium	0.59	1.6E+05	3.1E-08	1.7E-04
Cobalt	0.29	7.9E+04	1.5E-08	2.5E-06
Lead	0.27	7.4E+04	1.4E-08	1.0E-05
Lithium	0.85	2.3E+05	4.4E-08	(a)
Mercury	0.0018	4.9E+02	9.4E-11	3.4E-07
Thallium	0.0026	7.1E+02	1.4E-10	1.2E-09
Radionuclides				
Radium-226+228	23	6.3E+06	1.2E-06	5.0E-03
Other				
Chloride	830	2.3E+08	4.3E-05	(a)
Fluoride	10.2	2.8E+06	5.3E-07	8.3E-05
Sulfate	570	1.6E+08	3.0E-05	(a)

Notes:
COI = Constituent of Concern; K_d = Equilibrium Partition Coefficient; pCi/L = PicoCuries Per Liter; pCi/kg = PicoCuries Per Kilogram.
(a) Lithium, chloride, and sulfate do not readily sorb to soil or sediment particles; a K_d value of 0 was used for the modeling.

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3.4 Human Health Risk Evaluation

The section below presents the results of the human health risk evaluation for recreators (boaters, swimmers and anglers) along the Illinois River adjacent to the Site. Risks were assessed using the maximum measured or modeled COIs in surface water.

3.4.1 Recreators Exposed to Surface Water

Screening Exposures: Recreators could be exposed to surface water *via* incidental ingestion and dermal contact while swimming or boating. In addition, anglers could consume fish caught in the Illinois River. 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 swimming) 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, 2021c) as a conservative estimate of the ADI. The RfDs are given in mg/kg-day, while the ADIs are given in mg/day; thus, Gradient multiplied the RfD by a standard body weight of 70 kg to obtain the ADI in mg/day. The calculation of the HTC values is shown in Appendix B, Table B.1.

Gradient used bioconcentration factors (BCFs) from a hierarchy of sources. The primary BCFs were those that US EPA used to calculate the National Recommended Water Quality Criteria (NRWQC) for human health (US EPA, 2002). Other sources included BCFs used in the US EPA coal combustion ash risk assessment (US EPA, 2014) and BCFs reported by Oak Ridge National Laboratory's Risk Assessment

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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, 2020a,b; ATSDR, 2010).

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.

The HTC for fish consumption for radium-226+228 was calculated as follows:

$$\mathrm{HTC} = \frac{\mathrm{TCR}}{(\mathrm{SF} \times \mathrm{BAF} \times \mathrm{F})}$$

where:

HTC = Human health protection criterion in picoCuries per liter (pCi/L)
TCR = Target cancer risk ($1x10^{-5}$)
SF = Food ingestion slope factor (risk/pCi)
BAF = Bioaccumulation factor (L/kg-tissue)
F = Fish consumption rate (kg/day)

The food ingestion slope factor (lifetime excess total cancer risk per unit exposure, in risk/pCi) used to calculate the HTC was the highest value of those for radium-226 (Ra-226), radium-228 (Ra-228), and "Ra-228+D" (US EPA, 2001). According to US EPA (2001), "+D" indicates that "the risks from associated short-lived radioactive decay products (*i.e.*, those decay products with radioactive half-lives less than or equal to 6 months) are also included."

Screening Risk Evaluation: The maximum modeled and measured COI concentrations in surface water were compared to the calculated Illinois HTC values (Table 3.6). All surface water concentrations were below their respective benchmarks. The HTC values are protective of recreational exposure *via* water and/or fish ingestion and do not account for dermal exposures to COIs in surface water while swimming. 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 swimming and anglers consuming fish caught in the Illinois River.

[5] Although recommended by US EPA (2015c), 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.

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Table 3.6 Risk Evaluation for Recreators Exposed to Surface Water

COI	Maximum Surface Water Concentration		HTC for Water and Fish	HTC for Water Only	HTC for Fish Only	COPC	
	Modeled	Measured[a]				Based on Modeled Concentrations	Based on Measured Concentrations
Total Metals (mg/L)							
Arsenic	5.1E-09	2.5E-03	0.022	2.0	0.023	No	No
Barium	4.5E-07	8.0E-02	1.5	400	1.5	No	No
Beryllium	8.9E-10	NR	0.021	0.80	0.021	No	NA
Boron	6.3E-07	9.7E-02	467	1,400	700	No	No
Cadmium	2.1E-10	2.3E-04	0.0018	1.0	0.0019	No	No
Chromium	3.1E-08	7.3E-03	0.61	20	0.63	No	No
Cobalt	1.5E-08	NR	0.0035	2.1	0.0035	No	NA
Lead	1.4E-08	4.9E-03	0.015	0.015	0.015	No	No
Lithium	4.4E-08	NR	4.7	14	7.0	No	NA
Mercury	9.4E-11	1.5E-05	0.000053	0.40	0.000053	No	No
Thallium	1.4E-10	NR	0.0017	0.40	0.0017	No	NA
Radionuclides (pCi/L)							
Radium-226+228	1.2E-06	NR	1,000	1,000	87,413	No	NA
Other (mg/L)							
Chloride	4.3E-05	1.0E+02	NA	NA	NA	NA	NA
Fluoride	5.3E-07	2.3E-01	143	800	174	No	No
Sulfate	3.0E-05	6.5E+01	NA	NA	NA	NA	NA

Notes:

COI = Constituent of Interest; COPC = Constituent of Potential Concern; HTC = Human Threshold Criteria; NA = Not Analyzed or Not Applicable; NR = Not Reported; pCi/L = PicoCuries Per Liter.

(a) Measured concentrations are shown only for COIs. Measured surface water concentrations may be different from modeled concentrations because measured data include the effects of background and other industrial sources. Modeled concentrations only represent the potential effect on surface water quality resulting from the measured groundwater concentrations.

3.4.2 Recreators Exposed to Sediment

Recreational exposure to sediment may occur during boating and swimming activity along the Illinois River; 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, 2021b). 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, 2021b). 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 (Stalcup, 2014). The daily recommended residential soil ingestion rates of 200 mg/day for a child and 100 mg/day for an adult are based on an all-day exposure to residential soils (Stalcup, 2014; US EPA,

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2011b). 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; Stalcup, 2014), which was used in the US EPA RSL User's Guide for a child recreator exposed to soil or sediment (US EPA, 2021b). The sediment screening benchmarks were calculated based on a target hazard quotient of 1, or a target cancer risk of $1x10^{-5}$. Appendix B, Table B.2 presents the calculation of screening benchmarks protective of recreational exposures to sediment. A recreator sediment screening benchmark for radium-226+228 was based on soil Preliminary Remediation Goals (PRGs) calculated for radium-226 and radium-228 using US EPA's PRG calculator (US EPA, 2020). The lower of the two values was used as the recreator sediment screening benchmark for radium-226+228 (Appendix B, Table B.3).

Screening Risk Evaluation: The modeled sediment concentrations were well below the recreational sediment screening benchmarks (Table 3.7). Therefore, exposure to sediment is not expected to pose an unacceptable risk to recreators while swimming or boating.

Table 3.7 Risk Evaluation for Recreators Exposed to Sediment

COI[a]	Modeled Sediment Concentration (mg/kg)	Recreator Sediment Screening Benchmark (mg/kg)	COPC
Total Metals (mg/kg)			
Arsenic	6.9E-07	6.8E+01	No
Barium	6.9E-05	2.7E+05	No
Beryllium	2.1E-07	2.7E+03	No
Boron	2.2E-06	2.7E+05	No
Chromium	1.7E-04	2.1E+06	No
Cobalt	2.5E-06	4.1E+02	No
Lead	1.0E-05	4.0E+02	No
Lithium	(a)	2.7E+03	NA
Thallium	1.2E-09	1.4E+01	No
Radionuclides (pCi/kg)			
Radium-226+228	5.0E-03	7.9E+03	No
Other (mg/kg)			
Fluoride	8.3E-05	5.5E+04	No

Notes:
COI = Constituent of Interest; COPC = Constituent of Potential Concern; K_d = Equilibrium Partition Coefficient; NA = Not Applicable; pCi/kg = PicoCuries Per Kilogram.
(a) Lithium does not readily sorb to soil or sediment particles; a K_d value of 0 was used for the modeling.

3.5 Ecological Risk Evaluation

Based on the ecological CEM (Figure 3.3), ecological receptors could be exposed to surface water and dietary items (*i.e.*, prey and plants) potentially impacted by identified COIs (barium, boron, cadmium, chromium, cobalt, lead, lithium, mercury, radium-226+228, chloride, and fluoride).

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3.5.1 Ecological Receptors Exposed to Surface Water

Screening Exposures: The ecological evaluation considered aquatic communities in the Illinois River 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.
- US DOE benchmarks from the guidance document, "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" (US DOE, 2019).

Risk Evaluation: The maximum measured or modeled COI concentrations in surface water were compared to the benchmarks protective of aquatic life (Table 3.8). The modeled surface water concentrations were below their respective benchmarks. In the measured data, iron, nickel, and zinc were slightly above their respective benchmarks (Table 3.8); however, they were not retained as COPCs. The measured concentrations for these three constituents are likely reflective of background concentrations in the Illinois River, as opposed to the AP, because they are all naturally occurring constituents that are not commonly associated with CCR (*i.e.*, none of the three constituents are listed in Appendix IV of the Federal CCR Rule [US EPA, 2015a]). Furthermore, the exceedance ratios (measured concentration divided by the benchmark) were very low for nickel (1.2) and zinc (1.03), thus, they are not expected to present an ecological risk. Iron was detected at 4.2 mg/L, *versus* an ecological benchmark of 1 mg/L; however, iron is ubiquitous in the environment and is not characteristic of impacts from CCR impoundments. Thus, none of the COIs evaluated are expected to pose an unacceptable risk to aquatic life in the Illinois River.

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

Table 3.8 Risk Evaluation of Ecological Receptors Exposed to Surface Water

COI	Maximum Surface Water Concentration		Ecological Freshwater Benchmark	Basis	COPC	
	Modeled	Measured			Based on Modeled Concentrations	Based on Measured Concentrations
Total Metals (mg/L)						
Barium	4.5E-07	8.0E-02	5.0	IEPA (2019)	No	No
Boron	6.3E-07	9.7E-02	7.6	IEPA (2019)	No	No
Cadmium	2.1E-10	2.3E-04	0.00093	IEPA (2019)	No	No
Chromium	3.1E-08	7.3E-03	0.18	IEPA (2019)	No	No
Cobalt	1.5E-08	NA	0.019	US EPA R4 (2018)	No	NA
Lead	1.4E-08	4.9E-03	0.016	IEPA (2019)	No	No
Lithium	4.4E-08	NA	0.44	US EPA R4 (2018)	No	NA
Mercury	9.4E-11	1.5E-05	0.0011	IEPA (2019)	No	No
Thallium	1.4E-10	NA	0.0060	US EPA R4 (2018)	No	NA
Radionuclides (pCi/L)						
Radium-226+228	1.2E-06	NA	3.4	US DOE (2019)	No	NA
Other (mg/L)						
Chloride	4.3E-05	1.0E+02	230	US EPA R4 (2018)	No	No
Fluoride	5.3E-07	2.3E-01	2.7	US EPA R4 (2018)	No	No

Notes:
COI = Constituent of Interest; COPC = Constituent of Potential Concern; IEPA = Illinois Environmental Protection Agency; NA =Not Analyzed or Not Applicable; pCi/L = PicoCuries Per Liter; US DOE = United States Department of Energy; US EPA R4 = United States Environmental Protection Agency Region IV.

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3.5.2 Ecological Receptors Exposed to Sediment

Screening Exposures: COIs in impacted groundwater flowing to the Illinois River 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.

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 no observed effect concentration (NOEC) of 38 mg/kg was used as a conservative benchmark for boron in the absence of an ESV (ECHA, 2019). Lithium, chloride, and fluoride are not expected to sorb to sediment; therefore, risk to ecological receptors exposed to sediment was not evaluated for these constituents. The benchmarks used in this evaluation are listed in Table 3.9.

Screening Risk Results: The maximum modeled COI sediment concentrations were below their respective sediment screening benchmarks (Table 3.9). The modeled sediment concentrations attributed to potential contributions from Site groundwater for all COIs were less than 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 Illinois River adjacent to the Site.

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[7] The biota concentration guide (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).

Table 3.9 Risk Evaluation of Ecological Receptors Exposed to Sediment

COI	Modeled Sediment Concentration	ESV[a]	COPC	% of Benchmark
Total Metals (mg/kg)				
Barium	6.9E-05	20	No	0.00035%
Boron	2.2E-06	38[b]	No	0.000006%
Cadmium	4.5E-08	0.99	No	0.000005%
Chromium	1.7E-04	43	No	0.0004%
Cobalt	2.5E-06	50	No	0.000005%
Lead	1.0E-05	35.8	No	0.00003%
Lithium	-	-	-	-
Mercury	3.4E-07	0.18	No	0.0002%
Radionuclides (pCi/kg)				
Radium-226+228	5.0E-03	90,000[c]	No	0.0000056%
Other (mg/kg)				
Chloride	-	-	-	-
Fluoride	8.3E-05	NA	No	-

Notes:
COI = Constituent of Interest; COPC = Constituent of Potential Concern; ESV = Ecological Screening Value; NA = Not Available; NOEC = No Observed Effect Concentration; pCi/kg = PicoCuries Per Kilogram; US DOE = United States Department of Energy; US EPA = United States Environmental Protection Agency.
(a) ESV from US EPA Region IV (2018).
(b) NOEC of 38 mg/kg was used as a conservative benchmark for boron in the absence of an ESV (ECHA, 2019).
(c) ESV from US DOE (2019); value converted from 90 pCi/g to 90,000 pCi/kg.

3.5.3 Ecological Receptors Exposed to Bioaccumulative Constituents of Interest

Screening Exposures: COIs with bioaccumulative properties can impact higher-trophic-level wildlife exposed to these COIs *via* direct exposures (surface water and sediment exposure) and secondary exposures through the consumption of dietary items (*e.g.*, plants, invertebrates, small mammals, and fish).

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

Risk Evaluation: With the exception of mercury, the ecological COIs (barium, boron, cadmium, chromium, cobalt, lead, lithium, radium-226+228, chloride, and fluoride) 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 (9.4×10^{-11} mg/L) was below the mercury surface water ESV for wildlife (1.3×10^{-6} mg/L), and the modeled mercury concentration in sediment (3.4×10^{-7} mg/kg) was below the sediment ESV for wildlife (0.18 mg/kg) (US EPA Region IV, 2018). Both the modeled surface water and sediment concentrations were below benchmarks protective of receptors

[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.

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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.

3.6 Uncertainties and Conservatisms

A number of uncertainties and their potential impact on the risk evaluation are discussed below. Wherever possible, conservative assumptions were used in an effort to minimize uncertainties and overestimate rather than underestimate risks.

Exposure Estimates:

- The risk evaluation included the IL Part 845.600 constituents detected in groundwater samples collected from wells associated with the AP. However, it is possible that not all of the detected constituents are related specifically to the AP.
- 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 AP groundwater, the detection limits were below the IL 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, which are lower than total concentrations, represent the mobile fractions of constituents that could likely flow to and mix with surface water.
- The COIs identified in this evaluation also occur naturally in the environment. Contributions to exposure from natural or other non-AP-related sources were not considered in the evaluation of modeled concentrations; only exposure contributions potentially attributable to Site groundwater mixing with surface water were evaluated. While not quantified, exposures from potential AP-related groundwater contributions are likely to represent only a small fraction of the overall human and ecological exposure to COIs that also have natural or non-AP-related sources.
- Screening benchmarks for human health were developed using exposure inputs based on US EPA's recommended values for reasonable maximum exposure (RME) assessments (Stalcup, 2014). RME is defined as "the highest exposure that is reasonably expected to occur at a site but that is still within the range of possible exposures" (US EPA, 2004). US EPA states the "intent of the RME is to estimate a conservative exposure case (*i.e.*, well above the average case) that is still within the range of possible exposures" (US EPA, 1989). US EPA also notes 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, 2015b). Thus, most individuals will have lower exposures than those presented in this risk assessment.

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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. Gradient relied on US EPA's default hardness of 100 mg/L due to the lack of hardness data from the Illinois River adjacent to the Site. However, United States Geological Survey (USGS) data from Hennepin, Illinois, (approximately 55 miles upstream of the Site) reported hardness ranging from 200 to 370 mg/L, with a mean of 288 mg/L, based on samples collected in 1980-1997 (USGS, 2021). Increasing the hardness from 100 to 288 mg/L would increase the cadmium SWQS because benchmarks increase (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. 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.

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4 Summary and Conclusions

A screening-level risk evaluation was performed for Site-related constituents in groundwater at the EPP in Peoria County, Illinois, between Mapleton and Bartonville. The CSM developed for the Site indicates that groundwater beneath the AP flows into the Illinois River adjacent to the Site and may potentially impact surface water and sediment.

CEMs were developed for human and ecological receptors. The complete exposure pathways for humans include recreators in the Illinois River who are exposed to surface water and sediment (boaters and swimmers) and anglers who consume locally caught fish. Based on the local hydrogeology, residential exposure to groundwater used for drinking water or irrigation is not a complete pathway and was not evaluated. The complete exposure pathways for ecological receptors include aquatic life (including aquatic and marsh plants, amphibians, reptiles, and fish) exposed to surface water; benthic invertebrates exposed to sediment; and avian and mammalian wildlife exposed to bioaccumulative COIs in surface water, sediment, and dietary items.

Groundwater data collected from 2015 to 2021 were used to estimate exposures, and data from the one available surface water sample was 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 and ecological receptors resulting from CCR exposures associated with the AP 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 (boaters and swimmers) 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 boating or swimming in the Illinois River 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 concentration are not expected to pose an unacceptable risk to recreators exposed to sediment in the Illinois River adjacent to the Site.
- For anglers consuming locally caught fish, the modeled concentrations of all COIs in surface water (as well as the measured data) were below conservative benchmarks protective of fish consumption. Therefore, none of the COIs evaluated are expected to pose an unacceptable risk to recreators consuming fish caught in the Illinois River.
- 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

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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 that tend to overestimate exposure and risk. The risk evaluation was based on the maximum detected COI concentration; however, US EPA guidance states that risks should be based on a representative average concentration such as the 95% upper confidence limit on the mean; thus, using the maximum concentration tends to overestimate exposure. Although the COIs identified in this evaluation also occur naturally in the environment, the contributions to exposure from natural background sources and nearby industry were not considered; thus, CCR-related exposures were likely overestimated. 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 AP is 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

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Gradient modeled concentrations in river surface water and sediment based on available groundwater data. First, we estimated the flow rate of constituents of interest (COIs) discharged to the Illinois River *via* groundwater. Then, we adapted United States Environmental Protection Agency (US EPA) indirect exposure assessment methodology (US EPA, 1998) in order to model surface water and sediment water concentrations in the Illinois River.

Model Overview

The groundwater flow to the river is represented by a one-dimensional, steady-state model. In this model, the groundwater plume migrates horizontally in the Uppermost Aquifer (UA) prior to flowing to the Illinois River. The groundwater flow entering the river is the flow going through a cross-sectional area that has a length equal to the Edwards Ash Pond (AP) and a width equal to the maximum saturated thickness of the UA. It was assumed that all the groundwater flowing through the UA would ultimately discharge to the Illinois River. The length of groundwater discharge zone was estimated using Google Earth Pro (Google, LLC, 2022).

The groundwater flow to the Illinois River mixes with the surface water in the river. The COIs entering the river *via* groundwater can dissolve into the water column, sorb to suspended sediments, or sorb to benthic sediments. Using US EPA's indirect exposure assessment methodology (US EPA, 1998), the model evaluates the surface water and sediment concentrations at a location downstream of the groundwater discharge, assuming a well-mixed water column.

Groundwater Discharge Rate

The groundwater discharge rate was evaluated using conservative assumptions. Gradient conservatively assumed that the groundwater concentrations were uniformly equal to the maximum detected concentration for each individual COI. Further, Gradient ignored adsorption by subsurface soil and assumed that all the groundwater flowing through the UA was discharged into the river.

For each groundwater unit, the groundwater flow rate into the river was derived using Darcy's Law:

$$Q = K \times i \times A$$

where:

Q = Groundwater flow rate (m^3/s)
K = Hydraulic conductivity (m/s)
i = Hydraulic gradient (m/m)
A = Cross-sectional area (m^2)

For each COI, the mass discharge rate into the river was then calculated by:

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

where:

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

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

The cross-sectional area for the UA was 1,277 m^2. The length of the discharge zone was estimated to be equal to the length of the AP (*i.e.*, approximately 1,047 m). The height of the discharge zone was assumed to be the maximum thickness of the UA (1.22 m) (Burns McDonnell, 2021). The hydraulic gradient was 0.004 m/m, based on the maximum average horizontal hydraulic gradient determined for the UA (Burns McDonnell, 2021). The hydraulic conductivity of the UA was 0.00017 cm/s, based on the geometric mean horizontal hydraulic conductivity for all UA wells (Burns McDonnell, 2021).

Surface Water and Sediment Concentration

Groundwater discharged into the river 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 we 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 [CCR]" (US EPA, 2014). This model describes the partitioning of constituents between surface water, suspended sediments, and benthic sediments based on equilibrium partition coefficients (K_d). 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 our analysis, Gradient used the partitioning coefficients given in Table J-1 of the US EPA CCR Risk Assessment for all COIs (US EPA, 2014). These coefficients are presented in Table A.2.

To be conservative, Gradient assumed that the constituents were not affected by dissipation or degradation once they entered the water body. The total water body concentration of the COI was calculated as (US EPA, 1998):

$$C_{wtot} = \frac{m_c}{V_f \times f_{water}}$$

where:

C_{wtot} = Total water body concentration of the constituent (mg/L)
m_c = Mass discharge rate of the COI (mg/year)
V_f = Water body annual flow (L/year)
f_{water} = Fraction of COI in the water column (unitless)

For the Illinois River annual flow rate, Gradient conservatively used the low flow (10th percentile) discharge rate of about 5,946 cubic feet per second (cfs) or 5.3 x 10^{12} L/yr based on the daily mean discharge rates measured at United States Geological Survey (USGS) station at Kingston Mines, IL (USGS 05568500) between 2017 and 2021 (USGS, 2022). The surface water parameters are presented in Table A.3.

The fraction of COIs in the water column was calculated for each COI using the sediment/water and suspended solids/water partition coefficients (US EPA, 2014, Table J-1). The fraction of COIs in the water column is defined as (US EPA, 2014):

$$f_{water} = \frac{(1 + [K_{dsw} \times TSS \times 0.000001]) \times \frac{d_w}{d_z}}{\left([1 + (K_{dsw} \times TSS \times 0.000001)] \times \frac{d_w}{d_z}\right) + ([bsp + K_{dbs} \times bsc] \times \frac{d_b}{d_z})}$$

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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 105 mg/L measured at the Illinois River inlet (Foth Infrastructure & Environment, LLC, 2017)
0.000001	=	Units conversion factor
d_w	=	Depth of the water column (m). The depth of the water column was estimated as 2.74 m, based on bathymetry data for the Illinois River (Bist LLC, 2022).
d_b	=	Depth of the upper benthic layer (m), set equal to 0.03 m (US EPA, 2014)
$d_z = d_w + d_b$	=	Depth of the water body (m)
bsp	=	Bed sediment porosity (unitless), set equal to 0.6 (US EPA, 2014)
bsc	=	Bed sediment particle concentration (g/cm^3), set equal to 1.0 g/cm^3 (US EPA, 2014)

The fraction of COIs dissolved in the water column (f_d) is calculated as (US EPA 2014):

$$f_d = \frac{1}{1 + K_{dsw} \times TSS \times 0.000001}$$

The values of the fraction of COIs in the water column and other calculated parameters are presented in Table A.4.

The total water column concentration (C_{wcTot}) of the COIs, comprising both the dissolved and suspended sediment phases, is then calculated as (US EPA, 2014):

$$C_{wcTot} = C_{wtot} \times f_{water} \times \frac{d_z}{d_w}$$

Finally, the dissolved water column concentration (C_{dw}) for the COIs is calculated as (US EPA, 2014):

$$C_{dw} = f_d \times C_{wcTot}$$

The dissolved water column concentration was then used to calculate the concentration of COIs sorbed to suspended solids in the water column (US EPA, 1998):

$$C_{sw} = C_{dw} \times K_{dsw}$$

where:

C_{sw}	=	Concentration sorbed to suspended solids (mg/kg)
C_{dw}	=	Concentration dissolved in the water column (mg/L)
K_{dsw}	=	Suspended solids/water partition coefficient (mL/g)

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In the same way, using the total water body concentration and the fraction of COIs in the benthic sediments, the model derives the total concentration in benthic sediments (US EPA, 2014, Table J-1-12):

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

where:

C_{bstot}	=	Total concentration in bed sediment (mg/L or g/m^3)
C_{wtot}	=	Total water body concentration of the constituent (mg/L)
f_{benth}	=	Fraction of 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 (used the default value of 1 g/cm^3 from US EPA, 2014)

The total sediment concentration is composed of the concentration dissolved in the bed sediment pore water (equal to the concentration dissolved in the water column) and the concentration sorbed to benthic sediments (US EPA, 1998).

The concentration sorbed to benthic sediments was calculated from (US EPA, 1998):

$$C_{sb} = C_{dbs} \times K_{dbs}$$

where:

C_{sb}	=	Concentration sorbed to bottom sediments (mg/kg)
C_{dbs}	=	Concentration dissolved in the sediment pore water (mg/L)
K_{dbs}	=	Sediments/water partition coefficient (mL/kg)

For each COI, the modeled total water column concentration, the modeled dry weight sediment concentration, and the modeled concentration sorbed to sediment are presented in Table A.5.

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Table A.1 Parameters Used to Estimate Groundwater Discharge to Surface Water

Groundwater Unit	Parameter	Name	Value	Unit
UA	A	Cross-Sectional Area	1,277	m^2
UA	i	Hydraulic Gradient	0.004	m/m
UA	K	Hydraulic Conductivity	0.00017	cm/s

Notes:
Source: Hydraulic gradient and hydraulic conductivity values from Burns McDonnell (2021).
Cross-sectional area was estimated from Burns McDonnell (2021).
UA = Uppermost Aquifer.

Table A.2 Partition Coefficients

Constituent	Sediment-Water, Mean, K_{dbs}		Suspended Sediment-Water, Mean, K_{dsw}	
	Value (log_{10}) (mL/g)	Value (mL/g)	Value (log_{10}) (mL/g)	Value (mL/g)
Metals				
Arsenic	2.4	2.51E+02	3.9	7.94E+03
Barium	2.5	3.16E+02	4	1.00E+04
Beryllium	2.8	6.31E+02	4.2	1.58E+04
Boron	0.8	6.31E+00	3.9	7.94E+03
Cadmium	3.3	2.00E+03	4.9	7.94E+04
Chromium	4.9	7.94E+04	5.1	1.26E+05
Cobalt	3.1	1.26E+03	4.8	6.31E+04
Lead	4.6	3.98E+04	5.7	5.01E+05
Lithium	-	-	-	-
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
Other				
Chloride	-	-	-	-
Fluoride	2.2	1.58E+02	2.2	1.58E+02
Sulfate	-	-	-	-

Notes:
Source: US EPA (2014).
Lithium, chloride, and sulfate do not readily sorb to soils and sediments. Consequently, sediment concentrations were not modeled for these constituents (K_d was assumed to be 0).

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Table A.3 Surface Water Parameters

Parameter	Name	Value	Unit
TSS	Total Suspended Solids	105	mg/L
V_{fx}	Surface Water Flow Rate	5.3×10^{12}	L/yr
d_b	Depth of Upper Benthic Layer (default)	0.03	m
d_w	Depth of Water Column	2.74	m
d_z	Depth of Water Body	2.77	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]	0.29	kg/m^2
M_S	Sediment Mass per Unit Area[b]	30	kg/m^2

Notes:
Source of default values: US EPA (2014).
Source of TSS data: Foth Infrastructure & Environment, LLC (2017).
(a) Determined by multiplying total suspended solids, TSS, by the depth of water column, d_w.
(b) Determined by multiplying depth of upper benthic layer, d_b, by the sediment bed particle concentration of 1 g/cm^3.

Table A.4 Calculated Parameters

COI	Fraction of Constituent in the Water Column f_{water}	Fraction of Constituent in the Benthic Sediments $f_{benthic}$	Fraction of Constituent Dissolved in the Water Column $f_{dissolved}$
Arsenic	0.400	0.600	0.545
Barium	0.372	0.628	0.488
Beryllium	0.278	0.722	0.375
Boron	0.960	0.040	0.545
Cadmium	0.300	0.700	0.107
Chromium	0.016	0.984	0.070
Cobalt	0.356	0.644	0.131
Lead	0.110	0.890	0.019
Lithium	0.993	0.007	
Mercury	0.025	0.975	0.046
Thallium	0.912	0.088	0.431
Radionuclides			
Radium-226+228	0.021	0.979	0.563
Other			
Fluoride	0.369	0.631	0.984

Notes:
COI = Constituent of Concern.

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Table A.5 Surface Water and Sediment Modeling Results

COI	Groundwater Concentration (mg/L or pCi/L)	Mass Discharge Rate (mg/year or pCi/year)	Total Water Column Concentration (mg/L or pCi/L)	Concentration Sorbed to Bottom Sediments (mg/kg or pCi/kg)
Total Metals				
Arsenic	0.097	2.7E+04	5.1E-09	6.9E-07
Barium	8.6	2.4E+06	4.5E-07	6.9E-05
Beryllium	0.017	4.7E+03	8.9E-10	2.1E-07
Boron	12	3.3E+06	6.3E-07	2.2E-06
Cadmium	0.0040	1.1E+03	2.1E-10	4.5E-08
Chromium	0.59	1.6E+05	3.1E-08	1.7E-04
Cobalt	0.29	7.9E+04	1.5E-08	2.5E-06
Lead	0.27	7.4E+04	1.4E-08	1.0E-05
Lithium	0.85	2.3E+05	4.4E-08	(a)
Mercury	0.0018	4.9E+02	9.4E-11	3.4E-07
Thallium	0.0026	7.1E+02	1.4E-10	1.2E-09
Radionuclides				
Radium-226+228	23	6.3E+06	1.2E-06	5.0E-03
Other				
Chloride	830	2.3E+08	4.3E-05	(a)
Fluoride	10.2	2.8E+06	5.3E-07	8.3E-05
Sulfate	570	1.6E+08	3.0E-05	(a)

Notes:
COI = Constituent of Concern; pCi/kg = PicoCuries Per Kilogram; pCi/L = PicoCuries Per Liter.
(a) Lithium, chloride, and sulfate do not readily sorb to soil or sediment particles; a K_d value of 0 was used for the modeling.

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Appendix B

Screening Benchmarks

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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
Barium	130	US EPA (2014)	2.0	0.20	4.0	1.5	400	1.5
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
Chromium	16	NRWQC (2002)	0.10	1.5	0.20	0.61	20	0.63
Cobalt	300	ORNL (2020)	NC	0.00030	0.021	0.0035	2.1	0.0035
Fluoride	2.3	US EPA (2014)	4.0	0.040	8.0	143	800	174
Lead	46	US EPA (2014)	0.015	NC	0.030	0.015	0.015	0.015
Lithium	1	(c)	NC	0.002	0.14	4.7	14	7.0
Thallium	116	NRWQC (2002)	0.0020	0.000010	0.0040	0.0017	0.40	0.0017

Human Health COI	BAF (L/kg-tissue)		MCL (pCi/L)	ADI (pCi/day)	Food Ingestion Slope Factor[d] (risk/pCi)	Human Threshold Criteria		
	SW-Fish	Basis				Water & Fish (pCi/L)	Water Only (pCi/L)	Fish Only (pCi/L)
Radium-226+228	4.0	ORNL (2020)	5	10	1.43E-09	1,000	1,000	87,413

Notes:

ADI = Acceptable Daily Intake; BAF = Bioaccumulation Factor; BCF = Bioconcentration Factor; MCL = Maximum Contaminant Level; NC = No Criterion Available; NRWQC = National Recommended Water Quality Criteria; ORNL = Oak Ridge National Laboratory; pCi = PicoCurie; Ra = Radium; 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 (2014). 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 lack of published BCF.

(d) Food ingestion slope factors for Ra-226+D and Ra-228+D were compared and the higher factor (Ra-228+D) was selected. The "+D" indicates that the risks from "associated short-lived radioactive decay products are also included" (US EPA, 2001).

Equations from IEPA (2019):

Consumption of Water and Fish

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

Incidental Consumption of Water Only

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

Consumption of Fish Only

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

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)/ Bioaccumulation Factor (BAF)	Chemical-specific	L/kg-tissue
Water Consumption Rate (W)	0.01	L/day
Body Weight	70	kg
Target Cancer Risk (TCR)	1.0E-05	

Radium-226+228

$$HTC = \frac{TCR}{(SF \times BAF \times F)}$$

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Table B.2 Recreator Exposure to Sediment

COI	Relative Bioavailability (unitless)	Dermal Absorption Fraction (unitless)	Cancer TRV CSF (mg/kg-day)$^{-1}$	Cancer TRV Dermal CSF (mg/kg-day)$^{-1}$	Cancer Child + Adult Incidental Ingestion SL (mg/kg)	Cancer Child + Adult Dermal Contact SL (mg/kg)	Cancer SL (mg/kg)	Non-Cancer TRV RfD (mg/kg-day)	Non-Cancer TRV Dermal RfD (mg/kg-day)	Non-Cancer Child Incidental Ingestion SL (mg/kg)	Non-Cancer Child Dermal Contact SL (mg/kg)	Non-Cancer Adult Incidental Ingestion SL (mg/kg)	Non-Cancer Adult Dermal Contact SL (mg/kg)	Non-Cancer SL Child (mg/kg)	Non-Cancer SL Adult (mg/kg)	Recreator RSL Sediment (mg/kg)	Basis[a]
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
Barium	1	NA	NC	NC	NC	NC	NC	2.0E-01	1.4E-02	2.7E+05	NA	2.9E+06	NA	2.7E+05	2.9E+06	2.7E+05	nc
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
Chromium	1	NA	NC	NC	NC	NC	NC	1.5E+00	2.0E-02	2.1E+06	NA	2.2E+07	NA	2.1E+06	2.2E+07	2.1E+06	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
Lithium	1	NA	NC	NC	NC	NC	NC	2.0E-03	2.0E-03	2.7E+03	NA	2.9E+04	NA	2.7E+03	2.9E+04	2.7E+03	nc
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
Other																	
Fluoride	1	NA	NC	NC	NC	NC	NC	4.0E-02	4.0E-02	5.5E+04	NA	5.8E+05	NA	5.5E+04	5.8E+05	5.5E+04	nc
Radionuclides																**Total Soil PRG (pCi/kg)**	
Radium-226+228																7.9E+03	

Notes:

ABS = Dermal Absorption Fraction; COI = Constituent of Interest; CSF = Cancer Slope Factor; NC = No Criterion Available; pCi = PicoCurie; PRG = Preliminary Remediation Goal; 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)

Intake Factor (IF) = $\frac{IR \times EF \times ED \times CF}{BW \times AT}$ =

		Non-Cancer Child	Non-Cancer Adult	Cancer Child	Cancer Adult	Basis
		7.3E-07	6.8E-08	6.3E-08	2.0E-08	
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)

Intake Factor (IF) = $\frac{SA \times AF \times EF \times ED \times CF}{BW \times AT}$ =

		Non-Cancer Child	Non-Cancer Adult	Cancer Child	Cancer Adult	Basis
		2.2E-06	1.2E-06	1.9E-07	3.6E-07	
SA	Surface Area Exposed to Sediment (cm^2/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/cm^2)	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)

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Table B.3.1 Recreator PRGs for Soil, Input Values

Variable	Recreator Soil Default Value	Form-input Value
A (PEF Dispersion Constant)	16.2302	16.8653
B (PEF Dispersion Constant)	18.7762	18.7848
City (Climate Zone)	Default	Chicago, IL (7)
C (PEF Dispersion Constant)	216.108	215.0624
Cover layer thickness for GSF (gamma shielding factor) cm	0 cm	0 cm
$CF_{rec\text{-}fowl}$ (fowl contaminated fraction) unitless	1	1
$CF_{rec\text{-}game}$ (game contaminated fraction) unitless	1	1
ED_{rec} (exposure duration - recreator) yr		26
EF_{rec} (exposure frequency - recreator) day/yr		60
$f_{p\text{-}fowl}$ (fowl on-site fraction) unitless	1	1
$f_{p\text{-}game}$ (land game on-site fraction) unitless	1	1
$f_{s\text{-}fowl}$ (fraction of year fowl is on site) unitless	1	1
$f_{s\text{-}game}$ (fraction of year land game is on site) unitless	1	1
$MLF_{pasture}$ (pasture plant mass loading factor) unitless	0.25	0.25
t_{rec} (time - recreator) yr		26
TR (target risk) unitless	0.000001	0.000001
F(x) (function dependent on U_m/U_t) unitless	0.194	0.182
PEF (particulate emission factor) m^3/kg	1,359,344,438	1,560,521,177
Q/C_{wind} (g/m^2-s per kg/m^3)	93.77	98.431
A_s (acres)	0.5	0.5
Site area for ACF (area correction factor) m^2	1,000,000 m^2	1,000 m^2
ED_{rec} (exposure duration - recreator) yr		26
$ED_{rec\text{-}a}$ (exposure duration - recreator adult) yr		20
$ED_{resc\text{-}c}$ (exposure duration - recreator child) yr		6
EF_{rec} (exposure frequency - recreator) day/yr		60
$EF_{rec\text{-}a}$ (exposure frequency - recreator adult) day/yr		60
$EF_{rec\text{-}c}$ (exposure frequency - recreator child) day/yr		60
ET_{rec} (exposure time - recreator) hr/day		8
$ET_{rec\text{-}a}$ (exposure time - recreator) hr/day		8
$ET_{rec\text{-}c}$ (exposure time - recreator) hr/day		8
$IFA_{rec\text{-}adj}$ (age-adjusted inhalation rate - recreator) m^3		9,200
$IFS_{rec\text{-}adj}$ (age-adjusted soil intake rate - recreator) mg		63,720
$IRA_{rec\text{-}a}$ (inhalation rate - recreator adult) m^3/day	20	20
$IRA_{rec\text{-}c}$ (inhalation rate - recreator child) m^3/day	10	10
$IRS_{rec\text{-}a}$ (soil intake rate - recreator adult) mg/day	100	33
$IRS_{rec\text{-}c}$ (soil intake rate - recreator child) mg/day	200	67
t_{rec} (time - recreator) yr		26
TR (target risk) unitless	0.000001	0.000001
U_m (mean annual wind speed) m/s	4.69	4.65
U_t (equivalent threshold value)	11.32	11.32
V (fraction of vegetative cover) unitless	0.5	0.5

Notes:

IL = Illinois; PRG = Preliminary Remediation Goal

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Table B.3.2 Recreator PRGs for Soil, Ra-226

Isotope	ICRP Lung Absorption Type	Soil Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)	1,000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Particulate Emission Factor (m^3/kg)	Dry Soil-to-plant transfer factor (pCi/g-fresh plant per pCi/g-dry soil)	Beef Transfer Factor (pCi/kg per pCi/d)	Poultry Transfer Factor (pCi/kg per pCi/d)	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (mg/kg)	Total PRG TR=1.0E-06 (pCi/kg)
Ra-226	S	6.77E-10	2.82E-08	2.50E-08	5.14E-10	4.33E-04	1.60E+03	6.85E-01	1.00E+00	1.56E+09	1.95E-02	1.70E-03	-	2.32E+01	6.02E+03	4.10E+01	1.48E+01	1.50E-05	1.48E+04

Notes:
d = Day; ICRP = International Commission on Radiological Protection; Ra = Radium; S = Slow; pCi = PicoCurie; PRG = Preliminary Remediation Goal; TR = Target Risk; yr = Year.

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Table B.3.3 Recreator PRGs for Soil, Ra-228

Isotope	ICRP Lung Absorption Type	Soil Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)	1,000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Particulate Emission Factor (m^3/kg)	Dry Soil-to-plant transfer factor (pCi/g-fresh plant per pCi/g-dry soil)	Beef Transfer Factor (pCi/kg per pCi/d)	Poultry Transfer Factor (pCi/kg per pCi/d)	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (mg/kg)	Total PRG TR=1.0E-06 (pCi/kg)
Ra-228	S	1.98E-09	4.37E-08	3.43E-11	1.42E-09	1.21E-01	5.75E+00	1.00E+00	1.00E+00	1.56E+09	1.95E-02	1.70E-03	-	7.93E+00	3.89E+03	2.04E+04	7.91E+00	2.90E-08	7.91E+03

Notes:

d = Day; ICRP = International Commission on Radiological Protection; Ra= Radium; S = Slow; pCi = PicoCurie; PRG = Preliminary Remediation Goal; TR = Target Risk; yr = Year.

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Appendix B

Corrective Action Alternatives Analysis – Supporting Information Report

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Intended for
Illinois Power Resources Generating, LLC
7800 Cilco Lane
Bartonville, Illinois 61607

Date
March 28, 2025

Project No.
1940110241-003

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CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT

ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

IEPA ID NO. W1438050005-01

RAMBOLL Bright ideas. Sustainable change.

CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT EDWARDS POWER PLANT, ASH POND, IEPA ID NO. W1438050005-01

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Project name	**Edwards Power Plant Ash Pond**
Project no.	**1940110241-003**
Recipient	**Illinois Power Resources Generating, LLC**
Document type	**Corrective Action Plan**
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Date	**March 28, 2025**
Prepared by	**Beth Richter, PE**
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Approved by	**Brian G. Hennings, PG**
Description	**Corrective Action Alternatives Analysis Supporting Information Report**

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Appendix B1 Groundwater Modeling Technical Memorandum
Appendix B2 Groundwater Modeling Report
Appendix C Material Quantity, Labor, and Mileage Estimates for Alternative 2 and Alternative 3 Remedies

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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
AP	Ash Pond
BMP	best management practice
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
CIP	closure-in-place
CMA	Corrective Measures Assessment
COC	constituent of concern
EDW	Edwards Power Station
EPP	Edwards Power Plant
gpm	gallons per minute
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
IPRG	Illinois Power Resources Generating, LLC
Kd	soil adsorption coefficient
LEL	lower explosive limit
mg/L	milligrams per liter
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	operation and maintenance
PMP	potential migration pathway
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

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1. INTRODUCTION AND BACKGROUND

1.1 Plant and Site Information

Illinois Power Resources Generating, LLC (IPRG) is the owner of the inactive coal-fired Edwards Power Plant (EPP), also referred to as the Edwards Power Station (EDW), in Bartonville, Illinois (the "site"). IPRG intends to complete groundwater corrective action at the coal combustion residuals (CCR) surface impoundment (SI) known as the Ash Pond (AP), which has an Illinois Environmental Protection Agency (IEPA) identification (ID) number (No.) of W1438050005-01, a CCR Unit ID of 301, and a National Inventory of Dams (NID) No. IL50710. Groundwater corrective action for the EPP AP 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 EPP AP 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 EPP AP.

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 design 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 groundwater protection standards (GWPS), physical dimensions and scope of the remedy, engineering design parameters, and number and location of wells included in the monitoring system. These differences are due to the further refinement of the remedial design that is inherent with advancing the selected remedy into the permit-level remedial design that is included within the CAP.

1.2.1 Identified Corrective Action Alternatives

Corrective action remedies selected for additional evaluation within this CAAA-SIR were identified as potentially feasible for the AP in the Corrective Measures Assessment (CMA) [3], performed 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);
- Alternative 2: Source control with groundwater extraction (GWE); and
- Alternative 3: Source control with phytoremediation.

Other remedies, including source control with a cutoff wall and source control with permeable reactive barrier, were determined to be infeasible for the site during the CMA process.

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1.2.2 Scope of CAAA-SIR

Ramboll completed the following tasks and documented the tasks within this CAAA-SIR, for each of the corrective action alternative remedies listed in **Section 1.2.1**:

- Feasibility-level design drawings (**Appendix A**) were developed to show the approximate extents and typical sections/details of the Alternative 2 remedy (source control with GWE) and the Alternative 3 remedy (source control with phytoremediation). 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 closure phases.
- Feasibility-level schedules providing the estimated time to implement each 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 [4] for the EPP AP will also be implemented. The AP will be closed using a hybrid consolidation and closure-in-place (CIP) method. This will include completely removing approximately 1,130,000 cubic yards of CCR from the closure-by-removal (CBR) area (high points and northwestern sections of the SI) and relocating the waste material to the south end and other low areas of the SI (the CIP area). Additionally, approximately 210,000 cubic yards will be relocated from the rail loop embankment into the CIP footprint. The excavation and consolidation will reduce the total CCR footprint from approximately 102 acres to approximately 69 acres, providing a 33-acre, or approximately 32 percent (%), reduction in the consolidated and closed final footprint of the AP. Additional closure activities will include construction of an earthen separation berm at the perimeter of the relocation area of the AP to contain the relocated ash, and installation of an engineered low permeability geomembrane cover system.

Updated groundwater modeling (**Appendix B**) estimates that source control alone will result in GWPS being achieved approximately 800 years after closure completion 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 using the groundwater flow and transport model as provided in **Appendix B**. This approach was utilized to provide a consistent comparison of the time to reach GWPS for each remedy, as required by 35 I.A.C. § 845.670(e)(f).

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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 for the Alternative 3 remedy: source control with phytoremediation;
- **Section 5** includes information used to develop estimates of material quantities, labor hours, and mileage; and
- **Section 6** includes reference documents used in the development of this CAAA-SIR.

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2. ALTERNATIVE 1 REMEDY: SOURCE CONTROL WITH GROUNDWATER POLISHING

The Alternative 1 remedy, source control with GWP, includes a consolidate-and-cap approach for source control, after which GWP would be implemented. GWP is a remedial alternative that relies on natural geochemical processes and can be an appropriate remedy, as recognized by the United States Environmental Protection Agency (USEPA) in a final policy directive [5] for groundwater remediation.

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 boron, sulfate, and total dissolved solids. Boron was selected for modeling source control presented in the Final Closure Plan and was identified as a surrogate for the exceedance[1] of sulfate, as described in the Groundwater Modeling Report [7] (included in **Appendix B2**). For modeling purposes, it was assumed that boron 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. Boron 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) [7]. 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 [8].

Groundwater modeling for the Alternative 1 remedy, performed to support the Closure Plan for the AP and further refined in 2024 (**Appendix B1**), estimated that GWPS would be met in approximately 800 years after the implementation of source control for all wells within the existing AP monitoring network.

2.2 Remedy Implementation

Implementation of this remedy would be initiated after source control (*e.g.,* final closure of the AP) 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 well network designed in accordance with 35 I.A.C. § 845.680(c), which specifies that wells must be installed in the plume of contamination that lies beyond the waste boundary.

[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 IPRG's operating permit application for the EPP AP. That operating permit application, including the proposed groundwater monitoring program, remains under review by the IEPA and, therefore, IPRG has not identified any actual exceedances.

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    - Samples would be collected for major ions for evaluating groundwater chemistry and COCs. Samples would be collected on a quarterly basis initially and potentially reduced to a semiannual basis once five years of monitoring have occurred, in accordance with 35 I.A.C. § 845.650(b)(4).
    - Monitoring results would be submitted to IEPA for each monitoring event, in addition to an annual groundwater monitoring and corrective action report, in accordance with 35 I.A.C. § 845.610(e).
    - Routine maintenance of the monitoring well network would occur during the monitoring period. This would include inspecting the wells, making repairs to the wells (as and if needed), and rehabilitating and/or replacing wells to improve performance (as and if needed).

- Adaptive Management during Monitoring
  - Groundwater monitoring results would be evaluated and documented in 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 model, groundwater, and geochemical models.
  - If remedy progress does not correspond with expectations, additional methods or techniques to achieve compliance with GWPS would be evaluated and, if feasible, implemented in accordance with 35 I.A.C. § 845.680(b).
- Corrective Action Confirmation Monitoring and Completion
  - After GWPS have been met for all corrective action monitoring wells, corrective action confirmation groundwater monitoring would be implemented. This would include monitoring each well for three additional years to confirm that GWPS have been achieved, in accordance 35 I.A.C. § 845.680(c).
    - 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.

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Table A. Feasibility-Level Implementation Schedule – Alternative 1: Source Control with Groundwater Polishing

Implementation Phase	Implementation Task	Timeframe* (Preliminary Estimates)
Corrective Action Implementation	Corrective Action Monitoring (Time to Meet GWPS)	9,600 months
	Corrective Action Confirmation Monitoring	36 months
	Corrective Action Completion	6 months
	Timeframe to Complete Corrective Action Implementation	Approximately 800 years
	Total Timeline to Complete Corrective Action (after completion of Source Control)	Approximately 800 years

*All timeframes are assumed to start after source control (*e.g.,* final closure of the SI) is complete.

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 EPP AP 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 construction difficulty for the remedy.
- Expected Operational Reliability of the Remedy - 35 I.A.C. § 845.670(e)(3)(B)
  - A report detailing the GWP process [8] has been developed and evaluates the reliability and the potential for reversibility of the chemical attenuation mechanisms. This report is attached to the Gradient CAAA.
  - 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 [9]).

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- 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 progressing as intended and to 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.

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3. ALTERNATIVE 2 REMEDY: SOURCE CONTROL WITH GROUNDWATER EXTRACTION

The Alternative 2 remedy, source control with GWE, includes the construction of two GWE trenches that would be constructed in conjunction with source control (*e.g.*, final closure) implementation. Each trench is described below.

- North Trench
  - Approximately 1,700-foot-long north trench extending along the inboard CCR removal area excavation slope.
  - The north trench is proposed to be installed to the bottom of the uppermost aquifer (UA) which is at an elevation of approximately 411 to 421 feet[2]..
- South Trench
  - Approximately 800-foot-long south trench on the crest of the existing embankment after removal of the rail line, ballast and CCR embankment section.
  - The south trench would extend from the post-construction crest elevation (approximate elevation 450 feet) to the bottom of the UA and would require construction of a work platform into the existing dike. The work platform is anticipated to be at an approximate elevation of 440 feet. The trench would extend from the platform grade to an approximate elevation of 401.5 feet.

The preliminary depth and extents of both trenches were based on available groundwater and other site data and may be adjusted during future phases of design. The trenches would be on the order of 3 feet wide, installed into the UA and Upper Cahokia Formation/potential migration pathway (PMP) to capture CCR constituents in both units, and backfilled with highly permeable aggregate surrounding a perforated collection pipe. Collection sumps would be located approximately every 500 feet along the trench alignments. Groundwater would be pumped from each of the sumps and routed to a collection pond constructed within the CBR area of the AP. After settling, the groundwater would be discharged to either the Illinois River or the drainage channel adjacent to the AP via a new or existing National Pollutant Discharge Elimination System (NPDES) outfall, and in accordance with site-specific permit requirements.

Drawings showing the location of the GWE remedy are provided as Figures 1 and 2 in **Appendix A.**

3.1 Remedy Scoping and Groundwater Modeling Results

The size and scope of the remedy (*e.g.,* number and location of trenches, trench depths, expected discharge rates) were selected using iterative, three-dimensional groundwater fate and transport modeling. Initial locations where trenches could feasibly be constructed were evaluated by reviewing physical constraints around the AP and designating locations on IPRG property where the trenches could feasibly be constructed with limited impacts to other site features. In particular, the trench alignments were selected to avoid, to the extent possible, the existing sewer force main which crosses the northern portion of the pond, while avoiding sensitive areas

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

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such as wetlands and regulatory floodplains [10, 11]. Additionally, the trench alignments are located outside of the AP, where they would provide minimal impacts to the source control construction (*e.g.,* closure activities). However, limited right-of-way for the southern trench would necessitate modification to the existing AP dikes in order to allow for the trench to be installed.

The depths of the trenches were selected using iterative, three-dimensional groundwater fate and transport modeling. Various depth intervals and configurations were evaluated during groundwater modeling simulations to identify optimal depths to achieve reduction in the time to reach GWPS while also retaining feasibility to construct and operate. During these groundwater modeling simulations, a single continuous trench was determined not to be beneficial and did not result in additional reduction in the time to reach GWPS. Thus, two separate trenches were selected to address exceedances in the northern and southern areas of the AP, respectively.

The resulting GWE trench remedy includes two separate trenches located along the western side of the AP. This two-trench configuration would capture CCR constituents in both the PMP and the UA and reduce the potential for off-site migration of groundwater containing CCR constituents. Additionally, the selected two-trench remedy would reduce, to the extent feasible, portions of the AP dikes, which require intrusive modifications to allow the trenches to be constructed.

Groundwater flow and transport modeling indicated that the GWPS would be met in approximately 37 years. The mean time to meet the GWPS for wells that were evaluated is approximately 5 years; however, GWPS would be achieved at certain wells within the first year of remedy operation. The two GWE trenches are expected to require that extraction continue for a total of 50 years (*i.e.*, 13 years after GWPS have been met) to reduce the potential for concentrations to rebound above the GWPS after pumping from the trenches ceases. The estimated discharge rate from the north trench would initially be on the order of 20 gallons per minute (gpm) and would stabilize to below 10 gpm after approximately 7 years; the discharge rate from the south trench would initially be on the order of 20 gpm and would stabilize to below 10 gpm after approximately 12 years. This results in a total estimated extraction rate ranging from 40 gpm to a long-term rate of approximately 20 gpm or less.

A Groundwater Modeling Technical Memorandum providing additional information on the groundwater modeling used to support the CAAA-SIR evaluation of this remedy is provided in **Appendix B**. This memorandum also includes estimated times to meet GWPS at each well.

3.2 Remedy Implementation

Implementation of the Alternative 2 source control with GWE remedy is expected to include multiple tasks spread out over three phases, including pre-construction activities (Phase 1), corrective action construction (Phase 2), and corrective action operations, maintenance, and closure (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:

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  - Completion of additional subsurface investigations and groundwater monitoring to further refine the necessary extents and design of both the north and south trenches.
  - Collection of geotechnical data to support the design of dike modifications to allow the trench to be constructed.
  - Additional data collection and analyses may be required to characterize the potential impact of known naturally occurring sources of subsurface methane on construction and to design an extraction system.
  - Completion of engineering calculations, design drawings, specifications, and a construction quality assurance plan.
  - Bidding and selection of the GWE construction contractor.
- Obtaining permits or modifications from other agencies including:
  - A general stormwater permit for construction site activities though IEPA, including construction of stormwater controls and implementation of other best management practices (BMPs) such as silt fences and other measures.
  - An Illinois Department of Natural Resources (IDNR) Office of Water Resources, Dam Safety modification permit would be obtained for modification of the AP embankment.
  - A NPDES permit modification would be obtained to accept discharge of extracted groundwater for the operational lifetime of the GWE trenches.
  - An amendment to the submitted AP Final Closure Plan and Construction Permit Application would be completed to allow for the disposal of trench spoils beneath the AP final cover system.

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, constructing a work platform for the south trench, constructing the north and south trenches (which would include replacement of existing subgrade soils with permeable trench materials), constructing the extracted groundwater management system, and performing post-construction and site restoration activities.

GWE trench construction is assumed to occur concurrently within the latter phases of AP closure construction. This would allow all spoils generated during trench construction to be placed beneath the final cover system within the AP, in addition to reducing the risk of intrusive trench construction activities from negatively impacting the stability of the AP dikes. This would likely mean that the trenches would be constructed after the AP has been dewatered; after CCR has been removed from the CBR portions of the AP; and after the existing sewer force main has been abandoned, but before the final cover system has been completed. It was assumed that a construction contractor, separate from the closure construction contractor, would complete installation of the trenches.

Information associated with each of these activities is described below.

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- Site Preparation
  - The contractor would mobilize equipment, construction facilities, and materials to the site; implement stormwater BMPs around the construction area; construct a staging and laydown area; and construct temporary access roads leading from the southern trench alignment to the existing site access road.
  - Site utilities would be modified and/or abandoned, as necessary, to provide construction access. This may require raising existing high-voltage power lines that cross the northern trench alignment to provide a safe working distance between the energized lines and construction equipment. Additionally, previously abandoned portions of a sewer force main within the trench alignment may need to be removed to allow for trench construction.
  - A 30-foot wide, level work platform would be constructed into the existing dike in the vicinity of the southern trench. The work platform is required due to the lack of right-of-way between the existing AP perimeter dike and the adjacent stormwater drainage channel and property boundary. The excavation would require substantial physical modification to the AP dike and may require the use of temporary or permanent shoring to supplement embankment grading to construct the work platform and reduce the risk of instability and other negative impacts to the AP dike during trench construction.
  - Geotechnical monitoring would be performed during construction of the work platform and south trench to evaluate the AP perimeter dikes for signs of distress during construction.
  - Methane is known to be present in aquifers throughout Illinois, due to both natural and anthropogenic processes (coal mining), and has been encountered at the AP [12]. A detailed methane monitoring plan would be developed and implemented during on-site construction activities where the potential to encounter methane has been identified.
- Trench Installation
  - The north and south trenches are assumed to be constructed using specialized trenching equipment (*i.e.*, one-pass trenching methods) due to the relatively deep trench depths (up to approximately 40 feet). This method uses a specialized one-pass trencher to excavate subgrade soils, place collection piping and sumps, and backfill the trench with granular fill in a single operation. Other construction methods may be considered during later phases of design.
  - The north trench would be excavated along the design alignment near the inboard CCR removal area excavation slope. Excavation would be conducted to the base of the UA. The south trench would be excavated along the design alignment to a depth of approximately 39 feet from the platform grade, terminating within the UA. Both trenches are expected to be on the order of 3 feet wide. Perforated groundwater collection pipe would be laid in the trench bases at an approximate 0.5 to 2% grade to slope towards collection sumps.
    - Excavated soils (*e.g.*, spoils) would be placed into off-road dump trucks and hauled to the AP for use as contouring (*i.e.*, 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 AP final closure.
  - Collection sumps would be installed along the trenches. Sumps would consist of a pit to hold extracted water, a discharge line, a pneumatic pump to pump water to the discharge

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line, and an air compressor. Collection sumps would be located every 500 feet along the length of each collection trench.

  - The trenches would be backfilled with imported 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.
  - Underground trenches would be excavated to allow placement of high-density polyethylene (HDPE) piping to convey extracted groundwater from the trenches to the settling pond and from the settling pond to either an existing or a new NDPES outfall.

- Mechanical, Electrical, and Piping Installation
  - Electrical power drops would be installed in the northern and southern trench areas and the settling pond area, to provide power for the trench pumping and water management systems.
  - Equalization tanks and transfer pumps would be placed at the surface adjacent to each trench due to the extended distance required for conveyance of extracted groundwater to the settling pond.
- Discharge Management Installation
  - An approximately 1-acre settling pond for management of extracted groundwater was assumed to be constructed using conventional construction equipment. However, other groundwater treatment and management technologies may be evaluated during a later phase of design.
    - The location of the settling pond would be sited to limit adverse impacts or conflicts with the AP final closure construction and future solar redevelopment. The precise location of the pond would be evaluated during later phases of design and in conjunction with final closure design updates. For the purpose of this CAAA-SIR, the pond was assumed to be located within the CBR area of the AP final closure.
    - The settling pond was assumed to be approximately 1 acre in size and 5 feet deep. Soils from the settling pond excavation and/or from the construction of the southern trench working platform would be used to create 10-foot-wide berms around the perimeter of the settling pond to contain extracted groundwater. Excavated soils from the settling pond would be managed within the settling pond footprint. A geomembrane liner system would be installed in the settling pond to reduce the potential for releases of extracted groundwater.
  - An additional transfer pump may be required for discharge of extracted groundwater to the settling pond.
- Site Restoration
  - Following completion of the installation of the trenches, the work platform for the south trench area would be restabilized. This would include the replacement of excavated materials as backfill to the original dike grades and potentially the removal of any excavation shoring.

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- Site restoration would be completed following the installation of the trenches. This would include repairing site infrastructure that was relocated or damaged during construction and minor regrading and seeding of disturbed areas.
- Temporary BMPs would also be installed during the site restoration period. The BMPs would be removed once vegetation is established.

3.2.3 Phase 3: Corrective Action Operations, Maintenance, and Closure

Corrective action operations, maintenance, and closure would be initiated after corrective action construction is completed. It would include operating and maintaining the remedy, performing corrective action groundwater compliance monitoring, 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 O&M
  - Continued operation of the trench systems 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 trenches may include tasks such as repair or replacement of the extraction pumps, repair or replacement of a 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 and either existing or new outfall would also be completed during this phase.
  - Groundwater modeling provided in **Appendix B** indicates that ongoing operation and associated O&M activities of the two GWE trenches may need to continue for a total of 50 years (*i.e.*, 13 years after GWPS have been met) to prevent concentrations from rebounding above the GWPS. Therefore, it was assumed that O&M will occur over a period of 50 years, after which the trenches will be shut off and O&M will cease.
- Corrective Action Groundwater Monitoring
  - Regular corrective action groundwater monitoring would be conducted using a corrective action groundwater monitoring system 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 each constituent 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 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.

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    - Routine maintenance of the monitoring system would be conducted during the monitoring period. This would include inspection of 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 will be evaluated and documented 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 will 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 after pumping of the trenches has ceased, corrective action would be considered complete, per 35 I.A.C. § 845.680(c).
  - After completion of the corrective action confirmation monitoring period, a Corrective Action Completion Report and Certification would then be submitted to IEPA, in accordance with 35 I.A.C. § 845.680(e).

3.2.4 Remedy Implementation Schedule

A feasibility-level implementation schedule for the Alternative 2 source control with GWE remedy is provided in **Table B** below.

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

Implementation Phase	Implementation Task	Timeframe (Preliminary Estimates)
1: Pre-Construction	Agency Coordination, Approvals, and Permitting	18 to 24 months
	Final Design and Bid Process	24 to 36 months
	Timeframe to Complete Corrective Action Pre-Construction Activities	42 to 60 months
2: Corrective Action Construction	Corrective Action Construction	9 to 18 months
	Timeframe to Complete Corrective Action Construction	9 to 18 months
3: Corrective Action O&M and Closure*	Corrective Action Monitoring and O&M	600 months (50 years)
	Corrective Action Groundwater Compliance Monitoring	36 months
	Corrective Action Completion	6 months
	Timeframe to Complete Corrective Action O&M and Closure	642 months (53.5 years)
	Total Timeline to Complete Corrective Action	693 to 720 months (58 to 60 years)

*Denotes a timeframe that is assumed to start after source control (*e.g.,* final closure of the SI) is complete.

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 AP final cover system. Therefore, the start of Phase 3 (Corrective Action O&M and Closure) is assumed to begin at the completion of source control (final closure of the AP). 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 was assumed to be managed and treated by the GWE system and a newly constructed settling pond, to be located on-site. However, other forms of groundwater management and/or treatment may be evaluated during future phases of design.

The settling pond would need to be sited to not conflict with site infrastructure and planned solar development and may be incorporated into the footprint of the CBR portion of the AP, where a stormwater detention basin is currently proposed. 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 trenches would be sent to the settling pond via the pneumatic extraction pumps and transfer piping. Treated water would discharge via an existing or new NPDES outfall. Groundwater would be discharged in accordance with site-specific NPDES permit requirements.

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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 AP 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 design life of the remedy, 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)
  - The remedy would require use of specialized contractors and equipment (*i.e.*, one-pass trenching contractor and equipment) for the installation of the trenches, in addition to general construction equipment (*i.e.*, excavation and grading equipment).
  - While trenches are routinely constructed to similar depths in similar geologic environments, they may encounter difficulties during construction. The difficulties could include encountering obstructions that require specialized techniques and/or equipment to advance past.
  - Construction of the south trench could require modifications to the EPP AP embankment to provide a working platform for construction equipment. The modifications may require the use of temporary excavation shoring and/or other methods to avoid instability of the dike during construction.
  - In addition to likely requiring a permit from the IDNR Office of Water Resources, Dam Safety section, the construction would require the detailed geotechnical design of the working platform.
  - The modification would likely need to use risk management systems, such as a geotechnical monitoring program to evaluate the embankment for signs of distress during construction.
  - In the event that distress is noted, construction may need to be temporarily paused to evaluate the sources of the distress and mitigate, if needed.
  - The high-voltage power lines crossing the northern trench alignment may need to be raised in order to provide a safe working distance between the energized lines and construction equipment.
  - Naturally occurring methane is known to be present at the AP. The presence of methane would require the implementation of a methane monitoring and response plan. This may result in periodic safety shutdowns during construction, where work activity is stopped to allow methane concentrations to decrease to safe levels.
- Expected Operational Reliability of the Remedy - 35 I.A.C. § 845.670(e)(3)(B)
  - The trenches are expected to have high operational reliability if they are constructed in accordance with the design and specifications.

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  - The extraction systems are mechanical systems 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 construction of stormwater controls and BMPs, in addition to a joint water pollution control construction and operating permit, modifications to the site's NDPES permit, and an IDNR Dam Safety modification permit. These permits typically take 18 to 24 months to obtain.
    - While these permits may also be obtained for the AP final closure, the schedule for approval of both the Final Closure Plan and the eventual CAP is 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 trenches would require a specialized contractor experienced with construction of similar types of trenches in similar geologic environments. Relatively few construction contractors with this experience, particularly using one-pass equipment, are available. The contractor would likely need specialized and often custom-built one-pass construction equipment.
  - Specialists in one-pass trenching methods would also need to be utilized during the design and construction phase. The specialists would include design engineers, construction managers, and contractor staff experienced with trench construction and equipment operation.
  - Geotechnical specialists would be needed to design the working platform and monitor the AP embankment for signs of distress during one-pass trench installation.
  - These types of equipment and specialists have been utilized in the past for other similar types of trench design and construction projects. However, there may be backlogs associated with the equipment and specialists, due to high existing demand for specialty subsurface contractors and design specialists who are supporting similar types of projects in the electric utility, dam/levee, and other market sectors. These backlogs could add additional delay to the project schedule above current assumptions.
  - 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.

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- Available Capacity and Location of Needed Treatment, Storage, and Disposal Services – 35 I.A.C. § 845.670(e)(3)(E)
  - Wastes generated during trench construction would be limited to spoils; these would be disposed of on-site in the AP during closure construction as compacted contouring fill beneath the final cover system. Completing the trench construction at the same time as the AP closure would provide sufficient on-site capacity for the disposal of generated spoils.
  - The trench 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. Additionally, either a new NDPES outfall would need to be constructed, or outflow from the settling pond would need to be pumped to the existing NPDES outfall.
  - Relatively limited right-of-way is available at EPP for siting a settling pond in areas that avoid conflicts with planned solar redevelopment, wetlands, floodplains, or other site infrastructure.

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4. ALTERNATIVE 3 REMEDY: SOURCE CONTROL WITH PHYTOREMEDIATION

The Alternative 3 remedy, source control with phytoremediation, would include the installation of two tree segments on the western side of the AP to control the westerly off-site migration of CCR constituents in groundwater. The tree segments would be installed concurrently with source control (*e.g.*, final closure) implementation. It is anticipated that each segment would contain a narrow grid of plantings. Each individual planting would consist of one tree and a well system to passively draw groundwater upward to the root zone. With the assistance of the tree well, roots would access and uptake water from the UA, allowing phytoremediation of boron and sulfate to occur.

Tree segments would consist of a grid of tree plantings. At each planting location, a tree well structure would also be installed consisting of a borehole advanced into the UA and backfilled with a tree cutting, porous material to allow groundwater from the UA and PMP to rise to the potentiometric surface elevation, a standpipe to provide a passive source of oxygen to the subsurface, and (at some locations) soil moisture sensors and piezometers to monitor subsurface moisture and groundwater levels. Downward root growth at each planting would be encouraged via the use of a surface liner to reduce precipitation inflow and a drip irrigation system installed near targeted depths.

Feasibility-level design drawings of the Alternative 3 source control with phytoremediation are provided in **Appendix A.**

4.1 Remedy Scoping and Groundwater Modeling Results

The size and scope of the remedy (*e.g.,* number and location of plantings, root depths) were selected using iterative, three-dimensional groundwater fate and transport modeling. Initial locations where plantings could feasibly be constructed were evaluated by reviewing physical constraints around the AP and designating locations on IPRG property where the tree wells would have limited impacts to other site features. The locations were additionally selected to avoid sensitive areas such as wetlands and floodplains [10, 11] while limiting adverse impacts or conflicts with the AP final closure construction, and other site utilities or features.

Various depth intervals and configurations were evaluated during groundwater modeling simulations to identify optimal designs to achieve reduction in the time to reach GWPS while also remaining feasible to construct and maintain. During these groundwater modeling simulations, a single continuous tree segment was determined not to be beneficial and did not result in additional reduction in the time to reach GWPS. Thus, two separate segments were selected to address exceedances in the northern areas and southern areas, respectively. This resulted in the northern tree segment extending along the berm within the CBR area and the southern tree segment being located along the exterior toe of the former perimeter dike of the AP. The target areas are in the vicinity of AW-19 on the northwestern side of the AP and AW-15S on the southwestern side of the AP. These locations have areas where accessible space exists or can be created that is not within regulatory floodplains or known wetlands to allow for the tree well systems to be constructed. Additionally, the areas are outside the limits of the AP final closure, and therefore would reduce impacts to the final closure to the extent practicable.

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The two tree segments would include an approximately 1,700-foot-long northern segment extending along the inboard side of the CBR area and an approximately 1,900-foot-long segment near the downstream toe at the southwestern side of the existing embankment. The southern segment would require construction of a work platform into the existing dike. The segments would include a total of approximately 550 trees. The work platform is anticipated to be at an elevation of approximately 440 feet. Each tree segment is further described below.

- Northern Tree Segment
  - The northern tree segment would be located in the vicinity of monitoring wells AW-06, AW-18, AW-19, and AW-20 to address impacts of boron at AP07S, AW-05, AW-19, AW-20, and AW-21.
  - Trees would be planted at the post-closure construction surface grade at an elevation of 440 feet, and the co-located tree wells would be used to passively draw groundwater from the PMP and UA upward to the potentiometric surface elevation of approximately 433 feet.
  - Approximately 200 trees are anticipated to be planted in the northern tree segment, with a spacing of 8 to 10 feet between the trees.
- Southern Tree Segment
  - The southern tree segment would be located in the vicinity of monitoring wells AW-09, AW-15S, AW-16, and AW-17 to address impacts of boron and sulfate at AW-15S.
  - Trees would be planted at the post-closure construction surface grade at an approximate elevation of 438 feet, and the co-located tree wells would be used to passively draw groundwater from the PMP and UA upward to the potentiometric surface elevation of approximately 431 feet.
  - Approximately 350 trees are anticipated to be planted in the southern tree segment, with a spacing of 8 to 10 feet between the trees.

Groundwater modeling estimated that the tree wells would result in GWPS being achieved in approximately 48 years for all wells, assuming ideal tree performance, but could take up to 77 years with suboptimal growth or tree performance. The groundwater modeling also indicated that the phytoremediation system would need to remain operating for a total time period of 70 years with ideal tree performance and 150 years with sub-optimal performance, in order to reduce the potential for post-operational rebound above GWPS. This would result in the system operating for approximately 22 to 73 years after GWPS's have been met. Groundwater modeling assumed no uptake for the first five years while roots are established at target depths and no uptake during winter seasons (*i.e.,* October to March). A Groundwater Modeling Technical Memorandum, providing additional information on the groundwater modeling used to support the feasibility-level design of this remedy, is provided in **Appendix B**. This memorandum also includes estimated times to meet GWPS at each well.

4.2 Remedy Implementation

Implementation of the Alternative 3 phytoremediation remedy is expected to include multiple tasks spread out over three phases, including pre-construction activities (Phase 1), corrective action construction (Phase 2), and corrective action operations, maintenance, and closure (Phase 3). Information for each phase is described in this section.

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4.2.1 Phase 1: Pre-Construction Activities

Pre-construction activities would include further pre-design investigation, obtaining permits from other agencies, completing the final design of the remedy, and selecting a remedy implementation contractor via a bidding process. Information associated with each of these activities is described below.

- Completing pre-design investigation, final design and bid activities, including:
  - Completion of additional subsurface investigations and groundwater monitoring to further refine the necessary extents of both tree segments.
  - Collection of geotechnical data to support the design of dike modifications to allow construction of the southern segment.
  - Additional data collection and analyses may be required to characterize the potential impact of known naturally occurring sources of subsurface methane on the construction and design of the phytoremediation system.
  - Implementation of a pilot study to optimize tree species/variety, backfill materials, irrigation depth and flow rates, and other parameters that are specific to the site.
  - Completion of engineering calculations, design drawings, specifications, and a construction quality assurance plan.
  - Bidding and selection of the tree well system construction contractor.
- Obtaining permits or modifications from other agencies including:
  - A general stormwater permit for construction site activities though IEPA, including construction stormwater controls and other BMPs such as installation of silt fences and other measures.
  - IDNR Office of Water Resources, Dam Safety modification permit, for modification of the embankment.

4.2.2 Phase 2: Corrective Action Construction

Corrective action construction would be initiated after pre-construction activities are complete. It would include mobilizing construction equipment to the site, preparing the site for construction activities, constructing the tree well systems, and performing post-construction and site restoration activities.

Phytoremediation construction is assumed to occur concurrently within the latter phases of the with AP closure construction. This would allow spoils generated during tree well installation to be placed beneath the final cover system within the AP, in addition to reducing the risk of intrusive construction activities from negatively impacting the stability of the AP dikes while they still retain water and/or free liquids. This would likely mean that phytoremediation would be implemented after the AP has been dewatered; after free liquids have been removed from the CCR; after CCR has been removed from the CBR portions of the AP; and after the existing sewer force main has been abandoned, but before the final cover system has been completed. It was assumed that a construction contractor separate from the closure construction contractor would complete installation of the tree segments.

Information associated with each of these activities is described below.

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- The contractor would mobilize equipment, construction facilities, and materials to the site, and implement stormwater BMPs around the construction area, construct a staging and laydown area, and construct temporary access roads leading from the tree well system alignment to the existing site access road.
- Site utilities would be modified and/or abandoned, as necessary, to provide suitable clearance. This may require raising existing high-voltage power lines that cross the northern trench alignment to provide a safe working distance between the energized lines and construction equipment and for mature tree canopy growth.
- A 30-foot wide, level, and stable work platform would be constructed into the existing dike in the vicinity of the southern segment. The work platform is required due to the lack of right-of-way between the existing AP perimeter dike and the adjacent stormwater drainage channel and property boundary. The excavation would require substantial physical modification to the AP dike and may require the use of temporary or permanent shoring to supplement embankment grading to construct the work platform.
- Geotechnical monitoring would be performed to evaluate the AP embankment for signs of distress during construction.
- The phytoremediation installations are assumed to be constructed using a hollow stem auger drill rig capable of drilling approximately 10-inch diameter boreholes which would allow enough space for a tree cutting, appropriate backfill, and any additional items associated with the phytoremediation installation (irrigation tube, aeration tube, moisture meter, piezometer).
  - The phytoremediation installations would be installed along the design alignment on the outer side of the existing dike.
  - The upper portion of each borehole, above the groundwater potentiometric surface elevation, would be backfilled with mixture of porous material, organic moisture-wicking material, and compost/fertilizer (60% sand, 30% peat, 10% compost, trace extended-release fertilizer).
  - Methane is known to be present in aquifers throughout Illinois, due to both natural and anthropogenic processes (coal mining), and has been encountered at the AP [12]. A detailed methane monitoring plan would be developed and implemented during on-site construction activities where the potential to encounter methane has been identified.
- Following completion of the phytoremediation installations, the work platform area would be permanently stabilized. This may entail the partial or complete backfill of the excavated materials, or reinforcement of the excavation shoring to convert into a permanent retaining wall, with less or no backfill. As such, tree plantings would be located along the outer (downslope) edge of the work platform.
- Site restoration would be completed following the completion of the phytoremediation installations. This would include repairing site infrastructure that was relocated or damaged during construction and 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.

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Following installation of the trees, it is expected that there would be a period of approximately five years where no or limited uptake of groundwater occurs, in order to allow the roots to become established at target depths. It is also assumed that the trees would be dormant with no uptake during winter seasons (*i.e.,* October to March). During these periods, monitoring of trees and conditions would be conducted to encourage appropriate growth.

4.2.3 Phase 3: Corrective Action Operations, Maintenance, and Closure

Corrective action operations, maintenance, and closure would be initiated after corrective action construction is completed. It would include operating and maintaining the remedy, performing corrective action groundwater compliance monitoring, 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 O&M
  - Continued operation of the phytoremediation installations would require routine, scheduled inspections and associated maintenance including, but not limited to, irrigation, maintenance of water delivery systems and/or the delivery of irrigation water, maintenance to irrigation systems, maintenance and pruning of the trees, mowing and clearing other vegetation around the trees, collection of tree tissue samples, harvesting tree waste (*i.e.*, fallen leaves and branches), and maintenance of phytoremediation installation components.
  - Non-routine maintenance that may occur during extended operation of the tree wells may include complete replacement of the trees and repair or replacement of phytoremediation installation components.
  - Groundwater modeling provided in **Appendix B** indicates that ongoing operation and associated O&M of the tree installations may need to continue for a total of 70 to 150 years (*i.e.,* 22 to 73 years after GWPS have been met). Therefore, it was assumed that O&M will occur over a period of 70 to 150 years, after which O&M of the tree installations will be ceased.
- Corrective Action Groundwater Monitoring
  - Regular corrective action groundwater monitoring would be conducted using a corrective action groundwater monitoring system designed in accordance with 35 I.A.C. § 845.680(c), which specifies that wells must be installed within the plume of contamination that lies beyond the waste boundary.
    - Samples would be collected for each constituent 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 after each monitoring event, in addition to an annual groundwater monitoring and corrective action report, in accordance with 35 I.A.C. § 845.640(c). The annual corrective action report would include an evaluation of the actual performance of the remedy relative to the remedy's expected performance.

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  - Routine maintenance of the monitoring system would be conducted during the monitoring period. This would include inspection of 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 will 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 will be evaluated and, if feasible, implemented in accordance with 35 I.A.C. § 845.680(b).
- Corrective Action Confirmation Monitoring and Completion
  - After GWPS have been met for all corrective action monitoring wells for a period of three years after O&M of the phytoremediation system has ceased, corrective action would be considered complete, per 35 I.A.C. § 845.680(c).
  - After completion of the corrective action confirmation monitoring period, a Corrective Action Completion Report and Certification would be prepared and submitted to IEPA, in accordance with 35 I.A.C. § 845.680(e).

4.2.4 Remedy Implementation Schedule

A feasibility-level implementation schedule for the Alternative 3 source control with phytoremediation is provided in **Table C** below.

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Table C. Feasibility-Level Implementation Schedule – Alternative 3: Source Control with Phytoremediation

Implementation Phase	Implementation Task	Timeframe (Preliminary Estimates)
1: Pre-Construction	Agency Coordination, Approvals, and Permitting	18 to 24 months
	Pilot Study	6 to 12 months
	Final Design and Bid Process	24 to 36 months
	Timeframe to Complete Corrective Action Pre-Construction Activities	48 to 72 months
2: Corrective Action Construction	Corrective Action Construction	9 to 18 months
	Timeframe to Complete Corrective Action Construction	9 to 18 months
3: Corrective Action O&M and Closure*	Corrective Action Monitoring and O&M	840 to 1800 months (70 to 150 years)
	Corrective Action Groundwater Compliance Monitoring	36 months
	Corrective Action Completion	6 months
	Timeframe to Complete Corrective Action O&M and Closure	882 to 1,842 months (74 to 154 years)
	Total Timeline to Complete Corrective Action	939 to 1,932 months (78 to 161 years)

*Denotes a timeframe that is assumed to start after source control (*e.g.,* final closure of the SI) is complete.

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 AP final cover system. Therefore, the start of Phase 3 (Corrective Action O&M and Closure) is assumed to begin at the completion of source control (final closure of the AP). 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.

4.2.5 Management of Extracted Groundwater

No groundwater extraction would occur under this remedy.

4.2.6 35 I.A.C. § 845.670(e)(1)(H) and 35 I.A.C. § 845.670(e)(3) Information

As requested by Gradient, the following information required by 35 I.A.C. § 845.670(e)(1)(H) and 35 I.A.C. § 845.670(e)(3) has been developed for the remedy. The information was developed based on preliminary-level information contained within the CMA for the AP 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)
  - Tree replacement is expected to be required during the design life of the remedy. It is estimated that trees would need to be replaced one to five times (assuming a 30- to 50-year tree lifespan), depending on the timeframe required to achieve GWPS and overall tree performance at the site.

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  - The remedy would require ongoing monitoring and maintenance to retain its effectiveness. Replacement of the trees was assumed to be at a rate of 10% annually (*i.e.*, approximately 60 trees) for the first five years, followed by 5% annually after the first five years. Larger tree replacement events may be difficult due to the space and access limitations.

- Degree of Difficulty Associated with Constructing the Remedy – 35 I.A.C. § 845.670(e)(3)(A)
  - The remedy would require use of a hollow stem auger drill rig for installation of the tree well systems in addition to general construction equipment (*i.e.*, excavation and grading equipment) for the installation of a working platform for the southern tree segment. These types of construction equipment are readily available at a regional level and construction of these portions for the remedy are not expected to present significant challenges.
  - Construction of the southern tree segment would require modifications to the EPP AP embankment in order to provide a working platform for construction equipment. The modifications may require the use of temporary excavation shoring and/or other methods to avoid instability of the dike during construction.
  - In addition to likely requiring a permit from the IDNR Office of Water Resources, Dam Safety section, the construction would require a detailed geotechnical design of the working platform.
  - The modification would likely need to use risk management systems, such as a geotechnical monitoring program to evaluate the embankment for signs of distress during construction.
  - In the event that distress is noted, construction may need to be temporarily paused to evaluate the sources of the distress and mitigate, if needed.
  - Although embankments are routinely modified, the modifications required for this work platform are intrusive and could temporarily increase the risk of dike instability relative to current conditions.
  - The high-voltage power lines crossing the northern tree alignment may need to be raised in order to provide a safe working distance between the energized lines and construction equipment.
  - Naturally occurring methane is known to be present at the EPP AP. During field activities in 2021, methane was detected above 10% of the lower explosive limit (LEL) at borehole monitoring well locations AW-13, AW-14, AW-15, AW-15C, AW-16, AW-17, AW-22, and P002. Levels quickly dissipated after venting the monitoring wells to the atmosphere [12]. The presence of methane would require the implementation of a methane monitoring and response plan. This may result in periodic safety shutdowns during construction, where work activity is stopped to allow methane concentrations to decrease to safe levels.
- Expected Operational Reliability of the Remedy - 35 I.A.C. § 845.670(e)(3)(B)
  - While the phytoremediation installations are expected to have high operational reliability if they are constructed in accordance with the design and specifications, performance of the phytoremediation installations would be dependent on the trees' ability to grow in site conditions.

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  - Performance of the system would require establishment of root systems to achieve desired uptake rates (approximately 40 gallons per day per tree).
  - Sensitivity analyses evaluating a range of uptake rates performed during modeling indicate a wide variation in time to reach GWPS (48 to 77 years) and total required remedy duration (70 to 150 years) to prevent rebounding concentrations; this indicates that the overall operational reliability is highly sensitive to the performance of the living/biological phytoremediation system, and therefore results in uncertain operational reliability.
  - While studies have found that low concentrations of boron and inorganics can be addressed by phytoremediation [13, 14, 15, 16, 17], few case studies could be found that document the use of phytoremediation on a large scale to remediate boron in groundwater or specifically CCR. The limited nature of these examples provides additional uncertainty on tree health and the corresponding long-term operational reliability of phytoremediation in this application.
  - The phytoremediation systems are a combination of mechanical and biological systems that would require routine and ongoing maintenance in order to reliably operate, as outlined in **Section 4.2.3**.
- Need to Coordinate with and Obtain Necessary Approvals and Permits from Other Agencies - 35 I.A.C. § 845.670(e)(3)(C)
  - Agency permits would need to be obtained for an IDNR Dam Safety modification permit. These permits typically take 18 to 24 months to obtain.
  - While these permits may also be obtained for the AP final closure, the schedule for approval of both the Final Closure Plan and the eventual CAP is 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 phytoremediation installations would require a hollow stem auger drill rig, which are widely available at a regional level. The drilling crew would not need specialized skills outside of typical capabilities.
  - Specialists in phytoremediation design may need to be utilized during the design and construction phase.
  - Geotechnical specialists would be needed to design the working platform and monitor the AP embankment for signs of distress during phytoremediation installations.
  - These types of equipment and specialists have been utilized in the past for other similar types of phytoremediation design and construction projects.
  - 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.

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    - 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 phytoremediation installations would be limited to spoils; these would be disposed of on-site in the AP during closure construction. Completing the phytoremediation installations at the same time as the AP closure would provide sufficient on-site capacity for the disposal of generated spoils.
  - Organic waste would be generated annually during the lifespan of the phytoremediation remedy. Trees that have been removed for replacement and seasonal fallen leaves and branches would be periodically sampled to profile the waste. Based on organic waste sampling results, the material may be chipped and used for mulch/compost on-site or may require off-site disposal. If material requires off-site disposal, Waste Management Peoria City, a local landfill, is 18 miles from the site, and has sufficient capacity to receive the expected small volume of organic waste.

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5. MATERIAL QUANTITY, LABOR, AND MILEAGE ESTIMATES

Estimates of material quantities, total labor hours, and mileage were prepared for Alternative 2 source control with GWE and Alternative 3 source control with phytoremediation, to support Gradient in preparing their CAAA. Estimates were not prepared for Alternative 1 source control with GWP as the alternative does not require remedial construction or O&M of a physical remedy.

These 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) [18] 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 and Alternative 3 source control with phytoremediation, daily construction and O&M labor mobilization miles were estimated assuming a weekly mobilization/demobilization from Chicago (340 miles round trip) and a local commute of 30 miles round trip per day. The number of working days and hours per week were estimated from the construction schedule developed for each remedy.
- Estimates of material delivery miles were prepared based on Ramboll's experience.

The detailed material quantity, labor, and mileage estimates are provided in **Appendix C** for each alternative.

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6. REFERENCES

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

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

[3] Ramboll Americas Engineering Solutions, Inc., "35 I.A.C. § 845 Corrective Measures Assessment, Edwards Power Plant, Ash Pond, IEPA ID No. W1438050005-01," June 4, 2024.

[4] IngenAE, LLC, "Final Closure Plan Edwards Power Plant Ash Pond, Bartonville, Illinois," June 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.

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[7] Ramboll Americas Engineering Solutions, Inc., "Groundwater Modeling Report, Ash Pond, Edwards Power Plant," Bartonville, IL, 2022.

[8] Life Cycle Geo, LLC, "Groundwater Polishing Evaluation Report," April 2025.

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[13] R. Rees, B. H. Robinson, C. J. Rog, A. Papritz and R. Schulin, "Boron accumulation and tolerance of hybrid poplars grown on a B-laden mixed paper mill waste landfill," *Science of the Total Environment,* vol. 447, no. March 2013, pp. 515-524, 2013.

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[15] K. Yildirim and G. Citir Kasim, Phytoremediation potential of poplar and willow species in small scale constructed wetland for boron removal, Chemosphere, 2018.

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APPENDIX A
FEASIBILITY-LEVEL DESIGN DRAWINGS FOR ALTERNATIVES 2 AND 3 REMEDIES

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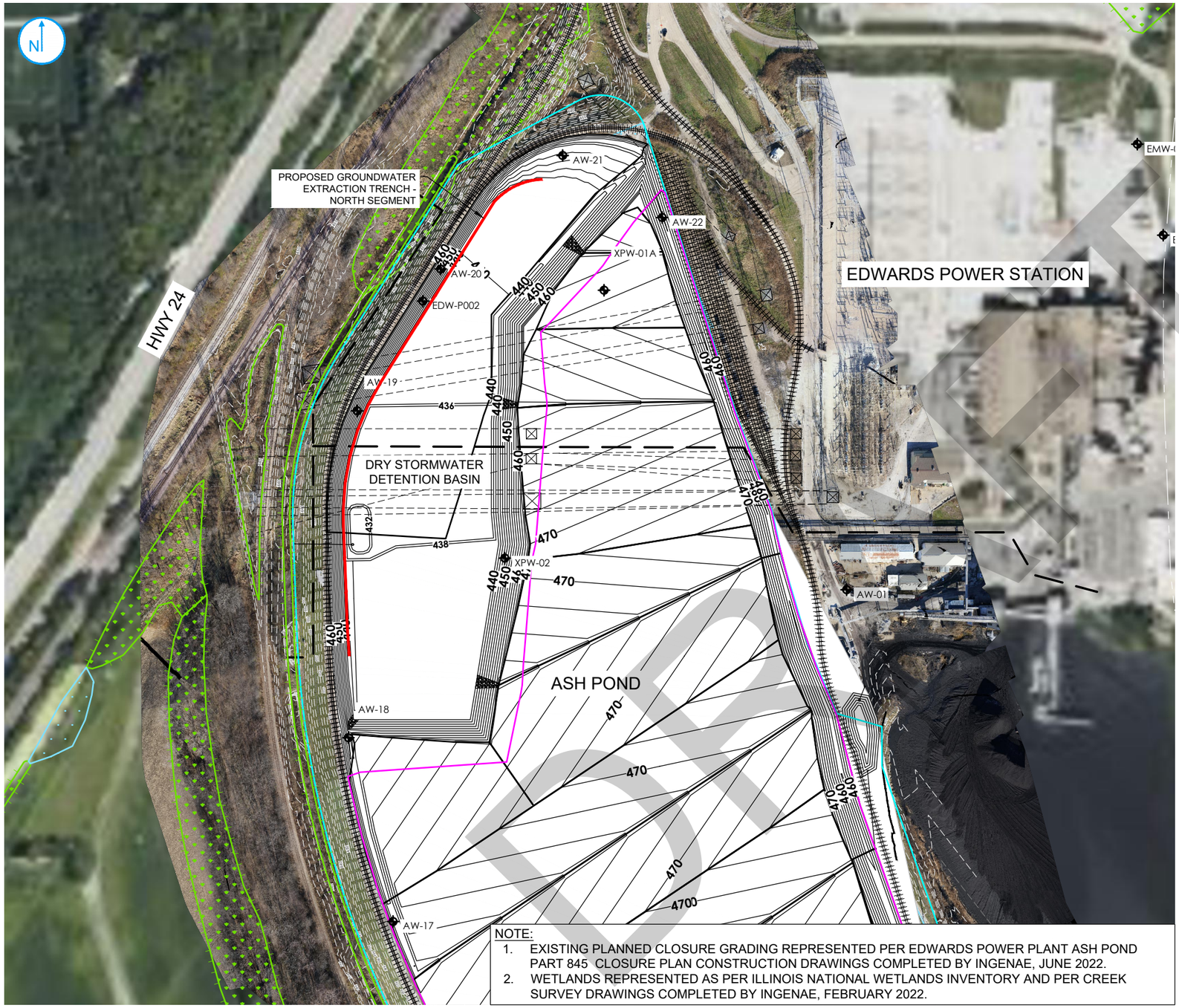
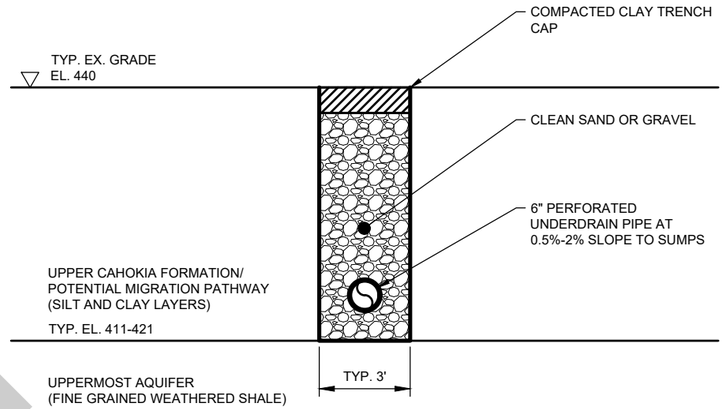


NOTE:
1. EXISTING PLANNED CLOSURE GRADING REPRESENTED PER EDWARDS POWER PLANT ASH POND PART 845 CLOSURE PLAN CONSTRUCTION DRAWINGS COMPLETED BY INGENAE, JUNE 2022.
2. WETLANDS REPRESENTED AS PER ILLINOIS NATIONAL WETLANDS INVENTORY AND PER CREEK SURVEY DRAWINGS COMPLETED BY INGENAE, FEBRUARY 2022.



TRENCH DETAIL

NOT TO SCALE

EXISTING

- BODY OF WATER
- WETLANDS BOUNDARY (SEE NOTE 2)
- HIGH VOLTAGE UTILITY TOWER AND OVERHEAD POWER LINES
- MONITORING WELLS
- MAJOR CONTOUR
- MAJOR CONTOUR
- RAILROAD TRACKS
- SEWER FORCEMAIN
- CCR BOUNDARY
- EXTENT OF CAP

PROPOSED

- MAJOR CONTOUR
- MAJOR CONTOUR
- GROUNDWATER EXTRACTION TRENCH

0 300 Feet

NORTH TRENCH
FEASIBILITY-LEVEL DESIGN

Edwards Ash Pond
Edwards Power Plant 7800 Cilco Lane Bartonville, IL 61607

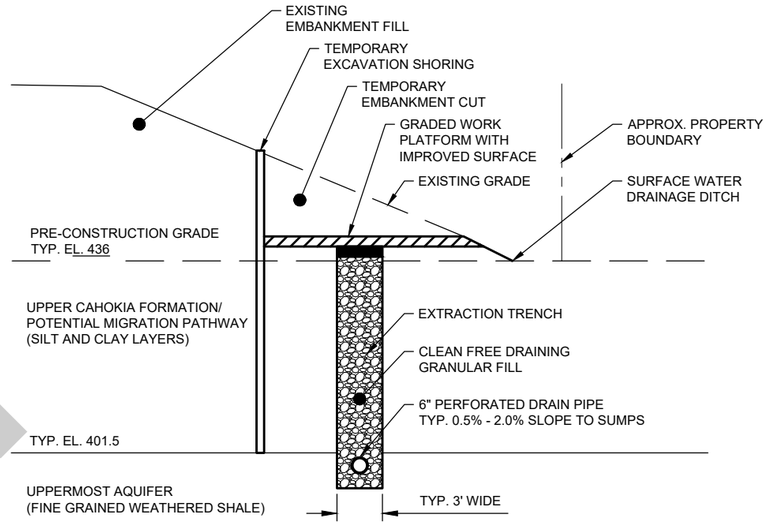
FIGURE 1

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL

PROJECT: ----
DATED: 4/4/2024
DESIGNER: CHICAGOD
C:\Users\CHICAGOD\Documents\Ramboll Gruppen AS\RUS-194010358 4-004 Vistra Energy EDW-AP\Project Files\4 Delivery\40 WIP\401 CivilDrawings\03_CAAA-SIR\EDW-AP CAAA-SIR.dwg





WORK PAD AND TRENCH DETAIL

NOT TO SCALE

NOTE:
1. EXISTING PLANNED CLOSURE GRADING REPRESENTED PER EDWARDS POWER PLANT ASH POND PART 845 CLOSURE PLAN CONSTRUCTION DRAWINGS COMPLETED BY INGENAE, JUNE 2022.
2. WETLANDS REPRESENTED AS PER ILLINOIS NATIONAL WETLANDS INVENTORY AND PER CREEK SURVEY DRAWINGS COMPLETED BY INGENAE, FEBRUARY 2022.

PROJECT: ---- DATED: 4/4/2024 DESIGNER: LEMMONBN C:\DCAGSDocs\Ramboll Gruppen AS\RUS-1940103584-004 Vistra Energy EDW-AP\Project Files\4 Delivery\40 WIP\401 Civil\Drawings\03_CAAA-SIR\EDW-AP CAAA-SIR.dwg

EXISTING		PROPOSED	
BODY OF WATER	MAJOR CONTOUR	360	MAJOR CONTOUR
WETLANDS BOUNDARY (SEE NOTE 2)	MAJOR CONTOUR		MAJOR CONTOUR
HIGH VOLTAGE UTILITY TOWER AND OVERHEAD POWER LINES	RAILROAD TRACKS		GROUNDWATER EXTRACTION TRENCH
MONITORING WELLS	SEWER FORCEMAIN		
	CCR BOUNDARY		
	EXTENT OF CAP		

0 300 Feet

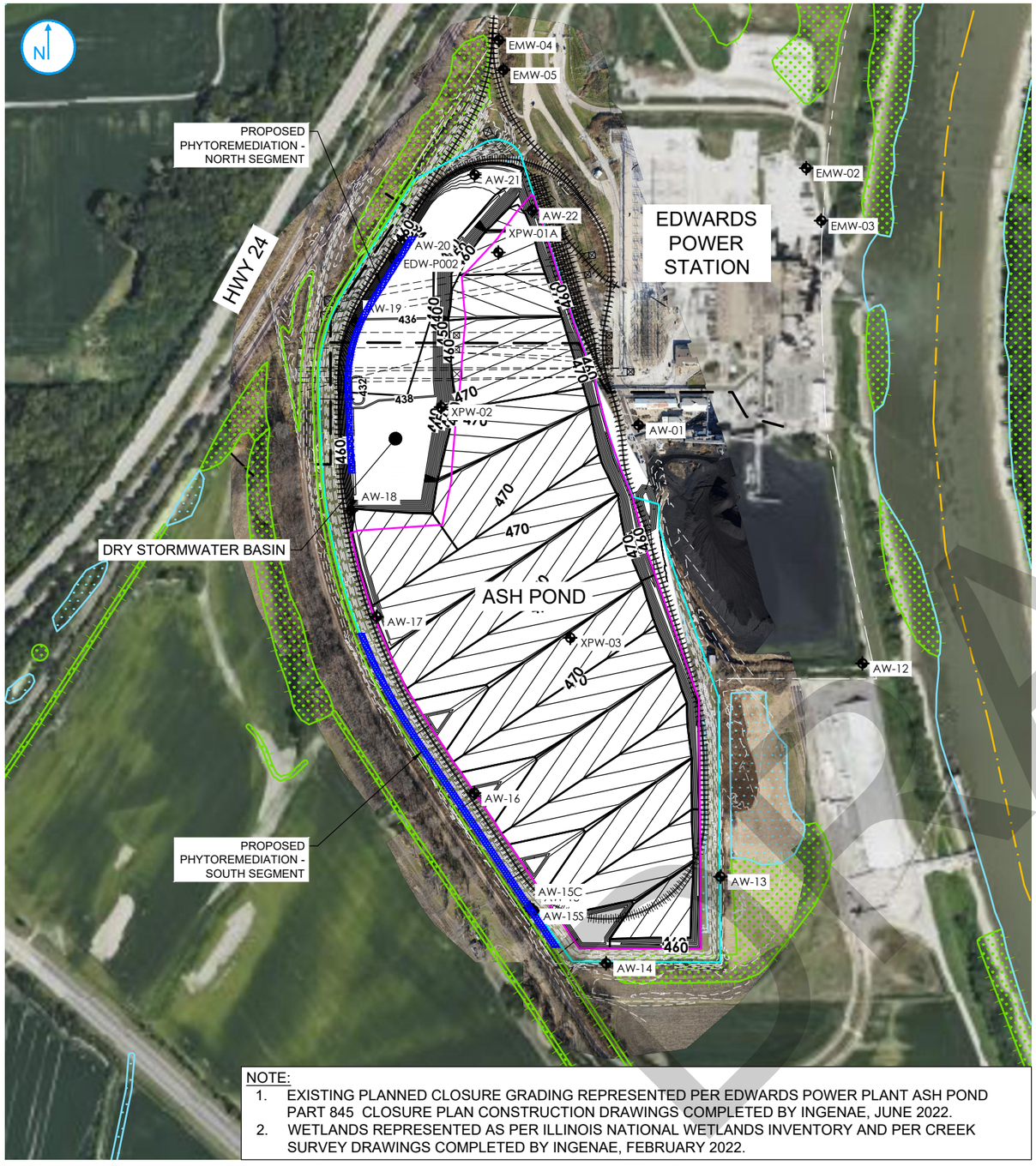
SOUTH TRENCH
FEASIBILITY-LEVEL DESIGN

Edwards Ash Pond
Edwards Power Plant 7800 Cilco Lane Bartonville, IL 61607

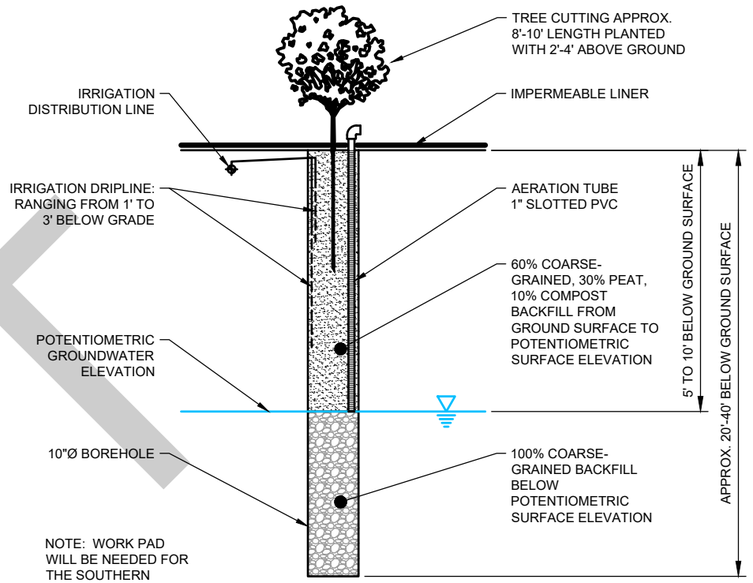
FIGURE 2

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL



NOTE:
1. EXISTING PLANNED CLOSURE GRADING REPRESENTED PER EDWARDS POWER PLANT ASH POND PART 845 CLOSURE PLAN CONSTRUCTION DRAWINGS COMPLETED BY INGENAE, JUNE 2022.
2. WETLANDS REPRESENTED AS PER ILLINOIS NATIONAL WETLANDS INVENTORY AND PER CREEK SURVEY DRAWINGS COMPLETED BY INGENAE, FEBRUARY 2022.



TREE PLANTING SYSTEM DETAIL

NOT TO SCALE

WORK PAD DETAIL

NOT TO SCALE

EXISTING

- BODY OF WATER
- WETLANDS BOUNDARY (SEE NOTE 2)
- HIGH VOLTAGE UTILITY TOWER AND OVERHEAD POWER LINES
- MONITORING WELLS
- MAJOR CONTOUR
- MAJOR CONTOUR
- RAILROAD TRACKS
- SEWER FORCEMAIN
- CCR BOUNDARY
- EXTENT OF CAP

PROPOSED

- 360 MAJOR CONTOUR
- MAJOR CONTOUR
- PHYTOREMEDIATION AREA

0 600 Feet

PHYTOREMEDIATION
FEASIBILITY-LEVEL DESIGN

Edwards Ash Pond
Edwards Power Plant 7800 Cilco Lane Bartonville, IL 61607

FIGURE 3

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL

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PROJECT: ---- DATED: 4/4/2024 DESIGNER: EMMONSN C:\DOCS\Ramboll Gruppen AS\RUS-1940103584-004 Vistra Energy EDW-AP\Project Files\4 Delivery\40 WIP\401 Civil\Drawings\03_CAAA-SIR\EDW-AP CAAA-SIR.dwg

APPENDIX B
GROUNDWATER MODELING DOCUMENTS

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APPENDIX B1
GROUNDWATER MODELING TECHNICAL MEMORANDUM

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Intended for
Illinois Power Resources Generating, LLC
7800 Cilco Lane
Bartonville, Illinois, 61607

Date
March 28, 2025

Project No.
1940110241-003

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GROUNDWATER MODELING TECHNICAL MEMORANDUM

ASH POND

EDWARDS POWER PLANT

BARTONVILLE, ILLINOIS

IEPA ID NO. W1438050005-01

RAMBOLL Bright ideas. Sustainable change.

GROUNDWATER MODELING TECHNICAL MEMORANDUM EDWARDS POWER PLANT ASH POND, IEPA ID NO. W1438050005-01

DRAFT

Project name	**Edwards Power Plant Ash Pond**
Project no.	**1940110241-003**
Recipient	**Illinois Power Resources Generating, LLC**
Document type	**Technical Memorandum**
Revision	**DRAFT**
Date	**March 28, 2025**
Prepared by	**Jinjun Wang, PhD**
Checked by	**Jake J. Walczak, PG**
Approved by	**Brian G. Hennings, PG**

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ACRONYMS AND ABBREVIATIONS

35 I.A.C.	Title 35 of the Illinois Administrative Code
AP	Ash Pond
CAAA	Corrective Action Alternatives Analysis
CAP	Corrective Action Plan
CCR	coal combustion residual(s)
CBR	closure-by-removal
CIP	closure-in-place
COC	constituent of concern
EPP	Edwards Power Plant
ft/d	feet per day
gpd/tree	gallons per day per tree
gpm	gallons per minute
GWE	groundwater extraction
GWP	Groundwater Polishing
GWPS	groundwater protection standard(s)
ID	identification
IEPA	Illinois Environmental Protection Agency
IPRG	Illinois Power Resources Generating, LLC
mg/L	milligrams per liter
mL/g	milliliters per gram
NAVD88	North American Vertical Datum of 1988
NID	National Inventory of Dams
No.	number
Ramboll	Ramboll Americas Engineering Solutions, Inc.
UA	uppermost aquifer

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EXECUTIVE SUMMARY

Ramboll Americas Engineering Solutions, Inc. (Ramboll) has prepared this Groundwater Modeling Technical Memorandum on behalf of the Edwards Power Plant (EPP), operated by Illinois Power Resources Generating, LLC (IPRG), in accordance with requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845. This document presents the results of predictive groundwater modeling simulations for proposed corrective action. A total of three potential remedial alternatives were evaluated, including (1) Alternative 1: source control with groundwater polishing (GWP), (2) Alternative 2: source control with groundwater extraction (GWE), and (3) Alternative 3: source control with phytoremediation. Each remedial alternative simulation was based off the closure-in-place (CIP) scenario that was selected as the closure plan for EPP AP in 2022 (IngenAE, 2022) and modeled in the Groundwater Modeling Report (Ramboll, 2022).

The groundwater modeling efforts described in this Groundwater Modeling Technical Memorandum include groundwater flow modeling using MODFLOW-NWT (Niswonger et al., 2011) and contaminant fate and transport modeling using MT3DMS (Zheng and Wang, 1999) to evaluate how each corrective action will achieve compliance with the applicable groundwater protection standards (GWPSs); and describe fate and transport of contaminants in accordance with 35 I.A.C. § 845.220 (c)(2). The effectiveness of each corrective action was assessed based on the time for simulated boron concentrations to decrease below the GWPS in each of the groundwater monitoring wells in the vicinity of EPP AP (**Figure 1**). Each corrective action was assumed to be implemented at the completion of the EPP AP final closure.

Alternative 1 remedy consists of source control with GWP, which represents the selected closure alternative for EPP AP in 2022 (IngenAE, 2022). Groundwater modeling results for this remedy indicate the simulated boron concentrations would achieve the applicable GWPS of 2 milligrams per liter (mg/L) in each of the monitoring wells within approximately 800 years[1].

Alternative 2 remedy consists of source control with installation and operation of GWE trench. Groundwater modeling results for this remedy indicate the simulated boron concentrations would achieve the GWPS of 2 mg/L in each of the EPP AP monitoring wells within 37 years. Prediction modeling suggests that operation of Alternative 2 remedy for an additional 13 years (50 years total) may be necessary to reduce the potential for boron concentration to rebound above the GWPS after groundwater extraction operations have ceased.

Alternative 3 remedy consists of source control with phytoremediation. Simulation results from groundwater modeling, including uncertainty analyses based on the assumption of optimal and sub-optimal phytoremediation groundwater uptake rate performance, indicate the simulated boron concentrations would achieve the GWPS of 2 mg/L in all the groundwater monitoring wells within 42 to 77 years. Operation of Alternative 3 remedy for 55 to 150 years is expected to reduce the potential for boron concentration from rebounding above the GWPS after phytoremediation operations have ceased.

[1] The 2022 model results estimated approximately 750 years for all wells to achieve the GWPS. Following model updates described in this document, the estimated time to achieve the GWPS at each well for Alternative 1 remedy has been updated to approximately 800 years.

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1. INTRODUCTION

1.1 Background

This Groundwater Modeling Technical Memorandum is prepared to evaluate how potential CAP remedial alternatives would achieve compliance with the applicable GWPSs, and to describe fate and transport of contaminants in accordance with 35 I.A.C. § 845.220 (c)(2). The groundwater modeling efforts consist of predictive groundwater modeling to assess the long-term effectiveness and time to achieve GWPS for boron for the following remedial alternatives: (1) Alternative 1: source control with GWP, (2) Alternative 2: source control with GWE, and (3) Alternative 3: source control with phytoremediation. In all remedial alternatives, source control is the CIP that had been selected as the closure alternative for EPP AP in 2022 (IngenAE, 2022) and modeled in the Groundwater Modeling Report (Ramboll, 2022).

1.2 Previous Groundwater Modeling Report

In accordance with requirements of 35 I.A.C. § 845, Ramboll developed groundwater flow and transport models for EPP AP in 2022 to evaluate the CIP closure scenario (Ramboll, 2022). The groundwater flow model was built using MODFLOW-2005 (Harbaugh, 2005), and the contaminant fate and transport model was built using MT3DMS. The groundwater models were used to evaluate two closure scenarios, including consolidation of the coal combustion residuals (CCR) and CIP, and closure-by-removal (CBR). The CIP was selected as the primary corrective action to meet regulatory requirements for closure of EPP AP. The modeling exercises and results were summarized in the Groundwater Modeling Report (Ramboll, 2022).

The groundwater modeling efforts presented in this Groundwater Modeling Technical Memorandum are based on the Ramboll (2022) groundwater modeling exercises, as detailed in **Section 2**.

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2. ALTERNATIVE 1 SIMULATION

2.1 Closure in Place (CIP)

The Groundwater Modeling Report (Ramboll, 2022) simulates the CIP closure of EPP AP as presented in the Final Closure Plan (IngenAE, 2022). The closure of EPP AP consists of a consolidate-and-cap approach for source control.

2.2 Alternative 1 - Source Control with Groundwater Polishing (GWP)

This scenario is consistent with the closure conditions (consolidate-and-cap and CIP of the AP) for source control (Ramboll, 2022), after which GWP will be used to reduce the residual concentration remaining in the groundwater after closure. These activities constitute the Alternative 1 remedy: source control with GWP. Groundwater polishing of boron is further discussed in the Groundwater Polishing Evaluation Report (GPR) (Life Cycle Geo, LLC, 2025) and **Section 3.3** of this document.

2.3 Ramboll (2022) Model Description

The Ramboll (2022) groundwater modeling simulated the fate and transport of boron to support closure of EPP AP. Modeling activities conducted to simulate the CIP closure (*i.e.*, Alternative 1 remedy) included:

- Initial modeling was performed for a 62-year period to represent boron concentrations for site conditions in 2022, 62 years following construction of EPP AP in 1960. The model was calibrated to represent groundwater elevations and concentrations observed in groundwater monitoring wells.
- Prediction modeling was conducted to simulate initial corrective action measures, which include dewatering of the EPP AP (1-year period), consolidation of CCR and cover system construction or removal of CCR.
- Prediction simulation was performed to evaluate the effects of CIP closure scenario for EPP AP on groundwater quality for a period of 1,000 years after the completion of closure activities.
- According to the prediction simulation results for CIP closure, monitoring well AW-16 is the last well to achieve the 2 mg/L GWPS for boron. The simulated boron concentration in well AW-16 would drop below the GWPS 767 years after the implementation of closure.

For the contaminant fate and transport simulations, boron was selected as the constituent to evaluate the effectiveness of the closure scenario. Boron has similar groundwater transport characteristics as the other constituents that have been detected with potential GWPS exceedances[2] (*i.e.,* sulfate and total dissolved solids). Therefore, subsurface transport during closure conditions would be similar for all these constituents. Boron has been detected in EPP AP groundwater at the highest concentrations relative to its GWPS and it will likely take the longest

[2] 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 IPRG's operating permit application for the EPP AP. That operating permit application, including the proposed groundwater monitoring program, remains under review by the IEPA and, therefore, IPRG has not identified any actual exceedances.

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time to meet the GWPS. 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 will likely achieve their GWPSs more quickly (Gradient, 2024).

2.4 Groundwater Model Update

For the purpose of evaluating the potential groundwater remedial alternatives, the groundwater flow modeling program associated with the prediction simulations, including the 1-year dewatering simulation and the 1,000-year CIP simulation, was updated from MODFLOW-2005 to MODFLOW-NWT. MODFLOW-NWT is a modeling program designed to solve nonlinear groundwater flow problems due to unconfined aquifer conditions and is superior in solving problems involving drying and rewetting of unconfined aquifers (Niswonger et al., 2011), which were expected for the selected remedial alternatives. In addition, the layer types associated with model Layers 2 through 5 in the prediction models were updated from "confined" to "unconfined (T Varies)" to accommodate the drying and rewetting conditions. MT3DMS remained as the fate and transport modeling program.

The updated simulation results are discussed in **Section 2.3**. In this Groundwater Modeling Technical Memorandum, it is assumed the CAP remedial alternatives would be implemented simultaneously with the CIP. Therefore, the simulated groundwater elevations and boron concentrations at the end of the 1-year dewatering period also served as the initial conditions for the following remedial alternative simulations described in **Section 3**.

2.5 Simulation Results of Updated Model

The simulated boron concentrations in EPP AP's groundwater monitoring wells versus time are shown in **Figure 2**. The simulated time to achieve boron GWPS in the monitoring wells is summarized in **Table 1**. According to the simulation results, monitoring well AW-16 has the longest time to achieve compliance among all the monitoring wells, which is 801 years. As mentioned in **Section 2.1**, the simulated time to achieve compliance from the Ramboll (2022) modeling is 767 years. The minor difference between the two results is a result of model update as described in **Section 2.2**.

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3. ALTERNATIVE 2 AND ALTERNATIVE 3 SIMULATIONS

The source control with CIP (*i.e.*, Alternative 1 remedy) simulation described in **Section 2** provides a baseline scenario for comparison to the two supplemental corrective action remedies, including Alternative 2 (source control with GWE), and Alternative 3 (source control with phytoremediation).

3.1 Alternative 2 Remedy – Source Control with GWE

3.1.1 Overview

Alternative 2 remedy consists of the installation and operation of GWE trenches. The GWE trenches would be installed during the completion of source control (*e.g.*, final closure) construction activities and become operational at the same time source control is complete. The extents and depths of GWE trenches were selected through iterative fate and transport simulations. Various depth intervals and trench lengths were evaluated to identify optimal depths and locations to reduce the time to achieve GWPS while remaining feasible to construct and operate.

The proposed GWE trenches include two segments located near the western boundary of the EPP AP (**Figure 3**): the Northern Segment and the Southern Segment. The Northern Segment is proposed to be installed to the bottom of the uppermost aquifer (UA) to an elevation of approximately 411 to 421 feet[3]. The Southern Segment is proposed to be installed within the UA to an elevation of approximately 401.5 feet[3]. The goal of Alternative 2 remedy is to increase the hydraulic gradient towards the extraction trench by collecting groundwater from the near bottom of the trench and lowering the head in the surrounding soil units. A greater hydraulic gradient will induce higher groundwater flow velocity, which will increase the speed of dissolved phase mass removal from EPP AP. The time to achieve GWPS in the groundwater monitoring wells will be reduced accordingly.

3.1.2 Model Approach

The 1,000-year CIP prediction model described in **Section 2** was modified to simulate the effectiveness of Alternative 2 Remedy. The proposed GWE trench was simulated as drains located within the UA, which was simulated as Layer 4 in the model. The drain stage was set to the bottom of the UA for the Northern Segment, and to 401.5 feet for the Southern Segment. The GWE trench was assumed to be 3-foot thick, and the backfill material for the GWE trench was assumed to be sand with a hydraulic conductivity of 62.4 feet per day (ft/d). The model cells simulating the GWE trench were sized 25 feet by 25 feet, with 12% of the volume being backfill material. Therefore, the hydraulic conductivities in model cells within and above the drain were adjusted to 10 ft/d, both vertically and horizontally, to account for the permeability of fill material in the extraction trench.

3.1.3 Simulation Results

Simulation of Alternative 2 remedy assumed operation of the GWE trench for 50 years. The simulated boron concentrations in the groundwater monitoring wells versus time for Alternative 2 remedy are shown in **Figure 4**. The simulated time to achieve boron GWPS in the monitoring

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

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wells is summarized in **Table 1**. According to the simulation results, monitoring well AP07S is the last well to reach GWPS, in 37 years under Alternative 2 remedy. The simulation results also indicate that operating the GWE trench for 50 years may be necessary to reduce the potential of boron concentrations from rebounding above GWPS after operation of the trenches has ceased. Monitoring and adaptive site management practices presented in the Corrective Action Groundwater Monitoring Plan (Ramboll, 2025) describe how stability in groundwater data will be evaluated before assessing if compliance with the GWPS has been attained to allow any transient effects of treatment on the groundwater (e.g., rebounding concentrations) to dissipate.

The simulated extraction rate from the GWE trench versus time is plotted in **Figure 5**. As shown in the figure, the extraction rates in both segments are higher at the beginning of the operation (*e.g.,* about 20 gallon per minute [gpm] in Northern Segment and 19 gpm in Southern Segment at the end of year 2) due to higher initial groundwater elevations at the start of extraction. As simulated, groundwater levels near the extraction trench decrease as operation of the GWE trench continues, as does the simulated extraction rates. Groundwater extraction decreases to approximately 6 gpm in Northern Segment and 8 gpm in Southern Segment at the end of 50-year operation.

3.2 Alternative 3 Remedy – Source Control with Phytoremediation

3.2.1 Overview

Alternative 3 remedy consists of source control with phytoremediation. The phytoremediation would be installed during the completion of source control construction activities and become active at the same time source control is complete. The phytoremediation configuration was selected through iterative fate and transport simulations. Various configurations were evaluated to identify optimal designs to reduce the time to achieve GWPS while remaining feasible to construct and maintain.

The proposed phytoremediation zone is composed of two segments: the Northern Segment and the Southern Segment, as shown in **Figure 6**. It is anticipated that each segment would contain a narrow grid (*i.e.,* approximately 8- to 10-foot grid spacing) of plantings with each planting consisting of one tree and a well system designed to passively draw groundwater upward to the root zone from the UA, allowing phytoremediation to occur.

The simulations for optimal phytoremediation performance assumed an ideal uptake rate of 40 gallons per day per tree (gpd/tree) during growing season (*i.e.*, April – September) and 0 uptake rate during dormant season (*i.e.*, October – March). The optimal number of trees for the phytoremediation was determined to be 194 trees in Northern Segment, and 354 trees in Southern Segment.

3.2.2 Model Approach

The 1,000-year CIP prediction model described in **Section 2** was updated to simulate the phytoremediation. In the updated model, groundwater uptake by the trees was simulated as groundwater extraction wells installed within the UA, which was simulated as Layer 4 in the model.

There are two possible approaches in simulating the ideal groundwater uptake rate of 40 gpd/tree during growing season in the model: Method A assumes an uptake rate of 40 gpd/tree for half of year and 0 rate for the other half. Method B assumes a consistent average uptake rate

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of 20 gpd/tree throughout the year. The simulated boron concentrations in selected groundwater monitoring wells from both methods are compared and shown in **Figure 7**. As shown in the figure, the simulated concentrations from both methods are in good agreement. Therefore, Method B was chosen for the remaining simulations as this method is both easier to implement in the prediction model simulations and is more computationally efficient.

3.2.3 Simulation Results

Simulation of Alternative 3 remedy assumed maintenance of phytoremediation for 70 years, with an ideal groundwater uptake rate of 40 gpd/tree during growing season. The simulated boron concentrations in the groundwater monitoring wells versus time under Alternative 3 Remedy are shown in **Figure 8**. The simulated time to achieve boron GWPS in the monitoring wells is summarized in **Table 1**. As shown, monitoring well AW-21 is the last monitoring location to achieve GWPS compliance for boron. Under Alternative 3 Remedy, the time for boron concentration in well AW-21 to drop below GWPS is 47 years. The simulation results also indicate that maintenance of phytoremediation for 70 years may be necessary to reduce the potential for boron concentrations from rebounding above GWPS after phytoremediation is ceased.

3.2.4 Uncertainty Analysis

In addition to the simulation described above, uncertainty analysis was conducted to assess the impact of uncertainty in the estimated groundwater uptake rate for Alternative 3 remedy. For the uncertainty analysis, a high-end (*i.e.,* optimal) uptake rate of 50 gpd/tree during growing season and a low-end (*i.e.*, suboptimal) uptake rate of 20 gpd/tree during growing season were applied in the model, respectively.

According to the simulation results, GWPS compliance will be achieved in 42 years under high uptake rate, and maintenance of phytoremediation for 55 years will prevent boron concentrations from rebounding above GWPS. The time to achieve GWPS compliance under low uptake rate is 77 years, and a 150-year maintenance is required to prevent boron concentration from rebounding above GWPS.

3.3 Assessment of Geochemical Processes

This groundwater flow and transport model estimates the time for boron to reach the GWPS under different potential corrective actions based on physical components of groundwater polishing. As described in the Groundwater Modeling Report submitted with the construction permit, it was assumed that boron would not significantly sorb or chemically react with aquifer solids (distribution coefficient [K_d] was set to 0 milliliters per gram [mL/g]), which is a conservative estimate for estimating contaminant transport times.

A Groundwater Polishing Evaluation Report (Life Cycle Geo, 2025) was attached to the Corrective Actions Alternative Analysis (Gradient, 2025). The geochemical modeling effort presented in the GPR supports the assessment of groundwater polishing as a component of the proposed corrective action by evaluating the potential for chemical attenuation of constituents of concern (COCs) before and after source control as a means of contextualizing the times estimated in the flow and transport model. The GPR also provides an initial foundation for understanding groundwater chemistry to inform adaptive site management as a key component of the Corrective Action Groundwater Monitoring Program.

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In their report, Life Cycle Geo evaluated the potential for natural groundwater polishing processes, which involve both physical and chemical mechanisms, to attenuate boron and sulfate and evaluate the potential for previously attenuated boron and sulfate to be remobilized into groundwater as concentrations return to background levels. The groundwater polishing evaluation determined that adsorption of both boron and sulfate has occurred in association with the oxidized mineral surfaces found in the underlying soils (based on site-specific SEP results).

Modeling results presented in the GPR show that a substantial proportion of boron and sulfate are retained on the solid phase under current conditions. Base case reaction modeling results indicate that substantial remobilization of COCs back to the groundwater phase is unlikely as conditions return to background. Simulations show a minor increase in adsorbent mineral masses is possible and solid sorbing phases are anticipated to be stable. Notably, the precipitation of barite is also simulated, which provides a further sink for sulfate. These data suggest that the changing geochemical conditions that come with the "return to background" are overall unlikely to cause a longer observed time to reach the GWPS. In other words, the impact of groundwater polishing through chemical attenuation mechanisms has only a minimal effect on the estimated time it takes for boron concentrations to reach the GWPS of 2 mg/L, as modeled by the flow and transport model.

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4. CONCLUSIONS

The groundwater modeling efforts in this Groundwater Modeling Technical Memorandum consist of flow and transport modeling using MODFLOW-NWT and MT3DMS to assess the time to achieve GWPS for boron for three CAP remedy alternatives: Alternative 1 remedy (source control with GWP), Alternative 2 remedy (source control with GWE) and Alternative 3 remedy (source control with phytoremediation).

A summary of predicted time for boron concentrations to meet the GWPS at the compliance monitoring wells is provided in **Table 1**. Percentage of compliance monitoring wells predicted to attain GWPS is summarized below in **Table A**. As shown in the tables, the time to achieve boron GWPS compliance in each of the EPP AP groundwater monitoring wells is approximately 800 years under Alternative 1 remedy. Under Alternative 2 remedy, the time to achieve GWPS compliance is estimated to be 37 years. Operation of Alternative 2 remedy for 50 years may be necessary to reduce the potential for boron concentration from rebounding above the GWPS after remedy operations are ceased. The time to achieve GWPS compliance under Alternative 3 remedy is estimated to be 42, 47, and 77 years, depending on assumed phytoremediation uptake rates. Maintenance of phytoremediation for 55, 70, and 150 years, depending on phytoremediation uptake rates, may be necessary to reduce the potential for boron concentration from rebounding above the GWPS after remedy operations have ceased.

Table A. Estimated Timeframes to Attain GWPS in Groundwater Monitoring Wells

Alternative	Impacted Wells†	Percentage of Wells Predicted to Attain GWPS†							
		5 Years‡	10 Years‡	20 Years‡	37 Years‡	42 Years‡	47 Years‡	77 Years‡	801 Years‡
1	16	38%	44%	44%	44%	50%	50%	38%	100%
2	10	20%	60%	80%	100%	100%	100%	100%	100%
3 (40 gpd/tree)	13	23%	38%	62%	62%	85%	100%	100%	100%
3 (20 gpd/tree)	13	23%	31%	38%	62%	69%	62%	100%	100%
3 (50 gpd/tree)	13	23%	38%	62%	77%	100%	100%	100%	100%

†: Estimated timeframes per the number of impacted wells (wells with estimated times to achieve the GWPS) shown in Table 1
‡: Years counted starting from completion of corrective action

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TABLES

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TABLE 1. SIMULATED TIME TO ACHIEVE BORON GWPS IN EPP AP MONITORING WELLS

GROUNDWATER MODELING TECHNICAL MEMORANDUM

EDWARDS POWER PLANT

ASH POND

BARTONVILLE, ILLINOIS

Monitoring Well	Time to Achieve GWPS* in Monitoring Well (Year)				
	Alternative 1 Remedy (Source Control with Groundwater Polishing)	Alternative 2 Remedy (Source Control with Groundwater Extraction)	Alternative 3 Remedy (Source Control with Phytoremediation)		
			Uptake Rate = 40 gpd/tree**	Uptake Rate = 20 gpd/tree**	Uptake Rate = 50 gpd/tree**
AP05S	0	0	0	0	0
AP05D	0	0	0	0	0
AP06	0	0	0	0	0
AP07S	40	37	41	41	42
AP07D	0	0	0	0	0
APW-01	0	0	0	0	0
APW-02	0	0	0	0	0
APW-03	0	0	0	0	0
APW-04	0	0	0	0	0
AW-05	9	1	8	8	7
AW-06	0	0	0	0	0
AW-08	0	0	0	0	0
AW-09	691	0	41	76	34
AW-10	0	0	0	0	0
AW-11	222	0	0	0	0
AW-12	0	0	0	0	0
AW-13	0	0	0	0	0
AW-14	296	0	8	25	0
AW-15	356	0	0	0	0
AW-15C	0	0	0	0	0
AW-15S	2	0	2	2	2
AW-16	801	35	0	0	42
AW-17	455	9	34	77	28
AW-18	212	9	16	22	15
AW-19	190	10	13	18	11
AW-20	146	9	42	63	36
AW-21	126	11	47	63	42
AW-22	156	9	39	58	34
AW-23	14	0	6	7	6
P002	194	12	17	28	15
Minimum	**0**	**0**	**0**	**0**	**0**
Maximum	**801**	**37**	**47**	**77**	**42**
Average	**130**	**5**	**11**	**16**	**11**

* GWPS - groundwater protection standard

** Uptake rate during growing season

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FIGURES

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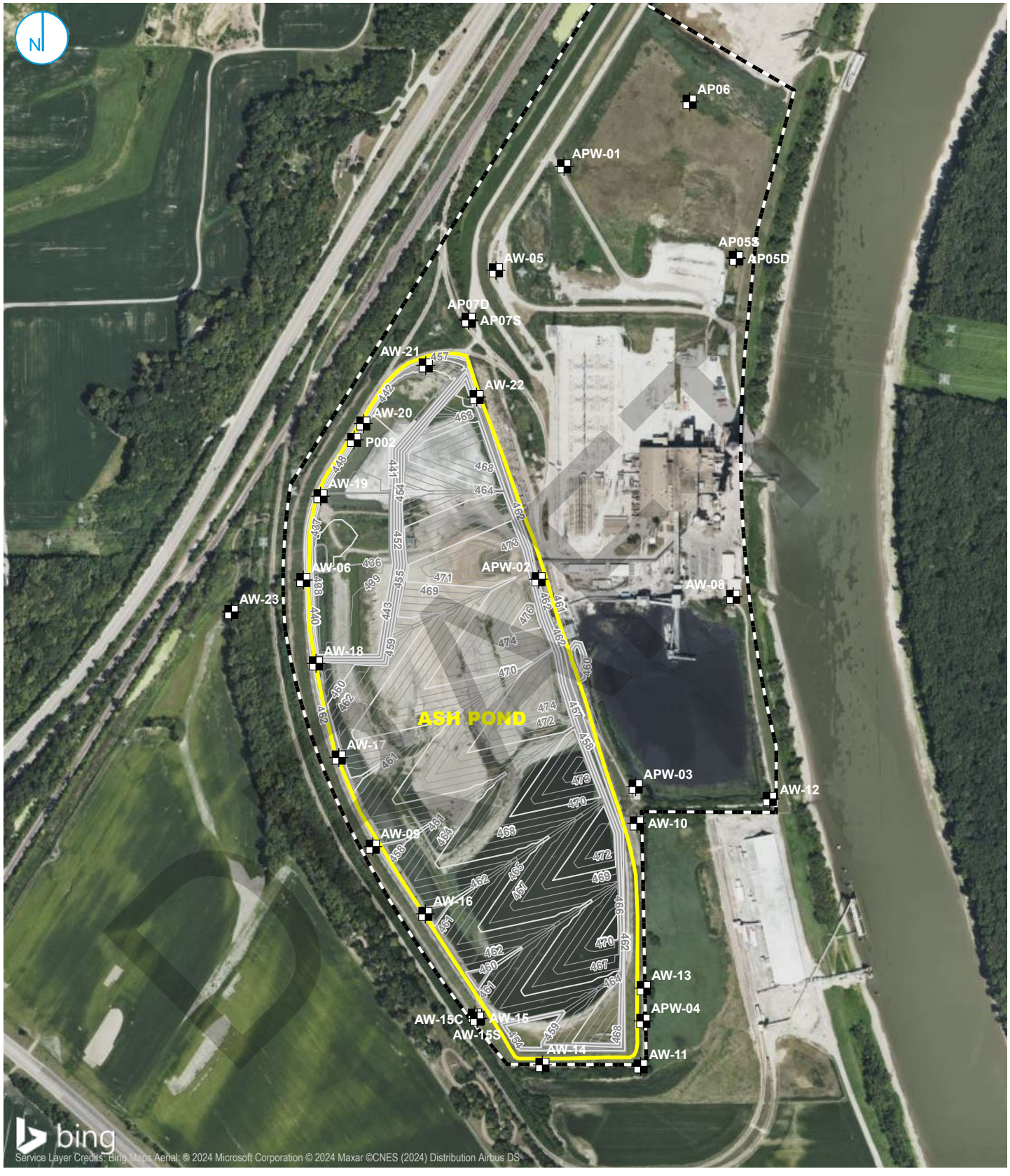


Y:\Mapping\Projects\22\22685\MXD\Model_Figures\Edwards\CAAA-SIR\EDW_CAAA aprx\Figure 1. Monitoring Well Location Map

PROJECT: 169000XXXX | DATED: 4/5/2024 | DESIGNER: GALARNMC

MONITORING WELL

PROPOSED CLOSURE GRADES

5FT ELEVATION CONTOUR

1FT ELEVATION CONTOUR

REGULATED UNIT (SUBJECT UNIT)

PROPERTY BOUNDARY

0 350 700 Feet

MONITORING WELL LOCATION MAP

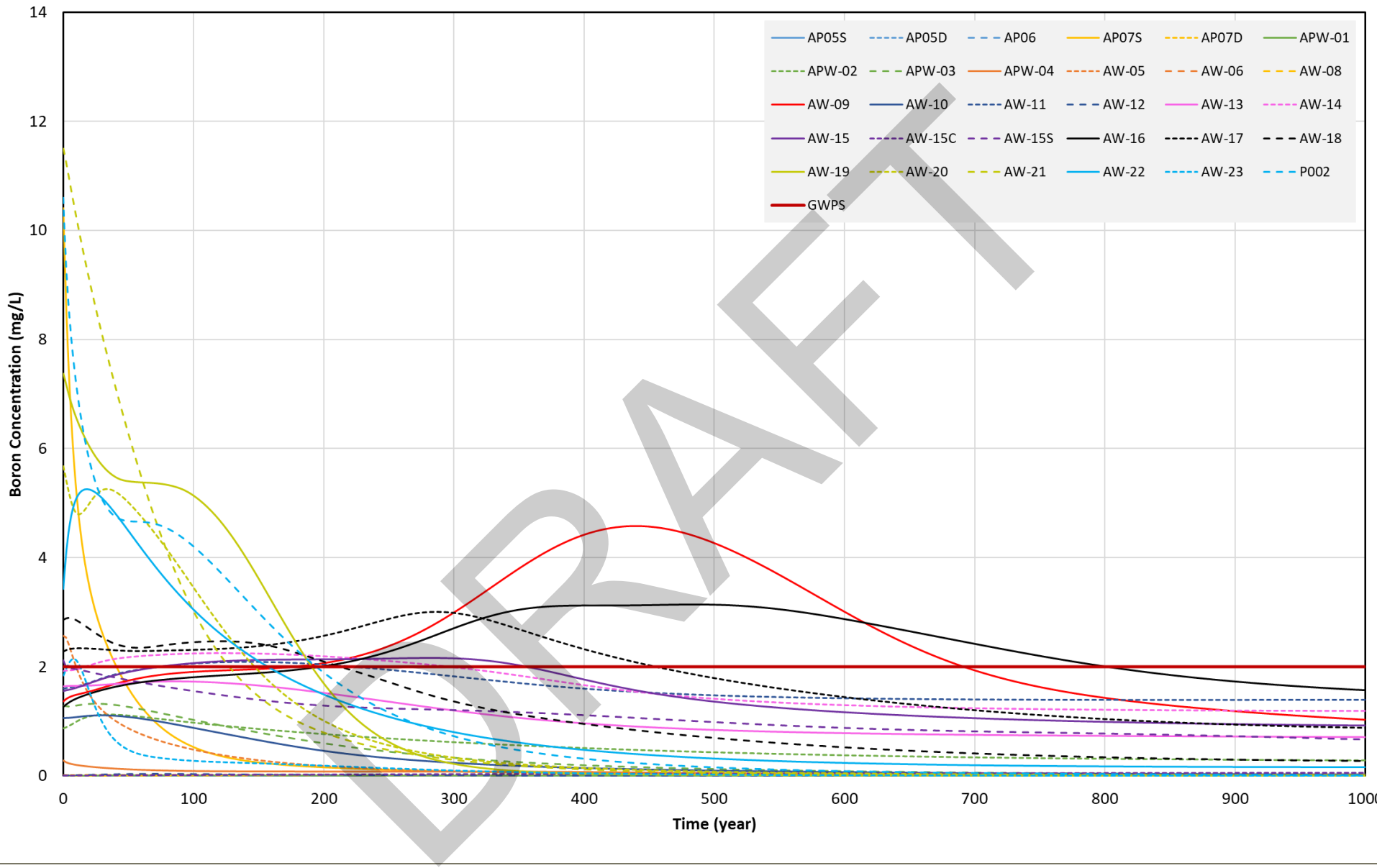
ASH POND

EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



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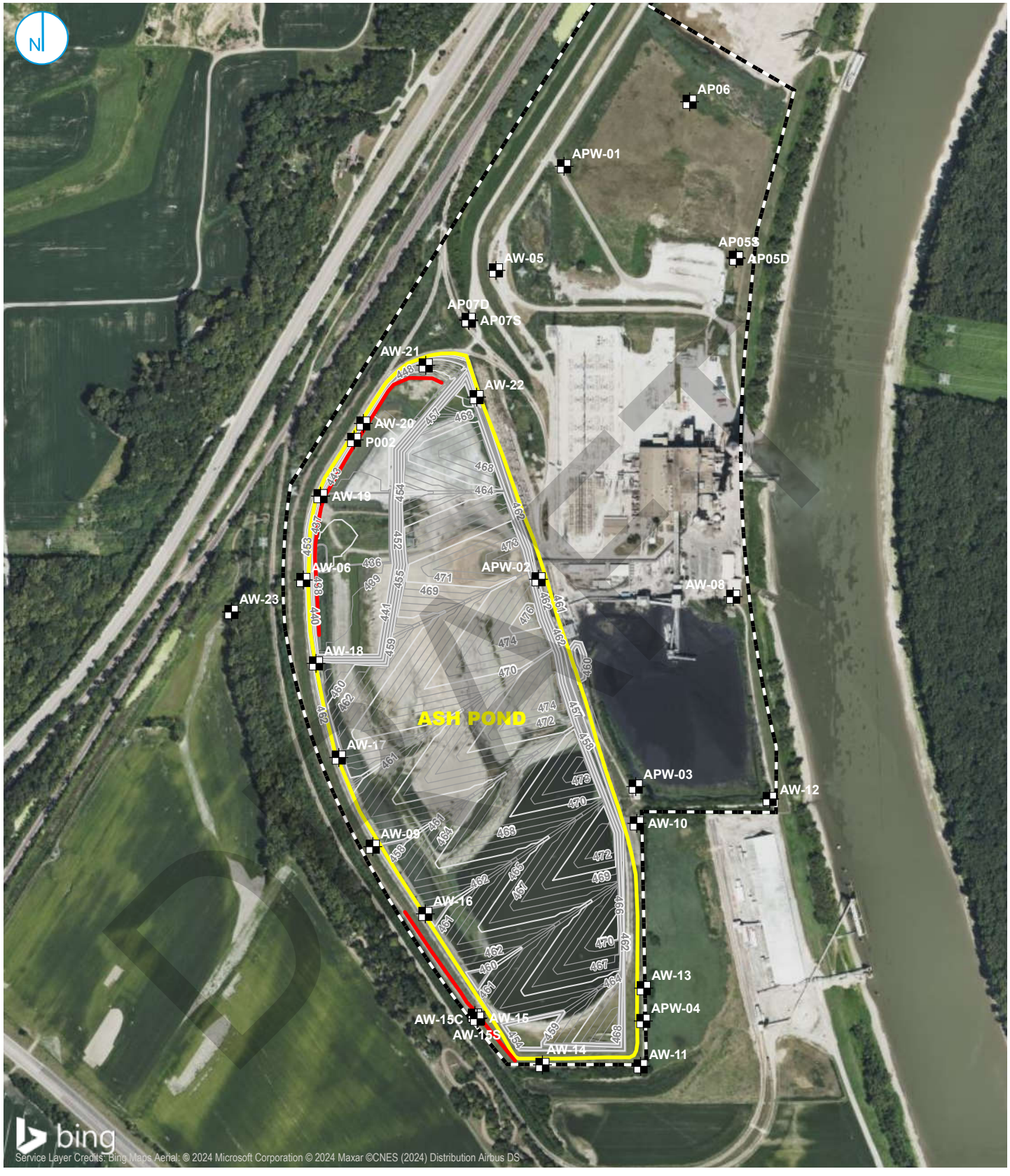
SIMULATED BORON CONCENTRATIONS IN EPP AP MONITORING WELLS - ALTERNATIVE 1 REMEDY

ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 2

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY



Y:\Mapping\Projects\22\2285\MXD\Model_Figures\Edwards\CAAA-SIR\EDW_CAAA.aprx\Figure 3. Alternative 2 Extraction Trench

PROJECT: 169000XXXX | DATED: 4/5/2024 | DESIGNER: GALARNMC

MONITORING WELL

GROUNDWATER EXTRACTION TRENCH

PROPOSED CLOSURE GRADES

5FT ELEVATION CONTOUR

1FT ELEVATION CONTOUR

REGULATED UNIT (SUBJECT UNIT)

PROPERTY BOUNDARY

0 350 700 Feet

PROPOSED GROUNDWATER EXTRACTION TRENCH LOCATION - ALTERNATIVE 2 REMEDY

ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 3

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

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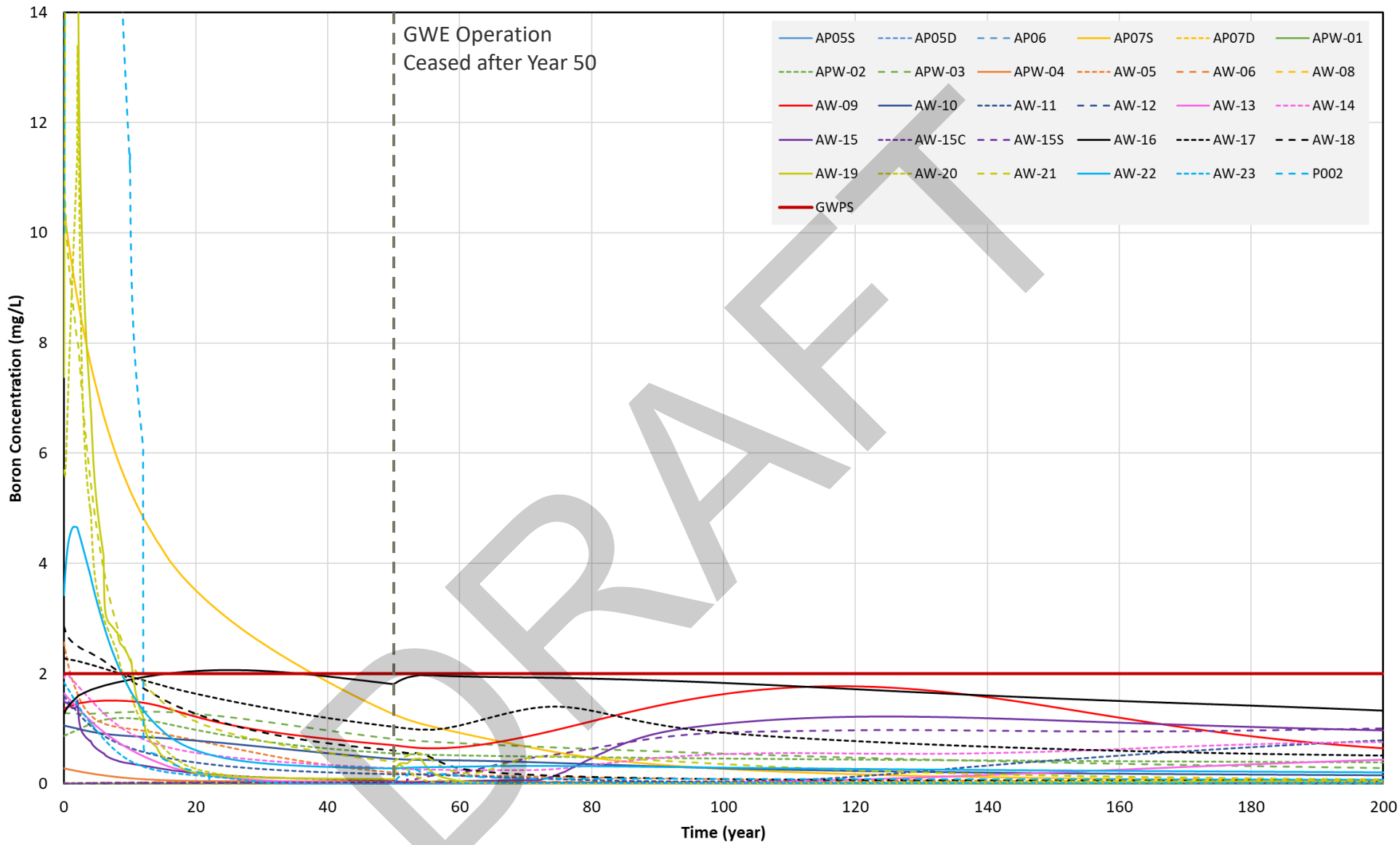

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SIMULATED BORON CONCENTRATIONS IN EPP AP MONITORING WELLS - ALTERNATIVE 2 REMEDY

FIGURE 4

ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

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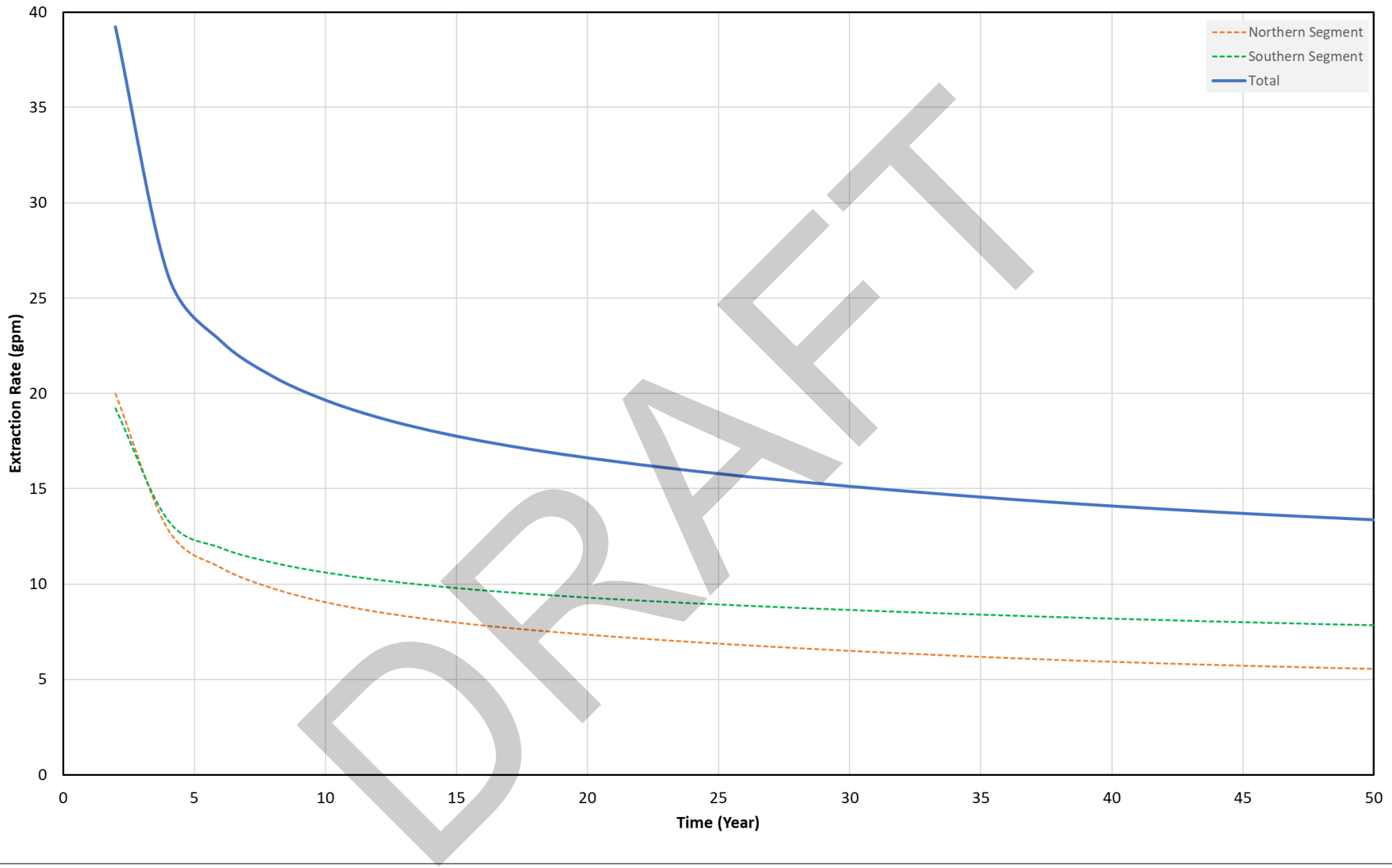

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SIMULATED EXTRACTION RATE FROM THE EXTRACTION TRENCH - ALTERNATIVE 2 REMEDY

FIGURE 5

ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

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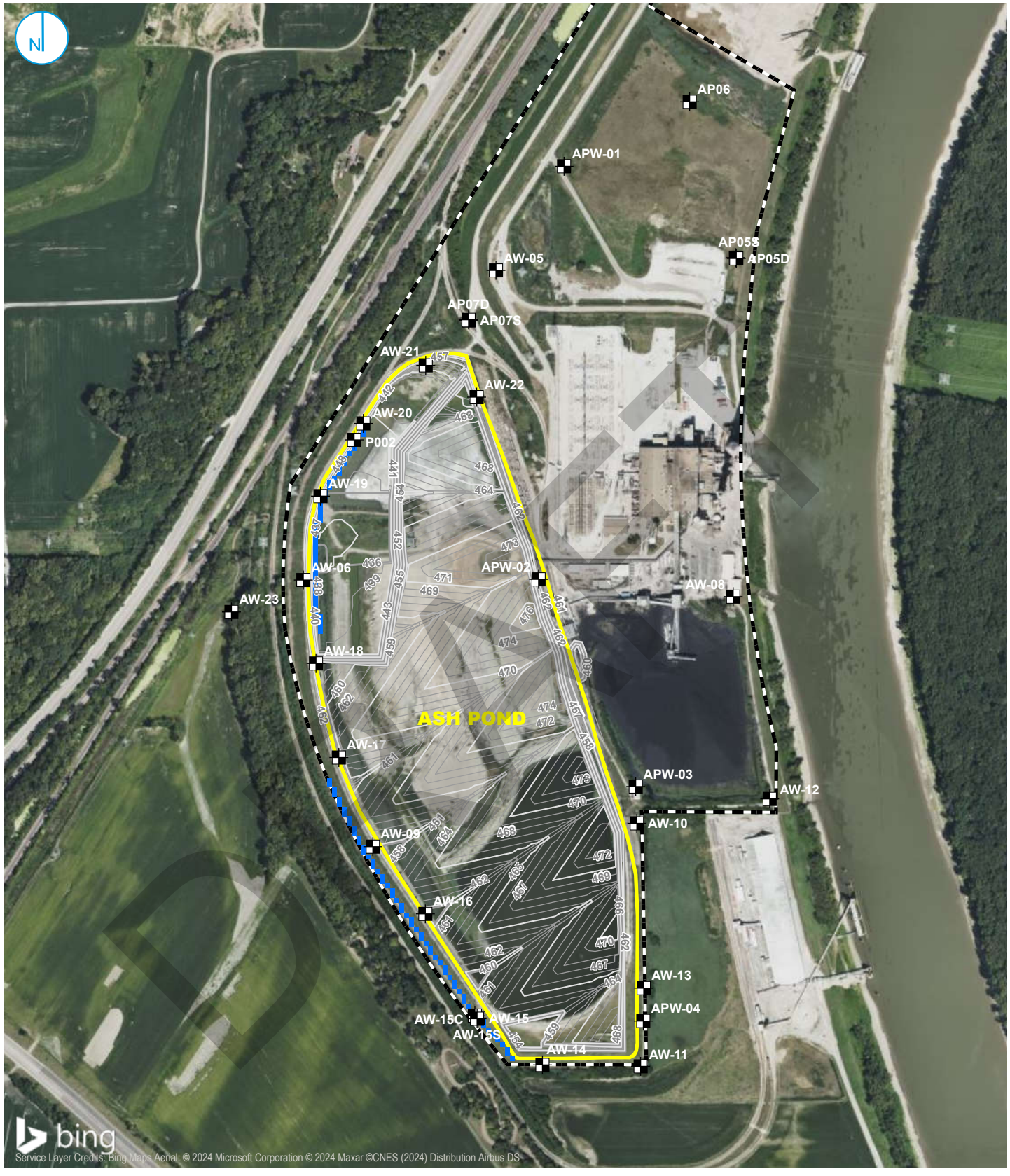

Y:\Mapping\Projects\22\2285\MXD\Model_Figures\Edwards\CAAA-SIR\EDW_CAAA.aprx\Figure 6. Alternative 3 Phytoremediation

PROJECT: 169000XXXX | DATED: 4/5/2024 | DESIGNER: GALARNMC

MONITORING WELL
PHYTOREMEDIATION AREA
PROPOSED CLOSURE GRADES
5FT ELEVATION CONTOUR
1FT ELEVATION CONTOUR
REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY

0 350 700 Feet

PROPOSED PHYTOREMEDIATION ZONE - ALTERNATIVE 3 REMEDY

ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 6

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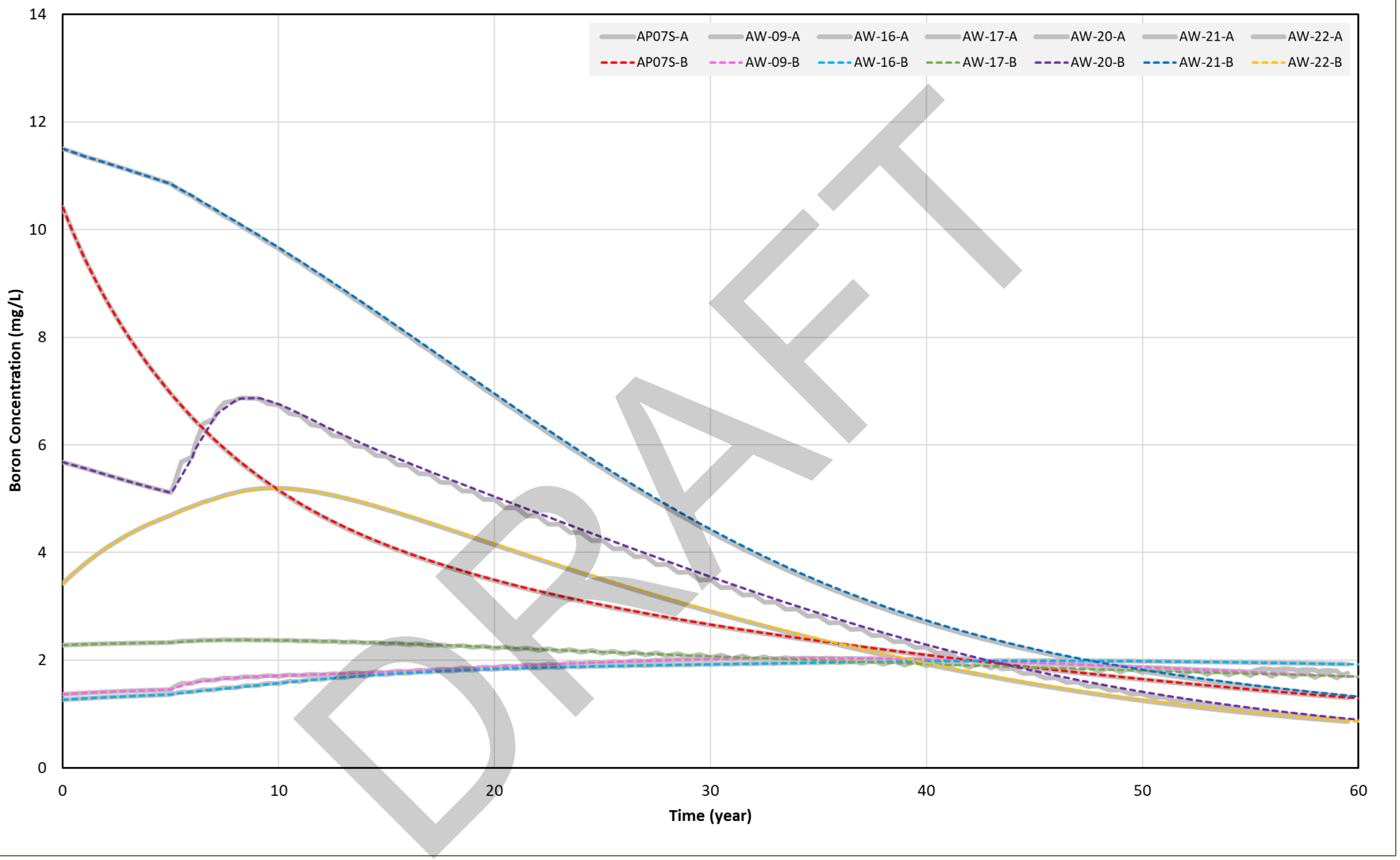

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COMPARISON OF SIMULATION RESULTS BETWEEN MODELING METHODS - ALTERNATIVE 3 REMEDY

ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 7

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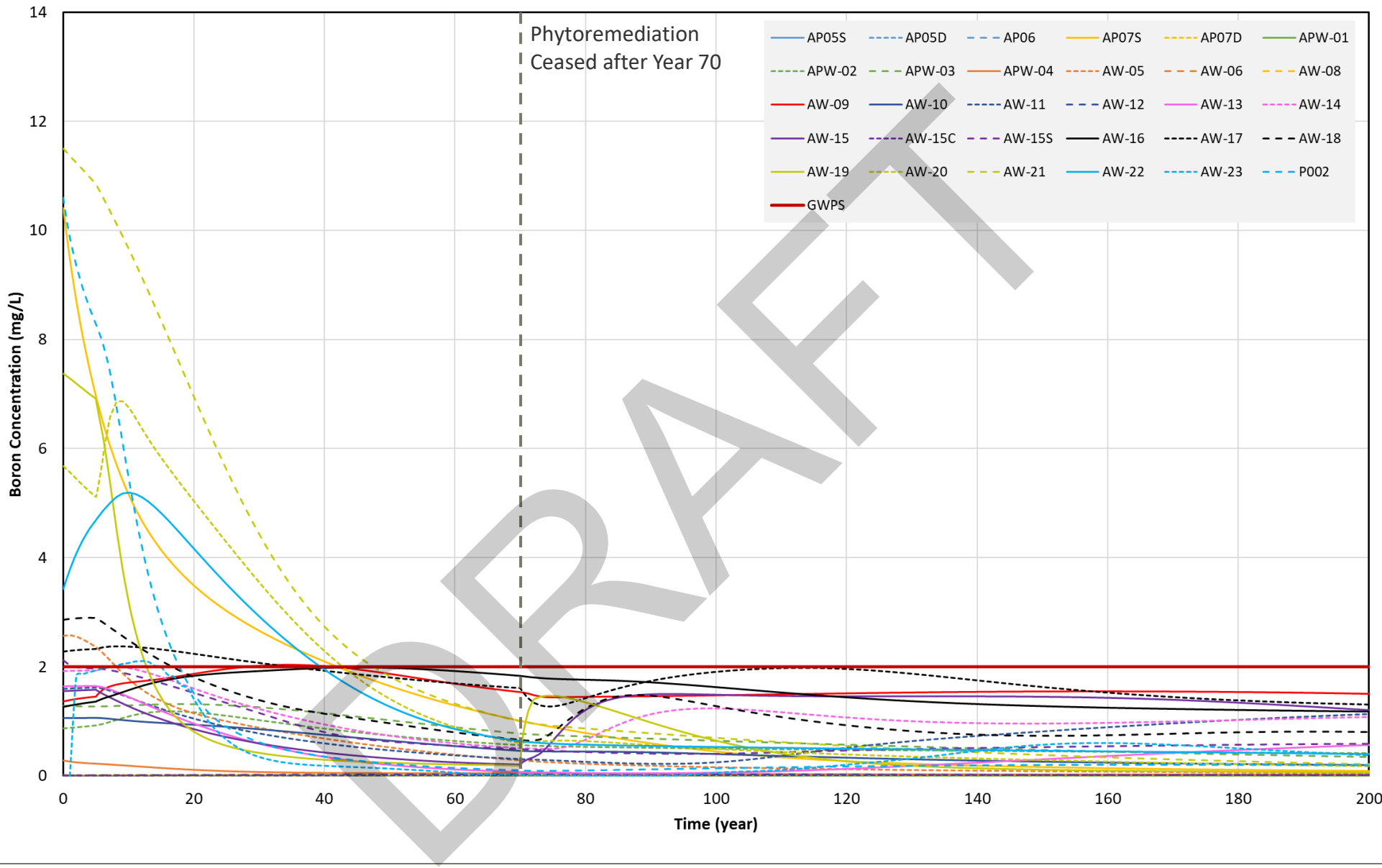

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SIMULATED BORON CONCENTRATIONS IN EPP AP MONITORING WELLS - ALTERNATIVE 3 REMEDY

FIGURE 8

ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

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APPENDIX B2
GROUNDWATER MODELING REPORT

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Intended for
Illinois Power Resources Generating, LLC

Date
June 30, 2022

Project No.
1940101010-010

GROUNDWATER MODELING REPORT

ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

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GROUNDWATER MODELING REPORT
EDWARDS POWER PLANT ASH POND

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Project Name	**Edwards Power Plant Ash Pond**
Project No.	**1940101010-010**
Recipient	**Illinois Power Resources Generating, LLC**
Document Type	**Groundwater Modeling Report**
Revision	**FINAL**
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ACRONYMS AND ABBREVIATIONS

§	Section
35 I.A.C.	Title 35 of the Illinois Administrative Code
40 C.F.R.	Title 40 of the Code of Federal Regulations
BCU	bedrock confining unit
bgs	below ground surface
CBR	closure by removal
CCR	coal combustion residuals
CIP	closure in place
cm/s	centimeters per second
CSM	conceptual site model
EPP	Edwards Power Plant
Federal CCR Rule	40 C.F.R. § 257 Subpart D
ft/day	feet/foot per day
ft^2/d	feet squared per day
GHB	general head boundary conditions
GMP	Groundwater Monitoring Plan
GMR	Groundwater Modeling Report
Golder	Golder Associates USA Inc.
GWPS	Groundwater Protection Standard
HCR	Hydrogeologic Site Characterization Report
HELP	Hydrologic Evaluation of Landfill Performance
ID	identification
IEPA	Illinois Environmental Protection Agency
in	inches
in/yr	inches per year
IngenAE	IngenAE, LLC
IPRG	Illinois Power Resources Generating, LLC
ISWS	Illinois State Water Survey
Kd	distribution coefficient
K_D	linear partition coefficients
K_F	Freundlich partition coefficients
K_L	Langmuir partition coefficients
Kh/Kv	vertical anisotropy
L/kg	liters per kilogram
mg/L	milligrams per liter
MGD	million gallons per day
mL/g	milliliters per gram
NAVD88	North American Vertical Datum of 1988
NGVD29	National Geodetic Vertical Datum of 1929
NID	National Inventory of Dams
No.	number
NPDES	National Pollutant Discharge Elimination System
NRT	Natural Resource Technology, Inc.

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NRT/OBG	Natural Resource Technology Inc., an OBG Company
p	probability
Part 845	35 I.A.C. § 845: Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments
PMP	Potential Migration Pathway
R2	correlation coefficient
Ramboll	Ramboll Americas Engineering Solutions, Inc.
SI	surface impoundment
SSR	sum of squared residuals
S_y	specific yield
SW	surface water
TDS	total dissolved solids
TVD	total-variation-diminishing
UA	uppermost aquifer
UCF	Upper Cahokia Formation
US	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
Wittman	Wittman Hydro Planning Associates, Inc.

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EXECUTIVE SUMMARY

Ramboll Americas Engineering Solutions, Inc. (Ramboll) has prepared this Groundwater Modeling Report (GMR) on behalf of the Edwards Power Plant (EPP), operated by Illinois Power Resources Generating, LLC (IPRG), in accordance with requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) Section (§) 845: Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments (Part 845) (Illinois Environmental Protection Agency [IEPA], April 15, 2021). This document presents the results of predictive groundwater modeling simulations for proposed closure scenarios for the Ash Pond. The Ash Pond (Vistra identification [ID] number [No.] 301, IEPA ID No. W1438050005-01, and National Inventory of Dams [NID] No. IL50710) is the only coal combustion residuals (CCR) unit present on the EPP property.

The EPP is located in Bartonville, Illinois (**Figure 1-1**). The EPP property is situated in an agricultural/industrial area. The EPP is bound by a salt processing facility to the north, a fertilizer processing plant and the Illinois River to the east, agricultural fields to the south, and railroad tracks, former Orchard Mines, and Highway 24 to the west (**Figure 1-2**).

A detailed summary of site conditions was provided in the Hydrogeologic Site Characterization Report (HCR; Ramboll, 2021a). Four distinct water-bearing units have been identified in the vicinity of the Ash Pond based on stratigraphic relationships and common hydrogeologic characteristics. The units are described as follows from the surface downward:

- **CCR:** Saturated CCR consisting primarily of fly ash within the Ash Pond. CCR is present at thicknesses up to 46.5 feet and at elevations as low as 413.9 feet North American Vertical Datum of 1988 (NAVD88) in the central and northern portion of the Ash Pond.
- **Upper Cahokia Formation (UCF)/Potential Migration Pathway (PMP):** Low permeability clays and silts of the UCF are present at the surface. This unit is considered a PMP at elevations similar to the base of the Ash Pond, and in places where thin discontinuous sand lenses occur within the UCF adjacent to the Ash Pond.
- **Uppermost Aquifer (UA):** Thin (generally less than 4 feet), moderate permeability sand, silty sand, and clayey gravel material within the Lower Cahokia Formation, bedrock, and/or weathered shale bedrock, where present. In locations where higher permeability materials and coarser grained material are absent, the UA is interpreted as the interface between the Lower Cahokia Formation and shale bedrock.
- **Bedrock Confining Unit (BCU):** Thick, very low permeability shales and siltstones of the Carbondale and Modesto Formations. This unit was encountered at elevations ranging from approximately 400 to 422 feet NAVD88 with higher bedrock elevations occurring beneath the northern portion of the Ash Pond.

In general, the UCF consists of low permeability clays and silts, with limited occurrences of thin discontinuous sand lenses. Occasional sand lenses within the UCF, and clay intervals downgradient at elevations similar to the base of ash in the Ash Pond were identified as PMPs. In several locations, generally near the southern and western portions of the unit, coarser grained materials are present at the base of the Lower Cahokia Formation and/or the top of the bedrock is weathered resulting in relatively higher hydraulic conductivities. Because the interface is laterally continuous, and has relatively higher conductivity, the unlithified/lithified contact was designated as the UA.

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The underlying bedrock is interpreted as the lower confining unit and has hydraulic conductivities generally an order of magnitude less than those measured in the UA. Groundwater occurs within both the unlithified materials and bedrock and consistently flows east to west in the UA. Offsite groundwater in the Sankoty Aquifer flows to the north and south towards identified Peoria and Pekin pumping centers, respectively. Groundwater in the Sankoty Aquifer may be hydraulically connected to the UA (*i.e.,* unlithified/ lithified contact) identified onsite.

A review and summary of data collected from 2015 through 2021 for parameters with groundwater protection standards (GWPS) listed in 35 I.A.C. § 845.600 is provided in the HCR (Ramboll, 2021a). Concentration results presented in the HCR and summarized in the History of Potential Exceedances (Ramboll, 2021b) are considered potential exceedances because the methodology used to determine them is proposed in the Statistical Analysis Plan (Appendix A to the Groundwater Monitoring Plant [GMP], Ramboll 2021c), which has not been reviewed or approved by IEPA at the time of submittal of the Part 845 operating permit application. The following constituents with potential exceedances of the GWPS listed in 35 I.A.C. § 845.600 were identified: barium, boron, chloride, lithium, sulfate, and total dissolved solids (TDS) (Ramboll, 2021b).

A Technical Memorandum (**Appendix A**) was prepared by Golder Associates USA Inc. (Golder, 2022a), *Evaluation of Potential GWPS Exceedances, Edwards Ash Pond [CCR Unit 301], Edwards Power Plant, Peoria County, Illinois*, to further evaluate potential GWPS exceedances. The results of the evaluation demonstrated that the potential GWPS exceedances of lithium in well AP05D and AP07D, chloride in well AP07D, and barium in well AW-15C are not related to the Ash Pond based on multiple lines of evidence presented in the Technical Memorandum. Statistically significant correlations between boron concentrations and concentrations of sulfate and TDS identified as potential exceedances of the GWPS indicate boron is an acceptable surrogate for these parameters in the groundwater model. Concentrations of these parameters are expected to change along with model predicted boron concentrations.

Groundwater monitoring wells recently installed near the plant's property boundary have detected elevated levels of boron in groundwater. IPRG notified IEPA of the elevated boron detections and letters were issued to neighboring property owners in May of 2022 requesting permission for IPRG's consultants to access their property and collect groundwater samples. Until responses are received, and access granted, the groundwater modeling and available well data are being used to delineate the plume.

It was assumed that boron would not significantly sorb or chemically react with aquifer solids (distribution coefficient [Kd] was set to 0 milliliters per gram [mL/g]) which is a conservative estimate for predicting contaminant transport times in the model. Boron, sulfate, and TDS transport is likely to be affected by both chemical and physical attenuation mechanisms (*i.e.,* adsorption and/or precipitation reactions as well as dilution and dispersion).

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Data collected from previous field investigations, as well as the 2021 field investigations, were used to develop a groundwater model for the Ash Pond. The MODFLOW and MT3DMS models were then used to evaluate two closure scenarios, including CCR consolidation and closure in place (CIP), and closure by removal (CBR) scenarios, using information provided in the Final Closure Plan (IngenAE, 2022):

- Scenario 1: CIP (CCR removal from the northwest areas of the Ash Pond, consolidation to the northeast, central and southern areas of the Ash Pond, and construction of a cover system over the remaining CCR)
- Scenario 2: CBR (CCR removal from the Ash Pond)

Prior to the simulation of these scenarios, a dewatering simulation was included for the removal of free liquids from the Ash Pond prior to the implementation of the two scenarios.

Scenario 1 (CIP) was predicted to reduce total flux in and out of the Fill Unit (CCR) by approximately 97% and 94%, respectively, when simulated post-construction heads in the groundwater monitoring wells are predicted to stabilize.

Differences exist in the timeframes to reach the GWPS for most monitoring wells between CIP and CBR. For instance, wells with observations above the standard GWPS for boron (2 milligrams per liter [mg/L]) from November 2015 to August 2021 (AP07S, AW-05, AW-15S, AW-18, AW-19, AW-20, AW-21) are predicted to reach the GWPS in 198 years after CIP implementation, and 104 years after CBR implementation. Shorter timeframes were predicted to reach the GWPS for wells located on the northern edge of the Ash Pond where observed boron concentrations were the highest (AW-21 and AP07S). AW-21 and AP07S, which had the highest concentrations in the UA and UCF, respectively, were predicted to decline below the GWPS at 121 and 32 years, respectively, after CIP implementation, and at 88 and 15 years, respectively, after CBR implementation. However, as a result of the south-southwest trending plume of residual boron concentrations above the standard GWPS for boron (2 mg/L) released prior to closure, which remains for a long period of time following implementation of both scenarios, all monitoring wells are not predicted to reach the GWPS until after 767 years and 748 years following implementation of CIP and CBR, respectively.

The observed timeframes to reach the GWPS for both the CIP and CBR prediction scenarios were on the order of hundreds of years from present. These predicted timeframes to meet the GWPS are less reliable than timeframes that are closer temporally to the data used for calibration (between 2015 and 2021). From a modeling perspective, the 19-year difference between CIP and CBR to reach the GWPS at all monitoring wells surrounding the ash pond is negligible. In other words, both scenarios are predicted to reach the GWPS after approximately 750 years, and the simulated 19-year difference between these two scenarios is not significant. Further, the boron plumes for both CIP and CBR remain in close proximity to the Ash Pond while they recede, indicating they are equally protective.

Results of groundwater fate and transport modeling conservatively estimate that groundwater will attain the GWPS for all constituents identified as potential exceedances of the GWPS in approximately 750 years following closure implementation for both CIP and CBR. The long timeframes observed are a result of the generally low permeability materials adjacent to and underlying the Ash Pond, and generally low groundwater flow velocities observed within the water-bearing units of the site, which results in reduced transport and slow physical attenuation (dilution and dispersion). The predicted maximum extent of the plume above the standard GWPS for boron (2 mg/L) stays in close proximity to the ash pond as it recedes.

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1. INTRODUCTION

1.1 Overview

In accordance with requirements of Part 845 (IEPA, 2021), Ramboll has prepared this GMR on behalf of EPP, operated by IPRG. This report will apply specifically to the CCR unit referred to as the Ash Pond (**Figure 1-1**). The Ash Pond is a 91-acre unlined CCR surface impoundment (SI) used to manage CCR and non-CCR waste streams prior to discharge in accordance with the plant's National Pollutant Discharge Elimination System (NPDES) permit (IL0001970) at the EPP. This GMR presents and evaluates the results of predictive groundwater modeling simulations for two proposed closure scenarios, including CCR consolidation and CIP, and CBR scenarios summarized below:

- Scenario 1: CIP (CCR removal from the northwest areas of the Ash Pond, consolidation to the northeast, central and southern areas of the Ash Pond, and construction of a cover system over the remaining CCR)
- Scenario 2: CBR (CCR removal from the Ash Pond)

1.2 Site Location and Background

The EPP is located in Peoria County between Mapleton and Bartonville in Section 11, Township 7 North, Range 7 East (**Figure 1-1**). The EPP is located near the Illinois River adjacent to a levee and has one CCR SI, the Ash Pond.

The EPP is situated in a predominantly agricultural area with industrial parcels bordering the property. Historically several coal mines were operated at depths of 100 to 160 feet below ground surface (bgs) in the vicinity of the EPP. The EPP property is bordered by a salt processing facility to the north, railroad right-of-way and former Orchard Mines to the west, the Illinois River and fertilizer production facility to the east, and agricultural land to the south (**Figure 1-2**).

The Ash Pond was investigated in 2013 (Natural Resource Technology, Inc. [NRT], 2013) and exceedances of Class I Groundwater Standards were reported for pH, chloride, iron, manganese, TDS, and sulfate. Additional wells were installed in 2015 to comply with Title 40 of the Code of Federal Regulations (40 C.F.R) § 257 Subpart D (Federal CCR Rule), and again in 2021 to collect additional data to meet the requirements of 35 I.A.C. § 845.620.

1.3 Site History and Unit Description

The EPP began power generation in 1960 and the original Ash Pond embankments were placed into service at that time. In 2004, modifications to the rail loop surrounding the Ash Pond increased the elevations of the embankments and reduced the footprint of the active impoundment (AECOM, 2016a). CCR material remains between the rail loop and the berm at the south end of the Ash Pond. High power transmission lines bisect the Ash Pond and two sub-basins, referred to as the North and South Ponds, were established. The sub-basins are hydraulically connected and CCR placement is continuous throughout the Ash Pond.

The Ash Pond has a surface area of approximately 91 acres with berms up to 27 feet higher than the surrounding land surface. This pond currently discharges to the Illinois River through Outfall 001 included in the facility NPDES permit, IL0001970. The primary treatment method for the pond water is settlement via reduced velocity whereby solids settle out in various flow channels and in the main South Pond. The permitted total average daily flow is 5.24 million gallons per day (MGD) (Foth, 2017).

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2. SITE GEOLOGY AND HYDROGEOLOGY

Ash Pond hydrogeologic and groundwater quality data presented in the HCR (Ramboll, 2021a) was used to establish a conceptual site model (CSM) for this GMR, and is summarized below. The EPP and embankments surrounding the Ash Pond are located at an elevation of approximately 460 feet NAVD88 (**Figure 2-1**). Topographic maps drawn prior to construction indicate the areas of the Ash Pond were generally between 435 and 440 feet National Geodetic Vertical Datum (NGVD29), except for a historic drainage feature or former river channel located in the western portion of the Ash Pond, which has an elevation of approximately 430 feet NGVD29 (Appendix A of the HCR). The areas surrounding the EPP are generally at an elevation of around 435 to 440 feet NVGD29. West of the Ash Pond (across Highway 24), the elevation increases to approximately 600 feet NGVD29 (**Figure 1-1**), where bedrock outcrops are present near the surface at the edge of the former historic Illinois River valley.

There are three principal types of unlithified materials above the bedrock in the vicinity of the Ash Pond, these include the following in descending order: Fill, predominantly coal ash (fly ash, bottom ash, and slag) within the Ash Pond, and materials within constructed berms and railroad embankments, are present around the Ash Pond; UCF (fine-grained deposits of the Cahokia Formation ranging in thickness at the Ash Pond from 5 to 40 feet); and Lower Cahokia Formation (course-grained deposits of the Cahokia Formation consisting of sands and gravels ranging in thickness at the Ash Pond from 1 to 4 feet). Depth to bedrock at the Ash Pond ranges from approximately 20 feet in the north to 58 feet in the southwest.

Four distinct water-bearing units have been identified in the vicinity of the Ash Pond based on stratigraphic relationships and common hydrogeologic characteristics. The units are described as follows from the surface downward:

- **CCR:** Saturated CCR consisting primarily of fly ash within the Ash Pond. CCR is present at thicknesses up to 46.5 feet and at elevations as low as 413.9 feet NAVD88 in the central and northern portion of the Ash Pond**.**
- **UCF/ PMP:** Low permeability clays and silts of the UCF are present at the surface. This unit is considered a PMP at elevations similar to the base of the Ash Pond, and in places where thin discontinuous sand lenses occur within the UCF adjacent to the Ash Pond.
- **UA:** Thin (generally less than 4 feet), moderate permeability sand, silty sand, and clayey gravel material within the Lower Cahokia Formation, bedrock, and/or weathered shale bedrock, where present. In locations where higher permeability materials and coarser grained material are absent, the UA is interpreted as the interface between the Lower Cahokia Formation and shale bedrock.
- **BCU:** Thick, very low permeability shales and siltstones of the Carbondale and Modesto Formations. This unit was encountered at elevations ranging from approximately 400 to 422 feet NAVD88 with higher bedrock elevations occurring beneath the northern portion of the Ash Pond.

In general, the UCF consists of low permeability clays and silts, with limited occurrences of thin discontinuous sand lenses. Occasional sand lenses within the UCF, and clay intervals downgradient at elevations similar to the base of ash in the Ash Pond were identified as PMPs. In several locations, generally near the southern and western portions of the Ash Pond, coarser

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grained materials are present at the base of the Lower Cahokia Formation and/or the top of the bedrock is weathered resulting in relatively higher hydraulic conductivities. Because the interface is laterally continuous, and has relatively higher conductivity, the unlithified/lithified contact was designated as the UA.

The underlying bedrock is interpreted as the lower confining unit and has hydraulic conductivities generally an order of magnitude less than those measured in the UA. Groundwater occurs within both the unlithified materials and bedrock and consistently flows east to west in the UA (**Figure 2-2** and **Figure 2-3**). In the northernmost portion of the Ash Pond there is a minor northwest and northern component of flow in both the UA and PMP. In the southern portion of the Ash Pond, groundwater flow has a southerly component of flow towards what is interpreted as a former channel of the Illinois River. Groundwater elevations vary seasonally, generally less than 5 feet, while across the site they range between approximately 430 and 450 feet, although flow directions are generally consistent. Additional groundwater contour maps are located in Appendix E of the HCR (Ramboll, 2021a).

Groundwater elevations in PMP wells range from approximately 455 feet NAVD88 (APW-02) to 430 feet NAVD88 (AW-15S) with flow generally from the east to the south and northwest (**Figure 2-2** and **Figure 2-3**), similar to that observed in the UA. Groundwater elevations measured at APW02 are similar to CCR piezometers and the location of the well (within the berm of the unit) may be affected by water elevations in the active Ash Pond. Given the elevations of groundwater detected in these unconfined wells and the lowest elevation of ash (414 feet NAVD88), portions of the Ash Pond are likely in contact with groundwater. Comparison of elevations in bedrock wells shows flow directions may be consistent with shallower flow systems.

Groundwater velocities in the UA determined in the center portion of the Ash Pond (between AW-08 and AW-06) ranged from approximately 1.7×10^{-4} to 4.0×10^{-4} feet per day (ft/day) in 2021 with an average of 2.5×10^{-4} ft/day. Groundwater velocities determined in the southern portion of the Ash Pond between AW-10 and AW-15 were consistent with an average of 0.26 ft/day. The higher velocities observed in the southern portion of the Ash Pond are a result of coarse-grained materials present there.

The results of a recent review of available offsite groundwater level and flow direction data completed after submittal of the HCR (Ramboll, 2021a) and presented herein supports the CSM presented in the HCR (summarized above) and further describes offsite hydrogeologic conditions. The existing CSM has been refined in this GMR to incorporate additional offsite hydrogeologic information as follows:

- The unlithified/lithified contact designated as the UA onsite may be hydraulically connected to the sands of the Sankoty Aquifer identified offsite and utilized for potable supply in Peoria, East Peoria, and Pekin.
- The thick sand and gravels along the Illinois River from Hennepin to Peoria form what has been commonly referred to as the Sankoty Aquifer. The Sankoty sand and gravels are hydrologically connected to the Illinois River and are a productive aquifer in the Middle Illinois water supply planning (Illinois State Water Survey [ISWS], 2016). At the EPP, the thick sands and gravels of the Sankoty Aquifer are absent. Fine-grained quaternary deposits of the Cahokia Formation are present from ground surface to the top of bedrock. The UA at the EPP represents the most permeable material present above bedrock. Alluvial deposits belonging to either the Cahokia or the Sankoty are present in a north-south orientation along the Illinois

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River at the EPP and are not expected to occur in the areas west of United States (US) Highway 24 where the bedrock elevation increases above ground surface at the EPP. US Highway 24 runs along the base of the bluff and areas west of US Highway 24 are coincident with areas where the aquifer is not present as illustrated in Figure 5 of Burch and Kelly, 1993 (**Appendix B**).

- Offsite groundwater in the Sankoty Aquifer flows to the north and south towards identified Peoria and Pekin pumping centers, respectively, as illustrated in Figure 5 and Figure 6 of Burch and Kelly, 1993 (**Appendix B**). As reported by Burch and Kelly (1993), "*Smaller flow domains are sometimes formed by pumpage at municipal well fields, which reverse the ground-water flow direction and frequently capture induced recharge from the river and the ground-water ordinarily moving toward it*."
- A review of pumping data for Peoria (ISWS, 2018) indicates that between 1990 and 2010 potable groundwater supply usage increased approximately three percent, while East Peoria and Pekin estimates (Wittman Hydro Planning Associates, Inc. [Wittman], 2008) indicate an increase of 30 and 60 percent, respectively, between 1990 and 2005. Based on these references and IEPA databases (IEPA, 2022) Peoria and Pekin pumping centers identified in the 1993 ISWS Peoria-Pekin Regional Ground-Water Quality Assessment report (Burch and Kelly, 1993) remain active. The increase in reported usage in conjunction with historic records and reports (Burch and Kelley, 1993) indicate high-capacity wells located in Peoria and Pekin continue to influence groundwater flow directions towards their respective pumping centers.

Prior to 2015, there were four monitoring wells (APW-01 through APW-04) located around the Ash Pond for monitoring groundwater. In 2015 and 2017, additional wells and piezometers were installed within and around the Ash Pond to meet requirements of 40 C.F.R. § 257. In 2021, additional wells were installed to provide information to meet the requirements of Part 845. A summary of monitoring well locations and construction details are included in **Table 2-1** and depicted on **Figure 2-4**. Boring logs, monitoring well and piezometer construction forms are provided in Appendix C of the HCR (Ramboll, 2021a).

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3. GROUNDWATER QUALITY

Per 35 I.A.C. § 620.210, groundwater within the UA at the Ash Pond meets the definition of a Class I – Potable Resource Groundwater based on the following criteria:

- Groundwater in the UA extends 10 feet or more below the land surface.
- Hydraulic conductivity exceeds the 1 x 10^{-4} centimeters per second (cm/s) criterion (Table 3-3 of the HCR; Ramboll, 2021a).

Field hydraulic conductivity tests performed on the unlithified geologic materials that include moderate permeability sand, silty sand, and clayey gravel units which includes the Lower Cahokia Formation and the bedrock interface) and lithified materials (shales and siltstones of the Carbondale and Modesto Formations) at the EPP had geometric mean hydraulic conductivities exceeding 1 x 10^{-4} cm/s. Based on this information groundwater is classified as Class I – Potable Resource Groundwater.

A review and summary of data collected from 2015 through 2021 for parameters with GWPSs listed in 35 I.A.C. § 845.600 is provided in the HCR (Ramboll, 2021a). Concentration results presented in the HCR were compared directly to 35 I.A.C. § 845.600 GWPSs to determine potential exceedances. The results are considered potential exceedances because the results were compared directly to the standard and did not include an evaluation of background groundwater quality or utilize the statistical methodologies proposed in the groundwater monitoring plan (GMP; Ramboll, 2021c) attached to the operating permit application.

Groundwater concentrations from 2015 to 2021 are summarized in the History of Potential Exceedances (Ramboll, 2021b) (attached to the operating permit application) and are considered potential exceedances because the methodology used to determine them is proposed in the Statistical Analysis Plan (Appendix A to the GMP, Ramboll 2021c), which has not been reviewed or approved by IEPA at the time of submittal of the Part 845 operating permit application.

The History of Potential Exceedances attached to the operating permit application summarizes all potential groundwater exceedances following the proposed Statistical Analysis Plan. The following potential exceedances were identified:

- Barium – determined at well AW-15C
- Boron – determined at wells AP07S, AW-05, AW-15S, AW-19, AW-20, and AW-21
- Chloride – determined at wells AP07D
- Lithium – determined at wells AP05D and AP07D
- Sulfate – determined at well AW-15S
- TDS – determined at wells AP07S and AW-15S

A Technical Memorandum (**Attachment A**) was prepared by Golder (2022), *Evaluation of Potential GWPS Exceedances, Edwards Ash Pond [CCR Unit 301], Edwards Power Plant, Peoria County, Illinois*, to further evaluate potential GWPS exceedances. The results of the evaluation demonstrated that the potential GWPS exceedances of lithium in well AP05D and AP07D, chloride in well AP07D and barium in well AW-15C are not related to the Ash Pond based on several lines of evidence presented in the Technical Memorandum. Since potential GWPS exceedances for lithium, chloride, and barium are not related to the Ash Pond, these parameters will not be discussed further in this GMR.

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Groundwater monitoring wells recently installed near the plant's property boundary have detected elevated levels of boron in groundwater. IPRG notified IEPA of the elevated boron detections and letters were issued to neighboring property owners in May of 2022 requesting permission for IPRG's consultants to access their property and collect groundwater samples. Until responses are received, and access granted, the groundwater modeling and available well data are being used to delineate the plume.

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4. GROUNDWATER MODEL

4.1 Overview

Data collected from previous field investigations, as well as the 2021 field investigations, were used to develop a groundwater model for the Ash Pond. The MODFLOW and MT3DMS models were then used to evaluate two closure scenarios, including CCR consolidation and CIP using information provided in the Final Closure Plan (IngenAE, 2022), and CBR scenarios. The results of the CIP and CBR closure scenarios are summarized and evaluated in this GMR. Associated model files are included as **Appendix C.**

4.2 Conceptual Site Model

The HCR (Ramboll, 2021a) is the foundation document for the site setting and CSM that describes groundwater flow at the Site, which was refined to incorporate additional offsite hydrogeologic information summarized in Section 2 of this GMR. The Ash Pond overlies the recharge area for the underlying geologic media (*i.e.,* low permeability clays and silts of the UCF; and moderate permeability sand, silty sand, and clayey gravel material within the Lower Cahokia Formation, bedrock, and/or weathered shale bedrock, where present [UA]). Groundwater enters the model domain vertically via recharge. Groundwater may also enter or exit the model through the stormwater drainage ditches and ponds identified immediately west and north of the Ash Pond, or the Illinois River located east of the Ash Pond. Groundwater occurs within both the unlithified materials and bedrock and consistently flows east to west in the UA. In the northernmost portion of the Ash Pond, there is a minor northwest and northern component of flow in both the UA and PMP. In the southern portion of the Ash Pond groundwater flow has a southerly component of flow towards what is interpreted as a former channel of the Illinois River. Offsite groundwater in the Sankoty Aquifer flows to the north and south towards identified Peoria and Pekin pumping centers, respectively.

Boron was selected for transport modeling. Boron is commonly used as an indicator parameter for contaminant transport modeling for CCR because: (i) it is commonly present in coal ash leachate; (ii) it is mobile and typically not very reactive but conservative (*i.e.*, low rates of sorption or degradation) in groundwater; and (iii) it is less likely than other constituents to be present in background groundwater from natural or other anthropogenic sources. The only significant source of boron is the Ash Pond. The Ash Pond is constructed over low permeability clays and silts of the UCF. Mass (boron) is added to groundwater via vertical recharge through CCR, and horizontal groundwater flow through CCR where it is in contact with the water table. Mass flows with groundwater (onsite and offsite groundwater flow directions described above). The primary transport pathway is the UA, as indicated by groundwater observations. The UCF is also a PMP at elevations similar to the base of the Ash Pond, and in places where thin discontinuous sand lenses occur within the UCF adjacent to the Ash Pond.

4.3 Model Approach

Comparisons of observed sulfate and TDS concentrations to boron (**Figure A** and **Figure B**, respectively, below) indicate statistically significant correlations between these parameters at UCF and UA wells. Observed concentrations were transformed into Log10 concentrations for evaluation. The correlation coefficient (R2) and p values (indicator of statistical significance) are also provided on **Figure A** and **Figure B**. Higher R2 values (*i.e.*, closer to 1) indicate stronger

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correlation between parameters. A correlation is considered statistically significant when the probability (p) value is lower than 0.05. Both correlations have p values less than the target of 0.05, indicating correlations are statistically significant. The correlations are strongest between sulfate and boron. The statistically significant correlations associated with boron concentrations indicate boron is an acceptable surrogate for sulfate and TDS in the groundwater model, and concentrations of these parameters are expected to change along with model predicted boron concentrations.

Figure A. Boron Correlation with Sulfate in UCF and UA Wells

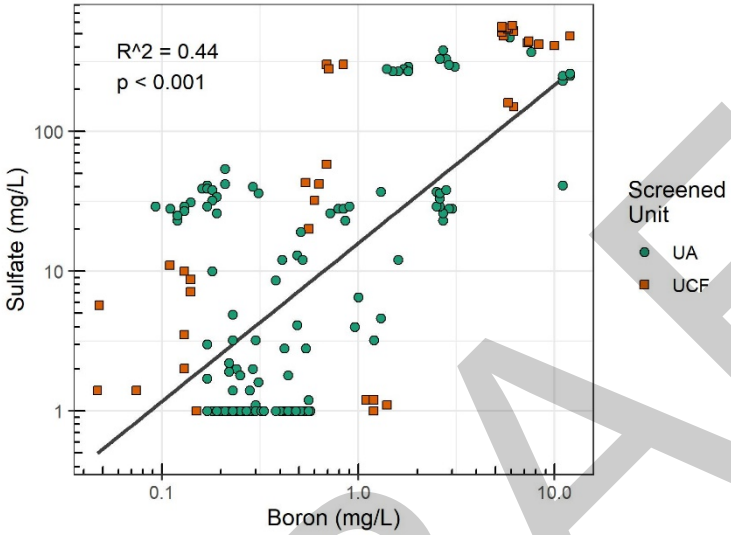
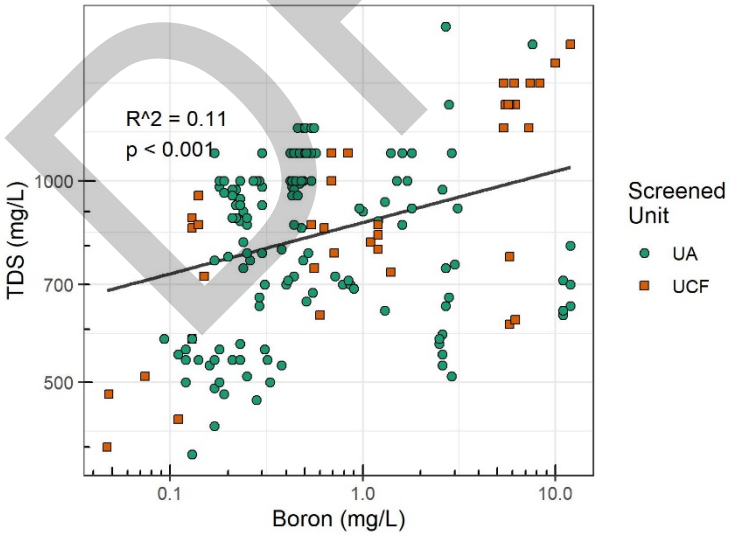


Figure B. Boron Correlation with TDS in UCF and UA Wells



A three-dimensional groundwater flow and transport model was calibrated to represent the conceptual flow system described above. Initial modeling was performed for a 62-year period to

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represent boron concentrations for site conditions in 2022, 62 years following construction of the Ash Pond in 1960. The model was calibrated to match groundwater elevation and concentration observed at each monitoring well. Prediction simulations were then performed to evaluate the effects of CIP and CBR closure scenarios for the Ash Pond on groundwater quality for a period of 1,000 years following initial corrective action measures, which include dewatering of the Ash Pond (1-year period), consolidation of CCR and cover system construction or removal of CCR. The calibration and prediction model timelines are illustrated in **Figure 4-1**.

Three model codes were used to simulate groundwater flow and contaminant transport:

- Groundwater flow was modeled in three dimensions using MODFLOW 2005
- Contaminant transport was modeled in three dimensions using MT3DMS
- Percolation (recharge) after consolidation of CCR and cover system construction was modeled using the results of the Hydrologic Evaluation of Landfill Performance (HELP) model.

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5. MODEL SETUP AND CALIBRATION

5.1 Model Descriptions

For the construction and calibration of the numerical groundwater flow model for the site, Ramboll selected the model code MODFLOW, a publicly available groundwater flow simulation program developed by the United States Geological Survey (USGS) (McDonald and Harbaugh, 1988). MODFLOW is thoroughly documented, widely used by consultants, government agencies and researchers, and is consistently accepted in regulatory and litigation proceedings. MODFLOW uses a finite difference approximation to solve a three-dimensional head distribution in a transient, multi-layer, heterogeneous, anisotropic, variable-gradient, variable-thickness, confined or unconfined flow system—given user-supplied inputs of hydraulic conductivity, aquifer/layer thickness, recharge, wells, and boundary conditions. The program also calculates water balance at wells, rivers, and drains.

Major assumptions of the MODFLOW code are: (i) groundwater flow is governed by Darcy's law; (ii) the formation behaves as a continuous porous medium; (iii) flow is not affected by chemical, temperature, or density gradients; and (iv) hydraulic properties are constant within a grid cell. Other assumptions concerning the finite difference equation can be found in McDonald and Harbaugh (1988). MODFLOW 2005 was used for these simulations with Groundwater Vistas 7 software for model pre- and post- processing tasks (Environmental Simulations, Inc., 2017).

MT3DMS (Zheng and Wang, 1998) is an update of MT3D. It calculates concentration distribution for a single dissolved solute as a function of time and space. Concentration is distributed over a three-dimensional, non-uniform, transient flow field. Solute mass may be input at discrete points (wells, drains, river nodes, constant head cells), or distributed evenly or unevenly over the land surface (recharge).

MT3DMS accounts for advection, dispersion, diffusion, first-order decay, and sorption. Sorption can be calculated using linear, Freundlich, or Langmuir isotherms. First-order decay terms may be differentiated for the adsorbed and dissolved phases.

The program uses the standard finite difference method, the particle-tracking-based Eulerian-Lagrangian methods, and the higher-order finite-volume total-variation-diminishing (TVD) method for the solution schemes. The finite difference solution has numerical dispersion for low-dispersivity transport scenarios but conserves good mass balance. The particle-tracking method avoids numerical dispersion but was not accurate in conserving mass. The TVD solution is not subject to significant numerical distribution and adequately conserves mass, but is numerically intensive, particularly for long-term models such as developed for the Ash Pond. The finite difference solution was used for this simulation.

Major assumptions of MT3DMS are: (i) changes in the concentration field do not affect the flow field; (ii) changes in the concentration of one solute do not affect the concentration of another solute; (iii) chemical and hydraulic properties are constant within a grid cell; and (iv) sorption is instantaneous and fully reversible, while decay is not reversible.

The HELP model was developed by the United States Environmental Protection Agency (USEPA). HELP is a one-dimensional hydrologic model of water movement across, into, through, and out of a landfill or soil column based on precipitation, evapotranspiration, runoff, and the geometry and

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hydrogeologic properties of a layered soil and waste profile. For this modeling, results of the HELP model, HELP Version 4.0 (Tolaymat and Krause, 2020), were used to estimate the hydraulic conditions beneath removal and consolidation areas.

5.2 Flow and Transport Model Setup

The modeled area was approximately 15,975 feet (478 rows) by 9,500 feet (334 columns) with the Ash Pond located in the west-central portion of the model. The eastern edge of the model is bounded by the Illinois River. The north, west, and south edges of the model were selected to maintain sufficient distance from the Ash Pond to reduce boundary interference with model calculations, while not extending too far past the extent of available calibration data. The northwest edge of the model is defined by the edge of the former historic Illinois River valley, where the elevation increases to approximately 600 feet NGVD29, and bedrock outcrops or is present near the surface (across Highway 24). The model grid and boundary conditions are displayed in **Figure 5-1 through Figure 5-6**.

Evaluation of monitoring well data for the Ash Pond has not identified statistically significant seasonal trends in groundwater quality which could affect model applicability for prediction of boron transport. The MODFLOW model was calibrated to mean groundwater elevation collected from November 2015 to August 2021 presented in **Table 2-2**. MT3DMS was run on the calibrated flow model and model-simulated concentrations were calibrated to the range of observed boron concentration values at the monitoring wells from November 2015 to August 2021 presented in **Table 2-2**. Multiple iterations of MODFLOW and MT3DMS calibration were performed to achieve an acceptable match to observed flow and transport data. For the Ash Pond, the calibrated flow and transport models were used in predictive modeling to evaluate the CIP and CBR closure scenarios by removing saturated ash cells and using HELP modeled recharge values to simulate changes proposed in the closure scenarios.

5.2.1 Grid and Boundary Conditions

A five-layer, 478 x 334 node grid was established with 25-foot grid spacing in the vicinity of the Ash Pond and EPP property. The grid increases gradually to a maximum 225-foot row spacing and 112.5-foot column spacing near the edges of the model (**Figure 5-1**). Boundary conditions are illustrated in **Figure 5-2 through Figure 5-6**. The northwest and eastern edges of the model are no-flow (Neumann) boundaries in all layers of the model with the exceptions of the eastern edge in Layer 3, where a river (Mixed) boundary was placed to simulate the mean flow conditions of the Illinois River, and the north and southeast edges in layer 4, where a general head (Dirichlet) boundary (denoted as general head boundary conditions [GHB] on the figure) was placed to simulate the influence of pumping centers located in Peoria and Pekin on groundwater flow direction. The bottom of the model was also a no-flow (Neumann) boundary. The top of the model was a time-dependent specified flux (Neumann) boundary, with specified flux rates equal to the recharge rate. A specified mass flux (Cauchy condition) boundary was used to simulate downward percolation of solute mass from the Ash Pond. This boundary condition assigns a specified concentration to recharge water entering the node, and the resulting concentration in the node is a function of the relative rate and concentration of recharge water (water percolating from the impoundment) compared to the rate and concentration of other water entering the node.

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5.2.2 Flow Model Input Values and Sensitivity

Flow model input values and sensitivity analyses results are presented in **Table 5-1** and described below.

The modeled well location layers and flow model calibration targets (*i.e.*, mean groundwater elevations from November 2015 to August 2021 and target well locations) are summarized in **Table 2-2**. Anomalous groundwater elevations (*e.g.,* groundwater elevations that do not represent static groundwater conditions or groundwater elevations measured in error) monitored between November 2015 and August 2021 were removed from the mean groundwater calculations used as flow calibration targets at wells AP05D, AP07D, APW-02, APW-03, AW-08, and AW-14. Wells APW-02, AW-18, AW-19, AW-20, AW-21, AW-22, and P002 are hydraulically connected to multiple hydrostratigraphic units (*i.e.,* modeled layers) and/or screened across multiple hydrostratigraphic units (*i.e.,* modeled layers). In the flow calibration model, flow calibration targets for wells APW-02, AW-18, AW-19, AW-20, AW-21, AW-22, and P002 were placed in model layers that exhibited heads more representative of the groundwater observations in these wells.

Sensitivity analysis was conducted by changing input values and observing changes in the sum of squared residuals (SSR). Horizontal conductivity, vertical conductivity, and river and general head conductance terms were all varied between one-tenth and ten times calibrated values. Recharge terms were varied between one-half and two times calibrated values. River stage for river reach 1 and general head boundary head terms were varied between 98.5 and 101.5 percent of calibrated values. River stage for river reaches 2 through 4 were varied between 99.5 and 100.5 percent of calibrated values. When the calibrated model was tested, SSR was 374.3. Sensitivity test results were categorized into negligible, low, moderate, moderately high, and high sensitivity based on the change in SSR as summarized in the notes in **Table 5-1**.

5.2.2.1 Model Layers

The bottom elevation of the BCU in layer 5 was flat lying and assumed to be an elevation of 200 feet NAVD88. All available boring log data included in the HCR (Ramboll, 2021a) was used to develop surfaces utilizing Surfer® software for each of the four distinct water-bearing units described in **Section 2**. The modeled UCF was split into three modeled layers, where model layer 1 represented the upper clay of the UCF, model layer 2 represented a transmissive zone within the UCF (this unit is considered a PMP at elevations similar to the base of the Ash Pond, and in places where thin discontinuous sand lenses occur within the UCF adjacent to the Ash Pond), and model layer 3 represented the lower clay of the UCF. Model layer 4 represented the UA onsite, as well as the hydraulically connected sands of the Sankoty Aquifer identified offsite. Model layer 5 represented the BCU. The approximate base of ash surface in the Ash Pond was developed from information presented in the HCR (Ramboll, 2021a) and confirmed with IngenAE. The CCR was modeled in layers 1 and 2 within the limits of the Ash Pond, where the base of layer 2 within the limits of the Ash Pond was consistent with the base of ash surface. The resulting surfaces were imported as layers into the model to represent the distribution and change in thickness of each water-bearing unit across the model domain.

5.2.2.2 Hydraulic Conductivity

Hydraulic conductivity values and sensitivity results are summarized in **Table 5-1**. When available, these values were derived from field or laboratory measured values reported in the

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Geotechnical Data Report (AECOM, 2016b), Hydrogeologic Monitoring Plan (Natural Resource Technology, an OBG Company [NRT/OBG], 2017), Technical Memorandum: Ash Pond – Underlying Clay and Depth of CCR Evaluation (Haley & Aldrich, Inc., 2018), and Hydrogeologic Site Characterization Report (Ramboll, 2021a), to be representative of site-specific conditions. The sources of the hydraulic conductivity values are summarized in **Table 5-1**. Conductivity zones that did not have representative site data (*i.e.,* zones 7 and 9, representing the cells above the river cells and the Sankoty Aquifer, respectively) were determined through model calibration. No horizontal anisotropy was assumed. Vertical anisotropy (presented as Kh/Kv in **Table 5-1**) was applied to conductivity zones to simulate preferential flow in the horizontal direction in these materials. Permeability tests discussed in the Geotechnical Data Report (AECOM, 2016b), 2017 Hydrogeologic Monitoring Plan (NRT/OBG, 2017), Technical Memorandum: Ash Pond – Underlying Clay and Depth of CCR Evaluation (Haley & Aldrich, Inc., 2018), and 2021 Hydrogeologic Characterization Report (Ramboll, 2021a) indicate vertical conductivity values that are lower than horizontal conductivity values.

The spatial distribution of the hydraulic conductivity zones (**Figure 5-7 through Figure 5-11**) in each layer simulates the distribution of hydrostratigraphic units as reported in the HCR (Ramboll, 2021a). All hydraulic conductivity zones were laterally continuous within the model with the exception of the Fill Unit (CCR) hydraulic conductivity zone (zone 6), the Weathered Shale (UA) hydraulic conductivity zone (zone 4), and the Sankoty Aquifer hydraulic conductivity (zone 9). The limits of the ash fill were determined from data presented in the HCR (Ramboll, 2021a) and confirmed with IngenAE. The ash fill extent was propagated through all related ash fill property zones and boundary conditions (*i.e.*, recharge, storage, effective porosity, and constant concentration cells). The extent of the Weathered Shale (UA) hydraulic conductivity zone and Sankoty Aquifer hydraulic conductivity zone offsite in model layer 4 was determined through a review of available offsite water well boring logs and through calibration. Conductivity zone 7 was also placed above river cells representing the Illinois River to improve communication between the river and the groundwater in layers above the layer in which the river was placed.

The model was highly sensitive to changes in horizontal conductivity in zones 2 (Transmissive Zone [UCF/PMP]), 4 (Weathered Shale [UA]), 6 (Fill Unit [CCR]), and 9 (Sankoty Aquifer - Sands), where the model was moderately sensitive to horizontal conductivity in the remaining hydrostratigraphic units and low in zone 1 (Upper Clay [UCF]). The model was highly sensitive to changes in vertical conductivity in zone 1 (Upper Clay [UCF]) and zone 3 (Lower Clay [UCF]), while the model exhibited a negligible to moderate sensitivity in the remaining zones.

5.2.2.3 Recharge

Recharge rates were determined through calibration of the model to the groundwater elevation and groundwater quality data collected from November 2015 to August 2021 (**Table 5-1**). The spatial distribution of recharge zones were based on the location and type of material present at land surface (**Figure 5-12**). Six different zones were created to simulate recharge in the model area. One zone (zone 1) was used to simulate ambient recharge over the upper clay of the UCF outside the limits of the Ash Pond. The recharge occurring through the ash fill placed in the Ash Pond was split into five different values, where recharge was varied based upon the historical use of each ash fill area (AECOM, 2016a) and the response of flow calibration target heads. Zones 2, 3, 4, 5, and 7 represent recharge in the Ash Pond area. The greatest recharge in the model was simulated in an area on the northeast edge of the pond where the fill materials are sluiced into the Ash Pond (zone 7) and the greatest heads were observed. The remaining ash fill areas

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(recharge zones) are listed in order of greatest to least simulated recharge along with their historical use based on the history of construction (AECOM, 2016a): central area (zone 2, Fly Ash Pond), northwest area (zone 4, Process Water Pond), south area (zone 5, Clarification Pond), and south of railroad area (zone 3, Inactive Area). The area south of the railroad (zone 3) was simulated to have recharge values near ambient recharge as a result of the 2004 modifications to the rail loop surrounding the Ash Pond which increased the elevations of the embankments and reduced the footprint of the active impoundment (AECOM, 2016a).

The model had a high sensitivity to changes in recharge in zones 1 (Upper Clay [UCF]), 2 (Fill Unit – CCR [Central, Fly Ash Pond]), and 7 (Fill Unit - CCR [Northeast, Sluice Area]). The model had negligible to moderate sensitivity to changes in recharge in the remaining zones, with the exception of zone 4 (Fill Unit – CCR [Northwest, Process Water Pond), where sensitivity was moderately high.

5.2.2.4 Storage and Specific Yield

The calibration model did not use these terms because it was run at steady state. For the transport model, which was run in transient, no field data defining these terms were available so published values were used consistent with Fetter (1988). Specific yield (S_y) was set to equal effective porosity values described in **Section 5.2.3.3**. The spatial distribution of the storage and specific yield zones were consistent with those of the hydraulic conductivity zones. The sensitivity of these parameters was tested by evaluating their effect on the transport model as described in **Section 5.2.3.4**.

5.2.2.5 River Parameters

The Illinois River was simulated using head-dependent flux nodes in modeled river reach 1 that required inputs for river stage, width, bed thickness, and bed hydraulic conductivity (**Table 5-1**). River width, bed thickness, and bed hydraulic conductivity parameters were used to calculate a conductance term for the boundary node. This conductance term was determined by adjusting hydraulic conductivity during model calibration, while bed thickness was set at 1 foot and river width was set at 750 feet. Final hydraulic conductivity value was set at 1 ft/day. The length of the modeled river extends from the northernmost extent of the model domain to the southernmost extent of the model domain using river reach 1. The modeled river stage in the calibration model was based on available Illinois River stage data at Peoria, Illinois (United States Army Corps of Engineers [USACE] 404208089335201 Illinois River at Peoria, Illinois [Corps]), Edwards Power Plant (Plant Gaging Station), and Kingston, Illinois (USGS 05568500 Illinois River at Kingston Mines, Illinois) gaging stations. The river boundary was placed in layer 3 corresponding with simulated river elevation (**Figure 5-4**).

A median slope was calculated from available data at upstream Peoria, Illinois gaging station (USACE 404208089335201 Illinois River at Peoria, Illinois [Corps]) and downstream Kingston, Illinois gaging station (USGS 05568500 Illinois River at Kingston Mines, Illinois). The mean river stage was then calculated based upon available gage data (hourly data from October 2007 to January 2022) of the Illinois River from Kingston, Illinois (USGS 05568500 Illinois River at Kingston Mines, Illinois) gaging station. The calculated median slope along with the mean river stage at Kingston, Illinois was used to interpolate the mean river stage throughout the model domain. The interpolated mean value near the EPP was confirmed to be within the range of observations at EPP gaging station.

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The drainage ditch, bordering the western edge of the Ash Pond and continuing south to the Illinois River, was simulated using head dependent flux nodes in modeled river reach 2 (**Table 5-1**). The conductance term was determined by adjusting hydraulic conductivity during model calibration, while bed thickness was set at 1 foot and river width was set at 20 feet. Final hydraulic conductivity value was set at 0.00001 ft/day to reflect the low vertical hydraulic conductivity of the underlying UCF material. The drainage ditch stage was based on the mean drainage ditch water surface elevation from survey data collected by IngenAE in February 2022. The drainage ditch modeled river reach 2 was placed in layer 1. A second drainage feature, the drainage swale (reach 3) to the north of the Ash Pond had similar input parameters, however the river width was set to 25 and simulated river stage had a slightly lower elevation based on survey data collected by IngenAE in February 2022. A third drainage feature, the drainage pond (reach 4) to the northeast of the Ash Pond had similar input parameters; however, the river stage had a slightly higher elevation based on survey data collected by IngenAE in February 2022. River reaches 3 through 4 were also placed in layer 1.

The model had negligible to low sensitivity to changes in river stage, with the exception of reach 1 (Illinois River), where the sensitivity was moderate. The model had negligible to low sensitivity to changes in river conductance, with the exception of reach 2 (Drainage Ditch West of Ash Pond), where the sensitivity was moderate.

5.2.2.6 General Head Boundary Parameters

GHB were used along the north edge of the model as well as along the southeast edge of the model in layer 4 (**Figure 5-5**). The GHB at the northern limit of the model (reach 1) was used to simulate groundwater flow leaving the model domain in the Sankoty Aquifer due to the influence of pumping centers in Peoria. GHB elevation, conductance, and distance were established during calibration (**Table 5-1**). GHB cell width was set at 150 feet, distance to the GHB head was set at 1 foot, and average saturated thickness of the cell was set at 100 feet. Final hydraulic conductivity value was set at 100 ft/day to be similar in magnitude to the horizontal conductivity of the permeable sands. The GHB at the southeastern limit of the model (reach 1) was used to simulate groundwater flow leaving the model domain in the Sankoty Aquifer due to the influence of pumping centers in Pekin. GHB elevation, conductance, and distance were established during calibration (**Table 5-1**). GHB cell width was set at 750 feet, distance to the GHB head was set at 1 foot, and average saturated thickness of the cell was set at 39 feet. Final hydraulic conductivity value was set at 100 ft/day to be similar in magnitude to the horizontal hydraulic conductivity of the permeable sands. The GHB at the north edge of the model (reach 1) and the southeast edge of the model (reach 1) were placed in layer 4 with a constant elevation of 426 feet NAVD88. The sensitivity to changes in specified head was high for reach 1. The flow calibration model had a negligible sensitivity to changes in conductance.

5.2.3 Transport Model Input Values and Sensitivity

MT3DMS input values are listed in **Table 5-2** and described below. Sensitivity of the transport model is summarized in **Table 5-3**.

Groundwater transport was calibrated to groundwater boron concentration ranges at each well as measured from the monitoring wells between November 2015 and August 2021. The transport model calibration targets are summarized in **Table 2-2**.

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Sensitivity analysis was conducted by changing input values and observing percent change in boron concentration at each well from the calibrated model boron concentration. Effective porosity was varied by decreasing and increasing calibrated model values by 0.05. Storage values were multiplied and divided by a factor of 10, and specific yield by a factor of 2. High specific yield sensitivity was not analyzed for zone 8 (UCF above River Boundary Conditions) since the calibration value was already near upper limits of acceptable values for specific yield (0.5).

5.2.3.1 Initial Concentrations

No initial concentrations were placed in the calibration model. The flow model was run as transient and concentration was added to the model through recharge and constant concentration cells starting at the same time as flow simulation. Modeling was performed for two stress periods, where the first stress period (stress period 1) started at the time of Ash Pond construction (1960) and ended in 2004 (44-year stress period) when modifications to the rail loop surrounding the Ash Pond increased the elevations of the embankments and reduced the footprint of the active impoundment (AECOM, 2016a). The second stress period (stress period 2) started in 2005 following the Ash Pond modifications and included reduced recharge in the ash fill area south of the railroad (recharge zone 3) to simulate the reduced activity in this area of the pond. The second stress period ended in 2022 (18-year stress period). The transport model timeline is illustrated in **Figure 4-1**.

5.2.3.2 Source Concentrations

Five concentration sources in the form of vertical percolation (recharge) through CCR were simulated in fill unit layer 1 for calibration (**Table 5-2**) (in order of greatest to least simulated recharge): (i) percolation through CCR in the northeast edge of the pond where the fill materials are sluiced into the Ash Pond (zone 7, Sluice Area), (ii) percolation through CCR in the central area (zone 2, Fly Ash Pond), (iii) percolation through CCR in the northwest area (zone 4, Process Water Pond), (iv) percolation through CCR in the south area (zone 5, Clarification Pond), and (v) percolation through CCR south of railroad (zone 3, Inactive Area)(**Figure 5-12**). All five sources were simulated by assigning concentration to the recharge input. The CCR sources were also simulated with constant concentration cells placed in fill unit layer 1 and layer 2 (**Figure 5-2** and **Figure 5-3**) to simulate saturated ash conditions. From the model perspective, this means that when the simulated water level is above the base of these cells, water that passes through the cell will take on the assigned concentration. All source concentrations were calibrated in the transport model to the boron concentration data collected from November 2015 to August 2021. The source concentrations applied to the recharge zones and saturated ash cells immediately below the recharge zones have the same concentration values.

Because these are the sources of concentration in the model, the model will be highly sensitive to changes in the input values. For that reason, sensitivity testing was not completed for the source values.

5.2.3.3 Effective Porosity

Effective porosity for each modeled hydrostratigraphic unit were derived from an average between estimated values of 0.20 for silt material, 0.267 for gravel, 0.07 for clay, and 0.28 for sand from Morris and Johnson (1967) and Heath (1983) and presented in **Table 5-2**.

The model had a negligible to moderately high sensitivity to decreases in porosity values, with the exception of four monitoring locations where sensitivity was high (*i.e.,* APW-01, APW-04,

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AW-05, and AW-12) and not including monitoring locations where the calibration concentration was less than 0.1 mg/L (*i.e.*, AP05S, AP05D, AP07D, AW-06, AW-08, and AW-15C) (**Table 5-3**). The model had a negligible to moderate sensitivity to increases in porosity values, not including monitoring locations where the calibration concentration was less than 0.1 mg/L (*i.e.*, AP05S, AP05D, AP07D, APW-01, APW-04, AW-06, AW-08, AW-12, and AW-15C) (**Table 5-3**).

5.2.3.4 Storage and Specific Yield Sensitivity

The transport model had a negligible to low sensitivity to changes in storage and specific yield, with the exception of sensitivity at monitoring wells AP05S, AP05D, APW-01, APW-04, and AW-12, where sensitivity was moderate to moderately high; however, boron concentration in both the calibrated model and sensitivity models were negligible (<0.1 mg/L) at these wells (**Table 5-3**).

5.2.3.5 Dispersivity

Physical attenuation (dilution and dispersion) of contaminants is simulated in MT3DMS. Dispersion in porous media refers to the spreading of contaminants over a greater region than would be predicted solely from the average groundwater velocity vectors (Anderson, 1979; Anderson, 1984). Dispersion is caused by both mechanical dispersion, a result of deviations of actual velocity at a microscale from the average groundwater velocity, and molecular diffusion driven by concentration gradients. Molecular diffusion is generally secondary and negligible compared to the effects of mechanical dispersion and only becomes important when groundwater velocity is very low. The sum of mechanical dispersion and molecular diffusion is termed hydrodynamic dispersion, or simply dispersion (Zheng and Wang, 1998).

Dispersivity values were applied to the entire model domain and determined during calibration. Longitudinal dispersivity was set at 3 feet. The transverse and vertical dispersivity were set at 1/10 and 1/100 of longitudinal dispersivity. These input values were determined during model calibration. With travel distances of less than 100 feet for groundwater from the source to the majority of the monitoring points, the model is not expected to be sensitive to dispersivity inputs and the sensitivity of the model to dispersivity was not tested.

5.2.3.6 Retardation

It was assumed that boron would not significantly sorb or chemically react with aquifer solids (distribution coefficient [Kd] was set to 0 mL/g) which is a conservative estimate for estimating contaminant transport times. Boron, sulfate, and TDS transport is likely to be affected by both chemical and physical attenuation mechanisms (*i.e.*, adsorption and/or precipitation reactions as well as dilution and dispersion). Batch adsorption testing was conducted to generate site specific partition coefficient results for boron and sulfate (Golder, 2022b, **Appendix D**) for locations AW-15S and AW-19. Results of the testing are summarized below:

- Boron: Calculated linear partition coefficient (K_D) values were 1.50 and -0.19 liters per kilogram (L/kg), respectively. Langmuir partition coefficient (K_L) values were 3.8×10^4 and -2×10^5 L/kg, respectively. Freundlich partition coefficients (K_F) values were 82 and 215 L/kg, respectively. In Strenge and Peterson (1989), partition coefficients for boron range from 0.19 to 1.3 L/kg, depending on pH conditions and the amount of sorbent present.
- Sulfate: Calculated K_D values were 0.47 and -1.0 L/kg, respectively. K_L values were 778 and -2,950 L/kg, respectively. The K_F values for AW-15S and AW-19 were 63 and 1.2 L/kg,

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respectively. In Strenge and Peterson (1989), partition coefficients for sulfate are 0.0 L/kg, regardless of pH conditions and the amount of sorbent present.

The results from site samples have a high degree of variation and little correlation with the literature values provided for comparison. The potential exceedances identified in groundwater (boron, sulfate, and TDS) are affected by natural attenuation processes in multiple ways and to varying degrees. Further assessment of these processes and how they may be applied as a potential groundwater remedy will be completed as part of future remedy selection evaluations, as necessary. For the purposes of this GMR, and as mentioned at the beginning of this section, no retardation was applied to boron transport in the model (*i.e.,* Kd was set to 0).

5.3 Flow and Transport Model Assumptions and Limitations

Simplifying assumptions were made while developing this model:

- Leading up to 2022, the groundwater flow system can be simulated as steady state.
- Natural recharge is constant over the long term.
- Fluctuations in river stage do not affect groundwater flow and transport over the long term.
- Hydraulic conductivity is consistent within hydrostratigraphic units
- The approximate base of ash surface in the Ash Pond was developed from information presented in the HCR (Ramboll, 2021a) and confirmed with IngenAE. Observed concentrations in groundwater exhibit no long-term trend.
- Source concentrations are assumed to remain constant over time. Only recharge rate was modified in 2004 to simulate modifications to Ash Pond operation south of the railroad (recharge zone 3).
- Boron is not adsorbed and does not decay, and mixing and dispersion are the only attenuation mechanisms.

The model is limited by the data used for calibration, which adequately define the local groundwater flow system and the source and extent of the plume. Since data used for calibration are near the Ash Pond, model predictions of transport distant spatially and temporally from the calibrated conditions at the CCR units will not be as reliable as predictions closer to the CCR units and concentrations observed between 2015 and 2021.

5.4 Calibration Flow and Transport Model Results

Results of the MODFLOW/MT3DMS modeling are presented below. Electronic copies of the model files are attached to this report (**Appendix C**).

Observed and simulated heads are presented in **Figure 5-13 through Figure 5-17**. The mass balance error for the flow model was -0.19 percent and the ratio of the residual standard deviation to the range was 11.6 percent; the mass balance error for the flow model was within the target for the criteria of 1 percent and the ratio of the residual standard deviation to the range was near target for the criteria of 10 percent. Another flow model calibration goal is that residuals are evenly distributed such that there is no bias affecting modeled flow. The observed heads are plotted versus the simulated heads in **Figure 5-18**. The near-linear relationship between observed and simulated values indicates that the model adequately represents the calibration dataset. The residual mean was -1.81 feet; in general the simulated values were

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evenly distributed above and below the observed values. This is also illustrated in the observed versus residuals plot at the bottom of **Figure 5-19**; however, some simulated values were overpredicted in the areas north of the Ash Pond or in model layer 2 immediately adjacent to the Ash Pond (transmissive zone within the UCF) where observed heads in the UCF (flow calibration targets) were significantly lower than observed heads (flow calibration targets) in the adjacent Ash Pond. These residuals plot in the lower left quadrant of **Figure 5-19**.

The range of observed boron concentrations between November 2015 and August 2021 for transport calibration locations are summarized in **Table 2-2**. The goals of the transport model calibration were to have predicted concentrations fall within the range of observed concentrations, and/or have predicted concentrations above and below the GWPS for boron (2 mg/L) match observed concentrations above or below the standard at each well. One or both of these goals were achieved at all but three of the transport calibration location wells, including AW-17, AW-22, and P002, where concentrations were overpredicted (**Figure 5-20**). Deviations from the observed ranges are discussed below.

- P002 is identified as a PMP well in the HCR (Ramboll, 2021a). P002 was modeled in layer 3 which represents the lower clay beneath the Ash Pond rather than layer 2, which represents the transmissive zone of the UCF (PMP) in the model. Since layer 2 was modeled as ash fill at the location of P002, the well was placed in layer 3 of the model immediately beneath the ash fill. The ash fill above the modeled location of P002 had the highest model source concentrations, which contribute to the over-predicted concentrations of boron at P002.
- In general, the model over-predicts boron concentrations to the north of the Ash Pond (AW-19, AW-20, AW-22, and P002) in wells adjacent to wells AP07S and AW021 where the highest boron concentrations were observed. The proximity of P002 and AW-22 to the highest boron concentration targets contributed to the over-predicted boron concentrations at these wells. Similarly, the over-prediction of boron concentration at AW-17 is associated with the proximity of AW-17 to AW-18 where observed boron concentrations are elevated.

The remaining calibration locations had predicted concentrations that fall within the range of observed concentrations and/or have predicted concentrations above and below the GWPS for boron (2 mg/L) matching observed concentrations above or below the standard at each well. In other words, there was a very good match between predicted and observed boron concentrations relative to wells with concentrations above and below the GWPS. UA well AW-21, located north of the Ash Pond, where the highest boron concentrations were observed, was also calibrated near the mean concentration of the observed values from November 2015 to August 2021. Similarly, PMP well AP07S located north of the Ash Pond, where the highest concentrations in the UCF were observed, was calibrated just below the maximum of the observed range from November 2015 to August 2021. The calibration result for wells AW-21 and AP07S indicate the transport calibration model was able to simulate the highest observed concentrations in both the UA and transmissive zone of the UCF (PMP), respectively. The remaining wells with observations above the standard GWPS for boron (2 mg/L) from November 2015 to August 2021 had calibrated concentrations above the GWPS (AW-05, AW-15S, AW-18, AW-19, AW-20). The distribution of boron concentrations in the calibrated model are presented on **Figure 5-21 through Figure 5-25**.

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6. SIMULATION OF CLOSURE SCENARIOS

6.1 Overview and Prediction Model Development

Prediction simulations were performed to evaluate the effects of closure (source control) measures (CCR consolidation and CIP and CBR scenarios) for the Ash Pond on groundwater quality following initial corrective action measures, which includes removal of free liquids from the Ash Pond (**Figure 4-1**). As discussed in **Section 5.2.3.5**, physical attenuation (dilution and dispersion) of contaminants in groundwater is simulated in MT3DMS, which captures the physical process of natural attenuation as part of corrective actions for both closure scenarios simulated. No retardation was applied to boron transport in the model (*i.e.,* Kd was set to 0) as discussed in **Section 5.2.3.6**. The following methods were used to develop the prediction models and simulate the CIP and CBR closure scenarios:

- Define ash fill material removal and consolidation areas based on designs provided in the Final Closure Plan (IngenAE, 2022).
- Apply a constant head to the Ash Pond for the dewatering period (approximately 1 year) to remove free liquids within the Ash Pond and simulate heads near ambient conditions.
- Remove source concentrations within the removal areas (source concentrations associated with recharge zones and saturated ash cells [constant concentration cells]).
- Apply drains (drain input parameters approximated designs provided in the Final Closure Plan [IngenAE, 2022]) to simulate storm water management within removal areas following closure.
- Apply hydraulic conductivity, recharge (HELP calculated percolation rates were developed based on soil backfill materials and final grading designs provided in the Final Closure Plan [IngenAE, 2022]), storage, and specific yield property zones to simulate soil backfill materials placed in the Ash Pond removal areas.
- Apply reduced recharge in the consolidation and closure in place areas to simulate the effects of the cover system on transport (HELP calculated percolation rates were developed based on cover system construction materials and designs provided in the Final Closure Plan [IngenAE, 2022]).

HELP modeling input and output values are summarized in **Table 6-1** and described in detail below. Prediction simulations were performed to evaluate changes in boron concentrations from two closure scenarios, including consolidation and CIP, and CBR scenarios. The following simplifying assumptions were made during the simulations:

- In the two closure scenarios, HELP-calculated average annual percolation rates were developed from a 30-year HELP model run. This 30-year HELP-calculated percolation rate remained constant over duration of the closure scenario prediction model runs following closure.
- Changes in recharge resulting from dewatering, ash fill removal, consolidation, construction of the cover system, and soil backfill placement and final grading (recharge rates are based on HELP-calculated average annual percolation rates) have an instantaneous effect on recharge and percolation through surface materials.

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- Boron source concentrations were assumed to remain constant as a function of time following the end of the calibration simulation. Boron concentration in the ash fill removal areas was assumed to be 0 mg/L following construction to simulate removal of ash that is the source of boron.
- The start of each closure prediction simulation was initiated at the end of the calibration model period from 1960 to 2022. Two models were included for each closure prediction simulation, where the first model simulated the removal of free liquids period (1 year) and the second model simulated the final closure conditions (1,000 years). The prediction modeling timeline for each scenario is illustrated in **Figure 4-1**.
- The geocomposite drainage layer and geomembrane liner placed over the ash consolidation area were assumed to have good field placement and assumed to have the same slope as the final grade of the overlying cover materials based on the design drawings provided in the Final Closure Plan (IngenAE, 2022).
- Ash fill removal areas were assumed to be graded following placement of soil backfill based on the design drawings provided in the Final Closure Plan (IngenAE, 2022).
- All saturated ash (constant concentration cells) within removal areas in the transport calibration model were removed instantaneously in all prediction models following ash fill removal/final soil backfill grading. Local fill materials assumed to be sourced from surrounding UCF materials replaced ash fill in areas of removal.
- Local fill materials applied to the prediction models have similar hydraulic properties as the UCF materials used in the transport calibration models.

6.2 HELP Model Setup and Results

HELP (Version 4.0; Tolaymat and Krause, 2020) was used to estimate percolation through the Ash Pond areas for two ash fill closure scenarios and three area types, including CBR removal areas, CIP removal areas, and CIP consolidation and cover system areas. HELP files are included electronically (**Appendix C**) and outputs are attached to this report (**Appendix E**).

HELP input data and results are provided in **Table 6-1**. All scenarios were modeled for a period of 30 years. Climatic inputs were synthetically generated using default equations developed for Peoria, Illinois (the closest weather station included in the HELP database). Precipitation, temperature, and solar radiation was simulated based on the latitude of the Ash Pond. Thickness and type of the geosynthetic drainage layer, geomembrane liner, soil backfill, and soil runoff input parameters were developed for the ash fill removal and consolidation scenarios using data provided the Final Closure Plan (IngenAE, 2022).

HELP model results (**Table 6-1**) indicated 5.09 inches of percolation per year for the Ash Pond CBR removal areas, 4.03 inches of percolation per year for the Ash Pond CIP removal areas, and 0.0002 inches of percolation per year for the Ash Pond consolidation and cover system areas. The differences in HELP model runs for each area included the following parameters: evaporation zone thickness (limited by unsaturated soil backfill thickness in the Ash Pond), area, soil backfill thickness, and soil runoff slope length; all other HELP model input parameters were the same for each simulated area. Two additional HELP model simulations were completed to support the *Proposed Alternative Final Protective Layer Equivalency Demonstration*, (Geosyntec, 2022) which is an appendix to the Construction Permit Application to which this report is also attached.

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Results of these two HELP simulations were not incorporated in the MODFLOW simulations for closure. Simulation inputs and output results are presented in **Appendix E**.

6.3 Simulation of Closure Scenarios

The calibrated model was used to evaluate the effectiveness of the two closure scenarios by defining ash fill material removal and consolidation area, reducing head to simulate a dewatering period (approximately 1 year), removing source concentrations within the removal areas, applying drains to simulate storm water management within removal areas following closure, applying hydraulic conductivity, recharge, storage, and specific yield property zones to simulate soil backfill materials placed in the Ash Pond removal areas, and applying reduced recharge in the consolidation and closure in place areas to simulate the effects of the cover system on transport.

Each prediction scenario was initiated at the end of the calibration model and consisted of two models where the first model simulated the dewatering period (1 year) and the second model simulated the final closure conditions (**Figure 4-1**). The prediction model input values are summarized in **Table 6-2** and illustrated in **Figure 6-1 through Figure 6-6**.

In general, long predicted timeframes to reach the GWPS were observed for most wells in both CIP and CBR prediction scenarios. The long timeframes observed are a result of the generally low permeability materials adjacent to and underlying the Ash Pond, and generally low groundwater flow velocities observed within the water-bearing units of the site, which results in reduced transport and slow physical attenuation (dilution and dispersion). The observed timeframes to reach the GWPS for some wells in both the CIP and CBR prediction scenarios were on the order of hundreds of years from present. These predicted timeframes to meet the GWPS are less reliable than timeframes that are closer temporally to the data used for calibration (between 2015 and 2021). The two closure scenarios are discussed in this report based on predicted changes in boron concentrations as described below.

6.3.1 Closure Scenario 1 (CIP) Predicted Boron Concentrations

The design for Scenario 1: CIP includes an initial 1-year dewatering period to remove free liquids followed by CCR removal from the northwest areas of the Ash Pond, consolidation to the northeast, central and southern areas of the Ash Pond, and construction of a cover system over the remaining CCR (**Figure 4-1**).

Predicted concentrations start to decline at all monitoring wells with observations above the GWPS for boron (2 mg/L) (AP07S, AW-05, AW-15S, AW-18, AW-19, AW-20, AW-21) once closure actions are initiated within the prediction model. These declines occur as the northwest area of ash fill is removed and saturated ash cells (constant concentration cells) are reduced in the area of the highest modeled source concentrations. Following removal of ash fill in the northwest area, boron concentrations are no longer entering the model domain from recharge or from saturated ash cells (constant concentration cells). Dewatering also reduces the head within the Ash Pond. These low heads are maintained following completion of closure by the drain cells that simulate storm water management designs within the removal area to the northwest, and by the greatly reduced infiltration rates (recharge) that result from placement of the cover system over the consolidated ash fill. As a result of the reduced heads and recharge, downward percolation of solute mass from the Ash Pond is reduced, which decreases the boron concentration entering the model domain. The reduced recharge resulting from placement of the cover system also reduces the number of

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active saturated ash cells (constant concentration cells) contributing boron to the model domain. All monitoring wells with observations above the GWPS for boron (2 mg/L) are predicted to be below the GWPS 198 years after CIP implementation (model year 260 as illustrated in **Figure 6-7**). AW-19 takes the longest of these wells to be reduced below the GWPS, but like AW-20, this well is over-predicted in the calibration model. AW-21 and AP07S, which had the highest concentrations in the UA and UCF, respectively, and were among the wells with the best-fit model calibrations for boron concentration, were predicted to decline below the GWPS at 121 (model year 183) and 32 years (model year 94) after CIP implementation, as illustrated in **Figure 6-7**.

With the exception of wells AW-09 and AW-16, located along the southwestern side of the Ash Pond, all other modeled boron concentrations are predicted to decrease below the GWPS 382 years after CIP implementation (model year 444 as illustrated in **Figure 6-7**). The maximum extent of the plume above the standard GWPS for boron (2 mg/L) at this time is illustrated in **Figure 6-8,** where boron exceedances have retreated within the footprint of the former Ash Pond except along the southwestern edge of the pond. Along the southwestern edge of the pond, including wells AW-09 and AW-16, the model indicates concentrations will increase for a period of time following implementation of corrective measures before decreases are predicted.

The predicted increase and delayed reduction in concentration at wells AW-09 and AW-16 is a result of the wells being located along the flow path of the residual boron concentrations released into native geologic materials prior to closure. The prediction model indicates that as the plume recedes over time a south-southwest trending plume of historic boron concentrations above the standard GWPS for boron (2 mg/L) slowly moves along this flow path as physical attenuation takes place, eventually reducing concentrations at these wells to concentrations below the standard GWPS 767 years after implementation of closure (model year 829 as illustrated in **Figure 6-7**). The maximum extent of the plume at this time (model year 829) is illustrated in **Figure 6-9**. As illustrated in **Figure 6-8** and **Figure 6-9** the maximum extent of the plume at 382 (model year 444) and 767 (model year 829) years after CIP implementation remains in close proximity to the Ash Pond as the plume recedes and concentrations at monitoring wells AW-09 and AW-16 decrease (**Figure 6-7**).

Evaluations of post-construction water flux through the consolidated and covered Fill Unit (CCR) were completed using data obtained from the Scenario 1 (CIP) prediction model when simulated post-construction heads in the groundwater monitoring wells are predicted to stabilize (once heads stabilized in the model, the post-construction movement of water in and out of the Fill Unit [CCR] were compared to pre-construction conditions). The pre-construction (calibration model) and post-construction Scenario 1 (CIP) prediction model simulated water flux values are summarized in **Appendix F** and discussed below. Data export files used for flux evaluations are found along with model files in **Appendix C**.

Scenario 1 (CIP) was predicted to reduce total flux in and out of the Fill Unit (CCR) by approximately 97% and 94%, respectively, when simulated post-construction heads in the groundwater monitoring wells are predicted to stabilize (approximate hydraulic steady state) as illustrated in **Figure 6-10**. **Figure 6-11** is a plot showing the changes in flux reduction (shown as negative percentage) over time, starting from implementation of Scenario 1 (CIP) through approximate hydraulic steady state conditions. Following implementation of Scenario 1 (CIP), influx into the CCR unit increases for approximately 2 years as free liquids are no longer being actively removed from the CCR unit, then influx to the CCR unit decreases rapidly as illustrated in

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Figure 6-11. Concurrently, outflux from the CCR unit is briefly reduced by approximately 100% following removal of free liquids, after 30 days a reduction of outflux of at least 80% is maintained as heads approach hydraulic stabilization (**Figure 6-11**).

6.3.2 Closure Scenario 2 (CBR) Predicted Boron Concentrations

The design for Scenario 2: CBR includes an initial 1-year dewatering period followed by CCR removal from the Ash Pond (**Figure 4-1**).

Like CIP, predicted concentrations for CBR start to decline at all monitoring wells with observations above the standard GWPS for boron (2 mg/L) (AP07S, AW-05, AW-15S, AW-18, AW-19, AW-20, AW-21) once the closure actions are initiated within the prediction model. In CBR, these declines occur as the ash fill is removed from the Ash Pond and saturated ash cells (constant concentration cells) are removed. Following removal of ash fill, boron concentrations are no longer entering the model domain from recharge or from saturated ash cells (constant concentration cells); all source concentrations are removed. Dewatering through removal of free liquids also reduces the head within the Ash Pond. These low heads are maintained following completion of closure by the drain cells that simulate storm water management designs within the Ash Pond. As a result of the reduced heads, downward percolation of existing solute mass from the Ash Pond is reduced. All monitoring wells with observations above the standard GWPS for boron (2 mg/L) are predicted to be below the GWPS 104 years after closure implementation (model year 166 as illustrated in **Figure 6-12**). Similar to CIP, AW-19 takes the longest of these wells to be reduced below the GWPS. AW-21 and AP07S, which had the highest concentrations in the UA and UCF, respectively, and were among the wells with the best-fit model calibrations for boron concentration, were predicted to decline below the GWPS at 88 (model year 150) and 15 years (model year 77) after CBR implementation, as illustrated in **Figure 6-12**.

With the exception of wells AW-09 and AW-16, boron concentrations are predicted to decrease below the GWPS 201 years after CBR implementation (model year 263 as illustrated in **Figure 6-12**). The maximum extent of the plume at this time is illustrated in **Figure 6-13** where boron exceedances have retreated within the footprint of the former Ash Pond except along a limited portion of the southwestern edge of the pond. Like CIP, at wells AW-09 and AW-16 the model indicates concentrations will increase for a period of time following implementation of closure before decreases are predicted.

Also, like CIP, the predicted increase and delayed reduction in concentration at wells AW-09 and AW-16 is a result of the wells being located along the flow path of the residual boron concentrations released into native geologic materials prior to closure. The prediction model indicates that as the plume recedes over time a south-southwest trending plume of historic boron concentrations above the standard GWPS for boron (2 mg/L) slowly moves along this flow path as physical attenuation takes place, eventually reducing concentrations at these wells to concentrations below the GWPS 748 years after implementation of closure (model year 810 as illustrated in **Figure 6-12**). The maximum extent of the plume at this time is illustrated in **Figure 6-14**. As illustrated in **Figure 6-13** and **Figure 6-14**, the maximum extent of the plume at 201 (model year 263) and 748 (model year 810) years after CBR implementation, remains in close proximity to the Ash Pond as the plume recedes and concentrations at monitoring wells AW-09 and AW-16 decrease (**Figure 6-12**).

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7. CONCLUSIONS

This GMR has been prepared to evaluate how proposed CIP and CBR closure scenarios will achieve compliance with the applicable groundwater standards at the EPP. Data collected from sampling events between November 2015 and August 2021 was used to develop a groundwater model for the EPP Ash Pond and surrounding area. The MODFLOW and MT3DMS models were then used to evaluate CIP using information provided in the Final Closure Plan (IngenAE, 2022), and CBR closure scenarios:

- Scenario 1: CIP (CCR removal from the northwest areas of the Ash Pond, consolidation to the northeast, central and southern areas of the Ash Pond, and construction of a cover system over the remaining CCR)
- Scenario 2: CBR (CCR removal from the Ash Pond)

Scenario 1 (CIP) was predicted to reduce total flux in and out of the Fill Unit (CCR) by approximately 97% and 94%, respectively, when simulated post-construction heads in the groundwater monitoring wells are predicted to stabilize.

Differences exist in the timeframes to reach the GWPS for most monitoring wells between CIP and CBR. For instance, wells with observations above the standard GWPS for boron (2 mg/L) from November 2015 to August 2021 (AP07S, AW-05, AW-15S, AW-18, AW-19, AW-20, AW-21) are predicted to reach the GWPS in 198 years after CIP implementation, and 104 years after CBR implementation. Shorter timeframes were predicted to reach the GWPS for wells located on the northern edge of the Ash Pond where observed boron concentrations were the highest (AW-21 and AP07S). AW-21 and AP07S, which had the highest concentrations in the UA and UCF, respectively, were predicted to decline below the GWPS at 121 and 32 years, respectively, after CIP implementation, and at 88 and 15 years, respectively, after CBR implementation. However, as a result of the south-southwest trending plume of residual boron concentrations above the GWPS for boron (2 mg/L) released to native geologic materials prior to closure, which remains for a long period of time following implementation of both scenarios, all monitoring wells are not predicted to reach the GWPS until after 767 years and 748 years following implementation of CIP and CBR, respectively.

The observed timeframes to reach the GWPS for both the CIP and CBR prediction scenarios were on the order of hundreds of years from present; these predicted timeframes to meet the GWPS are less reliable than timeframes that are closer temporally to the data used for calibration (between 2015 and 2021). From a modeling perspective, the 19-year difference between CIP and CBR to reach the GWPS is negligible. In other words, both scenarios are predicted to reach the GWPS after approximately 750 years, and the simulated 19-year difference between these two scenarios is not significant. Further, the boron plumes for both CIP and CBR remain in close proximity to the Ash Pond while they recede, indicating they are equally protective.

Statistically significant correlations between boron concentrations and concentrations of sulfate and TDS identified as potential exceedances of the GWPS indicate boron is an acceptable surrogate for these parameters in the groundwater model. Concentrations of these parameters are expected to change along with model predicted boron concentrations.

Results of groundwater fate and transport modeling conservatively estimate that groundwater will attain the GWPS for all constituents identified as potential exceedances of the GWPS in approximately 750 years following closure implementation for both CIP and CBR. The long timeframes observed are a result of the generally low permeability materials adjacent to and

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underlying the Ash Pond, and generally low groundwater flow velocities observed within the water-bearing units of the site, which results in reduced transport and slow physical attenuation (dilution and dispersion). The predicted maximum extent of the plume above the standard GWPS for boron (2 mg/L) stays in close proximity to the ash pond as it recedes.

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TABLES

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TABLE 2-1. MONITORING WELL LOCATIONS AND CONSTRUCTION DETAILS
GROUNDWATER MODELING REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, ILLINOIS

Well Number	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)
AP05S	UA	11/29/2016	443.53	443.53	Top of PVC	441.13	32.87	37.64	408.26	403.49	38.06	403.10	4.8	2	40.598807	-89.66191
AP05D	BCU	12/05/2016	443.45	443.45	Top of PVC	441.23	47.09	56.69	394.14	384.54	57.17	382.90	9.6	2	40.598796	-89.661901
AP06	UCF	11/30/2016	442.17	442.17	Top of PVC	439.53	19.93	24.72	419.60	414.81	25.00	414.50	4.8	2	40.601038	-89.662759
AP07S	UCF	12/02/2016	461.08	461.08	Top of PVC	458.31	29.95	34.74	428.36	423.57	35.00	423.30	4.8	2	40.59793	-89.666919
AP07D	BCU	12/08/2016	460.89	460.89	Top of PVC	458.42	55.01	64.59	403.41	393.83	65.00	393.40	9.6	2	40.597941	-89.666926
AP08	CCR	12/06/2016	460.60	460.60	Top of PVC	458.10	9.99	19.58	448.11	438.52	19.98	438.10	9.6	2	40.594578	-89.668728
AP09	CCR	12/07/2016	460.22	460.22	Top of PVC	457.24	9.79	19.39	447.45	437.85	19.80	437.40	9.6	2	40.59149	-89.666303
APW-01	UCF	07/27/2010	441.07	441.07	Top of PVC	437.83	7.60	18.00	430.23	419.83	18.00	419.30	10.4	2	40.600127	-89.66512
APW-02	UCF	07/20/2010	464.92	464.92	Top of PVC	461.72	39.60	50.00	422.12	411.72	50.00	411.70	10.4	2	40.594228	-89.665642
APW-03	UCF	07/19/2010	444.37	444.37	Top of PVC	441.22	19.60	30.00	421.62	411.22	30.00	411.20	10.4	2	40.591259	-89.663843
APW-04	UCF	07/27/2010	439.66	439.66	Top of PVC	437.19	9.60	20.00	427.59	417.19	20.00	417.20	10.4	2	40.587909	-89.663726
AW-01	PMP	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
AW-05	UA	07/22/2015	--	443.37	Top of Disk	440.55	15.87	20.47	424.68	420.08	21.10	419.50	4.6	2	40.598645	-89.666407
AW-06	UA	08/03/2015	--	461.57	Top of Disk	459.19	36.60	41.09	422.59	418.10	41.69	416.90	4.5	2	40.594237	-89.670051
AW-08	UA	07/21/2015	--	462.54	Top of Disk	460.66	47.55	57.19	413.11	403.47	57.70	403.00	9.6	2	40.593964	-89.661996
AW-09	UA	08/03/2015	--	461.45	Top of Disk	458.32	47.14	51.62	411.18	406.70	52.23	406.10	4.5	2	40.590422	-89.668777
AW-10	UA	07/23/2015	--	439.93	Top of Disk	437.64	27.62	32.23	410.02	405.41	32.74	404.90	4.6	2	40.590733	-89.663826
AW-11	UA	07/28/2015	--	439.87	Top of Disk	437.16	24.21	28.81	412.95	408.35	29.31	407.20	4.6	2	40.587261	-89.663781
AW-12	UA	01/07/2021	443.80	443.80	Top of PVC	441.16	26.00	31.00	415.16	410.16	31.00	406.20	5	2	40.591071	-89.661333
AW-13	UA	01/09/2021	441.26	441.26	Top of PVC	438.67	25.00	30.00	413.67	408.67	30.00	408.70	5	2	40.588378	-89.663714
AW-14	UA	01/08/2021	439.40	439.40	Top of PVC	436.83	24.00	29.00	412.83	407.83	29.00	401.80	5	2	40.58729	-89.665621
AW-15	UA	01/08/2021	441.51	441.51	Top of PVC	438.95	33.00	38.00	405.95	400.95	38.00	399.00	5	2	40.587964	-89.666822
AW-15C	BCU	01/08/2021	440.02	440.02	Top of PVC	437.62	43.00	48.00	394.62	389.62	48.00	337.60	5	2	40.588	-89.666882

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TABLE 2-1. MONITORING WELL LOCATIONS AND CONSTRUCTION DETAILS
GROUNDWATER MODELING REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, ILLINOIS

Well Number	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)
AW-15S	UCF	01/08/2021	440.71	440.71	Top of PVC	437.92	8.00	18.00	429.92	419.92	18.00	417.90	10	2	40.587955	-89.666841
AW-16	UA	01/08/2021	461.79	461.79	Top of PVC	459.45	55.00	60.00	404.45	399.45	60.00	396.50	5	2	40.589457	-89.667799
AW-17	UA	01/08/2021	462.10	462.10	Top of PVC	459.69	51.00	56.00	408.69	403.69	56.00	402.70	5	2	40.591698	-89.669404
AW-18	UA	01/09/2021	462.65	462.65	Top of PVC	460.28	46.00	51.00	414.28	409.28	51.00	405.30	5	2	40.593044	-89.669822
AW-19	UA	01/09/2021	460.74	460.74	Top of PVC	458.53	35.00	40.00	423.53	418.53	40.00	415.50	5	2	40.595434	-89.66972
AW-20	UA	01/10/2021	461.48	461.48	Top of PVC	459.08	36.50	41.50	422.58	417.58	41.50	416.10	5	2	40.596469	-89.66891
AW-21	UA	01/10/2021	460.61	460.61	Top of PVC	458.28	32.00	37.00	426.28	421.28	37.00	420.30	5	2	40.597294	-89.667734
AW-22	UA	01/08/2021	463.19	463.19	Top of PVC	460.30	44.00	49.00	416.30	411.30	49.00	410.30	5	2	40.596836	-89.666783
P002	UCF	--	460.39	460.39	Top of PVC	458.70	30.60	35.60	--	--	35.90	--	5	2	40.596235	-89.669084
XPW01A	CCR	01/09/2021	464.16	464.16	Top of PVC	460.99	33.00	43.00	427.99	417.99	43.00	418.00	10	2	40.596306	-89.667345
XPW02	CCR	01/09/2021	473.79	473.79	Top of PVC	471.16	36.00	46.00	435.16	425.16	46.00	424.20	10	2	40.594351	-89.668312
XPW03	CCR	01/10/2021	466.04	466.04	Top of PVC	462.62	27.00	37.00	435.62	425.62	37.00	422.60	10	2	40.591416	-89.666188
SG-01	SW	--	--	--	--	--	--	--	--	--	--	--	--	--	40.596075	-89.661625

Notes:
All elevation data are presented relative to the North American Vertical Datum 1988 (NAVD88), GEOID 12A
-- = data not available
BCU = bedrock confining unit
bgs = below ground surface
CCR = coal combustion residuals
ft = foot or feet
HSU = Hydrostratigraphic Unit
PMP = potential migration pathway
PVC = polyvinyl chloride
SW = surface water
UA = uppermost aquifer
UCF = Upper Cahokia Formation

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TABLE 2-2. FLOW AND TRANSPORT MODEL CALIBRATION TARGETS
GROUNDWATER MODELING REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, IL

Well ID	Monitored Hydrogeologic Unit	Modeled Well Location (Layer Number)	Modeled Target Location (Layer Number)	Flow Model Target Groundwater Elevation Mean Value November 2015 to August 2021 (feet NAVD88)	Transport Model Target Boron Concentrations November 2015 to August 2021 (mg/L)		
					Minimum	Mean	Maximum
G01D	UA	4	4	438.14	0.2	0.3	0.4
G02D	BCU	5	5	439.88 [1]	1.0	1.3	1.7
G03	UCF	3	3	437.72	No Target		
G04	UCF	2	2	436.45	5.8	7.9	12.0
G05	BCU	5	5	437.92 [1]	1.2	1.4	1.8
G06	CCR	1	1	452.28	3.0	7.5	12.0
G07	CCR	1	1	451.93	3.1	4.2	5.3
APW-01	UCF	3	3	435.62	0.7	0.7	0.8
APW-02	UCF	3	1	454.95 [2]	0.0	0.1	0.1
APW-03	UCF	3	3	436.52 [2]	0.1	0.1	0.2
APW-04	UCF	2	2	432.65	0.5	0.6	0.7
AW-05	UA	4	4	434.93	1.4	2.9	7.6
AW-06	UA	5	5	434.49	0.1	0.2	0.3
AW-08	UA	4	4	440.60 [2]	0.1	0.1	0.2
AW-09	UA	4	4	435.68	0.2	0.5	1.3
AW-10	UA	4	4	438.89	0.4	0.5	0.6
AW-11	UA	4	4	433.79	0.2	0.2	0.3
AW-12	UA	4	4	436.56	0.2	0.2	0.3
AW-13	UA	4	4	435.69	0.3	0.3	0.3
AW-14	UA	4	4	432.85 [3]	0.2	0.2	0.2
AW-15	UA	4	4	433.66	0.3	0.4	0.6
AW-15C	BCU	5	5	433.38	0.6	0.7	0.8
AW-15S	UCF	2	2	430.93	5.4	5.7	6.2
AW-16	UA	4	4	437.68	0.5	0.5	0.6
AW-17	UA	4	4	437.31	0.4	0.4	0.5
AW-18	UA	4	5	435.15	0.4	1.5	3.0
AW-19	UA	4	3	447.39	2.5	2.7	2.9
AW-20	UA	4	3	445.03	2.1	2.2	2.3
AW-21	UA	4	3	443.70	11.0	11.5	12.0
AW-22	UA	3	1	451.58	0.2	0.3	0.4

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TABLE 2-2. FLOW AND TRANSPORT MODEL CALIBRATION TARGETS

GROUNDWATER MODELING REPORT

EDWARDS POWER PLANT

ASH POND

BARTONVILLE, IL

Well ID	Monitored Hydrogeologic Unit	Modeled Well Location (Layer Number)	Modeled Target Location (Layer Number)	Flow Model Target Groundwater Elevation Mean Value November 2015 to August 2021 (feet NAVD88)	Transport Model Target Boron Concentrations November 2015 to August 2021 (mg/L)		
					Minimum	Mean	Maximum
P002	UCF	3	2	448.39	1.1	1.2	1.4
XPW01A	CCR	2	2	452.57	15	16.7	19
XPW02	CCR	2	2	453.29	13	14.5	16
XPW03	CCR	2	2	450.75	4.9	5.5	7

[O: EGP4/5/22, C: JJW 4/5/22; JRK 4/11/22]

Notes:

[1] Target groundwater elevations presented are from data collected between February 2020 and February 2021. Groundwater elevations collected prior to and after these dates were recovering between sampling events and do not represent static groundwater conditions in each well.

[2] Target groundwater elevations exclude February 11th, 2021 event due to groundwater elevations recovering between sampling events.

[3] Target groundwater elevations exclude June 15th, 2021 event due to gauging error.

ID = identification

mg/L = milligrams per liter

NAVD88 = North American Vertical Datum of 1988

Hydrogeologic Unit:

BCU = bedrock confining unit

CCR = coal combustion residuals

PMP = primary migration pathway

UA = uppermost aquifer

UCF = upper cahokia formation

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TABLE 5-1. FLOW MODEL INPUT AND SENSITIVITY ANALYSIS RESULTS
GROUNDWATER MODELING REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, ILLINOIS

Zone	Hydrostratigraphic Unit	Materials	ft/d	cm/s	Kh/Kv	Value Source	Sensitivity[1]
Horizontal Hydraulic Conductivity			**Calibration Model**			**Calibration Model**	
1	Upper Clay (UCF)	clay and silt	0.002	7.06E-07	NA	Calibrated	low
2	Transmissive Zone (UCF [PMP])	clay and silt at elevations similar to base of ash, thin discontinuous sand lenses	2	7.06E-04	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	high
3	Lower Clay (UCF)	clay and silt	0.011	3.88E-06	NA	Calibrated	moderate
4	Weathered Shale (UA)	weathered shale, sand, silty sand, clayey gravel, bedrock contact with overlying materials	3	1.06E-03	NA	Calibrated - Within Range of Field Test Results (Ramboll, 2021a)	high
5	Competent Shale (BCU)	shale	0.01	3.53E-06	NA	Geomean of Field Test Results (Ramboll, 2021a)	moderate
6	Fill Unit (CCR)	CCR	0.1	3.53E-05	NA	Calibrated	high
7	UCF above River Boundary Conditions	NA	200	7.06E-02	NA	Calibrated - Conductivity Value to Allow Groundwater Flow from UCF to River Boundary Conditions	moderate
9	Sankoty Aquifer - Sands	sand	42	1.48E-02	NA	Calibrated	high
Vertical Hydraulic Conductivity			**Calibration Model**			**Calibration Model**	
1	Upper Clay (UCF)	clay and silt	0.0002	7.06E-08	10	Geomean of Laboratory Test Results (Ramboll, 2021a)	high
2	Transmissive Zone (UCF [PMP])	clay and silt at elevations similar to base of ash, thin discontinuous sand lenses	0.2	7.06E-05	10	Calibrated	low
3	Lower Clay (UCF)	clay and silt	0.00011	3.88E-08	100	Geomean of Laboratory Test Results (Ramboll, 2021a; Haley & Aldrich, Inc., 2018)	high
4	Weathered Shale (UA)	weathered shale, sand, silty sand, clayey gravel, bedrock contact with overlying materials	0.3	1.06E-04	10	Calibrated	negligible
5	Competent Shale (BCU)	shale	0.0001	3.53E-08	100	Calibrated	moderate
6	Fill Unit (CCR)	CCR	0.006	2.12E-06	17	Calibrated - Within Range Laboratory Test Results (Ramboll, 2021a)	moderate
7	UCF above River Boundary Conditions	NA	200	7.06E-02	1	Calibrated - Conductivity Value to Allow Groundwater Flow from UCF to River Boundary Conditions	negligible
9	Sankoty Aquifer - Sands	sand	42	1.48E-02	1	Calibrated	negligible
Zone	**Hydrostratigraphic Unit**	**Materials**	**ft/d**	**in/yr**	**Kh/Kv**	**Value Source**	**Sensitivity[1]**
Recharge			**Calibration Model**			**Calibration Model**	
1	Upper Clay (UCF)	clay and silt	1.00E-05	0.044	NA	Calibrated	high
2	Fill Unit - CCR (Central, Fly Ash Pond)	CCR	2.20E-04	0.96	NA	Calibrated	high
3	Fill Unit - CCR (South of Railroad, Inactive Area)	CCR	1.00E-05	0.044	NA	Calibrated	negligible
4	Fill Unit - CCR (Northwest, Process Water Pond)	CCR	1.50E-04	0.66	NA	Calibrated	moderately high
5	Fill Unit - CCR (South, Clarification Pond)	CCR	5.00E-05	0.22	NA	Calibrated	moderate
7	Fill Unit - CCR (Northeast, Sluice Area)	CCR	9.00E-04	3.94	NA	Calibrated	high
Storage							
1	Upper Clay (UCF)	clay and silt	*Not used in steady-state calibration model*				
2	Transmissive Zone (UCF [PMP])	clay and silt at elevations similar to base of ash, thin discontinuous sand lenses					
3	Lower Clay (UCF)	clay and silt					
4	Weathered Shale (UA)	weathered shale, sand, silty sand, clayey gravel, bedrock contact with overlying materials					
5	Competent Shale (BCU)	shale					
6	Fill Unit (CCR)	CCR					
7	Sankoty Aquifer - Sands	sand					
8	UCF above River Boundary Conditions	NA					

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TABLE 5-1. FLOW MODEL INPUT AND SENSITIVITY ANALYSIS RESULTS
GROUNDWATER MODELING REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, ILLINOIS

River Parameters

	Relative Location	River Width (feet)	Average Length of River (feet)	Bed Thickness (feet)	Hydraulic Conductivity (ft/d)	Stage (feet)	Average River Conductance (ft^2/d)
Reach 1	Illinois River	750	24.5	1	1	438.44 - 438.24	1.84E+04
Sensitivity[1]	NA	- - -	- - -	- - -	- - -	moderate	negligible
Reach 2	Drainage Ditch West of Ash Pond	20	25	1	0.00001	432	5.00E-03
Sensitivity[1]	NA	- - -	- - -	- - -	- - -	low	moderate
Reach 3	Drainage Swale North of Ash Pond	25	25	1	0.00001	430.07	6.25E-03
Sensitivity[1]	NA	- - -	- - -	- - -	- - -	negligible	low
Reach 4	Drainage Pond Northeast of Ash Pond	25	25	1	0.00001	433.24	6.25E-03
Sensitivity[1]	NA	- - -	- - -	- - -	- - -	low	low
Value Source	NA	Calibrated	Calibrated	Calibrated	Calibrated	Calibrated - Mean Illinois River Stage at Edwards Power Plant Interpolated from Stage Data Provided at Peoria, Illinois (USCE 404208089335201), Edwards Power Plant (Plant Gaging Station), and Kingston, Illinois (USGS 05568500) Gaging Stations; Drainage Feature Stage (Reach 2 - 4) Based on Survey Data Collected by IngenAE in February 2022	Calibrated

General Head Parameters

	Relative Location	Width of General Head Boundary Cell (feet)	Distance to General Head Boundary Head (feet)	Average Saturated Thickness of Cell (feet)	Hydraulic Conductivity (ft/d)	Head (feet)	Average General Head Boundary Conductance (ft^2/d)
Reach 1	North Edge of Model (Peoria Pumping Center) and Southeast Edge of Model (Pekin Pumping Center)	150 (North Edge of Model); 750 (Southeast Edge of Model)	1	100 (North Edge of Model); 39 (Southeast Edge of Model)	100	426	1.50E+06 (North Edge of Model); 2.92E+06 (Southeast Edge of Model)
Sensitivity[1]	NA	- - -	- - -	- - -	- - -	high	negligible
Value Source	NA	Calibrated	Calibrated	Calibrated	Calibrated	Calibrated - Location of General Head Boundaries Based on Data Availabile in Burch and Kelly (1993)	Calibrated

[O: JJW 4/14/22; C: JRK 4/14/22]

Notes:

[1] Sensitivity Explanation:
Negligible - SSR changed by less than 1%
Low - SSR change between 1% and 10%
Moderate - SSR change between 10% and 50%
Moderately High - SSR change between 50% and 100%
High - SSR change greater than 100%
SSR = sum of squared residuals
- - - = not tested
CCR = coal combustion residuals
cm/s = centimeters per second
ft/d = feet per day
ft^2/day = feet squared per day
in/yr = inches per year
Kh/Kv = anisotropy ratio
NA = not applicable

Hydrogeologic Unit:
BCU = bedrock confining unit
CCR = coal combustion residuals
PMP = primary migration pathway
UA = uppermost aquifer
UCF = upper cahokia formation

References:

Burch, S. L. and D. J. Kelly., 1993. Peoria-Pekin Regional Ground-Water Quality Assessment. Illinois State Water Survey (ISWS), Champaign, Research Report 124.
Haley & Aldrich, Inc., 2018. Technical Memorandum: Ash Pond – Underlying Clay and Depth of CCR Evaluation, Edwards Station, Bartonville, Illinois, February 12, 2018.
Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2021a. Hydrogeologic Site Characterization Report. Edwards Ash Pond. Edwards Power Plant. Bartonville, Illinois.

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TABLE 5-2. TRANSPORT MODEL INPUT VALUES (CALIBRATION)
GROUNDWATER MODELING REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, ILLINOIS

Zone	Hydrostratigraphic Unit	Materials	Calibration Model						
			Stress Period 1 Dates: 1960-2004 Recharge (ft/d)	Stress Period 2 Dates: 2005-2022 Recharge (ft/d)	Boron Concentration (mg/L)			Value Source	Sensitivity
Initial Concentration									
Entire Domain	NA	NA	NA	NA	0			NA	- - -
Source Concentration (recharge)									
2	Fill Unit - CCR (Central, Fly Ash Pond)	CCR	2.20E-04	2.20E-04	3			calibrated	- - -
3	Fill Unit - CCR (South of Railroad, Inactive Area)	CCR	5.00E-05	1.00E-05	3			calibrated	- - -
4	Fill Unit - CCR (Northwest, Process Water Pond)	CCR	1.50E-04	1.50E-04	13			calibrated	- - -
5	Fill Unit - CCR (South, Clarification Pond)	CCR	5.00E-05	5.00E-05	3			calibrated	- - -
7	Fill Unit - CCR (Northeast, Sluice Area)	CCR	9.00E-04	9.00E-04	0.5			calibrated	- - -
Source Concentration (constant concentration cells)									
Reach 2	Fill Unit - CCR (Central, Fly Ash Pond)	CCR	NA	NA	3			calibrated	- - -
Reach 3	Fill Unit - CCR (South of Railroad, Inactive Area)	CCR	NA	NA	3			calibrated	- - -
Reach 4	Fill Unit - CCR (Northwest, Process Water Pond)	CCR	NA	NA	13			calibrated	- - -
Reach 5	Fill Unit - CCR (South, Clarification Pond)	CCR	NA	NA	3			calibrated	- - -
Reach 7	Fill Unit - CCR (Northeast, Sluice Area)	CCR	NA	NA	0.5			calibrated	- - -
Storage, Specific Yield and Effective Porosity									
Zone	**Hydrostratigraphic Unit**	**Materials**	NA	NA	**Storage**	**Specific Yield**	**Effective Porosity**	**Value Source**	**Sensitivity**
1	Upper Clay (UCF)	clay and silt	NA	NA	0.003	0.135	0.135	Storage Estimated from Literature (Fetter, 1988); Specific Yield Set Equal to Effective Porosity; Effective Porosity Esitmated from Literature (Morris and Johnson, 1967; Heath, 1983)	see Table 5-3
2	Transmissive Zone (UCF [PMP])	clay and silt at elevations similar to base of ash, thin discontinuous sand lenses	NA	NA	0.003	0.183	0.183	Storage Estimated from Literature (Fetter, 1988); Specific Yield Set Equal to Effective Porosity; Effective Porosity Esitmated from Literature (Morris and Johnson, 1967; Heath, 1983)	see Table 5-3
3	Lower Clay (UCF)	clay and silt	NA	NA	0.003	0.07	0.07	Storage Estimated from Literature (Fetter, 1988); Specific Yield Set Equal to Effective Porosity; Effective Porosity Esitmated from Literature (Morris and Johnson, 1967; Heath, 1983)	see Table 5-3
4	Weathered Shale (UA)	weathered shale, sand, silty sand, clayey gravel, bedrock contact with overlying materials	NA	NA	0.003	0.204	0.204	Storage Estimated from Literature (Fetter, 1988); Specific Yield Set Equal to Effective Porosity; Effective Porosity Esitmated from Literature (Morris and Johnson, 1967; Heath, 1983)	see Table 5-3
5	Competent Shale (BCU)	shale	NA	NA	0.003	0.1	0.1	Storage Estimated from Literature (Fetter, 1988); Specific Yield Set Equal to Effective Porosity; Effective Porosity Esitmated from Literature (Morris and Johnson, 1967; Heath, 1983)	see Table 5-3
6	Fill Unit (CCR)	CCR	NA	NA	0.003	0.2	0.2	Storage Estimated from Literature (Fetter, 1988); Specific Yield Set Equal to Effective Porosity; Effective Porosity Esitmated from Literature (Morris and Johnson, 1967; Heath, 1983)	see Table 5-3
7	Sankoty Aquifer - Sands	sand	NA	NA	0.003	0.274	0.274	Storage Estimated from Literature (Fetter, 1988); Specific Yield Set Equal to Effective Porosity; Effective Porosity Esitmated from Literature (Morris and Johnson, 1967; Heath, 1983)	see Table 5-3
8	UCF above River Boundary Conditions	NA	NA	NA	0.003	0.5	0.5	Storage Estimated from Literature (Fetter, 1988); Specific Yield Set Equal to Effective Porosity; Effective Porosity Esitmated from Literature (Morris and Johnson, 1967; Heath, 1983)	see Table 5-3
Dispersivity									
Applicable Region	**Hydrostratigraphic Unit**	**Materials**	NA	NA	**Longitudinal (feet)**	**Transverse (feet)**	**Vertical (feet)**	**Value Source**	**Sensitivity**
Entire Domain	NA	NA	NA	NA	3	0.3	0.03	calibrated	- - -

[O: JJW 4/11/22; EGP 4/11/22]

Notes:
[1] The concentrations from the end of the calibrated transport model were imported as initial concentrations for the prediction model runs.
- - - = not tested
ft/d = feet per day
mg/L = milligrams per liter
NA = not applicable

Hydrogeologic Unit:
BCU = bedrock confining unit
CCR = coal combustion residuals
PMP = primary migration pathway
UA = uppermost aquifer
UCF = upper cahokia formation

References:
Fetter, C.W., 1988, Applied Hydrogeology, Merrill Publishing Company, Columbis, Ohio.
Morris, D.A and A.I. Johnson, 1967. Summary of hydrologic and physical properties of rock and soil materials as analyzed by the Hydrologic Laboratory of the U.S. Geological Survey. U.S. Geological Survey Water-Supply Paper 1839-D, 42p.
Heath, R.C., 1983. Basic ground-water hydrology, U.S. Geological Survey Water-Supply Paper 2220, 86p.

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TABLE 5-3. TRANSPORT MODEL INPUT VALUES (SENSITIVITY)
GROUNDWATER MODELING REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, ILLINOIS

Well ID	Calibration Concentration (mg/L)	Storage and Specific Yield				Effective Porosity			
		File Name		File Name		File Name		File Name	
		EDW_Conc_339_s_sy_low.gwv		EDW_Conc_339_s_sy_high.gwv		EDW_Conc_339_Por_low.gwv		EDW_Conc_339_Por_high.gwv	
		Concentration (mg/L)	Sensitivity [1]	Concentration (mg/L)	Sensitivity [1]	Concentration (mg/L)	Sensitivity [1]	Concentration (mg/L)	Sensitivity [1]
AP05S	0.0	0.0	moderate	0.0	moderate	0.0	high	0.0	moderately high
AP05D	0.0	0.0	moderately high	0.0	moderately high	0.0	high	0.0	moderately high
AP07S	11.6	11.5	negligible	11.5	negligible	11.8	low	11.3	low
AP07D	0.0	0.0	low	0.0	low	0.1	high	0.0	moderately high
AP08	3.0	3.0	negligible	3.0	negligible	3.0	negligible	3.0	negligible
AP09	3.0	3.0	negligible	3.0	negligible	3.0	negligible	3.0	negligible
APW-01	0.0	0.0	moderate	0.0	moderate	0.4	high	0.0	moderately high
APW-02	0.8	0.8	low	0.8	low	1.4	moderately high	0.5	moderate
APW-03	1.3	1.3	low	1.3	low	2.1	moderately high	0.9	moderate
APW-04	0.1	0.1	low	0.1	moderate	0.3	high	0.0	moderately high
AW-05	2.3	2.4	low	2.3	low	7.5	high	0.6	moderately high
AW-06	0.0	0.0	low	0.0	low	0.0	high	0.0	moderately high
AW-08	0.0	0.0	low	0.0	low	0.0	high	0.0	moderately high
AW-09	1.3	1.3	negligible	1.3	negligible	2.3	moderately high	0.7	moderate
AW-10	1.1	1.1	negligible	1.1	negligible	1.9	moderately high	0.7	moderate
AW-11	1.6	1.6	negligible	1.6	negligible	2.0	moderate	1.3	moderate
AW-12	0.0	0.0	moderate	0.0	moderate	0.1	high	0.0	moderately high
AW-13	1.6	1.6	low	1.6	low	2.1	moderate	1.3	moderate
AW-14	1.9	1.9	negligible	1.9	low	2.3	moderate	1.7	moderate
AW-15	1.5	1.5	low	1.6	low	2.1	moderate	1.2	moderate
AW-15C	0.0	0.0	negligible	0.0	low	0.0	high	0.0	moderately high
AW-15S	2.4	2.4	negligible	2.5	negligible	2.6	low	2.2	low
AW-16	1.2	1.2	negligible	1.2	negligible	2.0	moderately high	0.7	moderate
AW-17	2.2	2.2	negligible	2.2	negligible	2.9	moderate	1.6	moderate
AW-18	2.8	2.8	negligible	2.8	negligible	3.3	moderate	2.3	moderate
AW-19	7.3	7.3	negligible	7.3	negligible	9.5	moderate	5.4	moderate
AW-20	5.3	5.5	low	5.5	low	9.4	moderately high	3.2	moderate
AW-21	11.4	11.4	negligible	11.4	negligible	12.4	low	10.2	moderate
AW-22	3.3	3.3	negligible	3.3	negligible	3.6	moderate	2.5	moderate
P002	11.4	11.4	negligible	11.4	negligible	12.3	low	10.4	low
XPW01A	13.0	13.0	negligible	13.0	negligible	13.0	negligible	13.0	negligible
XPW02	3.0	3.0	negligible	3.0	negligible	3.0	negligible	3.0	negligible
XPW03	3.0	3.0	negligible	3.0	negligible	3.0	negligible	3.0	negligible
		S*0.1 Sy*0.5		S*10 Sy*2[2]		Porosity-0.05		Porosity+0.05	

[O: JJW 4/14/22; C: JRK 4/14/22]

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TABLE 5-3. TRANSPORT MODEL INPUT VALUES (SENSITIVITY)
GROUNDWATER MODELING REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, ILLINOIS

Notes:
[1] Sensitivity Explanation:
Negligible = concentration changed by less than 1%
Low = concentration change between 1% and 10%
Moderate = concentration change between 10% and 50%
Moderately High = concentration change between 50% and 100%
High = concentration change greater than 100%
[2] High specific yield sensitivity not analyzed for zone 8 (UCF above River Boundary Conditions) since the calibration value was already near upper limits of acceptable values for specific yield
ID = identification
mg/L = milligrams per liter
S = storativity
Sy = specific yield

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TABLE 6-1. HELP MODEL INPUT AND OUTPUT VALUES
GROUNDWATER MODELING REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, ILLINOIS

Closure Scenario - Area Description	CBR - Removal Area	CIP - Removal Area	CIP - Consolidation and Cover System Area	Notes
Input Parameter				
Climate-General				
City	Bartonville, IL	Bartonville, IL	Bartonville, IL	Nearby city to the Site within HELP database
Latitude	40.60	40.60	40.60	Site latitude
Evaporative Zone Depth	18	18	18	Estimated based on geographic location (Illinois) and uppermost soil type (Tolaymat, T. and Krause, M, 2020)
Maximum Leaf Area Index	4.5	4.5	4.5	Maximum for geographic location (Illinois) (Tolaymat, T. and Krause, M, 2020)
Growing Season Period, Average Wind Speed, and Quarterly Relative Humidity	Peoria, IL	Peoria, IL	Peoria, IL	Nearby city to the Edwards Ash Pond within HELP database
Number of Years for Synthetic Data Generation	30	30	30	
Temperature, Evapotranspiration, and Precipitation	Precipitation, temperature, and solar radiation was simulated based on HELP V4 weather simulation for: Lat/Long: 40.60/-89.66	Precipitation, temperature, and solar radiation was simulated based on HELP V4 weather simulation for: Lat/Long: 40.60/-89.66	Precipitation, temperature, and solar radiation was simulated based on HELP V4 weather simulation for: Lat/Long: 40.60/-89.66	
Soils-General				
% where runoff possible	100	100	100	
Area (acres)	91	22	69	CBR - Removal Area based on HCR (Ramboll, 2021a); CIP - Consolidation and Cover System Area based on construction drawing for Edwards Ash Pond; CIP -Removal Area equals the difference
Specify Initial Moisture Content	No	No	No	
Surface Water/Snow	Model Calculated	Model Calculated	Model Calculated	
Soils-Layers				
1	Unsaturated Backfill Material (HELP Final Cover Soil [topmost layer])	Unsaturated Backfill Material (HELP Final Cover Soil [topmost layer])	Vegetative Soil Layer (HELP Final Cover Soil [topmost layer])	Layers details for CBR and CIP areas based on grading plans, construction drawings, and cover system design for Edwards Ash Pond
2	--	--	Protective Soil Layer (HELP Vertical Percolation Layer)	
3	--	--	Geocomposite Drainage Layer (HELP Geosynthetic Drainage Net)	
4	--	--	Geomembrane Liner	
5	--	--	Unsaturated CCR Material (HELP Waste)	
Soil Parameters--Layer 1, Unsaturated Backfill Material (HELP Final Cover Soil [topmost layer]) or Vegetative Soil Layer (HELP Final Cover Soil [topmost layer])				
Type	1	1	1	Vertical Percolation Layer (Cover Soil)
Thickness (in)	12	72	6	For CBR and CIP removal areas, layer 1 thickness is the average thickness of unsaturated backfill material placed after removal
Texture	12	12	23	defaults used
Description	Silty Clay Loam	Silty Clay Loam	Silty Loam (Moderate)	
Saturated Hydraulic Conductivity (cm/s)	4.20E-05	4.20E-05	9.00E-06	defaults used
Soil Parameters--Layer 2, Protective Soil Layer (HELP Vertical Percolation Layer)				
Type	--	--	1	Vertical Percolation Layer
Thickness (in)	--	--	18	design thickness
Texture	--	--	10	defaults used
Description	--	--	Sandy Clay Loam	
Saturated Hydraulic Conductivity (cm/s)	--	--	1.20E -4	defaults used

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TABLE 6-1. HELP MODEL INPUT AND OUTPUT VALUES
GROUNDWATER MODELING REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, ILLINOIS

Closure Scenario - Area Description	CBR - Removal Area	CIP - Removal Area	CIP - Consolidation and Cover System Area	Notes
Soil Parameters--Layer 3, Geocomposite Drainage Layer(HELP Geosynthetic Drainage Net)				
Type	--	--	2	Lateral Drainage Layer
Thickness (in)	--	--	0.2	design thickness
Texture	--	--	20	defaults used
Description	--	--	Geosynthetic Drainage Net	
Saturated Hydraulic Conductivity (cm/s)	--	--	1.00E+01	defaults used
Soil Parameters--Layer 4, Geomembrane Liner				
Type	--	--	4	Flexible Membrane Liner
Thickness (in)	--	--	0.04	design thickness
Texture	--	--	36	defaults used
Description	--	--	Geomembrane	
Saturated Hydraulic Conductivity (cm/s)			4.00E -13	defaults used
Soil Parameters--Layer 5, Unsaturated CCR Material (HELP Waste)				
Type	--	--	1	Vertical Percolation Layer (Waste)
Thickness (in)	--	--	408	Estimated unsaturated CCR thickness within CIP Consolidation and Cover System Area
Texture	--	--	30	Custom layer, adjusted for site specific hydraulic conductivity
Description	--	--	High-Density Electric Plant Coal Fly Ash	
Saturated Hydraulic Conductivity (cm/s)	--	--	2.08E-06	calibrated flow model vertical hydraulic conductivity for CCR
Soils--Runoff				
Runoff Curve Number	86.1	86.1	89.3	HELP-computed curve number
Slope	0.25%	0.25%	1.27%	Estimated average from construction design drawings for Edwards Ash Pond
Length (ft)	1300	1300	1190	estimated maximum flow path
Texture	12	12	23	uppermost layer texture
Vegetation	fair	fair	fair	fair indicating fair stand of grass on surface of soil backfill
Execution Parameters				
Years	30	30	30	
Report Daily	No	No	No	
Report Monthly	No	No	No	
Report Annual	Yes	Yes	Yes	
Output Parameter				
Percolation Rate (in/yr)	**5.09**	**4.03**	**0.0002**	

O: EGP 4/5/2022 C: JJW 4/5/2022

Notes:
% = percent
cm/s = centimeters per second
ft = feet
HELP = Hydrologic Evaluation of Landfill Performance
IL = Illinois
in = inches
in/yr = inches per year
Lat = latitude
Long = longitude
CBR = Closure By Removal
CIP = Closure In Place
HCR = Hydrogeologic Characterization Report

References:
Tolaymat, T. and Krause, M, 2020. *Hydrologic Evaluation of Landfill Performance: HELP 4.0 User Manual*. United States Environmental Protection Agency, Washington, DC, EPA/600/B 20/219.
Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2021a. Hydrogeologic Site Characterization Report. Edwards Ash Pond. Edwards Power Plant. Bartonville, Illinois.

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TABLE 6-2. PREDICTION MODEL INPUT VALUES
GROUNDWATER MODELING REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, ILLINOIS

Scenario 1: CIP (CCR removal from the northwest areas of the Ash Pond, consolidation to the northeast, central and southern areas of the Ash Pond, and construction of a cover system over the remaining CCR)

Prediction Model	Construction Period (years)	Hydrostratigraphic Unit	Recharge Zone	Boron Recharge Concentration (mg/L)	Recharge (ft/day)	Recharge (in/yr)	Constant Head (feet)	Constant Concentration (mg/L)
Dewatering	1	Fill Unit - CCR Consolidation and Cover System (Central, Fly Ash Pond)	2	3	4.44E-08	0.0002	434	3
Dewatering	1	Fill Unit - CCR Consolidation and Cover System (South of Railroad, Inactive Area)	3	3	4.44E-08	0.0002	434	3
Dewatering	1	Fill Unit - CCR Consolidation and Cover System (Northwest, Process Water Pond)	4	13	4.44E-08	0.0002	434	13
Dewatering	1	Fill Unit - CCR Consolidation and Cover System (South, Clarification Pond)	5	3	4.44E-08	0.0002	434	3
Dewatering	1	Fill Unit - CCR Consolidation and Cover System (Northeast, Sluice Area)	7	0.5	4.44E-08	0.0002	434	0.5
Dewatering	1	Fill Unit - CCR Removal (Northwest, Process Water Pond and Fly Ash Pond)	10	0	9.19E-04	4.03	434	0
CIP	1000	Fill Unit - CCR Consolidation and Cover System (Central, Fly Ash Pond)	2	3	4.44E-08	0.0002	--	3
CIP	1000	Fill Unit - CCR Consolidation and Cover System (South of Railroad, Inactive Area)	3	3	4.44E-08	0.0002	--	3
CIP	1000	Fill Unit - CCR Consolidation and Cover System (Northwest, Process Water Pond)	4	13	4.44E-08	0.0002	--	13
CIP	1000	Fill Unit - CCR Consolidation and Cover System (South, Clarification Pond)	5	3	4.44E-08	0.0002	--	3
CIP	1000	Fill Unit - CCR Consolidation and Cover System (Northeast, Sluice Area)	7	0.5	4.44E-08	0.0002	--	0.5
CIP	1000	Fill Unit - CCR Removal (Northwest, Process Water Pond and Fly Ash Pond)	10	0	9.19E-04	4.03	--	--

Prediction Model	Construction Period (years)	Hydrostratigraphic Unit	Hydraulic Conductivity Zone	Horizontal Hydraulic Conductivity (ft/d)	Horizontal Hydraulic Conductivity (cm/s)	Vertical Hydraulic Conductivity (ft/d)		Vertical Hydraulic Conductivity (cm/s)
Dewatering	1	Fill Unit (CCR)	6	0.1	3.53E-05	0.006		2.12E-06
Dewatering	1	Fill Unit (Soil Backfill)	10	1.19	4.20E-04	0.119		4.20E-05
CIP	1000	Fill Unit (CCR)	6	0.1	3.53E-05	0.006		2.12E-06
CIP	1000	Fill Unit (Soil Backfill)	10	1.19	4.20E-04	0.119		4.20E-05

Prediction Model	Construction Period (years)	Hydrostratigraphic Unit	Storage, Specific Yield and Effective Porosity Zone	Storage	Specific Yield		Effective Porosity
Dewatering	1	Fill Unit (CCR)	6	0.003	0.2		0.2
Dewatering	1	Fill Unit (Soil Backfill)	10	0.003	0.16		0.16
CIP	1000	Fill Unit (CCR)	6	0.003	0.2		0.2
CIP	1000	Fill Unit (Soil Backfill)	10	0.003	0.16		0.16

Prediction Model	Construction Period (years)	Drain Width (feet)	Length of Drain Cell (feet)	Drain Bed Thickness (feet)	Hydraulic Conductivity (ft/d)	Stage of Drain (feet)		Drain Conductance (ft^2/d)
Dewatering	1	Fill Unit (Soil Backfill)	--	--	--	--		--
CIP	1000	Fill Unit (Soil Backfill)	25	1	50	433		3.13E+04

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TABLE 6-2. PREDICTION MODEL INPUT VALUES
GROUNDWATER MODELING REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, ILLINOIS

Scenario 2: CBR (CCR removal from the Ash Pond)

Prediction Model	Construction Period (years)	Hydrostratigraphic Unit	Recharge Zone	Boron Recharge Concentration (mg/L)	Recharge (ft/day)	Recharge (in/yr)	Constant Head (feet)	Constant Concentration (mg/L)
Dewatering	1	Fill Unit - CCR Removal (Central, Fly Ash Pond)	2	0	1.16E-03	5.08	434	0
Dewatering	1	Fill Unit - CCR Removal (South of Railroad, Inactive Area)	3	0	1.16E-03	5.08	434	0
Dewatering	1	Fill Unit - CCR Removal (Northwest, Process Water Pond)	4	0	1.16E-03	5.08	434	0
Dewatering	1	Fill Unit - CCR Removal (South, Clarification Pond)	5	0	1.16E-03	5.08	434	0
Dewatering	1	Fill Unit - CCR Removal (Northeast, Sluice Area)	7	0	1.16E-03	5.08	434	0
CBR	1000	Fill Unit - CCR Removal (Central, Fly Ash Pond)	2	0	1.16E-03	5.08	--	--
CBR	1000	Fill Unit - CCR Removal (South of Railroad, Inactive Area)	3	0	1.16E-03	5.08	--	--
CBR	1000	Fill Unit - CCR Removal (Northwest, Process Water Pond)	4	0	1.16E-03	5.08	--	--
CBR	1000	Fill Unit - CCR Removal (South, Clarification Pond)	5	0	1.16E-03	5.08	--	--
CBR	1000	Fill Unit - CCR Removal (Northeast, Sluice Area)	7	0	1.16E-03	5.08	--	--

Prediction Model	Construction Period (years)	Hydrostratigraphic Unit	Hydraulic Conductivity Zone	Horizontal Hydraulic Conductivity (ft/d)	Horizontal Hydraulic Conductivity (cm/s)	Vertical Hydraulic Conductivity (ft/d)		Vertical Hydraulic Conductivity (cm/s)
Dewatering	1	Fill Unit (CCR)	--	--	--	--		--
Dewatering	1	Fill Unit (Soil Backfill)	6	1.19	4.20E-04	0.119		4.20E-05
CBR	1000	Fill Unit (CCR)	--	--	--	--		--
CBR	1000	Fill Unit (Soil Backfill)	6	1.19	4.20E-04	0.119		4.20E-05

Prediction Model	Construction Period (years)	Hydrostratigraphic Unit	Storage, Specific Yield and Effective Porosity Zone	Storage	Specific Yield		Effective Porosity
Dewatering	1	Fill Unit (CCR)	--	--	--		--
Dewatering	1	Fill Unit (Soil Backfill)	6	0.003	0.16		0.16
CBR	1000	Fill Unit (CCR)	--	--	--		--
CBR	1000	Fill Unit (Soil Backfill)	6	0.003	0.16		0.16

Prediction Model	Construction Period (years)	Drain Width (feet)	Length of Drain Cell (feet)	Drain Bed Thickness (feet)	Hydraulic Conductivity (ft/d)	Stage of Drain (feet)		Drain Conductance (ft^2/d)
Dewatering	1	Fill Unit (Soil Backfill)	--	--	--	--		--
CBR	1000	Fill Unit (Soil Backfill)	25	1	50	433		3.13E+04

[O: JJW 4/11/22; C: EGP 4/12/22]

Notes:
-- = boundary condition or property zone not included in prediction model
CBR = Closure By Removal
CCR = coal combustion residuals
CIP = Closure In Place
ft^2/day = feet squared per day
ft/day = feet per day
in/yr = inches per year
mg/L = milligrams per liter
cm/s = centimeters per second

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FIGURES

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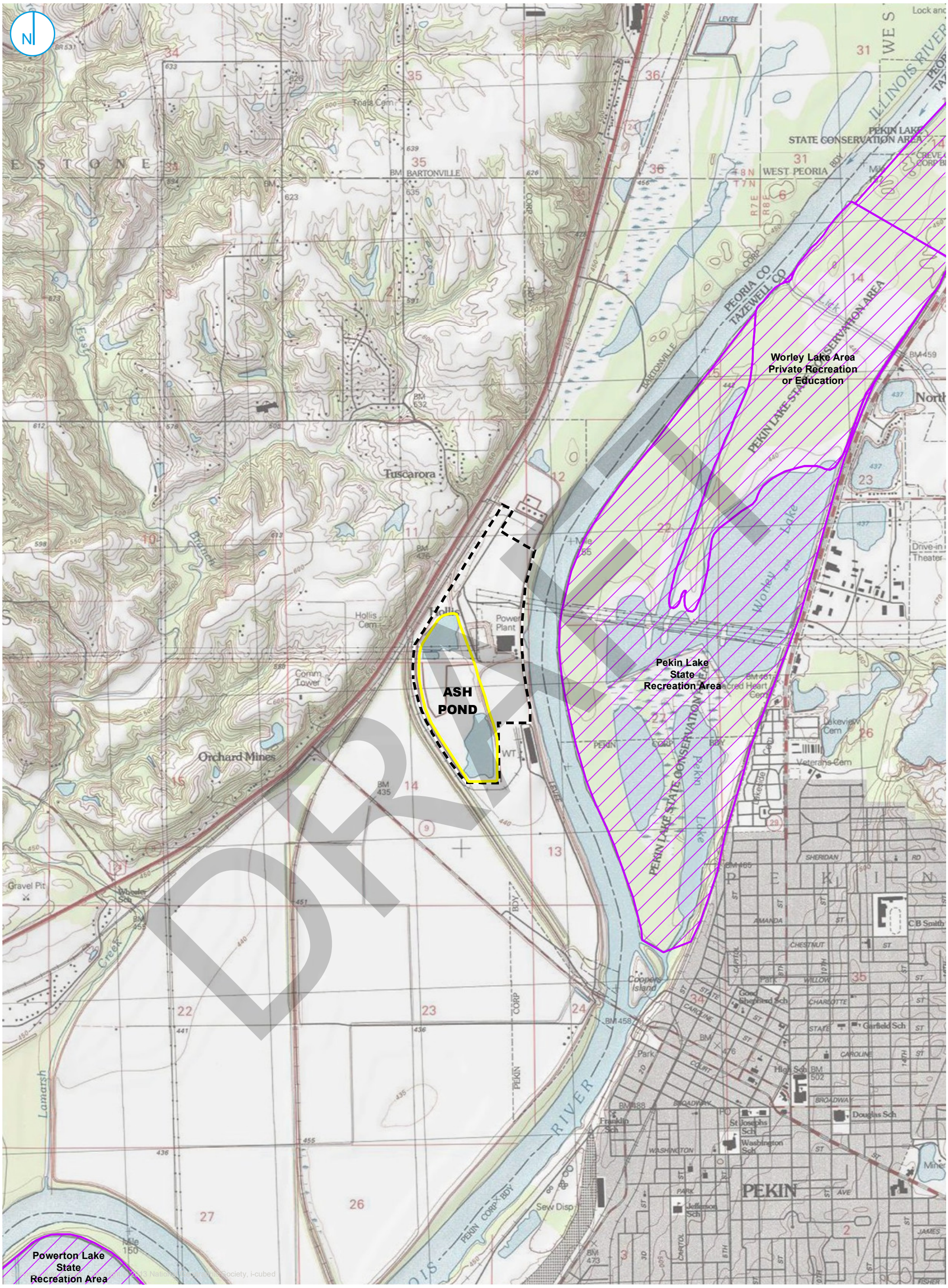

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PART 845 REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY
PROTECTED AREA

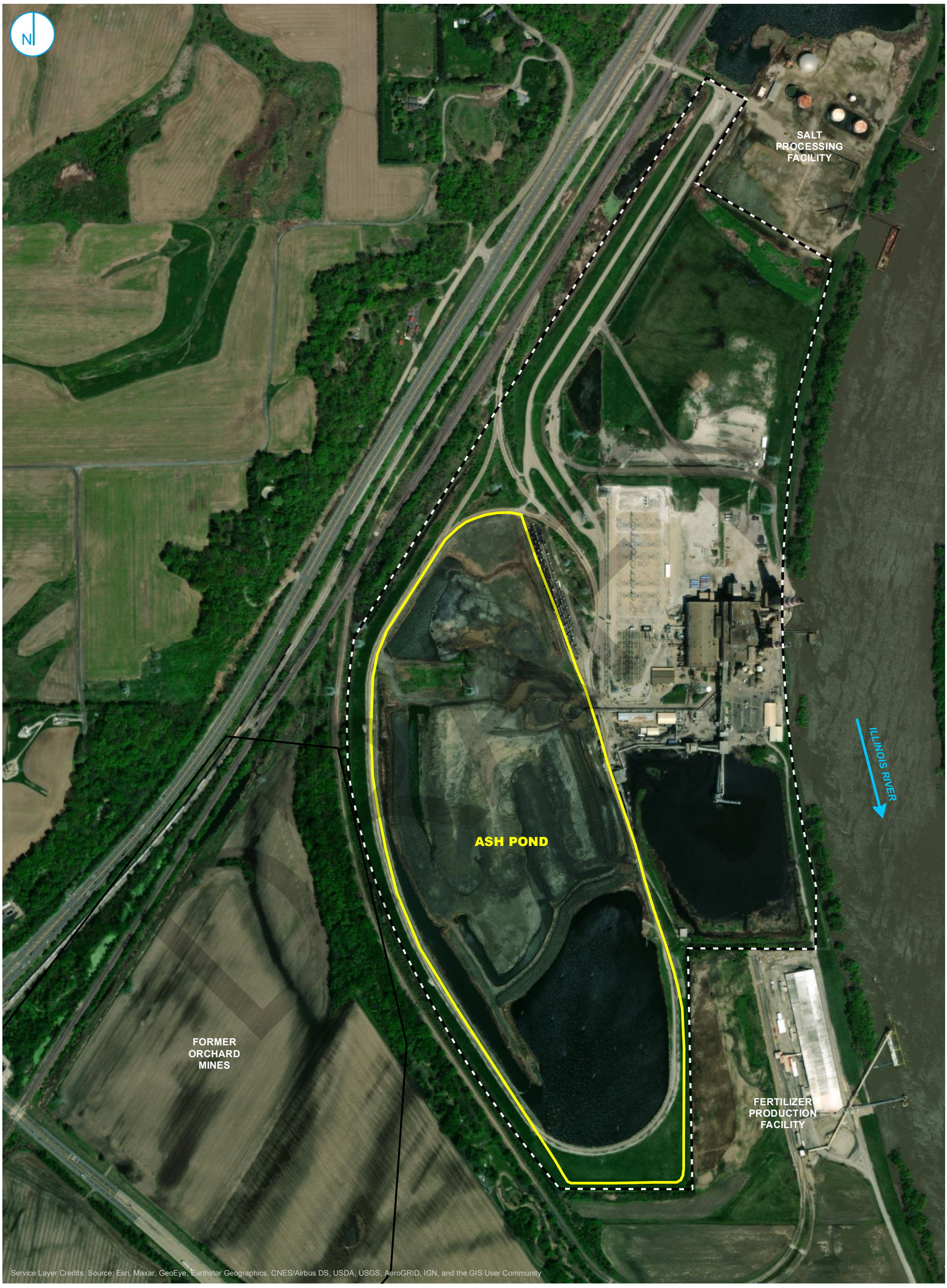
SITE LOCATION MAP

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 1-1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



PART 845 REGULATED UNIT (SUBJECT UNIT)
FORMER ORCHARD MINES AREA
PROPERTY BOUNDARY

0 250 500 Feet

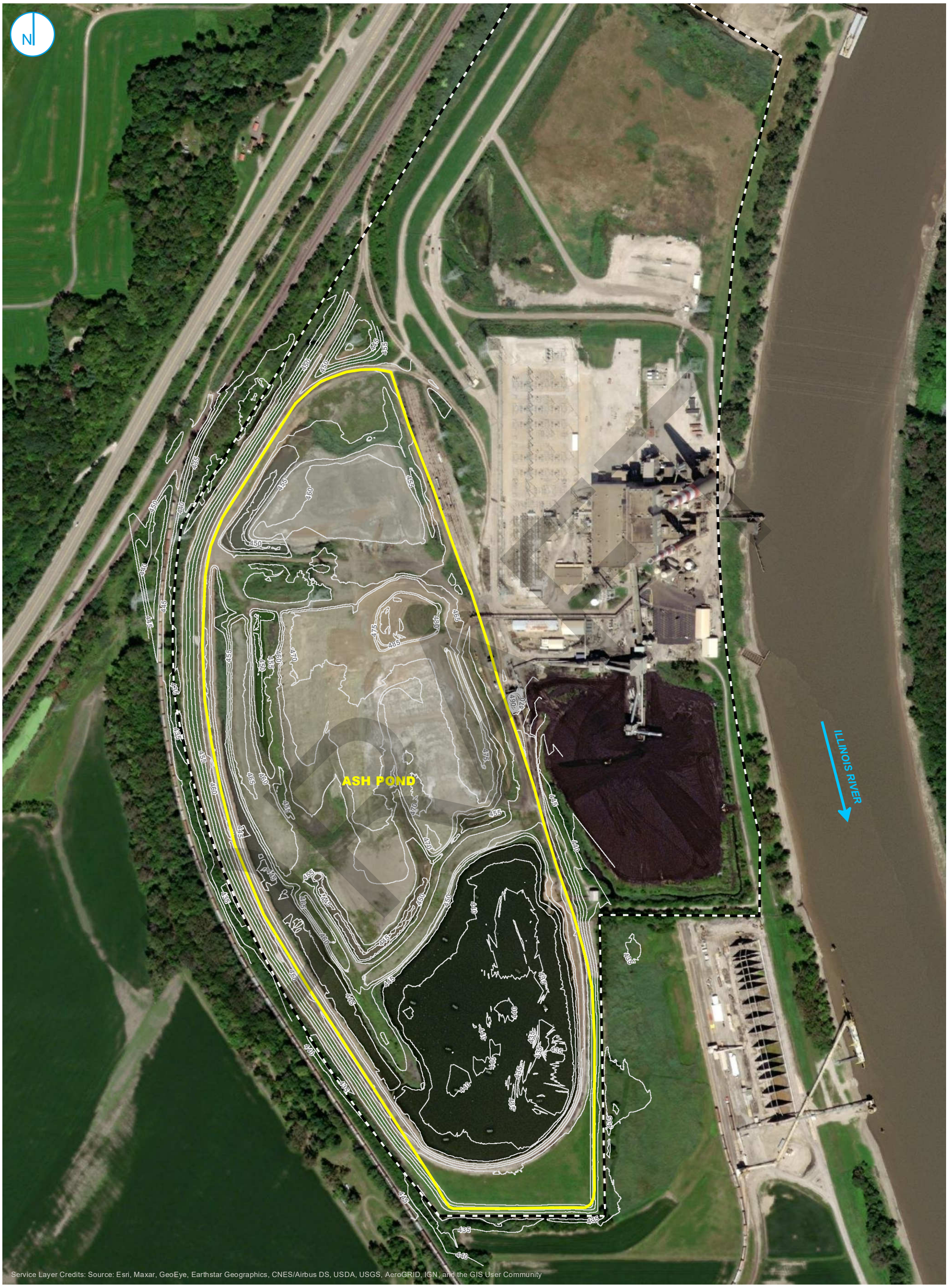
SITE MAP

FIGURE 1-2

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



5FT TOPOGRAPHIC CONTOUR
PART 845 REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY

Note:
Elevation contours shown in feet, North American Vertical Datum of 1988 (NAVD88)

0 200 400
Feet

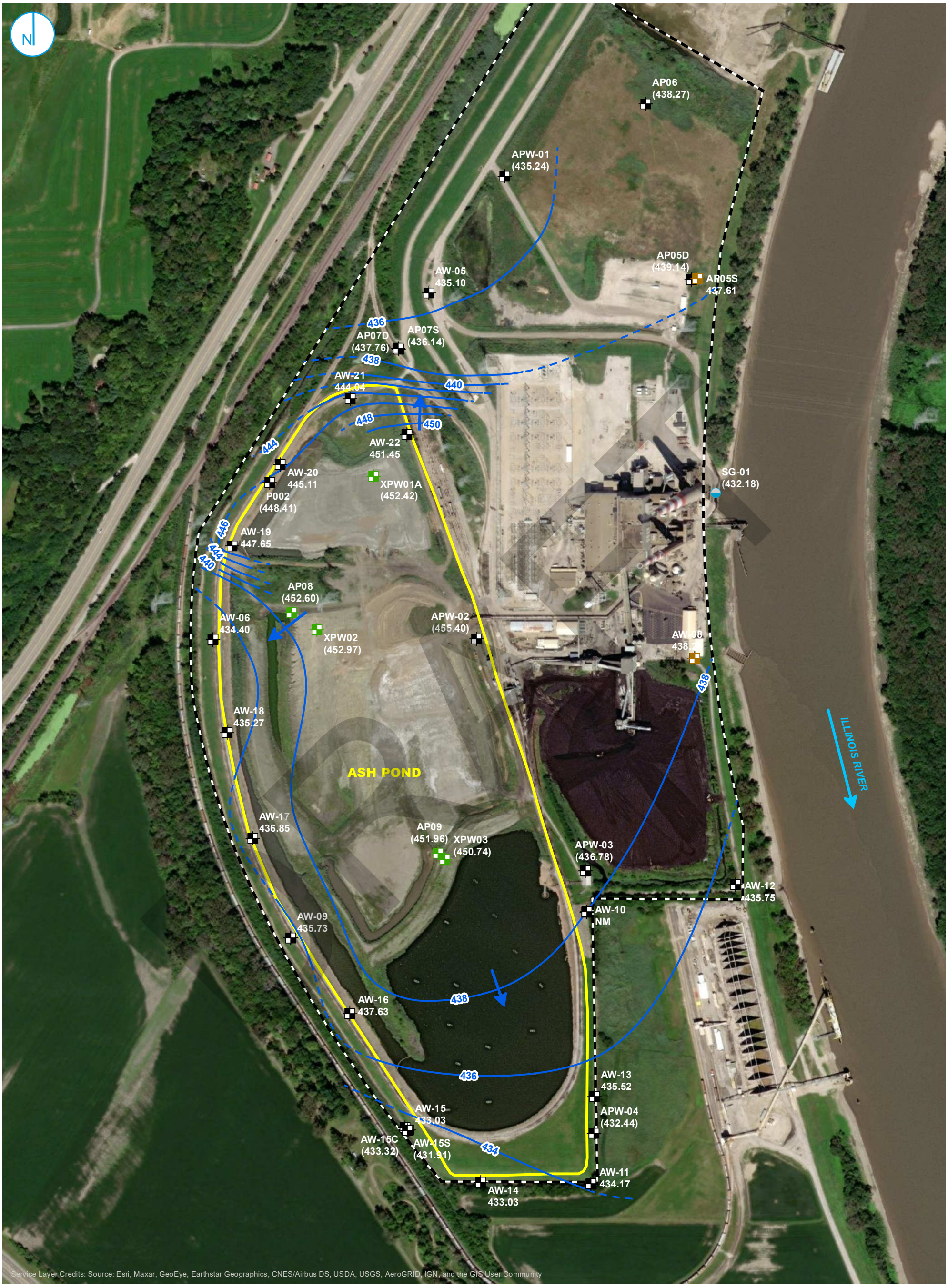
SITE TOPOGRAPHIC MAP

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 2-1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



BACKGROUND WELL
MONITORING WELL
PORE WATER WELL
STAFF GAGE, RIVER
PART 845 REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY

GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
INFERRED GROUNDWATER ELEVATION CONTOUR
GROUNDWATER FLOW DIRECTION

0 212.5 425 Feet

NOTES
1. PARENTHESIS INDICATES WELL NOT USED FOR CONTOURING
2. ELEVATION CONTOURS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988

UPPERMOST AQUIFER POTENTIOMETRIC SURFACE MAP FEBRUARY 9, 2021

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 2-2

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

N

AP06
(438.98)

APW-01
(435.38)

AP05D
(433.33)

AP05S
438.43

AW-05
435.28

436

AP07S
(436.73)

438

440

AP07D
(415.52)

442

444

AW-21
444.42

446

448

450

446

AW-20
445.41

AW-22
451.80

P002
(448.60)

XPW01A
(452.88)

SG-01
(441.07)

AW-19
447.71

444

AP08
(453.59)

AW-06
434.70

XPW02
(454.08)

APW-02
(455.21)

AW-08
439.2

438

440

442

436

AW-18
435.38

ASH POND

ILLINOIS RIVER

AW-17
437.42

AP09
(451.95)

XPW03
(450.77)

APW-03
(436.75)

AW-12
437.06

AW-10
438.84

AW-09
435.77

438

AW-16
437.67

436

AW-13
435.86

AW-15
433.68

APW-04
(432.75)

AW-15C
(433.66)

AW-15S
(431.33)

434

AW-11
434.60

AW-14
432.79

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

- BACKGROUND WELL
- MONITORING WELL
- PORE WATER WELL
- STAFF GAGE, RIVER
- PART 845 REGULATED UNIT (SUBJECT UNIT)
- PROPERTY BOUNDARY

- GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
- INFERRED GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION

0 212.5 425 Feet

NOTES
1. PARENTHESIS INDICATES WELL NOT USED FOR CONTOURING
2. ELEVATION CONTOURS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

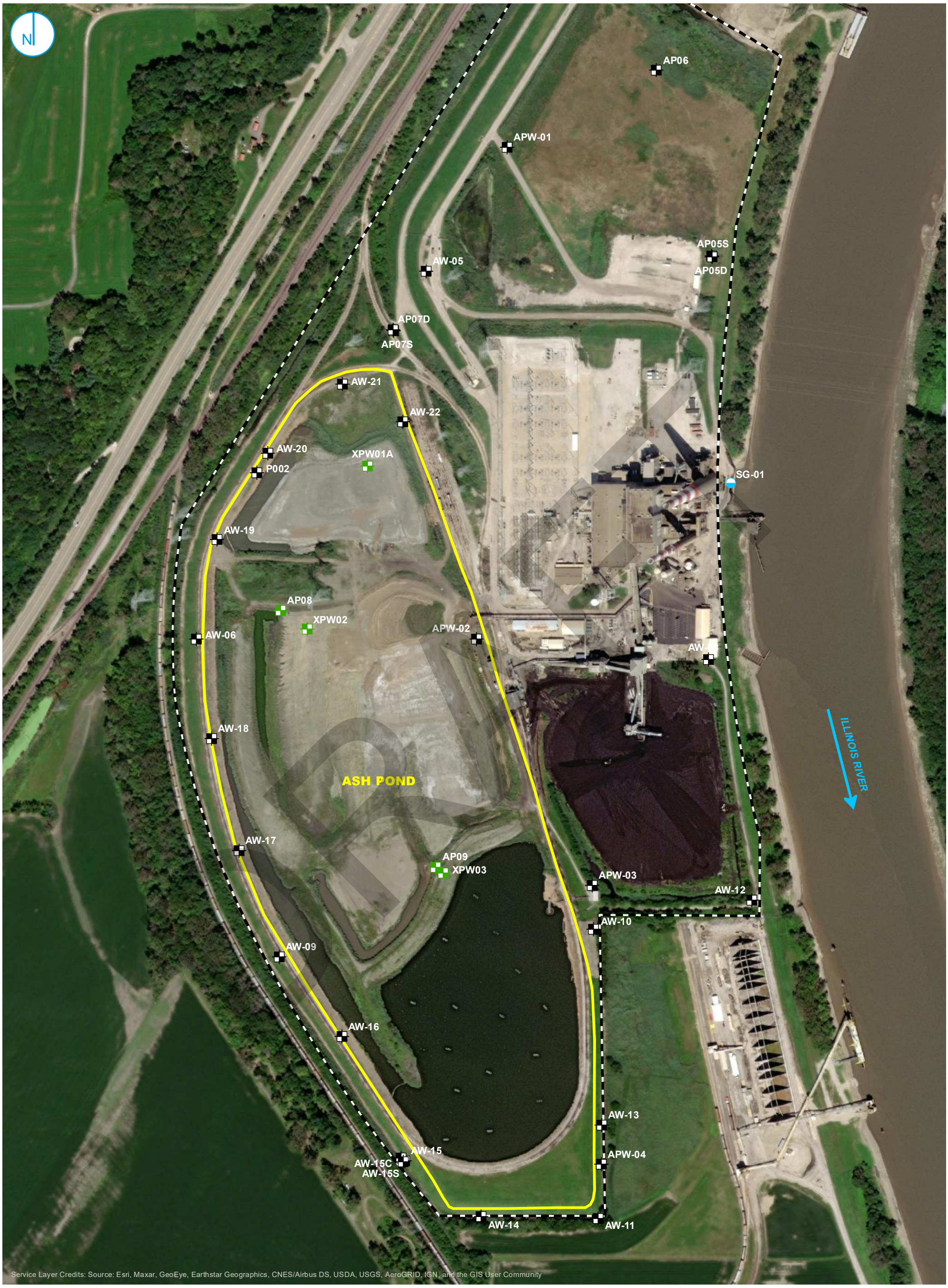
UPPERMOST AQUIFER POTENTIOMETRIC SURFACE MAP MARCH 22, 2021

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 2-3

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



MONITORING WELL
PORE WATER WELL
STAFF GAGE, RIVER
PART 845 REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY

0 200 400 Feet

MONITORING WELL LOCATION MAP

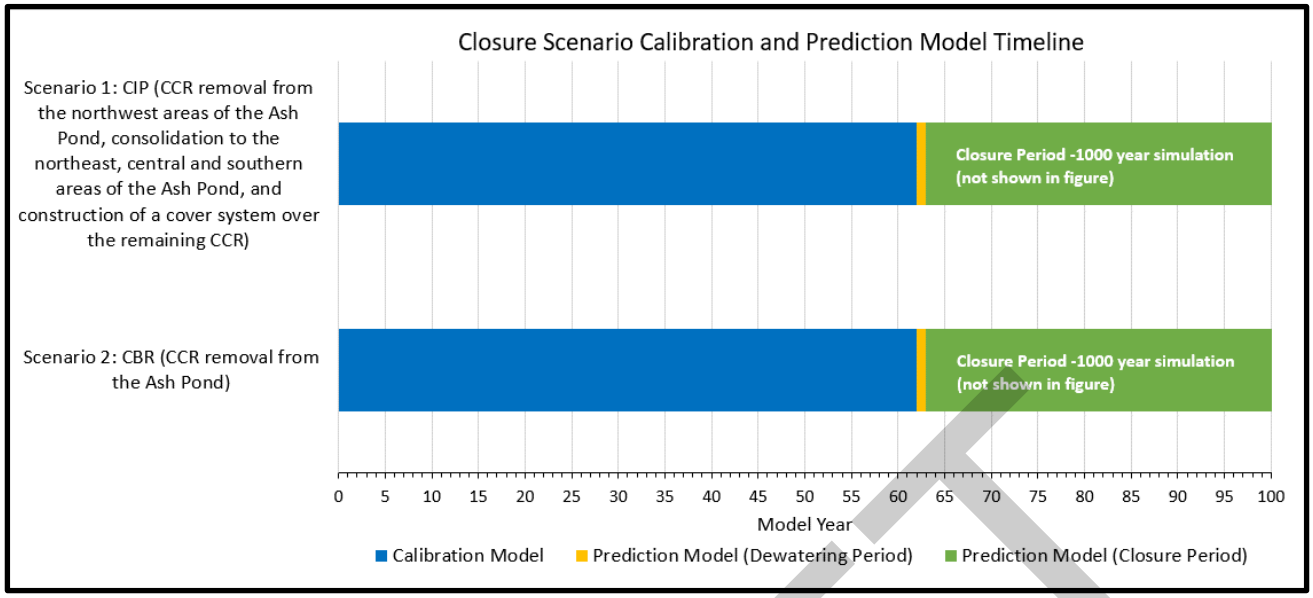
GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 2-4

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

FIGURE 4-1



CLOSURE SCENARIO CALIBRATION AND PREDICTION MODEL TIMELINE

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL

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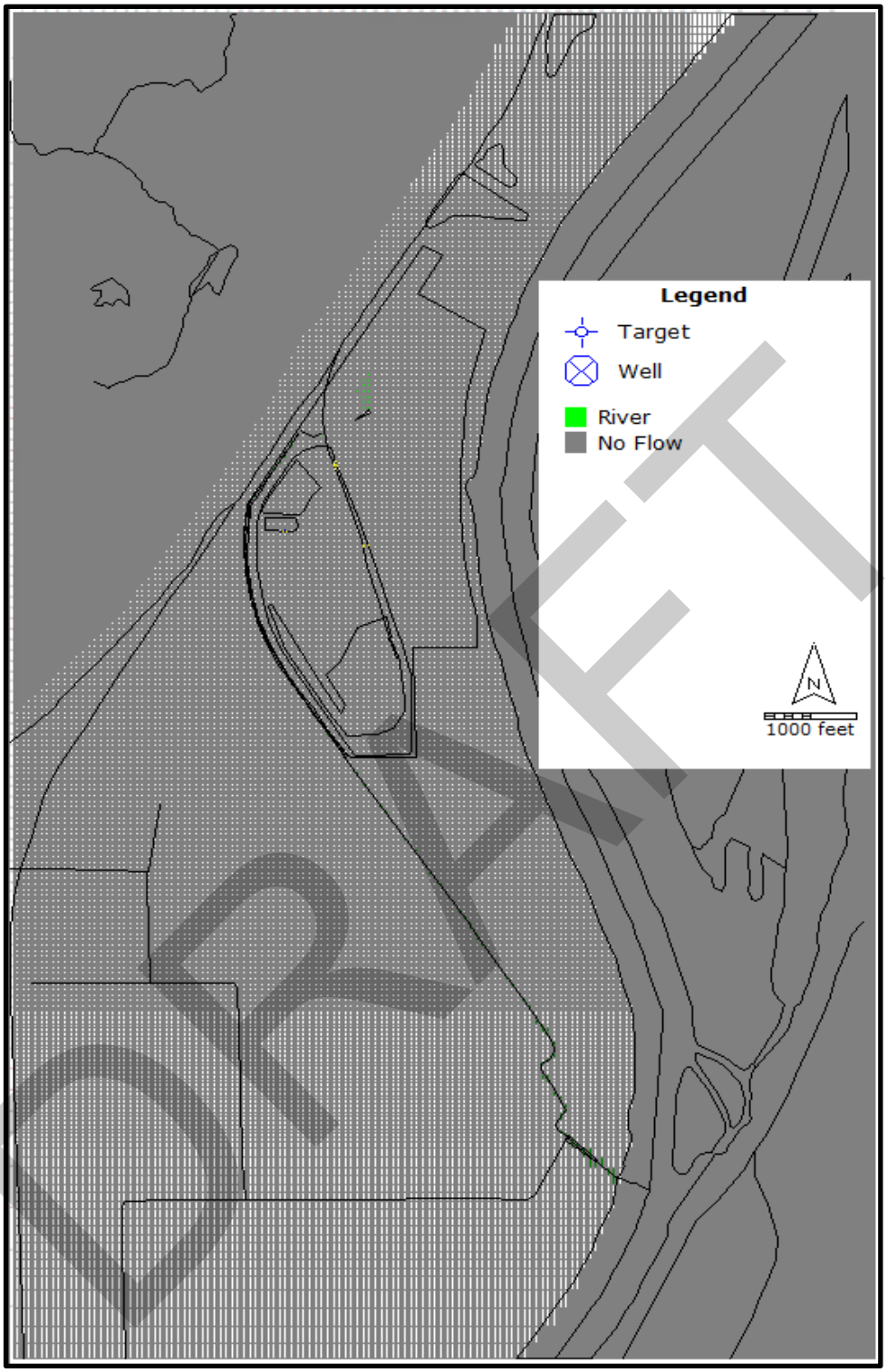

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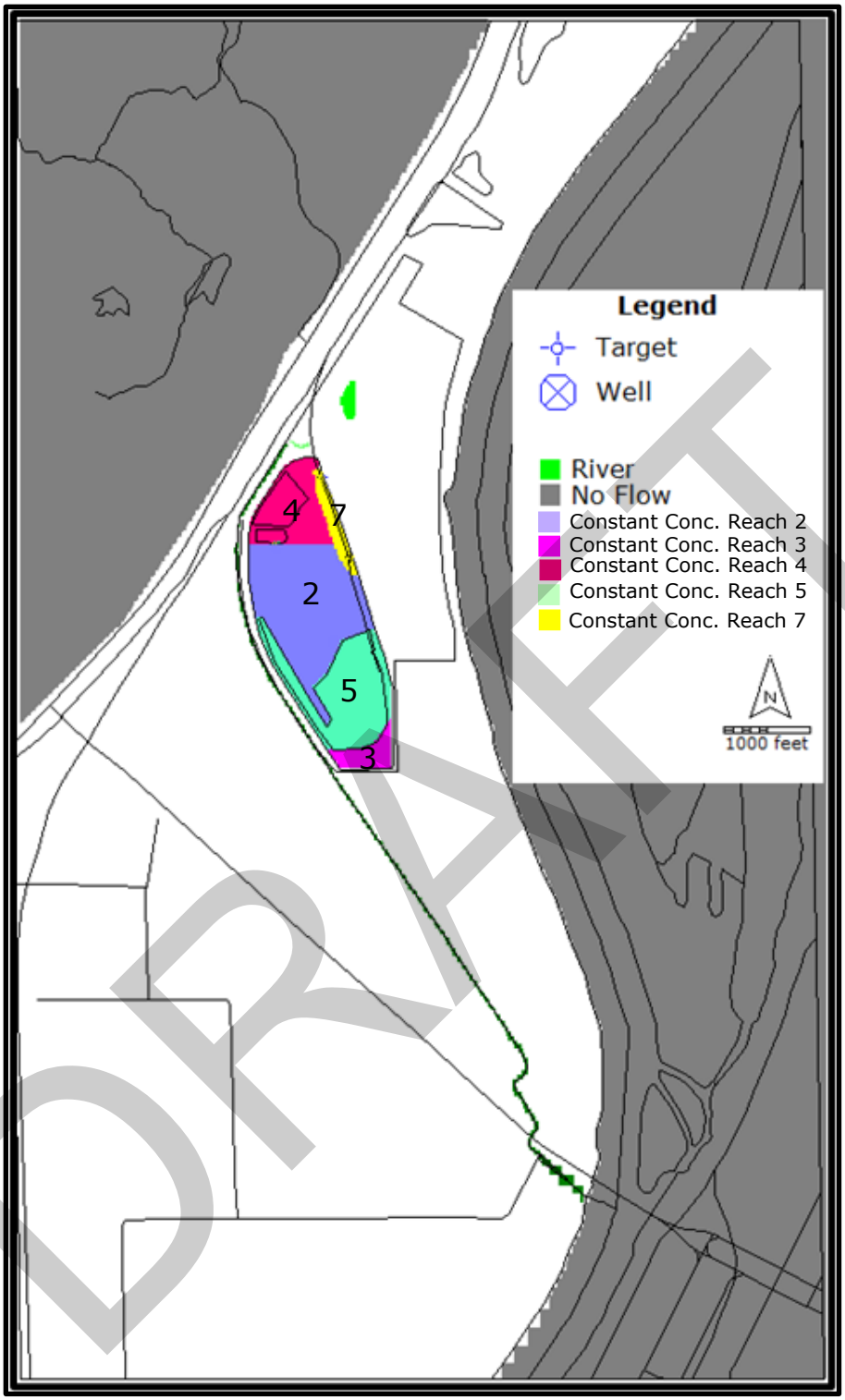
MODEL GRID FOR LAYERS 1 THROUGH 5

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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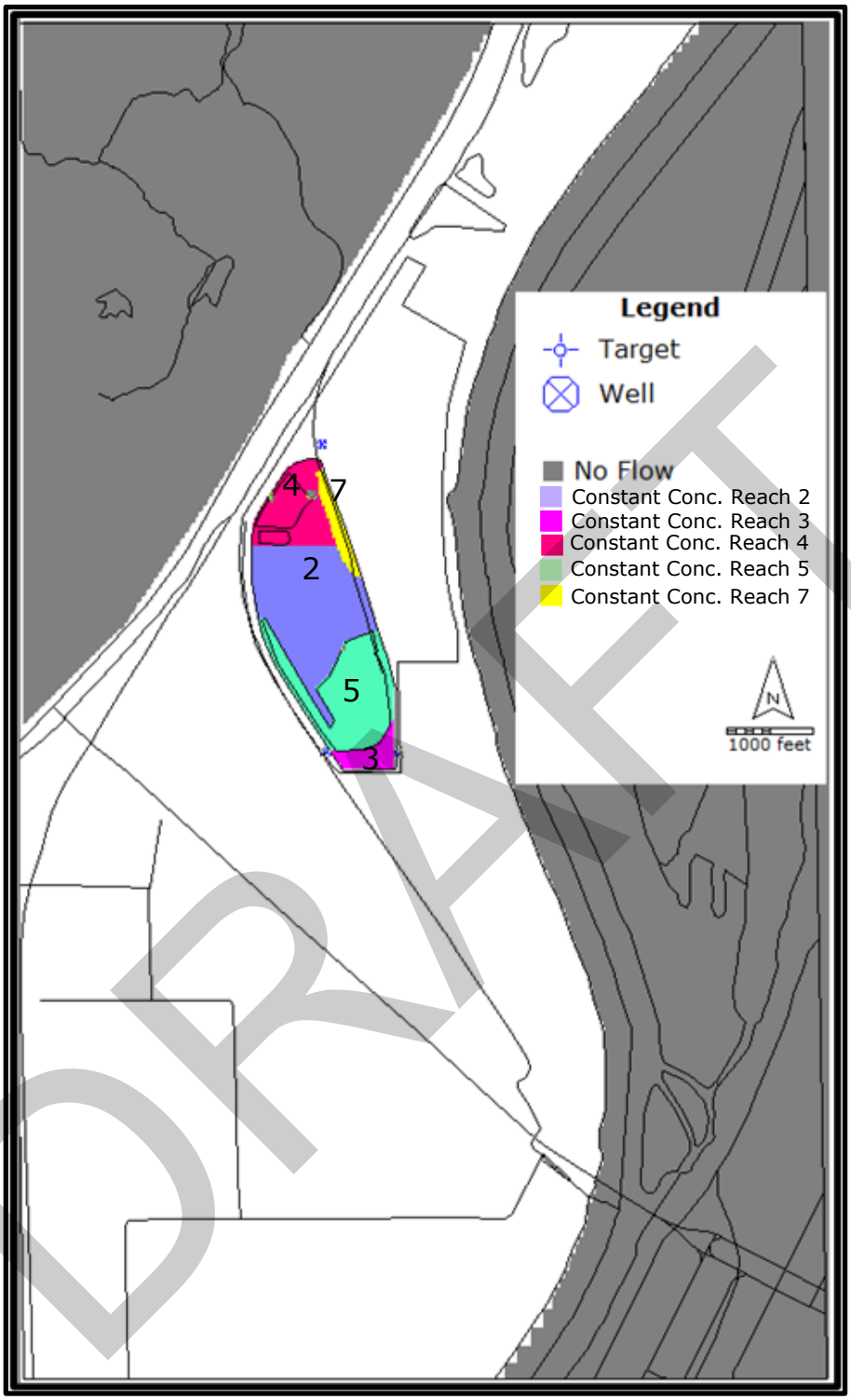
BOUNDARY CONDITIONS FOR LAYER 1

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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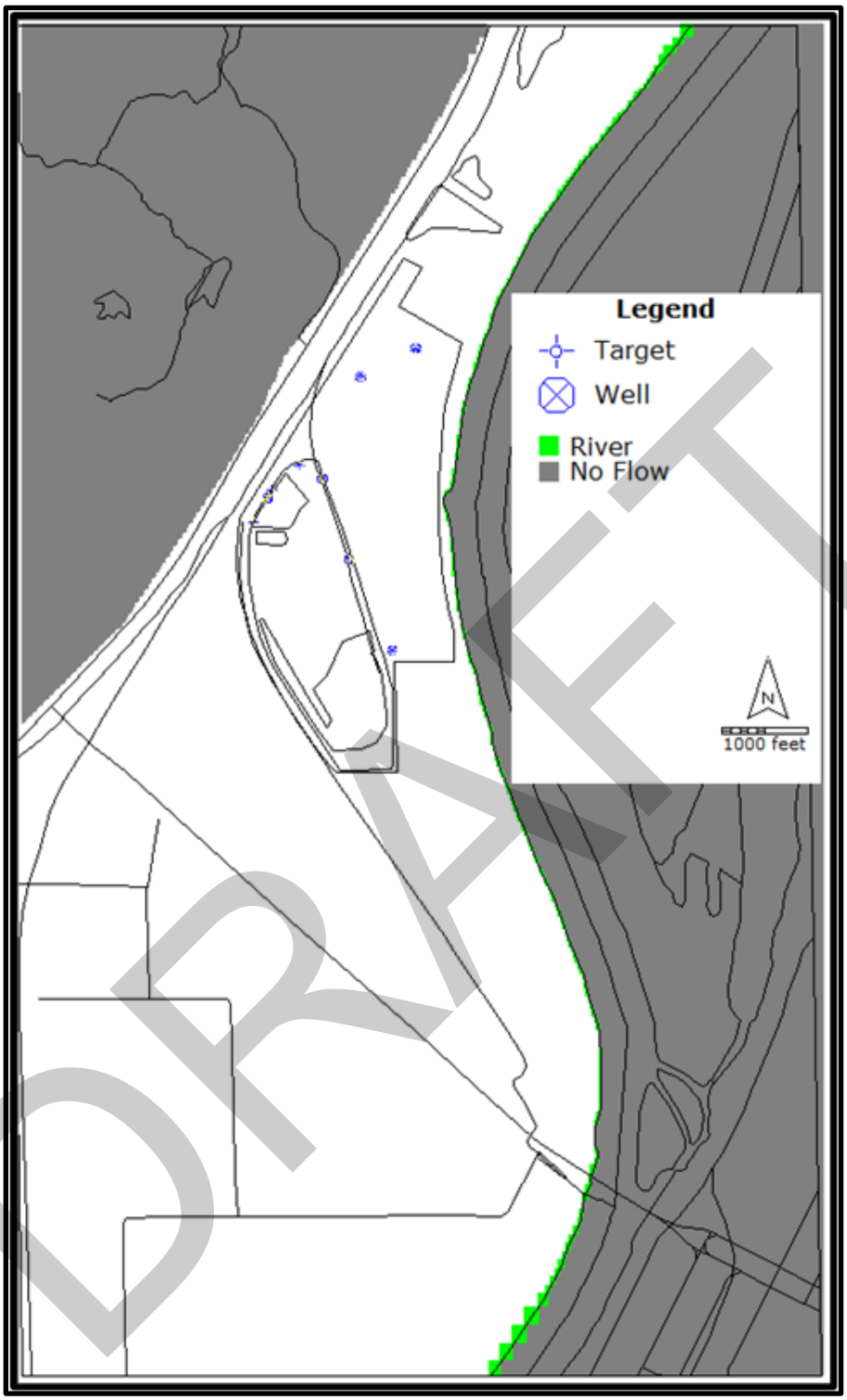
BOUNDARY CONDITIONS FOR LAYER 2

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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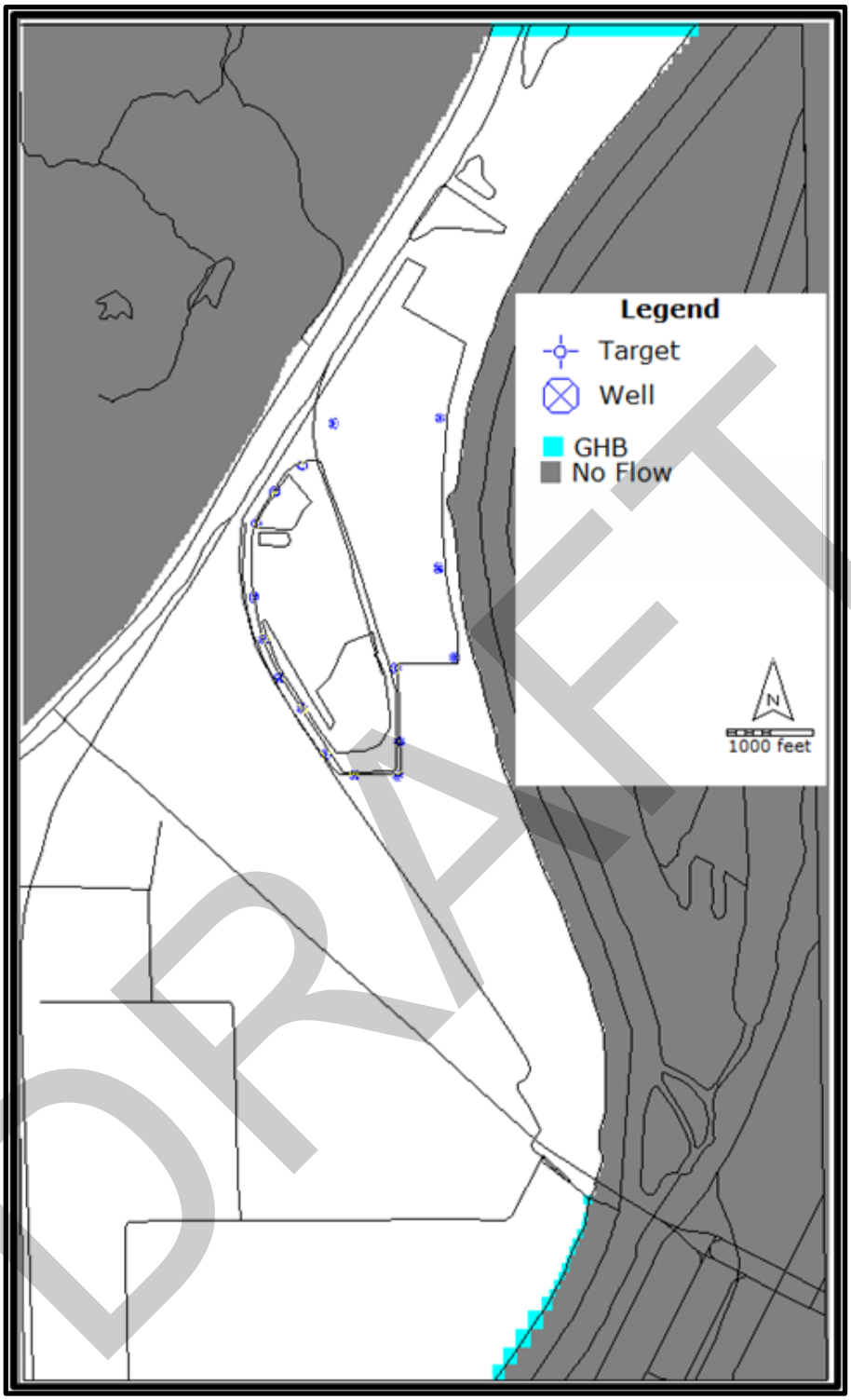
BOUNDARY CONDITIONS FOR LAYER 3

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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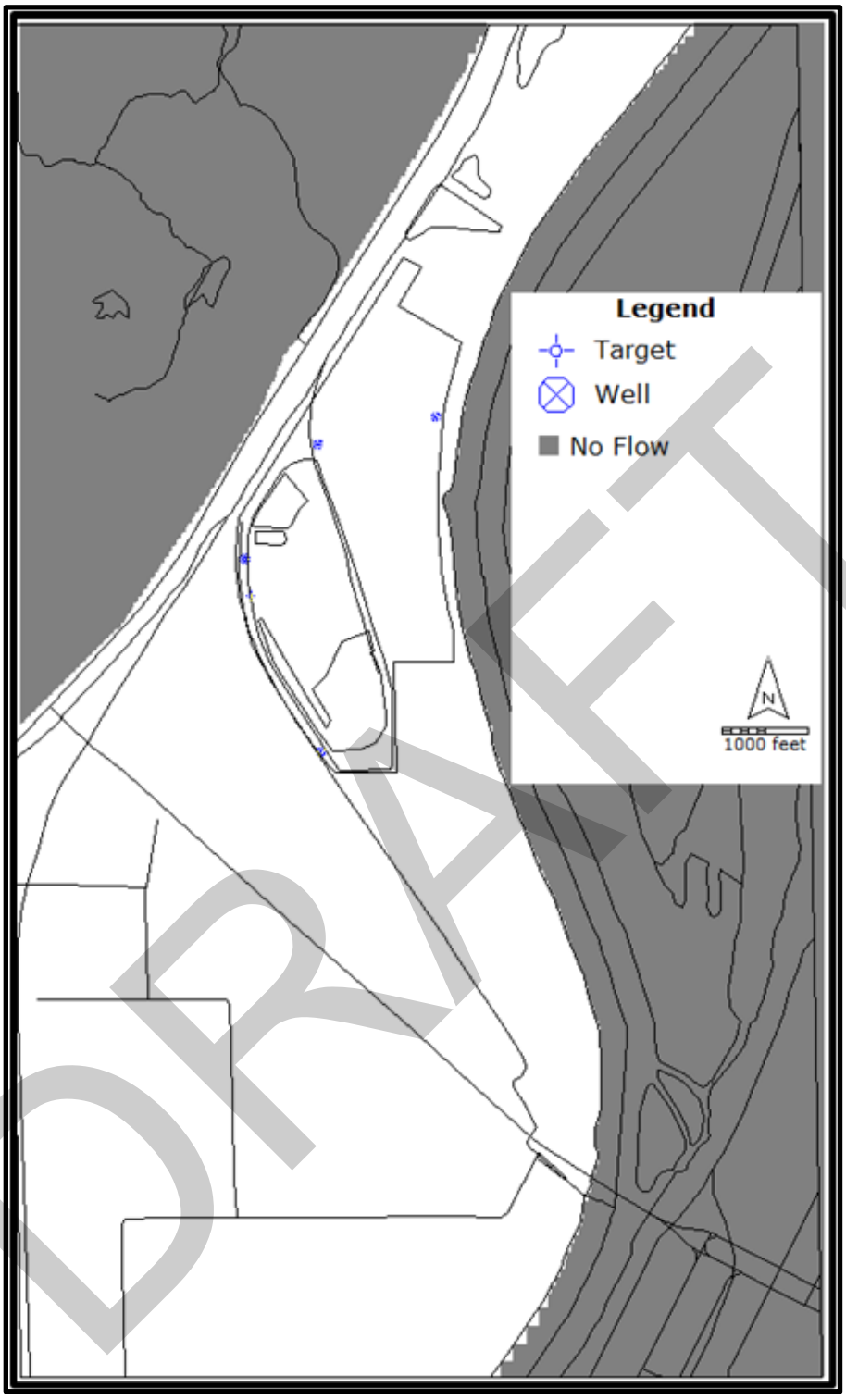
BOUNDARY CONDITIONS FOR LAYER 4

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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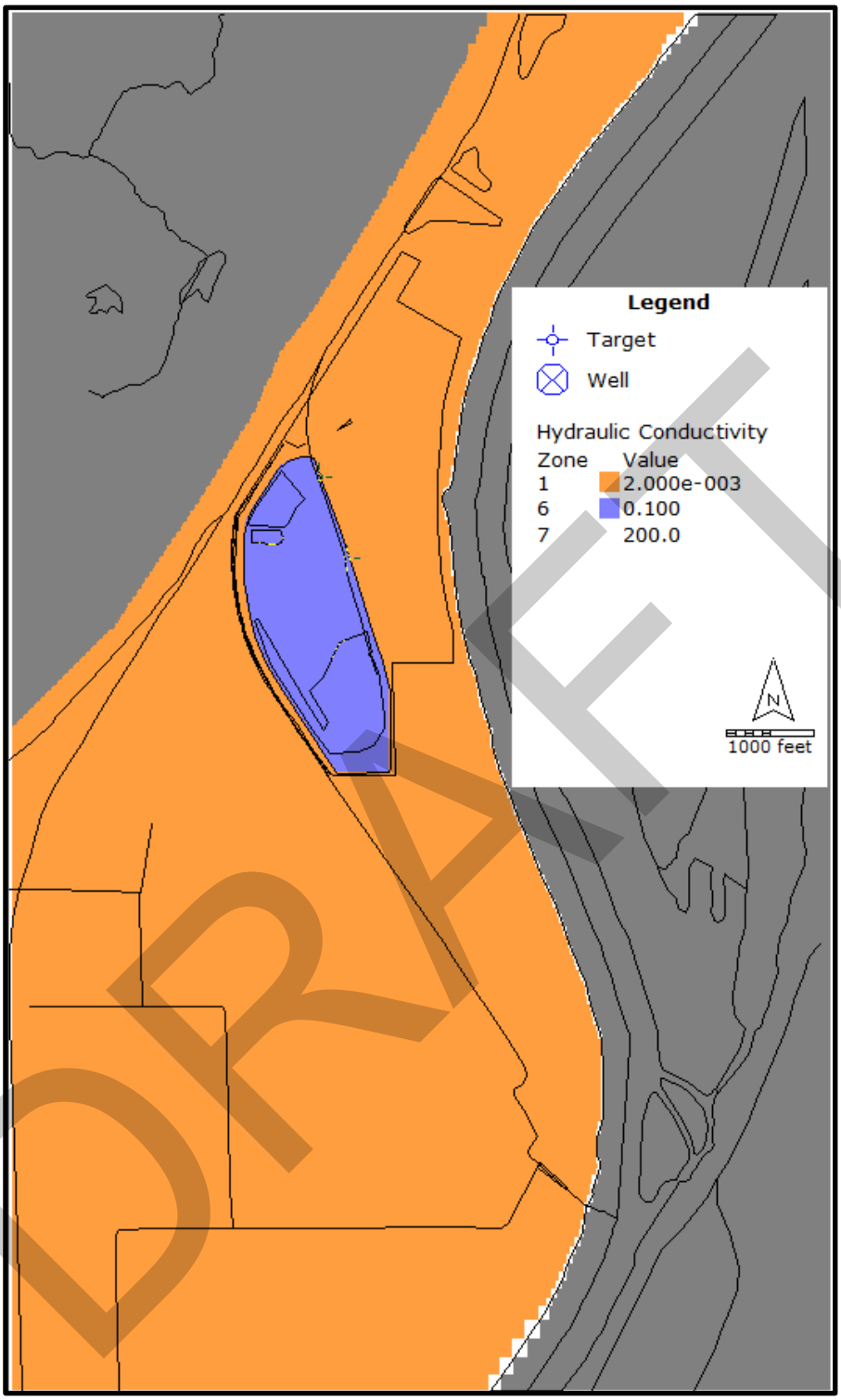
BOUNDARY CONDITIONS FOR LAYER 5

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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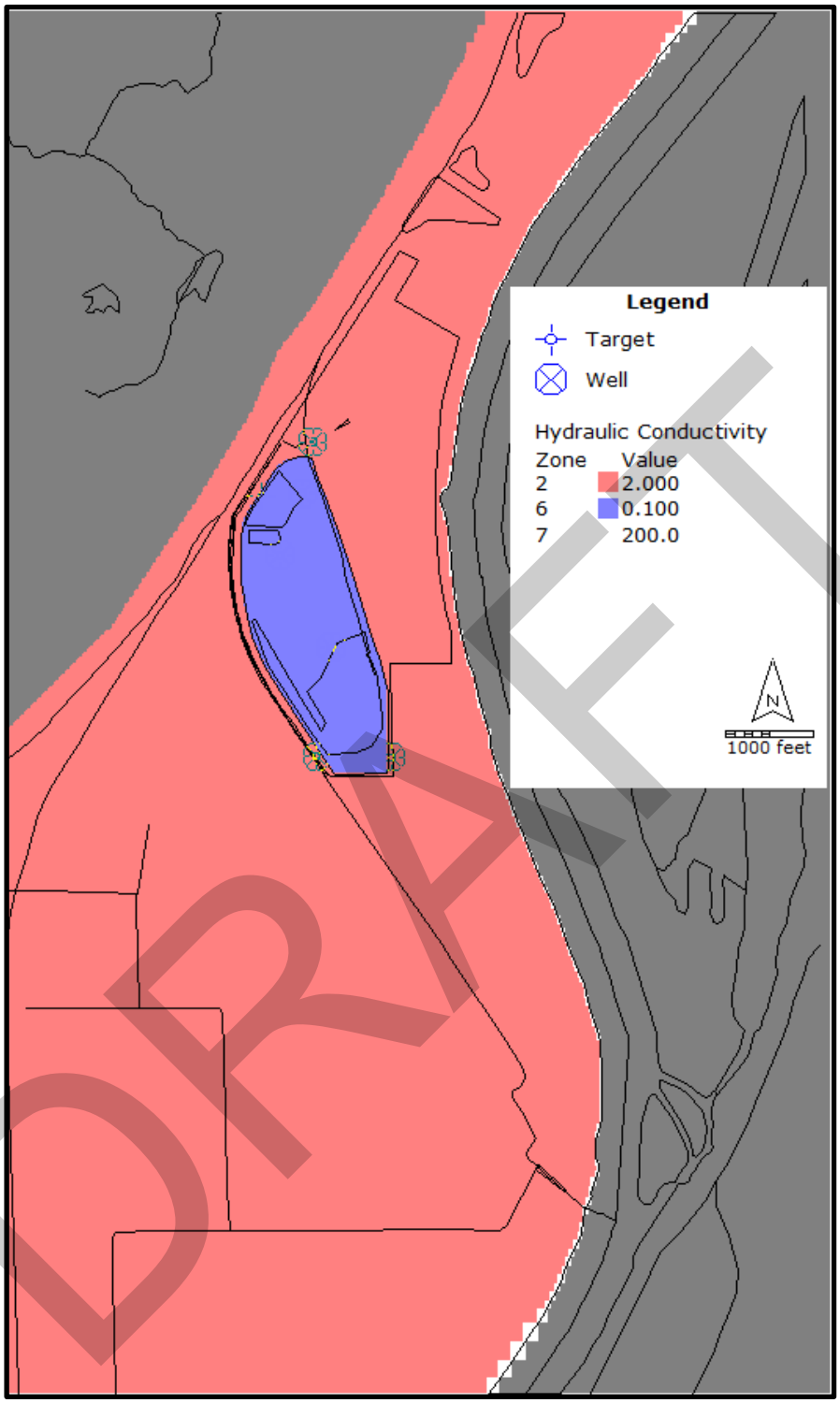
DISTRIBUTION OF HYDRAULIC CONDUCTIVITY ZONE (FEET/DAY) FOR LAYER 1

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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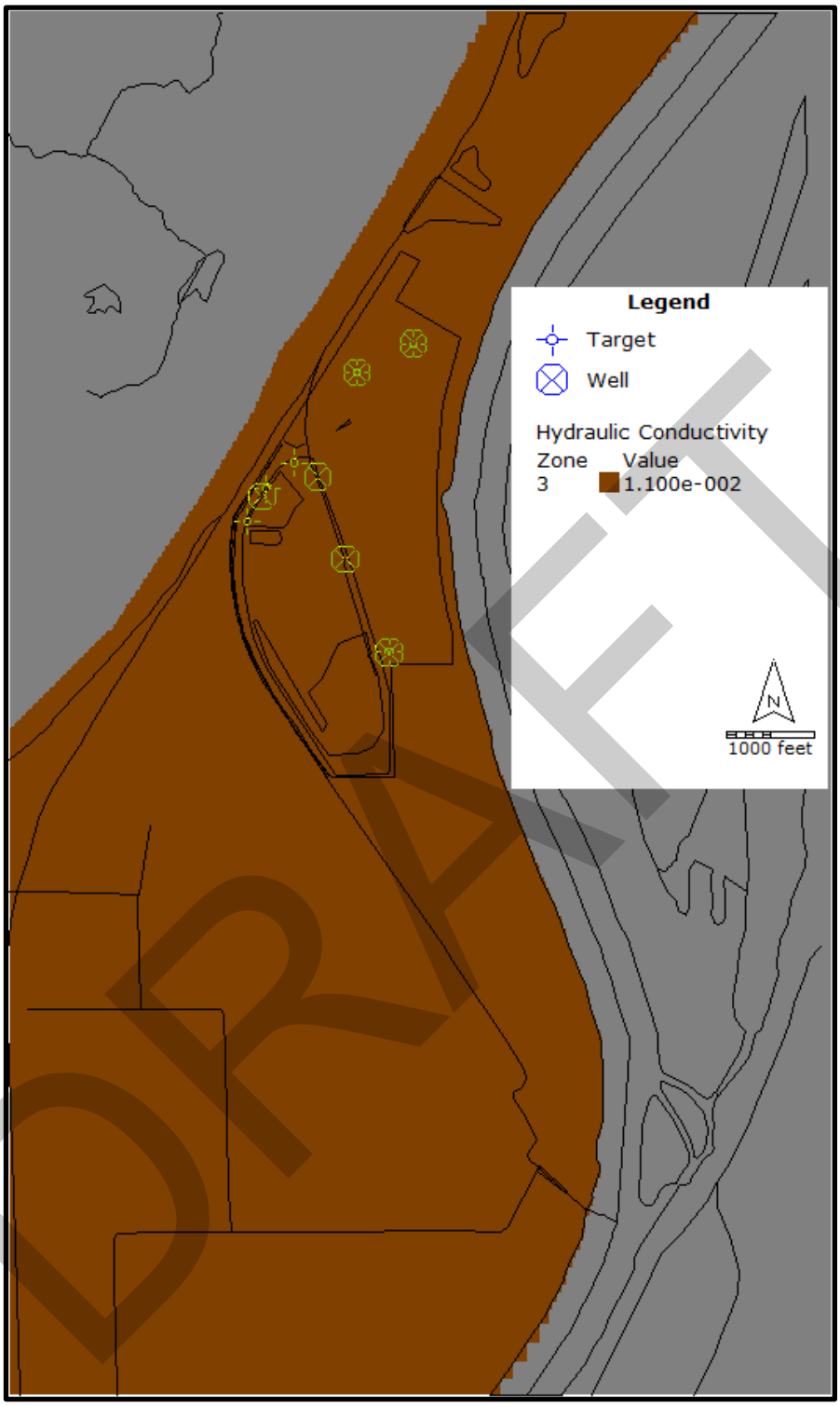
DISTRIBUTION OF HYDRAULIC CONDUCTIVITY ZONE (FEET/DAY) FOR LAYER 2

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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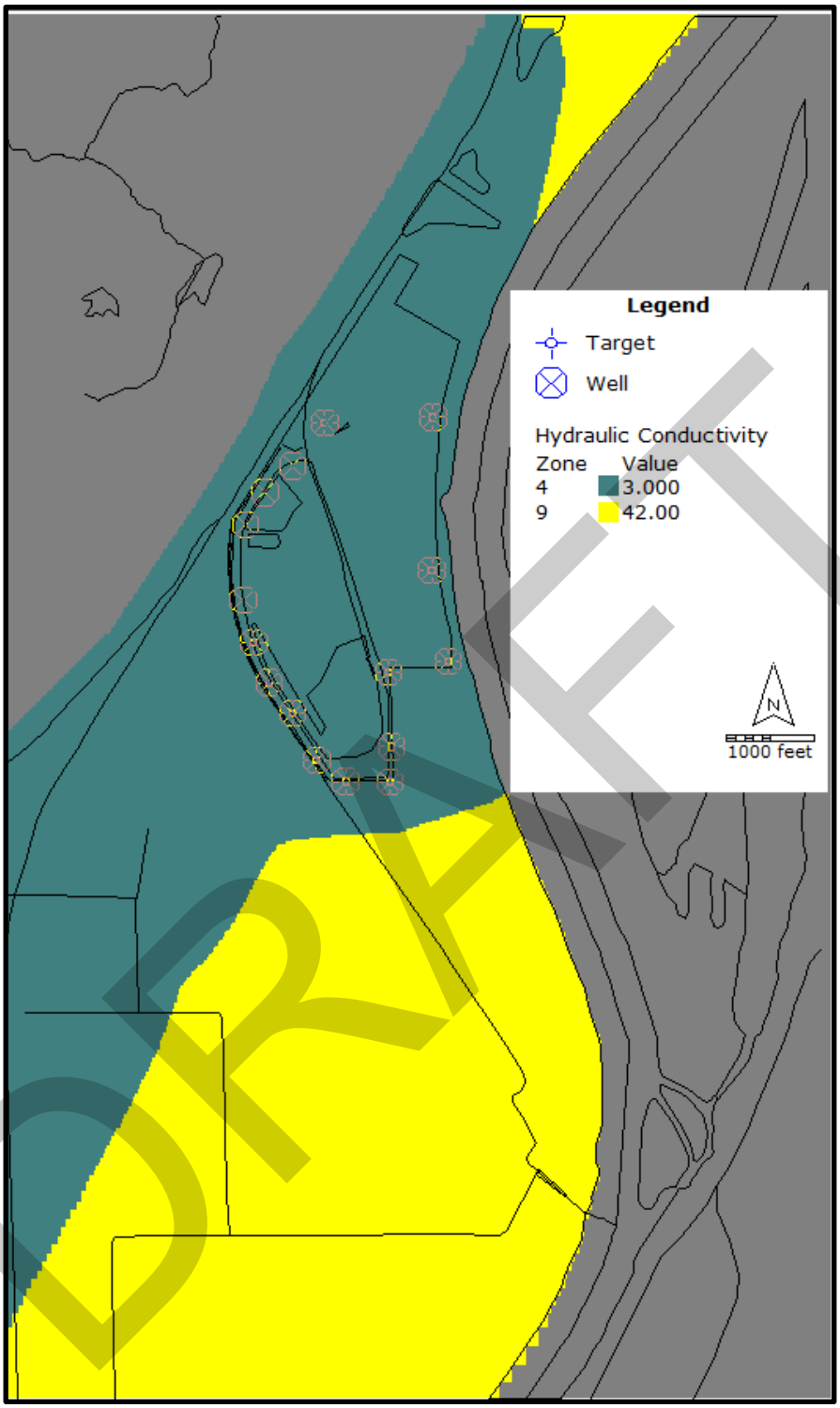
DISTRIBUTION OF HYDRAULIC CONDUCTIVITY ZONE (FEET/DAY) FOR LAYER 3

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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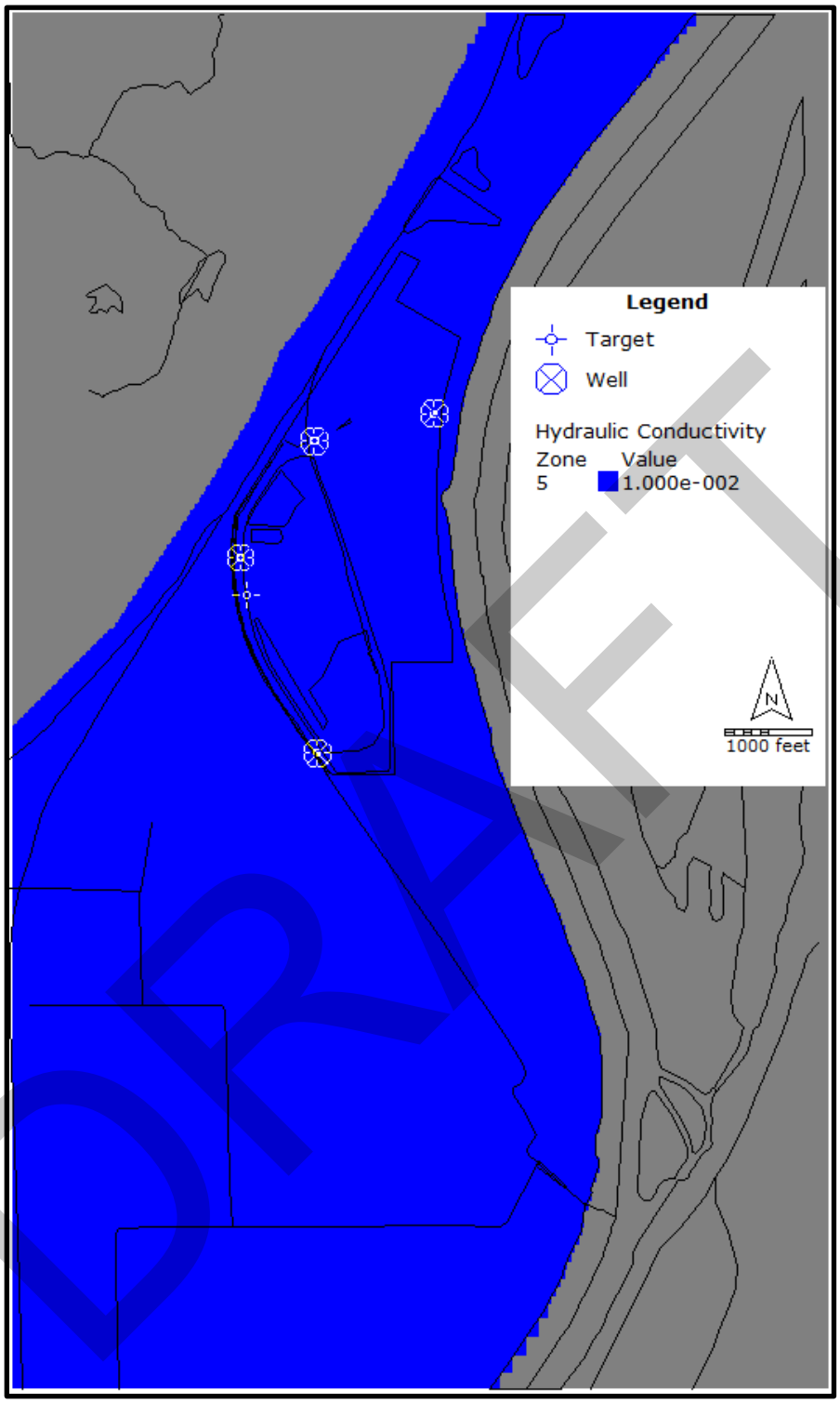
DISTRIBUTION OF HYDRAULIC CONDUCTIVITY ZONE (FEET/DAY) FOR LAYER 4

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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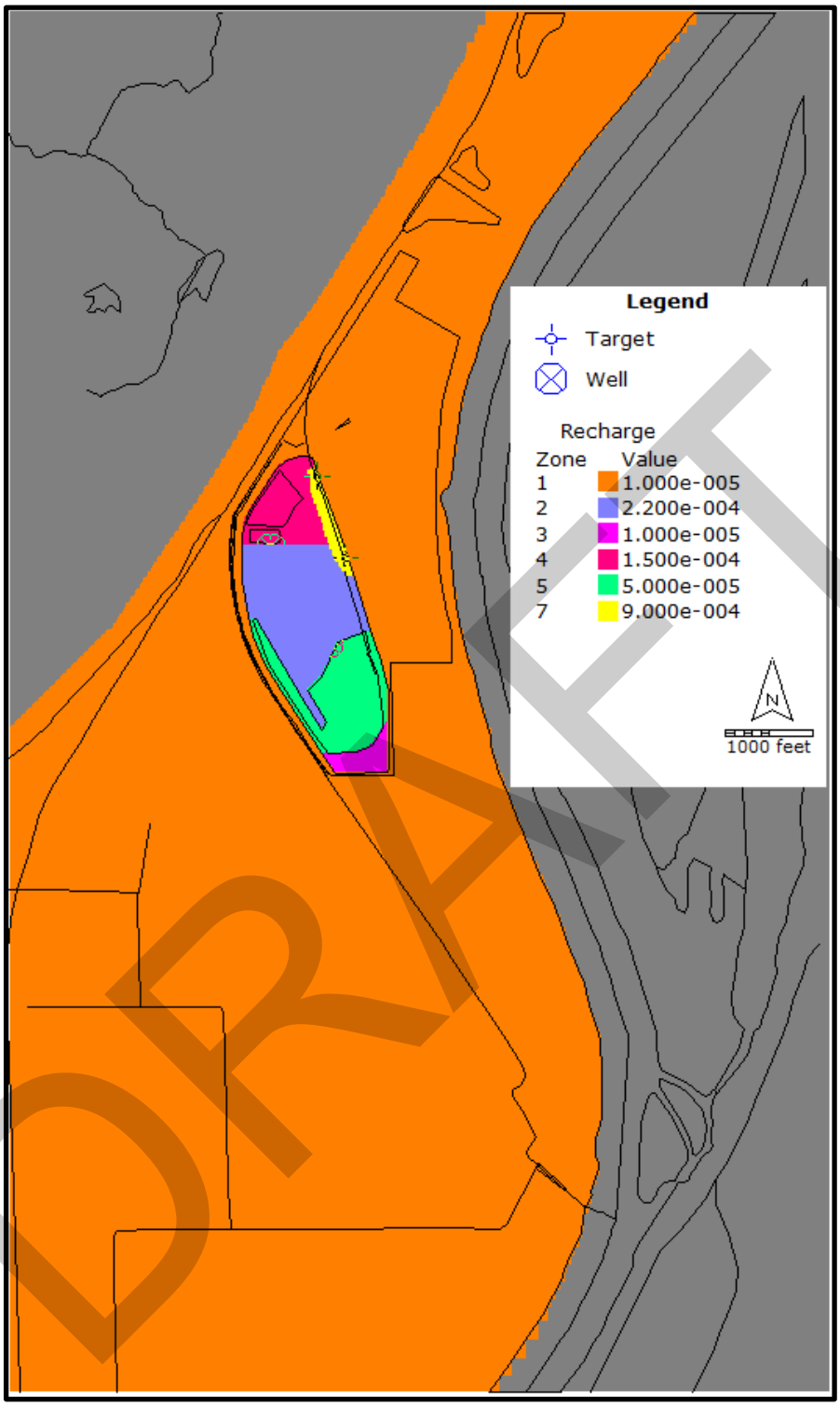
DISTRIBUTION OF HYDRAULIC CONDUCTIVITY ZONE (FEET/DAY) FOR LAYER 5

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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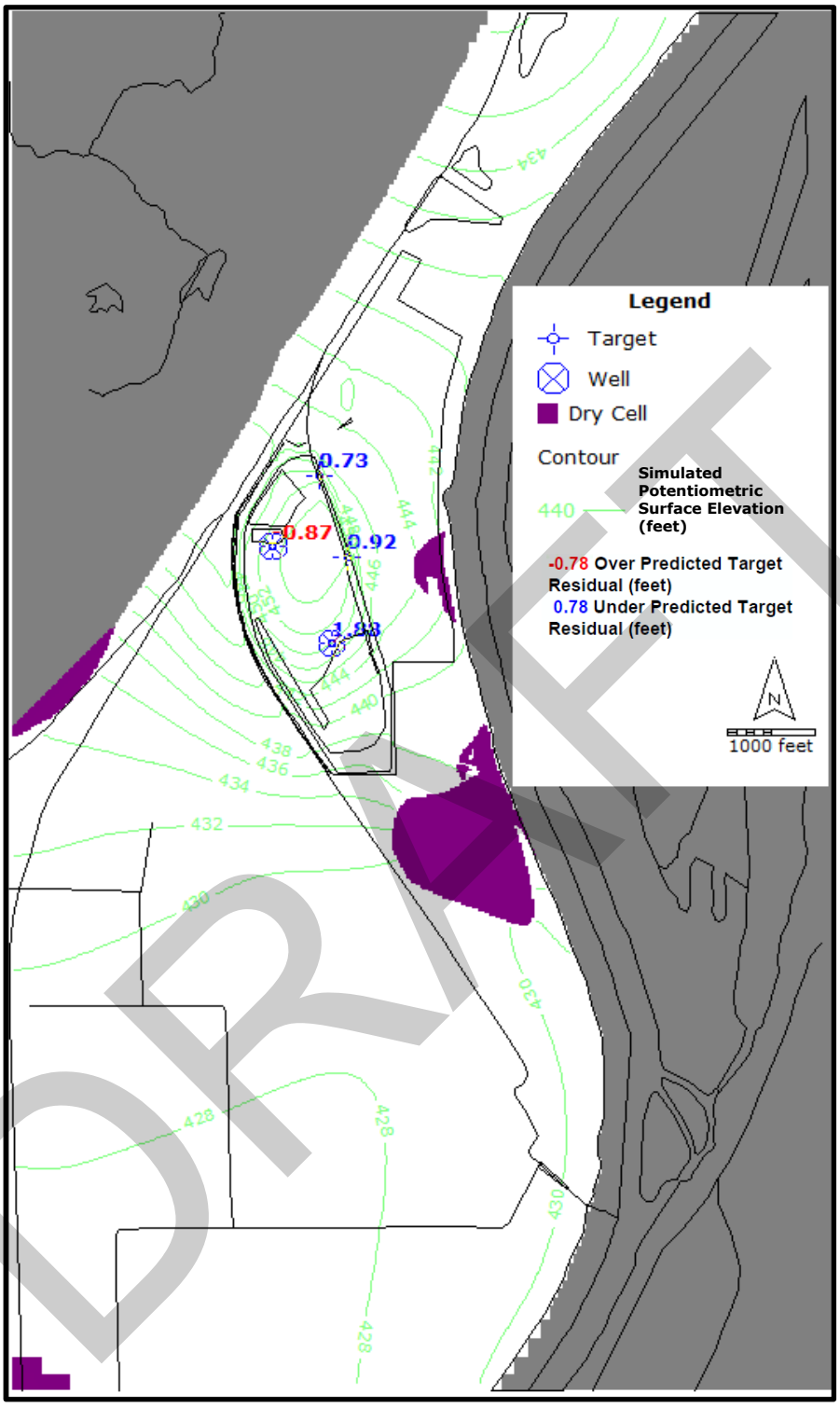
DISTRIBUTION OF RECHARGE ZONES (FEET/DAY)

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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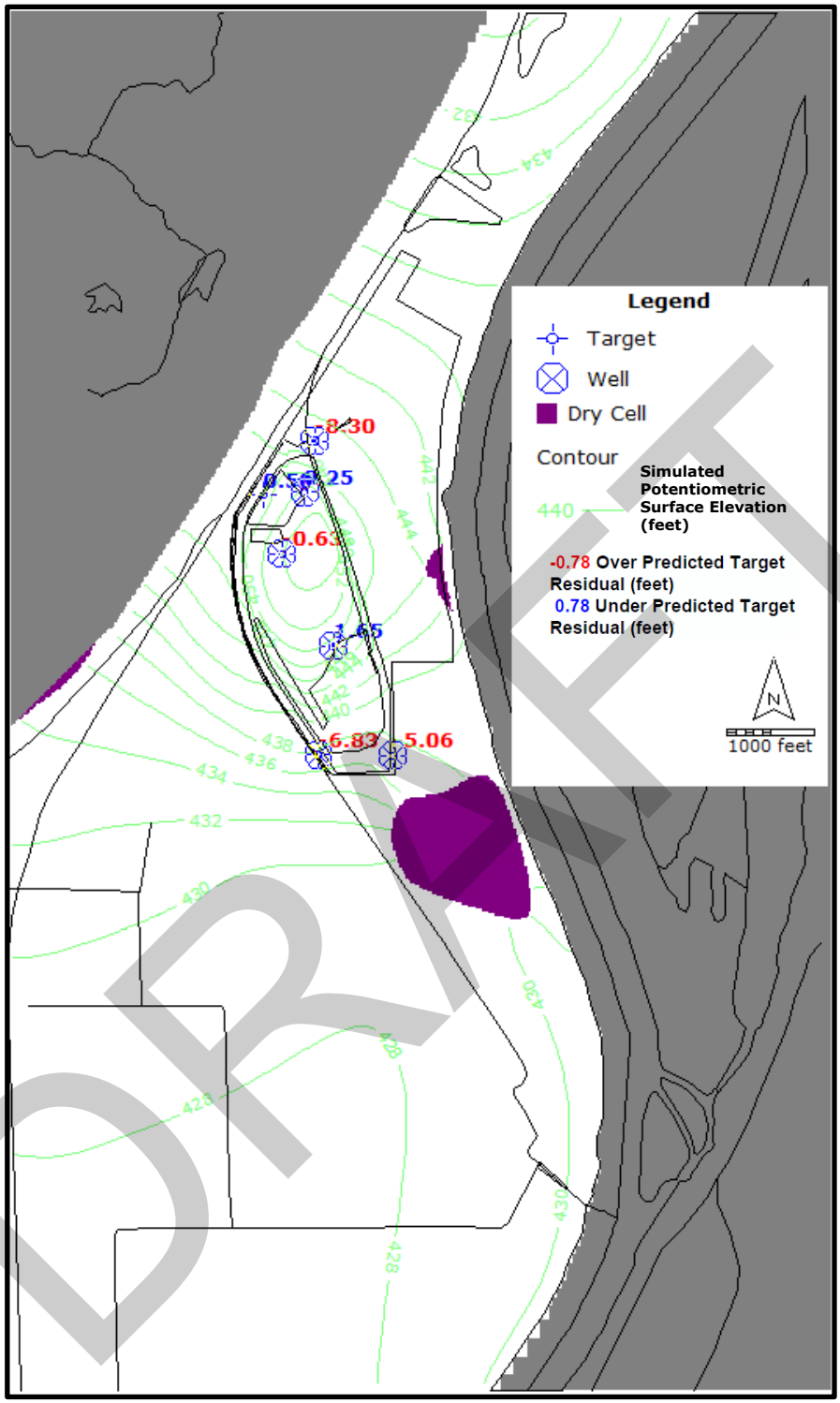
OBSERVED VERSUS SIMULATED GROUNDWATER ELEVATIONS FOR LAYER 1

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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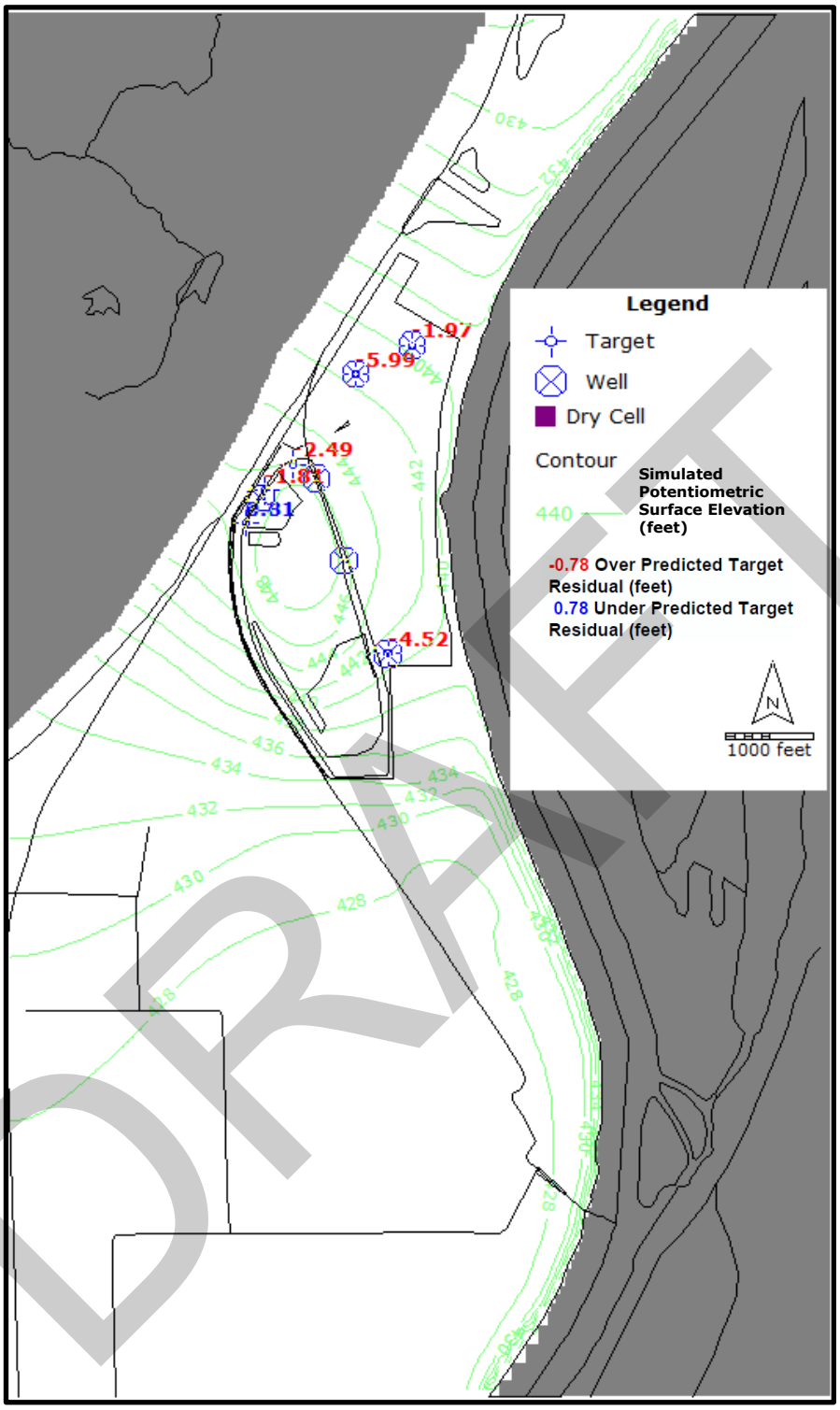
OBSERVED VERSUS SIMULATED GROUNDWATER ELEVATIONS FOR LAYER 2

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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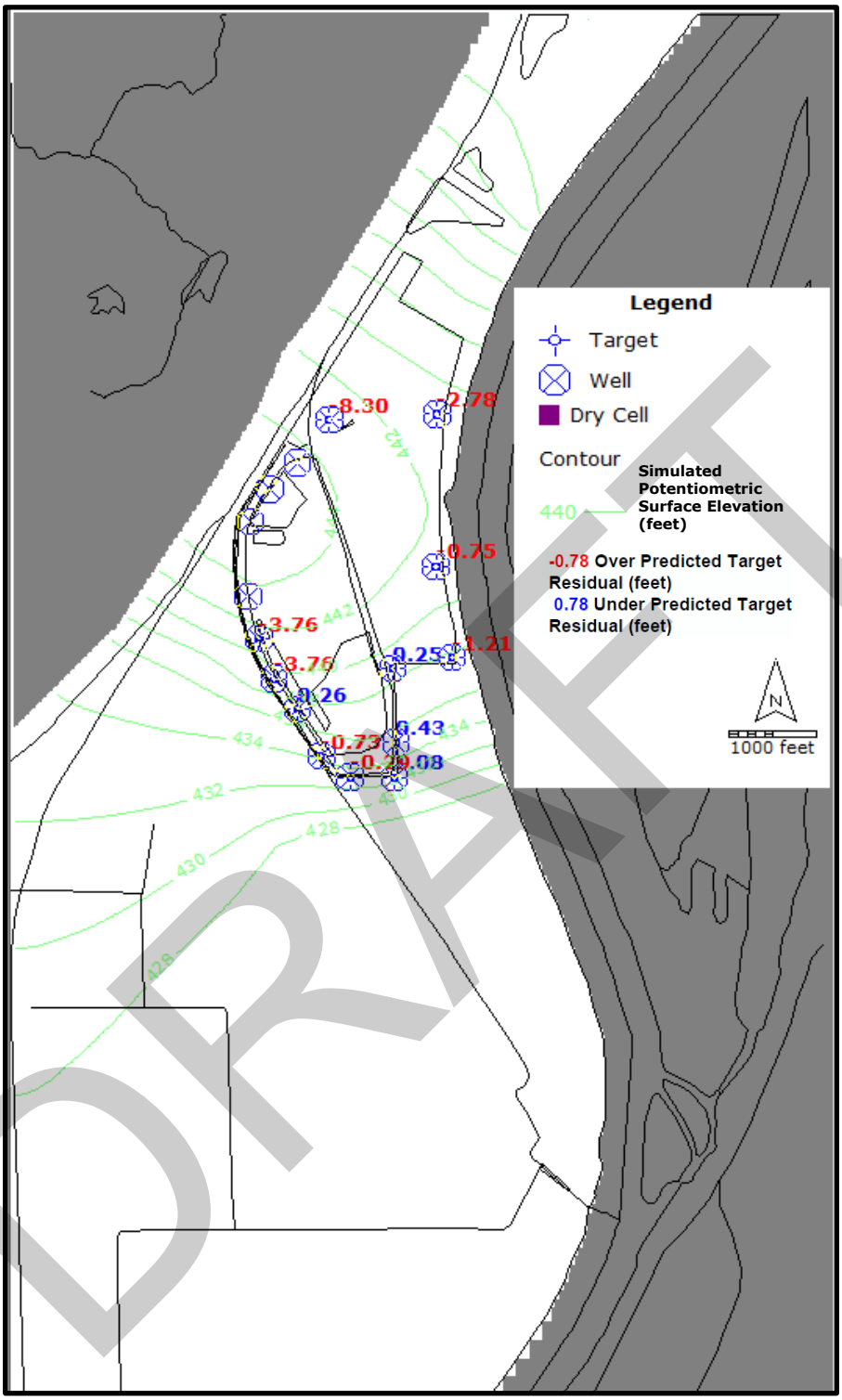
OBSERVED VERSUS SIMULATED GROUNDWATER ELEVATIONS FOR LAYER 3

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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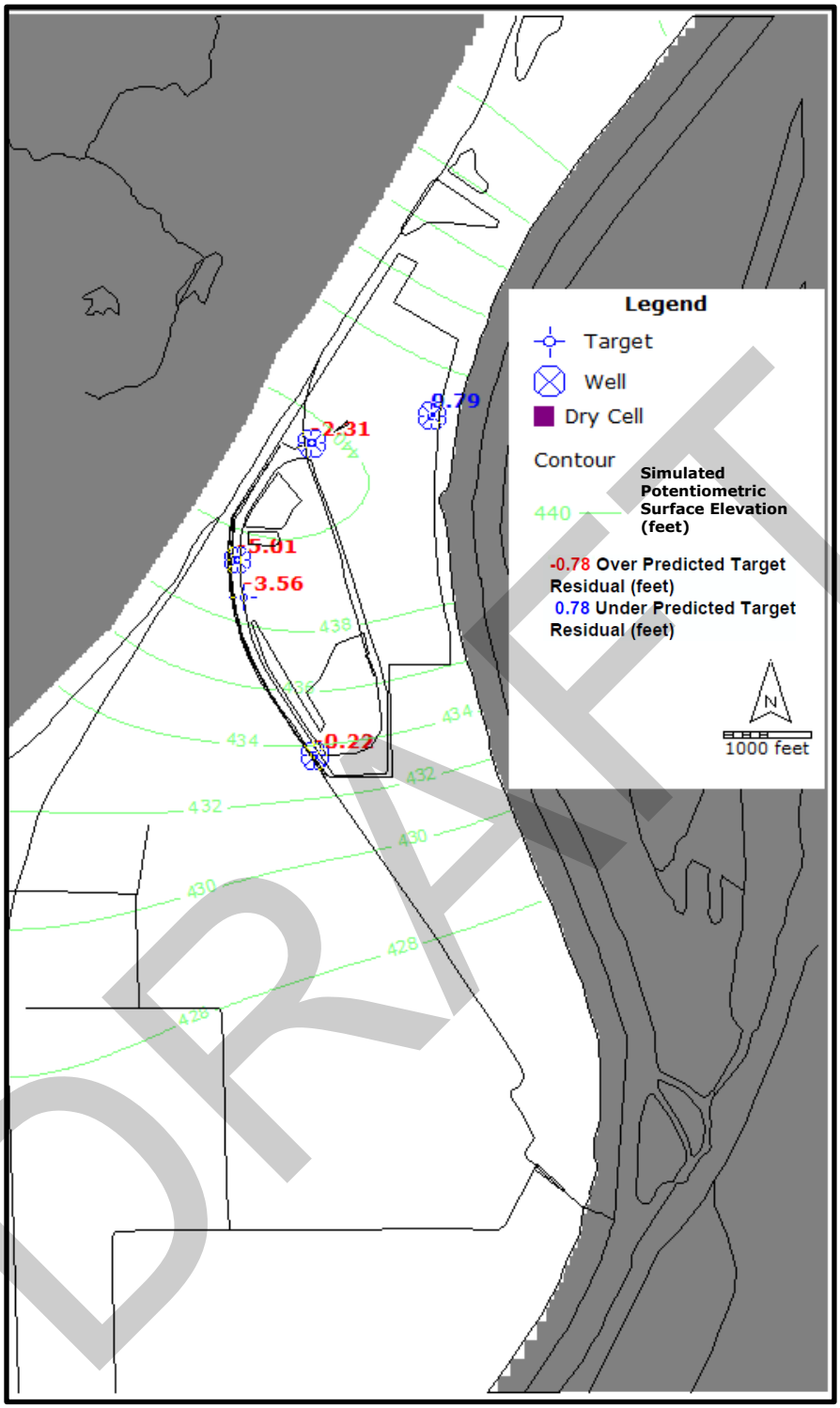
OBSERVED VERSUS SIMULATED GROUNDWATER ELEVATIONS FOR LAYER 4

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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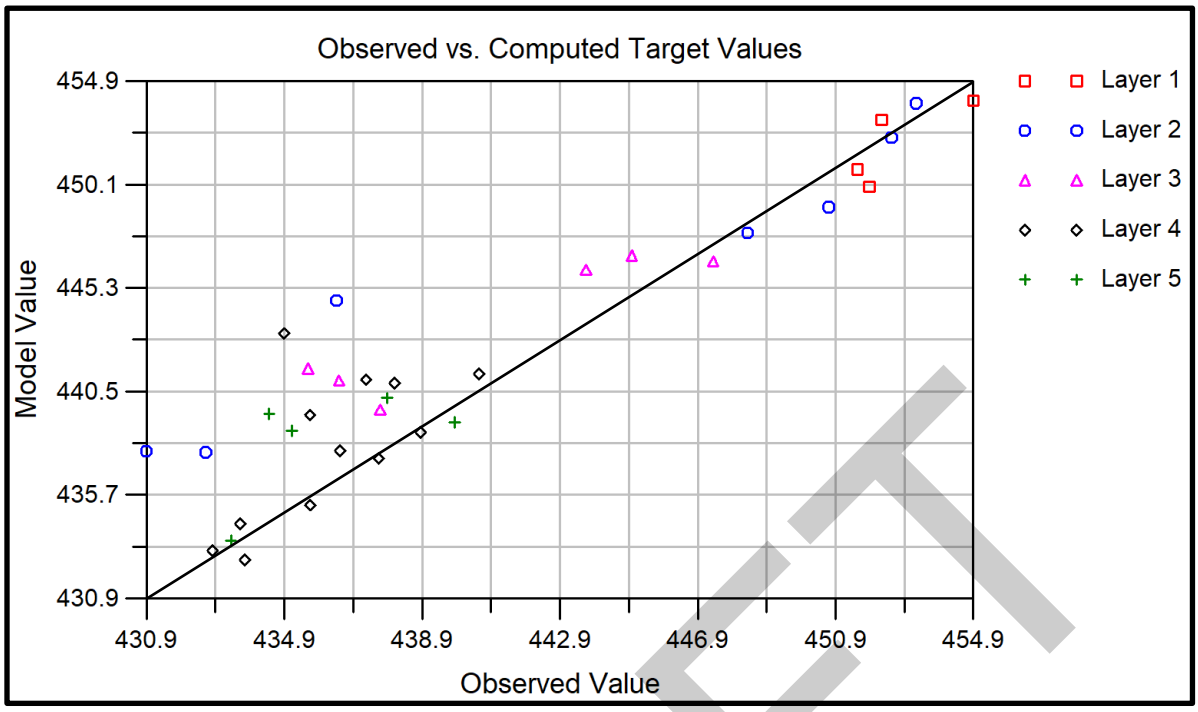
OBSERVED VERSUS SIMULATED GROUNDWATER ELEVATIONS FOR LAYER 5

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL

FIGURE 5-18

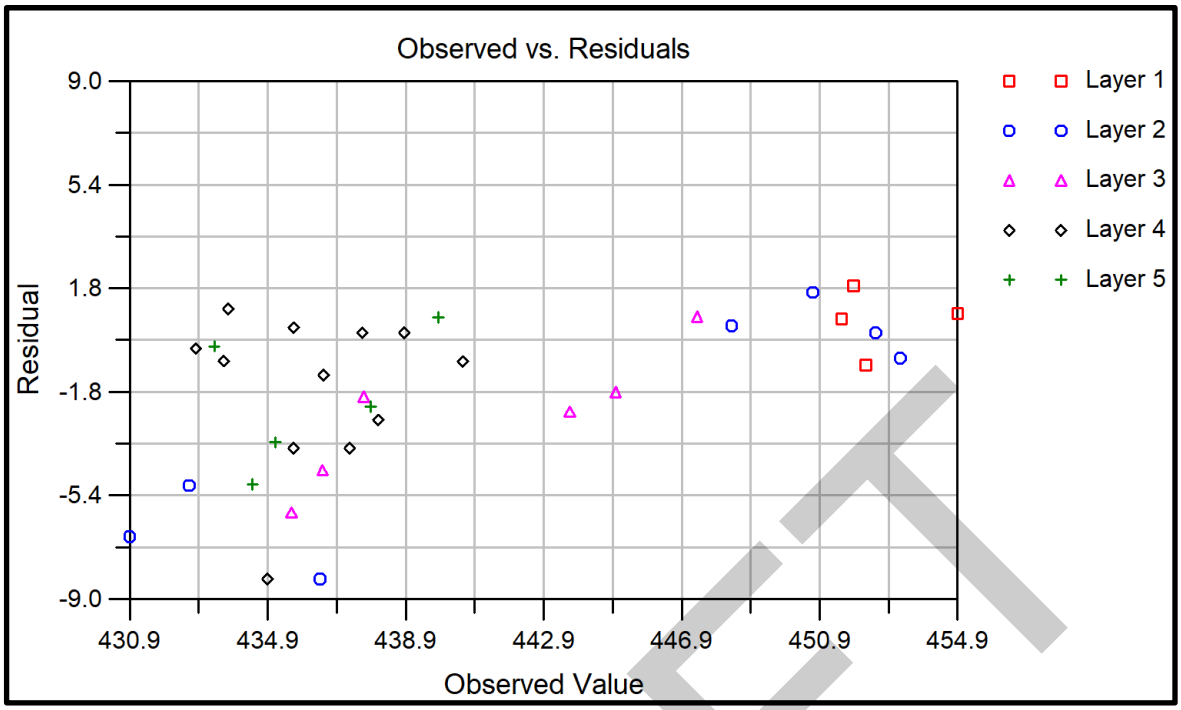


STEADY STATE MODFLOW CALIBRATION RESULTS – OBSERVED VERSUS SIMULATED (FT)

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL

DRAFT



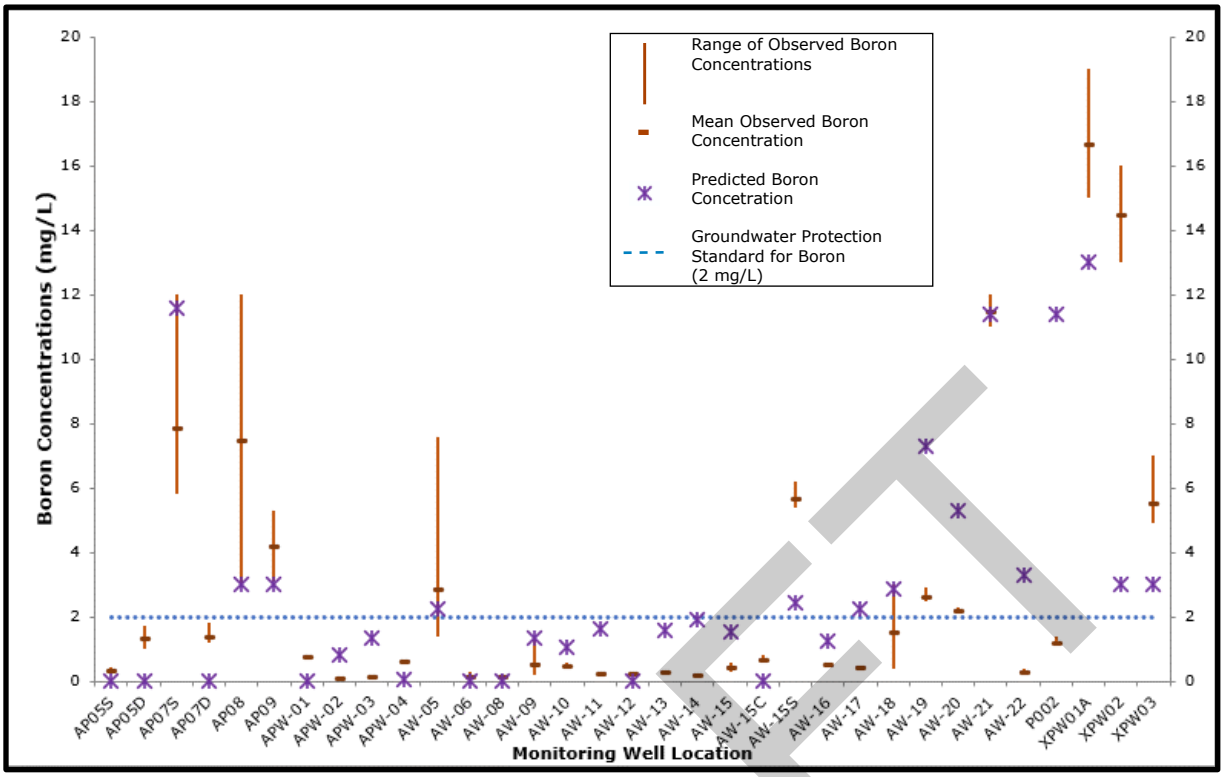
STEADY STATE MODFLOW CALIBRATION RESULTS – OBSERVED VERSUS RESIDUALS (FT)

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL

DRAFT

FIGURE 5-20

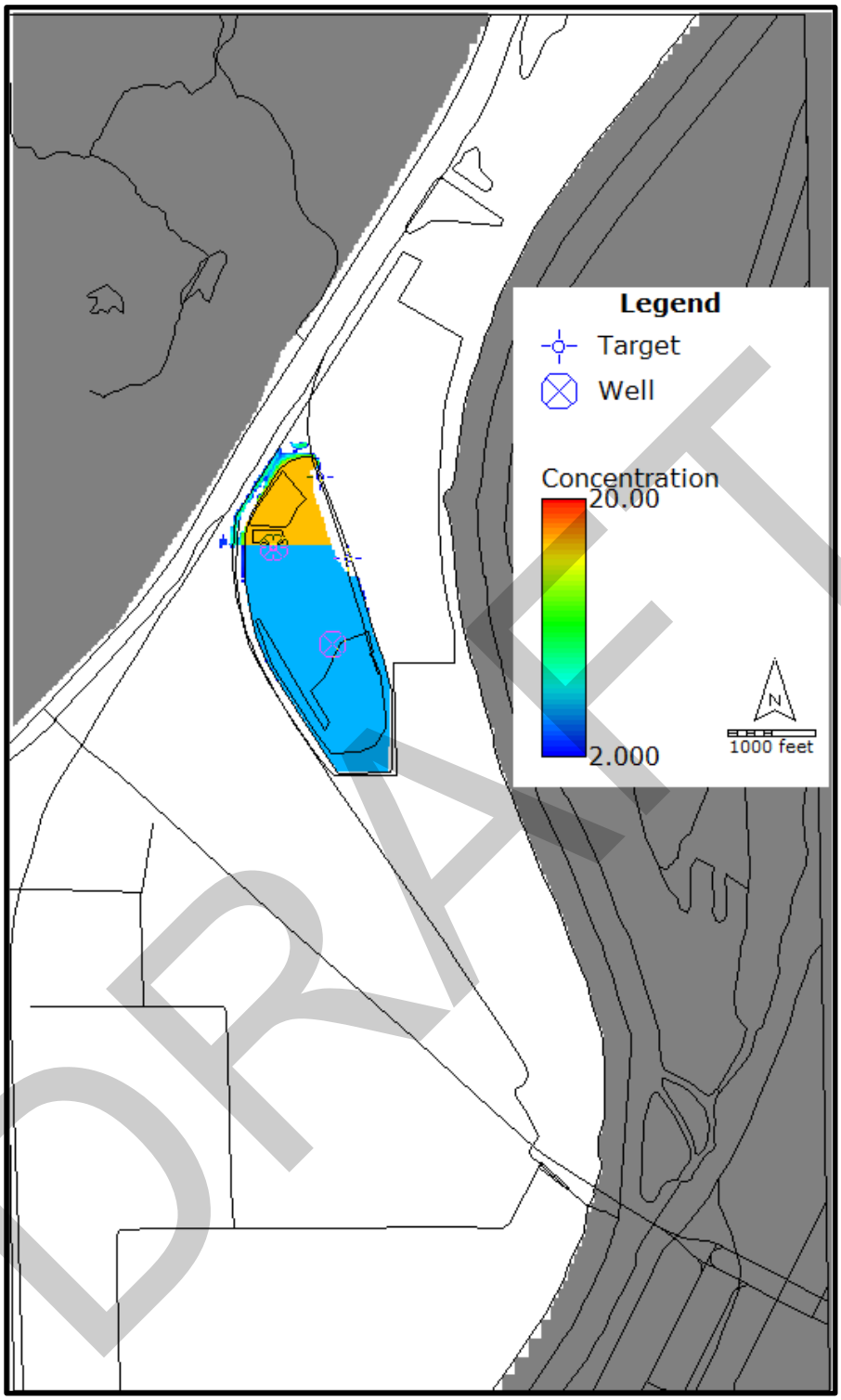


OBSERVED AND SIMULATED BORON CONCENTRATIONS (mg/L)

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL

DRAFT



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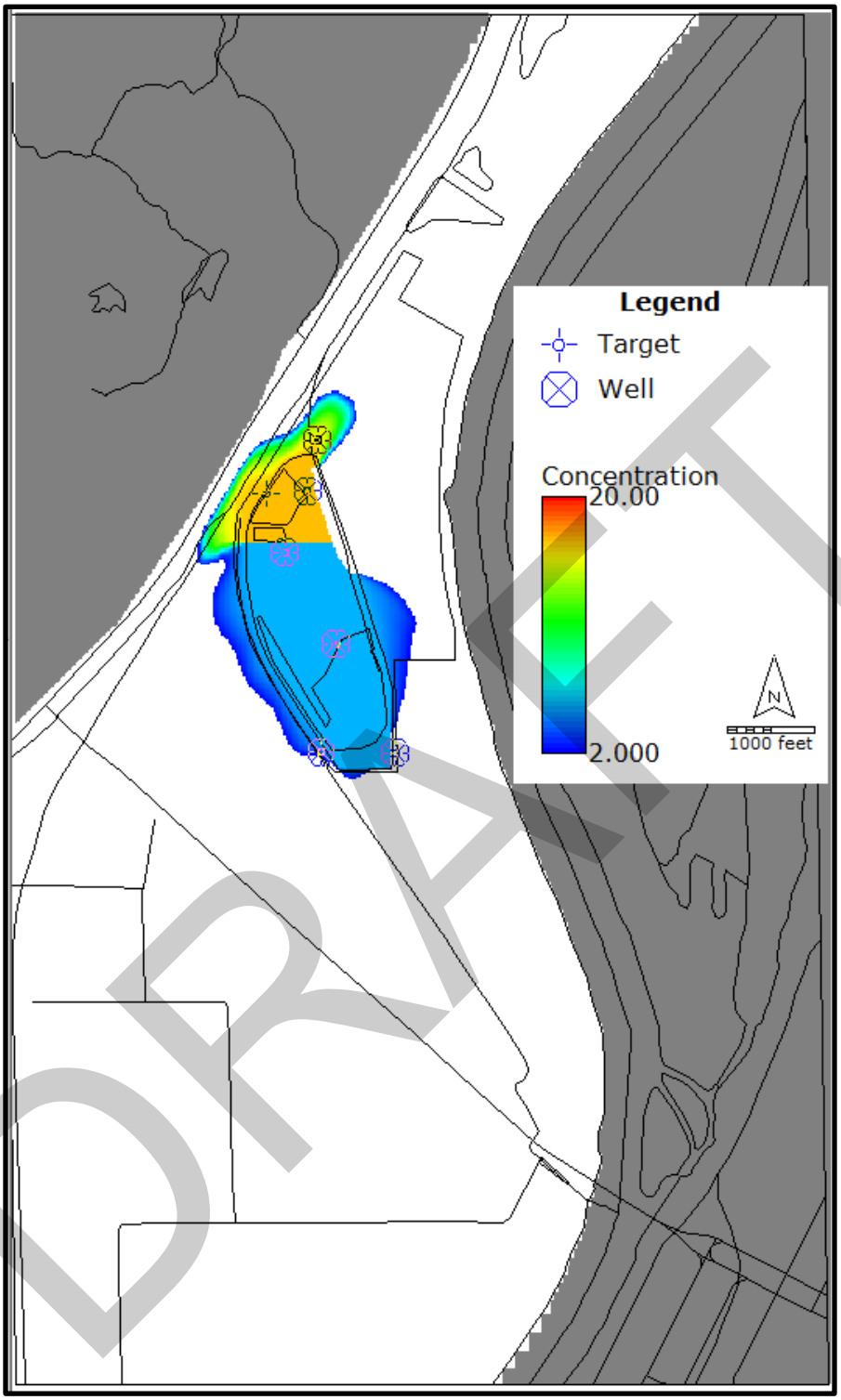
LAYER 1 DISTRIBUTION OF BORON CONCENTRATIONS (mg/L) IN THE CALIBRATED MODEL (UCF)

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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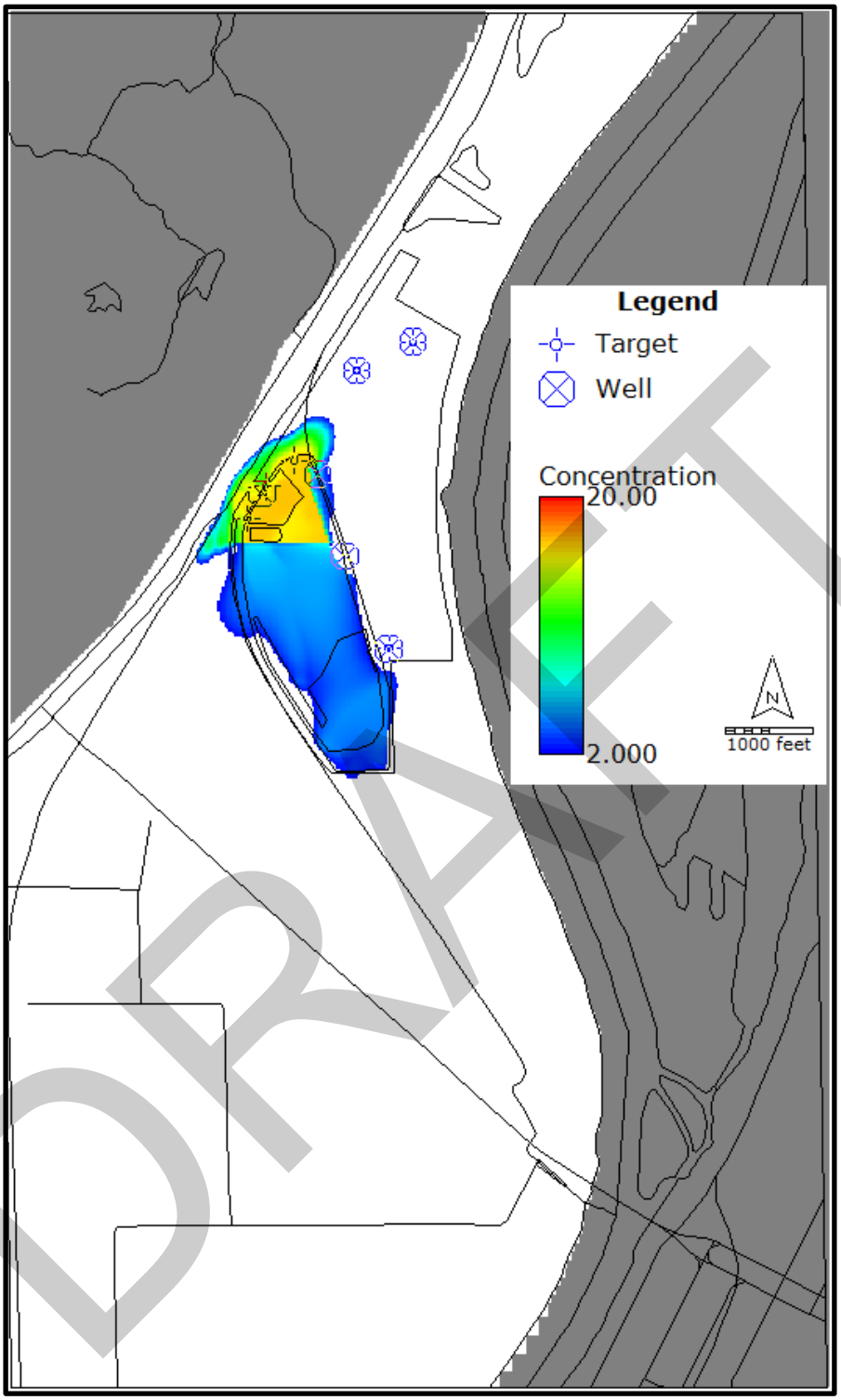
LAYER 2 DISTRIBUTION OF BORON CONCENTRATIONS (mg/L) IN THE CALIBRATED MODEL (UCF [PMP])

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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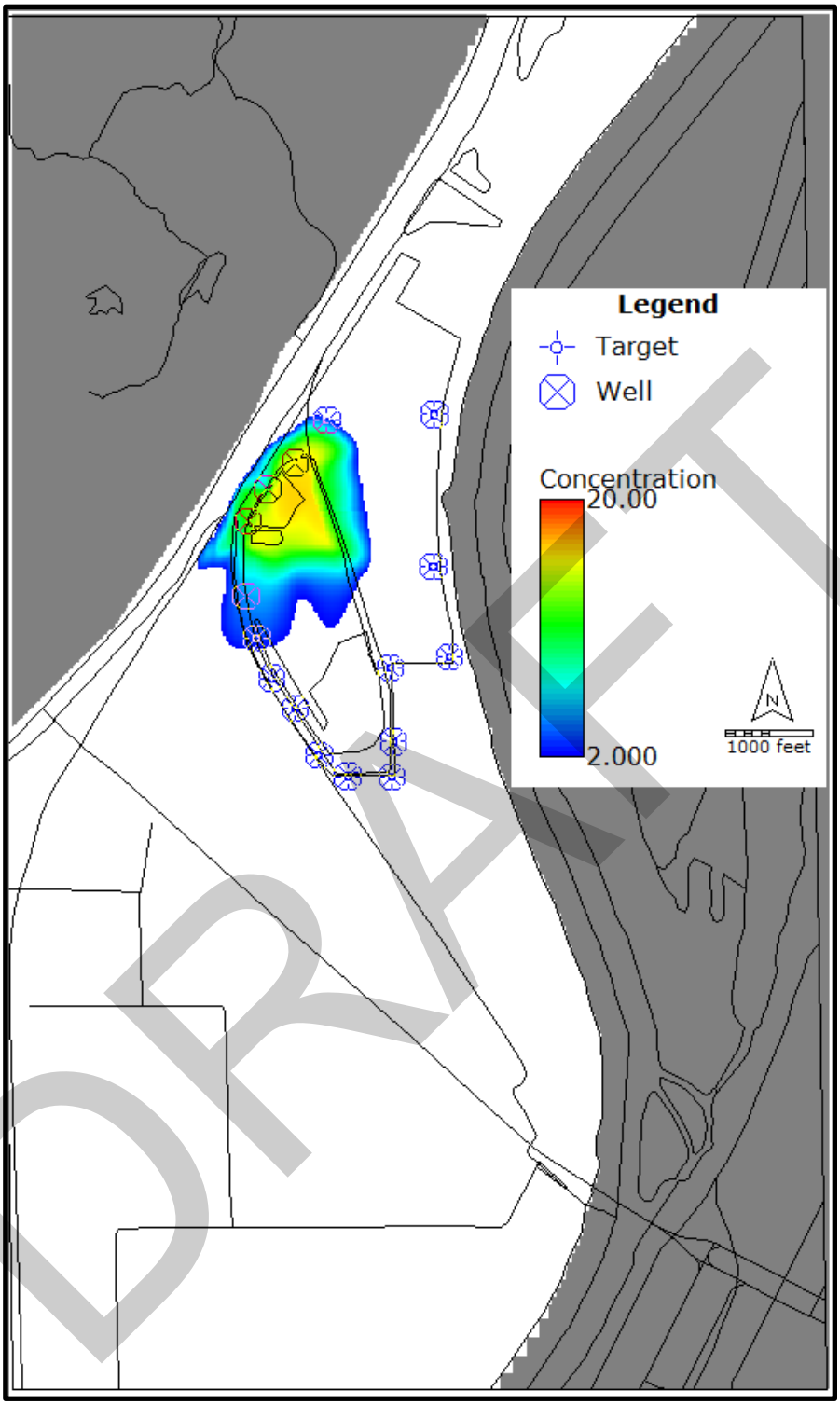
LAYER 3 DISTRIBUTION OF BORON CONCENTRATIONS (mg/L) IN THE CALIBRATED MODEL (UCF)

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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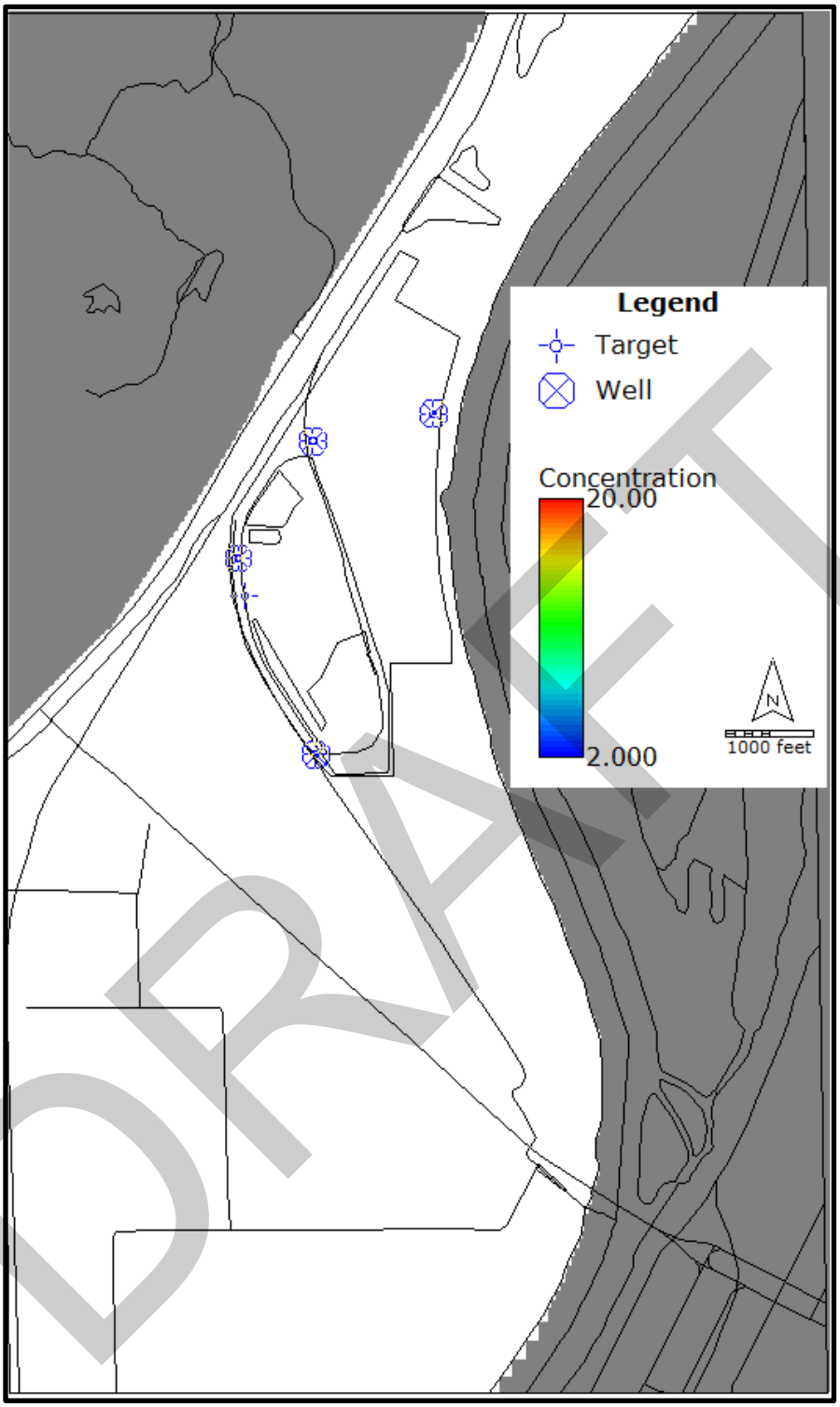
LAYER 4 DISTRIBUTION OF BORON CONCENTRATIONS (mg/L) IN THE CALIBRATED MODEL (UA)

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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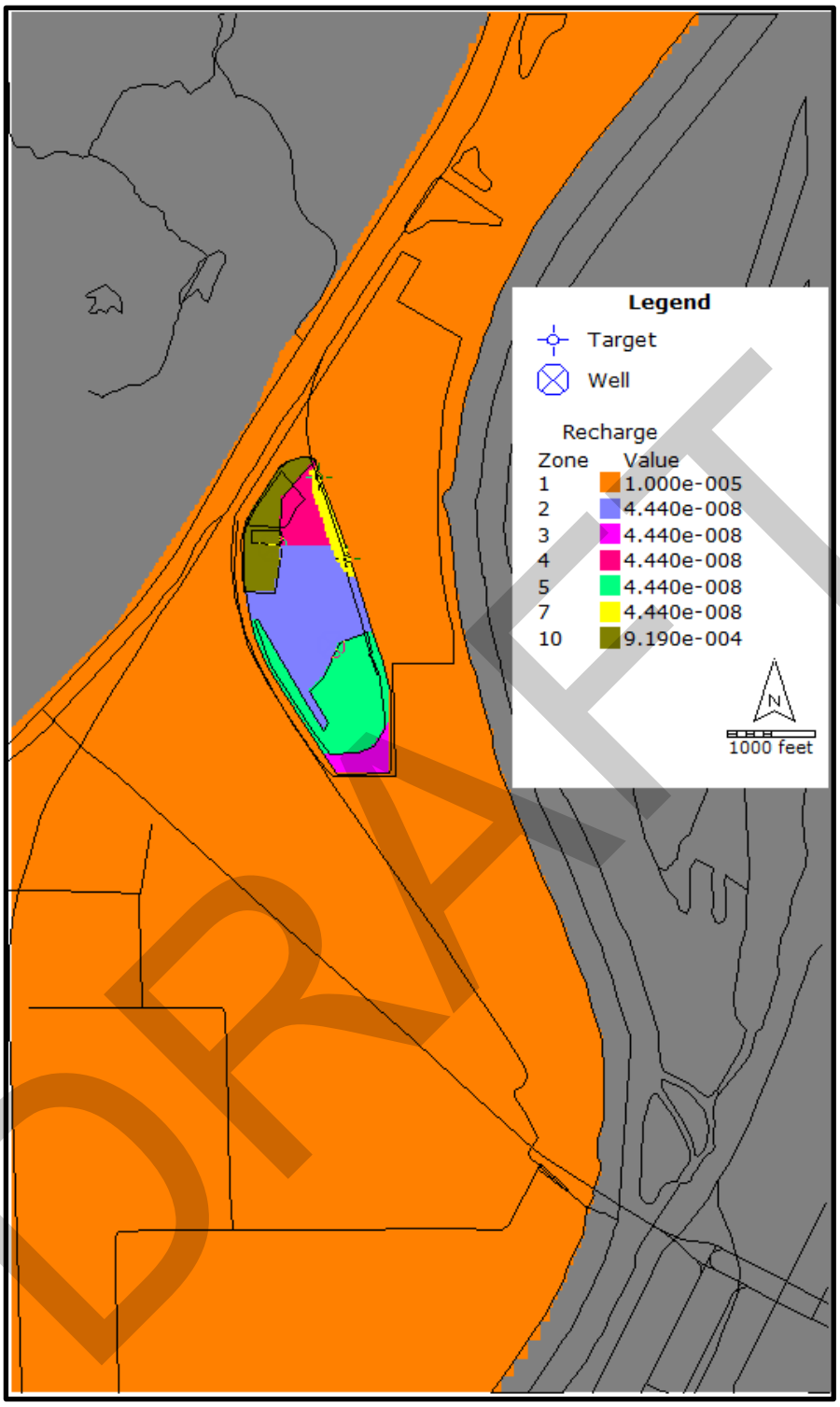
LAYER 5 DISTRIBUTION OF BORON CONCENTRATIONS (mg/L) IN THE CALIBRATED MODEL (BCU)

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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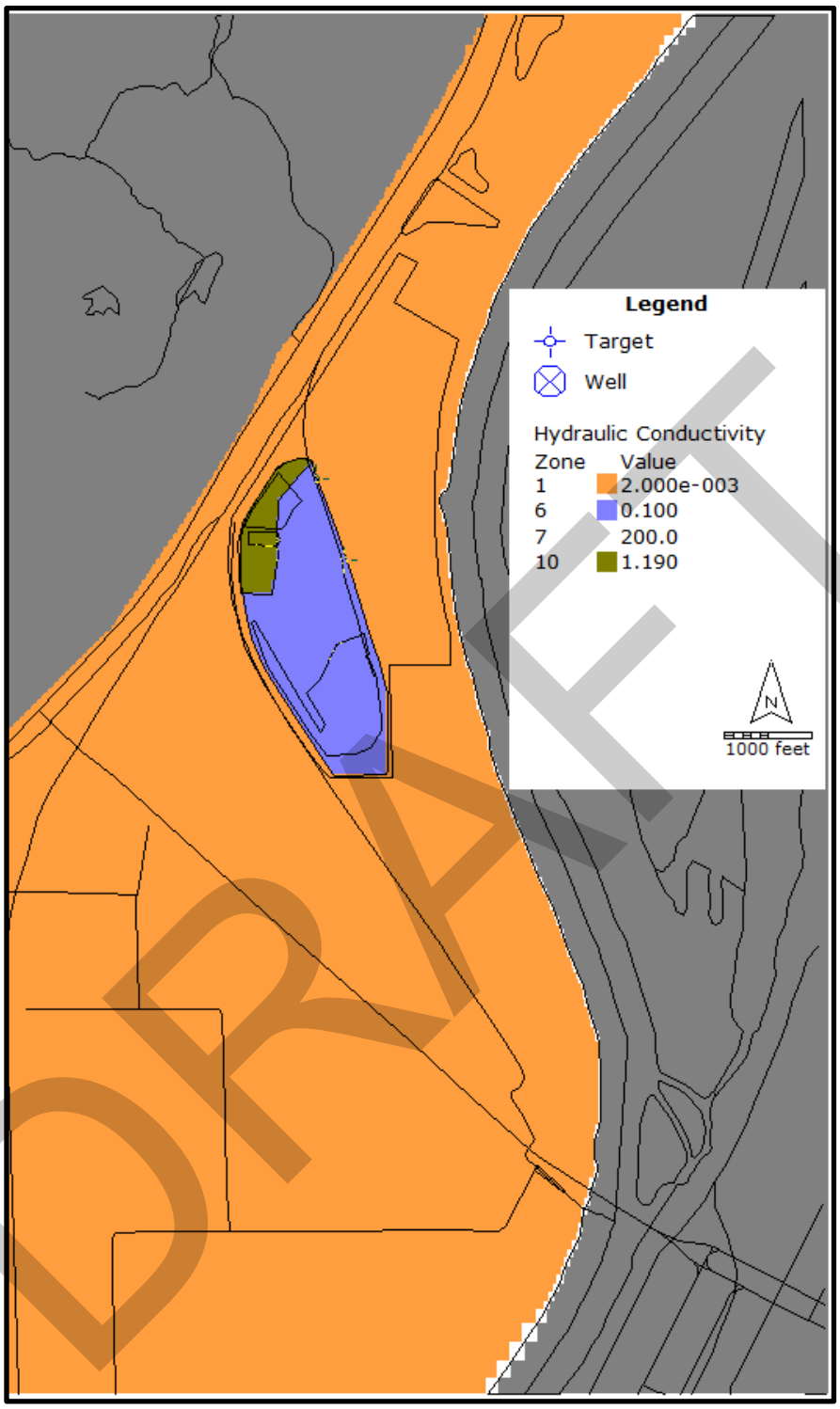
DISTRIBUTION OF RECHARGE ZONES (FEET/DAY) FOR CLOSURE IN PLACE

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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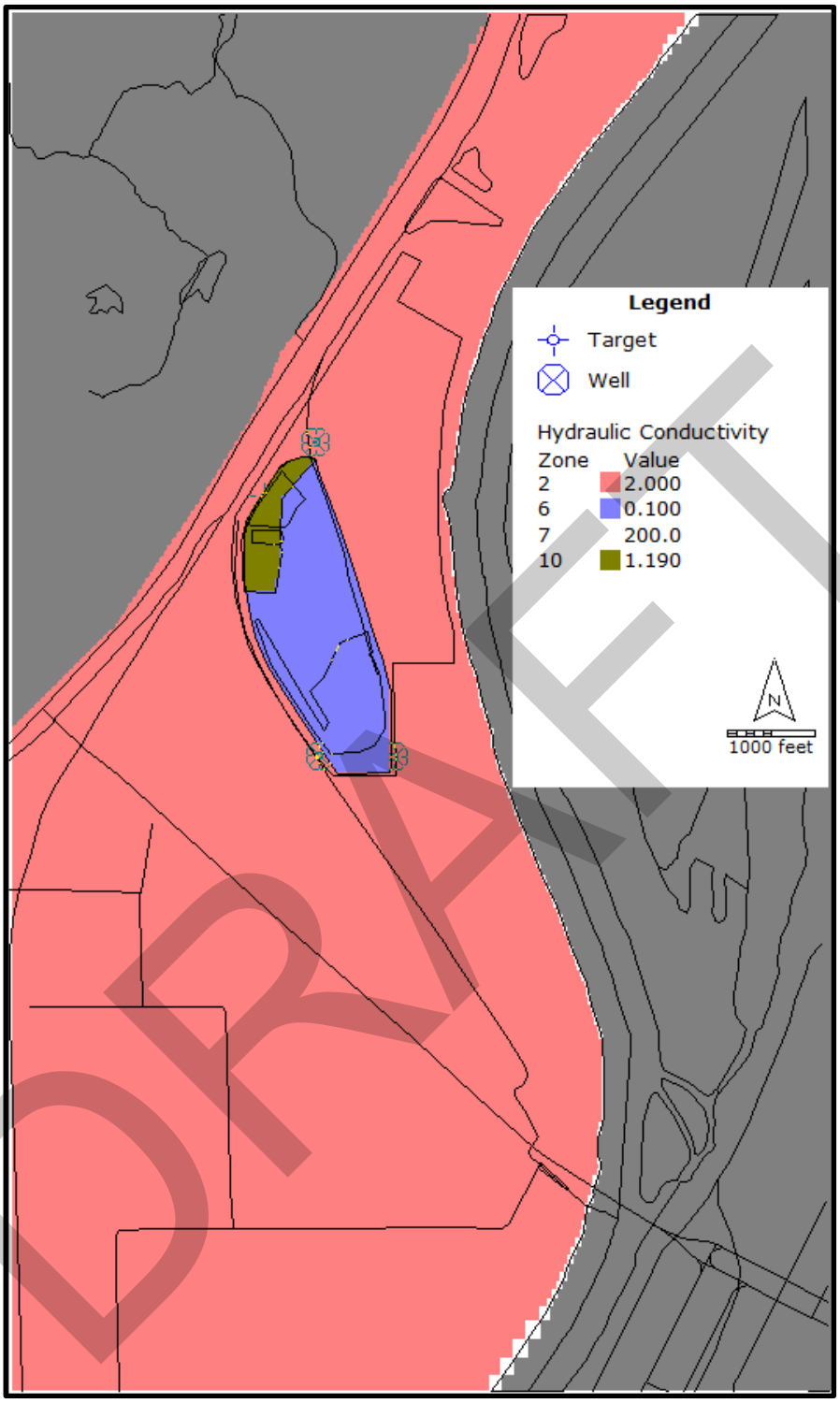
DISTRIBUTION OF HYDRAULIC CONDUCTIVITY ZONES (FEET/DAY) FOR LAYER 1 FOR CLOSURE IN PLACE

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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DISTRIBUTION OF HYDRAULIC CONDUCTIVITY ZONES (FEET/DAY) FOR LAYER 2 FOR CLOSURE IN PLACE

GROUNDWATER MODELING REPORT
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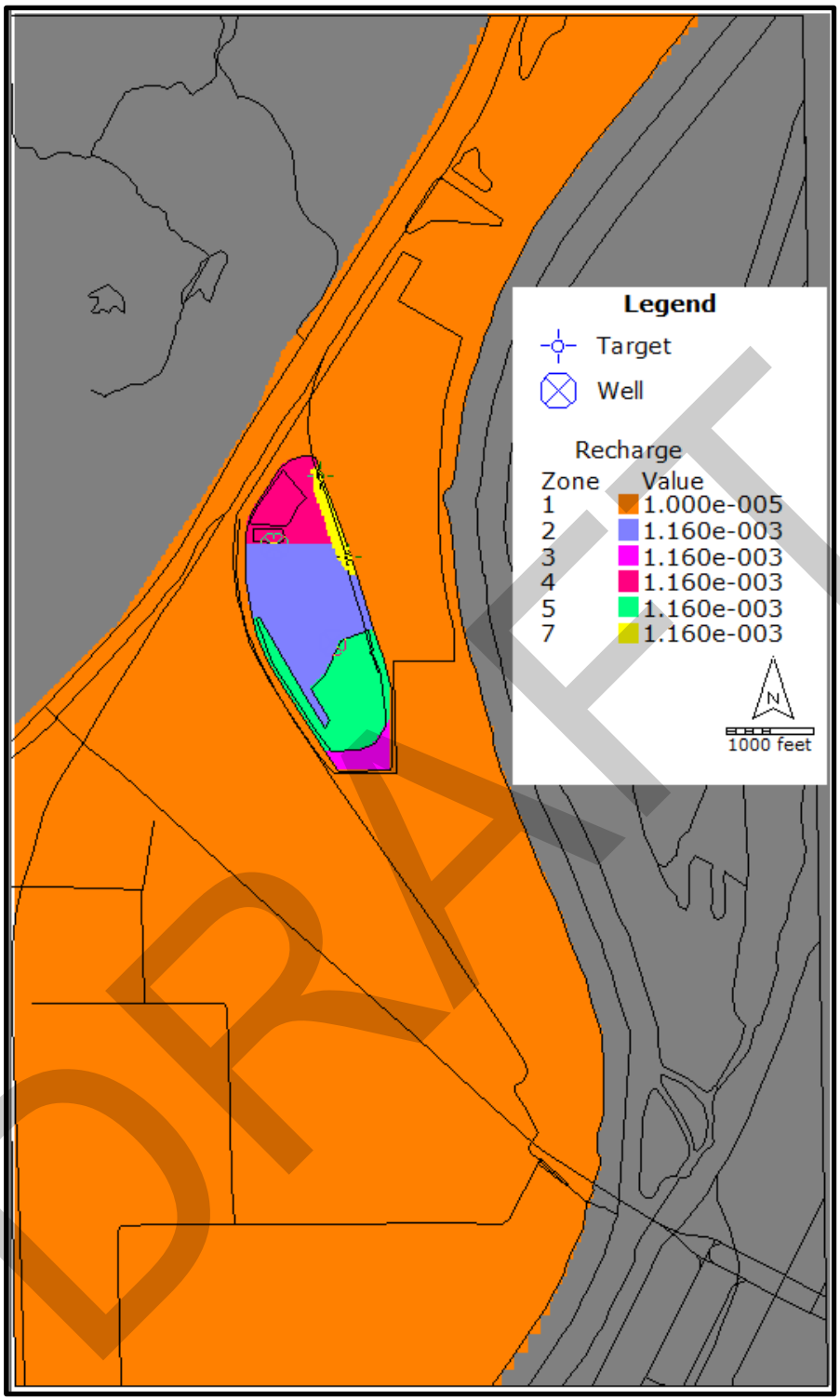
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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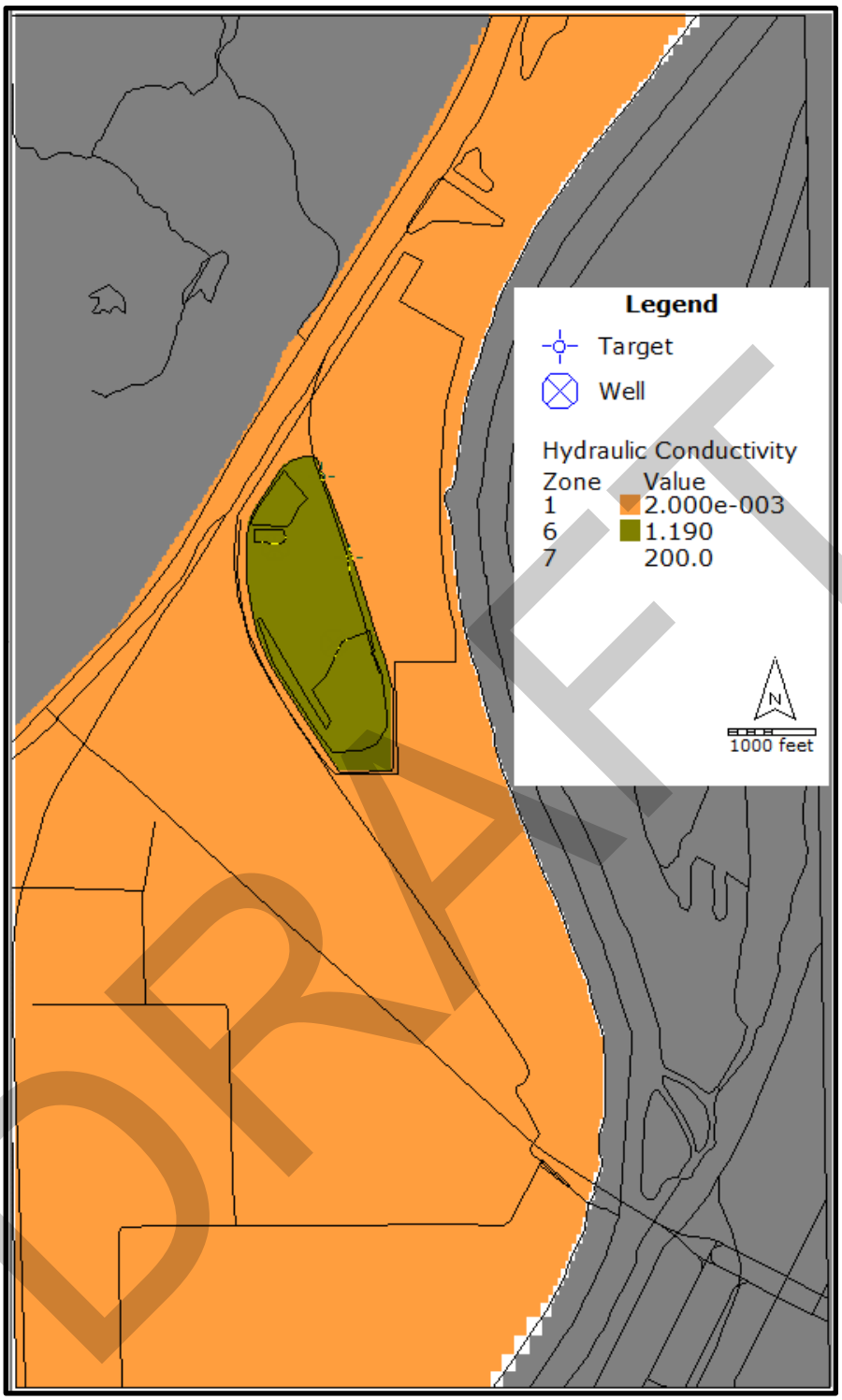
DISTRIBUTION OF RECHARGE ZONES (FEET/DAY) FOR CLOSURE BY REMOVAL

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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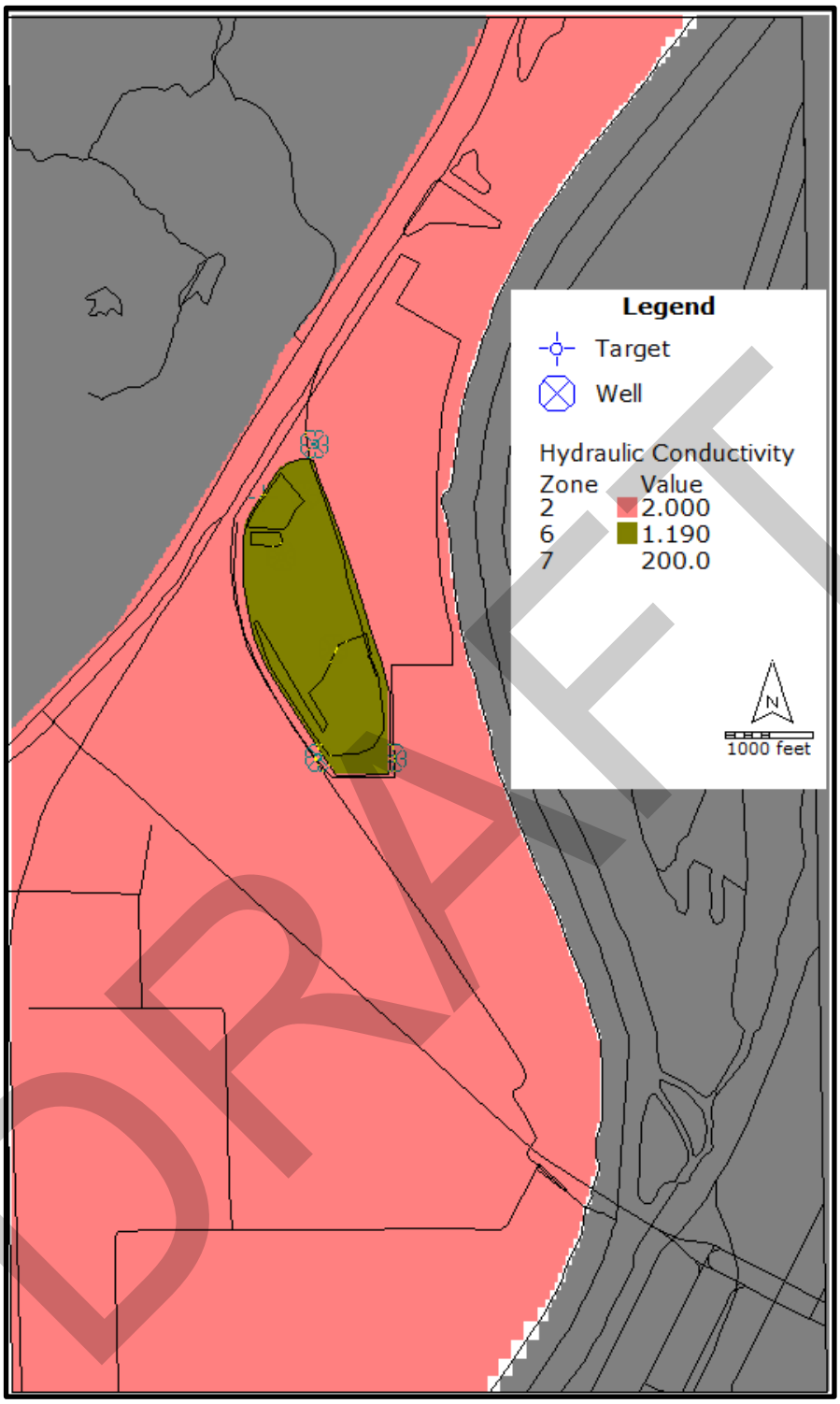
DISTRIBUTION OF HYDRAULIC CONDUCTIVITY ZONES (FEET/DAY) FOR LAYER 1 FOR CLOSURE BY REMOVAL

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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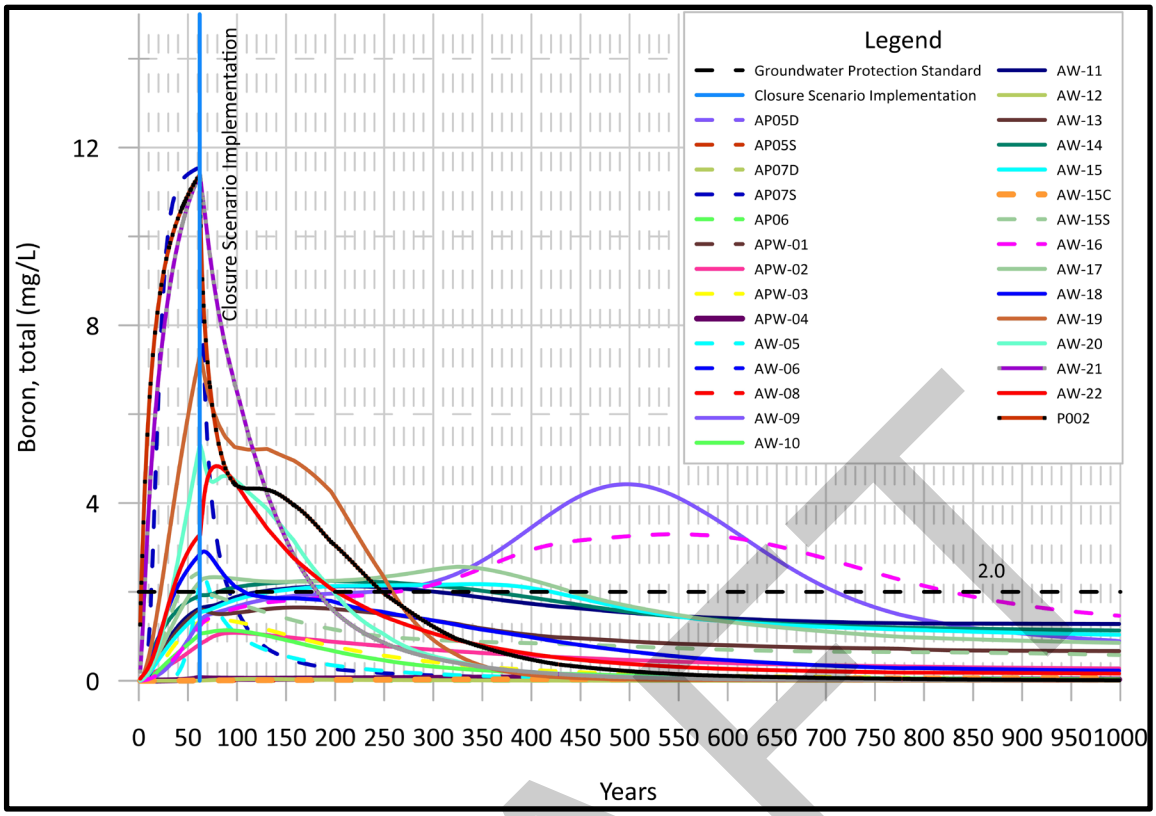
DISTRIBUTION OF HYDRAULIC CONDUCTIVITY ZONES (FEET/DAY) FOR LAYER 2 FOR CLOSURE BY REMOVAL

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL

FIGURE 6-7



CIP – MODEL PREDICTED BORON CONCENTRATION

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL

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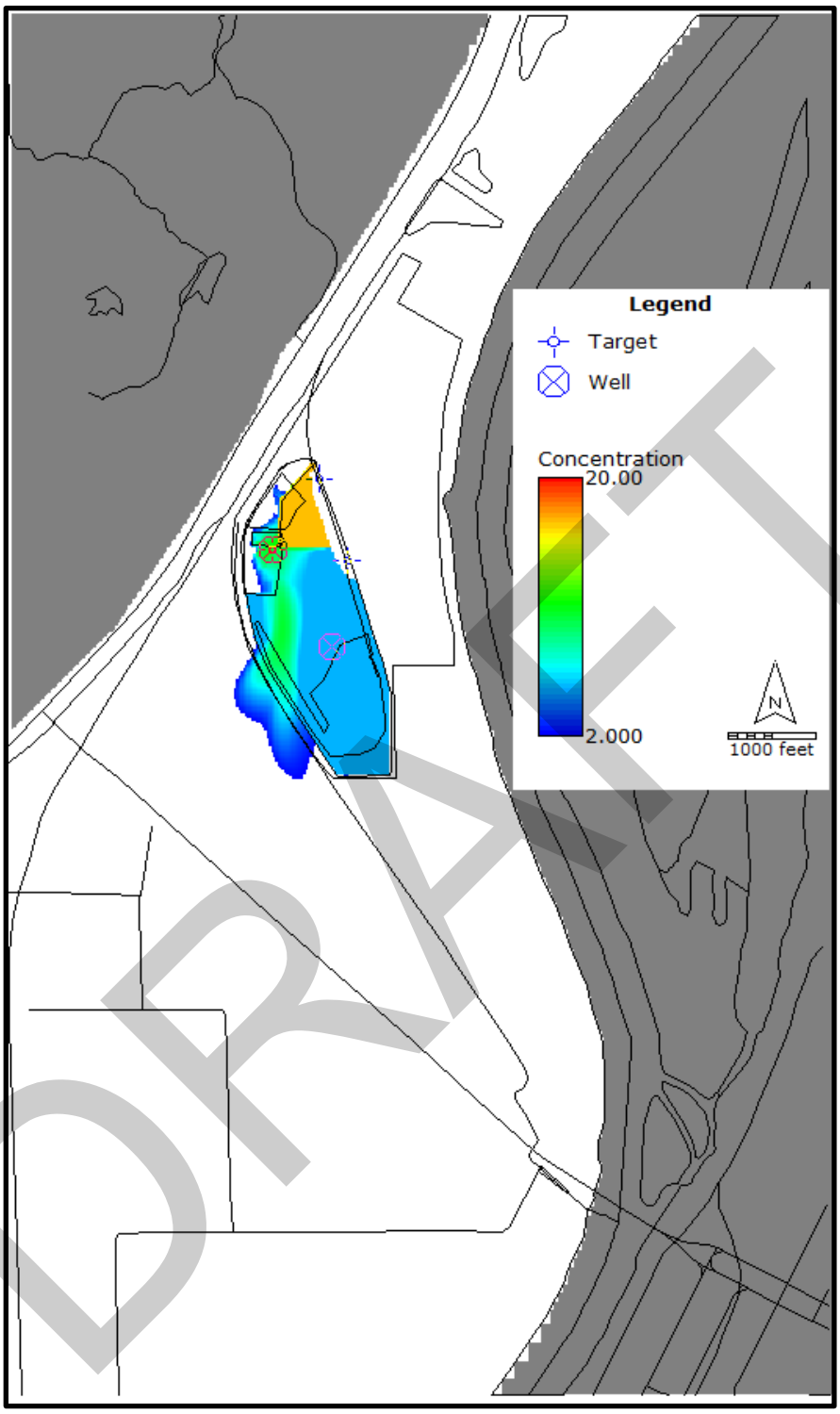

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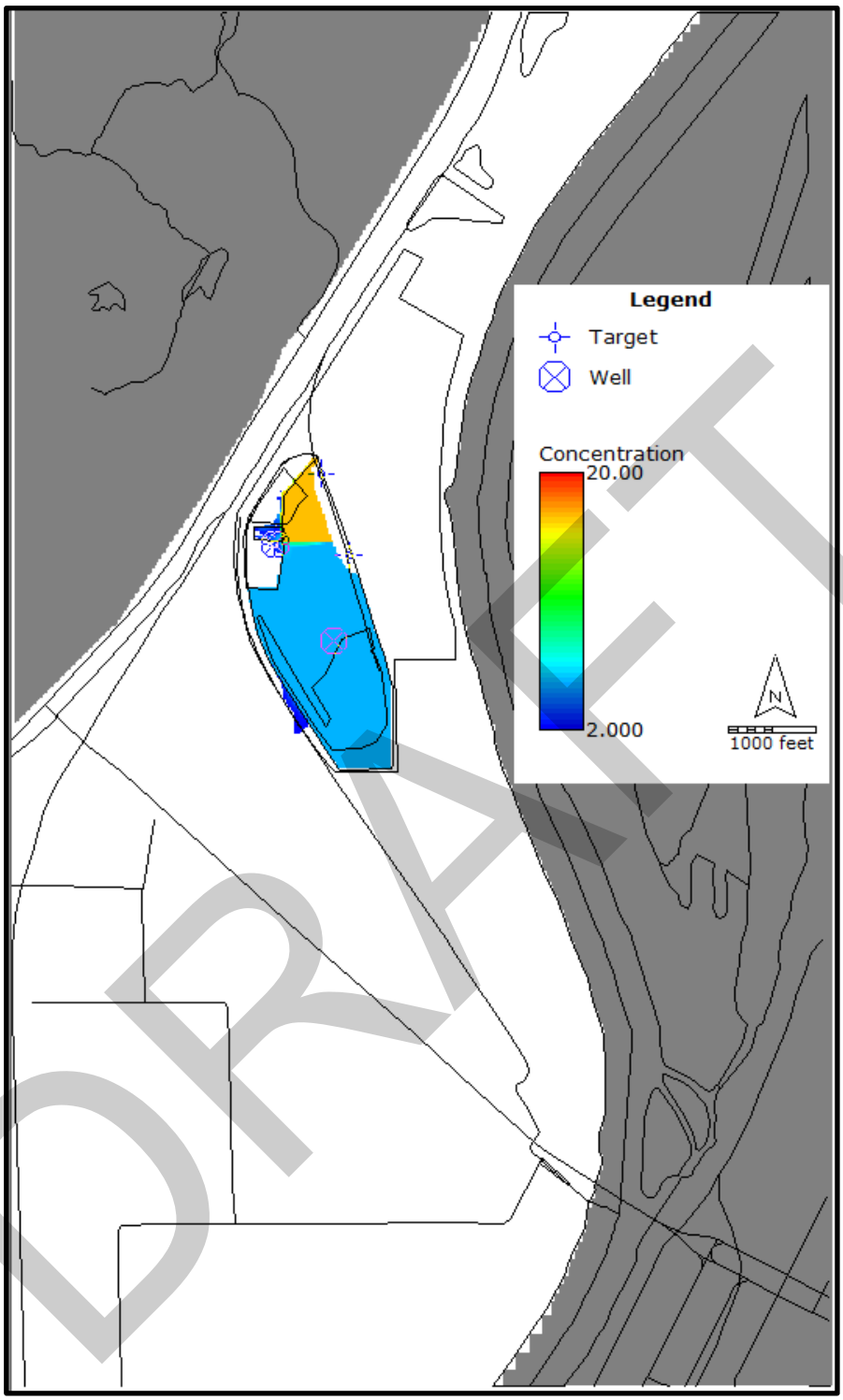
CIP – (SCENARIO 1) – MODEL PREDICTED MAXIMUM BORON PLUME IN ALL LAYERS
APPROXIMATELY 382 YEARS AFTER IMPLEMENTATION

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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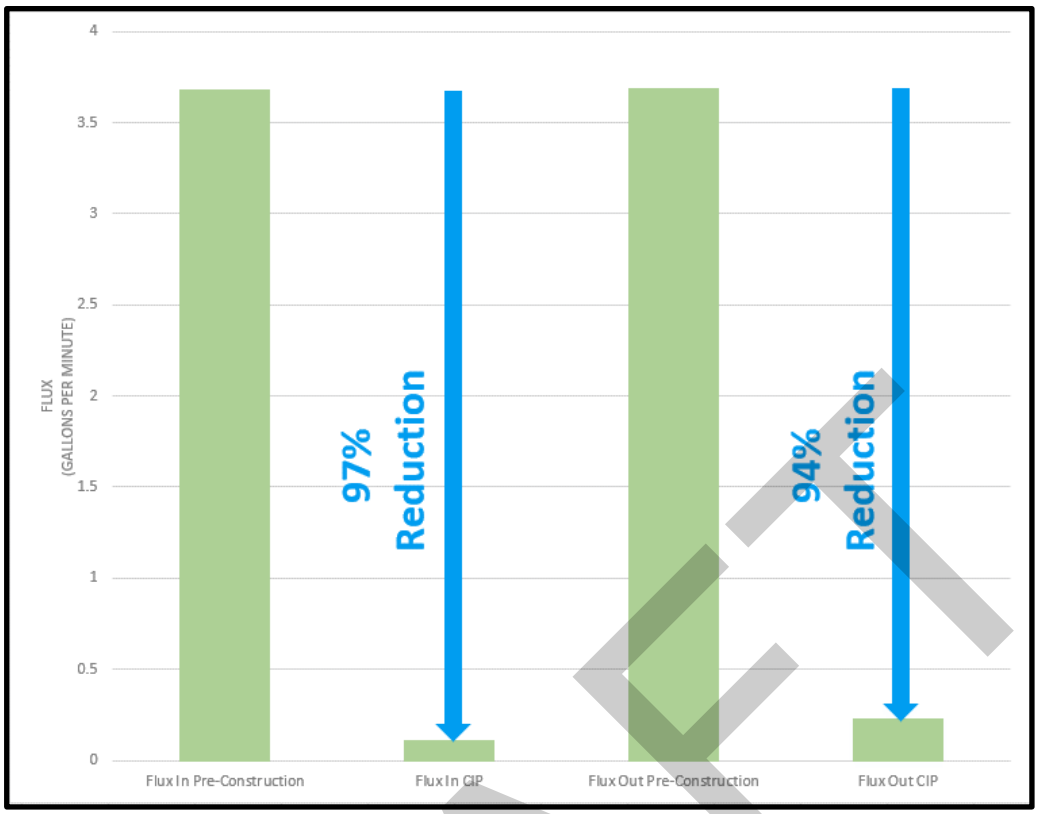
CIP – (SCENARIO 1) – MODEL PREDICTED MAXIMUM BORON PLUME IN ALL LAYERS
APPROXIMATELY 767 YEARS AFTER IMPLEMENTATION

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



SCENARIO 1 (CIP) –
HYDRAULIC STEADY STATE REDUCTIONS IN TOTAL FLUX IN AND OUT OF FILL UNIT (CCR)

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL

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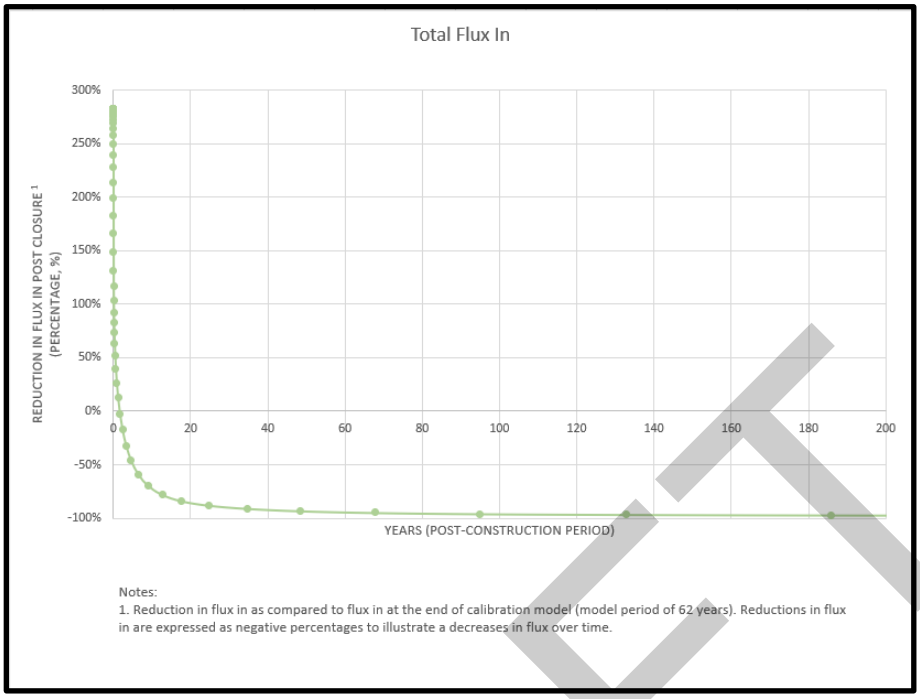

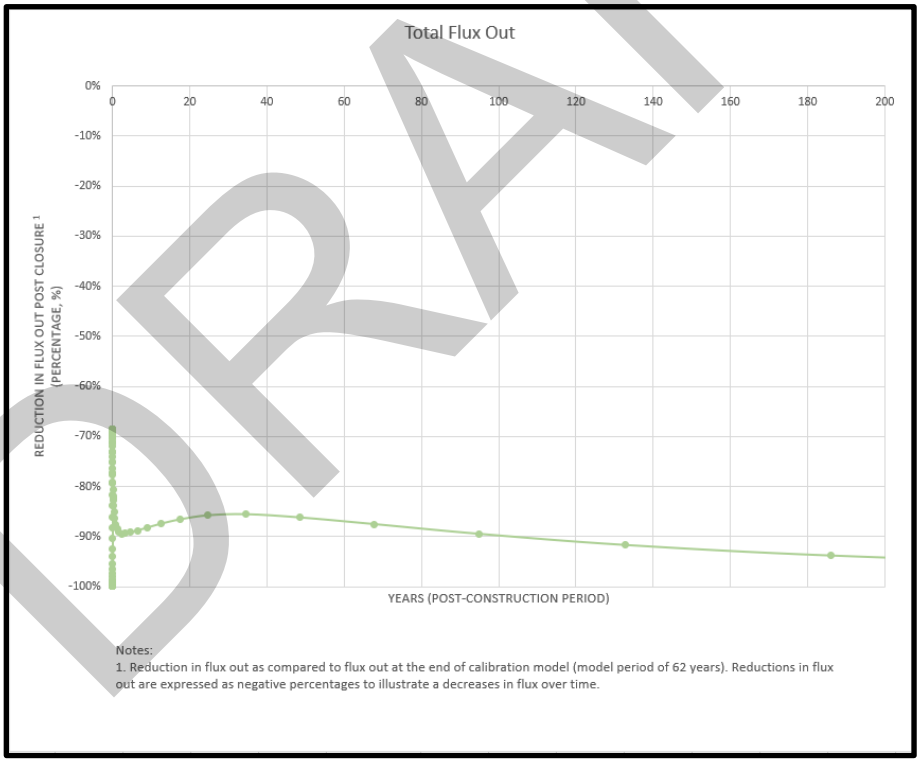

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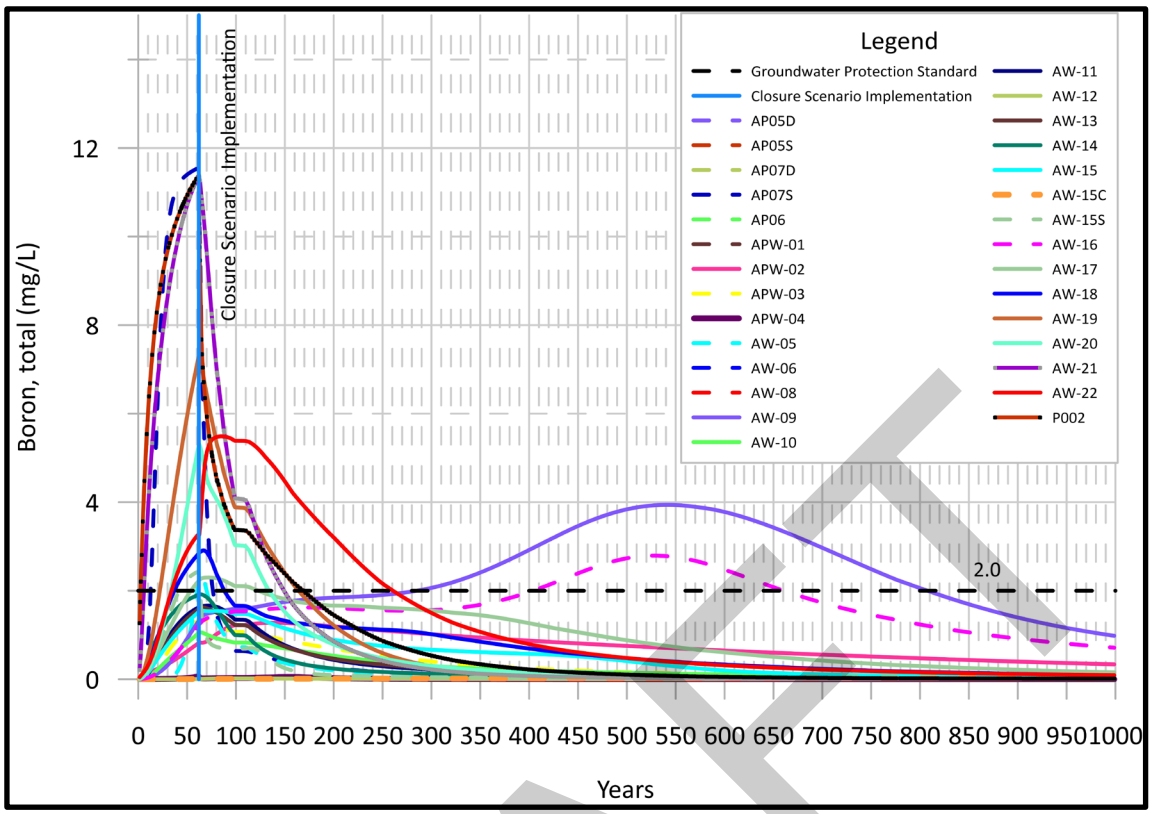
SCENARIO 1 (CIP) –
REDUCTIONS IN TOTAL FLUX IN AND OUT OF FILL UNIT (CCR)

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL

FIGURE 6-12



CBR – MODEL PREDICTED BORON CONCENTRATION

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

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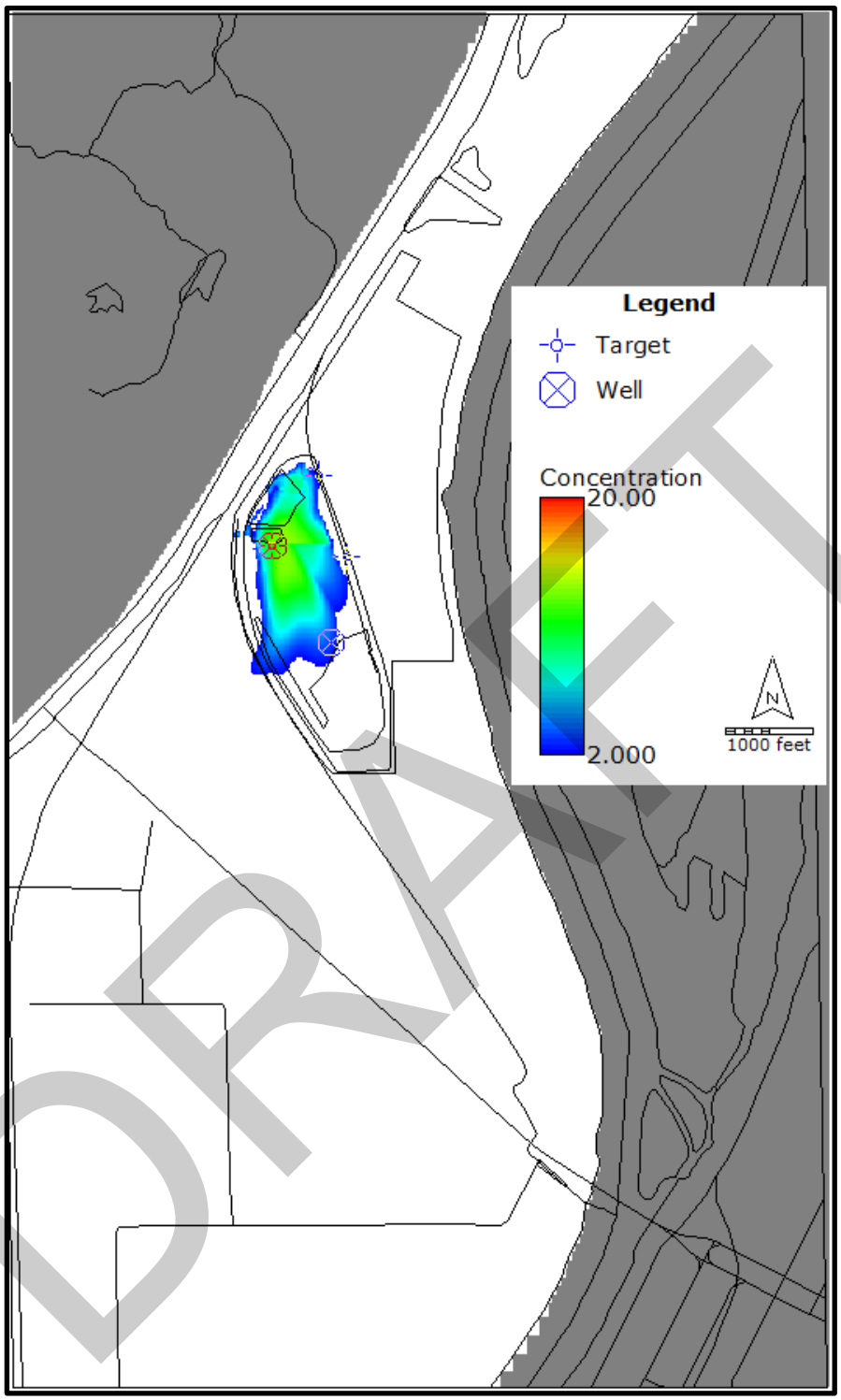

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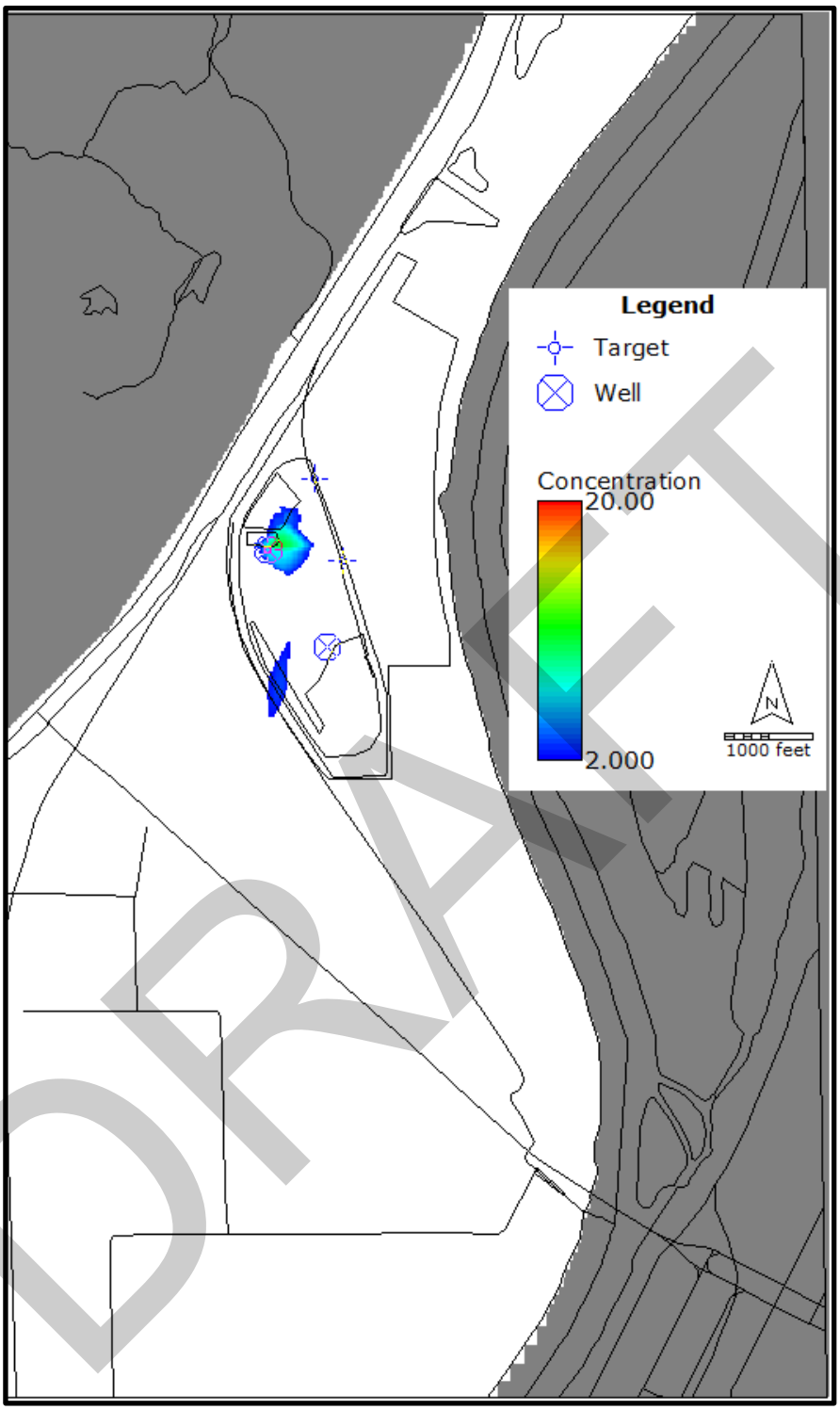
CBR – (SCENARIO 2) – MODEL PREDICTED MAXIMUM BORON PLUME IN ALL LAYERS
APPROXIMATELY 201 YEARS AFTER IMPLEMENTATION

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL



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CBR – (SCENARIO 2) – MODEL PREDICTED MAXIMUM BORON PLUME IN ALL LAYERS
APPROXIMATELY 748 YEARS AFTER IMPLEMENTATION

GROUNDWATER MODELING REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

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APPENDIX A
EVALUATION OF POTENTIAL GWPS EXCEEDANCES (GOLDER ASSOCIATES USA INC., 2022)

DRAFT

TECHNICAL MEMORANDUM

DATE April 14, 2022 **Project No.** 21454831

TO David Mitchell, Stu Cravens, Vic Modeer
Illinois Power Resources Generating, LLC.

CC Brian Hennings - Ramboll

FROM Roberta Russell, Jeffrey Ingram, Pat Behling **EMAIL jeffrey.ingram@wsp.com**

EVALUATION OF POTENTIAL GWPS EXCEEDANCES, EDWARDS ASH POND (CCR UNIT 301), EDWARDS POWER PLANT, PEORIA COUNTY, ILLINOIS

1.0 INTRODUCTION

Illinois Power Resource Generating, LLC (IPRG) currently operates the Edwards Power Plant (EPP) located in Peoria County, Illinois. The Edwards Ash Pond (EAP), Illinois Environmental Protection Agency (IEPA ID No. W1438050005 - 01) is a 91-acre unlined surface impoundment used to manage coal combustion residuals (CCRs) at the EPP. The EAP is regulated under Part 845 *"Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments"* (State CCR Rule or Part 845) which was promulgated by the Illinois Pollution Control Board (IPCB) on April 21, 2021.

IPRG is currently preparing a Construction Permit application for the EAP as required under Section 845.220 which requires groundwater modeling be completed for the known potential exceedances of groundwater protection standards (GWPS) as outlined in the Operating Permit application (Burns and McDonnell 2021). In October 2021, Ramboll Americas Engineering Solutions, Inc. (Ramboll) identified potential GWPS exceedances for lithium, chloride and barium in certain monitoring wells in the vicinity of the EAP (Ramboll 2021b). This Technical Memorandum was developed to further evaluate these potential GWPS exceedances.

1.1 Site Setting, Geology, and Hydrogeology

The EPP is located in Peoria County between Mapleton and Bartonville in Section 11, Township 7 North, Range 7 East, on the floodplain of the Illinois River adjacent to a levee. The EPP has one CCR surface impoundment, the Ash Pond, covering approximately 91 surface acres.

The EPP is situated in a predominantly agricultural area with industrial parcels bordering the property. Historically, several coal mines were operated at depths of 100 to 160 feet below ground surface (bgs) in the vicinity of the EPP. The EPP property is bordered by a salt processing facility to the north, railroad right-of-way and former Orchard Mines to the west, the Illinois River and a fertilizer production facility to the east, and agricultural land to the south.

Four hydrogeologic units are present at the EPP. They are described as follows in the Hydrogeologic Site Characterization Report (Ramboll 2021c), in downward order:

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Golder Associates USA Inc.
701 Emerson Road, Suite 250, Creve Coeur, Missouri, 63141 T: +1 314 984 8800 F: +1 314 984-8770

- **CCR:** Saturated CCR consisting primarily of fly ash within the Ash Pond. CCR is present at thicknesses up to 46.5 feet and at elevations as low as 413.9 feet North American Vertical Datum of 1988 (NAVD88) in the central and northern portion of the Ash Pond**.**
- **Upper Cahokia Formation/Potential Migration Pathway (PMP):** Low-permeability clays and silts of the Upper Cahokia Formation are present at the surface. This unit is considered a PMP at elevations similar to the base of the Ash Pond, and in places where thin discontinuous sand lenses occur within the Upper Cahokia Formation adjacent to the Ash Pond.
- **Uppermost Aquifer (UA):** Thin (generally less than 4 feet), moderate-permeability sand, silty sand, and clayey gravel material within the Lower Cahokia Formation, bedrock, and/or weathered shale bedrock, where present. In locations where higher-permeability materials and coarser-grained materials are absent, the Uppermost Aquifer is interpreted as the interface between the Lower Cahokia Formation and the Bedrock Confining Unit.
- **Bedrock Confining Unit (BCU):** Thick, very low-permeability shales and siltstones of the Carbondale and Modesto Formations. This unit was encountered at elevations ranging from approximately 400 to 422 feet NAVD88 with higher bedrock elevations occurring beneath the northern portion of the Ash Pond. In general, the Upper Cahokia Formation consists of low-permeability clays and silts, with limited occurrences of thin, discontinuous sand lenses. In several locations, generally near the southern and western portions of the unit, coarser-grained materials are present at the base of the Lower Cahokia Formation and/or the top of the bedrock is weathered, resulting in relatively higher hydraulic conductivities. Because the interface is laterally continuous and has relatively higher conductivity, the unlithified/lithified upper contact was designated as the Uppermost Aquifer.

Occasional sand lenses within the Upper Cahokia Formation and downgradient clay intervals present at elevations similar to the base of ash in the Ash Pond were identified as PMPs. The underlying BCU is interpreted as the confining base of the aquifer, with hydraulic conductivities generally two orders of magnitude lower than those measured in the Uppermost Aquifer (Ramboll 2021c).

Groundwater flows east to west in the central portion of the EAP, south/southeast at the south end of the EAP and to the north/northwest at the north end of the EAP (Ramboll 2021b) (**Figure 1**).

2.0 POTENTIAL GWPS EXCEEDANCES REVIEW

As required by Section 845.230 (d)(2)(M), an evaluation of the history of potential GWPS exceedances was completed for the Operating Permit application (Burns and McDonnell 2021 and Ramboll 2021b). Water quality data from groundwater samples collected from the EAP monitoring well network since February 2021 were evaluated using the statistical methods described in the Statistical Analysis Plan included in the Operating Permit application (Ramboll, 2021b). The following potential exceedances of the GWPSs were evaluated in this Technical Memorandum:

- Barium at monitoring well AW-15C: A barium exceedance (2.9 mg/L) in this well was reported based on calculation of a confidence interval around the mean of samples collected during 2021. AW-15C is located downgradient from the EAP and the screened interval is within a shale unit of the BCU.

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- Chloride at monitoring well AP07D: A chloride exceedance (498 mg/L) in this well was reported based on calculation of a confidence interval around the mean of samples collected during 2021. AP07D is located downgradient from the Ash Pond; the screened interval is within a siltstone unit of the BCU.
- Lithium at monitoring well AP05D: A lithium exceedance (0.077 mg/L) in this well was reported based on calculation of a future median (i.e. a median of the three most recent samples) of samples collected during 2021. AP05D is located cross-gradient from the EAP and the screened interval is within a siltstone unit of the BCU.
- Lithium at monitoring well AP07D: A lithium exceedance (0.15 mg/L) in this well was reported based on calculation of a future median of samples collected during 2021. AP07D is located downgradient from the EAP and the screened interval is within a siltstone unit of the BCU.

3.0 COMPOSITIONAL ANALYSIS OF GEOLOGIC MATERIAL

3.1 Chemical Composition and Sequential Extraction

Results from sequential extractions and chemical analysis were used to determine the chemical composition of the BCU and the distribution of barium and lithium over various operationally-defined fractions in the BCU material. This testing was conducted on three samples collected from two boreholes (E-SB-05 and E-SB-07; Figure 1) advanced within the BCU. Results are presented in Section 4.0.

A description of the sequential extractions is presented in Footnote 1, Section 4.0. Metals extracted in steps 1 through 5 are considered environmentally available, whereas metals extracted in steps 6 and 7 are present in refractory fractions and are not expected to be released under conditions typically encountered in aquifers (Tessier et al. 1979). Total metal quantities from the sequential extraction are expressed as “SEP Total”, extracted by a discrete total step (separate aliquot of same sample). The sum of the sequential extraction steps is also calculated but does not represent an analytically determined value. The leachates produced during each step of the sequential extractions and the total metals step were analyzed for metal concentrations using US EPA SW-846 Method 6010B.

3.2 Mineralogical Composition

Quantitative X-ray diffraction (XRD) with Rietveld refinement was used to identify and quantify minerals in three BCU samples collected from two borings (E-SB-05 and E-SB-07) during drilling activities. These samples were obtained to determine the mineralogical composition of the BCU and identify any naturally occurring minerals that have the potential to release constituents of potential concern into groundwater. The mineralogical results are presented in Table 1. The mineralogical composition primarily included quartz and feldspars (58 – 63%) and phyllosilicates muscovite, chlorite and biotite (33 – 36%). The samples also contained from less than 1% - 6% carbonates (e.g. dolomite, calcite, siderite) and 1% iron or titanium oxides.

4.0 EVIDENCE THAT POTENTIAL GWPS EXCEEDANCES ARE NOT RELATED TO THE EAP

Groundwater quality data for samples collected from monitoring wells that exhibited potential GWPS exceedances, background monitoring well AP05S, upgradient monitoring wells, and pore water samples from the EAP were evaluated. The review indicates that the GWPS exceedances are not related to the EAP, as described in the lines of evidence that follow:

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- **In accordance with the procedures of the Statistical Analysis Plan, barium, chloride, or lithium did not occur statistically above the GWPS in any wells completed within the shallower UA and paired with or upgradient of AP05D, AP07D and AW-15C.**

Shallow paired wells are completed adjacent to AP05D (AP05S), AP07D (AP07S) and AW-15C (AW-15S and AW-15) in either the PMP or the UA. Groundwater samples collected from the shallow paired wells did not contain concentrations of barium, chloride, or lithium above the site GWPS (Table 2). In addition, wells between these locations and the Ash Pond (in a vertical migration pathway), or upgradient of these locations did not detect concentrations above the GWPS for these parameters. This includes AW-16 (upgradient of AW-15C), AW-21 and AW-22 (upgradient of AP07D). There are no monitoring wells directly upgradient of AP05D. A cross section location map and cross section showing the hydraulic positions of these wells is presented on Figures 2 and 3. The elevated concentrations of barium, chloride or lithium are not attributed to the Ash Pond because the migration pathway is not impacted (i.e. concentrations of the constituents in paired wells completed in the UA, which overlies the BCU, would be equal to or greater than the paired/exceedance wells completed in the BCU). Figures 4 to 6 show concentrations of barium, chloride and lithium in groundwater from the wells with GWPS exceedances; their respective paired wells AP05S, AP07S, AW-15, and AW-15S; and upgradient wells AW-16, AW-21, and AW-22.

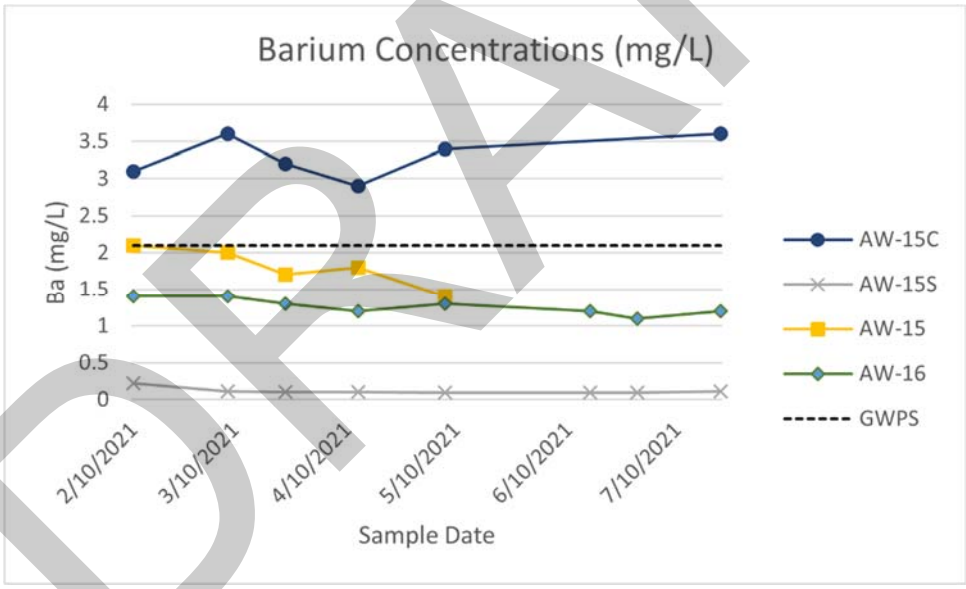

Figure 4. Barium (Ba) concentrations in groundwater from exceedance well AW-15C, shallow paired wells AW-15S and AW-15, and upgradient well AW-16

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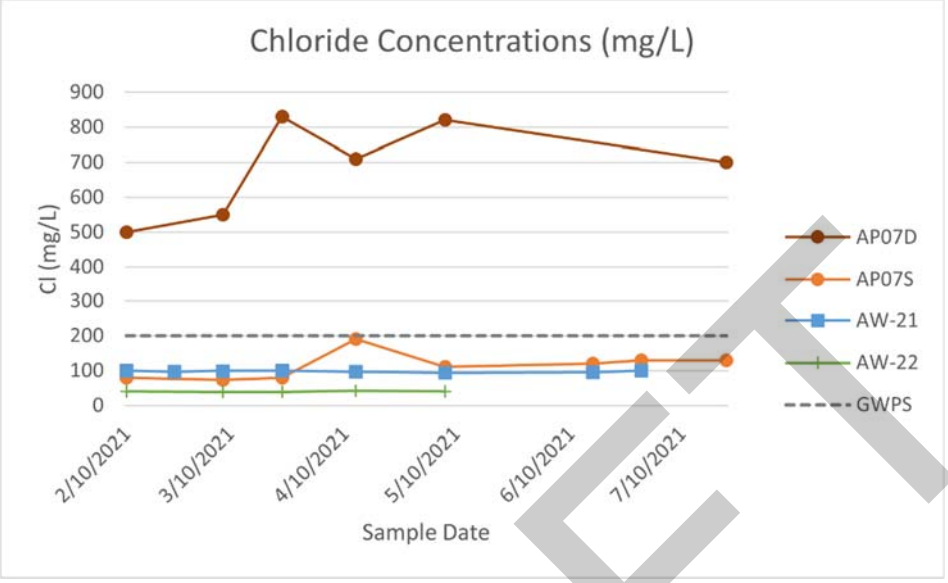

Figure 5. Chloride (Cl) concentrations in groundwater exceedance well AP07D, shallow paired well AP07S, and upgradient wells AW-21 and AW 22

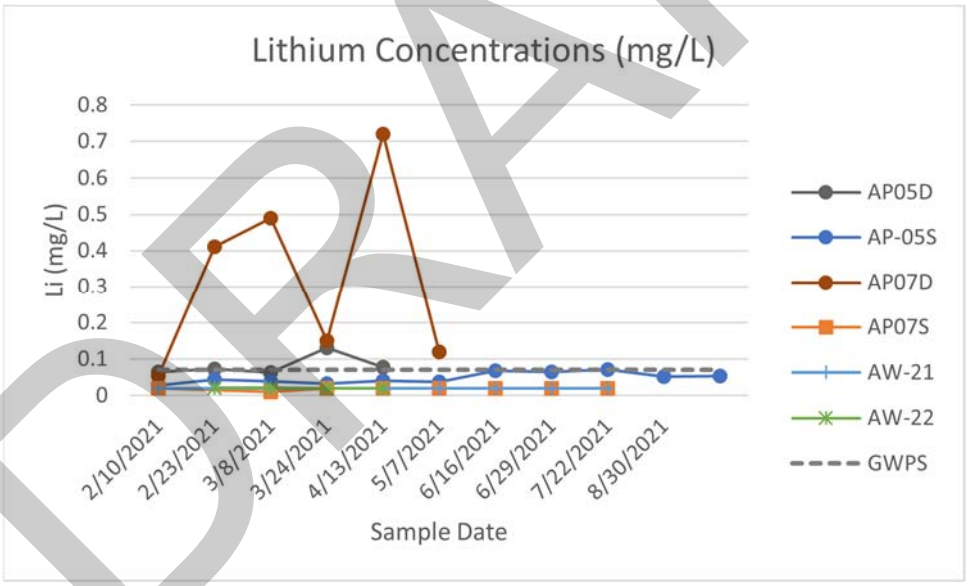

Figure 6. Lithium (Li) concentrations in groundwater exceedance wells AP05D and AP07D, shallow paired wells AP05S and AP07S, and upgradient wells AW21 and AW22

- **Concentrations of key CCR tracer constituents in EAP pore water samples differ significantly from groundwater in BCU monitoring wells AP05D, AP07D, and AW-15C.**

Concentrations of indicator parameters typically associated with the CCR managed in the EAP (e.g., boron, chloride, and sulfate) differ between porewater in the EAP and groundwater in the BCU wells AP05D, AP07D, and AW-15C. Data from the May 2021 sampling event for pore water, the BCU/exceedance wells, the shallow paired wells, and the background well are summarized in Table 3. Boron and sulfate concentrations are higher while chloride concentrations are lower in CCR porewater samples when compared to groundwater concentrations in

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the wells with GWPS exceedances and the background well. The relative proportions of these constituents in porewater versus the BCU/exceedance wells differ as well, as shown on the ternary diagram (Figure 7). The BCU/exceedance wells plot with the background well AP05S on the ternary diagram. The EAP porewater plots closer to the sulfate apex than the background and exceedance wells. Given the conservative behavior of sulfate and boron (see next paragraph for more detail on sulfate), if the EAP were the source, groundwater in the exceedance wells would plot in between the background groundwater and EAP pore water compositions. The concentrations of chloride in the porewater are consistently lower than in AP07D, as discussed in the next line of evidence

Sulfate, unlike boron and chloride, is sensitive to redox conditions (e.g., reduction of sulfate to sulfide) and may also be affected by the precipitation of sulfate-bearing minerals. These geochemical processes may alter sulfate concentrations in Site groundwater and affect the interpretive value of graphical methods such as ternary diagrams. To evaluate the potential for sulfate reactions in porewater and groundwater (which could affect the interpretation of sulfate concentration data), precipitation of sulfate-bearing minerals was evaluated with the help of the geochemical modeling code PHREEQC (Parkhurst and Appelo 2013), using a saturation index (SI) calculation:

$$SI = \log (IAP/Ksp)$$

The saturation index is the ratio of the ion activity product (IAP) of a mineral to the solubility product (Ksp). An SI value greater than zero indicates that the solution is supersaturated with respect to a particular mineral phase and, therefore, precipitation of this mineral may occur. An evaluation of precipitation kinetics is then required to determine whether the supersaturated mineral will indeed form. An SI value less than zero indicates the solution is undersaturated with respect to a particular mineral phase. An SI value close to zero indicates equilibrium conditions exist between the mineral and the solution. SI values between -0.5 and 0.5 are generally considered to represent ‘equilibrium’ in this report to account for the uncertainties inherent in the analytical methods and geochemical modeling (Nordstrom and Alpers 1999). The widely accepted thermodynamic database Minteq.v4, 2017 edition (USEPA 1998b, as amended), was used as a basis for the thermodynamic constants required for modeling, with additions and modifications from recent literature as required. Relevant sulfate-bearing minerals that were evaluated included gypsum, barite, and others that would be kinetically feasible to form under low-temperature conditions, as listed in Table 6.10 in Nordstrom and Alpers (1999). Calculated mineral SIs are presented in Table 4.

The geochemical modeling indicates that sulfate-bearing minerals are undersaturated across the Site, with the exception of barite. However, barite precipitation will be minimal, and is not expected to be a significant influence on sulfate concentrations in groundwater. Additionally, slightly oxidizing to oxidizing redox conditions were observed in Site groundwater (average Eh of +270 mV), indicating that reduction of sulfate to sulfide is not occurring. As such, sulfate in Site groundwater behaves conservatively and can be used as a tracer for potential EAP impacts.

These observations support that the GWPS exceedances of Ba in AW-15C, Li in AP05D, and Li and Cl in AP07D are not related to the EAP.

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Table 3. Concentrations of boron, sulfate and chloride in exceedance wells and EAP pore water samples.

Well ID	Date	Boron (mg/L)	Sulfate (mg/L)	Chloride (mg/L)
Background Well				
AP-05S	5/7/2021	0.36	2.7	43
Bedrock Confining Unit Wells (GWPS Exceedance Wells)				
AP05D	5/7/2021	1.6	1.3	510
AP07D	5/5/2021	1.4	47	820
AW-15C	5/6/2021	0.63	<1	63
EAP Pore Water Samples				
XPW01A	5/4/2021	17	210	47
XPW02	5/4/2021	15	950	120
XPW03	5/4/2021	5.5	280	86

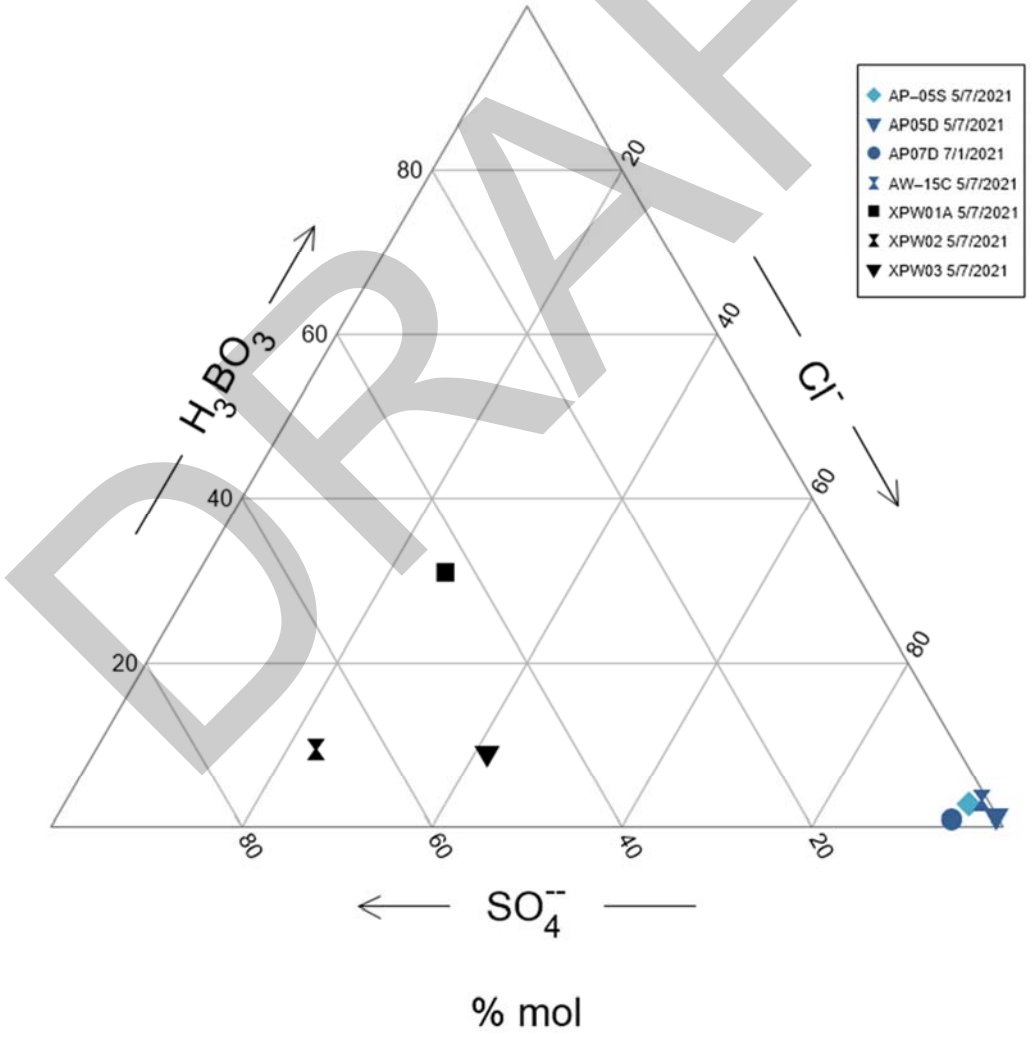

Figure 7: Ternary diagram showing relationships between CCR tracers boron, chloride, and sulfate.

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- **Barium and chloride concentrations in CCR porewater are consistently lower than in BCU wells AW-15C and AP07D.**

Barium and chloride concentrations are consistently lower in CCR porewater than in BCU wells AW-15C and AP07D, as shown on **Figures 8 and 9**. Therefore, barium and chloride cannot be sourced from the CCR porewater.

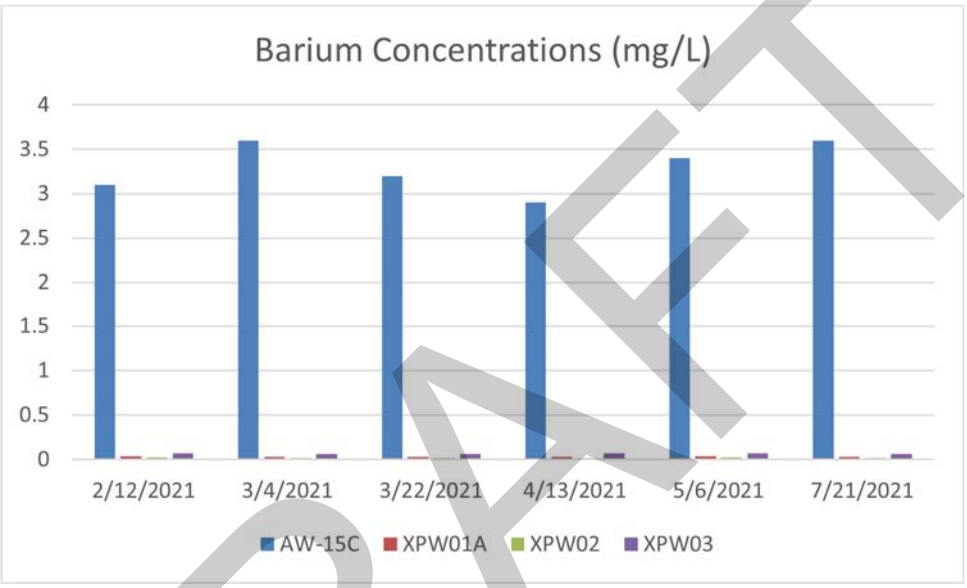

Figure 8. Barium concentrations in monitoring well AW-15C and CCR porewater samples XPW01A, XPW02 and XPW03.

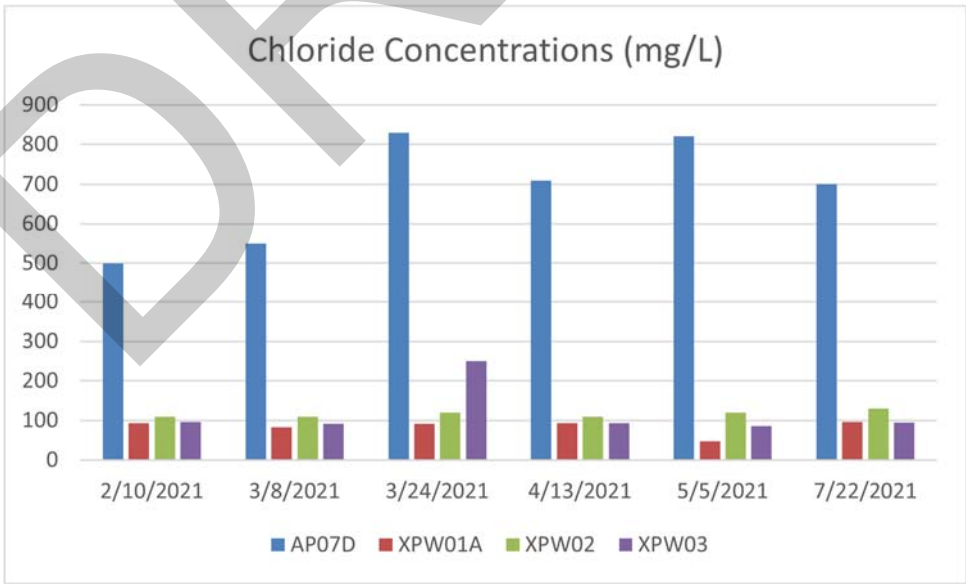

Figure 9. Chloride concentrations in monitoring well AP07D and CCR porewater samples XPW01A, XPW02 and XPW03.

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- **Barium, lithium and chloride are naturally occurring constituents of the BCU.**

Barium, lithium, and chloride occur naturally within the BCU. Samples collected from the BCU aquifer matrix were analyzed for total concentrations and sequential extractions[1] were performed for barium and lithium. Total concentrations were between 390 and 480 mg/kg and 42 and 49 mg/kg for barium and lithium, respectively. For comparison, consensus average crustal barium and lithium concentrations are very similar, at 430 mg/kg and 30 mg/kg, respectively, with ranges of 179 to 1,070 mg/kg and 18 to 65 mg/kg (Smith and Huyck 1999). According to Hem (1985), average concentrations of barium and lithium in typical shale, such as the shale that comprises the BCU (Section 1.1) are 250 and 46 mg/kg, respectively.

The results of the sequential extractions are summarized in **Figures 10** and **11** for barium and lithium, respectively. As indicated in the figures, the majority of barium and lithium is present in fractions that have limited environmental availability under typical groundwater conditions, i.e. the acid/sulfide fraction and the residual fraction (and organic fraction for barium). The remainder of the barium and lithium occurs within the environmentally available fractions (exchangeable, carbonate, amorphous and metal hydroxide). As such, a natural reservoir for these parameters is present, albeit that their release from aquifer solids will likely be slow.

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[1] Sequential extraction of metals from overburden samples consisted of seven discrete steps for this investigation:

Step 1 - Exchangeable Fraction: This extraction includes trace elements that are reversibly adsorbed to overburden minerals, amorphous solids, and/or organic material by electrostatic forces.

Step 2 - Carbonate Fraction: This extraction targets trace elements that are adsorbed or otherwise bound to carbonate minerals (carbonate minerals comprised between 1-6 percent of BCU samples).

Step 3 - Non-Crystalline Materials Fraction: This extraction targets trace elements that are complexed by amorphous minerals (e.g., iron).

Step 4 - Metal Hydroxide Fraction: Trace elements bound to hydroxides of iron, manganese, and/or aluminum.

Step 5 - Organic Fraction: This extraction targets trace elements strongly bound via chemisorption to organic material.

Step 6 - Acid/Sulfide Fraction: The extraction is used to identify trace elements precipitated as sulfide minerals.

Step 7 - Residual Fraction: Trace elements remaining in the overburden after the previous extractions will be distributed between silicates, phosphates, and refractory oxides (silicates and refractory oxides comprised between 94-99% of BCU samples).

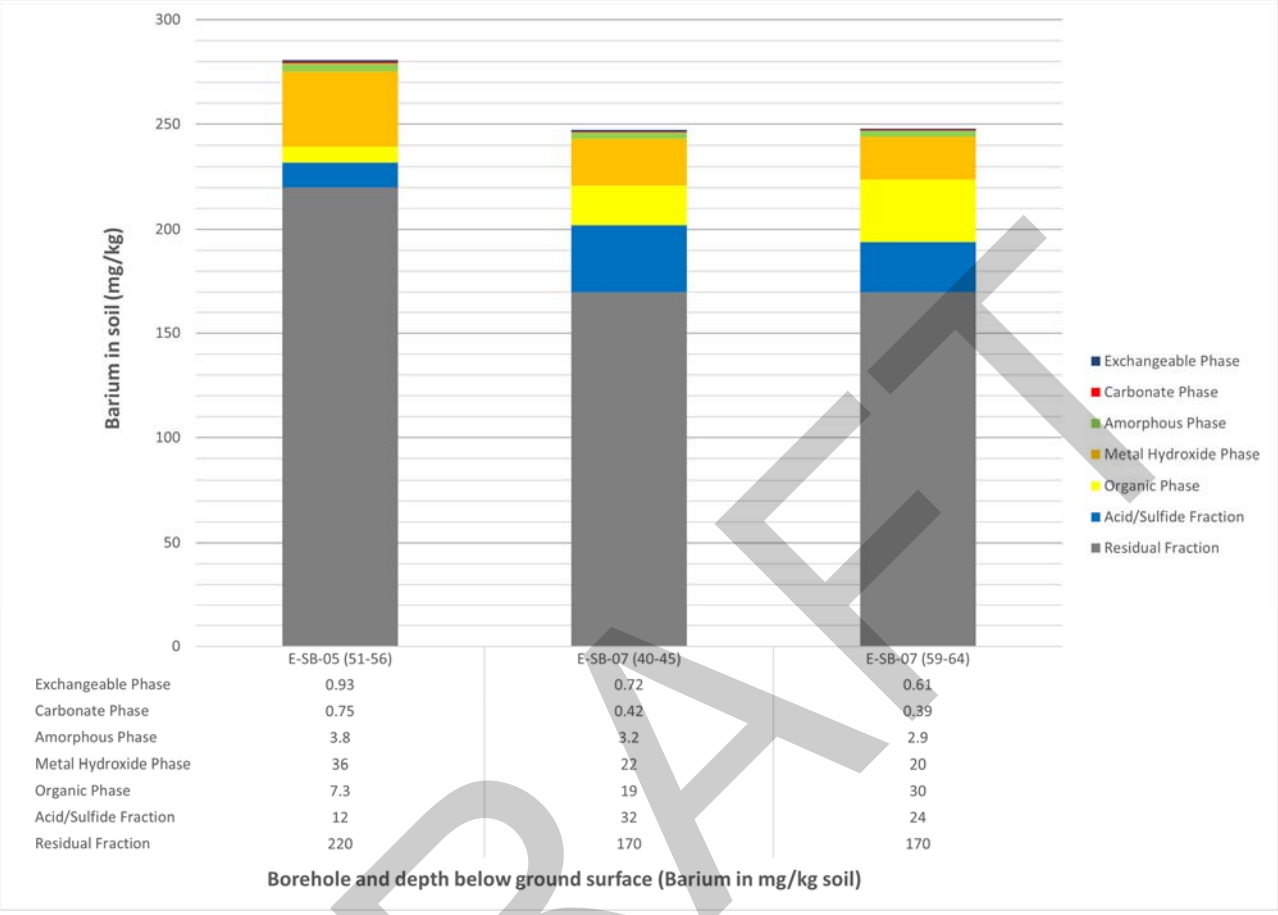

Figure 10. Sequential extraction results for barium. Concentrations in mg/kg are shown at the bottom of the figure, with the distribution presented in the bar graphs.

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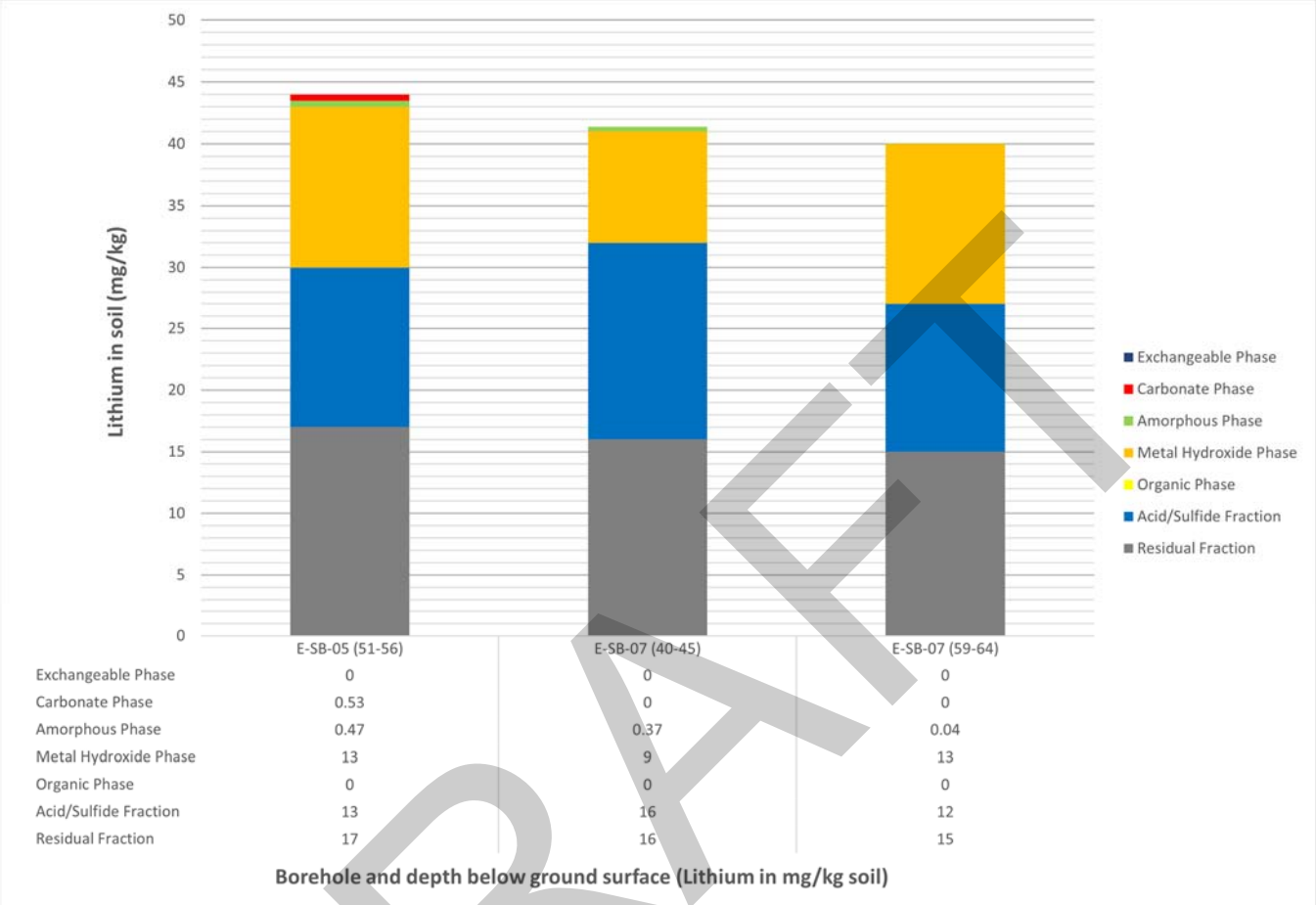

Figure 11. Sequential extraction results for lithium. Concentrations in mg/kg are shown at the bottom of the figure, with the distribution presented in the bar graphs.

Although chloride in aquifer matrix samples was not analyzed in the sequential extraction, chlorides are naturally occurring within shale of marine origin such as that which comprises the BCU. Hem (1985) discusses the geochemistry of various geologic materials. Typical chloride concentrations of shale are indicated as approximately 170 mg/kg in Hem (1985). In addition, the groundwater samples collected from the BCU occurs within a weathered zone of the BCU that is overlain and underlain by very low-permeability shales and siltstones. The constituents released as a product of the weathering process have the potential to increase due to long residence time and limited recharge.

5.0 SUMMARY

The evaluation presented in this document demonstrates that the GWPS exceedances of lithium in well AP05D and AP07D, chloride in well AP07D, and barium in well AW-15C are not attributable to the EAP based on the following lines of evidence:

- The migration pathway between Ash Pond and the wells with GWPS exceedances is not impacted with Ba, Li and/or Cl. Evaluations of groundwater water quality data in accordance with the procedures of the

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Statistical Analysis Plan indicate that barium, lithium, and/or chloride do not occur above the GWPS the shallow UA wells paired with, or upgradient of AP05D, AP07D and AW-15C.

- Concentrations and relative proportions of key CCR indicator parameters differ significantly between AP porewater and groundwater from monitoring wells AP05D, AP07D and AW-15C.
- Barium and chloride concentrations in CCR porewater are consistently lower than in BCU wells AW-15C and AP07D.
- Barium, lithium, and chloride occur naturally in the aquifer minerals and/or connate water of siltstones and shales including those of the BCU.

6.0 CLOSING

Golder appreciates the opportunity to serve as your consultant on this project. If you have any questions concerning this Technical Memorandum or need additional information, please contact the undersigned.

Golder Associates USA Inc.

Roberta Russell
Senior Geologist

Patrick J. Behling
Principal, Practice Leader

RR/JSI/PJN/RV/PJB

Attachments: Table 1 – Summary of Rietveld Quantitative Analysis X-Ray Diffraction Results
Table 2 – Evaluation of Potential GWPS Exceedances
Table 4 – Gypsum Saturation Indices

Figure 1 – Edwards Well Locations and Typical Groundwater Flow Direction
Figure 2 – Generalized Fence Diagram Location
Figure 3 – Generalized Fence Diagram of Monitoring Wells

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7.0 REFERENCES

Burns and McDonnell 2021. Initial Operating Permit, Edwards Power Plan Ash Pond. October 25.

Hem, John D, 1985. Study and Interpretation of the Chemical Characteristics of Natural Water. United States Geological Survey Water-Supply Paper 2254.

Parkhurst, D. and Appelo, C. 2013. Description of input and examples for PHREEQC version 3: a computer program for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations (No. 6-A43). US Geological Survey.

Ramboll, 2021a. Groundwater Sampling and Analysis Program. Ash Pond, Edwards Power Plant, Bartonville, Illinois. October 25.

Ramboll, 2021b. History of Known Groundwater Exceedances. Ash Pond, Edwards Power Plant, Bartonville, Illinois.

Ramboll 2021c. Hydrogeologic Site Characterization Report. Ash Pond, Edwards Power Plant, Bartonville, Illinois. October 25.

Smith, K. and Huyck, H. 1999. An Overview of the Abundance, Relative Mobility, Bioavailability, and Human Toxicity of Metals. The Environmental Geochemistry of Mineral Deposits, Reviews in Economic Geology Vol. 6A, pp.29-70.

Tessier, A., Campbell, P.G. and Bisson, M., 1979. Sequential extraction procedure for the speciation of particulate trace metals. Analytical chemistry, 51(7), pp.844-851.

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Table 1
Evaluation of Potential Exceedances
Summary of Rietveld Quantitative Analysis X-Ray Diffraction Results
Edwards Ash Pond, Peoria County, IL

Mineral	Mineral Formula	E-SB-07 40-45 ft bgs	E-SB-07 59-64 ft bgs	E-SB-05 51-56 ft bgs
Quartz	SiO_2	44.9	43.6	38.7
Albite	$NaAlSi_3O_8$	14.7	15.6	15.0
Microcline	$KAlSi_3O_8$	2.9	3.4	4.3
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$	8.1	9.4	7.5
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	22.4	22.5	24.1
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	2.5	3.8	3.7
Ankerite	$CaFe(CO_3)_2$	0.0	0.0	0.1
Dolomite	$CaMg(CO_3)_2$	0.0	0.0	0.8
Calcite	$CaCO_3$	0.4	0.5	0.3
Siderite	$FeCO_3$	3.1	0.2	5.0
Hematite	Fe_2O_3	0.0	0.0	0.0
Magnetite	Fe_3O_4	0.3	0.3	0.4
Ilmenite	$FeTiO_3$	0.1	0.0	0.1
Rutile	TiO_2	0.7	0.6	0.3
Diopside	$CaMgSi_2O_6$	-	-	-
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$	-	-	-
Epidote	$Ca_2(Al,Fe)Al_2O(SiO_4)(Si_2O_7)(OH)$	-	-	-
Kaolinite	$Al_2Si_2O_5(OH)_4$	-	-	-
Mullite	$\sim Al_6Si_3O_{15}$	-	-	-
Anorthite	$CaAl_2Si_2O_8$	-	-	-
TOTAL		100	100	100

Notes:
1.) Results provided in weight percentage - percent by weight of each mineral.
2.) ft bgs - feet below ground surface.
3.) Non-detect minerals within a sample are represented by "-".
4.) Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.
5.) Samples were collected by Golder in August 2021.

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Checked by: RJR
Reviewed by: PJB

Table 2
Evaluation of Potential GWPS Exceedances
Constituent Concentrations
Edwards Ash Pond
Peoria County, Illinois

Well ID	Sample Date	Barium mg/L	Lithium mg/L	Chloride mg/L
Part 845 Groundwater Protection Standards				
Site Background[1]		2.1	0.071	56
Part 845 Standard		2	0.04	200
Part 845 GWPS		2.1	0.071	200
Bedrock Confining Unit Wells				
AP05D	5/7/2021	1.3	0.077	510
AP05D	Statistical Result[2]	0.044	0.077	122
AP07D	5/5/2021	8.6	0.72	820
AP07D	Statistical Result	-1.15	0.15	498
AW-15C	5/6/2021	3.4	0.047	63
AW-15C	Statistical Result	2.9	0.047	46
Wells Paired with Bedrock Confining Unit Wells[3]				
AP05S	5/7/2021	1.2	0.037	43
AP07S	5/5/2021	0.15	<0.02	110
AW-15S	5/6/2021	0.098	<0.02	40
AW-15	5/6/2021	1.8	0.033	41
Wells Upgradient from Bedrock Confining Wells				
AW-16	5/5/2021	1.3	0.039	53
AW-21	5/5/2021	0.067	<0.02	96
AW-22	5/5/2021	0.8	<0.02	40
EAP Pore Water Samples				
XPW01A	5/4/2021	0.034	0.67	47
XPW02	5/4/2021	0.022	0.3	120
XPW03	5/4/2021	0.07	0.16	86

1. Site background is for the uppermost aquifer (UA).
2. Calculated in accordance with Statistical Analysis Plan using constituent concentrations observed at monitoring well during all sampling events from February-July 2021
3. Paired wells are completed in the UA.
4. mg/L - milligrams per liter.
5. EAP - Edwards Ash Pond.
6. GWPS - Groundwater Protection Standard.

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Checked by: BTT
Reviewed by: PJB

Table 4
Evaluation of Potential GWPS Exceedances
Gypsum Saturation Indices
Edwards Ash Pond, Peoria County, Illinois

MINERAL PHASES - Saturation Indices		APW-1	AP-05S	AP05D	AW-05	AW-06	AP07S	AP07D	AW-09	AW-14	AW-15
Gypsum	$CaSO_4:2H_2O$	-1.03	-3.13	-4.10	-1.02	-2.06	-0.73	-2.47	-3.52	-3.45	-3.53
Barite	$BaSO_4$	**0.95**	**-0.14**	**-0.50**	**0.77**	**0.08**	**0.99**	**1.33**	-1.03	-0.82	**-0.41**

MINERAL PHASES - Saturation Indices		AW-15S	AW-15C	AW-16	AW-17	AW-18	AW-19	AW-20	AW-21	AW-22
Gypsum	$CaSO_4:2H_2O$	-0.62	-3.60	-3.55	-3.59	-2.92	-1.98	-1.83	-1.14	-3.62
Barite	$BaSO_4$	**1.03**	**-0.09**	-0.59	-0.59	**-0.09**	**0.19**	**0.09**	**0.63**	-0.64

Notes:

1) SI values between -0.5 and 0.5 are generally considered to represent 'equilibrium' in this report to account for the uncertainties inherent in the analytical methods and geochemical modeling (Nordstrom and Alpers 1999).

2) SI values greater than -0.5 identified by red bold type and grey shading.

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Checked by: PJN
Reviewed by: PJN

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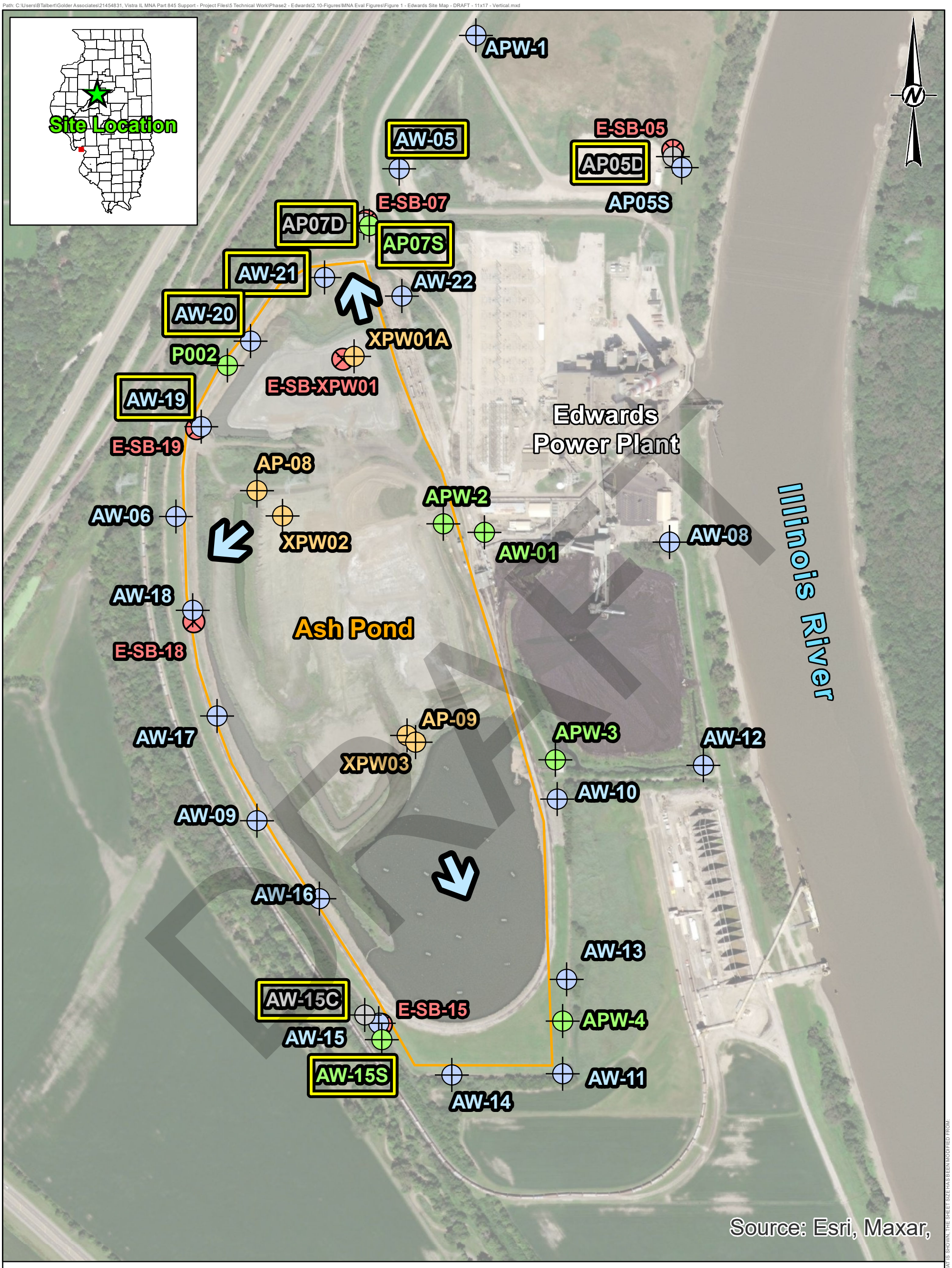

LEGEND

- Ash Pond
- Soil Boring Location

Monitoring Wells

- Monitoring Well Screened in Bedrock
- Monitoring Well Screened in CCR Material
- Monitoring Well Screened in the Upper Cahokia Formation
- Monitoring Well Screened in the Uppermost
- Typical Groundwater Flow Direction
- Potential Exceedance

NOTES

1. SOIL BORING LOCATIONS SURVEYED BY INGENAE ON SEPTEMBER 23, 2021.
2. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
3. GWPS - GROUNDWATER PROTECTION STANDARD

REFERENCE

1. BURNS AND MCDONNELL 2021, INITIAL OPERATING PERMIT - EDWARDS POWER PLANT ASH POND. AVAILABLE ONLINE AT HTTPS://WWW.LUMINANT.COM/ILLINOIS-CCR/

0 500 1,000 Feet

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC.

PROJECT
EDWARDS POWER PLANT - EVALUATION OF POTENTIAL GWPS EXCEEDANCES

TITLE
EDWARDS WELL LOCATIONS AND TYPICAL GROUNDWATER FLOW DIRECTION

CONSULTANT

YYYY-MM-DD	2022-02-17
PREPARED	BTT
DESIGN	BTT
REVIEW	JSI
APPROVED	PJB

PROJECT No. 21454831 PHASE 0002A FIGURE **1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 1 in 0

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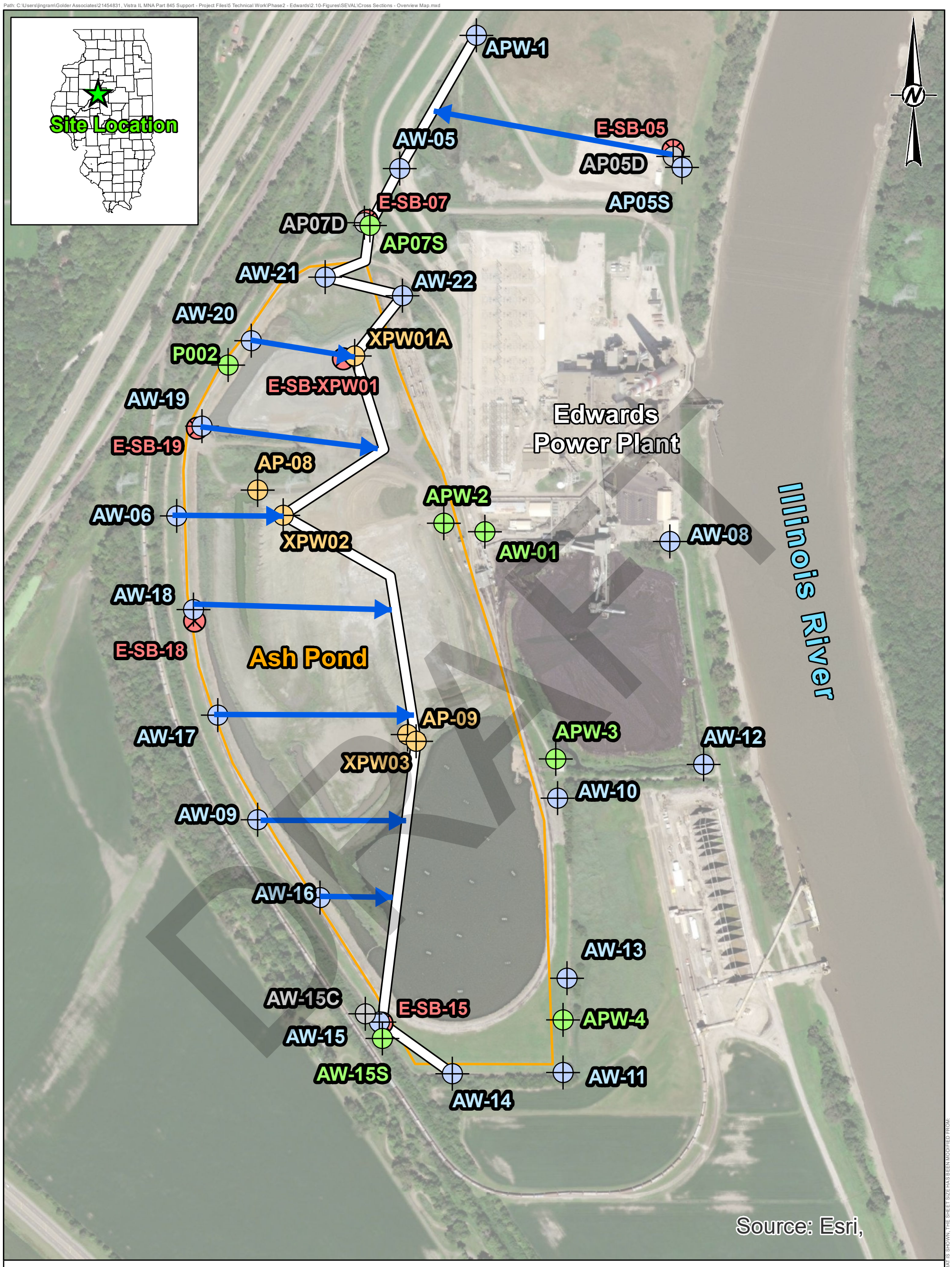

LEGEND

- Ash Pond
- Golder Soil Boring Location
- Monitoring Wells Projected onto the Generalized Fence Diagram Line
- Generalized Fence Diagram Line

Monitoring Wells

- Monitoring Well Screened in Bedrock
- Monitoring Well Screened in CCR Material
- Monitoring Well Screened in the Upper Cahokia Formation
- Monitoring Well Screened in the Uppermost Aquifer

NOTES

1. SOIL BORING LOCATIONS SURVEYED BY INGENAE ON SEPTEMBER 23, 2021.
2. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.

REFERENCE

1. BURNS AND MCDONNELL 2021, INITIAL OPERATING PERMIT - EDWARDS POWER PLANT ASH POND. AVAILABLE ONLINE AT HTTPS://WWW.LUMINANT.COM/ILLINOIS-CCR/

0 500 1,000 Feet

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC.

PROJECT
EDWARDS POWER PLANT - EVALUATION OF POTENTIAL GWPS EXCEEDANCES

TITLE
GENERALIZED FENCE DIAGRAM LOCATION

CONSULTANT
WSP GOLDER

YYYY-MM-DD	2022-02-17
PREPARED	JSI
DESIGN	JSI
REVIEW	BTT
APPROVED	PJB

PROJECT No. 21454831
PHASE 0002
FIGURE **2**

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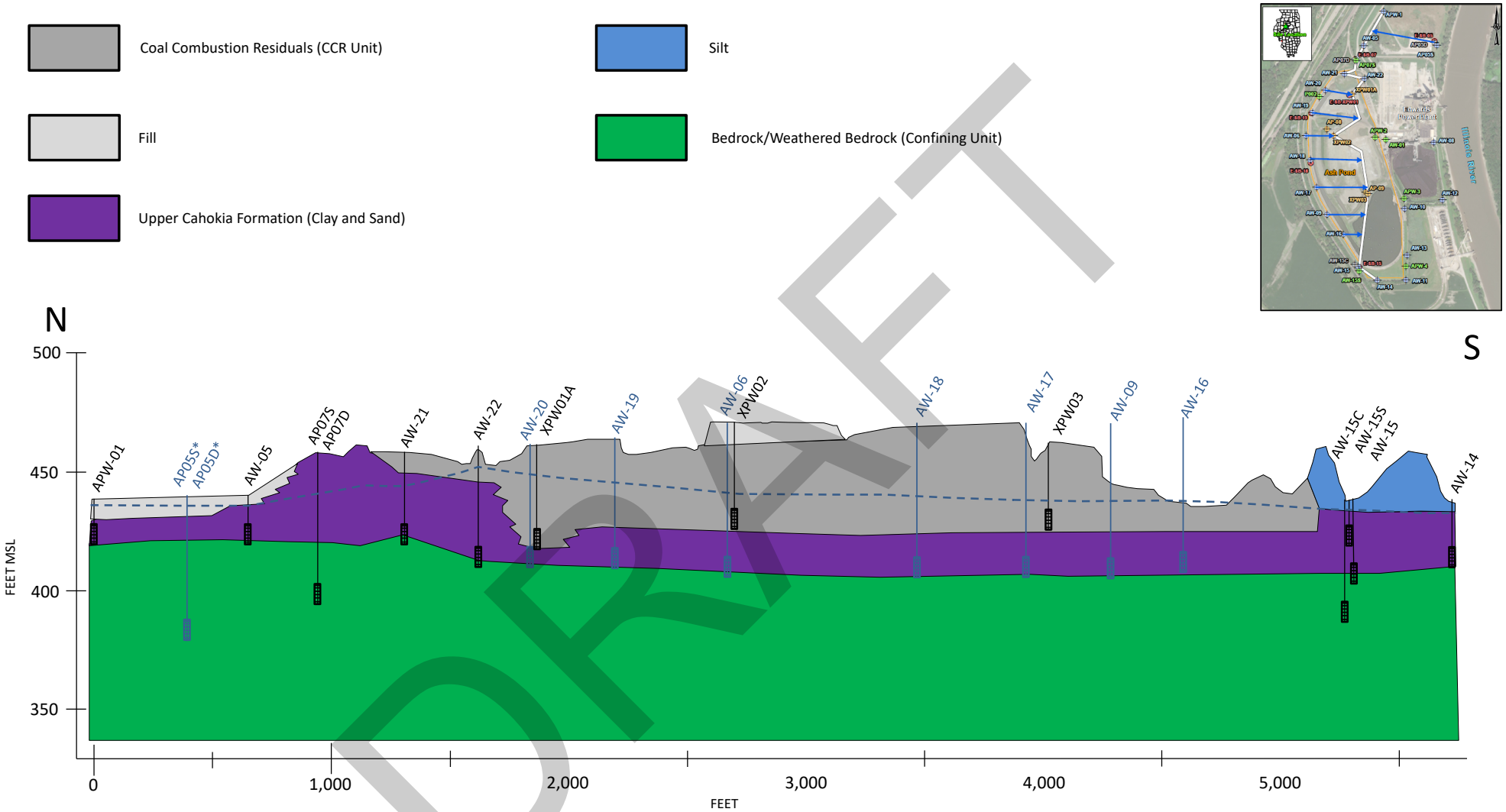

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Notes
1) mg/L – Milligrams per liter, MSL – mean sea level
2) Wells in blue text indicate wells projected onto the cross section. Well screen location for projected wells are based on geologic unit, not elevation.
3) Wells in black text indicate wells located along the tie line. Well screen locations are based on elevation.
4) Generalized fence diagram based on generalized cross section from Ramboll (2021).
5) * indicates well is upgradient of the Edwards Ash Pond, near the Illinois River north of the plant.
6) Sizes and distances not to scale.
7) GWPS – Groundwater Protection Standards

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC.

PROJECT
EDWARDS POWER PLANT – EVALUATION OF POTENTIAL GWPS EXCEEDANCES

CONSULTANT
wsp GOLDER

YYYY-MM-DD	2022-03-16
PREPARED	BTT
DESIGNED	JSI
REVIEWED	GTM
APPROVED	PJB

TITLE
Generalized Fence Diagram of Monitoring Wells

PROJECT NO.	PHASE	REV.	FIGURE
21454831	0002		3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25 mm

APPENDIX B
FIGURE 5 AND FIGURE 6 OF *BURCH, S. L. AND D. J. KELLY., 1993. PEORIA-PEKIN REGIONAL GROUND-WATER QUALITY ASSESSMENT. ILLINOIS STATE WATER SURVEY (ISWS), CHAMPAIGN, RESEARCH REPORT 124.*

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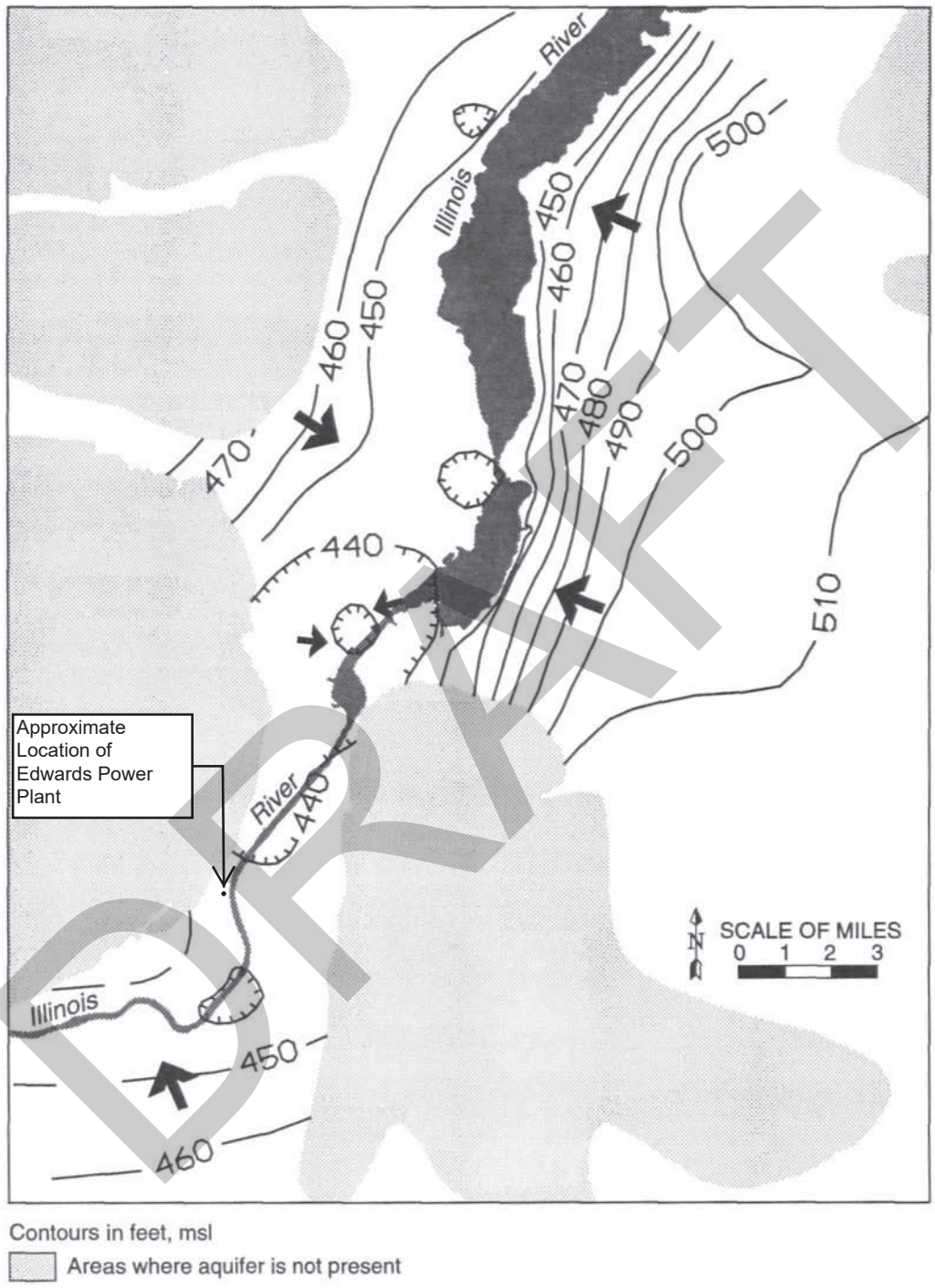

Figure 5. Elevation of potentiometric surface and direction of regional ground-water flow for the Peoria-Pekin region: 1990-1991 data

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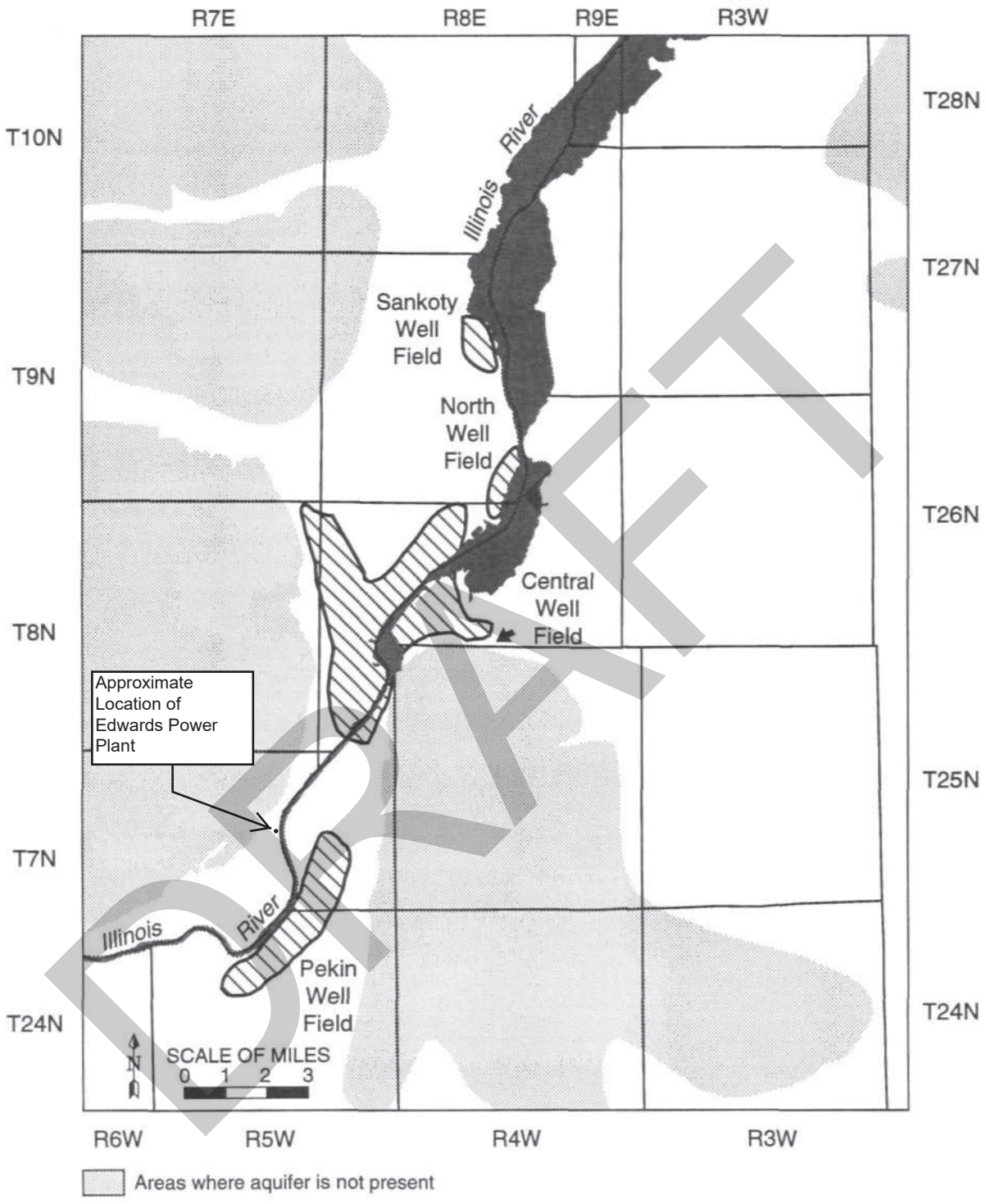

Figure 6. Locations of the Sankoty, North, Central, and Pekin municipal well fields

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APPENDIX C
MODFLOW, MT3DMS, HELP MODEL, AND FLUX EVALUATION DATA EXPORT FILES (ELECTRONIC ONLY)

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APPENDIX D
EVALUATION OF PARTITION COEFFICIENT RESULTS (GOLDER ASSOCIATES USA INC., 2022)

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Senior Consultant, Geologist

P□□□e□i□g□

Practice Leader

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Table 3: Batch Attenuation Testing Results, AW-15S

Geologic Material Sample ID	Treatment	Date	Day	Replicate	Dissolved Barium	Dissolved Boron	Dissolved Lithium	Dissolved Sulfate	pH	ORP
					mg/L	mg/L	mg/L	mg/L	SU	mV
	Groundwater Only Control	1/14/2022	0	AW-15S-1a	0.31	12	0.47	390	7.07	202
				AW-15S-2a	0.36	13	0.48	397	7.06	181
				Average Concentration (mg/L)	**0.33**	**13**	**0.48**	**394**	**7.07**	**192**
		1/21/2022	7	AW-15S-1a	0.069	13	0.49	395	6.95	64
				AW-15S-2a	0.074	13	0.48	392	6.96	66
				Average Concentration (mg/L)	**0.072**	**13**	**0.49**	**394**	**6.96**	**65**
AW-15S E-SB-05 (30.0-33.5)	2:1 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-15S 2:1-1	0.39	4.6	0.15	266	6.89	-60
				E-SB-05 (30.0-33.5): AW-15S 2:1-2	0.32	4.4	0.12	274	6.93	-75
				Average Concentration (mg/L)	**0.35**	**4.5**	**0.14**	**270**	**6.91**	**-68**
	1:1 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-15S 1:1-1	0.23	6.5	0.21	313	6.83	-68
				E-SB-05 (30.0-33.5): AW-15S 1:1-2	--	--	--	--	--	--
				Average Concentration (mg/L)	**0.23**	**6.5**	**0.21**	**313**	**6.83**	**-68**
	1:5 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-15S 1:5-1	0.13	10	0.36	375	6.89	15
				E-SB-05 (30.0-33.5): AW-15S 1:5-2	0.12	10	0.36	370	6.86	72
				Average Concentration (mg/L)	**0.13**	**10**	**0.36**	**373**	**6.88**	**44**
	1:10 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-15S 1:10-1	0.12	11	0.42	382	6.91	73
				E-SB-05 (30.0-33.5): AW-15S 1:10-2	0.11	12	0.43	375	6.94	68
				Average Concentration (mg/L)	**0.11**	**11**	**0.43**	**379**	**6.93**	**71**
	1:20 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-15S 1:20-1	0.10	12	0.45	393	6.99	96
				E-SB-05 (30.0-33.5): AW-15S 1:20-2	0.11	12	0.44	383	6.96	42
				Average Concentration (mg/L)	**0.11**	**12**	**0.45**	**388**	**6.98**	**69**

Notes:
1) mg/L- Miligrams per liter
2) SU - Standard Units
3) mV -milivolts
4) ORP - Oxidation Reduction Potential

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Table 4: Batch Attenuation Testing Results, AW-19

Geologic Material Sample ID	Treatment	Date	Day	Replicate	Dissolved Barium	Dissolved Boron	Dissolved Lithium	Dissolved Sulfate	pH	ORP
					mg/L	mg/L	mg/L	mg/L	SU	mV
	Groundwater Only Control	1/14/2022	0	AW-19-1a	0.22	12	0.46	386	7.08	156
				AW-19-2a	0.27	12	0.45	380	7.07	133
				Average Concentration (mg/L)	**0.25**	**12**	**0.46**	**383**	**7.08**	**145**
		1/21/2022	7	AW-19-1a	0.048	12	0.48	375	6.98	39
				AW-19-2a	0.049	12	0.51	390	6.92	62
				Average Concentration (mg/L)	**0.049**	**12**	**0.50**	**383**	**6.95**	**51**
AW-19 E-SB-05 (30.0-33.5)	2:1 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-19 2:1-1	0.27	4.3	0.11	270	6.93	-58
				E-SB-05 (30.0-33.5): AW-19 2:1-2	0.51	4.4	0.15	269	6.94	-71
				Average Concentration (mg/L)	**0.39**	**4.4**	**0.13**	**270**	**6.94**	**-65**
	1:1 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-19 1:1-1	0.24	6.6	0.24	314	6.98	-60
				E-SB-05 (30.0-33.5): AW-19 1:1-2	0.32	6.3	0.22	308	6.99	-82
				Average Concentration (mg/L)	**0.28**	**6.5**	**0.23**	**311**	**6.99**	**-71**
	1:5 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-19 1:5-1	0.16	10	0.36	358	6.92	-42
				E-SB-05 (30.0-33.5): AW-19 1:5-2	0.19	10	0.38	360	6.95	-32
				Average Concentration (mg/L)	**0.18**	**10**	**0.37**	**359**	**6.94**	**-37**
	1:10 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-19 1:10-1	0.17	10	0.40	365	6.92	-48
				E-SB-05 (30.0-33.5): AW-19 1:10-2	0.14	11	0.45	389	6.95	-52
				Average Concentration (mg/L)	**0.16**	**11**	**0.43**	**377**	**6.94**	**-50**
	1:20 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-19 1:20-1	0.11	12	0.46	381	7.00	-3
				E-SB-05 (30.0-33.5): AW-19 1:20-2	0.16	12	0.47	387	6.97	-45
				Average Concentration (mg/L)	**0.13**	**12**	**0.47**	**384**	**6.99**	**-24**

Notes:
1) mg/L- Miligrams per liter
2) SU - Standard Units
3) mV -milivolts
4) ORP - Oxidation Reduction Potential

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Table 5: Partition Coefficient Results, AW-15S

Analyte	Isotherm	Variable	With Soil Mass
Barium	Raw Data R^2		0.46
	Linear K_D (L/kg)		-22.85
	Langmuir	R^2	1.00
		q_m (mg/g)	0.498
		K_L (L/kg)	-6.48E+08
	Freundlich	R^2	0.55
		1/n	-0.01
		K_F (L/kg)	736.03
Boron	Raw Data R^2		0.99
	Linear K_D (L/kg)		1.50
	Langmuir	R^2	0.79
		q_m (mg/g)	0.068
		K_L (L/kg)	3.79E+04
	Freundlich	R^2	0.98
		1/n	0.764
		K_F (L/kg)	82.21
Lithium	Raw Data R^2		0.80
	Linear K_D (L/kg)		1.89
	Langmuir	R^2	1.00
		q_m (mg/g)	0.035
		K_L (L/kg)	2.58E+08
	Freundlich	R^2	0.79
		1/n	0.014
		K_F (L/kg)	234.30
Sulfate	Raw Data R^2		0.54
	Linear K_D (L/kg)		0.47
	Langmuir	R^2	0.07
		q_m (mg/g)	0.88
		K_L (L/kg)	7.78E+02
	Freundlich	R^2	0.56
		1/n	0.8
		K_F (L/kg)	63.43

Note(s):
K_D: linear partition coefficient
K_L: Langmuir partition coefficient
K_F: Freundlich partition coefficient
qm: 1/slope in the linear expression of the isotherm
n: non-linearity constant

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Table 6: Partition Coefficient Results, AW-19

Analyte	Isotherm	Variable	With Soil Mass
Barium	Raw Data R^2		0.51
	Linear K_D (L/kg)		-12.44
	Langmuir	R^2	1.00
		q_m (mg/g)	0.498
		K_L (L/kg)	-8.45E+08
	Freundlich	R^2	0.62
		1/n	-0.007
		K_F (L/kg)	737.55
Boron	Raw Data R^2		0.01
	Linear K_D (L/kg)		-0.19
	Langmuir	R^2	0.35
		q_m (mg/g)	0.002
		K_L (L/kg)	-1.99E+05
	Freundlich	R^2	0.07
		1/n	-0.578
		K_F (L/kg)	215.36
Lithium	Raw Data R^2		0.19
	Linear K_D (L/kg)		-1.27
	Langmuir	R^2	1.00
		q_m (mg/g)	0.034
		K_L (L/kg)	-2.37E+08
	Freundlich	R^2	0.119
		1/n	-0.008
		K_F (L/kg)	230.26
Sulfate	Raw Data R^2		0.28
	Linear K_D (L/kg)		-1.00
	Langmuir	R^2	0.16
		q_m (mg/g)	-0.021
		K_L (L/kg)	-2.95E+03
	Freundlich	R^2	0.16
		1/n	2.40
		K_F (L/kg)	1.16

Note(s):
K_D: linear partition coefficient
K_L: Langmuir partition coefficient
K_F: Freundlich partition coefficient
qm: 1/slope in the linear expression of the isotherm
n: non-linearity constant

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Partition Coefficient Graphs

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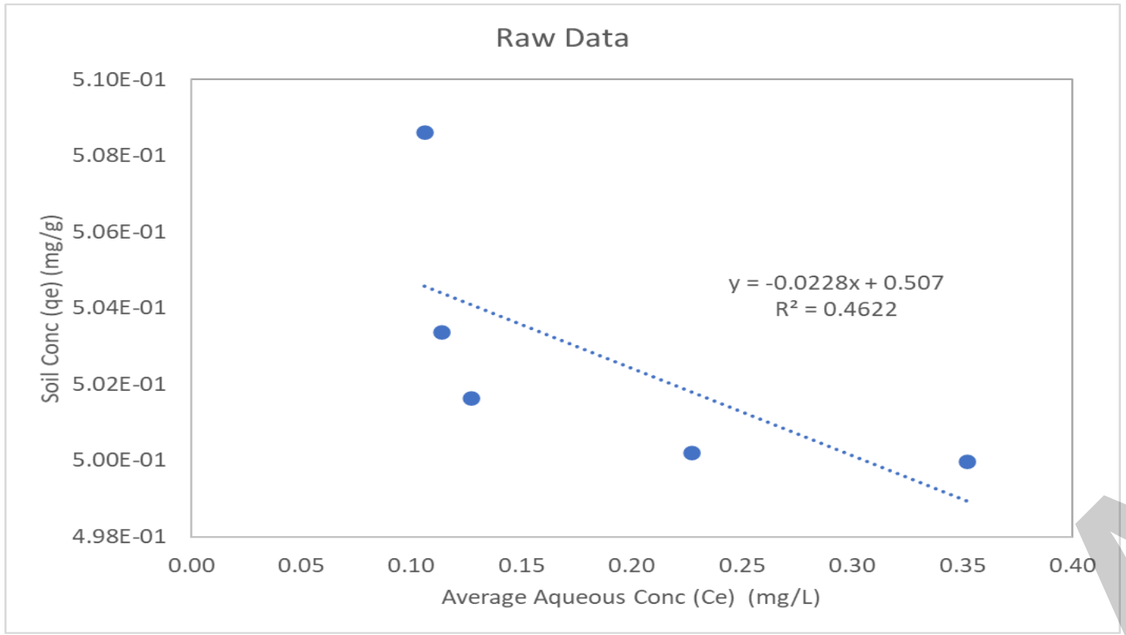

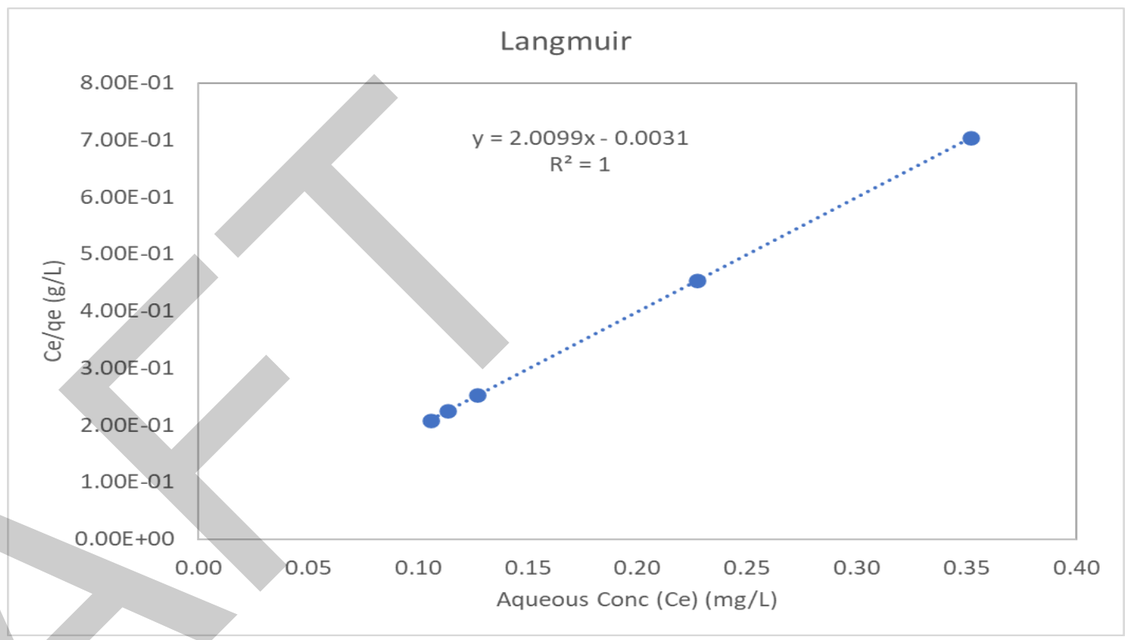

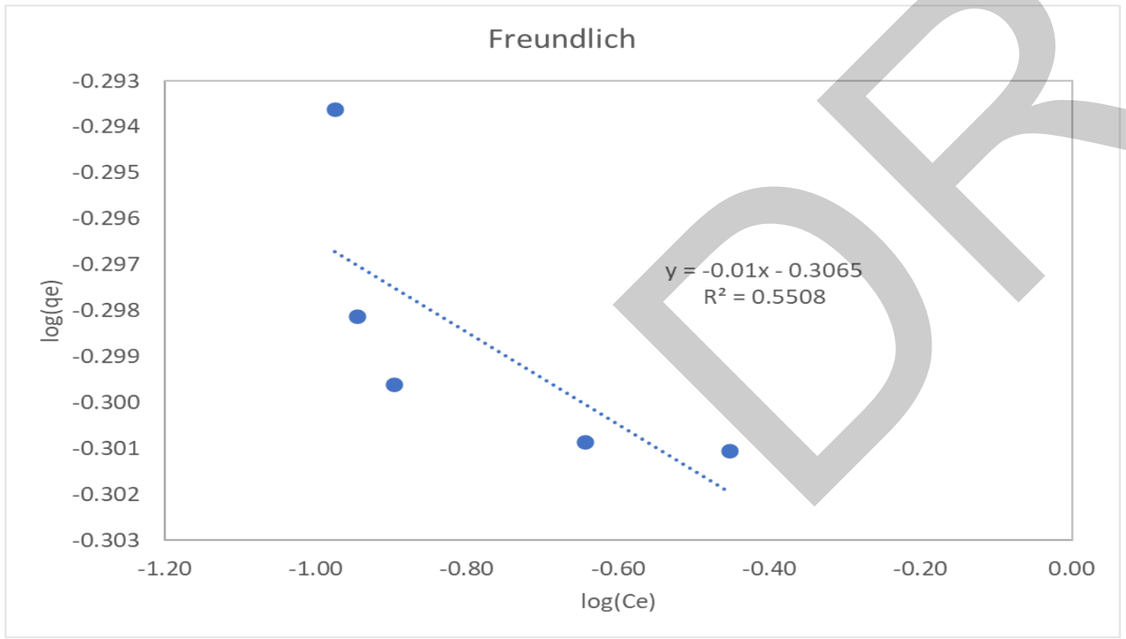

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Note(s):
mg/L: milligrams per liter
mg/g: milligrams per gram
g/L: grams per liter
Ce: aqueous concentration of the adsorbate

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EDWARDS ASH POND (CCR UNIT 301)

CONSULTANT
WSP GOLDER

PROJECT
EVALUATION OF PARTITION COEFFICIENT RESULTS EAP

TITLE
AW-15S BARIUM PARTITION COEFFICIENTS

PROJECT NO.	PHASE	REV.	FIGURE
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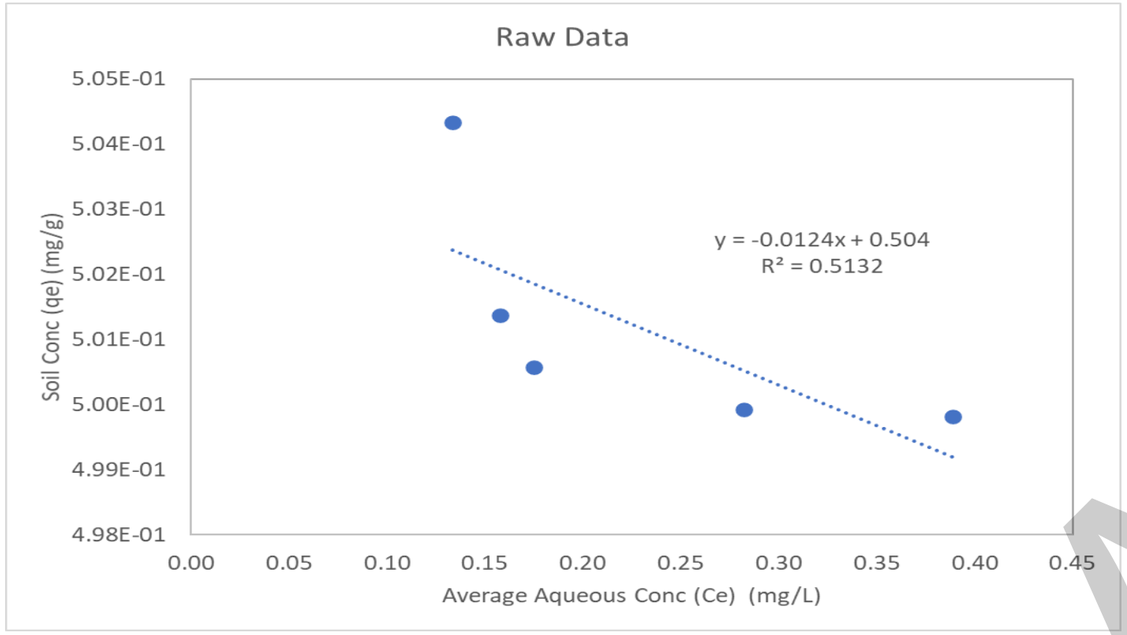

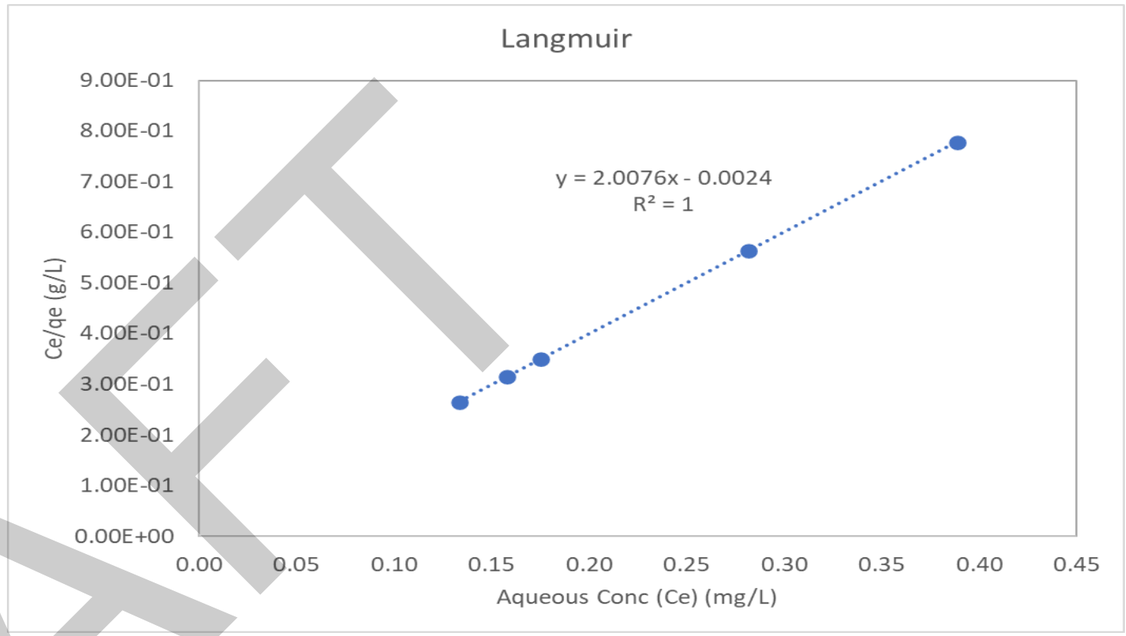

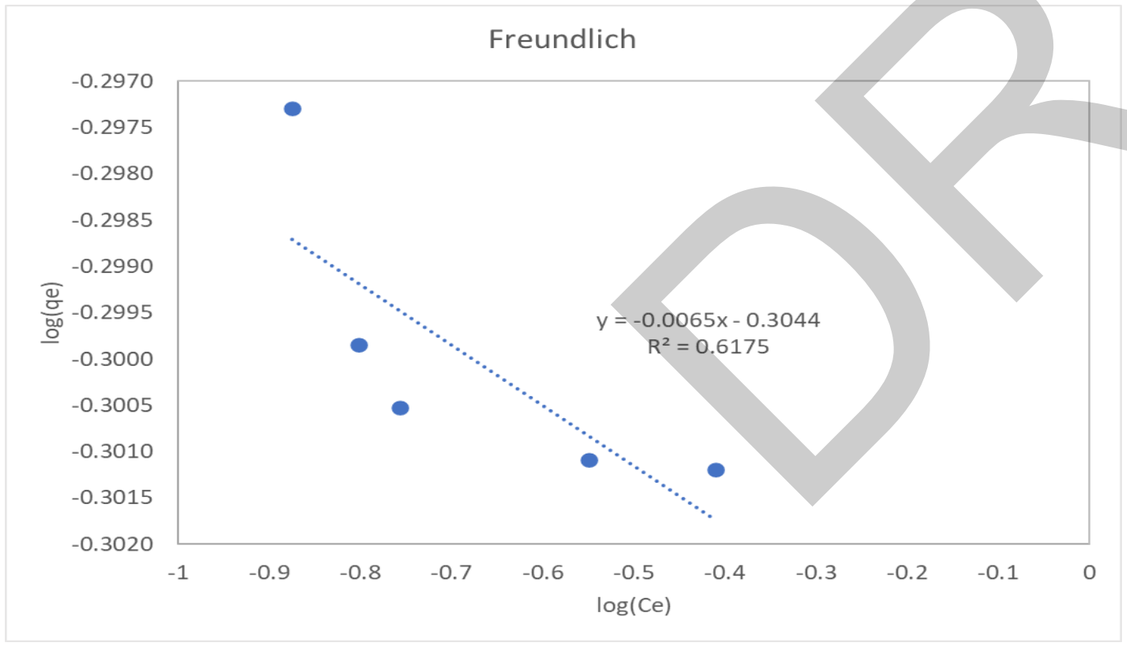

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AW-19 BARIUM PARTITION COEFFICIENTS

PROJECT NO.	PHASE	REV.	FIGURE
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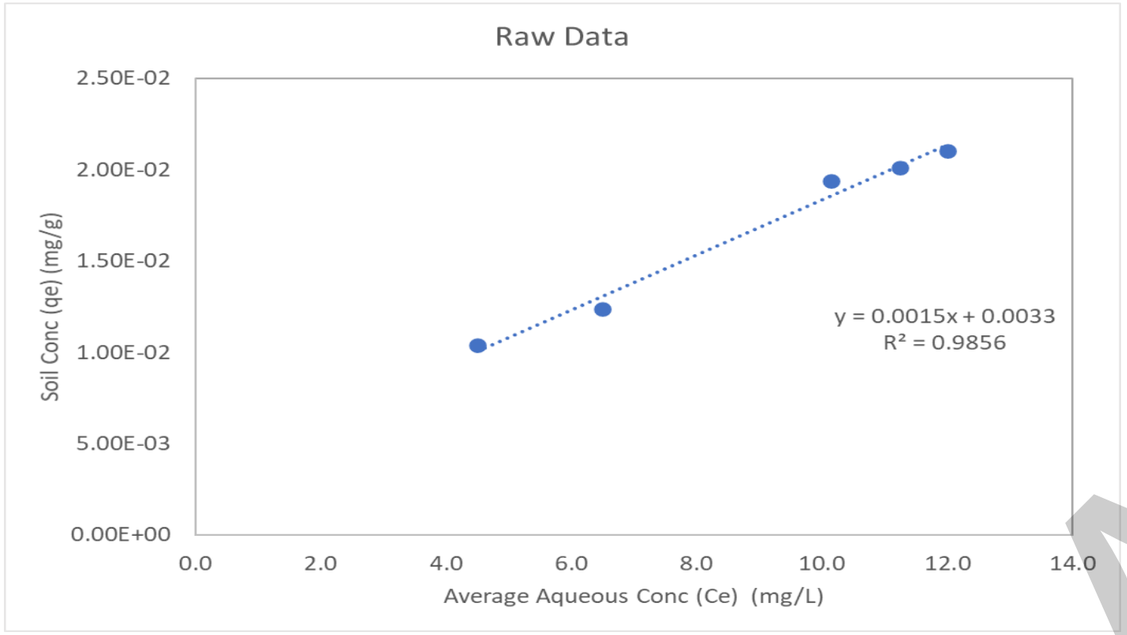

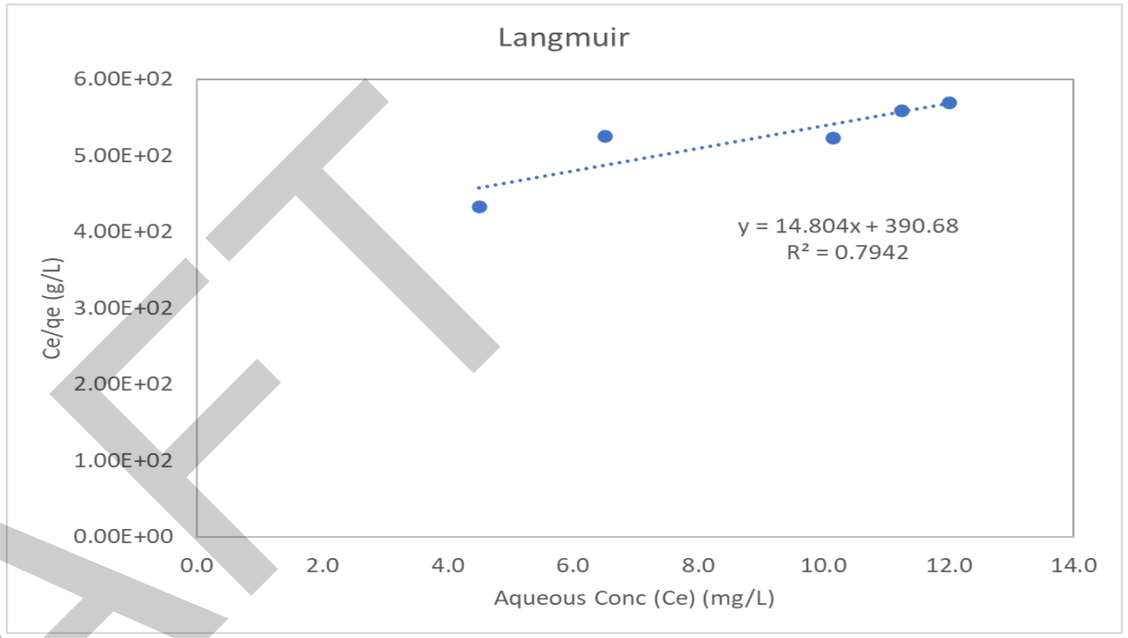

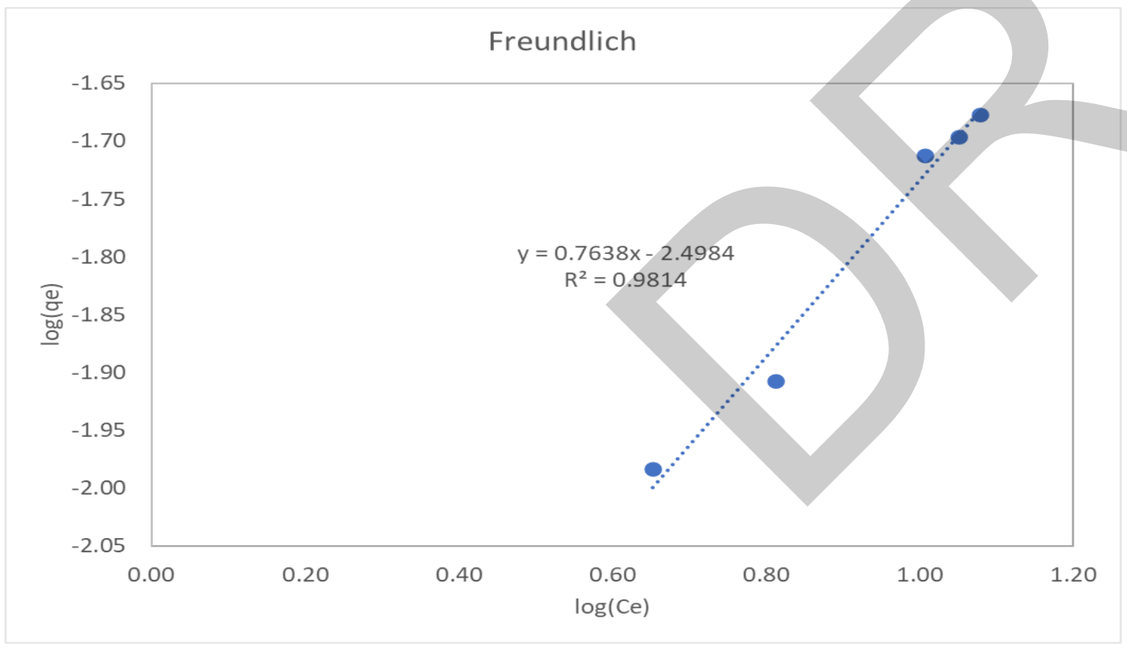

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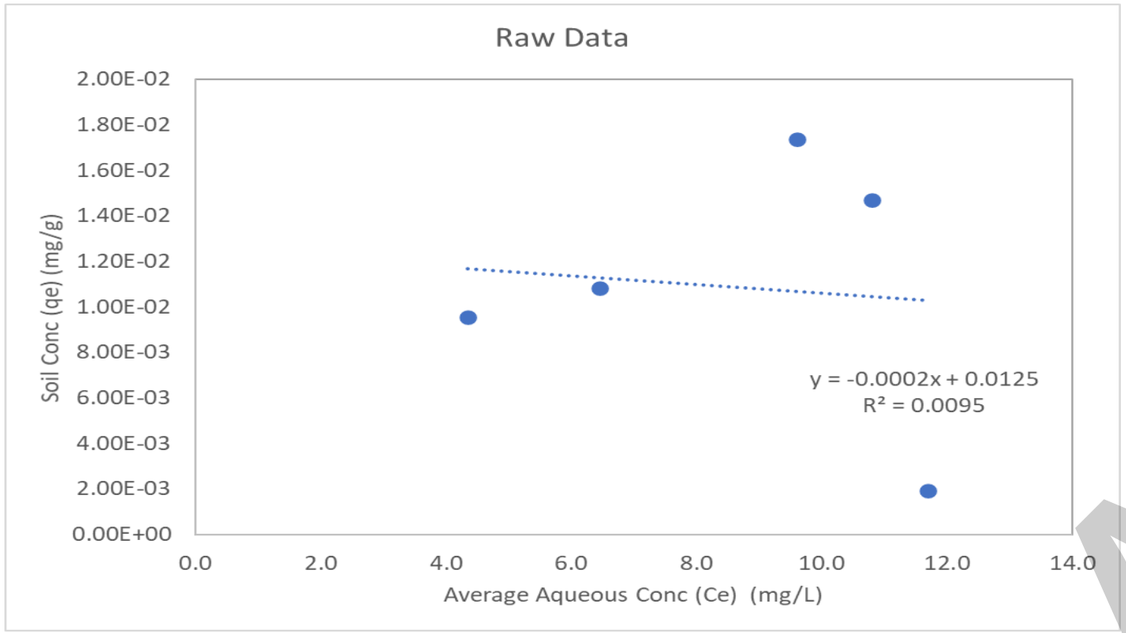

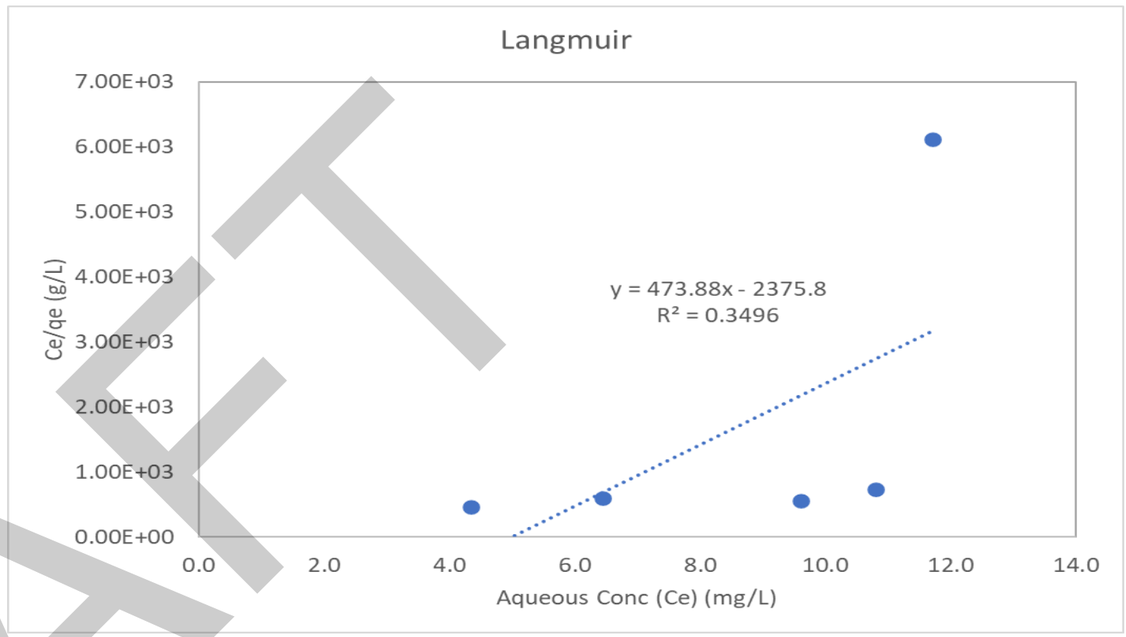

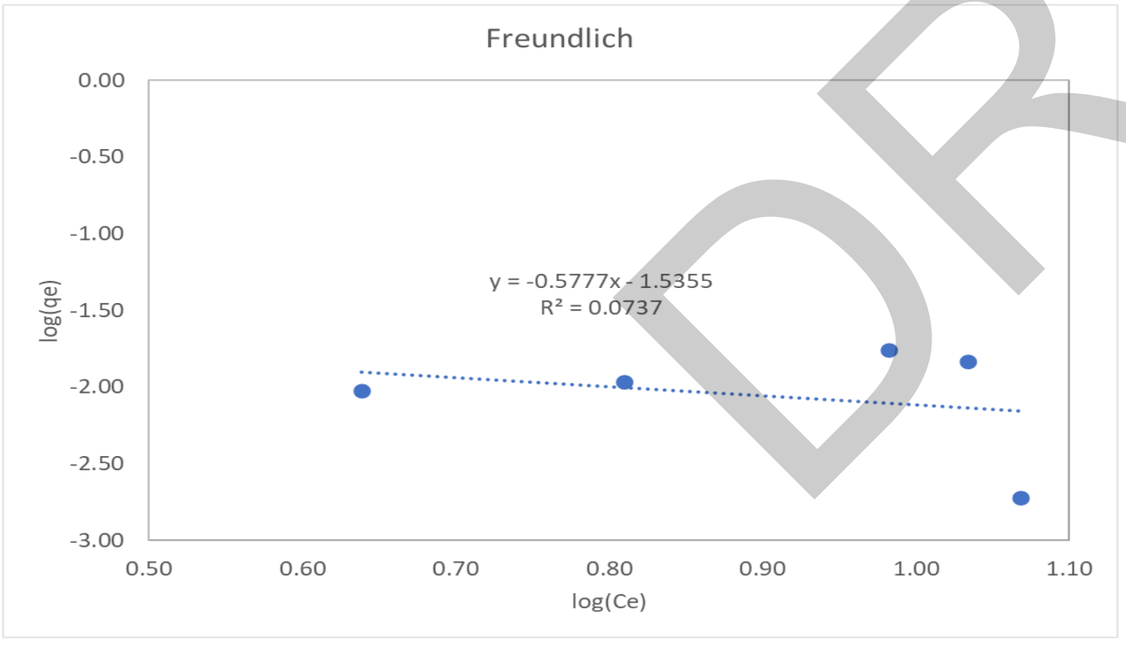

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AW-19 BORON PARTITION COEFFICIENTS

PROJECT NO.	PHASE	REV.	FIGURE
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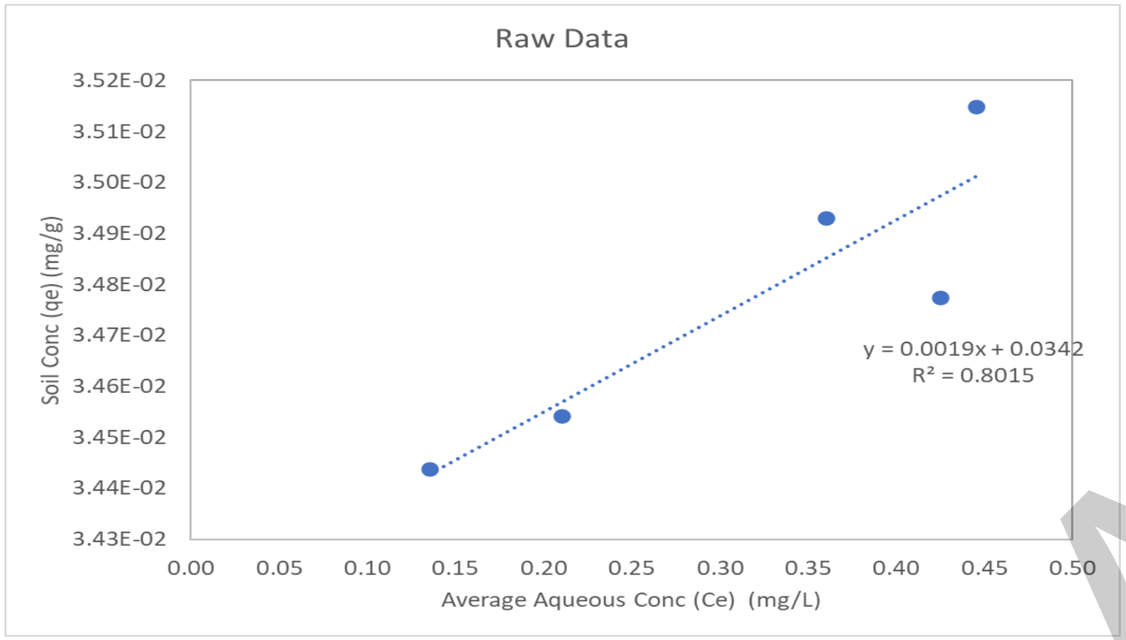

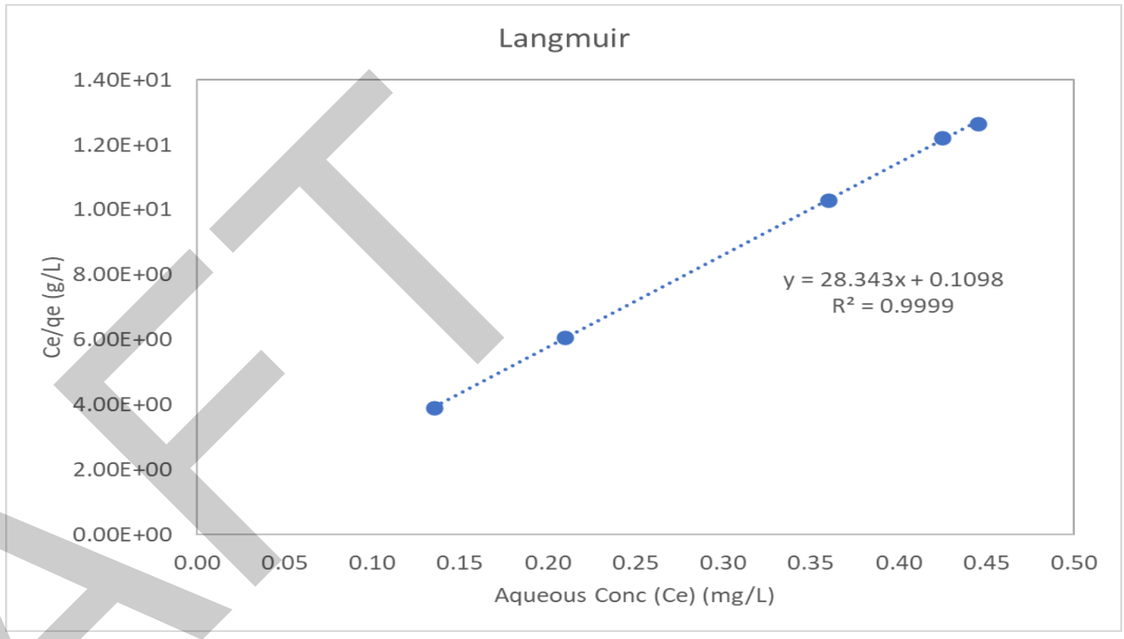

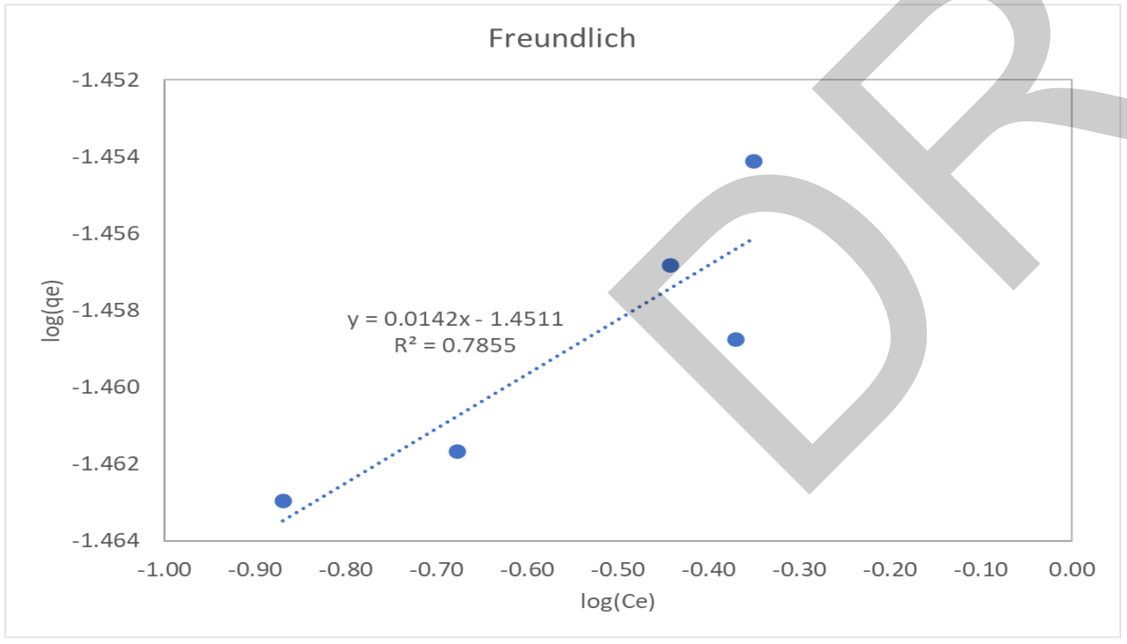

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TITLE
AW-15S LITHIUM PARTITION COEFFICIENTS

PROJECT NO.	PHASE	REV.	FIGURE
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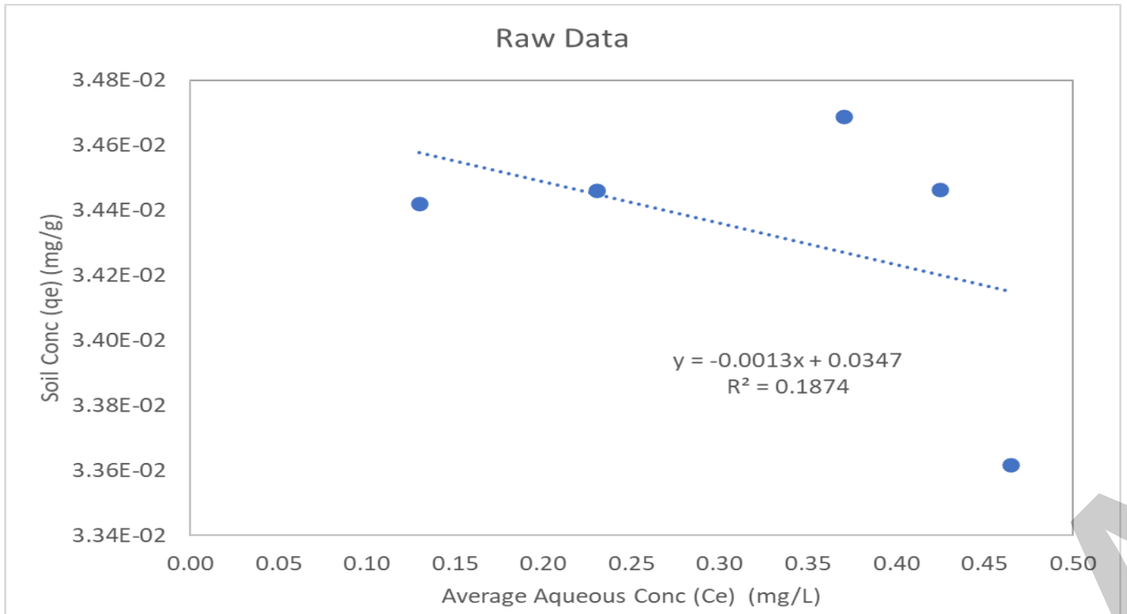

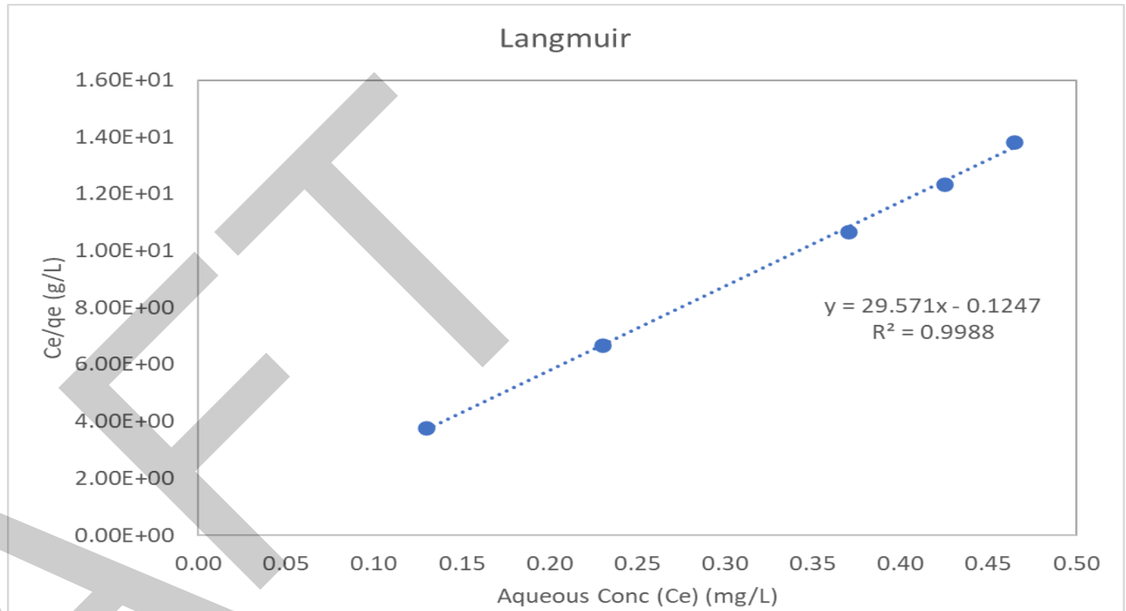

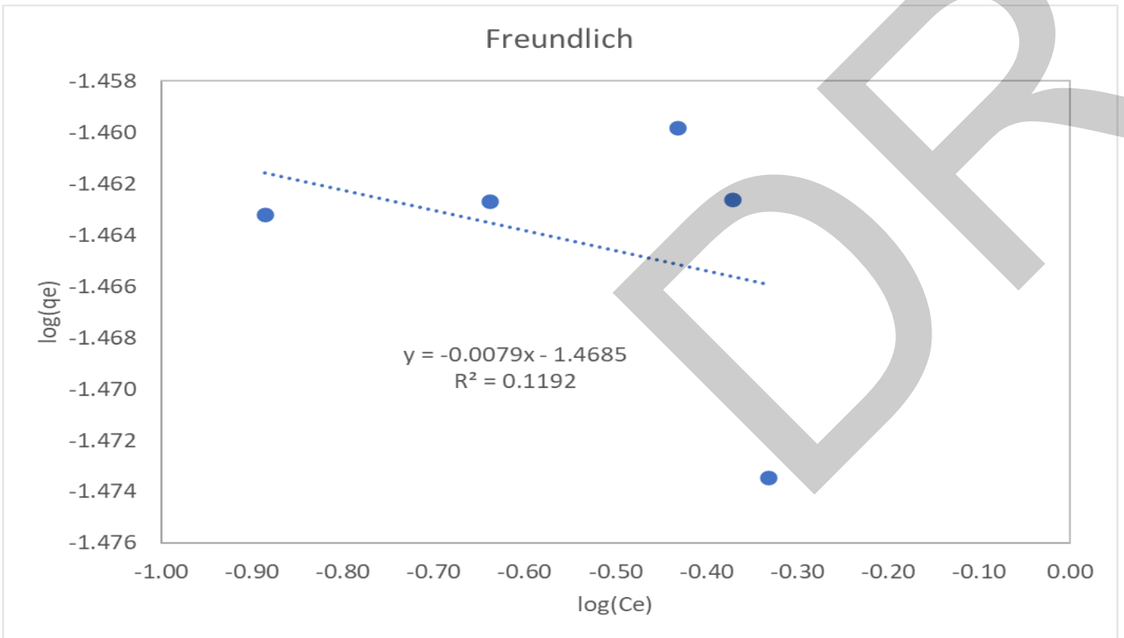

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TITLE
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PROJECT NO.	PHASE	REV.	FIGURE
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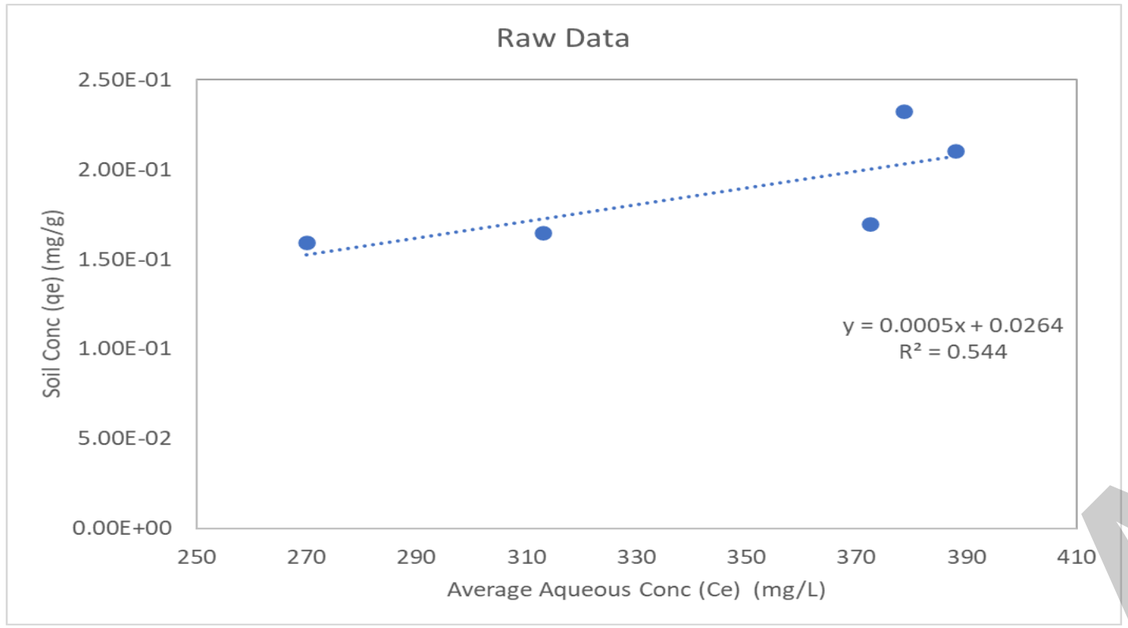
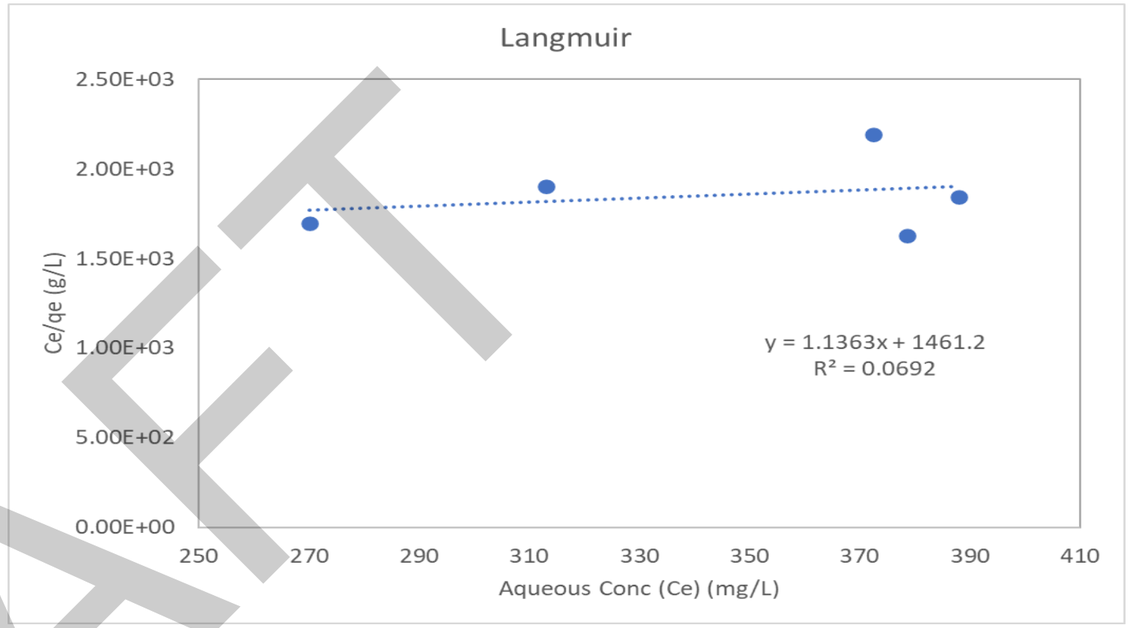
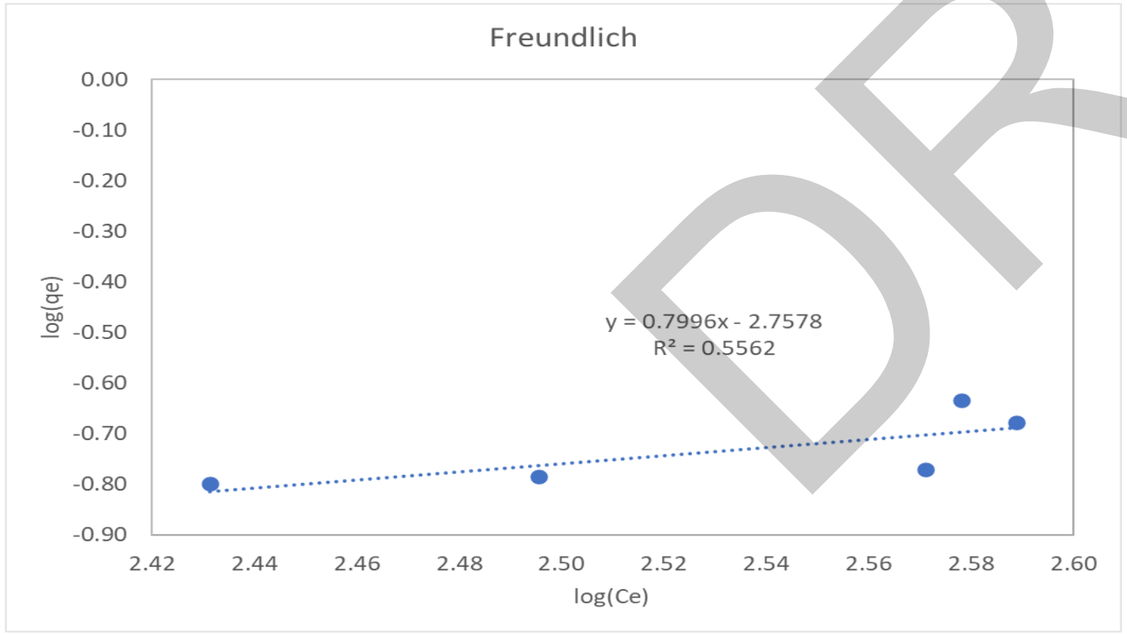






DRAFT

Note(s):
mg/L: milligrams per liter
mg/g: milligrams per gram
g/L: grams per liter
Ce: aqueous concentration of the adsorbate

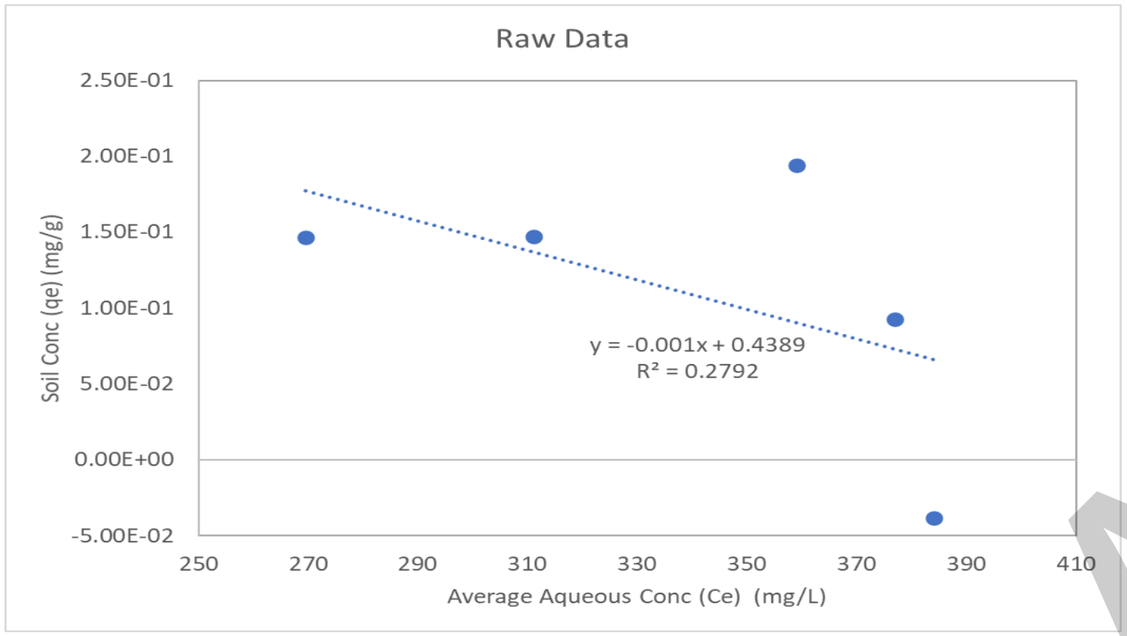
CLIENT
ILLIONIS POWER RESOURCES GENERATING, LLC
EDWARDS ASH POND (CCR UNIT 301)

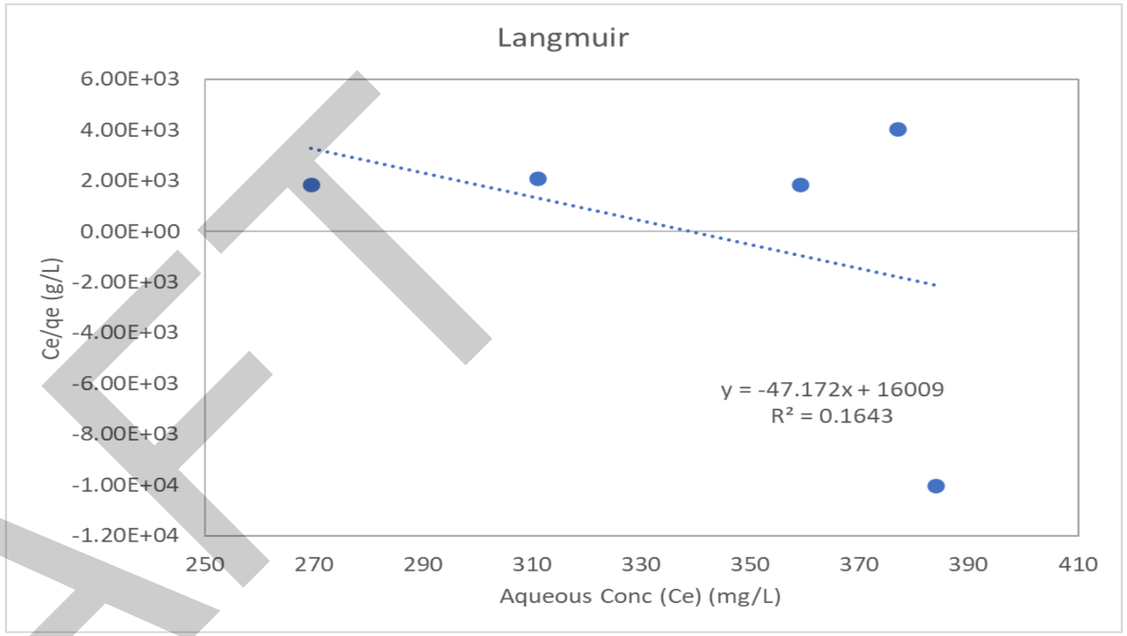
CONSULTANT
wsp GOLDER

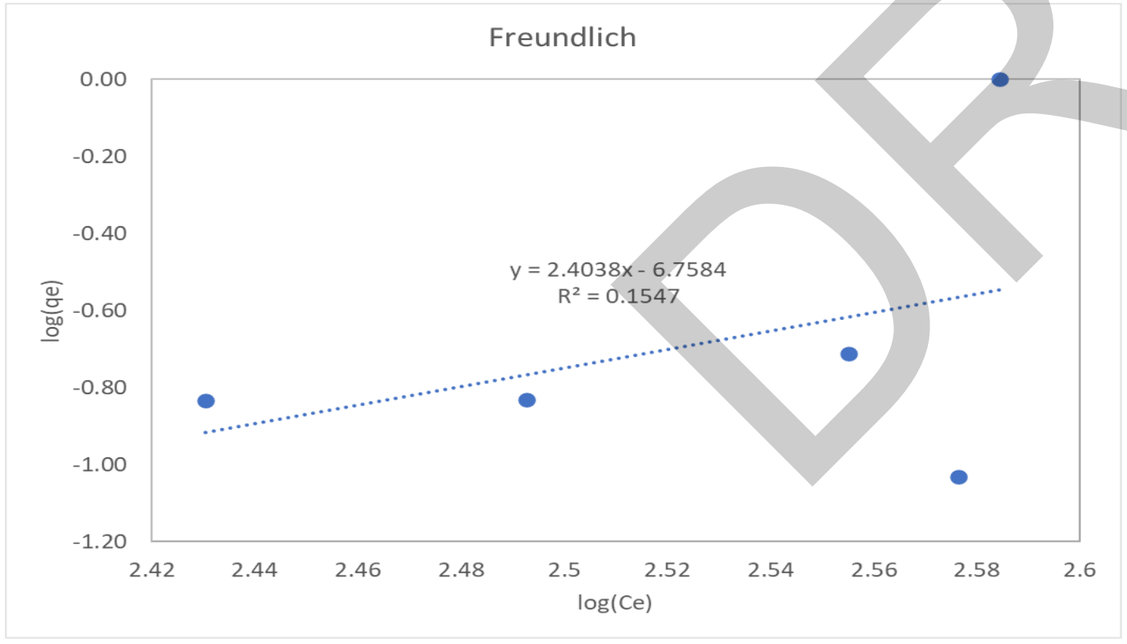
PROJECT
EVALUATION OF PARTITION COEFFICIENT RESULTS EAP

TITLE
AW-15S SULFATE PARTITION COEFFICIENTS

PROJECT NO.	PHASE	REV.	FIGURE
21454831	002	0	A-7







DRAFT

Note(s):
mg/L: milligrams per liter
mg/g: milligrams per gram
g/L: grams per liter
Ce: aqueous concentration of the adsorbate

CLIENT
ILLIONIS POWER RESOURCES GENERATING, LLC
EDWARDS ASH POND (CCR UNIT 301)

CONSULTANT
WSP GOLDER

PROJECT
EVALUATION OF PARTITION COEFFICIENT RESULTS EAP

TITLE
AW-19 SULFATE PARTITION COEFFICIENTS

PROJECT NO.	PHASE	REV.	FIGURE
21454831	002	0	A-8

APPENDIX E
HELP MODEL OUTPUT FILES

DRAFT

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: EDW AP CBR **Simulated On:** 6/24/2022 15:45

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
SiCL - Silty Clay Loam
Material Texture Number 12

Thickness	=	12	inches
Porosity	=	0.471	vol/vol
Field Capacity	=	0.342	vol/vol
Wilting Point	=	0.21	vol/vol
Initial Soil Water Content	=	0.3322	vol/vol
Effective Sat. Hyd. Conductivity	=	4.20E-05	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	86.1	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	91	acres
Evaporative Zone Depth	=	12	inches
Initial Water in Evaporative Zone	=	3.987	inches
Upper Limit of Evaporative Storage	=	5.652	inches
Lower Limit of Evaporative Storage	=	2.52	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	3.987	inches
Total Initial Water	=	3.987	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	40.6	Degrees
Maximum Leaf Area Index	=	4.5	
Start of Growing Season (Julian Date)	=	120	days
End of Growing Season (Julian Date)	=	300	days
Average Wind Speed	=	9	mph

DRAFT

Average 1st Quarter Relative Humidity	=	70 %
Average 2nd Quarter Relative Humidity	=	66 %
Average 3rd Quarter Relative Humidity	=	74 %
Average 4th Quarter Relative Humidity	=	77 %

Note: Evapotranspiration data was obtained for Bartonville, Illinois

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.919862	1.515505	2.970702	3.839356	3.771468	3.644309
3.594188	3.45941	2.562909	2.359867	2.871942	2.037439

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
29.8	35.5	42.2	56.1	68.7	78.2
83.2	80.7	72	62.3	43.5	35.6

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66

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Average Annual Totals Summary

Title: EDW AP CBR
Simulated on: 6/24/2022 15:46

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	34.55	[4.31]	11,411,896.6	100.00
Runoff	3.704	[2.301]	1,223,418.2	10.72
Evapotranspiration	25.760	[3.86]	8,509,175.3	74.56
Subprofile1				
Percolation/leakage through Layer 1	5.087551	[1.891252]	1,680,570.9	14.73
Water storage				
Change in water storage	-0.0038	[0.8344]	-1,267.8	-0.01

* Note: Average inches are converted to volume based on the user-specified area.

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HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: EDW AP CIP Rem **Simulated On:** 6/24/2022 15:41

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
SiCL - Silty Clay Loam
Material Texture Number 12

Thickness	=	72	inches
Porosity	=	0.471	vol/vol
Field Capacity	=	0.342	vol/vol
Wilting Point	=	0.21	vol/vol
Initial Soil Water Content	=	0.3456	vol/vol
Effective Sat. Hyd. Conductivity	=	4.20E-05	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	86.1	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	22	acres
Evaporative Zone Depth	=	18	inches
Initial Water in Evaporative Zone	=	6.174	inches
Upper Limit of Evaporative Storage	=	8.478	inches
Lower Limit of Evaporative Storage	=	3.78	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	24.883	inches
Total Initial Water	=	24.883	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	40.6	Degrees
Maximum Leaf Area Index	=	4.5	
Start of Growing Season (Julian Date)	=	120	days
End of Growing Season (Julian Date)	=	300	days
Average Wind Speed	=	9	mph

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Average 1st Quarter Relative Humidity	=	70 %
Average 2nd Quarter Relative Humidity	=	66 %
Average 3rd Quarter Relative Humidity	=	74 %
Average 4th Quarter Relative Humidity	=	77 %

Note: Evapotranspiration data was obtained for Bartonville, Illinois

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.919862	1.515505	2.970702	3.839356	3.771468	3.644309
3.594188	3.45941	2.562909	2.359867	2.871942	2.037439

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
29.8	35.5	42.2	56.1	68.7	78.2
83.2	80.7	72	62.3	43.5	35.6

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66

DRAFT

Average Annual Totals Summary

Title: EDW AP CIP Rem
Simulated on: 6/24/2022 15:41

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	34.55	[4.31]	2,758,920.1	100.00
Runoff	3.567	[2.195]	284,844.6	10.32
Evapotranspiration	26.939	[3.969]	2,151,375.4	77.98
Subprofile1				
Percolation/leakage through Layer 1	4.025858	[1.305157]	321,505.0	11.65
Water storage				
Change in water storage	0.0150	[1.5498]	1,195.0	0.04

* Note: Average inches are converted to volume based on the user-specified area.

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HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: EDW AP CIP Cons **Simulated On:** 6/27/2022 16:01

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	6	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.3485	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	18	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.2559	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 3

Type 2 - Lateral Drainage Layer
Drainage Net (0.5 cm)
Material Texture Number 20

Thickness	=	0.2	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.0126	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E+01	cm/sec
Slope	=	1.27	%
Drainage Length	=	1190	ft

Layer 4

Type 4 - Flexible Membrane Liner

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LDPE Membrane
Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	1	Holes/Acre
FML Installation Defects	=	1	Holes/Acre
FML Placement Quality	=	3	Good

Layer 5

Type 1 - Vertical Percolation Layer (Waste)
High-Density Electric Plant Coal Fly Ash
Material Texture Number 30

Thickness	=	408	inches
Porosity	=	0.541	vol/vol
Field Capacity	=	0.187	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.187	vol/vol
Effective Sat. Hyd. Conductivity	=	2.08E-06	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	89.3	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	69.1	acres
Evaporative Zone Depth	=	18	inches
Initial Water in Evaporative Zone	=	5.231	inches
Upper Limit of Evaporative Storage	=	7.542	inches
Lower Limit of Evaporative Storage	=	2.85	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	82.995	inches
Total Initial Water	=	82.995	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	40.6	Degrees
Maximum Leaf Area Index	=	2	
Start of Growing Season (Julian Date)	=	120	days
End of Growing Season (Julian Date)	=	300	days
Average Wind Speed	=	9	mph

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Average 1st Quarter Relative Humidity	=	70 %
Average 2nd Quarter Relative Humidity	=	66 %
Average 3rd Quarter Relative Humidity	=	74 %
Average 4th Quarter Relative Humidity	=	77 %

Note: Evapotranspiration data was obtained for Bartonville, Illinois

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.919862	1.515505	2.970702	3.839356	3.771468	3.644309
3.594188	3.45941	2.562909	2.359867	2.871942	2.037439

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
29.8	35.5	42.2	56.1	68.7	78.2
83.2	80.7	72	62.3	43.5	35.6

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66

DRAFT

Average Annual Totals Summary

Title: EDW AP CIP Cons
Simulated on: 6/27/2022 16:02

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	34.55	[4.31]	8,665,517.1	100.00
Runoff	5.498	[2.429]	1,379,079.0	15.91
Evapotranspiration	26.321	[3.85]	6,602,232.4	76.19
Subprofile1				
Lateral drainage collected from Layer 3	2.7222	[1.0387]	682,816.5	7.88
Percolation/leakage through Layer 4	0.000194	[0.000197]	48.6	0.00
Average Head on Top of Layer 4	0.0594	[0.0662]	---	---
Subprofile2				
Percolation/leakage through Layer 5	0.000195	[0.000191]	48.8	0.00
Water storage				
Change in water storage	0.0053	[1.0273]	1,340.4	0.02

* Note: Average inches are converted to volume based on the user-specified area.

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HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: EDW AP Default **Simulated On:** 6/24/2022 16:19

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	6	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.3485	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	30	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.2511	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 3

Type 2 - Lateral Drainage Layer
Drainage Net (0.5 cm)
Material Texture Number 20

Thickness	=	0.2	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.0126	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E+01	cm/sec
Slope	=	1.27	%
Drainage Length	=	1190	ft

Layer 4

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Type 4 - Flexible Membrane Liner
LDPE Membrane
Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	1	Holes/Acre
FML Installation Defects	=	1	Holes/Acre
FML Placement Quality	=	3	Good

Layer 5

Type 1 - Vertical Percolation Layer (Waste)
High-Density Electric Plant Coal Fly Ash
Material Texture Number 30

Thickness	=	408	inches
Porosity	=	0.541	vol/vol
Field Capacity	=	0.187	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.187	vol/vol
Effective Sat. Hyd. Conductivity	=	2.08E-06	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	89.3	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	69.1	acres
Evaporative Zone Depth	=	18	inches
Initial Water in Evaporative Zone	=	5.231	inches
Upper Limit of Evaporative Storage	=	7.542	inches
Lower Limit of Evaporative Storage	=	2.85	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	85.923	inches
Total Initial Water	=	85.923	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	40.6	Degrees
Maximum Leaf Area Index	=	2	
Start of Growing Season (Julian Date)	=	120	days

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End of Growing Season (Julian Date)	=	300	days
Average Wind Speed	=	9	mph
Average 1st Quarter Relative Humidity	=	70	%
Average 2nd Quarter Relative Humidity	=	66	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	77	%

Note: Evapotranspiration data was obtained for Bartonville, Illinois

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.919862	1.515505	2.970702	3.839356	3.771468	3.644309
3.594188	3.45941	2.562909	2.359867	2.871942	2.037439

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
29.8	35.5	42.2	56.1	68.7	78.2
83.2	80.7	72	62.3	43.5	35.6

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66

DRAFT

Average Annual Totals Summary

Title: EDW AP Default
Simulated on: 6/24/2022 16:20

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	34.55	[4.31]	8,665,517.1	100.00
Runoff	5.500	[2.427]	1,379,467.8	15.92
Evapotranspiration	26.321	[3.847]	6,602,070.5	76.19
Subprofile1				
Lateral drainage collected from Layer 3	2.7200	[0.9825]	682,274.9	7.87
Percolation/leakage through Layer 4	0.000098	[0.000126]	24.6	0.00
Average Head on Top of Layer 4	0.0267	[0.0439]	---	---
Subprofile2				
Percolation/leakage through Layer 5	0.000098	[0.000117]	24.7	0.00
Water storage				
Change in water storage	0.0067	[1.1405]	1,679.2	0.02

* Note: Average inches are converted to volume based on the user-specified area.

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HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: EDW AP Default Earth **Simulated On:** 6/24/2022 16:16

DRAFT

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	6	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.3485	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	30	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.2563	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 3

Type 3 - Barrier Soil Liner
Liner Soil (High)
Material Texture Number 16

Thickness	=	36	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Layer 4

Type 1 - Vertical Percolation Layer (Waste)
High-Density Electric Plant Coal Fly Ash
Material Texture Number 30

Thickness	=	408	inches
Porosity	=	0.541	vol/vol
Field Capacity	=	0.187	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.1894	vol/vol
Effective Sat. Hyd. Conductivity	=	2.08E-06	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	89.3	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	69.1	acres
Evaporative Zone Depth	=	18	inches
Initial Water in Evaporative Zone	=	5.235	inches
Upper Limit of Evaporative Storage	=	7.542	inches
Lower Limit of Evaporative Storage	=	2.85	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	102.427	inches
Total Initial Water	=	102.427	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	40.6	Degrees
Maximum Leaf Area Index	=	2	
Start of Growing Season (Julian Date)	=	120	days
End of Growing Season (Julian Date)	=	300	days
Average Wind Speed	=	9	mph
Average 1st Quarter Relative Humidity	=	70	%
Average 2nd Quarter Relative Humidity	=	66	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	77	%

Note: Evapotranspiration data was obtained for Bartonville, Illinois

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.919862	1.515505	2.970702	3.839356	3.771468	3.644309
3.594188	3.45941	2.562909	2.359867	2.871942	2.037439

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Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
29.8	35.5	42.2	56.1	68.7	78.2
83.2	80.7	72	62.3	43.5	35.6

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.6/-89.66

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Average Annual Totals Summary

Title: EDW AP Default Earth
Simulated on: 6/24/2022 16:17

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	34.55	[4.31]	8,665,517.1	100.00
Runoff	5.205	[2.496]	1,305,465.6	15.07
Evapotranspiration	27.450	[3.924]	6,885,299.6	79.46
Subprofile1				
Percolation/leakage through Layer 3	1.826281	[0.161421]	458,091.5	5.29
Average Head on Top of Layer 3	16.9565	[4.5453]	---	---
Subprofile2				
Percolation/leakage through Layer 4	0.000191	[0.001041]	47.8	0.00
Water storage				
Change in water storage	1.8925	[1.6409]	474,704.0	5.48

* Note: Average inches are converted to volume based on the user-specified area.

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APPENDIX F
FLUX EVALUATION DATA

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APPENDIX F. FLUX EVALUATION DATA
GROUNDWATER MODELING REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, ILLINOIS

Calibration Model					
Model	**Years (Model Period)**	**HSU**	**Total Flux In[1] (ft^3/d)**	**Total Flux In (gpm)**	
Calibration Model	62	Fill Unit (CCR)	708.27	3.68	
Model	**Years (Model Period)**	**HSU**	**Total Flux Out[1] (ft^3/d)**	**Total Flux Out (gpm)**	
Calibration Model	62	Fill Unit (CCR)	-709.88	-3.69	
Scenario 1: CIP (CCR removal from the northwest areas of the Ash Pond, consolidation to the northeast, central and southern areas of the Ash Pond, and construction of a cover system over the remaining CCR)					
Prediction Model	**Years (Post-Construction Period)**	**HSU**	**Total Flux In[1] (ft^3/d)**	**Total Flux In (gpm)**	**Reduction in Flux In Post Closure[2] (Percentage, %)**
CIP	186	Fill Unit (CCR)	20.95	0.11	97%
Prediction Model	**Years (Post-Construction Period)**	**HSU**	**Total Flux Out[1] (ft^3/d)**	**Total Flux Out (gpm)**	**Reduction in Flux Out Post Closure[2] (Percentage, %)**
CIP	186	Fill Unit (CCR)	-43.80	-0.23	94%

[O: JJW 6/20/22; C: EGP 6/16/22; U: JJW 6/24/22;U: BGH 6/27/22]

Notes:
1. Reduction in flux in as compared to flux in at the end of calibration model (model period of 62 years).
2. Total flux in and out source data provided in flux calculation data files included in Appendix C.

CCR = coal combustion residuals
CIP = closure in place
HSU = Hydrostratigraphic Unit
% = percentage
ft^3/d = cubic feet per day
gpm = gallons per minute

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APPENDIX C
MATERIAL QUANTITY, LABOR, AND MILEAGE ESTIMATES FOR ALTERNATIVE 2 AND ALTERNATIVE 3 REMEDIES

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ILLINOIS POWER RESOURCES GENERATING, LLC - EDWARDS POWER PLANT
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 2 - SOURCE CONTROL WITH GROUNDWATER EXTRACTION TRENCH[1]

ITEM NO.	ENGINEERING, PRE-CONSTRUCTION, AND CONSTRUCTION SUPPORT TASKS	Units	Quantity	Crew	Daily Output	Labor Hours	Equipment Hours	Notes
1	Pre-Design Investigation, Final Groundwater Extraction Trench Design and Bid Support	LS	1	-	-	-	-	Assumes pre-design investigation is needed as part of the Final Groundwater Extraction Trench design.
2	Engineering Support and CQA During Construction	LS	1	Eng	12	3,600	3,000	Assumed labor and equipment hours based on Ramboll project experience.
	ENGINEERING, PRE-CONSTRUCTION, AND CONSTRUCTION SUPPORT ESTIMATED SUBTOTAL					**3,600**	**3000**	
ITEM NO.	**SITE PREPARATION**	**Units**	**Quantity**	**Crew**	**Daily Output**	**Labor Hours**	**Equipment Hours**	**Notes**
3	Mobilization and De-Mobilization	LS	-	-	-	-	-	Assumes general construction and One-Pass mobilization and demoibilization.
	General Construction Mobilization and De-Mobilization	LS	1	-	-	-	-	Assumes general construction contractor is mobilizing equipment from out of state.
	One-Pass Trencher Mobilization, Assembly, and De-Mobilization	LS	1	-	-	-	-	Assumes construction contractor is mobilizing One-Pass equipment from out of state.
4	Staging Area & Temporary Roads Preparation	-	-	-	-	1,569	1,140	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	6,000	2 Clab	2500	38	0	313219161550: Geosynthetic soil stabilization, geotextile fabric, non-woven, 120 lb tensile strength includes scarifying and compaction. Assumes 1 acre (4800 sy) staging area and approximately 2000 ft of temporary access road (15 ft wide). 2000 ft is to improve access road for the southern trench area.
	Offsite Fill for South Area Ramp	CY	8,000	B13D	376	340	340	Imported clay for south area ramp. Assumes 8000 CY. Based on Ramboll experience.
	Haul Fill to Site	LCY	8,000	B34C	99	646	646	312323203104: Cycle hauling(wait, load, travel, unload or dump & reutrn) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 16.5 C.Y. truck, cycle 50 miles, 45 mph, excludes loading equipment
	Haul Material to South Area Ramp	CY	8,000	B34G	850	75	75	312323206170: Hauling; no loading equipment, including hauling, waiting, loading/dumping; 34 C.Y. off-road, 15 min wait/ld./uld., 15 MPH, cycle 1 mile. Daily output extrapolated down to 10 min wait. Assumes onsite stockpile location approximately 1/2 mile from south ramp area. Assumes hauling of clay to south ramp area.
	Construct Staging Area & Temporary Roads	SY	6,000	B14	615	468	78	015523500100: Temporary, roads, gravel fill, 8" gravel depth, excluding surfacing. Assumes 1 acre staging area and approximately 2000 ft of temporary access road.
5	Construction Soil Erosion & Sediment Controls	-	-	-	-	278	93	Assumes soil erosion and sediment controls will be implemented only during the groundwater extraction trench construction.
	Silt Fence	LF	5,200	B62	650	192	64	312514161000: Synthetic erosion control, silt fence, install and remove, 3' high. Assumes silt fence is installed on downgradient side of the extraction trench alignments [2,600 ft of combined extraction trenches (1,700 feet in the north, 900 feet in the south)]. Assumes the silt fence will get replaced once during construction.
	Sediment Log, Filter Sock	LF	3,600	A2	1000	86	29	312514160705: Sediment Log, Filter Sock, 9". Assume sediment log is needed along alignment of extraction trench (2,600 LF total) and settling pond perimeter (1,000 LF).
6	Construction Facilities	-	-	-	-	-	-	Assumes office trailer, storage boxes, and portable toilets are required during the construction phase of the alternative.
	Office Trailer	MO - in use	12	-	-	-	-	015213200350: Office trailer, furnished, no hookups, 32' x 8'. Assume quantity of one (1).
	Storage Trailers	MO - in use	12	-	-	-	-	015213201350: Storage boxes, 40' x 8'. Assume quantity of two (2) boxes onsite.
	Portable Toilet	MO - in use	12	-	-	-	-	015433406410: Toilet, portable chemical. Assume quantity of four (4) units onsite.
7	Electrical Installation	EA	3	R1B	-	720	0	Assumes electrical installation based on Ramboll experience to install one power drop for low-voltage (120V) power for the irrigation pumps, control equipment, etc. For each power drop, consider the distances from existing power sources.
8	Existing Site Utilities Preparation	-	-	-	-	216	158	Assumes utility survey, relocate, and power line relocation to identify/inventory existing active or abandoned site utilities in conflict with proposed extraction trench activities. Assumes updated layout will be determined during design phase.
	Utility Survey	LS	-	UL	-	40	20	Private and public utility location services to adequately locate and inventory existing site utilities that may be in conflict with proposed extraction trench locations based on Ramboll experience.
	Utility Relocate/Removal	EA	1	R6	1	88	69	Addressing potential conflicting of abandoned section of sewer force main based on Ramboll experience. Sewer force main crossing the AP is to be abandoned as part of AP closure activities, but if abandoned main is to remain in place, then sections may need to be removed to accomodate extraction trench installation.
	Power Line Relocation	EA	1	R6	1	88	69	Relocation/raising of high voltage power lines crossing the CBR portion of the AP to allow for adqueate clearance for construction equipment for trench installation based on Ramboll experience.
9	Geotechnical Monitoring	LS	-	GM	-	600	0	Assumes installation of inclinometers, survey prisms, and settlement monitoring devices along the southern trench where the dike will be modified for work pad installation. Assumes a 4-person crew installs the monitoring system over a period of 3 weeks. Based on Ramboll experience

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10	Extraction Trench Alignment Preparation Work Pad	-	-	-	-	4,405	1,116	Assumes construction of a 30-ft wide work pad for the full length of the northern and southern trenches. For the southern trench, excavation of berm material on the upslope side and fill along the downslope side will be required to level off the work area. The slope will be reinforced to ensure structural integrity (*e.g.* , by installation of excavation shoring or other means). Once prepared, surface grading and stabilization will be completed along the southern trench work pad. For the northern trench, it is anticipated that only surface grading and stabilization will be required for the work pad.
	Excavation of Berm Material and Stockpiling for South Trench	CY	6,000	B12C	1320	73	36	312316420260: Excavating, bulk bank measure, hydraulic, crawler mtd., 2 C.Y. cap (165 CY/hr). Using 900 ft long, 12 ft deep, and 20 ft wide.
	Concrete Jersey Barriers for South Trench	EA	90	B21B	24	150	30	347113171500. Security vehicle barriers, concrete barrier, jersey, 10' L x 2' by 6" W x 32" H, 10 or more same site. Assumes silt fence is installed on downgradient side of the extraction trench alignments 900 ft. Requested by specialty contractor to protect the limit of disturbance.
	Temporary Excavation Shoring	S.F	49,500	B40	960	3,300	825	314116101500. 20' deep excavation, 27 psf, left in place. Assumes length of 900 ft and retained height of 15 ft and 40 ft embedment. Based on Ramboll experience.
	Loading Stockpiled Berm Material for South Trench	BCY	6,000	B10S	970	74	49	312323154060: Borrow, common earth, 1-1/2 C.Y. bucket, loading and/or spreading, front end loader, wheel-mounted. Assumes stockpiling of upslope material adjacent to work area.
	Hauling Berm Material to Stockpile for South Trench	LCY	6,000	B34G	986	49	49	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.
	Surface Grading for North Trench	MSF	51	B11L	30	27	14	312216103600: Fine grading, work pad area. Assumes grading along the northern (1,700 ft) alignment.
	Subsurface Stabilization Nonwoven Geotextile for North and South Trenches	SY	8,667	2 Clab	2500	55	-	313219161550: Geosynthetic soil stabilization, geotextile fabric, non-woven, 120 lb tensile strength includes scarifying and compaction; assume we need for working pad. At northern trench, work pad will span 1,700 ft long and 30 ft wide. At southern trench, work pad will span 900 ft long and 30 ft wide.
	Install Crushed Gravel Work Pad (8" Thick) for North and South Trenches	SY	8,667	B14	615	676	113	015523500100: Temporary, roads, gravel fill, 8" gravel depth, excluding surfacing. At northern trench, work pad will span 1,700 ft long and 30 ft wide. At southern trench, work pad will span 900 ft long and 30 ft wide.
	SITE PREPARATION ESTIMATED SUBTOTAL			-	-	**7,788**	**2,506**	
ITEM NO.	**GROUNDWATER EXTRACTION TRENCH CONSTRUCTION**	**Units**	**Quantity**	**Crew**	**Daily Output**	**Labor Hours**	**Equipment Hours**	**Notes**
11	Materials	-	-	-	-	1,182	1,182	Purchase of sand/granular material for backfilling the extraction trenches.
	Sand/Granular Backfill	CY	8,906	B13D	376	379	379	Sand/granular backfill for extraction trenches. Assumes northern trench is 1,700 ft with an approximate depth of 26.5 ft (depth varies between 24-29 ft deep) and southern trench is 900 ft and 39 ft deep. Assumes both trenches are 3 ft wide. Based on Ramboll experience.
	Haul Material to Site	LCY	8,906	B34C	99	720	720	312323203104: Cycle hauling(wait, load, travel, unload or dump & reutrn) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 16.5 C.Y. truck, cycle 50 miles, 45 mph, excludes loading equipment
	Haul Material to Trench Locations	CY	8,906	B34G	850	84	84	312323206170: Hauling; no loading equipment, including hauling, waiting, loading/dumping; 34 C.Y. off-road, 15 min wait/ld./uld., 15 MPH, cycle 1 mile. Daily output extrapolated down to 10 min wait. Assumes onsite stockpile location approximately 1/2 mile from each trench. Assumes hauling of granular material to trenches.
12	Installation of Groundwater Extraction Trench	-	-	-	-	1,433	878	Installation of groundwater extraction trench performed by a specialty contractor and associated clay cap surface completion activities. Also includes restabilization of the slope along the work pad alignment via
	Trench Excavation (North)	LF	1,835	OP	200	459	459	OP crew determined from crew information provided by specialty contractor. Assumes one trench totaling 1,700 ft in length with an approximate depth of 26.5 ft (depth varies between 24-29 feet). Adding on 135 LF per Contractor's additional length requirements.
	Trench Excavation (South)	LF	1,035	OP	200	259	259	OP crew determined from crew information provided by specialty contractor. Assumes one trench totaling 900 ft in length with an approximate depth of 39 ft. Adding on 135 LF per Contractor's additional length requirements.
	Methane Monitoring during Trench Excavation	LS	1	M	1	500	0	Health and safety monitoring for potential presence of methane.
	CONTINGENCY: STANDBY TIME FOR METHANE IMPACTS	LS	1	--	--	--	--	Standby time for potential stop work related to presence of methane in the subsurface.
	Restabilization of Work Pad - Loading Backfill Material for South Trench	BCY	6,000	B10S	970	74	49	312323154060: Borrow, common earth, 1-1/2 C.Y. bucket, loading and/or spreading, front end loader, wheel-mounted. Assumes stockpiling of upslope material adjacent to work area.
	Restabilization of Work Pad - Hauling Backfill Material to South Trench	LCY	6,000	B34G	986	49	49	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.
	Restabilization of Work Pad - Spreading of Backfill Material for South Trench	CY - as excavated	6,000	B10B	1000	72	48	312323170020: Spread dumped material, no compaction, by dozer. Daily output edited to match excavation based on experience. Assumes use of overexcavated berm material.
	Restabilization of Work Pad - Compaction of Backfill Material for South Trench	CY - in place	6,000	B10G	5200	14	9	312323235680: Compaction; Riding, sheepfoot roller, 12" lifts, 2 passes. RS Means Crew is B10G.
	Hauling Berm Stockpiled Clay for Trench Cap	LCY	289	B34G	850	3	3	312323206170: Hauling; no loading equipment, including hauling, waiting, loading/dumping; 34 C.Y. off-road, 15 min wait/ld./uld., 15 MPH, cycle 1 mile. Daily output extrapolated down to 10 min wait. Assumes onsite stockpile location approximately 1/2 mile from each trench. Assumes hauling of excavated berm material for use as trench cap.
	Spread Lifts for Clay Trench Cap	CY - as excavated	289	B10B	1000	3	2	312323170020: Spread dumped material, no compaction, by dozer. Daily output edited to match excavation based on experience. Assumes use of overexcavated berm material.
	Compaction of Clay Trench Cap	CY - in place	289	B10Y	5200	1	0	312323235060: Compaction; Riding, vibrating roller, 12" lifts, 2 passes. RS Means Crew is B10Y.

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13	Spoils Management	-	-	-	-	258	203	Hauling and management of trench excavation spoils to the AP for placement beneath the final cover system.
	Loading	CY - as excavated	9,888	B14B	5000	24	16	312316435320: Excavating, large volume projects; excavation with truck loading; excavator, 6 C.Y. bucket, 100% fill factor (assume 10% fluff factor from ground to excavated).
	Hauling and Placement at AP	CY - as excavated	9,888	B34G	850	93	93	312323206170: Hauling; no loading equipment, including hauling, waiting, loading/dumping; 34 C.Y. off-road, 15 min wait/ld./uld., 15 MPH, cycle 1 mile. Daily output extrapolated down to 10 min wait.
	Spreading Lifts	CY - as excavated	9,888	B10B	1000	119	79	312323170020: Spread dumped material, no compaction, by dozer. Daily output edited to match excavation based on experience.
	Compaction of Material	BCY	9,888	B10G	5200	23	15	312323235680: Compaction, 2 passes, 12" lifts, sheepsfoot or wobbly wheel roller.
14	Groundwater Extraction Trench Mechanical Installation	-	-	-	-	1,712	553	Installion of a system to pump and convey extracted groundwater from the trenches to the new settling pond and associated discharge.
	Install Pneumatic Pumps	EA	10	Q1	1.8	90	0	221429132010: Wet-pit-mounted, vertical sump pump, single stage, 25 GPM, 1 HP, 1-1/2" discharge. Assumes one pump per 200 ft of extraction trench.
	Install Equalization Tank	EA	2	B6	1.0	48	16	Installation of equalization tank at each trench and associated site preparation and instrumentation based on Ramboll project experience. Assumes 2 days for installation.
	Install Transfer Pumps and Controllers	EA	2	R30	1.0	52	0	Installation of transfer pump and pump controller at each extraction trench to convey water from settling pond to discharge outfall based on Ramboll project experience. Assumes inclusion of housing structure and 2 days for installation.
	Excavate Utility Trench for Lines to Compressors and Extraction Pumps	LF	5,000	B54	860	47	47	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	-	390	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 15 days of work.
	Excavate Utility Trench for Conveyance to Settling Pond	LF	7,700	B54	860	72	72	312316142750: Utility trench excavating, chain trencher, 40 HP operator riding, 12" wide trench and backfill, 18" deep. Utility trench installed from groundwater extraction trench to convey extracted water to the settling pond.
	Install 8" HDPE Conveyance Pipe to Settling Pond	LF	7,700	B22A	320	963	385	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 trenches to settling pond.
	Backfill Utility Trench with Granular Trench Backfill	LCY	428	B10R	100	51	34	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, 7,700 ft long.
15	Construction of Compressor & Mechanical Sheds	-	-	-	-	540	180	Assumes two compressor sheds are required to operate vertical sump pumps and compressor shed system components.
	Construct Compressor Shed	EA	2	B6	-	540	180	Assumes pre-fabricated mechnical instrumentation shelter, installed primarily by hand with light equipment assistance. Hours are based on Ramboll experience. Two sheds will include extraction equipment (air compressor and transfer pump) and will be located at the trenches.
16	Installation of Settling Pond	-	-	-	-	1,079	386	Quantity based on 1-acre pond, 5 feet deep. Assume all excavated material is reused for berm construction.
	Excavation and Loading of Settling Pond Material	BCY	8,148	B12C	1320	99	49	312316420260: Excavating, bulk bank measure, hydraulic, crawler mtd., 2 C.Y. cap (165 CY/hr). Assumes size of settling pond to be 1 acre and 5 feet deep.
	Hauling and Placement of Settling Pond Material	LCY	8,148	B34G	986	66	66	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	8,148	B10B	1000	98	65	312323170020: Spread dumped material, no compaction, by dozer. Daily output edited to match excavation based on experience.
	Compaction of Material in Berm	BCY	8,148	B10G	5200	19	13	312323235680: Compaction, 2 passes, 12" lifts, sheepsfoot or wobbly wheel roller
	Fine Grading of Berm	MSF	8	B11L	30	4	2	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 (≈5000 SY) settling pond.
	Settling Pond Liner	SF	44,000	B63B	1850	761	190	310519531100: Reservoir liners, membrane lining, 40 mil, LLDPE. Assumes 1 acre ft print.
17	Extracted Water Discharge Management	-	-	-	-	263	96	Based on approximate 1,500 ft distance from settling pond to discharge outfall.
	Install Transfer Pump and Controller	EA	1	R30	1	52	0	Lump sum for 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 and 2 days for installation.
	Excavate Utility Trench for Conveyance to Discharge	LF	1,500	B54	860	14	14	312316142750: Utility trench excavating, chain trencher, 40 HP operator riding, 12" wide trench and backfill, 18" deep. Trench installed from settling pond to convey settled water to outfall for discharge.
	Install 8" HDPE Conveyance Pipe to Discharge	LF	1,500	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 water from settling pond to discharge point.
	Backfill with Granular Trench Backfill	LCY	83	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.
	GROUNDWATER EXTRACTION TRENCH CONSTRUCTION			-	-	**6,468**	**3,479**	

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ITEM NO.	SITE RESTORATION	Units	Quantity	Crew	Daily Output	Labor Hours	Equipment Hours	Notes
18	Site Restoration	-	-	-	-	346	56	Assumes restoration of grade surface following extraction trench installation activities.
	Erosion Control Blanket	SY	30,000	B1	2500	288	0	312514160100: Rolled erosion control mats and blankets, plastic nettling stapled, 2" x 1" mesh, 20 mil. Assumes approximately 6 acres of erosion control.
	Lime	MSF	270	B66	700	4	3	329113234250: Soil preparation, structural soil mixing, spread soil conditioners, ground limestone, 1#/S.Y., tractor spreader. Assume soils possibly being void of nutrients. Quantity assumes approximately 6 acreas of disturbed areas including staging area and temporary roads, as well as adjacent areas.
	Fertilizer	MSF	270	B66	700	4	3	329113234150: Soil preparation, structural soil .mixing, spread soil conditioners, fertilizer, 0.2#/S.Y., tractor spreader. Assume soils possibly being void of nutrients. Quantity assumes approximately 6 acreas of disturbed areas including staging area and temporary roads, as well as adjacent areas.
	Grassland Mix	MSF	270	B66	52	42	42	329219142300: Seeding athletic fields, seeding fescue, tall, 5.5 lb. per M.S.F., tractor spreader. Quantity assumes approximately 6 acreas of disturbed areas including staging area and temporary roads, as well as adjacent areas.
	Mulch	MSF	270	B65	530	8	8	329113160350: Mulching, Hay, 1" deep, power mulcher, large. Quantity assumes approximately 6 acreas of disturbed areas including staging area and temporary roads, as well as adjacent areas.
	SITE RESTORATION ESTIMATED SUBTOTAL			-	-	**346**	**56**	

ITEM NO.	Corrective Action Operation and Maintenance	Units	Quantity	Crew	Daily Output	Labor Hours	Equipment Hours	Notes
Corrective Action Operation and Maintenance								
19	Groundwater Extraction Trench Operation & Maintenance	-	-	-	-	9,600	0	Assumes routine monitoring, maintenance, and electrical service charges for the duration of system operation.
	Field Maintenance	Day	480	TM	-	9,600	0	Assumes quarterly maintenance on pneumatic pumps and air compressors over 30 years of operation. Each quarterly maintenance event assumes 2 staff for 4 days to check, clean, and service all mechanical parts.
	Electrical Distribution	MO	360	-	-	-	-	Assumes Ameren Corporation will supply power to the GWET electrical distribution system to power extraction and transfer pumps.
20	Non-routine System O&M	-	-	-	-	4,800	900	Assumes non-routine tasks including flushing of groundwater conveyance lines and periodic site visits (e.g., alarm responses or equipment troubleshooting).
	Groundwater Conveyance Line Flushing - Vacuum Truck	LF	240,000	VT	-	3,000	900	330130116140: Pipe, internal cleaning and inspection, cleaning, power rodder with header & cutts, 4"-12" diameter. Assumes one 5-day cleaning event of 8,000 LF of 6" HDPE pipe per year for a total of 30 years.
	Non-Routine Site Visits/Alarm Responses	LS	180	OM	-	1,800	0	Assumes 6 non-routine site visits per year over 30 years of operation. Each non-routine event assumes 2 staff for 1 day.
21	Engineering Oversight/Support	LS	30	-	-	-	-	Assumes office-based engineering support over 30 years of operation.
	CORRECTIVE ACTION OPERATION AND MAINTENANCE SUBTOTAL			-	-	**14,400**	**900**	

	Total Labor Hours	Total Equipment Hours
ENGINEERING AND CONSTRUCTION SUBTOTAL	**18,200**	**9,000**
CORRECTIVE ACTION OPERATION AND MAINTENANCE SUBTOTAL	**14,400**	**900**
ALTERNATIVE 2 SUBTOTAL	**32,600**	**9,900**

NOTES:

1. Alternative 2: Source Control with groundwater extraction trench is estimated to take approximately 37 years to achieve groundwater protection standards (GWPS-35 I.A.C Section 845.600) at all perimeter wells associated with the Ash Pond (AP) following AP closure in place (CIP). Assumes the monitoring period has been capped at 30 years total, plus 3 additional years of compliance monitoring.
2. RS Means refers to the 2023 Quarter 4 online edition of RS Means Commercial New Construction.
3. See crew tab (Alt 2 - Crews) for assumptions regarding crew size, total labor hours and required construction equipment, as needed, for each task.
4. See mileage tab (Alt 2 - Mileage) for assumptions regarding total mileage for tasks outlined in this alternative.

ACRONYMS:

AC = Acre
CIP = closure in place
CY = Cubic Yard
Loose: Material swelled when removed from compacted state
EA = Each
GWPS = groundwater protection standards
LCY = Loose Cubic Yards
LF = Linear Foot
LS = Lump Sum
MSF = square feet divided by 1000
MO = Month
O&M = Operation and Maintenance
AP = Ash Pond
SF = Square Feet
SY = Square Yard

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CREW CODES
ILLINOIS POWER RESOURCES GENERATING, LLC - EDWARDS POWER PLANT
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	Onsite Labor Hours	Onsite Heavy Equipment Hours
Construction							
4,10,16	2 Clab	Laborer x 2	16	None	0	126	0
5	A2	Laborer x 2 Truck Driver (light) x 1	24	Flatbed Truck, Gas, 1.5 ton	8	86	29
18	B1	Labor Foreman x 1 Laborer x 2	24	None	0	288	0
14,15	B6	Laborer x 2 Operator (light) x 1	24	Backhoe Loader, 48 H.P.	8	588	196
12,13,16	B10B	Operator (med) x1 Laborer x0.5	12	Dozer, 200 H.P.	8	292	195
16	B10G	Operator (med) x 1 Laborer x 0.5	12	1 Sheepsfoot Roller, 240 HP	8	55	37
10,12	B10S	Operator (med) x 1 Laborer x 0.5	12	1 F.E. Loader, W.M., 1.5 C.Y.	8	148	99
14,17	B10R	Operator (med) x 1 Laborer x 0.5	12	Frontend loader, W.M., 1 C.Y.	8	61	41
12,13	B10Y	Operator (med) x1 Laborer x0.5	12	1 Vibr. Roller, Towed, 12 ton	8	1	0
10,16	B11L	Operator (med) x 1 Laborer x 1	16	Grader, 30,000lb	8	32	16
10,16	B12C	Operator (med) x 1 Laborer x 1	16	Hydraulic excavator, 2 C.Y.	8	171	86
4,11	B13D	Operator (crane) x 1 Laborer x 1	16	Hydraulic excavator, 1 C.Y. Trench Box	16	719	719
4,10	B14	Labor Foreman x 1 Operator (light) x1 Laborer x 4	48	Backhoe Loader, 48 H.P.	8	1,145	191
13	B14B	Operator (crane) x 1 Laborer x 0.5	12	Hydraulic excavator, 6. C.Y.	8	24	16
10	B21B	Labor Foreman (outside) x 1 Laborer x 3 Operator (crane) x 1	40	1 Hydraulic Crane, 12 Ton	8	150	30
14,17	B22A	Labor Foreman x 1 Skilled Worker x 1 Laborer x 2 Operator (crane) x 1	40	S.P. Crane, 4x4, 5 ton Butt Fusion Machine, 4-12" diam.	16	1,150	460
4,11	B34C	Truck Driver x 1	8	Truck Tractor, 6x4, 380 H.P. Dump Trailer, 16.5 C.Y.	8	1,366	1,366
4,10,11,12,13,16	B34G	Truck Driver x 1	8	Dump Truck, Off Hwy., 50 ton	8	418	418
10	B40	Pile Driver Foreman (outside) x 1 Pile Drivers x 4 Operator (Crane) x 1 Operator (Oiler) x 1	64	1 Crawler Crane, 40 Ton 1 Vibratory Hammer & Gen.	16	3,300	825
14,17	B54	Operator (light) x 1	8	Trencher, Chain, 40 H.P.	8	132	132
5	B62	Laborer x 2 Operator (light) x 1	24	Loader, Skid Steer, 30 H.P.	8	192	64
16	B63B	Labor Foreman x 1 Laborer x 2 Operator (light) x 1	32	Loader, Skid Steer, 78 H.P.	8	761	190
18	B65	Laborer x1 Truck Driver (light) x 1	16	Power Mulcher (large) Flatbed Truck, Gas, 1.5 ton	16	8	8
18	B66	Operator (light) x 1	8	Loader-Backhoe, 40 H.P.	8	50	48
14	Q1	Plumber x1 Plumber Apprentice x1	16	None	0	90	0
7	R1B	Electrician x 1 Electrician Apprentice x 2	16	None	0	720	0
8	R6	Electrician Foreman x1 Electrician Lineman x4 Electrician Operators x2 Electrician Groundmen x4	88	Crew Truck x1 Flatbed Truck, 20,000 GVW x1 Pickup Truck, 3/4 Ton x1 Hyd. Crane, 12 Ton x0.2 Hyd. Crane, 55 Ton x0.2 Earth Auger, Truck-Mtd x0.2 Tractor w/Winch x1 Cable Trailers x3 Tensioning Rig x0.5 Cable Pulling Rig x0.5	68.8	176	138
14,17	R30	Electrician Foreman x 0.25 Electrician x 1 Laborer (Semi-Skilled) x 2	26	None	0	494	0
12	M	Laborer x 1	10	Service Truck x1	0	500	0
2	Eng	Engineering Staff x 1.2	10	Side by Side x1	10	3,600	3,000

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9	GM	Engineering Staff x 4	40	Service Vehicle X 2	0	600	0
12	OP	Operator x 3 Laborer x 2	50	CAT 950 Loader x 3, CAT 374 Excavator x 1 CAT 349 Excavator x 1 Manlift x 1, Telehandlers x 2	50	718	718
8	UL	Laborer x 2	20	Service Truck x1	20	40	20
				Construction Subtotals		18,200	9,000
Corrective Action Operation & Maintenance							
20	OM	Laborer x 1	10	Service Truck x1	0	1,800	0
19	TM	Maintenance Crew x 2	20	Service Truck x2 Hand Tools	0	9,600	0
20	VT	Laborer x 1 Operator x 1	20	Vacuum Truck with Flushing Capabilities	10	3,000	900
				O&M Subtotals		14,400	900
					Totals	**32,600**	**9,900**

Note: Blue shaded crew codes were created by Ramboll based on experience (not pulled from RS Means).

ACRONYMS:
O&M = Operation and Maintenance

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CONSTRUCTION MILEAGE AND LABOR ESTIMATES
ILLINOIS POWER RESOURCES GENERATING, LLC - EDWARDS POWER PLANT
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 2 - SOURCE CONTROL WITH GROUNDWATER EXTRACTION TRENCH

Item	Quantity	Assumptions
Labor Total Hours	18,189	Per projected Construction total in cost estimate (does not include contingency)
Duration of Onsite Construction Days	300	Total Days
Average Daily Crew Size	15	Assumes multiple crew sizes and a 10 hour work day Assumes 1 Ramboll personnel daily for construction oversight
Daily Labor Mobilization Miles	315,000	Includes light and medium commercial vehicles Average of 70 miles round trip per day, as proposed in construction permit for AP Closure
Vehicles Miles Onsite	67,500	Includes light and medium commercial vehicles 15 miles per day, including onsite mileage and local trips No contingency Included
Equipment Mobilization Miles - Unloaded	8,500	Average of 170 miles one-way trip for equipment hauling (from Chicago, IL) Average 1 load of equipment per working week for a 6 day work week.
Equipment Mobilization Miles - Loaded	8,500	Average of 170 miles one-way trip for equipment hauling (from Chicago, IL) Average 1 load of equipment per working week for a 6 day work week.
Onsite Haul Truck Miles - Unloaded	484	34 CY Off Road Dump Truck 1/2 mile per trip per load
Onsite Haul Truck Miles - Loaded	484	34 CY Off Road Dump Truck 1/2 mile per trip per load
Offsite Haul Truck Miles - Unloaded	62,500	Assumes 20,000 CY delivered in 16 CY loads of fill material (granular and low permeability material) are delivered to the site from a regional supplier located within 50 miles of the site. Assumes truck is returning to the origin location.
Offsite Haul Truck Miles - Loaded	62,500	Assumes 20,000 CY delivered in 16 CY loads of fill material (granular and low permeability material) are delivered to the site from a regional supplier located within 50 miles of the site.
Material Delivery Miles - Unloaded	12,000	Misc. construction materials (erosion controls, piping, geotextile) Assumes 100 mile one-way trip, average 2 trips per working week
Material Delivery Miles - Loaded	12,000	Misc. construction materials (erosion controls, piping, geotextile) Assumes 100 mile one-way trip, average 2 trips per working week

O&M Mileage and Labor Estimates - Alternative 2: Groundwater Extraction Trench

Item	Quantity	Assumptions
Labor Total Hours	14,400	Per projected O&M total in cost estimate (does not include contingency)
Duration of Onsite O&M Days	810	Total Days
Average Daily Crew Size	2	Assumes multiple crew sizes and a 10 hour work day
Daily Labor Mobilization Miles	244,800	Includes mob/demob from Chicago (340 miles round trip) and local daily commute mileage (30 miles per day) for an average of 170 miles round trip per day
Vehicles Miles Onsite	21,600	Includes light and medium commercial vehicles 15 miles per day, including onsite mileage and local trips No contingency Included
Equipment Mobilization Miles - Unloaded	5,100	Average of 170 miles one-way trip for equipment hauling (from Chicago, IL) Average 1 load of equipment per year.
Equipment Mobilization Miles - Loaded	5,100	Average of 170 miles one-way trip for equipment hauling (from Chicago, IL) Average 1 load of equipment per year.
Onsite Haul Truck Miles - Unloaded	0	No material hauling onsite will occur under this alternative
Onsite Haul Truck Miles - Loaded	0	No material hauling onsite will occur under this alternative
Offsite Haul Truck Miles - Unloaded	0	No material hauling offsite will occur under this alternative
Offsite Haul Truck Miles - Loaded	0	No material hauling offsite will occur under this alternative
Material Delivery Miles - Unloaded	0	No materials will be delivered during O&M
Material Delivery Miles - Loaded	0	No materials will be delivered during O&M

ACRONYMS:
CAGM = Corrective Action Groundwater Monitoring
CY = Cubic yard
O&M = Operation and Maintenance

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ILLINOIS POWER RESOURCES GENERATING, LLC - EDWARDS POWER PLANT
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 3 - SOURCE CONTROL WITH PHYTOREMEDIATION[1]

ITEM NO.	ENGINEERING, PRE-CONSTRUCTION, AND CONSTRUCTION SUPPORT TASKS	Units	Quantity	Crew	Daily Output	Labor Hours	Equipment Hours	Notes
1	Pre-Design Investigation, Pilot Test, Final Phytoremediation Design and Bid Support	LS	1	-	-	0	0	Assumes pre-design investigation is needed as part of the Phytoremediation design.
2	Engineering Support and CQA During Construction	LS	1	Eng	12	3,000	2,500	Assumed labor and equipment hours based on Ramboll project experience.
ENGINEERING, PRE-CONSTRUCTION, AND CONSTRUCTION SUPPORT ESTIMATED SUBTOTAL				**-**	**-**	**3,000**	**2500**	
ITEM NO.	**SITE PREPARATION**	**Units**	**Quantity**	**Crew**	**Daily Output**	**Labor Hours**	**Equipment Hours**	**Notes**
3	Mobilization and De-Mobilization	LS	-	-	-	-	-	Assumes general construction mobilization and demoibilization.
	General Construction Mobilization and De-Mobilization	LS	1	-	-	-	-	Assumes general construction contractor is mobilizing equipment from out of state.
4	Staging Area & Temporary Roads Preparation	-	-	-	-	1,569	1,140	Assumes some work general preparation of temporary access roads along the tree alignment will be needed specific to tree system installation.
	Subsurface Stabilization Nonwoven Geotextile	SY	6,000	2 Clab	2500	38	0	313219161550: Geosynthetic soil stabilization, geotextile fabric, non-woven, 120 lb tensile strength includes scarifying and compaction. Assumes 1 acre staging area and approximately 3,500 ft of temporary access road.
	Offsite Fill for South Area Ramp	CY	8,000	B13D	376	340	340	Imported clay for south area ramp. Assumes 8000 CY. Based on Ramboll experience.
	Haul Fill to Site	LCY	8,000	B34C	99	646	646	312323203104: Cycle hauling(wait, load, travel, unload or dump & reutrn) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 16.5 C.Y. truck, cycle 50 miles, 45 mph, excludes loading equipment
	Haul Material to South Area Ramp	CY	8,000	B34G	850	75	75	312323206170: Hauling; no loading equipment, including hauling, waiting, loading/dumping; 34 C.Y. off-road, 15 min wait/ld./uld., 15 MPH, cycle 1 mile. Daily output extrapolated down to 10 min wait. Assumes onsite stockpile location approximately 1/2 mile from south ramp area. Assumes hauling of clay to south ramp area.
	Construct Staging Area & Temporary Roads	SY	6,000	B14	615	468	78	015523500100: Temporary, roads, gravel fill, 8" gravel depth, excluding surfacing. Assumes 1 acre staging area and approximately 3,500 ft of temporary access road.
5	Construction Soil Erosion & Sediment Controls	-	-	-	-	391	130	Assumes soil erosion and sediment controls will be implemented only during the tree alignment construction.
	Silt Fence	LF	8,000	B62	650	295	98	312514161000: Synthetic erosion control, silt fence, install and remove, 3' high. Assumes silt fence is installed on downgradient side of the tree alignments (4,000 ft total). Assumes the silt fence will get replaced once during construction.
	Sediment Log, Filter Sock	LF	4,000	A2	1000	96	32	312514160705: Sediment Log, Filter Sock, 9". Assume sediment log is needed along tree allignment (4,000 LF total).
6	Construction Facilities	-	-	-	-	-	-	Assumes office trailer, storage boxes, and portable toilets are required during the construction phase of the alternative.
	Office Trailer	MO - in use	12	-	-	-	-	015213200350: Office trailer, furnished, no hookups, 32' x 8'. Assume quantity of one (1).
	Storage Trailers	MO - in use	12	-	-	-	-	015213201350: Storage boxes, 40' x 8'. Assume quantity of two (2) boxes onsite.
	Portable Toilet	MO - in use	12	-	-	-	-	015433406410: Toilet, portable chemical. Assume quantity of four (4) units onsite.
7	Electrical Installation	EA	1	R1B	-	720	0	Assumes electrical installation based on Ramboll experience to install one power drop for low-voltage (120V) power for the irrigation pumps, control equipment, etc. For each power drop, consider the distances from existing power sources.
8	Existing Site Utilities Preparation	-	-	-	-	216	158	Assumes utility survey, relocate, and power line relocation. Assumes updated layout will be determined during design phase.
	Utility Survey	LS	-	UL	-	40	20	Private and public utility location services to adequately locate and inventory existing site utilities that may be in conflict with proposed tree segment locations based on Ramboll experience.
	Utility Relocate/Removal	EA	1	R6	1	88	69	Addressing potential conflicting of abandoned section of sewer force main based on Ramboll experience. Sewer force main crossing the AP is to be abandoned as part of AP closure activities, but if abandoned main is to remain in place, then sections may need to be removed to accomodate tree segment installation.
	Power Line Relocation	EA	1	R6	1	88	69	Relocation/raising of high voltage power lines crossing the CBR portion of the AP to allow for adqueate clearance for construction equipment for tree segment installation based on Ramboll experience.

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9	Geotechnical Monitoring	LS	-	GM	-	600	0	Assumes installation of inclinometers, survey prisms, and settlement monitoring devices along the south tree alignment where the embankment will be modified. Assumes a 4-person crew installs the monitoring system over a period of 3 weeks. Based on Ramboll experience
10	Phytoremediation Alignment Preparation Work Pad	-	-	-	-	7,840	2,056	Assumes construction of a 30-ft wide work pad for the full length of the northern and southern tree segments. For the southern tree segment, excavation of berm material on the upslope side and fill along the downslope side will be required to level off the work area. Once prepared, surface grading and stabilization will be completed along the southern tree segment work pad. For the northern tree segment, it is anticipated that only surface grading and stabilization will be required for the work pad.
	Excavation of Berm Material and Stockpiling for South Tree Well Segment	CY	12,000	B12C	1320	145	73	312316420260: Excavating, bulk bank measure, hydraulic, crawler mtd., 2 C.Y. cap (165 CY/hr). 15% addition included for loading of material onto trucks. Using 1800 ft long, 12 ft deep, and 30 ft wide.
	Loading Stockpiled Berm Material for South Tree Well Segment	BCY	12,000	B10S	970	148	99	312323154060: Borrow, common earth, 1-1/2 C.Y. bucket, loading and/or spreading, front end loader, wheel-mounted. Assumes stockpiling of upslope material adjacent to work area.
	Temporary Excavation Shoring	SF	99,000	B40	960	6,600	1,650	314116101500. 20' deep excavation, 27 psf, left in place. Assumes length of 900 ft and retained height of 15 ft and 40 ft embedment. Based on Ramboll experience.
	Hauling Berm Material to Stockpile for South Tree Well Segment	LCY	12,000	B34G	986	97	97	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.
	Surface Grading for North Tree Well Segment	MSF	35	B11L	30	18	9	312216103600: Fine grading, work pad area. Assumes grading along the northern (1,150 ft) alignment.
	Subsurface Stabilization Nonwoven Geotextile for North and South Tree Well Segments	SY	9,833	2 Clab	2500	63	-	313219161550: Geosynthetic soil stabilization, geotextile fabric, non-woven, 120 lb tensile strength includes scarifying and compaction; assume we need for working pad. At northern tree segment, work pad will span 1,150 ft long and 30 ft wide. At southern tree segment, work pad will span 1800 ft long and 30 ft wide.
	Install Crushed Gravel Work Pad (8" Thick) for North and South Tree Well Segments	SY	9,833	B14	615	767	128	015523500100: Temporary, roads, gravel fill, 8" gravel depth, excluding surfacing. At northern tree segment, work pad will span 1,700 ft long and 30 ft wide. At southern tree segment, work pad will span 900 ft long and 30 ft wide.
	SITE PREPARATION ESTIMATED SUBTOTAL			-	**-**	**11,336**	**3,484**	

ITEM NO.	**TREE WELL SYSTEM INSTALLATIONS**	**Units**	**Quantity**	**Crew**	**Daily Output**	**Labor Hours**	**Equipment Hours**	**Notes**
11	Materials	-	-	-	-	366	99	Materials for approximately 550 phytoremediation plantings, including backfill soil and ammendments, tree cuttings, and monitoring equipment.
	Tree Cuttings	Each	550	-	-	-	-	Assumes tree cutting based on Ramboll experience.
	Tree Well Aeration Tubes	Each	550	-	-	-	-	Perforated pipe from 2-3 feet above ground surface to just above groundwater table. Assuming 15 ft to groundwater. 90-degree elbow on top. Allows passive oxygenation of subsurface root zone. Based on Ramboll experience.
	Tree Well Moisture Sensors	Each	12	-	-	-	-	Assuming 1% of trees will have soil moisture sensors at two depths per tree. Based onsupplier and Ramboll experience.
	Tree Moisture Sensor Meter	Each	1	-	-	-	-	Device for reading moisture levels. Based on supplier and Ramboll experience.
	Tree Well Piezometers	Each	6	-	-	-	-	Assuming 1% of trees will have piezometers to monitor groundwater potentiometric surface elevation
	Sand / Granular Backfill	CY	333	-	-	-	-	Sand/granular backfill for tree well boring backfill material. Assumes average boring total depth of 40 feet backfilled with 100% sand/granular backfill from total depth to 10 feet below surface grade then 60% by volume sand/granular fill for top 10 feet for 550 total trees. Based on Ramboll experience.
	Peat Moss	CY	133	-	-	-	-	Shallow tree backfill material. Assumes 10-inch diameter borehole backfilled to 10 feet with 30% by volume peat moss for 550 total trees. Based on Ramboll experience.
	Compost	CY	44	-	-	-	-	Shallow tree backfill material. Assumes 10-inch diameter borehole backfilled to 10 feet with 10% by volume compost for 550 total trees. Based on Ramboll experience.
	Surface Cover Soil	SY	6,667	B14	1,000	320	53	015523500100: Topsoil placement and grading, loam or topsoil, fine grading and seeding, with equipment. Assumes placement of cover soil along approximately 15 feet in width across both tree segments (4,000 total feet in length).
	Haul Material to Site	LCY	511	B34C	99	41	41	312323203104: Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 16.5 C.Y. truck, cycle 50 miles, 45 mph, excludes loading equipment.
	Haul Material to Tree Well Locations	CY	511	B34G	850	5	5	312323206170: Hauling; no loading equipment, including hauling, waiting, loading/dumping; 34 C.Y. off-road, 15 min wait/ld./uld., 15 MPH, cycle 1 mile. Daily output extrapolated down to 10 min wait. Assumes onsite stockpile location approximately 1/2 mile from each trench. Assumes hauling of granular material to trenches.

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12	Installation of Tree Well Systems	-	-	-	-	4,668	5,931	Equipment and labor required for installation of tree plantings in the northern tree segment (200 trees) and southern tree segment (350 trees).
	Borehole Drilling, Backfill, and Tree Installation	Each	550	B56B	3	4,400	5,867	Assumes 10" borehole, backfilling with sand/peat/compost mix, installing tree cutting, aeration tube, irrigation. Assuming 3 tree locations per day. Track mounted hollow stem auger drill rig. Excludes spoils management. Based on Ramboll experience.
	Installing Geomembrane (Material and Labor)	SF	32,000	B47H	4000	256	64	025613100610: Secure burial cell construction, polymeric liner and cover system, top cover, polyvinyl chloride (PVC) 60 mil. Assumes 4000 ft length by 8 ft wide area.
	Installing Moisture Sensor Components (Labor)	Each	12	2 Clab	24	8	0	Installing moisture sensors at correct depths when borehole already created prior to backfilling by driling crew. Select locations only. Based on Ramboll experience.
	Installing Piezometers (Labor)	Each	6	2 Clab	24	4	0	Installing piezometers at correct depths when borehole already created prior to backfilling by driling crew. Select locations only. Based on Ramboll experience.
	Methane Monitoring during Drilling	LS	1	M	1	500	0	Health and safety monitoring for potential presence of methane.
	CONTINGENCY: STANDBY TIME FOR METHANE IMPACTS	*LS*	*1*	--	--	--	--	*Standby time for potential stop work related to presence of naturally occuring methane in the subsurface. Percentage applied to subsurface work (drilling) line item only.*
13	Spoils Management	-	-	-	-	13	10	Quantities assume that soil cuttings generated from installation of tree well borings will be managed under the CIP areas of the AP.
	Loading	CY - as excavated	500	B10S	5000	1	1	312323154060: Borrow, common earth, 1-1/2 C.Y. bucket, loading and/or spreading, front end loader, wheel-mounted. Assumes stockpiling of borehole cuttings. Volume of borehole used, assuming 10% fluff factor from ground to excavated.
	Hauling and Placement at AP	CY - as excavated	500	B34G	850	5	5	312323206170: Hauling; no loading equipment, including hauling, waiting, loading/dumping; 34 C.Y. off-road, 15 min wait/ld./uld., 15 MPH, cycle 1 mile. Daily output extrapolated down to 10 min wait.
	Spreading Lifts	CY - as excavated	500	B10B	1000	6	4	312323170020: Spread dumped material, no compaction, by dozer. Daily output edited to match excavation based on experience.
	Compaction of Material	BCY	500	B10G	5200	1	1	312323235680: Compaction, 2 passes, 12" lifts, sheepsfoot or wobbly wheel roller.
14	Irrigation System Installation	-	-	-	-	710	241	Irrigation system will include a water storage tank, main irrigation lines, and drip lines to deliver water to each planting during the growing season for the first few years of establishment prior to tree roots reaching groundwater. Irrigation lines will be installed below ground surface.
	Install Irrigation Water Storage Tank	Each	1	B6	1.0	24	8	Installation of irrigation tank and associated site preparation and instrumentation assumes 2 days for installation.
	Install Irrigation Pump and Controller	Each	1	R30	1.0	26	0	Installation of irrigation pump and pump controller at irrigation tank to convey water from tank to irrigation main lines and individual drip lines based on Ramboll project experience. Assumes inclusion of housing structure and 1 day for installation.
	Trenching, Installing, and Backfilling Main Lines	LF	4,000	Q1C	220	436	145	331413254120: Water supply, polyvinyl chloride pipe. Including trenching to 3' deep, 2" diameter. Trench installed from power drop/irrigation tank to ends of north and south tree alignments.
	Installing Main Irrigation Fittings (Labor)	EA	550	Q1A	48	115	0	331413254370: Water supply, distribution piping, fitting, tee, class 200 polyvinyl chloride pipe, pressure pipe, 2", includes gaskets. Assumes one tee in main line at each tree location (550 total tees).
	Irrigation Fittings (Materials)	Each	1,100	-	-	-	-	2" x 2" x 3/4" Schedule 40 PVC Reducing Tee, 3/4" threaded to 1/2" barbed fitting, 15 feet blank 1/2" tubing, 1/2" barbed elbow, 5 feet drip tubing, and drip end closure. Two of each at 550 tree locations.
	Irrigation Various Fittings (Materials)	Each	100	Q1A	48	21	0	Various components that will be necessary for the irrigation system including elbows, tees, valves, valve boxes, filters, pressure regulators, and labor to install them.
	Trenching, Placing Drip Irrigation to Each Tree, Backfilling	LF	5,500	B53	500	88	88	328413100700: Subsurface drip irrigation, looped grid, pressure compensating, preinserted emitter, line, trenching, and backfill. Trenches installed from main irrigation line to each tree system. Assuming 10 ft span from main line to each tree location. Labor only.
15	Irrigation Water Delivery	-	-	-	-	542	542	Purchase and delivery of water from off site. Water will be hauled to site by truck and stored in the irrigation water tank.
	Water Delivery	Each	271	B34C	4	542	542	Assumes 2 gallons of water per day per tree. 1,100 total gallons per day. 10,000-gallon tank on site. Can have 6,000 gallons delivered per load. Need delivery every 5.4 days. Allows for 11 gallons of losses per tank refill. 67.6 refills needed per year for 4 years. 271 total refills. 30 mile water haul.
	TREE WELL SYSTEM CONSTRUCTION				**-**	**6,299**	**6,282**	

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ITEM NO.	SITE RESTORATION	Units	Quantity	Crew	Daily Output	Labor Hours	Equipment Hours	Notes
16	Site Restoration	-	-	-	-	346	56	Assumes restoration of grade surface following tree segment installation activities.
	Erosion Control Blanket	SY	30,000	B1	2500	288	0	312514160100: Rolled erosion control mats and blankets, plastic nettling stapled, 2" x 1" mesh, 20 mil. Assumes approximately 6 acres of erosion control.
	Lime	MSF	270	B66	700	4	3	329113234250: Soil preparation, structural soil mixing, spread soil conditioners, ground limestone, 1#/S.Y., tractor spreader. Assume soils possibly being void of nutrients. Quantity assumes approximately 6 acreas of disturbed areas including staging area and temporary roads, as well as adjacent areas.
	Fertilizer	MSF	270	B66	700	4	3	329113234150: Soil preparation, structural soil .mixing, spread soil conditioners, fertilizer, 0.2#/S.Y., tractor spreader. Assume soils possibly being void of nutrients. Quantity assumes approximately 6 acreas of disturbed areas including staging area and temporary roads, as well as adjacent areas.
	Grassland Mix	MSF	270	B66	52	42	42	329219142300: Seeding athletic fields, seeding fescue, tall, 5.5 lb. per M.S.F., tractor spreader. Quantity assumes approximately 6 acreas of disturbed areas including staging area and temporary roads, as well as adjacent areas.
	Mulch	MSF	270	B65-modified	530	8	8	329113160350: Mulching, Hay, 1" deep, power mulcher, large. Quantity assumes approximately 6 acres of disturbed areas including staging area and temporary roads, as well as adjacent areas.
	SITE RESTORATION ESTIMATED SUBTOTAL			**-**	**-**	**346**	**56**	

ITEM NO.	Corrective Action Operation and Maintenance	Units	Quantity	Crew	Daily Output	Labor Hours	Equipment Hours	Notes
Corrective Action Operation and Maintenance								
17	Tree Well System O&M	-	-	-	-	1,264	700	Operation and Maintenance requirements assuming 30 year maintenance period.
	Monthly Tree System O&M first 6 months	Each	6	Eng	1	60	60	Assumes one ten hour day by Ramboll staff to perform survey with side by side for site access. Monthly O&M while trees first establishing.
	Semiannual Tree Health Survey	Each	60	Eng	1	600	600	Assumes one ten hour day by Ramboll staff to perform survey with side by side for site access. Two surveys per year: Spring and Autumn
	Annual Leaf Collection and Disposal	MSF	2,400	B66	480	40	40	320190194170: Mowing, lawn mowing improved areas, 48"- 58", riding mower. Collect and mulch leaves with mower. Assuming 4,000 ft x 20 ft area for tree alignments. One collection per year. Testing material and disposal based on Ramboll experience.
	Annual Tree Tissue Sampling	Each	300	-	-	-	-	Assumes 10 tree tissue samples per year. Tree tissue sample analysis only. Samples will be collected during tree health survey. Based on Ramboll experience.
	Start-up Moisture and Irrigation Monitoring	LS	1	Eng	-	-	-	Monitoring moisture and tree health for first few months while rooting. Adjusting irrigation as needed.
	Annual Irrigation Winterization	Each	30	OM	1	300	0	Assumes one laborer can drain water from system, insulate aboveground infrastructure in one ten hour day. Conduct prior to freezing temperatures each year.
	Pruning	Each	330	2 Clab	20	264	0	311313203100: Selective clearing and grubbing, 8" to 12" diameter, remove selective trees, on site using chain saws and chipper, excludes stump. Assuming 10% of trees would need significant reduction pruning every 5 years. Treating pruning as tree removal since significant amount of tree will be cut and removed. Modified crew type and daily output for this scenario based on Ramboll experience.
18	Non-routine System O&M	-	-	-	-	6,968	8,489	Assumes non-routine tasks including replacement of trees and other items.
	Site Visits for Irrigation or Maintenance Issues	LS	120	OM	-	960	960	Assumes 4 non-routine site visits per year over 30 years of operation. Each non-routine event assumes 2 staff for 1 day. Based on Ramboll experience.
	Periodic Pesticide Treatment	Each	3,300	PA	300	88	88	Assumes treatment approximately every 5 years for poplar borer required for duration of project. Annual application in Spring.
	Periodic Tree Replacement - Mobilization/ Demobilization	LS	1	-	-	-	-	Assumes mobilization, re-installation, spoils and tree debris management, and irrigation re-installation. Based on Ramboll experience.
	Periodic Tree Replacement - Dead Tree Removal and Disposal	Each	550	B7R	20	660	1,155	311313203100: Selective clearing and grubbing, 8" to 12" diameter, remove selective trees, on site using chain saws and chipper, excludes stump. Modified crew type and daily output for this scenario based on Ramboll experience. Assumes 3 replacement events of approximately 180 trees (1/3 of total trees) each event. Assuming tree material is non-hazardous and can be disposed of via regular green waste disposal.
	Periodic Tree Replacement - Installation	Each	550	B56B	3	4,400	5,867	Assumes 3 replacement events of approximately 180 trees (1/3 of total trees) each event. Includes materials and equipment/labor based on Items 11 and 12.
	Periodic Tree Replacement - Spoils Disposal	CY	489	B34C	20	196	196	Assumes non-hazardous soil needs disposed of off site. Volume of borehole used, assuming 10% fluff factor from ground to excavated. Based on Ramboll experience.
	Periodic Tree Replacement - Irrigation Installation	Each	550	Q1C	20	660	220	Assumes all trees that are replaced will need irrigation system re-installed. Assumes irrigation storage tank, pump and controller, and main irrigation lines will not need replaced, but other irrigation plumbing will need replaced for replacement trees.
	Periodic Tree Replacement - Water Delivery for Irrigation during Re-establishment	Each	2	B34C	4	4	4	Assumes water will need hauled to site for two additional four-year periods in addition to the initial four-year period when trees are originally installed.

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19	Engineering Oversight/Support	LS	30	-	-	-	-	Assumes office-based engineering support over 30 years of operation.
	CORRECTIVE ACTION OPERATION AND MAINTENANCE SUBTOTAL			**-**	**-**	**8,230**	**9,190**	

	Total Labor Hours	**Total Equipment Hours**
ENGINEERING AND CONSTRUCTION SUBTOTAL	**21,000**	**12,300**
CORRECTIVE ACTION OPERATION AND MAINTENANCE SUBTOTAL	**8,200**	**9,200**
ALTERNATIVE 3 SUBTOTAL	**29,200**	**21,500**

NOTES:

1. Alternative 3: Source Control with phytoremediation is estimated to take an estimated 42 to 77 years to achieve groundwater protection standards (GWPS-35 I.A.C Section 845.600) at all perimeter wells associated with the Ash Pond (AP) following AP closure in place (CIP). Assumes the monitoring period has been capped at 30 years total, plus 3 additional years of compliance monitoring.
2. RS Means refers to the 2023 Quarter 4 online edition of RS Means Commercial New Construction.
3. See crew tab (Alt 3 - Crews) for assumptions regarding crew size, total labor hours and required construction equipment, as needed, for each task.
4. See mileage tab (Alt 3 - Mileage) for assumptions regarding total mileage for tasks outlined in this alternative.

ACRONYMS:

AC = Acre
CIP = closure in place
CY = Cubic Yard
Loose: Material swelled when removed from compacted state
EA = Each
GWPS = groundwater protection standards
LCY = Loose Cubic Yards
LF = Linear Foot
LS = Lump Sum
MSF = square feet divided by 1000
MO = Month
O&M = Operation and Maintenance
AP = Ash Pond
SF = Square Feet
SY = Square Yard

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CREW CODES
ILLINOIS POWER RESOURCES GENERATING, LLC - EDWARDS POWER PLANT
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 3 - SOURCE CONTROL WITH PHYTOREMEDIATION

Item No.	Crew Code	Labor	Daily Labor Hours	Equipment	Daily Equipment Hours	Onsite Labor Hours	Onsite Heavy Equipment Hours
Construction							
4,10,12,17	2 Clab	Laborer x2	16	None	0	377	0
5	A2	Laborer x2 Truck Driver (light) x1	24	Flatbed Truck, Gas, 1.5 ton	8	96	32
16	B1	Labor Foreman x1 Laborer x2	24	None	0	288	0
14	B6	Laborer x 2 Operator (light) x 1	24	Backhoe Loader, 48 H.P.	8	24	8
13	B10B	Operator (med) x1 Laborer x0.5	12	Dozer, 200 H.P.	8	6	4
13	B10G	Operator (med) x 1 Laborer x 0.5	12	1 Sheepsfoot Roller, 240 HP	8	55	37
10, 13	B10S	Operator (med) x 1 Laborer x 0.5	12	1 F.E. Loader, W.M., 1.5 C.Y.	8	150	100
10	B11L	Operator (med) x 1 Laborer x 1	16	Grader, 30,000lb	8	18	9
10	B12C	Operator (med) x 1 Laborer x 1	16	Hydraulic excavator, 2 C.Y.	8	145	73
4	B13D	Operator (crane) x 1 Laborer x 1	16	Hydraulic excavator, 1 C.Y. Trench Box	16	719	719
4,10,11	B14	Labor Foreman x 1 Operator (light) x1 Laborer x 4	48	Backhoe Loader, 48 H.P.	8	1,556	259
4,11,18	B34C	Truck Driver x1	8	Truck Tractor, 6x4, 380 H.P. Dump Trailer, 16.5 C.Y.	8	1,429	1,429
4,10,11,13	B34G	Truck Driver x1	8	Dump Truck, Off Hwy., 50 ton	8	182	182
10	B40	Pile Driver Foreman (outside) x 1 Pile Drivers x 4 Operator (Crane) x 1 Operator (Oiler) x 1	64	1 Crawler Crane, 40 Ton 1 Vibratory Hammer & Gen.	16	6,600	1,650
12	B47H	Skilled Worker Foreman (out) x1 Skilled Workers x3	32	1 Flatbed Truck, Gas, 3 Ton	8	256	64
14	B53	1 Equipment Operator (light)	8	1 Trencher, Chain, 12 HP	8	88	88
12	B56B	Laborer x2 Equipment operator (light) x1	24	1 Track Mounted Auger Drill, 10" 2 Support Trucks 1 Decontamination Trailer	32	8,800	11,733
5	B62	Laborer x2 Operator (light) x 1	24	Loader, Skid Steer, 30 H.P.	8	295	98
16,17	B66	Operator (light) x1	8	Loader-Backhoe, 40 H.P.	8	90	88
14	Q1A	Plumber Foreman (outside x0.25 Plumber x1	10	None	0	135	0
14	Q1C	Plumber x1 Plumber Apprentice x1 Equipment Operator (medium) x1	24	Trencher, Chain, 8' D	8	1,096	365
7	R1B	Electrician x1 Electrician Apprentice x2	16	None	0	720	0
8	R6	Electrician Foreman x1 Electrician Lineman x4 Electrician Operators x2 Electrician Groundmen x4	88	Crew Truck x1 Flatbed Truck, 20,000 GVW x1 Pickup Truck, 3/4 Ton x1 Hyd. Crane, 12 Ton x0.2 Hyd. Crane, 55 Ton x0.2 Earth Auger, Truck-Mtd x0.2 Tractor w/Winch x1 Cable Trailers x3 Tensioning Rig x0.5 Cable Pulling Rig x0.5	68.8	176	138
14	R30	Electrician Foreman x0.25 Electrician x1 Laborer (Semi-Skilled) x2	26	None	0	26	0
17,18	M	Laborer x1	10	Service Truck x1	0	500	0
16	B65-modified	Laborer x1 Truck Driver (light) x1	16	Power Mulcher (large) Flatbed Truck, Gas, 1.5 ton	16	8	8
2,17,19	Eng	Engineering Staff x1.2	10	Side by Side x1	10	3,660	3,160
9	GM	Engineering Staff x4	40	Service Vehicle X 2	0	600	0
				Construction Subtotals		28,100	20,200

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Corrective Action Operation & Maintenance							
17	1 Clab	Laborer x1	8	None	0	0	0
4,10,12,17	2 Clab	Laborer x2	16	None	0	377	0
17	B7R	Labor Foreman (outside) x1 Laborers x2	24	1 Bruch Chipper, 12", 130 H.P. 1 Dump Truck, 8 CY, 220 H.P. 2 Chain Saws, Gas, 18" bar	42	660	1,155
16,17	B66	Operator (light) x1	8	Loader-Backhoe, 40 H.P.	8	90	88
17	B86	Equiment Operator (medium) x1	8	1 Stump Grinder, S.P.	8	0	0
2,17,19	Eng	Engineering Staff x1.2	10	Side by Side x1	10	3,660	3,160
17,18	OM	Laborer x1	10	Service Truck x1	0	1,260	960
17	PA	Operator x1	8	Pesticide Application Truck x1	8	88	88
				O&M Subtotals		6,135	5,451
					Totals	**34,200**	**25,700**

Note: Blue shaded crew codes were created by Ramboll based on experience (not pulled from RS Means).

ACRONYMS:
O&M = Operation and Maintenance

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CONSTRUCTION MILEAGE AND LABOR ESTIMATES
ILLINOIS POWER RESOURCES GENERATING, LLC - EDWARDS POWER PLANT
CORRECTIVE ACTION ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT (CAAA-SIR)
ALTERNATIVE 3 - SOURCE CONTROL WITH PHYTOREMEDIATION

Item	Quantity	Assumptions
Labor Total Hours	14,602	Per projected Construction total in cost estimate (does not include contingency)
Duration of Onsite Construction Days	250	Total Days
Average Daily Crew Size	15	Assumes multiple crew sizes and a 10 hour work day Assumes 1 Ramboll personnel daily for construction oversight
Daily Labor Mobilization Miles	262,500	Includes light and medium commercial vehicles Average of 70 miles round trip per day, as proposed in construction permit for AP Closure
Vehicles Miles Onsite	56,250	Includes light and medium commercial vehicles 15 miles per day, including onsite mileage and local trips No contingency Included
Equipment Mobilization Miles - Unloaded	7,083	Average of 170 miles one-way trip for equipment hauling (from Chicago, IL) Average 1 load of equipment per working week for a 6 day work week.
Equipment Mobilization Miles - Loaded	7,083	Average of 170 miles one-way trip for equipment hauling (from Chicago, IL) Average 1 load of equipment per working week for a 6 day work week.
Onsite Haul Truck Miles - Unloaded	191	34 CY Off Road Dump Truck 1/2 mile per trip per load
Onsite Haul Truck Miles - Loaded	191	34 CY Off Road Dump Truck 1/2 mile per trip per load
Offsite Haul Truck Miles - Unloaded	15,625	Assumes 10,000 CY delivered in 16 CY loads of fill material (granular and low permeability material) are delivered to the site from a regional supplier located within 50 miles of the site. Assumes truck is returning to the origin location.
Offsite Haul Truck Miles - Loaded	15,625	Assumes 10,000 CY delivered in 16 CY loads of fill material (granular and low permeability material) are delivered to the site from a regional supplier located within 50 miles of the site.
Material Delivery Miles - Unloaded	8,333	Misc. construction materials (erosion controls, piping, geotextile) Assumes 100 mile one-way trip, average 2 trips per working week
Material Delivery Miles - Loaded	8,333	Misc. construction materials (erosion controls, piping, geotextile) Assumes 100 mile one-way trip, average 2 trips per working week

O&M Mileage and Labor Estimates - Alternative 3: Phytoremediation

Item	Quantity	Assumptions
Labor Total Hours	8,230	Per projected O&M total in cost estimate (does not include contingency)
Duration of Onsite O&M Days	565	Total Days
Average Daily Crew Size	1	Assumes multiple crew sizes and a 10 hour work day
Daily Labor Mobilization Miles	139,910	Includes mob/demob from Chicago (340 miles round trip) and local daily commute mileage (30 miles per day) for an average of 170 miles round trip per day
Vehicles Miles Onsite	12,345	Includes light and medium commercial vehicles 15 miles per day, including onsite mileage and local trips No contingency Included
Equipment Mobilization Miles - Unloaded	26,010	Average of 170 miles one-way trip for equipment hauling (from Chicago, IL) Average 5 mobilizations per year plus additional mobilizations during tree replacement years.
Equipment Mobilization Miles - Loaded	26,010	Average of 170 miles one-way trip for equipment hauling (from Chicago, IL) Average 5 mobilizations per year plus additional mobilizations during tree replacement years.
Onsite Haul Truck Miles - Unloaded	565	34 CY Off Road Dump Truck 1/2 mile per trip per load
Onsite Haul Truck Miles - Loaded	565	34 CY Off Road Dump Truck 1/2 mile per trip per load
Offsite Haul Truck Miles - Unloaded	1500	Assumes one offsite disposal event each year of tree material to a disposal facility located within 50 miles of the site. Assumes truck is returning to the origin location.
Offsite Haul Truck Miles - Loaded	1500	Assumes one offsite disposal event each year of tree material to a disposal facility located within 50 miles of the site. Assumes truck is returning to the origin location.
Material Delivery Miles - Unloaded	300	Assumes two deliveries every 10 years for replacement tree cuttings and associated materials from a supplier located within 50 miles of the site. Assumes truck is returning to the origin location.
Material Delivery Miles - Loaded	300	Assumes two deliveries every 10 years for replacement tree cuttings and associated materials from a supplier located within 50 miles of the site. Assumes truck is returning to the origin location.

ACRONYMS:
CAGM = Corrective Action Groundwater Monitoring
CY = Cubic yard
O&M = Operation and Maintenance

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Appendix C

Corrective Measures Assessment

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Intended for
Illinois Power Generating Company

Date
June 4, 2024

Project No.
1940103584-008

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35 I.A.C. § 845 CORRECTIVE MEASURES ASSESSMENT

EDWARDS POWER PLANT, ASH POND, IEPA ID: W1438050005-01

RAMBOLL Bright ideas. Sustainable change.

35 I.A.C. § 845 CORRECTIVE MEASURES ASSESSMENT EDWARDS POWER PLANT EDWARDS POWER PLANT, ASH POND, IEPA ID: W1438050005-01

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Project name	**Edwards Power Plant Ash Pond**
Project no.	**1940103584-004**
Recipient	**Illinois Power Resources Generating, LLC**
Document type	**35 I.A.C. § 845 Corrective Measures Assessment**
Revision	**Final**
Date	**June 4, 2024**
Prepared by	**Frances Ackerman, RG, PE**
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ATTACHMENTS

Attachment A	Selected Construction Permit Application Plans

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ACRONYMS AND ABBREVIATIONS

%	percent
35 I.A.C.	Title 35 of the Illinois Administrative Code
AP	Ash Pond
ASD	alternative source demonstration
CAAA	Corrective Action Alternatives Analysis
CAP	Corrective Action Plan
CBR	closure-by-removal
CCR	coal combustion residuals
CIP	closure-in-place
CMA	Corrective Measures Assessment
cm/s	centimeters per second
CSM	conceptual site model
EPP	Edwards Power Plant, also referred to as Site
EPRI	Electric Power Research Institute
E001	Event 1
E002	Event 2
E003	Event 3
GMP	Groundwater Monitoring Plan
GWPS	groundwater protection standard(s)
ID	identification
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
IPRG	Illinois Power Resources Generating, LLC
ITRC	National Research Council, Interstate Technology & Regulatory Council
LLDPE	linear low-density polyethylene
NAVD88	North American Vertical Datum of 1988
NID	National Inventory of Dams
No.	number
NPDES	National Pollutant Discharge Elimination System
NRT/OBG	Natural Resource Technology, an OBG Company
PRB	Permeable Reactive Barrier
PMP	Potential Migration Pathway
Ramboll	Ramboll Americas Engineering Solutions, Inc.
SI	surface impoundment
UA	uppermost aquifer
UCF	Upper Cahokia Formation
USEPA	United States Environmental Protection Agency
ZVI	zero-valent iron

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1. INTRODUCTION

Ramboll Americas Engineering Solutions, Inc. (Ramboll) has developed this assessment of groundwater corrective measures on behalf of Illinois Power Resources Generating, LLC (IPRG) to assist in the compliance with the requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845 Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments. This assessment applies specifically to the coal combustion residuals (CCR) unit referred to as the Ash Pond (AP) at the Edwards Power Plant (EPP), also identified by CCR unit identification (ID) number (No.) 301, Illinois Environmental Protection Agency (IEPA) ID No. W143805000501, and National Inventory of Dams (NID) No. IL 50710. This report addresses content requirements specific to 35 I.A.C. § 845.660 (Assessment of Corrective Measures) for exceedances of boron and sulfate at the AP.

1.1 Source Control and Residual Plume Management

IPRG intends to initiate significant source and residual plume management efforts as part of the AP closure, as documented in the Construction Permit Application that was submitted to IEPA in June 2022 (IngenAE, 2022). 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 and maintaining that condition during the closure construction period. 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 [USEPA], 2015a, p. 21342):

> *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 AP will be closed using a consolidate-and-cap approach consisting of excavating over 1.3 million cubic yards of CCR and placing it in a consolidated CCR footprint to provide a minimum separation of 5 feet above the uppermost aquifer (UA). The consolidated CCR will be covered with an alternate geomembrane final cover system having performance that exceeds the minimum final cover requirements per 35 I.A.C. § 845.750(c)(2) (IngenAE, 2022). The proposed source control is predicted to reduce water flux into and out of the AP by approximately 97% and 94%, respectively (Ramboll, 2022). These source control activities will serve as the primary groundwater corrective measure at the AP. 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. These source control activities will serve as the primary groundwater corrective measure at the AP. 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.

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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 AP. The adaptive site management approach will allow timely incorporation of new site information over the closure and post-closure life cycle of the AP 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. 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 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 AP 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 AP. 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 AP. 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 AP.
3. Ongoing groundwater monitoring at the AP 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 35 I.A.C. § 845.780(c). A comprehensive groundwater monitoring plan (GMP) will be developed as part of the CAP process in accordance with 35 I.A.C. § 845.670 and 35 I.A.C. § 845.220(c)(4). The GMP will include the functional goals and proposed action levels.

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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).

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2. SITE INFORMATION

The EPP is located in Peoria County between Mapleton and Bartonville in Section 11, Township 7 North, Range 7 East (**Figure 2-1**). The EPP is situated in a predominantly agricultural area with industrial properties bordering the property. The EPP property is bordered by a salt processing facility to the north, railroad right-of-way and former Orchard Mines to the west, the Illinois River and a fertilizer production facility to the east, and agricultural land to the south (**Figure 2-1**). The EPP is located on the floodplain of the Illinois River adjacent to a levee and has one CCR SI, the AP. (**Figure 2-2**).

The AP has a surface area of approximately 91 acres with berms up to 27 feet higher than the surrounding land surface. This pond currently discharges to the Illinois River through Outfall 001 included in the facility National Pollutant Discharge Elimination System (NPDES) permit, IL0001970. A construction permit application for the closure of the AP (*e.g.,* source control) was submitted to IEPA on July 28, 2022 (IngenAE, 2022); permit approval is pending at this time.

2.1 Conceptual Site Model

Significant site investigation has been completed at the EPP to characterize the geology, hydrogeology, and groundwater quality. Based on extensive investigation and monitoring, the AP has been well-characterized and detailed in the Hydrogeologic Site Characterization Report (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.

The AP is located in the Illinois Valley where the general sequence of unlithified Quaternary deposits consists of poorly sorted sand, silt, and clay of the Cahokia Formation. The upper part of the Cahokia Formation consists of overbank silts and clays, while the coarser textured lower portion is mainly sandy channel and lateral accretion deposits (Willman and Frye, 1970). The Site is characterized by three hydrostratigraphic units:

- **Upper Cahokia Formation (UCF)/Potential Migration Pathway (PMP):** Low permeability clays and silts of the UCF are present at the surface. This unit is considered a PMP at elevations similar to the base of the AP, and in places where thin discontinuous sand lenses occur within the UCF adjacent to the AP. The thickness of the UCF is variable beneath the AP and ranges from 5 feet to approximately 40 feet across the site. The geometric mean horizontal hydraulic conductivity for the PMP wells is 9.2×10^{-4} centimeters per second (cm/s) (Ramboll, 2021).
- **Uppermost Aquifer (UA):** Thin (generally less than 4 feet), moderate permeability sand, silty sand, and clayey gravel material within the Lower Cahokia Formation, bedrock, and/or weathered shale bedrock, where present. In locations where higher permeability materials and coarser grained materials are absent, the UA is interpreted as the interface between the Lower Cahokia Formation and shale bedrock. The geometric mean horizontal hydraulic conductivity for UA wells is 1.7×10^{-4} cm/s (Ramboll, 2021).
- **Bedrock Confining Unit:** Thick, very low permeability shales and siltstones of the Carbondale and Modesto Formations. This unit was encountered at elevations ranging from

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approximately 400 to 422 feet[1] with higher bedrock elevations occurring beneath the northern portion of the AP. The geometric mean horizontal hydraulic conductivity at monitoring wells AP05D, AP07D, and AW-15C results in 3.2 x 10^{-6} cm/s, which is likely representative of the bedrock underlying the Site (Ramboll, 2021).

Groundwater occurs within both the unlithified materials and bedrock and consistently flows from east to west/southwest at the central portion of the AP towards what is interpreted as a former channel of the Illinois River, and south/southeast at the south end of the AP. In the northernmost portion of the Ash Pond there is a minor northwest and northern component of flow in both the uppermost aquifer and PMP. Upward vertical gradients have been calculated between the bedrock and the UA, indicating the Illinois River may be a regional discharge zone for bedrock near the AP. Groundwater elevations vary seasonally, generally less than 5 feet, while across the site they range between approximately 430 and 450 feet, although flow directions are generally consistent. Groundwater elevations and contours for the UA from the monitoring event on June 12, 2023 are presented in **Figure 2-3**.

2.2 Groundwater Quality

Groundwater monitoring in accordance with the proposed GMP and sampling methodologies provided in the operating permit application for the AP 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 17 wells screened in the UA (two background and 15 compliance) and three temporary water level only wells screened in CCR material, and one temporary water level only surface water staff gage (SG-01). The groundwater samples collected from the 17 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 first quarterly sampling event (Event 1 [E001]) was completed on June 15, 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 and supplemental groundwater monitoring wells (Ramboll, 2023a)[1]:

- Boron in UCF/PMP wells AP07S and AW-15S, and in UA wells AW-19, AW-20, and AW-21
- Sulfate in UCF/PMP well AW-15S

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, 2023b; Ramboll, 2024). The following additional exceedance was identified during the E002 monitoring event:

- Boron in UA well AW-05

Boron and sulfate exceedances are addressed in this CMA, in accordance with 35 I.A.C. § 845.660.

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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 AP during the E001 groundwater monitoring event (Ramboll, 2023a). The CMA was initiated on January 6, 2024, within 90 days after the detection of exceedance(s) of GWPS. Under 35 I.A.C. § 845, owners and operators of existing CCR 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 35 I.A.C. § 845.670 CAP process.

This CMA identified applicable corrective measure technologies and evaluated them for viability, given the site-specific conditions and considerations at the AP, 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 AP. 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 Analysis (CAAA).

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4. DESCRIPTION OF POTENTIAL CORRECTIVE MEASURE TECHNOLOGIES

The potential groundwater corrective measures summarized below are applicable to the AP 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** (hybrid consolidate-and-cap approach with a geomembrane final cover system). The source control is expected to reduce the total groundwater flux in and out of the CCR by approximately 97% and 94%, respectively, relative to pre-closure conditions. Ongoing monitoring will be an integral part of all corrective measures to verify and document the remedial process. The corrective measures ultimately advanced to the Corrective Action Alternatives Analysis (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 AP, 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;
- Source Control with In-Situ Treatment (Permeable Reactive Barrier [PRB] or In-Situ Chemical Treatment); and
- Source Control with Phytoremediation

4.1 Source Control with Groundwater Polishing

Both federal and state regulators have long recognized that natural geochemical processes can be an acceptable component of a remedial action when it can achieve remedial action objectives in a reasonable timeframe. In 1999, the United States Environmental Protection Agency (USEPA) published a final policy directive (USEPA, 1999a) 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;*

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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, 1999a). 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, 1999a; 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 AP, and the toxicity, mobility, volume, or concentration of contaminants in groundwater. Physical processes applicable to CCR constituents in groundwater include dilution, dispersion, and flushing. Chemical processes applicable to CCR constituents in groundwater include precipitation and coprecipitation (*e.g.,* incorporation into sulfide minerals), sorption (*e.g.,* to iron, manganese, aluminum; to other metal oxides or oxyhydroxides; or to sulfide minerals or organic matter), and ion exchange.

All inorganic compounds are subject to physical processes and under typical environmental conditions, physical mechanisms most often exert the dominant control on the CCR constituents of interest. Chemical mechanisms are also likely to be active, though not often dominant, such as adsorption, ion exchange, and organic complexation. In combination with source control, these natural controls can provide an effective means to polish residual loading and achieve the GWPS in a reasonable timeframe. Additional data collection and analysis may be required to evaluate site-specific geochemical attenuation processes 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 an extraction trench 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 or trenches and operating at a rate to allow capture of CCR impacted groundwater within the UA and or the UCF/PMP.

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- 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.

Groundwater extraction may reduce the timeframe to achieve GWPS and limit the off-site migration of constituents that exceed the GWPS. Extraction could be accomplished using a groundwater pumping well system or an extraction trench.

4.3 Source Control with Groundwater 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 flow between 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, secant-pile drill rigs, or one-pass machines, 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 boron and sulfate are not well established, therefore performance is unknown.

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Chemical treatment could consist of injection of reactive materials into the subsurface to treat contaminants at specific, targeted locations. Alternatively, treatment could be accomplished via PRB, where subsurface barriers (*i.e.,* cutoff walls) are placed 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 reactive media and are transformed or immobilized. A variety of media have been used or proposed for use in PRBs. Zero-valent iron (ZVI) has been shown to effectively immobilize some CCR constituents, including arsenic, chromium, cobalt, molybdenum, selenium, and sulfate. Use of a combination media consisting of ZVI and a boron-selective ion exchange (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 emplaced in front of barriers to direct flow through the barrier.
- Stability - The media should remain reactive for an amount of time that makes its use economically advantageous over other technologies.
- Environmentally compatible by-products - Any by-products of media reaction should be environmentally acceptable. For example, iron released by zero-valent iron corrosion should not occur at levels exceeding regulatory acceptance levels.
- Availability and price: The media should be easy to obtain in large quantities at a price that does not negate the economic feasibility of using a PRB.

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4.5 Source Control with Phytoremediation

Phytoremediation has been shown to be effective for treating groundwater up to 30 feet below ground surface when correctly implemented. Phytoremediation is an accepted and proven remedial technology that refers to several ways in which plants are used to remediate sites by removing pollutants from soil and water. Phytoremediation can provide an aesthetically pleasing, solar-energy driven technique that can be used to clean up sites with shallow, low to moderate levels of contamination (USEPA, 1999b).

The specific mechanisms that contribute to phytoremediation are largely a function of the site conditions, plant species, and the nature of the contaminant. Phytoremediation can be an effective treatment for boron (Bañuelos et al., 1999), and boron is an essential micronutrient for plant growth. However, if boron concentrations in irrigation water become too elevated (greater than approximately 20 mg/L for poplars and willows), the water can be toxic to plants (Yıldırım & Kasım, 2018). While sulfate phytoremediation is not well documented, sulfate is a necessary nutrient for plant growth, and phytoremediation would likely reduce sulfate concentrations in groundwater. Boron and sulfate impacts to groundwater would also be reduced via increased groundwater uptake by the phytoremediation plantation.

Several different phytoremediation mechanisms can contribute to contaminant degradation, removal (through accumulation or dissipation), or immobilization:

- Degradation (for destruction or alteration of organic contaminants)
  - Rhizodegradation: enhancement of biodegradation in the below-ground root zone by microorganisms;
  - Phytodegradation: contaminant uptake and metabolism above or below ground, within the root, stem, or leaves;
- Accumulation (for containment or removal of organic and/or metal contaminants)
  - Phytoextraction: contaminant uptake and accumulation for removal;
  - Rhizofiltration: contaminant adsorption on roots for containment and/or removal;
- Dissipation (for removal of organic and/or inorganic contaminants into the atmosphere)
  - Phytovolatilization: contaminant uptake and volatilization;
- Immobilization (for containment of organic and/or inorganic contaminants)
  - Hydraulic Control: control of ground-water flow by plant uptake of water;
  - Phytostabilization: contaminant immobilization in the soil.

In most circumstances, multiple mechanisms act simultaneously and synergistically to remediate contaminants.

Phytoremediation requires more effort than simply planting vegetation and, with minimal maintenance, and assuming that the contaminant will disappear. Phytoremediation requires an understanding of the applicable remediation mechanisms, careful plant species selection, and the provision of an environment conducive to successful plant growth to achieve optimal results. Site specific verification of the applicability and efficacy of phytoremediation would be required (USEPA, 2001).

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At the AP, two phytoremediation mechanisms would be the predominant contributors to reduction of contaminants in groundwater: phytoextraction and hydraulic control. Phytoextraction would consist of uptake impacted of groundwater through tree roots and storage of the contaminants in the above-ground tree tissues (predominantly leaves). Simultaneously, the plantings would improve hydraulic control of impacted groundwater due to the root systems impeding the downgradient groundwater flux and thereby reducing the downgradient contaminant mass flux.

Phytoremediation could be implemented in a variety of different ways. One straightforward approach involves planting directly into contaminated soil or in areas where roots can directly contact contaminated groundwater. This strategy provides a simple approach under the proper conditions (roots can naturally reach contamination, environment is not toxic to plants, etc.); however, in some cases contaminated groundwater cannot be easily accessed by plant roots and other strategies are required.

Where groundwater is too deep for roots to naturally access it, specialized planting systems can be utilized to provide access to the groundwater. At each planting location, the groundwater wells or soil borings are backfilled with a course grained material allowing groundwater to rise to its potentiometric surface elevation. When designed correctly, these systems provide significantly increased access to groundwater for the tree roots, especially when combined with other cultivation techniques to encourage deep root growth such as deep irrigation during the tree establishment, aeration tubes to provide oxygen to the subsurface, and utilizing long tree cuttings planted deeply. An additional technique to encourage deep root growth is to install a casing or liner around the root zone that requires tree roots to advance downward toward groundwater.

Phytoremediation implementation at the AP would consist of planting phreatophytes (plants that thrive with roots submerged in water) in downgradient area(s) where elevated concentrations of boron and sulfate in groundwater have been observed. Following installation, the trees would require an initial establishment period of several (3 to 5) years to grow large enough for roots to reach the groundwater table and begin uptake of groundwater. During this establishment period supplemental irrigation would be necessary. Once the trees have sufficiently matured to uptake groundwater, boron (and possibly sulfate) would be incorporated into tree tissues including the leaves of the trees. Leaves from the trees would be collected and removed from the tree plantation thereby providing for a mechanism of boron (and possibly sulfate) removal from the site.

Since phytoremediation is dependent upon the tree roots contacting and extracting groundwater, enhancements could be implemented to promote downward root growth. Examples include planting long tree cuttings deeper in the ground, having deep irrigation systems that encourage downward root growth, and planting boron accumulating grass cover or utilizing impermeable membranes to reduce infiltration and thereby encourage tree root growth toward the groundwater table. Phreatophytes are favored for their ability to grow deep root systems quickly as well as their capability to utilize high volumes of water once established. Phytoremediation using phreatophytes has been shown to be effective for treating groundwater up to 30 feet below ground surface if appropriate measures are implemented.

Phytoremediation can offer several advantages over traditional remedial technologies. When properly applied, phytoremediation can be a low cost, low maintenance, environmentally friendly, and aesthetically pleasing technology while also providing effective contaminant reduction.

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Phytoremediation can be well-suited for projects with longer time frames (tens of years) or low concentration contaminant fluxes. However, under some conditions clean up can be achieved in shorter time frames (several years).

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5. ASSESSMENT OF CORRECTIVE MEASURE TECHNOLOGIES

This CMA was initiated to address exceedances of the 35 I.A.C. § 845.600 GWPS for boron and sulfate at the downgradient waste boundary of the AP 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 boron and sulfate 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 AP.

5.2 Groundwater Corrective Technology Assessment

Source control, consisting of CCR consolidation and CIP with a final cover system, will be the primary groundwater corrective measure for the AP. Closure is expected to be completed in 2028 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 boron and sulfate GWPS exceedances. Technologies that are not viable for addressing the GWPS at the AP 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 reduce the mass loading to the groundwater system and the groundwater polishing process could decrease the timeframe for attainment of GWPS in the UA. Groundwater flow and fate and transport modeling indicated that the total groundwater flux in and out of the CCR would be reduced by approximately 97% and 94%, respectively, relative to pre-closure conditions.

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

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regulatory approval. Site conditions may be favorable for contaminant degradation by physical processes. The chemical processes in the fine-grained PMP require further evaluation.

Naturally occurring geochemical processes are ongoing at the AP and will continue to affect groundwater constituent concentrations during and after AP 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. Enhancements to the groundwater monitoring system may be required to ensure that groundwater polishing is occurring as predicted and consistent with the adaptive site management approach. The reliability of groundwater polishing as a groundwater corrective measure is high because operation and maintenance requirements are limited. However, the reliability can also vary based on site-specific hydrogeologic and geochemical conditions.

Following characterization and approval of the CAP, monitoring of the groundwater polishing processes and comparison to functional goals established to monitor progress toward the remedial objective could begin prior to, or concurrently with, site closure activities. Installing additional monitoring wells could begin as quickly as within a few months of CAP approval. The time required could be reduced if existing groundwater monitoring well systems could be utilized for monitoring.

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, which require detailed technical analysis which are ongoing and will be evaluated in connection with the CAAA. Selecting groundwater polishing as a corrective measure for the AP will require approval of the closure and CAP permits by the IEPA.

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

Monitoring the groundwater polishing to track progress toward achievement of the GWPS, in conjunction with source control at the AP, would require long-term maintenance and monitoring of the groundwater monitoring system to confirm source control and verify the effectiveness in reducing groundwater concentrations to levels below the GWPS. 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 2028.

5.2.2 Source Control with Groundwater Extraction

Source control will reduce the mass loading to the groundwater system and implementing a groundwater extraction system may reduce the time required to attain the GWPS in the UA. However, the groundwater impacts present in the low permeability PMP may limit the reduction in time to attain the GWPS that can be achieved by a groundwater extraction system.

Groundwater extraction is a widely accepted corrective measure with a long track record of performance and reliability. It is routinely approved by the IEPA. For a corrective measure using groundwater extraction to effectively control off-site flow and/or to remove potentially

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contaminated groundwater, horizontal and vertical capture zone(s) must be created. However, the variability and heterogeneity of the UA, and the low permeability PMP, would constrain the ability to pump at rates high enough to establish the required capture zone(s). An extraction trench or an extraction system consisting of a high density, low flow wells would be required. Variable performance of a groundwater extraction system would be expected in the heterogeneous UA.

Implementation of a groundwater extraction system presents design challenges due to the heterogeneous and varied nature of the UA and the low permeability of the PMP. Site access limitations would impose construction challenges and construction of an extraction system between the AP and the property boundary would be challenging due to the physical site constraints (limited construction area due to adjacent surface water drainage and associated wetlands). The AP embankment would need to be modified to provide an access road and a working platform for trench construction. Extracted groundwater would need to be managed, which may include modification to the existing NPDES permit and treatment prior to discharge, if necessary. Specialized treatment equipment may be required, and ongoing operations and maintenance activities would be necessary.

There could be some impacts associated with constructing and operating a groundwater extraction system, including some limited exposure to extracted groundwater. Construction could be completed within 1 year following completion of a final design. Time of implementation is approximately 3 to 4 years after approval of the CAP permit, including characterization, design, permitting, and construction. Timeframes to achieve GWPS are dependent on site-specific conditions. An extraction system may reduce the time to attain GWPS in the UA relative to the post-closure timeframe predicted by the groundwater modeling. However, accelerated attainment of the GWPS is expected to be limited by the low permeability of the PMP.

Implementing a groundwater extraction system at the AP would require IEPA approval of the CAP permit, and discharge of extracted groundwater may require a modification to the NPDES permit, as well as possible permitting and construction of a new outfall.

Groundwater extraction could be viable corrective measure for the boron and sulfate exceedances at the AP. 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 additional groundwater corrective measures may reduce the time required to attain the GWPS in the UA. However, the groundwater impacts already present in the low permeability PMP may limit the reduction in time to attain the GWPS. 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. 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.

The effectiveness of a cutoff wall as a hydraulic barrier 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 aquifer they

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are in contact with. A cutoff wall could be used to address groundwater impacts in the UA; however, the effectiveness of a cutoff wall, typically designed with hydraulic conductivity of 1×10^{-7} cm/s, constructed in the low permeability PMP would be limited. Site access limitations would impose construction challenges and construction of an extraction system between the AP and the property boundary would be challenging due to the physical site constraints (limited construction area). The AP embankment would need to be modified to provide an access road and a working platform for trench construction.

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.

Construction could be completed within 1 year following completion of a final design. Time of implementation is approximately 4 to 5 years, including characterization, design, permitting, and construction. To attain GWPSs, cutoff walls require a separate groundwater corrective measure to operate in concert with the cutoff wall(s). Constructing a cutoff wall at the AP would require IEPA approval of the CAP permit.

A cutoff wall alone would not be a viable corrective measure for the boron and sulfate exceedances at the AP. Cutoff walls are commonly coupled with groundwater polishing and/or groundwater extraction or other 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. Use of a cutoff wall coupled groundwater extraction to supplement the ongoing groundwater polishing may provide improvement over source control in the time required to attain GWPS.

Due to the uncertain performance, reliability, and requirement that a cutoff wall be coupled with other groundwater corrective measures, a cutoff wall is not a viable corrective measure for the boron and sulfate exceedances at the AP. Therefore, it 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 to address boron and sulfate exceedances in groundwater is not an established or widely accepted groundwater corrective measure; therefore, its performance and reliability are unknown. Regulatory acceptance of this innovative approach to achieving the GWPS is uncertain.

In-situ treatment presents design and construction challenges, including targeted reactive media delivery via injection to the heterogeneous UA and the low permeability PMP. Construction of a PRB would be complicated by the site access limitations (proximity of the AP embankment to the property line, adjacent surface water drainage and associated wetlands). The embankment would

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need to be modified to provide an access road and a working platform for PRB construction. Depending upon the location of the PRB system, construction may affect the AP embankment and/or final cover system and periodic change-outs of ion-exchange resin media may be required.

Additional data collection and analyses would be required to design an in-situ treatment system and bench scale and/or pilot scale testing may be required to demonstrate performance and reliability. Time of implementation is approximately 4 to 6 years after approval of the CAP permit, including characterization, design, permitting, and construction. Timeframes to achieve GWPS are dependent on demonstrations of performance and reliability 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 boron and sulfate exceedances at the AP and is not being advanced to the CAAA for further evaluation.

5.2.5 Source Control with Phytoremediation

Source control will reduce the mass loading to the groundwater system, and implementing a groundwater phytoremediation system may reduce the time required to attain the GWPS in the UA and in the PMP. Groundwater extraction via phytoremediation ("phytoextraction") is a proven and accepted corrective measure with a track record of performance and reliability and has been approved by the IEPA. However, phytoremediation has not been widely implemented to reduce groundwater contaminant migration from CCR impoundments to date. For phytoextraction to effectively control off-site flow and/or to remove potentially contaminated groundwater, horizontal and vertical capture zone(s) must be created. Implementation of phytoremediation for the relatively deep UA would require installing a tree system with passive wells and potentially root liners (*i.e.,* TreeWell® technology or similar) to create a hydraulic connection between the tree roots and the UA. Site access limitations would impose construction challenges and construction of a phytoextraction system between the AP and the property boundary would be challenging due to the physical site constraints (limited construction area). The AP embankment would need to be modified to provide an access road and a working platform for tree installation.

Implementation of a groundwater phytoextraction system presents design challenges due to the heterogeneous and varied nature of the UA and the low permeability of the PMP. Construction challenges to implementing a phytoremediation system between the AP and the property boundary would include access issues due to the physical site constraints (limited construction area) and close proximity of property boundary and adjacent wetlands and water bodies The AP embankment would need to be modified to provide an access road and a working platform for construction. Specialized contractors may be required to install the system. Uptake of impacted groundwater would occur through the tree roots and contaminants would be stored in the above-ground tree tissues (stems and leaves), which would need to be managed and/or disposed of following extraction. Specialized treatment equipment may be required, and ongoing operations and maintenance activities would be necessary, including leaf collection and disposal, and possible tree replacement, depending upon the time required to achieve GWPS.

Additional data collection and analyses would be required to design a phytoextraction system. Construction could be completed within 1 year following design. Time of implementation is

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approximately 4 to 5 years after approval of the CAP permit, including characterization, design, pilot-scale testing of phytoremediation at the site, permitting, and construction. Timeframes to achieve GWPS are dependent on site-specific conditions. A phytoextraction system may reduce the time to attain GWPS in the UA relative to the post-closure timeframe predicted by the groundwater modeling. Implementing a groundwater phytoextraction system at the AP would require IEPA approval of the CAP permit.

Groundwater phytoextraction could be viable corrective measure for the boron and sulfate exceedances at the AP. Therefore, phytoremediation is being advanced to the CAAA for further evaluation.

5.3 Technologies Advanced to CAAA

Based on the evaluations presented above, the following potential corrective technologies are being advanced to the CAAA, individually or in combination, for more detailed evaluations:

- Source control with groundwater polishing;
- Source control and with groundwater extraction; and
- Source control with phytoremediation.

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TABLES

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TABLE 5-1.
Table 5-1. 35 I.A.C. § 845 Corrective Measures Assessment Matrix
Ash Pond
Edwards Power Plane
Peoria, Illinois
June 4, 2024

Remedy	Evaluation Factors						
	Performance	**Reliability**	**Ease of Implementation**	**Potential Impacts of Remedy (safety impacts, cross-media impacts, control of exposure to any residual contamination)**	**Time Required to Begin and Implement Remedy[1]**	**Time to Attain Groundwater Protection Standards**	**Institutional Requirements (state/local permit requirements, environmental/public health requirements that affect implementation of remedy)**
Source Control with Groundwater Polishing	Performs best paired with source control, which is expected to be completed prior to 2028. Site conditions are favorable for physical processes, while chemical processes may be limited under normal aquifer conditions.	Evaluation is underway and is expected to be completed in 2024. Ongoing analysis will evaluate if geochemical processes have low reversibility and the aquifer has sufficient capacity.	Long-term monitoring would be required. Implementing would not require extensive specialized equipment or contractors	None identified.	90 days after closure (source control) is completed.	Dependent on site-specific conditions including source decay rate. Attainment of groundwater protection standards will be limited by the low permeability Upper Confining Unit. Hence timeframes for groundwater polishing and other measures may be similar.	Illinois Environmental Protection Agency approval of the closure and Corrective Action Plan permits is required. A Groundwater Management Zone would be required, which may potentially impact nearby property owners.
Source Control with Groundwater Extraction	Widely accepted, routinely approved technology; variable performance anticipated due to the heterogeneous, varied nature of Uppermost Aquifer. Would likely be a trench along the north and west side of the unit between AW21 to AW15.	Reliable if properly designed, constructed and maintained. The heterogeneous, varied nature of Uppermost Aquifer may present reliability challenges for pumping wells; a trench may be more reliable.	Design challenges due to heterogeneous, varied nature of Uppermost Aquifer. Site access limitations (proximity to railroad, property boundary and adjacent wetlands) may be challenging. Specialized contractors may be necessary. Extracted groundwater would require management, possibly including treatment, which may require specialized equipment/contractors.	Alters groundwater flow system and there is the some limited potential for contact exposure to extracted groundwater. Groundwater extraction may induce settlement, which could cause impacts to adjacent structures. Trench construction may also cause structural impacts to adjacent embankments, due to site access challenges.	Design, permitting and construction is expected to take 3 to 4 years after closure.	Time to attain groundwater protection standards may be similar to groundwater polishing due to the low permeability Upper Confining Unit.	Illinois Environmental Protection Agency approval of the closure and Corrective Action Plan permits is required. Extracted groundwater could likely be discharged under the National Pollutant Discharge Elimination System permit. May also require an evaluation and/or permitting of wetlands and/or Waters of the US impacts, if determined to be necessary.
Source Control with Cutoff Wall	Widely accepted, routinely approved 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 groundwater protection standards may be exceeded. Would not be effective in the PMP, but could be used to address impacts in UA.	Reliable for groundwater directional control in UA if properly designed and constructed.	Widely used, established technology. May require specialized contractors depending upon the construction/implementation method.	Alters groundwater flow system but does not provide any treatment. Can result in unintended consequences resulting from redirecting contaminants to areas where they are not currently present. May cause structural impacts to existing embankments, depending on the location of the cutoff wall.	Design, permitting and construction would take 4 to 5 years after closure. 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, has the potential to reduce the time required to achieve and attain groundwater protection standards. Time required to achieve groundwater protection standards may be similar to groundwater polishing due to the low permeability Upper Confining Unit.	Illinois Environmental Protection Agency approval of the closure and Corrective Action Plan permits is required. May also require an evaluation and/or permitting of wetlands and/or Waters of the United States impacts, if determined to be necessary.
Source Control with In-Situ Treatment	In-situ treatment using ion exchange (IX) not well established for sulfate or boron, therefore performance is unknown.	Unknown reliability for sulfate or boron.	Design challenges related to reactive material delivery due to heterogeneous, discontinuous nature of Uppermost Aquifer. Could require periodic change-outs of IX resin media.	May cause structural impacts to existing embankments, depending on the location of the permeable reactive barrier.	May require bench scale and/or pilot scale testing as part of design. Design, permitting and construction would take 4 to 6 years after Corrective Action Plan approval.	There is uncertainty regarding whether a in-situ treatment would reduce sulfate or boron concentrations to achieve the groundwater protection standards. Dependent on conditions specific to the reactive media used and the site. Treatment technology is not well understood.	Illinois Environmental Protection Agency approval of the Corrective Action Plan permit is required. Illinois Environmental Protection Agency approval of this innovative and relatively unproved solution may be challenging. May also require an evaluation and/or permitting of wetlands and/or Waters of the United States impacts, if determined to be necessary.
Source Control with Phytoremediation	Accepted and proven remedial strategy. Accumulation through phytoextraction may be viable for boron impacts in the northern portion of the Site and may be equally viable for the Potential Migration Pathway or the Uppermost Aquifer.	Reliable for boron if tree variety is properly selected for site conditions. Unknown reliability for sulfate.	Less complicated engineering design but may require specialized contractors depending upon the construction/implementation method.	Potential need for future management/disposal of trees following accumulation of contaminant mass.	Permitting and construction would take 4 to 5 years after closure. Could be combined with closure.	Phytoremediation has the potential to reduce the time required to achieve and attain groundwater protection standards. Time required is dependent on ability of root structure to access low permeability unit.	Illinois Environmental Protection Agency approval of the Corrective Action Plan permit is required. Illinois Environmental Protection Agency approval of this innovative and relatively unproved solution for CCR impacts may be challenging. May also require an evaluation and/or permitting of wetlands and/or Waters of the United States impacts, if determined to be necessary.

Notes:
[1] Time required to begin and implement remedy includes design, permitting, and construction.

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FIGURES

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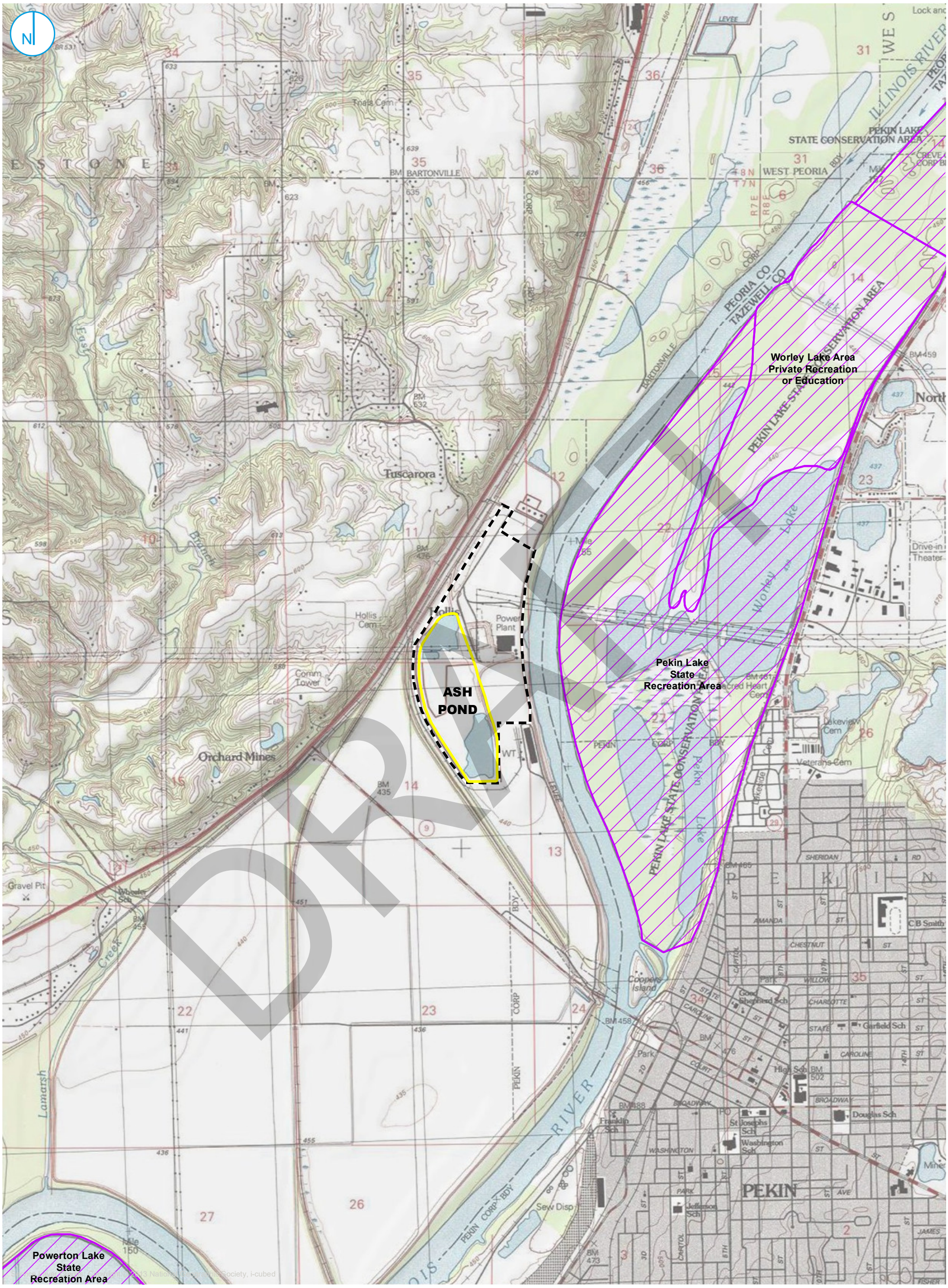


REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY
PROTECTED AREA

SITE LOCATION MAP

FIGURE 2-1

35 I.A.C. § 845 CORRECTIVE MEASURES ASSESSMENT
ASH POND

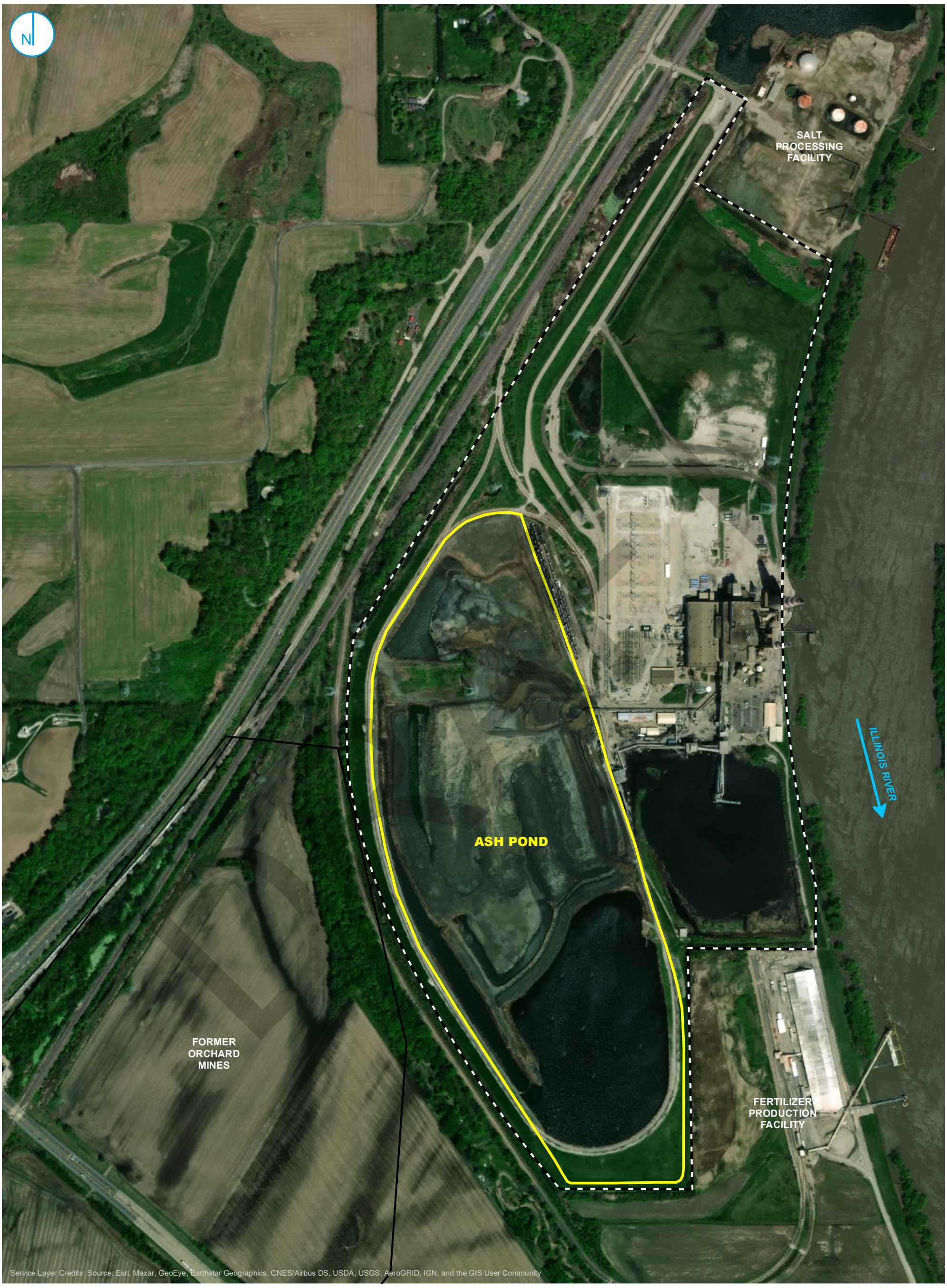
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

PROJECT: 169000XXXX | DATED: 8/12/2021 | DESIGNER: STOLZSD

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Edwards\GMP\Figure 1-2_Site Map.mxd



REGULATED UNIT (SUBJECT UNIT)

FORMER ORCHARD MINES AREA

PROPERTY BOUNDARY

0 250 500 Feet

SITE MAP

35 I.A.C. § 845 CORRECTIVE MEASURES ASSESSMENT ASH POND

EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 2-2

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

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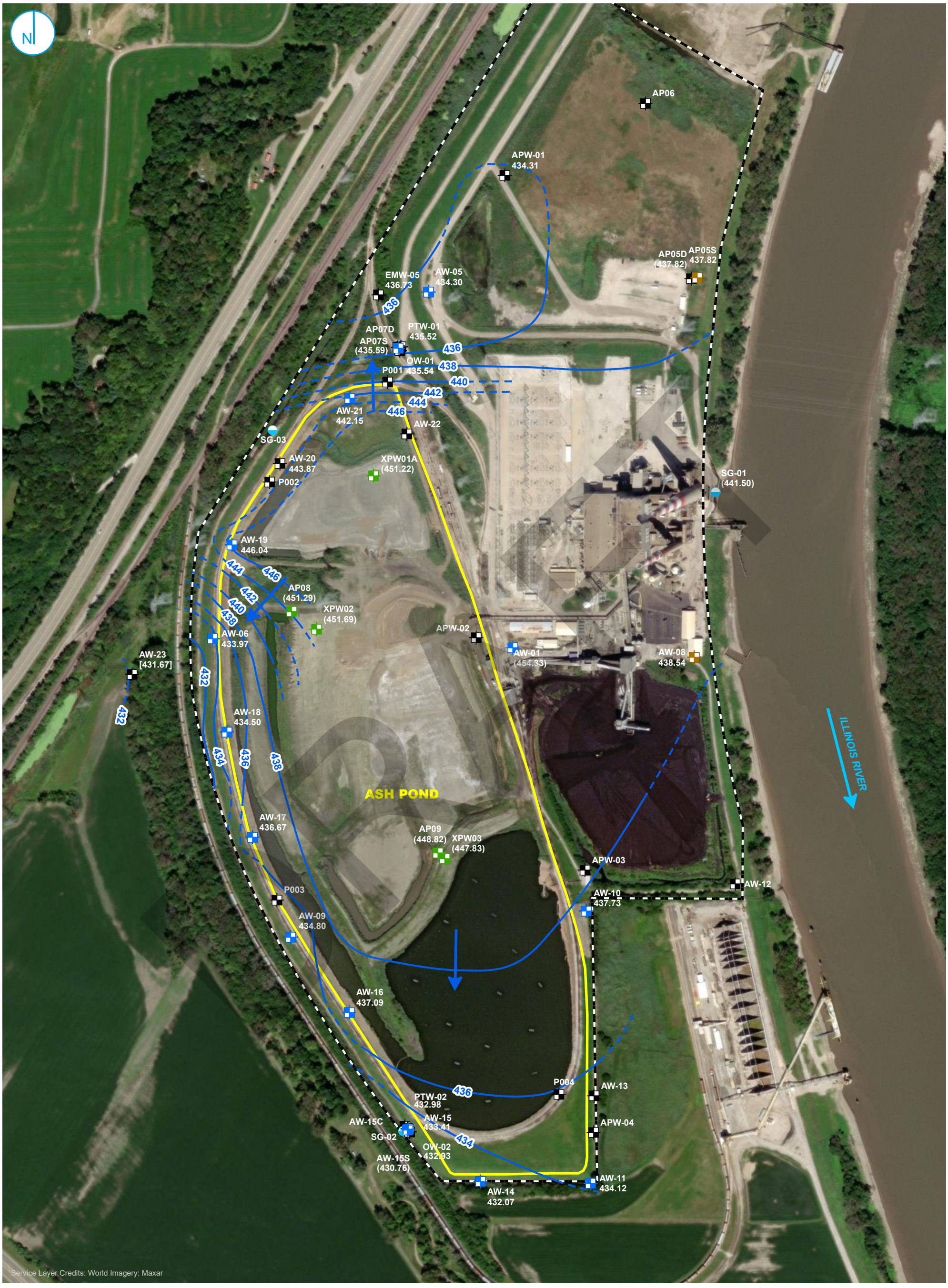

- COMPLIANCE MONITORING WELL
- BACKGROUND MONITORING WELL
- MONITORING WELL
- PORE WATER WELL
- STAFF GAGE, RIVER
- GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
- INFERRED GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION
- REGULATED UNIT (SUBJECT UNIT)
- PROPERTY BOUNDARY

0 212.5 425 Feet

NOTES
1. ELEVATIONS IN PARENTHESES WERE NOT USED FOR CONTOURING.
2. ELEVATION CONTOURS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. ELEVATIONS IN BRACKETS WERE OBTAINED OUTSIDE OF THE 24-HOUR PERIOD FROM INITIATION OF DEPTH TO GROUNDWATER MEASUREMENTS BUT WITHIN THE SAME SAMPLING EVENT.

UPPERMOST AQUIFER POTENTIOMETRIC SURFACE MAP JUNE 12, 2023

2023 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT ASH POND

EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 2-3

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

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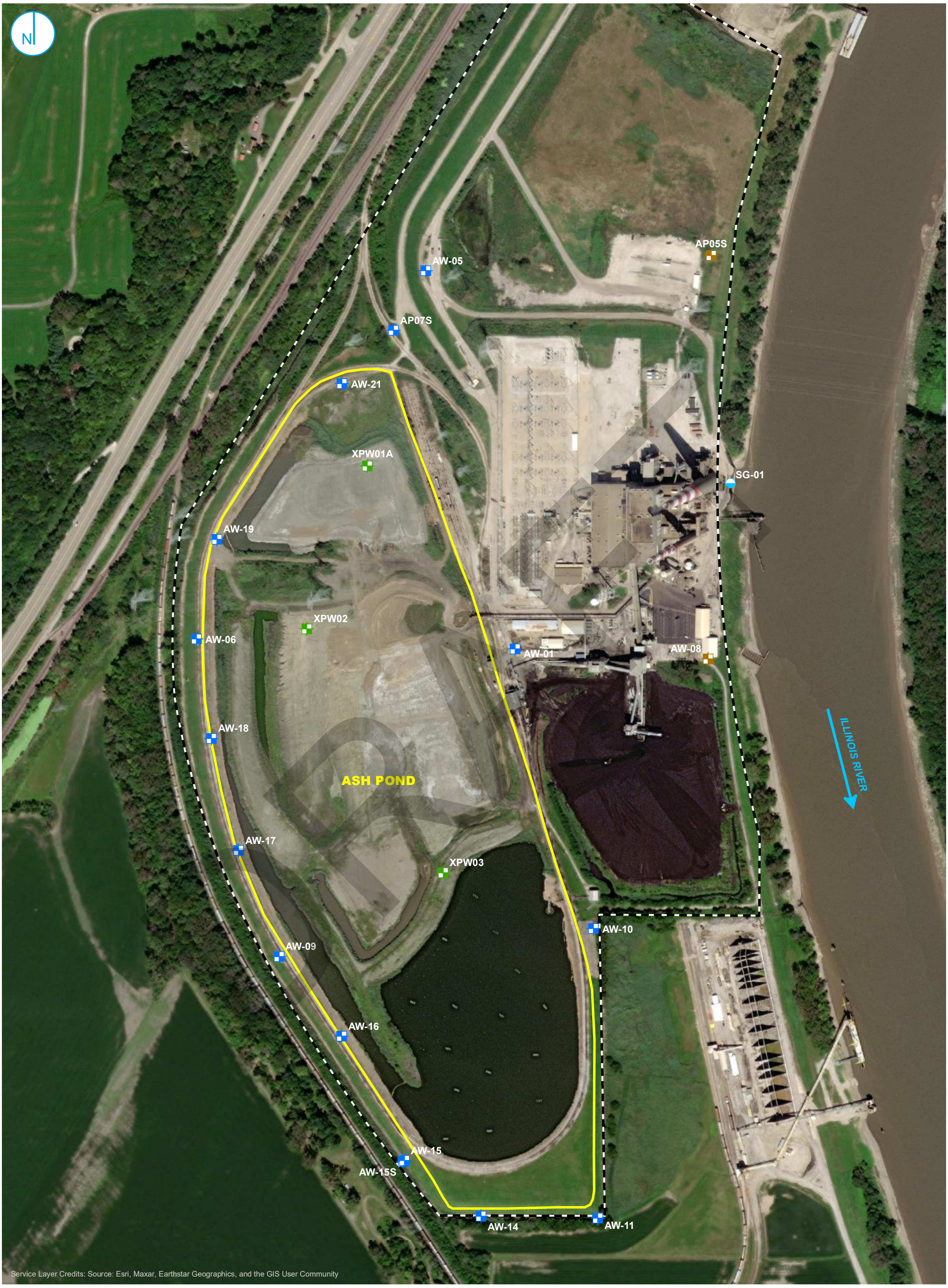

COMPLIANCE MONITORING WELL
BACKGROUND MONITORING WELL
PORE WATER WELL
STAFF GAGE, RIVER
REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY

0 200 400 Feet

35 I.A.C. § 845 MONITORING WELL LOCATION MAP

35 I.A.C. § 845 CORRECTIVE MEASURES ASSESSMENT ASH POND

EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 2-4

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

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ATTACHMENTS

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ATTACHMENT A
Selected Construction Permit Application Plans

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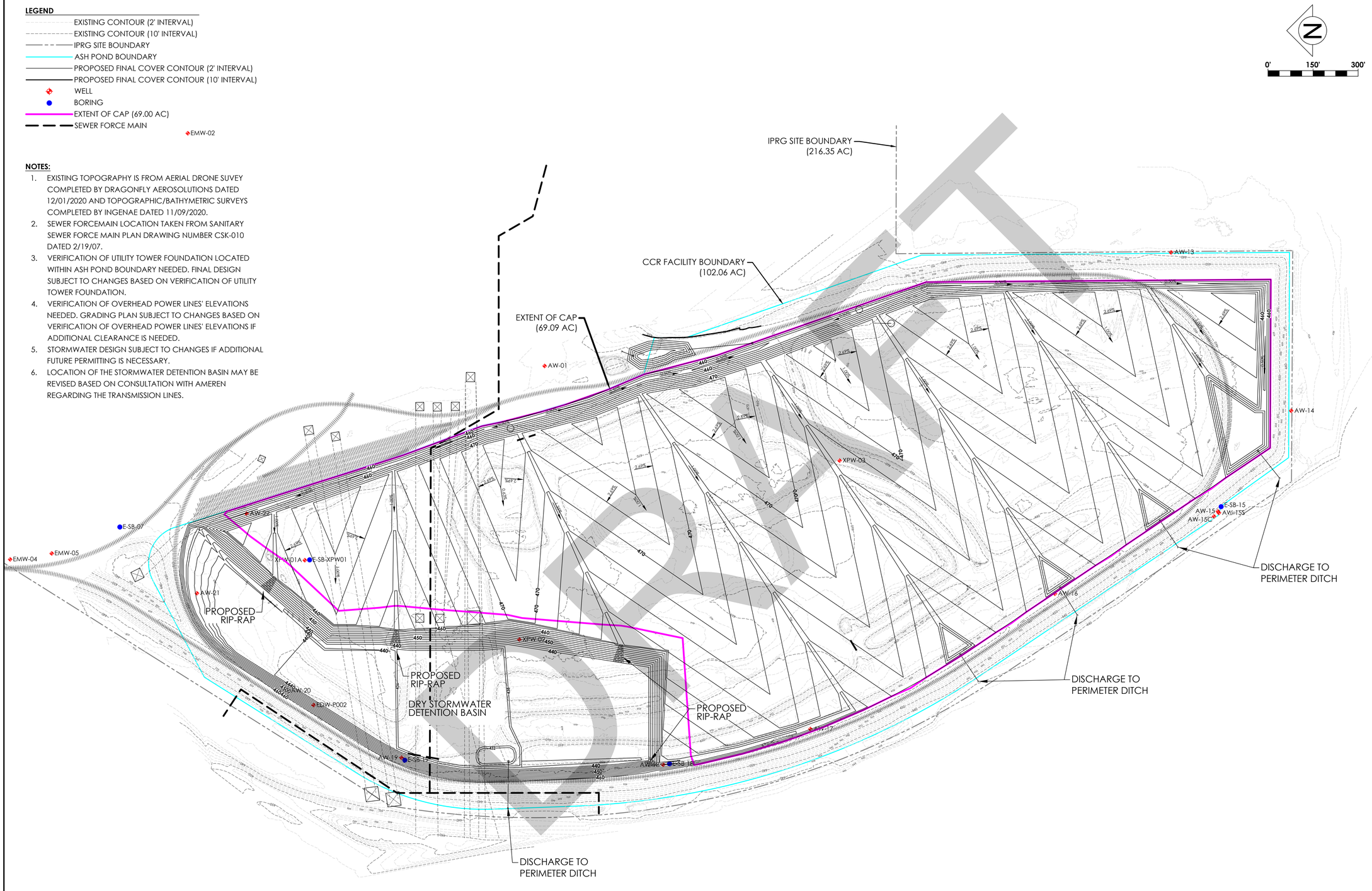
LEGEND

- EXISTING CONTOUR (2' INTERVAL)
- EXISTING CONTOUR (10' INTERVAL)
- IPRG SITE BOUNDARY
- ASH POND BOUNDARY
- PROPOSED FINAL COVER CONTOUR (2' INTERVAL)
- PROPOSED FINAL COVER CONTOUR (10' INTERVAL)
- WELL
- BORING
- EXTENT OF CAP (69.00 AC)
- SEWER FORCE MAIN

EMW-02

NOTES:

1. EXISTING TOPOGRAPHY IS FROM AERIAL DRONE SUVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 12/01/2020 AND TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/09/2020.
2. SEWER FORCEMAIN LOCATION TAKEN FROM SANITARY SEWER FORCE MAIN PLAN DRAWING NUMBER CSK-010 DATED 2/19/07.
3. VERIFICATION OF UTILITY TOWER FOUNDATION LOCATED WITHIN ASH POND BOUNDARY NEEDED. FINAL DESIGN SUBJECT TO CHANGES BASED ON VERIFICATION OF UTILITY TOWER FOUNDATION.
4. VERIFICATION OF OVERHEAD POWER LINES' ELEVATIONS NEEDED. GRADING PLAN SUBJECT TO CHANGES BASED ON VERIFICATION OF OVERHEAD POWER LINES' ELEVATIONS IF ADDITIONAL CLEARANCE IS NEEDED.
5. STORMWATER DESIGN SUBJECT TO CHANGES IF ADDITIONAL FUTURE PERMITTING IS NECESSARY.
6. LOCATION OF THE STORMWATER DETENTION BASIN MAY BE REVISED BASED ON CONSULTATION WITH AMEREN REGARDING THE TRANSMISSION LINES.



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ILLINOIS POWER RESOURCES GENERATING, LLC.

Project Name & Location:

ASH POND PART 845 CONSTRUCTION DRAWINGS EDWARDS ASH POND

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FINAL COVER & STORMWATER PLAN

Date: 6/30/2022	Project No.
Type: PLAN	Drawing No. 6
Drawn By: CB	
Approved By: BH	
Scale: AS NOTED	

LEGEND

- EXISTING CONTOUR (2' INTERVAL)
- EXISTING CONTOUR (10' INTERVAL)
- IPRG SITE BOUNDARY
- ASH POND BOUNDARY
- BATHYMETRIC BOUNDARY
- PROPOSED TOP OF ASH CONTOUR (2' INTERVAL)
- PROPOSED TOP OF ASH CONTOUR (10' INTERVAL)
- WELL
- BORING
- EXTENT OF CAP (69.00 AC)
- SEWER FORCE MAIN

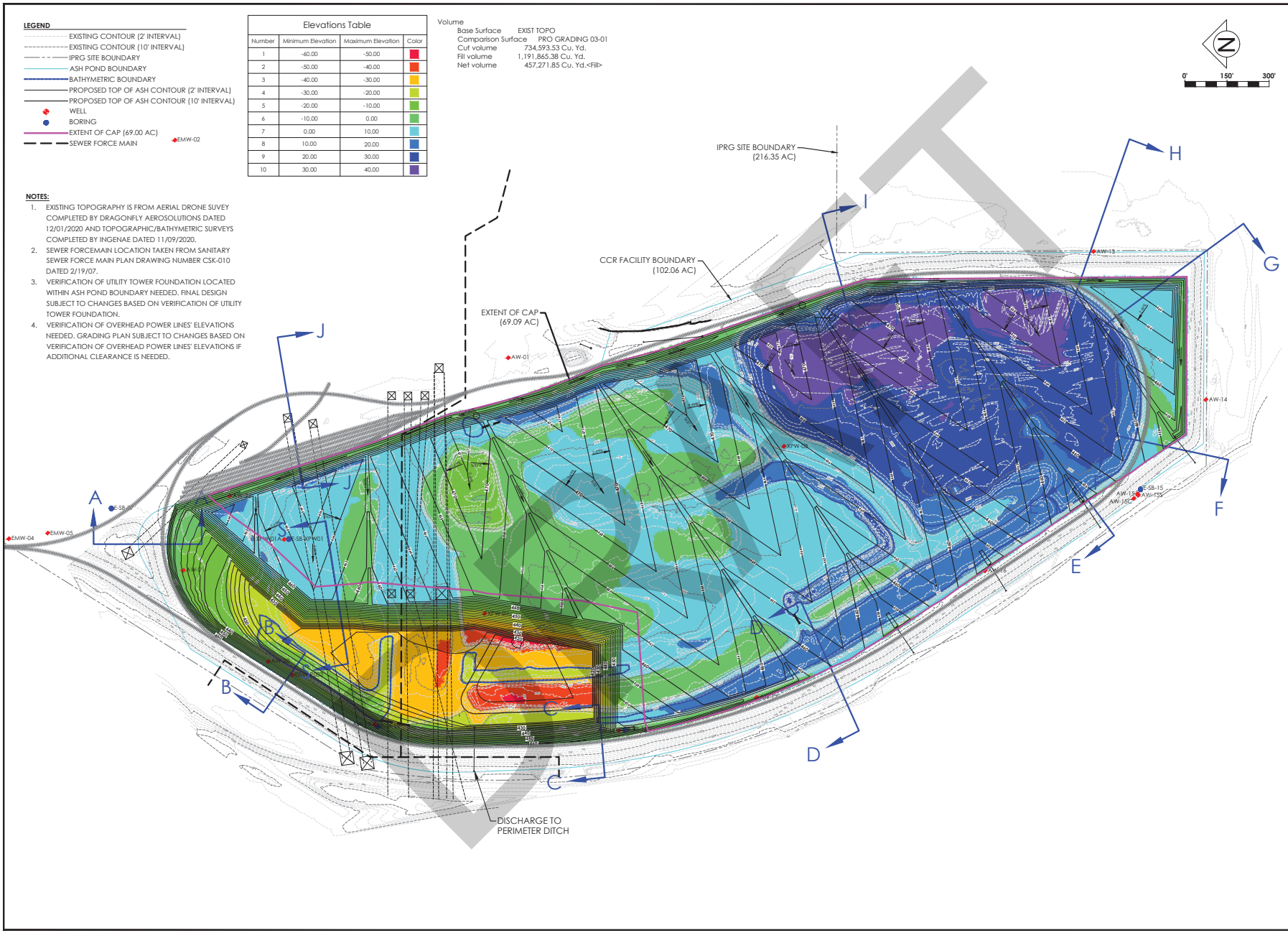
EMW-02

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	-60.00	-50.00	
2	-50.00	-40.00	
3	-40.00	-30.00	
4	-30.00	-20.00	
5	-20.00	-10.00	
6	-10.00	0.00	
7	0.00	10.00	
8	10.00	20.00	
9	20.00	30.00	
10	30.00	40.00	

Volume
Base Surface EXIST TOPO
Comparison Surface PRO GRADING 03-01
Cut volume 734,593.53 Cu. Yd.
Fill volume 1,191,865.38 Cu. Yd.
Net volume 457,271.85 Cu. Yd.<Fill>

NOTES:

1. EXISTING TOPOGRAPHY IS FROM AERIAL DRONE SUVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 12/01/2020 AND TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/09/2020.
2. SEWER FORCEMAIN LOCATION TAKEN FROM SANITARY SEWER FORCE MAIN PLAN DRAWING NUMBER CSK-010 DATED 2/19/07.
3. VERIFICATION OF UTILITY TOWER FOUNDATION LOCATED WITHIN ASH POND BOUNDARY NEEDED. FINAL DESIGN SUBJECT TO CHANGES BASED ON VERIFICATION OF UTILITY TOWER FOUNDATION.
4. VERIFICATION OF OVERHEAD POWER LINES' ELEVATIONS NEEDED. GRADING PLAN SUBJECT TO CHANGES BASED ON VERIFICATION OF OVERHEAD POWER LINES' ELEVATIONS IF ADDITIONAL CLEARANCE IS NEEDED.



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Project Name & Location:

ASH POND PART 845 CONSTRUCTION DRAWINGS EDWARDS ASH POND

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TOP OF ASH GRADING PLAN

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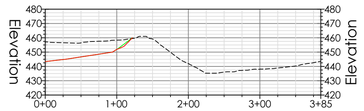
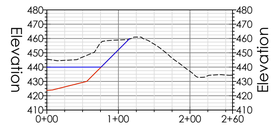
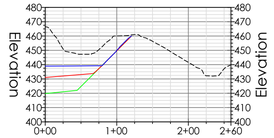
Approved By: BH	
Scale: AS NOTED	



A-A CROSS SECTION



B-B CROSS SECTION



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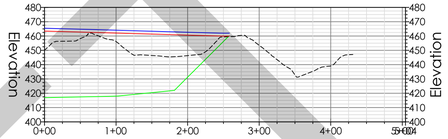

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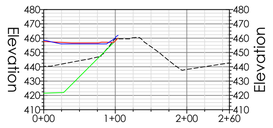

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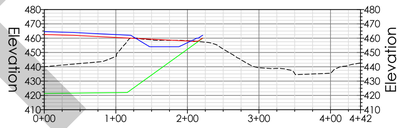

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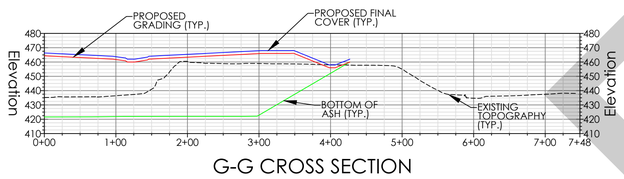

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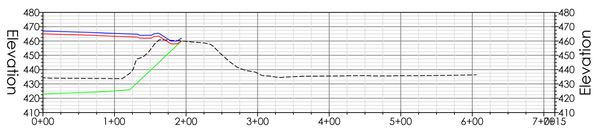

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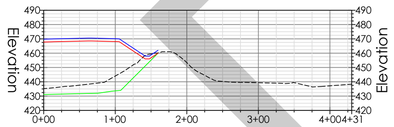

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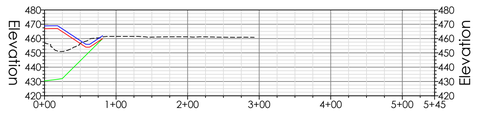

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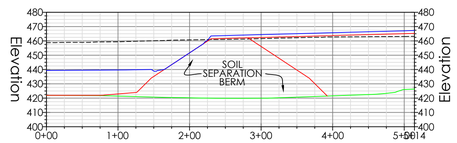

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Project Name & Location:

ASH POND PART 845 CONSTRUCTION DRAWINGS EDWARDS ASH POND

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Appendix D

Nature and Extent Report

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Intended for

Illinois Power Resources Generating, LLC
7800 Cilco Lane
Bartonville, Illinois 61607

Date

June 4, 2024

Project No.

1940103584-004

NATURE AND EXTENT REPORT

EDWARDS POWER PLANT, ASH POND, IEPA ID NO. W1438050005-01

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RAMBOLL Bright ideas. Sustainable change.

NATURE AND EXTENT REPORT
EDWARDS POWER PLANT, ASH POND, IEPA ID NO. W1438050005-01

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Project name	**Edwards Power Plant Ash Pond**
Project no.	**1940103584-004**
Recipient	**Illinois Power Resources Generating, LLC**
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Prepared by	**Alison O'Connor and Nathaniel Keller**
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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
AP	Ash Pond
BCU	bedrock confining unit
CCR	coal combustion residuals
CMA	Corrective Measures Assessment
cm/s	centimeters per second
CSM	conceptual site model
E001	Event 1
E002	Event 2
E003	Event 3
EPP	Edwards Power Plant
GCSM	geochemical conceptual site model
GMR	Groundwater Modeling Report
GPM	gallons per minute
GWPS	groundwater protection standard
HCR	Hydrogeologic Site Characterization Report
HSU	hydrostratigraphic unit
IEPA	Illinois Environmental Protection Agency
LCL	lower confidence limit
mg/L	milligrams per liter
NAVD88	North American Vertical Datum 1988
redox	reduction and oxidation
PMP	potential migration pathway
SI	surface impoundment
SSI	supplemental site investigation
UA	uppermost aquifer
UCF	Upper Cahokia Formation
US	United States
USEPA	United States Environmental Protection Agency

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EXECUTIVE SUMMARY

Groundwater samples collected at the Edwards Power Plant (EPP) Ash Pond (AP) 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. Exceedances were identified in the following hydrostratigraphic units (HSUs) and wells:

- Detected uppermost aquifer (UA) Exceedances:
  - Boron at AW-05, AW-19 and AW-21
- Detected Upper Cahokia Formation (UCF) (potential migration pathway [PMP]) Exceedances:
  - Boron at AP07S and AW-15S
  - Sulfate at AW-15S

Supplemental data for monitoring wells APW-01, AW-20, AW-23, and EMW-05 was provided for events E001, E002, and E003 as part of on-going nature and extent characterization activities consistent with 35 I.A.C. § 845.650(d)(1) at the EPP AP. In accordance with 35 I.A.C. § 845.610(b)(3)(C) statistically derived values for constituent concentrations observed at supplemental monitoring wells were also evaluated quarterly for exceedances of the GWPS [1].

The following supplemental GWPS exceedance was also determined during E001:

- Detected UA Exceedance:
  - Boron at AW-20

As a result of the identified E001 exceedances, a Corrective Measures Assessment (CMA) was initiated on December 7, 2023 and submitted June 4, 2024 [2] in accordance with 35 I.A.C. § 845.660. The subsequent compliance sampling events for the Quarter 3 and Quarter 4, 2023 sampling events (Event 2 [E002] and Event 3 [E003]) were completed in August and November 2023 and groundwater samples were evaluated for exceedances of the GWPS as described in 35 I.A.C. § 845.600. In addition to the exceedances listed above, the following exceedance was identified in the UA during the E002 event:

- Boron at AW-05

Exceedances identified during the E003 event were consistent with those listed above.

The additional boron exceedance at AW-05 was evaluated with respect to the groundwater model, feasible alternatives, and remedy extents and was determined to not substantially affect the findings and conclusions of the previously initiated CMA evaluations and has been incorporated into the CMA and this report.

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

Boron and sulfate above the GWPS were encountered within the two HSUs: the UCF and associated PMP, and in the UA where it occurs at its highest elevation.

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1. INTRODUCTION

35 I.A.C. § 845.650(d)(1) requires the owner or operator of a coal combustion residuals (CCR) surface impoundment (SI) to characterize the nature and extent of a release and relevant site conditions that may affect the remedy ultimately selected for a CCR SI if any constituent regulated under 35 I.A.C. § 845 is found to exceed the GWPS. This report documents the nature and extent of constituents detected above the GWPS that are attributable to the EPP AP.

The groundwater data and analysis in this report includes results from historical sampling (initiated in 2015) through E001, which was completed on June 15, 2023. Results of events E001, E002, and E003 were submitted and placed in the facility's operating record within 60 days of receiving final laboratory analytical data [3, 4, 5] as required by 35 I.A.C. § 845.800(d)(15). The statistical determination presented in the reports identified the following exceedances of the GWPS at compliance groundwater wells in the following HSUs:

- Detected UA Exceedances:
  - Boron at AW-05, AW-19, and AW-21
- Detected UCF/PMP Exceedances:
  - Boron at AP07S and AW-15S
  - Sulfate at AW-15S

Supplemental data for monitoring wells APW-01, AW-20, AW-23, and EMW-05 was provided for events E001, E002, and E003 as part of on-going nature and extent characterization activities consistent with 35 I.A.C. § 845.650(d)(1) at the EPP AP. In accordance with 35 I.A.C. § 845.610(b)(3)(C) statistically derived values for constituent concentrations observed at supplemental monitoring wells were also evaluated quarterly for exceedances of the GWPS [1].The following supplemental GWPS exceedance was also determined in E001:

- Detected UA Exceedance:
  - Boron at AW-20

This report discusses in detail the extent of the boron and sulfate exceedances as well as a geochemical conceptual site model (GCSM) describing the nature of these exceedances.

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2. UNIT BACKGROUND

2.1 Site Location and Description

The EPP is located in Peoria County, Illinois between Mapleton and Bartonville in Section 11, Township 7 North, Range 7 East (**Figure 2-1**). The EPP is located on the floodplain of the Illinois River adjacent to a levee and has one CCR SI, the AP. The AP is located west of the EPP and the EPP property is bordered by a salt processing facility to the north, railroad right-of-way and former Orchard Mines to the west, the Illinois River and a fertilizer production facility to the east, and agricultural land to the south (**Figure 2-2**).

2.2 Description of CCR SI

The AP (Illinois Environmental Protection Agency [IEPA] Unit Identification W1438050005-01) is an unlined CCR SI used to manage CCR and non-CCR waste streams at the EPP. The AP has a surface area of approximately 91 acres with berms up to 27 feet higher than the surrounding land surface. This pond currently discharges to the Illinois River through Outfall 001 included in the facility National Pollutant Discharge Elimination System permit IL0001970. The primary treatment method for the pond water is settlement via reduced velocity whereby solids settle out in various flow channels and in the main South Pond. The permitted total average daily flow is 5.24 million gallons per day [6].

The EPP began power generation in 1960 and the original AP embankments were placed into service at that time. In 2004, modifications to the rail loop surrounding the AP increased the elevations of the embankments and reduced the footprint of the active impoundment [7]. CCR material remains between the rail loop and the berm at the south end of the AP. High power transmission lines bisect the AP and two sub-basins, referred to as the North and South Ponds. The sub-basins are hydraulically connected and CCR placement is continuous throughout the AP.

Characterization of the CCR material was completed in 2021 and included in the Hydrogeologic Site Characterization Report (HCR) [8]. Summary geotechnical and solid analytical data tables from CCR samples are included in **Appendix A**. CCR consisting primarily of fly ash is present within the AP at thicknesses up to 46.5 feet as measured in XPW02 and ash is generally between 30.5 and 43 feet thick as observed in XPW01, XPW01A, XPW03, EDW-B002, EDW-B003, and EDW-B014 (**Figure 2-3**). The AP overlies the UCF, and the lowest base of ash elevation at 413.9 feet[1] was observed in the central and northern portion (HAB-03) of the AP while the highest base of CCR elevation was observed along the berms around 450 feet (**Figure 2-3**). Water that may come into contact with CCR within the footprint of the AP becomes CCR source water. CCR source water samples collected from porewater monitoring wells (**Figure 2-4**) screened within the CCR materials at the AP are used to provide information for Alternative Source Demonstrations and groundwater transport modeling[2].

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

[2] Per Federal Register 80 (21302), which promulgated the final Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257 rule, porewater concentrations should be used to characterize potential leaching from impoundments. As discussed further in the United States Environmental Protection Agency's (USEPA) risk assessment of CCR surface impoundments [24], porewater is "collected from the interstitial water between waste particles in surface impoundments as it occurs in the field," and concentrations within the porewater are "the most representative data available for impoundments because these data are field-measured concentrations of leachate." Therefore, CCR source water collected from porewater wells screened near the base of ash within the unit represents the CCR source term.

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2.3 Geology and Hydrogeology

Significant site investigation has been completed at the EPP to characterize the geology, hydrogeology, and groundwater quality. Based on extensive investigation and monitoring, the AP has been well characterized and detailed in the HCR [8].

2.3.1 Hydrostratigraphic Units

In addition to the CCR present at the AP, there are two principal layers of unlithified material present above the bedrock, which are categorized into the HSUs described below (from surface downward) based on stratigraphic relationships, geologic composition, and common hydrogeologic properties.

- **Upper Cahokia Formation (UCF) / Potential Migration Pathway (PMP):** Low permeability clays and silts of the UCF present from the ground surface to the top of bedrock. The formation is generally characterized by lean and fat clays with siltier composition along the southern portion of the site. Within the low permeability materials thin discontinuous sand lenses (less than five feet in thickness) were encountered at 436.8 feet at EMW-05 and 429.4 feet at PTW-01 (**Appendix B, Figures 1-4** and **4-1**). These unconfined sandy lenses, where present, and silt and clay material near the former land surface (approximately 425 to 430 feet) adjacent to the base of ash in the southern portion of the property have been identified as PMPs.
- **Uppermost Aquifer (UA):** Thin (generally less than four feet in thickness), moderate permeability sand, silty sand, and clayey gravel material within the Lower Cahokia Formation, and bedrock interface, including weathered shale bedrock where present. In locations where higher permeability materials and coarser grained materials are absent, the UA is interpreted as the interface between the Lower Cahokia Formation and weathered bedrock of the Carbondale and Modesto Formations, with an interpreted thickness of 1.5 feet in PTW-01 to 2.5 feet in PTW-02 (**Appendix B, Figures 1-4** and **4-1**).
- **Bedrock Confining Unit (BCU):** Thick, very low permeability shales and siltstones of the Carbondale and Modesto Formations. The elevation of the top of bedrock (**Figure 2-8**) is highest north of the AP at AW-21 (422.88 feet) and declines in elevation to the east towards AW-08 (404.5 feet) and south toward AW-16 (400.92 feet). The geologic cross sections (**Figures 2-5** through **2-7**) and top of bedrock interpretation (**Figure 2-8**) indicate the presence of a bedrock valley/depression in the west and southwest portion of the AP. Based on the distribution of coarser grained materials of the Lower Cahokia Formation, it appears that the materials are likely present in limited areas on the southern side of this bedrock valley.

2.3.2 Uppermost Aquifer

The UA includes the lower portions of the Cahokia Formation in the vicinity of the site. Higher permeability materials are generally present at the interface between the unlithified materials and the underlying bedrock. Groundwater monitoring for the UA is focused on this zone because it is continuous, moderate permeability, and likely to indicate potential impacts from the AP. The top of UA was evaluated with respect to the location restrictions in 2018 [9] and is presented in **Figure 2-9**. The UA immediately overlies the BCU, except where comprised of weathered bedrock, and as described above occurs at a higher elevation north of the AP (422.88 feet at AW-21; **Figure 2-8**) and generally slopes downward to the south along the bedrock surface.

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2.3.3 Potential Migration Pathways

The UCF consists of low permeability clays and silts, with limited occurrences of thin discontinuous sand lenses. Isolated sand lenses of limited extent within the UCF, and clay intervals downgradient of the AP at elevations similar to the base of ash and above the unlithified/lithified interface, were identified as PMPs. Monitoring wells AP06, APW-02 through APW-04, P002, AW-15S (clay and silts of the UCF) and AP07S (discontinuous sand lens) are considered to be screened within PMPs.

2.3.4 Regional Bedrock Geology

The unlithified deposits are underlain by Pennsylvanian age bedrock, much of which is shale, of the Carbondale and Modesto Formations [10, 11]. The Carbondale Formation varies in thickness from less than 150 feet in western and northeastern Illinois to more than 400 feet in southern Illinois. The Carbondale Formation consists of sandstones, shales, limestones, and coals. Gray shales make up the greatest part of the formation, with the thicker gray shales representing delta front or prodelta deposits.

The Modesto Formation overlies the Carbondale Formation and varies in thickness from less than 125 feet along the LaSalle Anticlinal Belt in east-central Illinois to over 450 feet in southern Illinois, averaging approximately 350 feet. The Modesto Formation consists of sediments similar to those found in the underlying Carbondale Formation, but the coals are thinner and less extensive, the limestones tend to be thicker and less argillaceous, and several red claystones and shales are associated with the open-marine limestones. Gray shales constitute a major part of the Modesto Formation and individual beds tend to be extremely thick.

The elevation of the bedrock surface in the study area ranges from approximately 400 to 450 feet above mean sea level [12]. Well logs indicate that the depth to bedrock ranges from more than 50 feet in the Illinois Valley to less than 20 feet in the adjacent uplands, and the lithology of the uppermost bedrock is mainly shale.

2.3.5 Water Table Elevation and Groundwater Flow Direction

The elevations of water within the AP, as observed in XPW01A, XPW02, XPW03, AP08, and AP09 between 2021 and 2023, averaged 451.71 feet with a range from 447.68 feet at XPW03 (central southern third of the AP) to 454.08 feet at XPW02 (central northern third of the AP). Groundwater elevations supporting the discussion presented in this section are provided in **Table 2-1**.

The groundwater elevation in monitoring wells screened in the UA averaged 437.47 feet between 2021 and 2023, with a range from 430.48 feet at AW-14 (south of the AP) to 452.04 feet in AW-22 (north of the AP). Groundwater in the UA generally flows from east to west in the central portion of the AP towards what is interpreted as a former channel of the Illinois River, and south/southeast at the south end of the AP (**Figure 2-10**). In the northernmost portion of the AP there is a minor northwest and northern component of flow in both the UA and PMP that may be attributed to a surface water drainage ditch constructed at an elevation below surrounding groundwater elevations with the stage ranging from 430.07 to 432 feet [13] along the northern and western side of the AP. Groundwater elevations vary seasonally in both the UA and PMP, generally less than 5 feet, although flow directions are consistent.

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Groundwater elevations in UCF/PMP wells range from approximately 429.63 feet at AW-15S (southwest of the AP) to 460.23 feet at AW-01 (east of the AP), with flow generally from the east to the south and northwest similar to that observed in the UA (**Figure 2-10**). Groundwater elevations measured at APW-02 are similar to CCR piezometers and the location of the well (within the berm of the unit) may be affected by water elevations in the AP. Elevations of groundwater detected in these unconfined wells are higher than the lowest elevation of ash (413.9 feet) measured in borings.

Groundwater elevations within the BCU at wells AP05D and AW-15C averaged 434.79 feet between 2021 and 2023 and ranged from 430.80 feet to 439.14 feet in AP05D (northeast of the AP). Well AP07D was not included in this analysis because the elevations did not equilibrate between sampling events in 2021. BCU groundwater elevations are not contoured because the wells are screened at different elevations and within different lithologic materials in this confining unit. However, comparison of elevations in bedrock wells shows flow directions may be consistent with shallower flow systems.

2.3.5.1 Vertical Hydraulic Gradients

Vertical hydraulic gradients calculated using available groundwater elevation data from February to August 2021 at nested well locations within the UCF (*i.e.,* PMP) and UA wells indicated downward gradients [8] which were consistent with historical results [14]. Recent data collected through December 2023 is also consistent with these results (**Appendices C** and **D**). The results of the vertical hydraulic gradient calculations for these HSUs are summarized below:

- CCR (shallow to deep):
  - Gradients calculated between AP08 (shallow) and XPW02 (deep) were upward for all events.
  - Gradients calculated between AP09 (shallow) and XPW03 (deep) were downward for all events.
- UCF (*i.e.,* PMP) to UA:
  - Gradients calculated between AW-15S (PMP) and AW-15 (UA) were upward for all events.
  - Gradients calculated between AP07S (PMP) and OW-01 (UA) were consistently upward, with the exception of one event in October 2023.
  - Gradients calculated between APW-03 (PMP) and AW-10 (UA) were upward for all events.
  - Gradients calculated between P002 (PMP) and AW-20 (UA) were downward for all events.
  - Gradients calculated between APW-04 (PMP) and AW-13 (UA) were upward for all events.
- UA to BCU:
  - Gradients calculated between AW-15 (UA) and AW-15C (BCU) alternated between upward, flat, and downward during various events.
  - Gradients calculated between AP05S (UA) and AP05D (BCU) are typically upward, with downward gradients coinciding with elevated Illinois River elevations.

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2.3.5.2 Impact of Surface Water Bodies on Groundwater Flow

Based on groundwater elevations and flow maps, groundwater from the UA adjacent to the AP does not typically flow eastward towards the Illinois River adjacent to the EPP property (**Figure 2-10**). However, the river is likely a regional receiving body for groundwater from the unlithified materials and bedrock, although not along this section of the EPP property. Vertical gradients observed in 2021, as discussed in the previous section, indicate that water within the bedrock periodically migrates vertically upward into the Illinois River.

2.3.6 Hydraulic Conductivities

2.3.6.1 Field Hydraulic Conductivities

Field hydraulic conductivity tests were performed within the HSUs at the AP as part of the 2017 field investigation [14] and were supplemented with additional data collected from field investigations in 2021 [8]. The results of the 2021 field investigations are summarized in **Table 2-2**, and discussed below:

- **CCR**: Field hydraulic conductivity tests from wells screened within the ash (XPW01A, XPW02, and XPW03) resulted in a geometric mean horizontal hydraulic conductivity of 6.8×10^{-4} centimeters per second (cm/s) (**Table 2-2**). This is an order of magnitude lower than previous field hydraulic conductivity tests performed in 2017, which resulted in a geometric mean of 2.7×10^{-3} cm/s at AP08 and 1.44×10^{-3} cm/s at AP09 [14].
- **UCF/PMP**: Field hydraulic conductivity tests performed in UCF monitoring well AW-15S in 2021 resulted in a horizontal hydraulic conductivity of 3.2×10^{-3} cm/s (**Table 2-2**), which is an order of magnitude higher than previous results of approximately 5×10^{-4} cm/s from tests conducted in AP06 and AP07S [14].
- **UA**: In the UA wells (AW-12, AW-15, AW-16, AW-17, AW-18, AW-19, AW-20, AW-21, and AW-22) analysis of hydraulic conductivity tests resulted in a geometric mean horizontal conductivity of 1.6×10^{-4} cm/s (**Table 2-2**). These results are consistent with previous field hydraulic conductivity tests in wells screened within the UA, which indicated a geometric mean horizontal hydraulic conductivity of 2.1×10^{-4} cm/s [14].
- **BCU**: Previous field hydraulic conductivity tests [14] performed in bedrock wells AP07D and AP05D resulted in horizontal hydraulic conductivities that ranged 1.1×10^{-7} to 3.49×10^{-7} cm/s. A field hydraulic conductivity test from bedrock well AW-15C resulted in a horizontal hydraulic conductivity of 8.2×10^{-4} cm/s. AW-15C is located in the southern portion of the site within the top 15 feet of shale bedrock. The hydraulic conductivity measured at this location indicates that the surficial bedrock is likely weathered, while it is more competent in the northern portions of the site and at greater depths. The overall geometric mean hydraulic conductivity calculated from AP05D, AP07D, and AW-15C results in a horizontal hydraulic conductivity of 3.2×10^{-6} cm/s which is likely more representative of the bedrock underlying the site.

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 [8]. The results are summarized in **Appendix A** and discussed below.

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- **CCR**: Six samples collected in 2021 from ash borings XPW01, XPW01A, XPW02, and XPW03. Vertical permeability test results in the ash indicated a geometric mean vertical hydraulic conductivity of 9.3 x 10^{-6} cm/s. Historical results from two samples collected from ash borings EDW-B002 and EDW-B003 indicated a geometric mean vertical hydraulic conductivity of 7.9 x 10^{-5} cm/s [15].
- **UCF:** Four samples were collected in 2021 from clayey materials within soil borings AW-13A, AW-15, AW-20, and AW-22 for geotechnical testing. Falling head permeability tests results in the UCF from these locations indicated a geometric mean vertical hydraulic conductivity of 6.4 x 10^{-8} cm/s. This result is consistent with results of historical samples collected by Haley & Aldrich, Inc. [16] and AECOM [17] which indicated a geometric mean vertical hydraulic conductivity of 7.3 x 10^{-8} cm/s.
- **Lower Cahokia Formation:** Samples were either unable to be collected or analyzed due to their composition.
- **BCU:** Samples were either unable to be collected or analyzed due to their composition.

2.3.6.3 Pump Test Evaluation

Following installation and development of PTW-01 and PTW-02 (**Figure 2-10**), constant-rate tests for these UA wells were conducted in October 2022. The constant-rate tests performed did not fully identify appropriate well yields due to continued drawdown at pumped rates of 0.25 gallons per minute (gpm) and 1 gpm. Lower pumping rates were not sustainable with the field equipment utilized and the constant rate tests were terminated due to the drawdown and release of methane gas in both of the pumping wells. Sustainable yield at these locations may be much lower than the tested rates. However, measurable drawdown was identified at nearby observation wells screened within the UA and used to develop estimates of transmissivity and storativity for the geologic materials near the tested locations. Transmissivity calculated from the two pump tests ranged from 19 to 52 feet square per day and storativity ranged from 1.1 x 10^{-3} to 5 x 10^{-3} [18], which is consistent with thin aquifers containing fine grained material [19].

2.4 Groundwater Monitoring

The monitoring system for the AP is shown on **Figure 2-4** and consists of two background monitoring wells (AP05S and AW-08), 15 compliance monitoring wells (AP07S, AW-01, AW-05, AW-06, AW-09, AW-10, AW-11, AW-14, AW-15, AW-15S, AW-16, AW-17, AW-18, AW-19, and AW-21), and one temporary water level only surface water staff gage (SG-01) to monitor potential impacts from the AP [20]. These monitoring wells are screened within the UCF/PMP (AP07S, AW-01, and AW-15S) and the UA (AP05S, AW-05, AW-06, AW-08, AW-09, AW-10, AW-11, AW-14, AW-15, AW-16, AW-17, AW-18, AW-19, and AW-21) along the perimeter of the AP. Porewater (*i.e.*, CCR source water) samples are collected from locations XPW01A and XPW02 on the northern side of the AP and XPW03 on the southern side of the AP (**Figure 2-4**).

Supplemental data for monitoring wells APW-01, AW-20, AW-23, and EMW-05 was provided for events E001, E002, and E003 as part of on-going nature and extent characterization activities consistent with 35 I.A.C. § 845.650(d)(1) at the EPP AP. In accordance with 35 I.A.C. § 845.610(b)(3)(C), statistically derived values for constituent concentrations observed at supplemental monitoring wells were also evaluated quarterly for exceedances of the GWPS [1].

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2.5 Hydrogeologic Conceptual Site Model

The HCR [8] and information provided above forms the foundation of the AP hydrogeological setting. The AP overlies the recharge area for the underlying geologic media (*i.e.,* low permeability clays and silts of the UCF; and moderate permeability sand, silty sand, and clayey gravel material within the Lower Cahokia Formation, bedrock, and/or weathered shale bedrock, where present [UA]). Thin sandy lenses within the UCF have been identified as potential migration pathways within the UCF.

The geologic conceptual model for the site used for groundwater modeling and summarized in the Groundwater Modeling Report (GMR) [13] consists of the following layers:

- Fill, predominantly coal ash (fly ash, bottom ash, and slag) within the AP, and materials within constructed berms and railroad embankments.
- Fine-grained clays and silts of the UCF ranging in thickness from 5 to 40 feet at the AP.
- Coarse-grained sands and gravels of the Lower Cahokia Formation ranging in thickness from 1 to 4 feet at the AP.

Bedrock at the AP consists of thick, very low permeability shales and siltstones of the Carbondale and Modesto Formations and is encountered at elevations ranging from 400 to 422 feet at the AP.

The overall groundwater flow system within the unlithified materials is consistent with previous reports [8]. Additional off-site groundwater level and flow direction data evaluated after 2021 was used to refine the existing conceptual site model (CSM) to incorporate the following interpreted hydrogeologic conditions:

- The unlithified/lithified contact designated as the UA on-site may be hydraulically connected to the sands of the Sankoty Aquifer which are present off-site and used for potable supply in nearby Peoria, East Peoria, and Pekin.
- The thick sand and gravels along the Illinois River from Hennepin to Peoria form the Sankoty Aquifer. The Sankoty sand and gravels are hydrologically connected to the Illinois River and are a productive aquifer in the Middle Illinois water supply planning [21]. At the EPP, the thick sands and gravels of the Sankoty Aquifer are absent. The UA at the EPP represents the most permeable material present above bedrock. Alluvial deposits belonging either to the Cahokia or the Sankoty are present in a north-south orientation along the Illinois River at the EPP and are not expected to occur in areas west of the United States (US) Highway 24, where the bedrock elevation increases above ground surface at the EPP. US Highway 24 runs along the base of the bluff and areas west of US Highway 24 are coincident with areas where the aquifer is not present [22].
- Off-site groundwater in the Sankoty Aquifer flows to the north and south towards identified Peoria and Pekin pumping centers, respectively [22]. As reported by Burch and Kelly [22], "*Smaller flow domains are sometimes formed by pumpage at municipal well fields, which reverse the ground-water flow direction and frequently capture induced recharge from the river and the ground-water ordinarily moving toward it*".

Infiltration of precipitation into the AP or nearby surface water bodies, including the Illinois River and adjacent stormwater drainage ditches and ponds, recharges groundwater and flows to the north and northwest within the northernmost portion of the AP and generally flows south,

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towards what is interpreted as a former channel of the Illinois River, within the southern portion of the AP. The northward flow in the northernmost portion of the AP may be a result of the drainage ditch that borders the AP. Additional survey work completed in 2022 [18] (**Appendix B**) and included in the GMR [13], indicates that the surface water drainage ditch along the northern and western side of the AP is at a lower elevation than surrounding groundwater elevations. As a result, the ditch is likely a discharge point for shallow groundwater.

Groundwater occurs within both the unlithified materials and bedrock and consistently flows east to west in the UA. In the southern portion of the AP, groundwater flow has a southerly component of flow towards what is interpreted as a former channel of the Illinois River. Groundwater elevations vary seasonally, generally less than five feet, while across the site they range between approximately 430 and 450 feet, although flow directions are generally consistent. Off-site groundwater in the coarse sand and gravel Sankoty Aquifer is expected to flow to the north and south towards identified Peoria and Pekin pumping centers, respectively. Groundwater in the Sankoty Aquifer may be hydraulically connected to the UA (*i.e.*, unlithified/lithified contact) identified on site.

Vertical gradients are generally upward between the UCF/PMP and UA across the site, with the exception of P002 (PMP) and AW-20 (UA) in the northwest corner of the AP and adjacent to the drainage ditch. Upward gradients are also generally observed between the BCU and UA. The upward gradients are likely a result of the proximity of the site to the Illinois River which is a regional receiving body for groundwater.

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3. OCCURRENCE AND DISTRIBUTION OF GROUNDWATER EXCEEDANCES (EXTENT)

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 exceedances of the GWPS was completed for sampling events E001, E002, and E003 [4, 3, 5] as described in **Section 1**. Exceedances include the following parameters and wells by HSU:

- Detected UA Exceedances (**Figure 3-1**):
  - Boron in compliance wells AW-05, AW-19, and AW-21 and supplemental well AW-20[3]
- Detected UCF/PMP Exceedances (**Figure 3-2**):
  - Boron at AP07S and AW-15S
  - Sulfate at AW-15S
  -

The extents of exceedances discussed below were defined using existing monitoring wells, including wells present on-site that may not be included in the 35 I.A.C. § 845 monitoring program for the AP (**Table 3-1**).

3.1 Additional Investigations to Define Nature and Extent

3.1.1 Geochemical Investigation

Following initial sampling in 2021, potential exceedances of the GWPS were identified for the parameters and locations identified above [23]. Additional investigation was completed in 2021 and 2022 to collect soil samples to further evaluate the concentrations and potential attenuation mechanisms near the AP. A total of seven borings were advanced at the AP in 2021 and 2022 and samples were collected from the following: the UA adjacent to compliance monitoring wells AP05S, AP07S and AP07D, AW-15, AW-18, AW-19, and AW-23; the UCF/PMP adjacent to compliance monitoring well AW-15S, the BCU adjacent to compliance monitoring wells AP05S, AP07S, and AW-19; and the CCR material adjacent to porewater well XPW01 (**Appendix E**).

Solids samples were collected and analyzed for the following:

- EPA 6010B for 7-step sequential extraction (aluminum, arsenic, barium, boron, calcium, cobalt, iron, lead, lithium, manganese, molybdenum, selenium) for samples collected in 2021;
- EPA 6010B for 6-step sequential extraction (aluminum, arsenic, barium, boron, calcium, cobalt, iron, lead, lithium, manganese, molybdenum, selenium) for samples collected in 2022 and archived samples collected in 2021;
- EPA 6010B for Total Metals (aluminum, arsenic, barium, boron, calcium, cobalt, iron, lead, lithium, manganese, molybdenum, selenium);
- Bulk Mineralogy by Reitveld x-ray diffraction analysis;

[3] Supplemental data was provided as part of on-going nature and extent characterization activities consistent with 35 I.A.C. § 845.650(d)(1) at the Edwards AP.

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- Bulk Elemental Composition by x-ray fluorescence analysis;
- Cation Exchange Capacity analysis; and
- Total Organic Carbon analysis.

In addition, four monitoring wells (AP05S, AW-15S, AW-15, and AW-19) were sampled for groundwater polishing parameters, including 35 I.A.C. § 845.600 parameters (total and dissolved), ferrous and ferric iron, and major ions.

3.1.2 Hydrogeologic Supplemental Site Investigation

An additional supplemental site investigation (SSI) was conducted from September 2021 through February 2023 [18] (**Appendix B**). The objective of the SSI was to further assess the nature, degree, and extent of boron concentrations downgradient (west and north) of the AP. Access requests were sent to adjacent property owners to obtain permission to install monitoring wells north and west of the AP (**Appendix B**). Only a single response was received, and a monitoring well was installed on this property. The SSI included the installation and development of one additional plume delineation monitoring well (AW-23), two observation wells (OW-01 and OW-02), and two pump test wells (PTW-01 and PTW-02) to further delineate the previously identified boron impacts associated with the EPP AP and complete aquifer testing to assess aquifer parameters and evaluate potential corrective actions.

3.2 Extent in the Uppermost Aquifer

Exceedances are identified quarterly 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 exceedances, because there is no single value for LCLs. The statistical results from the three compliance monitoring events are presented in **Table 3-2** and all data evaluated has been summarized in **Table 3-3**.

3.2.1 Boron

Boron concentrations in UA monitoring wells AW-19, AW-21, and AW-05 resulted in exceedances of the GWPS (2 milligrams per liter [mg/L]; **Table 3-2**; **Figure 3-1**). Additionally, boron concentrations in UA delineation monitoring well AW-20 resulted in LCLs above the GWPS (**Table 3-2**; **Figure 3-1**). The concentrations and extent of boron exceedances at the AP are summarized as follows:

- AW-19, AW-21, AW-05, and delineation monitoring well AW-20 - Concentrations of boron between 2021 and 2023 at AW-19 range from 2.30 to 3.20 mg/L and from 8.70 to 13.0 mg/L at AW-21 (**Table 3-3**). Concentrations of boron between 2015 and 2023 at AW-05 range from 1.40 to 11.0 mg/L. Boron concentrations between 2021 and 2023 at AW-20 range from 2.10 to 3.40 mg/L. Monitoring wells AW-19, AW-21 and AW-05, and delineation well AW-20 are situated at the northern end of the AP.

  As discussed in **Section 2.3.5**, there is a northern to northwest component of groundwater flow in the northern section of the AP and a western component to groundwater flow in the central portion of the AP. The extent of boron concentrations is defined laterally in the UA to the west of AW-05 by EMW-05, with boron concentrations ranging from 0.32 to 1.50 mg/L between 2022 and 2023, and to the northeast by APW-01 with boron concentrations ranging from 0.69 to 1.10 mg/L between 2021 and 2023 (**Figure 3-1**). Landowners to the northwest

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did not respond to access agreement requests to perform additional investigations. In addition, it is expected that the UA pinches out to the northwest of the AP where the bedrock is present near or at the ground surface (defined by the bluff west of US Highway 24). Boron concentrations are defined laterally to the east by AW-22 **(Figure 3-1),** which reported boron concentrations ranging from 0.23 to 0.38 mg/L in 2021. The extent of boron concentrations is defined laterally to the south by AW-06, which had concentrations ranging from 0.093 to 0.31 mg/L between 2015 and 2023, and to the southwest by AW-23 where boron concentrations ranged from 0.48 to 0.60 mg/L between 2022 and 2023 (**Table 3-3**).

Downward migration of boron in the UA is inhibited by the underlying low permeability shales and siltstones of the Carbondale and Modesto Formations comprising the BCU. Vertical gradients observed at nearby paired monitoring wells AP05S (UA) and AP05D (BCU) are typically upward, with downward gradients coinciding with elevated Illinois River elevations.

3.3 Extents in Upper Cahokia Formation / Potential Migration Pathways

Exceedances are identified quarterly following comparison of the 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 exceedances, because there is no single value for LCLs.

3.3.1 Boron

Concentrations of boron in UCF/PMP monitoring wells AP07S and AW-15S resulted in exceedances of the GWPS (2 mg/L) for the three compliance monitoring events (**Table 3-2**; **Figure 3-2**). Concentrations and the extent of boron at these locations are summarized as follows:

- AP07S – Concentrations of boron between 2021 and 2023 at AP07S range from 5.8 to 18.0 mg/L (**Table 3-3**). Monitoring well AP07S is located north of the unit, and the extent of boron is limited by the discontinuous nature of the sand lenses acting as the PMP in the UCF. These sand lenses were not encountered in borings completed at AW-05 to the north or AW-21 to the south of AP07S. Boron is defined laterally in the UCF/PMP to the southeast by AW-01 with boron concentrations in 2022 through 2023 ranging from 0.072 to 1.10 mg/L (**Table 3-3**).

  Vertical migration of boron is limited by the upward gradients observed between wells AP07S (PMP) and OW-01 (UA). Additionally, the absence of measurable drawdown at AP07D during the pump test conducted in 2022 at PTW-01 indicate that the UCF is isolated from bedrock in this area [18].

- AW-15S - Concentrations of boron between 2021 and 2023 at AW-15S range from 5.4 to 6.8 mg/L (**Table 3-3**). Monitoring well AW-15S is located near the southwest side of the unit and screened within the low conductivity materials of the UCF. The extent of boron is limited laterally in the UCF/PMP by the discontinuous nature of the sand lenses acting as the PMP and low permeability clay and silt in the UCF. No sand lenses were encountered in the boring or at AW-14 to the southeast, and the landowner did not respond to requests for access to perform additional investigations to the west.

  The vertical migration of boron is limited by the upward gradients observed between wells AW-15 (UA) and APW-15S (UCF/PMP). Appreciable drawdown was observed at AW-15 but not AW-15S during the pump test conducted in 2022 at PTW-02, indicating that the shallow

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materials are isolated from the UA. Concentrations of boron between 2021 and 2023 at UA well AW-15 range from 0.30 to 0.57 mg/L (**Table 3-3**) which supports there is no significant downward migration.

3.3.2 Sulfate

Concentrations of sulfate in UCF/PMP monitoring well AW-15S resulted in exceedances of the GWPS (400 mg/L) for the three compliance monitoring events (**Table 3-2**; **Figure 3-2**). Concentrations of sulfate at AW-15S between 2021 and 2023 range from 480 to 590 mg/L (**Table 3-3**). Monitoring well AW-15S is located near the southwest side of the AP and screened within the low conductivity materials of the UCF. Sulfate is limited laterally by the discontinuous nature of the sand lenses acting as the PMP and the low permeability clay and silt in the UCF. No sand lenses were encountered in the boring, or at AW-14 to the southeast, and access requests to perform additional investigations to the west did not receive a response from landowners.

Like boron at this location, sulfate is limited by the upward gradients observed between wells AW-15 (UA) and APW-15S (UCF/PMP). Appreciable drawdown was observed at AW-15 during the pump test conducted in 2022 at PTW-02 but not in AW-15S [18] indicating that the shallow materials are isolated from the UA. Concentrations of sulfate between 2021 and 2023 at UA well AW-15 range from below laboratory method detection limits (0.18 mg/L) to 1.0 mg/L (**Table 3-3**), which also supports the lack of downward migration.

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4. GEOCHEMICAL CONCEPTUAL SITE MODEL (NATURE)

A GCSM was developed to describe the conditions of the groundwater in the vicinity of the EPP AP and is summarized here (full analysis presented in **Appendix E**). 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 AP groundwater and will be addressed in the Corrective Action Plan are included in the GCSM. As discussed in previous sections, the exceedances observed at the AP include boron and sulfate.

CCR porewater is water "collected from the interstitial water between waste particles in surface impoundments as it occurs in the field" [24] and represents the material potentially leached from impoundments. The CCR materials are the primary source of constituent loading to the CCR porewater (*i.e.*, CCR source water). Over an extended period (*e.g.*, months to years), the CCR porewater (*i.e.*, water contained within the interstitial pore spaces of the CCR that can be sampled by low-flow groundwater sampling methods) reaches equilibrium with the CCR materials. The porewater is therefore representative of the mobile phase constituents capable of migrating into the underlying materials and potentially downgradient in groundwater. The AP CCR source water is therefore 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. Boron and sulfate are assessed as indicators of influence from the CCR materials. Where observed in shallow groundwater at concentrations above the GWPSs, concentrations of boron and sulfate are indicative of influence by CCR porewater. The uneven distribution of sulfate in the shallow UA and PMP groundwater is attributed to physical or chemical heterogeneity along the groundwater flow path.

Geochemical attenuation of constituents in groundwater is a function of groundwater pH, redox potential, availability of adsorbent, and presence of competing ions, among other factors. Groundwater pH exerts a major control on constituent mobility and reflects a neutral and generally stable condition in the range of 6 to 8 S.U., independent of location, lithology, or exceedance status. The stability of pH in groundwater is an indication that groundwater is well buffered, largely due to the widespread presence of carbonate minerals in the aquifer solids which buffer pH within this range. Neutral groundwater pH is generally favorable to attenuation of constituents in groundwater, such that it promotes the precipitation of the mineral phases that adsorb constituents from the aqueous phase. Groundwater pH additionally controls the tendency of various constituents to adsorb to the mineral surface. CCR porewater pH is alkaline, with a pH measured between 11 and 12.5 S.U.

The reduction and oxidation (redox) potential of groundwater exerts another major control on constituent mobility in groundwater. The redox condition is more variable across the site and shows a distinct pattern above and below the elevation of 420 feet, the approximate elevation at which a redox transition appears to occur. The locations with exceedances of either boron or sulfate are all within the shallower elevation of the UCF/PMP. The shallow groundwater (above the 420-foot reference elevation) is more oxidized with low concentrations of dissolved iron and methane, and non-detect sulfide. The deeper groundwater of the UA (Lower Cahokia Formation and BCU interface) reflects a reducing signature based on high concentrations of methane, dissolved and ferrous iron, and presence of sulfide. This deeper, reducing groundwater signature is not attributed to the CCR unit based on (1) the absence of boron and (2) the presence of constituents in the deeper groundwater that are incompatible with the chemistry of the shallower

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groundwater (*e.g.,* methane will reduce/consume sulfate if intermixed, and barium, present in the deeper groundwater, will precipitate as barite if in the presence of sulfate). This suggests a physical or hydraulic separation between the shallow and deep water at the site, which limits the extent of the influence from the AP porewater.

Characterization data from the aquifer solids is considered to understand the reactive mineral fractions present in the aquifer solids and the binding mechanisms that control the partitioning of constituents between the solid and aqueous phases. The key finding from the aquifer solids assessment is that adsorptive minerals are present in the aquifer solids and have bound both boron and sulfate within the reactive fraction of the solid matrix. The inference follows that some degree of attenuation of the exceedance constituents by the aquifer solids has occurred in the past, most notably through adsorption to both iron and aluminum hydroxide minerals. The future condition of related attenuation is reserved for subsequent assessment and predictions related to the closure condition and corrective action.

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5. COMBINED GEOCHEMICAL AND HYDROGEOLOGIC CONCEPTUAL SITE MODELS

5.1 Boron and Sulfate Conceptual Site Model

The CSM describing current conditions at the AP combining the hydrogeologic and geochemical CSMs for boron and sulfate is as follows. Water that may come into contact with CCR in the AP becomes porewater within the unlined CCR unit. Porewater primarily migrates laterally to the north, west, and south into the UCF/PMP and UA where it occurs at a shallow elevation, similar to the base of the AP, north of the Unit. The porewater mixes with groundwater in the UCF/PMP, and in the UA it mixes with groundwater migrating upward from the bedrock. Downward migration of porewater through the base of the unit and downward movement of groundwater outside the AP is limited by the low permeability clay in the Cahokia Formation. This is supported by the observed redox transition that occurs near an elevation of 420 feet, the lack of elevated concentrations of boron and sulfate in UA wells screened below an elevation of 420 feet, and the lack of response in MW-15S during pumping tests at OW-2.

Continued lateral migration to the west and south in the UCF/PMP is limited due to the discontinuous nature of the sandy zones within the PMP and the general low permeability of the UCF and UA. The surface water drainage may also limit the migration of the impacted groundwater as it is generally at a lower elevation than those measured in monitoring wells. Concentrations are also physically attenuated via dilution, dispersion, and chemical attenuation. The geochemical evaluation indicates that adsorptive minerals are present in the aquifer solids and suggest that attenuation of the exceedance constituents by the aquifer solids has occurred in the past through adsorption to both iron and aluminum hydroxide minerals.

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6. CONCLUSIONS AND FUTURE ACTIVITIES

In accordance with 35 I.A.C. § 845.650(d)(1), the nature and extent of GWPS exceedances of boron and sulfate 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 AP.

Boron was selected for modeling source control as presented in the Final Closure Plan and was identified as a surrogate for the exceedances of sulfate, as described in the GMR [13]. For modeling purposes it was assumed that boron 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. Additional geochemical modeling will be completed to evaluate how sorption to solid phases may affect boron and sulfate mobility and therefore the time to reach the GWPS for these parameters.

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[22] S. L. Burch and D. J. Kelly, "Peoria-Pekin Regional Ground-Water Quality Assessment," Illinois State Water Survey, Research Report 124, Champaign, Illinois, 1993.

[23] Ramboll Americas Engineering Solutions, Inc., "History of Potential Exceedances. Edwards Power Plant, Ash Pond, Bartonville, Illinois. Illinois Power Resources Generating," October 25, 2021.

[24] United States Environmental Protection Agency, "Human and Ecological Risk Assessment of Coal Combustion Residuals (2050-AE81)," December 2014.

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TABLES

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Table 2-1. Summary of Groundwater Elevation Data
Nature and Extent Report
Edwards Power Plant
Ash Pond
Bartonville, Illinois

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
AP05S	Background	UA	02/09/2021	5.92	437.61
AP05S	Background	UA	02/11/2021	5.58	437.95
AP05S	Background	UA	03/02/2021	5.60	437.93
AP05S	Background	UA	03/22/2021	5.10	438.43
AP05S	Background	UA	04/12/2021	4.94	438.59
AP05S	Background	UA	05/04/2021	5.10	438.43
AP05S	Background	UA	06/15/2021	5.23	438.30
AP05S	Background	UA	06/28/2021	5.29	438.24
AP05S	Background	UA	07/21/2021	4.86	438.67
AP05S	Background	UA	08/30/2021	5.40	438.13
AP05S	Background	UA	02/16/2022	5.38	438.15
AP05S	Background	UA	07/25/2022	5.91	437.62
AP05S	Background	UA	11/21/2022	7.65	435.88
AP05S	Background	UA	12/16/2022	6.80	436.73
AP05S	Background	UA	01/09/2023	6.48	437.05
AP05S	Background	UA	02/27/2023	4.82	438.46
AP05S	Background	UA	04/12/2023	4.13	439.14
AP05S	Background	UA	05/12/2023	4.39	438.88
AP05S	Background	UA	06/12/2023	5.45	437.82
AP05S	Background	UA	07/21/2023	5.95	437.32
AP05S	Background	UA	08/21/2023	5.90	437.37
AP05S	Background	UA	09/27/2023	6.42	436.85
AP05S	Background	UA	10/27/2023	6.23	437.05
AP05S	Background	UA	11/20/2023	6.36	436.92
AP05S	Background	UA	12/27/2023	5.83	437.45
AP05D	Water Level	BCU	02/09/2021	4.31	439.14
AP05D	Water Level	BCU	02/11/2021	12.65	430.80
AP05D	Water Level	BCU	03/02/2021	7.64	435.81
AP05D	Water Level	BCU	03/22/2021	10.12	433.33
AP05D	Water Level	BCU	04/12/2021	11.49	431.96
AP05D	Water Level	BCU	05/04/2021	11.16	432.29
AP05D	Water Level	BCU	06/15/2021	8.43	435.02
AP05D	Water Level	BCU	06/28/2021	10.31	433.14
AP05D	Water Level	BCU	07/21/2021	6.30	437.15
AP05D	Water Level	BCU	08/30/2021	5.09	438.36
AP05D	Water Level	BCU	02/16/2022	4.71	438.74
AP05D	Water Level	BCU	07/25/2022	4.67	438.78
AP05D	Water Level	BCU	11/21/2022	5.92	437.53
AP05D	Water Level	BCU	12/16/2022	5.94	437.51
AP05D	Water Level	BCU	01/09/2023	5.90	437.55
AP05D	Water Level	BCU	02/27/2023	5.63	437.82

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Table 2-1. Summary of Groundwater Elevation Data
Nature and Extent Report
Edwards Power Plant
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Bartonville, Illinois

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
AP07S	Compliance	PMP	02/09/2021	24.94	436.14
AP07S	Compliance	PMP	02/11/2021	24.96	436.12
AP07S	Compliance	PMP	03/02/2021	24.58	436.50
AP07S	Compliance	PMP	03/22/2021	24.35	436.73
AP07S	Compliance	PMP	04/12/2021	24.47	436.61
AP07S	Compliance	PMP	05/04/2021	24.85	436.23
AP07S	Compliance	PMP	06/15/2021	25.11	435.97
AP07S	Compliance	PMP	06/28/2021	24.71	436.37
AP07S	Compliance	PMP	07/21/2021	24.82	436.26
AP07S	Compliance	PMP	08/30/2021	25.33	435.75
AP07S	Compliance	PMP	02/16/2022	25.09	435.99
AP07S	Compliance	PMP	07/25/2022	25.51	435.57
AP07S	Compliance	PMP	11/21/2022	25.49	435.59
AP07S	Compliance	PMP	12/16/2022	24.68	436.40
AP07S	Compliance	PMP	01/09/2023	25.08	436.00
AP07S	Compliance	PMP	02/27/2023	24.30	436.78
AP07S	Compliance	PMP	04/12/2023	24.37	436.70
AP07S	Compliance	PMP	05/12/2023	24.74	436.33
AP07S	Compliance	PMP	06/12/2023	25.48	435.59
AP07S	Compliance	PMP	07/21/2023	25.36	435.72
AP07S	Compliance	PMP	08/21/2023	25.01	436.07
AP07S	Compliance	PMP	09/12/2023	[25.47]	[435.61]
AP07S	Compliance	PMP	10/27/2023	25.38	435.70
AP07S	Compliance	PMP	11/20/2023	25.38	435.70
AP07S	Compliance	PMP	12/27/2023	24.63	436.45
AP08	Water Level	CCR	02/09/2021	8.00	452.60
AP08	Water Level	CCR	02/11/2021	8.02	452.58
AP08	Water Level	CCR	03/02/2021	7.75	452.85
AP08	Water Level	CCR	03/22/2021	7.01	453.59
AP08	Water Level	CCR	04/12/2021	7.44	453.16
AP08	Water Level	CCR	05/04/2021	7.90	452.70
AP08	Water Level	CCR	06/15/2021	8.20	452.40
AP08	Water Level	CCR	06/28/2021	7.68	452.92
AP08	Water Level	CCR	07/21/2021	7.63	452.97
AP08	Water Level	CCR	08/30/2021	8.71	451.89
AP08	Water Level	CCR	02/16/2022	7.91	452.69
AP08	Water Level	CCR	07/25/2022	9.18	451.42
AP08	Water Level	CCR	02/27/2023	7.63	452.97
AP08	Water Level	CCR	06/12/2023	9.31	451.29
AP08	Water Level	CCR	08/21/2023	8.20	452.40
AP08	Water Level	CCR	10/27/2023	9.10	451.50

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Table 2-1. Summary of Groundwater Elevation Data
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Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
AP09	Water Level	CCR	02/09/2021	8.26	451.96
AP09	Water Level	CCR	02/11/2021	8.38	451.84
AP09	Water Level	CCR	03/02/2021	8.27	451.95
AP09	Water Level	CCR	03/22/2021	8.27	451.95
AP09	Water Level	CCR	04/12/2021	8.36	451.86
AP09	Water Level	CCR	05/04/2021	8.10	452.12
AP09	Water Level	CCR	06/15/2021	8.61	451.61
AP09	Water Level	CCR	06/28/2021	8.13	452.09
AP09	Water Level	CCR	07/21/2021	8.03	452.19
AP09	Water Level	CCR	08/30/2021	8.26	451.96
AP09	Water Level	CCR	02/16/2022	8.36	451.86
AP09	Water Level	CCR	07/25/2022	8.62	451.60
AP09	Water Level	CCR	02/27/2023	9.41	450.81
AP09	Water Level	CCR	06/12/2023	11.40	448.82
AP09	Water Level	CCR	08/21/2023	10.09	450.13
AP09	Water Level	CCR	10/27/2023	10.82	449.40
APW-01	Water Level	UA	02/09/2021	5.83	435.24
APW-01	Water Level	UA	02/11/2021	5.93	435.14
APW-01	Water Level	UA	03/02/2021	5.65	435.42
APW-01	Water Level	UA	03/22/2021	5.69	435.38
APW-01	Water Level	UA	04/12/2021	5.51	435.56
APW-01	Water Level	UA	05/04/2021	5.88	435.19
APW-01	Water Level	UA	06/15/2021	7.45	433.62
APW-01	Water Level	UA	06/28/2021	5.75	435.32
APW-01	Water Level	UA	07/21/2021	6.02	435.05
APW-01	Water Level	UA	08/30/2021	6.09	434.98
APW-01	Water Level	UA	02/16/2022	5.64	435.43
APW-01	Water Level	UA	07/25/2022	6.34	434.73
APW-01	Water Level	UA	06/12/2023	6.76	434.31
APW-01	Water Level	UA	08/21/2023	6.17	434.90
APW-01	Water Level	UA	10/27/2023	5.73	435.34
APW-02	Water Level	UCF	02/09/2021	9.52	455.40
APW-02	Water Level	UCF	02/11/2021	14.55	450.37
APW-02	Water Level	UCF	03/02/2021	9.61	455.31
APW-02	Water Level	UCF	03/22/2021	9.71	455.21
APW-02	Water Level	UCF	04/12/2021	9.49	455.43
APW-02	Water Level	UCF	05/04/2021	9.49	455.43
APW-02	Water Level	UCF	06/15/2021	9.22	455.70
APW-02	Water Level	UCF	06/28/2021	9.29	455.63
APW-02	Water Level	UCF	07/21/2021	9.23	455.69
APW-02	Water Level	UCF	08/30/2021	9.37	455.55

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Table 2-1. Summary of Groundwater Elevation Data
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Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
APW-02	Water Level	UCF	02/16/2022	9.05	455.87
APW-02	Water Level	UCF	07/25/2022	9.21	455.71
APW-02	Water Level	UCF	11/21/2022	9.63	455.29
APW-02	Water Level	UCF	12/16/2022	9.29	455.63
APW-02	Water Level	UCF	01/09/2023	9.17	455.75
APW-02	Water Level	UCF	02/27/2023	9.02	455.90
APW-03	Water Level	UCF	02/09/2021	7.59	436.78
APW-03	Water Level	UCF	02/11/2021	14.56	429.81
APW-03	Water Level	UCF	03/02/2021	7.90	436.47
APW-03	Water Level	UCF	03/22/2021	7.62	436.75
APW-03	Water Level	UCF	04/12/2021	8.12	436.25
APW-03	Water Level	UCF	05/04/2021	8.31	436.06
APW-03	Water Level	UCF	06/15/2021	8.73	435.64
APW-03	Water Level	UCF	06/28/2021	8.15	436.22
APW-03	Water Level	UCF	07/21/2021	8.24	436.13
APW-03	Water Level	UCF	08/30/2021	8.80	435.57
APW-03	Water Level	UCF	02/16/2022	7.90	436.47
APW-03	Water Level	UCF	07/25/2022	9.44	434.93
APW-03	Water Level	UCF	02/27/2023	7.86	436.51
APW-04	Water Level	UCF	02/09/2021	7.22	432.44
APW-04	Water Level	UCF	02/11/2021	7.36	432.30
APW-04	Water Level	UCF	03/02/2021	6.92	432.74
APW-04	Water Level	UCF	03/22/2021	6.91	432.75
APW-04	Water Level	UCF	04/12/2021	6.75	432.91
APW-04	Water Level	UCF	05/04/2021	7.26	432.40
APW-04	Water Level	UCF	06/15/2021	7.87	431.79
APW-04	Water Level	UCF	06/28/2021	8.45	431.21
APW-04	Water Level	UCF	07/21/2021	7.53	432.13
APW-04	Water Level	UCF	08/30/2021	7.68	431.98
APW-04	Water Level	UCF	02/16/2022	7.28	432.38
APW-04	Water Level	UCF	07/25/2022	8.51	431.15
APW-04	Water Level	UCF	02/27/2023	7.01	432.65
AW-01	Compliance	PMP	11/21/2022	13.80	450.63
AW-01	Compliance	PMP	12/15/2022	9.77	454.66
AW-01	Compliance	PMP	01/09/2023	10.70	453.73
AW-01	Compliance	PMP	02/27/2023	4.20	460.23
AW-01	Compliance	PMP	04/12/2023	9.78	454.64
AW-01	Compliance	PMP	05/12/2023	9.88	454.54
AW-01	Compliance	PMP	06/12/2023	10.09	454.33
AW-01	Compliance	PMP	07/21/2023	10.40	454.02
AW-01	Compliance	PMP	08/21/2023	10.33	454.09

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Table 2-1. Summary of Groundwater Elevation Data
Nature and Extent Report
Edwards Power Plant
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Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
AW-01	Compliance	PMP	09/27/2023	10.54	453.89
AW-01	Compliance	PMP	10/27/2023	10.12	454.31
AW-01	Compliance	PMP	11/20/2023	12.04	452.39
AW-01	Compliance	PMP	12/27/2023	9.74	454.69
AW-05	Compliance	UA	02/09/2021	8.27	435.10
AW-05	Compliance	UA	02/11/2021	8.34	435.03
AW-05	Compliance	UA	03/02/2021	8.20	435.17
AW-05	Compliance	UA	03/22/2021	8.09	435.28
AW-05	Compliance	UA	04/12/2021	7.82	435.55
AW-05	Compliance	UA	05/04/2021	8.21	435.16
AW-05	Compliance	UA	06/15/2021	8.69	434.68
AW-05	Compliance	UA	06/28/2021	8.25	435.12
AW-05	Compliance	UA	07/21/2021	8.46	434.91
AW-05	Compliance	UA	08/30/2021	8.93	434.44
AW-05	Compliance	UA	02/16/2022	8.37	435.00
AW-05	Compliance	UA	07/25/2022	8.99	434.38
AW-05	Compliance	UA	11/21/2022	8.50	434.87
AW-05	Compliance	UA	12/16/2022	7.97	435.40
AW-05	Compliance	UA	01/09/2023	8.53	434.84
AW-05	Compliance	UA	02/27/2023	7.61	435.76
AW-05	Compliance	UA	04/12/2023	7.94	435.43
AW-05	Compliance	UA	05/12/2023	8.19	435.18
AW-05	Compliance	UA	06/12/2023	9.06	434.30
AW-05	Compliance	UA	07/21/2023	8.91	434.46
AW-05	Compliance	UA	08/21/2023	8.79	434.58
AW-05	Compliance	UA	09/27/2023	8.79	434.58
AW-05	Compliance	UA	10/27/2023	8.43	434.94
AW-05	Compliance	UA	11/20/2023	8.81	434.56
AW-05	Compliance	UA	12/27/2023	8.21	435.16
AW-06	Compliance	UA	02/09/2021	27.17	434.40
AW-06	Compliance	UA	02/11/2021	27.07	434.50
AW-06	Compliance	UA	03/02/2021	26.95	434.62
AW-06	Compliance	UA	03/22/2021	26.87	434.70
AW-06	Compliance	UA	04/12/2021	26.72	434.85
AW-06	Compliance	UA	05/04/2021	27.09	434.48
AW-06	Compliance	UA	06/15/2021	27.31	434.26
AW-06	Compliance	UA	06/28/2021	26.97	434.60
AW-06	Compliance	UA	07/21/2021	27.17	434.40
AW-06	Compliance	UA	08/30/2021	25.56	436.01
AW-06	Compliance	UA	02/16/2022	25.61	435.96
AW-06	Compliance	UA	07/25/2022	27.63	433.94

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Table 2-1. Summary of Groundwater Elevation Data
Nature and Extent Report
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Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
AW-06	Compliance	UA	11/21/2022	27.57	434.00
AW-06	Compliance	UA	12/16/2022	26.86	434.71
AW-06	Compliance	UA	01/09/2023	27.27	434.30
AW-06	Compliance	UA	02/27/2023	26.89	434.68
AW-06	Compliance	UA	04/12/2023	27.29	434.27
AW-06	Compliance	UA	05/12/2023	27.34	434.22
AW-06	Compliance	UA	06/12/2023	27.59	433.97
AW-06	Compliance	UA	07/21/2023	27.81	433.75
AW-06	Compliance	UA	08/21/2023	27.58	433.98
AW-06	Compliance	UA	09/27/2023	27.67	433.90
AW-06	Compliance	UA	10/27/2023	27.48	434.09
AW-06	Compliance	UA	11/20/2023	27.39	434.18
AW-06	Compliance	UA	12/27/2023	27.00	434.57
AW-08	Background	UA	02/09/2021	24.26	438.28
AW-08	Background	UA	02/11/2021	28.38	434.16
AW-08	Background	UA	03/02/2021	24.77	437.77
AW-08	Background	UA	03/22/2021	23.27	439.27
AW-08	Background	UA	04/12/2021	22.45	440.09
AW-08	Background	UA	05/04/2021	23.07	439.47
AW-08	Background	UA	06/15/2021	22.40	440.14
AW-08	Background	UA	06/28/2021	23.13	439.41
AW-08	Background	UA	07/21/2021	20.80	441.74
AW-08	Background	UA	08/30/2021	23.05	439.49
AW-08	Background	UA	02/16/2022	23.75	438.79
AW-08	Background	UA	07/25/2022	23.37	439.17
AW-08	Background	UA	11/21/2022	25.37	437.17
AW-08	Background	UA	12/16/2022	25.29	437.25
AW-08	Background	UA	01/09/2023	24.98	437.56
AW-08	Background	UA	02/27/2023	24.58	437.96
AW-08	Background	UA	04/12/2023	22.06	440.47
AW-08	Background	UA	05/12/2023	22.88	439.65
AW-08	Background	UA	06/12/2023	23.99	438.54
AW-08	Background	UA	07/21/2023	24.84	437.69
AW-08	Background	UA	08/21/2023	24.84	437.69
AW-08	Background	UA	09/27/2023	25.34	437.20
AW-08	Background	UA	10/27/2023	25.41	437.13
AW-08	Background	UA	11/20/2023	25.78	436.76
AW-08	Background	UA	12/27/2023	25.00	437.54
AW-09	Compliance	UA	02/09/2021	25.72	435.73
AW-09	Compliance	UA	02/11/2021	25.78	435.67
AW-09	Compliance	UA	03/02/2021	26.82	434.63

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Table 2-1. Summary of Groundwater Elevation Data
Nature and Extent Report
Edwards Power Plant
Ash Pond
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Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
AW-09	Compliance	UA	03/22/2021	25.68	435.77
AW-09	Compliance	UA	04/12/2021	25.49	435.96
AW-09	Compliance	UA	05/04/2021	25.82	435.63
AW-09	Compliance	UA	06/15/2021	25.81	435.64
AW-09	Compliance	UA	06/28/2021	24.94	436.51
AW-09	Compliance	UA	07/21/2021	25.55	435.90
AW-09	Compliance	UA	08/30/2021	26.10	435.35
AW-09	Compliance	UA	02/16/2022	25.57	435.88
AW-09	Compliance	UA	07/25/2022	26.43	435.02
AW-09	Compliance	UA	11/21/2022	27.22	434.23
AW-09	Compliance	UA	12/16/2022	26.58	434.87
AW-09	Compliance	UA	01/09/2023	26.56	434.89
AW-09	Compliance	UA	02/27/2023	25.94	435.51
AW-09	Compliance	UA	04/12/2023	26.40	435.04
AW-09	Compliance	UA	05/12/2023	26.50	434.94
AW-09	Compliance	UA	06/12/2023	26.64	434.80
AW-09	Compliance	UA	07/21/2023	26.95	434.50
AW-09	Compliance	UA	08/21/2023	26.81	434.64
AW-09	Compliance	UA	09/27/2023	26.97	434.48
AW-09	Compliance	UA	10/27/2023	27.29	434.16
AW-09	Compliance	UA	11/20/2023	27.09	434.36
AW-09	Compliance	UA	12/27/2023	26.42	435.03
AW-10	Compliance	UA	03/02/2021	1.09	438.84
AW-10	Compliance	UA	03/22/2021	1.09	438.84
AW-10	Compliance	UA	04/12/2021	1.08	438.85
AW-10	Compliance	UA	05/04/2021	1.13	438.80
AW-10	Compliance	UA	06/15/2021	1.31	438.62
AW-10	Compliance	UA	06/28/2021	1.32	438.61
AW-10	Compliance	UA	07/21/2021	1.33	438.60
AW-10	Compliance	UA	08/30/2021	2.00	437.93
AW-10	Compliance	UA	02/16/2022	1.88	438.05
AW-10	Compliance	UA	07/25/2022	2.31	437.62
AW-10	Compliance	UA	11/21/2022	2.74	437.19
AW-10	Compliance	UA	12/16/2022	2.36	437.57
AW-10	Compliance	UA	01/09/2023	2.40	437.53
AW-10	Compliance	UA	02/27/2023	1.55	438.38
AW-10	Compliance	UA	04/12/2023	1.89	438.03
AW-10	Compliance	UA	05/12/2023	1.93	437.99
AW-10	Compliance	UA	06/12/2023	2.19	437.73
AW-10	Compliance	UA	08/28/2023	[2.35]	[437.58]
AW-10	Compliance	UA	09/11/2023	[2.23]	[437.70]

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Table 2-1. Summary of Groundwater Elevation Data
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Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
AW-10	Compliance	UA	10/27/2023	2.33	437.60
AW-10	Compliance	UA	11/20/2023	2.54	437.39
AW-10	Compliance	UA	12/27/2023	2.24	437.69
AW-11	Compliance	UA	02/09/2021	5.70	434.17
AW-11	Compliance	UA	02/11/2021	5.74	434.13
AW-11	Compliance	UA	03/02/2021	5.36	434.51
AW-11	Compliance	UA	03/22/2021	5.27	434.60
AW-11	Compliance	UA	04/12/2021	5.22	434.65
AW-11	Compliance	UA	05/04/2021	5.31	434.56
AW-11	Compliance	UA	06/15/2021	6.47	433.40
AW-11	Compliance	UA	06/28/2021	5.49	434.38
AW-11	Compliance	UA	07/21/2021	5.31	434.56
AW-11	Compliance	UA	08/30/2021	5.82	434.05
AW-11	Compliance	UA	02/16/2022	5.40	434.47
AW-11	Compliance	UA	07/25/2022	6.22	433.65
AW-11	Compliance	UA	11/21/2022	7.78	432.09
AW-11	Compliance	UA	02/27/2023	5.69	434.18
AW-11	Compliance	UA	04/12/2023	5.44	434.42
AW-11	Compliance	UA	05/12/2023	5.42	434.44
AW-11	Compliance	UA	06/12/2023	5.74	434.12
AW-11	Compliance	UA	07/21/2023	6.35	433.51
AW-11	Compliance	UA	08/21/2023	6.32	433.54
AW-11	Compliance	UA	09/27/2023	6.56	433.31
AW-11	Compliance	UA	10/27/2023	7.03	432.84
AW-11	Compliance	UA	11/20/2023	6.88	432.99
AW-11	Compliance	UA	12/27/2023	6.39	433.48
AW-13	Water Level	UA	02/09/2021	5.74	435.52
AW-13	Water Level	UA	03/02/2021	5.42	435.84
AW-13	Water Level	UA	03/22/2021	5.40	435.86
AW-13	Water Level	UA	04/12/2021	5.34	435.92
AW-13	Water Level	UA	05/04/2021	5.43	435.83
AW-13	Water Level	UA	06/15/2021	5.70	435.56
AW-13	Water Level	UA	06/28/2021	5.86	435.40
AW-13	Water Level	UA	07/21/2021	5.28	435.98
AW-13	Water Level	UA	08/30/2021	5.98	435.28
AW-13	Water Level	UA	02/16/2022	5.52	435.74
AW-13	Water Level	UA	07/25/2022	6.61	434.65
AW-13	Water Level	UA	11/21/2022	7.72	433.54
AW-13	Water Level	UA	12/16/2022	7.01	434.25
AW-13	Water Level	UA	01/09/2023	6.65	434.61
AW-13	Water Level	UA	02/27/2023	5.40	435.86

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Table 2-1. Summary of Groundwater Elevation Data
Nature and Extent Report
Edwards Power Plant
Ash Pond
Bartonville, Illinois

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
AW-14	Compliance	UA	02/09/2021	6.37	433.03
AW-14	Compliance	UA	03/02/2021	6.46	432.94
AW-14	Compliance	UA	03/22/2021	6.61	432.79
AW-14	Compliance	UA	04/12/2021	6.45	432.95
AW-14	Compliance	UA	05/04/2021	6.41	432.99
AW-14	Compliance	UA	06/15/2021	6.69	432.71
AW-14	Compliance	UA	06/28/2021	6.53	432.87
AW-14	Compliance	UA	07/21/2021	6.36	433.04
AW-14	Compliance	UA	08/30/2021	7.19	432.21
AW-14	Compliance	UA	02/16/2022	6.44	432.96
AW-14	Compliance	UA	07/25/2022	7.63	431.77
AW-14	Compliance	UA	11/21/2022	8.92	430.48
AW-14	Compliance	UA	12/16/2022	7.67	431.73
AW-14	Compliance	UA	01/09/2023	7.54	431.86
AW-14	Compliance	UA	02/27/2023	6.88	432.52
AW-14	Compliance	UA	06/12/2023	7.33	432.07
AW-14	Compliance	UA	08/21/2023	7.07	432.33
AW-14	Compliance	UA	10/27/2023	8.30	431.10
AW-15	Compliance	UA	02/09/2021	8.48	433.03
AW-15	Compliance	UA	03/02/2021	8.01	433.50
AW-15	Compliance	UA	03/22/2021	7.83	433.68
AW-15	Compliance	UA	04/12/2021	7.75	433.76
AW-15	Compliance	UA	05/04/2021	7.82	433.69
AW-15	Compliance	UA	06/15/2021	7.86	433.65
AW-15	Compliance	UA	06/28/2021	7.92	433.59
AW-15	Compliance	UA	07/21/2021	7.86	433.65
AW-15	Compliance	UA	08/30/2021	7.08	434.43
AW-15	Compliance	UA	02/16/2022	8.00	433.51
AW-15	Compliance	UA	07/25/2022	7.77	433.74
AW-15	Compliance	UA	11/21/2022	10.76	430.75
AW-15	Compliance	UA	02/27/2023	8.92	432.59
AW-15	Compliance	UA	04/12/2023	8.14	433.36
AW-15	Compliance	UA	05/12/2023	8.00	433.50
AW-15	Compliance	UA	06/12/2023	8.09	433.41
AW-15	Compliance	UA	07/21/2023	8.51	432.99
AW-15	Compliance	UA	08/21/2023	8.68	432.82
AW-15	Compliance	UA	10/27/2023	10.02	431.49
AW-15	Compliance	UA	11/20/2023	9.99	431.52
AW-15	Compliance	UA	12/27/2023	9.52	431.99
AW-15C	Water Level	BCU	02/09/2021	6.70	433.32
AW-15C	Water Level	BCU	03/02/2021	6.52	433.50

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Table 2-1. Summary of Groundwater Elevation Data
Nature and Extent Report
Edwards Power Plant
Ash Pond
Bartonville, Illinois

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
AW-15C	Water Level	BCU	03/22/2021	6.36	433.66
AW-15C	Water Level	BCU	04/12/2021	6.22	433.80
AW-15C	Water Level	BCU	05/04/2021	6.31	433.71
AW-15C	Water Level	BCU	06/15/2021	6.39	433.63
AW-15C	Water Level	BCU	06/28/2021	6.44	433.58
AW-15C	Water Level	BCU	07/21/2021	6.35	433.67
AW-15C	Water Level	BCU	08/30/2021	8.51	431.51
AW-15C	Water Level	BCU	02/16/2022	6.50	433.52
AW-15C	Water Level	BCU	07/25/2022	7.16	432.86
AW-15C	Water Level	BCU	02/27/2023	7.46	432.56
AW-15S	Compliance	PMP	02/09/2021	8.80	431.91
AW-15S	Compliance	PMP	03/02/2021	9.52	431.19
AW-15S	Compliance	PMP	03/22/2021	9.38	431.33
AW-15S	Compliance	PMP	04/12/2021	9.58	431.13
AW-15S	Compliance	PMP	05/04/2021	10.89	429.82
AW-15S	Compliance	PMP	06/15/2021	9.71	431.00
AW-15S	Compliance	PMP	06/28/2021	10.85	429.86
AW-15S	Compliance	PMP	07/21/2021	9.46	431.25
AW-15S	Compliance	PMP	08/30/2021	9.84	430.87
AW-15S	Compliance	PMP	02/16/2022	8.92	431.79
AW-15S	Compliance	PMP	07/25/2022	8.64	432.07
AW-15S	Compliance	PMP	02/27/2023	10.05	430.66
AW-15S	Compliance	PMP	04/12/2023	9.46	431.24
AW-15S	Compliance	PMP	05/12/2023	9.46	431.24
AW-15S	Compliance	PMP	06/12/2023	9.94	430.76
AW-15S	Compliance	PMP	07/21/2023	10.06	430.64
AW-15S	Compliance	PMP	08/21/2023	9.82	430.88
AW-15S	Compliance	PMP	09/27/2023	10.25	430.46
AW-15S	Compliance	PMP	10/27/2023	10.04	430.67
AW-15S	Compliance	PMP	11/20/2023	11.08	429.63
AW-15S	Compliance	PMP	12/27/2023	9.52	431.19
AW-16	Compliance	UA	02/09/2021	24.16	437.63
AW-16	Compliance	UA	03/02/2021	24.18	437.61
AW-16	Compliance	UA	03/22/2021	24.12	437.67
AW-16	Compliance	UA	04/12/2021	24.00	437.79
AW-16	Compliance	UA	05/04/2021	24.05	437.74
AW-16	Compliance	UA	06/15/2021	24.02	437.77
AW-16	Compliance	UA	06/28/2021	24.00	437.79
AW-16	Compliance	UA	07/21/2021	24.05	437.74
AW-16	Compliance	UA	08/30/2021	24.38	437.41
AW-16	Compliance	UA	02/16/2022	23.88	437.91

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Table 2-1. Summary of Groundwater Elevation Data
Nature and Extent Report
Edwards Power Plant
Ash Pond
Bartonville, Illinois

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
AW-16	Compliance	UA	07/25/2022	23.75	438.04
AW-16	Compliance	UA	02/27/2023	24.60	437.19
AW-16	Compliance	UA	04/12/2023	24.54	437.24
AW-16	Compliance	UA	05/12/2023	24.44	437.34
AW-16	Compliance	UA	06/12/2023	24.69	437.09
AW-16	Compliance	UA	07/21/2023	25.05	436.73
AW-16	Compliance	UA	08/21/2023	25.21	436.58
AW-16	Compliance	UA	09/27/2023	25.59	436.20
AW-16	Compliance	UA	10/27/2023	25.92	435.87
AW-16	Compliance	UA	11/20/2023	26.05	435.74
AW-16	Compliance	UA	12/27/2023	25.62	436.17
AW-17	Compliance	UA	02/09/2021	25.25	436.85
AW-17	Compliance	UA	03/02/2021	24.90	437.20
AW-17	Compliance	UA	03/22/2021	24.68	437.42
AW-17	Compliance	UA	04/12/2021	24.52	437.58
AW-17	Compliance	UA	05/04/2021	24.70	437.40
AW-17	Compliance	UA	06/15/2021	24.76	437.34
AW-17	Compliance	UA	06/28/2021	24.86	437.24
AW-17	Compliance	UA	07/21/2021	24.40	437.70
AW-17	Compliance	UA	08/30/2021	25.07	437.03
AW-17	Compliance	UA	02/16/2022	24.47	437.63
AW-17	Compliance	UA	07/25/2022	25.34	436.76
AW-17	Compliance	UA	02/27/2023	24.85	437.25
AW-17	Compliance	UA	04/12/2023	25.29	436.80
AW-17	Compliance	UA	05/12/2023	25.32	436.77
AW-17	Compliance	UA	06/12/2023	25.42	436.67
AW-17	Compliance	UA	07/21/2023	25.95	436.14
AW-17	Compliance	UA	08/21/2023	26.14	435.96
AW-17	Compliance	UA	09/27/2023	26.20	435.90
AW-17	Compliance	UA	10/27/2023	26.56	435.54
AW-17	Compliance	UA	11/20/2023	26.52	435.58
AW-17	Compliance	UA	12/27/2023	26.08	436.02
AW-18	Compliance	UA	02/09/2021	27.38	435.27
AW-18	Compliance	UA	03/02/2021	27.48	435.17
AW-18	Compliance	UA	03/22/2021	27.27	435.38
AW-18	Compliance	UA	04/12/2021	27.28	435.37
AW-18	Compliance	UA	05/04/2021	27.61	435.04
AW-18	Compliance	UA	06/15/2021	27.67	434.98
AW-18	Compliance	UA	06/28/2021	27.42	435.23
AW-18	Compliance	UA	07/21/2021	27.40	435.25
AW-18	Compliance	UA	08/30/2021	27.97	434.68

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Table 2-1. Summary of Groundwater Elevation Data
Nature and Extent Report
Edwards Power Plant
Ash Pond
Bartonville, Illinois

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
AW-18	Compliance	UA	02/16/2022	26.82	435.83
AW-18	Compliance	UA	07/25/2022	28.00	434.65
AW-18	Compliance	UA	11/21/2022	27.89	434.76
AW-18	Compliance	UA	12/16/2022	27.20	435.45
AW-18	Compliance	UA	01/09/2023	27.54	435.11
AW-18	Compliance	UA	02/27/2023	26.96	435.69
AW-18	Compliance	UA	04/12/2023	27.84	434.80
AW-18	Compliance	UA	05/12/2023	27.93	434.71
AW-18	Compliance	UA	06/12/2023	28.14	434.50
AW-18	Compliance	UA	07/21/2023	27.99	434.65
AW-18	Compliance	UA	08/21/2023	27.79	434.85
AW-18	Compliance	UA	09/27/2023	28.01	434.64
AW-18	Compliance	UA	10/27/2023	28.00	434.65
AW-18	Compliance	UA	11/20/2023	27.96	434.69
AW-18	Compliance	UA	12/27/2023	27.33	435.32
AW-19	Compliance	UA	02/09/2021	13.09	447.65
AW-19	Compliance	UA	03/02/2021	13.10	447.64
AW-19	Compliance	UA	03/22/2021	13.03	447.71
AW-19	Compliance	UA	04/12/2021	13.19	447.55
AW-19	Compliance	UA	05/04/2021	13.38	447.36
AW-19	Compliance	UA	06/15/2021	13.65	447.09
AW-19	Compliance	UA	06/28/2021	13.34	447.40
AW-19	Compliance	UA	07/21/2021	13.52	447.22
AW-19	Compliance	UA	08/30/2021	13.86	446.88
AW-19	Compliance	UA	02/16/2022	13.74	447.00
AW-19	Compliance	UA	07/25/2022	13.96	446.78
AW-19	Compliance	UA	11/21/2022	13.79	446.95
AW-19	Compliance	UA	12/16/2022	13.52	447.22
AW-19	Compliance	UA	01/09/2023	13.87	446.87
AW-19	Compliance	UA	02/27/2023	13.39	447.35
AW-19	Compliance	UA	04/12/2023	14.46	446.27
AW-19	Compliance	UA	05/12/2023	14.53	446.20
AW-19	Compliance	UA	06/12/2023	14.69	446.04
AW-19	Compliance	UA	07/21/2023	14.34	446.39
AW-19	Compliance	UA	08/21/2023	14.19	446.54
AW-19	Compliance	UA	10/27/2023	14.16	446.58
AW-19	Compliance	UA	11/20/2023	14.05	446.69
AW-19	Compliance	UA	12/27/2023	13.81	446.93
AW-20	Water Level	UA	02/09/2021	16.37	445.11
AW-20	Water Level	UA	03/02/2021	16.25	445.23
AW-20	Water Level	UA	03/22/2021	16.07	445.41

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Table 2-1. Summary of Groundwater Elevation Data
Nature and Extent Report
Edwards Power Plant
Ash Pond
Bartonville, Illinois

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
AW-20	Water Level	UA	04/12/2021	16.19	445.29
AW-20	Water Level	UA	05/04/2021	16.40	445.08
AW-20	Water Level	UA	06/15/2021	16.93	444.55
AW-20	Water Level	UA	06/28/2021	16.40	445.08
AW-20	Water Level	UA	07/21/2021	16.24	445.24
AW-20	Water Level	UA	08/30/2021	17.23	444.25
AW-20	Water Level	UA	02/16/2022	16.78	444.70
AW-20	Water Level	UA	11/21/2022	17.09	444.39
AW-20	Water Level	UA	12/16/2022	16.38	445.10
AW-20	Water Level	UA	01/09/2023	16.69	444.79
AW-20	Water Level	UA	02/27/2023	16.15	445.33
AW-20	Water Level	UA	06/12/2023	17.61	443.87
AW-20	Water Level	UA	08/21/2023	16.80	444.68
AW-20	Water Level	UA	10/27/2023	17.10	444.38
AW-21	Compliance	UA	02/09/2021	16.57	444.04
AW-21	Compliance	UA	03/02/2021	16.41	444.20
AW-21	Compliance	UA	03/22/2021	16.19	444.42
AW-21	Compliance	UA	04/12/2021	16.44	444.17
AW-21	Compliance	UA	05/04/2021	16.87	443.74
AW-21	Compliance	UA	06/15/2021	17.78	442.83
AW-21	Compliance	UA	06/28/2021	16.82	443.79
AW-21	Compliance	UA	07/21/2021	17.15	443.46
AW-21	Compliance	UA	08/30/2021	17.93	442.68
AW-21	Compliance	UA	02/16/2022	17.39	443.22
AW-21	Compliance	UA	07/25/2022	18.46	442.15
AW-21	Compliance	UA	11/21/2022	18.20	442.41
AW-21	Compliance	UA	12/16/2022	18.11	442.50
AW-21	Compliance	UA	01/09/2023	17.58	443.03
AW-21	Compliance	UA	02/27/2023	16.35	444.26
AW-21	Compliance	UA	04/12/2023	17.92	442.68
AW-21	Compliance	UA	05/12/2023	17.99	442.61
AW-21	Compliance	UA	06/12/2023	18.45	442.15
AW-21	Compliance	UA	07/21/2023	18.20	442.40
AW-21	Compliance	UA	08/21/2023	17.41	443.19
AW-21	Compliance	UA	09/27/2023	18.03	442.58
AW-21	Compliance	UA	10/27/2023	17.80	442.81
AW-21	Compliance	UA	11/20/2023	17.84	442.77
AW-21	Compliance	UA	12/27/2023	16.84	443.77
AW-22	Water Level	UA	02/09/2021	11.74	451.45
AW-22	Water Level	UA	03/02/2021	11.55	451.64
AW-22	Water Level	UA	03/22/2021	11.39	451.80

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Table 2-1. Summary of Groundwater Elevation Data
Nature and Extent Report
Edwards Power Plant
Ash Pond
Bartonville, Illinois

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
AW-22	Water Level	UA	04/12/2021	11.64	451.55
AW-22	Water Level	UA	05/04/2021	11.73	451.46
AW-22	Water Level	UA	06/15/2021	11.89	451.30
AW-22	Water Level	UA	06/28/2021	11.75	451.44
AW-22	Water Level	UA	07/21/2021	11.65	451.54
AW-22	Water Level	UA	08/30/2021	11.15	452.04
AW-22	Water Level	UA	02/16/2022	11.73	451.46
AW-22	Water Level	UA	07/25/2022	12.25	450.94
AW-22	Water Level	UA	02/27/2023	11.30	451.89
AW-23	Water Level	UA	11/21/2022	6.72	430.85
AW-23	Water Level	UA	12/16/2022	3.86	433.71
AW-23	Water Level	UA	01/09/2023	3.95	433.62
AW-23	Water Level	UA	06/14/2023	[5.90]	[431.67]
AW-23	Water Level	UA	08/21/2023	4.36	433.21
AW-23	Water Level	UA	10/27/2023	5.46	432.11
AW-23	Water Level	UA	12/27/2023	3.48	434.09
EMW-05	Water Level	UA	11/21/2022	22.02	436.08
EMW-05	Water Level	UA	12/16/2022	21.69	436.25
EMW-05	Water Level	UA	01/09/2023	21.43	436.51
EMW-05	Water Level	UA	02/27/2023	20.29	437.65
EMW-05	Water Level	UA	04/12/2023	18.92	439.01
EMW-05	Water Level	UA	05/12/2023	19.61	438.32
EMW-05	Water Level	UA	06/12/2023	21.20	436.73
EMW-05	Water Level	UA	08/28/2023	[20.84]	[437.10]
EMW-05	Water Level	UA	10/27/2023	21.67	436.27
EMW-05	Water Level	UA	11/20/2023	21.60	436.34
EMW-05	Water Level	UA	12/27/2023	20.85	437.09
OW-01	Water Level	UA	11/21/2022	24.34	435.58
OW-01	Water Level	UA	02/27/2023	23.19	436.74
OW-01	Water Level	UA	06/12/2023	24.39	435.54
OW-01	Water Level	UA	08/21/2023	23.90	436.03
OW-01	Water Level	UA	10/27/2023	24.22	435.71
P002	Water Level	UCF	02/09/2021	11.98	448.41
P002	Water Level	UCF	03/02/2021	11.89	448.50
P002	Water Level	UCF	03/22/2021	11.79	448.60
P002	Water Level	UCF	04/12/2021	11.97	448.42
P002	Water Level	UCF	05/04/2021	12.08	448.31
P002	Water Level	UCF	06/15/2021	12.20	448.19
P002	Water Level	UCF	06/28/2021	12.06	448.33
P002	Water Level	UCF	02/16/2022	12.36	448.03
P002	Water Level	UCF	07/25/2022	12.54	447.85
P002	Water Level	UCF	02/27/2023	12.05	448.34

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Table 2-1. Summary of Groundwater Elevation Data
Nature and Extent Report
Edwards Power Plant
Ash Pond
Bartonville, Illinois

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
XPW01A	Water Level	CCR	02/09/2021	11.74	452.42
XPW01A	Water Level	CCR	03/02/2021	11.44	452.72
XPW01A	Water Level	CCR	03/22/2021	11.28	452.88
XPW01A	Water Level	CCR	04/12/2021	11.51	452.65
XPW01A	Water Level	CCR	05/04/2021	11.75	452.41
XPW01A	Water Level	CCR	06/15/2021	12.03	452.13
XPW01A	Water Level	CCR	06/28/2021	11.18	452.98
XPW01A	Water Level	CCR	07/21/2021	11.53	452.63
XPW01A	Water Level	CCR	08/30/2021	11.84	452.32
XPW01A	Water Level	CCR	02/16/2022	11.58	452.58
XPW01A	Water Level	CCR	07/25/2022	12.10	452.06
XPW01A	Water Level	CCR	02/27/2023	11.16	453.00
XPW01A	Water Level	CCR	04/12/2023	12.58	451.57
XPW01A	Water Level	CCR	05/12/2023	12.58	451.57
XPW01A	Water Level	CCR	06/12/2023	12.93	451.22
XPW01A	Water Level	CCR	07/21/2023	12.14	452.01
XPW01A	Water Level	CCR	08/21/2023	11.86	452.30
XPW01A	Water Level	CCR	09/27/2023	12.05	452.11
XPW01A	Water Level	CCR	10/27/2023	11.89	452.27
XPW01A	Water Level	CCR	11/20/2023	12.24	451.92
XPW01A	Water Level	CCR	12/27/2023	11.34	452.82
XPW02	Water Level	CCR	02/09/2021	20.82	452.97
XPW02	Water Level	CCR	03/02/2021	20.62	453.17
XPW02	Water Level	CCR	03/22/2021	19.71	454.08
XPW02	Water Level	CCR	04/12/2021	20.06	453.73
XPW02	Water Level	CCR	05/04/2021	20.56	453.23
XPW02	Water Level	CCR	06/15/2021	20.89	452.90
XPW02	Water Level	CCR	06/28/2021	20.32	453.47
XPW02	Water Level	CCR	07/21/2021	20.12	453.67
XPW02	Water Level	CCR	08/30/2021	21.43	452.36
XPW02	Water Level	CCR	02/16/2022	20.58	453.21
XPW02	Water Level	CCR	07/25/2022	21.94	451.85
XPW02	Water Level	CCR	02/27/2023	19.78	454.01
XPW02	Water Level	CCR	04/12/2023	21.29	452.49
XPW02	Water Level	CCR	05/12/2023	21.55	452.23
XPW02	Water Level	CCR	06/12/2023	22.09	451.69
XPW02	Water Level	CCR	07/21/2023	21.99	451.79
XPW02	Water Level	CCR	08/21/2023	20.77	453.01
XPW02	Water Level	CCR	10/27/2023	21.63	452.16
XPW02	Water Level	CCR	11/20/2023	21.48	452.31
XPW02	Water Level	CCR	12/27/2023	20.42	453.37

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Table 2-1. Summary of Groundwater Elevation Data
Nature and Extent Report
Edwards Power Plant
Ash Pond
Bartonville, Illinois

Well ID	Well Type	Monitored Unit	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
XPW03	Water Level	CCR	02/09/2021	15.30	450.74
XPW03	Water Level	CCR	03/02/2021	15.32	450.72
XPW03	Water Level	CCR	03/22/2021	15.27	450.77
XPW03	Water Level	CCR	04/12/2021	15.42	450.62
XPW03	Water Level	CCR	05/04/2021	15.20	450.84
XPW03	Water Level	CCR	06/15/2021	15.66	450.38
XPW03	Water Level	CCR	06/28/2021	15.18	450.86
XPW03	Water Level	CCR	07/21/2021	15.01	451.03
XPW03	Water Level	CCR	08/30/2021	15.28	450.76
XPW03	Water Level	CCR	02/16/2022	15.39	450.65
XPW03	Water Level	CCR	07/25/2022	15.71	450.33
XPW03	Water Level	CCR	02/27/2023	16.34	449.70
XPW03	Water Level	CCR	04/12/2023	17.71	448.32
XPW03	Water Level	CCR	05/12/2023	17.77	448.26
XPW03	Water Level	CCR	06/12/2023	18.20	447.83
XPW03	Water Level	CCR	07/21/2023	18.01	448.03
XPW03	Water Level	CCR	08/21/2023	17.20	448.84
XPW03	Water Level	CCR	10/27/2023	18.23	447.81
XPW03	Water Level	CCR	11/20/2023	18.36	447.68
XPW03	Water Level	CCR	12/27/2023	17.34	448.70
SG-01	Water Level	SW	02/09/2021	--	431.82
SG-01	Water Level	SW	06/15/2021	--	434.13
SG-01	Water Level	SW	08/30/2021	--	432.63
SG-01	Water Level	SW	02/16/2022	--	434.07
SG-01	Water Level	SW	07/25/2022	--	433.45
SG-01	Water Level	SW	11/21/2022	--	430.01
SG-01	Water Level	SW	12/16/2022	--	433.03
SG-01	Water Level	SW	02/27/2023	--	441.00
SG-01	Water Level	SW	06/12/2023	--	441.50
SG-01	Water Level	SW	08/21/2023	--	435.00
SG-01	Water Level	SW	10/27/2023	--	431.00
SG-01	Water Level	SW	11/20/2023	--	440.04
SG-01	Water Level	SW	12/27/2023	--	440.64

Notes:
BCU = bedrock confining unit
BMP = below measuring point
CCR = coal combustion residuals
NAVD 88 = North American Vertical Datum of 1988
PMP = potential migration pathway
SW = surface water (Illinois River)
UA = uppermost aquifer
UCF = Upper Cahokia Formation

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Table 2-2. Field Horizontal Hydraulic Conductivities
Nature and Extent Report
Edwards Power Plant
Ash Pond
Bartonville, Illinois

Well ID	Gradient Position	Bottom of Screen Elevation (ft NAVD88)	Screen Length [1] (ft)	Field Identified Screened Material	Slug Type	Analysis Method	Number of Field Tests	Test Analyzed [3]	Hydraulic Conductivity (cm/s)	Minimum Hydraulic Conductivity (cm/s)	Maximum Hydraulic Conductivity (cm/s)	Hydraulic Conductivity Geometric Mean (cm/s)
Uppermost Aquifer												
AW-12	U	410.16	5	(GW)s	Solid	Bouwer-Rice	6	RH-2	1.5E-02	4.7E-07	1.5E-02	1.6E-04
AW-15	D	400.95	5	CL/BR [2]	Solid	Cooper-Bredehoeft-Papadopulos	6	RH-3	7.5E-03			
AW-16	D	399.45	5	CL/ML/BR [2]	Solid	Cooper-Bredehoeft-Papadopulos	4	RH-1	7.7E-04			
AW-17	D	403.69	5	CL/ML/BR	Solid	Bouwer-Rice	1	FH-1	4.7E-07			
AW-18	D	409.28	5	CL/ML/BR	Solid	Bouwer-Rice	1	RH-1	7.3E-07			
AW-19	D	418.53	5	CL/ML	Solid	Cooper-Bredehoeft-Papadopulos	1	RH-1	4.1E-05			
AW-20	D	417.58	5	CL/ML/BR [2]	Solid	Cooper-Bredehoeft-Papadopulos	1	RH-1	2.5E-03			
AW-21	D	421.28	5	CL/ML/BR [2]	Solid	Cooper-Bredehoeft-Papadopulos	2	RH-2	2.5E-04			
AW-22	D	411.30	5	CL/BR [2]	Solid	Cooper-Bredehoeft-Papadopulos	2	RH-2	1.1E-04			
Potential Migration Pathway												
AW-15S	D	419.92	10	ML/CL	Solid	Bouwer-Rice	3	RH-1	3.2E-03	3.2E-03	3.2E-03	3.2E-03
Bedrock												
AW-15C	D	389.62	5	BR	Solid	Cooper-Bredehoeft-Papadopulos	6	RH-2	8.2E-04	8.2E-04	8.2E-04	8.2E-04
Ash Pond												
XPW01A	CCR	417.99	10	s(ML)	Solid	Cooper-Bredehoeft-Papadopulos	4	FH-1	3.2E-04	3.2E-04	1.8E-03	6.8E-04
XPW02	CCR	425.16	10	s(ML)	Solid	Kansas Geological Survey	5	RH-2	1.8E-03			
XPW03	CCR	425.62	10	(SP-SM)g	Solid	Cooper-Bredehoeft-Papadopulos	4	RH-1	5.5E-04			

[O:SSW 7/13/21, U: SSW 08/13/21; C:CJC 08/16/21; U:CJC 08/16/21; U: KRP 05/20/24]

Notes:

[1] All wells are constructed from 2 inch PVC with 0.01 inch slotted screens.
[2] Boring log indicates well is screened in weathered shale bedrock.
[3] Test response data (elapsed time and corresponding changes in water levels) were plotted as normalized displacement to evaluate similarity among repeat test data within each well. A single test was selected for analysis at each well based on the quality of the test data (*i.e.,* smooth recovery curve) and coincidence of repeat test data.

cm/s = centimeters per second
BR = bedrock
CCR = coal combustion residuals
CL = lean clay
D = downgradient
FH-1 = Falling Head 1 Test
ft = foot/feet
(GW)s = well graded gravel with sand
ML = silt
NAVD88 = North American Vertical Datum of 1988
RH-1 = Rising Head 1 Test
RH-2 = Rising Head 2 Test
RH-3 = Rising Head 3 Test
s(ML) = sandy silt
(SP-SM)g = poorly graded sand and silt with gravel
U = upgradient

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Table 3-1. Monitoring Well Construction Details
Nature and Extent Report
Edwards Power Plant
Ash Pond
Bartonville, Illinois

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)
AP05S	UA	11/29/2016	443.28	443.01	Top of PVC	441.13	32.87	37.64	408.26	403.49	38.06	403.10	4.8	2	40.598807	-89.66191
AP07S	PMP	12/2/2016	461.08	461.02	Top of PVC	458.31	29.95	34.74	428.36	423.57	35	423.30	4.8	2	40.59793	-89.666919
APW-01	UA	7/27/2010	441.07	441.07	Top of PVC	437.83	7.6	18	430.23	419.83	18	419.30	10.4	2	40.600127	-89.66512
AW-01	PMP	9/8/2021	464.43	464.60	Top of PVC	462.30	28.2	37.7	434.10	424.60	38.2	423.30	9.5	2	40.594098	-89.665033
AW-05	UA	7/22/2015	--	443.31	Top of Disk	440.55	15.87	20.47	424.68	420.08	21.1	419.50	4.6	2	40.598645	-89.666407
AW-06	UA	8/3/2015	--	461.57	Top of Disk	459.19	36.6	41.09	422.59	418.10	41.69	416.90	4.5	2	40.594237	-89.670051
AW-08	UA	7/21/2015	--	462.54	Top of Disk	460.66	47.55	57.19	413.11	403.47	57.7	403.00	9.6	2	40.593964	-89.661996
AW-09	UA	8/3/2015	--	461.45	Top of Disk	458.32	47.14	51.62	411.18	406.70	52.23	406.10	4.5	2	40.590422	-89.668777
AW-10	UA	7/23/2015	--	440.10	Top of Disk	437.64	27.62	32.23	410.02	405.41	32.74	404.90	4.6	2	40.590733	-89.663826
AW-11	UA	7/28/2015	--	440.04	Top of Disk	437.16	24.21	28.81	412.95	408.35	29.31	407.20	4.6	2	40.587261	-89.663781
AW-14	UA	1/8/2021	439.40	439.40	Top of PVC	436.83	24	29	412.83	407.83	29	401.80	5	2	40.58729	-89.665621
AW-15	UA	1/8/2021	441.51	441.68	Top of PVC	438.95	33	38	405.95	400.95	38	399.00	5	2	40.587964	-89.666822
AW-15S	PMP	1/8/2021	440.71	440.88	Top of PVC	437.92	8	18	429.92	419.92	18	417.90	10	2	40.587955	-89.666841
AW-16	UA	1/8/2021	461.79	461.96	Top of PVC	459.45	55	60	404.45	399.45	60	396.50	5	2	40.589457	-89.667799
AW-17	UA	1/8/2021	462.10	462.27	Top of PVC	459.69	51	56	408.69	403.69	56	402.70	5	2	40.591698	-89.669404
AW-18	UA	1/9/2021	462.65	462.82	Top of PVC	460.28	46	51	414.28	409.28	51	405.30	5	2	40.593044	-89.669822
AW-19	UA	1/9/2021	460.74	460.91	Top of PVC	458.53	35	40	423.53	418.53	40	415.50	5	2	40.595434	-89.66972
AW-20	UA	1/10/2021	461.48	461.48	Top of PVC	459.08	36.5	41.5	422.58	417.58	41.5	416.10	5	2	40.596469	-89.66891
AW-21	UA	1/10/2021	460.61	460.78	Top of PVC	458.28	32	37	426.28	421.28	37	420.30	5	2	40.597294	-89.667734
AW-23	UA	10/20/2022	437.57	437.74	Top of PVC	435.69	6	16	429.69	419.69	16	419.69	10	2	40.5937859	-89.6714015
EMW-05	UA	9/9/2021	457.94	458.11	Top of PVC	455.80	25.7	30.2	430.10	425.60	30.7	421.80	4.5	2	40.5986102	-89.6672471
XPW01A	CCR	1/9/2021	464.16	464.33	Top of PVC	460.99	33	43	427.99	417.99	43	418.00	10	2	40.596306	-89.667345
XPW02	CCR	1/9/2021	473.79	473.96	Top of PVC	471.16	36	46	435.16	425.16	46	424.20	10	2	40.594351	-89.668312
XPW03	CCR	1/10/2021	466.04	466.21	Top of PVC	462.62	27	37	435.62	425.62	37	422.60	10	2	40.591416	-89.666188

Notes:
All elevation data are presented relative to the North American Vertical Datum 1988 (NAVD88), GEOID 12A
bgs = below ground surface
CCR = Coal Combustion Residuals
ft = foot or feet
HSU = Hydrostratigraphic Unit
PMP = Potential Migration Pathway
PVC = polyvinyl chloride
UA = Uppermost Aquifer

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Table 3-2. Exceedance Parameter Statistical Results
Nature and Extent Report
Edwards Power Plant
Ash Pond
Bartonville, Illinois

Location	Parameter	Unit	Groundwater Protection Standard	2023 Q2 LCL	2023 Q3 LCL	2023 Q4 LCL
AP07S	Boron, total	mg/L	2	6.94	6.34	5.82
AW-05	Boron, total	mg/L	2	1.88	2.16	2.90
AW-15S	Boron, total	mg/L	2	5.43	5.46	5.51
AW-19	Boron, total	mg/L	2	2.47	2.50	2.52
AW-20	Boron, total	mg/L	2	3.10	1.90	2.04
AW-21	Boron, total	mg/L	2	10.3	10.5	11.0
AW-15S	Sulfate, total	mg/L	400	480	503	510

Notes:
LCL = Lower Confidence Level
mg/L = milligrams per liter

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Table 3-3. Summary of Groundwater Data
Nature and Extent Report
Edwards Power Plant
Ash Pond
Bartonville, Illinois

HSU	Location	Parameter	Unit	Sample Count	Non-Detect Results	Percent Non-Detect Results	First Sample	Last Sample	Minimum	Median	Mean	Maximum
CCR	XPW01A	Boron, total	mg/L	9	0	0	02/11/2021	08/21/2023	15.0	18.0	17.6	21.0
CCR	XPW01A	Sulfate, total	mg/L	9	0	0	02/11/2021	08/21/2023	210	210	217	230
CCR	XPW02	Boron, total	mg/L	9	0	0	02/11/2021	08/22/2023	13.0	15.0	15.0	17.0
CCR	XPW02	Sulfate, total	mg/L	9	0	0	02/11/2021	08/22/2023	800	930	940	1,100
CCR	XPW03	Boron, total	mg/L	9	0	0	02/11/2021	08/28/2023	4.90	5.50	5.54	7.00
CCR	XPW03	Sulfate, total	mg/L	9	0	0	02/11/2021	08/28/2023	260	280	283	310
PMP	AP07S	Boron, total	mg/L	12	0	0	02/10/2021	11/03/2023	5.80	8.05	8.86	18.0
PMP	AP07S	Sulfate, total	mg/L	12	0	0	02/10/2021	11/03/2023	150	325	311	480
PMP	AW-01	Boron, total	mg/L	7	0	0	11/18/2022	11/06/2023	0.0720	0.0860	0.227	1.10
PMP	AW-01	Sulfate, total	mg/L	7	0	0	11/18/2022	11/06/2023	41.0	50.0	79.9	280
PMP	AW-15S	Boron, total	mg/L	12	0	0	02/12/2021	11/02/2023	5.40	5.75	5.82	6.70
PMP	AW-15S	Sulfate, total	mg/L	12	0	0	02/12/2021	11/02/2023	480	550	542	590
UA	AP05S	Boron, total	mg/L	31	0	0	01/18/2017	11/06/2023	0.240	0.330	0.331	0.420
UA	AP05S	Sulfate, total	mg/L	31	6	19	01/18/2017	11/06/2023	<0.18	3.30	8.91	38.0
UA	APW-01	Boron, total	mg/L	6	0	0	06/17/2021	11/06/2023	0.690	0.920	0.907	1.10
UA	APW-01	Sulfate, total	mg/L	6	0	0	06/17/2021	11/06/2023	280	295	293	300
UA	AW-05	Boron, total	mg/L	17	0	0	11/09/2015	11/06/2023	1.40	2.80	3.83	11.0
UA	AW-05	Sulfate, total	mg/L	17	0	0	11/09/2015	11/06/2023	5.70	300	310	470
UA	AW-06	Boron, total	mg/L	23	0	0	11/10/2015	11/06/2023	0.0930	0.150	0.160	0.310
UA	AW-06	Sulfate, total	mg/L	23	0	0	11/10/2015	11/06/2023	21.0	29.0	30.6	42.0
UA	AW-08	Boron, total	mg/L	31	0	0	11/09/2015	11/06/2023	0.0850	0.120	0.136	0.350
UA	AW-08	Sulfate, total	mg/L	31	11	35	11/09/2015	11/06/2023	<0.18	2.30	15.6	80.0
UA	AW-09	Boron, total	mg/L	23	0	0	11/10/2015	11/06/2023	0.100	0.310	0.461	1.30
UA	AW-09	Sulfate, total	mg/L	23	10	43	11/10/2015	11/06/2023	<0.18	1.00	10.1	37.0
UA	AW-10	Boron, total	mg/L	24	0	0	11/09/2015	11/06/2023	0.420	0.475	0.483	0.560
UA	AW-10	Sulfate, total	mg/L	24	19	79	11/09/2015	11/06/2023	<0.18	1.00	1.15	4.10
UA	AW-11	Boron, total	mg/L	23	0	0	11/09/2015	11/03/2023	0.180	0.230	0.233	0.300
UA	AW-11	Sulfate, total	mg/L	23	14	61	11/09/2015	11/03/2023	<0.18	1.00	1.28	4.90
UA	AW-14	Boron, total	mg/L	11	0	0	02/11/2021	11/03/2023	0.170	0.180	0.187	0.240
UA	AW-14	Sulfate, total	mg/L	11	2	18	02/11/2021	11/03/2023	<0.18	3.00	10.3	54.0
UA	AW-15	Boron, total	mg/L	9	0	0	02/12/2021	11/02/2023	0.300	0.400	0.411	0.570
UA	AW-15	Sulfate, total	mg/L	9	7	78	02/12/2021	11/02/2023	<0.18	1.00	0.639	1.00
UA	AW-16	Boron, total	mg/L	12	0	0	02/11/2021	11/02/2023	0.420	0.495	0.492	0.560
UA	AW-16	Sulfate, total	mg/L	12	9	75	02/11/2021	11/02/2023	<0.18	1.00	1.08	3.40
UA	AW-17	Boron, total	mg/L	12	0	0	02/11/2021	11/01/2023	0.400	0.435	0.435	0.480
UA	AW-17	Sulfate, total	mg/L	12	11	92	02/11/2021	11/01/2023	<0.18	1.00	0.730	<0.18
UA	AW-18	Boron, total	mg/L	12	0	0	02/11/2021	11/01/2023	0.330	1.20	1.28	3.00
UA	AW-18	Sulfate, total	mg/L	12	0	0	02/11/2021	11/01/2023	3.20	7.95	10.5	28.0
UA	AW-19	Boron, total	mg/L	12	0	0	02/11/2021	11/01/2023	2.30	2.65	2.71	3.20
UA	AW-19	Sulfate, total	mg/L	12	0	0	02/11/2021	11/01/2023	26.0	36.5	38.8	57.0
UA	AW-20	Boron, total	mg/L	8	0	0	02/11/2021	11/01/2023	2.10	2.30	2.59	3.40
UA	AW-20	Sulfate, total	mg/L	8	0	0	02/11/2021	11/01/2023	39.0	46.5	48.4	59.0
UA	AW-21	Boron, total	mg/L	12	0	0	02/11/2021	11/02/2023	8.70	12.0	11.5	13.0
UA	AW-21	Sulfate, total	mg/L	12	0	0	02/11/2021	11/02/2023	41.0	250	233	280
UA	AW-23	Boron, total	mg/L	6	0	0	11/21/2022	11/03/2023	0.480	0.550	0.542	0.600
UA	AW-23	Sulfate, total	mg/L	6	0	0	11/21/2022	11/03/2023	180	200	200	230
UA	EMW-05	Boron, total	mg/L	6	0	0	11/18/2022	11/03/2023	0.320	0.760	0.835	1.50
UA	EMW-05	Sulfate, total	mg/L	6	0	0	11/18/2022	11/03/2023	120	125	125	130

Notes:
< = less than the method detection limit
CCR = Coal Combustion Residuals
HSU = Hydrostratigraphic Unit
mg/L = milligrams per liter
PMP = Potential Migration Pathway
UA = Uppermost Aquifer

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FIGURES

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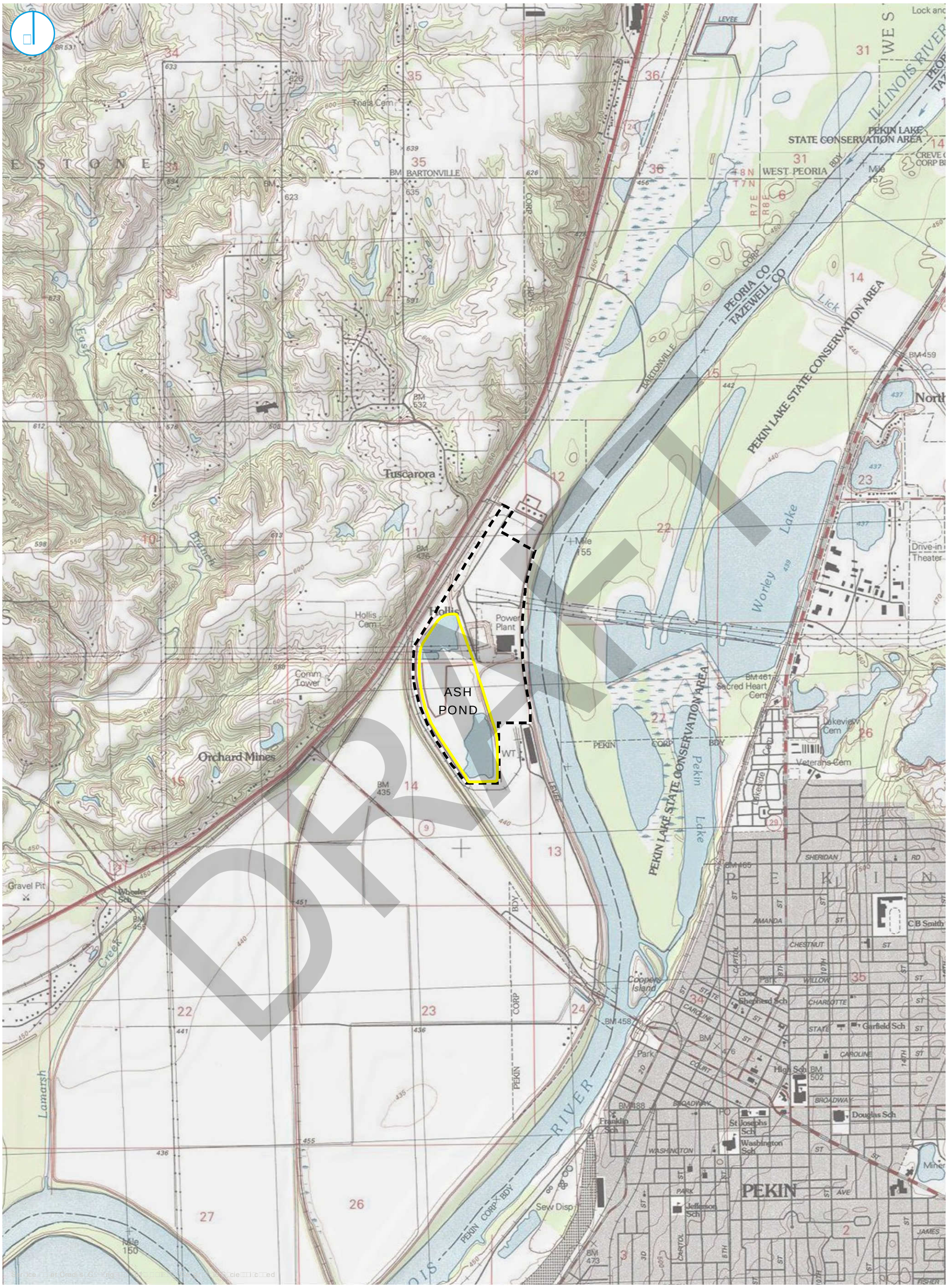

R□G□□A□□D □□I□ □S□□□□C□ □□I□□

PR□P□R□□ □□□□DAR□

SITE LOCATION MAP

FIGURE 2-1

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NATURE AND EXTENT REPORT
ASH POND
□D□ ARDS P□□ □R P□A□□
□AR□□ □□I□□□□I□□I□□IS

RAM□□ □□ AM□RICAS
□□GI□□□RI□G S□ □□□I□□S□I□C.

RAMBOLL



R□G□□A□□D □□I□ □S□□□□C□ □□I□□

□□RM□R □RC□ARD MI□□S AR□A

PR□P□R□□ □□□□DAR□

0 □□0 □00

□ee□

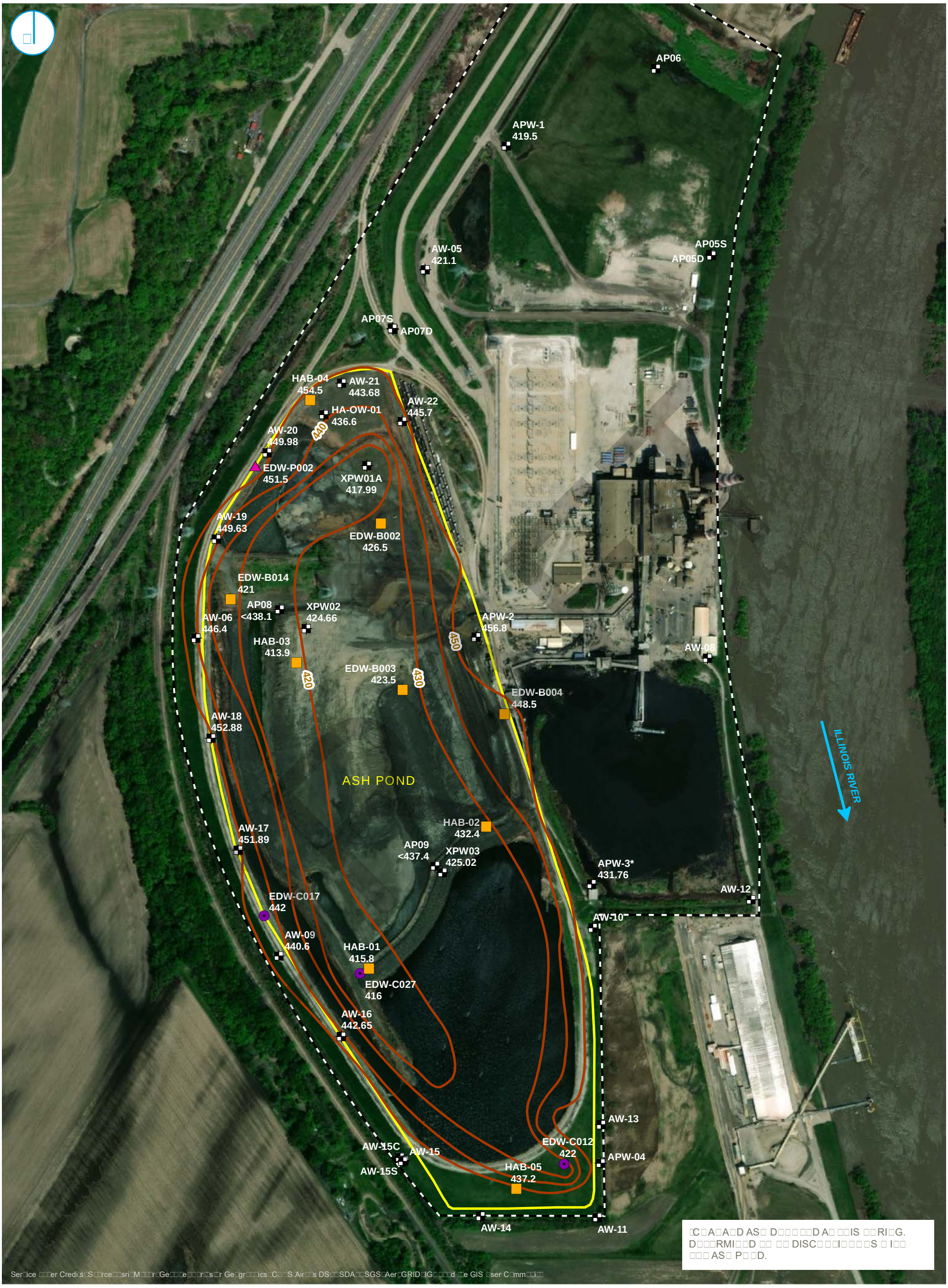
SITE MAP

NATURE AND EXTENT REPORT
ASH POND
□D□ ARDS P□□ □R P□A□□
□AR□□ □□I□□□□I□□I□□IS

FIGURE 2-2

RAM□□ □□ AM□RICAS
□□GI□□□RI□G S□ □□□I□□S□I□C.

RAMBOLL



□□RI□G
M□□I□□RI□G □ □□□ □□CA□I□□
CP□
PI□□□M□□□R
□□ □□□M □□AS□ □□□□A□I□□ C□□□□□R
R□G□□A□□D □□I□ □S□□□□C□ □□I□□
PR□P□R□□ □□□□DAR□

0 □00 □00
□ee□

NOTE:
□□□□A□I□□ C□ □□□□□RS S□□□ □ I□
□□□□□□□□R□□ AM□RICA□ □□R□ICA□
DA□□M □ □ 1□□□ □□A□D□□□

BASE OF CCR

NATURE AND EXTENT REPORT
ASH POND
□D□ARDS P□□ □R P□A□□
□AR□□ □□I□□□□I□□I□□IS

FIGURE 2-3

RAM□□ □□AM□RICAS
□□GI□□□RI□G S□ □□□I□□S□I□C.

RAMBOLL

APW-01
AP05S
EMW-05
AW-05
AP07S
AW-21
AW-20
XPW01A
SG-01
AW-19
XPW02
AW-06
AW-01
AW-08
AW-23
AW-18
ASH POND
ILLINOIS RIVER
AW-17
XPW03
AW-10
AW-09
AW-16
AW-15
AW-15S
AW-14
AW-11

Ser□ice □□□er Credi□s□S□□rce□□sri□M□□□r□□□r□□s□□r Ge□gr□□□ics□□□d □□e GIS □ser C□mm□□i□□

C□MP□A□C□ □ □□□
□AC□GR□□□D □ □□□
S□PP□□M□□□A□□ □□□
P□R□ □ A□□R □ □□□
S□A□□ GAG□□RI□□R

R□G□□A□□D □□I□ □S□□□C□□□I□□
PR□P□R□□ □□□□DAR□

MONITORING WELL LOCATION MAP

0 □00 □00
□ee□

NATURE AND EXTENT REPORT
ASH POND
□D□ ARDS P□□ □R P□A□□
□AR□□ □□I□□□□I□□I□□IS

FIGURE 2-4

RAM□□ □□AM□RICAS
□□GI□□□RI□G S□ □□□I□□S□I□C.

RAMBOLL

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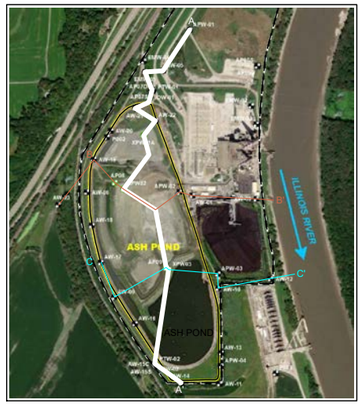
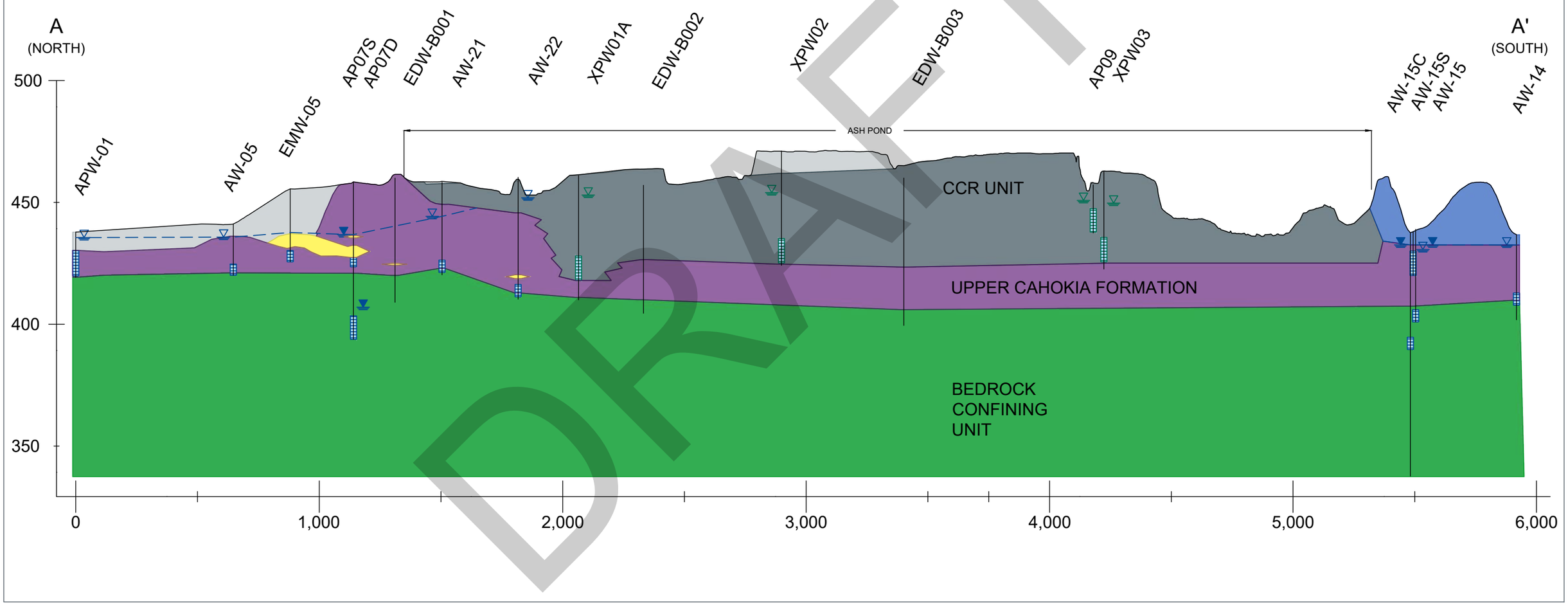


NOTES

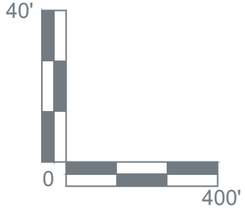
1. This profile was developed by interpolation between widely spaced boreholes. Only at the borehole location should it be considered as an approximately accurate representation and then only to the degree implied by the notes on the borehole logs.
2. Scale is approximate.
3. Vertical scale is exaggerated 10X.
4. Groundwater elevations measured February, 2023.

DRAFT



LEGEND

- COAL COMBUSTION RESIDUALS (CCR)
- FILL
- CLAY (CL/CH)
- SILT (ML)
- SAND (SP/SM/SW)
- BEDROCK / WEATHERED BEDROCK (INTERBEDDED SHALE, LIMESTONE, SANDSTONE, VERY LITTLE SANDSTONE)
- WELL SCREEN INTERVAL
- UPPERMOST AQUIFER POTENTIOMETRIC SURFACE
- UPPER AQUIFER GROUNDWATER ELEVATION
- POREWATER ELEVATION
- BEDROCK GROUNDWATER / OTHER GROUNDWATER / SURFACE WATER ELEVATION(S)



GEOLOGIC CROSS SECTION A-A'

NATURE AND EXTENT REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 2-5

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

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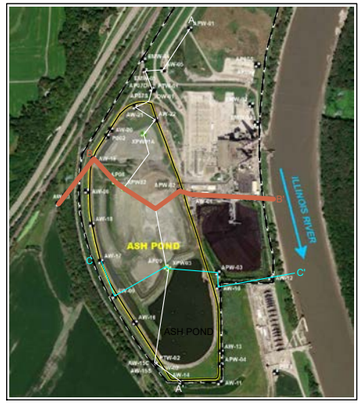
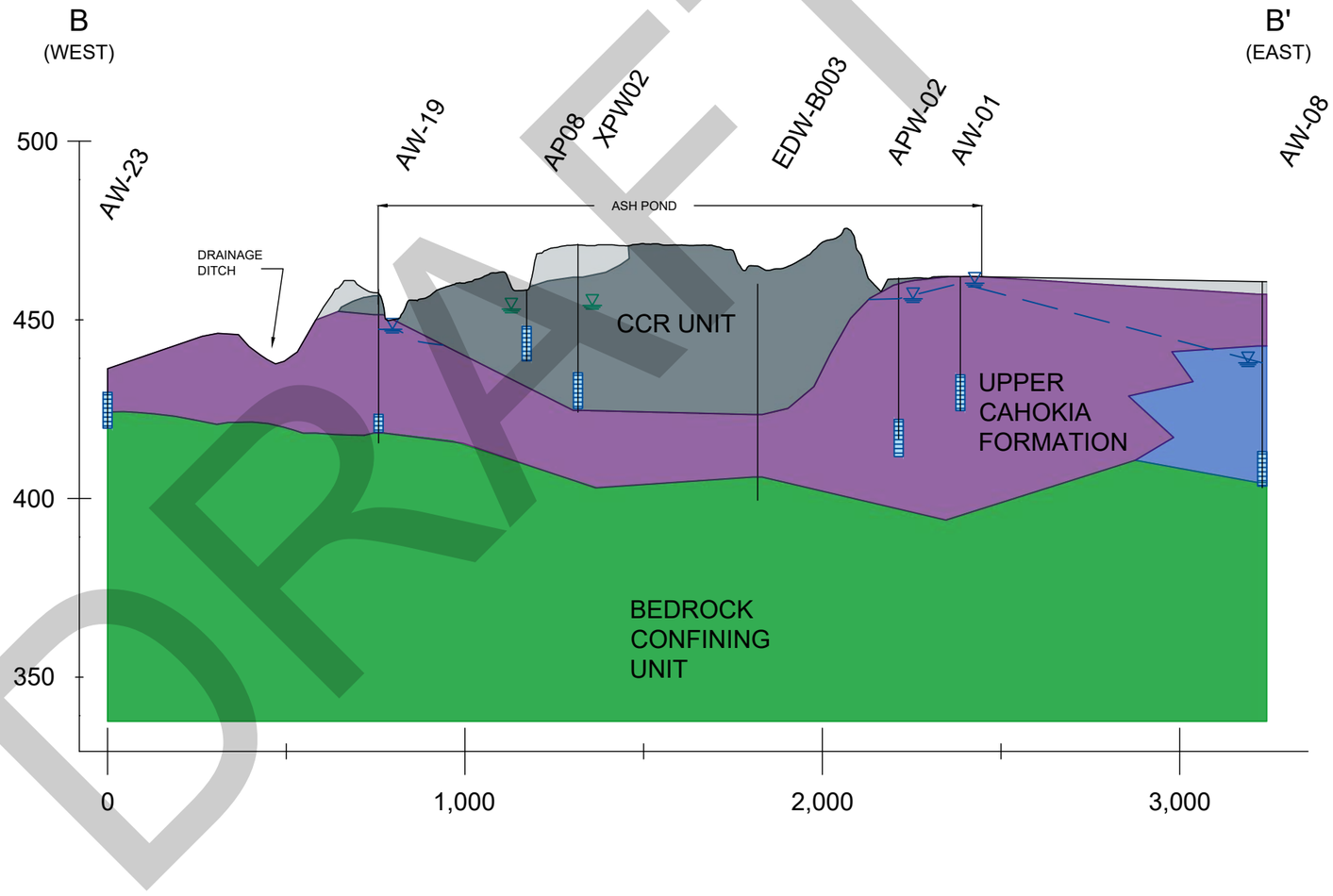
PROJECT: 1940100806 DATED: 6/9/2023 4:36 PM DESIGNER: LEMMONBN



NOTES

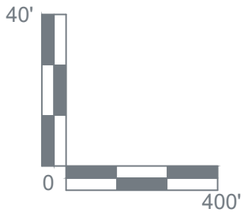
1. This profile was developed by interpolation between widely spaced boreholes. Only at the borehole location should it be considered as an approximately accurate representation and then only to the degree implied by the notes on the borehole logs.
2. Scale is approximate.
3. Vertical scale is exaggerated 10X.
4. Groundwater elevations measured February, 2023.



DRAFT

LEGEND

- COAL COMBUSTION RESIDUALS (CCR)
- FILL
- CLAY (CL/CH)
- SILT (ML)
- SAND (SP/SM/SW)
- BEDROCK / WEATHERED BEDROCK (INTERBEDDED SHALE, LIMESTONE, SANDSTONE, VERY LITTLE SANDSTONE)
- WELL SCREEN INTERVAL
- UPPERMOST AQUIFER POTENTIOMETRIC SURFACE
- UPPER AQUIFER GROUNDWATER ELEVATION
- POREWATER ELEVATION
- BEDROCK GROUNDWATER / OTHER GROUNDWATER / SURFACE WATER ELEVATION(S)



GEOLOGIC CROSS SECTION B-B'

NATURE AND EXTENT REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 2-6

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

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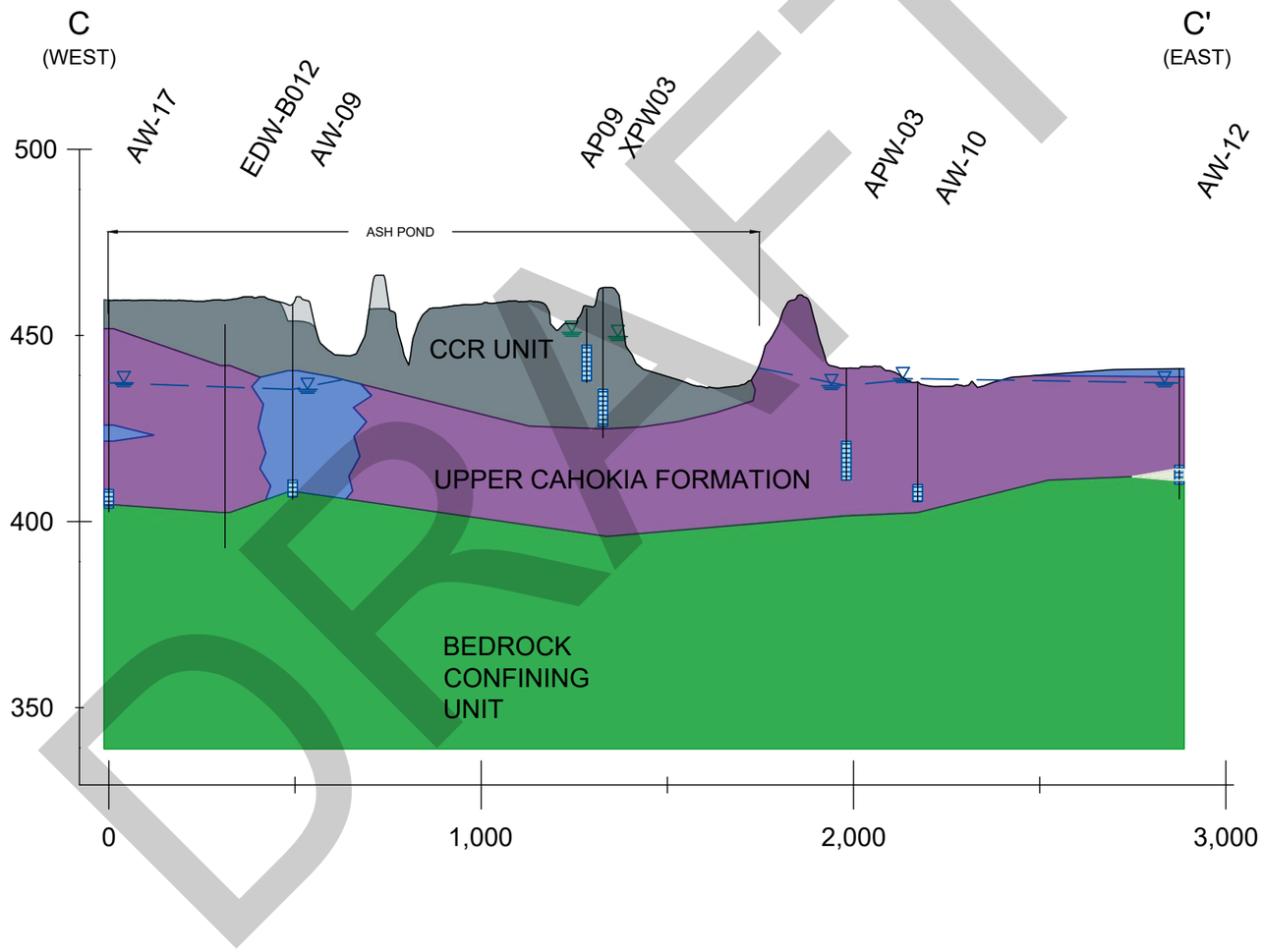
PROJECT: 1940100806 DATED: 6/9/2023 4:36 PM DESIGNER: LEMMONBN



NOTES

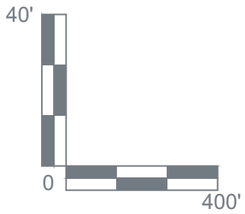
1. This profile was developed by interpolation between widely spaced boreholes. Only at the borehole location should it be considered as an approximately accurate representation and then only to the degree implied by the notes on the borehole logs.
2. Scale is approximate.
3. Vertical scale is exaggerated 10X.
4. Groundwater elevations measured February, 2023.



DRAFT

LEGEND

- COAL COMBUSTION RESIDUALS (CCR)
- FILL
- CLAY (CL/CH)
- SILT (ML)
- GRAVEL (GP/GW)
- BEDROCK / WEATHERED BEDROCK (INTERBEDDED SHALE, LIMESTONE, SANDSTONE, VERY LITTLE SANDSTONE)
- WELL SCREEN INTERVAL
- UPPERMOST AQUIFER POTENTIOMETRIC SURFACE
- UPPER AQUIFER GROUNDWATER ELEVATION
- POREWATER ELEVATION
- BEDROCK GROUNDWATER / OTHER GROUNDWATER / SURFACE WATER ELEVATION(S)



GEOLOGIC CROSS SECTION C-C'

NATURE AND EXTENT REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 2-7

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

AP06
<414.5

APW-1
419.6

AW-05
421.1

AP05D
404.2

AP07D
419.6

EDW-B001
420

HAB-04
<441.8

AW-21
422.88

AW-22
412.80

HA-OW-01
<421.1

AW-20
418.28

XPW01A
410.99

EDW-B002
410

AW-19
418.33

EDW-B014
415.5

XPW02
<424.16

AW-06
419.7

HAB-03
406.9

APW-2
<411.8

AW-08
404.5

EDW-B004
405

AW-18
410.48

ASH POND

HAB-02
<419.9

AW-17
404.59

XPW03
<422.62

APW-3
<411.2

AW-12
411.16

AW-10
406.9

AW-09
406

HAB-01
399

AW-16
400.95

AW-13
409.67

AW-15C
407.42

APW-4
<453.3

HAB-05
<417.7

AW-14
409.83

AW-11
408.3

420
416
412
408
406
404
410

ILLINOIS RIVER

Ser□ice □□□er Credi□s□S□□rce□□sri□M□□□r□Ge□□□e□□□r□□s□r Ge□gr□□□ics□C□□S Air□□s DS□□SDA□□SGS□Aer□GRID□IG□□□□d □□e GIS □ser C□mm□□i□□

□□RI□GS

M□□I□□RI□G □ □□□

□□DR□C□ □□□□A□I□□ C□□□□□R □1□□□ I□□□R□A□□

PAR□ □□□ R□G□□A□□D □□I□ □S□□□□C□ □□I□□

PR□P□R□□ □□□□DAR□

NOTE:
□□□□A□I□□ C□□□□□RS S□□□ □ I□
□□□□□□□R□□ AM□RICA□ □□R□ICA□
DA□□M □□1□□□ □□A□D□□□

TOP OF BEDROCK

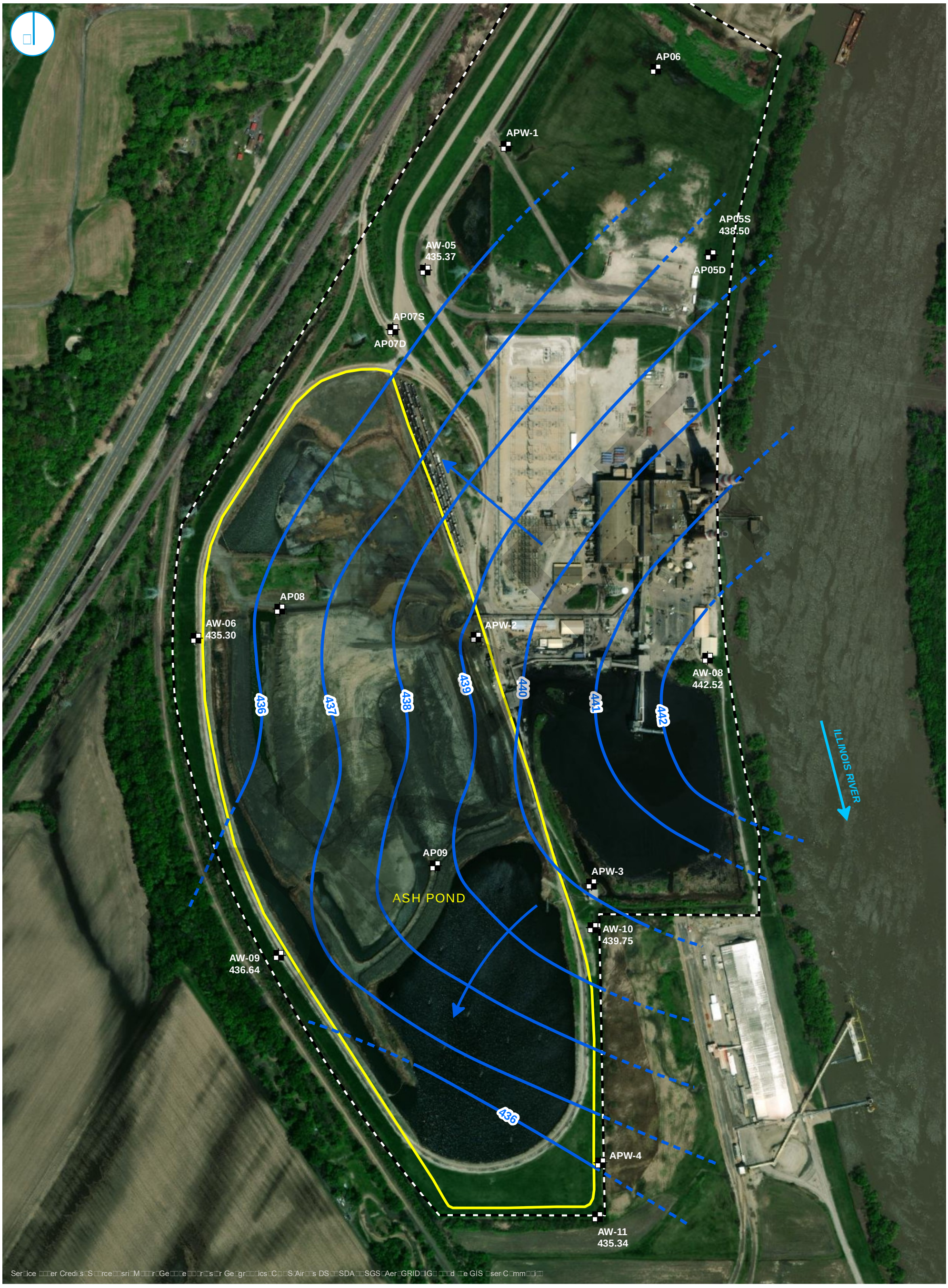
FIGURE 2-8

0 □00 □00
□ee□

NATURE AND EXTENT REPORT
ASH POND
□D□ARDS P□□ □R P□A□□
□AR□□ □□I□□□□I□□I□□IS

RAM□□ □□ AM□RICAS
□□GI□□□RI□G S□ □□ □I□□S□I□C.

RAMBOLL



M□□I□□RI□G □ □□□

I□□□RPR□□□D □□P □ □ □PP□RM□S□A□□I□□R □□□□□
P□RC□□□I□□ GR□□□D□ A□□R □□□□A□I□□ C□□□□□RS□□01□□

I□□□RR□D □□P □ □ □PP□RM□S□A□□I□□R C□□□□□R

GR□□□D□ A□□R □□□□ DIR□C□I□□

R□G□□A□□D □□I□ □S□□□□C□ □□I□□

PR□P□R□□ □□□□DAR□

0 □00 □00
□ee□

TOP OF UPPERMOST AQUIFER

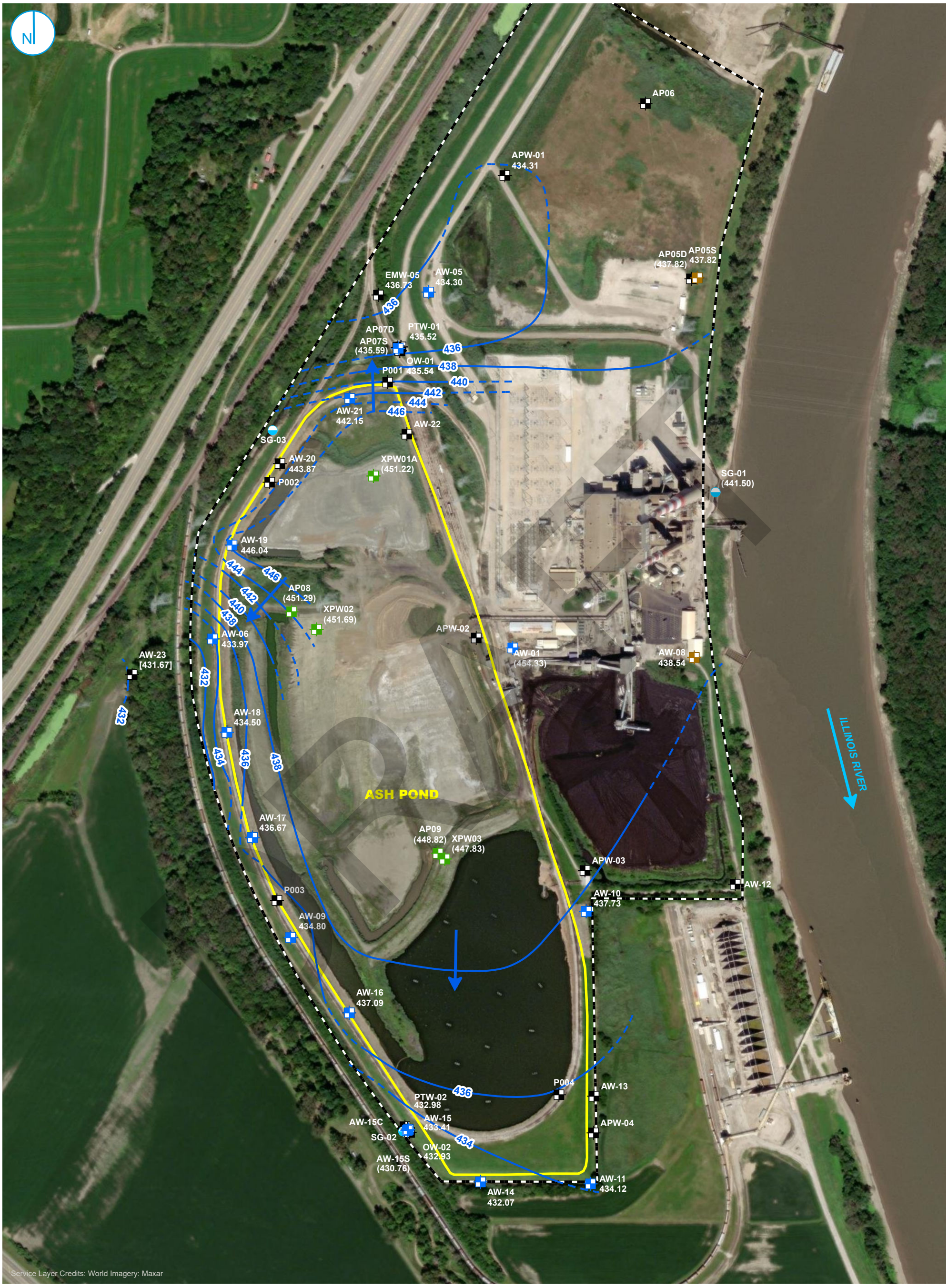
NATURE AND EXTENT REPORT
ASH POND

□D□ ARDS P□□ □R P□A□□
□AR□□ □□I□□□□I□□I□□IS

FIGURE 2-9

RAM□□ □□ AM□RICAS
□□GI□□□RI□G S□ □□ □I□□S□I□C.

RAMBOLL



COMPLIANCE MONITORING WELL
BACKGROUND MONITORING WELL
MONITORING WELL
PORE WATER WELL
STAFF GAGE, RIVER

GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
INFERRED GROUNDWATER ELEVATION CONTOUR
GROUNDWATER FLOW DIRECTION
REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY

0 212.5 425 Feet

NOTES
1. ELEVATIONS IN PARENTHESES WERE NOT USED FOR CONTOURING.
2. ELEVATION CONTOURS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. ELEVATIONS IN BRACKETS WERE OBTAINED OUTSIDE OF THE 24-HOUR PERIOD FROM INITIATION OF DEPTH TO GROUNDWATER MEASUREMENTS BUT WITHIN THE SAME SAMPLING EVENT.

UPPERMOST AQUIFER POTENTIOMETRIC SURFACE MAP JUNE 12, 2023 (E001)

NATURE AND EXTENT REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 2-10

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



COMPLIANCE WELL WITH T□ □A□ □□R□□ □□C□□DA□C□

S□PP□□M□□□A□□ □□□□ I□□ □□□A□ □□R□□ □□C□□DA□C□

C□MP□IA□C□ □ □□□□ I□□□□□ □□C□□DA□C□

S□PP□□M□□□A□□ □□□□ I□□□□□ □□C□□DA□C□

R□G□□A□□D □□I□ □S□□□□C□ □□I□□

PR□P□R□□ □□□□DAR□

0 □1□.□ □□□

□ee□

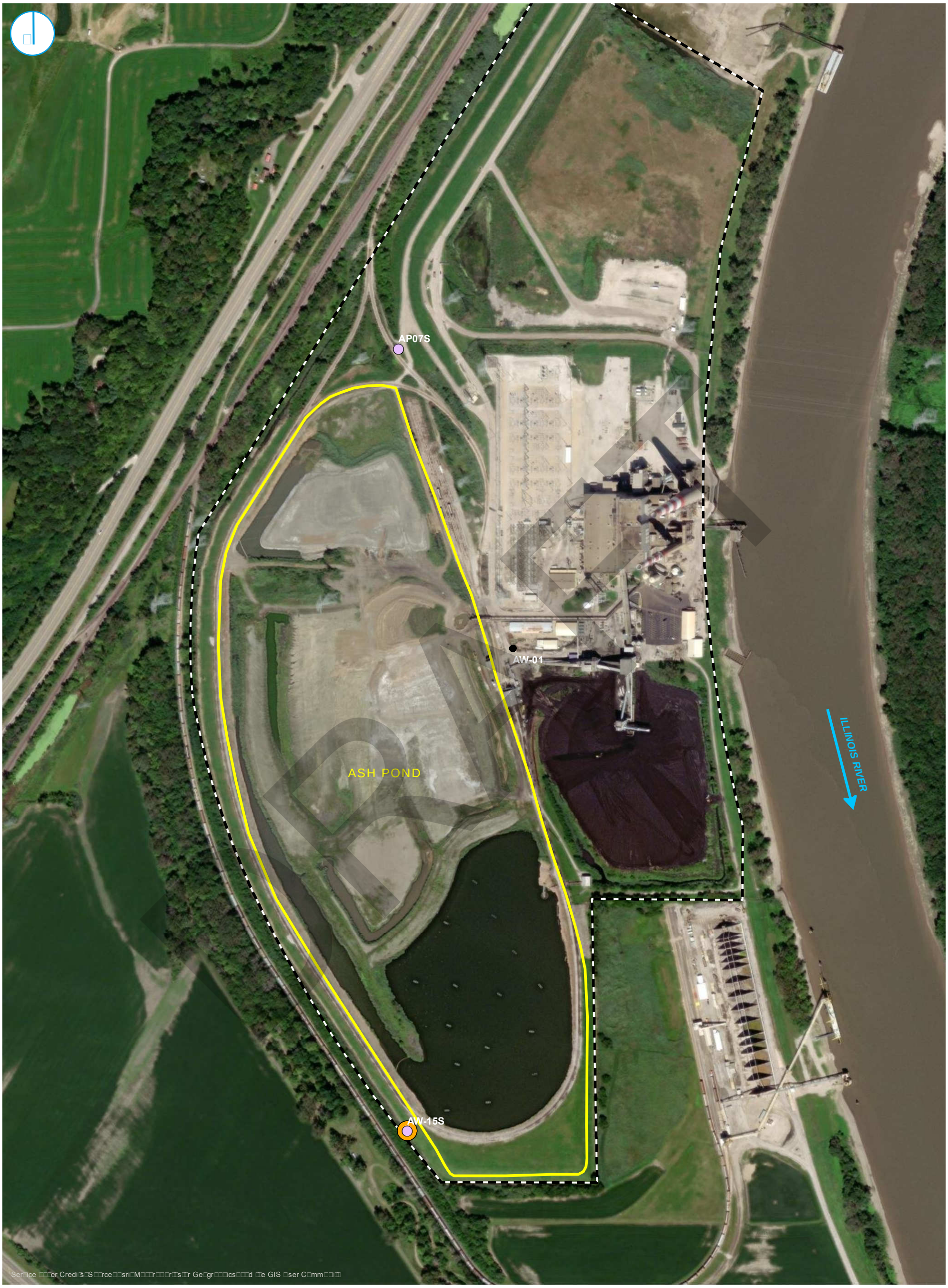
GWPS EXCEEDANCE MAP - UPPERMOST AQUIFER

FIGURE 3-1

NATURE AND EXTENT REPORT
ASH POND
□D□ ARDS P□□ □R P□A□□
□AR□□ □□I□□□□I□□I□□IS

RAM□□ □□AM□RICAS
□□GI□□□RI□G S□ □□□I□□S□I□C.

RAMBOLL



□□ □A□ □□R□□ □□C□□DA□C□

□□ □A□ S□□□A□□ □□C□□DA□C□

C□MP□IA□C□ □ □□□ □ I□□□□□ □□C□□DA□C□

R□G□□A□□D □□I□ □S□□□□C□ □ □I□□

PR□P□R□□ □□□□DAR□

0 □1□.□ □□□

□ee□

GWPS EXCEEDANCE MAP
POTENTIAL MIGRATION PATHWAY

NATURE AND EXTENT REPORT
ASH POND

□D□ ARDS P□ □ □R P□A□□
□AR□□ □□I□□□□I□□I□□IS

FIGURE 3-2

RAM□□ □□AM□RICAS
□□GI□□□RI□G S□ □□□I□□S□I□C.

RAMBOLL

APPENDICES

DRAFT

APPENDIX A
CCR Geotechnical and Analytical Results

DRAFT

TABLE 2-1. GEOTECHNICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, ILLINOIS

Sample Location	Field Location ID	Top of Sample (ft bgs)	Bottom of Sample (ft bgs)	Moisture Content (%)	Dry Density (pcf)	Specific Gravity	Total Porosity [1]	Vertical Hydraulic Conductivity (cm/s)	LL	PL	PI	Laboratory USCS	Gravel (%)	Sand (%)	Fines (%)
CCR															
XPW01 (20-22)	XPW01	20	22	43.7	69.8	2.381	53%	1.18E-05	51	53	NP	SM	0	68.9	31.1
XPW01A (41-41.5)	XPW01A	41	41.5	35.1	71.7	2.378	52%	6.77E-06	60	43	17	MH	0	13.7	86.3
XPW02 (10-12)	XPW02	10	12	45.1	67.5	2.414	55%	1.20E-05	52	47	5	MH	0.5	28.1	71.4
XPW02 (22-24)	XPW02	22	24	33.4	77.1	2.335	47%	2.08E-06	38	30	8	ML	0	4.1	95.9
XPW02 (45.5-46.5)	XPW02	45.5	46.5	41.7	73.5	2.397	51%	1.00E-05	39	33	6	ML	0.1	37.4	62.5
XPW03 (10-12)	XPW03	10	12	43.8	68	2.388	54%	3.29E-05	36	29	7	ML	0.4	27.2	72.4
Upper Cahokia Formation															
AW-13A (5-7)	AW-13A	5	7	25.2	96.5	2.661	42%	4.72E-08	30	14	16	CL	0	30.3	69.7
AW-15 (20-22)	AW-15	20	22	27.9	85.8	2.694	49%	2.87E-08	57	19	38	CH	0	2.0	98
AW-20 (15-17)	AW-20	15	17	35.1	83.9	2.690	50%	7.23E-08	47	18	29	CL	0	7.8	92.2
AW-22 (30-32)	AW-22	30	32	23.2	101.3	2.700	40%	1.74E-07	22	13	9	SC	0	57.4	42.6

[O:LTA 7/13/21, U: SSW 08/13/21; C:CJC 08/16/21; U: LDC 09/16/21; C: SSW 09/16/21]

Notes:

[1] Porosity calculated as relationship of bulk density to particle density ($n = 100[1- (p_b/p_d)]$)
bgs = below ground surface
% = Percent
CCR = coal combustion residuals
cm/s = centimeters per second
ft = foot/feet
LL = Liquid limit
NP = Non Plastic
pcf = pounds per cubic foot
PI = Plasticity Index
PL = Plastic Limit

USCS = Unified Soil Classification System
CH = Fat Clay
CL = Lean Clay
MH = Elastic Silt
ML = Silt
SC = Clayey Sand
SM = Silty Sand
SP = Poorly Graded-Sand

DRAFT

TABLE 2-2. ASH ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, ILLINOIS

Sample Location	Sample Depth (ft BGS)	Sample Date	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Boron (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Lead (mg/kg)	Lithium (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Selenium (mg/kg)	Thallium (mg/kg)
XPW01	17-19	01/08/2021	<6.6	24	840	4	170	7.5	67	11	90	47	<0.44	25	4.9	<2.2
XPW01A	40.5-42.5	01/08/2021	<7	22	190	4.7	700	11	37	4.7	93	<12	<0.46	11	4	<2.3
XPW02	24-25	01/09/2021	20	72	160	6.8	400	2.3	60	19	76	20	<0.32	7	5.5	<1.6
XPW02	43-45	01/09/2021	8.9	42	94	8.3	840	8.5	84	19	140	<91	<0.36	14	6.5	2.1
XPW03	13-15	01/09/2021	<5.5	8	1300	2.2	500	<1.8	27	6.1	14	33	<0.37	3.2	2.2	<1.8
XPW03	35-37	01/09/2021	<7	37	600	5.8	970	20	65	8	130	20	<0.47	11	3.6	<2.3

Notes:
< = concentration is less than the concentration shown, which corresponds to the reporting limit for the method.
BGS = below ground surface
ft = feet
mg/kg = milligrams per kilogram

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APPENDIX B
2023 Supplemental Site Investigation Report

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Prepared for

Illinois Power Resources Generating, LLC

Date

December 1, 2023

Project No.

1940102792

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2023 SUPPLEMENTAL SITE INVESTIGATION REPORT

ASH POND

EDWARDS POWER PLANT

BARTONVILLE, ILLINOIS

RAMBOLL Bright ideas. Sustainable change.

2023 SUPPLEMENTAL SITE INVESTIGATION REPORT
EDWARDS POWER PLANT ASH POND

Project name	**Edwards Power Plant Ash Pond**
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Description	**Supplemental Site Investigation Report**

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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
AP	Ash Pond, also referred to as Site
bgs	below ground surface
CCR	coal combustion residuals
CMA	Corrective Measures Assessment
CRT	constant-rate test
CSM	conceptual site model
DO	dissolved oxygen
EPP	Edwards Power Plant
ft^2/d	feet square per day
GPRS	Ground Penetrating Radar Systems
gpm	gallons per minute
GWPS	groundwater protection standard
HCR	Hydrogeologic Site Characterization Report
ID	identification
IEPA	Illinois Environmental Protection Agency
IPRG	Illinois Power Resources Generating, LLC
JULIE	Joint Utility Locating Information Excavators
MET	Midwest Engineering and Testing, Inc.
mg/L	milligrams per liter
NAVD88	North American Vertical Datum of 1988
NID	National Inventory of Dams
No.	number
NRT	Natural Resource Technology
NRT/OBG	Natural Resource Technology, an OBG Company
NTU	Nephelometric Turbidity Units
Pace	Pace Analytical Services, LLC
PMP	potential migration pathway
PVC	polyvinyl chloride
Ramboll	Ramboll Americas Engineering Solutions, Inc.
SAP	Multi-Site Sampling and Analysis Plan
SI	surface impoundment
SSI	Supplemental Site Investigation
UA	uppermost aquifer
USCS	Unified Soil Classification System

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1. INTRODUCTION

1.1 Overview

Ramboll Americas Engineering Solutions, Inc. (Ramboll) has prepared this Supplemental Site Investigation (SSI) report on behalf of Edwards Power Plant (EPP), operated by Illinois Power Resources Generating, LLC (IPRG), to document SSI efforts and additional groundwater monitoring completed in September 2021 through February 2023.

This SSI report applies specifically to the coal combustion residuals (CCR) surface impoundment (SI) referred to as the Ash Pond (AP) (CCR unit identification [ID] Number [No.] 301, Illinois Environmental Protection Agency [IEPA] ID No. W1438050005-01, and National Inventory of Dams [NID] No. IL50710). The AP is a 91-acre unlined CCR SI used to manage CCR and non-CCR waste streams at the EPP.

Sampling completed to establish background in accordance with Title 35 of the Illinois Administrative Code (35 I.A.C) § 845.600 found potential exceedances of boron above the anticipated site-specific groundwater protection standard (GWPS) associated with the AP as provided in the Initial Operating Permit (Burns & McDonnell, 2021). The objective of this SSI was to further assess the nature, degree, and extent of boron groundwater impacts downgradient (west and north) of the AP. This includes wells installed by Golder in 2021, as well as the expansion of the study area onto an adjacent property west of the Site. Field efforts documented in this report include groundwater monitoring well installation, aquifer testing to further characterize the hydraulic conductivity of the uppermost aquifer (UA), and groundwater analytical sampling from the monitoring well network.

1.2 Site Location and Background

The EPP is located in Peoria County between Mapleton and Bartonville, Illinois in Section 11, Township 7 North, Range 7 East (**Figure 1-1**). The EPP is located on the floodplain of the Illinois River adjacent to a levee and has one CCR SI, the AP.

The EPP is situated in a predominantly agricultural area with industrial properties bordering the property. Historically, several coal mines were operated at depths of 100 to 160 feet below ground surface (bgs) in the vicinity of the EPP. The EPP property is bordered by a salt processing facility to the north, railroad right-of-way and former Orchard Mines to the west, the Illinois River and a fertilizer production facility to the east, and agricultural land to the south. **Figure 1-1** shows the location of the EPP and surrounding area; **Figure 1-2** is a site map showing the location of the AP. The AP will hereinafter be referred to as the Site.

1.3 Conceptual Site Model

Multiple site investigations have been completed at the EPP to characterize the geology, hydrogeology, and groundwater quality as required by Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257.91 (Groundwater Monitoring Systems). The AP has been well characterized and detailed in the Hydrogeologic Site Characterization Report (HCR) (Ramboll, 2021) [https://www.luminant.com/ccr/illinois-ccr/?dir=il-ccr%2FEdwards%2F2021], that was included with the Operating Permit application submitted to IEPA. The HCR was prepared to comply with the requirements specified in 35 I.A.C. § 845.620 and expands upon the Hydrogeologic

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Monitoring Plan (Natural Resource Technology, an OBG Company [NRT/OBG], 2017). A conceptual site model (CSM) has been developed and is discussed below.

The Site is characterized by four distinct water bearing units:

- **CCR:** Saturated CCR consisting primarily of fly ash within the AP. CCR is present at thicknesses up to 46.5 feet and at elevations as low as 413.9 feet North American Vertical Datum of 1988 (NAVD88) in the central and northern portion of the AP.
- **Upper Cahokia Formation/Potential Migration Pathway (PMP):** Low permeability clays and silts of the Upper Cahokia Formation are present at the surface. This unit is considered a PMP at elevations similar to the base of the AP, and in places where thin discontinuous sand lenses occur within the Upper Cahokia Formation adjacent to the AP.
- **Uppermost Aquifer (UA):** Thin (generally less than 4 feet), moderate permeability sand, silty sand, and clayey gravel material within the Lower Cahokia Formation, bedrock, and/or weathered shale bedrock, where present. In locations where higher permeability materials and coarser grained materials are absent, the UA is interpreted as the interface between the Lower Cahokia Formation and shale bedrock.
- **Bedrock Confining Unit:** Thick, very low permeability shales and siltstones of the Carbondale and Modesto Formations. This unit was encountered at elevations ranging from approximately 400 to 422 feet NAVD88 with higher bedrock elevations occurring beneath the northern portion of the AP.

In general, the Upper Cahokia Formation consists of low permeability clays and silts, with limited occurrences of thin discontinuous sand lenses. In several locations, generally near the southern and western portions of the unit, coarser grained materials are present at the base of the Lower Cahokia Formation and/or the top of the bedrock is weathered, resulting in relatively higher hydraulic conductivities. Because the interface is laterally continuous, and has relatively higher conductivity, the unlithified/lithified contact was designated as the UA.

Occasional sand lenses within the Upper Cahokia Formation, and clay intervals downgradient at elevations similar to the base of ash in the AP were identified as PMPs. The underlying bedrock is interpreted as the lower confining unit and, in general, has hydraulic conductivities an order of magnitude lower than those measured in the UA.

Groundwater occurs within both the unlithified materials and bedrock and consistently flows from east to west/southwest at the central portion of the AP towards what is interpreted as a former channel of the Illinois River, and south/southeast at the south end of the AP (**Figure 1-3**). In the northernmost portion of the AP, there is a minor northwest and northern component of flow in both the UA and PMP. The unlithified/lithified contact designated as the UA onsite may be hydraulically connected to the sands of the Sankoty Aquifer identified offsite (Ramboll, 2022). Upward vertical gradients have been calculated between the bedrock and the UA, indicating the Illinois River may be the receiving body of water for groundwater in bedrock near the AP.

Additional monitoring wells were installed in 2021 and 2022 and groundwater samples were collected from the newly installed wells and existing wells within the 35 I.A.C § 845 network. The additional monitoring wells were installed for further hydrogeologic investigation and water quality delineation. Monitoring well locations are shown on **Figure 1-4**.

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2. HYDROGEOLOGIC EVALUATION FIELD ACTIVITIES

Investigation activities completed between 2009 and February 2023 are discussed herein. Recent investigations were completed to the north and west in response to boron exceedances that have been identified in groundwater migrating in those directions. This report documents field activities completed to provide further delineation of the extent of boron in groundwater and characterize hydrogeologic conditions at the Site.

The following sections summarize the field activities completed to further delineate the extent of boron in groundwater between February 2022 and February 2023. Prior to field activities in 2022, IPRG sent letters to owners of adjacent properties requesting access to install wells and evaluate the extent of boron concentrations (**Appendix A**). A response was received from only one property owner located west of the AP. One well (AW-23) was installed on this property in October 2022. An additional four wells, including two observation wells (OW-01, OW-02) and two pumping wells (PTW-01, PTW-02) were installed during October 2022 to facilitate aquifer testing in the UA.

Further delineation of the boron concentrations was provided by pre-existing wells that were installed by Golder (AW-01 and EMW-05) as shown on **Figure 1-4**. These wells were previously installed in September 2021 and were incorporated into the supplemental site investigation to evaluate the extent of boron concentrations along northern and eastern edges of the AP.

2.1 Drilling and Well Installation Methods

For wells installed in 2022, Ramboll retained Midwest Engineering and Testing, Inc. (MET), a licensed drilling contractor in the state of Illinois, to advance soil borings and install monitoring wells at each boring location. Prior to drilling, all locations were cleared by Joint Utility Locating Information Excavators (JULIE) and Ground Penetrating Radar Systems (GPRS). GPRS utilized an underground scanning ground penetrating radar antenna and an electromagnetic pipe and cable locator to clear a 30-foot radius around each planned boring location.

A drill rig mounted onto an all-terrain vehicle was used to advance the borings. Borings were drilled using a hollow-stem auger. Soil lithology was logged in accordance with the Unified Soil Classification System (USCS) and other observations were noted in the attached boring logs (**Appendix B**). The wells were completed at depths ranging from 16 to 39.5 feet bgs. Well construction details are provided in **Table 2-1**.

2.2 Monitoring and Observation Well Installation

The monitoring and observations wells were constructed using 2-inch diameter, Schedule 40 polyvinyl chloride (PVC) casing and set with a ten-foot PVC screen (five-foot PVC screen at well EMW-05) with a slot width of 0.010 inches. Monitoring well AW-23 was installed with a sand pack around the screen extending to approximately one foot above the top of the screen. Monitoring wells AW-01 and EMW-05 were installed with a sand pack around the screen extending to approximately two feet above the top of the screen. The observation wells were installed with a sand pack around the screen extending to approximately three feet above the top of the screen and at observation well OW-01, approximately two feet of #45-55 fine-grained sand was placed above the sand pack The wells were sealed with bentonite chips or a high solids bentonite grout extending to the ground surface. Riser pipes extend an estimated two feet (AW-23) or three feet (OW-01 and OW-02) above the ground surface and are protected with steel casing, a cement

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pad, and three steel bollards. Riser pipes for wells AW-01 and EMW-05 extend an estimated two feet above the ground surface and are protected with aluminum casing, a cement pad, and three steel bollards. Wells are protected from vandalism via J-plug caps and locks. Refer to **Table 2-1** for well construction details. Monitoring well construction forms are included in **Appendix C**.

2.3 Pumping Well Installation

The pumping wells (PTW-01 and PTW-02) were constructed using 4-inch diameter, Schedule 40 PVC casing and set with a ten-foot PVC screen with a slot width of 0.010 inches. A sand pack of #5 sand was placed around the screen extending approximately three feet above the top of the screen at pumping well PTW-01 and five feet above the top of the screen at pumping well PTW-02. In addition, at pumping well PTW-01, two feet of a finer grain sand was placed above the coarse sand pack. The wells were sealed with bentonite chips extending to the ground surface. The riser extends to approximately three feet above the ground surface and is protected with steel casing, a cement pad, and three steel bollards. The wells are protected from vandalism with J-plug caps and locks.

2.4 Well Development

Ramboll developed all monitoring, observation, and pumping wells via submersible pump. Development was completed a minimum of 24 hours following well installation. Wells were surged and pumped until the turbidity was below 100 Nephelometric Turbidity Units (NTU) or at least five well volumes were extracted. Geochemical field parameters (pH, dissolved oxygen [DO], temperature, specific conductance) were also monitored and logged throughout the development process. The volume of water extracted and the depth to water in the well prior to and after development was noted on the well development forms, included in **Appendix D**.

2.5 Monitoring Well Sampling

Three rounds of initial groundwater sampling were performed monthly at AW-01, AW-23, and EMW-05 from November 2022 through January 2023 in accordance with the Multi-Site Sampling and Analysis Plan (SAP) (Ramboll, 2022a). These events were supplemented by sampling that occurred in February 2023. Sampling was performed using a low-flow sampling method. Episodic water level readings were taken on the last day of sample collection for the November and December 2022 sampling events, while the readings for the January 2023 sampling event were taken prior to the first day of sample collection. Groundwater elevation readings from the initial rounds along with additional groundwater elevation readings from February 2023 are included in **Table 2-2**. Groundwater sampling field forms including purge records for the initial three rounds are included in **Appendix E** and the February 2023 purge records are included along with the analytical laboratory reports in **Appendix F**.

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3. PUMP TEST EVALUATION

Following installation and development of PTW-01 and PTW-02, constant-rate tests (CRTs) were performed at pumping well PTW-01 on October 25 and October 26, 2022, and at PTW-02 on October 28, 2022. Water levels were monitored during the tests in nearby observation and monitoring wells by in-well pressure transducers throughout the length of the tests.

The constant-rate tests performed at wells PTW-01 and PTW-02 did not fully identify appropriate well yields due to continued drawdown at pumped rates of 0.25 gallons per minute (gpm) and 1 gpm. Lower pumping rates were not sustainable with the field equipment utilized and the constant rate tests were terminated early due to the drawdown and presence of methane gas in both of the pumping wells. Sustainable yield at these locations may be much lower than the tested rates. However, measurable drawdown was identified at nearby observation wells and used to develop estimates of transmissivity and storativity for the geologic materials near the tested locations. Transmissivity calculated from the two pump tests ranged from 19 to 52 feet square per day (ft^2/d) and storativity ranged from 1.1×10^{-3} to 5×10^{-3}. Detailed information on the pump test procedures and results are included in **Appendix G**.

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4. ADDITIONAL SITE CHARACTERIZATION

4.1 Geologic Characterization

The lithology encountered during drilling of additional locations is documented in the attached boring logs (**Appendix B**) and visualized using geologic cross sections (**Figures 4-1, 4-2, and 4-3**). Consistent with previous investigations and the HCR (Ramboll, 2021), the following units were observed in investigation borings:

- The shallowest lithologies observed were clays and/or silts and are interpreted as the Upper Cahokia Formation. The formation is generally characterized by lean and fat clays with siltier portions along the southern portion of the Site (Ramboll, 2021). Thin discontinuous sand lenses (less than 5 feet) were noted in two locations (EMW-05 and PTW-01). These materials are considered PMPs within the study area and were encountered at depths of 19 feet bgs (EMW-05) and 30 feet bgs (PTW-01) within the advanced borings.
- The weathered bedrock interface between the Cahokia Formation and bedrock confining unit of the Carbondale and Modesto Formations was observed to be from 1.5 feet (PTW-01) to 2.5 feet thick (PTW-02) at borings that encountered its entire interval. Moderate permeability sand, silty sand, and clayey gravel material within the Lower Cahokia Formation comprise the UA at the Site.
- The shales and siltstones of the Carbondale and Modesto Formations were encountered at depths ranging from 11.5 feet bgs (at AW-23) to greater than 39 feet bgs (at AW-01). The competent bedrock formations underlying the Site comprise the bedrock confining unit.

4.2 Hydrogeologic Characterization

Groundwater elevation readings from the three initial rounds (November 2022 through January 2023) along with additional groundwater elevation readings from February 2023 are included in **Table 2-2**. A potentiometric surface map for the February 2023 sampling event was generated with the additional wells and is presented in **Figure 4-4**. Groundwater flow directions observed during this round are consistent with historical observations. Groundwater flows generally to the west from the Illinois River, with localized flow to the north in the northern portion of the AP, and more southerly in the southern portion of the AP.

The northward flow may be a result of the drainage ditch that borders the AP. Additional survey work completed in 2022 and included in the groundwater modeling (Ramboll, 2022b), indicates that the surface water drainage ditch along the northern and western side of the AP is at a lower elevation than surrounding groundwater elevations. As a result, the ditch is likely a discharge point for shallow groundwater.

4.3 Analytical Results

Groundwater samples collected by Ramboll were submitted to Pace Analytical Services, LLC (Pace) for analytical analysis (**Appendix G**). The results are presented in **Table 4-2** and are visualized in **Figure 4-5**. Concentrations of boron in groundwater exceed the groundwater quality standard (35 I.A.C. § 620.410(a)) for boron (2.0 milligrams per liter [mg/L]) along the western portion of boundary of the EPP property, consistent with the HCR (Ramboll, 2021). However, boron is below the established standard in the delineation well AW-23 installed on the adjacent property west of the EPP AP and also in EMW-05 located north of the AP (**Figure 4-5**).

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Access was requested near AW-15S to delineate boron exceedances of the groundwater quality standard (35 I.A.C. § 620.410(a)), but there was no response from adjacent property owners.

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5. POTENTIAL RECEPTORS ANALYSIS

Previous water well surveys have been completed in the vicinity of the EPP to identify possible receptors and evaluate the potential for impacts from the AP. Results have been included in the following reports:

- RAPPS, 2009. *Site Characterization and Groundwater Monitoring Plan for CCP Impoundment. Ameren Energy Resources Generating. E.D. Edwards Plant. Peoria County, IL.* November 2009.
- Natural Resource Technology (NRT), 2013. *Phase I Hydrogeological Assessment Report. Coal Combustion Product Impoundment. E.D. Edwards Energy Center. Peoria County, IL.* March 19, 2013.
- Ramboll, 2021. *Hydrogeologic Site Characterization Report, included as Attachment H to Part 845 Operating Permit Application. Ash Pond, Edwards Power Plant, Joppa, Illinois.* October 25, 2021.

The most recent potable water well inventory was completed utilizing federal and state databases to identify nearby pumping wells, drinking water receptors, and other uses of water in the vicinity of the AP as provided in Section 5.1 of the HCR. Boring Logs and well construction information are included in Appendix B of the HCR (Ramboll, 2021).

Additional evaluation of these receptors was completed as part of this investigation to determine the status and use of wells at locations identified in the most recent survey. The evaluation resulted in identification of seven potential water wells within 1,000 meters of the AP boundary (**Figure 5-1**). The well IDs, depths, and status of the wells is summarized as follows:

- Two potential wells north and northeast of the AP (121432221000 and 121432356000) were identified to have depths of 65 and 60 feet bgs, respectively. Well 121432221000 is located upgradient of the AP on the slope of the bedrock bluff and is a 24-inch well drilled approximately 35 feet into bedrock. The well log for 121432356000 indicates there was no water and therefore no well is expected at this location.
- Four potential wells were identified southeast of the AP (121433424000, 1214300133300, 121433566000, and 121433566500) with depths of 20, 30, 98, and 300 feet bgs, respectively. Owners of 121433424000 and 1214300133300 are listed as Cargo Carriers, LLC and Cargill Fertilizer, both of which previously owned and/or had operations at The Mosaic Company parcel located southeast of the AP. The Mosaic Company is listed as owner of wells 121433566000 and 121433566500. The shallower of the two wells indicated no water was present and the deeper well was installed to provide water to the facility. Based on discussions with the Mosaic Company Environmental Manager, there is only one well that remains on the property (121433566500). The well is only used for non-potable water supply. Based on these discussions with the current property owner (the Mosaic Company), wells 121433424000 and 12143001333000 are no longer present and well 121433566000 was only a boring and never completed as a well. In addition, there is a deed restriction on the property that precludes the installation of wells for potable use (**Appendix H**).
- One non-community water supply well was identified west of the AP (shown as NC01 on **Figure 5-1**). The well is located at the Amoco (formerly Freedom) Gas Station and is used only for non-potable purposes (NRT, 2013).

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Based on the analysis only 3 wells are present within 1,000-meters of the AP, two are non-potable supplies and the third well is located upgradient of AP and will not be impacted by a potential release from the AP.

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6. SUMMARY

Ramboll performed the above-mentioned field activities, including the installation and development of one (1) additional plume delineation monitoring well, two (2) observation wells, and two (2) pump test wells to further delineate the previously identified boron plume associated with the EPP AP and complete aquifer testing to evaluate potential corrective actions. The newly installed wells were sampled by Ramboll and groundwater samples were analyzed by Pace. Conclusions and results are summarized as follows:

- Geologic and hydrogeologic results and findings are consistent with previous investigations and the previous HCR (Ramboll, 2021)
  - Geology identified in the additional wells is consistent with previous observations and consists of clays and silts on top of shale/ siltstone bedrock. Thin and discontinuous sand units were identified in borings completed north of the AP.
  - Groundwater flow was observed to be consistent with previous monitoring events, generally to the west with localized flow to the north toward the drainage ditch.
- No exceedances of boron or sulfate were reported in the additional monitoring wells installed and monitored to define the extent of groundwater concentrations above 35 I.A.C. § 620 standards.
- Aquifer testing did not fully identify appropriate well yields due to limitations of the testing equipment. However, the low well yields observed during testing indicates that extraction technologies will be limited by the clays and silts of the Cahokia formation.

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7. REFERENCES

Burns & McDonnell, 2021. *Initial Operating Permit. Edwards Ash Pond. Edwards Power Plant. Bartonville, Illinois. Attachment M: History of Potential Exceedances.* October 25, 2021.

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, effective April 17, 2015.

Illinois Administrative Code, Title 35, Subtitle F, Chapter I, Part 620: Groundwater Quality Standards for Class I: Potable Resource Groundwater, effective October 5, 2012.

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.

Natural Resource Technology, Inc. (NRT), 2013. *Phase I Hydrogeological Assessment Report, Coal Combustion Product Impoundment, E.D. Edwards Energy Center, Peoria County IL.* March 19, 2013.

Natural Resource Technology, an OBG Company (NRT/OGB), 2017. *Hydrogeologic Monitoring Plan, Edwards Ash Pond, Edwards Ash Pond– CCR Unit ID 301. Edwards Power Station, Bartonville, Illinois.* October 17, 2017.

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RAPPS, 2009. *Site Characterization and Groundwater Monitoring Plan for CCP Impoundment. Ameren Energy Resources Generating. E.D. Edwards Plant. Peoria County, IL.* November 2009.

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TABLES

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TABLE 2-1
WELL LOCATIONS AND CONSTRUCTION DETAILS
2023 SUPPLEMENTAL SITE INVESTIGATION REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, IL

Well Number	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)
AW-01	PMP	2021-09-08	464.43	464.43	Top of PVC	462.30	28.20	37.70	434.10	424.60	38.20	423.30	9.5	2	40.594098	-89.665033
AW-23	UA	2022-10-20	437.57	437.57	Top of PVC	435.69	6.00	16.00	429.69	419.69	16.00	419.69	10	2	40.5937859	-89.6714015
EMW-05	UA	2021-09-09	457.94	457.94	Top of PVC	455.80	25.70	30.20	430.10	425.60	30.70	421.80	4.5	2	40.5986102	-89.6672471
OW-01	UA	2022-10-21	459.93	459.93	Top of PVC	457.84	26.25	35.92	431.58	421.92	36.42	421.34	9.67	2	40.5979024	-89.6668928
OW-02	UA	2022-10-19	440.88	440.88	Top of PVC	438.66	24.91	34.58	413.75	404.08	35.08	401.66	9.67	2	40.5879278	-89.6668054
PTW-01	UA	2022-10-20	461.60	461.60	Top of PVC	459.38	27.19	36.61	432.19	422.77	38.44	420.88	9.42	4	40.5979486	-89.6668725
PTW-02	UA	2022-10-18	441.12	441.12	Top of PVC	439.02	26.92	36.34	412.10	402.68	38.42	399.52	9.42	4	40.5879725	-89.666839

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TABLE 2-2
GROUNDWATER ELEVATIONS
2023 SUPPLEMENTAL SITE INVESTIGATION REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, IL

Sample Location	Sample Date	Groundwater Elevation (ft NAVD88)
AP05S	11/21/2022	435.88
	12/16/2022	436.73
	01/09/2023	437.05
	02/27/2023	438.46
AP07S	11/21/2022	435.59
	12/16/2022	436.40
	01/09/2023	436.00
	02/27/2023	436.78
AW-01	11/21/2022	450.63
	12/16/2022	432.95
	01/09/2023	453.73
	02/27/2023	460.23
AW-05	11/21/2022	434.87
	12/16/2022	435.40
	01/09/2023	434.84
	02/27/2023	435.76
AW-06	11/21/2022	434.00
	12/16/2022	434.71
	01/09/2023	434.30
	02/27/2023	434.68
AW-08	11/21/2022	437.17
	12/16/2022	437.25
	01/09/2023	437.56
	02/27/2023	437.96
AW-09	11/21/2022	434.23
	12/16/2022	434.87
	01/09/2023	434.89
	02/27/2023	435.51
AW-10	11/21/2022	437.19
	12/16/2022	437.57
	01/09/2023	437.53
	02/27/2023	438.38
AW-11	11/21/2022	432.09
	02/27/2023	434.18
AW-14	11/21/2022	430.48
	12/16/2022	431.73
	01/09/2023	431.86
	02/27/2023	432.52
AW-15	11/21/2022	430.75
	02/27/2023	432.59
AW-15S	02/27/2023	430.66
AW-16	02/27/2023	437.19
AW-17	02/27/2023	437.25
AW-18	11/21/2022	434.76
	12/16/2022	435.45
	01/09/2023	435.11

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TABLE 4-1
GROUNDWATER ELEVATIONS
2023 SUPPLEMENTAL SITE INVESTIGATION REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, IL

Sample Location	Sample Date	Groundwater Elevation (ft NAVD88)
	02/27/2023	435.69
AW-19	11/21/2022	446.95
	12/16/2022	447.22
	01/09/2023	446.87
	02/27/2023	447.35
AW-21	11/21/2022	442.41
	12/16/2022	442.50
	01/09/2023	443.03
	02/27/2023	444.26
AW-23	11/21/2022	430.85
	12/16/2022	433.71
	01/09/2023	433.62
EMW-05	11/21/2022	436.08
	12/16/2022	436.25
	01/09/2023	436.51
	02/27/2023	437.65
OW-01	11/21/2022	435.58
	02/27/2023	436.74
PTW-01	11/21/2022	435.51
	02/27/2023	436.77
XPW01A	02/27/2023	453.00
XPW02	02/27/2023	454.01
XPW03	02/27/2023	449.70
SG-01	11/21/2022	430.01
	12/16/2022	433.03
	02/27/2023	441.00

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TABLE 4-2
ANALYTICAL RESULTS - GROUNDWATER
2023 SUPPLEMENTAL SITE INVESTIGATION REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, IL

Well ID	Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 + Radium 228, total (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
Groundwater Quality Standards (35 I.A.C. § 620.410)		*0.006*	*0.010*	*2.0*	*0.004*	*2.0*	*0.005*	*NA*	*200.0*	*0.1*	*1.0*	*4.0*	*0.0075*	*NA*	*0.002*	*NA*	*6.5/9.0*	*NA*	*0.05*	*400.0*	*0.002*	*1,200*
AP05S	02/16/2022	0.003 U	0.00390	1.20	0.001 U	0.340	0.001 U	110	48.0	0.0120	0.00680	0.25 U	0.00810	0.0400	0.0002 U	0.00120	6.7	4.40	0.001 U	3.30	0.001 U	840
	07/25/2022	--	0.0140	1.80	0.00190	0.350	--	190	49.0	0.0640	0.0360	0.083	0.0430	0.0740	--	0.00460	6.7	4.00	0.00190	2.40	--	680
	02/28/2023	0.00043 U	0.00730	0.940	0.00063 J	0.340	0.00074 U	120	33.0	0.0250	0.0120	0.088 J	0.0140	0.0390	0.00014 U	0.00210	7.0	3.12	0.00074 U	14.0	0.00038 U	820
AP07S	02/28/2023	0.00043 U	0.00210	0.0870	0.00059 U	7.90	0.00350	130	73.0	0.0250	0.00480	0.248 J	0.00340	0.0067 J	0.00014 U	0.00350	7.1	0.782	0.00074 U	180	0.00038 U	720
AW-01	11/18/2022	0.003 U	0.0170	0.140	0.001 U	0.0900	0.001 U	190	13.0	0.004 U	0.00480	0.268	0.001 U	0.02 U	0.0002 U	0.00330	6.9	0.449	0.001 U	41.0	0.001 U	810 J
	12/15/2022	0.003 U	0.00150 J	0.100 J	0.001 U	0.0720	0.001 U	150	19.0	0.004 U	0.00360 J	0.25 U	0.001 U	0.02 U	0.0002 U	0.00290	7.3	0.288 B	0.001 U	43.0	0.001 U	790
	01/10/2023	0.00064 J	0.00710	0.120	0.00059 U	0.0750	0.00074 U	170	14.0	0.0028 U	0.00370	0.277	0.0007 J	0.0059 J	0.00014 U	0.00510	6.8	0	0.00074 U	41.0	0.00038 U	760
	02/28/2023	0.00043 U	0.0200	0.170	0.00059 U	1.10	0.00074 U	180	110	0.0190	0.00700	0.177 J	0.00920	0.018 J	0.00014 U	0.00220	7.0	2.77 J+	0.00110	280	0.00038 U	1,000
AW-05	02/28/2023	0.00043 U	0.00680	0.210	0.00059 U	4.50	0.00074 U	170	78.0	0.0200	0.0110	0.186 J	0.00910	0.0250	0.00014 U	0.00260	7.2	1.44 J+	0.00120	320	0.00038 U	1,100
AW-06	02/16/2022	0.003 U	0.00470	0.180	0.001 U	0.120	0.001 U	110	37.0	0.004 U	0.002 U	0.338	0.001 U	0.02 U	0.0002 U	0.00450	6.8	1.04	0.001 U	25.0	0.001 U	560
	07/25/2022	--	0.00170	0.150	0.00059 U	0.110	--	110	40.0	0.0028 U	0.00048 U	0.04 U	0.00022 U	0.011	--	0.00460	7.2	0.679	0.00074 U	24.0	--	550
	02/28/2023	0.00043 U	0.00640	0.190	0.00059 U	0.180	0.00074 U	110	31.0	0.0028 U	0.00096 J	0.327	0.00058 J	0.012 J	0.00014 U	0.00530	7.4	0.489	0.00074 U	22.0	0.00038 U	610
AW-08	02/16/2022	0.003 U	0.0180	0.230	0.001 U	0.0980	0.001 U	140	17.0	0.004 U	0.002 U	0.264	0.001 U	0.02 U	0.0002 U	0.00200	7.0	1.20	0.001 U	1 U	0.001 U	760
	07/25/2022	--	0.00730	0.160	0.00059 U	0.100	--	140	18.0	0.0028 U	0.00048 U	0.273	0.00022 U	0.016	--	0.00190	7.3	1.09	0.00074 U	0.94	--	680
	02/28/2023	0.00043 U	0.0110	0.200	0.00059 U	0.100	0.00074 U	140	14.0	0.0028 U	0.00048 U	0.223 J	0.00022 U	0.0097 J	0.00014 U	0.00180	8.9	0.261	0.00074 U	0.35 J	0.00038 U	740
AW-09	02/16/2022	0.003 U	0.0120	0.370	0.001 U	0.250	0.001 U	120	28.0	0.004 U	0.00340	0.25 U	0.00180	0.02 U	0.0002 U	0.0140	6.9	1.34	0.001 U	1 U	0.001 U	780
	07/25/2022	--	0.0170	0.470	0.00059 U	0.250	--	130	30.0	0.0028 U	0.00210	0.19	0.00022 U	0.013	--	0.0140	7.0	0.803	0.00074 U	0.18 U	--	800
	02/28/2023	0.00043 U	0.0120	0.200	0.00059 U	0.100	0.00074 U	140	26.0	0.0028 U	0.00048 U	0.04 U	0.00022 U	0.013 J	0.00014 U	0.00190	7.0	1.12 J+	0.00074 U	0.23 J	0.00038 U	830
AW-10	02/16/2022	0.003 U	0.00990	0.980	0.001 U	0.460	0.001 U	130	92.0	0.004 U	0.002 U	0.25 U	0.001 U	0.0400	0.0002 U	0.001 U	7.0	2.52	0.001 U	1 U	0.001 U	1,200
	07/25/2022	--	0.00990	1.00	0.00059 U	0.460	--	140	100	0.0036	0.00330	0.17	0.00220	0.0330	--	0.00097	7.1	2.16	0.00074 U	0.18 U	--	1,300
	02/28/2023	0.00043 U	0.0160	1.30	0.00059 U	0.520	0.00074 U	140	85.0	0.00950	0.00680	0.0973 J	0.00620	0.0430	0.00014 U	0.00120	7.0	1.57	0.00074 U	0.18 U	0.00038 U	1,300
AW-11	02/16/2022	0.003 U	0.00990	1.10	0.001 U	0.230	0.001 U	150	35.0	0.004 U	0.002 U	0.25 U	0.001 U	0.0230	0.0002 U	0.001 U	6.9	2.79	0.001 U	1 U	0.001 U	1,000
	07/25/2022	--	0.00940	1.00	0.00059 U	0.230	--	160	39.0	0.0028 U	0.0014	0.133	0.00039	0.019	--	0.00110	6.9	0.756	0.00074 U	0.18 U	--	1,000
	02/28/2023	0.00043 U	0.0130	1.10	0.00059 U	0.240	0.00074 U	170	30.0	0.0170	0.0100	0.0647 J	0.0100	0.0310	0.00014 U	0.00320	7.2	2.25	0.00074 U	0.18 U	0.00038 U	1,000
AW-14	02/28/2023	0.002 J	0.0150	0.720	0.00059 U	0.180	0.00074 U	170	21.0	0.0028 U	0.00480	0.0778 J	0.00170	0.017 J	0.00014 U	0.0190	7.0	1.30	0.00086 J	5.70	0.00038 U	1,100

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TABLE 4-2
ANALYTICAL RESULTS - GROUNDWATER
2023 SUPPLEMENTAL SITE INVESTIGATION REPORT
EDWARDS POWER PLANT
ASH POND
BARTONVILLE, IL

Well ID	Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 + Radium 228, total (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
AW-15	02/27/2023	0.00043 U	0.00350	1.80	0.00059 U	0.370	0.00074 U	140	32.0	0.0028 U	0.0018 J	0.067 J	0.00027 J	0.0270	0.000210	0.00074 U	6.8	7.65	0.00074 U	0.18 U	0.00038 U	1,100
AW-15S	02/27/2023	0.00043 U	0.00180	0.0810	0.00059 U	5.90	0.00074 U	260	28.0	0.0028 U	0.00048 U	0.252	0.00022 U	0.013 J	0.00015 J	0.00300	6.8	1.99	0.00074 J	510	0.00038 U	1,300
AW-16	02/28/2023	0.00043 U	0.00220	1.30	0.00059 U	0.490	0.00074 U	140	46.0	0.0028 U	0.0015 J	0.0535 J	0.00022 U	0.0370	0.00014 U	0.00074 U	6.8	3.13	0.00074 U	3.40	0.00038 U	1,200
AW-17	02/28/2023	0.00043 U	0.00610	1.20	0.00059 U	0.420	0.00074 U	110	47.0	0.00400	0.00340	0.0605 J	0.00180	0.0340	0.00014 U	0.00078 J	6.9	3.46	0.00074 U	0.18 U	0.00038 U	1,100
AW-18	02/27/2023	0.00049 J	0.00800	1.80	0.00059 U	0.380	0.00074 U	140	81.0	0.0620	0.00620	0.04 U	0.00800	0.0350	0.00014 U	0.00510	6.9	3.69	0.0008 J	10.0	0.00038 U	830
AW-19	02/27/2023	0.00043 U	0.0220	0.370	0.00059 U	2.90	0.00074 U	130	69.0	0.0310	0.00480	0.336	0.00540	0.015 J	0.00014 U	0.00550	7.0	1.59	0.00074 U	46.0	0.00038 U	600
AW-21	02/28/2023	0.00079 J	0.00270	0.0580	0.00059 U	13.0	0.00074 U	110	80.0	0.0033 J	0.00078 J	0.360	0.00022 U	0.005 U	0.00014 U	0.0290	8.0	0.642	0.00170	240	0.00038 U	680
AW-23	11/21/2022	0.003 U	0.001 U	0.0320	0.001 U	0.580	0.001 U	130	42.0	0.004 U	0.002 U	0.294	0.001 U	0.02 U	0.0002 U	0.00110	7.0	0.365 J	0.001 U	200	0.001 U	800
	12/16/2022	0.003 U	0.001 U	0.0270	0.001 U	0.480	0.001 U	130	46.0	0.004 U	0.002 U	0.254	0.001 U	0.02 U	0.0002 U	0.00170	6.6	0.204 UJ	0.001 U	200	0.001 U	720
	01/10/2023	0.00043 U	0.00120	0.0270	0.00059 U	0.550	0.00074 U	130	50.0	0.0028 U	0.00048 U	0.302	0.00022 U	0.016 J	0.00014 U	0.00096 J	6.9	0.666	0.00074 U	190	0.00038 U	760
EMW-05	11/18/2022	0.003 U	0.00130	0.0690	0.001 U	0.670	0.001 U	160	28.0	0.004 U	0.00220	0.25 U	0.001 U	0.02 U	0.0002 U	0.00190	--	0.479	0.001 U	120	0.001 U	890 J
	12/15/2022	0.003 U	0.00120	0.0790	0.001 U	0.770	0.001 U	170	20.0	0.00500	0.00200	0.25 U	0.00290	0.02 U	0.0002 U	0.00170	6.5	1.53	0.001 U	120	0.001 U	860
	01/10/2023	0.00043 U	0.0200 J	0.650 J	0.00390 J	0.320	0.00200 J	230	29.0	0.130 J	0.0670 J	0.264	0.0740 J	0.0920 J	0.000320 J	0.00400	6.6	1.33	0.00360 J	130	0.0008 J	830

Notes:
Exceedance of 35 I.A.C. § 620.410 standard
§ = Section
35 I.A.C. = Title 35 of the Illinois Administrative Code
mg/L = milligrams per liter
pCi/L = picocuries per liter
SU = Standard Units
NA = 35 I.A.C. § 620.410 groundwater quality standard not available
– = data not available
B = The analyte was found in sample and in associated method blank.
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+ = The result is an estimated quantity, but the result may be biased high.
U = The analyte was analyzed for, but was not detected above the level of the adjusted detection limit or quantitation limit, as appropriate.
UJ = The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
Results were compared to applicable 35 I.A.C. § 620.410 standards

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FIGURES

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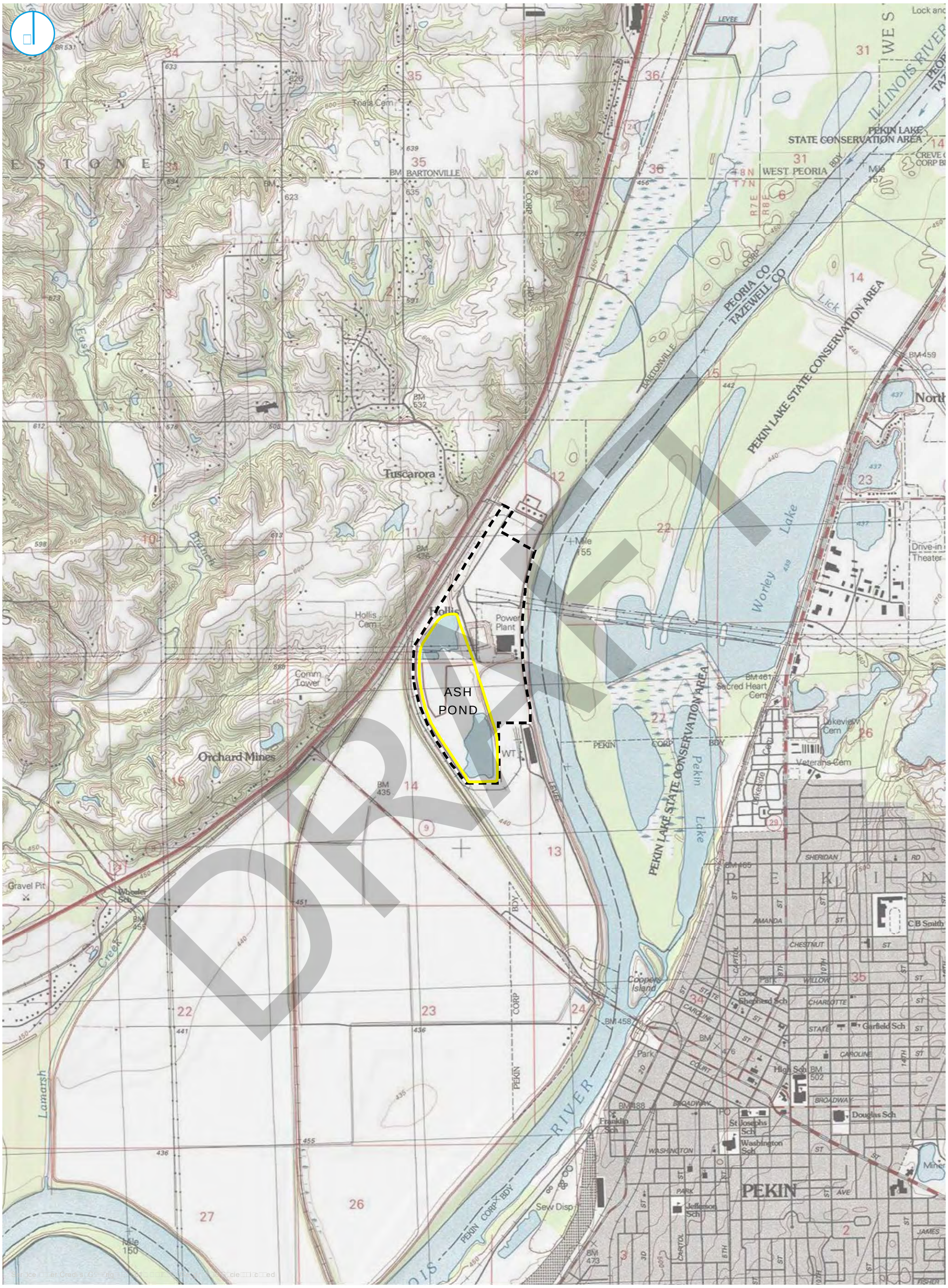

R□G□□A□□D □□I□ □S□□□□C□ □□I□□

PR□P□R□□ □□□□DAR□

SITE LOCATION MAP

FIGURE 1-1

0 1□000 □000

□ee□

2023 SUPPLEMENTAL SITE INVESTIGATION REPORT
ASH POND
□D□ ARDS P□□ □R P□A□□
□AR□□ □□I□□□□I□□I□□IS

RAM□□ □□ AM□RICAS
□□GI□□□RI□G S□ □□□I□□S□I□C.

RAMBOLL



R□G□□A□□D □□I□ □S□□□□C□ □□I□□

□□RM□R □RC□ARD MI□□S AR□A

PR□P□R□□ □□□□DAR□

0 □□0 □00

□ee□

SITE MAP

FIGURE 1-2

2023 SUPPLEMENTAL SITE INVESTIGATION REPORT
ASH POND
□D□ ARDS P□□ □R P□A□□
□AR□□ □□I□□□□I□□I□□IS

RAM□□ □□ AM□RICAS
□□GI□□□RI□G S□ □□□I□□S□I□C.

RAMBOLL

AP06
(437.56)

APW-01
(435.43)

AW-05
435

AP05S
438.15

AP05D
(438.14)

AP07S
(435.99)

AP07D
(423.76)

AW-21
443.22

436
438
440
442
444
446
448
450

AW-20
444.7

AW-22
451.46

P002
(448.03)

XPW01A
(452.58)

SG-01
(434.07)

AW-19
447

AP08
(452.69)

AW-06
435.96

XPW02
(453.21)

APW-02
(455.87)

AW-01

AW-08
438.79

ILLINOIS RIVER

AW-18
435.83

ASH POND

AW-17
437.63

AP09
(451.86)

XPW03
(450.65)

APW-03
(436.47)

AW-12
436.2

AW-10
438.05

AW-09
435.88

AW-16
437.91

AW-13
435.74

AW-15
433.51

APW-04
(432.38)

AW-15C
(433.52)

AW-15S
(431.79)

AW-11
434.47

AW-14
432.96

Ser□ice □□□er Credi□s□S□□rce□□sri□M□□□r□□□r□□s□□r Ge□gr□□□ics□□□d □□e GIS □ser C□mm□□i□□

C□MP□IA□C□ M□□I□□RI□G □ □□□

□AC□GR□□□D M□□I□□RI□G □ □□□

S□A□□ GAG□□RI□□R

M□□I□□RI□G □ □□□

R□G□□A□□D □□I□ □S□□□□C□ □□I□□

PR□P□R□□ □□□□DAR□

GR□□□D□ A□□R □□□□A□I□□
C□□□□□R □□□□□C□ □□□□R
I□□□R□A□□□A□D□□□

I□□□RR□D GR□ □□D□ A□□R
□□□□A□I□□ C□□□□□R

GR□□□D□ A□□R □□□□ DIR□C□I□□

NOTES

1. PAR□□□□□S□S I□DICA□□S □ □□□□□□□□S□D □□R C□□□□□RI□G □ □□□□A□I□□ C□□□□□RS S□□□ □ I□ □□□□□□□R□□ AM□RICA□ □□R□ICA□ DA□□M □□ 1□□□ □□A□D□□□

0 □1□.□ □□□ □ee□

POTENTIOMETRIC SURFACE MAP
FEBRUARY 16, 2022

2023 SUPPLEMENTAL SITE INVESTIGATION REPORT
ASH POND
□D□ ARDS P□□ □R P□A□□
□AR□□ □□I□□□□I□□I□□IS

FIGURE 1-3

RAM□□ □□ AM□RICAS
□□GI□□□RI□G S□ □□□I□□S□I□C.

RAMBOLL



P□R□ □ A□□R □ □□□

M□□I□□RI□G □ □□□

S□A□□ GAG□□RI□□R

SI□□ □□A□□R□

PR□P□R□□ □□□□DAR□

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MONITORING WELL LOCATION MAP

ASH POND

□D□ ARDS P□□ □R P□A□□

□AR□□ □□I□□□□I□□I□□IS

FIGURE 1-4

RAM□□ □□AM□RICAS

□□GI□□□RI□G S□ □□□I□□S□I□C.

RAMBOLL

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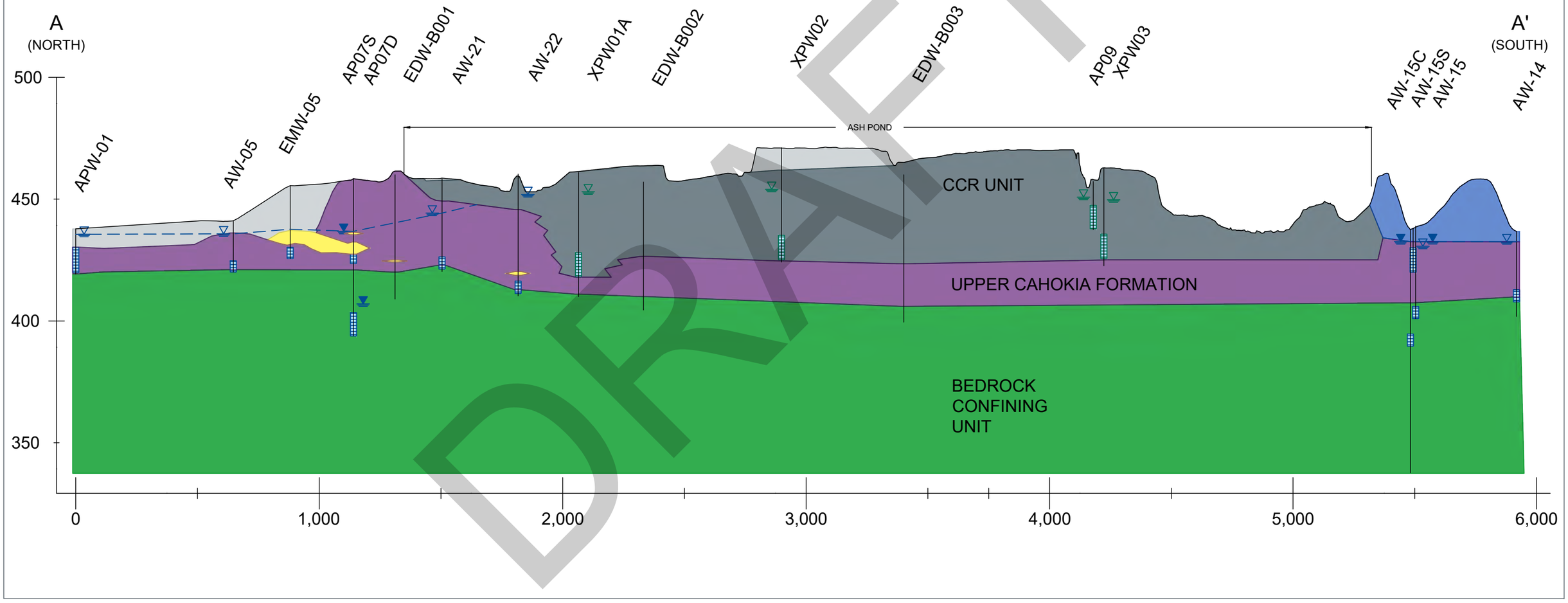
PROJECT: 1940100806 DATED: 6/9/2023 4:36 PM DESIGNER: LEMMONBN



NOTES

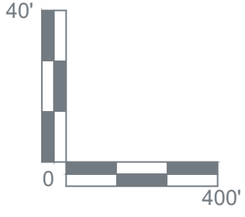
1. This profile was developed by interpolation between widely spaced boreholes. Only at the borehole location should it be considered as an approximately accurate representation and then only to the degree implied by the notes on the borehole logs.
2. Scale is approximate.
3. Vertical scale is exaggerated 10X.
4. Groundwater elevations measured February, 2023.



DRAFT

LEGEND

- COAL COMBUSTION RESIDUALS (CCR)
- FILL
- CLAY (CL/CH)
- SILT (ML)
- SAND (SP/SM/SW)
- BEDROCK / WEATHERED BEDROCK (INTERBEDDED SHALE, LIMESTONE, SANDSTONE, V. LITTLE SS)
- WELL SCREEN INTERVAL
- UPPERMOST AQUIFER POTENTIOMETRIC SURFACE
- UPPER AQUIFER GROUNDWATER ELEVATION
- POREWATER ELEVATION
- BEDROCK GROUNDWATER / OTHER GROUNDWATER / SURFACE WATER ELEVATION(S)



GEOLOGIC CROSS SECTION A-A'

2023 SUPPLEMENTAL SITE INVESTIGATION REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 4-1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

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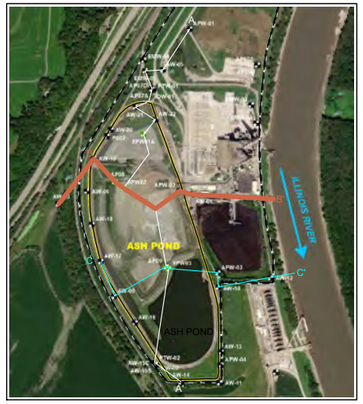
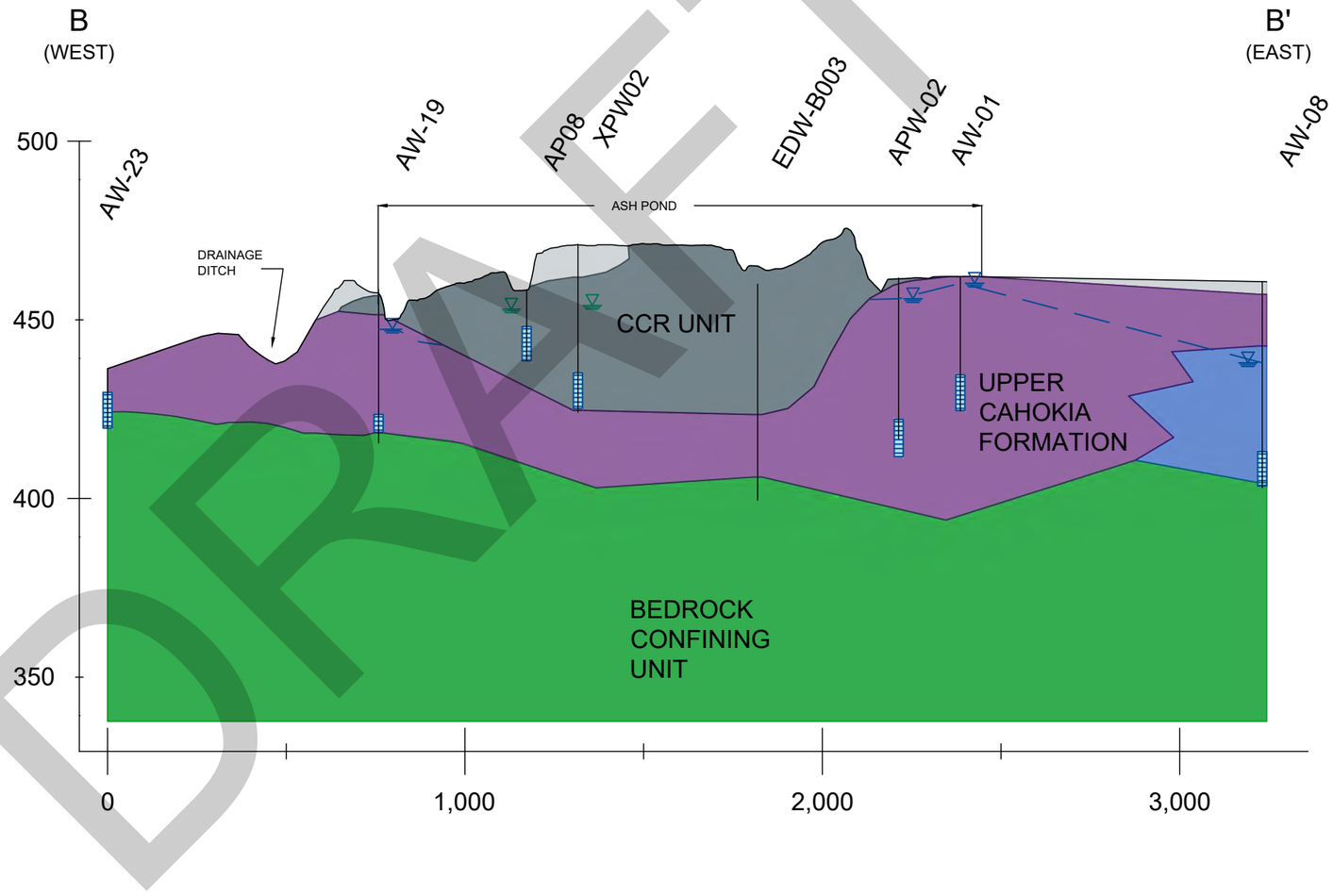
PROJECT: 1940100806 DATED: 6/9/2023 4:36 PM DESIGNER: LEMMONBN



NOTES

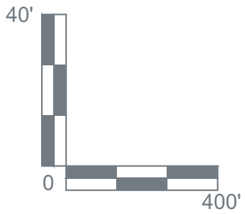
1. This profile was developed by interpolation between widely spaced boreholes. Only at the borehole location should it be considered as an approximately accurate representation and then only to the degree implied by the notes on the borehole logs.
2. Scale is approximate.
3. Vertical scale is exaggerated 10X.
4. Groundwater elevations measured February, 2023.



DRAFT

LEGEND

- COAL COMBUSTION RESIDUALS (CCR)
- FILL
- CLAY (CL/CH)
- SILT (ML)
- SAND (SP/SM/SW)
- BEDROCK / WEATHERED BEDROCK (INTERBEDDED SHALE, LIMESTONE, SANDSTONE, V. LITTLE SS)
- WELL SCREEN INTERVAL
- UPPERMOST AQUIFER POTENTIOMETRIC SURFACE
- UPPER AQUIFER GROUNDWATER ELEVATION
- POREWATER ELEVATION
- BEDROCK GROUNDWATER / OTHER GROUNDWATER / SURFACE WATER ELEVATION(S)



GEOLOGIC CROSS SECTION B-B'

2023 SUPPLEMENTAL SITE INVESTIGATION REPORT ASH POND

EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 4-2

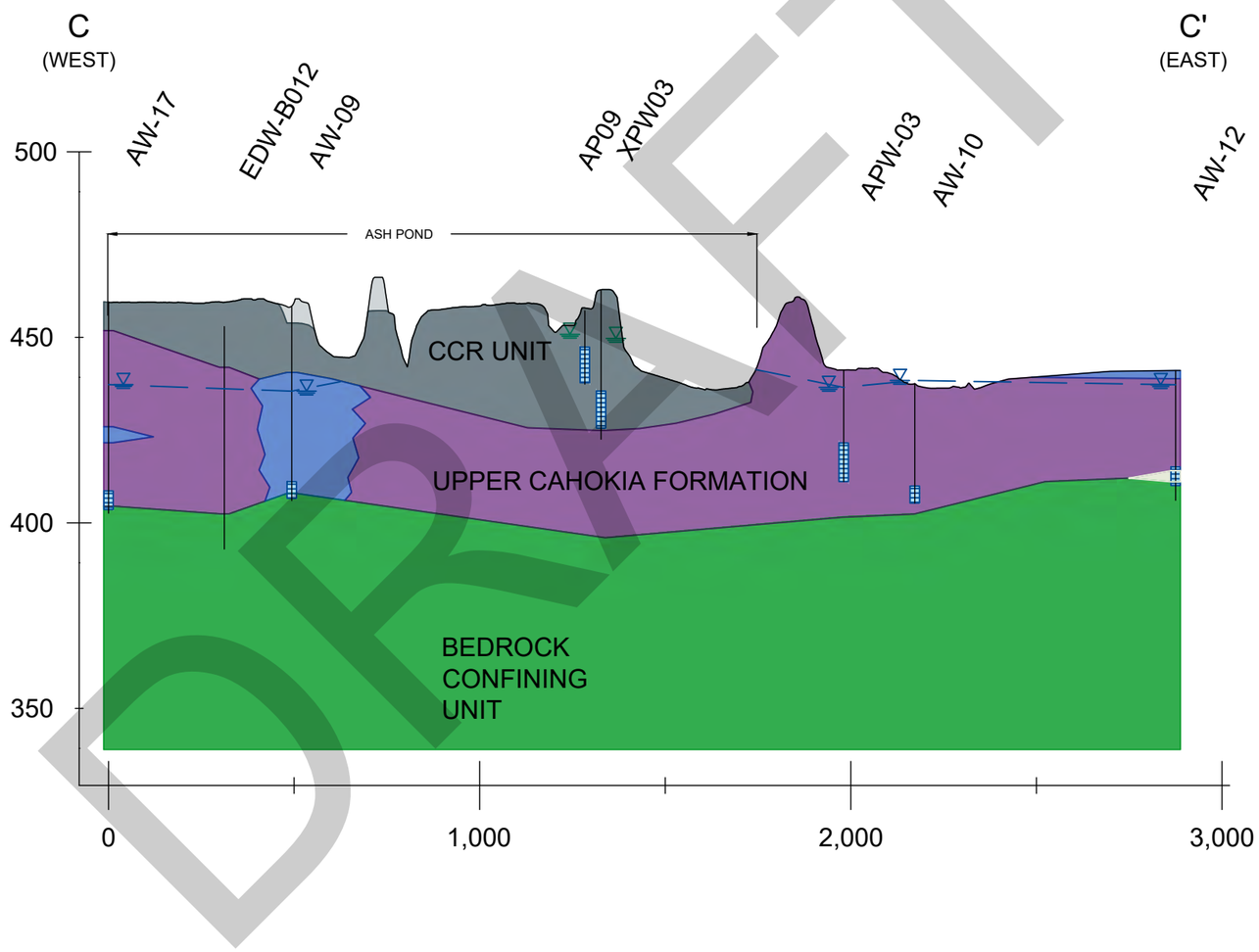
RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



NOTES

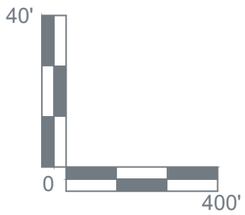
1. This profile was developed by interpolation between widely spaced boreholes. Only at the borehole location should it be considered as an approximately accurate representation and then only to the degree implied by the notes on the borehole logs.
2. Scale is approximate.
3. Vertical scale is exaggerated 10X.
4. Groundwater elevations measured February, 2023.



DRAFT

LEGEND

- COAL COMBUSTION RESIDUALS (CCR)
- FILL
- CLAY (CL/CH)
- SILT (ML)
- GRAVEL (GP/GW)
- BEDROCK / WEATHERED BEDROCK (INTERBEDDED SHALE, LIMESTONE, SANDSTONE, V. LITTLE SS)
- WELL SCREEN INTERVAL
- UPPERMOST AQUIFER POTENTIOMETRIC SURFACE
- UPPER AQUIFER GROUNDWATER ELEVATION
- POREWATER ELEVATION
- BEDROCK GROUNDWATER / OTHER GROUNDWATER / SURFACE WATER ELEVATION(S)



GEOLOGIC CROSS SECTION C-C'

2023 SUPPLEMENTAL SITE INVESTIGATION REPORT
ASH POND
EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

FIGURE 4-3

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

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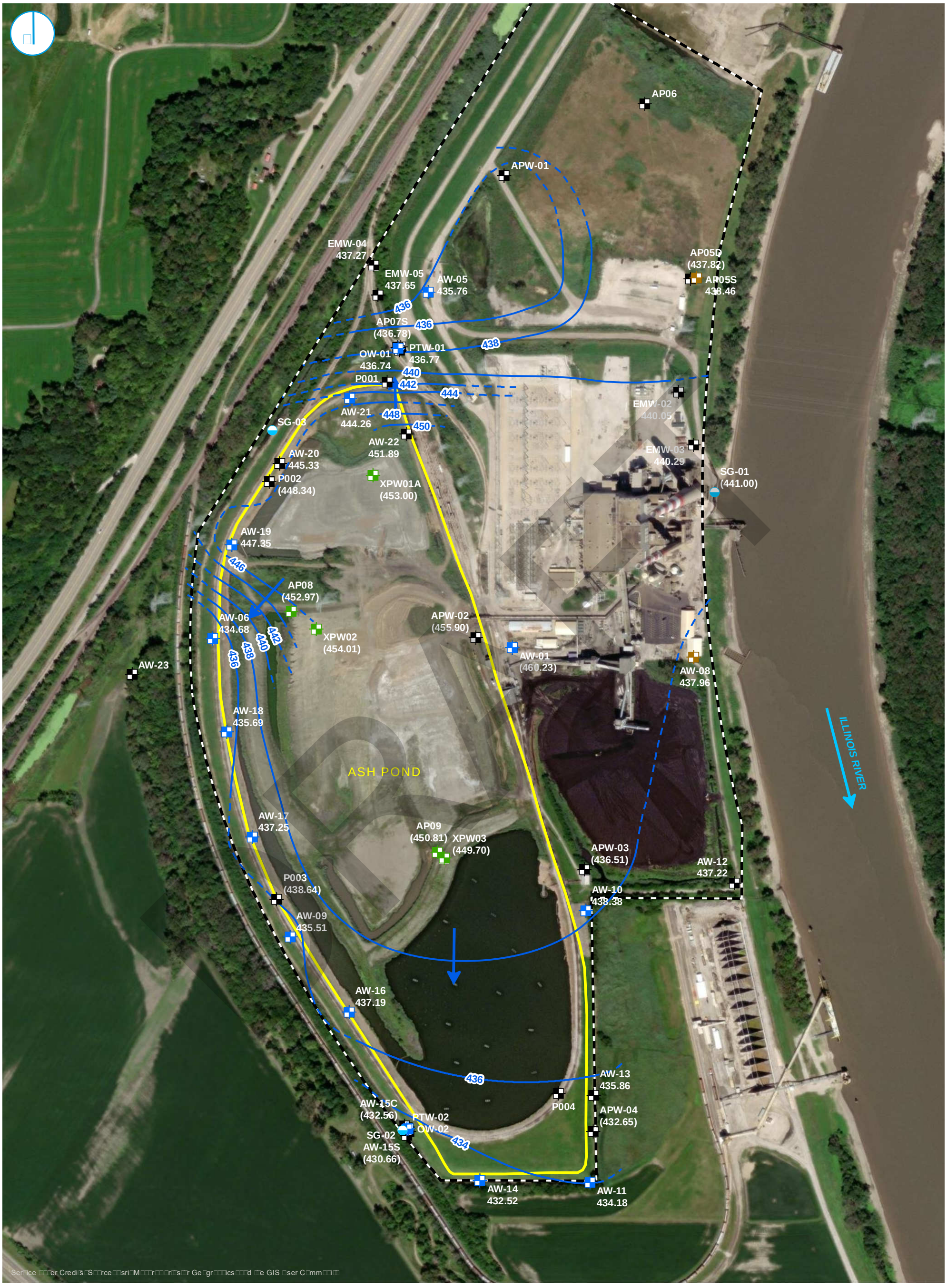
PROJECT: 1940100806 DATED: 6/9/2023 4:36 PM DESIGNER: LEMMONBN



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NOTES

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POTENTIOMETRIC SURFACE MAP
FEBRUARY 27, 2023

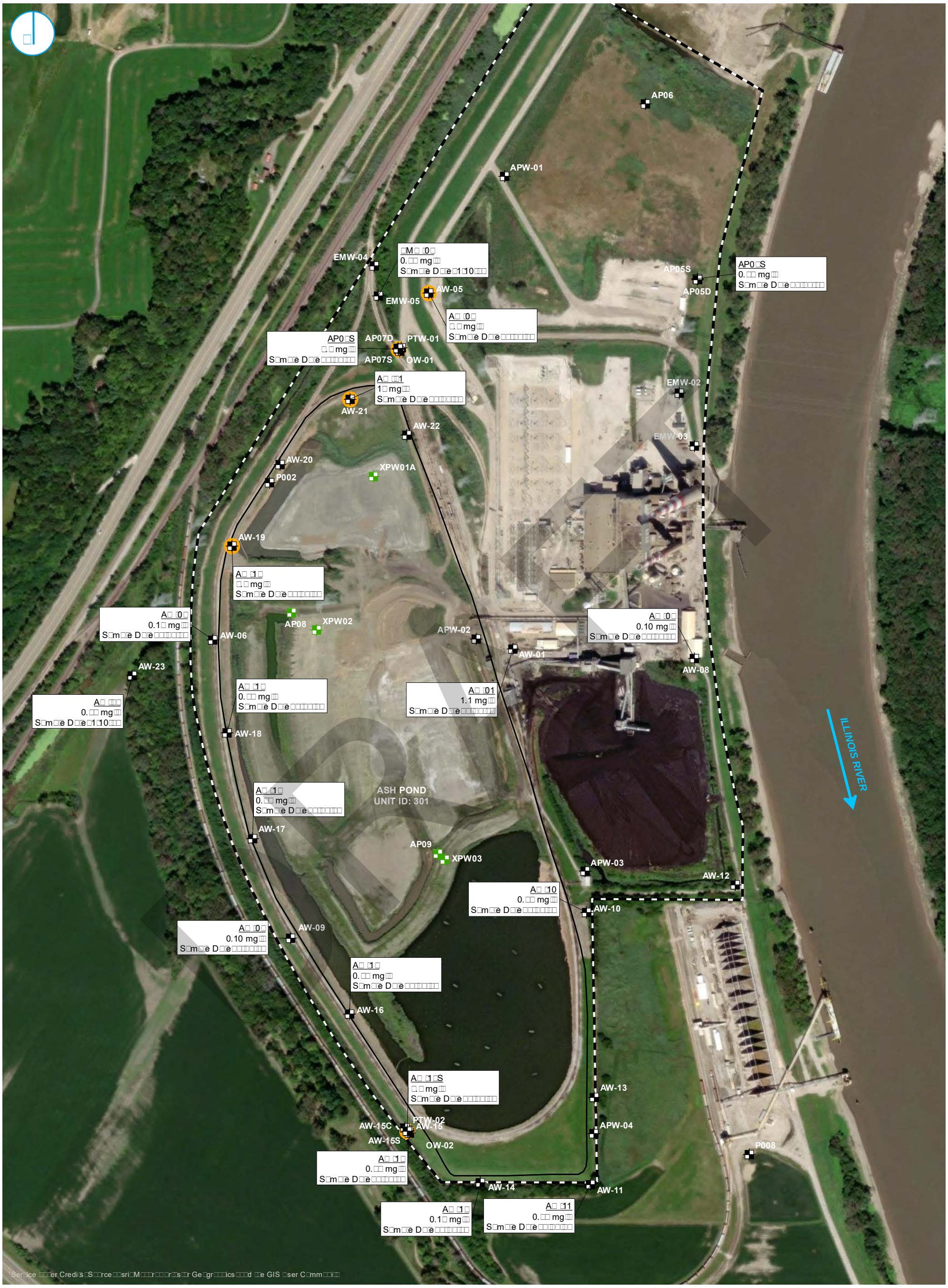
2023 SUPPLEMENTAL SITE INVESTIGATION REPORT
ASH POND

□D□ ARDS P□□ □R P□A□□
□AR□□ □□I□□□□I□□I□□IS

FIGURE 4-4

RAM□□ □□ AM□RICAS
□□GI□□□RI□G S□ □□□I□□S□I□C.

RAMBOLL



P□R□ □A□□R □ □□□

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BOUNDARY CONCENTRATIONS IN GROUNDWATER - QUARTER 1, 2023

2023 SUPPLEMENTAL SITE INVESTIGATION REPORT ASH POND

□D□ ARDS P□□ □R P□A□□ □AR□□ □□I□□□□I□□I□□IS

FIGURE 4-5

RAM□□ □□ AM□RICAS □□GI□□□RI□G S□ □□□I□□S□I□C.

RAMBOLL



□ □ □C□MM□□I□□ □ A□□R S□PP□□ □ □□□

□ A□□R

I□S□I□□□I□□A□C□□□R□□AR□A □□□ P□□A□□□ □ □□□S

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DRINKING WATER INTAKES, PUMPS, AND OTHER WATER USES

FIGURE 5-1

2023 SUPPLEMENTAL SITE INVESTIGATION REPORT
ASH POND
□D□ ARDS P□□ □R P□A□□
□AR□□ □□I□□□I□□I□□IS

RAM□□ □□AM□RICAS
□□GI□□□RI□G S□ □□□I□□S□I□C.

RAMBOLL

APPENDICES

DRAFT

APPENDIX A
THIRD-PARTY LETTERS AND ACCESS REQUESTS

DRAFT

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As □□r□□□□□r di□ge□ce□gr□□□d□□□er m□□i□ri□g s□□i□□s rece□□□i□s□□□ed □e□r □□e □□□□□s □r□□er□□ □□□□□d□r□ □□rs□□□□ □□ □□e re□□ireme□□s □□ l□i□□□is□s □e□ c□□□□s□ r□e □□□e de□ec□ed e□e□□□ed □e□e□s □□ □□r□□ i□ gr□□□d□□□er. □□e de□ec□ed □e□e□s □□□□□r□□ □□□□ese gr□□□d□□□er m□□i□ri□g s□□i□□s e□ceedi□g □□e □□□□ic□□□e s□□□e gr□□□d□□□er s□□□d□rd □□□□.0 mi□i□gr□ms □er i□er □mg□□□r□□ge r□m □.□mg□□ □□ 1□ mg□□. □ e □re □□□i□□i□g □□□□ □ec□□se □□ere is □□e □□□e□i□□□□□□□eig□□□□ri□g □r□□er□es m□□ □s□ □□□e e□e□□□ed □e□e□s □□□□r□□ i□ gr□□□d□□□er. ***Importantly, there is no indication that local drinking water has been impacted by the plant's operations.***

IPRG □□s □□i□ied □□e l□i□□□is □PA □□□□e e□e□□□ed □□r□□ de□ec□i□□s □□ i□s □r□□er□□ □□d is □□r□i□g □□ g□□□er □ddi□□□□□d□□□. As □□r□□□□□ese e□□□r□s□IPRG re□□es□s □ermissi□□ □□r i□s c□□s□□□□□s □□ □ccess □□□r □r□□er□□ □□ i□s□□□□□ gr□□□d□□□er m□□i□ri□g s□□i□□ □□d c□□d□c□□□e □r m□re gr□□□d□□□er s□m□i□g e□e□□s.

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DRAFT

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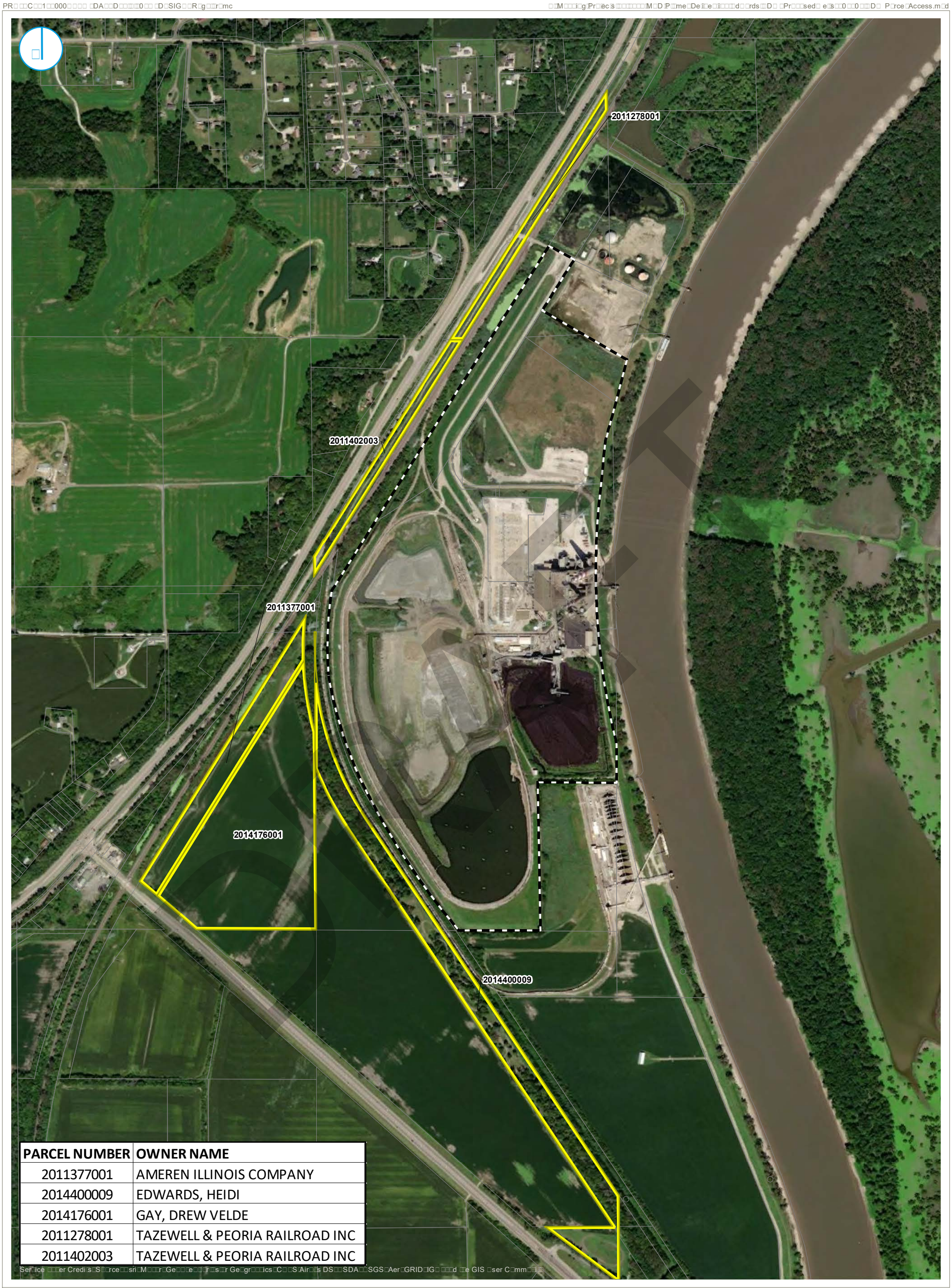

PARCEL NUMBER	OWNER NAME
2011377001	AMEREN ILLINOIS COMPANY
2014400009	EDWARDS, HEIDI
2014176001	GAY, DREW VELDE
2011278001	TAZEWELL & PEORIA RAILROAD INC
2011402003	TAZEWELL & PEORIA RAILROAD INC

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ADJACENT PROPERTIES OVERVIEW

Graphic 1

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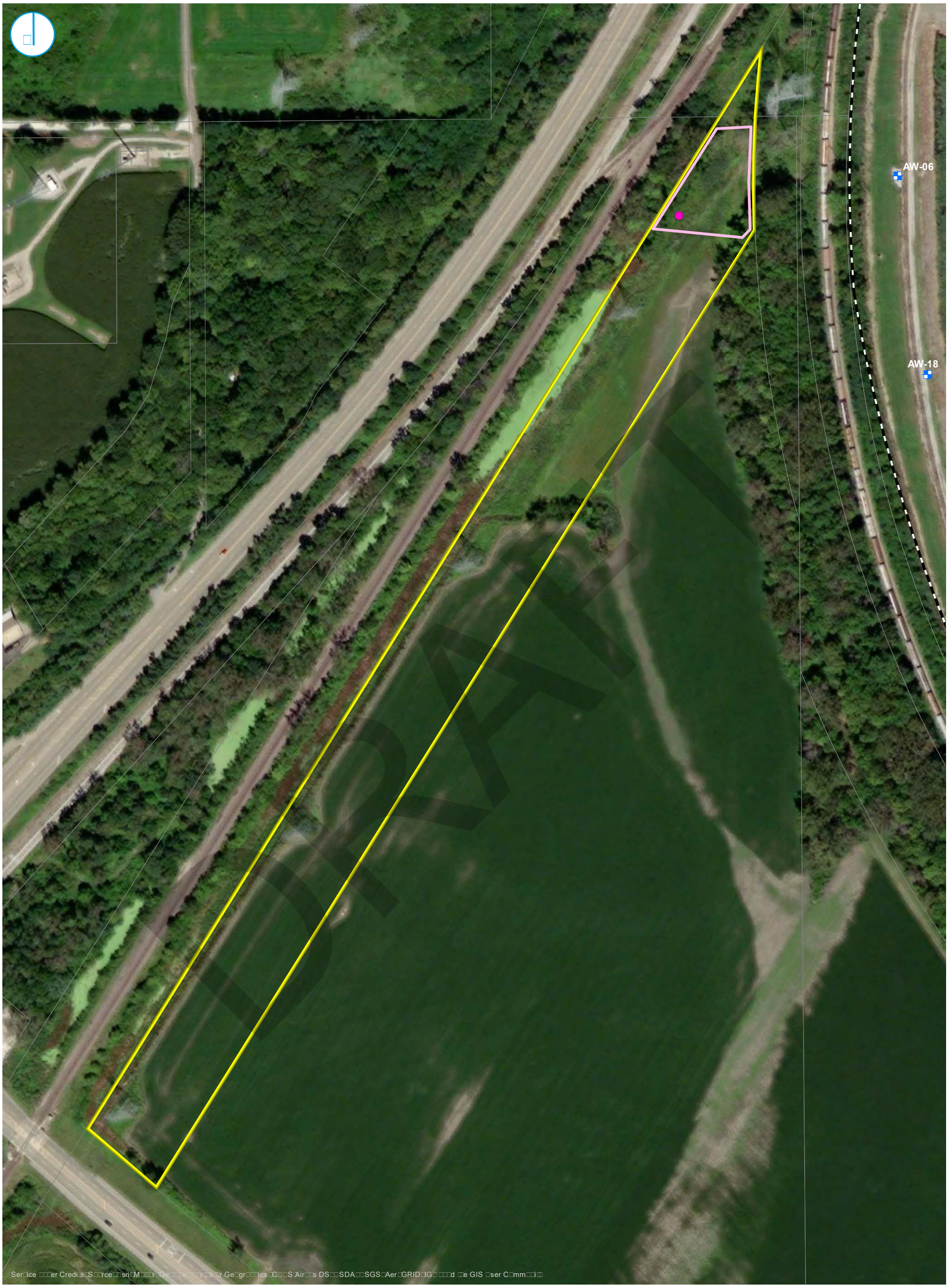

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PROPOSED WELL LOCATION
AMEREN ILLINOIS COMPANY PROPERTY

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ACCESS AGREEMENT

This Access Agreement ("Agreement") is made on this _____ day of _____, 2022, by and between Ameren Illinois Company ("Owner") and Illinois Power Resources Generating, LLC ("IPRG"), an Illinois corporation with its principal place of business at 601 Travis Street, Suite 1400, Houston, Texas 77002 (collectively, "the Parties" and each a "Party").

WHEREAS, Owner represents that it owns Parcel Number 20-11-377-001, located at the following legal description: SW 1/4 SEC 11-7N-7E 12.064 AC ALL THAT PT OF SE 1/4 SW 1/4 SEC 11 & THE NW 1/4 SEC 14 LYING ELY & ADJACENT TO C&NW RR ROW (the "Property");

WHEREAS, IPRG is conducting certain environmental investigation activities at or around the retired Edwards Power Plant located at 7800 S Cilco Lane, Peoria, Illinois 61607;

WHEREAS, IPRG has contracted with Ramboll US Consulting Inc. ("Ramboll") to perform the environmental investigation; and

WHEREAS, IPRG requests access to the Property to conduct certain groundwater investigation activities described below.

NOW THEREFORE, the Parties agree as follows:

1. Grant of Access. Owner permits IPRG, its consultants, and its contractors, including Ramboll, to enter the Property for the purposes of installing a groundwater monitoring station, located as depicted in the attached graphic, and collecting groundwater samples from that groundwater monitoring station and any existing groundwater well(s) from time to time. The location of the proposed groundwater station depicted in attached graphic is not exact and may be modified based on access, utilities, and drilling logistics and is intended to be on Owner's property. ("The Covered Activities.") Upon

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completion of the Covered Activities, which may include more than one sampling event, the Property will be restored pursuant to Paragraph 6. In the event IPRG wishes to propose activities in addition to the Covered Activities, IPRG shall provide Owner advanced written notice of such proposed additional actions and shall not undertake any such additional work until Owner has agreed to provide access for the additional work, the approval of which shall not be unreasonably withheld.

2. Pre-Investigation Obligations. IPRG shall give Owner not less than five (5) business days prior notice each time it plans to enter the Property to conduct the Covered Activities. Prior to commencing any sub-surface work at the Property, IPRG shall contact Illinois's Joint Utility Locating Information for Excavators **(**"JULIE") as well as any applicable local digger's hotline to receive clearance to commence work.
3. Compliance with Laws. IPRG and its agents, consultants, and contractors shall, in performing the Covered Activities, comply with all applicable laws, ordinances, and regulations.
4. Interference. IPRG and its agents, consultants, and contractors shall perform the Covered Activities in a manner that will not unreasonably interfere with the use of the Property by Owner.
5. Data and Sampling. IPRG agrees to timely provide Owner with the analytical results from any sampling conducted by IPRG at the Property.
6. Restoration of Property. To the extent feasible, IPRG shall restore all areas of the Property disturbed by the Covered Activities, including closing and abandoning any monitoring wells installed by IPRG as part of the Covered Activities, to its condition

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immediately prior to performance of the Covered Activities. The restoration activities will be completed within sixty (60) days after termination of this Agreement.

7. Indemnity. Owner shall not be liable to IPRG or IPRG's agents, consultants, or contractors for any personal injury, property damage, or loss of life or property caused by or arising out of the Covered Activities. Except as may result from the negligent or willful misconduct of Owner, or any officers, employees, agents, representatives of Owner, or from a breach of this Agreement by Owner, IPRG shall defend against, hold Owner harmless from, and indemnify Owner against any claim, loss, expense, or damage arising out of any negligent act or omission of IPRG or its agents, consultants, or contractors in performing the Covered Activities.

8. Applicable Law. The rights of the Parties under this Agreement shall be governed by the laws of the State of Illinois.

9. Notice. Notices, letters, and other written correspondence relating to this Agreement shall be directed to the respective Party as set forth below, or as modified by that Party by written notice:

For Illinois Power Resources Generating, LLC:
David Mitchell
Vistra Corp.
6555 Sierra Drive
Irving, Texas 75039
David.Mitchell@vistracorp.com
(972) 556-6350

With a copy to:
Joshua R. More
ArentFox Schiff LLP
233 South Wacker Drive, Suite 7100
Chicago, Illinois 60606
joshua.more@afslaw.com
Phone: (312) 258-5769

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For Owner:

Name: _____

Address: _____

_____

Email: _____

Phone: _____

10. Assignment. This Agreement shall be binding on the Parties and their successors and assigns. No Party shall assign this Agreement without the consent of the other Party, and such consent shall not be unreasonably withheld.

11. Term. This Agreement shall terminate at the completion of the Covered Activities, unless extended by written agreement of the Parties. IPRG shall notify Owner in writing upon the completion of the Covered Activities.

12. Reservation of Rights. By entering into, and performing under, this Agreement, neither IPRG nor Owner waives any rights, claims, or defenses, nor makes any admission of liability or responsibility.

[The Remainder of This Page Is Intentionally Left Blank]
(signature page follows)

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IN WITNESS WHEREOF, the Parties have caused this Agreement to be executed by their duly authorized representative as follows:

OWNER **AMEREN ILLINOIS COMPANY**

Signature: _____

Name: _____

Title: _____

Date: _____

ILLINOIS POWER RESOURCES GENERATING, LLC

Signature: _____

Name: _____

Title: _____

Date: _____

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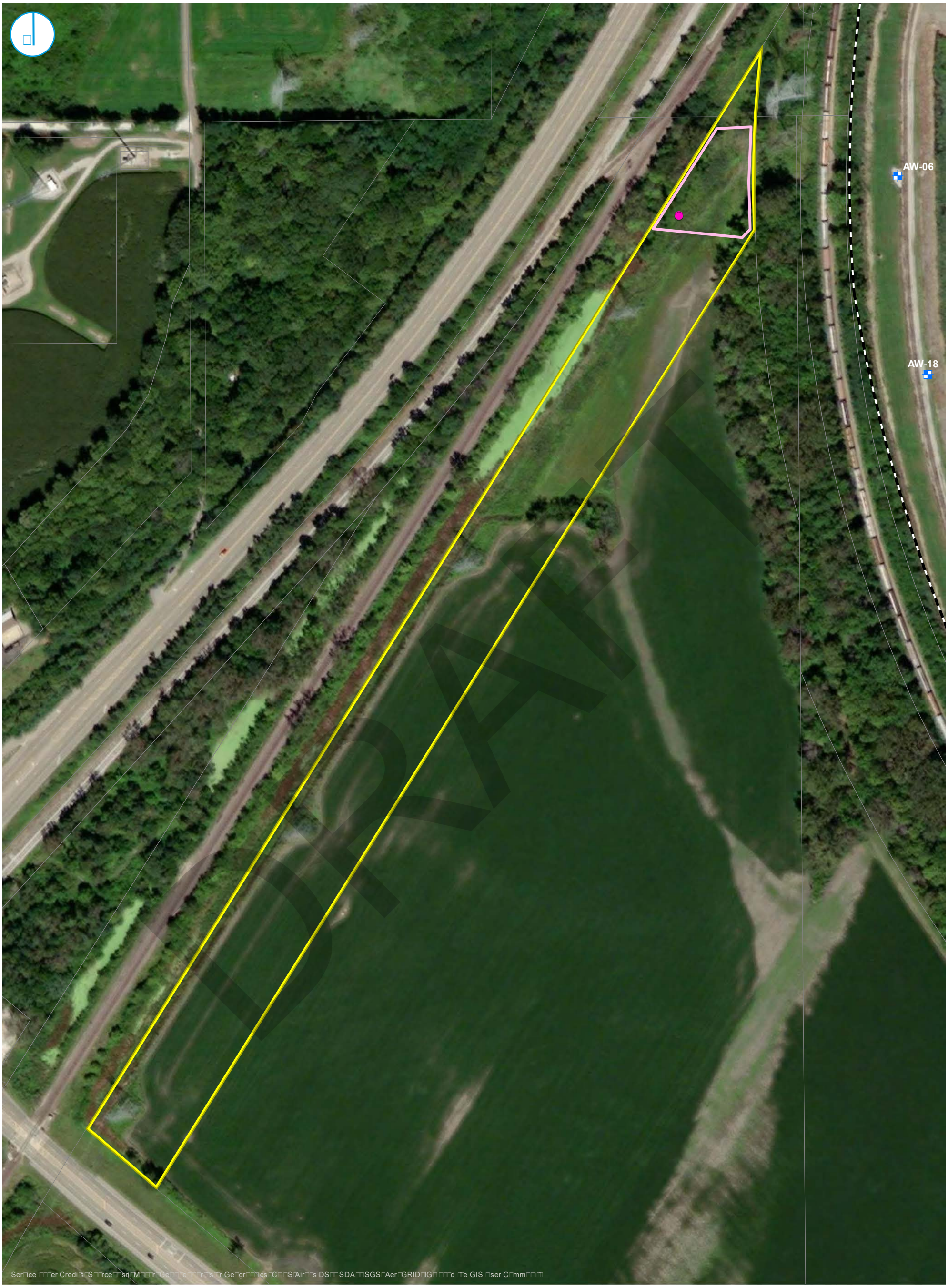

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PROPOSED WELL LOCATION
AMEREN ILLINOIS COMPANY PROPERTY

Access Agreement Attached Graphic

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VIA U.S. MAIL

Re: Parcel ID 2014176001

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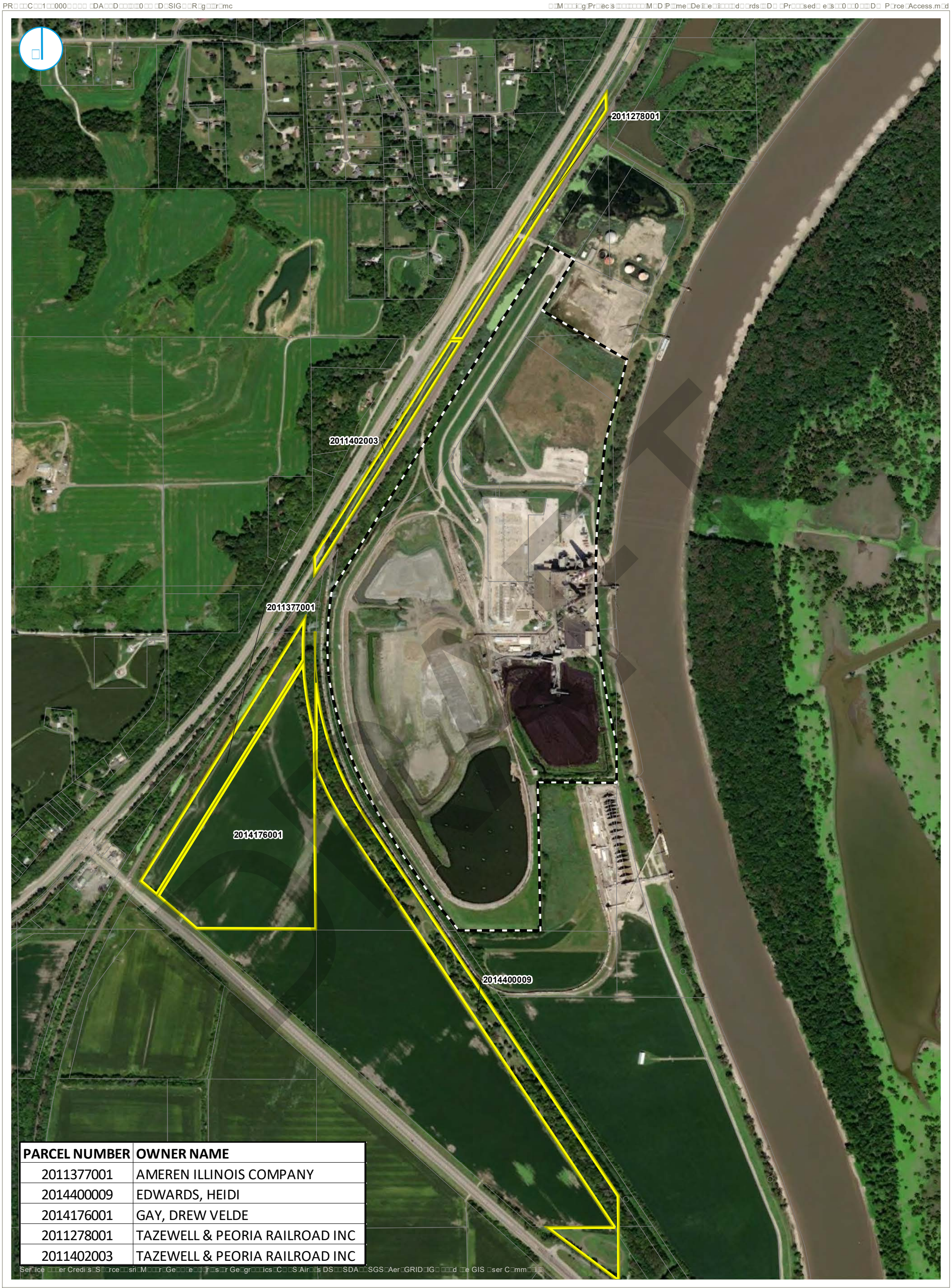

PARCEL NUMBER	OWNER NAME
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2014176001	GAY, DREW VELDE
2011278001	TAZEWELL & PEORIA RAILROAD INC
2011402003	TAZEWELL & PEORIA RAILROAD INC

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ADJACENT PROPERTIES OVERVIEW

Graphic 1

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PROPOSED WELL LOCATION
DREW VELDE GAY PROPERTY

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ACCESS AGREEMENT

This Access Agreement ("Agreement") is made on this _____ day of _____, 2022, by and between Drew Velde Gay ("Owner") and Illinois Power Resources Generating, LLC ("IPRG"), an Illinois corporation with its principal place of business at 601 Travis Street, Suite 1400, Houston, Texas 77002 (collectively, "the Parties" and each a "Party").

WHEREAS, Owner represents that it owns Parcel Number 20-14-176-001, located at the following legal description: NW 1/4 SEC 14-7-7E 42.87 AC (PL) ALL THAT PT NW 1/4 SEC 14 LYING SW OF TR DESC PER DOC #66-04266, SE OF P&PU RR ROW, & N OF RTE #9 ROW (89-00257) (the "Property");

WHEREAS, IPRG is conducting certain environmental investigation activities at or around the retired Edwards Power Plant located at 7800 S Cilco Lane, Peoria, Illinois 61607;

WHEREAS, IPRG has contracted with Ramboll US Consulting Inc. ("Ramboll") to perform the environmental investigation; and

WHEREAS, IPRG requests access to the Property to conduct certain groundwater investigation activities described below.

NOW THEREFORE, the Parties agree as follows:

1. Grant of Access. Owner permits IPRG, its consultants, and its contractors, including Ramboll, to enter the Property for the purposes of installing a groundwater monitoring station, located as depicted in the attached graphic, and collecting groundwater samples from that groundwater monitoring station and any existing groundwater well(s) from time to time. The location of the proposed groundwater station depicted in attached graphic is not exact and may be modified based on access, utilities, and drilling logistics and is intended to be on Owner's property. ("The Covered Activities.") Upon

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completion of the Covered Activities, which may include more than one sampling event, the Property will be restored pursuant to Paragraph 6. In the event IPRG wishes to propose activities in addition to the Covered Activities, IPRG shall provide Owner advanced written notice of such proposed additional actions and shall not undertake any such additional work until Owner has agreed to provide access for the additional work, the approval of which shall not be unreasonably withheld.

2. Pre-Investigation Obligations. IPRG shall give Owner not less than five (5) business days prior notice each time it plans to enter the Property to conduct the Covered Activities. Prior to commencing any sub-surface work at the Property, IPRG shall contact Illinois's Joint Utility Locating Information for Excavators **(**"JULIE") as well as any applicable local digger's hotline to receive clearance to commence work.
3. Compliance with Laws. IPRG and its agents, consultants, and contractors shall, in performing the Covered Activities, comply with all applicable laws, ordinances, and regulations.
4. Interference. IPRG and its agents, consultants, and contractors shall perform the Covered Activities in a manner that will not unreasonably interfere with the use of the Property by Owner.
5. Data and Sampling. IPRG agrees to timely provide Owner with the analytical results from any sampling conducted by IPRG at the Property.
6. Restoration of Property. To the extent feasible, IPRG shall restore all areas of the Property disturbed by the Covered Activities, including closing and abandoning any monitoring wells installed by IPRG as part of the Covered Activities, to its condition

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immediately prior to performance of the Covered Activities. The restoration activities will be completed within sixty (60) days after termination of this Agreement.

7. Indemnity. Owner shall not be liable to IPRG or IPRG's agents, consultants, or contractors for any personal injury, property damage, or loss of life or property caused by or arising out of the Covered Activities. Except as may result from the negligent or willful misconduct of Owner, or any officers, employees, agents, representatives of Owner, or from a breach of this Agreement by Owner, IPRG shall defend against, hold Owner harmless from, and indemnify Owner against any claim, loss, expense, or damage arising out of any negligent act or omission of IPRG or its agents, consultants, or contractors in performing the Covered Activities.

8. Applicable Law. The rights of the Parties under this Agreement shall be governed by the laws of the State of Illinois.

9. Notice. Notices, letters, and other written correspondence relating to this Agreement shall be directed to the respective Party as set forth below, or as modified by that Party by written notice:

For Illinois Power Resources Generating, LLC:
David Mitchell
Vistra Corp.
6555 Sierra Drive
Irving, Texas 75039
David.Mitchell@vistracorp.com
(972) 556-6350

With a copy to:
Joshua R. More
ArentFox Schiff LLP
233 South Wacker Drive, Suite 7100
Chicago, Illinois 60606
joshua.more@afslaw.com
Phone: (312) 258-5769

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For Owner:

Name: _____

Address: _____

_____

Email: _____

Phone: _____

10. Assignment. This Agreement shall be binding on the Parties and their successors and assigns. No Party shall assign this Agreement without the consent of the other Party, and such consent shall not be unreasonably withheld.

11. Term. This Agreement shall terminate at the completion of the Covered Activities, unless extended by written agreement of the Parties. IPRG shall notify Owner in writing upon the completion of the Covered Activities.

12. Reservation of Rights. By entering into, and performing under, this Agreement, neither IPRG nor Owner waives any rights, claims, or defenses, nor makes any admission of liability or responsibility.

[The Remainder of This Page Is Intentionally Left Blank]
(signature page follows)

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IN WITNESS WHEREOF, the Parties have caused this Agreement to be executed by their duly authorized representative as follows:

OWNER **DREW VELDE GAY**

Signature: _____

Name: _____

Title: _____

Date: _____

ILLINOIS POWER RESOURCES GENERATING, LLC

Signature: _____

Name: _____

Title: _____

Date: _____

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PROPOSED WELL LOCATION
DREW VELDE GAY PROPERTY

Access Agreement Attached Graphic

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Re: Parcel ID 2014400009

VIA U.S. MAIL

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IPRG □□s □□□□ied □□e l□i□□is □PA □□□□e e□e□□□ed □□r□□ de□ec□□□s □□ i□s □r□□er□ □□d is □□r□□g □□ g□□□er □dditi□□□□d□□□. As □□r□□□□□□ese e□□□r□ IPRG re□□es□ □ermissi□□ □□r i□s c□□s□□□□□s □□ □ccess □□□r □r□□er□ □□i□s□□□□ gr□□□d□□□er m□□i□□ri□g s□□i□□ □□d c□□d□c□□□e □r m□re gr□□□d□□□er s□m□i□g e□e□□s.

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IPRG □□d i□s c□□s□□□□□s □i□□□□□□□ccess □□□r □r□□er□ □i□□□□□□□□r c□□se□□. A□□es□i□g □i□□e c□□d□c□ed □□ IPRG□s e□□e□se□□□d □□□ □i□□e □r□ided □i□□ □ c□□□ □□□□e res□□s □□□□□d□□ c□□ec□ed □□ □□□r □r□□er□. □ □ce □□is i□□es□g□i□□ is c□□□e□e□□e m□□i□□ri□g s□□i□□ □i□□e c□□sed □□d □□□□d□□ed i□ □cc□rd□□ce □i□□ □□□□ic□□e re□□ireme□□s □□d □□e □□□□c□ed □ccess □greeme□□.

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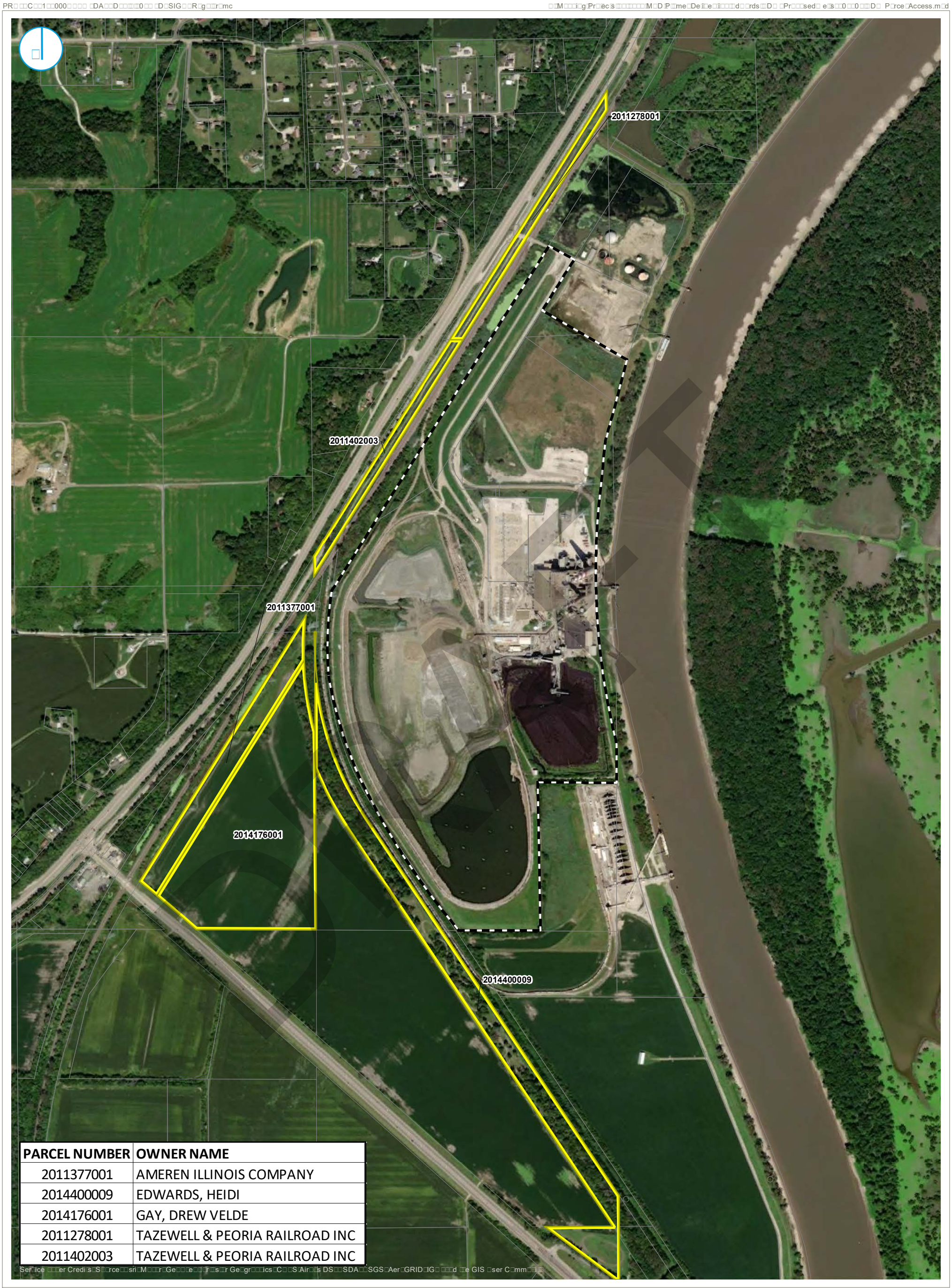

PARCEL NUMBER	OWNER NAME
2011377001	AMEREN ILLINOIS COMPANY
2014400009	EDWARDS, HEIDI
2014176001	GAY, DREW VELDE
2011278001	TAZEWELL & PEORIA RAILROAD INC
2011402003	TAZEWELL & PEORIA RAILROAD INC

Ser□ice □□□er Credi□s□S□□rce□□sri□M□□□r□Ge□□□e□□□r□□s□□r Ge□gr□□□ics□C□□S□Air□□s DS□□SDA□□SGS□Aer□GRID□IG□ □□□d □□e GIS □ser C□mm□□□□

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ADJACENT PROPERTIES OVERVIEW

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PROPOSED WELL LOCATION
HEIDI EDWARDS PROPERTY

Graphic 2

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ACCESS AGREEMENT

This Access Agreement ("Agreement") is made on this _____ day of _____, 2022, by and between Heidi Edwards ("Owner") and Illinois Power Resources Generating, LLC ("IPRG"), an Illinois corporation with its principal place of business at 601 Travis Street, Suite 1400, Houston, Texas 77002 (collectively, "the Parties" and each a "Party").

WHEREAS, Owner represents that it owns Parcel Number 20-14-400-009, located at South Cargill Road, Peoria, Illinois, at the following legal description: NE 1/4 & SE 1/4 SEC 14-7N-7E 27.84 AC ALL THAT PT FORMER C&NW RR ROW LYING IN NE 1/4 & SE 1/4 SEC 14; ALSO ALL THAT PT FORMER C&NW RR ROW LYING IN NE COR NE 1/4 SEC 23 & NE 1/4 SEC 23 LYING NW OF ROUTE 9 PT NE 1/4 SEC 23 (the "Property");

WHEREAS, IPRG is conducting certain environmental investigation activities at or around the retired Edwards Power Plant located at 7800 S Cilco Lane, Peoria, Illinois 61607;

WHEREAS, IPRG has contracted with Ramboll US Consulting Inc. ("Ramboll") to perform the environmental investigation; and

WHEREAS, IPRG requests access to the Property to conduct certain groundwater investigation activities described below.

NOW THEREFORE, the Parties agree as follows:

1. Grant of Access. Owner permits IPRG, its consultants, and its contractors, including Ramboll, to enter the Property for the purposes of installing a groundwater monitoring station, located as depicted in the attached graphic, and collecting groundwater samples from that groundwater monitoring station and any existing groundwater well(s) from time to time. The location of the proposed groundwater station depicted in attached graphic is not exact and may be modified based on access, utilities, and drilling logistics

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4. Interference. IPRG and its agents, consultants, and contractors shall perform the Covered Activities in a manner that will not unreasonably interfere with the use of the Property by Owner.
5. Data and Sampling. IPRG agrees to timely provide Owner with the analytical results from any sampling conducted by IPRG at the Property.
6. Restoration of Property. To the extent feasible, IPRG shall restore all areas of the Property disturbed by the Covered Activities, including closing and abandoning any monitoring wells installed by IPRG as part of the Covered Activities, to its condition

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immediately prior to performance of the Covered Activities. The restoration activities will be completed within sixty (60) days after termination of this Agreement.

7. Indemnity. Owner shall not be liable to IPRG or IPRG's agents, consultants, or contractors for any personal injury, property damage, or loss of life or property caused by or arising out of the Covered Activities. Except as may result from the negligent or willful misconduct of Owner, or any officers, employees, agents, representatives of Owner, or from a breach of this Agreement by Owner, IPRG shall defend against, hold Owner harmless from, and indemnify Owner against any claim, loss, expense, or damage arising out of any negligent act or omission of IPRG or its agents, consultants, or contractors in performing the Covered Activities.

8. Applicable Law. The rights of the Parties under this Agreement shall be governed by the laws of the State of Illinois.

9. Notice. Notices, letters, and other written correspondence relating to this Agreement shall be directed to the respective Party as set forth below, or as modified by that Party by written notice:

For Illinois Power Resources Generating, LLC:
David Mitchell
Vistra Corp.
6555 Sierra Drive
Irving, Texas 75039
David.Mitchell@vistracorp.com
(972) 556-6350

With a copy to:
Joshua R. More
ArentFox Schiff LLP
233 South Wacker Drive, Suite 7100
Chicago, Illinois 60606
joshua.more@afslaw.com
Phone: (312) 258-5769

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For Owner:

Name: _____

Address: _____

_____

Email: _____

Phone: _____

10. Assignment. This Agreement shall be binding on the Parties and their successors and assigns. No Party shall assign this Agreement without the consent of the other Party, and such consent shall not be unreasonably withheld.

11. Term. This Agreement shall terminate at the completion of the Covered Activities, unless extended by written agreement of the Parties. IPRG shall notify Owner in writing upon the completion of the Covered Activities.

12. Reservation of Rights. By entering into, and performing under, this Agreement, neither IPRG nor Owner waives any rights, claims, or defenses, nor makes any admission of liability or responsibility.

[The Remainder of This Page Is Intentionally Left Blank]
(signature page follows)

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IN WITNESS WHEREOF, the Parties have caused this Agreement to be executed by their duly authorized representative as follows:

OWNER **HEIDI EDWARDS**

Signature: _____

Name: _____

Title: _____

Date: _____

ILLINOIS POWER RESOURCES GENERATING, LLC

Signature: _____

Name: _____

Title: _____

Date: _____

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PROPOSED WELL LOCATION
HEIDI EDWARDS PROPERTY

Access Agreement Attached Graphic

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VIA U.S. MAIL

Re: Parcel IDs 2011278001 & 2011402003

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IPRG □□s □□i□□ed □□e l□i□□is □PA □□□□e e□e□□□ed □□r□□ de□ec□i□□s □□ i□s □r□□er□ □□d is □□r□i□g □□ g□□□er □ddi□□□□□d□□□. As □□r□□□□□□ese e□□□r□s □IPRG re□□es□s □ermissi□□ □□r i□s c□□s□□□□□□s □□ □ccess □□□r □r□□er□ □□ i□s□□□□gr□□□d□□er m□□i□□ri□g s□□i□□s □□d c□□d□c□□□e □r m□re gr□□□d□□er s□m□i□g e□e□□s.

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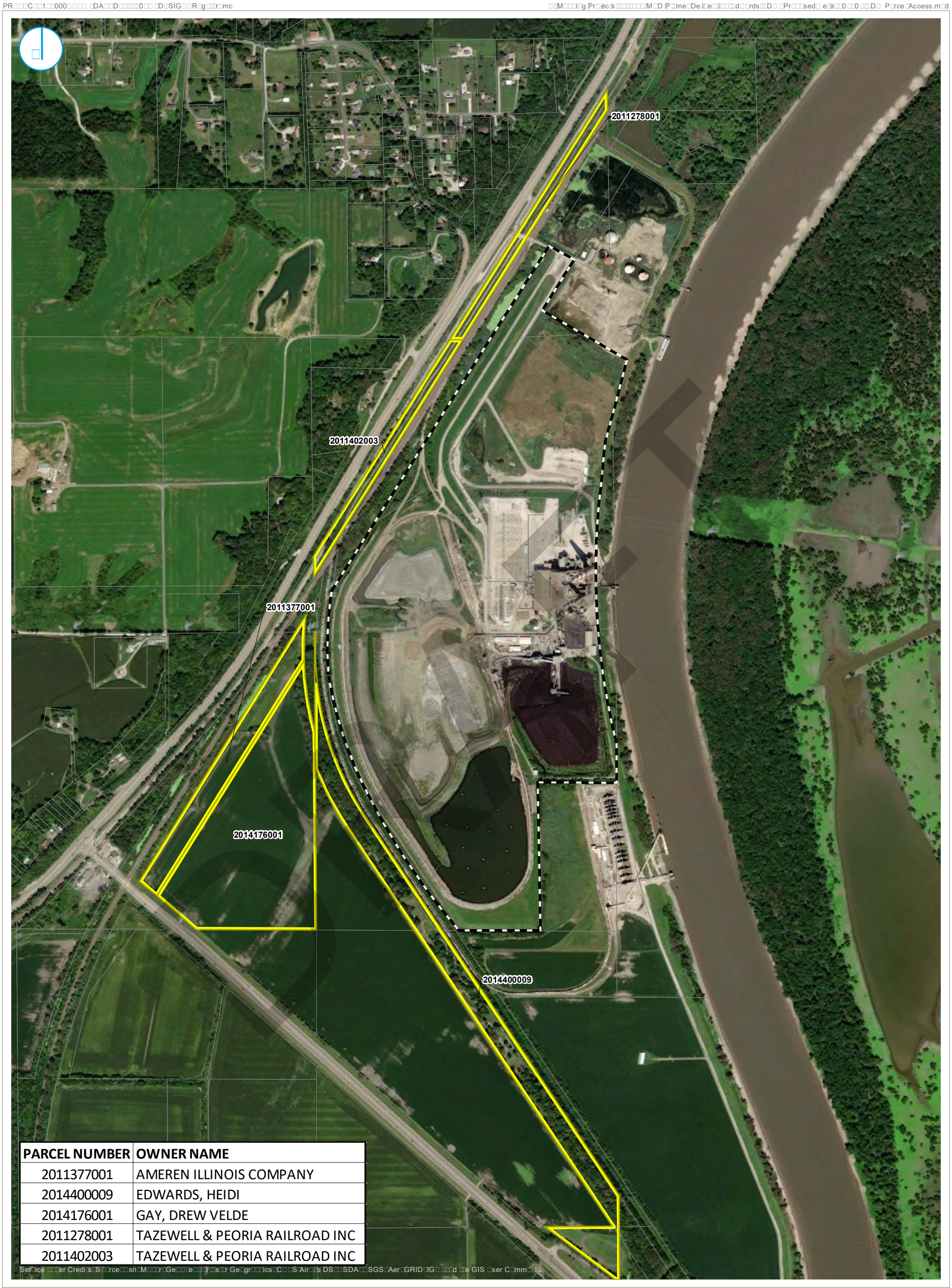

PARCEL NUMBER	OWNER NAME
2011377001	AMEREN ILLINOIS COMPANY
2014400009	EDWARDS, HEIDI
2014176001	GAY, DREW VELDE
2011278001	TAZEWELL & PEORIA RAILROAD INC
2011402003	TAZEWELL & PEORIA RAILROAD INC

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ADJACENT PROPERTIES OVERVIEW

Graphic 1

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PROPOSED WELL LOCATION
TAZEWELL & PEORIA RAILROAD INC PROPERTY

Graphic 2

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ACCESS AGREEMENT

This Access Agreement ("Agreement") is made on this _____ day of _____, 2022, by and between Tazewell & Peoria Railroad, Inc. ("Owner") and Illinois Power Resources Generating, LLC ("IPRG"), an Illinois corporation with its principal place of business at 601 Travis Street, Suite 1400, Houston, Texas 77002 (collectively, "the Parties" and each a "Party").

WHEREAS, Owner represents that it owns Parcel Number 20-11-278-001, located at the following legal description: NE 1/4 SEC 11-7N-7E 5.75 AC 100' WIDE STRIP OF ABANDONED P&PU RR ROW ACROSS NE 1/4 SEC 11 (20-R/33-8) NON CARRIER REAL ESTATE SCHEDULE 537;

WHEREAS, Owner represents that it also owns Parcel Number 20-11-402-003, located at the following legal description: SE 1/4 SEC 11-7N-7E 4.63 AC IRREG STRIP OF ABANDONED P&PU RR ROW ACROSS SE 1/4 SEC 11 (20-R/33-7) NON CARRIER REAL ESTATE SCHEDULE 537 (both parcels collectively, the "Property");

WHEREAS, IPRG is conducting certain environmental investigation activities at or around the retired Edwards Power Plant located at 7800 S Cilco Lane, Peoria, Illinois 61607;

WHEREAS, IPRG has contracted with Ramboll US Consulting Inc. ("Ramboll") to perform the environmental investigation; and

WHEREAS, IPRG requests access to the Property to conduct certain groundwater investigation activities described below.

NOW THEREFORE, the Parties agree as follows:

1. Grant of Access. Owner permits IPRG, its consultants, and its contractors, including Ramboll, to enter the Property for the purposes of installing groundwater monitoring stations, located as depicted in the attached graphic, and collecting groundwater

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samples from those groundwater monitoring stations and any existing groundwater well(s) from time to time. The locations of the proposed groundwater stations depicted in attached graphic are not exact and may be modified based on access, utilities, and drilling logistics and are intended to be on Owner's property. ("The Covered Activities.") Upon completion of the Covered Activities, which may include more than one sampling event, the Property will be restored pursuant to Paragraph 6. In the event IPRG wishes to propose activities in addition to the Covered Activities, IPRG shall provide Owner advanced written notice of such proposed additional actions and shall not undertake any such additional work until Owner has agreed to provide access for the additional work, the approval of which shall not be unreasonably withheld.

2. Pre-Investigation Obligations. IPRG shall give Owner not less than five (5) business days prior notice each time it plans to enter the Property to conduct the Covered Activities. Prior to commencing any sub-surface work at the Property, IPRG shall contact Illinois's Joint Utility Locating Information for Excavators **(**"JULIE") as well as any applicable local digger's hotline to receive clearance to commence work.
3. Compliance with Laws. IPRG and its agents, consultants, and contractors shall, in performing the Covered Activities, comply with all applicable laws, ordinances, and regulations.
4. Interference. IPRG and its agents, consultants, and contractors shall perform the Covered Activities in a manner that will not unreasonably interfere with the use of the Property by Owner.
5. Data and Sampling. IPRG agrees to timely provide Owner with the analytical results from any sampling conducted by IPRG at the Property.

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6. Restoration of Property. To the extent feasible, IPRG shall restore all areas of the Property disturbed by the Covered Activities, including closing and abandoning any monitoring wells installed by IPRG as part of the Covered Activities, to its condition immediately prior to performance of the Covered Activities. The restoration activities will be completed within sixty (60) days after termination of this Agreement.

7. Indemnity. Owner shall not be liable to IPRG or IPRG's agents, consultants, or contractors for any personal injury, property damage, or loss of life or property caused by or arising out of the Covered Activities. Except as may result from the negligent or willful misconduct of Owner, or any officers, employees, agents, representatives of Owner, or from a breach of this Agreement by Owner, IPRG shall defend against, hold Owner harmless from, and indemnify Owner against any claim, loss, expense, or damage arising out of any negligent act or omission of IPRG or its agents, consultants, or contractors in performing the Covered Activities.

8. Applicable Law. The rights of the Parties under this Agreement shall be governed by the laws of the State of Illinois.

9. Notice. Notices, letters, and other written correspondence relating to this Agreement shall be directed to the respective Party as set forth below, or as modified by that Party by written notice:

   For Illinois Power Resources Generating, LLC:

   David Mitchell
   Vistra Corp.
   6555 Sierra Drive
   Irving, Texas 75039
   David.Mitchell@vistracorp.com
   (972) 556-6350

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With a copy to:

Joshua R. More
ArentFox Schiff LLP
233 South Wacker Drive, Suite 7100
Chicago, Illinois 60606
joshua.more@afslaw.com
Phone: (312) 258-5769

For Owner:

Name: _____

Address: _____

_____

Email: _____

Phone: _____

10. Assignment. This Agreement shall be binding on the Parties and their successors and assigns. No Party shall assign this Agreement without the consent of the other Party, and such consent shall not be unreasonably withheld.

11. Term. This Agreement shall terminate at the completion of the Covered Activities, unless extended by written agreement of the Parties. IPRG shall notify Owner in writing upon the completion of the Covered Activities.

12. Reservation of Rights. By entering into, and performing under, this Agreement, neither IPRG nor Owner waives any rights, claims, or defenses, nor makes any admission of liability or responsibility.

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(signature page follows)

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IN WITNESS WHEREOF, the Parties have caused this Agreement to be executed by their duly authorized representative as follows:

OWNER **TAZEWELL & PEORIA RAILROAD INC.**

Signature: _____

Name: _____

Title: _____

Date: _____

ILLINOIS POWER RESOURCES GENERATING, LLC

Signature: _____

Name: _____

Title: _____

Date: _____

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PROPOSED WELL LOCATION
TAZEWELL & PEORIA RAILROAD INC
PROPERTY

Access Agreement Attached Graphic

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APPENDIX B
SOIL BORING LOGS

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RECORD OF BOREHOLE AW-1

SHEET 1 of 2

PROJECT: Part 845 - Edwards Litigation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 9/8/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,430,685.26 E: 2,435,889.03

ELEVATION: 462.29
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
0	7" Sonic	(0.0-0.2) FILL - (GW) sandy GRAVEL, fine to coarse sub-angular well-graded gravel, fine sub-rounded poorly-graded sand, trace non-plastic fines; white (N9); non-cohesive, dry, loose.	GW		462.1 0.2				
		(0.2-1.2) (SP) - silty SAND, fine sub-rounded poorly-graded sand, non-plastic fines, some fine to coarse gravel; black (N1), CCR; non-cohesive, dry, loose.	CCR		461.1 1.2				
		(1.2-2.2) (GW) sandy GRAVEL, fine to coarse sub-angular well-graded gravel, fine sub-rounded poorly-graded sand, trace non-plastic fines; white (N9); non-cohesive, dry, loose.	GW		460.1 2.2				
5		(2.2-8.8) (SP) SAND, fine sub-rounded poorly-graded sand, trace fine sub-rounded poorly-graded gravel, trace non-plastic fines; moderate yellowish brown (10YR 5/4); non-cohesive, dry, loose.	SP			1	SO	10.0 / 10.0	▽ Water Level 7.71 ft bgs 9/15/2021
		(8.8-20.0) (CL) SILTY CLAY, medium plasticity fines, trace fine sub-rounded sand; dark yellowish brown (10YR 4/2); cohesive, w~P, firm.			453.5 8.8				(8.8) Native wood fragment caked in SILTY CLAY material, 0.7' thick.
10									(10.0) Switched from 7" casing to 6" casing; 7" casing acted as temporary override to prevent migration of CCR fill material down into the native formation.
15	6" Sonic		CL			2	SO	10.0 / 10.0	
20					442.3 20.0				
		(20.0-39.0) (ML) CLAYEY SILT, non-plastic to medium plasticity fines, trace fine sand, trace fine gravel; dark yellowish brown (10YR 4/2); cohesive, w~PL, firm.							
25	6" Sonic		ML			3	SO	19.0 / 19.0	
30		Log continued on next page							

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

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RECORD OF BOREHOLE AW-1

PROJECT: Part 845 - Edwards Litigation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 9/8/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,430,685.26 E: 2,435,889.03

ELEVATION: 462.29
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
30	6" Sonic	(20.0-39.0) (ML) CLAYEY SILT, non-plastic to medium plasticity fines, trace fine sand, trace fine gravel; dark yellowish brown (10YR 4/2); cohesive, w~PL, firm. *(Continued)*	ML			3	SO	19.0 / 19.0	
					430.1 / 32.2				
		(32.2) Same as Above (SAA) except, no gravel; light brown (5YR 5/6).							
35									
					426.3 / 36.0				
		(36.0) SAA except, light olive gray (5Y 5/2).							
					423.3 / 39.0				
		END OF BORING AT 39.0 FEET BELOW GROUND SURFACE.							
40									
45									
50									
55									
60									

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

GOLDER

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GOLDER STL RECORD OF BOREHOLE MWD EDWARDS.GPJ GLDR_CO.GDT 11/9/21

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SOIL BORING LOG INFORMATION

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Edwards Power Station		AW-23

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Dustin Crump Midwest Engineering and Testing, Inc.	10/24/2022	10/24/2022	hollow stem auger

Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
AW-23	Feet (NAVD88)	435.69 Feet (NAVD88)	8.0 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 1,430,561.48 N, 2,434,121.16 E E/W
1/4 of 1/4 of Section , T N, R
Lat 40° 35' 16.7"
Long 89° 40' 0.62"
Local Grid Location
Feet ☐ N ☐ S Feet ☐ E ☐ W

Facility ID	County	State	Civil Town/City/ or Village
	Peoria	IL	Peoria

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24 16	3 4 4 5	0	0 - 11.5' **LEAN CLAY:** CL, very dark gray (10YR 3/1), roots (0-5%), stiff, moist.	CL								SS = Split Spoon
2 SS	24 16	3 3 3 4	2	2' dark grayish brown (10YR 4/2), orange mottling (50%).									
3 SS	24 16	1 1 2 3	4	4' dark gray (10YR 4/1), soft.									
4 SS	24 18	1 2 1 2	6										
5 SS	24 17	1 1 1 1	8	8' gray (10YR 5/1).									
6 SS	24 21	WOH 1 2 40	10	10' wet.									WOH = Weight of Hammer
			11.5	11.5 - 16' **BEDROCK:** BDX, SILTSTONE.	BDX								

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I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm Ramboll
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Tel: (414)837-3607
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Boring Number AW-23 Page 2 of 2

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
7 SS	15 10	1 15 50 for 3"	13	11.5 - 16' **BEDROCK:** BDX, SILTSTONE. *(continued)*									
8 SS	8 8	8 50 for 2"	14		BDX								
			15										
			16	16' End of Boring.									

DRAFT

RECORD OF BOREHOLE EMW-05

PROJECT: Part 845 - Edwards Litigation
PROJECT NUMBER: 21454831.0002A
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 9/9/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,432,325.51 E: 2,435,264.90

ELEVATION: 455.78
INCLINATION: -90

DEPTH (feet)	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	NUMBER	TYPE	REC / ATT	REMARKS
0	6" Sonic	(0.0-7.0) NO RECOVERY - Hydrovac cleared to 7 feet below ground surface.			448.8 7.0	0	VAC	0.0 7.0	
10	6" Sonic	(7.0-18.5) FILL - (SC) CLAYEY SAND, fine sub-rounded poorly-graded sand, low to medium plasticity fines, trace sub-rounded poorly-graded gravel; moderate yellowish brown (10YR 5/4) with dark yellowish brown (10YR 2/2) mottling; non-cohesive, dry, compact.	SC			1	SO	10.9 13.0	
15	6" Sonic				437.3 18.5				
20	6" Sonic	(18.5-19.0) (ML) CLAYEY SILT, non-plastic to low plasticity fines, some fine sub-rounded poorly-graded sand, trace fine sub-rounded gravel; medium dark gray (N4); cohesive, w<PL, firm.	ML		436.8 19.0				
		(19.0-20.0) (SC) CLAYEY SAND, fine sub-rounded poorly-graded sand, non-plastic to low plasticity fines, trace gravel; dark yellowish brown (10YR 4/2); non-cohesive, dry, loose.	SC		435.8 20.0				▽ Water Level 21.30 ft bgs 9/15/2021
		(20.0-24.0) (SP&ML) SAND and SILT, fine sub-rounded poorly-graded sand, non-plastic fines, trace sub-rounded gravel; yellowish gray (5Y 7/2); non-cohesive, moist, compact.	SP&ML		431.8 24.0				
25	6" Sonic	(24.0-31.0) (ML) CLAYEY SILT, low to medium plasticity fines, trace fine sub-rounded sand, trace fine sub-rounded gravel; pale brown (5YR 5/2); cohesive, w~PL, soft.	ML			2	SO	14.0 14.0	
30		Log continued on next page							

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

GOLDER

DRAFT

C□□□ID□□□IA□ A□□□R□□□
C□I□□□ PRI□I□□G□ □ □R□ I□
PR□GR□SS

GOLDER STL RECORD OF BOREHOLE MWD EDWARDS.GPJ GLDR_CO.GDT 11/9/21

RECORD OF BOREHOLE EMW-05

PROJECT: Part 845 - Edwards Litigation
PROJECT NUMBER: 21454831.0002A
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 9/9/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,432,325.51 E: 2,435,264.90

ELEVATION: 455.78
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
30	6" Sonic		ML		424.8				
		(31.0-32.0) (SC) CLAYEY SAND, fine sub-rounded poorly-graded sand, medium plasticity fines, trace fine sub-rounded gravel; medium light gray (N6); non-cohesive, dry, compact.	SC		31.0 423.8	2	SO	14.0 14.0	
		(32.0-34.0) Moderately weathered (W3), thinly laminated, light gray (N7), very fine grained, moderately porous, very weak (R1), SILTSTONE, [Carbondale Formation] .			32.0 421.8				
		END OF BORING AT 34.0 FEET BELOW GROUND SURFACE.			34.0				
35									
40									
45									
50									
55									
60									

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

GOLDER

DRAFT

C□□□ID□□□IA□ A□□□R□□□
C□I□□□ PRI□I□□G□ □ □R□ I□
PR□GR□SS

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SOIL BORING LOG INFORMATION

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Edwards Power Station		OW-01

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Dustin Crump Midwest Engineering and Testing, Inc.	10/21/2022	10/21/2022	hollow stem auger

Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
OW-01	Feet (NAVD88)	457.84 Feet (NAVD88)	8.3 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒

State Plane 1,432,068.21 N, 2,435,364.74 E E/W

1/4 of 1/4 of Section , T N, R

Lat 40° 35' 52.61"

Long 89° 40' 0.74"

Local Grid Location ☐ N ☐ S Feet ☐ E ☐ W Feet

Facility ID	County	State	Civil Town/City/ or Village
	Peoria	IL	Peoria

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0	0 - 0.25' **FILL, SILTY SAND:** SM, Blind drilled to 36.5 feet below ground surface (ft bgs). See boring log PTW-01 for detailed lithology..	(FILL) SM								Blind Drill
			1	0.25 - 0.7' **FILL, WELL-GRADED GRAVEL:** GW.	(FILL) GW								
			2	0.7 - 5.75' **FILL, ASH (Coal):** ML.									
			3		(FILL) ML								
			4										
			5										
			6	5.75 - 6.2' **FILL, SANDY SILT WITH GRAVEL:** s(ML)g.	(FILL) s(ML)g								
			7	6.2 - 14' **FILL, SILTY CLAY:** CL/ML.									
			8										
			9		(FILL) CL/ML								
			10										
			11										
			12										

DRAFT

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

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Boring Number OW-01 Page 2 of 3

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	Soil Properties: Compressive Strength (tsf)	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			13	6.2 - 14' **FILL, SILTY CLAY:** CL/ML. *(continued)*	(FILL) CL/ML								
			14	14 - 22' **FILL, LEAN CLAY:** CL.									
			15										
			16										
			17										
			18		(FILL) CL								
			19										
			20										
			21										
			22	22 - 26' **LEAN CLAY:** CL.									
			23										
			24		CL								
			25										
			26	26 - 30' **SANDY LEAN CLAY:** s(CL).									
			27										
			28		s(CL)								
			29										
			30	30 - 31' **POORLY-GRADED SAND:** SP.									
			31	31 - 32.7' **LEAN CLAY:** CL.	SP								
			32		CL								

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Boring Number OW-01 Page 3 of 3

Sample								Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			33	31 - 32.7' **LEAN CLAY:** CL. *(continued)*	CL								
				32.7 - 34.4' **SILT WITH SAND:** (ML)s.	(ML)s								
			34										
			35	34.4 - 36.5' **SILTY CLAY WITH SAND:** (CL/ML)S.	(CL/ML)S								
			36										
				36.5' End of Boring.									

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SOIL BORING LOG INFORMATION

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Edwards Power Station		OW-02

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Dustin Crump Midwest Engineering and Testing, Inc.	10/19/2022	10/20/2022	hollow stem auger

Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
OW-02	Feet (NAVD88)	438.66 Feet (NAVD88)	8.3 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒

State Plane 1,428,434.56 N, 2,435,409.63 E E/W

1/4 of 1/4 of Section , T N, R

Lat 40° 35' 16.54"

Long 89° 40' 0.5"

Local Grid Location ☐ Feet ☐ N ☐ S ☐ Feet ☐ E ☐ W

Facility ID	County	State	Civil Town/City/ or Village
	Peoria	IL	Peoria

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0	0 - 0.4' **POORLY-GRADED SAND:** SP, Blind drilled to 37 feet below ground surface (ft bgs). See boring log PTW-02 for detailed lithology..	SP								Blind Drill
			1	0.4 - 7.2' **SILT:** ML.									
			2										
			3										
			4		ML								
			5										
			6										
			7	7.2 - 12' **LEAN CLAY:** CL.									
			8										
			9										
			10		CL								
			11										
			12										

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I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

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Boring Number OW-02 Page 2 of 3

Sample								Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			12	12 - 23' **FAT CLAY:** CH.									
			13										
			14										
			15										
			16										
			17										
			18		CH								
			19										
			20										
			21										
			22										
			23	23 - 36.5' **LEAN CLAY:** CL.									
			24										
			25										
			26										
			27										
			28		CL								
			29										
			30										
			31										
			32										

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Boring Number OW-02 Page 3 of 3

Sample								Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			33	23 - 36.5' **LEAN CLAY:** CL. *(continued)*	CL								
			34										
			35										
			36										
			37	36.5 - 37' **WEATHERED BEDROCK** to **SANDSTONE:** BDX.	BDX								
				37' End of Boring.									

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SOIL BORING LOG INFORMATION

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Edwards Power Station		PTW-01

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Dustin Crump Midwest Engineering and Testing, Inc.	10/20/2022	10/21/2022	hollow stem auger

Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
PTW-01	Feet (NAVD88)	459.38 Feet (NAVD88)	10.5 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 1,432,085.07 N, 2,435,370.28 E E/W
1/4 of 1/4 of Section , T N, R
Lat 40° 35' 52.45"
Long 89° 40' 0.81"
Local Grid Location Feet ☐N ☐S Feet ☐E ☐W

Facility ID	County	State	Civil Town/City/ or Village
	Peoria	IL	Peoria

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24 16	4 4 4 7	1	0 - 0.25' **FILL, SILTY SAND:** SM, dark brown (10YR 3/3) with organics, loose, moist.	(FILL) SM								Drilled and sampled with 3.25" Hollow Stem Auger (HSA). Re-drilled location with 6.25" HSA for well installation. SS = Split Spoon
				0.25 - 0.7' **FILL, WELL-GRADED GRAVEL:** GW, white, loose.	(FILL) GW								
2 SS	24 17	4 4 3 6	2 3	0.7 - 5.75' **FILL, ASH (Coal):** ML, very dark gray (10YR 3/1), silt-sized ash, sand (0-5%), non-plastic, non-cohesive.	(FILL) ML								
3 SS	24 16	3 3 4 6	4 5										
4 SS	24 15	4 3 5 6	6 7	5.75 - 6.2' **FILL, SANDY SILT WITH GRAVEL:** s(ML)g, very dark grayish brown (10YR 3/2), loose, moist.	(FILL) s(ML)g								
5 SS	24 16	1 2 3 4	8 9	6.2 - 14' **FILL, SILTY CLAY:** CL/ML, dark gray (10YR 4/1), yellowish brown mottling (20%), gravel (0-5%), sand (0-5%), medium to low plasticity, moist. 8' medium to high plasticity.									
6 SS	24 14	2 1 3 3	10 11	10' medium to low plasticity, trace rootlets.	(FILL) CL/ML								
7 SS	24 17	2 2 4 4	12 13										
8 SS	24 16	1 2 2 3	14 15 16	14 - 22' **FILL, LEAN CLAY:** CL, dark grayish brown (2.5Y 4/2), yellowish brown (10YR 5/4) mottling (20%), silt (15-30%), sand (0-5%), roots (0-5%), soft, medium plasticity, moist.	(FILL) CL								

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I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

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Fax: (414)837-3608

Boring Number PTW-01 Page 2 of 2

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
9 SS	24 21	1 2 3 4	17	14 - 22' **FILL, LEAN CLAY:** CL, dark grayish brown (2.5Y 4/2), yellowish brown (10YR 5/4) mottling (20%), silt (15-30%), sand (0-5%), roots (0-5%), soft, medium plasticity, moist. *(continued)*									
10 SS	24 24	1 3 4 5	18 19		(FILL) CL								
11 SS	24 14	2 2 4 5	20 21										
12 SS	24 22	2 5 7 8	22 23	22 - 26' **LEAN CLAY:** CL, dark gray (2.5Y 4/1), silt (15-30%), high to medium plasticity, moist.									
13 SS	24 24	2 2 3 4	24 25	24' low to medium plasticity. 24.3' - 24.47' layer of silty sand, olive gray, dry.	CL								
14 SS	24 15	1 1 2 2	26 27	26 - 30' **SANDY LEAN CLAY:** s(CL), dark gray (2.5Y 4/1), silt (15-30%), shells (0-5%), sand (0-5%), very soft to soft, low plasticity, wet.									
15 SS	24 14.5	WOH 1 1 1	28 29		s(CL)								
16 SS	24 19	WOH WOH 2 2	30 31	30 - 31' **POORLY-GRADED SAND:** SP, dark gray (2.5Y 4/1), fine to medium-grained sand, silt (15-30%), shells (0-5%), clay (0-5%), loose, wet.	SP								WOH = Weight of Hammer
17 SS	24 24	1 2 2 2	32 33	31 - 32.7' **LEAN CLAY:** CL, olive gray, dark brown (5Y 4/2) mottling, organic material and shells (0-30%), medium to high plasticity, moist. 32.7 - 34.4' **SILT WITH SAND:** (ML)s, dark gray (5Y 4/1), fine-grained sand, black wood (0-5%), roots (0-5%), shells (0-5%), clay (0-5%), loose.	CL (ML)s								
18 SS	24 12	WOH 2 3 3	34 35	34.4 - 36.5' **SILTY CLAY WITH SAND:** (CL/ML)S, dark gray (5Y 4/1), organic material (0-5%), soft to medium stiff, low to medium plasticity, moist.	(CL/ML)S								
19 SS	17 13	2 23 50 for 5"	36 37	36.5 - 38' **WEATHERED BEDROCK** to **SILTY SAND:** BDX, **WEATHERED SILTSTONE** : dark greenish gray (GLEY 1 4/1), olive (5Y 5/4) mottling (50%), dense sand.	BDX								
20 SS	3 3	50 for 3"	38	38 - 38.25' **BEDROCK:** to **SANDSTONE:** BDX, **SILTSTONE** : dark greenish gray (GLEY 1 4/1), olive (5Y 5/4) mottling (50%), fine-grained sandstone, hard, moist. 38.25 - 38.5' Overdrilled to 38.5'. 38.5' End of Boring.	BDX								

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SOIL BORING LOG INFORMATION

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Edwards Power Station		PTW-02

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Dustin Crump Midwest Engineering and Testing, Inc.	10/18/2022	10/19/2022	hollow stem auger

Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
PTW-02	Feet (NAVD88)	439.02 Feet (NAVD88)	10.5 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 1,428,450.80 N, 2,435,400.23 E E/W
1/4 of 1/4 of Section , T N, R
Lat 40° 35' 37.63"
Long 89° 40' 17.05"
Local Grid Location ☐ N ☐ S Feet ☐ E ☐ W Feet

Facility ID	County	State	Civil Town/City/ or Village
	Peoria	IL	Peoria

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24 16	2 6 5 7	0	0 - 0.4' **POORLY-GRADED SAND:** SP, dark grayish brown (10YR 4/2), silt (15-30%), roots (0-5%), moist.	SP								Drilled and sampled with 3.25" Hollow Stem Auger (HSA). Re-drilled location with 6.25" HSA for well installation.
			1	0.4 - 7.2' **SILT:** ML, grayish brown (10YR 5/2), dark brown (7.5YR 3/4) mottling (0-5%), shells (0-5%), gravel (0-5%), sand (0-5%), no dilatancy, medium toughness, non-plastic.									
2 SS	24 12	4 4 6 6	2										
			3										
3 SS	24 10	3 6 7 8	4		ML								SS = Split Spoon
			5										
4 SS	24 19	2 4 3 4	6										
			7	7.2 - 12' **LEAN CLAY:** CL, dark grayish brown (10YR 4/2), grayish brown (10YR 5/2) mottling, slow dilatency, low toughness, medium plasticity, moist.									
5 SS	24 22	2 2 2 2	8										
			9										
6 SS	24 22	1 1 2 2	10	10' organic material (15-30%).	CL								
			11										
			12										

DRAFT

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

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Boring Number PTW-02 Page 2 of 3

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
7 SS	24 24	1 1 1 2	13	12 - 23' **FAT CLAY:** CH, dark gray (2.5Y 4/1), no to slow dilatency, low toughness, high plasticity, moist.									
8 SS	24 21	1 1 WOH 1	14 15										WOH = Weight of Hammer
9 SS	24 24	WOH WOH 2 1	16 17	16' shells (0-5%).									
10 SS	24 24	WOH 1 2 1	18 19	19.2' - 19.3' layer of crushed shells, wet.	CH								
11 SS	24 24	2 WOH 2 1	20 21										
12 SS	24 13	WOH 1 2 1	22 23										
13 SS	24 24	WOH WOH 2 1	24 25	23 - 36.5' **LEAN CLAY:** CL, dark gray (2.5Y 4/1), shells (0-5%), sand (0-5%), slow to no dilatency, low toughness, medium plasticity, moist. 24' organic material (5-10%).									
14 SS	24 24	WOH 1 1 2	26 27	26' organic material (15%), medium to low plasticity.	CL								
15 SS	24 24	WOH WOH 2 1	28 29	28' - 30' organic material (10-20%).									
16 SS	24 24	WOH WOH WOH 2	30 31 32										

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Boring Number PTW-02 Page 3 of 3

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
17 SS	24 20	WOH 1 1 2	33	23 - 36.5' **LEAN CLAY:** CL, dark gray (2.5Y 4/1), shells (0-5%), sand (0-5%), slow to no dilatency, low toughness, medium plasticity, moist. *(continued)* 32' organic material (0-5%), no shells.									
18 SS	24 24	WOH WOH 1 2	34 35	34' organic material (15%).	CL								
19 SS	11 12	10 50 for 5"	36 37	36.5 - 39' **WEATHERED BEDROCK** to **SANDSTONE:** BDX, **WEATHERED SILTSTONE** : gray (2.5 Y 5/1), fine sandstone, highly decomposed.	BDX								
21 SS	5 5	50 for 5"	38										
23 SS	3 3	50 for 3"	39	39 - 39.25' **BEDROCK:** to **SANDSTONE:** BDX, **SILTSTONE** : gray (2.5 Y 5/1), fine-grained sandstone, hard, wet. 39.25 - 39.5' Overdrilled to 39.5'. 39.5' End of Boring.	BDX								

DRAFT

APPENDIX C
MONITORING WELL CONSTRUCTION LOGS

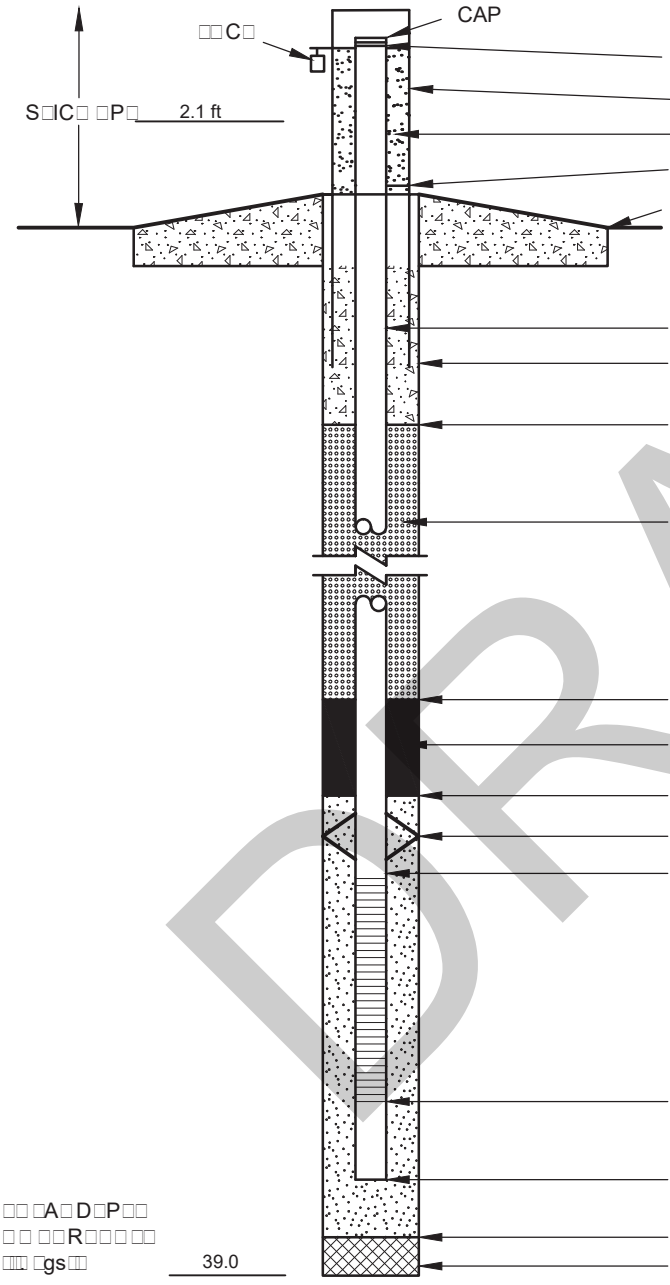
DRAFT

ABOVE GROUND MONITORING WELL CONSTRUCTION LOG

AW-1

PROJECT NAME: EDWARDS MNA EVALUATION	PROJECT NUMBER: 21454831.0002
SITE NAME: EDWARDS POWER PLANT	LOCATION: AW-1
CLIENT: ILLINOIS POWER RESOURCES GENERATING, LLC.	SURFACE ELEVATION: 462.3 FT MSL

GEOLOGIST: B. TALBERT	NORTHING: 1430685.3	EASTING: 2435889.0
DRILLER: D. GORDON	STATIC WATER LEVEL: 7.71 FT BTOC	COMPLETION DATE: 9/8/2021
DRILLING COMPANY: CASCADE ENVIRONMENTAL	DRILLING METHODS: SONIC	



TOP OF CASING ELEVATION	464.43 FT MSL
PROTECTIVE CASING (Yes) TYPE	4" X 5' ALUMINUM
PEA GRAVEL COLLAR SAND	
TOP OF SEAL	
GROUND SURFACE ELEVATION	462.3 FT MSL
DIAMETER OF RISER PIPE (in.)	2.0
DIAMETER OF BOREHOLE (in.)	7" TO 10.0 FT BGS, 6" TO 39 FT BGS
CENTRALIZER SET DEPTH (ft bgs)	0.3'
TOP SEAL AND AMOUNT OF ANNULAR SEAL	HIGH SOLIDS BENTONITE 1 BAG
TOP OF SECONDARY SEAL SET DEPTH (ft bgs)	24.2
TOP SEAL AND AMOUNT OF SECONDARY SEAL	3/8" BENTONITE CHIPS - 1 BAG
TOP OF SAND PACK SET DEPTH (ft bgs)	26.2
CENTRALIZER (Yes) SET DEPTH	NONE
TOP OF SCREEN SET DEPTH (ft bgs)	28.2
TOP OF SCREEN	2" x 9.5' SCHEDULE 40 PVC
SCREEN SLOT SIZE (in.)	0.010
SILICA SAND PACK	10/20 SILICA SAND
AMOUNT OF SAND PACK	4 BAGS
BOTTOM OF SCREEN SET DEPTH (ft bgs)	37.7
BOTTOM OF BOREHOLE SET DEPTH (ft bgs)	38.2
BOTTOM OF BOREHOLE SILICA PACK (ft bgs)	38.2
TOP OF ACTIVE FILL AMOUNT OF ACTIVE FILL	0.8 FT NATIVE FILL

ADDITIONAL NOTES: FT BGS = FEET BELOW GROUND SURFACE. FT MSL = FEET ABOVE MEAN SEA LEVEL. IN = INCHES. 20 GALLONS OF WATER USED DURING DRILLING. HORIZONTAL DATUM: STATE PLANE COORDINATES NAD83 US SURVEY FEET (2000) ILLINOIS WEST ZONE. VERTICAL DATUM: NAVD88. WELL SURVEYED BY INGENAE ON SEPTEMBER 23, 2021. SAND AND BENTONITE BAGS WEIGH 50 POUNDS EACH. CONCRETE SEAL IS AT SURFACE.

CHECKED BY: E. SCHNEIDER

DATE CHECKED: 10/11/2021

PREPARED BY: B. TALBERT

DRAFT

RAMBOLL

MONITORING WELL CONSTRUCTION

Facility/Project Name: Edwards Power Station	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: AW-23
Facility License, Permit or Monitoring No.	Local Grid Origin ☐ (estimated: ☐) or Well Location ☒ Lat. 40° 35' 16.7" Long. 89° 40' 0.6" or St. Plane 1,430,561 ft. N, 2,434,121 ft. E. E/Ⓦ	
Facility ID		Date Well Installed: 10/20/2022
Type of Well: Well Code 71/dw	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E ☐ W	Well Installed By: (Person's Name and Firm) Dustin Crump, Midwest Engineering and Testing, Inc.
Distance from Waste/Source ft. / State IL	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☐ Downgradient n ☐ Not Known	Gov. Lot Number

A. Protective pipe, top elevation 437.81 ft. (NAVD88)

B. Well casing, top elevation 437.57 ft. (NAVD88)

C. Land surface elevation 435.69 ft. (NAVD88)

D. Surface seal, bottom 434.7 ft. (NAVD88) or 1.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☒ CH ☐
Bedrock ☒

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ Hollow Stem Auger ☒ Other ☐

15. Drilling fluid used: Water ☐ 0 2 Air ☐ Drilling Mud ☐ 0 3 None ☒

16. Drilling additives used? ☐ Yes ☒ No

Describe ____

17. Source of water (attach analysis, if required): n/a

E. Bentonite seal, top 434.7 ft. (NAVD88) or 1.0 ft.

F. Fine sand, top ____ ft. (NAVD88) or ____ ft.

G. Filter pack, top 430.7 ft. (NAVD88) or 5.0 ft.

H. Screen joint, top 429.7 ft. (NAVD88) or 6.0 ft.

I. Well bottom 419.7 ft. (NAVD88) or 16.0 ft.

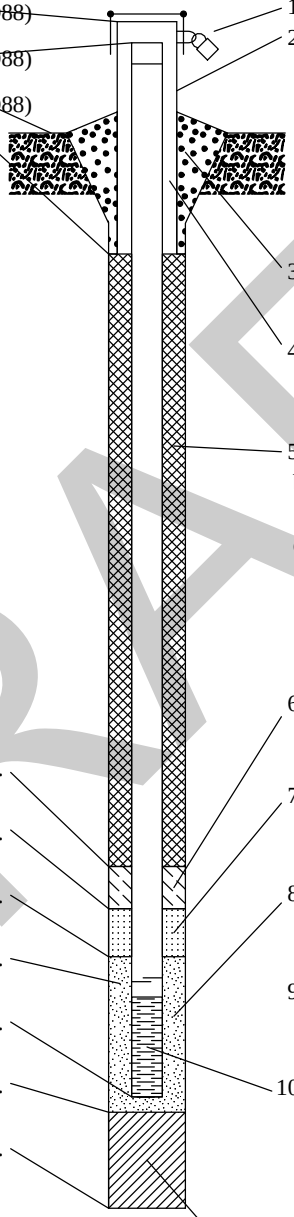
J. Filter pack, bottom 419.7 ft. (NAVD88) or 16.0 ft.

K. Borehole, bottom 419.7 ft. (NAVD88) or 16.0 ft.

L. Borehole, diameter 8.0 in.

M. O.D. well casing 2.38 in.

N. I.D. well casing 2.07 in.



1. Cap and lock? ☒ Yes ☐ No
2. Protective cover pipe:
   a. Inside diameter: 4.0 in.
   b. Length: 5.0 ft.
   c. Material: Steel ☒ Other ☐
   d. Additional protection? ☒ Yes ☐ No
   If yes, describe: 3 Steel Bollards
3. Surface seal: Bentonite ☐ Concrete ☒ Other ☐
4. Material between well casing and protective pipe: Bentonite ☐ Sand Other ☒
5. Annular space seal: a. Granular/Chipped Bentonite ☒
   b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐
   c. ____ Lbs/gal mud weight . . . Bentonite slurry ☐
   d. ____ % Bentonite . . . Bentonite-cement grout ☐
   e. 1.39 Ft^3 volume added for any of the above
   f. How installed: Tremie ☐ Tremie pumped ☐ Gravity ☒
6. Bentonite seal: a. Bentonite granules ☐
   b. ☐ 1/4 in. ☒ 3/8 in. ☐ 1/2 in. Bentonite chips ☒
   c. ____ Other ☐
7. Fine sand material: Manufacturer, product name & mesh size
   a. ____
   b. Volume added ____ ft^3
8. Filter pack material: Manufacturer, product name & mesh size
   a. RW Ridley NSF #5 Sand
   b. Volume added 3.06 ft^3
9. Well casing: Flush threaded PVC schedule 40 ☒ Flush threaded PVC schedule 80 ☐ Other ☐
10. Screen material: Schedule 40 PVC
    a. Screen Type: Factory cut ☒ Continuous slot ☐ Other ☐
    b. Manufacturer Johnson Screens
    c. Slot size: 0.010 in.
    d. Slotted length: 10.0 ft.
11. Backfill material (below filter pack): None ☒ Other ☐

DRAFT

I hereby certify that the information on this form is true and correct to the best of my knowledge. Date Modified: 1/6/2023

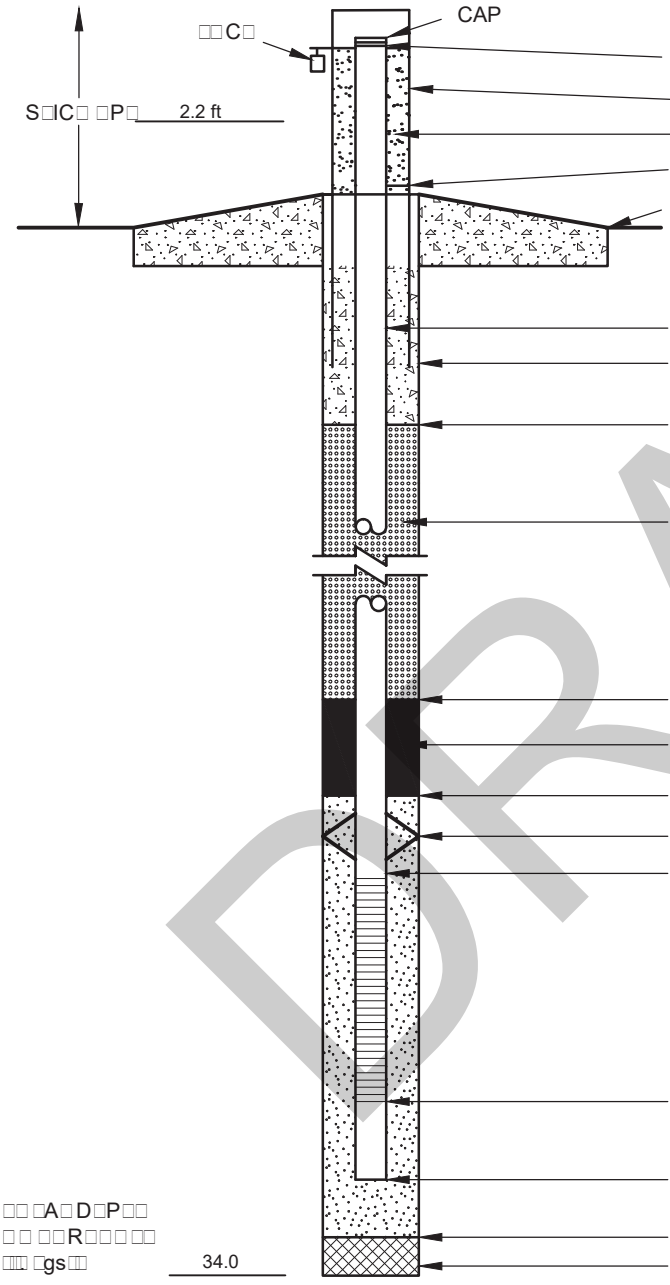
Signature ____ Firm Ramboll, 234 W Florida Street, 5th Floor, Milwaukee, WI 53204 Tel: (414)837-3607 Fax: (414)837-3608

ABOVE GROUND MONITORING WELL CONSTRUCTION LOG

EMW-05

PROJECT NAME: EDWARDS LITIGATION	PROJECT NUMBER: 21454831.0002B
SITE NAME: EDWARDS POWER PLANT	LOCATION: EMW-05
CLIENT: ILLINOIS POWER RESOURCES GENERATING, LLC.	SURFACE ELEVATION: 455.8 FT MSL

GEOLOGIST: B. TALBERT	NORTHING: 1432325.5	EASTING: 2435264.9
DRILLER: D. GORDON	STATIC WATER LEVEL: 21.30 FT BTOC	COMPLETION DATE: 9/9/2021
DRILLING COMPANY: CASCADE ENVIRONMENTAL	DRILLING METHODS: SONIC	



TOP OF CASING ELEVATION	457.94 FT MSL
PROTECTIVE CASING (Yes) TYPE	4" X 5' ALUMINUM
PEA GRAVEL COLLAR SAND	
TOP OF SEAL	
GROUND SURFACE ELEVATION	455.8 FT MSL
DIAMETER RISER PIPE (in.)	2.0
DIAMETER BOREHOLE (in.)	6.0
CONCRETE SEAL DEPTH (ft bgs)	0.3'
TOP OF ANNULAR SEAL	HIGH SOLIDS BENTONITE GROUT
	2 BAGS
TOP OF BENTONITE SEAL DEPTH (ft bgs)	21.7
TOP OF BENTONITE SEAL	3/8" BENTONITE CHIPS - 1 BAG
TOP OF SAND PACK DEPTH (ft bgs)	23.7
CENTRALIZER (Yes) QTY	NONE
TOP OF SCREEN DEPTH (ft bgs)	25.7
TOP OF SCREEN	2" x 4.5' SCHEDULE 40 PVC
SCREEN SLOT SIZE (in.)	0.010
SILICA SAND PACK	10/20 SILICA SAND
ANNULAR SAND	2 BAGS
BOTTOM OF SCREEN DEPTH (ft bgs)	30.2
BOTTOM OF BOREHOLE DEPTH (ft bgs)	30.7
BOTTOM OF SAND PACK DEPTH (ft bgs)	30.7
BOTTOM OF ANNULAR SEAL	3.3 FT NATIVE FILL

BOTTOM OF ANNULAR SEAL DEPTH (ft bgs) 34.0

ADDITIONAL INFORMATION: FT BGS = FEET BELOW GROUND SURFACE. FT MSL = FEET ABOVE MEAN SEA LEVEL. IN = INCHES. HORIZONTAL DATUM: STATE PLANE COORDINATES NAD83 US SURVEY FEET (2000) ILLINOIS WEST ZONE. VERTICAL DATUM: NAVD88. WELL SURVEYED BY INGENAE ON SEPTEMBER 23, 2021. SAND AND BENTONITE BAGS WEIGH 50 POUNDS EACH. CONCRETE SEAL IS AT SURFACE.

DRAFT

CONSTRUCTED BY: B. TALBERT

DATE CONSTRUCTED: 10/6/2021

PREPARED BY: E. SCHNEIDER

RAMBOLL

MONITORING WELL CONSTRUCTION

Facility/Project Name: Edwards Power Station

Facility License, Permit or Monitoring No.:

Facility ID:

Type of Well: Well Code 72/dp

Distance from Waste/Source: ft. State: IL

Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.

Local Grid Origin ☐ (estimated: ☐) or Well Location ☒

Lat. 40° 35' 52.6" Long. 89° 40' 0.7" or

St. Plane 1,432,068 ft. N, 2,435,365 ft. E / Ⓦ

Section Location of Waste/Source: ☐ E

____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ W

Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☐ Downgradient n ☐ Not Known

Gov. Lot Number:

Well Name: OW-01

Date Well Installed: 10/21/2022

Well Installed By: (Person's Name and Firm)

Dustin Crump

Midwest Engineering and Testing, Inc.

A. Protective pipe, top elevation 460.17 ft. (NAVD88)

B. Well casing, top elevation 459.93 ft. (NAVD88)

C. Land surface elevation 457.84 ft. (NAVD88)

D. Surface seal, bottom 455.8 ft. (NAVD88) or 2.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☒ SC ☐ ML ☒ MH ☐ CL ☒ CH ☐
Bedrock ☐

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ Hollow Stem Auger ☒ Other ☐

15. Drilling fluid used: Water ☐ 0 2 Air ☐ Drilling Mud ☐ 0 3 None ☒

16. Drilling additives used? ☐ Yes ☒ No

Describe ____

17. Source of water (attach analysis, if required):
n/a

E. Bentonite seal, top 455.8 ft. (NAVD88) or 2.0 ft.

F. Fine sand, top 436.8 ft. (NAVD88) or 21.0 ft.

G. Filter pack, top 434.8 ft. (NAVD88) or 23.0 ft.

H. Screen joint, top 431.9 ft. (NAVD88) or 25.9 ft.

I. Well bottom 421.4 ft. (NAVD88) or 36.4 ft.

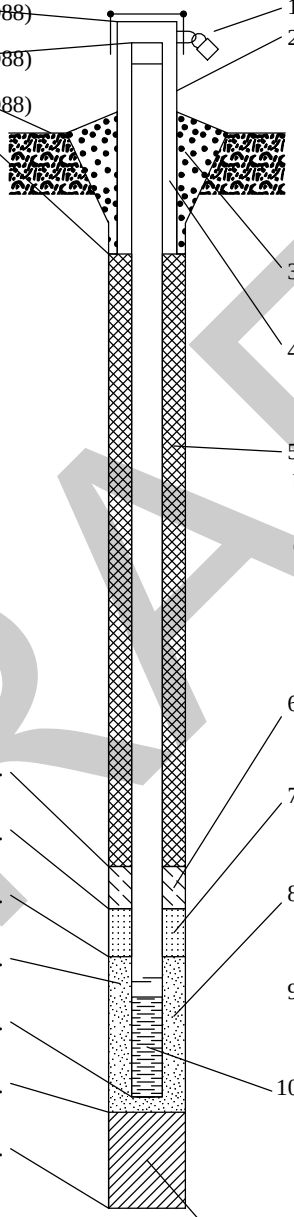
J. Filter pack, bottom 421.3 ft. (NAVD88) or 36.5 ft.

K. Borehole, bottom 421.3 ft. (NAVD88) or 36.5 ft.

L. Borehole, diameter 8.3 in.

M. O.D. well casing 2.38 in.

N. I.D. well casing 2.07 in.



1. Cap and lock? ☒ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 4.0 in.
b. Length: 5.0 ft.
c. Material: Steel ☒ Other ☐
d. Additional protection? ☒ Yes ☐ No
If yes, describe: 3 Steel Bollards

3. Surface seal: Bentonite ☐ Concrete ☒ Other ☐

4. Material between well casing and protective pipe: Bentonite ☐ Sand Other ☒

5. Annular space seal: a. Granular/Chipped Bentonite ☒
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐
c. ____ Lbs/gal mud weight . . . Bentonite slurry ☐
d. ____ % Bentonite . . . Bentonite-cement grout ☐
e. ____ Ft^3 volume added for any of the above
f. How installed: Tremie ☐ Tremie pumped ☐ Gravity ☒

6. Bentonite seal: a. Bentonite granules ☐
b. ☐ 1/4 in. ☒ 3/8 in. ☐ 1/2 in. Bentonite chips ☒
c. ____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. RW Ridley #45-55 Sand
b. Volume added ____ ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. RW Ridley NSF #5 Sand
b. Volume added ____ ft^3

9. Well casing: Flush threaded PVC schedule 40 ☒ Flush threaded PVC schedule 80 ☐ Other ☐

10. Screen material: Schedule 40 PVC
a. Screen Type: Factory cut ☒ Continuous slot ☐ Other ☐
b. Manufacturer Monoflex
c. Slot size: 0.010 in.
d. Slotted length: 9.7 ft.

11. Backfill material (below filter pack): None ☒ Other ☐

DRAFT

I hereby certify that the information on this form is true and correct to the best of my knowledge. Date Modified: 1/6/2023

Signature

Firm Ramboll
234 W Florida Street, 5th Floor, Milwaukee, WI 53204
Tel: (414)837-3607
Fax: (414)837-3608

RAMBOLL

MONITORING WELL CONSTRUCTION

Facility/Project Name: Edwards Power Station	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: OW-02
Facility License, Permit or Monitoring No.	Local Grid Origin ☐ (estimated: ☐) or Well Location ☒ Lat. 40° 35' 16.5" Long. 89° 40' 0.5" or St. Plane 1,428,435 ft. N, 2,435,410 ft. E / Ⓦ	
Facility ID		Date Well Installed: 10/19/2022
Type of Well: Well Code 72/dp	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E ☐ W	Well Installed By: (Person's Name and Firm) Dustin Crump, Midwest Engineering and Testing, Inc.
Distance from Waste/Source: ft. State: IL	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☐ Downgradient n ☐ Not Known	Gov. Lot Number:

A. Protective pipe, top elevation 441.08 ft. (NAVD88)

B. Well casing, top elevation 440.88 ft. (NAVD88)

C. Land surface elevation 438.66 ft. (NAVD88)

D. Surface seal, bottom 436.7 ft. (NAVD88) or 2.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☒ CH ☐
Bedrock ☐

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ Hollow Stem Auger ☒ Other ☐

15. Drilling fluid used: Water ☐ 0 2 Air ☐ Drilling Mud ☐ 0 3 None ☒

16. Drilling additives used? ☐ Yes ☒ No

Describe ____

17. Source of water (attach analysis, if required): n/a

E. Bentonite seal, top 436.7 ft. (NAVD88) or 2.0 ft.

F. Fine sand, top ____ ft. (NAVD88) or ____ ft.

G. Filter pack, top 417.7 ft. (NAVD88) or 21.0 ft.

H. Screen joint, top 414.1 ft. (NAVD88) or 24.6 ft.

I. Well bottom 403.6 ft. (NAVD88) or 35.1 ft.

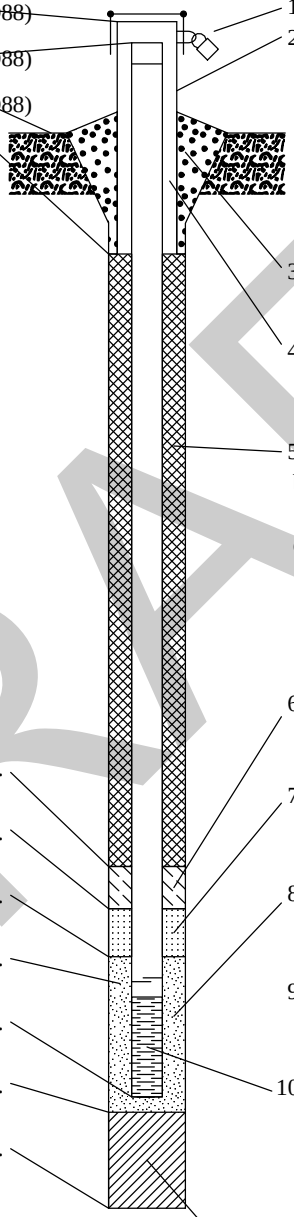
J. Filter pack, bottom 401.7 ft. (NAVD88) or 37.0 ft.

K. Borehole, bottom 401.7 ft. (NAVD88) or 37.0 ft.

L. Borehole, diameter 8.3 in.

M. O.D. well casing 2.38 in.

N. I.D. well casing 2.07 in.



1. Cap and lock? ☒ Yes ☐ No
2. Protective cover pipe:
   a. Inside diameter: 4.0 in.
   b. Length: 5.0 ft.
   c. Material: Steel ☒ Other ☐
   d. Additional protection? ☒ Yes ☐ No
   If yes, describe: 3 Steel Bollards
3. Surface seal: Bentonite ☐ Concrete ☒ Other ☐
4. Material between well casing and protective pipe: Bentonite ☐ Sand Other ☒
5. Annular space seal: a. Granular/Chipped Bentonite ☒
   b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐
   c. ____ Lbs/gal mud weight . . . Bentonite slurry ☐
   d. ____ % Bentonite . . . Bentonite-cement grout ☐
   e. ____ Ft^3 volume added for any of the above
   f. How installed: Tremie ☐ Tremie pumped ☐ Gravity ☒
6. Bentonite seal: a. Bentonite granules ☐
   b. ☐ 1/4 in. ☒ 3/8 in. ☐ 1/2 in. Bentonite chips ☒
   c. ____ Other ☐
7. Fine sand material: Manufacturer, product name & mesh size
   a. ____
   b. Volume added ____ ft^3
8. Filter pack material: Manufacturer, product name & mesh size
   a. RW Ridley NSF #5 Sand
   b. Volume added ____ ft^3
9. Well casing: Flush threaded PVC schedule 40 ☒ Flush threaded PVC schedule 80 ☐ Other ☐
10. Screen material: Schedule 40 PVC
    a. Screen Type: Factory cut ☒ Continuous slot ☐ Other ☐
    b. Manufacturer Monoflex
    c. Slot size: 0.010 in.
    d. Slotted length: 9.7 ft.
11. Backfill material (below filter pack): None ☒ Other ☐

DRAFT

I hereby certify that the information on this form is true and correct to the best of my knowledge. Date Modified: 12/12/2022

Signature ____ Firm Ramboll
234 W Florida Street, 5th Floor, Milwaukee, WI 53204
Tel: (414)837-3607
Fax: (414)837-3608

RAMBOLL

MONITORING WELL CONSTRUCTION

Facility/Project Name: Edwards Power Station	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: PTW-01
Facility License, Permit or Monitoring No.	Local Grid Origin ☐ (estimated: ☐) or Well Location ☒ Lat. 40° 35' 52.5" Long. 89° 40' 0.8" or St. Plane 1,432,085 ft. N, 2,435,370 ft. E / Ⓦ	
Facility ID		Date Well Installed: 10/20/2022
Type of Well: Well Code 72/dp	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E ☐ W	Well Installed By: (Person's Name and Firm) Dustin Crump, Midwest Engineering and Testing, Inc.
Distance from Waste/Source: ____ ft. State: IL	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☐ Downgradient n ☐ Not Known	Gov. Lot Number:

A. Protective pipe, top elevation 461.80 ft. (NAVD88)

B. Well casing, top elevation 461.60 ft. (NAVD88)

C. Land surface elevation 459.38 ft. (NAVD88)

D. Surface seal, bottom 457.4 ft. (NAVD88) or 2.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☒ SC ☐ ML ☒ MH ☐ CL ☒ CH ☐
Bedrock ☐

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ Hollow Stem Auger ☒ Other ☐

15. Drilling fluid used: Water ☐ 0 2 Air ☐ Drilling Mud ☐ 0 3 None ☒

16. Drilling additives used? ☐ Yes ☒ No

Describe ____

17. Source of water (attach analysis, if required): n/a

E. Bentonite seal, top 457.4 ft. (NAVD88) or 2.0 ft.

F. Fine sand, top 437.4 ft. (NAVD88) or 22.0 ft.

G. Filter pack, top 435.4 ft. (NAVD88) or 24.0 ft.

H. Screen joint, top 432.5 ft. (NAVD88) or 26.9 ft.

I. Well bottom 420.9 ft. (NAVD88) or 38.4 ft.

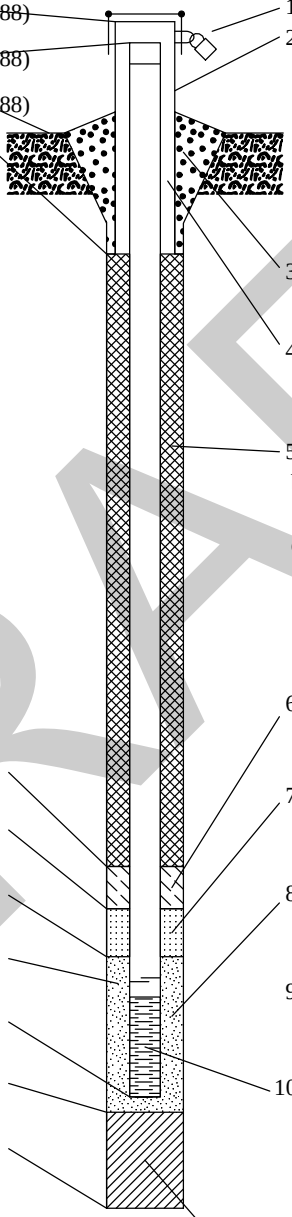
J. Filter pack, bottom 421.1 ft. (NAVD88) or 38.3 ft.

K. Borehole, bottom 420.9 ft. (NAVD88) or 38.5 ft.

L. Borehole, diameter 10.5 in.

M. O.D. well casing 4.50 in.

N. I.D. well casing 4.03 in.



1. Cap and lock? ☒ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 5.0 ft.
c. Material: Steel ☒ Other ☐
d. Additional protection? ☒ Yes ☐ No
If yes, describe: 3 Steel Bollards

3. Surface seal: Bentonite ☐ Concrete ☒ Other ☐

4. Material between well casing and protective pipe: Bentonite ☐ Sand Other ☒

5. Annular space seal: a. Granular/Chipped Bentonite ☒
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐
c. ____ Lbs/gal mud weight . . . Bentonite slurry ☐
d. ____ % Bentonite . . . Bentonite-cement grout ☐
e. ____ Ft^3 volume added for any of the above
f. How installed: Tremie ☐ Tremie pumped ☐ Gravity ☒

6. Bentonite seal: a. Bentonite granules ☐
b. ☐ 1/4 in. ☒ 3/8 in. ☐ 1/2 in. Bentonite chips ☒
c. ____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. RW Ridley #45-55 Sand
b. Volume added ____ ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. RW Ridley NSF #5 Sand
b. Volume added ____ ft^3

9. Well casing: Flush threaded PVC schedule 40 ☒ Flush threaded PVC schedule 80 ☐ Other ☐

10. Screen material: Schedule 40 PVC
a. Screen Type: Factory cut ☒ Continuous slot ☐ Other ☐
b. Manufacturer Monoflex
c. Slot size: 0.010 in.
d. Slotted length: 9.4 ft.

11. Backfill material (below filter pack): None ☒ Other ☐

DRAFT

I hereby certify that the information on this form is true and correct to the best of my knowledge. Date Modified: 12/12/2022

Signature ____ Firm Ramboll, 234 W Florida Street, 5th Floor, Milwaukee, WI 53204 Tel: (414)837-3607 Fax: (414)837-3608

RAMBOLL

MONITORING WELL CONSTRUCTION

Facility/Project Name: Edwards Power Station	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: PTW-02
Facility License, Permit or Monitoring No.	Local Grid Origin ☐ (estimated: ☐) or Well Location ☒ Lat. 40° 35' 37.6" Long. 89° 40' 17.1" or St. Plane 1,428,451 ft. N, 2,435,400 ft. E / Ⓦ	
Facility ID		Date Well Installed: 10/18/2022
Type of Well: Well Code 72/dp	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E ☐ W	Well Installed By: (Person's Name and Firm) Dustin Crump, Midwest Engineering and Testing, Inc.
Distance from Waste/Source: ft. State: IL	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☐ Downgradient n ☐ Not Known	Gov. Lot Number:

A. Protective pipe, top elevation 441.68 ft. (NAVD88)

B. Well casing, top elevation 441.12 ft. (NAVD88)

C. Land surface elevation 439.02 ft. (NAVD88)

D. Surface seal, bottom 437.0 ft. (NAVD88) or 2.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☒ CH ☐
Bedrock ☐

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ Hollow Stem Auger ☒ Other ☐

15. Drilling fluid used: Water ☐ 0 2 Air ☐ Drilling Mud ☐ 0 3 None ☒

16. Drilling additives used? ☐ Yes ☒ No

Describe ____

17. Source of water (attach analysis, if required): n/a

E. Bentonite seal, top 437.0 ft. (NAVD88) or 2.0 ft.

F. Fine sand, top ____ ft. (NAVD88) or ____ ft.

G. Filter pack, top 417.0 ft. (NAVD88) or 22.0 ft.

H. Screen joint, top 412.5 ft. (NAVD88) or 26.5 ft.

I. Well bottom 400.6 ft. (NAVD88) or 38.4 ft.

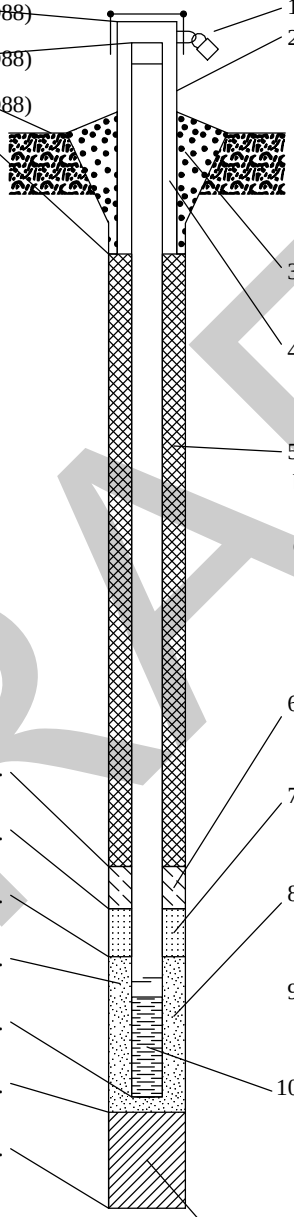
J. Filter pack, bottom 399.8 ft. (NAVD88) or 39.3 ft.

K. Borehole, bottom 399.5 ft. (NAVD88) or 39.5 ft.

L. Borehole, diameter 10.5 in.

M. O.D. well casing 4.50 in.

N. I.D. well casing 4.03 in.



1. Cap and lock? ☒ Yes ☐ No
2. Protective cover pipe:
   a. Inside diameter: 6.0 in.
   b. Length: 5.0 ft.
   c. Material: Steel ☒ Other ☐
   d. Additional protection? ☒ Yes ☐ No
   If yes, describe: 3 Steel Bollards
3. Surface seal: Bentonite ☐ Concrete ☒ Other ☐
4. Material between well casing and protective pipe: Bentonite ☐ Sand Other ☒
5. Annular space seal: a. Granular/Chipped Bentonite ☒
   b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐
   c. ____ Lbs/gal mud weight . . . Bentonite slurry ☐
   d. ____ % Bentonite . . . Bentonite-cement grout ☐
   e. ____ Ft^3 volume added for any of the above
   f. How installed: Tremie ☐ Tremie pumped ☐ Gravity ☒
6. Bentonite seal: a. Bentonite granules ☐
   b. ☐ 1/4 in. ☒ 3/8 in. ☐ 1/2 in. Bentonite chips ☒
   c. ____ Other ☐
7. Fine sand material: Manufacturer, product name & mesh size
   a. ____
   b. Volume added ____ ft^3
8. Filter pack material: Manufacturer, product name & mesh size
   a. RW Ridley NSF #5 Sand
   b. Volume added ____ ft^3
9. Well casing: Flush threaded PVC schedule 40 ☒ Flush threaded PVC schedule 80 ☐ Other ☐
10. Screen material: Schedule 40 PVC
    a. Screen Type: Factory cut ☒ Continuous slot ☐ Other ☐
    b. Manufacturer Monoflex
    c. Slot size: 0.010 in.
    d. Slotted length: 9.4 ft.
11. Backfill material (below filter pack): None ☒ Other ☐

DRAFT

I hereby certify that the information on this form is true and correct to the best of my knowledge. Date Modified: 1/6/2023

Signature ____ Firm Ramboll, 234 W Florida Street, 5th Floor, Milwaukee, WI 53204 Tel: (414)837-3607 Fax: (414)837-3608

APPENDIX D
WELL DEVELOPMENT FORMS

DRAFT

GOLDER
MEMBER OF WSP

WELL DEVELOPMENT/PURGING FORM

Project Ref: Edwards Litigation **Project No.:** 21454831

Location AW-01

Monitored By: EMS Date 9/15/2021 Time 1617

Well Piezometer Data

(circle one)

	Inital → Final	
Depth of Well (from top of PVC or ground)	38.35 → 40.30	feet
Depth of Water (from top of PVC or ground)	7.71 → Dry	feet
Radius of Casing	2.0	inches
		feet
Casing Volume		cubic feet
	11.23 x 3 = 33.69	gallons

Development / Purging Discharge Data

Purging Method: Hydrolift - Waterra

Start Purging Date 9/15/2021 Time 1218

Stop Purging Date 9/15/2021 Time 1617

Monitoring

Date	Time	Volume Discharge (gals)	Temp (°C)	pH	Spec.Cond. (µS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Redox Potential (+/- mV)	WL (ft BTOC)	Appearance of Water and Comments
9/15/21	1223	10	16.4	6.88	1228	>1000	3.39	67.3	32.21	Dark Brown, Highly
	1228	13	17.2	6.89	1259	>1000	6.49	21.7	38.31	Turbid. Flow rate reduced
↓	1615	15			33				39.50	due to high drawdown
										Well runs dry at 1229
										EMS returns to purge any water that has entered well from formation at 1615.
										Well runs dry at 1617.
						33				

DRAFT

RAMBOLL

MONITORING WELL DEVELOPMENT

Facility/Project Name	State	Well Name
Edwards Power Station	IL	AW-23

Facility License, Permit or Monitoring Number

1. Can this well be purged dry? ☐ Yes ☒ No

2. Well development method:
- surged with bailer and bailed ☐
- surged with bailer and pumped ☐
- surged with block and bailed ☐
- surged with block and pumped ☒
- surged with block, bailed, and pumped ☐
- compressed air ☐
- bailed only ☐
- pumped only ☐
- pumped slowly ☐
- other _____ ☐

3. Time spent developing well 129 min.

4. Depth of well (from top of well casing) 18.8 ft.

5. Inside diameter of well 2.07 in.

6. Volume of water in filter pack and well casing 10.5 gal.

7. Volume of water removed from well 129.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added not applicable

10. Analysis performed on water added? ☐ Yes ☒ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing) a.	7.81 ft.	10.73 ft.
Date b.	10/26/2022	10/26/2022
Time c.	01:01 ☐ a.m. ☒ p.m.	03:10 ☐ a.m. ☒ p.m.
12. Sediment in well bottom	0.0 inches	0.0 inches
13. Water clarity	Clear ☐ Turbid ☒ (Describe)	Clear ☒ Turbid ☐ (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

16. Well developed by: Person's Name and Firm
Evvan Plank
Ramboll

17. Additional comments on development:

Facility Address or Owner/Responsible Party Address

Name: Mark Davis

Firm: Illinois Power Generating Company

Street: 7800 S Cilco Ln

City/State/Zip: Peoria IL 61607

I hereby certify that the above information is true and correct to the best of my knowledge.

Signature: _____

Print Name: Evvan Plank

Firm: Ramboll

Template: RAMBOLL_WELL DEVELOPMENT - Project: 845_EDWARDS_

Date Modified: 1/6/2023

DRAFT

GOLDER
MEMBER OF WSP

WELL DEVELOPMENT/PURGING FORM

Project Ref: Edwards Litigation **Project No.:** 21454831

Location EMW-05

Monitored By: EMS Date 9/15/2021 Time 1720

Well Piezometer Data

	(circle one)	Intial → Final	
Depth of Well (from top of PVC or ground)		32.87 → 32.86	feet
Depth of Water (from top of PVC or ground)		21.30 → Dry	feet
Radius of Casing		20	inches
		ES	~~feet~~
Casing Volume		ES	~~cubic feet~~
		4.99 x 3 = 14.97	gallons

Development / Purging Discharge Data

Purging Method: Hydrolift - Waterra

Start Purging Date 9/15/2021 Time 1540

Stop Purging Date 9/15/2021 Time 1720

Monitoring

Date	Time	Volume Discharge (gals)	Temp (°C)	pH	Spec.Cond. (µS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Redox Potential (+/- mV)	WL (ft BTOC)	Appearance of Water and Comments
9/15/21	1545	~~7~~	16.4	7.24	1224	>1000	4.76	81.3	32.04	Dark Brown, Highly Turbid. Well runs dry at 1548
2	1717	9							30.56	
										EMS returns to remove Water that had entered through formation at 1717.
										Well runs dry at 1720
						ES				

DRAFT

RAMBOLL

MONITORING WELL DEVELOPMENT

Facility/Project Name	State	Well Name
Edwards Power Station	IL	OW-01

Facility License, Permit or Monitoring Number

1. Can this well be purged dry? ☒ Yes ☐ No

2. Well development method:
- surged with bailer and bailed ☐
- surged with bailer and pumped ☐
- surged with block and bailed ☐
- surged with block and pumped ☒
- surged with block, bailed, and pumped ☐
- compressed air ☐
- bailed only ☐
- pumped only ☐
- pumped slowly ☐
- other _____ ☐

3. Time spent developing well 73 min.

4. Depth of well (from top of well casing) 38.5 ft.

5. Inside diameter of well 2.07 in.

6. Volume of water in filter pack and well casing 11.5 gal.

7. Volume of water removed from well 146.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added not applicable

10. Analysis performed on water added? ☐ Yes ☒ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing) a.	24.58 ft.	38.51 ft.
Date b.	10/24/2022	10/24/2022
Time c.	09:52 ☒ a.m. ☐ p.m.	11:05 ☒ a.m. ☐ p.m.
12. Sediment in well bottom	1.0 inches	0.0 inches
13. Water clarity	Clear ☐ Turbid ☒ (Describe) grayish brown	Clear ☐ Turbid ☒ (Describe) grayish brown

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

16. Well developed by: Person's Name and Firm
Evvan Plank
Ramboll

17. Additional comments on development:
Purged well dry multiple times

DRAFT

Facility Address or Owner/Responsible Party Address

Name: Mark Davis

Firm: Illinois Power Generating Company

Street: 7800 S Cilco Ln

City/State/Zip: Peoria IL 61607

I hereby certify that the above information is true and correct to the best of my knowledge.

Signature: 

Print Name: Evvan Plank

Firm: Ramboll

Template: RAMBOLL_WELL DEVELOPMENT - Project: 845_EDWARDS_

Date Modified: 1/6/2023

RAMBOLL

MONITORING WELL DEVELOPMENT

Facility/Project Name	State	Well Name
Edwards Power Station	IL	OW-02

Facility License, Permit or Monitoring Number

1. Can this well be purged dry? ☐ Yes ☒ No

2. Well development method:
- surged with bailer and bailed ☐
- surged with bailer and pumped ☐
- surged with block and bailed ☐
- surged with block and pumped ☒
- surged with block, bailed, and pumped ☐
- compressed air ☐
- bailed only ☐
- pumped only ☐
- pumped slowly ☐
- other _____ ☐

3. Time spent developing well 247 min.

4. Depth of well (from top of well casing) 37.3 ft.

5. Inside diameter of well 2.07 in.

6. Volume of water in filter pack and well casing _____ gal.

7. Volume of water removed from well 61.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added not applicable

10. Analysis performed on water added? ☐ Yes ☒ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing) a.	10.10 ft.	12.43 ft.
Date b.	10/26/2022	10/27/2022
Time c.	03:52 ☐ a.m. ☒ p.m.	04:45 ☐ a.m. ☒ p.m.
12. Sediment in well bottom	0.0 inches	0.0 inches
13. Water clarity	Clear ☐ Turbid ☒ (Describe)	Clear ☒ Turbid ☐ (Describe)
14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

Fill in if drilling fluids were used and well is at solid waste facility:

16. Well developed by: Person's Name and Firm
Evvan Plank
Ramboll

17. Additional comments on development:
10/26/2022: Purging halted at 16:03 dude to LEL for methane. Eleven (11) gallons of water purged. development and purged 50 gallons.
10/27/2022: Resumed

Facility Address or Owner/Responsible Party Address

Name: Mark Davis

Firm: Illinois Power Generating Company

Street: 7800 S Cilco Ln

City/State/Zip: Peoria IL 61607

I hereby certify that the above information is true and correct to the best of my knowledge.

Signature: 

Print Name: Evvan Plank

Firm: Ramboll

Template: RAMBOLL_WELL DEVELOPMENT - Project: 845_EDWARDS_

Date Modified: 12/12/2022

DRAFT

RAMBOLL

MONITORING WELL DEVELOPMENT

Facility/Project Name	State	Well Name
Edwards Power Station	IL	PTW-01

Facility License, Permit or Monitoring Number

1. Can this well be purged dry? ☒ Yes ☐ No

2. Well development method:
- surged with bailer and bailed ☐
- surged with bailer and pumped ☐
- surged with block and bailed ☐
- surged with block and pumped ☒
- surged with block, bailed, and pumped ☐
- compressed air ☐
- bailed only ☐
- pumped only ☐
- pumped slowly ☐
- other _____ ☐

3. Time spent developing well 37 min.

4. Depth of well (from top of well casing) 40.7 ft.

5. Inside diameter of well 4.03 in.

6. Volume of water in filter pack and well casing 13.8 gal.

7. Volume of water removed from well 74.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added not applicable

10. Analysis performed on water added? ☐ Yes ☒ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing) a.	26.33 ft.	40.66 ft.
Date b.	10/24/2022	10/24/2022
Time c.	11:15 ☒ a.m. ☐ p.m.	02:09 ☐ a.m. ☒ p.m.
12. Sediment in well bottom	13.0 inches	0.0 inches
13. Water clarity	Clear ☐ Turbid ☒ (Describe) grayish brown	Clear ☐ Turbid ☒ (Describe) grayish brown

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

16. Well developed by: Person's Name and Firm
Evvan Plank
Ramboll

17. Additional comments on development:
Purged well dry multiple times

Facility Address or Owner/Responsible Party Address

Name: Mark Davis

Firm: Illinois Power Generating Company

Street: 7800 S Cilco Ln

City/State/Zip: Peoria IL 61607

I hereby certify that the above information is true and correct to the best of my knowledge.

Signature: 

Print Name: Evvan Plank

Firm: Ramboll

Template: RAMBOLL_WELL DEVELOPMENT - Project: 845_EDWARDS_

Date Modified: 12/12/2022

DRAFT

RAMBOLL

MONITORING WELL DEVELOPMENT

Facility/Project Name	State	Well Name
Edwards Power Station	IL	PTW-02

Facility License, Permit or Monitoring Number

1. Can this well be purged dry? ☐ Yes ☒ No

2. Well development method:
- surged with bailer and bailed ☐
- surged with bailer and pumped ☐
- surged with block and bailed ☐
- surged with block and pumped ☒
- surged with block, bailed, and pumped ☐
- compressed air ☐
- bailed only ☐
- pumped only ☐
- pumped slowly ☐
- other _____ ☐

3. Time spent developing well 210 min.

4. Depth of well (from top of well casing) 40.5 ft.

5. Inside diameter of well 4.03 in.

6. Volume of water in filter pack and well casing _____ gal.

7. Volume of water removed from well 210.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added not applicable

10. Analysis performed on water added? ☐ Yes ☒ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing) a.	10.41 ft.	15.87 ft.
Date b.	10/27/2022	10/27/2022
Time c.	08:24 ☒ a.m. ☐ p.m.	11:54 ☒ a.m. ☐ p.m.
12. Sediment in well bottom	inches	0.0 inches
13. Water clarity	Clear ☐ Turbid ☒ (Describe) grayish brown	Clear ☒ Turbid ☐ (Describe)
14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

Fill in if drilling fluids were used and well is at solid waste facility:

16. Well developed by: Person's Name and Firm
Evvan Plank
Ramboll

17. Additional comments on development:
Development stopped due to methane exceedance.

DRAFT

Facility Address or Owner/Responsible Party Address

Name: Mark Davis

Firm: Illinois Power Generating Company

Street: 7800 S Cilco Ln

City/State/Zip: Peoria IL 61607

I hereby certify that the above information is true and correct to the best of my knowledge.

Signature: 

Print Name: Evvan Plank

Firm: Ramboll

APPENDIX E
GROUNDWATER SAMPLING RECORDS

DRAFT

Low-Flow Test Report:

Test Date / Time: 11/18/2022 1:28:41 PM
Project: Baldwin, IL (11)
Operator Name:

Location Name: AW01	Flow Cell Volume: 130 ml	Instrument Used: Aqua TROLL 600 Vented Serial Number: 454596

Test Notes:

Low-Flow Readings:

Date Time	Elapsed Time	pH	Temperature	Specific Conductivity	RDO Concentration	Turbidity	ORP
		+/- 0.1	+/- 0.1	+/- 3 %	+/- 0.3	+/- 10 %	+/- 10
11/18/2022 1:28 PM	00:00	7.21 pH	12.56 °C	1,526.4 µS/cm	1.65 mg/L	131.20 NTU	124.4 mV
11/18/2022 1:31 PM	03:00	6.94 pH	11.20 °C	1,489.9 µS/cm	0.58 mg/L	92.03 NTU	130.8 mV
11/18/2022 1:34 PM	06:00	6.89 pH	10.30 °C	1,504.1 µS/cm	0.44 mg/L	104.40 NTU	132.3 mV
11/18/2022 1:37 PM	09:00	6.87 pH	9.69 °C	1,515.0 µS/cm	0.43 mg/L	103.24 NTU	132.3 mV
11/18/2022 1:40 PM	12:00	6.85 pH	9.31 °C	547.82 µS/cm	0.42 mg/L	361.77 NTU	131.3 mV
11/18/2022 1:43 PM	15:00	6.85 pH	9.02 °C	17.43 µS/cm	0.34 mg/L	371.64 NTU	129.5 mV
11/18/2022 1:46 PM	18:00	6.84 pH	8.63 °C	1.46 µS/cm	0.35 mg/L	306.99 NTU	127.5 mV
11/18/2022 1:49 PM	21:00	6.84 pH	8.24 °C	1,020.1 µS/cm	0.36 mg/L	37.55 NTU	124.3 mV
11/18/2022 1:52 PM	24:00	6.84 pH	7.82 °C	1,328.0 µS/cm	0.44 mg/L	222.47 NTU	121.4 mV
11/18/2022 1:55 PM	27:00	6.84 pH	7.64 °C	924.21 µS/cm	0.50 mg/L	18.36 NTU	118.1 mV
11/18/2022 1:58 PM	30:00	6.84 pH	7.41 °C	570.80 µS/cm	0.55 mg/L	108.77 NTU	114.2 mV
11/18/2022 2:01 PM	33:00	6.85 pH	7.37 °C	1,132.4 µS/cm	0.59 mg/L	12.76 NTU	110.1 mV
11/18/2022 2:04 PM	36:00	6.85 pH	7.18 °C	1,263.7 µS/cm	0.61 mg/L	134.80 NTU	106.0 mV
11/18/2022 2:07 PM	39:00	6.86 pH	6.92 °C	1,149.2 µS/cm	0.63 mg/L	458.28 NTU	102.3 mV
11/18/2022 2:10 PM	42:00	6.86 pH	6.72 °C	746.16 µS/cm	0.68 mg/L	12.32 NTU	98.7 mV
11/18/2022 2:13 PM	45:00	6.86 pH	6.72 °C	1,239.7 µS/cm	0.68 mg/L	8.97 NTU	95.1 mV
11/18/2022 2:16 PM	48:00	6.86 pH	6.57 °C	1,538.1 µS/cm	0.67 mg/L	11.40 NTU	91.3 mV
11/18/2022 2:19 PM	51:00	6.86 pH	6.60 °C	1,256.8 µS/cm	0.67 mg/L	11.53 NTU	88.0 mV

DRAFT

Samples

Sample ID:	Description:

Created using VuSitu from In-Situ, Inc.

DRAFT

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: EDWARDS P.P. | Client: VISTRA

Project Number: 194027.92 | Task #: 1000.LBR | Start Date: 11/10/2022 Time: 14:40

Field Personnel: AH, CAL | Finish Date: 11/10/2022 Time: 16:28

WELL INFORMATION

(STICK UP) Well ID: EMW-05

Casing ID: 2 Inches

Screen Interval: 27.84 – 32.41' BTOC

Borehole Diameter: 6 Inches

Filter Pack Interval: 25.84 – 32.84' BTOC

EVENT TYPE

- ☐ Well Development
- ☒ Low-Flow / Low-Stress Sampling
- ☐ Well Volume Approach Sampling
- ☐ Other (Specify below)

PURGE INFORMATION

Purge Method: ☐ Bailer ☒ Pump

Bailer Type: n/a

Pump Type and Serial #: EXISTING (IN-WELL) BLADDER Pump w/ MP-50 controller/compressor

Tube/Pump Intake Depth: ~29' BTOC (top of pump)

Stabilized Pumping Rate: 130 ~~120~~ ml/min

DEPTH MEASUREMENTS

	INITIAL		FINAL	
	Depth FT BTOC	Time (24-Hour)	Depth FT BTOC	Time (24-Hour)
LNAPL	N/A			
Groundwater	22.04	14:40	28.65	16:28
DNAPL	N/A			
Casing Base				

VOLUME CALCULATION AND PRODUCTION INFORMATION

Volume Calculation Type: ☐ Well Casing ☐ Borehole

Volume Per Foot:

Standing Water Column: N/A feet

1 Well Volume: Gallons 3 Well Volumes: Gallons

5 Well Volumes: Gallons 10 Well Volumes: Gallons

Total Volumes Produced: Gallons

Well Purged Dry? ☐ Yes ☐ No

Water Level Serial #: SOLINST MODEL 101 S/N: 363824

Water Quality Probe Type and Serial # AT600 # 454596

WATER QUALITY INDICATOR PARAMETERS

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
elapsed time											
0:00 initial	1442	—	22.04	—	9.73	1,521.4	6.85	0.74	241.32	87.6	Cloudy
0:600 purge	14:48		23.25	1.21	9.61	1,485.3	6.78	0.41	101.10	89.8	Slightly Cloudy
09:00	14:51		23.88	0.63							
12:00	14:54		24.50	0.62							
15:00	14:57		24.92	0.42							
18:00	15:00		24.25.34	0.42							
21:00	15:03		25.67	0.43							Clear
24:00	15:06		26.00	0.43							Clear

DRAFT

SAMPLE ID: EMW-05 AT 15:13 (MS/MSD)

- sample looked clear at time of sampling, became cloudy while filling up last few lab-ware jars (likely due to dropping water table).

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: EDWARDS PP Client: VISTRA

Project Number: 194010792 Task #: 1000.LBR Start Date: 11/18/2022 Time: 14:40

Field Personnel: AFH, CAL Finish Date: 11/18/2022 Time: 16:28

WELL INFORMATION

Well ID: EMW-05

Casing ID: 2 inches

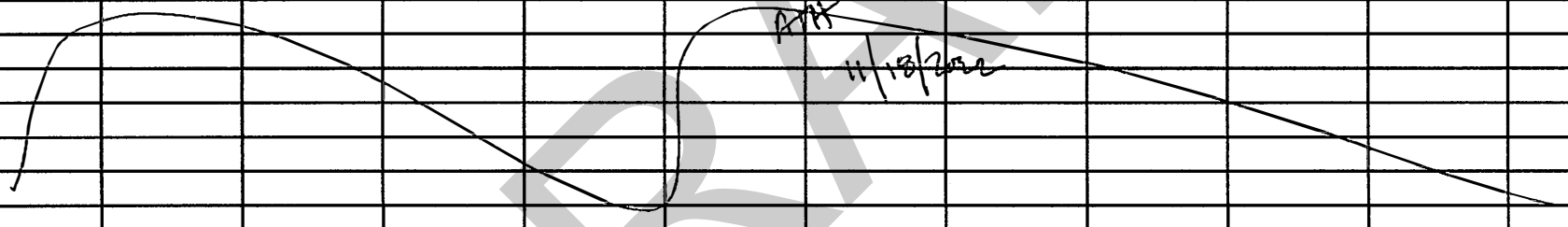
EVENT TYPE

☐ Well Development ☒ Low-Flow / Low Stress Sampling

☐ Well Volume Approach Sampling ☐ Other (Specify):

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
elapsed time (purge)											
27:00 Purge	15:09		26.41	0.41	DATA IN VIVO - SITU						Clear
30:00 Stable	15:12	~1 gal	26.82	0.41							Clear
(Sample)	15:13 - sampled well - all stable except turb.										



NOTES (continued)

☒ SAMPLE ID: EMW-05 AT 15:13. (MS/MSD)

◊ TRIPLE VOLUME

ABBREVIATIONS

Cond. - Actual Conductivity
FT BTOC - Feet Below Top of Casing
na - Not Applicable
nm - Not Measured
ORP - Oxidation-Reduction Potential
SEC - Specific Electrical Conductance
SU - Standard Units
Temp - Temperature
°C - Degrees Celcius

DRAFT

Low-Flow Test Report:

Test Date / Time: 11/21/2022 11:46:19 AM
Project: Baldwin, IL (13)
Operator Name:

Location Name: AW-23	Flow Cell Volume: 130 ml	Instrument Used: Aqua TROLL 600 Vented Serial Number: 454596

Test Notes:

Low-Flow Readings:

Date Time	Elapsed Time	pH	Temperature	Specific Conductivity	RDO Concentration	Turbidity	ORP
		+/- 0.1	+/- 0.1	+/- 3 %	+/- 0.3	+/- 10 %	+/- 10
11/21/2022 11:46 AM	00:00	7.43 pH	17.04 °C	1,111.4 µS/cm	7.96 mg/L	27.54 NTU	132.0 mV
11/21/2022 11:49 AM	03:00	7.02 pH	14.49 °C	1,128.4 µS/cm	0.76 mg/L	24.09 NTU	134.4 mV
11/21/2022 11:52 AM	06:00	6.98 pH	13.80 °C	1,121.6 µS/cm	0.63 mg/L	11.20 NTU	130.9 mV
11/21/2022 11:55 AM	09:00	6.93 pH	13.55 °C	1,134.9 µS/cm	0.57 mg/L	11.57 NTU	133.6 mV
11/21/2022 11:58 AM	12:00	6.92 pH	13.27 °C	1,138.1 µS/cm	0.43 mg/L	11.54 NTU	131.1 mV
11/21/2022 12:01 PM	15:00	6.91 pH	13.22 °C	1,132.1 µS/cm	0.44 mg/L	6.75 NTU	128.9 mV
11/21/2022 12:04 PM	18:00	6.90 pH	13.12 °C	1,141.8 µS/cm	0.44 mg/L	4.22 NTU	126.9 mV
11/21/2022 12:07 PM	21:00	6.90 pH	13.26 °C	1,152.4 µS/cm	0.46 mg/L	4.70 NTU	122.8 mV
11/21/2022 12:10 PM	24:00	6.92 pH	13.30 °C	1,158.9 µS/cm	0.38 mg/L	3.25 NTU	119.8 mV
11/21/2022 12:13 PM	27:00	6.92 pH	13.38 °C	1,164.6 µS/cm	0.38 mg/L	2.51 NTU	117.2 mV
11/21/2022 12:16 PM	30:00	6.92 pH	13.50 °C	1,174.2 µS/cm	0.84 mg/L	3.08 NTU	114.6 mV
11/21/2022 12:19 PM	33:00	6.93 pH	13.60 °C	1,173.6 µS/cm	0.51 mg/L	2.97 NTU	111.3 mV
11/21/2022 12:22 PM	36:00	6.94 pH	13.45 °C	1,174.6 µS/cm	0.26 mg/L	3.59 NTU	109.3 mV
11/21/2022 12:25 PM	39:10	6.96 pH	13.60 °C	1,179.2 µS/cm	0.27 mg/L	4.55 NTU	106.1 mV
11/21/2022 12:28 PM	42:10	6.96 pH	13.69 °C	1,183.9 µS/cm	0.24 mg/L	4.23 NTU	104.0 mV
11/21/2022 12:31 PM	45:10	6.96 pH	13.59 °C	1,187.2 µS/cm	0.22 mg/L	3.27 NTU	102.4 mV

Samples

DRAFT

Sample ID:	Description:

Created using VuSitu from In-Situ, Inc.

DRAFT

Low-Flow Test Report:

Test Date / Time: 12/16/2022 7:44:00 AM
Project: Edwards
Operator Name: S Mallow

Location Name: AW-23	**Estimated Total Volume Pumped: 9600 ml** **Flow Cell Volume: 130 ml** **Final Flow Rate: 120 ml/min**	**Instrument Used: Aqua TROLL 600 Vented** **Serial Number: 454820**

Test Notes:

Low-Flow Readings:

Date Time	Elapsed Time	pH	Temperature	Specific Conductivity	RDO Concentration	Turbidity	ORP	Flow
		+/- 0.1	+/- 0.1	+/- 3 %	+/- 0.3	+/- 10 %	+/- 10	
12/16/2022 7:44 AM	00:00	6.68 pH	6.04 °C	1,249.8 µS/cm	2.57 mg/L	113.92 NTU	200.7 mV	120.00 ml/min
12/16/2022 7:47 AM	03:00	6.69 pH	5.79 °C	1,236.1 µS/cm	0.61 mg/L	87.28 NTU	212.8 mV	120.00 ml/min
12/16/2022 7:50 AM	06:00	6.66 pH	5.91 °C	1,240.1 µS/cm	0.49 mg/L	86.97 NTU	215.4 mV	120.00 ml/min
12/16/2022 7:53 AM	09:00	6.63 pH	5.89 °C	1,239.0 µS/cm	0.42 mg/L	76.25 NTU	214.7 mV	120.00 ml/min
12/16/2022 7:56 AM	12:00	6.62 pH	6.24 °C	1,244.4 µS/cm	0.40 mg/L	71.83 NTU	211.6 mV	120.00 ml/min
12/16/2022 7:59 AM	15:00	6.60 pH	6.46 °C	1,246.1 µS/cm	0.38 mg/L	71.90 NTU	208.7 mV	120.00 ml/min
12/16/2022 8:02 AM	18:00	6.59 pH	6.70 °C	1,251.7 µS/cm	0.34 mg/L	58.84 NTU	206.0 mV	120.00 ml/min
12/16/2022 8:05 AM	21:00	6.58 pH	6.93 °C	1,267.5 µS/cm	0.30 mg/L	41.38 NTU	204.3 mV	120.00 ml/min
12/16/2022 8:08 AM	24:00	6.58 pH	6.45 °C	1,269.2 µS/cm	0.27 mg/L	46.01 NTU	202.2 mV	120.00 ml/min
12/16/2022 8:11 AM	27:00	6.57 pH	6.76 °C	1,293.7 µS/cm	0.25 mg/L	29.72 NTU	200.9 mV	120.00 ml/min
12/16/2022 8:14 AM	30:00	6.57 pH	6.64 °C	1,297.8 µS/cm	0.23 mg/L	25.22 NTU	199.8 mV	120.00 ml/min
12/16/2022 8:14 AM	30:34	6.57 pH	6.87 °C	1,293.0 µS/cm	0.23 mg/L	32.44 NTU	199.9 mV	120.00 ml/min
12/16/2022 8:16 AM	32:11	6.58 pH	6.57 °C	1,293.9 µS/cm	0.27 mg/L	35.13 NTU	188.5 mV	120.00 ml/min
12/16/2022 8:19 AM	35:11	6.54 pH	6.42 °C	1,291.8 µS/cm	0.25 mg/L	24.24 NTU	178.5 mV	120.00 ml/min
12/16/2022 8:22 AM	38:11	6.55 pH	6.81 °C	1,305.3 µS/cm	0.23 mg/L	26.71 NTU	173.6 mV	120.00 ml/min
12/16/2022 8:25 AM	41:11	6.55 pH	6.84 °C	1,312.0 µS/cm	0.22 mg/L	23.83 NTU	166.8 mV	120.00 ml/min
12/16/2022 8:28 AM	44:11	6.55 pH	7.05 °C	1,314.1 µS/cm	0.22 mg/L	21.25 NTU	161.8 mV	120.00 ml/min
12/16/2022 8:31 AM	47:11	6.56 pH	7.10 °C	1,316.6 µS/cm	0.21 mg/L	19.28 NTU	149.2 mV	120.00 ml/min

DRAFT

12/16/2022 8:34 AM	50:11	6.57 pH	6.90 °C	1,322.6 µS/cm	0.20 mg/L	14.32 NTU	133.8 mV	120.00 ml/min
12/16/2022 8:37 AM	53:11	6.56 pH	6.92 °C	1,327.1 µS/cm	0.19 mg/L	12.50 NTU	117.0 mV	120.00 ml/min
12/16/2022 8:40 AM	56:11	6.57 pH	6.43 °C	1,319.9 µS/cm	0.19 mg/L	13.89 NTU	106.2 mV	120.00 ml/min
12/16/2022 8:43 AM	59:11	6.57 pH	6.78 °C	1,334.6 µS/cm	0.19 mg/L	12.36 NTU	97.3 mV	120.00 ml/min
12/16/2022 8:46 AM	01:02:11	6.58 pH	6.66 °C	1,336.3 µS/cm	0.18 mg/L	10.50 NTU	72.1 mV	120.00 ml/min
12/16/2022 8:49 AM	01:05:11	6.59 pH	6.53 °C	1,336.6 µS/cm	0.19 mg/L	10.74 NTU	67.9 mV	120.00 ml/min
12/16/2022 8:52 AM	01:08:11	6.60 pH	6.64 °C	1,337.0 µS/cm	0.18 mg/L	10.01 NTU	48.2 mV	120.00 ml/min
12/16/2022 8:55 AM	01:11:11	6.60 pH	6.82 °C	1,338.3 µS/cm	0.18 mg/L	8.28 NTU	43.7 mV	120.00 ml/min
12/16/2022 8:58 AM	01:14:11	6.61 pH	6.74 °C	1,335.2 µS/cm	0.18 mg/L	8.78 NTU	38.0 mV	120.00 ml/min
12/16/2022 9:01 AM	01:17:11	6.62 pH	6.79 °C	1,349.5 µS/cm	0.17 mg/L	7.06 NTU	31.0 mV	120.00 ml/min
12/16/2022 9:04 AM	01:20:11	6.62 pH	6.75 °C	1,357.2 µS/cm	0.16 mg/L	5.85 NTU	22.6 mV	120.00 ml/min

Samples

Sample ID:	Description:

DRAFT

Low-Flow Test Report:

Test Date / Time: 12/15/2022 3:37:58 PM
Project: Edwards
Operator Name: A Margason, S Mallow

Location Name: AW-01	**Estimated Total Volume Pumped: 7800 ml** **Flow Cell Volume: 130 ml** **Final Flow Rate: 100 ml/min** **Final Draw Down: 15.68 ft**	**Instrument Used: Aqua TROLL 600 Vented** **Serial Number: 449093**

Test Notes:
Sample time at 1702

Weather Conditions:
Snowing

Low-Flow Readings:

Date Time	Elapsed Time	pH	Temperature	Specific Conductivity	RDO Concentration	Turbidity	ORP	Flow
		+/- 0.1	+/- 0.1	+/- 3 %	+/- 0.3	+/- 10 %	+/- 10	
12/15/2022 3:37 PM	00:00	7.44 pH	10.70 °C	1,511.0 µS/cm	0.95 mg/L	247.57 NTU	-233.7 mV	100.00 ml/min
12/15/2022 3:40 PM	03:00	7.43 pH	12.29 °C	214.83 µS/cm	0.84 mg/L	303.63 NTU	-230.2 mV	100.00 ml/min
12/15/2022 3:43 PM	06:00	7.42 pH	13.10 °C	204.36 µS/cm	0.69 mg/L	585.87 NTU	-231.0 mV	100.00 ml/min
12/15/2022 3:46 PM	09:00	7.42 pH	13.26 °C	216.60 µS/cm	0.63 mg/L	764.45 NTU	-232.0 mV	100.00 ml/min
12/15/2022 3:49 PM	12:00	7.42 pH	13.07 °C	181.14 µS/cm	0.60 mg/L	936.05 NTU	-233.6 mV	100.00 ml/min
12/15/2022 3:52 PM	15:00	7.42 pH	12.96 °C	173.51 µS/cm	0.59 mg/L	1,162.4 NTU	-234.8 mV	100.00 ml/min
12/15/2022 3:55 PM	18:00	7.42 pH	12.91 °C	141.56 µS/cm	0.58 mg/L	1,164.5 NTU	-234.6 mV	100.00 ml/min
12/15/2022 3:58 PM	21:00	7.42 pH	12.97 °C	87.02 µS/cm	0.58 mg/L	2,099.1 NTU	-235.8 mV	100.00 ml/min
12/15/2022 4:01 PM	24:00	7.42 pH	13.04 °C	97.52 µS/cm	0.58 mg/L	2,207.6 NTU	-216.6 mV	100.00 ml/min
12/15/2022 4:04 PM	27:00	7.42 pH	12.76 °C	73.96 µS/cm	0.57 mg/L	2,378.8 NTU	-197.7 mV	100.00 ml/min
12/15/2022 4:07 PM	30:00	7.40 pH	12.61 °C	77.70 µS/cm	0.57 mg/L	2,579.6 NTU	-188.1 mV	100.00 ml/min
12/15/2022 4:10 PM	33:00	7.40 pH	12.40 °C	83.54 µS/cm	0.58 mg/L	2,693.1 NTU	-182.0 mV	100.00 ml/min
12/15/2022 4:13 PM	36:00	7.40 pH	12.10 °C	90.88 µS/cm	0.59 mg/L	2,832.4 NTU	-177.5 mV	100.00 ml/min
12/15/2022 4:16 PM	39:00	7.40 pH	11.84 °C	96.23 µS/cm	0.60 mg/L	3,098.1 NTU	-174.9 mV	100.00 ml/min
12/15/2022 4:19 PM	42:00	7.40 pH	11.84 °C	52.35 µS/cm	0.62 mg/L	3,267.3 NTU	-171.7 mV	100.00 ml/min

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12/15/2022 4:22 PM	45:00	7.34 pH	13.31 °C	71.99 µS/cm	0.57 mg/L	2,989.6 NTU	-166.3 mV	100.00 ml/min
12/15/2022 4:25 PM	48:00	7.32 pH	13.21 °C	74.17 µS/cm	0.55 mg/L	3,300.6 NTU	-164.4 mV	100.00 ml/min
12/15/2022 4:28 PM	51:00	7.31 pH	13.09 °C	78.39 µS/cm	0.54 mg/L	4,345.1 NTU	-165.2 mV	100.00 ml/min
12/15/2022 4:31 PM	54:00	7.31 pH	12.67 °C	83.77 µS/cm	0.55 mg/L	4,234.8 NTU	-169.8 mV	100.00 ml/min
12/15/2022 4:34 PM	57:00	7.31 pH	13.08 °C	61.03 µS/cm	0.57 mg/L	4,389.7 NTU	-170.5 mV	100.00 ml/min
12/15/2022 4:37 PM	01:00:00	7.30 pH	12.93 °C	69.45 µS/cm	0.59 mg/L	3,143.6 NTU	-169.8 mV	100.00 ml/min
12/15/2022 4:40 PM	01:03:00	7.30 pH	12.95 °C	74.71 µS/cm	0.62 mg/L	3,538.8 NTU	-169.4 mV	100.00 ml/min
12/15/2022 4:43 PM	01:06:00	7.30 pH	12.86 °C	80.55 µS/cm	0.65 mg/L	3,509.9 NTU	-168.7 mV	100.00 ml/min
12/15/2022 4:46 PM	01:09:00	7.30 pH	12.94 °C	88.79 µS/cm	0.67 mg/L	3,660.7 NTU	-167.4 mV	100.00 ml/min
12/15/2022 4:49 PM	01:12:00	7.29 pH	12.91 °C	94.76 µS/cm	0.69 mg/L	4,029.5 NTU	-166.0 mV	100.00 ml/min
12/15/2022 4:52 PM	01:15:00	7.30 pH	12.92 °C	95.22 µS/cm	0.70 mg/L	4,120.6 NTU	-164.8 mV	100.00 ml/min
12/15/2022 4:55 PM	01:18:00	7.29 pH	12.97 °C	97.04 µS/cm	0.71 mg/L	4,095.8 NTU	-163.4 mV	100.00 ml/min

Samples

Sample ID:	Description:

DRAFT

Low-Flow Test Report:

Test Date / Time: 12/15/2022 1:21:12 PM
Project: Baldwin
Operator Name: A Tabares, S Mallow

Location Name: EMW-05 **Initial Depth to Water: 20.31 ft** **Volume Removed: 20400 mL**	**Flow Cell Volume: 130 ml** **Final Flow Rate: 150 ml/min** **Final Draw Down: 6.75 ft**	**Instrument Used: Aqua TROLL 600 Vented** **Serial Number: 454820**

Test Notes:

Low-Flow Readings:

Date Time	Elapsed Time	pH	Temperature	Specific Conductivity	RDO Concentration	Turbidity	ORP	Depth To Water (ft)	Flow
		+/- 0.1	+/- 0.1	+/- 3 %	+/- 0.3	+/- 10 %	+/- 10		
12/15/2022 1:21 PM	00:00	6.81 pH	9.59 °C	8.69 µS/cm	11.37 mg/L	9.23 NTU	206.0 mV	20.31	150.00 ml/min
12/15/2022 1:24 PM	03:00	6.73 pH	12.53 °C	2.73 µS/cm	7.75 mg/L	4.23 NTU	-13.3 mV	20.31	150.00 ml/min
12/15/2022 1:27 PM	06:00	6.67 pH	12.23 °C	5.50 µS/cm	7.56 mg/L	3.31 NTU	30.6 mV	24.01	150.00 ml/min
12/15/2022 1:30 PM	09:00	6.60 pH	12.19 °C	2.39 µS/cm	7.44 mg/L	73.66 NTU	61.2 mV	24.01	150.00 ml/min
12/15/2022 1:33 PM	12:00	6.62 pH	11.33 °C	0.46 µS/cm	8.13 mg/L	7.12 NTU	64.4 mV	24.01	150.00 ml/min
12/15/2022 1:36 PM	15:00	6.57 pH	10.39 °C	0.50 µS/cm	8.34 mg/L	3.87 NTU	68.6 mV	24.01	150.00 ml/min
12/15/2022 1:39 PM	18:00	6.59 pH	9.75 °C	0.47 µS/cm	8.45 mg/L	3.79 NTU	71.0 mV	24.29	150.00 ml/min
12/15/2022 1:42 PM	21:00	6.61 pH	9.28 °C	0.23 µS/cm	8.55 mg/L	2.52 NTU	72.3 mV	24.29	150.00 ml/min
12/15/2022 1:45 PM	24:00	6.63 pH	8.91 °C	0.68 µS/cm	8.57 mg/L	2.61 NTU	39.6 mV	24.29	150.00 ml/min
12/15/2022 1:48 PM	27:00	6.57 pH	11.44 °C	4.52 µS/cm	4.93 mg/L	391.88 NTU	37.7 mV	24.29	150.00 ml/min
12/15/2022 1:51 PM	30:00	6.55 pH	11.48 °C	1.66 µS/cm	4.83 mg/L	156.81 NTU	54.2 mV	24.83	150.00 ml/min
12/15/2022 2:00 PM	39:04	6.51 pH	10.71 °C	0.18 µS/cm	7.51 mg/L	1.44 NTU	93.3 mV	25.21	150.00 ml/min
12/15/2022 2:03 PM	42:04	6.50 pH	10.11 °C	1.83 µS/cm	7.10 mg/L		111.2 mV	25.97	150.00 ml/min
12/15/2022 2:06 PM	45:04	6.49 pH	11.10 °C	2.75 µS/cm	5.91 mg/L	616.62 NTU	128.4 mV	26.45	150.00 ml/min
12/15/2022 2:09 PM	48:04	6.48 pH	10.63 °C	51.61 µS/cm	4.99 mg/L	250.44 NTU	132.4 mV	26.45	150.00 ml/min
12/15/2022 2:12 PM	51:04	6.48 pH	10.13 °C	2.00 µS/cm	5.29 mg/L	2.10 NTU	118.0 mV	26.78	150.00 ml/min
12/15/2022 2:15 PM	54:04	6.48 pH	9.99 °C	3.38 µS/cm	5.76 mg/L	19.99 NTU	102.9 mV	27.04	150.00 ml/min
12/15/2022 2:18 PM	57:04	6.48 pH	9.89 °C	1.63 µS/cm	5.69 mg/L	1.86 NTU	117.9 mV	27.04	150.00 ml/min

DRAFT

12/15/2022 2:21 PM	01:00:04	6.48 pH	9.77 °C	5.11 µS/cm	5.47 mg/L	14.98 NTU	134.2 mV	27.04	150.00 ml/min
12/15/2022 2:24 PM	01:03:04	6.48 pH	9.82 °C	1.46 µS/cm	5.52 mg/L	1.97 NTU	150.7 mV	27.04	150.00 ml/min
12/15/2022 2:27 PM	01:06:04	6.48 pH	9.83 °C	1.97 µS/cm	5.22 mg/L	2.47 NTU	152.5 mV	27.06	150.00 ml/min
12/15/2022 2:30 PM	01:09:04	6.47 pH	9.70 °C	2.03 µS/cm	4.80 mg/L	4.08 NTU	144.8 mV	27.06	150.00 ml/min
12/15/2022 2:33 PM	01:12:04	6.47 pH	9.80 °C	2.07 µS/cm	4.68 mg/L	2.46 NTU	131.2 mV	27.06	150.00 ml/min
12/15/2022 2:36 PM	01:15:04	6.47 pH	9.75 °C	24.51 µS/cm	5.44 mg/L	48.23 NTU	89.1 mV	27.06	150.00 ml/min
12/15/2022 2:39 PM	01:18:04	6.48 pH	9.61 °C	1.56 µS/cm	5.23 mg/L	2.65 NTU	89.9 mV	27.06	150.00 ml/min
12/15/2022 2:42 PM	01:21:04	6.48 pH	9.45 °C	2.45 µS/cm	5.14 mg/L	57.62 NTU	104.5 mV	27.06	150.00 ml/min
12/15/2022 2:45 PM	01:24:04	6.48 pH	9.50 °C	2.30 µS/cm	5.07 mg/L	2.71 NTU	119.7 mV	27.06	150.00 ml/min
12/15/2022 2:48 PM	01:27:04	6.48 pH	9.70 °C	23.56 µS/cm	5.09 mg/L	3.82 NTU	123.8 mV	27.06	150.00 ml/min
12/15/2022 2:51 PM	01:30:04	6.48 pH	9.30 °C	0.96 µS/cm	6.41 mg/L	2.12 NTU	119.7 mV	27.06	150.00 ml/min
12/15/2022 2:54 PM	01:33:04	6.48 pH	8.67 °C	0.40 µS/cm	6.65 mg/L	1.75 NTU	118.4 mV	27.06	150.00 ml/min
12/15/2022 2:57 PM	01:36:04	6.47 pH	7.98 °C	0.35 µS/cm	6.86 mg/L	2.21 NTU	117.2 mV	27.06	150.00 ml/min
12/15/2022 3:00 PM	01:39:04	6.48 pH	7.25 °C	0.33 µS/cm	6.98 mg/L	2.47 NTU	115.8 mV	27.06	150.00 ml/min
12/15/2022 3:03 PM	01:42:04	6.49 pH	6.63 °C	0.30 µS/cm	7.14 mg/L	2.46 NTU	114.9 mV	27.06	150.00 ml/min
12/15/2022 3:06 PM	01:45:04	6.50 pH	6.09 °C	0.27 µS/cm	7.26 mg/L	2.40 NTU	113.8 mV	27.06	150.00 ml/min
12/15/2022 3:09 PM	01:48:04	6.53 pH	5.58 °C	0.30 µS/cm	7.25 mg/L	2.66 NTU	112.6 mV	27.06	150.00 ml/min
12/15/2022 3:12 PM	01:51:04	6.55 pH	5.08 °C	0.26 µS/cm	7.40 mg/L	3.08 NTU	111.7 mV	27.06	150.00 ml/min
12/15/2022 3:15 PM	01:54:04	6.57 pH	4.75 °C	0.25 µS/cm	7.51 mg/L	3.16 NTU	111.1 mV	27.06	150.00 ml/min
12/15/2022 3:18 PM	01:57:04	6.66 pH	4.03 °C	1,343.5 µS/cm	7.67 mg/L	277.49 NTU	94.9 mV	27.06	150.00 ml/min
12/15/2022 3:25 PM	02:04:39	6.49 pH	9.40 °C	1,612.2 µS/cm	3.93 mg/L	103.00 NTU	55.9 mV	27.06	150.00 ml/min
12/15/2022 3:28 PM	02:07:39	6.47 pH	9.17 °C	1,607.3 µS/cm	2.71 mg/L	94.02 NTU	54.5 mV	27.06	150.00 ml/min
12/15/2022 3:31 PM	02:10:39	6.46 pH	9.15 °C	1,607.2 µS/cm	2.36 mg/L	106.88 NTU	59.2 mV	27.06	150.00 ml/min
12/15/2022 3:34 PM	02:13:39	6.47 pH	9.14 °C	1,605.7 µS/cm	2.30 mg/L	83.43 NTU	62.4 mV	27.06	150.00 ml/min
12/15/2022 3:37 PM	02:16:39	6.46 pH	9.17 °C	1,605.6 µS/cm	2.22 mg/L	86.08 NTU	65.7 mV	27.06	150.00 ml/min

DRAFT

Samples

Sample ID:	Description:

Created using VuSitu from In-Situ, Inc.

DRAFT

Low-Flow Test Report:

Test Date / Time: 1/10/2023 8:43:04 AM
Project: Edwards Round 3 Sampling
Operator Name: S Mallow

Location Name: AW-23 **Well Diameter: 2 in** **Casing Type: PVC** **Initial Depth to Water: 3.96 ft**	**Pump Type: Peristaltic** **Pump Intake From TOC: ~15 ft** **Estimated Total Volume Pumped: 11610 ml** **Flow Cell Volume: 130 ml** **Final Flow Rate: 260 ml/min** **Final Draw Down: 0.14 ft**	**Instrument Used: Aqua TROLL 600 Vented** **Serial Number: 454660**

Test Notes:

Low-Flow Readings:

Date Time	Elapsed Time	pH	Temperature	Specific Conductivity	RDO Concentration	Turbidity	ORP	Depth To Water	Flow
		+/- 0.1	+/- 0.1	+/- 3 %	+/- 0.3	+/- 10 %	+/- 10	+/- 0.1	
1/10/2023 8:43 AM	00:00	6.96 pH	5.82 °C	1,177.7 µS/cm	1.20 mg/L	4.83 NTU	186.7 mV	3.96 ft	150.00 ml/min
1/10/2023 8:46 AM	03:00	6.94 pH	8.64 °C	1,129.0 µS/cm	0.94 mg/L	9.44 NTU	182.0 mV	4.04 ft	150.00 ml/min
1/10/2023 8:49 AM	06:00	6.93 pH	9.30 °C	1,122.7 µS/cm	0.80 mg/L	3.13 NTU	169.2 mV	4.04 ft	150.00 ml/min
1/10/2023 8:52 AM	09:00	6.92 pH	9.25 °C	1,121.0 µS/cm	0.69 mg/L	4.86 NTU	150.4 mV	4.04 ft	150.00 ml/min
1/10/2023 8:55 AM	12:00	6.91 pH	9.52 °C	1,122.2 µS/cm	0.61 mg/L	1.76 NTU	117.9 mV	4.04 ft	150.00 ml/min
1/10/2023 8:58 AM	15:00	6.91 pH	9.68 °C	1,123.0 µS/cm	0.52 mg/L	1.86 NTU	80.0 mV	4.04 ft	260.00 ml/min
1/10/2023 9:01 AM	18:00	6.90 pH	10.52 °C	1,122.7 µS/cm	0.45 mg/L	0.00 NTU	41.1 mV	4.10 ft	260.00 ml/min
1/10/2023 9:04 AM	21:00	6.90 pH	10.42 °C	1,120.5 µS/cm	0.39 mg/L	0.43 NTU	14.8 mV	4.10 ft	260.00 ml/min
1/10/2023 9:07 AM	24:00	6.89 pH	10.43 °C	1,120.2 µS/cm	0.29 mg/L	0.39 NTU	-4.3 mV	4.10 ft	260.00 ml/min
1/10/2023 9:10 AM	27:00	6.90 pH	10.23 °C	1,120.3 µS/cm	0.29 mg/L	0.26 NTU	-15.0 mV	4.10 ft	260.00 ml/min
1/10/2023 9:13 AM	30:00	6.89 pH	10.64 °C	1,118.7 µS/cm	0.21 mg/L	0.00 NTU	-26.6 mV	4.10 ft	260.00 ml/min
1/10/2023 9:16 AM	33:00	6.89 pH	10.59 °C	1,118.4 µS/cm	0.27 mg/L	0.00 NTU	-32.3 mV	4.10 ft	260.00 ml/min
1/10/2023 9:19 AM	36:00	6.90 pH	10.71 °C	1,117.3 µS/cm	0.19 mg/L	0.00 NTU	-39.5 mV	4.10 ft	260.00 ml/min
1/10/2023 9:22 AM	39:00	6.90 pH	10.45 °C	1,116.9 µS/cm	0.18 mg/L	0.27 NTU	-45.5 mV	4.10 ft	260.00 ml/min
1/10/2023 9:25 AM	42:00	6.90 pH	10.60 °C	1,115.6 µS/cm	0.15 mg/L	0.00 NTU	-50.7 mV	4.10 ft	260.00 ml/min
1/10/2023 9:28 AM	45:00	6.90 pH	10.80 °C	1,116.4 µS/cm	0.20 mg/L	0.00 NTU	-54.2 mV	4.10 ft	260.00 ml/min

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1/10/2023 9:31 AM	48:00	6.91 pH	10.83 °C	1,115.5 µS/cm	0.17 mg/L	0.00 NTU	-56.2 mV	4.10 ft	260.00 ml/min
1/10/2023 9:34 AM	51:00	6.91 pH	10.89 °C	1,113.7 µS/cm	0.14 mg/L	0.00 NTU	-60.4 mV	4.10 ft	260.00 ml/min

Samples

Sample ID:	Description:

Created using VuSitu from In-Situ, Inc.

DRAFT

Low-Flow Test Report:

Test Date / Time: 1/10/2023 11:32:24 AM
Project: Edwards Round 3 Sampling
Operator Name: A. Margason

Location Name: EMW-05 **Initial Depth to Water: 24.45 ft**	**Pump Type: QED Micropurge** **Estimated Total Volume Pumped: 6900 ml** **Flow Cell Volume: 130 ml** **Final Flow Rate: 100 ml/min** **Draw Down: 4.10 ft**	**Instrument Used: Aqua TROLL 600 Vented** **Serial Number: 449077**

Test Notes: Dedicated bladder pump appears to not be working. Well purged using portable bladder pump. Final four turbidity readings collected with separate turbidity meter (Geotech SN: 3550-1389).

Weather Conditions:
35F, Sunny

Low-Flow Readings:

Date Time	Elapsed Time	pH	Temperature	Specific Conductivity	RDO Concentration	Turbidity	ORP	Depth To Water	Flow
		+/- 0.1	+/- 0.1	+/- 3 %	+/- 0.3	+/- 10	+/- 10		
1/10/2023 11:32 AM	00:00	6.67 pH	12.89 °C	1,426.5 µS/cm	2.09 mg/L	2,023.3 NTU	-47.6 mV	24.45 ft	100.00 ml/min
1/10/2023 11:35 AM	03:00	6.67 pH	12.55 °C	1,420.7 µS/cm	2.14 mg/L	1,420.0 NTU	-43.4 mV	24.45 ft	100.00 ml/min
1/10/2023 11:38 AM	06:00	6.66 pH	12.60 °C	1,415.8 µS/cm	2.23 mg/L	1,346.4 NTU	-39.1 mV	25.11 ft	100.00 ml/min
1/10/2023 11:41 AM	09:00	6.66 pH	12.72 °C	1,418.4 µS/cm	2.33 mg/L	1,180.1 NTU	-33.5 mV	25.32 ft	100.00 ml/min
1/10/2023 11:44 AM	12:00	6.65 pH	12.77 °C	1,413.5 µS/cm	2.37 mg/L	908.60 NTU	-29.8 mV	25.60 ft	100.00 ml/min
1/10/2023 11:47 AM	15:00	6.65 pH	12.81 °C	1,406.5 µS/cm	2.44 mg/L	808.79 NTU	-28.7 mV	25.89 ft	100.00 ml/min
1/10/2023 11:50 AM	18:00	6.65 pH	12.74 °C	1,402.4 µS/cm	2.54 mg/L	746.63 NTU	-26.0 mV	25.99 ft	100.00 ml/min
1/10/2023 11:53 AM	21:00	6.64 pH	12.85 °C	1,405.4 µS/cm	2.61 mg/L	592.88 NTU	-21.0 mV	26.18 ft	100.00 ml/min
1/10/2023 11:56 AM	24:00	6.64 pH	13.01 °C	1,407.3 µS/cm	2.65 mg/L	497.27 NTU	-17.7 mV	26.58 ft	100.00 ml/min
1/10/2023 11:59 AM	27:00	6.64 pH	13.14 °C	1,403.3 µS/cm	2.73 mg/L	403.54 NTU	-15.9 mV	26.72 ft	100.00 ml/min
1/10/2023 12:02 PM	30:00	6.64 pH	13.10 °C	1,398.6 µS/cm	2.86 mg/L	314.52 NTU	-14.8 mV	26.88 ft	100.00 ml/min
1/10/2023 12:05 PM	33:00	6.64 pH	13.15 °C	1,398.0 µS/cm	2.93 mg/L	247.42 NTU	-12.9 mV	26.98 ft	100.00 ml/min
1/10/2023 12:08 PM	36:00	6.64 pH	13.14 °C	1,394.4 µS/cm	2.96 mg/L	217.06 NTU	-11.9 mV	27.23 ft	100.00 ml/min
1/10/2023 12:11 PM	39:00	6.64 pH	13.56 °C	1,398.0 µS/cm	2.95 mg/L	181.23 NTU	-10.6 mV	27.45 ft	100.00 ml/min
1/10/2023 12:14 PM	42:00	6.64 pH	13.73 °C	1,390.2 µS/cm	3.00 mg/L	164.93 NTU	-8.9 mV	27.45 ft	100.00 ml/min

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1/10/2023 12:17 PM	45:00	6.65 pH	13.66 °C	1,393.4 µS/cm	3.04 mg/L	152.80 NTU	-6.9 mV	27.45 ft	100.00 ml/min
1/10/2023 12:20 PM	48:00	6.65 pH	13.67 °C	1,391.7 µS/cm	3.00 mg/L	126.22 NTU	-4.1 mV	27.45 ft	100.00 ml/min
1/10/2023 12:23 PM	51:00	6.65 pH	13.50 °C	1,389.4 µS/cm	3.01 mg/L	126.94 NTU	-1.4 mV	28.01 ft	100.00 ml/min
1/10/2023 12:26 PM	54:00	6.69 pH	13.67 °C	1.91 µS/cm	6.50 mg/L	0.31 NTU	0.0 mV	28.01 ft	100.00 ml/min
1/10/2023 12:29 PM	57:00	6.64 pH	13.36 °C	1,405.5 µS/cm	2.84 mg/L	234.54 NTU	3.7 mV	28.01 ft	100.00 ml/min
1/10/2023 12:32 PM	01:00:00	6.63 pH	13.35 °C	1,411.6 µS/cm	2.47 mg/L	75.3 NTU	3.6 mV	28.18 ft	100.00 ml/min
1/10/2023 12:35 PM	01:03:00	6.63 pH	13.31 °C	1,412.8 µS/cm	2.04 mg/L	77.3 NTU	10.2 mV	28.26 ft	100.00 ml/min
1/10/2023 12:38 PM	01:06:00	6.63 pH	13.29 °C	1,414.9 µS/cm	1.83 mg/L	82.1 NTU	12.3 mV	28.48 ft	100.00 ml/min
1/10/2023 12:41 PM	01:09:00	6.63 pH	13.25 °C	1,414.6 µS/cm	1.86 mg/L	85.8 NTU	13.6 mV	28.55 ft	100.00 ml/min

Samples

Sample ID:	Description:

Created using VuSitu from In-Situ, Inc.

DRAFT

Low-Flow Test Report:

Test Date / Time: 1/10/2023 2:10:37 PM
Project: Edwards Round 3 Sampling
Operator Name: A. Margason

Location Name: AW-01 **Initial Depth to Water: 12.07 ft**	**Pump Type: QED Micropurge** **Estimated Total Volume Pumped: 6300 ml** **Flow Cell Volume: 130 ml** **Final Flow Rate: 100 ml/min Final Draw Down: 8.98 ft**	**Instrument Used: Aqua TROLL 600 Vented** **Serial Number: 449077**

Test Notes: Dedicated bladder pump does not appear to be working. Well purged using portable bladder pump. Final three turbidity readings collected with separate turbidity meter (Geotech SN: 3550-1389).

Low-Flow Readings:

Date Time	Elapsed Time	pH	Temperature	Specific Conductivity	RDO Concentration	Turbidity	ORP	Depth To Water	Flow
		+/- 0.1	+/- 0.1	+/- 3 %	+/- 0.3	+/- 10	+/- 10		
1/10/2023 2:10 PM	00:00	6.82 pH	14.65 °C	1,370.7 µS/cm	0.72 mg/L	400.04 NTU	-156.3 mV	12.07 ft	100.00 ml/min
1/10/2023 2:13 PM	03:00	6.83 pH	14.38 °C	1,366.6 µS/cm	0.87 mg/L	255.90 NTU	-154.6 mV	12.07 ft	100.00 ml/min
1/10/2023 2:16 PM	06:00	6.83 pH	14.14 °C	1,364.1 µS/cm	0.85 mg/L	226.41 NTU	-151.8 mV	15.53 ft	100.00 ml/min
1/10/2023 2:19 PM	09:00	6.83 pH	14.06 °C	1,372.1 µS/cm	0.81 mg/L	283.76 NTU	-149.8 mV	15.89 ft	100.00 ml/min
1/10/2023 2:22 PM	12:00	6.82 pH	14.17 °C	1,366.0 µS/cm	0.76 mg/L	303.24 NTU	-148.5 mV	16.07 ft	100.00 ml/min
1/10/2023 2:25 PM	15:00	6.82 pH	14.08 °C	1,366.0 µS/cm	0.74 mg/L	385.99 NTU	-147.3 mV	16.21 ft	100.00 ml/min
1/10/2023 2:28 PM	18:00	6.82 pH	14.14 °C	1,354.3 µS/cm	0.70 mg/L	457.43 NTU	-146.4 mV	16.50 ft	100.00 ml/min
1/10/2023 2:31 PM	21:00	6.83 pH	14.03 °C	1,316.8 µS/cm	0.66 mg/L	506.68 NTU	-144.7 mV	16.92 ft	100.00 ml/min
1/10/2023 2:34 PM	24:00	6.83 pH	13.74 °C	1,309.9 µS/cm	0.63 mg/L	601.45 NTU	-143.4 mV	17.11 ft	100.00 ml/min
1/10/2023 2:37 PM	27:00	6.83 pH	13.86 °C	1,302.6 µS/cm	0.59 mg/L	666.59 NTU	-142.1 mV	17.34 ft	100.00 ml/min
1/10/2023 2:40 PM	30:00	6.83 pH	13.80 °C	1,274.9 µS/cm	0.56 mg/L	577.02 NTU	-141.0 mV	17.56 ft	100.00 ml/min
1/10/2023 2:43 PM	33:00	6.83 pH	13.80 °C	1,305.7 µS/cm	0.54 mg/L	603.80 NTU	-140.2 mV	17.89 ft	100.00 ml/min
1/10/2023 2:46 PM	36:00	6.83 pH	13.57 °C	1,263.8 µS/cm	0.51 mg/L	503.22 NTU	-139.1 mV	18.17 ft	100.00 ml/min
1/10/2023 2:49 PM	39:00	6.83 pH	13.55 °C	1,331.6 µS/cm	0.48 mg/L	338.39 NTU	-137.8 mV	18.36 ft	100.00 ml/min
1/10/2023 2:52 PM	42:00	6.83 pH	13.66 °C	1,321.8 µS/cm	0.46 mg/L	374.51 NTU	-136.6 mV	18.36 ft	100.00 ml/min
1/10/2023 2:55 PM	45:00	6.84 pH	13.55 °C	1,314.5 µS/cm	0.43 mg/L	387.44 NTU	-135.7 mV	18.36 ft	100.00 ml/min
1/10/2023 2:58 PM	48:00	6.84 pH	13.60 °C	1,314.7 µS/cm	0.43 mg/L	451.51 NTU	-134.4 mV	18.36 ft	100.00 ml/min

DRAFT

1/10/2023 3:01 PM	51:00	6.84 pH	13.53 °C	1,324.2 µS/cm	0.43 mg/L	483.55 NTU	-133.4 mV	18.36 ft	100.00 ml/min
1/10/2023 3:04 PM	54:00	6.84 pH	13.57 °C	1,324.1 µS/cm	0.44 mg/L	509.66 NTU	-132.6 mV	20.00 ft	100.00 ml/min
1/10/2023 3:07 PM	57:00	6.84 pH	13.55 °C	1,317.8 µS/cm	0.45 mg/L	39.5 NTU	-131.6 mV	20.45 ft	100.00 ml/min
1/10/2023 3:10 PM	01:00:00	6.84 pH	13.60 °C	1,352.0 µS/cm	0.46 mg/L	37.9 NTU	-131.0 mV	20.71 ft	100.00 ml/min
1/10/2023 3:13 PM	01:03:00	6.84 pH	13.77 °C	1,350.8 µS/cm	0.46 mg/L	37.2 NTU	-129.9 mV	21.05 ft	100.00 ml/min

Samples

Sample ID:	Description:

Created using VuSitu from In-Situ, Inc.

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APPENDIX F
ANALYTICAL LABORATORY REPORTS

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

December 06, 2022

Brian Voelker
Vistra - Edwards
604 Pierce Boulevard
O'Fallon, IL 62269

RE: RAMBOLL DELINEATION

Dear Brian Voelker:

Please find enclosed the analytical results for the **6** sample(s) the laboratory received on **11/21/22 4:50 pm** and logged in under work order **FK04074**. 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 Pace Analytical Services, LLC.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

Pace Analytical Services 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 lisa.grant@pacelabs.com.

Gail J Schindler

Gail Schindler
Project Manager
(309) 692-9688 x1716
gail.schindler@pacelabs.com

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

SAMPLE RECEIPT CHECK LIST

Items not applicable will be marked as in compliance

Work Order FK04074

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 received 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

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: FK04074-01
Name: AW-01
Matrix: Ground Water - Grab

Sampled: 11/18/22 14:21
Received: 11/21/22 16:50

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	13	mg/L		12/03/22 00:46	5	5.0	12/03/22 00:46	CRD	EPA 300.0 REV 2.1
Fluoride	0.268	mg/L		12/02/22 01:19	1	0.250	12/02/22 01:19	CRD	EPA 300.0 REV 2.1
Sulfate	41	mg/L		12/03/22 00:46	5	5.0	12/03/22 00:46	CRD	EPA 300.0 REV 2.1
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	520	mg/L		12/01/22 14:53	1	10	12/01/22 14:53	HRF	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		12/01/22 14:53	1	10	12/01/22 14:53	HRF	SM 2320B 1997*
Solids - total dissolved solids (TDS)	810	mg/L	M	11/23/22 14:15	1	26	11/23/22 15:51	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		11/30/22 09:21	5	3.0	12/01/22 12:01	JMW	EPA 6020A
Arsenic	17	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:01	JMW	EPA 6020A
Barium	140	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:01	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/02/22 08:28	JMW	EPA 6020A
Boron	90	ug/L		11/30/22 09:21	5	10	12/01/22 12:01	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:01	JMW	EPA 6020A
Calcium	190	mg/L		11/30/22 09:21	5	0.20	12/01/22 12:01	JMW	EPA 6020A
Chromium	< 4.0	ug/L		11/30/22 09:21	5	4.0	12/01/22 12:01	JMW	EPA 6020A
Cobalt	4.8	ug/L		11/30/22 09:21	5	2.0	12/01/22 12:01	JMW	EPA 6020A
Lead	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:01	JMW	EPA 6020A
Magnesium	86	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:01	JMW	EPA 6020A
Mercury	< 0.20	ug/L		11/30/22 09:21	5	0.20	12/01/22 12:01	JMW	EPA 6020A
Molybdenum	3.3	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:01	JMW	EPA 6020A
Potassium	0.32	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:01	JMW	EPA 6020A
Selenium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:01	JMW	EPA 6020A
Sodium	18	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:01	JMW	EPA 6020A
Thallium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:01	JMW	EPA 6020A
Lithium	< 0.020	mg/L		11/30/22 09:21	1	0.020	11/30/22 13:15	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: FK04074-02
Name: EMW-05
Matrix: Ground Water - Grab

Sampled: 11/18/22 15:13
Received: 11/21/22 16:50

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	28	mg/L		12/02/22 02:13	10	10	12/02/22 02:13	CRD	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		12/02/22 01:55	1	0.250	12/02/22 01:55	CRD	EPA 300.0 REV 2.1
Sulfate	120	mg/L		12/02/22 02:31	100	100	12/02/22 02:31	CRD	EPA 300.0 REV 2.1
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	490	mg/L		12/01/22 14:53	1	10	12/01/22 14:53	HRF	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		12/01/22 14:53	1	10	12/01/22 14:53	HRF	SM 2320B 1997*
Solids - total dissolved solids (TDS)	890	mg/L	M	11/23/22 14:15	1	26	11/23/22 15:51	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		11/30/22 09:21	5	3.0	12/01/22 12:05	JMW	EPA 6020A
Arsenic	1.3	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:05	JMW	EPA 6020A
Barium	69	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:05	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/02/22 08:32	JMW	EPA 6020A
Boron	670	ug/L		11/30/22 09:21	5	10	12/01/22 12:05	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:05	JMW	EPA 6020A
Calcium	160	mg/L	Q4	11/30/22 09:21	5	0.20	12/01/22 12:05	JMW	EPA 6020A
Chromium	< 4.0	ug/L		11/30/22 09:21	5	4.0	12/01/22 12:05	JMW	EPA 6020A
Cobalt	2.2	ug/L		11/30/22 09:21	5	2.0	12/01/22 12:05	JMW	EPA 6020A
Lead	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:05	JMW	EPA 6020A
Magnesium	79	mg/L	Q4	11/30/22 09:21	5	0.10	12/01/22 12:05	JMW	EPA 6020A
Mercury	< 0.20	ug/L		11/30/22 09:21	5	0.20	12/01/22 12:05	JMW	EPA 6020A
Molybdenum	1.9	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:05	JMW	EPA 6020A
Potassium	0.51	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:05	JMW	EPA 6020A
Selenium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:05	JMW	EPA 6020A
Sodium	22	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:05	JMW	EPA 6020A
Thallium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:05	JMW	EPA 6020A
Lithium	< 0.020	mg/L		11/30/22 09:21	1	0.020	11/30/22 13:17	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: FK04074-03
Name: AW-23
Matrix: Ground Water - Grab

Sampled: 11/21/22 12:32
Received: 11/21/22 16:50

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	42	mg/L		12/02/22 03:08	10	10	12/02/22 03:08	CRD	EPA 300.0 REV 2.1
Fluoride	0.294	mg/L		12/02/22 02:49	1	0.250	12/02/22 02:49	CRD	EPA 300.0 REV 2.1
Sulfate	200	mg/L		12/02/22 03:26	100	100	12/02/22 03:26	CRD	EPA 300.0 REV 2.1
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	280	mg/L		12/01/22 14:53	1	10	12/01/22 14:53	HRF	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		12/01/22 14:53	1	10	12/01/22 14:53	HRF	SM 2320B 1997*
Solids - total dissolved solids (TDS)	800	mg/L		11/23/22 14:15	1	26	11/23/22 15:51	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		11/30/22 09:21	5	3.0	12/01/22 12:08	JMW	EPA 6020A
Arsenic	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:08	JMW	EPA 6020A
Barium	32	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:08	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/02/22 08:42	JMW	EPA 6020A
Boron	580	ug/L		11/30/22 09:21	5	10	12/01/22 12:08	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:08	JMW	EPA 6020A
Calcium	130	mg/L		11/30/22 09:21	5	0.20	12/01/22 12:08	JMW	EPA 6020A
Chromium	< 4.0	ug/L		11/30/22 09:21	5	4.0	12/01/22 12:08	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		11/30/22 09:21	5	2.0	12/01/22 12:08	JMW	EPA 6020A
Lead	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:08	JMW	EPA 6020A
Magnesium	51	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:08	JMW	EPA 6020A
Mercury	< 0.20	ug/L		11/30/22 09:21	5	0.20	12/01/22 12:08	JMW	EPA 6020A
Molybdenum	1.1	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:08	JMW	EPA 6020A
Potassium	0.66	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:08	JMW	EPA 6020A
Selenium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:08	JMW	EPA 6020A
Sodium	51	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:08	JMW	EPA 6020A
Thallium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:08	JMW	EPA 6020A
Lithium	< 0.020	mg/L		11/30/22 09:21	1	0.020	11/30/22 13:25	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: FK04074-04
Name: EB-01
Matrix: DI Water - Equipment Blank

Sampled: 11/18/22 16:30
Received: 11/21/22 16:50

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Total Metals - PIA									
Antimony	< 3.0	ug/L		11/30/22 09:21	5	3.0	12/01/22 12:12	JMW	EPA 6020A
Arsenic	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:12	JMW	EPA 6020A
Barium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:12	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/02/22 08:46	JMW	EPA 6020A
Boron	16	ug/L		11/30/22 09:21	5	10	12/01/22 12:12	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:12	JMW	EPA 6020A
Calcium	< 0.20	mg/L		11/30/22 09:21	5	0.20	12/01/22 12:12	JMW	EPA 6020A
Chromium	< 4.0	ug/L		11/30/22 09:21	5	4.0	12/01/22 12:12	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		11/30/22 09:21	5	2.0	12/01/22 12:12	JMW	EPA 6020A
Lead	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:12	JMW	EPA 6020A
Magnesium	< 0.10	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:12	JMW	EPA 6020A
Mercury	< 0.20	ug/L		11/30/22 09:21	5	0.20	12/01/22 12:12	JMW	EPA 6020A
Molybdenum	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:12	JMW	EPA 6020A
Potassium	< 0.10	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:12	JMW	EPA 6020A
Selenium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:12	JMW	EPA 6020A
Sodium	< 0.10	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:12	JMW	EPA 6020A
Thallium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:12	JMW	EPA 6020A
Lithium	< 0.020	mg/L		11/30/22 09:21	1	0.020	11/30/22 13:28	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: FK04074-05
Name: EB-02
Matrix: DI Water - Equipment Blank

Sampled: 11/21/22 13:15
Received: 11/21/22 16:50

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Total Metals - PIA									
Antimony	< 3.0	ug/L		11/30/22 09:21	5	3.0	12/01/22 12:16	JMW	EPA 6020A
Arsenic	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:16	JMW	EPA 6020A
Barium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:16	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/02/22 09:04	JMW	EPA 6020A
Boron	13	ug/L		11/30/22 09:21	5	10	12/01/22 12:16	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:16	JMW	EPA 6020A
Calcium	< 0.20	mg/L		11/30/22 09:21	5	0.20	12/01/22 12:16	JMW	EPA 6020A
Chromium	< 4.0	ug/L		11/30/22 09:21	5	4.0	12/01/22 12:16	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		11/30/22 09:21	5	2.0	12/01/22 12:16	JMW	EPA 6020A
Lead	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:16	JMW	EPA 6020A
Magnesium	< 0.10	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:16	JMW	EPA 6020A
Mercury	< 0.20	ug/L		11/30/22 09:21	5	0.20	12/01/22 12:16	JMW	EPA 6020A
Molybdenum	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:16	JMW	EPA 6020A
Potassium	< 0.10	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:16	JMW	EPA 6020A
Selenium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:16	JMW	EPA 6020A
Sodium	< 0.10	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:16	JMW	EPA 6020A
Thallium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:16	JMW	EPA 6020A
Lithium	< 0.020	mg/L		11/30/22 09:21	1	0.020	11/30/22 13:30	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: FK04074-06
Name: DUP-01
Matrix: Ground Water - Grab

Sampled: 11/21/22 12:45
Received: 11/21/22 16:50

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	45	mg/L		12/02/22 04:38	10	10	12/02/22 04:38	CRD	EPA 300.0 REV 2.1
Fluoride	0.296	mg/L		12/02/22 04:20	1	0.250	12/02/22 04:20	CRD	EPA 300.0 REV 2.1
Sulfate	210	mg/L		12/02/22 04:56	100	100	12/02/22 04:56	CRD	EPA 300.0 REV 2.1
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	290	mg/L		12/01/22 14:53	1	10	12/01/22 14:53	HRF	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		12/01/22 14:53	1	10	12/01/22 14:53	HRF	SM 2320B 1997*
Solids - total dissolved solids (TDS)	780	mg/L		11/23/22 14:15	1	26	11/23/22 15:51	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		11/30/22 09:21	5	3.0	12/01/22 12:33	JMW	EPA 6020A
Arsenic	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:33	JMW	EPA 6020A
Barium	32	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:33	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/02/22 09:08	JMW	EPA 6020A
Boron	580	ug/L		11/30/22 09:21	5	10	12/01/22 12:33	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:33	JMW	EPA 6020A
Calcium	140	mg/L		11/30/22 09:21	5	0.20	12/01/22 12:33	JMW	EPA 6020A
Chromium	< 4.0	ug/L		11/30/22 09:21	5	4.0	12/01/22 12:33	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		11/30/22 09:21	5	2.0	12/01/22 12:33	JMW	EPA 6020A
Lead	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:33	JMW	EPA 6020A
Magnesium	52	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:33	JMW	EPA 6020A
Mercury	< 0.20	ug/L		11/30/22 09:21	5	0.20	12/01/22 12:33	JMW	EPA 6020A
Molybdenum	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:33	JMW	EPA 6020A
Potassium	0.73	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:33	JMW	EPA 6020A
Selenium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:33	JMW	EPA 6020A
Sodium	52	mg/L		11/30/22 09:21	5	0.10	12/01/22 12:33	JMW	EPA 6020A
Thallium	< 1.0	ug/L		11/30/22 09:21	5	1.0	12/01/22 12:33	JMW	EPA 6020A
Lithium	< 0.020	mg/L		11/30/22 09:21	1	0.020	11/30/22 13:33	TJJ	EPA 6010B

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QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B249950 - No Prep - SM 2540C									
Blank (B249950-BLK1)				Prepared & Analyzed: 11/23/22					
Solids - total dissolved solids (TDS)	< 17	mg/L							
LCS (B249950-BS1)				Prepared & Analyzed: 11/23/22					
Solids - total dissolved solids (TDS)	973	mg/L		1000		97	84.9-109		
Duplicate (B249950-DUP1)	**Sample: FK04074-01**			Prepared & Analyzed: 11/23/22					
Solids - total dissolved solids (TDS)	900	mg/L	M		810			11	5
Duplicate (B249950-DUP2)	**Sample: FK04074-02**			Prepared & Analyzed: 11/23/22					
Solids - total dissolved solids (TDS)	820	mg/L	M		890			8	5
Batch B250255 - SW 3015 - EPA 6020A									
Blank (B250255-BLK1)				Prepared: 11/30/22 Analyzed: 12/01/22					
Antimony	< 3.0	ug/L							
Arsenic	< 1.0	ug/L							
Barium	< 1.0	ug/L							
Beryllium	< 1.0	ug/L							
Boron	< 10	ug/L							
Cadmium	< 1.0	ug/L							
Calcium	< 0.20	mg/L							
Chromium	< 4.0	ug/L							
Cobalt	< 2.0	ug/L							
Lead	< 1.0	ug/L							
Magnesium	< 0.10	mg/L							
Mercury	< 0.20	ug/L							
Molybdenum	< 1.0	ug/L							
Potassium	< 0.10	mg/L							
Selenium	< 1.0	ug/L							
Sodium	< 0.10	mg/L							
Thallium	< 1.0	ug/L							
Lithium	< 0.020	mg/L							
LCS (B250255-BS1)				Prepared: 11/30/22 Analyzed: 12/01/22					
Antimony	455	ug/L		555.6		82	80-120		
Arsenic	480	ug/L		555.6		86	80-120		
Barium	464	ug/L		555.6		83	80-120		
Beryllium	488	ug/L		555.6		88	80-120		
Boron	504	ug/L		555.6		91	80-120		
Cadmium	494	ug/L		555.6		89	80-120		
Calcium	4.78	mg/L		5.556		86	80-120		
Chromium	498	ug/L		555.6		90	80-120		
Cobalt	479	ug/L		555.6		86	80-120		
Lead	528	ug/L		555.6		95	80-120		
Magnesium	5.19	mg/L		5.556		93	80-120		
Mercury	48.8	ug/L		55.56		88	80-120		
Molybdenum	463	ug/L		555.6		83	80-120		

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QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B250255 - SW 3015 - EPA 6020A									
LCS (B250255-BS1)				Prepared: 11/30/22 Analyzed: 12/01/22					
Potassium	4.90	mg/L		5.556		88	80-120		
Selenium	473	ug/L		555.6		85	80-120		
Sodium	4.98	mg/L		5.556		90	80-120		
Thallium	506	ug/L		555.6		91	80-120		
Lithium	0.543	mg/L		0.5556		98	80-120		
Matrix Spike (B250255-MS2)	**Sample: FK04074-02**			Prepared: 11/30/22 Analyzed: 12/01/22					
Antimony	512	ug/L		555.6	0.511	92	75-125		
Arsenic	531	ug/L		555.6	1.26	95	75-125		
Barium	576	ug/L		555.6	69.1	91	75-125		
Beryllium	545	ug/L		555.6	ND	98	75-125		
Boron	1240	ug/L		555.6	670	102	75-125		
Cadmium	547	ug/L		555.6	ND	99	75-125		
Calcium	169	mg/L	Q4	5.556	163	108	75-125		
Chromium	545	ug/L		555.6	ND	98	75-125		
Cobalt	503	ug/L		555.6	2.17	90	75-125		
Lead	577	ug/L		555.6	ND	104	75-125		
Magnesium	84.8	mg/L	Q4	5.556	79.3	99	75-125		
Mercury	57.8	ug/L		55.56	ND	104	75-125		
Molybdenum	526	ug/L		555.6	1.92	94	75-125		
Potassium	6.15	mg/L		5.556	0.514	101	75-125		
Selenium	523	ug/L		555.6	ND	94	75-125		
Sodium	27.4	mg/L		5.556	21.6	103	75-125		
Thallium	548	ug/L		555.6	ND	99	75-125		
Matrix Spike Dup (B250255-MSD2)	**Sample: FK04074-02**			Prepared: 11/30/22 Analyzed: 12/01/22					
Antimony	491	ug/L		555.6	0.511	88	75-125	4	20
Arsenic	521	ug/L		555.6	1.26	94	75-125	2	20
Barium	567	ug/L		555.6	69.1	90	75-125	2	20
Beryllium	533	ug/L		555.6	ND	96	75-125	2	20
Boron	1210	ug/L		555.6	670	98	75-125	2	20
Cadmium	531	ug/L		555.6	ND	96	75-125	3	20
Calcium	166	mg/L	Q4	5.556	163	66	75-125	1	20
Chromium	536	ug/L		555.6	ND	97	75-125	2	20
Cobalt	488	ug/L		555.6	2.17	87	75-125	3	20
Lead	557	ug/L		555.6	ND	100	75-125	3	20
Magnesium	83.3	mg/L	Q4	5.556	79.3	72	75-125	2	20
Mercury	55.4	ug/L		55.56	ND	100	75-125	4	20
Molybdenum	512	ug/L		555.6	1.92	92	75-125	3	20
Potassium	5.97	mg/L		5.556	0.514	98	75-125	3	20
Selenium	507	ug/L		555.6	ND	91	75-125	3	20
Sodium	27.0	mg/L		5.556	21.6	97	75-125	1	20
Thallium	528	ug/L		555.6	ND	95	75-125	4	20

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B250514 - IC No Prep - EPA 300.0 REV 2.1									
Calibration Blank (B250514-CCB1)				Prepared & Analyzed: 12/01/22					
Sulfate	0.00	mg/L							
Fluoride	0.00	mg/L							
Chloride	0.00	mg/L							
Calibration Check (B250514-CCV1)				Prepared & Analyzed: 12/01/22					
Sulfate	4.93	mg/L		5.000		99	90-110		
Fluoride	5.01	mg/L		5.000		100	90-110		
Chloride	4.93	mg/L		5.000		99	90-110		
Batch B250671 - No Prep - SM 2320B 1997									
Duplicate (B250671-DUP2)	**Sample: FK04074-02**			Prepared & Analyzed: 12/01/22					
Alkalinity - bicarbonate as CaCO3	488	mg/L			488			0	10
Alkalinity - carbonate as CaCO3	< 10	mg/L			ND				10
Batch B250672 - IC No Prep - EPA 300.0 REV 2.1									
Calibration Blank (B250672-CCB1)				Prepared & Analyzed: 12/03/22					
Chloride	0.762	mg/L							
Sulfate	0.00	mg/L							
Calibration Check (B250672-CCV1)				Prepared & Analyzed: 12/03/22					
Chloride	4.71	mg/L		5.000		94	90-110		
Sulfate	4.87	mg/L		5.000		97	90-110		

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

NOTES

Specifications regarding method revisions, method modifications, and calculations used for analysis are available upon request. Please contact your project manager.

* Not a TNI accredited analyte

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

M	Analyte failed to meet the required acceptance criteria for duplicate analysis.
Q4	The matrix spike recovery result is unusable since the analyte concentration in the sample is greater than four times the spike level. The associated blank spike was acceptable.

DRAFT

Gail J Schindler

Certified by: Gail Schindler, Project Manager

PACE ANALYTICAL SERVICES
WWW.PACELABS.COM

REGULATORY PROGRAM (CIRCLE):	NPDES
MORBCA	RCRA
CCDD	TACO: RES OR IND/COMM

CHAIN OF CUSTODY RECORD

STATE WHERE SAMPLE COLLECTED IL

(1) CLIENT: VISTRA – EDWARDS STATION

ADDRESS: 7800 S CILCO LANE

CITY / STATE / ZIP: BARTONVILLE, IL 61607

CONTACT PERSON: BRIAN VOELKER

PROJECT NUMBER: RAM.BOULPN# 1940102792

PROJECT LOCATION: BARTONVILLE, IL

PURCHASE ORDER #:

PHONE NUMBER: (217) ~~494~~ 753 ~~AFH~~ 8911

E-MAIL: BRIAN.VOELKER@VISTRACORP.COM

DATE SHIPPED: SAMPLES DROPPED OFF AT LAB ON 11/21/22

SAMPLER (PLEASE PRINT): ANDREW HARDWICK (RAMBOLL)

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 # FK0407406

LOGGED BY: SMB

CLIENT: VISTRA-EDWARDS

PROJECT: EDWARDS DELINEATION

PROJ. 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	CL, F, SO4, HCO3, CO3,	TDS, AS, B, BA, BE, CA, CD	CO, CR, HG, K, LI, MG, MO	NA, PB, SB, SE, TL	RAD 226/228	845 metals only	REMARKS
AW-01	11/18/22	14:21	X		GW	3	3,6	X	X	X	X	X		
EMW-05	11/18/22	15:13	X		GW	9	3,6	X	X	X	X	X		TRIPLE VOLUME PREP FOR MS/MSD
AW-23	11/~~21~~22	12:32	X		GW	3	3,6	X	X	X	X	X		
EB-01	11/~~AFH~~18/22	16:30	X		W	1	3						X	
EB-02	11/21/22	13:15	X		W	1	3						X	
DUP-01	11/21/22	12:45	X		GW	3	3,6	X	X	X	X	X		
		AFH 11/21/2022												

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) AFH

(7)		DATE	TIME
RELINQUISHED BY: (SIGNATURE)		11/21/22	1650
RELINQUISHED BY: (SIGNATURE)		DATE	TIME
RELINQUISHED BY: (SIGNATURE)		DATE	TIME
RECEIVED BY: (SIGNATURE)		DATE	TIME
RECEIVED BY: (SIGNATURE)		DATE	TIME
RECEIVED BY: (SIGNATURE)		11-21-22	16:50

(8) COMMENTS: (FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT 3.2 °C

CHILL PROCESS STARTED PRIOR TO RECEIPT ~~Y OR N~~
SAMPLE(S) RECEIVED ON ICE Y OR N
SAMPLE ACCEPTANCE NONCONFORMANT ~~Y OR N~~
REPORT IS NEEDED Y OR N

DATE AND TIME TAKEN FROM SAMPLE BOTTLE

DRAFT

Pace Analytical Services, LLC
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

December 22, 2022

Amy Holmes

,

RE: Project: FK04084
Pace Project No.: 30542629

Dear Amy Holmes:

Enclosed are the analytical results for sample(s) received by the laboratory on December 01, 2022. The results relate only to the samples included in this report. Results reported herein conform to the applicable TNI/NELAC Standards and the laboratory's Quality Manual, where applicable, unless otherwise noted in the body of the report.

The test results provided in this final report were generated by each of the following laboratories within the Pace Network:

- Pace Analytical Services - Greensburg

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Carla Cmar
carla.cmar@pacelabs.com
(724)850-5600
Project Manager

Enclosures

cc: Chenise Lambert-Sykes, PDC Laboratories, Inc.

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Greensburg, PA 15601
(724)850-5600

CERTIFICATIONS

Project: FK04084
Pace Project No.: 30542629

Pace Analytical Services Pennsylvania
1638 Roseytown Rd Suites 2,3&4, Greensburg, PA 15601
ANAB DOD-ELAP Rad Accreditation #: L2417
Alabama Certification #: 41590
Arizona Certification #: AZ0734
Arkansas Certification
California Certification #: 04222CA
Colorado Certification #: PA01547
Connecticut Certification #: PH-0694
Delaware Certification
EPA Region 4 DW Rad
Florida/TNI Certification #: E87683
Georgia Certification #: C040
Florida: Cert E871149 SEKS WET
Guam Certification
Hawaii Certification
Idaho Certification
Illinois Certification
Indiana Certification
Iowa Certification #: 391
Kansas/TNI Certification #: E-10358
Kentucky Certification #: KY90133
KY WW Permit #: KY0098221
KY WW Permit #: KY0000221
Louisiana DHH/TNI Certification #: LA180012
Louisiana DEQ/TNI Certification #: 4086
Maine Certification #: 2017020
Maryland Certification #: 308
Massachusetts Certification #: M-PA1457
Michigan/PADEP Certification #: 9991
Missouri Certification #: 235
Montana Certification #: Cert0082
Nebraska Certification #: NE-OS-29-14
Nevada Certification #: PA014572018-1
New Hampshire/TNI Certification #: 297617
New Jersey/TNI Certification #: PA051
New Mexico Certification #: PA01457
New York/TNI Certification #: 10888
North Carolina Certification #: 42706
North Dakota Certification #: R-190
Ohio EPA Rad Approval: #41249
Oregon/TNI Certification #: PA200002-010
Pennsylvania/TNI Certification #: 65-00282
Puerto Rico Certification #: PA01457
Rhode Island Certification #: 65-00282
South Dakota Certification
Tennessee Certification #: 02867
Texas/TNI Certification #: T104704188-17-3
Utah/TNI Certification #: PA014572017-9
USDA Soil Permit #: P330-17-00091
Vermont Dept. of Health: ID# VT-0282
Virgin Island/PADEP Certification
Virginia/VELAP Certification #: 460198
Washington Certification #: C868
West Virginia DEP Certification #: 143
West Virginia DHHR Certification #: 9964C
Wisconsin Approve List for Rad
Wyoming Certification #: 8TMS-L

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Greensburg, PA 15601
(724)850-5600

SAMPLE SUMMARY

Project: FK04084
Pace Project No.: 30542629

Lab ID	Sample ID	Matrix	Date Collected	Date Received
30542629001	**FK04084-01**	Water	11/18/22 14:21	12/01/22 09:35
30542629002	**FK04084-02**	Water	11/18/22 15:13	12/01/22 09:35
30542629003	**FK04084-03**	Water	11/21/22 12:32	12/01/22 09:35
30542629004	**FK04084-04**	Water	11/21/22 12:45	12/01/22 09:35

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Greensburg, PA 15601
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SAMPLE ANALYTE COUNT

Project: FK04084
Pace Project No.: 30542629

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
30542629001	**FK04084-01**	EPA 903.1	CLM	1	PASI-PA
		EPA 904.0	JJS1	1	PASI-PA
		Total Radium Calculation	JAL	1	PASI-PA
30542629002	**FK04084-02**	EPA 903.1	CLM	1	PASI-PA
		EPA 904.0	JJS1	1	PASI-PA
		Total Radium Calculation	JAL	1	PASI-PA
30542629003	**FK04084-03**	EPA 903.1	CLM	1	PASI-PA
		EPA 904.0	JJS1	1	PASI-PA
		Total Radium Calculation	JAL	1	PASI-PA
30542629004	**FK04084-04**	EPA 903.1	CLM	1	PASI-PA
		EPA 904.0	JJS1	1	PASI-PA
		Total Radium Calculation	JAL	1	PASI-PA

PASI-PA = Pace Analytical Services - Greensburg

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1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

PROJECT NARRATIVE

Project: FK04084
Pace Project No.: 30542629

Method: **EPA 903.1**
Description: 903.1 Radium 226
Client: PDC/Pace Analytical Services (Peoria, IL)
Date: December 22, 2022

General Information:
4 samples were analyzed for EPA 903.1 by Pace Analytical Services Greensburg. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

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1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

PROJECT NARRATIVE

Project: FK04084
Pace Project No.: 30542629

Method: **EPA 904.0**
Description: 904.0 Radium 228
Client: PDC/Pace Analytical Services (Peoria, IL)
Date: December 22, 2022

General Information:
4 samples were analyzed for EPA 904.0 by Pace Analytical Services Greensburg. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

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1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

PROJECT NARRATIVE

Project: FK04084
Pace Project No.: 30542629

Method: **Total Radium Calculation**
Description: Total Radium 228+226
Client: PDC/Pace Analytical Services (Peoria, IL)
Date: December 22, 2022

General Information:
4 samples were analyzed for Total Radium Calculation by Pace Analytical Services Greensburg. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

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1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

ANALYTICAL RESULTS - RADIOCHEMISTRY

Project: FK04084
Pace Project No.: 30542629

Sample: FK04084-01 **Lab ID: 30542629001** Collected: 11/18/22 14:21 Received: 12/01/22 09:35 Matrix: Water
PWS: Site ID: Sample Type:

Parameters	Method	Act ± Unc (MDC) Carr Trac	Units	Analyzed	CAS No.	Qual
	Pace Analytical Services - Greensburg					
Radium-226	EPA 903.1	**-0.0634 ± 0.373 (0.832) C:NA T:98%**	pCi/L	12/20/22 16:47	13982-63-3	
	Pace Analytical Services - Greensburg					
Radium-228	EPA 904.0	**0.449 ± 0.341 (0.665) C:77% T:97%**	pCi/L	12/20/22 14:51	15262-20-1	
	Pace Analytical Services - Greensburg					
Total Radium	Total Radium Calculation	**0.449 ± 0.714 (1.50)**	pCi/L	12/22/22 13:17	7440-14-4	

Sample: FK04084-02 **Lab ID: 30542629002** Collected: 11/18/22 15:13 Received: 12/01/22 09:35 Matrix: Water
PWS: Site ID: Sample Type:

Parameters	Method	Act ± Unc (MDC) Carr Trac	Units	Analyzed	CAS No.	Qual
	Pace Analytical Services - Greensburg					
Radium-226	EPA 903.1	**0.201 ± 0.603 (1.12) C:NA T:89%**	pCi/L	12/20/22 16:47	13982-63-3	
	Pace Analytical Services - Greensburg					
Radium-228	EPA 904.0	**0.278 ± 0.318 (0.667) C:83% T:91%**	pCi/L	12/20/22 14:51	15262-20-1	
	Pace Analytical Services - Greensburg					
Total Radium	Total Radium Calculation	**0.479 ± 0.921 (1.79)**	pCi/L	12/22/22 13:17	7440-14-4	

Sample: FK04084-03 **Lab ID: 30542629003** Collected: 11/21/22 12:32 Received: 12/01/22 09:35 Matrix: Water
PWS: Site ID: Sample Type:

Parameters	Method	Act ± Unc (MDC) Carr Trac	Units	Analyzed	CAS No.	Qual
	Pace Analytical Services - Greensburg					
Radium-226	EPA 903.1	**0.000 ± 0.474 (0.969) C:NA T:100%**	pCi/L	12/20/22 17:07	13982-63-3	
	Pace Analytical Services - Greensburg					
Radium-228	EPA 904.0	**0.365 ± 0.337 (0.687) C:82% T:87%**	pCi/L	12/20/22 14:51	15262-20-1	
	Pace Analytical Services - Greensburg					
Total Radium	Total Radium Calculation	**0.365 ± 0.811 (1.66)**	pCi/L	12/22/22 13:17	7440-14-4	

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REPORT OF LABORATORY ANALYSIS

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Greensburg, PA 15601
(724)850-5600

ANALYTICAL RESULTS - RADIOCHEMISTRY

Project: FK04084
Pace Project No.: 30542629

Sample: FK04084-04 **Lab ID: 30542629004** Collected: 11/21/22 12:45 Received: 12/01/22 09:35 Matrix: Water
PWS: Site ID: Sample Type:

Parameters	Method	Act ± Unc (MDC) Carr Trac	Units	Analyzed	CAS No.	Qual
	Pace Analytical Services - Greensburg					
Radium-226	EPA 903.1	**-0.269 ± 0.495 (1.12) C:NA T:94%**	pCi/L	12/20/22 17:07	13982-63-3	
	Pace Analytical Services - Greensburg					
Radium-228	EPA 904.0	**0.0473 ± 0.277 (0.634) C:83% T:96%**	pCi/L	12/20/22 14:52	15262-20-1	
	Pace Analytical Services - Greensburg					
Total Radium	Total Radium Calculation	**0.0473 ± 0.772 (1.75)**	pCi/L	12/22/22 13:17	7440-14-4	

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REPORT OF LABORATORY ANALYSIS

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Greensburg, PA 15601
(724)850-5600

QUALITY CONTROL - RADIOCHEMISTRY

Project: FK04084
Pace Project No.: 30542629

QC Batch: 551101
QC Batch Method: EPA 903.1
Analysis Method: EPA 903.1
Analysis Description: 903.1 Radium-226
Laboratory: Pace Analytical Services - Greensburg
Associated Lab Samples: 30542629001, 30542629002, 30542629003, 30542629004

METHOD BLANK: 2676327 Matrix: Water
Associated Lab Samples: 30542629001, 30542629002, 30542629003, 30542629004

Parameter	Act ± Unc (MDC) Carr Trac	Units	Analyzed	Qualifiers
Radium-226	0.0490 ± 0.224 (0.360) C:NA T:95%	pCi/L	12/20/22 16:47	

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Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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Greensburg, PA 15601
(724)850-5600

QUALITY CONTROL - RADIOCHEMISTRY

Project: FK04084
Pace Project No.: 30542629

QC Batch: 551102 Analysis Method: EPA 904.0
QC Batch Method: EPA 904.0 Analysis Description: 904.0 Radium 228
Laboratory: Pace Analytical Services - Greensburg
Associated Lab Samples: 30542629001, 30542629002, 30542629003, 30542629004

METHOD BLANK: 2676329 Matrix: Water
Associated Lab Samples: 30542629001, 30542629002, 30542629003, 30542629004

Parameter	Act ± Unc (MDC) Carr Trac	Units	Analyzed	Qualifiers
Radium-228	0.275 ± 0.321 (0.674) C:85% T:82%	pCi/L	12/20/22 14:50	

DRAFT

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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Pace Analytical Services, LLC
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

QUALIFIERS

Project: FK04084
Pace Project No.: 30542629

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Reported results are not rounded until the final step prior to reporting. Therefore, calculated parameters that are typically reported as "Total" may vary slightly from the sum of the reported component parameters.

Act - Activity

Unc - Uncertainty: For Safe Drinking Water Act (SDWA) analyses, the reported Unc. Is the calculated Count Uncertainty (95% confidence interval) using a coverage factor of 1.96. For all other matrices (non-SDWA), the reported Unc. is the calculated Expanded Uncertainty (aka Combined Standard Uncertainty, CSU), reported at the 95% confidence interval using a coverage factor of 1.96.

Gamma Spec: The Unc. reported for all gamma-spectroscopy analyses (EPA 901.1), is the calculated Expanded Uncertainty (CSU) at the 95.4% confidence interval, using a coverage factor of 2.0.

(MDC) - Minimum Detectable Concentration

Trac - Tracer Recovery (%)

Carr - Carrier Recovery (%)

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

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SUBCONTRACT ORDER
Transfer Chain of Custody

Pace Analytical Services, LLC

FK04084

SENDING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(800) 752-6651

RECEIVING LABORATORY

PACE Analytical - Greensburg
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724) 850-5600

Sample: FK04084-01
Name: AW-01

Sampled: 11/18/22 14:21
Matrix: Ground Water
Preservative: HNO3, pH <2

Analysis	Due	Expires	Comments
01-Radium 226/228 combined	12/05/22 16:00	05/17/23 14:21	

Sample: FK04084-02
Name: EMW-05

Sampled: 11/18/22 15:13
Matrix: Ground Water
Preservative: HNO3, pH <2

Analysis	Due	Expires	Comments
01-Radium 226/228 combined	12/05/22 16:00	05/17/23 15:13	MS/MSD

Sample: FK04084-03
Name: AW-23

Sampled: 11/21/22 12:32
Matrix: Ground Water
Preservative: HNO3, pH <2

Analysis	Due	Expires	Comments
01-Radium 226/228 combined	12/05/22 16:00	05/20/23 12:32	

Sample: FK04084-04
Name: DUP-01

Sampled: 11/21/22 12:45
Matrix: Ground Water
Preservative: HNO3, pH <2

Analysis	Due	Expires	Comments
01-Radium 226/228 combined	12/05/22 16:00	05/20/23 12:45	

DRAFT

WO# : 30542629

30542629

SUBCONTRACT ORDER
Transfer Chain of Custody

Pace Analytical Services, LLC

FK04084

DRAFT

WO# : 30542629

PM: CMC Due Date: 12/22/22

CLIENT: PDC

Please email results to Gail Schindler at gail.schindler@pacelabs.com

Date Shipped: 11-29-22 Total # of Containers: 6 Sample Origin (State): IL PO #: _____

Turn-Around Time Requested ☑ NORMAL ☐ RUSH Date Results Needed: _____

Relinquished By	Date/Time	Received By	Date/Time
[signature]	11-29-22 15:00	[signature]	12-1-22 9:35

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

Pace ANALYTICAL SERVICES

DC#_Title: ENV-FRM-GBUR-0088 v02_Sample Condition Upon Receipt-Pittsburgh

Effective Date: 10/03/2022

WO# : 30542629

PM: CMC Due Date: 12/22/22

CLIENT: PDC

Client Name: PDC

Courier: ☐ Fed Ex ☑ UPS ☐ USPS ☐ Client ☐ Commercial ☐ Pace ☐ Other

Tracking Number: 1Z647 2960 3694 9569 29

Examined By TH

Labeled By TH

Temped By —

Custody Seal on Cooler/Box Present: ☐ Yes ☑ No **Seals Intact:** ☐ Yes ☑ No

Thermometer Used: — **Type of Ice:** Wet Blue (None)

Cooler Temperature: Observed Temp — °C Correction Factor: — °C Final Temp: — °C

Temp should be above freezing to 6°C

Comments:	Yes	No	NA	pH paper Lot# 10D222	D.P.D. Residual Chlorine Lot # —
Chain of Custody Present	✓			1.	
Chain of Custody Filled Out:	✓			2.	
-Were client corrections present on COC		✓			
Chain of Custody Relinquished	✓			3.	
Sampler Name & Signature on COC:		✓		4.	
Sample Labels match COC: -Includes date/time/ID Matrix: WT	✓			5.	
Samples Arrived within Hold Time:	✓			6.	
Short Hold Time Analysis (<72hr remaining):		✓		7.	
Rush Turn Around Time Requested:		✓		8.	
Sufficient Volume:	✓			9.	
Correct Containers Used:	✓			10.	
-Pace Containers Used		✓			
Containers Intact:	✓			11.	
Orthophosphate field filtered:			✓	12.	
Hex Cr Aqueous samples field filtered:			✓	13.	
Organic Samples checked for dechlorination			✓	14:	
Filtered volume received for dissolved tests:			✓	15:	
All containers checked for preservation: exceptions: VOA, coliform, TOC, O&G, Phenolics, Radon, non-aqueous matrix	✓			16. PH<2	
All containers meet method preservation requirements:	✓			Initial when completed TH	Date/Time of Preservation
				Lot# of added Preservative	
Headspace in VOA Vials (>6mm):			✓	17.	
Trip Blank Present:			✓	18.	
Trip Blank Custody Seals Present			✓		
Rad Samples Screened <0.5 mrem/hr.	✓			Initial when completed TH	Date: 12/01/22 Survey Meter SN: 1563

Comments:

Note: For NC compliance samples with discrepancies, a copy of this form must be sent to the DEHNR Certification office.
PM Review is documented electronically in LIMS through the SRF Review schedule in the Workorder Edit Screen.

DRAFT

Pace Analytical®

Pace Greensburg Lab -Sample Container Count

Client

Site FK040824

Profile Number 18537

Notes

Sample Line Item	Matrix	AG1H	AG1S	AG1T	AG2U	AG3S	AG3U	AG5U	AG5T	BG1U	BG2U	BP1N	BP1U	BP2S	BP2U	BP3C	BP3N	BP3S	BP3U	DG9S	GCUB	VG9H	VG9T	VG9U	VOAK	WGFU	WGKU	ZPLC	12GN
1	SL																												4
2	SL																												3
3	SL																												1
4	SL																												1
5																													
6																													
7																													
8																													
9																													
10																													
11																													
12																													

Container Codes

Glass

GJN	1 Gallon Jug with HNO3	DG9S	40mL amber VOA vial H2SO4
AG5U	100mL amber glass unprserved	VG9U	40mL clear VOA vial
AG5T	100mL amber glass Na Thiosulfate	VG9T	40mL clear VOA vial Na Thiosul
GJN	1 Gallon Jug	VG9H	40mL clear VOA vial HCl
AG1S	1L amber glass H2SO4	JGFU	4oz amber wide jar
AG1H	1L amber glass HCl	WGFU	4oz wide jar unpreserved
AG1T	1L amber glass Na Thiosulfate	BG2U	500mL clear glass unpreserved
BG1U	1L clear glass unpreserved	AG2U	500mL amber glass unpreserve
AG3S	250mL amber glass H2SO4	WGKU	8oz wide jar unpreserved
AG3U	250mL amber glass unpreserved		

Plastic / Misc.

GCUB	1 Gallon Cubitainer
12GN	1/2 Gallon Cubitainer
SP5T	120mL Coliform Na Thiosulfate
BP1N	1L plastic HNO3
BP1U	1L plastic unpreserved
BP3S	250mL plastic H2SO4
BP3N	250mL plastic HNO3
BP3U	250mL plastic unpreserved
BP3C	250ml plastic NAOH
BP2S	500mL plastic H2SO4
BP2U	500mL plastic unpreserved

EZI	5g Encore
VOAK	Kit for Volatile Solid
I	Wipe/Swab
ZPLC	Ziploc Bag

WT	Water
SL	Solid
OL	Non-aqueous liquid
WP	Wipe

WO: 30542029

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

December 29, 2022

Brian Voelker
Vistra - Edwards
604 Pierce Boulevard
O'Fallon, IL 62269

RE: RAMBOLL DELINEATION

Dear Brian Voelker:

Please find enclosed the analytical results for the **6** sample(s) the laboratory received on **12/16/22 4:14 pm** and logged in under work order **FL03537**. 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 Pace Analytical Services, LLC.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

Pace Analytical Services 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 lisa.grant@pacelabs.com.

Gail J Schindler

Gail Schindler
Project Manager
(309) 692-9688 x1716
gail.schindler@pacelabs.com

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

SAMPLE RECEIPT CHECK LIST

Items not applicable will be marked as in compliance

Work Order FL03537

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 received 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

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: FL03537-01
Name: AW-01
Matrix: Ground Water - Grab

Sampled: 12/15/22 17:02
Received: 12/16/22 16:14

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	19	mg/L	Q4	12/27/22 16:46	5	5.0	12/27/22 16:46	LAM	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		12/27/22 15:52	1	0.250	12/27/22 15:52	LAM	EPA 300.0 REV 2.1
Sulfate	43	mg/L	Q4	12/27/22 16:46	5	5.0	12/27/22 16:46	LAM	EPA 300.0 REV 2.1
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	680	mg/L		12/27/22 11:10	1	10	12/27/22 11:10	HRF	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		12/27/22 11:10	1	10	12/27/22 11:10	HRF	SM 2320B 1997*
Solids - total dissolved solids (TDS)	790	mg/L		12/21/22 09:33	1	26	12/21/22 10:56	CPS	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		12/27/22 09:01	5	3.0	12/27/22 14:47	JMW	EPA 6020A
Arsenic	1.5	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:47	JMW	EPA 6020A
Barium	100	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:47	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:47	JMW	EPA 6020A
Boron	72	ug/L		12/27/22 09:01	5	10	12/27/22 14:47	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:47	JMW	EPA 6020A
Calcium	150	mg/L		12/27/22 09:01	5	0.20	12/27/22 14:47	JMW	EPA 6020A
Chromium	< 4.0	ug/L		12/27/22 09:01	5	4.0	12/27/22 14:47	JMW	EPA 6020A
Cobalt	3.6	ug/L		12/27/22 09:01	5	2.0	12/27/22 14:47	JMW	EPA 6020A
Lead	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/28/22 08:28	JMW	EPA 6020A
Magnesium	64	mg/L		12/27/22 09:01	5	0.10	12/27/22 14:47	JMW	EPA 6020A
Mercury	< 0.20	ug/L		12/27/22 09:01	5	0.20	12/28/22 08:28	JMW	EPA 6020A
Molybdenum	2.9	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:47	JMW	EPA 6020A
Potassium	0.54	mg/L		12/27/22 09:01	5	0.10	12/27/22 14:47	JMW	EPA 6020A
Selenium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:47	JMW	EPA 6020A
Sodium	17	mg/L		12/27/22 09:01	5	0.10	12/27/22 14:47	JMW	EPA 6020A
Thallium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/28/22 08:28	JMW	EPA 6020A
Lithium	< 0.020	mg/L		12/27/22 09:01	1	0.020	12/28/22 14:27	TJJ	EPA 6010B

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: FL03537-02
Name: EMW-05
Matrix: Ground Water - Grab

Sampled: 12/15/22 15:38
Received: 12/16/22 16:14

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	20	mg/L	Q4	12/27/22 18:53	5	5.0	12/27/22 18:53	LAM	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		12/27/22 17:22	1	0.250	12/27/22 17:22	LAM	EPA 300.0 REV 2.1
Sulfate	120	mg/L	Q4	12/27/22 19:11	25	25	12/27/22 19:11	LAM	EPA 300.0 REV 2.1
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	600	mg/L		12/27/22 11:10	1	10	12/27/22 11:10	HRF	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		12/27/22 11:10	1	10	12/27/22 11:10	HRF	SM 2320B 1997*
Solids - total dissolved solids (TDS)	860	mg/L		12/21/22 09:33	1	26	12/21/22 10:56	CPS	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		12/27/22 09:01	5	3.0	12/27/22 14:51	JMW	EPA 6020A
Arsenic	1.2	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:51	JMW	EPA 6020A
Barium	79	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:51	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:51	JMW	EPA 6020A
Boron	770	ug/L		12/27/22 09:01	5	10	12/27/22 14:51	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:51	JMW	EPA 6020A
Calcium	170	mg/L		12/27/22 09:01	5	0.20	12/27/22 14:51	JMW	EPA 6020A
Chromium	5.0	ug/L		12/27/22 09:01	5	4.0	12/27/22 14:51	JMW	EPA 6020A
Cobalt	2.0	ug/L		12/27/22 09:01	5	2.0	12/27/22 14:51	JMW	EPA 6020A
Lead	2.9	ug/L		12/27/22 09:01	5	1.0	12/28/22 08:32	JMW	EPA 6020A
Magnesium	70	mg/L		12/27/22 09:01	5	0.10	12/27/22 14:51	JMW	EPA 6020A
Mercury	< 0.20	ug/L		12/27/22 09:01	5	0.20	12/28/22 08:32	JMW	EPA 6020A
Molybdenum	1.7	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:51	JMW	EPA 6020A
Potassium	1.1	mg/L		12/27/22 09:01	5	0.10	12/27/22 14:51	JMW	EPA 6020A
Selenium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:51	JMW	EPA 6020A
Sodium	17	mg/L		12/27/22 09:01	5	0.10	12/27/22 14:51	JMW	EPA 6020A
Thallium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/28/22 08:32	JMW	EPA 6020A
Lithium	< 0.020	mg/L		12/27/22 09:01	1	0.020	12/28/22 14:29	TJJ	EPA 6010B

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: FL03537-03
Name: EB-01
Matrix: Ground Water - Grab

Sampled: 12/15/22 17:05
Received: 12/16/22 16:14

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Total Metals - PIA									
Antimony	< 3.0	ug/L		12/27/22 09:01	5	3.0	12/27/22 14:55	JMW	EPA 6020A
Arsenic	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:55	JMW	EPA 6020A
Barium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:55	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:55	JMW	EPA 6020A
Boron	< 10	ug/L		12/27/22 09:01	5	10	12/27/22 14:55	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:55	JMW	EPA 6020A
Calcium	< 0.20	mg/L		12/27/22 09:01	5	0.20	12/27/22 14:55	JMW	EPA 6020A
Chromium	< 4.0	ug/L		12/27/22 09:01	5	4.0	12/27/22 14:55	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		12/27/22 09:01	5	2.0	12/27/22 14:55	JMW	EPA 6020A
Lead	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/28/22 08:35	JMW	EPA 6020A
Magnesium	< 0.10	mg/L		12/27/22 09:01	5	0.10	12/27/22 14:55	JMW	EPA 6020A
Mercury	< 0.20	ug/L		12/27/22 09:01	5	0.20	12/28/22 08:35	JMW	EPA 6020A
Molybdenum	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:55	JMW	EPA 6020A
Potassium	< 0.10	mg/L		12/27/22 09:01	5	0.10	12/27/22 14:55	JMW	EPA 6020A
Selenium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:55	JMW	EPA 6020A
Sodium	< 0.10	mg/L		12/27/22 09:01	5	0.10	12/27/22 14:55	JMW	EPA 6020A
Thallium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/28/22 08:35	JMW	EPA 6020A
Lithium	< 0.020	mg/L		12/27/22 09:01	1	0.020	12/28/22 14:32	TJJ	EPA 6010B

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: FL03537-04
Name: EB-02
Matrix: Ground Water - Grab

Sampled: 12/16/22 13:25
Received: 12/16/22 16:14

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Total Metals - PIA									
Antimony	< 3.0	ug/L		12/27/22 09:01	5	3.0	12/27/22 14:58	JMW	EPA 6020A
Arsenic	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:58	JMW	EPA 6020A
Barium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:58	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:58	JMW	EPA 6020A
Boron	< 10	ug/L		12/27/22 09:01	5	10	12/27/22 14:58	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:58	JMW	EPA 6020A
Calcium	< 0.20	mg/L		12/27/22 09:01	5	0.20	12/27/22 14:58	JMW	EPA 6020A
Chromium	< 4.0	ug/L		12/27/22 09:01	5	4.0	12/27/22 14:58	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		12/27/22 09:01	5	2.0	12/27/22 14:58	JMW	EPA 6020A
Lead	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/28/22 08:39	JMW	EPA 6020A
Magnesium	< 0.10	mg/L		12/27/22 09:01	5	0.10	12/27/22 14:58	JMW	EPA 6020A
Mercury	< 0.20	ug/L		12/27/22 09:01	5	0.20	12/28/22 08:39	JMW	EPA 6020A
Molybdenum	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:58	JMW	EPA 6020A
Potassium	< 0.10	mg/L		12/27/22 09:01	5	0.10	12/27/22 14:58	JMW	EPA 6020A
Selenium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 14:58	JMW	EPA 6020A
Sodium	< 0.10	mg/L		12/27/22 09:01	5	0.10	12/27/22 14:58	JMW	EPA 6020A
Thallium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/28/22 08:39	JMW	EPA 6020A
Lithium	< 0.020	mg/L		12/27/22 09:01	1	0.020	12/28/22 14:34	TJJ	EPA 6010B

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: FL03537-05
Name: Dup-01
Matrix: Ground Water - Grab

Sampled: 12/15/22 17:02
Received: 12/16/22 16:14

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	16	mg/L		12/27/22 19:47	5	5.0	12/27/22 19:47	LAM	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		12/27/22 19:29	1	0.250	12/27/22 19:29	LAM	EPA 300.0 REV 2.1
Sulfate	40	mg/L		12/27/22 19:47	5	5.0	12/27/22 19:47	LAM	EPA 300.0 REV 2.1
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	710	mg/L		12/27/22 11:10	1	10	12/27/22 11:10	HRF	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		12/27/22 11:10	1	10	12/27/22 11:10	HRF	SM 2320B 1997*
Solids - total dissolved solids (TDS)	820	mg/L		12/21/22 09:33	1	26	12/21/22 10:56	CPS	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		12/27/22 09:01	5	3.0	12/27/22 15:02	JMW	EPA 6020A
Arsenic	15	ug/L		12/27/22 09:01	5	1.0	12/27/22 15:02	JMW	EPA 6020A
Barium	160	ug/L		12/27/22 09:01	5	1.0	12/27/22 15:02	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 15:02	JMW	EPA 6020A
Boron	78	ug/L		12/27/22 09:01	5	10	12/27/22 15:02	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 15:02	JMW	EPA 6020A
Calcium	160	mg/L		12/27/22 09:01	5	0.20	12/27/22 15:02	JMW	EPA 6020A
Chromium	15	ug/L		12/27/22 09:01	5	4.0	12/27/22 15:02	JMW	EPA 6020A
Cobalt	6.9	ug/L		12/27/22 09:01	5	2.0	12/27/22 15:02	JMW	EPA 6020A
Lead	4.5	ug/L		12/27/22 09:01	5	1.0	12/28/22 08:43	JMW	EPA 6020A
Magnesium	69	mg/L		12/27/22 09:01	5	0.10	12/27/22 15:02	JMW	EPA 6020A
Mercury	< 0.20	ug/L		12/27/22 09:01	5	0.20	12/28/22 08:43	JMW	EPA 6020A
Molybdenum	3.7	ug/L		12/27/22 09:01	5	1.0	12/27/22 15:02	JMW	EPA 6020A
Potassium	2.1	mg/L		12/27/22 09:01	5	0.10	12/27/22 15:02	JMW	EPA 6020A
Selenium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 15:02	JMW	EPA 6020A
Sodium	15	mg/L		12/27/22 09:01	5	0.10	12/27/22 15:02	JMW	EPA 6020A
Thallium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/28/22 08:43	JMW	EPA 6020A
Lithium	< 0.020	mg/L		12/27/22 09:01	1	0.020	12/28/22 14:36	TJJ	EPA 6010B

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: FL03537-06
Name: AW-23
Matrix: Ground Water - Grab

Sampled: 12/16/22 09:12
Received: 12/16/22 16:14

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	46	mg/L		12/27/22 20:41	5	5.0	12/27/22 20:41	LAM	EPA 300.0 REV 2.1
Fluoride	0.254	mg/L		12/27/22 20:23	1	0.250	12/27/22 20:23	LAM	EPA 300.0 REV 2.1
Sulfate	200	mg/L		12/27/22 20:59	50	50	12/27/22 20:59	LAM	EPA 300.0 REV 2.1
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	340	mg/L		12/27/22 11:10	1	10	12/27/22 11:10	HRF	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		12/27/22 11:10	1	10	12/27/22 11:10	HRF	SM 2320B 1997*
Solids - total dissolved solids (TDS)	720	mg/L		12/21/22 09:33	1	26	12/21/22 10:56	CPS	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		12/27/22 09:01	5	3.0	12/27/22 15:06	JMW	EPA 6020A
Arsenic	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 15:06	JMW	EPA 6020A
Barium	27	ug/L		12/27/22 09:01	5	1.0	12/27/22 15:06	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 15:06	JMW	EPA 6020A
Boron	480	ug/L		12/27/22 09:01	5	10	12/27/22 15:06	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 15:06	JMW	EPA 6020A
Calcium	130	mg/L		12/27/22 09:01	5	0.20	12/27/22 15:06	JMW	EPA 6020A
Chromium	< 4.0	ug/L		12/27/22 09:01	5	4.0	12/27/22 15:06	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		12/27/22 09:01	5	2.0	12/27/22 15:06	JMW	EPA 6020A
Lead	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/28/22 08:46	JMW	EPA 6020A
Magnesium	46	mg/L		12/27/22 09:01	5	0.10	12/27/22 15:06	JMW	EPA 6020A
Mercury	< 0.20	ug/L		12/27/22 09:01	5	0.20	12/28/22 08:46	JMW	EPA 6020A
Molybdenum	1.7	ug/L		12/27/22 09:01	5	1.0	12/27/22 15:06	JMW	EPA 6020A
Potassium	0.61	mg/L		12/27/22 09:01	5	0.10	12/27/22 15:06	JMW	EPA 6020A
Selenium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/27/22 15:06	JMW	EPA 6020A
Sodium	52	mg/L		12/27/22 09:01	5	0.10	12/27/22 15:06	JMW	EPA 6020A
Thallium	< 1.0	ug/L		12/27/22 09:01	5	1.0	12/28/22 08:46	JMW	EPA 6020A
Lithium	< 0.020	mg/L		12/27/22 09:01	1	0.020	12/28/22 14:39	TJJ	EPA 6010B

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B252168 - No Prep - SM 2540C									
Blank (B252168-BLK1)				Prepared & Analyzed: 12/21/22					
Solids - total dissolved solids (TDS)	< 17	mg/L							
LCS (B252168-BS1)				Prepared & Analyzed: 12/21/22					
Solids - total dissolved solids (TDS)	997	mg/L		1000		100	84.9-109		
Duplicate (B252168-DUP2)	**Sample: FL03537-05**			Prepared & Analyzed: 12/21/22					
Solids - total dissolved solids (TDS)	825	mg/L			825			0	5
Batch B252441 - SW 3015 - EPA 6020A									
Blank (B252441-BLK1)				Prepared & Analyzed: 12/27/22					
Antimony	< 3.0	ug/L							
Arsenic	< 1.0	ug/L							
Barium	< 1.0	ug/L							
Beryllium	< 1.0	ug/L							
Boron	< 10	ug/L							
Cadmium	< 1.0	ug/L							
Calcium	< 0.20	mg/L							
Chromium	< 4.0	ug/L							
Cobalt	< 2.0	ug/L							
Lead	< 1.0	ug/L							
Magnesium	< 0.10	mg/L							
Mercury	< 0.20	ug/L							
Molybdenum	< 1.0	ug/L							
Potassium	< 0.10	mg/L							
Selenium	< 1.0	ug/L							
Sodium	< 0.10	mg/L							
Thallium	< 1.0	ug/L							
Lithium	< 0.020	mg/L							
LCS (B252441-BS1)				Prepared & Analyzed: 12/27/22					
Antimony	527	ug/L		555.6		95	80-120		
Arsenic	482	ug/L		555.6		87	80-120		
Barium	494	ug/L		555.6		89	80-120		
Beryllium	488	ug/L		555.6		88	80-120		
Boron	489	ug/L		555.6		88	80-120		
Cadmium	479	ug/L		555.6		86	80-120		
Calcium	5.05	mg/L		5.556		91	80-120		
Chromium	513	ug/L		555.6		92	80-120		
Cobalt	522	ug/L		555.6		94	80-120		
Lead	558	ug/L		555.6		100	80-120		
Magnesium	5.52	mg/L		5.556		99	80-120		
Mercury	62.4	ug/L		55.56		112	80-120		
Molybdenum	454	ug/L		555.6		82	80-120		
Potassium	5.30	mg/L		5.556		95	80-120		
Selenium	496	ug/L		555.6		89	80-120		

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2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B252441 - SW 3015 - EPA 6020A									
LCS (B252441-BS1)				Prepared & Analyzed: 12/27/22					
Sodium	5.46	mg/L		5.556		98	80-120		
Thallium	613	ug/L		555.6		110	80-120		
Lithium	0.545	mg/L		0.5556		98	80-120		
Batch B252534 - No Prep - EPA 300.0 REV 2.1									
Calibration Blank (B252534-CCB1)				Prepared & Analyzed: 12/27/22					
Chloride	0.00	mg/L							
Sulfate	0.00	mg/L							
Fluoride	0.00	mg/L							
Calibration Check (B252534-CCV1)				Prepared & Analyzed: 12/27/22					
Chloride	4.83	mg/L		5.000		97	90-110		
Sulfate	4.77	mg/L		5.000		95	90-110		
Fluoride	5.01	mg/L		5.000		100	90-110		
Matrix Spike (B252534-MS1)	**Sample: FL03537-01**			Prepared & Analyzed: 12/27/22					
Sulfate	1.00E9	mg/L	Q4	1.500	43.2	NR	80-120		
Chloride	< 1.0	mg/L	Q4	1.500	19	NR	80-120		
Fluoride	1.51	mg/L		1.500	0.155	90	80-120		
Matrix Spike (B252534-MS2)	**Sample: FL03537-02**			Prepared & Analyzed: 12/27/22					
Fluoride	1.47	mg/L		1.500	0.128	89	80-120		
Sulfate	1.00E9	mg/L	Q4	1.500	117	NR	80-120		
Chloride	< 1.0	mg/L	Q4	1.500	20	NR	80-120		
Matrix Spike Dup (B252534-MSD1)	**Sample: FL03537-01**			Prepared & Analyzed: 12/27/22					
Sulfate	1.00E9	mg/L	Q4	1.500	43.2	NR	80-120	0	20
Chloride	< 1.0	mg/L	Q4	1.500	19	NR	80-120		20
Fluoride	1.53	mg/L		1.500	0.155	92	80-120	1	20
Matrix Spike Dup (B252534-MSD2)	**Sample: FL03537-02**			Prepared & Analyzed: 12/27/22					
Fluoride	1.46	mg/L		1.500	0.128	89	80-120	0.6	20
Chloride	< 1.0	mg/L	Q4	1.500	20	NR	80-120		20
Sulfate	1.00E9	mg/L	Q4	1.500	117	NR	80-120	0	20

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

NOTES

Specifications regarding method revisions, method modifications, and calculations used for analysis are available upon request. Please contact your project manager.

* Not a TNI accredited analyte

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
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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

Q4 The matrix spike recovery result is unusable since the analyte concentration in the sample is greater than four times the spike level. The associated blank spike was acceptable.

Gail J Schindler

Certified by: Gail Schindler, Project Manager

DRAFT

RAMBOLL COC#: 1940102792-1216-002

FL03537 JPO

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: 1 of 1

Section A Required Client Information:	Section B Required Project Information:	Section C Invoice Information:
Company: Vistra Corp	Report To: Brian Voelker	Attention: Jason Stuckey
Address: 13498 E. 900th St	Copy To: Jason Stuckey	Company Name: Vistra Corp
		Address: see Section A
Email To: Brian.Voelker@Vistracorp.com	Purchase Order No.:	Quote Reference:
Phone: (217) 753-8911 Fax:	Project Name:	Project Manager:
Requested Due Date/TAT: standard	Project Number: 2285	Profile #:

REGULATORY AGENCY

NPDES GROUND WATER DRINKING WATER

UST RCRA OTHER

Site Location STATE: EDWARDS IL

Requested Analysis Filtered (Y/N)

ITEM #	Section D Required Client Information — SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N: EDW-845-301_R2	Residual Chlorine (Y/N)	Project No./ Lab I.D.
1	AW-01	WT	G	12/15/22	1702		2	X		X						X		
2	EMW-05			12/15/22	1538		2	X		X						X		
3	EB-01			12/15/22	1705		1			X						X		
4	EB-02			12/16/22	1325		1			X						X		
5	DUP-01			12/15/22	1702		2	X		X						X		
6																		
7																		
8																		
9																		
10																		
11																		
12																		
13																		
14																		
15																		
16																		

SM 12/16/22

SM 12/16/22

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
EDW-22Q4-845-301-R2 NO RADIUM 226 + RADIUM 228, TOTAL	SAMUEL MALLOW (RAMBOLL)	12/16/22	1614		12/16/22	1614	2.1

SAMPLER NAME AND SIGNATURE			Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
PRINT Name of SAMPLER:	SAMUEL MALLOW					
SIGNATURE of SAMPLER:		DATE Signed (MM/DD/YY): 12/16/22				

DRAFT

RAMBOLL COC#: 1940102792-2022-1216-003

FL03537

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Section A Required Client Information:

Company:	Vistra Corp
Address:	13498 E. 900th St
Email To:	Brian.Voelker@VistraCorp.com
Phone: (217) 753-8911	Fax:
Requested Due Date/TAT:	standard

Section B Required Project Information:

Report To:	Brian Voelker
Copy To:	Jason Stuckey
Purchase Order No.:	
Project Name:	
Project Number:	2285

Section C Invoice Information:

Attention:	Jason Stuckey
Company Name:	Vistra Corp
Address:	see Section A
Quote Reference:	
Project Manager:	
Profile #:	

REGULATORY AGENCY

NPDES GROUND WATER DRINKING WATER

UST RCRA OTHER

Site Location STATE: Edwards IL

Section D Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	Requested Analysis Filtered (Y/N): Radium 226 + Radium 228, total	Residual Chlorine (Y/N)	Project No./ Lab I.D.
1	AW-23			12/16/22	0912		3	X									X		
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
16																			

SM 12/16/22

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
EDW-22Q4-845-301-R2	SAMUEL MALLOW	12/16/22	1614		12/16/22	1614	2.1

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: SAMUEL MALLOW

SIGNATURE of SAMPLER:

DATE Signed (MM/DD/YY): 12/16/22

Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

January 27, 2023

Brian Voelker
Vistra - Edwards
604 Pierce Boulevard
O'Fallon, IL 62269

RE: RAMBOLL DELINEATION

Dear Brian Voelker:

Please find enclosed the **revised** analytical results for the **1** sample(s) the laboratory received on **12/16/22 4:14 pm** and logged in under work order **FL03741**. 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 Pace Analytical Services, LLC.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

Pace Analytical Services 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 lisa.grant@pacelabs.com.

Gail J Schindler

Gail Schindler
Project Manager
(309) 692-9688 x1716
gail.schindler@pacelabs.com

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

SAMPLE RECEIPT CHECK LIST

Items not applicable will be marked as in compliance

Work Order FL03741

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 received 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

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: FL03741-03
Name: AW-23
Matrix: Ground Water - Grab

Sampled: 12/16/22 09:12
Received: 12/16/22 16:14

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - Pace Analytical - Mt Juliet, Tn									
Rad 226 and 228-Subcontract	0.204 U	pCi/L			1	0.745	01/09/23 17:39		904.0 903.0

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

NOTES

Specifications regarding method revisions, method modifications, and calculations used for analysis are available upon request. Please contact your project manager.

Revised Report - separated wells

* Not a TNI accredited analyte

Memos

Radium 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

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SPMO - Springfield, MO - 1805 W Sunset Street, Springfield, MO 65807
USEPA DMR-QA Program

STL - Hazelwood, MO - 944 Anglum Rd, Hazelwood, MO 63042
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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

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Gail J Schindler

Certified by: Gail Schindler, Project Manager

ANALYTICAL REPORT

January 16, 2023

Revised Report

Pace IR - Peoria, IL

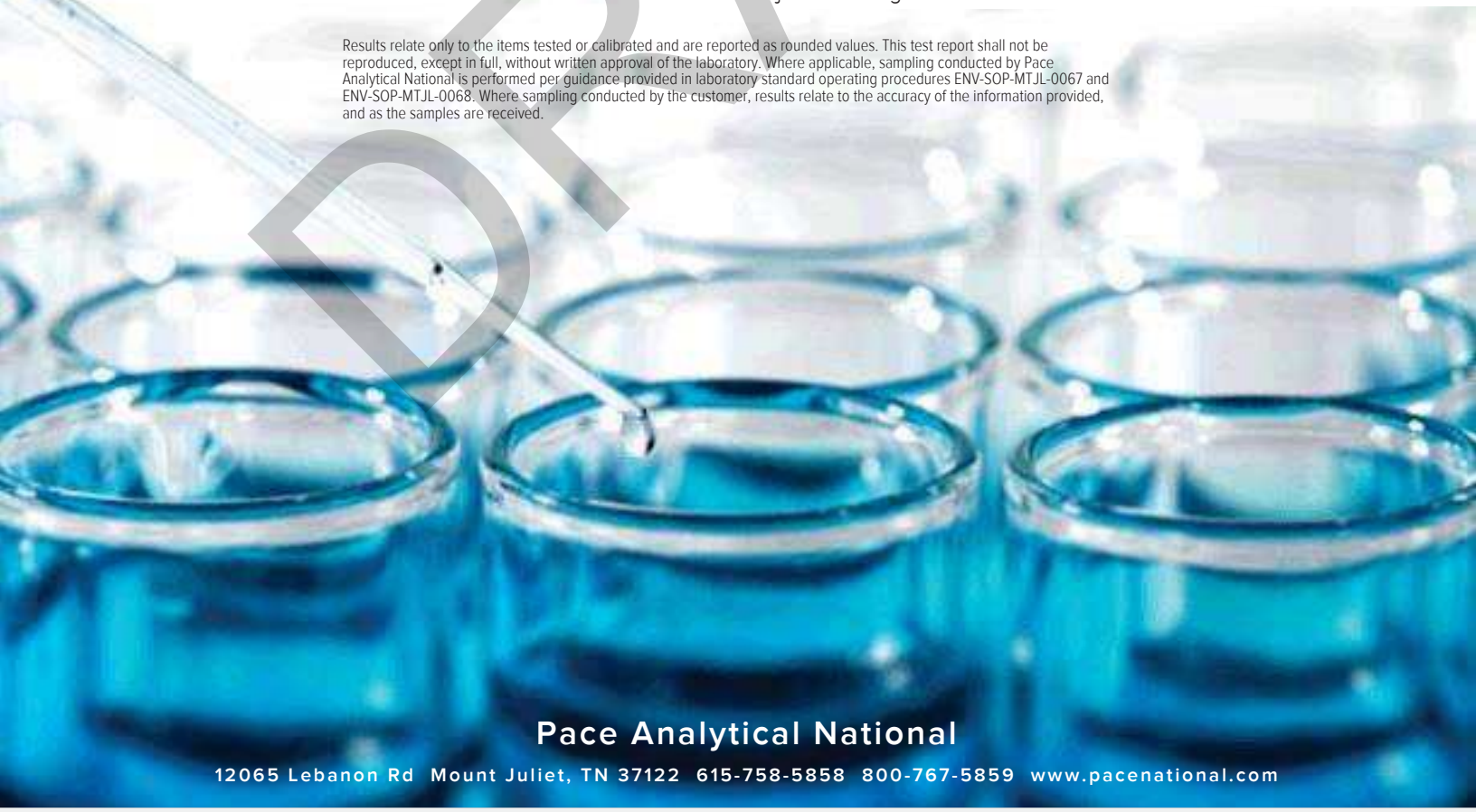
Sample Delivery Group:	L1570267
Samples Received:	12/22/2022
Project Number:	FL03741
Description:	Vistra Edwards
Site:	001
Report To:	Gail Schindler 2231 W. Altorfer Drive Peoria, IL 61615

Entire Report Reviewed By: Haley Torrence

Haley Torrence
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.

DRAFT



Pace Analytical National
12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.pacenational.com

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DRAFT

AW-01 L1570267-01 Non-Potable Water

Collected by	Collected date/time	Received date/time
	12/15/22 17:02	12/22/22 10:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904/9320	WG1982293	1	01/04/23 11:53	01/09/23 15:29	SWM	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1979914	1	01/03/23 09:45	01/09/23 17:39	SWM	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1979914	1	01/03/23 09:45	01/09/23 17:39	RGT	Mt. Juliet, TN

EMW-05 L1570267-02 Non-Potable Water

Collected by	Collected date/time	Received date/time
	12/15/22 15:38	12/22/22 10:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904/9320	WG1982293	1	01/04/23 11:53	01/09/23 15:29	SWM	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1979914	1	01/03/23 09:45	01/09/23 17:39	SWM	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1979914	1	01/03/23 09:45	01/09/23 17:39	RGT	Mt. Juliet, TN

AW-23 L1570267-03 Non-Potable Water

Collected by	Collected date/time	Received date/time
	12/16/22 09:12	12/22/22 10:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904/9320	WG1982293	1	01/04/23 11:53	01/09/23 15:29	SWM	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1979914	1	01/03/23 09:45	01/09/23 17:39	SWM	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1979914	1	01/03/23 09:45	01/09/23 17:39	RGT	Mt. Juliet, TN

DRAFT

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.



Haley Torrence
Project Manager

Report Revision History

Level II Report - Version 1: 01/13/23 11:41

Project Narrative

sample date correction

DRAFT

Radiochemistry by Method 904/9320

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	0.276		0.240	0.209	01/09/2023 15:29	WG1982293
(T) Barium	*99.2*			*30.0-143*	*01/09/2023 15:29*	WG1982293
(T) Yttrium	*102*			*30.0-136*	*01/09/2023 15:29*	WG1982293

Radiochemistry by Method Calculation

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
Combined Radium	0.288	J	0.309	0.403	01/09/2023 17:39	WG1979914

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	0.0129	U	0.195	0.345	01/09/2023 17:39	WG1979914
(T) Barium-133	*112*			*30.0-143*	*01/09/2023 17:39*	WG1979914

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1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method 904/9320

Analyte	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
	pCi/l		+ / -	pCi/l	date / time	
RADIUM-228	1.44		0.277	0.458	01/09/2023 15:29	WG1982293
(T) Barium	*99.0*			*30.0-143*	*01/09/2023 15:29*	WG1982293
(T) Yttrium	*98.9*			*30.0-136*	*01/09/2023 15:29*	WG1982293

Radiochemistry by Method Calculation

Analyte	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
	pCi/l		+ / -	pCi/l	date / time	
Combined Radium	1.53		0.326	0.533	01/09/2023 17:39	WG1979914

Radiochemistry by Method SM7500Ra B M

Analyte	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
	pCi/l		+ / -	pCi/l	date / time	
RADIUM-226	0.0911	U	0.171	0.272	01/09/2023 17:39	WG1979914
(T) Barium-133	*97.9*			*30.0-143*	*01/09/2023 17:39*	WG1979914

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Radiochemistry by Method 904/9320

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	-0.169	U	0.370	0.684	01/09/2023 15:29	WG1982293
(T) Barium	*100*			*30.0-143*	*01/09/2023 15:29*	WG1982293
(T) Yttrium	*114*			*30.0-136*	*01/09/2023 15:29*	WG1982293

Radiochemistry by Method Calculation

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
Combined Radium	0.204	U	0.430	0.745	01/09/2023 17:39	WG1979914

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	0.204	J	0.220	0.294	01/09/2023 17:39	WG1979914
(T) Barium-133	*106*			*30.0-143*	*01/09/2023 17:39*	WG1979914

DRAFT

QUALITY CONTROL SUMMARY

L1570267-01,02,03

Method Blank (MB)

(MB) R3880551-1 01/09/23 15:29

Analyte	MB Result pCi/l	MB Qualifier	MB Uncertainty + / -	MB MDA pCi/l
Radium-228	0.0610	J	0.223	0.197
(T) Barium	*103*		*103*	
(T) Yttrium	*94.9*		*94.9*	

L1570267-03 Original Sample (OS) • Duplicate (DUP)

(OS) L1570267-03 01/09/23 15:29 • (DUP) R3880551-4 01/09/23 15:29

Analyte	Original Result pCi/l	Original Uncertainty + / -	Original MDA pCi/l	DUP Result pCi/l	DUP Uncertainty + / -	DUP MDA pCi/l	Dilution	DUP RPD %	DUP RER	DUP Qualifier	DUP RPD Limits %	DUP RER Limit
Radium-228	-0.169	0.370	0.684	0.635	0.336	0.684	1	200	1.61		20	3
(T) Barium	*100*			*102*	*102*							
(T) Yttrium	*114*			*94.9*	*94.9*							

Laboratory Control Sample (LCS)

(LCS) R3880551-5 01/11/23 10:18

Analyte	Spike Amount pCi/l	LCS Result pCi/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Radium-228	5.00	5.45	109	80.0-120	
(T) Barium			*89.7*		
(T) Yttrium			*94.9*		

L1570838-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1570838-01 01/09/23 15:29 • (MS) R3880551-2 01/09/23 15:29 • (MSD) R3880551-3 01/09/23 15:29

Analyte	Spike Amount pCi/l	Original Result pCi/l	MS Result pCi/l	MSD Result pCi/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	MS RER	RPD Limits %
Radium-228	10.0	0.985	10.3	9.63	93.1	86.5	1	70.0-130			6.62		20
(T) Barium		*122*			*102*	*108*							
(T) Yttrium		*113*			*116*	*105*							

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Method Blank (MB)

(MB) R3880192-1 01/09/23 17:39

Analyte	MB Result pCi/l	MB Qualifier	MB Uncertainty + / -	MB MDA pCi/l
Radium-226	0.0103	U	0.0439	0.0776
(T) Barium-133	*93.5*		*93.5*	

L1569403-05 Original Sample (OS) • Duplicate (DUP)

(OS) L1569403-05 01/09/23 17:39 • (DUP) R3880192-5 01/09/23 17:39

Analyte	Original Result pCi/l	Original Uncertainty + / -	Original MDA pCi/l	DUP Result pCi/l	DUP Uncertainty + / -	DUP MDA pCi/l	Dilution	DUP RPD %	DUP RER	DUP Qualifier	DUP RPD Limits %	DUP RER Limit
Radium-226	0.204	0.205	0.266	0.0139	0.129	0.266	1	175	0.787	U	20	3
(T) Barium-133	*103*			*95.7*	*95.7*							

Laboratory Control Sample (LCS)

(LCS) R3880192-2 01/09/23 17:39

Analyte	Spike Amount pCi/l	LCS Result pCi/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Radium-226	5.02	5.53	110	80.0-120	
(T) Barium-133			*96.1*		

L1570267-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1570267-03 01/09/23 17:39 • (MS) R3880192-3 01/09/23 17:39 • (MSD) R3880192-4 01/09/23 17:39

Analyte	Spike Amount pCi/l	Original Result pCi/l	MS Result pCi/l	MSD Result pCi/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	MS RER	RPD Limits %
Radium-226	20.0	0.204	23.9	19.7	118	97.3	1	75.0-125			19.3		20
(T) Barium-133		*106*			*91.9*	*90.4*							

DRAFT

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.

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Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
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	LAO000356
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		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

* 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 Analytical.

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A187

Internal Transfer Chain of Custody

State of Origin: IL
Cert. Needed: [X] YES [ ] NO

Pace Analytical
www.pacelabs.com

Workorder: FL03741 **Workorder Name:** VISTRA EDWARDS **Owner Received Date:** 12/20/2022 **Results Requ By:** 1/18/2023

Report To:	Subcontract To:
Christina Pierce Pace Analytical - IL/MO 2231 W. Altorfer Drive Peoria, IL 61615 800-752-6651	Pace Analytical Services, LLC 12065 Lebanon Rd Mt Juliet, TN (615)758-5858

Item	Sample ID	Sample Type	Collect Date/Time	Lab ID	Matrix	Preserved Containers	Requested Analysis: Radium 226/228	LAB USE ONLY
1	AW-01	GRAB	12/15/2022 17:02	FL03741-01	GW		X	-01
2	EMW-05	GRAB	12/15/2022 15:38	FL03741-02	GW		X	-02
3	AW-23	GRAB	12/15/2022 9:12	FL03741-03	GW		X	-03
4								
5								
6								
7								
8								
9								
10								

L1570267

Transfers	Released By	Date/Time	Reveived By	Date/Time	Comments
1	[signature]	12-20-22 15:20	[signature]	12/20/22 [illegible]	Needs reported as 226, 228 and also combined 226/228 Include QC summary
2					
3					

Cooler Temperature on Receipt _____ °C **Custody Seal** Y or N **Received on Ice** Y or N **Sample Intact** Y or N

***In order to maintain client confidentiality, location/name of the sampling site, sampler's name and signature may not be provided on this COC document.
This chain of custody is considered complete as is since this information is available in the owner laboratory.

DRAFT

Sample Receipt Checklist

COC Seal Present/Intact:	Y/N	If Applicable	
COC Signed/Accurate:	Y/N	VOA Zero Headspace:	Y/N
Bottles arrive intact:	Y/N	Pres.Correct/Check:	Y/N
Correct bottles used:	Y/N		
Sufficient volume sent:	Y/N		
RAD Screen <0.5 mR/hr:	Y/N		

9.8 to 2g is 60mL

L1570267

Pace Analytical
www.pacelabs.com

Ship to :
Pace Analytical Services, LLC
12065 Lebanon Rd
Mt Juliet, TN 37122

(615)758-5858

INTER_LABORATORY WORK ORDER # FL03741

(To be complete by sending lab)

Sending Project No:	FL03741
Receiving Project No:	
Check Box for Consolidated Invoice:	
Date Prepared:	12/20/2022
REQUESTED COMPLETION DATE:	1/18/2023

Sending Region	IR72-IL/MO	Sending Project Mgr.	Gail Schindler
Receiving Region	IR80-NATIONAL	External Client	VISTRA - EDWARDS
State of Sample Origin	IL	QC Deliverable	**STD Report**

All questions should be addressed to sending project manager.

Requested Reportable Units _____ Report Wet or Dry Weight? NA Cert Needed: IL

WORK REQUESTED						
Method Description	**Container Type**	**Quantity of**	**Preservative**	**Quantity of**	**Unit Price**	**Amount**
Radium 226/228		1		3	$170.00	$510.00
						$0.00
						$0.00
					TOTAL	$510.00

Special Requirements: Report as 226, 228 & combined 226/228. Include QC summary

Receiving Region Department	Acctg. Code	Totals from above	Revenue Allocation	
			Receiving Region (80%)	Client Services Dept.
radiological	38	$510.00	$408.00	$102.00
* Custom Revenue Allocation		TOTAL	$408.00	$102.00

FOR ANALYTICAL WORK COMPLETED THIS SECTION ALSO

Return Samples to Sending Region: [ ] Yes [X] No

CONFIRMATION OF WORK COMPLETED

Date Completed: _____ Receiving Project Manager: _____

Original sent to the receiving lab - Copy kept at the sending lab.

When work completed: Original sent to the ABM at the receiving laboratory. Copies are made to corporate as needed.

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RAMBOLL COC#: 1940102792-2022-1216-003

FL03537

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: 1 of 1

Section A Required Client Information:

Company:	Vistra Corp
Address:	13498 E. 900th St
Email To:	Brian.Voelker@Vistracorp.com
Phone: (217) 753-8911	Fax:
Requested Due Date/TAT:	standard

Section B Required Project Information:

Report To:	Brian Voelker
Copy To:	Jason Stuckey
Purchase Order No.:	
Project Name:	
Project Number:	2285

Section C Invoice Information:

Attention:	Jason Stuckey
Company Name:	Vistra Corp
Address:	see Section A
Quote Reference:	
Project Manager:	
Profile #:	

REGULATORY AGENCY

NPDES GROUND WATER DRINKING WATER

UST RCRA OTHER

Site Location STATE: Edwards IL

Section D Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	Requested Analysis Filtered (Y/N): Radium 226 + Radium 228, total	Residual Chlorine (Y/N)	Project No./ Lab I.D.
1	AW-23			12/16/22	0912		3	X									X		
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
16																			

SM 12/16/22

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
EDW-22Q4-845-301-R2	SAMUEL MALLOW	12/16/22	1614		12/16/22	1614	2.1

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: SAMUEL MALLOW

SIGNATURE of SAMPLER:

DATE Signed (MM/DD/YY): 12/16/22

Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

January 27, 2023

Brian Voelker
Vistra - Edwards
604 Pierce Boulevard
O'Fallon, IL 62269

RE: RAMBOLL DELINEATION

Dear Brian Voelker:

Please find enclosed the **revised** analytical results for the **3** sample(s) the laboratory received on **12/16/22 4:14 pm** and logged in under work order **FL03741**. 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 Pace Analytical Services, LLC.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

Pace Analytical Services 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 lisa.grant@pacelabs.com.

Gail J Schindler

Gail Schindler
Project Manager
(309) 692-9688 x1716
gail.schindler@pacelabs.com

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

SAMPLE RECEIPT CHECK LIST

Items not applicable will be marked as in compliance

Work Order FL03741

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 received 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

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: FL03741-01
Name: AW-01
Matrix: Ground Water - Grab

Sampled: 12/15/22 17:02
Received: 12/16/22 16:14

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - Pace Analytical - Mt Juliet, Tn									
Rad 226 and 228-Subcontract	0.288 J	pCi/L			1	0.403	01/09/23 17:39		904.0 903.0

Sample: FL03741-02
Name: EMW-05
Matrix: Ground Water - Grab

Sampled: 12/15/22 15:38
Received: 12/16/22 16:14

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - Pace Analytical - Mt Juliet, Tn									
Rad 226 and 228-Subcontract	1.53	pCi/L			1	0.533	01/09/23 17:39		904.0 903.0

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

NOTES

Specifications regarding method revisions, method modifications, and calculations used for analysis are available upon request. Please contact your project manager.

Revised Report - separated wells

* Not a TNI accredited analyte

Memos

Radium 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

DRAFT

Gail J Schindler

Certified by: Gail Schindler, Project Manager

ANALYTICAL REPORT

January 16, 2023

Revised Report

Pace IR - Peoria, IL

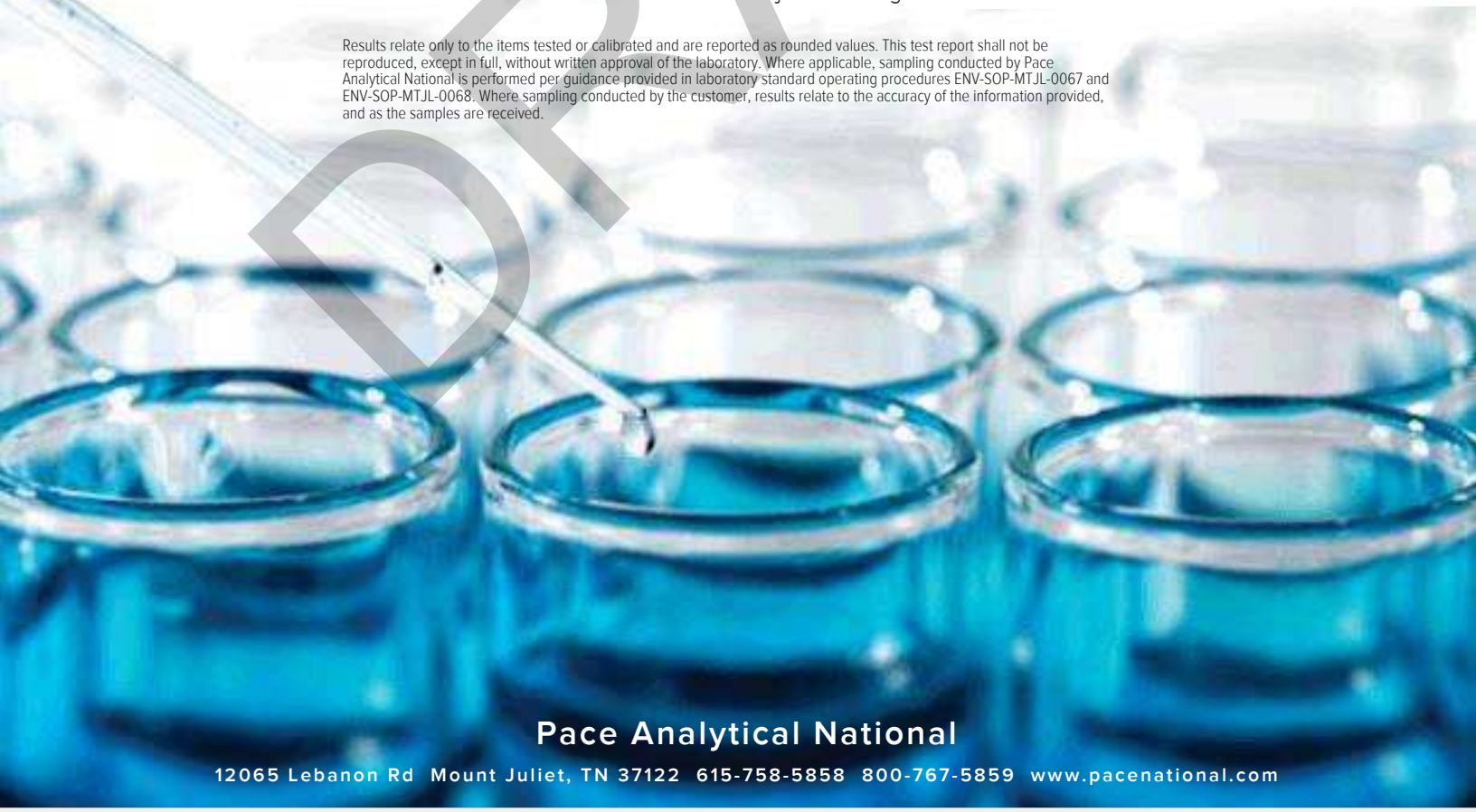
Sample Delivery Group:	L1570267
Samples Received:	12/22/2022
Project Number:	FL03741
Description:	Vistra Edwards
Site:	001
Report To:	Gail Schindler 2231 W. Altorfer Drive Peoria, IL 61615

Entire Report Reviewed By: Haley Torrence

Haley Torrence
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.

DRAFT



Pace Analytical National
12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.pacenational.com

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AW-01 L1570267-01 Non-Potable Water

Collected by	Collected date/time	Received date/time
	12/15/22 17:02	12/22/22 10:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904/9320	WG1982293	1	01/04/23 11:53	01/09/23 15:29	SWM	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1979914	1	01/03/23 09:45	01/09/23 17:39	SWM	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1979914	1	01/03/23 09:45	01/09/23 17:39	RGT	Mt. Juliet, TN

EMW-05 L1570267-02 Non-Potable Water

Collected by	Collected date/time	Received date/time
	12/15/22 15:38	12/22/22 10:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904/9320	WG1982293	1	01/04/23 11:53	01/09/23 15:29	SWM	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1979914	1	01/03/23 09:45	01/09/23 17:39	SWM	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1979914	1	01/03/23 09:45	01/09/23 17:39	RGT	Mt. Juliet, TN

AW-23 L1570267-03 Non-Potable Water

Collected by	Collected date/time	Received date/time
	12/16/22 09:12	12/22/22 10:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904/9320	WG1982293	1	01/04/23 11:53	01/09/23 15:29	SWM	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1979914	1	01/03/23 09:45	01/09/23 17:39	SWM	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1979914	1	01/03/23 09:45	01/09/23 17:39	RGT	Mt. Juliet, TN

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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.



Haley Torrence
Project Manager

Report Revision History

Level II Report - Version 1: 01/13/23 11:41

Project Narrative

sample date correction

DRAFT

Radiochemistry by Method 904/9320

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	0.276		0.240	0.209	01/09/2023 15:29	WG1982293
(T) Barium	*99.2*			*30.0-143*	*01/09/2023 15:29*	WG1982293
(T) Yttrium	*102*			*30.0-136*	*01/09/2023 15:29*	WG1982293

Radiochemistry by Method Calculation

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
Combined Radium	0.288	J	0.309	0.403	01/09/2023 17:39	WG1979914

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	0.0129	U	0.195	0.345	01/09/2023 17:39	WG1979914
(T) Barium-133	*112*			*30.0-143*	*01/09/2023 17:39*	WG1979914

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1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method 904/9320

Analyte	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
	pCi/l		+ / -	pCi/l	date / time	
RADIUM-228	1.44		0.277	0.458	01/09/2023 15:29	WG1982293
(T) Barium	*99.0*			*30.0-143*	*01/09/2023 15:29*	WG1982293
(T) Yttrium	*98.9*			*30.0-136*	*01/09/2023 15:29*	WG1982293

Radiochemistry by Method Calculation

Analyte	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
	pCi/l		+ / -	pCi/l	date / time	
Combined Radium	1.53		0.326	0.533	01/09/2023 17:39	WG1979914

Radiochemistry by Method SM7500Ra B M

Analyte	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
	pCi/l		+ / -	pCi/l	date / time	
RADIUM-226	0.0911	U	0.171	0.272	01/09/2023 17:39	WG1979914
(T) Barium-133	*97.9*			*30.0-143*	*01/09/2023 17:39*	WG1979914

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Radiochemistry by Method 904/9320

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	-0.169	U	0.370	0.684	01/09/2023 15:29	WG1982293
(T) Barium	*100*			*30.0-143*	*01/09/2023 15:29*	WG1982293
(T) Yttrium	*114*			*30.0-136*	*01/09/2023 15:29*	WG1982293

Radiochemistry by Method Calculation

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
Combined Radium	0.204	U	0.430	0.745	01/09/2023 17:39	WG1979914

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	0.204	J	0.220	0.294	01/09/2023 17:39	WG1979914
(T) Barium-133	*106*			*30.0-143*	*01/09/2023 17:39*	WG1979914

DRAFT

QUALITY CONTROL SUMMARY

L1570267-01,02,03

Method Blank (MB)

(MB) R3880551-1 01/09/23 15:29

Analyte	MB Result pCi/l	MB Qualifier	MB Uncertainty + / -	MB MDA pCi/l
Radium-228	0.0610	J	0.223	0.197
(T) Barium	*103*		*103*	
(T) Yttrium	*94.9*		*94.9*	

L1570267-03 Original Sample (OS) • Duplicate (DUP)

(OS) L1570267-03 01/09/23 15:29 • (DUP) R3880551-4 01/09/23 15:29

Analyte	Original Result pCi/l	Original Uncertainty + / -	Original MDA pCi/l	DUP Result pCi/l	DUP Uncertainty + / -	DUP MDA pCi/l	Dilution	DUP RPD %	DUP RER	DUP Qualifier	DUP RPD Limits %	DUP RER Limit
Radium-228	-0.169	0.370	0.684	0.635	0.336	0.684	1	200	1.61		20	3
(T) Barium	*100*			*102*	*102*							
(T) Yttrium	*114*			*94.9*	*94.9*							

Laboratory Control Sample (LCS)

(LCS) R3880551-5 01/11/23 10:18

Analyte	Spike Amount pCi/l	LCS Result pCi/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Radium-228	5.00	5.45	109	80.0-120	
(T) Barium			*89.7*		
(T) Yttrium			*94.9*		

L1570838-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1570838-01 01/09/23 15:29 • (MS) R3880551-2 01/09/23 15:29 • (MSD) R3880551-3 01/09/23 15:29

Analyte	Spike Amount pCi/l	Original Result pCi/l	MS Result pCi/l	MSD Result pCi/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	MS RER	RPD Limits %
Radium-228	10.0	0.985	10.3	9.63	93.1	86.5	1	70.0-130			6.62		20
(T) Barium		*122*			*102*	*108*							
(T) Yttrium		*113*			*116*	*105*							

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Method Blank (MB)

(MB) R3880192-1 01/09/23 17:39

Analyte	MB Result pCi/l	MB Qualifier	MB Uncertainty + / -	MB MDA pCi/l
Radium-226	0.0103	U	0.0439	0.0776
(T) Barium-133	*93.5*		*93.5*	

L1569403-05 Original Sample (OS) • Duplicate (DUP)

(OS) L1569403-05 01/09/23 17:39 • (DUP) R3880192-5 01/09/23 17:39

Analyte	Original Result pCi/l	Original Uncertainty + / -	Original MDA pCi/l	DUP Result pCi/l	DUP Uncertainty + / -	DUP MDA pCi/l	Dilution	DUP RPD %	DUP RER	DUP Qualifier	DUP RPD Limits %	DUP RER Limit
Radium-226	0.204	0.205	0.266	0.0139	0.129	0.266	1	175	0.787	U	20	3
(T) Barium-133	*103*			*95.7*	*95.7*							

Laboratory Control Sample (LCS)

(LCS) R3880192-2 01/09/23 17:39

Analyte	Spike Amount pCi/l	LCS Result pCi/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Radium-226	5.02	5.53	110	80.0-120	
(T) Barium-133			*96.1*		

L1570267-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1570267-03 01/09/23 17:39 • (MS) R3880192-3 01/09/23 17:39 • (MSD) R3880192-4 01/09/23 17:39

Analyte	Spike Amount pCi/l	Original Result pCi/l	MS Result pCi/l	MSD Result pCi/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	MS RER	RPD Limits %
Radium-226	20.0	0.204	23.9	19.7	118	97.3	1	75.0-125			19.3		20
(T) Barium-133		*106*			*91.9*	*90.4*							

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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.

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Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
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	LAO000356
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		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

* 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 Analytical.

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A187

Internal Transfer Chain of Custody

State of Origin: IL
Cert. Needed: [X] YES [ ] NO

Pace Analytical
www.pacelabs.com

Workorder: FL03741 **Workorder Name:** VISTRA EDWARDS **Owner Received Date:** 12/20/2022 **Results Requ By:** 1/18/2023

Report To:	Subcontract To:
Christina Pierce Pace Analytical - IL/MO 2231 W. Altorfer Drive Peoria, IL 61615 800-752-6651	Pace Analytical Services, LLC 12065 Lebanon Rd Mt Juliet, TN (615)758-5858

Item	Sample ID	Sample Type	Collect Date/Time	Lab ID	Matrix	Preserved Containers	Requested Analysis: Radium 226/228	LAB USE ONLY
1	AW-01	GRAB	12/15/2022 17:02	FL03741-01	GW		X	-01
2	EMW-05	GRAB	12/15/2022 15:38	FL03741-02	GW		X	-02
3	AW-23	GRAB	12/15/2022 9:12	FL03741-03	GW		X	-03
4								
5								
6								
7								
8								
9								
10								

L1570267

Transfers	Released By	Date/Time	Received By	Date/Time	Comments
1	[signature]	12-20-22 15:20	[signature]	12/20/22 [illegible]	Needs reported as 226, 228 and also combined 226/228 Include QC summary
2					
3					

Cooler Temperature on Receipt _____ °C **Custody Seal** Y or N **Received on Ice** Y or N **Sample Intact** Y or N

***In order to maintain client confidentiality, location/name of the sampling site, sampler's name and signature may not be provided on this COC document. This chain of custody is considered complete as is since this information is available in the owner laboratory.

Sample Receipt Checklist

COC Seal Present/Intact:	Y/N	If Applicable	
COC Signed/Accurate:	Y/N	VOA Zero Headspace:	Y/N
Bottles arrive intact:	Y/N	Pres.Correct/Check:	Y/N
Correct bottles used:	Y/N		
Sufficient volume sent:	Y/N		
RAD Screen <0.5 mR/hr:	Y/N		

9.8 to 2g is 60mL

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L1570267

Pace Analytical®
www.pacelabs.com

Ship to :
Pace Analytical Services, LLC
12065 Lebanon Rd
Mt Juliet, TN 37122

(615)758-5858

INTER_LABORATORY WORK ORDER # FL03741
(To be complete by sending lab)

Sending Project No:	FL03741
Receiving Project No:	
Check Box for Consolidated Invoice:	
Date Prepared:	12/20/2022
REQUESTED COMPLETION DATE:	1/18/2023

Sending Region	IR72-IL/MO	Sending Project Mgr.	Gail Schindler
Receiving Region	IR80-NATIONAL	External Client	VISTRA - EDWARDS
State of Sample Origin	IL	QC Deliverable	**STD Report**

All questions should be addressed to sending project manager.

Requested Reportable Units _____ Report Wet or Dry Weight? NA Cert Needed: IL

WORK REQUESTED						
Method Description	**Container Type**	**Quantity of**	**Preservative**	**Quantity of**	**Unit Price**	**Amount**
Radium 226/228		1		3	$170.00	$510.00
						$0.00
						$0.00
					TOTAL	$510.00

Special Requirements: Report as 226, 228 & combined 226/228. Include QC summary

Receiving Region Department	Acctg. Code	Totals from above	Revenue Allocation	
			Receiving Region (80%)	Client Services Dept.
radiological	38	$510.00	$408.00	$102.00
* Custom Revenue Allocation		TOTAL	$408.00	$102.00

FOR ANALYTICAL WORK COMPLETED THIS SECTION ALSO

Return Samples to Sending Region: [ ] Yes [X] No

CONFIRMATION OF WORK COMPLETED

Date Completed: _____ Receiving Project Manager: _____

Original sent to the receiving lab - Copy kept at the sending lab.
When work completed: Original sent to the ABM at the receiving laboratory. Copies are made to corporate as needed.

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RAMBOLL COC#: 1940102792-1216-002

FL03537 JPO

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Section A Required Client Information:	Section B Required Project Information:	Section C Invoice Information:
Company: Vistra Corp	Report To: Brian Voelker	Attention: Jason Stuckey
Address: 13498 E. 900th St	Copy To: Jason Stuckey	Company Name: Vistra Corp
		Address: see Section A
Email To: Brian.Voelker@Vistracorp.com	Purchase Order No.:	Quote Reference:
Phone: (217) 753-8911 Fax:	Project Name:	Project Manager:
Requested Due Date/TAT: standard	Project Number: 2285	Profile #:

REGULATORY AGENCY

NPDES GROUND WATER DRINKING WATER

UST RCRA OTHER

Site Location STATE: EDWARDS IL

Requested Analysis Filtered (Y/N)

ITEM #	Section D Required Client Information — SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	EDW-845-301_R2	Residual Chlorine (Y/N)	Project No./ Lab I.D.
1	AW-01	WT	G	12/15/22	1702		2	X		X							X		
2	EMW-05			12/15/22	1538		2	X		X							X		
3	EB-01			12/15/22	1705		1			X							X		
4	EB-02			12/16/22	1325		1			X							X		
5	DUP-01			12/15/22	1702		2	X		X							X		
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
16																			

Valid Matrix Codes: DRINKING WATER (DW), WATER (W), WASTE WATER (WW), PRODUCT (P), SOIL/SOLID (SL), OIL (OL), WIPE (WI), AIR (AR), OTHER (OT), TISSUE (TS)

SM 12/16/22

SM 12/16/22

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
EDW-22Q4-845-301-R2 NO RADIUM 226 + RADIUM 228, TOTAL	SAMUEL MALLOW (RAMBOLL)	12/16/22	1614				
					12/16/22	1614	2.1

SAMPLER NAME AND SIGNATURE			Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
PRINT Name of SAMPLER:	SAMUEL MALLOW					
SIGNATURE of SAMPLER:		DATE Signed (MM/DD/YY): 12/16/22				

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

February 03, 2023

Brian Voelker
Vistra - Edwards
604 Pierce Boulevard
O'Fallon, IL 62269

RE: RAMBOLL DELINEATION

Dear Brian Voelker:

Please find enclosed the analytical results for the **1** sample(s) the laboratory received on **1/10/23 4:00 pm** and logged in under work order **GA02461**. 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 Pace Analytical Services, LLC.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

Pace Analytical Services 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 General Manager, Lisa Grant, with any feedback you have about your experience with our laboratory at 309-683-1764 or lisa.grant@pacelabs.com.

Gail J Schindler

Gail Schindler
Project Manager
(309) 692-9688 x1716
gail.schindler@pacelabs.com

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

SAMPLE RECEIPT CHECK LIST

Items not applicable will be marked as in compliance

Work Order GA02461

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 received 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

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: GA02461-01
Name: AW-23
Matrix: Ground Water - Grab

Sampled: 01/10/23 09:36
Received: 01/10/23 16:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - Pace Analytical - Mt Juliet, Tn									
Rad 226 - Subcontract	0.0563	pCi/L			1	0.738	02/02/22 16:14		904.0 903.0
Rad 226 and 228-Subcontract	0.666	pCi/L			1	1.43	02/03/22 11:55		904.0 903.0
Rad 228- Subcontract	0.61	pCi/L			1	0.691	01/30/22 14:50		904.0 903.0

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2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

NOTES

Specifications regarding method revisions, method modifications, and calculations used for analysis are available upon request. Please contact your project manager.

* Not a TNI accredited analyte

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

DRAFT

Gail g Schindler

Certified by: Gail Schindler, Project Manager

Pace Analytical Services, LLC
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

February 03, 2023

Gail J. Schindler
PDC Laboratories
2231 W. Altorfer Drive
Peoria, IL 61615

RE: Project: GA02461
Pace Project No.: 30555850

Dear Gail Schindler:

Enclosed are the analytical results for sample(s) received by the laboratory on January 19, 2023. The results relate only to the samples included in this report. Results reported herein conform to the applicable TNI/NELAC Standards and the laboratory's Quality Manual, where applicable, unless otherwise noted in the body of the report.

The test results provided in this final report were generated by each of the following laboratories within the Pace Network:

- Pace Analytical Services - Greensburg

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Carla Cmar
carla.cmar@pacelabs.com
(724)850-5600
Project Manager

Enclosures

cc: Chenise Lambert-Sykes, PDC Laboratories, Inc.

DRAFT

Pace Analytical Services, LLC
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

CERTIFICATIONS

Project: GA02461
Pace Project No.: 30555850

Pace Analytical Services Pennsylvania
1638 Roseytown Rd Suites 2,3&4, Greensburg, PA 15601
ANAB DOD-ELAP Rad Accreditation #: L2417
Alabama Certification #: 41590
Arizona Certification #: AZ0734
Arkansas Certification
California Certification #: 04222CA
Colorado Certification #: PA01547
Connecticut Certification #: PH-0694
Delaware Certification
EPA Region 4 DW Rad
Florida/TNI Certification #: E87683
Georgia Certification #: C040
Florida: Cert E871149 SEKS WET
Guam Certification
Hawaii Certification
Idaho Certification
Illinois Certification
Indiana Certification
Iowa Certification #: 391
Kansas/TNI Certification #: E-10358
Kentucky Certification #: KY90133
KY WW Permit #: KY0098221
KY WW Permit #: KY0000221
Louisiana DHH/TNI Certification #: LA180012
Louisiana DEQ/TNI Certification #: 4086
Maine Certification #: 2017020
Maryland Certification #: 308
Massachusetts Certification #: M-PA1457
Michigan/PADEP Certification #: 9991
Missouri Certification #: 235
Montana Certification #: Cert0082
Nebraska Certification #: NE-OS-29-14
Nevada Certification #: PA014572018-1
New Hampshire/TNI Certification #: 297617
New Jersey/TNI Certification #: PA051
New Mexico Certification #: PA01457
New York/TNI Certification #: 10888
North Carolina Certification #: 42706
North Dakota Certification #: R-190
Ohio EPA Rad Approval: #41249
Oregon/TNI Certification #: PA200002-010
Pennsylvania/TNI Certification #: 65-00282
Puerto Rico Certification #: PA01457
Rhode Island Certification #: 65-00282
South Dakota Certification
Tennessee Certification #: 02867
Texas/TNI Certification #: T104704188-17-3
Utah/TNI Certification #: PA014572017-9
USDA Soil Permit #: P330-17-00091
Vermont Dept. of Health: ID# VT-0282
Virgin Island/PADEP Certification
Virginia/VELAP Certification #: 460198
Washington Certification #: C868
West Virginia DEP Certification #: 143
West Virginia DHHR Certification #: 9964C
Wisconsin Approve List for Rad
Wyoming Certification #: 8TMS-L

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Greensburg, PA 15601
(724)850-5600

SAMPLE SUMMARY

Project: GA02461
Pace Project No.: 30555850

Lab ID	Sample ID	Matrix	Date Collected	Date Received
30555850001	**AW-23**	Water	01/10/23 09:36	01/19/23 10:15

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(724)850-5600

SAMPLE ANALYTE COUNT

Project: GA02461
Pace Project No.: 30555850

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
30555850001	**AW-23**	EPA 903.1	JDZ	1	PASI-PA
		EPA 904.0	ZPC	1	PASI-PA
		Total Radium Calculation	JAL	1	PASI-PA

PASI-PA = Pace Analytical Services - Greensburg

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1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

PROJECT NARRATIVE

Project: GA02461
Pace Project No.: 30555850

Method: **EPA 903.1**
Description: 903.1 Radium 226
Client: PDC/Pace Analytical Services (Peoria, IL)
Date: February 03, 2023

General Information:
1 sample was analyzed for EPA 903.1 by Pace Analytical Services Greensburg. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

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1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

PROJECT NARRATIVE

Project: GA02461
Pace Project No.: 30555850

Method: **EPA 904.0**
Description: 904.0 Radium 228
Client: PDC/Pace Analytical Services (Peoria, IL)
Date: February 03, 2023

General Information:
1 sample was analyzed for EPA 904.0 by Pace Analytical Services Greensburg. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

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1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

PROJECT NARRATIVE

Project: GA02461
Pace Project No.: 30555850

Method: **Total Radium Calculation**
Description: Total Radium 228+226
Client: PDC/Pace Analytical Services (Peoria, IL)
Date: February 03, 2023

General Information:
1 sample was analyzed for Total Radium Calculation by Pace Analytical Services Greensburg. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

DRAFT

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Pace Analytical Services, LLC
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

ANALYTICAL RESULTS - RADIOCHEMISTRY

Project: GA02461
Pace Project No.: 30555850

Sample: AW-23 **Lab ID: 30555850001** Collected: 01/10/23 09:36 Received: 01/19/23 10:15 Matrix: Water
PWS: Site ID: Sample Type:

Parameters	Method	Act ± Unc (MDC) Carr Trac	Units	Analyzed	CAS No.	Qual
	Pace Analytical Services - Greensburg					
Radium-226	EPA 903.1	**0.0563 ± 0.366 (0.738) C:NA T:92%**	pCi/L	02/02/23 16:14	13982-63-3	
	Pace Analytical Services - Greensburg					
Radium-228	EPA 904.0	**0.610 ± 0.369 (0.691) C:90% T:88%**	pCi/L	01/30/23 14:50	15262-20-1	
	Pace Analytical Services - Greensburg					
Total Radium	Total Radium Calculation	**0.666 ± 0.735 (1.43)**	pCi/L	02/03/23 11:55	7440-14-4	

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REPORT OF LABORATORY ANALYSIS

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Pace Analytical Services, LLC
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

QUALITY CONTROL - RADIOCHEMISTRY

Project: GA02461
Pace Project No.: 30555850

QC Batch: 561786
QC Batch Method: EPA 904.0
Analysis Method: EPA 904.0
Analysis Description: 904.0 Radium 228
Laboratory: Pace Analytical Services - Greensburg
Associated Lab Samples: 30555850001

METHOD BLANK: 2728640 Matrix: Water
Associated Lab Samples: 30555850001

Parameter	Act ± Unc (MDC) Carr Trac	Units	Analyzed	Qualifiers
Radium-228	0.107 ± 0.263 (0.587) C:91% T:97%	pCi/L	01/30/23 14:50	

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Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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Pace Analytical Services, LLC
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

QUALITY CONTROL - RADIOCHEMISTRY

Project: GA02461
Pace Project No.: 30555850

QC Batch: 561782
QC Batch Method: EPA 903.1
Analysis Method: EPA 903.1
Analysis Description: 903.1 Radium-226
Laboratory: Pace Analytical Services - Greensburg
Associated Lab Samples: 30555850001

METHOD BLANK: 2728633 Matrix: Water
Associated Lab Samples: 30555850001

Parameter	Act ± Unc (MDC) Carr Trac	Units	Analyzed	Qualifiers
Radium-226	0.165 ± 0.230 (0.383) C:NA T:99%	pCi/L	02/02/23 16:14	

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Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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Pace Analytical Services, LLC
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

QUALIFIERS

Project: GA02461
Pace Project No.: 30555850

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Reported results are not rounded until the final step prior to reporting. Therefore, calculated parameters that are typically reported as "Total" may vary slightly from the sum of the reported component parameters.

Act - Activity

Unc - Uncertainty: For Safe Drinking Water Act (SDWA) analyses, the reported Unc. Is the calculated Count Uncertainty (95% confidence interval) using a coverage factor of 1.96. For all other matrices (non-SDWA), the reported Unc. is the calculated Expanded Uncertainty (aka Combined Standard Uncertainty, CSU), reported at the 95% confidence interval using a coverage factor of 1.96.

Gamma Spec: The Unc. reported for all gamma-spectroscopy analyses (EPA 901.1), is the calculated Expanded Uncertainty (CSU) at the 95.4% confidence interval, using a coverage factor of 2.0.

(MDC) - Minimum Detectable Concentration

Trac - Tracer Recovery (%)

Carr - Carrier Recovery (%)

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

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Internal Transfer Chain of Custody

State of Origin: IL
Cert. Needed: [X] YES [ ] NO

Pace Analytical
www.pacelabs.com

Workorder: GA02461 Workorder Name: VISTRA Owner Received Date: 1/10/2023 Results Requ By: 2/14/2023

Report To:	Subcontract To:
Gail Schindler Pace Analytical - IL/MO 2231 W. Altorfer Drive Peoria, IL 61615 800-752-6651	Pace Analytical Services, LLC 1638 Roseytown Rd - Suites 2,3,4 Greensburg, PA 15601 (724)850-5600

Requested Analysis

Item	Sample ID	Sample Type	Collect Date/Time	Lab ID	Matrix	Preserved Containers	Radium 226/228	LAB USE ONLY
1	AW-23	GRAB	1/10/2023 9:36	GA02461-01	GW		X	001
2								
3								
4								
5								
6								
7								
8								
9								
10								

Transfers	Released By	Date/Time	Reveived By	Date/Time	Comments
1	Melissa Sibley	1/17/23 1400	[signature]	1-19-23	Needs reported as 226, 228 and also combined 226/228
2				10:15	Include QC summary
3					

Cooler Temperature on Receipt — °C | Custody Seal Y or N | Received on Ice Y or N | Sample Intact Y or N

***In order to maintain client confidentiality, location/name of the sampling site, sampler's name and signature may not be provided on this COC document.
This chain of custody is considered complete as is since this information is available in the owner laboratory.

FMT-ALL-C-002rev.00 24March2009

Page 1 of 1

WO# : 30555850

30555850

DRAFT

DC#_Title: ENV-FRM-GBUR-0088 v02_Sample Condition Upon Receipt-Pittsburgh

Effective Date: 10/03/2022

WO# : 30555850

PM: CMC Due Date: 02/09/23

CLIENT: PDC

Client Name: PDC

Courier: ☐ Fed Ex ☑ UPS ☐ USPS ☐ Client ☐ Commercial ☐ Pace ☐ Other

Tracking Number: 1Z 647 296 03 7074 3665

Examined By PS

Labeled By PS

Temped By —

Custody Seal on Cooler/Box Present: ☐ Yes ☐ No **Seals Intact:** ☐ Yes ☐ No

Thermometer Used: — **Type of Ice:** Wet Blue None

Cooler Temperature: Observed Temp ____ °C Correction Factor: ____ °C Final Temp: ____ °C

Temp should be above freezing to 6°C

Comments:	Yes	No	NA	pH paper Lot# 10D222 / D.P.D. Residual Chlorine Lot # —
Chain of Custody Present	—			1.
Chain of Custody Filled Out:	—			2.
-Were client corrections present on COC		—		
Chain of Custody Relinquished	—			3.
Sampler Name & Signature on COC:		—		4.
Sample Labels match COC: -Includes date/time/ID Matrix: WT	—			5.
Samples Arrived within Hold Time:	—			6.
Short Hold Time Analysis (<72hr remaining):		—		7.
Rush Turn Around Time Requested:		—		8.
Sufficient Volume:	—			9.
Correct Containers Used:	—			10.
-Pace Containers Used		—		
Containers Intact:	—			11.
Orthophosphate field filtered:			—	12.
Hex Cr Aqueous samples field filtered:			—	13.
Organic Samples checked for dechlorination			—	14:
Filtered volume received for dissolved tests:			—	15:
All containers checked for preservation: exceptions: VOA, coliform, TOC, O&G, Phenolics, Radon, non-aqueous matrix	—			16. pH<2
All containers meet method preservation requirements:	—			Initial when completed PS / Date/Time of Preservation / Lot# of added Preservative
Headspace in VOA Vials (>6mm):			—	17.
Trip Blank Present:		—		18.
Trip Blank Custody Seals Present		—		
Rad Samples Screened <0.5 mrem/hr.	—			Initial when completed PS / Date: 1/20/23 / Survey Meter SN: 1563

Comments:

~~Amod 1/19/23 10:16~~ PS 1/20/23

Note: For NC compliance samples with discrepancies, a copy of this form must be sent to the DEHNR Certification office.
PM Review is documented electronically in LIMS through the SRF Review schedule in the Workorder Edit Screen.

Qualtrax ID: 55680

DRAFT

Client _____ Profile Number 2232

Site GA02461 Page 1 of 1 Notes _____

		Amber Glass					Plastic								Vials					Other									
Sample Line Item	Matrix	AG1H	AG3S	AG3U	AG5U	AG5T	BP1N	BP1U	BP2S	BP2U	BP3C	BP3N	BP3S	BP3U	DG9S	VG9H	VG9T	VG9U	VOAK	WGFU	WGKU	ZPLC	GCUB	GJN	12GN	GN	BG1U		
001	WT																								3				

WO#: 30555850
PM: CMC Due Date: 02/09/23
CLIENT: PDC

DRAFT

Container Codes

Glass

GJN	1 Gallon Jug with HNO3	DG9S	40mL amber VOA vial H2SO4
AG5U	100mL amber glass unpreserved	VG9U	40mL clear VOA vial
AG5T	100mL amber glass Na Thiosulfate	VG9T	40mL clear VOA vial Na Thiosulfate
GJN	1 Gallon Jug	VG9H	40mL clear VOA vial HCl
AG1S	1L amber glass H2SO4	JGFU	4oz amber wide jar
AG1H	1L amber glass HCl	WGFU	4oz wide jar unpreserved
AG1T	1L amber glass NA Thiosulfate	BG2U	500mL clear glass unpreserved
BG1U	1L clear glass unpreserved	AG2U	500mL amber glass unpreserved
AG3S	250mL amber glass H2SO4	WGKU	8oz wide jar unpreserved
AG3U	250mL amber glass unpreserved	GN	General

Plastic/Misc.

GCUB	1 gallon cubitainer
12GN	1/2 gallon cubitainer
SP5T	120mL coliform Na Thiosulfate
BP1N	1L plastic HNO3
BP1U	1L plastic unpreserved
BP3S	250mL plastic H2SO4
BP3N	250mL plastic HNO3
BP3U	250mL plastic unpreserved
BP3C	250mL plastic NAOH
BP2S	500mL plastic H2SO4
BP2U	500mL plastic unpreserved

EZI	5g Encore
VOAK	Kit Volatile Solid
I	Wipe/Swab
ZPLC	Siploc Bag

WT	Water
SL	Solid
OL	Non-Aq Liquid
WP	Wipe

Quality Control Sample Performance Assessment

Pace Analytical™ www.pacelabs.com

Test:	Ra-226
Analyst:	JDZ
Date:	1/24/2023
Batch ID:	71083
Matrix:	DW

Analyst Must Manually Enter All Fields Highlighted in Yellow.

Method Blank Assessment	
MB Sample ID	2728633
MB concentration:	0.165
M/B Counting Uncertainty:	0.229
MB MDC:	0.383
MB Numerical Performance Indicator:	1.41
MB Status vs Numerical Indicator:	N/A
MB Status vs. MDC:	Pass

Laboratory Control Sample Assessment	LCSD (Y or N)?	N
	LCS71083	LCSD71083
Count Date:	2/2/2023	
Spike I.D.:	21-040	
Spike Concentration (pCi/mL):	32.421	
Volume Used (mL):	0.10	
Aliquot Volume (L, g, F):	0.652	
Target Conc. (pCi/L, g, F):	4.970	
Uncertainty (Calculated):	0.234	
Result (pCi/L, g, F):	4.967	
LCS/LCSD Counting Uncertainty (pCi/L, g, F):	0.942	
Numerical Performance Indicator:	-0.01	
Percent Recovery:	99.93%	
Status vs Numerical Indicator:	N/A	
Status vs Recovery:	Pass	
Upper % Recovery Limits:	133%	
Lower % Recovery Limits:	73%	

Sample Matrix Spike Control Assessment	MS/MSD 1	MS/MSD 2
Sample Collection Date:		
Sample I.D.	TW71083	
Sample MS I.D.	TWMS71083	
Sample MSD I.D.		
Spike I.D.:	21-040	
MS/MSD Decay Corrected Spike Concentration (pCi/mL):	34.197	
Spike Volume Used in MS (mL):	0.20	
Spike Volume Used in MSD (mL):		
MS Aliquot (L, g, F):	0.652	
MS Target Conc.(pCi/L, g, F):	10.496	
MSD Aliquot (L, g, F):		
MSD Target Conc. (pCi/L, g, F):		
MS Spike Uncertainty (calculated):	0.493	
MSD Spike Uncertainty (calculated):		
Sample Result:	0.208	
Sample Result Counting Uncertainty (pCi/L, g, F):	0.245	
Sample Matrix Spike Result:	12.308	
Matrix Spike Result Counting Uncertainty (pCi/L, g, F):	1.424	
Sample Matrix Spike Duplicate Result:		
Matrix Spike Duplicate Result Counting Uncertainty (pCi/L, g, F):		
MS Numerical Performance Indicator:	2.060	
MSD Numerical Performance Indicator:		
MS Percent Recovery:	115.29%	
MSD Percent Recovery:		
MS Status vs Numerical Indicator:	N/A	
MSD Status vs Numerical Indicator:		
MS Status vs Recovery:	Pass	
MSD Status vs Recovery:		
MS/MSD Upper % Recovery Limits:	136%	
MS/MSD Lower % Recovery Limits:	71%	

Duplicate Sample Assessment		
Sample I.D.:	TWDUP71083	Enter Duplicate sample IDs if other than LCS/LCSD in the space below.
Duplicate Sample I.D.	TW71083	
Sample Result (pCi/L, g, F):	0.313	
Sample Result Counting Uncertainty (pCi/L, g, F):	0.243	
Sample Duplicate Result (pCi/L, g, F):	0.208	
Sample Duplicate Result Counting Uncertainty (pCi/L, g, F):	0.245	
Are sample and/or duplicate results below RL?	See Below ##	
Duplicate Numerical Performance Indicator:	0.597	TWDUP71083
Duplicate RPD:	40.26%	TW71083
Duplicate Status vs Numerical Indicator:	N/A	
Duplicate Status vs RPD:	Fail***	
% RPD Limit:	32%	

Matrix Spike/Matrix Spike Duplicate Sample Assessment		
Sample I.D.		
Sample MS I.D.		
Sample MSD I.D.		
Sample Matrix Spike Result:		
Matrix Spike Result Counting Uncertainty (pCi/L, g, F):		
Sample Matrix Spike Duplicate Result:		
Matrix Spike Duplicate Result Counting Uncertainty (pCi/L, g, F):		
Duplicate Numerical Performance Indicator:		
(Based on the Percent Recoveries) MS/ MSD Duplicate RPD:		
MS/ MSD Duplicate Status vs Numerical Indicator:		
MS/ MSD Duplicate Status vs RPD:		
% RPD Limit:		

Evaluation of duplicate precision is not applicable if either the sample or duplicate results are below the RL.

Comments:

~~***Batch must be re-prepped due to unacceptable precision~~ results < MDC, ut
Au 2/3/23

JDZ 2/3/23

DRAFT

Quality Control Sample Performance Assessment

Pace Analytical™ www.pacelabs.com

Test:	Ra-228
Analyst:	ZPC
Date:	1/25/2023
Worklist:	71084
Matrix:	WT

Analyst Must Manually Enter All Fields Highlighted in Yellow.

Method Blank Assessment	
MB Sample ID	2728640
MB concentration:	0.107
M/B 2 Sigma CSU:	0.263
MB MDC:	0.587
MB Numerical Performance Indicator:	0.80
MB Status vs Numerical Indicator:	Pass
MB Status vs. MDC:	Pass

Laboratory Control Sample Assessment	LCSD (Y or N)?	N
	LCS71084	LCSD71084
Count Date:	1/30/2023	
Spike I.D.:	22-040	
Decay Corrected Spike Concentration (pCi/mL):	33.720	
Volume Used (mL):	0.10	
Aliquot Volume (L, g, F):	0.810	
Target Conc. (pCi/L, g, F):	4.165	
Uncertainty (Calculated):	0.204	
Result (pCi/L, g, F):	4.338	
LCS/LCSD 2 Sigma CSU (pCi/L, g, F):	0.994	
Numerical Performance Indicator:	0.33	
Percent Recovery:	104.14%	
Status vs Numerical Indicator:	N/A	
Status vs Recovery:	Pass	
Upper % Recovery Limits:	135%	
Lower % Recovery Limits:	60%	

Sample Matrix Spike Control Assessment	MS/MSD 1	MS/MSD 2
Sample Collection Date:	1/24/2023	
Sample I.D.	TW71084	
Sample MS I.D.	TWMS71084	
Sample MSD I.D.		
Spike I.D.:	22-040	
MS/MSD Decay Corrected Spike Concentration (pCi/mL):	33.788	
Spike Volume Used in MS (mL):	0.20	
Spike Volume Used in MSD (mL):		
MS Aliquot (L, g, F):	0.801	
MS Target Conc.(pCi/L, g, F):	8.442	
MSD Aliquot (L, g, F):		
MSD Target Conc. (pCi/L, g, F):		
MS Spike Uncertainty (calculated):	0.414	
MSD Spike Uncertainty (calculated):		
Sample Result:	0.274	
Sample Result 2 Sigma CSU (pCi/L, g, F):	0.342	
Sample Matrix Spike Result:	6.315	
Matrix Spike Result 2 Sigma CSU (pCi/L, g, F):	1.297	
Sample Matrix Spike Duplicate Result:		
Matrix Spike Duplicate Result 2 Sigma CSU (pCi/L, g, F):		
MS Numerical Performance Indicator:	-3.352	
MSD Numerical Performance Indicator:		
MS Percent Recovery:	71.57%	
MSD Percent Recovery:		
MS Status vs Numerical Indicator:	Fail****	
MSD Status vs Numerical Indicator:		
MS Status vs Recovery:	Pass	
MSD Status vs Recovery:		
MS/MSD Upper % Recovery Limits:	135%	
MS/MSD Lower % Recovery Limits:	60%	

Duplicate Sample Assessment		
Sample I.D.:	TW71084	Enter Duplicate sample IDs if other than LCS/LCSD in the space below.
Duplicate Sample I.D.	TWDUP71084	
Sample Result (pCi/L, g, F):	0.274	
Sample Result 2 Sigma CSU (pCi/L, g, F):	0.342	
Sample Duplicate Result (pCi/L, g, F):	0.074	
Sample Duplicate Result 2 Sigma CSU (pCi/L, g, F):	0.293	
Are sample and/or duplicate results below RL?	See Below ##	
Duplicate Numerical Performance Indicator:	0.869	TW71084
Duplicate RPD:	114.57%	TWDUP71084
Duplicate Status vs Numerical Indicator:	Pass	
Duplicate Status vs RPD:	Fail***	
% RPD Limit:	36%	

Matrix Spike/Matrix Spike Duplicate Sample Assessment		
Sample I.D.		
Sample MS I.D.		
Sample MSD I.D.		
Sample Matrix Spike Result:		
Matrix Spike Result 2 Sigma CSU (pCi/L, g, F):		
Sample Matrix Spike Duplicate Result:		
Matrix Spike Duplicate Result 2 Sigma CSU (pCi/L, g, F):		
Duplicate Numerical Performance Indicator:		
(Based on the Percent Recoveries) MS/ MSD Duplicate RPD:		
MS/ MSD Duplicate Status vs Numerical Indicator:		
MS/ MSD Duplicate Status vs RPD:		
% RPD Limit:		

Evaluation of duplicate precision is not applicable if either the sample or duplicate results are below the MDC.

Comments:

LAM 1/31/23

****If all other QC criteria pass, this batch is acceptable. The matrix spike duplicate result indicates a possible bias for this sample only and may not be applicable to any other samples in this analytical batch.

RAMBOLL COC #: 1440702792-2023-0110-004

GA02461

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: 1 of 1

Section A Required Client Information:

Company:	Vistra Corp
Address:	13498 E. 900th St
Email To:	Brian.Voelker@VistraCorp.com
Phone: (217) 753-8911	Fax:
Requested Due Date/TAT:	standard

Section B Required Project Information:

Report To:	Brian Voelker
Copy To:	Jason Stuckey
Purchase Order No.:	
Project Name:	
Project Number:	2285

Section C Invoice Information:

Attention:	Jason Stuckey
Company Name:	Vistra Corp
Address:	see Section A
Quote Reference:	
Project Manager:	
Profile #:	

REGULATORY AGENCY

NPDES GROUND WATER DRINKING WATER

UST RCRA OTHER

Site Location STATE: IL

Section D Required Client Information

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	Radium 226 + Radium 228, total	Residual Chlorine (Y/N)	Project No./ Lab I.D.
1	AW-23	WT	G	1/10/22	0936		3			X							X		
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
16																			

SM 1/10/22

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
EDW-23Q1-845-301-R3		01/10/22	1600							
	RAMBOLL				1/10/22	1600	7.9	Y	Y	Y

SAMPLER NAME AND SIGNATURE			Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
PRINT Name of SAMPLER:	SAMUEL MALLOW					
SIGNATURE of SAMPLER:		DATE Signed (MM/DD/YY): 1/10/22				

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

February 01, 2023

Brian Voelker
Vistra - Edwards
604 Pierce Boulevard
O'Fallon, IL 62269

RE: RAMBOLL DELINEATION

Dear Brian Voelker:

Please find enclosed the analytical results for the **1** sample(s) the laboratory received on **1/10/23 4:00 pm** and logged in under work order **GA02452**. 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 Pace Analytical Services, LLC.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

Pace Analytical Services 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 General Manager, Lisa Grant, with any feedback you have about your experience with our laboratory at 309-683-1764 or lisa.grant@pacelabs.com.

Gail J Schindler

Gail Schindler
Project Manager
(309) 692-9688 x1716
gail.schindler@pacelabs.com

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

SAMPLE RECEIPT CHECK LIST

Items not applicable will be marked as in compliance

Work Order GA02452

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 received 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

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: GA02452-01
Name: AW-23
Matrix: Ground Water - Grab

Sampled: 01/10/23 09:36
Received: 01/10/23 16:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	50	mg/L		01/26/23 05:05	10	10	01/26/23 05:05	LAM	EPA 300.0 REV 2.1
Fluoride	0.302	mg/L		01/21/23 11:36	1	0.250	01/21/23 11:36	LAM	EPA 300.0 REV 2.1
Sulfate	190	mg/L		01/21/23 12:12	50	50	01/21/23 12:12	LAM	EPA 300.0 REV 2.1
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	380	mg/L		01/24/23 09:55	1	10	01/24/23 09:55	HRF	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		01/24/23 09:55	1	10	01/24/23 09:55	HRF	SM 2320B 1997*
Solids - total dissolved solids (TDS)	760	mg/L		01/16/23 11:08	1	26	01/16/23 12:25	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		01/18/23 09:10	5	3.0	01/20/23 10:18	JMW	EPA 6020A
Arsenic	1.2	ug/L		01/18/23 09:10	5	1.0	01/20/23 10:18	JMW	EPA 6020A
Barium	27	ug/L		01/18/23 09:10	5	1.0	01/20/23 10:18	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 10:18	JMW	EPA 6020A
Boron	550	ug/L		01/17/23 09:05	5	10	01/19/23 10:03	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 10:18	JMW	EPA 6020A
Calcium	130	mg/L		01/17/23 09:05	5	0.20	01/18/23 14:20	JMW	EPA 6020A
Chromium	< 4.0	ug/L		01/18/23 09:10	5	4.0	01/20/23 10:18	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		01/18/23 09:10	5	2.0	01/20/23 10:18	JMW	EPA 6020A
Lead	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 10:18	JMW	EPA 6020A
Magnesium	50	mg/L		01/17/23 09:05	5	0.10	01/18/23 14:20	JMW	EPA 6020A
Mercury	< 0.20	ug/L		01/18/23 09:10	5	0.20	01/20/23 10:18	JMW	EPA 6020A
Molybdenum	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 10:18	JMW	EPA 6020A
Potassium	1.1	mg/L	B	01/17/23 09:05	5	0.10	01/18/23 14:20	JMW	EPA 6020A
Selenium	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 10:18	JMW	EPA 6020A
Sodium	59	mg/L		01/17/23 09:05	5	0.10	01/18/23 14:20	JMW	EPA 6020A
Thallium	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 10:18	JMW	EPA 6020A
Lithium	< 20	ug/L		01/18/23 09:10	1	20	01/19/23 16:14	TJJ	EPA 6010B

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B323248 - No Prep - SM 2540C									
Blank (B323248-BLK1)				Prepared & Analyzed: 01/16/23					
Solids - total dissolved solids (TDS)	< 17	mg/L							
LCS (B323248-BS1)				Prepared & Analyzed: 01/16/23					
Solids - total dissolved solids (TDS)	920	mg/L		1000		92	84.9-109		
Batch B323334 - SW 3015 - EPA 6020A									
Blank (B323334-BLK1)				Prepared: 01/17/23 Analyzed: 01/18/23					
Boron	< 10	ug/L							
Calcium	< 0.20	mg/L							
Magnesium	< 0.10	mg/L							
Potassium	0.177	mg/L	B						
Sodium	0.195	mg/L							
LCS (B323334-BS1)				Prepared: 01/17/23 Analyzed: 01/18/23					
Boron	506	ug/L		555.6		91	80-120		
Calcium	5.53	mg/L		5.556		100	80-120		
Magnesium	5.59	mg/L		5.556		101	80-120		
Potassium	5.73	mg/L		5.556		103	80-120		
Sodium	5.49	mg/L		5.556		99	80-120		
Batch B323436 - SW 3015 - EPA 6020A									
Blank (B323436-BLK1)				Prepared: 01/18/23 Analyzed: 01/20/23					
Antimony	< 3.0	ug/L							
Arsenic	< 1.0	ug/L							
Barium	< 1.0	ug/L							
Beryllium	< 1.0	ug/L							
Cadmium	< 1.0	ug/L							
Chromium	< 4.0	ug/L							
Cobalt	< 2.0	ug/L							
Lead	< 1.0	ug/L							
Mercury	< 0.20	ug/L							
Molybdenum	< 1.0	ug/L							
Selenium	< 1.0	ug/L							
Thallium	< 1.0	ug/L							
Lithium	< 20	ug/L							
LCS (B323436-BS1)				Prepared: 01/18/23 Analyzed: 01/20/23					
Antimony	524	ug/L		555.6		94	80-120		
Arsenic	552	ug/L		555.6		99	80-120		
Barium	573	ug/L		555.6		103	80-120		
Beryllium	562	ug/L		555.6		101	80-120		
Cadmium	532	ug/L		555.6		96	80-120		
Chromium	533	ug/L		555.6		96	80-120		
Cobalt	545	ug/L		555.6		98	80-120		
Lead	541	ug/L		555.6		97	80-120		

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B323436 - SW 3015 - EPA 6020A									
LCS (B323436-BS1)				Prepared: 01/18/23 Analyzed: 01/20/23					
Mercury	53.9	ug/L		55.56		97	80-120		
Molybdenum	542	ug/L		555.6		98	80-120		
Selenium	567	ug/L		555.6		102	80-120		
Thallium	534	ug/L		555.6		96	80-120		
Lithium	516	ug/L		555.6		93	80-120		
Batch B323851 - IC No Prep - EPA 300.0 REV 2.1									
Calibration Blank (B323851-CCB1)				Prepared & Analyzed: 01/21/23					
Fluoride	0.00	mg/L							
Sulfate	0.00	mg/L							
Calibration Check (B323851-CCV1)				Prepared & Analyzed: 01/21/23					
Fluoride	5.11	mg/L		5.000		102	90-110		
Sulfate	4.82	mg/L		5.000		96	90-110		
Batch B324154 - IC No Prep - EPA 300.0 REV 2.1									
Calibration Blank (B324154-CCB1)				Prepared & Analyzed: 01/25/23					
Chloride	0.00	mg/L							
Calibration Check (B324154-CCV1)				Prepared & Analyzed: 01/25/23					
Chloride	4.80	mg/L		5.000		96	90-110		

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

NOTES

Specifications regarding method revisions, method modifications, and calculations used for analysis are available upon request. Please contact your project manager.

* Not a TNI accredited analyte

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

B Present in the method blank at 177 ug/L.

Gail J Schindler

Certified by: Gail Schindler, Project Manager

DRAFT

RAMBOLL COC#: 1940102792-2023-0110-002

GA07452

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: 1 of 1

Section A Required Client Information:

Company:	Vistra Corp
Address:	13498 E. 900th St
Email To:	Brian.Voelker@VistraCorp.com
Phone: (217) 753-8911	Fax:
Requested Due Date/TAT:	standard

Section B Required Project Information:

Report To:	Brian Voelker
Copy To:	Jason Stuckey
Purchase Order No.:	
Project Name:	
Project Number:	2285

Section C Invoice Information:

Attention:	Jason Stuckey
Company Name:	Vistra Corp
Address:	see Section A
Quote Reference:	
Project Manager:	
Profile #:	

REGULATORY AGENCY

NPDES GROUND WATER DRINKING WATER

UST RCRA OTHER

Site Location STATE: IL

Section D Required Client Information

SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Y/N	Analysis Test: EDW-845-301_R3	Residual Chlorine (Y/N)	Project No./ Lab I.D.
1	AW-23	WT	G	1/10/22	0936		6	X		X							X		
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
16																			

SM 1/10/22

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS: Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
EDW-23Q1-845-301-R3		01/10/23	1600							
R3 NO RADIUM 226 + RADIUM 228, TOTAL	RAMBOLL				1/10/23	1600	2.9	Y	Y	Y

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: SAMUEL MALLOW

SIGNATURE of SAMPLER: DATE Signed (MM/DD/YY): 1/10/22

DRAFT

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

February 13, 2023

Brian Voelker
Vistra - Edwards
604 Pierce Boulevard
O'Fallon, IL 62269

RE: RAMBOLL DELINEATION

Dear Brian Voelker:

Please find enclosed the analytical results for the **3** sample(s) the laboratory received on **1/10/23 4:00 pm** and logged in under work order **GA02470**. 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 Pace Analytical Services, LLC.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

Pace Analytical Services 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 General Manager, Lisa Grant, with any feedback you have about your experience with our laboratory at 309-683-1764 or lisa.grant@pacelabs.com.

Gail J Schindler

Gail Schindler
Project Manager
(309) 692-9688 x1716
gail.schindler@pacelabs.com

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

SAMPLE RECEIPT CHECK LIST

Items not applicable will be marked as in compliance

Work Order GA02470

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 received 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

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2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: GA02470-01
Name: AW-01
Matrix: Ground Water - Grab

Sampled: 01/10/23 14:14
Received: 01/10/23 16:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - Pace Analytical - Mt Juliet, Tn									
Rad 226 - Subcontract	0	pCi/L			1	0.721	02/02/23 16:14		904.0 903.0
Rad 226 and 228-Subcontract	0	pCi/L			1	1.44	02/03/23 11:55		904.0 903.0
Rad 228- Subcontract	-0.138	pCi/L			1	0.721	01/30/23 14:50		904.0 903.0

Sample: GA02470-02
Name: EMW-05
Matrix: Ground Water - Grab

Sampled: 01/10/23 11:41
Received: 01/10/23 16:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - Pace Analytical - Mt Juliet, Tn									
Rad 226 - Subcontract	-0.724	pCi/L			1	3.16	02/02/23 16:14		904.0 903.0
Rad 226 and 228-Subcontract	1.33	pCi/L			1	4.53	02/03/23 11:55		904.0 903.0
Rad 228- Subcontract	1.33	pCi/L			1	1.37	01/30/23 14:51		904.0 903.0

Sample: GA02470-03
Name: DUP-01
Matrix: Ground Water - Grab

Sampled: 01/10/23 11:41
Received: 01/10/23 16:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Miscellaneous - Pace Analytical - Mt Juliet, Tn									
Rad 226 - Subcontract	0.772	pCi/L			1	1.03	02/02/23 16:14		904.0 903.0
Rad 226 and 228-Subcontract	1.62	pCi/L			1	1.89	02/03/23 11:55		904.0 903.0
Rad 228- Subcontract	0.847	pCi/L			1	0.859	01/30/23 14:51		904.0 903.0

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

NOTES

Specifications regarding method revisions, method modifications, and calculations used for analysis are available upon request. Please contact your project manager.

* Not a TNI accredited analyte

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

DRAFT

Gail g Schindler

Certified by: Gail Schindler, Project Manager

Pace Analytical Services, LLC
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

February 06, 2023

Gail J. Schindler
PDC Laboratories
2231 W. Altorfer Drive
Peoria, IL 61615

RE: Project: GA02470
Pace Project No.: 30555853

Dear Gail Schindler:

Enclosed are the analytical results for sample(s) received by the laboratory on January 19, 2023. The results relate only to the samples included in this report. Results reported herein conform to the applicable TNI/NELAC Standards and the laboratory's Quality Manual, where applicable, unless otherwise noted in the body of the report.

The test results provided in this final report were generated by each of the following laboratories within the Pace Network:

- Pace Analytical Services - Greensburg

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Carla Cmar
carla.cmar@pacelabs.com
(724)850-5600
Project Manager

Enclosures

cc: Chenise Lambert-Sykes, PDC Laboratories, Inc.

DRAFT

Pace Analytical Services, LLC
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

CERTIFICATIONS

Project: GA02470
Pace Project No.: 30555853

Pace Analytical Services Pennsylvania
1638 Roseytown Rd Suites 2,3&4, Greensburg, PA 15601
ANAB DOD-ELAP Rad Accreditation #: L2417
Alabama Certification #: 41590
Arizona Certification #: AZ0734
Arkansas Certification
California Certification #: 04222CA
Colorado Certification #: PA01547
Connecticut Certification #: PH-0694
Delaware Certification
EPA Region 4 DW Rad
Florida/TNI Certification #: E87683
Georgia Certification #: C040
Florida: Cert E871149 SEKS WET
Guam Certification
Hawaii Certification
Idaho Certification
Illinois Certification
Indiana Certification
Iowa Certification #: 391
Kansas/TNI Certification #: E-10358
Kentucky Certification #: KY90133
KY WW Permit #: KY0098221
KY WW Permit #: KY0000221
Louisiana DHH/TNI Certification #: LA180012
Louisiana DEQ/TNI Certification #: 4086
Maine Certification #: 2017020
Maryland Certification #: 308
Massachusetts Certification #: M-PA1457
Michigan/PADEP Certification #: 9991
Missouri Certification #: 235
Montana Certification #: Cert0082
Nebraska Certification #: NE-OS-29-14
Nevada Certification #: PA014572018-1
New Hampshire/TNI Certification #: 297617
New Jersey/TNI Certification #: PA051
New Mexico Certification #: PA01457
New York/TNI Certification #: 10888
North Carolina Certification #: 42706
North Dakota Certification #: R-190
Ohio EPA Rad Approval: #41249
Oregon/TNI Certification #: PA200002-010
Pennsylvania/TNI Certification #: 65-00282
Puerto Rico Certification #: PA01457
Rhode Island Certification #: 65-00282
South Dakota Certification
Tennessee Certification #: 02867
Texas/TNI Certification #: T104704188-17-3
Utah/TNI Certification #: PA014572017-9
USDA Soil Permit #: P330-17-00091
Vermont Dept. of Health: ID# VT-0282
Virgin Island/PADEP Certification
Virginia/VELAP Certification #: 460198
Washington Certification #: C868
West Virginia DEP Certification #: 143
West Virginia DHHR Certification #: 9964C
Wisconsin Approve List for Rad
Wyoming Certification #: 8TMS-L

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Greensburg, PA 15601
(724)850-5600

SAMPLE SUMMARY

Project: GA02470
Pace Project No.: 30555853

Lab ID	Sample ID	Matrix	Date Collected	Date Received
30555853001	**AW-01**	Water	01/10/23 14:14	01/19/23 10:15
30555853002	**EMW-05**	Water	01/10/23 11:41	01/19/23 10:15
30555853003	**DUP-01**	Water	01/10/23 11:41	01/19/23 10:15

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Greensburg, PA 15601
(724)850-5600

SAMPLE ANALYTE COUNT

Project: GA02470
Pace Project No.: 30555853

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
30555853001	**AW-01**	EPA 903.1	JDZ	1	PASI-PA
		EPA 904.0	ZPC	1	PASI-PA
		Total Radium Calculation	JAL	1	PASI-PA
30555853002	**EMW-05**	EPA 903.1	JDZ	1	PASI-PA
		EPA 904.0	ZPC	1	PASI-PA
		Total Radium Calculation	JAL	1	PASI-PA
30555853003	**DUP-01**	EPA 903.1	JDZ	1	PASI-PA
		EPA 904.0	ZPC	1	PASI-PA
		Total Radium Calculation	JAL	1	PASI-PA

PASI-PA = Pace Analytical Services - Greensburg

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Greensburg, PA 15601
(724)850-5600

PROJECT NARRATIVE

Project: GA02470
Pace Project No.: 30555853

Method: **EPA 903.1**
Description: 903.1 Radium 226
Client: PDC/Pace Analytical Services (Peoria, IL)
Date: February 06, 2023

General Information:
3 samples were analyzed for EPA 903.1 by Pace Analytical Services Greensburg. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

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Greensburg, PA 15601
(724)850-5600

PROJECT NARRATIVE

Project: GA02470
Pace Project No.: 30555853

Method: **EPA 904.0**
Description: 904.0 Radium 228
Client: PDC/Pace Analytical Services (Peoria, IL)
Date: February 06, 2023

General Information:
3 samples were analyzed for EPA 904.0 by Pace Analytical Services Greensburg. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

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1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

PROJECT NARRATIVE

Project: GA02470
Pace Project No.: 30555853

Method: **Total Radium Calculation**
Description: Total Radium 228+226
Client: PDC/Pace Analytical Services (Peoria, IL)
Date: February 06, 2023

General Information:
3 samples were analyzed for Total Radium Calculation by Pace Analytical Services Greensburg. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

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Pace Analytical Services, LLC
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

ANALYTICAL RESULTS - RADIOCHEMISTRY

Project: GA02470
Pace Project No.: 30555853

Sample: AW-01 **Lab ID: 30555853001** Collected: 01/10/23 14:14 Received: 01/19/23 10:15 Matrix: Water
PWS: Site ID: Sample Type:

Parameters	Method	Act ± Unc (MDC) Carr Trac	Units	Analyzed	CAS No.	Qual
	Pace Analytical Services - Greensburg					
Radium-226	EPA 903.1	**0.000 ± 0.347 (0.721) C:NA T:95%**	pCi/L	02/02/23 16:14	13982-63-3	
	Pace Analytical Services - Greensburg					
Radium-228	EPA 904.0	**-0.138 ± 0.300 (0.721) C:88% T:92%**	pCi/L	01/30/23 14:50	15262-20-1	
	Pace Analytical Services - Greensburg					
Total Radium	Total Radium Calculation	**0.000 ± 0.647 (1.44)**	pCi/L	02/03/23 11:55	7440-14-4	

Sample: EMW-05 **Lab ID: 30555853002** Collected: 01/10/23 11:41 Received: 01/19/23 10:15 Matrix: Water
PWS: Site ID: Sample Type:

Parameters	Method	Act ± Unc (MDC) Carr Trac	Units	Analyzed	CAS No.	Qual
	Pace Analytical Services - Greensburg					
Radium-226	EPA 903.1	**-0.724 ± 1.25 (3.16) C:NA T:51%**	pCi/L	02/02/23 16:14	13982-63-3	
	Pace Analytical Services - Greensburg					
Radium-228	EPA 904.0	**1.33 ± 0.753 (1.37) C:90% T:82%**	pCi/L	01/30/23 14:51	15262-20-1	
	Pace Analytical Services - Greensburg					
Total Radium	Total Radium Calculation	**1.33 ± 2.00 (4.53)**	pCi/L	02/03/23 11:55	7440-14-4	

Sample: DUP-01 **Lab ID: 30555853003** Collected: 01/10/23 11:41 Received: 01/19/23 10:15 Matrix: Water
PWS: Site ID: Sample Type:

Parameters	Method	Act ± Unc (MDC) Carr Trac	Units	Analyzed	CAS No.	Qual
	Pace Analytical Services - Greensburg					
Radium-226	EPA 903.1	**0.772 ± 0.699 (1.03) C:NA T:57%**	pCi/L	02/02/23 16:14	13982-63-3	
	Pace Analytical Services - Greensburg					
Radium-228	EPA 904.0	**0.847 ± 0.470 (0.859) C:88% T:74%**	pCi/L	01/30/23 14:51	15262-20-1	
	Pace Analytical Services - Greensburg					
Total Radium	Total Radium Calculation	**1.62 ± 1.17 (1.89)**	pCi/L	02/03/23 11:55	7440-14-4	

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REPORT OF LABORATORY ANALYSIS

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1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

QUALITY CONTROL - RADIOCHEMISTRY

Project: GA02470
Pace Project No.: 30555853

QC Batch: 561786
QC Batch Method: EPA 904.0
Analysis Method: EPA 904.0
Analysis Description: 904.0 Radium 228
Laboratory: Pace Analytical Services - Greensburg
Associated Lab Samples: 30555853001, 30555853002, 30555853003

METHOD BLANK: 2728640
Matrix: Water
Associated Lab Samples: 30555853001, 30555853002, 30555853003

Parameter	Act ± Unc (MDC) Carr Trac	Units	Analyzed	Qualifiers
Radium-228	0.107 ± 0.263 (0.587) C:91% T:97%	pCi/L	01/30/23 14:50	

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Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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Greensburg, PA 15601
(724)850-5600

QUALITY CONTROL - RADIOCHEMISTRY

Project: GA02470
Pace Project No.: 30555853

QC Batch: 561782
QC Batch Method: EPA 903.1
Analysis Method: EPA 903.1
Analysis Description: 903.1 Radium-226
Laboratory: Pace Analytical Services - Greensburg
Associated Lab Samples: 30555853001, 30555853002, 30555853003

METHOD BLANK: 2728633 Matrix: Water
Associated Lab Samples: 30555853001, 30555853002, 30555853003

Parameter	Act ± Unc (MDC) Carr Trac	Units	Analyzed	Qualifiers
Radium-226	0.165 ± 0.230 (0.383) C:NA T:99%	pCi/L	02/02/23 16:14	

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Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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Pace Analytical Services, LLC
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

QUALIFIERS

Project: GA02470
Pace Project No.: 30555853

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Reported results are not rounded until the final step prior to reporting. Therefore, calculated parameters that are typically reported as "Total" may vary slightly from the sum of the reported component parameters.

Act - Activity

Unc - Uncertainty: For Safe Drinking Water Act (SDWA) analyses, the reported Unc. Is the calculated Count Uncertainty (95% confidence interval) using a coverage factor of 1.96. For all other matrices (non-SDWA), the reported Unc. is the calculated Expanded Uncertainty (aka Combined Standard Uncertainty, CSU), reported at the 95% confidence interval using a coverage factor of 1.96.

Gamma Spec: The Unc. reported for all gamma-spectroscopy analyses (EPA 901.1), is the calculated Expanded Uncertainty (CSU) at the 95.4% confidence interval, using a coverage factor of 2.0.

(MDC) - Minimum Detectable Concentration

Trac - Tracer Recovery (%)

Carr - Carrier Recovery (%)

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

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Internal Transfer Chain of Custody

State of Origin: IL
Cert. Needed: [X] YES [ ] NO

Pace Analytical

Workorder: GA02470 **Workorder Name:** VISTRA - EDWARDS **Owner Received Date:** 1/10/2023 **Results Requ By:** 2/14/2023

Report To:	Subcontract To:
Gail Schindler Pace Analytical - IL/MO 2231 W. Altorfer Drive Peoria, IL 61615 800-752-6651	Pace Analytical Services, LLC 1638 Roseytown Rd - Suites 2,3,4 Greensburg, PA 15601 (724)850-5600

Item	Sample ID	Sample Type	Collect Date/Time	Lab ID	Matrix	Preserved Containers	Requested Analysis: Radium 226/228	LAB USE ONLY
1	AW-01	GRAB	1/10/2023 14:14	GA02470-01	GW		X	
2	EMW-05	GRAB	1/10/2023 11:41	GA02470-02	GW		X	
3	DUP-01	GRAB	1/10/2023 11:41	GA02470-03	GW		X	
4								
5								
6								
7								
8								
9								
10								

Transfers	Released By	Date/Time	Reveived By	Date/Time	Comments
1	Melissa Sibley	1/10/23 10:00			Needs reported as 226, 228 and also combined 226/228 Include QC summary
2					
3					

Cooler Temperature on Receipt _____ °C	Custody Seal Y or N	Received on Ice Y or N	Sample Intact Y or N

***In order to maintain client confidentiality, location/name of the sampling site, sampler's name and signature may not be provided on this COC document. This chain of custody is considered complete as is since this information is available in the owner laboratory.

DRAFT

Pace Analytical
www.pacelabs.com

Ship to :
Pace Analytical Services, LLC
1638 Roseytown Rd - Suites 2,3,4
Greensburg, PA 15601

(724)850-5600

INTER_LABORATORY WORK ORDER # GA02470
(To be complete by sending lab)

Sending Project No:	GA02470
Receiving Project No:	
Check Box for Consolidated Invoice:	
Date Prepared:	1/16/2023
REQUESTED COMPLETION DATE:	2/14/2023

Sending Region	IR72-IL/MO	Sending Project Mgr.	GAIL SCHINDLER
Receiving Region	GREENSBURG	External Client	VISTRA - EDWARDS
State of Sample Origin	IL	QC Deliverable	**STD Report**

All questions should be addressed to sending project manager.

Requested Reportable Units _____ Report Wet or Dry Weight? _____ Cert Needed: IL

WORK REQUESTED						
Method Description	**Container Type**	**Quantity of**	**Preservative**	**Quantity of**	**Unit Price**	**Amount**
Radium 226/228		1		3	$242.10	$726.30
					$0.00	$0.00
						$0.00
					TOTAL	$726.30

Special Requirements: Report as 226, 228 & combined 226/228. Include QC summary

Receiving Region Department	**Acctg. Code**	**Totals from above**	**Revenue Allocation**	
			Receiving Region (80%)	Client Services Dept.
radiological	38	$726.30	$581.04	$145.26
* Custom Revenue Allocation		TOTAL	$581.04	$145.26

FOR ANALYTICAL WORK COMPLETED THIS SECTION ALSO

Return Samples to Sending Region: [ ] **Yes** [X] **No**

CONFIRMATION OF WORK COMPLETED

Date Completed: _____ Receiving Project Manager: _____

Original sent to the receiving lab - Copy kept at the sending lab.

When work completed: Original sent to the ABM at the receiving laboratory. Copies are made to corporate as needed.

DRAFT

Quality Control Sample Performance Assessment

Pace Analytical™ www.pacelabs.com

Test:	Ra-226
Analyst:	JDZ
Date:	1/24/2023
Batch ID:	71083
Matrix:	DW

Analyst Must Manually Enter All Fields Highlighted in Yellow.

Method Blank Assessment	
MB Sample ID	2728633
MB concentration:	0.165
M/B Counting Uncertainty:	0.229
MB MDC:	0.383
MB Numerical Performance Indicator:	1.41
MB Status vs Numerical Indicator:	N/A
MB Status vs. MDC:	Pass

Laboratory Control Sample Assessment	LCSD (Y or N)?	N
	LCS71083	LCSD71083
Count Date:	2/2/2023	
Spike I.D.:	21-040	
Spike Concentration (pCi/mL):	32.421	
Volume Used (mL):	0.10	
Aliquot Volume (L, g, F):	0.652	
Target Conc. (pCi/L, g, F):	4.970	
Uncertainty (Calculated):	0.234	
Result (pCi/L, g, F):	4.967	
LCS/LCSD Counting Uncertainty (pCi/L, g, F):	0.942	
Numerical Performance Indicator:	-0.01	
Percent Recovery:	99.93%	
Status vs Numerical Indicator:	N/A	
Status vs Recovery:	Pass	
Upper % Recovery Limits:	133%	
Lower % Recovery Limits:	73%	

Sample Matrix Spike Control Assessment	MS/MSD 1	MS/MSD 2
Sample Collection Date:		
Sample I.D.	TW71083	
Sample MS I.D.	TWMS71083	
Sample MSD I.D.		
Spike I.D.:	21-040	
MS/MSD Decay Corrected Spike Concentration (pCi/mL):	34.197	
Spike Volume Used in MS (mL):	0.20	
Spike Volume Used in MSD (mL):		
MS Aliquot (L, g, F):	0.652	
MS Target Conc.(pCi/L, g, F):	10.496	
MSD Aliquot (L, g, F):		
MSD Target Conc. (pCi/L, g, F):		
MS Spike Uncertainty (calculated):	0.493	
MSD Spike Uncertainty (calculated):		
Sample Result:	0.208	
Sample Result Counting Uncertainty (pCi/L, g, F):	0.245	
Sample Matrix Spike Result:	12.308	
Matrix Spike Result Counting Uncertainty (pCi/L, g, F):	1.424	
Sample Matrix Spike Duplicate Result:		
Matrix Spike Duplicate Result Counting Uncertainty (pCi/L, g, F):		
MS Numerical Performance Indicator:	2.060	
MSD Numerical Performance Indicator:		
MS Percent Recovery:	115.29%	
MSD Percent Recovery:		
MS Status vs Numerical Indicator:	N/A	
MSD Status vs Numerical Indicator:		
MS Status vs Recovery:	Pass	
MSD Status vs Recovery:		
MS/MSD Upper % Recovery Limits:	136%	
MS/MSD Lower % Recovery Limits:	71%	

Duplicate Sample Assessment		
Sample I.D.:	TWDUP71083	Enter Duplicate sample IDs if other than LCS/LCSD in the space below.
Duplicate Sample I.D.	TW71083	
Sample Result (pCi/L, g, F):	0.313	
Sample Result Counting Uncertainty (pCi/L, g, F):	0.243	
Sample Duplicate Result (pCi/L, g, F):	0.208	
Sample Duplicate Result Counting Uncertainty (pCi/L, g, F):	0.245	
Are sample and/or duplicate results below RL?	See Below ##	
Duplicate Numerical Performance Indicator:	0.597	TWDUP71083
Duplicate RPD:	40.26%	TW71083
Duplicate Status vs Numerical Indicator:	N/A	
Duplicate Status vs RPD:	Fail***	
% RPD Limit:	32%	

Matrix Spike/Matrix Spike Duplicate Sample Assessment		
Sample I.D.		
Sample MS I.D.		
Sample MSD I.D.		
Sample Matrix Spike Result:		
Matrix Spike Result Counting Uncertainty (pCi/L, g, F):		
Sample Matrix Spike Duplicate Result:		
Matrix Spike Duplicate Result Counting Uncertainty (pCi/L, g, F):		
Duplicate Numerical Performance Indicator:		
(Based on the Percent Recoveries) MS/ MSD Duplicate RPD:		
MS/ MSD Duplicate Status vs Numerical Indicator:		
MS/ MSD Duplicate Status vs RPD:		
% RPD Limit:		

Evaluation of duplicate precision is not applicable if either the sample or duplicate results are below the RL.

Comments:

~~***Batch must be re-prepped due to unacceptable precision~~ results < MDC, nt
Au 2/3/23

JDZ 2/3/23

Quality Control Sample Performance Assessment

Pace Analytical™ www.pacelabs.com

Test:	Ra-228
Analyst:	ZPC
Date:	1/25/2023
Worklist:	71084
Matrix:	WT

Analyst Must Manually Enter All Fields Highlighted in Yellow.

Method Blank Assessment	
MB Sample ID	2728640
MB concentration:	0.107
M/B 2 Sigma CSU:	0.263
MB MDC:	0.587
MB Numerical Performance Indicator:	0.80
MB Status vs Numerical Indicator:	Pass
MB Status vs. MDC:	Pass

Laboratory Control Sample Assessment	LCSD (Y or N)?	N
	LCS71084	LCSD71084
Count Date:	1/30/2023	
Spike I.D.:	22-040	
Decay Corrected Spike Concentration (pCi/mL):	33.720	
Volume Used (mL):	0.10	
Aliquot Volume (L, g, F):	0.810	
Target Conc. (pCi/L, g, F):	4.165	
Uncertainty (Calculated):	0.204	
Result (pCi/L, g, F):	4.338	
LCS/LCSD 2 Sigma CSU (pCi/L, g, F):	0.994	
Numerical Performance Indicator:	0.33	
Percent Recovery:	104.14%	
Status vs Numerical Indicator:	N/A	
Status vs Recovery:	Pass	
Upper % Recovery Limits:	135%	
Lower % Recovery Limits:	60%	

Sample Matrix Spike Control Assessment	MS/MSD 1	MS/MSD 2
Sample Collection Date:	1/24/2023	
Sample I.D.	TW71084	
Sample MS I.D.	TWMS71084	
Sample MSD I.D.		
Spike I.D.:	22-040	
MS/MSD Decay Corrected Spike Concentration (pCi/mL):	33.788	
Spike Volume Used in MS (mL):	0.20	
Spike Volume Used in MSD (mL):		
MS Aliquot (L, g, F):	0.801	
MS Target Conc.(pCi/L, g, F):	8.442	
MSD Aliquot (L, g, F):		
MSD Target Conc. (pCi/L, g, F):		
MS Spike Uncertainty (calculated):	0.414	
MSD Spike Uncertainty (calculated):		
Sample Result:	0.274	
Sample Result 2 Sigma CSU (pCi/L, g, F):	0.342	
Sample Matrix Spike Result:	6.315	
Matrix Spike Result 2 Sigma CSU (pCi/L, g, F):	1.297	
Sample Matrix Spike Duplicate Result:		
Matrix Spike Duplicate Result 2 Sigma CSU (pCi/L, g, F):		
MS Numerical Performance Indicator:	-3.352	
MSD Numerical Performance Indicator:		
MS Percent Recovery:	71.57%	
MSD Percent Recovery:		
MS Status vs Numerical Indicator:	Fail****	
MSD Status vs Numerical Indicator:		
MS Status vs Recovery:	Pass	
MSD Status vs Recovery:		
MS/MSD Upper % Recovery Limits:	135%	
MS/MSD Lower % Recovery Limits:	60%	

Duplicate Sample Assessment		
Sample I.D.:	TW71084	Enter Duplicate sample IDs if other than LCS/LCSD in the space below.
Duplicate Sample I.D.	TWDUP71084	
Sample Result (pCi/L, g, F):	0.274	
Sample Result 2 Sigma CSU (pCi/L, g, F):	0.342	
Sample Duplicate Result (pCi/L, g, F):	0.074	
Sample Duplicate Result 2 Sigma CSU (pCi/L, g, F):	0.293	
Are sample and/or duplicate results below RL?	See Below ##	
Duplicate Numerical Performance Indicator:	0.869	TW71084
Duplicate RPD:	114.57%	TWDUP71084
Duplicate Status vs Numerical Indicator:	Pass	
Duplicate Status vs RPD:	Fail***	
% RPD Limit:	36%	

Matrix Spike/Matrix Spike Duplicate Sample Assessment		
Sample I.D.		
Sample MS I.D.		
Sample MSD I.D.		
Sample Matrix Spike Result:		
Matrix Spike Result 2 Sigma CSU (pCi/L, g, F):		
Sample Matrix Spike Duplicate Result:		
Matrix Spike Duplicate Result 2 Sigma CSU (pCi/L, g, F):		
Duplicate Numerical Performance Indicator:		
(Based on the Percent Recoveries) MS/ MSD Duplicate RPD:		
MS/ MSD Duplicate Status vs Numerical Indicator:		
MS/ MSD Duplicate Status vs RPD:		
% RPD Limit:		

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1/31/23

Evaluation of duplicate precision is not applicable if either the sample or duplicate results are below the MDC.

Comments:

VAM 1/31/23

****If all other QC criteria pass, this batch is acceptable. The matrix spike duplicate result indicates a possible bias for this sample only and may not be applicable to any other samples in this analytical batch.

RAMBOLL COC#: 1940102792-2023-0110-001
GA02470

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Section A Required Client Information:

Company:	Vistra Corp
Address:	13498 E. 900th St
Email To:	Brian.Voelker@VistraCorp.com
Phone: (217) 753-8911	Fax:
Requested Due Date/TAT:	standard

Section B Required Project Information:

Report To:	Brian Voelker
Copy To:	Jason Stuckey
Purchase Order No.:	
Project Name:	
Project Number:	2285

Section C Invoice Information:

Attention:	Jason Stuckey
Company Name:	Vistra Corp
Address:	see Section A
Quote Reference:	
Project Manager:	
Profile #	

REGULATORY AGENCY

NPDES GROUND WATER DRINKING WATER
UST RCRA OTHER

Site Location STATE: IL

Section D Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	Radium 226 + Radium 228, total	Residual Chlorine (Y/N)	Project No./ Lab I.D.
1	AW-01	WT	G	1/10/22	1124		1			X						X	X		
2	EMW-05	1	1	1	1141		1			X						X	X		
3	DUP-01	1	1	1	1141		1			X						X	X		
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
16																			

SM 1/10/22

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS: Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
EDW-23Q1-845-301-R3		01/10/23	1600							
	RAMBOLL				1/10/23	1600	7.9	Y	Y	Y

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: SAMUEL MALLOW

SIGNATURE of SAMPLER: SMallow DATE Signed (MM/DD/YY): 1/10/22

DRAFT

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

February 01, 2023

Brian Voelker
Vistra - Edwards
604 Pierce Boulevard
O'Fallon, IL 62269

RE: RAMBOLL DELINEATION

Dear Brian Voelker:

Please find enclosed the analytical results for the **4** sample(s) the laboratory received on **1/10/23 4:00 pm** and logged in under work order **GA01675**. 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 Pace Analytical Services, LLC.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

Pace Analytical Services 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 General Manager, Lisa Grant, with any feedback you have about your experience with our laboratory at 309-683-1764 or lisa.grant@pacelabs.com.

Gail J Schindler

Gail Schindler
Project Manager
(309) 692-9688 x1716
gail.schindler@pacelabs.com

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

SAMPLE RECEIPT CHECK LIST

Items not applicable will be marked as in compliance

Work Order GA01675

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
NO	COC & labels match
YES	Sample labels are legible
YES	Appropriate bottle(s) received
YES	Sufficient sample volume received
YES	Sample containers received 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
NO	Current PDC COC submitted
NO	Case narrative provided

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: GA01675-01
Name: AW-01
Matrix: Ground Water - Grab

Sampled: 01/10/23 14:14
Received: 01/10/23 16:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	14	mg/L	Q4	01/21/23 11:07	10	10	01/21/23 11:07	LAM	EPA 300.0 REV 2.1
Sulfate	41	mg/L		01/24/23 19:48	10	10	01/24/23 19:48	CRD	EPA 300.0 REV 2.1
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	440	mg/L		01/17/23 10:08	1	2.0	01/17/23 10:08	HRF	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		01/17/23 10:08	1	2.0	01/17/23 10:08	HRF	SM 2320B 1997*
Fluoride	0.277	mg/L		01/27/23 13:26	1	0.250	01/27/23 13:26	ANK	SM 4500F C 1997
Solids - total dissolved solids (TDS)	760	mg/L		01/16/23 11:08	1	26	01/16/23 12:25	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		01/17/23 08:50	5	3.0	01/19/23 12:32	JMW	EPA 6020A
Arsenic	7.1	ug/L		01/17/23 08:50	5	1.0	01/19/23 12:32	JMW	EPA 6020A
Barium	120	ug/L		01/17/23 08:50	5	1.0	01/19/23 12:32	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		01/17/23 08:50	5	1.0	01/19/23 12:32	JMW	EPA 6020A
Boron	75	ug/L		01/17/23 08:50	5	10	01/19/23 12:32	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		01/17/23 08:50	5	1.0	01/19/23 12:32	JMW	EPA 6020A
Calcium	170	mg/L	Q4	01/17/23 08:50	5	0.20	01/19/23 12:32	JMW	EPA 6020A
Chromium	< 4.0	ug/L		01/17/23 08:50	5	4.0	01/19/23 12:32	JMW	EPA 6020A
Cobalt	3.7	ug/L		01/17/23 08:50	5	2.0	01/19/23 12:32	JMW	EPA 6020A
Lead	< 1.0	ug/L		01/17/23 08:50	5	1.0	01/19/23 12:32	JMW	EPA 6020A
Magnesium	73	mg/L	Q4	01/17/23 08:50	5	0.10	01/19/23 12:32	JMW	EPA 6020A
Mercury	< 0.20	ug/L		01/17/23 08:50	5	0.20	01/19/23 12:32	JMW	EPA 6020A
Molybdenum	5.1	ug/L		01/17/23 08:50	5	1.0	01/19/23 12:32	JMW	EPA 6020A
Potassium	0.98	mg/L	B	01/17/23 08:50	5	0.10	01/19/23 12:32	JMW	EPA 6020A
Selenium	< 1.0	ug/L		01/17/23 08:50	5	1.0	01/19/23 12:32	JMW	EPA 6020A
Sodium	22	mg/L		01/17/23 08:50	5	0.10	01/19/23 12:32	JMW	EPA 6020A
Thallium	< 1.0	ug/L		01/17/23 08:50	5	1.0	01/19/23 12:32	JMW	EPA 6020A
Lithium	< 0.020	mg/L		01/17/23 08:50	1	0.020	01/24/23 14:03	TJJ	EPA 6010B

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2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: GA01675-02
Name: EMW-05
Matrix: Ground Water - Grab

Sampled: 01/10/23 11:41
Received: 01/10/23 16:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	29	mg/L	Q4	01/21/23 12:20	5	5.0	01/21/23 12:20	LAM	EPA 300.0 REV 2.1
Fluoride	0.264	mg/L		01/21/23 11:26	1	0.250	01/21/23 11:26	LAM	EPA 300.0 REV 2.1
Sulfate	130	mg/L		01/24/23 20:06	25	25	01/24/23 20:06	CRD	EPA 300.0 REV 2.1
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	400	mg/L		01/17/23 10:08	1	2.0	01/17/23 10:08	HRF	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		01/17/23 10:08	1	2.0	01/17/23 10:08	HRF	SM 2320B 1997*
Solids - total dissolved solids (TDS)	830	mg/L		01/16/23 11:08	1	26	01/16/23 12:25	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		01/18/23 09:10	5	3.0	01/20/23 09:25	JMW	EPA 6020A
Arsenic	20	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:25	JMW	EPA 6020A
Barium	650	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:25	JMW	EPA 6020A
Beryllium	3.9	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:25	JMW	EPA 6020A
Boron	320	ug/L		01/17/23 08:50	5	10	01/19/23 12:36	JMW	EPA 6020A
Cadmium	2.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:25	JMW	EPA 6020A
Calcium	230	mg/L		01/17/23 08:50	5	0.20	01/19/23 12:36	JMW	EPA 6020A
Chromium	130	ug/L		01/18/23 09:10	5	4.0	01/20/23 09:25	JMW	EPA 6020A
Cobalt	67	ug/L		01/18/23 09:10	5	2.0	01/20/23 09:25	JMW	EPA 6020A
Lead	74	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:25	JMW	EPA 6020A
Magnesium	110	mg/L		01/17/23 08:50	5	0.10	01/19/23 12:36	JMW	EPA 6020A
Mercury	0.32	ug/L		01/18/23 09:10	5	0.20	01/20/23 11:37	JMW	EPA 6020A
Molybdenum	4.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:25	JMW	EPA 6020A
Potassium	7.1	mg/L		01/17/23 08:50	5	0.10	01/19/23 12:36	JMW	EPA 6020A
Selenium	3.6	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:25	JMW	EPA 6020A
Sodium	21	mg/L		01/17/23 08:50	5	0.10	01/19/23 12:36	JMW	EPA 6020A
Thallium	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:25	JMW	EPA 6020A
Lithium	0.092	mg/L		01/18/23 09:10	1	0.020	01/19/23 16:01	TJJ	EPA 6010B

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2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: GA01675-03
Name: EB-01
Matrix: Ground Water - Grab

Sampled: 01/10/23 15:00
Received: 01/10/23 16:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Total Metals - PIA									
Antimony	< 3.0	ug/L		01/18/23 09:10	5	3.0	01/20/23 09:29	JMW	EPA 6020A
Arsenic	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:29	JMW	EPA 6020A
Barium	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:29	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:29	JMW	EPA 6020A
Boron	26	ug/L		01/17/23 08:50	5	10	01/19/23 12:39	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:29	JMW	EPA 6020A
Calcium	< 0.20	mg/L		01/17/23 08:50	5	0.20	01/19/23 12:39	JMW	EPA 6020A
Chromium	< 4.0	ug/L		01/18/23 09:10	5	4.0	01/20/23 09:29	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		01/18/23 09:10	5	2.0	01/20/23 09:29	JMW	EPA 6020A
Lead	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:29	JMW	EPA 6020A
Magnesium	< 0.10	mg/L		01/17/23 08:50	5	0.10	01/19/23 12:39	JMW	EPA 6020A
Mercury	< 0.20	ug/L		01/18/23 09:10	5	0.20	01/20/23 09:29	JMW	EPA 6020A
Molybdenum	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:29	JMW	EPA 6020A
Potassium	0.17	mg/L	B	01/17/23 08:50	5	0.10	01/19/23 12:39	JMW	EPA 6020A
Selenium	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:29	JMW	EPA 6020A
Sodium	0.27	mg/L	Ba	01/17/23 08:50	5	0.10	01/19/23 12:39	JMW	EPA 6020A
Thallium	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:29	JMW	EPA 6020A
Lithium	< 0.020	mg/L		01/18/23 09:10	1	0.020	01/19/23 16:03	TJJ	EPA 6010B

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: GA01675-04
Name: DUP-01
Matrix: Ground Water - Grab

Sampled: 01/10/23 11:41
Received: 01/10/23 16:00

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	30	mg/L		01/21/23 13:50	5	5.0	01/21/23 13:50	LAM	EPA 300.0 REV 2.1
Fluoride	0.261	mg/L		01/21/23 13:32	1	0.250	01/21/23 13:32	LAM	EPA 300.0 REV 2.1
Sulfate	130	mg/L		01/24/23 20:24	25	25	01/24/23 20:24	CRD	EPA 300.0 REV 2.1
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	380	mg/L		01/17/23 10:08	1	2.0	01/17/23 10:08	HRF	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 2.0	mg/L		01/17/23 10:08	1	2.0	01/17/23 10:08	HRF	SM 2320B 1997*
Solids - total dissolved solids (TDS)	800	mg/L		01/16/23 11:08	1	26	01/16/23 12:25	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		01/18/23 09:10	5	3.0	01/20/23 09:33	JMW	EPA 6020A
Arsenic	11	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:33	JMW	EPA 6020A
Barium	470	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:33	JMW	EPA 6020A
Beryllium	2.6	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:33	JMW	EPA 6020A
Boron	310	ug/L		01/17/23 08:50	5	10	01/19/23 12:43	JMW	EPA 6020A
Cadmium	1.4	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:33	JMW	EPA 6020A
Calcium	210	mg/L		01/17/23 08:50	5	0.20	01/19/23 12:43	JMW	EPA 6020A
Chromium	89	ug/L		01/18/23 09:10	5	4.0	01/20/23 09:33	JMW	EPA 6020A
Cobalt	46	ug/L		01/18/23 09:10	5	2.0	01/20/23 09:33	JMW	EPA 6020A
Lead	52	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:33	JMW	EPA 6020A
Magnesium	100	mg/L		01/17/23 08:50	5	0.10	01/19/23 12:43	JMW	EPA 6020A
Mercury	0.24	ug/L		01/18/23 09:10	5	0.20	01/20/23 11:40	JMW	EPA 6020A
Molybdenum	3.2	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:33	JMW	EPA 6020A
Potassium	5.5	mg/L		01/17/23 08:50	5	0.10	01/19/23 12:43	JMW	EPA 6020A
Selenium	1.9	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:33	JMW	EPA 6020A
Sodium	22	mg/L		01/17/23 08:50	5	0.10	01/19/23 12:43	JMW	EPA 6020A
Thallium	< 1.0	ug/L		01/18/23 09:10	5	1.0	01/20/23 09:33	JMW	EPA 6020A
Lithium	0.066	mg/L		01/18/23 09:10	1	0.020	01/19/23 16:06	TJJ	EPA 6010B

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2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B323248 - No Prep - SM 2540C									
Blank (B323248-BLK1)				Prepared & Analyzed: 01/16/23					
Solids - total dissolved solids (TDS)	< 17	mg/L							
LCS (B323248-BS1)				Prepared & Analyzed: 01/16/23					
Solids - total dissolved solids (TDS)	920	mg/L		1000		92	84.9-109		
Duplicate (B323248-DUP1)	**Sample: GA01675-01**			Prepared & Analyzed: 01/16/23					
Solids - total dissolved solids (TDS)	780	mg/L			765			2	5
Batch B323330 - SW 3015 - EPA 6020A									
Blank (B323330-BLK1)				Prepared: 01/17/23 Analyzed: 01/19/23					
Antimony	< 3.0	ug/L							
Arsenic	< 1.0	ug/L							
Barium	< 1.0	ug/L							
Beryllium	< 1.0	ug/L							
Boron	< 10	ug/L							
Cadmium	< 1.0	ug/L							
Calcium	< 0.20	mg/L							
Chromium	< 4.0	ug/L							
Cobalt	< 2.0	ug/L							
Lead	< 1.0	ug/L							
Magnesium	< 0.10	mg/L							
Mercury	< 0.20	ug/L							
Molybdenum	< 1.0	ug/L							
Potassium	0.256	mg/L	B						
Selenium	< 1.0	ug/L							
Sodium	0.312	mg/L	Ba						
Thallium	< 1.0	ug/L							
Lithium	< 0.020	mg/L							
LCS (B323330-BS1)				Prepared: 01/17/23 Analyzed: 01/19/23					
Antimony	526	ug/L		555.6		95	80-120		
Arsenic	552	ug/L		555.6		99	80-120		
Barium	541	ug/L		555.6		97	80-120		
Beryllium	561	ug/L		555.6		101	80-120		
Boron	507	ug/L		555.6		91	80-120		
Cadmium	531	ug/L		555.6		96	80-120		
Calcium	5.43	mg/L		5.556		98	80-120		
Chromium	556	ug/L		555.6		100	80-120		
Cobalt	547	ug/L		555.6		98	80-120		
Lead	530	ug/L		555.6		95	80-120		
Magnesium	5.63	mg/L		5.556		101	80-120		
Mercury	54.1	ug/L		55.56		97	80-120		
Molybdenum	546	ug/L		555.6		98	80-120		
Potassium	6.06	mg/L		5.556		109	80-120		
Selenium	536	ug/L		555.6		96	80-120		

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Peoria, IL 61615
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QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B323330 - SW 3015 - EPA 6020A									
LCS (B323330-BS1)				Prepared: 01/17/23 Analyzed: 01/19/23					
Sodium	5.69	mg/L		5.556		102	80-120		
Thallium	530	ug/L		555.6		95	80-120		
Lithium	0.513	mg/L		0.5556		92	80-120		
Matrix Spike (B323330-MS1)	**Sample: GA01675-01**			Prepared: 01/17/23 Analyzed: 01/19/23					
Antimony	523	ug/L		555.6	0.639	94	75-125		
Arsenic	568	ug/L		555.6	7.09	101	75-125		
Barium	671	ug/L		555.6	125	98	75-125		
Beryllium	569	ug/L		555.6	ND	102	75-125		
Boron	586	ug/L		555.6	74.8	92	75-125		
Cadmium	538	ug/L		555.6	ND	97	75-125		
Calcium	175	mg/L	Q4	5.556	173	49	75-125		
Chromium	550	ug/L		555.6	ND	99	75-125		
Cobalt	544	ug/L		555.6	3.66	97	75-125		
Lead	527	ug/L		555.6	0.700	95	75-125		
Magnesium	76.7	mg/L	Q4	5.556	72.6	74	75-125		
Mercury	54.9	ug/L		55.56	ND	99	75-125		
Molybdenum	575	ug/L		555.6	5.08	103	75-125		
Potassium	6.78	mg/L		5.556	0.981	104	75-125		
Selenium	549	ug/L		555.6	ND	99	75-125		
Sodium	26.6	mg/L		5.556	21.7	89	75-125		
Thallium	523	ug/L		555.6	ND	94	75-125		
Lithium	0.526	mg/L		0.5556	0.00591	94	75-125		
Matrix Spike Dup (B323330-MSD1)	**Sample: GA01675-01**			Prepared: 01/17/23 Analyzed: 01/19/23					
Antimony	521	ug/L		555.6	0.639	94	75-125	0.4	20
Arsenic	574	ug/L		555.6	7.09	102	75-125	0.9	20
Barium	664	ug/L		555.6	125	97	75-125	1	20
Beryllium	576	ug/L		555.6	ND	104	75-125	1	20
Boron	595	ug/L		555.6	74.8	94	75-125	2	20
Cadmium	538	ug/L		555.6	ND	97	75-125	0.08	20
Calcium	176	mg/L	Q4	5.556	173	63	75-125	0.4	20
Chromium	556	ug/L		555.6	ND	100	75-125	1	20
Cobalt	547	ug/L		555.6	3.66	98	75-125	0.5	20
Lead	531	ug/L		555.6	0.700	96	75-125	0.8	20
Magnesium	76.9	mg/L	Q4	5.556	72.6	78	75-125	0.3	20
Mercury	56.0	ug/L		55.56	ND	101	75-125	2	20
Molybdenum	572	ug/L		555.6	5.08	102	75-125	0.6	20
Potassium	6.85	mg/L		5.556	0.981	106	75-125	1	20
Selenium	559	ug/L		555.6	ND	101	75-125	2	20
Sodium	27.1	mg/L		5.556	21.7	97	75-125	2	20
Thallium	532	ug/L		555.6	ND	96	75-125	2	20
Lithium	0.530	mg/L		0.5556	0.00591	94	75-125	0.7	200

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Peoria, IL 61615
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QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B323436 - SW 3015 - EPA 6020A									
Blank (B323436-BLK1)				Prepared: 01/18/23 Analyzed: 01/20/23					
Antimony	< 3.0	ug/L							
Arsenic	< 1.0	ug/L							
Barium	< 1.0	ug/L							
Beryllium	< 1.0	ug/L							
Cadmium	< 1.0	ug/L							
Chromium	< 4.0	ug/L							
Cobalt	< 2.0	ug/L							
Lead	< 1.0	ug/L							
Mercury	< 0.20	ug/L							
Molybdenum	< 1.0	ug/L							
Selenium	< 1.0	ug/L							
Thallium	< 1.0	ug/L							
Lithium	< 0.020	mg/L							
LCS (B323436-BS1)				Prepared: 01/18/23 Analyzed: 01/20/23					
Antimony	524	ug/L		555.6		94	80-120		
Arsenic	552	ug/L		555.6		99	80-120		
Barium	573	ug/L		555.6		103	80-120		
Beryllium	562	ug/L		555.6		101	80-120		
Cadmium	532	ug/L		555.6		96	80-120		
Chromium	533	ug/L		555.6		96	80-120		
Cobalt	545	ug/L		555.6		98	80-120		
Lead	541	ug/L		555.6		97	80-120		
Mercury	53.9	ug/L		55.56		97	80-120		
Molybdenum	542	ug/L		555.6		98	80-120		
Selenium	567	ug/L		555.6		102	80-120		
Thallium	534	ug/L		555.6		96	80-120		
Lithium	0.516	mg/L		0.5556		93	80-120		
Batch B323854 - IC No Prep - EPA 300.0 REV 2.1									
Calibration Blank (B323854-CCB1)				Prepared & Analyzed: 01/21/23					
Chloride	0.220	mg/L							
Fluoride	0.00	mg/L							
Calibration Check (B323854-CCV1)				Prepared & Analyzed: 01/21/23					
Fluoride	5.42	mg/L		5.000		108	90-110		
Chloride	5.42	mg/L		5.000		108	90-110		
Matrix Spike (B323854-MS1)	**Sample: GA01675-01**			Prepared & Analyzed: 01/21/23					
Chloride	1.0E9	mg/L	Q4	1.500	14	NR	80-120		
Matrix Spike (B323854-MS2)	**Sample: GA01675-02**			Prepared & Analyzed: 01/21/23					
Chloride	1.0E9	mg/L	Q4	1.500	29	NR	80-120		
Fluoride	1.68	mg/L		1.500	0.264	94	80-120		
Matrix Spike Dup (B323854-MSD1)	**Sample: GA01675-01**			Prepared & Analyzed: 01/21/23					
Chloride	1.0E9	mg/L	Q4	1.500	14	NR	80-120	0	20

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QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B323854 - IC No Prep - EPA 300.0 REV 2.1									
Matrix Spike Dup (B323854-MSD2)	**Sample: GA01675-02**			Prepared & Analyzed: 01/21/23					
Fluoride	1.68	mg/L		1.500	0.264	94	80-120	0.2	20
Chloride	1.0E9	mg/L	Q4	1.500	29	NR	80-120	0	20
Batch B324042 - IC No Prep - EPA 300.0 REV 2.1									
Calibration Blank (B324042-CCB1)				Prepared & Analyzed: 01/24/23					
Sulfate	0.00	mg/L							
Calibration Check (B324042-CCV1)				Prepared & Analyzed: 01/24/23					
Sulfate	4.77	mg/L		5.000		95	90-110		

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2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

NOTES

Specifications regarding method revisions, method modifications, and calculations used for analysis are available upon request. Please contact your project manager.

* Not a TNI accredited analyte

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

B	Present in the method blank at 256 UG/L.
Ba	Present in the method blank at 312 ug/L.
Q4	The matrix spike recovery result is unusable since the analyte concentration in the sample is greater than four times the spike level. The associated blank spike was acceptable.

Gail J Schindler

Certified by: Gail Schindler, Project Manager

DRAFT

RAMBOLL COC#: 1940102792-2023-0110-003

GA01675

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: 1 of 1

Section A Required Client Information:		Section B Required Project Information:		Section C Invoice Information:	
Company:	Vistra Corp	Report To:	Brian Voelker	Attention:	Jason Stuckey
Address:	13498 E. 900th St	Copy To:	Jason Stuckey	Company Name:	Vistra Corp
				Address:	see Section A
Email To:	Brian.Voelker@VistraCorp.com	Purchase Order No.:		Quote Reference:	
Phone:	(217) 753-8911 Fax:	Project Name:		Project Manager:	
Requested Due Date/TAT:	standard	Project Number:	2285	Profile #:	

REGULATORY AGENCY

NPDES GROUND WATER DRINKING WATER

UST RCRA OTHER

Site Location STATE: IL

ITEM #	Section D Required Client Information: SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE	Valid Matrix Codes MATRIX / CODE: DRINKING WATER DW; WATER WT; WASTE WATER WW; PRODUCT P; SOIL/SOLID SL; OIL OL; WIPE WP; AIR AR; OTHER OT; TISSUE TS	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	EDW-845-301_R3	Residual Chlorine (Y/N)	Project No./ Lab I.D.
1	AW-01		WT	G	1/10/22	1424		2	X		X						X		
2	EMW-05		1	1	1	1141		2	X		X						X		
3	EB-01		1	1	1	1500		1			X						X		
4	DUP-01		WT	G	1/10/22	1141		2	X		X						X		
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
13																				
14																				
15																				
16																				

SM 1/10/22

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS: Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
EDW-23Q1-845-301-R3 NO RADIUM 226 + RADIUM 228, TOTAL		01/10/23	1600							
	RAMBOLL			Jonathan O'Neil	1/10/23	1600	7.9	Y	Y	Y

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: SAMUEL MALLOW

SIGNATURE of SAMPLER: SMallow DATE Signed (MM/DD/YY): 1/10/22

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

March 27, 2023

Brian Voelker
Vistra - Edwards
604 Pierce Boulevard
O'Fallon, IL 62269

Dear Brian Voelker:

Please find enclosed the analytical results for the sample(s) the laboratory received. 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 Pace Analytical Services, LLC.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

Pace Analytical Services 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 General Manager, Lisa Grant, with any feedback you have about your experience with our laboratory at 309-683-1764 or lisa.grant@pacelabs.com.

Sincerely,

Gail Schindler
Project Manager
(309) 692-9688 x1716
gail.schindler@pacelabs.com

DRAFT

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

SAMPLE RECEIPT CHECK LIST

Items not applicable will be marked as in compliance

Work Order GB04667

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 received 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

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Peoria, IL 61615
(800)752-6651

Work Order GC00016

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 received undamaged
YES	Zero headspace, <6 mm present in VOA vials
YES	Trip blank(s) received
YES	All non-field analyses received within holding times
YES	Short hold time analysis
YES	Current PDC COC submitted
NO	Case narrative provided

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: GB04667-01
Name: AW-15
Matrix: Ground Water - Grab

Sampled: 02/27/23 15:28
Received: 02/28/23 07:20

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	32	mg/L		03/06/23 15:05	10	10	03/06/23 15:05	CRD	EPA 300.0 REV 2.1
Sulfate	< 1.0	mg/L		03/03/23 11:55	1	1.0	03/03/23 11:55	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	9	Feet		02/27/23 15:28	1		02/27/23 15:28	FIELD	Field*
Dissolved oxygen, Field	1.0	mg/L		02/27/23 15:28	1		02/27/23 15:28	FIELD	Field*
Oxidation Reduction Potential	-102	mV		02/27/23 15:28	1	-500	02/27/23 15:28	FIELD	Field*
pH, Field Measured	6.75	pH Units		02/27/23 15:28	1		02/27/23 15:28	FIELD	Field*
Specific Conductance, Field Measured	1840	umhos/cm		02/27/23 15:28	1		02/27/23 15:28	FIELD	Field*
Temperature, Field Measured	12.8	°C		02/27/23 15:28	1		02/27/23 15:28	FIELD	Field*
Turbidity, Field Measured	107	NTU		02/27/23 15:28	1	0.00	02/27/23 15:28	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	890	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Fluoride	< 0.250	mg/L		03/08/23 12:56	1	0.250	03/08/23 12:56	TTH	SM 4500F C 1997
Solids - total dissolved solids (TDS)	1100	mg/L		03/01/23 16:04	1	26	03/01/23 17:00	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 09:11	JMW	EPA 6020A
Arsenic	3.5	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:11	JMW	EPA 6020A
Barium	1800	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:11	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:11	JMW	EPA 6020A
Boron	370	ug/L		03/06/23 09:21	5	10	03/07/23 09:11	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:11	JMW	EPA 6020A
Calcium	140	mg/L		03/06/23 09:21	5	0.20	03/07/23 09:11	JMW	EPA 6020A
Chromium	< 4.0	ug/L		03/06/23 09:21	5	4.0	03/07/23 09:11	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		03/06/23 09:21	5	2.0	03/07/23 09:11	JMW	EPA 6020A
Lead	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:20	JMW	EPA 6020A
Magnesium	57	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:11	JMW	EPA 6020A
Mercury	0.21	ug/L		03/06/23 09:21	5	0.20	03/07/23 17:20	JMW	EPA 6020A
Molybdenum	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:11	JMW	EPA 6020A
Potassium	3.9	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:11	JMW	EPA 6020A
Selenium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:20	JMW	EPA 6020A
Sodium	210	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:11	JMW	EPA 6020A

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(800)752-6651

ANALYTICAL RESULTS

Sample: GB04667-01
Name: AW-15
Matrix: Ground Water - Grab

Sampled: 02/27/23 15:28
Received: 02/28/23 07:20

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:11	JMW	EPA 6020A
Lithium	27	ug/L		03/06/23 09:21	1	20	03/07/23 10:10	TJJ	EPA 6010B

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: GB04667-02
Name: AW-15S
Matrix: Ground Water - Grab

Sampled: 02/27/23 16:30
Received: 02/28/23 07:20

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	28	mg/L		03/03/23 13:25	10	10	03/03/23 13:25	CRD	EPA 300.0 REV 2.1
Fluoride	0.252	mg/L		03/03/23 13:07	1	0.250	03/03/23 13:07	CRD	EPA 300.0 REV 2.1
Sulfate	510	mg/L		03/03/23 13:43	100	100	03/03/23 13:43	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	10.04	Feet		02/27/23 16:30	1		02/27/23 16:30	FIELD	Field*
Dissolved oxygen, Field	0.64	mg/L		02/27/23 16:30	1		02/27/23 16:30	FIELD	Field*
Oxidation Reduction Potential	117	mV		02/27/23 16:30	1	-500	02/27/23 16:30	FIELD	Field*
pH, Field Measured	6.81	pH Units		02/27/23 16:30	1		02/27/23 16:30	FIELD	Field*
Specific Conductance, Field Measured	1670	umhos/cm		02/27/23 16:30	1		02/27/23 16:30	FIELD	Field*
Temperature, Field Measured	11.8	°C		02/27/23 16:30	1		02/27/23 16:30	FIELD	Field*
Turbidity, Field Measured	78.0	NTU		02/27/23 16:30	1	0.00	02/27/23 16:30	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	400	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	1300	mg/L		03/01/23 16:04	1	26	03/01/23 17:00	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 09:15	JMW	EPA 6020A
Arsenic	1.8	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:15	JMW	EPA 6020A
Barium	81	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:15	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:15	JMW	EPA 6020A
Boron	5900	ug/L		03/06/23 09:21	5	10	03/07/23 09:15	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:15	JMW	EPA 6020A
Calcium	260	mg/L		03/06/23 09:21	5	0.20	03/07/23 09:15	JMW	EPA 6020A
Chromium	< 4.0	ug/L		03/06/23 09:21	5	4.0	03/07/23 09:15	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		03/06/23 09:21	5	2.0	03/07/23 09:15	JMW	EPA 6020A
Lead	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:23	JMW	EPA 6020A
Magnesium	82	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:15	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 17:23	JMW	EPA 6020A
Molybdenum	3.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:15	JMW	EPA 6020A
Potassium	0.69	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:15	JMW	EPA 6020A
Selenium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:23	JMW	EPA 6020A
Sodium	52	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:15	JMW	EPA 6020A

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: GB04667-02
Name: AW-15S
Matrix: Ground Water - Grab

Sampled: 02/27/23 16:30
Received: 02/28/23 07:20

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:15	JMW	EPA 6020A
Lithium	< 20	ug/L		03/06/23 09:21	1	20	03/07/23 10:14	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GB04667-03
Name: AW-18
Matrix: Ground Water - Grab

Sampled: 02/27/23 16:50
Received: 02/28/23 07:20

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	81	mg/L		03/03/23 14:19	10	10	03/03/23 14:19	CRD	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		03/03/23 14:01	1	0.250	03/03/23 14:01	CRD	EPA 300.0 REV 2.1
Sulfate	10	mg/L		03/03/23 14:19	10	10	03/03/23 14:19	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	27	Feet		02/27/23 16:50	1		02/27/23 16:50	FIELD	Field*
Dissolved oxygen, Field	0.77	mg/L		02/27/23 16:50	1		02/27/23 16:50	FIELD	Field*
Oxidation Reduction Potential	-94.0	mV		02/27/23 16:50	1	-500	02/27/23 16:50	FIELD	Field*
pH, Field Measured	6.93	pH Units		02/27/23 16:50	1		02/27/23 16:50	FIELD	Field*
Specific Conductance, Field Measured	1660	umhos/cm		02/27/23 16:50	1		02/27/23 16:50	FIELD	Field*
Temperature, Field Measured	12.2	°C		02/27/23 16:50	1		02/27/23 16:50	FIELD	Field*
Turbidity, Field Measured	499	NTU		02/27/23 16:50	1	0.00	02/27/23 16:50	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	640	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	830	mg/L		03/01/23 16:04	1	26	03/01/23 17:00	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 09:19	JMW	EPA 6020A
Arsenic	8.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:19	JMW	EPA 6020A
Barium	1800	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:19	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:19	JMW	EPA 6020A
Boron	380	ug/L		03/06/23 09:21	5	10	03/07/23 09:19	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:19	JMW	EPA 6020A
Calcium	140	mg/L		03/06/23 09:21	5	0.20	03/07/23 09:19	JMW	EPA 6020A
Chromium	62	ug/L		03/06/23 09:21	5	4.0	03/07/23 09:19	JMW	EPA 6020A
Cobalt	6.2	ug/L		03/06/23 09:21	5	2.0	03/07/23 09:19	JMW	EPA 6020A
Lead	8.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:26	JMW	EPA 6020A
Magnesium	59	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:19	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 17:26	JMW	EPA 6020A
Molybdenum	5.1	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:19	JMW	EPA 6020A
Potassium	5.0	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:19	JMW	EPA 6020A
Selenium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:26	JMW	EPA 6020A
Sodium	210	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:19	JMW	EPA 6020A

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2231 W. Altorfer Drive
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ANALYTICAL RESULTS

Sample: GB04667-03
Name: AW-18
Matrix: Ground Water - Grab

Sampled: 02/27/23 16:50
Received: 02/28/23 07:20

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:19	JMW	EPA 6020A
Lithium	35	ug/L		03/06/23 09:21	1	20	03/07/23 10:15	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GB04667-04
Name: AW-19
Matrix: Ground Water - Grab

Sampled: 02/27/23 15:29
Received: 02/28/23 07:20

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	69	mg/L		03/03/23 15:31	10	10	03/03/23 15:31	CRD	EPA 300.0 REV 2.1
Fluoride	0.336	mg/L		03/03/23 14:37	1	0.250	03/03/23 14:37	CRD	EPA 300.0 REV 2.1
Sulfate	46	mg/L		03/03/23 15:31	10	10	03/03/23 15:31	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	13.37	Feet		02/27/23 15:29	1		02/27/23 15:29	FIELD	Field*
Dissolved oxygen, Field	1.9	mg/L		02/27/23 15:29	1		02/27/23 15:29	FIELD	Field*
Oxidation Reduction Potential	20.0	mV		02/27/23 15:29	1	-500	02/27/23 15:29	FIELD	Field*
pH, Field Measured	7.00	pH Units		02/27/23 15:29	1		02/27/23 15:29	FIELD	Field*
Specific Conductance, Field Measured	1080	umhos/cm		02/27/23 15:29	1		02/27/23 15:29	FIELD	Field*
Temperature, Field Measured	12.9	°C		02/27/23 15:29	1		02/27/23 15:29	FIELD	Field*
Turbidity, Field Measured	185	NTU		02/27/23 15:29	1	0.00	02/27/23 15:29	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	380	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	600	mg/L		03/01/23 16:04	1	26	03/01/23 17:00	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 09:23	JMW	EPA 6020A
Arsenic	22	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:23	JMW	EPA 6020A
Barium	370	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:23	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:23	JMW	EPA 6020A
Boron	2900	ug/L		03/06/23 09:21	5	10	03/07/23 09:23	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:23	JMW	EPA 6020A
Calcium	130	mg/L		03/06/23 09:21	5	0.20	03/07/23 09:23	JMW	EPA 6020A
Chromium	31	ug/L		03/06/23 09:21	5	4.0	03/07/23 09:23	JMW	EPA 6020A
Cobalt	4.8	ug/L		03/06/23 09:21	5	2.0	03/07/23 09:23	JMW	EPA 6020A
Lead	5.4	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:29	JMW	EPA 6020A
Magnesium	58	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:23	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 17:29	JMW	EPA 6020A
Molybdenum	5.5	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:23	JMW	EPA 6020A
Potassium	1.5	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:23	JMW	EPA 6020A
Selenium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:29	JMW	EPA 6020A
Sodium	56	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:23	JMW	EPA 6020A

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: GB04667-04
Name: AW-19
Matrix: Ground Water - Grab

Sampled: 02/27/23 15:29
Received: 02/28/23 07:20

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:23	JMW	EPA 6020A
Lithium	< 20	ug/L		03/06/23 09:21	1	20	03/07/23 10:16	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-01
Name: AP05S
Matrix: Ground Water - Grab

Sampled: 02/28/23 14:40
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	33	mg/L		03/06/23 17:41	10	10	03/06/23 17:41	CRD	EPA 300.0 REV 2.1
Sulfate	14	mg/L		03/06/23 17:41	10	10	03/06/23 17:41	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	5.43	Feet		02/28/23 14:40	1		02/28/23 14:40	FIELD	Field*
Dissolved oxygen, Field	1.2	mg/L		02/28/23 14:40	1		02/28/23 14:40	FIELD	Field*
Oxidation Reduction Potential	-87.0	mV		02/28/23 14:40	1	-500	02/28/23 14:40	FIELD	Field*
pH, Field Measured	7.01	pH Units		02/28/23 14:40	1		02/28/23 14:40	FIELD	Field*
Specific Conductance, Field Measured	1390	umhos/cm		02/28/23 14:40	1		02/28/23 14:40	FIELD	Field*
Temperature, Field Measured	14.0	°C		02/28/23 14:40	1		02/28/23 14:40	FIELD	Field*
Turbidity, Field Measured	>1000	NTU		02/28/23 14:40	1	0.00	02/28/23 14:40	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	660	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Fluoride	< 0.250	mg/L		03/08/23 12:57	1	0.250	03/08/23 12:57	TTH	SM 4500F C 1997
Solids - total dissolved solids (TDS)	820	mg/L		03/01/23 16:04	1	26	03/01/23 17:00	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 09:26	JMW	EPA 6020A
Arsenic	7.3	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:26	JMW	EPA 6020A
Barium	940	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:26	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:26	JMW	EPA 6020A
Boron	340	ug/L		03/06/23 09:21	5	10	03/07/23 09:26	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:26	JMW	EPA 6020A
Calcium	120	mg/L		03/06/23 09:21	5	0.20	03/07/23 09:26	JMW	EPA 6020A
Chromium	25	ug/L		03/06/23 09:21	5	4.0	03/07/23 09:26	JMW	EPA 6020A
Cobalt	12	ug/L		03/06/23 09:21	5	2.0	03/07/23 09:26	JMW	EPA 6020A
Lead	14	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:32	JMW	EPA 6020A
Magnesium	54	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:26	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 17:32	JMW	EPA 6020A
Molybdenum	2.1	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:26	JMW	EPA 6020A
Potassium	4.6	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:26	JMW	EPA 6020A
Selenium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:32	JMW	EPA 6020A
Sodium	180	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:26	JMW	EPA 6020A

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2231 W. Altorfer Drive
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(800)752-6651

ANALYTICAL RESULTS

Sample: GC00016-01
Name: AP05S
Matrix: Ground Water - Grab

Sampled: 02/28/23 14:40
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:26	JMW	EPA 6020A
Lithium	39	ug/L		03/06/23 09:21	1	20	03/07/23 10:17	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-02
Name: AP07S
Matrix: Ground Water - Grab

Sampled: 02/28/23 13:28
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	73	mg/L		03/06/23 18:18	50	50	03/06/23 18:18	CRD	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		03/06/23 18:00	1	0.250	03/06/23 18:00	CRD	EPA 300.0 REV 2.1
Sulfate	180	mg/L		03/06/23 18:18	50	50	03/06/23 18:18	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	24.55	Feet		02/28/23 13:28	1		02/28/23 13:28	FIELD	Field*
Dissolved oxygen, Field	6.8	mg/L		02/28/23 13:28	1		02/28/23 13:28	FIELD	Field*
Oxidation Reduction Potential	100	mV		02/28/23 13:28	1	-500	02/28/23 13:28	FIELD	Field*
pH, Field Measured	7.13	pH Units		02/28/23 13:28	1		02/28/23 13:28	FIELD	Field*
Specific Conductance, Field Measured	3820	umhos/cm		02/28/23 13:28	1		02/28/23 13:28	FIELD	Field*
Temperature, Field Measured	13.5	°C		02/28/23 13:28	1		02/28/23 13:28	FIELD	Field*
Turbidity, Field Measured	>1000	NTU		02/28/23 13:28	1	0.00	02/28/23 13:28	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	280	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	720	mg/L		03/01/23 16:04	1	26	03/01/23 17:00	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 09:30	JMW	EPA 6020A
Arsenic	2.1	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:30	JMW	EPA 6020A
Barium	87	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:30	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:30	JMW	EPA 6020A
Boron	7900	ug/L		03/06/23 09:21	5	10	03/07/23 09:30	JMW	EPA 6020A
Cadmium	3.5	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:30	JMW	EPA 6020A
Calcium	130	mg/L		03/06/23 09:21	5	0.20	03/07/23 09:30	JMW	EPA 6020A
Chromium	25	ug/L		03/06/23 09:21	5	4.0	03/07/23 09:30	JMW	EPA 6020A
Cobalt	4.8	ug/L		03/06/23 09:21	5	2.0	03/07/23 09:30	JMW	EPA 6020A
Lead	3.4	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:35	JMW	EPA 6020A
Magnesium	49	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:30	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 17:35	JMW	EPA 6020A
Molybdenum	3.5	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:30	JMW	EPA 6020A
Potassium	1.4	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:30	JMW	EPA 6020A
Selenium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:35	JMW	EPA 6020A
Sodium	63	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:30	JMW	EPA 6020A

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ANALYTICAL RESULTS

Sample: GC00016-02
Name: AP07S
Matrix: Ground Water - Grab

Sampled: 02/28/23 13:28
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:30	JMW	EPA 6020A
Lithium	< 20	ug/L		03/06/23 09:21	1	20	03/07/23 10:22	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-03
Name: AW-01
Matrix: Ground Water - Grab

Sampled: 02/28/23 15:41
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	110	mg/L		03/07/23 17:51	50	50	03/07/23 17:51	CRD	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		03/06/23 18:36	1	0.250	03/06/23 18:36	CRD	EPA 300.0 REV 2.1
Sulfate	280	mg/L		03/07/23 17:51	50	50	03/07/23 17:51	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	5.47	Feet		02/28/23 15:41	1		02/28/23 15:41	FIELD	Field*
Dissolved oxygen, Field	1.1	mg/L		02/28/23 15:41	1		02/28/23 15:41	FIELD	Field*
Oxidation Reduction Potential	-89.0	mV		02/28/23 15:41	1	-500	02/28/23 15:41	FIELD	Field*
pH, Field Measured	6.98	pH Units		02/28/23 15:41	1		02/28/23 15:41	FIELD	Field*
Specific Conductance, Field Measured	1400	umhos/cm		02/28/23 15:41	1		02/28/23 15:41	FIELD	Field*
Temperature, Field Measured	13.3	°C		02/28/23 15:41	1		02/28/23 15:41	FIELD	Field*
Turbidity, Field Measured	>1000	NTU		02/28/23 15:41	1	0.00	02/28/23 15:41	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	290	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	1000	mg/L		03/02/23 09:54	1	26	03/02/23 10:44	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 09:34	JMW	EPA 6020A
Arsenic	20	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:34	JMW	EPA 6020A
Barium	170	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:34	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:34	JMW	EPA 6020A
Boron	1100	ug/L		03/06/23 09:21	5	10	03/07/23 09:34	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:34	JMW	EPA 6020A
Calcium	180	mg/L		03/06/23 09:21	5	0.20	03/07/23 09:34	JMW	EPA 6020A
Chromium	19	ug/L		03/06/23 09:21	5	4.0	03/07/23 09:34	JMW	EPA 6020A
Cobalt	7.0	ug/L		03/06/23 09:21	5	2.0	03/07/23 09:34	JMW	EPA 6020A
Lead	9.2	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:38	JMW	EPA 6020A
Magnesium	82	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:34	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 17:38	JMW	EPA 6020A
Molybdenum	2.2	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:34	JMW	EPA 6020A
Potassium	2.1	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:34	JMW	EPA 6020A
Selenium	1.1	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:38	JMW	EPA 6020A
Sodium	49	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:34	JMW	EPA 6020A

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ANALYTICAL RESULTS

Sample: GC00016-03
Name: AW-01
Matrix: Ground Water - Grab

Sampled: 02/28/23 15:41
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:34	JMW	EPA 6020A
Lithium	< 20	ug/L		03/06/23 09:21	1	20	03/07/23 10:23	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-04
Name: AW-05
Matrix: Ground Water - Grab

Sampled: 02/28/23 11:57
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	78	mg/L		03/06/23 20:06	10	10	03/06/23 20:06	CRD	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		03/06/23 19:48	1	0.250	03/06/23 19:48	CRD	EPA 300.0 REV 2.1
Sulfate	320	mg/L		03/06/23 20:24	100	100	03/06/23 20:24	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	7.83	Feet		02/28/23 11:57	1		02/28/23 11:57	FIELD	Field*
Dissolved oxygen, Field	3.9	mg/L		02/28/23 11:57	1		02/28/23 11:57	FIELD	Field*
Oxidation Reduction Potential	162	mV		02/28/23 11:57	1	-500	02/28/23 11:57	FIELD	Field*
pH, Field Measured	7.24	pH Units		02/28/23 11:57	1		02/28/23 11:57	FIELD	Field*
Specific Conductance, Field Measured	1440	umhos/cm		02/28/23 11:57	1		02/28/23 11:57	FIELD	Field*
Temperature, Field Measured	12.7	°C		02/28/23 11:57	1		02/28/23 11:57	FIELD	Field*
Turbidity, Field Measured	>1000	NTU		02/28/23 11:57	1	0.00	02/28/23 11:57	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	340	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	1100	mg/L		03/02/23 09:54	1	26	03/02/23 10:44	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 09:38	JMW	EPA 6020A
Arsenic	6.8	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:38	JMW	EPA 6020A
Barium	210	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:38	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:38	JMW	EPA 6020A
Boron	4500	ug/L		03/06/23 09:21	5	10	03/07/23 09:38	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:38	JMW	EPA 6020A
Calcium	170	mg/L		03/06/23 09:21	5	0.20	03/07/23 09:38	JMW	EPA 6020A
Chromium	20	ug/L		03/06/23 09:21	5	4.0	03/07/23 09:38	JMW	EPA 6020A
Cobalt	11	ug/L		03/06/23 09:21	5	2.0	03/07/23 09:38	JMW	EPA 6020A
Lead	9.1	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:41	JMW	EPA 6020A
Magnesium	82	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:38	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 17:41	JMW	EPA 6020A
Molybdenum	2.6	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:38	JMW	EPA 6020A
Potassium	3.2	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:38	JMW	EPA 6020A
Selenium	1.2	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:41	JMW	EPA 6020A
Sodium	76	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:38	JMW	EPA 6020A

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ANALYTICAL RESULTS

Sample: GC00016-04
Name: AW-05
Matrix: Ground Water - Grab

Sampled: 02/28/23 11:57
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:38	JMW	EPA 6020A
Lithium	25	ug/L		03/06/23 09:21	1	20	03/07/23 10:24	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-05
Name: AW-06
Matrix: Ground Water - Grab

Sampled: 02/28/23 10:03
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	31	mg/L		03/06/23 21:00	10	10	03/06/23 21:00	CRD	EPA 300.0 REV 2.1
Fluoride	0.327	mg/L		03/06/23 20:42	1	0.250	03/06/23 20:42	CRD	EPA 300.0 REV 2.1
Sulfate	22	mg/L		03/06/23 21:00	10	10	03/06/23 21:00	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	26.79	Feet		02/28/23 10:03	1		02/28/23 10:03	FIELD	Field*
Dissolved oxygen, Field	1.6	mg/L		02/28/23 10:03	1		02/28/23 10:03	FIELD	Field*
Oxidation Reduction Potential	-65.0	mV		02/28/23 10:03	1	-500	02/28/23 10:03	FIELD	Field*
pH, Field Measured	7.39	pH Units		02/28/23 10:03	1		02/28/23 10:03	FIELD	Field*
Specific Conductance, Field Measured	971.0	umhos/cm		02/28/23 10:03	1		02/28/23 10:03	FIELD	Field*
Temperature, Field Measured	11.2	°C		02/28/23 10:03	1		02/28/23 10:03	FIELD	Field*
Turbidity, Field Measured	1000	NTU		02/28/23 10:03	1	0.00	02/28/23 10:03	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	400	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	610	mg/L		03/02/23 09:54	1	26	03/02/23 10:44	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 09:42	JMW	EPA 6020A
Arsenic	6.4	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:42	JMW	EPA 6020A
Barium	190	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:42	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:42	JMW	EPA 6020A
Boron	180	ug/L		03/06/23 09:21	5	10	03/07/23 09:42	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:42	JMW	EPA 6020A
Calcium	110	mg/L		03/06/23 09:21	5	0.20	03/07/23 09:42	JMW	EPA 6020A
Chromium	< 4.0	ug/L		03/06/23 09:21	5	4.0	03/07/23 09:42	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		03/06/23 09:21	5	2.0	03/07/23 09:42	JMW	EPA 6020A
Lead	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:44	JMW	EPA 6020A
Magnesium	45	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:42	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 17:44	JMW	EPA 6020A
Molybdenum	5.3	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:42	JMW	EPA 6020A
Potassium	0.84	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:42	JMW	EPA 6020A
Selenium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:44	JMW	EPA 6020A
Sodium	57	mg/L		03/06/23 09:21	5	0.10	03/07/23 09:42	JMW	EPA 6020A

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ANALYTICAL RESULTS

Sample: GC00016-05
Name: AW-06
Matrix: Ground Water - Grab

Sampled: 02/28/23 10:03
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 09:42	JMW	EPA 6020A
Lithium	< 20	ug/L		03/06/23 09:21	1	20	03/07/23 10:25	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-06
Name: AW-08
Matrix: Ground Water - Grab

Sampled: 02/28/23 15:57
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	14	mg/L		03/06/23 21:37	5	5.0	03/06/23 21:37	CRD	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		03/06/23 21:18	1	0.250	03/06/23 21:18	CRD	EPA 300.0 REV 2.1
Sulfate	< 1.0	mg/L		03/06/23 21:18	1	1.0	03/06/23 21:18	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	24.6	Feet		02/28/23 15:57	1		02/28/23 15:57	FIELD	Field*
Dissolved oxygen, Field	1.6	mg/L		02/28/23 15:57	1		02/28/23 15:57	FIELD	Field*
Oxidation Reduction Potential	-133	mV		02/28/23 15:57	1	-500	02/28/23 15:57	FIELD	Field*
pH, Field Measured	8.92	pH Units		02/28/23 15:57	1		02/28/23 15:57	FIELD	Field*
Specific Conductance, Field Measured	725.0	umhos/cm		02/28/23 15:57	1		02/28/23 15:57	FIELD	Field*
Temperature, Field Measured	13.7	°C		02/28/23 15:57	1		02/28/23 15:57	FIELD	Field*
Turbidity, Field Measured	11.9	NTU		02/28/23 15:57	1	0.00	02/28/23 15:57	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	620	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/03/23 13:45	1	10	03/03/23 13:45	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	740	mg/L		03/02/23 09:54	1	26	03/02/23 10:44	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 10:14	JMW	EPA 6020A
Arsenic	11	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:14	JMW	EPA 6020A
Barium	200	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:14	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:14	JMW	EPA 6020A
Boron	100	ug/L		03/06/23 09:21	5	10	03/07/23 10:14	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:14	JMW	EPA 6020A
Calcium	140	mg/L		03/06/23 09:21	5	0.20	03/07/23 10:14	JMW	EPA 6020A
Chromium	< 4.0	ug/L		03/06/23 09:21	5	4.0	03/07/23 10:14	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		03/06/23 09:21	5	2.0	03/07/23 10:14	JMW	EPA 6020A
Lead	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:47	JMW	EPA 6020A
Magnesium	58	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:14	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 17:47	JMW	EPA 6020A
Molybdenum	1.8	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:14	JMW	EPA 6020A
Potassium	1.4	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:14	JMW	EPA 6020A
Selenium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:47	JMW	EPA 6020A
Sodium	63	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:14	JMW	EPA 6020A

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ANALYTICAL RESULTS

Sample: GC00016-06
Name: AW-08
Matrix: Ground Water - Grab

Sampled: 02/28/23 15:57
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:47	JMW	EPA 6020A
Lithium	< 20	ug/L		03/06/23 09:21	1	20	03/07/23 10:26	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-07
Name: AW-09
Matrix: Ground Water - Grab

Sampled: 02/28/23 12:05
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	26	mg/L		03/03/23 16:08	10	10	03/03/23 16:08	CRD	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		03/03/23 15:50	1	0.250	03/03/23 15:50	CRD	EPA 300.0 REV 2.1
Sulfate	< 1.0	mg/L		03/03/23 15:50	1	1.0	03/03/23 15:50	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	26.01	Feet		02/28/23 12:05	1		02/28/23 12:05	FIELD	Field*
Dissolved oxygen, Field	1.0	mg/L		02/28/23 12:05	1		02/28/23 12:05	FIELD	Field*
Oxidation Reduction Potential	-130	mV		02/28/23 12:05	1	-500	02/28/23 12:05	FIELD	Field*
pH, Field Measured	7.02	pH Units		02/28/23 12:05	1		02/28/23 12:05	FIELD	Field*
Specific Conductance, Field Measured	1330	umhos/cm		02/28/23 12:05	1		02/28/23 12:05	FIELD	Field*
Temperature, Field Measured	12.6	°C		02/28/23 12:05	1		02/28/23 12:05	FIELD	Field*
Turbidity, Field Measured	77.2	NTU		02/28/23 12:05	1	0.00	02/28/23 12:05	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	750	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	830	mg/L		03/02/23 09:54	1	26	03/02/23 10:44	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 10:18	JMW	EPA 6020A
Arsenic	12	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:18	JMW	EPA 6020A
Barium	200	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:18	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:18	JMW	EPA 6020A
Boron	100	ug/L		03/06/23 09:21	5	10	03/07/23 10:18	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:18	JMW	EPA 6020A
Calcium	140	mg/L		03/06/23 09:21	5	0.20	03/07/23 10:18	JMW	EPA 6020A
Chromium	< 4.0	ug/L		03/06/23 09:21	5	4.0	03/07/23 10:18	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		03/06/23 09:21	5	2.0	03/07/23 10:18	JMW	EPA 6020A
Lead	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:59	JMW	EPA 6020A
Magnesium	59	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:18	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 17:59	JMW	EPA 6020A
Molybdenum	1.9	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:18	JMW	EPA 6020A
Potassium	1.4	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:18	JMW	EPA 6020A
Selenium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:59	JMW	EPA 6020A
Sodium	64	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:18	JMW	EPA 6020A

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2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: GC00016-07
Name: AW-09
Matrix: Ground Water - Grab

Sampled: 02/28/23 12:05
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 17:59	JMW	EPA 6020A
Lithium	< 20	ug/L		03/06/23 09:21	1	20	03/07/23 10:28	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-08
Name: AW-10
Matrix: Ground Water - Grab

Sampled: 02/28/23 15:45
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	85	mg/L		03/03/23 16:44	25	25	03/03/23 16:44	CRD	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		03/03/23 16:26	1	0.250	03/03/23 16:26	CRD	EPA 300.0 REV 2.1
Sulfate	< 1.0	mg/L		03/03/23 16:26	1	1.0	03/03/23 16:26	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	2	Feet		02/28/23 15:45	1		02/28/23 15:45	FIELD	Field*
Dissolved oxygen, Field	0.82	mg/L		02/28/23 15:45	1		02/28/23 15:45	FIELD	Field*
Oxidation Reduction Potential	-89.0	mV		02/28/23 15:45	1	-500	02/28/23 15:45	FIELD	Field*
pH, Field Measured	7.00	pH Units		02/28/23 15:45	1		02/28/23 15:45	FIELD	Field*
Specific Conductance, Field Measured	2030	umhos/cm		02/28/23 15:45	1		02/28/23 15:45	FIELD	Field*
Temperature, Field Measured	12.3	°C		02/28/23 15:45	1		02/28/23 15:45	FIELD	Field*
Turbidity, Field Measured	>1000	NTU		02/28/23 15:45	1	0.00	02/28/23 15:45	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	1100	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	1300	mg/L		03/02/23 09:54	1	26	03/02/23 10:44	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 10:22	JMW	EPA 6020A
Arsenic	16	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:22	JMW	EPA 6020A
Barium	1300	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:22	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:22	JMW	EPA 6020A
Boron	520	ug/L		03/06/23 09:21	5	10	03/07/23 10:22	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:22	JMW	EPA 6020A
Calcium	140	mg/L		03/06/23 09:21	5	0.20	03/07/23 10:22	JMW	EPA 6020A
Chromium	9.5	ug/L		03/06/23 09:21	5	4.0	03/07/23 10:22	JMW	EPA 6020A
Cobalt	6.8	ug/L		03/06/23 09:21	5	2.0	03/07/23 10:22	JMW	EPA 6020A
Lead	6.2	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:02	JMW	EPA 6020A
Magnesium	66	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:22	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 18:02	JMW	EPA 6020A
Molybdenum	1.2	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:22	JMW	EPA 6020A
Potassium	4.2	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:22	JMW	EPA 6020A
Selenium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:02	JMW	EPA 6020A
Sodium	290	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:22	JMW	EPA 6020A

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2231 W. Altorfer Drive
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ANALYTICAL RESULTS

Sample: GC00016-08
Name: AW-10
Matrix: Ground Water - Grab

Sampled: 02/28/23 15:45
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:02	JMW	EPA 6020A
Lithium	43	ug/L		03/06/23 09:21	1	20	03/07/23 10:29	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-09
Name: AW-11
Matrix: Ground Water - Grab

Sampled: 02/28/23 14:24
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	30	mg/L		03/03/23 17:20	10	10	03/03/23 17:20	CRD	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		03/03/23 17:02	1	0.250	03/03/23 17:02	CRD	EPA 300.0 REV 2.1
Sulfate	< 1.0	mg/L		03/03/23 17:02	1	1.0	03/03/23 17:02	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	6.23	Feet		02/28/23 14:24	1		02/28/23 14:24	FIELD	Field*
Dissolved oxygen, Field	0.91	mg/L		02/28/23 14:24	1		02/28/23 14:24	FIELD	Field*
Oxidation Reduction Potential	-103	mV		02/28/23 14:24	1	-500	02/28/23 14:24	FIELD	Field*
pH, Field Measured	7.17	pH Units		02/28/23 14:24	1		02/28/23 14:24	FIELD	Field*
Specific Conductance, Field Measured	1650	umhos/cm		02/28/23 14:24	1		02/28/23 14:24	FIELD	Field*
Temperature, Field Measured	10.8	°C		02/28/23 14:24	1		02/28/23 14:24	FIELD	Field*
Turbidity, Field Measured	>1000	NTU		02/28/23 14:24	1	0.00	02/28/23 14:24	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	990	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	1000	mg/L		03/02/23 09:54	1	26	03/02/23 10:44	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 10:26	JMW	EPA 6020A
Arsenic	13	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:26	JMW	EPA 6020A
Barium	1100	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:26	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:26	JMW	EPA 6020A
Boron	240	ug/L		03/06/23 09:21	5	10	03/07/23 10:26	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:26	JMW	EPA 6020A
Calcium	170	mg/L		03/06/23 09:21	5	0.20	03/07/23 10:26	JMW	EPA 6020A
Chromium	17	ug/L		03/06/23 09:21	5	4.0	03/07/23 10:26	JMW	EPA 6020A
Cobalt	10	ug/L		03/06/23 09:21	5	2.0	03/07/23 10:26	JMW	EPA 6020A
Lead	10	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:04	JMW	EPA 6020A
Magnesium	75	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:26	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 18:04	JMW	EPA 6020A
Molybdenum	3.2	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:26	JMW	EPA 6020A
Potassium	3.9	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:26	JMW	EPA 6020A
Selenium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:04	JMW	EPA 6020A
Sodium	150	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:26	JMW	EPA 6020A

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ANALYTICAL RESULTS

Sample: GC00016-09
Name: AW-11
Matrix: Ground Water - Grab

Sampled: 02/28/23 14:24
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:04	JMW	EPA 6020A
Lithium	31	ug/L		03/06/23 09:21	1	20	03/07/23 10:30	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-10
Name: AW-14
Matrix: Ground Water - Grab

Sampled: 02/28/23 13:13
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	21	mg/L	Q4	03/03/23 19:08	5	5.0	03/03/23 19:08	CRD	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		03/03/23 17:38	1	0.250	03/03/23 17:38	CRD	EPA 300.0 REV 2.1
Sulfate	5.7	mg/L		03/03/23 17:38	1	1.0	03/03/23 17:38	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	6.93	Feet		02/28/23 13:13	1		02/28/23 13:13	FIELD	Field*
Dissolved oxygen, Field	1.1	mg/L		02/28/23 13:13	1		02/28/23 13:13	FIELD	Field*
Oxidation Reduction Potential	-63.0	mV		02/28/23 13:13	1	-500	02/28/23 13:13	FIELD	Field*
pH, Field Measured	6.98	pH Units		02/28/23 13:13	1		02/28/23 13:13	FIELD	Field*
Specific Conductance, Field Measured	1690	umhos/cm		02/28/23 13:13	1		02/28/23 13:13	FIELD	Field*
Temperature, Field Measured	11.4	°C		02/28/23 13:13	1		02/28/23 13:13	FIELD	Field*
Turbidity, Field Measured	261	NTU		02/28/23 13:13	1	0.00	02/28/23 13:13	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	980	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	1100	mg/L		03/02/23 09:54	1	26	03/02/23 10:44	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 10:30	JMW	EPA 6020A
Arsenic	15	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:30	JMW	EPA 6020A
Barium	720	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:30	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:30	JMW	EPA 6020A
Boron	180	ug/L		03/06/23 09:21	5	10	03/07/23 10:30	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:30	JMW	EPA 6020A
Calcium	170	mg/L		03/06/23 09:21	5	0.20	03/07/23 10:30	JMW	EPA 6020A
Chromium	< 4.0	ug/L		03/06/23 09:21	5	4.0	03/07/23 10:30	JMW	EPA 6020A
Cobalt	4.8	ug/L		03/06/23 09:21	5	2.0	03/07/23 10:30	JMW	EPA 6020A
Lead	1.7	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:07	JMW	EPA 6020A
Magnesium	66	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:30	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 18:07	JMW	EPA 6020A
Molybdenum	19	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:30	JMW	EPA 6020A
Potassium	2.5	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:30	JMW	EPA 6020A
Selenium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:07	JMW	EPA 6020A
Sodium	150	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:30	JMW	EPA 6020A

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Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
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ANALYTICAL RESULTS

Sample: GC00016-10
Name: AW-14
Matrix: Ground Water - Grab

Sampled: 02/28/23 13:13
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:07	JMW	EPA 6020A
Lithium	< 20	ug/L		03/06/23 09:21	1	20	03/07/23 10:31	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-11
Name: AW-16
Matrix: Ground Water - Grab

Sampled: 02/28/23 13:08
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	46	mg/L	Q4	03/03/23 20:21	10	10	03/03/23 20:21	CRD	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		03/03/23 19:26	1	0.250	03/03/23 19:26	CRD	EPA 300.0 REV 2.1
Sulfate	3.4	mg/L		03/03/23 19:26	1	1.0	03/03/23 19:26	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	24.89	Feet		02/28/23 13:08	1		02/28/23 13:08	FIELD	Field*
Dissolved oxygen, Field	0.97	mg/L		02/28/23 13:08	1		02/28/23 13:08	FIELD	Field*
Oxidation Reduction Potential	-94.0	mV		02/28/23 13:08	1	-500	02/28/23 13:08	FIELD	Field*
pH, Field Measured	6.83	pH Units		02/28/23 13:08	1		02/28/23 13:08	FIELD	Field*
Specific Conductance, Field Measured	1950	umhos/cm		02/28/23 13:08	1		02/28/23 13:08	FIELD	Field*
Temperature, Field Measured	13.2	°C		02/28/23 13:08	1		02/28/23 13:08	FIELD	Field*
Turbidity, Field Measured	29.3	NTU		02/28/23 13:08	1	0.00	02/28/23 13:08	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	1100	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	1200	mg/L		03/02/23 09:54	1	26	03/02/23 10:44	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 10:33	JMW	EPA 6020A
Arsenic	2.2	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:33	JMW	EPA 6020A
Barium	1300	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:33	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:33	JMW	EPA 6020A
Boron	490	ug/L		03/06/23 09:21	5	10	03/07/23 10:33	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:33	JMW	EPA 6020A
Calcium	140	mg/L		03/06/23 09:21	5	0.20	03/07/23 10:33	JMW	EPA 6020A
Chromium	< 4.0	ug/L		03/06/23 09:21	5	4.0	03/07/23 10:33	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		03/06/23 09:21	5	2.0	03/07/23 10:33	JMW	EPA 6020A
Lead	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:10	JMW	EPA 6020A
Magnesium	59	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:33	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 18:10	JMW	EPA 6020A
Molybdenum	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:33	JMW	EPA 6020A
Potassium	4.9	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:33	JMW	EPA 6020A
Selenium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:10	JMW	EPA 6020A
Sodium	260	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:33	JMW	EPA 6020A

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ANALYTICAL RESULTS

Sample: GC00016-11
Name: AW-16
Matrix: Ground Water - Grab

Sampled: 02/28/23 13:08
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:10	JMW	EPA 6020A
Lithium	37	ug/L		03/06/23 09:21	1	20	03/07/23 10:32	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-12
Name: AW-17
Matrix: Ground Water - Grab

Sampled: 02/28/23 11:06
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	47	mg/L		03/03/23 20:57	10	10	03/03/23 20:57	CRD	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		03/03/23 20:39	1	0.250	03/03/23 20:39	CRD	EPA 300.0 REV 2.1
Sulfate	< 1.0	mg/L		03/03/23 20:39	1	1.0	03/03/23 20:39	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	25.6	Feet		02/28/23 11:06	1		02/28/23 11:06	FIELD	Field*
Dissolved oxygen, Field	0.36	mg/L		02/28/23 11:06	1		02/28/23 11:06	FIELD	Field*
Oxidation Reduction Potential	-108	mV		02/28/23 11:06	1	-500	02/28/23 11:06	FIELD	Field*
pH, Field Measured	6.90	pH Units		02/28/23 11:06	1		02/28/23 11:06	FIELD	Field*
Specific Conductance, Field Measured	1610	umhos/cm		02/28/23 11:06	1		02/28/23 11:06	FIELD	Field*
Temperature, Field Measured	12.6	°C		02/28/23 11:06	1		02/28/23 11:06	FIELD	Field*
Turbidity, Field Measured	869	NTU		02/28/23 11:06	1	0.00	02/28/23 11:06	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	900	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	1100	mg/L		03/02/23 09:54	1	26	03/02/23 10:44	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 10:37	JMW	EPA 6020A
Arsenic	6.1	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:37	JMW	EPA 6020A
Barium	1200	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:37	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:37	JMW	EPA 6020A
Boron	420	ug/L		03/06/23 09:21	5	10	03/07/23 10:37	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:37	JMW	EPA 6020A
Calcium	110	mg/L		03/06/23 09:21	5	0.20	03/07/23 10:37	JMW	EPA 6020A
Chromium	4.0	ug/L		03/06/23 09:21	5	4.0	03/07/23 10:37	JMW	EPA 6020A
Cobalt	3.4	ug/L		03/06/23 09:21	5	2.0	03/07/23 10:37	JMW	EPA 6020A
Lead	1.8	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:13	JMW	EPA 6020A
Magnesium	45	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:37	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 18:13	JMW	EPA 6020A
Molybdenum	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:37	JMW	EPA 6020A
Potassium	4.5	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:37	JMW	EPA 6020A
Selenium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:13	JMW	EPA 6020A
Sodium	230	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:37	JMW	EPA 6020A

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ANALYTICAL RESULTS

Sample: GC00016-12
Name: AW-17
Matrix: Ground Water - Grab

Sampled: 02/28/23 11:06
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:13	JMW	EPA 6020A
Lithium	34	ug/L		03/06/23 09:21	1	20	03/07/23 10:37	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-13
Name: AW-21
Matrix: Ground Water - Grab

Sampled: 02/28/23 10:05
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	80	mg/L		03/03/23 21:33	50	50	03/03/23 21:33	CRD	EPA 300.0 REV 2.1
Fluoride	0.360	mg/L		03/03/23 21:15	1	0.250	03/03/23 21:15	CRD	EPA 300.0 REV 2.1
Sulfate	240	mg/L		03/03/23 21:33	50	50	03/03/23 21:33	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	16.34	Feet		02/28/23 10:05	1		02/28/23 10:05	FIELD	Field*
Dissolved oxygen, Field	6.7	mg/L		02/28/23 10:05	1		02/28/23 10:05	FIELD	Field*
Oxidation Reduction Potential	227	mV		02/28/23 10:05	1	-500	02/28/23 10:05	FIELD	Field*
pH, Field Measured	7.99	pH Units		02/28/23 10:05	1		02/28/23 10:05	FIELD	Field*
Specific Conductance, Field Measured	728.0	umhos/cm		02/28/23 10:05	1		02/28/23 10:05	FIELD	Field*
Temperature, Field Measured	12.2	°C		02/28/23 10:05	1		02/28/23 10:05	FIELD	Field*
Turbidity, Field Measured	125	NTU		02/28/23 10:05	1	0.00	02/28/23 10:05	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	160	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	< 10	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	680	mg/L		03/02/23 09:54	1	26	03/02/23 10:44	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 10:41	JMW	EPA 6020A
Arsenic	2.7	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:41	JMW	EPA 6020A
Barium	58	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:41	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:41	JMW	EPA 6020A
Boron	13000	ug/L		03/06/23 09:21	100	200	03/07/23 12:08	JMW	EPA 6020A
Cadmium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:41	JMW	EPA 6020A
Calcium	110	mg/L		03/06/23 09:21	5	0.20	03/07/23 10:41	JMW	EPA 6020A
Chromium	< 4.0	ug/L		03/06/23 09:21	5	4.0	03/07/23 10:41	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		03/06/23 09:21	5	2.0	03/07/23 10:41	JMW	EPA 6020A
Lead	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:16	JMW	EPA 6020A
Magnesium	34	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:41	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 18:16	JMW	EPA 6020A
Molybdenum	29	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:41	JMW	EPA 6020A
Potassium	3.4	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:41	JMW	EPA 6020A
Selenium	1.7	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:16	JMW	EPA 6020A
Sodium	60	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:41	JMW	EPA 6020A

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ANALYTICAL RESULTS

Sample: GC00016-13
Name: AW-21
Matrix: Ground Water - Grab

Sampled: 02/28/23 10:05
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:16	JMW	EPA 6020A
Lithium	< 20	ug/L		03/06/23 09:21	1	20	03/07/23 10:38	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-14
Name: XPW01A
Matrix: Ground Water - Grab

Sampled: 02/28/23 10:48
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	86	mg/L		03/03/23 22:45	25	25	03/03/23 22:45	CRD	EPA 300.0 REV 2.1
Fluoride	< 0.250	mg/L		03/03/23 21:51	1	0.250	03/03/23 21:51	CRD	EPA 300.0 REV 2.1
Sulfate	220	mg/L		03/03/23 22:45	25	25	03/03/23 22:45	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	11.32	Feet		02/28/23 10:48	1		02/28/23 10:48	FIELD	Field*
Dissolved oxygen, Field	4.2	mg/L		02/28/23 10:48	1		02/28/23 10:48	FIELD	Field*
Oxidation Reduction Potential	54.0	mV		02/28/23 10:48	1	-500	02/28/23 10:48	FIELD	Field*
pH, Field Measured	11.8	pH Units		02/28/23 10:48	1		02/28/23 10:48	FIELD	Field*
Specific Conductance, Field Measured	1970	umhos/cm		02/28/23 10:48	1		02/28/23 10:48	FIELD	Field*
Temperature, Field Measured	11.0	°C		02/28/23 10:48	1		02/28/23 10:48	FIELD	Field*
Turbidity, Field Measured	52.9	NTU		02/28/23 10:48	1	0.00	02/28/23 10:48	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	< 10	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	75	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Solids - total dissolved solids (TDS)	960	mg/L		03/02/23 09:54	1	26	03/02/23 10:44	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/07/23 10:45	JMW	EPA 6020A
Arsenic	120	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:45	JMW	EPA 6020A
Barium	34	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:45	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:45	JMW	EPA 6020A
Boron	19000	ug/L		03/06/23 09:21	100	200	03/07/23 12:12	JMW	EPA 6020A
Cadmium	1.9	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:45	JMW	EPA 6020A
Calcium	57	mg/L		03/06/23 09:21	5	0.20	03/07/23 10:45	JMW	EPA 6020A
Chromium	< 4.0	ug/L		03/06/23 09:21	5	4.0	03/07/23 10:45	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		03/06/23 09:21	5	2.0	03/07/23 10:45	JMW	EPA 6020A
Lead	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:19	JMW	EPA 6020A
Magnesium	< 0.10	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:45	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 18:19	JMW	EPA 6020A
Molybdenum	3200	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:45	JMW	EPA 6020A
Potassium	240	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:45	JMW	EPA 6020A
Selenium	8.5	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:19	JMW	EPA 6020A
Sodium	120	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:45	JMW	EPA 6020A

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ANALYTICAL RESULTS

Sample: GC00016-14
Name: XPW01A
Matrix: Ground Water - Grab

Sampled: 02/28/23 10:48
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:19	JMW	EPA 6020A
Lithium	680	ug/L		03/06/23 09:21	1	20	03/07/23 10:39	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-15
Name: XPW02
Matrix: Ground Water - Grab

Sampled: 02/28/23 14:27
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	100	mg/L		03/03/23 23:03	100	100	03/03/23 23:03	CRD	EPA 300.0 REV 2.1
Sulfate	930	mg/L		03/03/23 23:03	100	100	03/03/23 23:03	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	20.13	Feet		02/28/23 14:27	1		02/28/23 14:27	FIELD	Field*
Dissolved oxygen, Field	1.6	mg/L		02/28/23 14:27	1		02/28/23 14:27	FIELD	Field*
Oxidation Reduction Potential	-148	mV		02/28/23 14:27	1	-500	02/28/23 14:27	FIELD	Field*
pH, Field Measured	12.2	pH Units		02/28/23 14:27	1		02/28/23 14:27	FIELD	Field*
Specific Conductance, Field Measured	4140	umhos/cm		02/28/23 14:27	1		02/28/23 14:27	FIELD	Field*
Temperature, Field Measured	13.9	°C		02/28/23 14:27	1		02/28/23 14:27	FIELD	Field*
Turbidity, Field Measured	19.8	NTU		02/28/23 14:27	1	0.00	02/28/23 14:27	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	< 10	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	120	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Fluoride	0.319	mg/L		03/06/23 16:44	1	0.250	03/06/23 16:44	TTH	SM 4500F C 1997
Solids - total dissolved solids (TDS)	2400	mg/L		03/02/23 09:54	1	26	03/02/23 10:44	HRF	SM 2540C
Total Metals - PIA									
Antimony	3.2	ug/L		03/06/23 09:21	5	3.0	03/07/23 10:49	JMW	EPA 6020A
Arsenic	170	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:49	JMW	EPA 6020A
Barium	38	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:49	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:49	JMW	EPA 6020A
Boron	16000	ug/L		03/06/23 09:21	100	200	03/07/23 12:15	JMW	EPA 6020A
Cadmium	1.9	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:49	JMW	EPA 6020A
Calcium	37	mg/L		03/06/23 09:21	5	0.20	03/07/23 10:49	JMW	EPA 6020A
Chromium	< 4.0	ug/L		03/06/23 09:21	5	4.0	03/07/23 10:49	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		03/06/23 09:21	5	2.0	03/07/23 10:49	JMW	EPA 6020A
Lead	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:22	JMW	EPA 6020A
Magnesium	0.23	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:49	JMW	EPA 6020A
Mercury	0.28	ug/L		03/06/23 09:21	5	0.20	03/07/23 18:22	JMW	EPA 6020A
Molybdenum	3200	ug/L		03/06/23 09:21	5	1.0	03/07/23 10:49	JMW	EPA 6020A
Potassium	110	mg/L		03/06/23 09:21	5	0.10	03/07/23 10:49	JMW	EPA 6020A
Selenium	160	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:22	JMW	EPA 6020A
Sodium	730	mg/L		03/06/23 09:21	100	2.0	03/08/23 07:55	JMW	EPA 6020A

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ANALYTICAL RESULTS

Sample: GC00016-15
Name: XPW02
Matrix: Ground Water - Grab

Sampled: 02/28/23 14:27
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:22	JMW	EPA 6020A
Lithium	310	ug/L		03/06/23 09:21	1	20	03/07/23 10:40	TJJ	EPA 6010B

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ANALYTICAL RESULTS

Sample: GC00016-16
Name: XPW03
Matrix: Ground Water - Grab

Sampled: 02/28/23 16:33
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Anions - PIA									
Chloride	93	mg/L		03/03/23 23:21	50	50	03/03/23 23:21	CRD	EPA 300.0 REV 2.1
Sulfate	260	mg/L		03/03/23 23:21	50	50	03/03/23 23:21	CRD	EPA 300.0 REV 2.1
Field - PIA									
Depth, From Measuring Point	16.34	Feet		02/28/23 16:33	1		02/28/23 16:33	FIELD	Field*
Dissolved oxygen, Field	2.6	mg/L		02/28/23 16:33	1		02/28/23 16:33	FIELD	Field*
Oxidation Reduction Potential	-51.0	mV		02/28/23 16:33	1	-500	02/28/23 16:33	FIELD	Field*
pH, Field Measured	11.9	pH Units		02/28/23 16:33	1		02/28/23 16:33	FIELD	Field*
Specific Conductance, Field Measured	1930	umhos/cm		02/28/23 16:33	1		02/28/23 16:33	FIELD	Field*
Temperature, Field Measured	15.1	°C		02/28/23 16:33	1		02/28/23 16:33	FIELD	Field*
Turbidity, Field Measured	78.1	NTU		02/28/23 16:33	1	0.00	02/28/23 16:33	FIELD	Field*
General Chemistry - PIA									
Alkalinity - bicarbonate as CaCO3	< 10	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Alkalinity - carbonate as CaCO3	120	mg/L		03/07/23 10:31	1	10	03/07/23 10:31	CPS	SM 2320B 1997*
Fluoride	< 0.250	mg/L		03/06/23 16:45	1	0.250	03/06/23 16:45	TTH	SM 4500F C 1997
Solids - total dissolved solids (TDS)	2000	mg/L		03/02/23 09:54	1	26	03/02/23 10:44	HRF	SM 2540C
Total Metals - PIA									
Antimony	< 3.0	ug/L		03/06/23 09:21	5	3.0	03/08/23 10:03	JMW	EPA 6020A
Arsenic	27	ug/L		03/06/23 09:21	5	1.0	03/07/23 11:41	JMW	EPA 6020A
Barium	120	ug/L		03/06/23 09:21	5	1.0	03/07/23 11:41	JMW	EPA 6020A
Beryllium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 11:41	JMW	EPA 6020A
Boron	5700	ug/L		03/06/23 09:21	5	10	03/07/23 11:41	JMW	EPA 6020A
Cadmium	2.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 11:41	JMW	EPA 6020A
Calcium	61	mg/L		03/06/23 09:21	5	0.20	03/07/23 11:41	JMW	EPA 6020A
Chromium	< 4.0	ug/L		03/06/23 09:21	5	4.0	03/07/23 11:41	JMW	EPA 6020A
Cobalt	< 2.0	ug/L		03/06/23 09:21	5	2.0	03/07/23 11:41	JMW	EPA 6020A
Lead	1.8	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:25	JMW	EPA 6020A
Magnesium	0.36	mg/L		03/06/23 09:21	5	0.10	03/07/23 11:41	JMW	EPA 6020A
Mercury	< 0.20	ug/L		03/06/23 09:21	5	0.20	03/07/23 18:25	JMW	EPA 6020A
Molybdenum	3100	ug/L		03/06/23 09:21	5	1.0	03/07/23 11:41	JMW	EPA 6020A
Potassium	68	mg/L		03/06/23 09:21	5	0.10	03/07/23 11:41	JMW	EPA 6020A
Selenium	18	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:25	JMW	EPA 6020A
Sodium	230	mg/L		03/06/23 09:21	5	0.10	03/08/23 10:03	JMW	EPA 6020A

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ANALYTICAL RESULTS

Sample: GC00016-16
Name: XPW03
Matrix: Ground Water - Grab

Sampled: 02/28/23 16:33
Received: 03/01/23 07:07

Parameter	Result	Unit	Qualifier	Prepared	Dilution	MRL	Analyzed	Analyst	Method
Thallium	< 1.0	ug/L		03/06/23 09:21	5	1.0	03/07/23 18:25	JMW	EPA 6020A
Lithium	130	ug/L		03/06/23 09:21	1	20	03/07/23 10:42	TJJ	EPA 6010B

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QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B327096 - No Prep - SM 2540C									
Blank (B327096-BLK1)				Prepared & Analyzed: 03/01/23					
Solids - total dissolved solids (TDS)	< 17	mg/L							
LCS (B327096-BS1)				Prepared & Analyzed: 03/01/23					
Solids - total dissolved solids (TDS)	957	mg/L		1000		96	84.9-109		
Batch B327134 - No Prep - SM 2540C									
Blank (B327134-BLK1)				Prepared & Analyzed: 03/02/23					
Solids - total dissolved solids (TDS)	< 17	mg/L							
LCS (B327134-BS1)				Prepared & Analyzed: 03/02/23					
Solids - total dissolved solids (TDS)	983	mg/L		1000		98	84.9-109		
Duplicate (B327134-DUP1)	**Sample: GC00016-06**			Prepared & Analyzed: 03/02/23					
Solids - total dissolved solids (TDS)	725	mg/L			735			1	5
Duplicate (B327134-DUP2)	**Sample: GC00016-07**			Prepared & Analyzed: 03/02/23					
Solids - total dissolved solids (TDS)	830	mg/L			830			0	5
Batch B327318 - No Prep - SM 2320B 1997									
Blank (B327318-BLK1)				Prepared & Analyzed: 03/03/23					
Alkalinity - bicarbonate as CaCO3	2.50	mg/L							
Batch B327371 - IC No Prep - EPA 300.0 REV 2.1									
Calibration Blank (B327371-CCB1)				Prepared & Analyzed: 03/03/23					
Sulfate	0.00	mg/L							
Fluoride	0.00	mg/L							
Chloride	0.489	mg/L							
Calibration Check (B327371-CCV1)				Prepared & Analyzed: 03/03/23					
Sulfate	4.91	mg/L		5.000		98	90-110		
Fluoride	5.11	mg/L		5.000		102	90-110		
Chloride	4.87	mg/L		5.000		97	90-110		
Matrix Spike (B327371-MS1)	**Sample: GB04667-01**			Prepared & Analyzed: 03/03/23					
Sulfate	1.54	mg/L		1.500	ND	103	80-120		
Matrix Spike (B327371-MS2)	**Sample: GC00016-10**			Prepared & Analyzed: 03/03/23					
Sulfate	7.27	mg/L		1.500	5.68	106	80-120		
Fluoride	1.45	mg/L		1.500	0.0778	91	80-120		
Chloride	< 1.0	mg/L	Q4	1.500	21	NR	80-120		
Matrix Spike (B327371-MS3)	**Sample: GC00016-11**			Prepared & Analyzed: 03/03/23					
Fluoride	1.40	mg/L		1.500	0.0535	90	80-120		
Chloride	< 1.0	mg/L	Q4	1.500	46	NR	80-120		
Sulfate	4.91	mg/L		1.500	3.37	102	80-120		
Matrix Spike Dup (B327371-MSD1)	**Sample: GB04667-01**			Prepared & Analyzed: 03/03/23					
Sulfate	1.57	mg/L		1.500	ND	105	80-120	2	20
Matrix Spike Dup (B327371-MSD2)	**Sample: GC00016-10**			Prepared & Analyzed: 03/03/23					
Fluoride	1.42	mg/L		1.500	0.0778	90	80-120	2	20
Sulfate	7.28	mg/L		1.500	5.68	107	80-120	0.1	20
Chloride	< 1.0	mg/L	Q4	1.500	21	NR	80-120		20
Matrix Spike Dup (B327371-MSD3)	**Sample: GC00016-11**			Prepared & Analyzed: 03/03/23					

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QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Matrix Spike Dup (B327371-MSD3)	**Sample: GC00016-11**			Prepared & Analyzed: 03/03/23					
Chloride	< 1.0	mg/L	Q4	1.500	46	NR	80-120		20
Sulfate	4.90	mg/L		1.500	3.37	102	80-120	0.2	20
Fluoride	1.40	mg/L		1.500	0.0535	89	80-120	0.3	20
Batch B327373 - SW 3015 - EPA 6010B									
Blank (B327373-BLK1)				Prepared: 03/06/23 Analyzed: 03/07/23					
Lithium	< 20	ug/L							
LCS (B327373-BS1)				Prepared: 03/06/23 Analyzed: 03/07/23					
Lithium	509	ug/L		555.6		92	80-120		
Matrix Spike (B327373-MS1)	**Sample: GB04667-01**			Prepared: 03/06/23 Analyzed: 03/07/23					
Lithium	511	ug/L		555.6	26.8	87	75-125		
Matrix Spike Dup (B327373-MSD1)	**Sample: GB04667-01**			Prepared: 03/06/23 Analyzed: 03/07/23					
Lithium	537	ug/L		555.6	26.8	92	75-125	5	200
Batch B327373 - SW 3015 - EPA 6020A									
Blank (B327373-BLK1)				Prepared: 03/06/23 Analyzed: 03/07/23					
Antimony	< 3.0	ug/L							
Arsenic	< 1.0	ug/L							
Barium	< 1.0	ug/L							
Beryllium	< 1.0	ug/L							
Boron	< 10	ug/L							
Cadmium	< 1.0	ug/L							
Calcium	< 0.20	mg/L							
Chromium	< 4.0	ug/L							
Cobalt	< 2.0	ug/L							
Lead	< 1.0	ug/L							
Magnesium	< 0.10	mg/L							
Mercury	< 0.20	ug/L							
Molybdenum	< 1.0	ug/L							
Potassium	< 0.10	mg/L							
Selenium	< 1.0	ug/L							
Sodium	< 0.10	mg/L							
Thallium	< 1.0	ug/L							
LCS (B327373-BS1)				Prepared: 03/06/23 Analyzed: 03/07/23					
Antimony	551	ug/L		555.6		99	80-120		
Arsenic	548	ug/L		555.6		99	80-120		
Barium	540	ug/L		555.6		97	80-120		
Beryllium	524	ug/L		555.6		94	80-120		
Boron	531	ug/L		555.6		96	80-120		
Cadmium	557	ug/L		555.6		100	80-120		
Calcium	5.73	mg/L		5.556		103	80-120		
Chromium	557	ug/L		555.6		100	80-120		
Cobalt	556	ug/L		555.6		100	80-120		
Lead	556	ug/L		555.6		100	80-120		
Magnesium	5.95	mg/L		5.556		107	80-120		
Mercury	52.8	ug/L		55.56		95	80-120		
Molybdenum	534	ug/L		555.6		96	80-120		

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QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
LCS (B327373-BS1)				Prepared: 03/06/23 Analyzed: 03/07/23					
Potassium	5.51	mg/L		5.556		99	80-120		
Selenium	560	ug/L		555.6		101	80-120		
Sodium	6.07	mg/L		5.556		109	80-120		
Thallium	540	ug/L		555.6		97	80-120		
Matrix Spike (B327373-MS1)	**Sample: GB04667-01**			Prepared: 03/06/23 Analyzed: 03/07/23					
Antimony	553	ug/L		555.6	ND	100	75-125		
Arsenic	548	ug/L		555.6	3.53	98	75-125		
Barium	2220	ug/L		555.6	1770	82	75-125		
Beryllium	531	ug/L		555.6	ND	96	75-125		
Boron	930	ug/L		555.6	366	102	75-125		
Cadmium	557	ug/L		555.6	ND	100	75-125		
Calcium	147	mg/L		5.556	142	85	75-125		
Chromium	546	ug/L		555.6	ND	98	75-125		
Cobalt	545	ug/L		555.6	1.83	98	75-125		
Lead	540	ug/L		555.6	0.272	97	75-125		
Magnesium	62.1	mg/L		5.556	56.8	95	75-125		
Mercury	54.2	ug/L		55.56	0.206	97	75-125		
Molybdenum	550	ug/L		555.6	ND	99	75-125		
Potassium	9.36	mg/L		5.556	3.95	97	75-125		
Selenium	547	ug/L		555.6	ND	98	75-125		
Sodium	214	mg/L		5.556	210	76	75-125		
Thallium	522	ug/L		555.6	ND	94	75-125		
Matrix Spike Dup (B327373-MSD1)	**Sample: GB04667-01**			Prepared: 03/06/23 Analyzed: 03/07/23					
Antimony	556	ug/L		555.6	ND	100	75-125	0.5	20
Arsenic	555	ug/L		555.6	3.53	99	75-125	1	20
Barium	2240	ug/L		555.6	1770	85	75-125	0.8	20
Beryllium	535	ug/L		555.6	ND	96	75-125	0.6	20
Boron	937	ug/L		555.6	366	103	75-125	0.7	20
Cadmium	562	ug/L		555.6	ND	101	75-125	0.9	20
Calcium	148	mg/L		5.556	142	99	75-125	0.5	20
Chromium	551	ug/L		555.6	ND	99	75-125	0.8	20
Cobalt	551	ug/L		555.6	1.83	99	75-125	1	20
Lead	546	ug/L		555.6	0.272	98	75-125	1	20
Magnesium	62.6	mg/L		5.556	56.8	105	75-125	0.9	20
Mercury	55.0	ug/L		55.56	0.206	99	75-125	1	20
Molybdenum	555	ug/L		555.6	ND	100	75-125	1	20
Potassium	9.43	mg/L		5.556	3.95	99	75-125	0.8	20
Selenium	543	ug/L		555.6	ND	98	75-125	0.6	20
Sodium	217	mg/L		5.556	210	117	75-125	1	20
Thallium	529	ug/L		555.6	ND	95	75-125	1	20
Batch B327405 - No Prep - SM 4500F C 1997									
Calibration Blank (B327405-CCB1)				Prepared & Analyzed: 03/06/23					
Fluoride	0.00900	mg/L							
Calibration Blank (B327405-CCB2)				Prepared & Analyzed: 03/06/23					
Fluoride	0.00500	mg/L							
Calibration Check (B327405-CCV1)				Prepared & Analyzed: 03/06/23					

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QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Calibration Check (B327405-CCV1)				Prepared & Analyzed: 03/06/23					
Fluoride	0.653	mg/L		0.7000		93	90-110		
Calibration Check (B327405-CCV2)				Prepared & Analyzed: 03/06/23					
Fluoride	0.698	mg/L		0.7000		100	90-110		
Batch B327509 - IC No Prep - EPA 300.0 REV 2.1									
Calibration Blank (B327509-CCB1)				Prepared & Analyzed: 03/06/23					
Chloride	0.00	mg/L							
Calibration Check (B327509-CCV1)				Prepared & Analyzed: 03/06/23					
Chloride	4.95	mg/L		5.000		99	90-110		
Batch B327510 - IC No Prep - EPA 300.0 REV 2.1									
Calibration Blank (B327510-CCB1)				Prepared & Analyzed: 03/06/23					
Fluoride	0.00	mg/L							
Chloride	0.194	mg/L							
Sulfate	0.00	mg/L							
Calibration Check (B327510-CCV1)				Prepared & Analyzed: 03/06/23					
Sulfate	4.91	mg/L		5.000		98	90-110		
Fluoride	4.95	mg/L		5.000		99	90-110		
Chloride	4.77	mg/L		5.000		95	90-110		
Batch B327556 - No Prep - SM 2320B 1997									
Duplicate (B327556-DUP2)	**Sample: GC00016-16**			Prepared & Analyzed: 03/07/23					
Alkalinity - carbonate as CaCO3	100	mg/L			125			22	10
Alkalinity - bicarbonate as CaCO3	< 10	mg/L			ND				10
Batch B327620 - No Prep - SM 4500F C 1997									
Calibration Blank (B327620-CCB1)				Prepared & Analyzed: 03/08/23					
Fluoride	0.00800	mg/L							
Calibration Blank (B327620-CCB2)				Prepared & Analyzed: 03/08/23					
Fluoride	0.0100	mg/L							
Calibration Check (B327620-CCV1)				Prepared & Analyzed: 03/08/23					
Fluoride	0.658	mg/L		0.7000		94	90-110		
Calibration Check (B327620-CCV2)				Prepared & Analyzed: 03/08/23					
Fluoride	0.703	mg/L		0.7000		100	90-110		
Batch B327644 - IC No Prep - EPA 300.0 REV 2.1									
Calibration Blank (B327644-CCB1)				Prepared & Analyzed: 03/07/23					
Chloride	0.176	mg/L							
Sulfate	0.00	mg/L							
Calibration Check (B327644-CCV1)				Prepared & Analyzed: 03/07/23					
Sulfate	4.86	mg/L		5.000		97	90-110		
Chloride	4.67	mg/L		5.000		93	90-110		

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NOTES

Specifications regarding method revisions, method modifications, and calculations used for analysis are available upon request. Please contact your project manager.

* Not a TNI accredited analyte

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

Q4 The matrix spike recovery result is unusable since the analyte concentration in the sample is greater than four times the spike level. The associated blank spike was acceptable.

Gail J Schindler

Certified by: Gail Schindler, Project Manager

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AP07D 24.57 at 1246 TD 62.23 AM
AP05D 5.63 at 1210 TD 59.58 APP
APW02 9.02 at 1052 TD 48.38 AM
APW03 7.86 at 1152 TD 33.38 APP

SAR-3: Depth to Groundwater Measurements
Plant: EDW
Event: EDW-23Q1-845-3013-R3

Well	Unique ID	Date	Time	Depth to Water, ft bmp		Transducer			Initials	Notes
				Manual	Transducer	Serial No.	Batt %	DL		
AP05S	EDW_AP05#S	2/27/23	1207	4.82					APP	TD 40.07
AP07S	EDW_AP07#S		1242	24.30					AM	TD 37.34
AP08	EDW_AP08		1318	7.63					APP	TD 21.97
AP09	EDW_AP09		1305	9.41					"	TD 20.89
AW-01	EDW_AW-01		1219	4.20					"	TD 21.42
AW-05	EDW_AW-05		1320	7.61					AM	
AW-06	EDW_AW-06		1202	26.89					"	
AW-08	EDW_AW-08		1200	24.58					APP	
AW-09	EDW_AW-09		1219	25.94					AM	
AW-10	EDW_AW-10		1147	1.55					APP	
AW-11	EDW_AW-11		1134	5.69					"	
AW-14	EDW_AW-14		1131	6.88					"	
AW-15	EDW_AW-15		1056	8.92					"	
AW-15S	EDW_AW-15#S		1054	10.05					"	
AW-16	EDW_AW-16		1222	24.60					AM	
AW-17	EDW_AW-17		1208	24.85					"	
AW-18	EDW_AW-18		1204	26.96					"	
AW-19	EDW_AW-19		1139	13.39					"	
AW-21	EDW_AW-21		1151	16.35					"	
AW-23	EDW_AW-23		~	~					APP	could not find
EMW-05	EDW_EMW-05		1300	20.29					AM	
SG-01	EDW_YILRIVER		1234	441.0					APP	
XPW01A	EDW_XPW01A_pore		1324	11.16					"	
XPW02	EDW_XPW02_pore		1244	19.78					"	
XPW03	EDW_XPW03_pore		1301	16.34					"	

APW04 7.01 at 1140 TD 23.01 unable to close casing APP
AW13 5.40 at 1144 APP
AW15c 7.46 at 1051 APP
AW12 6.58 at 1156 APP
AW20 ~~16.3~~ 16.15 at 1147 AM
AW22 11.30 at 1156 AM
EMW02 18.05 at 1226 APP
EMW03 21.22 at 1223 APP
EMW04 19.48 at 1309 AM
POO2 12.05 at 1144 AM
POO3 22.96 at 1212 TD 52.11
PTW01 24.53 at 1252 TD 40.57
OW-1 23.19 at 1254 TD 38.82

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Site: Edwards Ash Pond

WELL/SAMPLE POINT ~~APW05~~ APOSS **Purge Method:** Portable

Date: 2-28-23 Start Time: 13:48 Finish/Sample Time: 14:40

Well Depth (Bottom) From MP: 39.85 ft
Depth to Water From MP: 5.43 ft
Water Column Length: 34.42 ft
Well Water Volume: 5.5 Gal / L

Min. Purge Volume: 1.0 Gal / L
Total Purge Volume: 1.3 Gal / L
Max Drawdown: — ft
Total Drawdown: 0.19 ft

Reading (Units)	Time	Depth ft.	Flow Rate mL/min	pH s.u.	Spec Cond umhos/cm	Temp deg C	ORP mV	DO mg/L	Turb NTU
1	13:54	5.62	100	7.03	1,390	13.98	-81	1.29	~~1000+~~ >1000
2	13:59	5.63	|	7.00	1,380	14.00	-85	1.21	~~1000+~~ >1000
3	14:00	5.60	|	7.01	1,390	14.01	-87	1.16	~~1000+~~ >1000
4			|						
5			|						
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: MoriBa

Sample Appearance:

Odor: ☐ None ☐ Slight ☑ Mod. ☐ Strong

Color ☐ None ☐ Slight ☐ Mod. ☑ Strong

Turb: ☐ None ☐ Slight ☐ Mod ☑ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes	✓	

BOTTLE INFORMATION:

Unfiltered Qty	Unfiltered Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
	General (P, 250 mL)
1	2.5 L, HNO3
1	1000 ML, P

Filtered Qty	Filtered Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 5.62 ft

Comments

Sampler's Signature:

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Site: Edwards Ash Pond

WELL/SAMPLE POINT AP07S **Purge Method:** portable pump

Date: 2-28-23 Start Time: 12:35 Finish/Sample Time: 13:28

Well Depth (Bottom) From MP: 37.25 ft Min. Purge Volume: 1.0 Gal / L

Depth to Water From MP: 24.55 ft Total Purge Volume: 1.3 Gal / L

Water Column Length: 12.70 ft Max Drawdown: — ft

Well Water Volume: 2.0 Gal / L Total Drawdown: 1.78 ft

Reading (Units)	Time	Depth ft.	Flow Rate mL/min	pH s.u.	Spec Cond umhos/cm	Temp deg C	ORP mV	DO mg/L	Turb NTU
1	12:45	24.98	100	7.28	3,800	13.47	111	7.00	~~1000+~~ >1000
2	12:40	25.06	|	7.15	3,840	13.49	107	6.97	~~1000+~~ >1000
3	12:47	25.09	|	7.13	3,820	13.53	100	6.83	~~1000+~~ >1000
4			|						
5			|						
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horiba

Sample Appearance:

Odor: ☑ None ☐ Slight ☐ Mod. ☐ Strong

Color ☐ None ☐ Slight ☑ Mod. ☐ Strong

Turb: ☐ None ☐ Slight ☐ Mod ☑ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes	✓	

BOTTLE INFORMATION:

Unfiltered Qty	Unfiltered Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
	General (P, 250 mL)
1	2.5 L, HNO3
1	1000 mL, P

3

Filtered Qty	Filtered Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 26.33 ft

Comments

Sampler's Signature: [signature]

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-01 **Purge Method:** Portable Pump

Date: 2-28-23 Start Time: 14:48 Finish/Sample Time: 15:41

Well Depth (Bottom) From MP:	21.12 ft	Min. Purge Volume:	1.0 Gal / L
Depth to Water From MP:	5.47 ft	Total Purge Volume:	1.3 Gal / L
Water Column Length:	15.65 ft	Max Drawdown:	— ft
Well Water Volume:	2.5 Gal / L	Total Drawdown:	0.33 ft

Reading (Units)	Time	Depth ft.	Flow Rate mL/min	pH s.u.	Spec Cond umhos/cm	Temp deg C	ORP mV	DO mg/L	Turb NTU	
1	15:00	5.62	100	7.03	1,350	13.27	-86	1.18	~~1000+~~	>1000
2	15:01	5.64		7.02	1,390	13.29	-87	1.11	~~1000+~~	>1000
3	15:02	5.63		6.98	1,400	13:31	-89	1.07	~~1000+~~	>1000
4										
5										
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA	

Field Meter: Horiba

Sample Appearance:

Odor: ☑ None ☐ Slight ☐ Mod. ☐ Strong

Color ☐ None ☐ Slight ☐ Mod. ☑ Strong

Turb: ☐ None ☐ Slight ☐ Mod ☑ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes	✓	

BOTTLE INFORMATION:

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
	General (P, 250 mL)
1	2.5 L; HNO3
1	1000; NL; 0

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 5.80 ft

Comments

Sampler's Signature:

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-05 **Purge Method:** Bladder

Date: 2-28-23 Start Time: 11:03 Finish/Sample Time: 11:57

Well Depth (Bottom) From MP: 22.45 ft

Depth to Water From MP: 7.83 ft

Water Column Length: 14.62 ft

Well Water Volume: 2.3 Gal / L

Min. Purge Volume: 1.9 Gal / L

Total Purge Volume: 1.3 Gal / L

Max Drawdown: — ft

Total Drawdown: 0.23 ft

Reading (Units)	Time	Depth ft.	Flow Rate mL/min	pH s.u.	Spec Cond umhos/cm	Temp deg C	ORP mV	DO mg/L	Turb NTU
1	11:19	7.98	100	7.31	1,450	12.74	169	4.10	~~1000+~~ >1000
2	11:20	7.97		7.27	1,450	12.71	166	3.94	~~1000+~~ >1000
3	11:21	8.01		7.24	1,440	12.69	162	3.89	~~1000+~~ >1000
4									
5									
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: HoriBa

Sample Appearance:

Odor: ☑ None ☐ Slight ☐ Mod. ☑ Strong KL

Color ☐ None ☐ Slight ☐ Mod. ☑ Strong

Turb: ☐ None ☐ Slight ☐ Mod ☑ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes	✓	

BOTTLE INFORMATION:

3

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
	General (P, 250 mL)
1	2.5 L, HNO3
1	1000 mL, P

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 8.06 ft

Comments

Sampler's Signature:

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-06 **Purge Method:** Compressor

Date: 28-Feb-23 Start Time: 0904 Finish/Sample Time: 1003

Well Depth (Bottom) From MP: 42.30 ft Min. Purge Volume: 1 Gal / (L)

Depth to Water From MP: 26.79 ft Total Purge Volume: 1.4 Gal / (L)

Water Column Length: _____ ft Max Drawdown: _____ ft

Well Water Volume: _____ Gal / L Total Drawdown: _____ ft

Reading	Time	Depth	Flow Rate	pH	Spec Cond	Temp	ORP	DO	Turb
(Units)		ft.	mL/min	s.u.	umhos/cm	deg C	mV	mg/L	NTU
1	0927	28.91	100	7.54	972	11.15	-58	2.01	0.0
2	0928	29.05	1	7.46	970	11.22	-62	1.77	528
3	0929	29.20	1	7.39	971	11.21	-65	1.57	1000
4									
5									
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horriba

Sample Appearance:

Odor: ☑ None ☐ Slight ☐ Mod. ☐ Strong

Color ☐ None ☐ Slight ☐ Mod. ☑ Strong

Turb: ☐ None ☐ Slight ☐ Mod ☑ Strong

Well Integrity	Yes	No
Well has ID sign	/	
Casing locked/secure	/	
Well cap fits securely.	/	
Good seal/drainage	/	
Well has weep holes	/	

BOTTLE INFORMATION:

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
1	General (P, ~~250mL~~ 1L
1	HNO3 (P, 2.5L)

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 33.47 ft

Comments depth to bottom stops at pump

Sampler's Signature: Austin Moore

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-08 **Purge Method:** Compressor

Date: 28-Feb-23 Start Time: 1457 Finish/Sample Time: 1557

Well Depth (Bottom) From MP: 46.52 ft Min. Purge Volume: 1 Gal / L

Depth to Water From MP: 24.60 ft Total Purge Volume: 1.5 Gal / L

Water Column Length: _____ ft Max Drawdown: _____ ft

Well Water Volume: _____ Gal / L Total Drawdown: _____ ft

Reading	Time	Depth	Flow Rate	pH	Spec Cond	Temp	ORP	DO	Turb
(Units)		ft.	mL/min	s.u.	umhos/cm	deg C	mV	mg/L	NTU
1	1510	25.61	100	9.35	740	13.74	-142	2.10	11.6
2	1511	25.71	1	9.12	739	13.71	-137	1.74	11.6
3	1512	25.83	1	8.92	725	13.70	-133	1.56	11.9
4									
5									
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horiba

Sample Appearance:

Odor: ☐ None ☑ Slight ☐ Mod. ☐ Strong

Color ☐ None ☑ Slight ☐ Mod. ☐ Strong

Turb: ☐ None ☑ Slight ☐ Mod ☐ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes	✓	

BOTTLE INFORMATION:

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
1	General (P, ~~250 mL~~ 1L)
1	HNO3 (P, 2.5L)

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 31.62 ft

Comments

Sampler's Signature: Austin Moore

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-09 **Purge Method:** Compressor

Date: 28-Feb-23 Start Time: 1114 Finish/Sample Time: 1205

Well Depth (Bottom) From MP: 47.24 ft Min. Purge Volume: 1 Gal / L

Depth to Water From MP: 26.01 ft Total Purge Volume: 1.3 Gal / L

Water Column Length: ft Max Drawdown: ft

Well Water Volume: Gal / L Total Drawdown: ft

Reading	Time	Depth	Flow Rate	pH	Spec Cond	Temp	ORP	DO	Turb
(Units)		ft.	mL/min	s.u.	umhos/cm	deg C	mV	mg/L	NTU
1	1133	28.53	100	7.03	1340	12.52	-129	1.17	104
2	1134	28.71	1	7.02	1340	12.54	-130	1.08	95.6
3	1135	28.87	1	7.02	1330	12.57	-130	1.01	77.2
4									
5									
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horriba

Sample Appearance:

Odor: ☐ None ☑ Slight ☐ Mod. ☐ Strong

Color ☐ None ☑ Slight ☐ Mod. ☐ Strong

Turb: ☐ None ☑ Slight ☐ Mod ☐ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes	✓	

BOTTLE INFORMATION:

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
1	General (P, ~~250 mL~~) 1L
1	HNO3 (P,250L)

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

34.03 FTOW

Comments depth to bottom stops at pump

Sampler's Signature: Austin Moore

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-10 **Purge Method:** Waterra

Date: 2/28/2023 Start Time: 1449 Finish/Sample Time: 1545

Well Depth (Bottom) From MP: _____ ft

Depth to Water From MP: 2.00 ft

Water Column Length: _____ ft

Well Water Volume: _____ Gal / L

Min. Purge Volume: — Gal / L

Total Purge Volume: 1000 Gal / L (mL)

Max Drawdown: — ft

Total Drawdown: 3.65 ft

Reading	Time	Depth	Flow Rate	pH	Spec Cond	Temp	ORP	DO	Turb
(Units)		ft.	mL/min	s.u.	umhos/cm	deg C	mV	mg/L	NTU
1	1301	3.37	100	7.03	2030	12.38	-88	0.89	>1000
2	1303	3.50	100	7.01	2030	12.31	-88	0.86	>1000
3	1305	3.65	100	7.00	2030	12.34	-89	0.82	>1000
4									
5									
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horiba

Sample Appearance:

Odor: ☒ None ☐ Slight ☐ Mod. ☐ Strong

Color ☐ None ☒ Slight ☐ Mod. ☐ Strong

Turb: ☐ None ☐ Slight ☐ Mod ☒ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes	✓	

BOTTLE INFORMATION:

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
1	General (P, 250 mL)
1	(P, 2.5L HNO3)

(3)

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 5.65 ft

Comments

Sampler's Signature:

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-11 **Purge Method:** Bladder

Date: 2/28/2023 Start Time: 1328 Finish/Sample Time: 1424

Well Depth (Bottom) From MP: _____ ft

Depth to Water From MP: 6.23 ft

Water Column Length: _____ ft

Well Water Volume: _____ Gal / L

Min. Purge Volume: ~ Gal / L

Total Purge Volume: 1000 Gal / L (mL)

Max Drawdown: ~ ft

Total Drawdown: 0.05 ft

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Reading	Time	Depth	Flow Rate	pH	Spec Cond	Temp	ORP	DO	Turb
(Units)		6.35 ft.	mL/min	s.u.	umhos/cm	deg C	mV	mg/L	NTU
1	1341	~~6.25~~	100	7.18	1660	10.90	-100	0.98	>1000
2	1343	6.30	100	7.17	1650	10.85	-101	0.95	>1000
3	1345	6.30	100	7.17	1650	10.81	-103	0.91	>1000
4									
5									
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horiba

Sample Appearance:

Odor: ☒ None ☐ Slight ☐ Mod. ☐ Strong

Color ☐ None ☒ Slight ☐ Mod. ☐ Strong

Turb: ☐ None ☐ Slight ☐ Mod ☒ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes	✓	

BOTTLE INFORMATION:

(3)

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
1	General (P, ~~250 mL~~) 1000mL
1	(P, 2.5L, HNO3)

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: ~~9.~~ 6.30 ft

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Comments

Sampler's Signature:

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-14 **Purge Method:** bladder

Date: 2/28/2023 Start Time: 1217 Finish/Sample Time: 1313

Well Depth (Bottom) From MP: _____ ft

Depth to Water From MP: 6.93 ft

Water Column Length: _____ ft

Well Water Volume: _____ Gal / L

Min. Purge Volume: — Gal / L

Total Purge Volume: 1000 Gal / L (#2)

Max Drawdown: — ft

Total Drawdown: 7.04 ft

Reading (Units)	Time	Depth ft.	Flow Rate mL/min	pH s.u.	Spec Cond umhos/cm	Temp deg C	ORP mV	DO mg/L	Turb NTU
1	1230	9.20	100	6.97	1690	11.50	-60	1.24	253
2	1232	9.42	100	6.97	1690	11.48	-61	1.20	257
3	1234	9.64	100	6.98	1696	11.44	-63	1.11	261
4									
5									
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horiba

Sample Appearance:

Odor: ☒ None ☐ Slight ☐ Mod. ☐ Strong

Color ☐ None ☒ Slight ☐ Mod. ☐ Strong

Turb: ☐ None ☐ Slight ☒ Mod ☐ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes	✓	

BOTTLE INFORMATION:

(3)

Unfiltered Qty	Unfiltered Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
1	General (P, ~~250 mL~~) 1000 mL
1	(P, 2.5L, HNO3)

Filtered Qty	Filtered Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 13.97 ft

Comments

Sampler's Signature:

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-15 **Purge Method:** bladder

Date: 2/27/2023 Start Time: 1430 Finish/Sample Time: 1528

Well Depth (Bottom) From MP: _____ ft

Depth to Water From MP: 9.00 ft

Water Column Length: _____ ft

Well Water Volume: _____ Gal / L

Min. Purge Volume: – Gal / L

Total Purge Volume: 1000 Gal / L (mL)

Max Drawdown: – ft

Total Drawdown: 0.15 ft

Reading (Units)	Time	Depth ft.	Flow Rate mL/min	pH s.u.	Spec Cond umhos/cm	Temp deg C	ORP mV	DO mg/L	Turb NTU
1	1446	9.15	100	6.78	1850	12.98	-97	1.05	88.0
2	1448	9.15	100	6.75	1850	12.92	-100	1.02	102
3	1450	9.15	100	6.75	1840	12.84	-102	1.04	107
4									
5									
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horiba

Sample Appearance:

Odor: ☒ None ☐ Slight ☐ Mod. ☐ Strong

Color ☐ None ☒ Slight ☐ Mod. ☐ Strong

Turb: ☐ None ☒ Slight ☐ Mod ☐ Strong

Well Integrity	Yes	No
Well has ID sign	√	
Casing locked/secure	√	
Well cap fits securely.	√	
Good seal/drainage	√	
Well has weep holes	√	

BOTTLE INFORMATION:

Unfiltered Qty	Unfiltered Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
1	General (P, ~~250mL~~ 1000mL)
1	(P,2.5L, HNO3)

3

Filtered Qty	Filtered Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 9.15 ft

Comments

Sampler's Signature:

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-15S **Purge Method:** bladder

Date: 2/27/2023 Start Time: 1530 Finish/Sample Time: 1630

Well Depth (Bottom) From MP: _____ ft

Depth to Water From MP: 10.04 ft

Water Column Length: _____ ft

Well Water Volume: _____ Gal / L

Min. Purge Volume: — Gal / L

Total Purge Volume: 1000 Gal / L (mL)

Max Drawdown: — ft

Total Drawdown: 2.36 ft

Reading (Units)	Time	Depth ft.	Flow Rate mL/min	pH s.u.	Spec Cond umhos/cm	Temp deg C	ORP mV	DO mg/L	Turb NTU
1	1545	10.92	100	6.82	1670	11.80	119	0.73	109
2	1547	11.00	100	6.82	1670	11.78	118	0.66	93.7
3	1550	11.08	100	6.81	1670	11.76	114	0.64	78.0
4									
5									
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horiba

Sample Appearance:

Odor: ☒ None ☐ Slight ☐ Mod. ☐ Strong

Color ☐ None ☒ Slight ☐ Mod. ☐ Strong

Turb: ☐ None ☐ Slight ☒ Mod ☐ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes	✓	

BOTTLE INFORMATION:

(3)

Unfiltered Qty	Unfiltered Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
1	General (P, ~~250 mL~~ 1000mL
1	1P, 2.5L, HNO3 S

Filtered Qty	Filtered Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW 12.40

Comments

Sampler's Signature:

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-16 **Purge Method:** Compressor

Date: 28-Feb-23 Start Time: 1213 Finish/Sample Time: 1308

Well Depth (Bottom) From MP: 56.79 ft Min. Purge Volume: 1 Gal / (L)

Depth to Water From MP: 24.89 ft Total Purge Volume: 1.3 Gal / (L)

Water Column Length: ft Max Drawdown: ft

Well Water Volume: Gal / L Total Drawdown: ft

Reading	Time	Depth	Flow Rate	pH	Spec Cond	Temp	ORP	DO	Turb
(Units)		ft.	mL/min	s.u.	umhos/cm	deg C	mV	mg/L	NTU
1	1231	25.64	100	6.85	1950	13.26	-91	1.54	38.1
2	1232	25.64	1	6.84	1950	~~13.28~~	-93	1.17	30.2
3	1233	25.64	1	6.83	1950	13.25	-94	0.97	29.3
4									
5					uni	13.28			
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horiba

Sample Appearance:

Odor: ☐ None ☐ Slight ☑ Mod. ☐ Strong

Color ☑ None ☐ Slight ☐ Mod. ☐ Strong

Turb: ☐ None ☑ Slight ☐ Mod ☐ Strong

Well Integrity	Yes	No
Well has ID sign	/	
Casing locked/secure	/	
Well cap fits securely.	/	
Good seal/drainage	/	
Well has weep holes		/

BOTTLE INFORMATION:

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
	General (P, ~~250 mL~~) 1L
1	HNO3 (P, 2.5L)

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 25.64 ft

Comments

Sampler's Signature: Austin Moon

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-17 **Purge Method:** Compressor

Date: 28-Feb-23 Start Time: 1013 Finish/Sample Time: 1106

Well Depth (Bottom) From MP: ~~56.49~~ ft 56.56 Min. Purge Volume: 1 Gal / (L)

Depth to Water From MP: 25.60 ft Total Purge Volume: 1.3 Gal / (L)

Water Column Length: _____ ft Max Drawdown: _____ ft

Well Water Volume: _____ Gal / L Total Drawdown: _____ ft

Reading	Time	Depth	Flow Rate	pH	Spec Cond	Temp	ORP	DO	Turb
(Units)		ft.	mL/min	s.u.	umhos/cm	deg C	mV	mg/L	NTU
1	1031	26.94	100	6.91	1610	12.46	-103	0.53	968
2	1032	26.98	1	6.91	1610	12.50	-106	0.44	988
3	1033	27.01	1	6.90	1610	12.55	-108	0.36	869
4									
5									
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horriba

Sample Appearance:

Odor: ☑ None ☐ Slight ☐ Mod. ☐ Strong

Color ☐ None ☑ Slight ☐ Mod. ☐ Strong

Turb: ☐ None ☐ Slight ☐ Mod ☑ Strong

Well Integrity	Yes	No
Well has ID sign	/	
Casing locked/secure	/	
Well cap fits securely.	/	
Good seal/drainage	/	
Well has weep holes		/

BOTTLE INFORMATION:

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
1	General (P, ~~250mL~~) 1 L
1	HNO3 (P, 1L)

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 27.25 ft

Comments

Sampler's Signature: Austin Moore

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-18 **Purge Method:** Compressor

Date: 2/27/23 Start Time: 1545 Finish/Sample Time: 1650

Well Depth (Bottom) From MP: 50.68 ft Min. Purge Volume: 1 Gal / L

Depth to Water From MP: 27.00 ft Total Purge Volume: 1.5 Gal / L

Water Column Length: ____ ft Max Drawdown: ____ ft

Well Water Volume: ____ Gal / L Total Drawdown: ____ ft

Reading (Units)	Time	Depth ft.	Flow Rate mL/min	pH s.u.	Spec Cond umhos/cm	Temp deg C	ORP mV	DO mg/L	Turb NTU
1	1601	28.10	100	6.97	1640	12.18	-83	0.95	402
2	1602	28.17	1	6.94	1650	12.24	-89	0.72	497
3	1603	28.25	1	6.93	1660	12.25	-94	0.77	499
4									
5									
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horriba

Sample Appearance:

Odor: ☐ None ☑ Slight ☐ Mod. ☐ Strong

Color ☐ None ☐ Slight ☑ Mod. ☐ Strong

Turb: ☐ None ☐ Slight ☐ Mod ☑ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes		✓

BOTTLE INFORMATION:

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
1	General (P, ~~250 mL~~) 1L
1	HNO3 (P, 2.5L)

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 28.39 ft

Comments Depth to bottom stops at pump

Sampler's Signature: Austin Moore

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-19 **Purge Method:** Compressor

Date: 2/27/23 Start Time: 1425 Finish/Sample Time: 1529

Well Depth (Bottom) From MP: 38.60 ft Min. Purge Volume: 1 Gal / L

Depth to Water From MP: 13.37 ft Total Purge Volume: 1.4 Gal / L

Water Column Length: ____ ft Max Drawdown: ____ ft

Well Water Volume: ____ Gal / L Total Drawdown: ____ ft

Reading (Units)	Time	Depth ft.	Flow Rate mL/min	pH s.u.	Spec Cond umhos/cm	Temp deg C	ORP mV	DO mg/L	Turb NTU
1	1448	14.32	100	7.02	1081	12.88	49	2.17	185
2	1449	14.34	1	7.01	1080	12.86	33	2.01	184
3	1450	14.36	1	7.00	1080	12.86	20	1.89	185
4									
5									
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horiba

Sample Appearance:

Odor: ☑ None ☐ Slight ☐ Mod. ☐ Strong

Color ☐ None ☑ Slight ☐ Mod. ☐ Strong

Turb: ☐ None ☐ Slight ☐ Mod ☑ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes		✓

BOTTLE INFORMATION:

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
1	General (P, ~~250 mL~~) 1L
1	HNO3 (P, 2.5L)

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 16.03 ft

Comments Depth to bottom stops at pump

Sampler's Signature: Austin Moore

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT AW-21 **Purge Method:** Bladder

Date: 2-28-23 Start Time: 09:08 Finish/Sample Time: 10:05

Well Depth (Bottom) From MP: 33.53 ft top of pump Min. Purge Volume: 1.0 Gal / L

Depth to Water From MP: 16.34 ft Total Purge Volume: 1.3 Gal / L

Water Column Length: 17.19 ft Max Drawdown: — ft

Well Water Volume: 2.7 Gal / L Total Drawdown: 1.20 ft

Reading (Units)	Time	Depth ft.	Flow Rate mL/min	pH s.u.	Spec Cond umhos/cm	Temp deg C	ORP mV	DO mg/L	Turb NTU
1	09:22	17.10	100	7.89	0.772	12.13	228	6.60	136
2	09:23	17.12		7.95	0.754	12.14	227	6.64	133
3	09:24	17.13		7.99	0.728	12.15	227	6.72	125
4									
5									
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horiba

Sample Appearance:

Odor: ☑ None ☐ Slight ☐ Mod. ☐ Strong

Color ☑ None ☐ Slight ☐ Mod. ☐ Strong

Turb: ☑ None ☐ Slight ☐ Mod ☐ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes	✓	

BOTTLE INFORMATION:

3

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
	General (P, 250 mL)
1	250 mL, HNO3
1	100 mL, P

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 17.54 ft

Comments

Sampler's Signature:

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT XPW01A **Purge Method:** Bladder

Date: 2-28-23 Start Time: 10:08 Finish/Sample Time: 10:48

Well Depth (Bottom) From MP: 36.34 ft top of Pump Min. Purge Volume: 1.0 Gal / L

Depth to Water From MP: 11.32 ft Total Purge Volume: 1.3 Gal / L

Water Column Length: 25.02 ft Max Drawdown: — ft

Well Water Volume: 4.0 Gal / L Total Drawdown: 0.25 ft

Reading (Units)	Time	Depth ft.	Flow Rate mL/min	pH s.u.	Spec Cond umhos/cm	Temp deg C	ORP mV	DO mg/L	Turb NTU	DO
1	10:23	11.45	100	11.73	1,940	10.96	66	~~52.4~~	56.4	4.40
2	10:24	11.47		11.75	1,950	10.98	59	~~51.8~~	55.0	4.38
3	10:25	11.48		11.76	1,970	10.97	54	~~49.~~	52.9	4.23
4										
5										
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA	

Field Meter: HoriBa

Sample Appearance:

Odor: ☑ None ☐ Slight ☐ Mod. ☐ Strong

Color ☑ None ☐ Slight ☐ Mod. ☐ Strong

Turb: ☑ None ☐ Slight ☐ Mod ☐ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes	✓	

BOTTLE INFORMATION:

2

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
	General (P, 250 mL)
1	lead, ML, P

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 11.57 ft

Comments

Sampler's Signature:

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT XPW02 **Purge Method:** Compressor

Date: 28-Feb-23 Start Time: 1356 Finish/Sample Time: 1427

Well Depth (Bottom) From MP: 40.63 ft Min. Purge Volume: 1 Gal / (L)

Depth to Water From MP: 20.13 ft Total Purge Volume: 1.3 Gal / (L)

Water Column Length: _____ ft Max Drawdown: ~~_____~~ ft

Well Water Volume: _____ Gal / L Total Drawdown: _____ ft

Reading (Units)	Time	Depth ft.	Flow Rate mL/min	pH s.u.	Spec Cond umhos/cm	Temp deg C	ORP mV	DO mg/L	Turb NTU
1	1413	20.30	100	12.20	4110	17.07	-143	2.00	18.00
2	1414	20.30	"	12.19	4140	13.98	-145	1.84	20.8
3	1415	20.30	"	12.19	4140	13.91	-148	1.69	19.8
4	~~_____~~								
5	~~_____~~								
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horriba

Sample Appearance:

Odor: ☐ None ☑ Slight ☐ Mod. ☐ Strong

Color ☑ None ☐ Slight ☐ Mod. ☐ Strong

Turb: ☐ None ☑ Slight ☐ Mod ☐ Strong

Well Integrity	Yes	No
Well has ID sign	/	
Casing locked/secure	/	
Well cap fits securely.	/	
Good seal/drainage	/	
Well has weep holes		/

BOTTLE INFORMATION:

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
1	General (P, ~~250 mL~~) 1L

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW: 20.30 ft

Comments depth to bottom stops at pump

Sampler's Signature: Morgan Moore

DRAFT

Site: Edwards Ash Pond

WELL/SAMPLE POINT XPW03 **Purge Method:** bladder

Date: 2/28/2023 Start Time: 1551 Finish/Sample Time: 1633

Well Depth (Bottom) From MP: _____ ft

Depth to Water From MP: 16.34 ft

Water Column Length: _____ ft

Well Water Volume: _____ Gal / L

Min. Purge Volume: — Gal / L

Total Purge Volume: 1000 Gal / L

Max Drawdown: — ft

Total Drawdown: 0.21 ft

Reading (Units)	Time	Depth ft.	Flow Rate mL/min	pH s.u.	Spec Cond umhos/cm	Temp deg C	ORP mV	DO mg/L	Turb NTU
1	1610	16.55	100	11.92	1940	15.09	-46	2.75	104
2	1612	16.55	100	11.94	1930	15.13	-49	2.68	88.9
3	1614	16.55	100	11.94	1930	15.07	-51	2.55	78.1
4									
5									
Stabilization	NA	NA	NA	± 0.2	± 3%	± 0.2	± 20	± 10% or 0.2	NA

Field Meter: Horiba

Sample Appearance:

Odor: ☒ None ☐ Slight ☐ Mod. ☐ Strong

Color ☒ None ☐ Slight ☐ Mod. ☐ Strong

Turb: ☐ None ☒ Slight ☐ Mod ☐ Strong

Well Integrity	Yes	No
Well has ID sign	✓	
Casing locked/secure	✓	
Well cap fits securely.	✓	
Good seal/drainage	✓	
Well has weep holes	✓	

BOTTLE INFORMATION:

Unfiltered	
Qty	Bottles
	VOAs (C,V, 40mL, HCL)
	VOAS (C,V, 40mL)
	Organics (A,G,U 1000mL)
	Organics (A,G,U 500mL)
	TOC (A,V 40mL, H2SO4)
	TOX (A,G 250mL, H2SO4)
1	Metals (P,250mL, HNO3)
	Cyanide (P, 250mL, NaOH)
	Phenols (A,G,250mL, H2SO4)
1	General (P, ~~250~~ 1000mL)

(2)

Filtered	
Qty	Bottles
	Metals (P,250mL, HNO3)
	Ammonia (P,250mL, H2S04)
	General (P,500mL)

Final DTW 16.55 ft

Comments

Sampler's Signature:

DRAFT

Multiparameter Meter Field Calibration Checklist

Field Personnel:	AP	Location:	Edwards Power Station
Weather:	54°F cloudy, rain, wind 11 mph	Environment:	grass, mud
Multiparameter Water Meter	Make: Horiba	Model: D Scoo	Serial Number: UKVIFVTF
Water Level Meter	Make: Heron	Model: Dipper T	Serial Number: 3717-T

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
pH 4.00a	3.75	s.u.	±0.1 s.u.	F	Yes	4.00	MSI	L344-09	12/14/2023
pH 7.00a	6.87	s.u.	±0.1 s.u.	F	Yes	7.00	MSI	L343-07	12/9/2023
pH 10.00a	1006	s.u.	±0.1 s.u.	P	NO	—	MSI	M082-04	3/25/2024
SC Zero (DI)	00	µS/cm	0<25 µS/cm	P	NO	—	Pace Labs	N/A (DI)	N/A (DI)
SC 2000	2020	µS/cm	±5%	P	NO	—	Geotech	2GE1442	May-23
ORP	241	mV	±15 mV	P	NO	—	InSitu	2G1762	Jun-23
DO (Zero pt)	0.00	mg/L	±0.1	P	NO	—	Macron	#000228049	8/26/2025
DO (Saturated)	na.7	%	97-100%	P	NO	—	Pace Labs	N/A (DI)	N/A (DI)
Turbidity (DI)	0.0	NTU	<2 NTU	P	No	—	Pace Labs	N/A (DI)	N/A (DI)

Approx. every 4 hrs, unless only one well

241 @ 16°C

ICV (Initial Calibration Verification) — Time: 1415

Buffer	Check Value	Units	Range	Pass/Fail	Action Taken?	Manufacturer	Lot#	Exp.
pH 4.00b	3.99	s.u.	±0.15 s.u.	P	—	Geotech	2GC243	Mar-24
pH 7.00b	6.88	s.u.	±0.15 s.u.	P	—	Geotech	2GC931	Mar-24
pH 10.00b	10.04	s.u.	±0.15 s.u.	P	—	Geotech	2GE820	May-24
SC 1000	1010	µS/cm	±5%	P	—	Ricca	4205H64	May-24

Approx. every 4 hrs, unless only one well

CCV (Continued Calibration Verification): — Time: 1645

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
pH 4.00a	4.01	s.u.	±0.1 s.u.	P	NO	NA	MSI	L315-04	11/22/2023
pH 7.00a	7.02	s.u.	±0.1 s.u.				MSI	L172-33	6/23/2023
pH 10.00a	10.07	s.u.	±0.1 s.u.				MSI	L354-22	1/5/2024
SC 1000	1030	µS/cm	±5%				Ricca	2108D48	Jul-23
DO (Zero pt)	0.09	mg/L	±0.1 mg/L				Macron	#000228049	8/26/2025
Turbidity (DI)	0.0	NTU	<2 NTU			—	Pace Labs	N/A (DI)	N/A (DI)

Approx. every 4 hrs, unless only one well

CCV (Continued Calibration Verification): — Time:

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
4.00a		s.u.	±0.1 s.u.				MSI	L315-04	11/22/2023
7.00a		s.u.	±0.1 s.u.				MSI	L172-33	6/23/2023
10.00a		s.u.	±0.1 s.u.				MSI	L354-22	1/5/2024
SC 1000		µS/cm	±5%				Ricca	2108D48	Jul-23
DO (Zero pt)		mg/L	±0.1 mg/L				Macron	#000228049	8/26/2025
Turbidity (DI)		NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Comments:

Signature:	[signature]	Date:	2/27/2023

DRAFT

Multiparameter Meter Field Calibration Checklist

Field Personnel:	Austin Moore	Location:	Edwards
Weather:	59-71° cloudy 14 mph wind NE	Environment:	Mud/Grass

Multiparameter Water Meter	Make: Horiba	Model: U-5000	Serial Number:	PW2GYJD3	
Water Level Meter	Make: WT	Model: Heron	Serial Number:	1FF220930ML	

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
pH 4.00a	4.06	s.u.	±0.1 s.u.	P	N	N/A	MSI	L344-09	12/14/2023
pH 7.00a	6.93	s.u.	±0.1 s.u.				MSI	L343-07	12/9/2023
pH 10.00a	10.01	s.u.	±0.1 s.u.				MSI	M082-04	3/25/2024
SC Zero (DI)	0	µS/cm	0<25 µS/cm				Pace Labs	N/A (DI)	N/A (DI)
SC 2000	2020	µS/cm	±5%				Geotech	2GE1442	May-23
ORP	244	mV	±15 mV				InSitu	2G1762	Jun-23
DO (Zero pt)	0.05	mg/L	±0.1				Macron	#000228049	8/26/2025
DO (Saturated)	95.1	%	97-100%				Pace Labs	N/A (DI)	N/A (DI)
Turbidity (DI)	0.0	NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Approx. every 4 hrs, unless only one well

ICV (Initial Calibration Verification) Time: 1358

Buffer	Check Value	Units	Range	Pass/Fail	Action Taken?	Manufacturer	Lot#	Exp.
pH 4.00b	4.14	s.u.	±0.15 s.u.	P	N/A	Geotech	2GC243	Mar-24
pH 7.00b	6.99	s.u.	±0.15 s.u.			Geotech	2GC931	Mar-24
pH 10.00b	10.03	s.u.	±0.15 s.u.			Geotech	2GE820	May-24
SC 1000	980	µS/cm	±5%			Ricca	4205H64	May-24

Approx. every 4 hrs, unless only one well

CCV (Continued Calibration Verification): Time: 1700

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
pH 4.00a	4.03	s.u.	±0.1 s.u.	P	N	N/A	MSI	L315-04	11/22/2023
pH 7.00a	7.01	s.u.	±0.1 s.u.				MSI	L172-33	6/23/2023
pH 10.00a	10.00	s.u.	±0.1 s.u.				MSI	L354-22	1/5/2024
SC 1000	1010	µS/cm	±5%				Ricca	2108D48	Jul-23
DO (Zero pt)	0.05	mg/L	±0.1 mg/L				Macron	#000228049	8/26/2025
Turbidity (DI)	0.0	NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Approx. every 4 hrs, unless only one well

CCV (Continued Calibration Verification): Time:

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
4.00a		s.u.	±0.1 s.u.				MSI	L315-04	11/22/2023
7.00a		s.u.	±0.1 s.u.				MSI	L172-33	6/23/2023
10.00a		s.u.	±0.1 s.u.				MSI	L354-22	1/5/2024
SC 1000		µS/cm	±5%				Ricca	2108D48	Jul-23
DO (Zero pt)		mg/L	±0.1 mg/L				Macron	#000228049	8/26/2025
Turbidity (DI)		NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Comments:

Signature:	Austin Moore	Date:	27-Feb-23

DRAFT

Multiparameter Meter Field Calibration Checklist

Field Personnel:	Aaron Pemberton	Location:	Edwards
Weather:	46°-52°L Partly Cloudy West @ 7mph	Environment:	grass, gravel, mud

Multiparameter Water Meter	Make: Horiba	Model: U5000	Serial Number:	YL9K59HA	
Water Level Meter	Make: Heron	Model: Dipper T	Serial Number:	3717-T	

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
pH 4.00a	4.00	s.u.	±0.1 s.u.	P	NO	NA	MSI	L344-09	12/14/2023
pH 7.00a	7.03	s.u.	±0.1 s.u.				MSI	L343-07	12/9/2023
pH 10.00a	10.05	s.u.	±0.1 s.u.				MSI	M082-04	3/25/2024
SC Zero (DI)	18	µS/cm	0<25 µS/cm				Pace Labs	N/A (DI)	N/A (DI)
SC 2000	2000	µS/cm	±5%				Geotech	2GE1442	May-23
ORP	242	mV	±15 mV				InSitu	2G1762	Jun-23
DO (Zero pt)	0.09	mg/L	±0.1				Macron	#000228049	8/26/2025
DO (Saturated)	95.2	%	97-100%				Pace Labs	N/A (DI)	N/A (DI)
Turbidity (DI)	0.0	NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Approx. every 4 hrs, unless only one well

240 @ 17°C

ICV (Initial Calibration Verification)					Time: 1200			
Buffer	Check Value	Units	Range	Pass/Fail	Action Taken?	Manufacturer	Lot#	Exp.
pH 4.00b	3.98	s.u.	±0.15 s.u.	P	NA	Geotech	2GC243	Mar-24
pH 7.00b	6.88	s.u.	±0.15 s.u.			Geotech	2GC931	Mar-24
pH 10.00b	10.00	s.u.	±0.15 s.u.			Geotech	2GE820	May-24
SC 1000 @20	1020	µS/cm	±5%			Ricca	4205H64	May-24

Approx. every 4 hrs, unless only one well

CCV (Continued Calibration Verification):					Time: 1649				
Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
pH 4.00a	4.03	s.u.	±0.1 s.u.	P	NO	N/A	MSI	L315-04	11/22/2023
pH 7.00a	7.02	s.u.	±0.1 s.u.				MSI	L172-33	6/23/2023
pH 10.00a	10.08	s.u.	±0.1 s.u.				MSI	L354-22	1/5/2024
SC 1000	1030	µS/cm	±5%				Ricca	2108D48	Jul-23
DO (Zero pt)	0.09	mg/L	±0.1 mg/L				Macron	#000228049	8/26/2025
Turbidity (DI)	0.0	NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Approx. every 4 hrs, unless only one well

CCV (Continued Calibration Verification):					Time:				
Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
4.00a		s.u.	±0.1 s.u.				MSI	L315-04	11/22/2023
7.00a		s.u.	±0.1 s.u.				MSI	L172-33	6/23/2023
10.00a		s.u.	±0.1 s.u.				MSI	L354-22	1/5/2024
SC 1000		µS/cm	±5%				Ricca	2108D48	Jul-23
DO (Zero pt)		mg/L	±0.1 mg/L				Macron	#000228049	8/26/2025
Turbidity (DI)		NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Comments:

Signature:		Date:	2/28/2023

DRAFT

Multiparameter Meter Field Calibration Checklist

Field Personnel:	Austin Moore	Location:	Edwards Power Station
Weather:	33-37° sunny wind 10NW	Environment:	Grass Mud
Multiparameter Water Meter	Make: Horiba	Model: U-5000	Serial Number: PW2GKJD3
Water Level Meter	Make: Heron	Model: Water tape	Serial Number: IIFF220930SML

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
pH 4.00a	4.00	s.u.	±0.1 s.u.	P	N	N/A	MSI	L344-09	12/14/2023
pH 7.00a	6.97	s.u.	±0.1 s.u.				MSI	L343-07	12/9/2023
pH 10.00a	10.04	s.u.	±0.1 s.u.				MSI	M082-04	3/25/2024
SC Zero (DI)	18.45	µS/cm	0<25 µS/cm				Pace Labs	N/A (DI)	N/A (DI)
SC 2000	2031	µS/cm	±5%				Geotech	2GE1442	May-23
ORP	234	mV	±15 mV				InSitu	2G1762	Jun-23
DO (Zero pt)	0.00	mg/L	±0.1				Macron	#000228049	8/26/2025
DO (Saturated)	97.98	%	97-100%				Pace Labs	N/A (DI)	N/A (DI)
Turbidity (DI)	0.58	NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Approx. every 4 hrs, unless only one well

ICV (Initial Calibration Verification) — Time: 0830

Buffer	Check Value	Units	Range	Pass/Fail	Action Taken?	Manufacturer	Lot#	Exp.
pH 4.00b	3.99	s.u.	±0.15 s.u.	P	N	Geotech	2GC243	Mar-24
pH 7.00b	6.94	s.u.	±0.15 s.u.			Geotech	2GC931	Mar-24
pH 10.00b	9.96	s.u.	±0.15 s.u.			Geotech	2GE820	May-24
SC 1000	1015	µS/cm	±5%			Ricca	4205H64	May-24

Approx. every 4 hrs, unless only one well

CCV (Continued Calibration Verification): — Time: 1630

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
pH 4.00a	4.03	s.u.	±0.1 s.u.	P	N	N/A	MSI	L315-04	11/22/2023
pH 7.00a	7.02	s.u.	±0.1 s.u.				MSI	L172-33	6/23/2023
pH 10.00a	10.05	s.u.	±0.1 s.u.				MSI	L354-22	1/5/2024
SC 1000	1020	µS/cm	±5%				Ricca	2108D48	Jul-23
DO (Zero pt)	0.06	mg/L	±0.1 mg/L				Macron	#000228049	8/26/2025
Turbidity (DI)	0.0	NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Approx. every 4 hrs, unless only one well

CCV (Continued Calibration Verification): — Time:

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
4.00a		s.u.	±0.1 s.u.				MSI	L315-04	11/22/2023
7.00a		s.u.	±0.1 s.u.				MSI	L172-33	6/23/2023
10.00a		s.u.	±0.1 s.u.				MSI	L354-22	1/5/2024
SC 1000		µS/cm	±5%				Ricca	2108D48	Jul-23
DO (Zero pt)		mg/L	±0.1 mg/L				Macron	#000228049	8/26/2025
Turbidity (DI)		NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Comments:

Signature:	Austin Moore	Date:	28-Feb-23

DRAFT

Multiparameter Meter Field Calibration Checklist

Field Personnel:	Kyle Lane		Location:	Edwards Power	
Weather:	37° to 52° Cloudy		Environment:	Wet / Muddy	
Multiparameter Water Meter	Make: Horiba	Model: U-5000	Serial Number:	VHFV1FVTF	
Water Level Meter	Make: Heron	Model: water tape	Serial Number:	19FF2202131ML	

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
pH 4.00a	4.08	s.u.	±0.1 s.u.	P	N/A	N/A	MSI	L344-09	12/14/2023
pH 7.00a	7.04	s.u.	±0.1 s.u.				MSI	L343-07	12/9/2023
pH 10.00a	10.01	s.u.	±0.1 s.u.				MSI	M082-04	3/25/2024
SC Zero (DI)	20.48	µS/cm	0<25 µS/cm				Pace Labs	N/A (DI)	N/A (DI)
SC 2000	2020	µS/cm	±5%				Geotech	2GE1442	May-23
ORP	244	mV	±15 mV				InSitu	2G1762	Jun-23
DO (Zero pt)	0.84	mg/L	±0.1				Macron	#000228049	8/26/2025
DO (Saturated)	99.40	%	97-100%				Pace Labs	N/A (DI)	N/A (DI)
Turbidity (DI)	0.26	NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Approx. every 4 hrs, unless only one well

ICV (Initial Calibration Verification)					Time: 0952			
Buffer	Check Value	Units	Range	Pass/Fail	Action Taken?	Manufacturer	Lot#	Exp.
pH 4.00b	3.96	s.u.	±0.15 s.u.	P	N/A	Geotech	2GC243	Mar-24
pH 7.00b	6.84	s.u.	±0.15 s.u.			Geotech	2GC931	Mar-24
pH 10.00b	10.11	s.u.	±0.15 s.u.			Geotech	2GE820	May-24
SC 1000	1044	µS/cm	±5%			Ricca	4205H64	May-24

Approx. every 4 hrs, unless only one well

CCV (Continued Calibration Verification):					Time: X				
Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
pH 4.00a	X	s.u.	±0.1 s.u.	X	X	X	MSI	L315-04	11/22/2023
pH 7.00a		s.u.	±0.1 s.u.				MSI	L172-33	6/23/2023
pH 10.00a		s.u.	±0.1 s.u.				MSI	L354-22	1/5/2024
SC 1000		µS/cm	±5%				Ricca	2108D48	Jul-23
DO (Zero pt)		mg/L	±0.1 mg/L				Macron	#000228049	8/26/2025
Turbidity (DI)		NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Approx. every 4 hrs, unless only one well

CCV (Continued Calibration Verification):					Time: 1457				
Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
4.00a	4.03	s.u.	±0.1 s.u.	P	N/A	N/A	MSI	L315-04	11/22/2023
7.00a	7.04	s.u.	±0.1 s.u.				MSI	L172-33	6/23/2023
10.00a	10.00	s.u.	±0.1 s.u.				MSI	L354-22	1/5/2024
SC 1000	1002	µS/cm	±5%				Ricca	2108D48	Jul-23
DO (Zero pt)	0.04	mg/L	±0.1 mg/L				Macron	#000228049	8/26/2025
Turbidity (DI)	0.49	NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Comments:

Signature:		Date:	2-28-23

DRAFT

Multiparameter Meter Field Calibration Checklist

Field Personnel:	AP	Location:	Edwards Power Station
Weather:	54°F cloudy, rain wind 11 mph	Environment:	grass, mud

Multiparameter Water Meter	Make: Horiba	Model: DSC00	Serial Number:	UKVIFVTF	
Water Level Meter	Make: Heron	Model: Dipper T	Serial Number:	3717-T	

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
pH 4.00a	3.75	s.u.	±0.1 s.u.	F	Yes	4.00	MSI	L344-09	12/14/2023
pH 7.00a	6.87	s.u.	±0.1 s.u.	F	Yes	7.00	MSI	L343-07	12/9/2023
pH 10.00a	10.06	s.u.	±0.1 s.u.	P	NO	—	MSI	M082-04	3/25/2024
SC Zero (DI)	20	µS/cm	0<25 µS/cm	P	NO	—	Pace Labs	N/A (DI)	N/A (DI)
SC 2000	2020	µS/cm	±5%	P	NO	—	Geotech	2GE1442	May-23
ORP	241	mV	±15 mV	P	NO	—	InSitu	2G1762	Jun-23
DO (Zero pt)	0.00	mg/L	±0.1	P	NO	—	Macron	#000228049	8/26/2025
DO (Saturated)	99.7	%	97-100%	P	NO	—	Pace Labs	N/A (DI)	N/A (DI)
Turbidity (DI)	0.0	NTU	<2 NTU	P	No	—	Pace Labs	N/A (DI)	N/A (DI)

Approx. every 4 hrs, unless only one well

241 @ 16°C

ICV (Initial Calibration Verification) — Time: 1415

Buffer	Check Value	Units	Range	Pass/Fail	Action Taken?	Manufacturer	Lot#	Exp.
pH 4.00b	3.99	s.u.	±0.15 s.u.	P	—	Geotech	2GC243	Mar-24
pH 7.00b	6.88	s.u.	±0.15 s.u.	P	—	Geotech	2GC931	Mar-24
pH 10.00b	10.04	s.u.	±0.15 s.u.	P	—	Geotech	2GE820	May-24
SC 1000	1010	µS/cm	±5%	P	—	Ricca	4205H64	May-24

Approx. every 4 hrs, unless only one well

CCV (Continued Calibration Verification): — Time: 1645

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
pH 4.00a	4.01	s.u.	±0.1 s.u.	P	NO	NA	MSI	L315-04	11/22/2023
pH 7.00a	7.02	s.u.	±0.1 s.u.				MSI	L172-33	6/23/2023
pH 10.00a	10.07	s.u.	±0.1 s.u.				MSI	L354-22	1/5/2024
SC 1000	1030	µS/cm	±5%				Ricca	2108D48	Jul-23
DO (Zero pt)	0.09	mg/L	±0.1 mg/L				Macron	#000228049	8/26/2025
Turbidity (DI)	0.0	NTU	<2 NTU			—	Pace Labs	N/A (DI)	N/A (DI)

Approx. every 4 hrs, unless only one well

CCV (Continued Calibration Verification): — Time:

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
4.00a		s.u.	±0.1 s.u.				MSI	L315-04	11/22/2023
7.00a		s.u.	±0.1 s.u.				MSI	L172-33	6/23/2023
10.00a		s.u.	±0.1 s.u.				MSI	L354-22	1/5/2024
SC 1000		µS/cm	±5%				Ricca	2108D48	Jul-23
DO (Zero pt)		mg/L	±0.1 mg/L				Macron	#000228049	8/26/2025
Turbidity (DI)		NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Comments:

Signature:	[signature]	Date:	2/27/2023

DRAFT

Multiparameter Meter Field Calibration Checklist

Field Personnel:	Austin Moore	Location:	Edwards
Weather:	59°-71° cloudy 14mph wind NE	Environment:	Mud/Grass
Multiparameter Water Meter	Make: Horiba	Model: U-5000	Serial Number: PW26YJD3
Water Level Meter	Make: WT	Model: Heron	Serial Number: 1IFF220930ML

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
pH 4.00a	4.06	s.u.	±0.1 s.u.	P	N	N/A	MSI	L344-09	12/14/2023
pH 7.00a	6.93	s.u.	±0.1 s.u.				MSI	L343-07	12/9/2023
pH 10.00a	10.01	s.u.	±0.1 s.u.				MSI	M082-04	3/25/2024
SC Zero (DI)	0	µS/cm	0<25 µS/cm				Pace Labs	N/A (DI)	N/A (DI)
SC 2000	2020	µS/cm	±5%				Geotech	2GE1442	May-23
ORP	244	mV	±15 mV				InSitu	2G1762	Jun-23
DO (Zero pt)	0.05	mg/L	±0.1				Macron	#000228049	8/26/2025
DO (Saturated)	—	%	97-100%				Pace Labs	N/A (DI)	N/A (DI)
Turbidity (DI)	0.0	NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Approx. every 4 hrs, unless only one well

ICV (Initial Calibration Verification) — Time: 1358

Buffer	Check Value	Units	Range	Pass/Fail	Action Taken?	Manufacturer	Lot#	Exp.
pH 4.00b	4.17	s.u.	±0.15 s.u.	P	N/A	Geotech	2GC243	Mar-24
pH 7.00b	6.99	s.u.	±0.15 s.u.			Geotech	2GC931	Mar-24
pH 10.00b	10.03	s.u.	±0.15 s.u.			Geotech	2GE820	May-24
SC 1000	980	µS/cm	±5%			Ricca	4205H64	May-24

Approx. every 4 hrs, unless only one well

CCV (Continued Calibration Verification): — Time: 1700

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
pH 4.00a	4.03	s.u.	±0.1 s.u.	P	N	N/A	MSI	L315-04	11/22/2023
pH 7.00a	7.01	s.u.	±0.1 s.u.				MSI	L172-33	6/23/2023
pH 10.00a	10.02	s.u.	±0.1 s.u.				MSI	L354-22	1/5/2024
SC 1000	1010	µS/cm	±5%				Ricca	2108D48	Jul-23
DO (Zero pt)	0.05	mg/L	±0.1 mg/L				Macron	#000228049	8/26/2025
Turbidity (DI)	0.0	NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Approx. every 4 hrs, unless only one well

CCV (Continued Calibration Verification): — Time:

Buffer	Check Value	Units	Range	Pass/Fail	Calibrate?	Adjusted Reading	Manufacturer	Lot#	Exp.
4.00a		s.u.	±0.1 s.u.				MSI	L315-04	11/22/2023
7.00a		s.u.	±0.1 s.u.				MSI	L172-33	6/23/2023
10.00a		s.u.	±0.1 s.u.				MSI	L354-22	1/5/2024
SC 1000		µS/cm	±5%				Ricca	2108D48	Jul-23
DO (Zero pt)		mg/L	±0.1 mg/L				Macron	#000228049	8/26/2025
Turbidity (DI)		NTU	<2 NTU				Pace Labs	N/A (DI)	N/A (DI)

Comments:

Signature:	Austin Moore	Date:	27-Feb-23

DRAFT

GBO-SAB
GC00016-16 SAP

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Section A Required Client Information:

Company:	Vistra Corp
Address:	13498 E. 900th St
Email To:	Brian.Voelker@VistraCorp.com
Phone: (217) 753-8911	Fax:
Requested Due Date/TAT:	10 day

Section B Required Project Information:

Report To:	Brian Voelker
Copy To:	Jason Stuckey
Purchase Order No.:	
Project Name:	
Project Number:	2285

Section C Invoice Information:

Attention:	Jason Stuckey
Company Name:	Vistra Corp
Address:	see Section A
Quote Reference:	
Project Manager:	
Profile #:	

REGULATORY AGENCY

NPDES | GROUND WATER | DRINKING WATER
UST | RCRA | OTHER

Site Location STATE: IL

Section D Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	EDW_257_301	Residual Chlorine (Y/N)	Project No./ Lab I.D.
1	AP05S	WT	G	2/28/23	1440		3	X		X									
2	AP07S	WT	G	2/28/23	1328		3	X		X									
3	AW-01	WT	G	2/28/23	1541		3	X		X									
4	AW-05	WT	G	2/28/23	1157		3	X		X									
5	AW-06	WT	G	2/28/23	1003		3	X		X									
6	AW-08	WT	G	2/28/23	~~1440~~ 1515		3	X		X									
7	AW-09	WT	G	2/28/23	1205		3	X		X									
8	AW-10	WT	G	2/28/23	1545		3	X		X									
9	AW-11	WT	G	2/28/23	1424		3	X		X									
10	AW-14	WT	G	2/28/23	1313		3	X		X									
11	AW-15																		
12	AW-15S																		
13	AW-16	WT	G	2/28/23	1305		3	X		X									
14	AW-17	WT	G	2/28/23	1106		3	X		X									
15	AW-18																		
16	AW-19																		

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
EDW-23Q1-Rev 1		2/28/23	1725							
							2.7	Y	N	Y
							Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Aaron Pemberton

SIGNATURE of SAMPLER: DATE Signed (MM/DD/YY): 02/28/23

Vance Wagner 3-1-23 707
Courier

DRAFT

GB04667-04
SRD

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Section A Required Client Information:

Company:	Vistra Corp
Address:	13498 E. 900th St
Email To:	Brian.Voelker@VistraCorp.com
Phone: (217) 753-8911	Fax:
Requested Due Date/TAT:	10 day

Section B Required Project Information:

Report To:	Brian Voelker
Copy To:	Jason Stuckey
Purchase Order No.:	
Project Name:	
Project Number:	2285

Section C Invoice Information:

Attention:	Jason Stuckey
Company Name:	Vistra Corp
Address:	see Section A
Quote Reference:	
Project Manager:	
Profile #:	

REGULATORY AGENCY

NPDES GROUND WATER DRINKING WATER

UST RCRA OTHER

Site Location STATE: IL

Section D Required Client Information

SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Requested Analysis Filtered (Y/N) Y/N	Analysis Test: EDW_257_301	Residual Chlorine (Y/N)	Project No./ Lab I.D.
1	AP05S																		
2	AP07S																		
3	AW-01																		
4	AW-05																		
5	AW-06																		
6	AW-08																		
7	AW-09																		
8	AW-10																		
9	AW-11																		
10	AW-14																		
11	AW-15	WT	G	2/27/23	1528		3	W	X		X								
12	AW-15S	WT	G	2/27/23	1630		3	W	X		X								
13	AW-16																		
14	AW-17																		
15	AW-18	WT	G	2/27/23	1650		3	X		X									
16	AW-19	WT	G	2/27/23	1529		3	X		X									

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
EDW-23Q1-Rev 1		2/27/23	1752		2-28-23	720

SAMPLE CONDITIONS			
Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
1.3	Y	N	Y

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Aaron Pemberton

SIGNATURE of SAMPLER: DATE Signed (MM/DD/YY): 02/27/23

Courier

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GC00016-16

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Section A Required Client Information:

Company:	Vistra Corp
Address:	13498 E. 900th St
Email To:	Brian.Voelker@VistraCorp.com
Phone: (217) 753-8911	Fax:
Requested Due Date/TAT:	10 day

Section B Required Project Information:

Report To:	Brian Voelker
Copy To:	Jason Stuckey
Purchase Order No.:	
Project Name:	
Project Number:	2285

Section C Invoice Information:

Attention:	Jason Stuckey
Company Name:	Vistra Corp
Address:	see Section A
Quote Reference:	
Project Manager:	
Profile #:	

REGULATORY AGENCY

NPDES | GROUND WATER | DRINKING WATER

UST | RCRA | OTHER

Site Location STATE: IL

Section D Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	EDW_257_301	Residual Chlorine (Y/N)	Project No./ Lab I.D.
1	AW-21	WT	G	2/28/23	1005		3	X		X									
2	SG-01																		
3	XPW01A	WT	G	2/28/23	1048		2	X		X									
4	XPW02	WT	G	2/28/23	1127		2	X		X									
5	XPW03	WT	G	2/28/23	1633		2	X		X									
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Requested Analysis Filtered (Y/N)

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS: Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
EDW-23Q1-Rev 1		2/28/23	1723				2.7	Y	N	Y

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Aaron Kimberlin

SIGNATURE of SAMPLER: [signature] DATE Signed (MM/DD/YY): 02/28/23

Vance Wagner 3-1-23 707
Courier

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APPENDIX G
PUMP TEST MEMORANDUM

DRAFT

RAMBOLL

ENVIRONMENT & HEALTH

MEMO

Project name **Edwards Power Plant Pump Tests**
To **Stu Cravens, Luminant**

From **Katie Moran, Ramboll**
Copy to **Brian Hennings, Ramboll**
Nate Keller, Ramboll

December 01, 2023

Ramboll
4435 Waterfront Drive
Suite 205
Glen Allen, VA 23060
USA

T 804-822-4200
F 804-270-5808
https://ramboll.com

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Introduction

Midwest Engineering and Testing, Inc. installed two 4-inch pilot test wells (PTW-01 and PTW-02) in October 2022 to evaluate aquifer characteristics and develop potential interim remedial measures. Following installation and development of PTW-01 and PTW-02, constant-rate tests (CRTs) were performed by Ramboll at pumping well PTW-01 on October 25 and October 26, 2022, and at PTW-02 on October 28, 2022. Water levels were monitored during the tests in nearby observation and monitoring wells by in-well pressure transducers during the length of the tests. Recovery data was not recorded due to methane generation which delayed the CRT and associated field activities.

PTW-01 Constant Rate Test

The CRT performed at PTW-01 consisted of pumping at 0.25 gallons per minute (gpm) for 125 minutes. The test was stopped immediately prior to dewatering of the pumping well and a maximum drawdown of 11.53 feet was obtained during pumping. A step-drawdown test to identify yield characteristics at PTW-01 was not performed due to failure to obtain stable water levels at the lowest consistent pumping rate achievable with the pump (0.25 gpm, indicating a low yield well). The calculated specific capacity from the CRT for PTW-01 is 0.02 gpm per foot (gpm/ft); however, this does not represent a reasonable well yield given continued dewatering of the well at this rate.

Drawdown from pumping at PTW-01 was observed at wells OW-01 and AP07S, which are screened at similar depths as PTW-01, either across a discontinuous sandy material and/or weathered rock. Measurable drawdown was not identified at AP07D, which is screened approximately 20 feet below the pumping well within low permeability bedrock (Ramboll Americas Engineering Solutions, Inc. [Ramboll], 2021). The three observation wells (OW-01 and two monitoring wells) used for the pump test are located at distances of 13 to 18 feet from PTW-01.

Time-drawdown data for observation wells were analyzed using AQTESOLV for Windows® (Duffield, 2007). Evaluation of time-drawdown data collected at OW-01 with the Theis solution (Theis, 1935) yielded estimated transmissivity of 52 feet square per day (ft^2/d) and aquifer storativity of 2.5×10^{-3} (**Attachment 1**). As shown, this solution yields an approximate fit to data collected at AP07S; however, drawdown data collected from this well had a higher level of noise / fluctuation during the test. **Table 1** presents well construction information and observed drawdown.

A second CRT with a lower pumping rate was attempted at PTW-01 on October 26, 2022; however, the selected pump struggled to consistently maintain the lower pumping rate of 0.12 gpm and was shut off after 89 minutes. Data from this test was not evaluated.

PTW-02 Constant-Rate Test

The CRT at PTW-02 was initially attempted on October 26, 2022 at a rate of 0.5 gpm; however, the test was stopped after eight minutes due to elevated sediment and methane readings at the wellhead. Another CRT at PTW-02 was performed on October 28, 2022 and consisted of pumping at a rate of 1 gpm for 154 minutes. A step-drawdown test to identify yield characteristics at PTW-02 was not performed due to the challenges and safety considerations associated with the methane generated during pumping. Maximum drawdown obtained at PTW-02 was 8.15 feet after 154 minutes of pumping. The calculated specific capacity from the CRT for PTW-02 is 0.12 gpm/ft; however, this does not represent a conclusive well yield given failure of water levels to stabilize during the test.

Drawdown from pumping at PTW-02 was observed at wells OW-02 (1.98 feet) and AW-15 (2.36 feet), which are screened at similar depths as PTW-01 within the same clay material at the bedrock interface. Drawdown of 0.64 feet was also identified at AW-15C, which is completed in the shale bedrock (the top of which is weathered) underlying the clay. This indicates that vertical flow can occur between the clay and the bedrock when a hydraulic gradient is present. Measurable drawdown was not identified at AW-15S, which is screened above the pumping well in the shallower confining materials (Upper Cahokia Formation). The four observation wells (OW-02 and three monitoring wells) used for the pump test are located at distances of 7 to 19 feet from PTW-01.

Time-drawdown data for observation wells were analyzed using AQTESOLV for Windows® (Duffield, 2007). Evaluation of time-drawdown data collected at AW-15 with the Theis solution (Theis, 1935) yielded estimated transmissivity of 19 ft^2/d and aquifer storativity of 5×10^{-3} (**Attachment 1**). The fit to data from OW-02 yielded estimated transmissivity of 20 ft^2/d and aquifer storativity of 1.1×10^{-3} (**Attachment 1**). Drawdown data for AW-15C were not analyzed in AQTESOLV due to its completion in a different aquifer unit. **Table 1** presents well construction information and observed drawdown.

Discussion

The abbreviated constant-rate tests performed at wells PTW-01 and PTW-02 did not fully identify appropriate well yields due to continued drawdown at pumped rates of 0.25 gpm and 1 gpm, and difficulty obtaining lower pumping rates with the field equipment. Sustainable yield at these locations may be much lower than the tested rates. However, measurable drawdown was identified at nearby observation wells and used to develop estimates of transmissivity and storativity for the materials near the tested locations.

Attachments

Table 1 Well Information and Observed Drawdown
Figure 1 Pump Test Well Locations
Attachment 1 Aqtesolv Plots

References

Duffield, G., 2007. AQTESOLV® Professional Version 4.5. Hydrosolve, Inc.

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2021. Hydrogeologic Site Characterization Report. Edwards Power Plant, Ash Pond, Bartonville, IL. October 25, 2021.

Theis, C.V., 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage, Am. Geophys. Union Trans., vol. 16, pp. 519-524.

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Table 1. Well Information and Observed Drawdown
Edwards Power Plant Pump Tests
Edwards Power Plant Bartonville, IL

Well ID	Hydrostratigraphic Unit	Distance from Pumping Well (ft)	Maximum Drawdown (ft)	Well Depth (ft bTOC)	Screened Inverval (ft bgs)	Static Depth-to-water (ft bTOC)
PTW-01 Pump Test						
PTW-01	UA	--	11.5	38.4	27 - 37	26.4
OW-01	UA	17.7	0.2	36.4	26 - 36	24.6
AP07S	UA	13.3	0.2	35.0	30 - 35	25.8
AP07D	Bedrock	15.4	ND	65.0	55 - 65	26.2
PTW-02 Pump Test						
PTW-02	UA	--	8.2	38.4	27 - 36	10.3
OW-02	UA	18.9	2.0	35.1	25 - 35	10.0
AW-15	UA	7.3	2.4	38.0	33 - 38	10.6
AW-15C	Bedrock	14.1	0.6	48.0	43 - 48	9.1
AW-15S	UCF	8.7	ND	18.0	8 - 18	9.6

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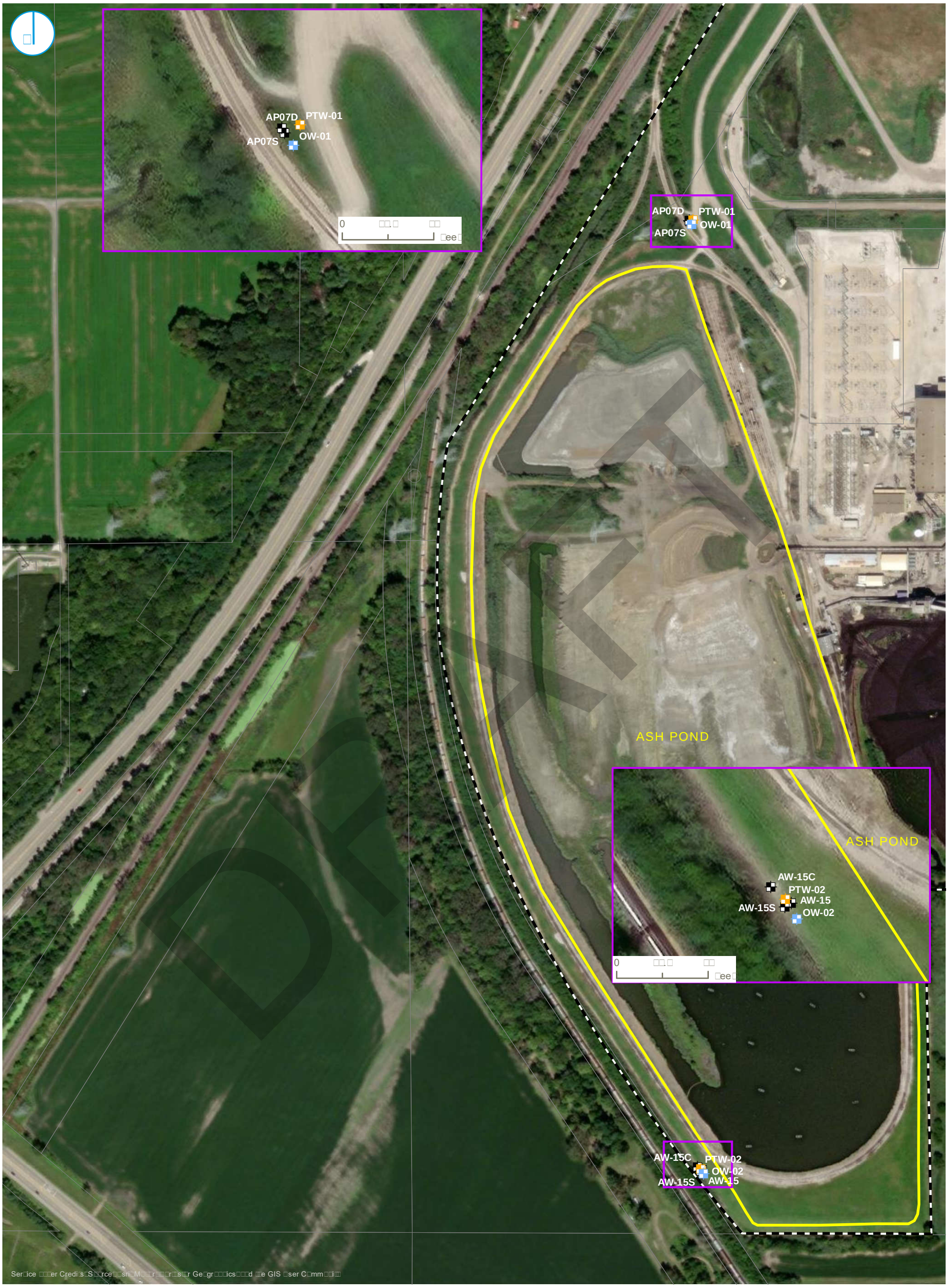

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PUMP TEST WELL LOCATIONS

FIGURE 1

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RAMBOLL

ATTACHMENT 1
AQTESOLV PLOTS

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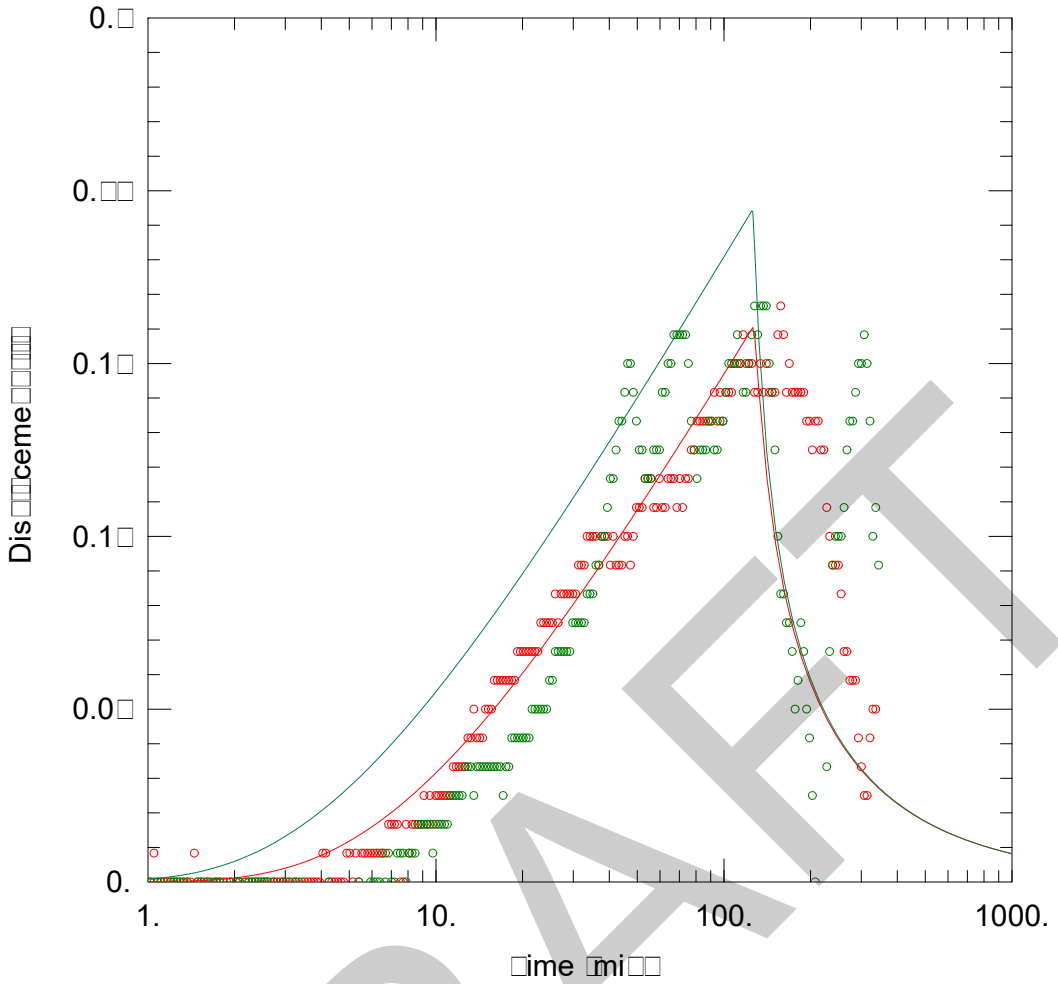

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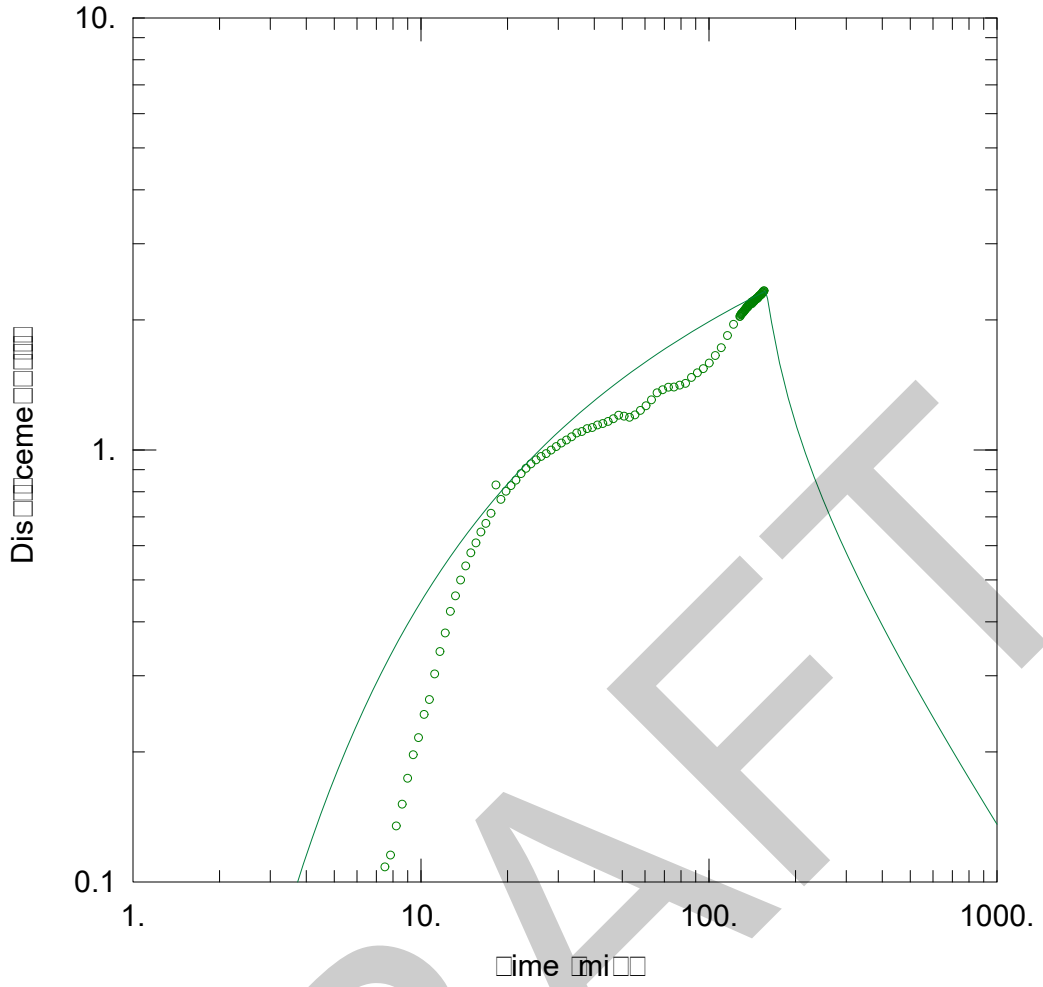

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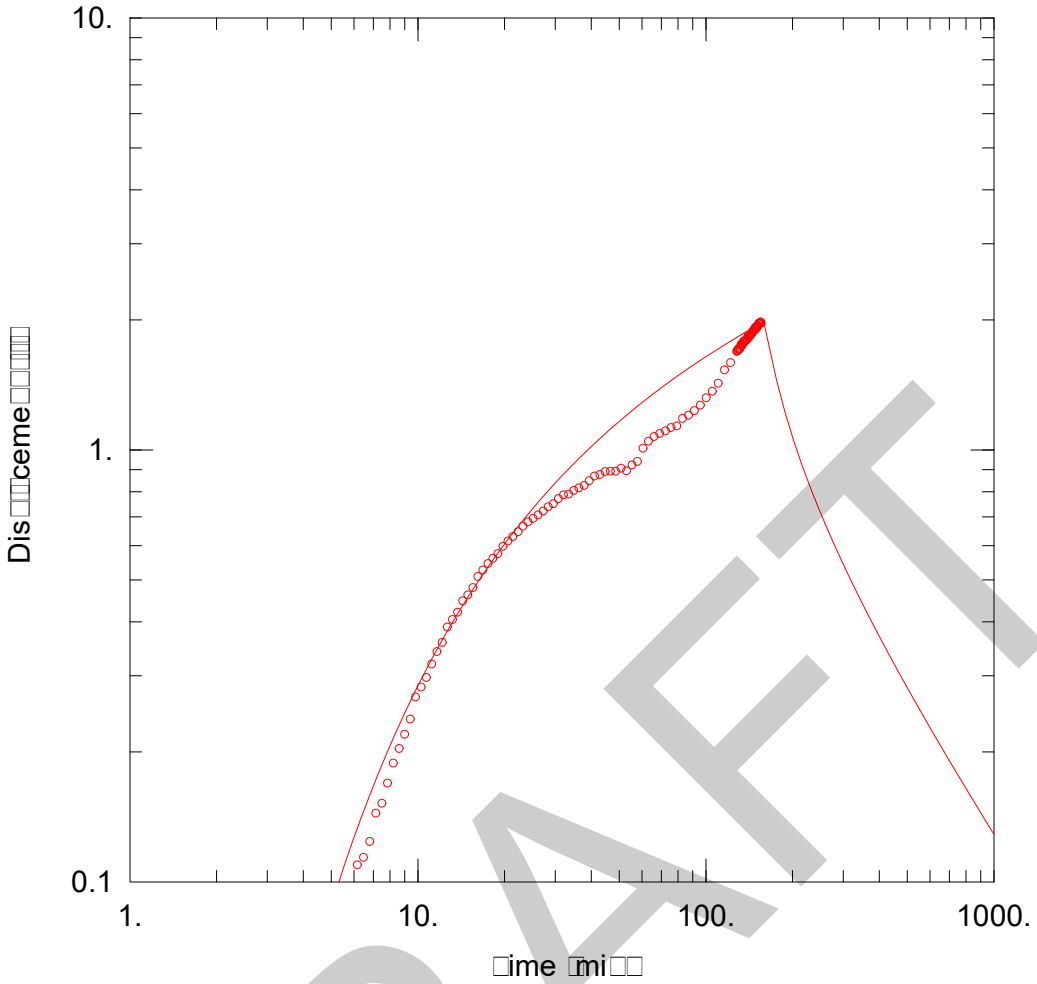

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APPENDIX H
NO FURTHER REMEDIATION LETTER

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03-47717

FILED
PEORIA COUNTY
STATE OF ILLINOIS

03 SEP 22 14 16

RECORDER OF DEEDS

PREPARED BY:

Name: Mr. Dennis Klein for Mr. Gerry Brown
President, Cargill Marine and Terminal, Inc.

Address: Box 9300
Minneapolis, MN 55440

RETURN TO:

Name: Mr. Dennis Klein for Mr. Gerry Brown
President, Cargill Marine and Terminal, Inc.

Address: Box 9300
Minneapolis, MN 55440

33

THE ABOVE SPACE FOR RECORDER'S OFFICE

This Environmental No Further Remediation Letter must be submitted by the remediation applicant within 45 days of its receipt, to the Office of the Recorder of Peoria County.

Illinois State EPA Number: 1434730002

Cargill Marine and Terminal Inc., the Remediation Applicant, whose address is Box 9300, Mail Stop # 8, Minneapolis, Minnesota, 55440, has performed investigative and/or remedial activities for the remediation site depicted on the attached Site Base Map and identified by the following:

1. Legal description or Reference to a Plat Showing the Boundaries: A part of the Northeast Quarter of Section 14, and part of a fraction of Section 13, all in Township 7 North, Range 7 East of the Fourth Principal Meridian, Peoria County, Illinois, more particularly described as follows. Bearings are for descriptive purposes only. Commencing at a found iron pipe in concrete at the North Quarter of said Section 14, as described in Document Number 67-11458, also, as recorded in Plat Book N, page 23, at the Peoria County Recorder's Office, as the Point of Beginning of the tract to be described; thence along the North line of said Southeast Quarter of said Northeast Quarter bearing South 88 degrees, 59 minutes, 23 seconds East, a distance of 725.75 feet to the Westerly Right of Way line of Pekin-LaMarsh Drainage and Levee District; thence along said Westerly Right of Way line for the next two courses bearing South 11 degrees, 23 minutes, 1 second East, a distance of 653.24 feet to a found iron pipe; thence bearing South 15 degrees, 45 minutes, 8 seconds East, a distance of 228.05 feet; thence leaving said Westerly Right of Way line bearing North 90 degrees, 0 minutes, 0 seconds West, a distance of 922.88 feet to the West line of said Southeast Quarter of said Northeast Quarter; thence along said West line bearing North 0 degrees, 25 minutes, 12 seconds East, a distance of 872.7 feet to the Point of Beginning, containing 16.248 acres, more or less.

LLA-50

2. Common Address: 8710 South Cargill Road, Pekin, Illinois 61555

3. Real Estate Tax Index/Parcel Index Number: 20-13-100-001 and 20-14-200-005

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4. Remediation Site Owner: Cargill Marine and Terminal, Inc.

5. Land Use: Industrial/Commercial

6. Site Investigation: Focused

See NFR letter for other terms.

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LLLH-03

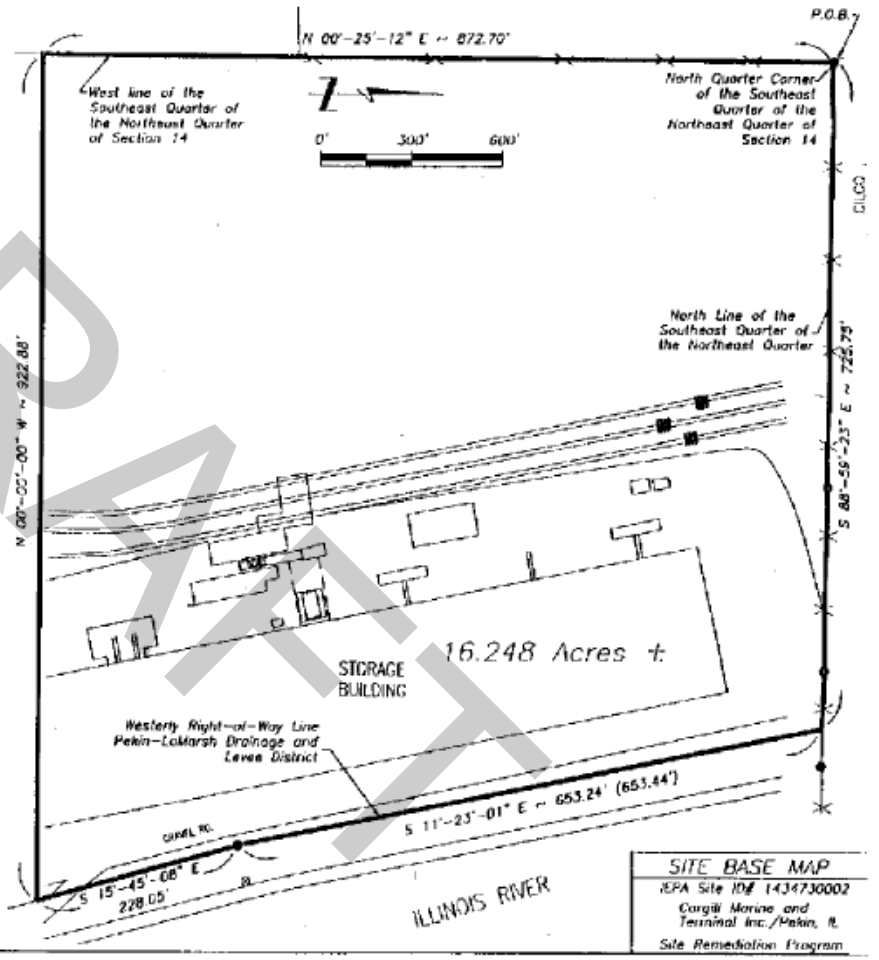
Remediation Site Description

A part of the Northeast Quarter of Section 14, and a part of Fractional Section 13, all in Township 7 North, Range 7 East of the Fourth Principal Meridian, Peoria County, Illinois, more particularly described as follows. Bearings are for descriptive purposes only.

Commencing at a found iron pipe in concrete at the North Quarter corner of the Southeast Quarter of said Northeast Quarter of Section 14, as described in document number 67-11458, also, as recorded in Plat Book N, page 23, at the Peoria County Recorder's office, as the Point of Beginning of the tract to be described; thence along the north line of said Southeast Quarter of said Northeast Quarter bearing South 88°-59'-23" East, a distance of 725.75 feet to the Westerly Right-of-Way line of Pekin-LaMarsh Drainage and Levee District; thence along said Westerly Right-of-Way line for the next 2 courses bearing South 11°-23'-01" East, a distance of 653.24 feet to a found iron pipe; thence bearing South 15°-45'-08" East, a distance of 228.05 feet; thence leaving said Westerly Right-of-Way line bearing North 90°-00'-00" West, a distance of 922.88 feet to the west line of said Southeast Quarter of said Northeast Quarter; thence along said west line bearing North 00°-25'-12" East, a distance of 872.70 feet to the Point of Beginning, containing 16.248 Acres, more or less.

LEGEND

P.O.B.	Point of Beginning
(653.44')	Record Distance
●	Found Survey Monument
⊕	Found Illinois Waterways Disk
▬▬	Remediation Site Boundary



REVISIONS			
NO.	DATE	DESCRIPTION	APPROVED

SURVEYED
DRAWN
CHECKED

MACTEC

SITE BASE MAP
IEPA Site ID# 1434730002
Cargill Marine and Terminal Inc./Pekin, IL
Site Remediation Program

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3

LILLh-EO

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276
JAMES R. THOMPSON CENTER, 100 WEST RANDOLPH, SUITE 11-300, CHICAGO, IL 60601

ROD R. BLAGOJEVICH, GOVERNOR RENEE CIPRIANO, DIRECTOR

(217) 782-6761

August 12, 2003

CERTIFIED MAIL
7002 3150 0000 1222 7749

Cargill Marine and Terminal, Inc./Pekin
Box 9300, Mail Stop No. 8
Minneapolis, Minnesota 55440
Attn: Mr. Gerry Brown
C/o Mr. Dennis Klein

Re: 1434730002—Peoria County
Cargo Carriers/Pekin
Site Remediation Program/Technical Reports

Dear Mr. Brown:

The *Remedial Completion Report, Cargill Fertilizer, Inc. (Formerly Cargo Carriers), Pekin, Illinois Terminal), Log No. 02-3288*, as prepared by Harding ESE, Inc. for the Cargill Marine and Terminal, Inc. property (previously referenced as Cargo Carriers and Cargill Fertilizer, Inc.), has been reviewed by the Illinois Environmental Protection Agency ("Illinois EPA"). The approved remediation objectives at the Site are equal to or are above the existing levels of regulated substances and the *Remedial Completion Report, Cargill Fertilizer, Inc. (Formerly Cargo Carriers), Pekin, Illinois Terminal, Log No. 02-3288*, shall serve as the approved Remedial Action Completion Report.

The Remediation Site, consisting of 16.248 acres, is located at 8710 South Cargill Road, Bartonville, Illinois. Pursuant to Section 58.10 of the Illinois Environmental Protection Act ("Act") (415 ILCS 5/1 et seq.), your request for a no further remediation determination is granted under the conditions and terms specified in this letter. The Remediation Applicant, as identified on the Illinois EPA's Site Remediation Program DRM-1 Form, Dated November 7, 1991, is Cargill Marine and Terminal, Inc.

This focused No Further Remediation Letter ("Letter") signifies a release from further responsibilities under the Act for the performance of the approved remedial action. This Letter shall be considered prima facie evidence that the Remediation Site described in the attached Illinois EPA Site Remediation Program Environmental Notice and shown in the attached Site Base Map does not constitute a threat to human health and the environment for the specified recognized environmental conditions so long as the Site is utilized in accordance with the terms of this Letter.

03-4111

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Conditions and Terms of Approval

Level of Remediation and Land Use Limitations

1) The recognized environmental conditions, as characterized by the focused site investigation, consist of the following:

   a) Regulated substances of concern that have been successfully addressed are Atrazine, Metolachlor, Chloride, and Sulfate.

2) The Remediation Site is restricted to Industrial/Commercial land use.

3) The land use specified in this Letter may be revised if:

   a) Further investigation or remedial action has been conducted that documents the attainment of objectives appropriate for the new land use; and

   b) A new Letter is obtained and recorded in accordance with Title XVII of the Act and regulations adopted thereunder.

Preventive, Engineering, and Institutional Controls

4) The implementation and maintenance of the following controls are required as part of the approval of the remediation objectives for this Remediation Site:

Institutional Controls:

5) No person shall construct, install, maintain, or operate a potable water supply well at the Remediation Site.

Other Terms

6) Where the Remediation Applicant is not the sole owner of the Remediation Site, the Remediation Applicant shall complete the attached *Property Owner Certification of the No Further Remediation Letter under the Site Remediation Program* Form. This certification, by original signature of each property owner, or the authorized agent of the owner(s), of the Remediation Site or any portion thereof who is not a Remediation Applicant shall be recorded along with this Letter.

7) Further information regarding this Remediation Site can be obtained through a written request under the Freedom of Information Act (5 ILCS 140) to:

Illinois Environmental Protection Agency
Attn: Freedom of Information Act Officer
Bureau of Land-#24
1021 North Grand Avenue East
Post Office Box 19276
Springfield, IL 62794-9276

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8) Pursuant to Section 58.10(f) of the Act (415 ILCS 5/58.10(f)), should the Illinois EPA seek to void this Letter, the Illinois EPA shall provide notice to the current title holder and to the Remediation Applicant at the last known address. The notice shall specify the cause for the voidance, explain the provisions for appeal, and describe the facts in support of this cause. Specific acts or omissions that may result in the voidance of the Letter under Sections 58.10(e)(1)-(7) of the Act (415 ILCS 5/58.10(e)(1)-(7)) include, but shall not be limited to:

   a) Any violation of institutional controls or the designated land use restrictions;

   b) The failure to operate and maintain preventive or engineering controls or to comply with any applicable groundwater monitoring plan;

   c) The disturbance or removal of contamination that has been left in-place in accordance with the Remedial Action Plan. Access to soil contamination may be allowed if, during and after any access, public health and the environment are protected consistent with the Remedial Action Plan;

   d) The failure to comply with the recording requirements for this Letter;

   e) Obtaining the Letter by fraud or misrepresentation;

   f) Subsequent discovery of contaminants, not identified as part of the investigative or remedial activities upon which the issuance of the Letter was based, that pose a threat to human health or the environment;

   g) The failure to pay the No Further Remediation Assessment Fee within forty-five (45) days after receiving a request for payment from the Illinois EPA;

   h) The failure to pay in full the applicable fees under the Review and Evaluation Services Agreement within forty-five (45) days after receiving a request for payment from the Illinois EPA.

9) Pursuant to Section 58.10(d) of the Act, this Letter shall apply in favor of the following persons:

   a) Cargill Marine and Terminal, Inc.;

   b) The owner and operator of the Remediation Site;

   c) Any parent corporation or subsidiary of the owner of the Remediation Site;

   d) Any co-owner, either by joint-tenancy, right of survivorship, or any other party sharing a relationship with the owner of the Remediation Site;

   e) Any holder of a beneficial interest of a land trust or inter vivos trust, whether revocable or irrevocable, involving the Remediation Site;

   f) Any mortgagee or trustee of a deed of trust of the owner of the Remediation Site or any assignee, transferee, or any successor-in-interest thereto;

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g) Any successor-in-interest of the owner of the Remediation Site;

h) Any transferee of the owner of the Remediation Site whether the transfer was by sale, bankruptcy proceeding, partition, dissolution of marriage, settlement or adjudication of any civil action, charitable gift, or bequest;

i) Any heir or devisee of the owner of the Remediation Site;

j) Any financial institution, as that term is defined in Section 2 of the Illinois Banking Act and to include the Illinois Housing Development Authority, that has acquired the ownership, operation, management, or control of the Remediation Site through foreclosure or under the terms of a security interest held by the financial institution, under the terms of an extension of credit made by the financial institution, or any successor-in-interest thereto; or

k) In the case of a fiduciary (other than a land trustee), the estate, trust estate, or other interest in property held in a fiduciary capacity, and a trustee, executor, administrator, guardian, receiver, conservator, or other person who holds the remediated site in a fiduciary capacity, or a transferee of such party.

10) This letter, including all attachments, must be recorded as a single instrument within forty-five (45) days of receipt with the Office of the Recorder of Peoria County. For recording purposes, the Illinois EPA Site Remediation Program Environmental Notice attached to this Letter should be the first page of the instrument filed. This Letter shall not be effective until officially recorded by the Office of the Recorder of Peoria County in accordance with Illinois law so that it forms a permanent part of the chain of title for the Cargill Marine and Terminal, Inc. property.

11) Within thirty (30) days of this Letter being recorded by the Office of the Recorder of Peoria County, a certified copy of this Letter, as recorded, shall be obtained and submitted to the Illinois EPA to:

Robert E. O'Hara
Illinois Environmental Protection Agency
Bureau of Land/RPMS
1021 North Grand Avenue East
Post Office Box 19276
Springfield, IL 62794-9276

12) In accordance with Section 58.10(g) of the Act, a No Further Remediation Assessment Fee based on the costs incurred for the Remediation Site by the Illinois EPA for review and evaluation services will be applied in addition to the fees applicable under the Review and Evaluation Services Agreement. Request for payment of the No Further Remediation Assessment Fee will be included with the billing statement.

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If you have any questions regarding this correspondence, you may contact the Illinois EPA project manager, Todd Gross, at 217/524-4862.

Sincerely,

Lawrence W. Eastep, P.E., Manager
Remedial Project Management Section
Division of Remediation Management
Bureau of Land

Attachments(3): Illinois EPA Site Remediation Program Environmental Notice
Site Base Map
Property Owner Certification of No Further Remediation Letter under the Site Remediation Program Form

cc: Christopher J. Everts, P.E., Ph. D.
Senior Project Engineer
MACTEC Engineering and Consulting, Inc.
8901 North Industrial Road
Peoria, Illinois 61615

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03-4114

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APPENDIX C
Vertical Hydraulic Gradients

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APPENDIX C. VERTICAL HYDRAULIC GRADIENTS

Nature and Extent Report

Edwards Power Plant

Ash Pond

Bartonville, Illinois

Date	AP08 Groundwater Elevation (ft NAVD88) CCR-shallow	XPW02 Groundwater Elevation (ft NAVD88) CCR-deep	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
2/9/2021	452.60	452.97	-0.37	13.16	-0.03	up
3/2/2021	452.85	453.17	-0.32	13.16	-0.02	up
3/22/2021	453.59	454.08	-0.49	13.16	-0.04	up
4/12/2021	453.16	453.73	-0.57	13.16	-0.04	up
5/4/2021	452.70	453.23	-0.53	13.16	-0.04	up
6/15/2021	452.40	452.90	-0.50	13.16	-0.04	up
6/28/2021	452.92	453.47	-0.55	13.16	-0.04	up
7/21/2021	452.97	453.67	-0.70	13.16	-0.05	up
8/30/2021	451.89	452.36	-0.47	13.16	-0.04	up
2/16/2022	452.69	453.21	-0.52	13.16	-0.04	up
7/25/2022	451.42	451.85	-0.43	13.16	-0.03	up
2/27/2023	452.97	454.01	-1.04	13.16	-0.08	up
6/12/2023	451.29	451.69	-0.40	13.16	-0.03	up
8/21/2023	452.40	453.01	-0.61	13.16	-0.05	up
10/27/2023	451.50	452.16	-0.66	13.16	-0.05	up
			Middle of screen elevation AP08			443.32
			Middle of screen elevation XPW02			430.16

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APPENDIX C. VERTICAL HYDRAULIC GRADIENTS

Nature and Extent Report

Edwards Power Plant

Ash Pond

Bartonville, Illinois

Date	AP09 Groundwater Elevation (ft NAVD88) CCR-shallow	XPW03 Groundwater Elevation (ft NAVD88) CCR-deep	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
2/9/2021	451.96	450.74	1.22	12.03	0.10	down
3/2/2021	451.95	450.72	1.23	12.03	0.10	down
3/22/2021	451.95	450.77	1.18	12.03	0.10	down
4/12/2021	451.86	450.62	1.24	12.03	0.10	down
5/4/2021	452.12	450.84	1.28	12.03	0.11	down
6/15/2021	451.61	450.38	1.23	12.03	0.10	down
6/28/2021	452.09	450.86	1.23	12.03	0.10	down
7/21/2021	452.19	451.03	1.16	12.03	0.10	down
8/30/2021	451.96	450.76	1.20	12.03	0.10	down
2/16/2022	451.86	450.65	1.21	12.03	0.10	down
7/25/2022	451.60	450.33	1.27	12.03	0.11	down
2/27/2023	450.81	449.70	1.11	12.03	0.09	down
6/12/2023	448.82	447.83	0.99	12.03	0.08	down
8/21/2023	450.13	448.84	1.29	12.03	0.11	down
10/27/2023	449.40	447.81	1.59	12.03	0.13	down
			Middle of screen elevation AP09			442.65
			Middle of screen elevation XPW03			430.62

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APPENDIX C. VERTICAL HYDRAULIC GRADIENTS

Nature and Extent Report

Edwards Power Plant

Ash Pond

Bartonville, Illinois

Date	AW-15S Groundwater Elevation (ft NAVD88)	AW-15 Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UCF/PMP	UA				
2/9/2021	431.91	433.03	-1.12	21.47	-0.05	up
3/2/2021	431.19	433.50	-2.31	21.47	-0.11	up
3/22/2021	431.33	433.68	-2.35	21.47	-0.11	up
4/12/2021	431.13	433.76	-2.63	21.47	-0.12	up
5/4/2021	429.82	433.69	-3.87	26.37	-0.15	up
6/15/2021	431.00	433.65	-2.65	21.47	-0.12	up
6/28/2021	429.86	433.59	-3.73	26.41	-0.14	up
7/21/2021	431.25	433.65	-2.40	21.47	-0.11	up
8/30/2021	430.87	434.43	-3.56	21.47	-0.17	up
2/16/2022	431.79	433.51	-1.72	21.47	-0.08	up
7/25/2022	432.07	433.74	-1.67	21.47	-0.08	up
2/27/2023	430.66	432.59	-1.93	21.47	-0.09	up
4/12/2023	431.24	433.36	-2.12	21.47	-0.10	up
5/12/2023	431.24	433.50	-2.26	21.47	-0.11	up
6/12/2023	430.76	433.41	-2.65	21.47	-0.12	up
7/21/2023	430.64	432.99	-2.35	21.47	-0.11	up
8/21/2023	430.88	432.82	-1.94	21.47	-0.09	up
10/27/2023	430.67	431.49	-0.82	21.47	-0.04	up
11/20/2023	429.63	431.52	-1.89	26.18	-0.07	up
12/27/2023	431.19	431.99	-0.80	21.47	-0.04	up
			Middle of screen elevation AW-15S			424.92
			Middle of screen elevation AW-15			403.45
			Top of screen elevation AW-15S			429.92
			Top of screen elevation AW-15			405.95

Date	AP07S Groundwater Elevation (ft NAVD88)	OW-01 Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UCF/PMP	UA				
11/21/2022	435.59	435.58	0.01	-0.79	-0.01	up
2/27/2023	436.78	436.74	0.04	-0.79	-0.05	up
6/12/2023	435.59	435.54	0.05	-0.79	-0.06	up
8/21/2023	436.07	436.03	0.04	-0.79	-0.05	up
10/27/2023	435.70	435.71	-0.01	-0.79	0.01	down
			Middle of screen elevation AP07S			425.97
			Middle of screen elevation OW-01			426.75

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APPENDIX C. VERTICAL HYDRAULIC GRADIENTS

Nature and Extent Report

Edwards Power Plant

Ash Pond

Bartonville, Illinois

Date	APW-03 Groundwater Elevation (ft NAVD88)	AW-10 Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UCF/PMP	UA				
2/9/2021	436.78	- - -	- - -	- - -	- - -	- - -
3/2/2021	436.47	438.84	-2.37	8.70	-0.27	up
3/22/2021	436.75	438.84	-2.09	8.70	-0.24	up
4/12/2021	436.25	438.85	-2.60	8.70	-0.30	up
5/4/2021	436.06	438.80	-2.74	8.70	-0.31	up
6/15/2021	435.64	438.62	-2.98	8.70	-0.34	up
6/28/2021	436.22	438.61	-2.39	8.70	-0.27	up
7/21/2021	436.13	438.60	-2.47	8.70	-0.28	up
8/30/2021	435.57	437.93	-2.36	8.70	-0.27	up
2/16/2022	436.47	438.05	-1.58	8.70	-0.18	up
7/25/2022	434.93	437.62	-2.69	8.70	-0.31	up
2/27/2023	436.51	438.38	-1.87	8.70	-0.21	up
			Middle of screen elevation APW-03			416.42
			Middle of screen elevation AW-10			407.72

Date	P002 Groundwater Elevation (ft NAVD88)	AW-20 Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UCF/PMP	UA				
2/9/2021	448.41	445.11	3.30	12.27	0.27	down
3/2/2021	448.50	445.23	3.27	12.27	0.27	down
3/22/2021	448.60	445.41	3.19	12.27	0.26	down
4/12/2021	448.42	445.29	3.13	12.27	0.26	down
5/4/2021	448.31	445.08	3.23	12.27	0.26	down
6/15/2021	448.19	444.55	3.64	12.27	0.30	down
6/28/2021	448.33	445.08	3.25	12.27	0.26	down
2/16/2022	448.03	444.70	3.33	12.27	0.27	down
2/27/2023	448.34	445.33	3.01	12.27	0.25	down
			Middle of screen elevation P002			432.35
			Middle of screen elevation AW-20			420.08

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APPENDIX C. VERTICAL HYDRAULIC GRADIENTS

Nature and Extent Report

Edwards Power Plant

Ash Pond

Bartonville, Illinois

Date	APW-04 Groundwater Elevation (ft NAVD88)	AW-13 Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UCF/PMP	UA				
2/9/2021	432.44	435.52	-3.08	11.22	-0.27	up
3/2/2021	432.74	435.84	-3.10	11.22	-0.28	up
3/22/2021	432.75	435.86	-3.11	11.22	-0.28	up
4/12/2021	432.91	435.92	-3.01	11.22	-0.27	up
5/4/2021	432.40	435.83	-3.43	11.22	-0.31	up
6/15/2021	431.79	435.56	-3.77	11.22	-0.34	up
6/28/2021	431.21	435.40	-4.19	11.22	-0.37	up
7/21/2021	432.13	435.98	-3.85	11.22	-0.34	up
8/30/2021	431.98	435.28	-3.30	11.22	-0.29	up
2/16/2022	432.38	435.74	-3.36	11.22	-0.30	up
7/25/2022	431.15	434.65	-3.50	11.22	-0.31	up
2/27/2023	432.65	435.86	-3.21	11.22	-0.29	up
			Middle of screen elevation APW-04			422.39
			Middle of screen elevation AW-13			411.17

Date	AW-15 Groundwater Elevation (ft NAVD88)	AW-15C Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UA	BCU				
2/9/2021	433.03	433.32	-0.29	11.33	-0.03	up
3/2/2021	433.50	433.50	0.00	11.33	0.000	flat
3/22/2021	433.68	433.66	0.02	11.33	0.002	down
4/12/2021	433.76	433.80	-0.04	11.33	-0.004	up
5/4/2021	433.69	433.71	-0.02	11.33	-0.002	up
6/15/2021	433.65	433.63	0.02	11.33	0.002	down
6/28/2021	433.59	433.58	0.01	11.33	0.001	flat
7/21/2021	433.65	433.67	-0.02	11.33	-0.002	up
8/30/2021	434.43	431.51	2.92	11.33	0.26	down
2/16/2022	433.51	433.52	-0.01	11.33	-0.001	flat
7/25/2022	433.74	432.86	0.88	11.33	0.08	down
2/27/2023	432.59	432.56	0.03	11.33	0.003	down
			Middle of screen elevation AW-15			403.45
			Middle of screen elevation AW-15C			392.12

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APPENDIX C. VERTICAL HYDRAULIC GRADIENTS

Nature and Extent Report

Edwards Power Plant

Ash Pond

Bartonville, Illinois

Date	AP05S Groundwater Elevation (ft NAVD88)	AP05D Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UA	BCU				
2/9/2021	437.61	439.14	-1.53	16.54	-0.09	up
3/2/2021	437.93	435.81	2.12	16.54	0.13	down
3/22/2021	438.43	433.33	5.10	16.54	0.31	down
4/12/2021	438.59	431.96	6.63	16.54	0.40	down
5/4/2021	438.43	432.29	6.14	16.54	0.37	down
6/15/2021	438.30	435.02	3.28	16.54	0.20	down
6/28/2021	438.24	433.14	5.10	16.54	0.31	down
7/21/2021	438.67	437.15	1.52	16.54	0.09	down
8/30/2021	438.13	438.36	-0.23	16.54	-0.01	up
2/16/2022	438.15	438.74	-0.59	16.54	-0.04	up
7/25/2022	437.62	438.78	-1.16	16.54	-0.07	up
11/21/2022	435.88	437.53	-1.65	16.54	-0.10	up
12/16/2022	436.73	437.51	-0.78	16.54	-0.05	up
1/9/2023	437.05	437.55	-0.50	16.54	-0.03	up
2/27/2023	438.46	437.82	0.64	16.54	0.04	down
			Middle of screen elevation AP05S			405.88
			Middle of screen elevation AP05D			389.34

[O:SSW 7/13/21, U: RAB 5/14/24, C: KRP 5/16/24]

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

BCU = bedrock confining unit

CCR = coal combustion residuals

dh = head change

dl = distance change

ft = foot/feet

NAVD88 = North American Vertical Datum of 1988

UCF/PMP = Upper Cahokia Formation/potential migration pathway

UA = uppermost aquifer

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APPENDIX D
Hydrographs Supporting Vertical Hydraulic Gradients

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Path: dara/Vistra – 845/Corrective Action Assessment/Nature and Extent/Hydrographs



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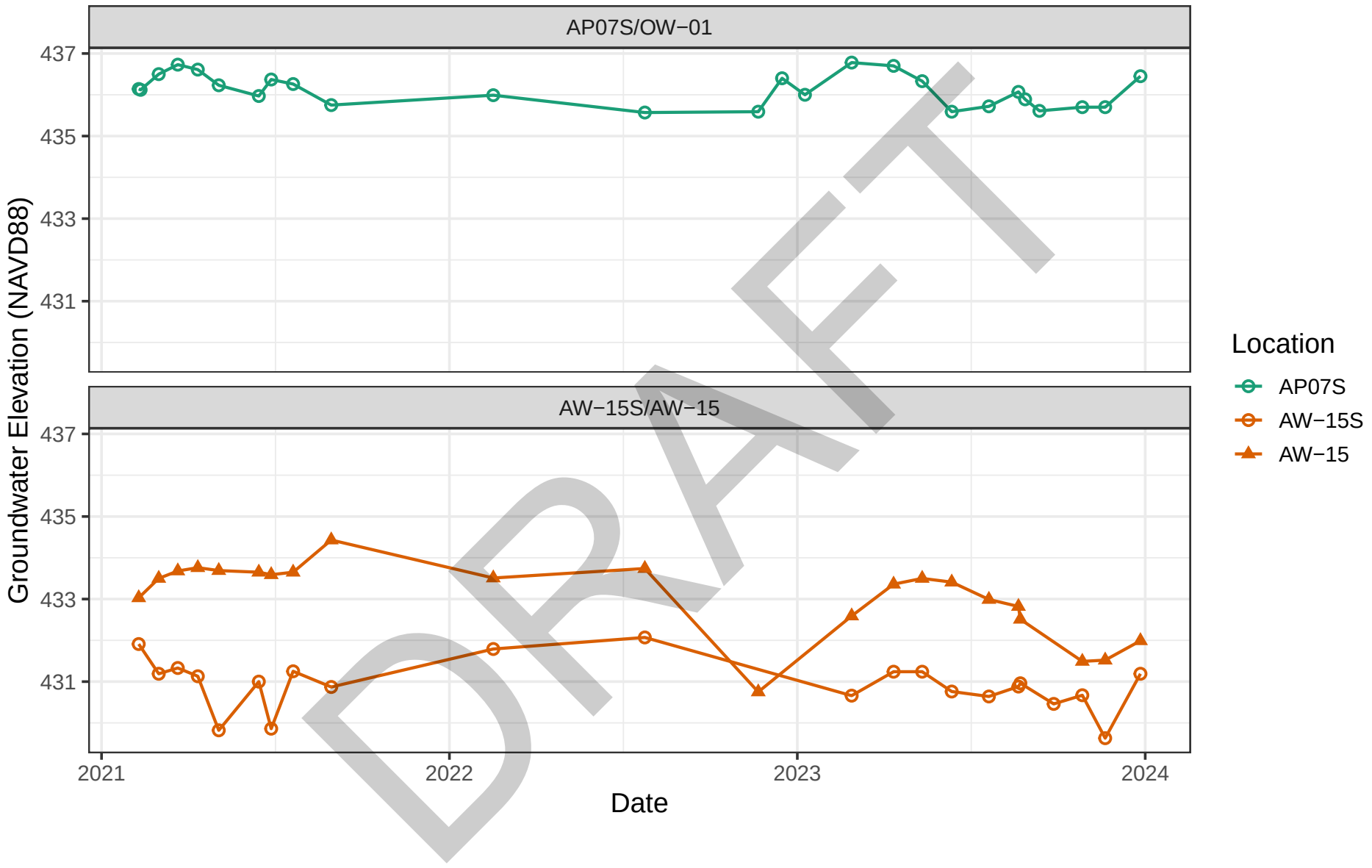
Hydrographs
Nature and Extent Report
Edwards Ash Pond
Bartonville, IL

Figure
1

Drafter: RAB Date: 2024-05-17 Contract Number: 1940103584

Path: dara/Vistra − 845/Corrective Action Assessment/Nature and Extent/Hydrographs



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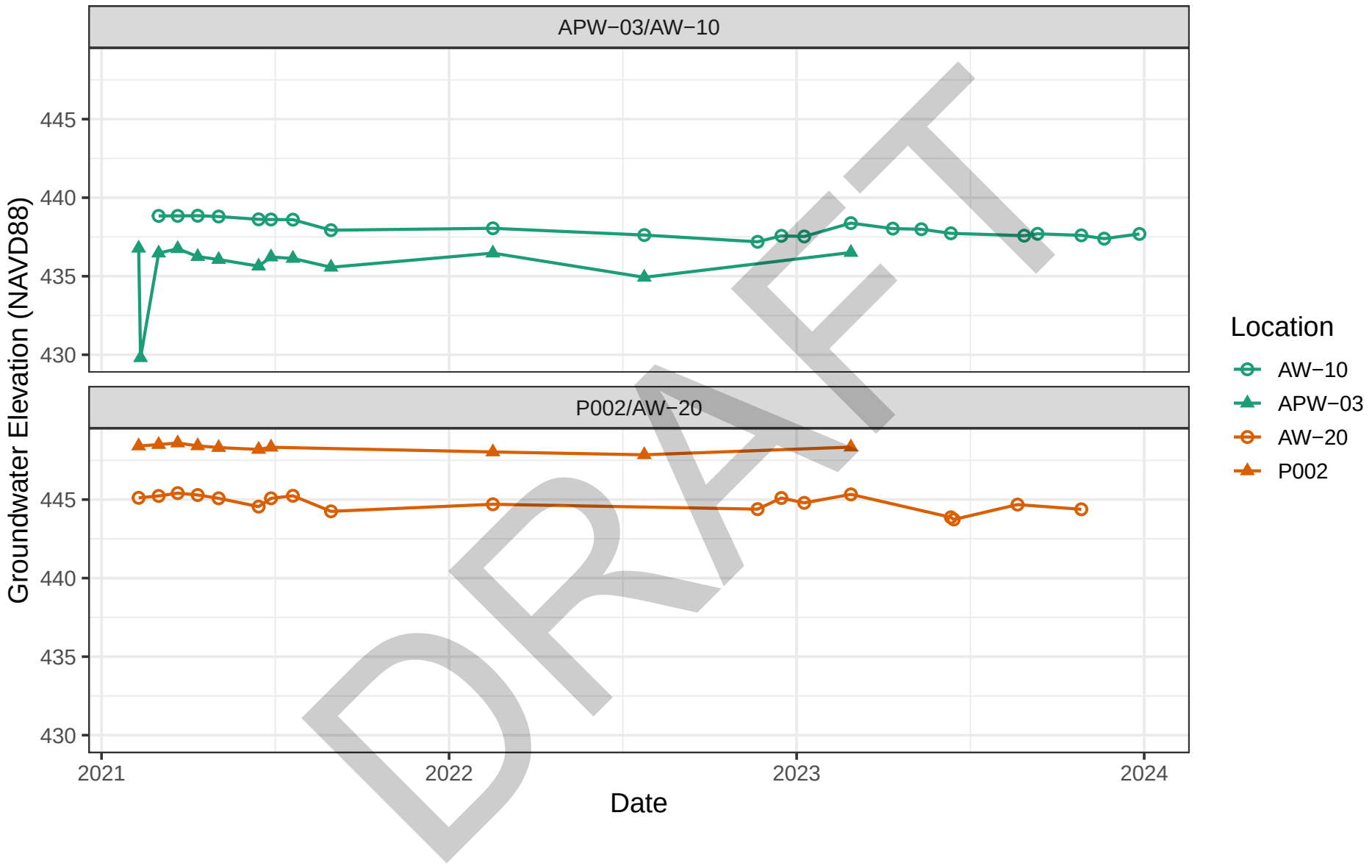
Hydrographs
Nature and Extent Report
Edwards Ash Pond
Bartonville, IL

Figure
2

Drafter: RAB Date: 2024−05−17 Contract Number: 1940103584

Path: dara/Vistra − 845/Corrective Action Assessment/Nature and Extent/Hydrographs



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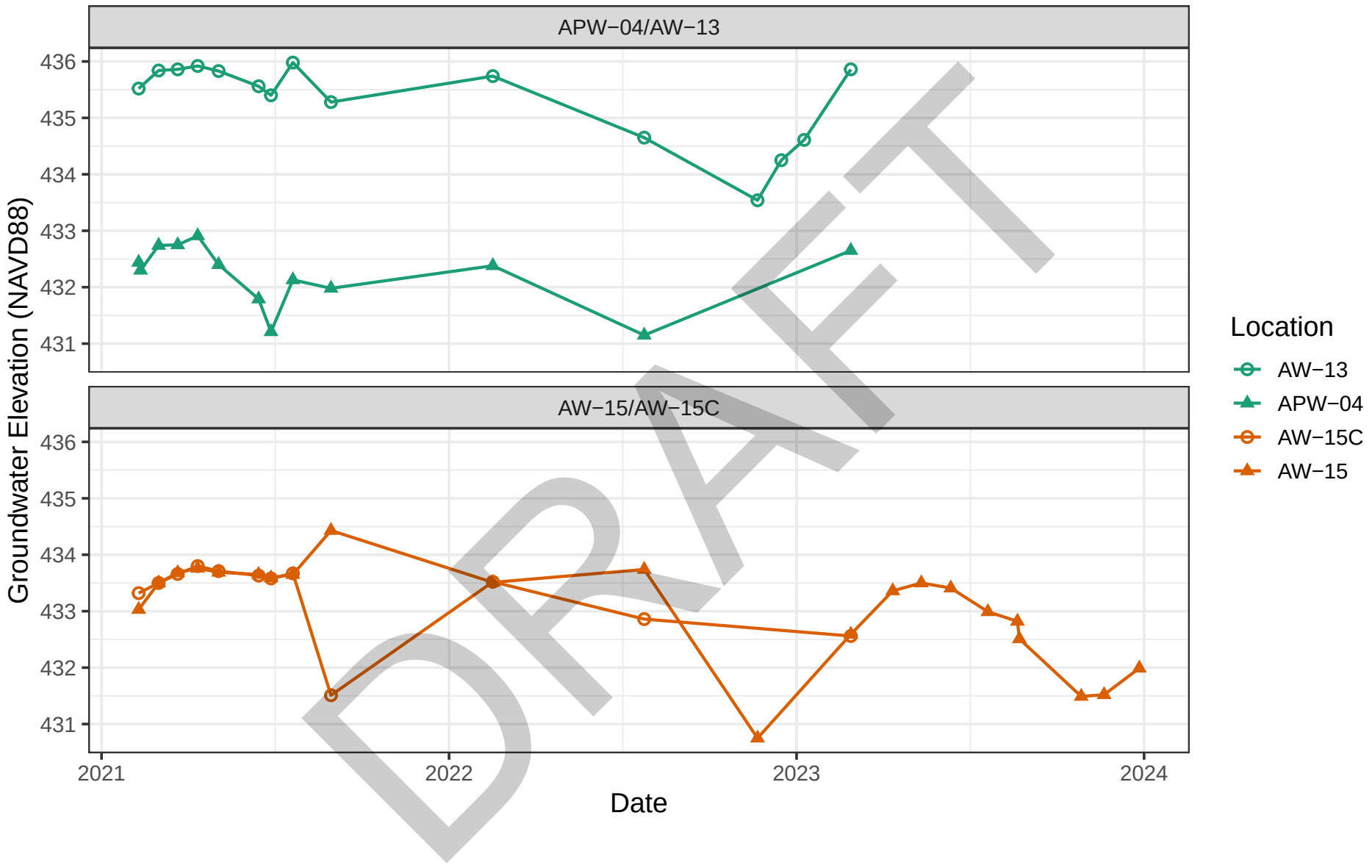
Hydrographs
Nature and Extent Report
Edwards Ash Pond
Bartonville, IL

Figure
3

Drafter: RAB Date: 2024−05−17 Contract Number: 1940103584

Path: dara/Vistra − 845/Corrective Action Assessment/Nature and Extent/Hydrographs



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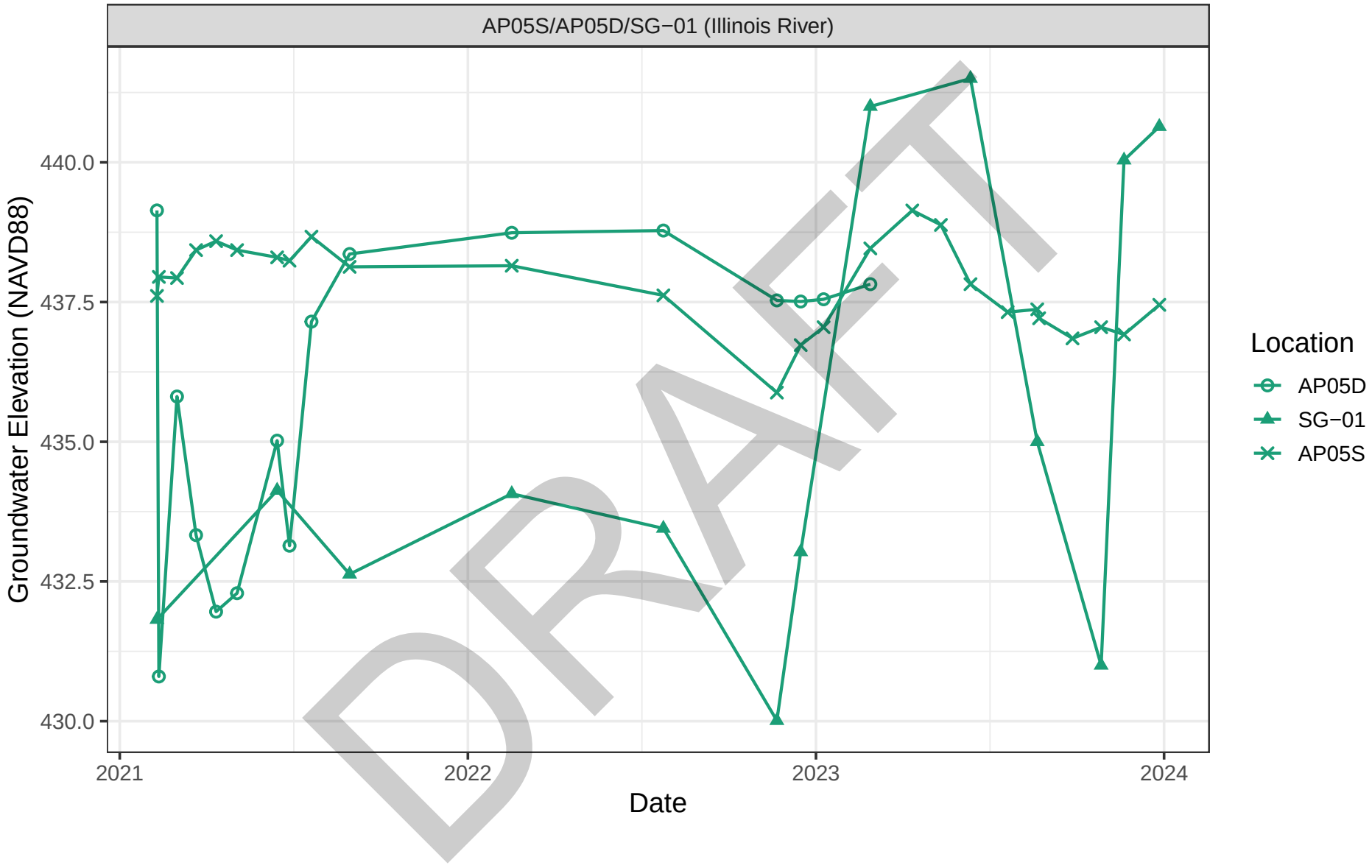
Hydrographs
Nature and Extent Report
Edwards Ash Pond
Bartonville, IL

Figure
4

Drafter: RAB Date: 2024−05−17 Contract Number: 1940103584

Path: dara/Vistra − 845/Corrective Action Assessment/Nature and Extent/Hydrographs



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Hydrographs
Nature and Extent Report
Edwards Ash Pond
Bartonville, IL

Figure
5

Drafter: RAB Date: 2024−05−17 Contract Number: 1940103584

APPENDIX E
Geochemical Conceptual Site Model

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GEOCHEMICAL CONCEPTUAL SITE MODEL

EDWARDS ASH POND

Submitted to:

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

Submitted by:

Life Cycle Geo, LLC
729 Main Street
Longmont, Colorado 80501

23RAM01-1
May 31, 2024

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1 EXECUTIVE SUMMARY

This report documents the geochemical conceptual site model (GCSM) describing the conditions of the groundwater in the vicinity of the Edwards (EDW) Ash Pond (AP). A GCSM describes the geochemical processes that contribute to mobilization and attenuation of constituents in the environment. This report describes the GCSM for parameters that have exceeded the GWPS in AP groundwater and which will be addressed in the corrective action plan. The exceedances observed at the AP occur in the uppermost aquifer (UA) and potential migration pathway (PMP) and include boron and sulfate.

The CCR materials are the primary source of constituent loading to the CCR porewater. Over an extended period (e.g., months to years), the CCR porewater (i.e., water contained within the interstitial pore spaces of the CCR that can be sampled by low-flow groundwater sampling methods) reaches equilibrium with the CCR materials. The porewater is therefore representative of the mobile phase constituents capable of migrating into the underlying materials and potentially downgradient in groundwater. The AP CCR porewater is therefore the primary vector of sulfate and boron *available* to the shallow groundwater and is considered as the primary source term for environmental investigation.

Boron and sulfate are assessed as indicators of influence from the CCR materials. Where observed in shallow groundwater at concentrations above the groundwater protection standard, concentrations of boron and sulfate are indicative of influence by CCR porewater. The uneven distribution of sulfate in the shallow UA/PMP groundwater is attributed to physical or chemical heterogeneity along the groundwater flow path.

Geochemical attenuation of constituents in groundwater is a function of groundwater pH, redox potential, availability of adsorbent, and presence of competing ions, among other factors. Groundwater pH exerts a major control on constituent mobility and reflects a neutral and generally stable condition in the range of 6 to 8 S.U. independent of location, lithology, or exceedance status. The stability of pH in groundwater is an indication that groundwater is well buffered, largely due to the widespread presence of carbonate minerals in the aquifer solids which buffer pH within this range. Neutral groundwater pH is generally favorable to attenuation of constituents in groundwater, such that it promotes the precipitation of the mineral phases that adsorb constituents from the aqueous phase. Groundwater pH additionally controls the tendency of various constituents to adsorb to the mineral surface. CCR porewater pH is alkaline, with a pH measured between 11 and 12.5 S.U.

The oxidation and reduction potential (redox potential) of groundwater exerts another major control on constituent mobility in groundwater. The redox condition is more variable across the site and shows a distinct pattern above and below the elevation of 420 feet elevation referenced to North American Vertical Datum of 1988 (ft NAVD88), the *approximate* elevation at which a redox transition appears to occur. The locations with exceedances of either boron or sulfate are all within the shallower elevation of the aquifer. The shallow groundwater (above the 420 ft NAVD88 approximate reference elevation) is more oxidized with low concentrations of dissolved iron and methane, and non-detect sulfide. The deeper groundwater reflects a reducing signature based on high concentrations of methane, dissolved and ferrous iron, and presence of sulfide. This deeper, reducing groundwater signature is not attributed to the CCR unit based on (1) the absence of boron and (2) the presence of constituents in the deeper groundwater that are

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incompatible with the chemistry of the shallower groundwater (e.g., methane will reduce/consume sulfate if intermixed, and barium, present in the deeper groundwater, will precipitate as barite if in the presence of sulfate). This suggests a physical or hydraulic separation between the shallow and deep water at the site, which limits the extent of the influence from the AP.

Characterization data from the aquifer solids is considered to understand the reactive mineral fractions present in the aquifer solids and the binding mechanisms that control the partitioning of constituents between the solid and aqueous phases. The key finding from the aquifer solids assessment is that adsorptive minerals are present in the aquifer solids and have currently bound both boron and sulfate within the reactive fraction of the solid matrix. The inference follows that some degree of attenuation of the exceedance constituents by the aquifer solids has occurred in the past, most notably through adsorption to both iron and aluminum hydroxide minerals. The future condition of related attenuation is reserved for subsequent assessment and predictions related to the closure condition and corrective action.

2 INTRODUCTION

This report documents the development of a geochemical conceptual site model (GCSM) to describe conditions at the Edwards (EDW) Ash Pond (AP), which is part of the Edwards Power Plant (EPP). The GCSM was prepared in support of an evaluation of the nature and extent (N&E) of exceedances of constituents of concern (COCs) above the groundwater protection standards (GWPS) at the AP. This document has been prepared as an attachment to the EDW N&E Report (Ramboll, 2024). Boron and sulfate are the constituents with exceedances above the GWPS at the EDW AP. Exceedances were observed at compliance monitoring wells AW-05, AP07S, AW-15S, AW-19, and AW-21 during the second through fourth quarter 2023 sampling event completed under 35 IAC §845. Boron exceedances are in the uppermost aquifer (UA; AW-05, AW-19, and AW-21) and the potential migration pathway (PMP; AP07S and AW-15S). Sulfate exceedances are exclusively in the PMP (AW-15S).

2.1 SITE OVERVIEW

A thorough overview of site characteristics is presented in EDW N&E Report (Ramboll, 2024). Briefly, the EPP is located in Bartonville, Illinois. The EDW AP is bordered to the north by a salt processing facility, to east by a fertilizer processing plant and the Illinois River, to the south by agricultural fields, and to the west by the EPP, railroad tracks, and the former Orchard Mines. The AP is an unlined 91-acre surface impoundment that began operations in 1960 and primarily contains fly ash.

Full descriptions of site geology and hydrogeology are available in the Hydrogeologic Site Characterization Report (Ramboll, 2021a). In addition to the coal combustion residuals (CCR) present at the AP, there are three hydrostratigraphic units (HSU) in the vicinity of the EPP, including the Upper Cahokia Formation (UCF), the uppermost aquifer (UA), and the bedrock confining unit (BCU). The UCF consists of low permeability clays and silts and is considered the potential migration pathway (PMP) at elevations similar to the base of the ash pond and where thin discontinuous sand lenses occur. The UA is a thin, moderately permeable sand, silty sand, and clayey gravel. The BCU is low permeability shales and siltstones.

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Exceedance wells AW-05, AW-19 and AW-21 are screened in the UA, while AP07S and AW-15S are screened in the UCF/PMP.

2.2 GROUNDWATER MONITORING NETWORK

A groundwater monitoring network was proposed in accordance with I.A.C Title 35 Section 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 AP. The proposed groundwater monitoring network is described in the Groundwater Monitoring Plan (Ramboll, 2021a). Groundwater flow in the UA is northwest in the northernmost portion of the pond, east to west in the central portion of the pond, and south/southeast in the southern portion of the pond (Figure 1). A detailed discussion of the hydrogeology is presented in EDW N&E Report (Ramboll, 2024).

3 CONSTITUENT TRANSPORT AND FATE

The two exceedance parameters at EDW AP are sulfate and boron. Sulfate is the dominant form of oxidized sulfur (S(VI) in the environment and is present as a divalent oxyanion at pH values greater than 2 S.U. (Stumm and Morgan, 1996). Under reducing conditions, sulfate in groundwater can be reduced to elemental sulfur (S(0)) or sulfide (S(-II)). Sulfur species in groundwater may sorb onto positively charged sites on solid metal oxide phases, most commonly iron and manganese oxides (Brown et al., 1999). The extent and strength of sorption to metal oxide surfaces depends on pH, ionic strength, size, and charge of the dissolved constituent, and available sorbing surface area. Sulfate can also form insoluble to low solubility complexes such as barite ($BaSO_4$) and gypsum ($CaSO_4$), while reduced sulfur readily precipitates as metal sulfide. Generally, reduced sulfur is less mobile in groundwater than sulfate.

Boron is primarily present in groundwater as boric acid (H_3BO_3) or borate ($B[OH]_4^-$) (Bolan et al., 2023). Boron speciation is pH dependent, with the charged $B(OH)_4^-$ being more dominant at higher pH. This species is more likely to sorb onto positively charged sites on solid metal oxide phases, most commonly aluminum and iron oxides (Bolan et al., 2023). Boron sorbs best to amorphous aluminum or iron phases (Goldberg and Glaubig, 1985). Boron adsorption is pH dependent, with maximum sorption occurring between pH 7 and 8 S.U. and dropping off at progressively higher or lower pH (Goldberg and Glaubig, 1985). Boron is not subject to oxidation-reduction reactions (Lemarchand et al., 2015; Bolan et al., 2023).

4 SOLIDS CHARACTERIZATION

4.1 METHODS

Aquifer solids were collected in 2021 to support the development of this GCSM. One additional aquifer solid sample was collected in 2022, during installation of monitoring well AW-23. **Attachment 1** details CCR and aquifer solids boring locations and collection methodology. **Table 4-1** summarizes boring identifiers, collection depth, associated monitoring well names, and methods of analysis. Three samples were

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collected at upgradient location AP05S, two from the UA just above the screened interval, and one corresponding to the BCU. Aquifer solids were sampled at exceedance locations AP07S, AW-15S, and AW-19 and generally coincide with the screened intervals of the respective monitoring well.

Bulk solid characterization included CEC, XRF, and loss-on-ignition (LOI). The CEC describes the capacity of a soil to exchange positively charged ions, aiding in understanding aquifer capacity for undergoing ion exchange reactions. The CEC is dependent on organic matter and types and quantity of clay minerals. Ten samples were analyzed for CEC by SiREM in Guelph, Ontario in 2021, including one sample of CCR. XRF analysis measures the fluorescent X-rays emitted from a solid sample excited by a primary X-ray source to quantify the relative proportions of major elements in a sample. This data is presented as weight percent of individual elements based on electron properties. Results from XRF analysis are reported as oxides due to the borate fusion preparation method used. LOI was quantified in conjunction with XRD and describes the combustible portion of the solid material, which is interpreted to represent the proportion of organic matter in the solids. This test involves heating a sample at a high temperature, combusting volatile compounds.

Mineralogy was determined through XRD and TIMA. The XRD analysis quantifies crystalline mineral phases with Rietveld refinement offering increased precision in quantification calculations. Identifying mineral phases aids in understanding attenuation mechanisms and aquifer capacity. TIMA identifies amorphous and crystalline mineral phases using a combination of energy dispersive X-ray silicon drift detectors and backscattered electron and secondary electron detectors.

Total metals content is a measure of bulk concentration and is a useful measure of metal content within a solid sample. It does not, however, provide meaningful information on the extent to which a metal may or may not be released from the solid. Total metal results for boron, sulfur, iron, manganese, and aluminum are presented to aid understanding of bulk condition. Refer to the SEP results for understanding of metal binding mechanisms and to infer conditions that may lead to the mobilization of a given fraction of the total metal from the solid phase.

For the SEP test, a fraction of the total metal content is isolated from a solid sample based on the metal association with different operationally defined fractions of the solid sample. Initial extractions target loosely bound metals, representing the fraction of the total metal concentration that is more likely to become mobile under near-surface environmental conditions. Subsequent steps progressively extract metals associated with more recalcitrant fractions of the soil. This method allows for a nuanced understanding of metal partitioning with various phases in the soils, aiding interpretation of conditions that may contribute to metal attenuation or release.

The SEP analyses conducted in 2021 and 2023 followed two different methodologies. The 2021 samples were analyzed by Eurofins Test America (Eurofins; Knoxville, Tennessee), whereas the 2023 samples were analyzed by SGS (Burnaby, British Columbia, Canada). Eurofins uses a seven-step extraction procedure (**Attachment 1**), while SGS uses a six-step procedure (**Attachment 2**). The extractions performed for the two test methods generally target a similar set of soil fractions, though variations in extraction conditions and reagents may lead to differences in absolute values. Other differences can result from sample heterogeneity and alterations due to sample storage conditions, particularly for the samples analyzed in 2023. Despite these differences, the trends and relative distribution patterns from both tests can still be

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informative. Results are presented for extracted iron (2021 and 2023), manganese (2021 and 2023), aluminum (2021 and 2023), boron (2023), and sulfur (2023). Boron and sulfur are included as the constituents of interest. Iron, manganese, and aluminum are presented due to their relevance for interpreting geochemical conditions and because they form the basis of the dominant adsorbent minerals in the aquifer matrix (iron, manganese, and aluminum hydroxides).

4.2 RESULTS

This section describes results of bulk characterization (CEC, **Table 4-2**; XRF, **Table 4-3**), mineralogical analysis (XRD, **Table 4-4**; TIMA, **Table 4-5**), organic carbon (TOC and LOI, **Table 4-6**), and SEP analysis and total metals (**Table 4-7**, **Table 4-8**, and **Figure 4-2**) for CCR (Section 4.2.1) and aquifer solids (Section 4.2.2).

4.2.1 CCR

The CCR sample collected in August 2021 from XPW01 was subjected to the analytical testing previously described (Section 3.1). The CCR sample had a LOI of 10.2% and a CEC of 86.5 meq/100g. The LOI is similar to the aquifer solids, but the CEC is significantly higher. Total iron concentrations (150,000 to 200,000 mg/kg) are an order of magnitude higher than those observed within the aquifer solids while total manganese (810 to 840 mg/kg) is similar to manganese found within the aquifer solids. The mineralogical analysis (Table 7) revealed the CCR material is distinct from aquifer materials with high proportions of anorthite (29.6%), hematite (23%), and magnetite (26%) and relatively low percentage of quartz (10.4%) and calcite (2.7%).

Most of the iron was detected in the residual fraction, followed by the acid sulfide fraction, indicating iron is not likely to become mobilized from the CCR solids. Overall manganese concentrations (850 mg/kg) were marginally higher than the aquifer solids (average 540 mg/kg). Manganese was predominantly associated with the carbonate fraction, followed by the non-crystalline and metal hydroxide fractions. Total aluminum concentrations in the CCR are similar to aquifer materials and the majority of aluminum was associated with the residual fraction.

4.2.2 AQUIFER SOLIDS

Results of the aquifer solids characterization are described below in order of bulk characterization, SEP, and mineralogy.

4.2.2.1 Bulk Characterization

Results of the CEC, XRF, and LOI bulk characterization are summarized as follows:

- **CEC:** The measured CEC in aquifer material ranges from 11.18 meq/100g in E-SB-07 to 36.47 meq/100g in E-SB-18, with an average of 22 meq/100g.

- **XRF:** The dominant species in the XRF analysis was SiO_2 with Al_2O_3 as the next most abundant species. In addition, CaO and MgO, common carbonate components, are present in all samples.

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Similarly, Fe_2O_3 is present in all samples indicating the presence of iron-bearing minerals in the aquifer solids.

- **LOI:** The LOI values range from 4.6% to 19.3% in the aquifer solids, demonstrating a substantial proportion of carbon, particularly for the UA solids. LOI results are presented in Table 5.

4.2.2.2 SEP Analysis

Figure 4a shows the concentration of iron, manganese, and aluminum in each SEP fraction and the proportion each fraction represents from the 2021 analysis (Figure 4-2a) and 2023 (Figure 4-2b). Boron analysis was attempted for the 2021 samples but all results for aquifer solids were below method detection limits. The mass of iron associated with the metal hydroxide and non-crystalline minerals fractions is interpreted to represent the equivalent molar mass of crystalline or amorphous iron hydroxide mineralization that is a key contributor to aquifer sorption capacity (further discussed in Section 5.0). The acid/sulfide, organic, and residual fractions are the most recalcitrant fractions of the solid sample and are generally interpreted to indicate iron mass that is not likely to be mobilized from the aquifer under typical environmental conditions.

Results are summarized as follows:

- **Iron:** In all samples, the non-crystalline and metal hydroxide fractions represent 30% or more of the total iron in each of the aquifer solid samples with the remaining iron balance associated with the recalcitrant acid/sulfide and residual fractions. The residual fraction captured in the 2023 SEP analysis is inferred to represent the sum of the residual and acid/sulfide fraction measured from the 2021 samples (acid/sulfide fraction was not differentiated in the 2023 samples due to a change in SEP methodology). The higher concentration of iron found in association with the 2021 samples could be due to a shift in iron from the oxide fraction into the residual fraction, different laboratory methodology, sample heterogeneity, or the aging process of the soils during the archive period. The bedrock BCU sample E-SB-19 contains substantially higher total iron than the UA and PMP samples analyzed.

- **Manganese:** The distribution of manganese within the SEP extractions is interpreted similarly to iron in that the metal hydroxide and non-crystalline (amorphous) fractions are inferred to be associated with the adsorptive manganese hydroxide minerals and the later extraction steps are associated with the recalcitrant mineral phases. Like iron, most manganese is bound with the combined metal hydroxide and non-crystalline fractions. In addition, a sizable portion of manganese is found in association with the carbonate fraction (approximately 1 to 30%). The distribution of manganese indicates most manganese is associated with the more reactive phases and thus is available to participate in redox and sorption reactions, contributing to overall attenuation capacity.

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- **Aluminum:** The majority of aluminum is bound with the residual fraction with small proportions associated with the iron and manganese oxide and carbonate fractions. This distribution indicates aluminum is not substantially available to participate in redox and sorption reactions.

- **Boron:** Boron was generally detected in all fractions in each of the samples. The highest boron concentrations were observed at exceedance location E-SB-15. The remaining samples are relatively consistent in overall concentration with the majority detected in association with the iron and manganese oxide fraction (39 to 55%), and the second most dominant association with the carbonate fraction (14 to 28%). These fractions are closely related to redox and pH conditions on site and constituents associated with these phases may be mobilized through mineral dissolution or other change in the geochemical regime. Boron is also associated with the organic fraction in most samples (9 to 18 %), suggesting attenuation with organic phases is possible.

- **Total sulfur:** Understanding sulfur distribution is valuable for understanding sulfate speciation and attenuation by the solid phase. Sulfur concentrations are generally similar across all samples, with a comparatively high concentration associated with sample E-SB-05. Sulfur was detected in every fraction except the carbonate fraction. The exchangeable metals fraction is the dominant association for sulfur, with additional mass measured in the organic and residual fractions. The organic and residual fractions are the most recalcitrant and indicate tightly bound and possibly reduced sulfur species. The exchangeable metals fraction is one of the least stable solid fractions, indicating this proportion of sulfur is likely loosely bound and relatively mobile, likely in the form of sulfate.

4.2.2.3 Mineralogical Analysis

Results of the XRD and TIMA are summarized as follows:

- **XRD:** The XRD results indicate quartz is the predominant mineral in all samples (34.6 to 59.7%). The next most abundant minerals are the silicate minerals albitic feldspar (4.6 to 19.3%) and muscovite mica (8.8 to 28.3%). Carbonates are present in high abundance and the distribution varies with depth (hydrostratigraphic unit) (0.0 to 9.5% in BCU; 0.0 to 21.4% in UA; 5.9% in the PMP). For most locations, dolomite is the predominant carbonate mineral present, with other phases including calcite, ankerite, and siderite. Trace amounts of the crystalline iron minerals hematite, magnetite, ilmenite, and siderite were additionally identified by XRD. Siderite is a reduced iron carbonate mineral, and magnetite, hematite, and ilmenite are iron oxide minerals that may contribute to adsorption and attenuation of dissolved constituents (though to much less extent than ferrihydrite). The presence of both siderite ($FeCO_3$) and magnetite (Fe_3O_4) in the aquifer matrix is suggestive of a dynamic iron equilibrium, whereby iron is cycling between the oxidized (magnetite) and reduced (siderite) forms. Ferrihydrite ($Fe[OH]_3$) is an amorphous precursor to magnetite that forms when dissolved iron first precipitates. Ferrihydrite is not identified by XRD because it is not a crystalline mineral. It is, however, inferred to be present based on the dynamic iron equilibrium and the SEP results, discussed further in Section 4.2.2.2. Ferrihydrite is a particularly effective adsorbent due to its electrochemical properties and the disordered nature of the elemental

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arrangement, which leads to a high reactive surface area available for interaction with dissolved constituents in groundwater.

- **TIMA:** Results of the TIMA are overall consistent with the XRD results and indicate quartz (29.0 to 42.3%) and mixed clays/micas (30.2 to 47.6%) are the dominant mineral phases. Moderate amounts of plagioclase (8.36 to 14.5%) and carbonates (0.12 to 20.11%) were also detected.

4.3 SORPTION AND DESORPTION BATCH STUDIES

In August 2021, select aquifer solids and groundwater samples were submitted by WSP to SiREM laboratory to test the sorption behavior of boron and sulfate (**Attachment 3**). Sorption studies pair groundwater with parameters above the GWPS with soils from upgradient background locations to evaluate both attenuation mechanisms and capacity of aquifer solids for sorption of contaminants. Soils from background location E-SB-05 (30-33.5 ft) were paired with groundwaters from AW-15S (PMP) and AW-19 (UA), which were selected based on statistical evaluation of potential exceedances in 2021 (WSP 2022). Each groundwater-soil sample was spiked to achieve a target concentration of boron, sulfate, lithium, and barium. Samples were equilibrated over a 7-day period, with concentrations of target constituents analyzed on day zero and day seven. This was repeated for different soil-water ratios. Sorption was estimated by calculating the difference between initial (day 0) concentrations and final (day 7) concentrations. For both samples, there was no appreciable difference between initial concentrations of boron and sulfate and final concentrations, regardless of the soil-water ratio. This indicates neither constituent sorbed onto the solid surface in any sample. Partition coefficients were very low for both samples, further indicating a lack of available additional sorption capacity for the aquifer solids. Calculated partition coefficients are reported in **Attachment 3**.

While the batch studies largely confirm the conservative nature of both boron and sulfate, the SEP results presented in Section 4.2.2.2 demonstrate that boron and sulfate are sorbed to solids collected from downgradient of the AP, indicating some degree of attenuation by the aquifer solids has occurred. Subsequent evaluation associated with a Corrective Action Plan will assess the sorption behavior of both boron and sulfate under return to background conditions, where it is anticipated that geochemical conditions will shift from the present condition, thereby influencing adsorption behavior under dynamic conditions not reflected by the sorption batch studies.

5 AQUEOUS GEOCHEMISTRY

This section summarizes groundwater conditions at the AP. The AP porewater and groundwater data discussed in this section are detailed in **Table 5-1**. Over time, different parameters have been collected at different frequencies at various wells due to the regulatory history of the unit. Groundwater chemistry for UA wells above 420 ft NAVD88 is similar to PMP wells across the site. These UA wells are discussed together with the PMP, henceforth referred to as “shallow UA/PMP” wells.

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5.1 EXCEEDANCE PARAMETERS AND CCR CONSTITUENTS

Boron and sulfate are the two exceedance parameters for the EDW AP. **Figure 5-1** shows timeseries of boron and sulfate collected from porewater and groundwater locations starting in 2020. Concentrations of boron are higher in all CCR porewater wells relative to groundwater. UA exceedance well AW-21 consistently maintains the highest boron concentrations in groundwater, followed by the other exceedance locations. In addition, UA wells AW-05 and AW-20, located near the northern exceedance wells, also exhibit relatively high boron concentrations near the GWPS with an increasing trend. Several other UA (APW-01, AW-01, AW-18, and AW-20) and BCU (AP05D and AP07D) wells also exhibit concentrations above UA background, though concentrations are stable and do not exceed the GWPS.

Groundwater well AW-15S is the only groundwater well that exhibits sulfate concentrations statistically exceeding the GWPS. This PMP well is located at the southern edge of the AP. All other wells (including UCF, UA, and BCU wells) at the southern edge of the AP are installed at a lower elevation and exhibit low sulfate concentrations (<0.18 to 58 mg/L). Wells at the most northern edge of the AP reflect relatively high concentrations of sulfate upwards of 480 mg/L, though no wells have statistical exceedances of the GWPS. Exceedance locations AP07S, AW-05, and AW-21 and UA well APW-01 have sulfate concentrations similar to porewater locations XPW01A and XPW03. These wells are downgradient from XPW01A and are all within the same hydrogeologic flow path.

5.2 MAJOR ION DISTRIBUTION

A Piper diagram shows proportions of major ions within groundwater and porewater. **Figure 5-2** shows a Piper diagram for samples from 2020 to the fourth quarter of 2023. Porewater is characterized by a high proportion of sodium and sulfate. Porewater locations XPW01A and XPW03 have slightly lower proportions of sulfate and higher proportions of chloride.

Groundwater samples exhibit heterogeneity in ion distribution. The background groundwater and all shallower wells, including exceedance locations, exhibit a calcium-magnesium dominant signature. In contrast, the deeper wells have a more even distribution of cations. BCU well AP05D and two AP07D samples have a similar cation signature to porewater while AW-15C and most AP07D samples have higher proportions of magnesium and calcium, though still predominantly a sodium-potassium signature. Most groundwater (including background, deep, and shallow wells) exhibits a carbonate dominated anion signature, including exceedance well AW-19. However, several shallow wells, including the other exceedance locations, have a similar anion signature to porewater locations XPW01A and XPW03. BCU wells have distinct anion signature, dominated by high carbonate and chloride proportions.

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5.3 PH AND REDOX CONDITIONS

Groundwater pH and the oxidation-reduction (redox) potential of the groundwater are dominant controls on the solubility, fate, and transport of many constituents in the groundwater. These so-called master variables govern the chemical interaction of dissolved phase constituents (mobile phase) with the solid matrix (immobile phase). This section provides a description of the measured pH and redox conditions for both groundwater and CCR porewater. The geochemical controls on constituent release and attenuation of boron and sulfate are discussed further in Section 5.0.

Groundwater pH is neutral and generally stable within the range of 6 to 8 S.U. independent of location, lithology, or exceedance status. This stable pH indicates groundwater is well buffered against change, likely due to the widespread presence of carbonate minerals in the aquifer solids which buffer pH within this range (Section 5.2).

Groundwater redox conditions are evaluated based on field measured oxidation-reduction potential (ORP) (**Figure 5-3**) and ferrous iron as well as laboratory analytical measurements of redox-sensitive constituents such as iron, manganese, sulfate, sulfide, and methane. Groundwater ORP represents the average electrical potential of an aqueous solution and is relied upon as a field measure of redox condition. Discussion of aqueous analysis is focused on data collected from 2020 through present[1].

While groundwater ORP is useful as an initial estimation of redox condition, ORP is influenced by multiple aqueous reactions and can prove an inadequate or incomplete measure of redox if disequilibrium exists within the aquifer. Evaluation of redox sensitive parameters and redox couples such as dissolved manganese, dissolved and ferrous iron, sulfate and sulfide, and methane in combination with ORP provide a more complete understanding of redox conditions within the aquifer. These species exist along a spectrum of more oxidizing to more reducing conditions, with sulfate dominant in an oxidized environment and species such as ferrous iron, sulfide, and methane more dominant in increasingly reducing environments. The presence of dissolved iron and manganese are also generally suggestive of a reducing environment.

Redox condition is evaluated spatially based on the combined dataset, with reference to the elevation of 420 ft NAVD88), the *approximate* depth at which a redox transition appears to occur based on observed chemistry, as follows:

- **Background** – The background wells are installed within the UA at a depth below the elevation of approximately 420 ft NAVD88, immediately east of the AP (AW-08) and to the northeast of the AP (AP05S). Background groundwater is interpreted to be chemically reduced based on consistently negative ORP, high concentrations of methane, dissolved and ferrous iron, and the presence of sulfide in background well AP05S.

[1] A substantial shift in ORP occurred in 2020 from a positive ORP to a more commonly negative ORP, which prevails through present. While it is not known with certainty, this shift is most likely the result of a change in the field equipment used to collect the measurements, which occurred around this same time. The more recent data is therefore inferred to provide the best representation of current aquifer conditions.

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- **Shallow UA/PMP groundwater (above 420 ft NAVD88)** – The redox condition associated with the shallow UA/PMP groundwater is mildly oxidized to mildly reduced as indicated by slightly negative to positive ORP in combination with ample sulfate and much lower concentrations of dissolved iron and methane, and an absence of sulfide (despite ample sulfate).

    - **Exceedance wells** – The five wells with either boron or sulfate exceedances all fall within the category of shallow UA/PMP wells screened at an elevation above 420 ft NAVD88 and exhibit the mildly oxidized conditions discussed.

- **Deep UA groundwater (below 420 ft NAVD88)** - The presence of methane, sulfide, dissolved iron, and ferrous iron in the deeper wells indicates a chemically reduced groundwater at depth in the UA. Sulfate concentrations are low (non-detect to <100 mg/L) in deeper wells. Sulfate is reduced to sulfide under highly reducing conditions and generally precipitates as metal sulfide with sufficient time. While the ORP measured at depth is generally more negative than that measured for the shallow UA/PMP wells, the range of ORP measurements is not as low as would be expected if the sulfide and methane were generated in-situ. It is likely that the methane (and sulfide) associated with the deeper UA clay lenses migrated from an organic-rich source at depth. One plausible source of methane is the former coal mine workings that underlies the EDW AP property (Ramboll, 2021a).

- **Bedrock** – Sulfate concentrations are low (non-detect to <100 mg/L) in the BCU and ORP measurements are predominantly negative. Dissolved iron, manganese, sulfide, and methane were not measured in BCU samples. The lack of measured redox couples inhibits complete understanding of BCU redox conditions, though ORP measurements suggest a reducing environment.

- **CCR porewater** - The CCR porewater pH and redox condition is important for understanding how porewater interacts with the natural groundwater. The CCR porewater is highly alkaline with pH measured from 11 to 12 S.U. and the ORP is generally negative. The CCR porewater also contained low concentrations of measurable sulfide (0.4 to 0.8 mg/L) and methane (150 to 950 mg/L), though very low concentrations of dissolved manganese and iron. Low concentrations of dissolved iron and manganese are consistent with SEP results indicating most iron is bound into recalcitrant phases and most manganese is bound into carbonates, which is unlikely to be released under high pH conditions. The sulfide and methane are likely formed as residual organic matter within the CCR decomposes. Methane concentrations are one to two orders of magnitude lower in CCR porewater than concentrations found within deeper UA wells, as discussed further in Section 5.5.2.

In addition to the redox distinction observed at depth, there is additional spatial variability observed from north to south of the AP. In general, the wells installed on the north end of the AP are shallower due to the bedrock surface being at a higher elevation to the north of the AP. This leads to a redox condition of more oxidized water in the north. In the south, the groundwater wells are generally screened deeper within the UA below the elevation of 420 ft NAVD88. This leads to a more reducing signature in the south with redox chemistry dominated by methane and ferrous iron. It is notable that exceedance well AW-15S, located at

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the southern end of the AP, is screened in a shallower PMP horizon, and exhibits the oxidized condition discussed for the shallower wells.

5.4 POURBAIX DIAGRAM

Pourbaix diagrams show possible thermodynamically stable phases at equilibrium conditions across pH values and redox potentials. **Figure 5-4** shows second quarter 2023 (June 2023) samples plotted on a Pourbaix diagram for iron phases. The ORP was converted to Eh by adding a correction factor of 200 mV to measured field data. The iron diagram shows a distinct separation between porewater and groundwater, largely driven by differences in pH. The porewater indicates stability of iron hydroxides. The groundwater samples plot around the equilibrium line of dissolved iron (Fe^{++}) and iron hydroxide ($Fe[OH]_3$).

5.5 SUPPORTING STATISTICAL ANALYSIS AND CORRELATIONS

5.5.1 PRINCIPAL COMPONENT ANALYSIS

Groundwater chemistry data are multivariate by nature given the high number of parameters observed per sampling location and within a given timeframe. With such a large number of variables, advanced statistical analysis of multivariate groundwater data can provide important insights into spatial, temporal, and chemical relationships influencing constituent distribution and compliance in groundwater. The multivariate technique Principal Component Analysis (PCA) is used to interrogate the groundwater chemistry around the exceedance wells. PCA is a multivariate technique that reduces dataset dimensionality to its principal, independent components thereby revealing the inner structure of the dataset. Multivariate techniques such as PCA are valuable because they identify variables that are highly dependent on each other and reduce the multivariate data dimensionality to eliminate this redundant information. This reveals inner structures in the data that might otherwise be obscured by these dependencies. In the case of groundwater data, these structures might include groups of related variables, chemical evolution through time, or spatial locations with similar chemical signatures.

The PCA analysis includes samples from the second and third quarters of 2023. This dataset was chosen as it includes a full analytical suite, including methane and total organic carbon measurements. All samples and analytes with a high percentage (≥40%) of missing data or data below a method detection limit (MDL) were first assessed to ensure that meaningful statistical variance exists. If overall analyte variance was determined to be low, the analyte was removed, otherwise the data were included in the analysis. Any data reported as below the MDL were converted to half the MDL. The final dataset contains 19 measured analytes (including the hydrogen ion (H+), which represents acidity in groundwater and is inversely proportional to pH), 912 total measurements from 48 individual groundwater samples at 24 wells (3 CCR, 18 UA, 3 PMP). All data were log transformed, scaled, and centered so parameters with larger concentrations do not unduly influence results.

PCA results are most easily viewed on a biplot (**Figure 5-5**), which depicts the sample population plotted on two axes, each representing a principal component. The principal components are created from a linear combination of the original variables in the dataset and variance in the data. Principal component 1 (PC1)

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and principal component 2 (PC2) are represented on the x and y axis and explain 52% and 25% of the statistical variance in the water quality dataset, respectively. Constituent variables are expressed as vectors. The grouping of samples relative to the component vectors is useful for providing immediate insight into geochemical relationships among groups of variables and samples. The biplot exhibits the following key features:

- PCA identifies three distinct geochemical clusters at the AP: porewater, deep groundwater, and shallow groundwater (including the exceedance locations).
- The porewater chemical cluster dominates the right side of the plot and is closely associated with potassium, molybdenum, aluminum, arsenic, sodium, silica, and lithium.
- The shallow UA/PMP groundwater disposition plots in the upper left corner and is dominated by sulfate and calcium. This includes all exceedance wells and several other nearby shallow wells.
- The deeper UA groundwater group plots near the bottom of the PCA and is dominated by barium, total organic carbon (TOC), and methane (CH4) association. The well locations nearest to the TOC and methane vectors tend to be deeper than the wells nearest to the barium vector. The two background wells plot near the barium vector.
- The barium, TOC, and methane vectors are pointing in opposite directions from the sulfate and boron vectors, indicating a negative correlation between these analytes, further supporting the distinction between the shallow and deep UA water signatures.

Observations from the PCA support and align with the observed redox signature that separates the shallow UA/PMP zones compared from the signature observed in the deeper UA.

5.5.2 CORRELATIONS

There is a distinct spatial pattern in the distribution of barium, radium, and methane in groundwater downgradient of the EDW AP. **Figures 5-6** and **5-7** demonstrates that barium, radium, and methane are elevated in deeper wells compared to the shallower wells. Figure 9 similarly shows elevated barium, radium, and methane in the southernmost wells, compared to more northern wells. The north-south spatial distribution should not be overinterpreted as the northernmost wells are all generally shallower than the southernmost wells. While these analytes are among the CCR regulated parameters, these parameters are known to be naturally occurring in Illinois aquifers (Gilkeson et al, 1983). Furthermore, barium and radium correlations with boron and sulfate (**Figure 5-8**) demonstrate that the presence of one constituent is associated with very low concentrations of the other constituent. While single-variate statistical analysis (i.e., Pearson correlation) would indicate these parameters are completely uncorrelated, their positioning relative to one another on the PCA indicates a strong negative correlation when considered in the context of other variables. Similarly, the organized distribution of data on the correlation plots also indicates a meaningful pattern in the data. This distribution is suggestive of two different and separate waters and aligns with the redox signature and PCA results as discussed. The separation of the shallow UA/PMP and deep UA groundwater is most likely due to a physical or hydraulic separation of the shallow and deep water. This interpretation is based primarily on the observed boron behavior. If a strong geochemical mechanism were responsible for controlling the chemistry observed, boron being a generally conservative and not highly reactive constituent, would not separate between the two waters in this manner. This separation of deep and shallow groundwater additionally aligns with the fact that the CCR signature, as

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indicated by high boron and sulfate and low barium, is observed only in the shallow wells and is absent in the deeper wells.

6 GEOCHEMICAL CONCEPTUAL SITE MODEL

6.1 SOURCE AND MOBILIZATION MECHANISMS

The CCR materials are the primary source of constituent loading to the CCR porewater. Over an extended period (e.g., months to years), the porewater reaches equilibrium with the CCR materials, signifying the constituents within the porewater are representative of the mobile phase capable of migrating to downgradient groundwater. This conclusion is drawn from the prolonged interaction between the CCR solids and the porewater, allowing for the transfer of soluble constituents like sulfate and boron into the porewater. The AP CCR porewater is therefore the primary vector of sulfate and boron *available* to the shallow groundwater and is considered as the primary source term for environmental investigation.

Both boron and sulfate are common CCR indicator parameters and are observed in shallow groundwater at some locations at concentrations indicative of influence from porewater. The uneven distribution of boron and sulfate in the groundwater is attributed to be a function of the observed chemical and physical heterogeneity along the groundwater flow path. The mobilization mechanism is advective transport from the CCR porewater source into the underlying groundwater.

Two distinct groundwater types are identified at the EDW AP, including:

- Shallow UA/PMP groundwater (above an elevation of approximately 420 ft NAVD88) that exhibits boron and sulfate exceedances. This water is mildly reduced to mildly oxidized and exhibits a signature that is influenced by the CCR porewater. The UA and PMP groundwater are chemically similar in this shallow zone, particularly to the north of the AP.

- Deep UA groundwater (below an elevation of approximately 420 ft NAVD88) exhibits a distinct signature of strongly reducing conditions associated with high concentrations of methane, TOC, traces of sulfide, and a low ORP. This deeper groundwater additionally is characterized by low concentrations of boron and sulfate and a signature of barium and radium that is less apparent in the shallow UA/PMP groundwater. This deep UA groundwater is not influenced by the CCR porewater.

6.2 POTENTIAL/LIKELY ATTENUATION MECHANISMS

Boron and sulfate are generally regarded as conservative CCR constituents under most environmental conditions; however, downgradient of the EDW AP, several attenuation mechanisms are inferred to be active within the UA/PMP groundwater based on the available data and measured geochemical condition.

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The specific attenuation mechanisms are discussed for the two exceedance parameters as follows:

Sulfate

- **Mineral precipitation** – Mineral precipitation of the barium sulfate mineral barite ($BaSO_4$) is identified as a probable and dominant attenuation mechanism and control on sulfate mobility in the shallow UA/PMP groundwater. Barium is measured in association with the UA and PMP groundwater (higher concentrations in the deep UA groundwater) and bedrock groundwater. Precipitation of barite is a likely attenuation mechanism for sulfate in the shallow UA/PMP groundwater, despite the low concentrations of barium relative to the deep UA and bedrock groundwater. Barite precipitation is similarly observed in groundwaters in northern Illinois (Gilkeson et al, 1983), providing further evidence that this natural attenuation mechanism is an important influence on sulfate mobility broadly for Illinois groundwater.

- **Adsorption** – Sulfate is known to sorb to iron and manganese oxide phases (Kitadai, 2018; He, 1996; Geelhoed, 1997). A relatively small amount of sulfur is observed from the 2023 SEP results in association with the iron and manganese oxide phases and is interpreted to represent adsorbed sulfate on the mineral surfaces. This mechanism is not likely a dominant attenuation mechanism for sulfate given the mildly reducing conditions within the aquifer that will tend to limit the stability of the hydroxide phases such as ferrihydrite. In addition, the sorption batch studies conducted demonstrated little additional adsorption to the soil surface under the conditions evaluated, suggesting that the existing adsorption capacity may be exhausted. The batch studies largely confirmed the conservative nature of sulfate, whereas the SEP results demonstrate that sulfate is sorbed to solids collected from downgradient of the AP, indicating some degree of attenuation by the aquifer solids has occurred. It is anticipated that geochemical conditions will shift from the present condition in response to source control and unit closure, thereby influencing adsorption behavior under dynamic conditions not reflected by the sorption batch studies. Evaluation of longer-term changes in adsorption behavior under a "return to background" scenario will be addressed in subsequent evaluation associated with a Corrective Action Plan.

- **Organic complexation** – Sulfur is an essential element for living organisms and is a critical component of many amino acids. Soil organic matter represents a major source and sink for sulfur in the environment, the partitioning and speciation of which depends on the geochemical conditions of the soil and groundwater (Schroth et al, 2007). Sulfur cycles through multiple different oxidation states and undergoes both biotic and abiotic transformations in relation to soil and groundwater pH, redox condition, groundwater ionic strength, and available organic compounds, among other additional factors. The 2023 SEP results identified a sizable proportion of sulfur associated with the organic fraction. Given the predominance of organic sulfur within most soils, it is likely the sulfur bound with this fraction is innate and not necessarily attenuated.

- **Chemical reduction** - Sulfate reduction is a biologically mediated redox reaction that readily occurs under strongly reducing conditions such as is observed in the deep UA groundwater.

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Sulfate reduces to hydrogen sulfide through a transfer of electrons, and subsequently precipitates as metal sulfide mineralization within the solid matrix. The net result of these reactions is removal of sulfate from the aqueous phase. While the exceedance locations in the shallow UA/PMP groundwater are not sufficiently reducing for this mechanism to occur (at present), this reaction is believed to be a controlling factor in the deep UA zone based on presence of sulfide, very low concentrations of sulfate, and the high concentrations of methane that confirm conditions are sufficiently reducing for sulfate reduction to occur. Should the upward gradient become stronger following closure, in response to source control, this redox mechanism may be a plausible sink for sulfate in the shallow UA/PMP long-term.

Boron

- **Adsorption** – Boron is known to sorb to aluminum and iron hydroxide mineralization in the solid phase (Goldberg and Glaubig, 1985) and to organic compounds (Lemarchand et al., 2005; Goli et al., 2019). Roughly 50% of the solid phase boron measured from the 2023 SEP results is found to be associated with the iron and manganese oxide phases and is therefore interpreted to represent adsorbed boron on the mineral surfaces. Similarly, 2023 SEP results found boron associated with the organic fraction, possibly indicating boron is adsorbed to organic material or in the form of boron-organic complexes (discussed below). Studies have found boron ($B(OH)_4^-$) sorption onto organic matter is three to six times higher than onto aluminum and iron oxides (Lemarchand et al., 2005). Sorption onto solid surfaces is likely to be the dominant attenuation mechanism for boron in the shallow UA/PMP based on the available data and overall limited reactivity of the borate molecule. The sorption/desorption batch studies conducted demonstrated little additional adsorption to the soil surface under the conditions evaluated, suggesting that the existing adsorption capacity of the soils is limited. The batch studies largely confirmed the conservative nature of boron, whereas the SEP results demonstrate that boron is sorbed to solids collected from downgradient of the AP, indicating some degree of attenuation by the aquifer solids has occurred. It is anticipated that geochemical conditions will shift from the present condition in response to source control and unit closure, thereby influencing adsorption behavior under dynamic conditions not reflected by the sorption batch studies. Evaluation of longer-term changes in adsorption behavior under a "return to background" scenario will be addressed in subsequent evaluation associated with a Corrective Action Plan.

- **Organic complexation** – Boron is known to form complexes with organic compounds including, but not limited to carbohydrates, polyols, esters, malic acids, and humic acids (Lemarchand et al., 2005; Geffen et al., 2006; Goli et al., 2019; Bolan et al., 2023). Boron complexation with organic matter is dependent on pH, ionic strength, and available organic compounds. The 2023 SEP results identified boron associated with the organic fraction. It is unknown if this boron was adsorbed to the organic matter or in the form of boron-organic complexes.

The combined solid and aqueous phase data collected from around the EDW AP suggests that multiple interrelated attenuation mechanisms may be active and influencing partitioning of both boron and sulfate in

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the groundwater. The predominance, long-term stability, and rates of the discussed geochemical reactions in response to planned closure and source control activities will be further documented in subsequent geochemical evaluations.

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8 ACRONYMNS AND ABBREVIATIONS

Alk	Total Alkalinity
Al	Aluminum
amsl	above mean sea level
AP	Ash Pond
As	Arsenic
B	Boron
Ba	Barium
$BaSO_4$	Barite
BCU	Bedrock confining unit
Ca	Calcium
CCR	Coal combustion residual
CEC	Cation exchange capacity
CH4	Methane
Cl	Chloride
EDW	Edwards
Fe	Iron
ft	feet
g	grams
GCSM	Geochemical conceptual site model
GWPS	Groundwater Protection Standard
H+	Hydrogen ion, represents acidity in groundwater
K	Potassium
Li	Lithium
LOI	Loss-on-ignition
meq	milliequivalents
Mg	Magnesium
mg/L	milligrams per liter
mg/kg	milligrams per kilogram

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Mn	Manganese
Mo	Molybdenum
mV	millivolts
Na	Sodium
NAVD88	North American Vertical Datum of 1988
ORP	Oxidation reduction potential
PCA	Principal components analysis
pCi/L	picocuries per liter
PMP	Potential Migration Pathway
Ramboll	Ramboll Americas Engineering Solutions, Inc.
Redox	Oxidation-Reduction
SEP	Sequential extraction procedure
Si	Silica
SO4	Sulfate
TIMA	Tescan Integrated Mineral Analyzer
TOC	Total organic carbon
UA	Uppermost Aquifer
UCF	Upper Cahokia Formation
XRD	X-ray diffraction
XRF	X-ray fluorescence

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TABLES

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Table 4-1. Summary of Solid Samples

HSU	Location	Depth Range (ft bgs)	CEC	LOI	SEP	XRD	XRF	TIMA	Total Metals
UA	E-SB-05	25-30	--	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)
UA	E-SB-05	30-33.5	2021 (SGS)	2021 (SGS)	2021 (Eurofins)	2021 (SGS)	--	--	2021 (SGS)
BCU	E-SB-05	51-56	2021 (SGS)	2021 (SGS) 2023 (SGS)	2021 (Eurofins) 2023 (SGS)	2021 (SGS) 2023 (SGS)	--	--	2021 (SGS) 2023 (SGS)
UA	E-SB-07	21-27	2021 (SGS)	2021 (SGS)	2021 (Eurofins)	2021 (SGS)	--	--	2021 (SGS)
UA	E-SB-07	27-30	--	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)
BCU	E-SB-07	40-45	2021 (SGS)	2021 (SGS)	2021 (Eurofins)	2021 (SGS)	--	--	2021 (SGS)
BCU	E-SB-07	59-64	2021 (SGS)	2021 (SGS) 2023 (SGS)	2021 (Eurofins) 2023 (SGS)	2021 (SGS) 2023 (SGS)	--	--	2021 (SGS) 2023 (SGS)
PMP	E-SB-15	10-15	2021 (SGS)	2021 (SGS) 2023 (SGS)	2021 (Eurofins) 2023 (SGS)	2021 (SGS) 2023 (SGS)	--	--	2021 (SGS) 2023 (SGS)
UA	E-SB-15	30-35	2021 (SGS)	2021 (SGS)	2021 (Eurofins)	2021 (SGS)	--	--	2021 (SGS)
UA	E-SB-15	35-40	--	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)
UA	E-SB-18	40-44	2021 (SGS)	2021 (SGS)	2021 (Eurofins)	2021 (SGS)	--	--	2021 (SGS)
UA	E-SB-19	35-40	2021 (SGS)	2021 (SGS) 2023 (SGS)	2021 (Eurofins) 2023 (SGS)	2021 (SGS) 2023 (SGS)	--	--	2021 (SGS) 2023 (SGS)
BCU	E-SB-19	40-44	--	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)
UA	AW-23	6-11.5	--	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)	2023 (SGS)
CCR	E-SB-XPW01	25-30	2021 (SGS)	2021 (SGS)	2021 (Eurofins)	2021 (SGS)	--	--	2021 (SGS)

Notes:

CEC = cation exchange capacity
ft bgs = feet below ground surface
LOI = loss on ignition
SEP = sequential extraction procedure
TIMA = TESCAN integrated mineral analysis
XRD = X-ray diffraction
XRF = X-ray fluorescence
HSU = hydrostratigraphic unit
CCR = coal combustion residual
UA = uppermost aquifer
PMP = potential migration pathway
BCU = bedrock confining unit
-- = not measured
SGS, Eurofins = labs that perform the analysis

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Table 4-2. CEC Results

Sample ID	HSU	CEC Actual (meq/100g)
E-SB-07 (21.0-27.0)	UA	25.70
E-SB-07 (40.0-45.0)	BCU	12.16
E-SB-07 (59.0-64.0)	BCU	11.18
E-SB-05 (30.0-33.5)	UA	30.59
E-SB-05 (51.0-56.0)	BCU	19.28
E-SB-19 (35.0-40.0)	UA	20.95
E-SB-18 (40.0-44.0)	UA	36.47
E-SB-15 (10.0-15.0)	PMP	25.73
E-SB-15 (30.0-35.0)	UA	20.83
E-SB-XPW01 (25.0-30.0)	CCR	86.50

Notes:

CEC = cation exchange capacity

meq = milliequivalents

g = grams

HSU = hydrostratigraphic unit

CCR = coal combustion residual

UA = uppermost aquifer

PMP = potential migration pathway

BCU = bedrock confining unit

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Table 4-3. XRF Results from 2023 Analysis

Mineral/Compound	E-SB-05 (51-56) (wt %) BCU	E-SB-07 (59-64) (wt %) BCU	E-SB-15 (35-40) (wt %) UA	E-SB-07 (27-30) (wt %) UA	E-SB-15 (10-15) (wt %) UA	E-SB-19 (35-40) (wt %) UA	AW-23 (6-11.5) (wt %) UA	E-SB-19 (40-44) (wt %) BCU	E-SB-05 (25-30) (wt %) UA
S	0.11	0.05	0.04	0.04	0.12	0.04	0.06	0.05	0.33
Cl	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Al2O3	14.33	15.53	13.92	11.29	13.58	14.03	12.97	14.76	10.45
CaO	2.36	0.26	0.32	2.94	2.71	1.30	2.15	0.63	8.90
Cr2O3	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Fe2O3	6.36	4.30	3.77	4.50	5.70	6.10	5.85	7.65	4.22
K2O	2.63	2.74	2.38	2.57	2.92	2.57	2.55	2.50	2.35
MgO	2.66	1.75	1.47	2.62	2.54	1.89	1.81	2.17	3.02
Mn3O4	0.10	0.04	0.04	0.04	0.04	0.09	0.06	0.09	0.08
Na2O	1.28	1.60	1.58	0.93	0.69	1.19	0.84	1.27	0.70
P2O5	0.15	0.13	0.14	0.15	0.16	0.12	0.16	0.11	0.16
SiO2	60.93	67.35	71.02	64.96	58.57	64.99	62.86	62.50	49.43
TiO2	0.85	1.05	1.00	0.71	0.75	0.92	0.75	0.95	0.61
V2O5	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Sum	91.90	94.86	95.74	90.88	87.94	93.34	90.18	92.76	80.70

Notes:
wt % = weight percent

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Table 4-4. LOI Results

HSU	Location	Depth Range (ft bgs)	LOI (%) 2021	LOI (%) 2023
UA	E-SB-05	25-30	--	19.0
UA	E-SB-05	30-33.5	15.5	--
BCU	E-SB-05	51-56	8.80	8.2
UA	E-SB-07	21-27	6.78	--
UA	E-SB-07	27-30	--	8.7
BCU	E-SB-07	40-45	6.17	--
BCU	E-SB-07	59-64	4.58	4.4
PMP	E-SB-15	10-15	11.0	11.7
UA	E-SB-15	30-35	15.3	--
UA	E-SB-15	35-40	--	4.1
UA	E-SB-18	40-44	19.3	--
UA	E-SB-19	35-40	10.5	6.3
BCU	E-SB-19	40-44	--	6.8
UA	AW-23	6-11.5	--	8.6
CCR	E-SB-XPW01	25-30	10.2	--

HSU = hydrostratigraphic unit
CCR = coal combustion residual
UA = uppermost aquifer
PMP = potential migration pathway
BCU = bedrock confining unit
LOI = loss on ignition
ft bgs= feet below ground surface

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Table 4-5a. XRD Results from 2021 Analysis

Well ID Depth (ft bgs)			E-SB-07 (21.0-27.0)	E-SB-07 (40.0-45.0)	E-SB-07 (59.0-64.0)	E-SB-05 (30.0-33.5)	E-SB-05 (51.0-56.0)	E-SB-19 (35.0-40.0)	E-SB-18 (40.0-44.0)	E-SB-15 (10.0-15.0)	E-SB-15 (30.0-35.0)	E-SB-XPW01 (25.0-30.0)
Sampled Aquifer Unit			(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)
Mineral/Compound	Formula	Mineral Type	UA	BCU	BCU	UA	BCU	UA	UA	PMP	UA	CCR
Quartz	SiO_2	Silicate	59.7	44.9	43.6	39.0	38.7	46.8	34.6	38.6	37.0	10.4
Albite	$NaAlSi_3O_8$	Feldspar	8.6	14.7	15.6	9.6	15.0	12.0	10.0	12.1	11.6	--
Microcline	$KAlSi_3O_8$	Feldspar	9.3	2.9	3.4	9.8	4.3	7.5	8.8	10.7	10.2	--
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$	Phyllosilicate	3.4	8.1	9.4	4.5	7.5	4.8	5.2	5.8	4.5	--
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	Mica	8.8	22.4	22.5	16.3	24.1	14.5	17.8	16.8	15.5	--
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	Mica	1.5	2.5	3.8	1.9	3.7	2.2	2.1	2.6	2.6	--
Ankerite	$CaFe(CO_3)_2$	Carbonate	2.5	0.0	0.0	3.5	0.1	2.6	3.5	1.5	3.3	--
Dolomite	$CaMg(CO_3)_2$	Carbonate	4.4	0.0	0.0	8.5	0.8	7.7	6.7	3.5	6.5	--
Calcite	$CaCO_3$	Carbonate	0.9	0.4	0.5	4.6	0.3	0.0	3.5	0.7	2.0	2.7
Siderite	$FeCO_3$	Carbonate	0.0	3.1	0.2	1.0	5.0	1.0	1.1	0.2	0.7	--
Hematite	Fe_2O_3	Oxide	0.4	0.0	0.0	0.1	0.0	0.1	0.2	0.0	0.2	23
Magnetite	Fe_3O_4	Oxide	0.1	0.3	0.3	0.6	0.4	0.3	0.0	0.1	0.0	25.5
Ilmenite	$FeTiO_3$	Oxide	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.1	--
Rutile	TiO_2	Oxide	0.3	0.7	0.6	0.7	0.3	0.5	0.5	1.0	0.5	0.2
Diopside	$CaMgSi_2O_6$	Silicate	--	--	--	--	--	--	1.4	0.6	0.7	--
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$	Amphibole	--	--	--	--	--	--	0.3	0.2	0.4	--
Epidote	$Ca_2(Al,Fe)Al_2O(SiO_4)(Si_2O_7)(OH)$	Silicate	--	--	--	--	--	--	0.3	0.4	0.4	--
Kaolinite	$Al_2Si_2O_5(OH)_4$	Clay	--	--	--	--	--	--	4.0	5.1	3.8	--
Mullite	$Al_6Si_3O_{15}$	Silicate	--	--	--	--	--	--	--	--	--	8.7
Anorthite	$CaAl_2Si_2O_8$	Feldspar	--	--	--	--	--	--	--	--	--	29.6
Total			100	100	100	100	100	100	100	100	100	100

Notes:

wt % = weight percent

Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identified by the analyst and not included in the refinement calculation for the sample.

The weight percent quantities indicated have been normalized to a sum of 100%. The quantity of amorphous material has not been determined.

ft bgs = feet below ground surface

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Table 4-5b. XRD Results from 2023 Analysis

Well ID Depth (ft bgs)			E-SB-05 (51-56)	E-SB-07 (59-64)	E-SB-15 (35-40)	E-SB-07 (27-30)	E-SB-15 (10-15)	E-SB-19 (35-40)	AW-23 (6-11.5)	E-SB-19 (40-44)	E-SB-05 (25-30)
Sampled Aquifer Unit			(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)
Mineral/Compound	Formula	Mineral Type	BCU	BCU	UA	UA	UA	UA	UA	BCU	UA
Quartz	SiO_2	Silicate	44.4	44.4	50.2	51.2	40.1	49.0	51.4	45.3	38.4
Albite	$NaAlSi_3O_8$	Feldspar	13.0	14.2	14.9	11.9	10.6	12.4	10.9	14.5	9.2
Orthoclase	$KAlSi_3O_8$	Silicate	1.2	0.5	1.3	5.3	7.0	1.8	1.8	--	4.8
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	Mica	1.2	2.1	1.3	1.0	0.8	3.7	3.7	1.3	1.7
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	Mica	25.1	28.3	22.7	16.8	24.1	25.0	25.6	23.8	20.5
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$	Phyllosilicate	5.2	10.5	9.6	8.5	13.2	3.5	3.1	5.5	4.1
Fluorapatite	$Ca_5(PO_4)_3F$	Phosphate	--	--	--	--	--	--	--	--	--
Magnetite	Fe_3O_4	Oxide	0.5	--	--	--	--	0.5	--	0.3	--
Ankerite	$CaFe(CO_3)_2$	Carbonate	2.3	--	--	--	0.5	--	--	--	1.0
Calcite	$CaCO_3$	Carbonate	0.9	--	--	--	--	0.5	1.2	--	12.3
Siderite	$FeCO_3$	Carbonate	4.2	--	--	--	--	0.3	--	9.2	--
Dolomite	$CaMg(CO_3)_2$	Carbonate	2.1	--	--	5.4	3.7	3.2	2.2	--	8.1
Total			100	100	100	100	100	100	100	100	100

Notes:

wt % = weight percent

Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identified by the analyst and not included in the refinement calculation for the sample.

The weight percent quantities indicated have been normalized to a sum of 100%. The quantity of amorphous material has not been determined.

LOI = loss on ignition

ft bgs = feet below ground surface

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Table 4-6. TIMA Results

Mineral	EB	EB	EB		EB	EB
Quartz	39.2	42.3	38.5	33.3	36.5	29
Plagioclase	12	14.5	10.6	8.36	10.9	11.7
K-Feldspar	0.76	0.67	1.42	2.33	0.58	2.69
Mixed Clays/Micas	30.6	34.5	36.9	47.6	35.3	30.2
Chlorites	4.25	5.58	4.05	1.79	4.69	1.51
Other Silicates	0.71	0.51	1.14	1.71	0.65	1.6
Iron Oxides	4.83	0.14	3.31	0.15	10	0.2
Ti Fe Oxide	1.06	1.36	1.07	0.74	1.01	1.68
Other Oxides	0.01	0.01	0.03	0.03	0	0.07
Calcite	1.04	0.02	0.62	1.21	0.05	11
Dolomite	3.75	0.01	2.14	2.59	0.01	8.53
Ankerite	1.52	0.09	0.07	0.03	0.14	0.58
Sulphides	0.08	0.02	0.01	0.02	0.03	0.61
Sulphates/Phosphates	0.27	0.28	0.19	0.13	0.16	0.48
Other	0.03	0.02	0.02	0.03	0.02	0.09
Total	100	100	100	100	100	100

NOTES:

High-Resolution Mapping (THRM), was the selected scan mode. The THRM collects a Backscattered Electron signal and an X-ray spectrum at a set resolution (3 micrometer) to map the particles.

It collects modal and textural information, such as liberation or exposure analysis of grains of interest

Due to the chemical properties of the iron carbonate mineral siderite, it will be indistinguishable from iron oxide using TIMA and, therefore, would be classified along with the iron oxides.

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Table 4-7. Total Metals Data for Iron, Manganese, Aluminum, Boron, and Sulfate

HSU	Location	Depth Range (ft bgs)	Iron (mg/kg)			Manganese (mg/kg)			Aluminum (mg/kg)			Boron (mg/kg)		Sulfate (%)	Sulfur (mg/kg)
			2021 (SGS)	2021 (Eurofins)	2023 (SGS)	2021 (SGS)	2021 (Eurofins)	2023 (SGS)	2021 (SGS)	2021 (Eurofins)	2023 (SGS)	2021 (SGS)	2023 (SGS)	2021 (SGS)	2023 (SGS)
UA	E-SB-05	25-30	NA	NA	31000	NA	NA	580	NA	NA	47000	NA	<1	NA	4700
UA	E-SB-05	30-33.5	35000	23000	NA	680	550	NA	52000	64000	NA	<40	NA	<0.1	NA
BCU	E-SB-05	51-56	55000	27000	45000	870	460	710	72000	95000	70000	51	<1	<0.1	1800
UA	E-SB-07	21-27	22000	17000	NA	490	400	NA	36000	53000	NA	<40	NA	<0.1	NA
UA	E-SB-07	27-30	NA	NA	34000	NA	NA	330	NA	NA	55000	NA	<1	NA	1300
BCU	E-SB-07	40-45	45000	37000	NA	510	440	NA	67000	76000	NA	47	NA	<0.1	NA
BCU	E-SB-07	59-64	31000	21000	31000	340	300	340	70000	76000	79000	49	<1	<0.1	710
PMP	E-SB-15	10-15	49000	27000	42000	340	170	280	68000	91000	65000	54	<1	<0.1	1500
UA	E-SB-15	30-35	32000	26000	NA	630	520	NA	57000	69000	NA	43	NA	<0.1	NA
UA	E-SB-15	35-40	NA	NA	27000	NA	NA	320	NA	NA	66000	NA	<1	NA	650
UA	E-SB-18	40-44	48000	28000	NA	850	490	NA	50000	72000	NA	<40	NA	<0.1	NA
UA	E-SB-19	35-40	35000	18000	46000	600	360	680	52000	54000	71000	<40	<1	<0.1	1300
BCU	E-SB-19	40-44	NA	NA	56000	NA	NA	650	NA	NA	74000	NA	<1	NA	1200
UA	AW-23	6-11.5	NA	NA	44000	NA	NA	450	NA	NA	62000	NA	<1	NA	990
CCR	E-SB-XPW01	25-30	200000	150000	NA	810	840	NA	71000	85000	NA	896	NA	0.7	NA

Notes:

mg/kg = milligrams per kilogram

% = percent

< = less than

SGS, Eurofins = labs that perform the analysis

Full total metals data available in Attachment 1.

NA = not applicable

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Table 4-8. SEP Results for Iron, Manganese, Aluminum, Boron, and Sulfur

HSU	Location	Depth Range (ft bgs)	Analyst	Analysis Year	SEP Fraction	Iron		Manganese	
						Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)
UA	E-SB-07	21-27	Eurofins	2021	Exchangeable Fraction	<14	NA	<0.15	NA
UA	E-SB-07	21-27	Eurofins	2021	Carbonate Fraction	13	0.07	74	14
UA	E-SB-07	21-27	Eurofins	2021	Non-Crystalline Minerals Fraction	440	2.2	190	35
UA	E-SB-07	21-27	Eurofins	2021	Metal Hydroxide Fraction	6900	35	160	30
UA	E-SB-07	21-27	Eurofins	2021	Organic Fraction	<54	NA	3.1	0.57
UA	E-SB-07	21-27	Eurofins	2021	Acid/Sulfide Fraction	8400	42	75	14
UA	E-SB-07	21-27	Eurofins	2021	Residual Fraction	4600	23	40	7.4
UA	E-SB-07	21-27	Eurofins	2021	Sum	20000	NA	540	NA
UA	E-SB-07	21-27	Eurofins	2021	Total/NA	17000	NA	400	NA
BCU	E-SB-07	40-45	Eurofins	2021	Exchangeable Fraction	<12	NA	4.0	0.68
BCU	E-SB-07	40-45	Eurofins	2021	Carbonate Fraction	150	0.38	7.4	1.3
BCU	E-SB-07	40-45	Eurofins	2021	Non-Crystalline Minerals Fraction	1700	4.4	30	5.1
BCU	E-SB-07	40-45	Eurofins	2021	Metal Hydroxide Fraction	17000	44	260	44
BCU	E-SB-07	40-45	Eurofins	2021	Organic Fraction	<47	NA	13	2.2
BCU	E-SB-07	40-45	Eurofins	2021	Acid/Sulfide Fraction	15000	38	220	37
BCU	E-SB-07	40-45	Eurofins	2021	Residual Fraction	5300	14	47	8.0
BCU	E-SB-07	40-45	Eurofins	2021	Sum	39000	NA	590	NA
BCU	E-SB-07	40-45	Eurofins	2021	Total/NA	37000	NA	440	NA
BCU	E-SB-07	59-64	Eurofins	2021	Exchangeable Fraction	<13	NA	1.7	0.47
BCU	E-SB-07	59-64	Eurofins	2021	Carbonate Fraction	84	0.35	3.9	1.1
BCU	E-SB-07	59-64	Eurofins	2021	Non-Crystalline Minerals Fraction	740	3.1	19	5.3
BCU	E-SB-07	59-64	Eurofins	2021	Metal Hydroxide Fraction	10000	42	180	50
BCU	E-SB-07	59-64	Eurofins	2021	Organic Fraction	<48	NA	<2	NA
BCU	E-SB-07	59-64	Eurofins	2021	Acid/Sulfide Fraction	8400	35	120	33
BCU	E-SB-07	59-64	Eurofins	2021	Residual Fraction	4400	18	34	9.4
BCU	E-SB-07	59-64	Eurofins	2021	Sum	24000	NA	360	NA
BCU	E-SB-07	59-64	Eurofins	2021	Total/NA	21000	NA	300	NA
UA	E-SB-05	30-33.5	Eurofins	2021	Exchangeable Fraction	<16	NA	7.2	1.0
UA	E-SB-05	30-33.5	Eurofins	2021	Carbonate Fraction	250	0.81	150	21
UA	E-SB-05	30-33.5	Eurofins	2021	Non-Crystalline Minerals Fraction	5500	18	150	21
UA	E-SB-05	30-33.5	Eurofins	2021	Metal Hydroxide Fraction	11000	35	270	37
UA	E-SB-05	30-33.5	Eurofins	2021	Organic Fraction	<61	NA	54	7.4
UA	E-SB-05	30-33.5	Eurofins	2021	Acid/Sulfide Fraction	8300	27	63	8.6
UA	E-SB-05	30-33.5	Eurofins	2021	Residual Fraction	5400	17	45	6.2
UA	E-SB-05	30-33.5	Eurofins	2021	Sum	31000	NA	730	NA
UA	E-SB-05	30-33.5	Eurofins	2021	Total/NA	23000	NA	550	NA

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Table 4-8. SEP Results for Iron, Manganese, Aluminum, Boron, and Sulfur

HSU	Location	Depth Range (ft bgs)	Analyst	Analysis Year	SEP Fraction	Aluminum		Boron		Sulfur	
						Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)
UA	E-SB-07	21-27	Eurofins	2021	Exchangeable Fraction	<7.9	NA	<49	NA	NA	NA
UA	E-SB-07	21-27	Eurofins	2021	Carbonate Fraction	13	0.04	<37	NA	NA	NA
UA	E-SB-07	21-27	Eurofins	2021	Non-Crystalline Minerals Fraction	210	0.58	<12	NA	NA	NA
UA	E-SB-07	21-27	Eurofins	2021	Metal Hydroxide Fraction	1600	4.4	<12	NA	NA	NA
UA	E-SB-07	21-27	Eurofins	2021	Organic Fraction	140	0.39	<180	NA	NA	NA
UA	E-SB-07	21-27	Eurofins	2021	Acid/Sulfide Fraction	4900	14	<12	NA	NA	NA
UA	E-SB-07	21-27	Eurofins	2021	Residual Fraction	30000	83	NA	NA	NA	NA
UA	E-SB-07	21-27	Eurofins	2021	Sum	36000	NA	NA	NA	NA	NA
UA	E-SB-07	21-27	Eurofins	2021	Total/NA	53000	NA	NA	NA	NA	NA
BCU	E-SB-07	40-45	Eurofins	2021	Exchangeable Fraction	<6.8	NA	<43	NA	NA	NA
BCU	E-SB-07	40-45	Eurofins	2021	Carbonate Fraction	94	0.21	<32	NA	NA	NA
BCU	E-SB-07	40-45	Eurofins	2021	Non-Crystalline Minerals Fraction	370	0.82	<11	NA	NA	NA
BCU	E-SB-07	40-45	Eurofins	2021	Metal Hydroxide Fraction	3100	6.9	<11	NA	NA	NA
BCU	E-SB-07	40-45	Eurofins	2021	Organic Fraction	41	0.09	<160	NA	NA	NA
BCU	E-SB-07	40-45	Eurofins	2021	Acid/Sulfide Fraction	7600	17	<11	NA	NA	NA
BCU	E-SB-07	40-45	Eurofins	2021	Residual Fraction	34000	76	NA	NA	NA	NA
BCU	E-SB-07	40-45	Eurofins	2021	Sum	45000	NA	NA	NA	NA	NA
BCU	E-SB-07	40-45	Eurofins	2021	Total/NA	76000	NA	NA	NA	NA	NA
BCU	E-SB-07	59-64	Eurofins	2021	Exchangeable Fraction	<7.0	NA	<44	NA	NA	NA
BCU	E-SB-07	59-64	Eurofins	2021	Carbonate Fraction	76.0	0.17	<33	NA	NA	NA
BCU	E-SB-07	59-64	Eurofins	2021	Non-Crystalline Minerals Fraction	280	0.64	<11	NA	NA	NA
BCU	E-SB-07	59-64	Eurofins	2021	Metal Hydroxide Fraction	4400	10	<11	NA	NA	NA
BCU	E-SB-07	59-64	Eurofins	2021	Organic Fraction	40	NA	<160	NA	NA	NA
BCU	E-SB-07	59-64	Eurofins	2021	Acid/Sulfide Fraction	5800	13	<11	NA	NA	NA
BCU	E-SB-07	59-64	Eurofins	2021	Residual Fraction	34000	77	NA	NA	NA	NA
BCU	E-SB-07	59-64	Eurofins	2021	Sum	44000	NA	NA	NA	NA	NA
BCU	E-SB-07	59-64	Eurofins	2021	Total/NA	76000	NA	NA	NA	NA	NA
UA	E-SB-05	30-33.5	Eurofins	2021	Exchangeable Fraction	<8.9	NA	<55	NA	NA	NA
UA	E-SB-05	30-33.5	Eurofins	2021	Carbonate Fraction	22	0.05	<42	NA	NA	NA
UA	E-SB-05	30-33.5	Eurofins	2021	Non-Crystalline Minerals Fraction	210	0.47	<14	NA	NA	NA
UA	E-SB-05	30-33.5	Eurofins	2021	Metal Hydroxide Fraction	2400	5.3	<14	NA	NA	NA
UA	E-SB-05	30-33.5	Eurofins	2021	Organic Fraction	40	0.09	<210	NA	NA	NA
UA	E-SB-05	30-33.5	Eurofins	2021	Acid/Sulfide Fraction	5000	11	<14	NA	NA	NA
UA	E-SB-05	30-33.5	Eurofins	2021	Residual Fraction	37000	82	NA	NA	NA	NA
UA	E-SB-05	30-33.5	Eurofins	2021	Sum	45000	NA	NA	NA	NA	NA
UA	E-SB-05	30-33.5	Eurofins	2021	Total/NA	64000	NA	NA	NA	NA	NA

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Table 4-8. SEP Results for Iron, Manganese, Aluminum, Boron, and Sulfur

HSU	Location	Depth Range (ft bgs)	Analyst	Analysis Year	SEP Fraction	Iron		Manganese	
						Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)
BCU	E-SB-05	51-56	Eurofins	2021	Exchangeable Fraction	<13	NA	3.4	0.64
BCU	E-SB-05	51-56	Eurofins	2021	Carbonate Fraction	180	0.60	12	2.3
BCU	E-SB-05	51-56	Eurofins	2021	Non-Crystalline Minerals Fraction	2000	6.7	47	8.9
BCU	E-SB-05	51-56	Eurofins	2021	Metal Hydroxide Fraction	14000	47	290	55
BCU	E-SB-05	51-56	Eurofins	2021	Organic Fraction	<49	NA	11	2.1
BCU	E-SB-05	51-56	Eurofins	2021	Acid/Sulfide Fraction	9700	32	140	26
BCU	E-SB-05	51-56	Eurofins	2021	Residual Fraction	4600	15	33	6.2
BCU	E-SB-05	51-56	Eurofins	2021	Sum	30000	NA	530	NA
BCU	E-SB-05	51-56	Eurofins	2021	Total/NA	27000	NA	460	NA
UA	E-SB-19	35-40	Eurofins	2021	Exchangeable Fraction	<14	NA	19	3.4
UA	E-SB-19	35-40	Eurofins	2021	Carbonate Fraction	160	0.64	150	27
UA	E-SB-19	35-40	Eurofins	2021	Non-Crystalline Minerals Fraction	1200	4.8	79	14
UA	E-SB-19	35-40	Eurofins	2021	Metal Hydroxide Fraction	9600	38	170	30
UA	E-SB-19	35-40	Eurofins	2021	Organic Fraction	<54	NA	8.0	1.4
UA	E-SB-19	35-40	Eurofins	2021	Acid/Sulfide Fraction	9800	39	94	17
UA	E-SB-19	35-40	Eurofins	2021	Residual Fraction	4600	18	38	6.8
UA	E-SB-19	35-40	Eurofins	2021	Sum	25000	NA	560	NA
UA	E-SB-19	35-40	Eurofins	2021	Total/NA	18000	NA	360	NA
UA	E-SB-18	40-44	Eurofins	2021	Exchangeable Fraction	<17	NA	7.9	1.3
UA	E-SB-18	40-44	Eurofins	2021	Carbonate Fraction	200	0.51	100	16
UA	E-SB-18	40-44	Eurofins	2021	Non-Crystalline Minerals Fraction	5500	14	110	18
UA	E-SB-18	40-44	Eurofins	2021	Metal Hydroxide Fraction	17000	44	270	44
UA	E-SB-18	40-44	Eurofins	2021	Organic Fraction	93	0.24	38	6.1
UA	E-SB-18	40-44	Eurofins	2021	Acid/Sulfide Fraction	10000	26	51	8.2
UA	E-SB-18	40-44	Eurofins	2021	Residual Fraction	6300	16	42	6.8
UA	E-SB-18	40-44	Eurofins	2021	Sum	39000	NA	620	NA
UA	E-SB-18	40-44	Eurofins	2021	Total/NA	28000	NA	490	NA
PMP	E-SB-15	10-15	Eurofins	2021	Exchangeable Fraction	<18	NA	1.2	0.57
PMP	E-SB-15	10-15	Eurofins	2021	Carbonate Fraction	100	0.31	19	9.0
PMP	E-SB-15	10-15	Eurofins	2021	Non-Crystalline Minerals Fraction	1900	5.9	10	4.7
PMP	E-SB-15	10-15	Eurofins	2021	Metal Hydroxide Fraction	10000	31	90	43
PMP	E-SB-15	10-15	Eurofins	2021	Organic Fraction	320	1.0	15	7.1
PMP	E-SB-15	10-15	Eurofins	2021	Acid/Sulfide Fraction	13000	41	42	20
PMP	E-SB-15	10-15	Eurofins	2021	Residual Fraction	6800	21	29	14
PMP	E-SB-15	10-15	Eurofins	2021	Sum	32000	NA	210	NA
PMP	E-SB-15	10-15	Eurofins	2021	Total/NA	27000	NA	170	NA

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Table 4-8. SEP Results for Iron, Manganese, Aluminum, Boron, and Sulfur

HSU	Location	Depth Range (ft bgs)	Analyst	Analysis Year	SEP Fraction	Aluminum		Boron		Sulfur	
						Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)
BCU	E-SB-05	51-56	Eurofins	2021	Exchangeable Fraction	9.7	0.02	<44	NA	NA	NA
BCU	E-SB-05	51-56	Eurofins	2021	Carbonate Fraction	110	0.21	<33	NA	NA	NA
BCU	E-SB-05	51-56	Eurofins	2021	Non-Crystalline Minerals Fraction	380	0.73	<11	NA	NA	NA
BCU	E-SB-05	51-56	Eurofins	2021	Metal Hydroxide Fraction	4500	8.7	<11	NA	NA	NA
BCU	E-SB-05	51-56	Eurofins	2021	Organic Fraction	37	0.07	<170	NA	NA	NA
BCU	E-SB-05	51-56	Eurofins	2021	Acid/Sulfide Fraction	6700	13	<11	NA	NA	NA
BCU	E-SB-05	51-56	Eurofins	2021	Residual Fraction	41000	79	NA	NA	NA	NA
BCU	E-SB-05	51-56	Eurofins	2021	Sum	52000	NA	NA	NA	NA	NA
BCU	E-SB-05	51-56	Eurofins	2021	Total/NA	95000	NA	NA	NA	NA	NA
UA	E-SB-19	35-40	Eurofins	2021	Exchangeable Fraction	<7.8	NA	<49	NA	NA	NA
UA	E-SB-19	35-40	Eurofins	2021	Carbonate Fraction	40	0.11	<37	NA	NA	NA
UA	E-SB-19	35-40	Eurofins	2021	Non-Crystalline Minerals Fraction	200	0.53	<12	NA	NA	NA
UA	E-SB-19	35-40	Eurofins	2021	Metal Hydroxide Fraction	1600	4.2	<12	NA	NA	NA
UA	E-SB-19	35-40	Eurofins	2021	Organic Fraction	99	0.26	<180	NA	NA	NA
UA	E-SB-19	35-40	Eurofins	2021	Acid/Sulfide Fraction	5700	15	<12	NA	NA	NA
UA	E-SB-19	35-40	Eurofins	2021	Residual Fraction	31000	82	NA	NA	NA	NA
UA	E-SB-19	35-40	Eurofins	2021	Sum	38000	NA	NA	NA	NA	NA
UA	E-SB-19	35-40	Eurofins	2021	Total/NA	54000	NA	NA	NA	NA	NA
UA	E-SB-18	40-44	Eurofins	2021	Exchangeable Fraction	<9.1	NA	<57	NA	NA	NA
UA	E-SB-18	40-44	Eurofins	2021	Carbonate Fraction	18	0.04	<43	NA	NA	NA
UA	E-SB-18	40-44	Eurofins	2021	Non-Crystalline Minerals Fraction	220	0.51	<14	NA	NA	NA
UA	E-SB-18	40-44	Eurofins	2021	Metal Hydroxide Fraction	3900	9.1	<14	NA	NA	NA
UA	E-SB-18	40-44	Eurofins	2021	Organic Fraction	50	0.12	<210	NA	NA	NA
UA	E-SB-18	40-44	Eurofins	2021	Acid/Sulfide Fraction	5400	13	<14	NA	NA	NA
UA	E-SB-18	40-44	Eurofins	2021	Residual Fraction	34000	79	NA	NA	NA	NA
UA	E-SB-18	40-44	Eurofins	2021	Sum	43000	NA	NA	NA	NA	NA
UA	E-SB-18	40-44	Eurofins	2021	Total/NA	72000	NA	NA	NA	NA	NA
PMP	E-SB-15	10-15	Eurofins	2021	Exchangeable Fraction	<9.8	NA	<62	NA	NA	NA
PMP	E-SB-15	10-15	Eurofins	2021	Carbonate Fraction	12	0.02	<46	NA	NA	NA
PMP	E-SB-15	10-15	Eurofins	2021	Non-Crystalline Minerals Fraction	320	0.65	<15	NA	NA	NA
PMP	E-SB-15	10-15	Eurofins	2021	Metal Hydroxide Fraction	5300	11	<15	NA	NA	NA
PMP	E-SB-15	10-15	Eurofins	2021	Organic Fraction	130	0.27	<230	NA	NA	NA
PMP	E-SB-15	10-15	Eurofins	2021	Acid/Sulfide Fraction	8700	18	<15	NA	NA	NA
PMP	E-SB-15	10-15	Eurofins	2021	Residual Fraction	35000	71	NA	NA	NA	NA
PMP	E-SB-15	10-15	Eurofins	2021	Sum	49000	NA	NA	NA	NA	NA
PMP	E-SB-15	10-15	Eurofins	2021	Total/NA	91000	NA	NA	NA	NA	NA

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Table 4-8. SEP Results for Iron, Manganese, Aluminum, Boron, and Sulfur

HSU	Location	Depth Range (ft bgs)	Analyst	Analysis Year	SEP Fraction	Iron		Manganese	
						Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)
UA	E-SB-15	30-35	Eurofins	2021	Exchangeable Fraction	<18	NA	4.9	0.67
UA	E-SB-15	30-35	Eurofins	2021	Carbonate Fraction	280	0.90	130	18
UA	E-SB-15	30-35	Eurofins	2021	Non-Crystalline Minerals Fraction	6500	21	170	23
UA	E-SB-15	30-35	Eurofins	2021	Metal Hydroxide Fraction	11000	35	270	37
UA	E-SB-15	30-35	Eurofins	2021	Organic Fraction	200	0.65	53	7.3
UA	E-SB-15	30-35	Eurofins	2021	Acid/Sulfide Fraction	7800	25	56	7.7
UA	E-SB-15	30-35	Eurofins	2021	Residual Fraction	6000	19	47	6.4
UA	E-SB-15	30-35	Eurofins	2021	Sum	31000	NA	730	NA
UA	E-SB-15	30-35	Eurofins	2021	Total/NA	26000	NA	520	NA
CCR	E-SB-XPW01	25-30	Eurofins	2021	Exchangeable Fraction	<19	NA	0.92	0.11
CCR	E-SB-XPW01	25-30	Eurofins	2021	Carbonate Fraction	2600	1.7	320	38
CCR	E-SB-XPW01	25-30	Eurofins	2021	Non-Crystalline Minerals Fraction	2400	1.6	150	18
CCR	E-SB-XPW01	25-30	Eurofins	2021	Metal Hydroxide Fraction	12000	8.0	150	18
CCR	E-SB-XPW01	25-30	Eurofins	2021	Organic Fraction	<72	NA	<3	NA
CCR	E-SB-XPW01	25-30	Eurofins	2021	Acid/Sulfide Fraction	53000	35	78	9.2
CCR	E-SB-XPW01	25-30	Eurofins	2021	Residual Fraction	80000	53	150	18
CCR	E-SB-XPW01	25-30	Eurofins	2021	Sum	150000	NA	850	NA
CCR	E-SB-XPW01	25-30	Eurofins	2021	Total/NA	150000	NA	840	NA
UA	AW-23	6-11.5	SGS	2023	Water Soluble Metals	200	0.45	1.8	0.38
UA	AW-23	6-11.5	SGS	2023	Exchangeable Metals	150	0.34	20	4.3
UA	AW-23	6-11.5	SGS	2023	Metals Bound to Carbonates	530	1.2	180	38
UA	AW-23	6-11.5	SGS	2023	Metals Bound to Fe and Mn Oxides	2900	6.6	65	14
UA	AW-23	6-11.5	SGS	2023	Metals Bound to Organics	62	0.14	20	4.3
UA	AW-23	6-11.5	SGS	2023	Residual	40000	91	190	40
UA	AW-23	6-11.5	SGS	2023	Sum	44000	NA	470	NA
UA	AW-23	6-11.5	SGS	2023	Total	44000	NA	450	NA
UA	E-SB-05	25-30	SGS	2023	Water Soluble Metals	43	0.14	0.78	0.14
UA	E-SB-05	25-30	SGS	2023	Exchangeable Metals	12	0.04	20	3.5
UA	E-SB-05	25-30	SGS	2023	Metals Bound to Carbonates	1100	3.7	310	54
UA	E-SB-05	25-30	SGS	2023	Metals Bound to Fe and Mn Oxides	6500	22	130	23
UA	E-SB-05	25-30	SGS	2023	Metals Bound to Organics	1400	4.7	15	2.6
UA	E-SB-05	25-30	SGS	2023	Residual	21000	70	100	18
UA	E-SB-05	25-30	SGS	2023	Sum	30000	NA	570	NA
UA	E-SB-05	25-30	SGS	2023	Total	31000	NA	580	NA

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Table 4-8. SEP Results for Iron, Manganese, Aluminum, Boron, and Sulfur

HSU	Location	Depth Range (ft bgs)	Analyst	Analysis Year	SEP Fraction	Aluminum		Boron		Sulfur	
						Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)
UA	E-SB-15	30-35	Eurofins	2021	Exchangeable Fraction	<9.8	NA	<61	NA	NA	NA
UA	E-SB-15	30-35	Eurofins	2021	Carbonate Fraction	20	0.04	<46	NA	NA	NA
UA	E-SB-15	30-35	Eurofins	2021	Non-Crystalline Minerals Fraction	260	0.50	<15	NA	NA	NA
UA	E-SB-15	30-35	Eurofins	2021	Metal Hydroxide Fraction	3600	6.9	<15	NA	NA	NA
UA	E-SB-15	30-35	Eurofins	2021	Organic Fraction	98	0.19	<230	NA	NA	NA
UA	E-SB-15	30-35	Eurofins	2021	Acid/Sulfide Fraction	5500	11	<15	NA	NA	NA
UA	E-SB-15	30-35	Eurofins	2021	Residual Fraction	43000	83	NA	NA	NA	NA
UA	E-SB-15	30-35	Eurofins	2021	Sum	52000	NA	NA	NA	NA	NA
UA	E-SB-15	30-35	Eurofins	2021	Total/NA	69000	NA	NA	NA	NA	NA
CCR	E-SB-XPW01	25-30	Eurofins	2021	Exchangeable Fraction	<10	NA	<65	NA	NA	NA
CCR	E-SB-XPW01	25-30	Eurofins	2021	Carbonate Fraction	2900	3.5	590	NA	NA	NA
CCR	E-SB-XPW01	25-30	Eurofins	2021	Non-Crystalline Minerals Fraction	4700	5.6	100	NA	NA	NA
CCR	E-SB-XPW01	25-30	Eurofins	2021	Metal Hydroxide Fraction	4900	5.8	76	NA	NA	NA
CCR	E-SB-XPW01	25-30	Eurofins	2021	Organic Fraction	<38	NA	<240	NA	NA	NA
CCR	E-SB-XPW01	25-30	Eurofins	2021	Acid/Sulfide Fraction	4700	5.6	20	NA	NA	NA
CCR	E-SB-XPW01	25-30	Eurofins	2021	Residual Fraction	67000	80	NA	NA	NA	NA
CCR	E-SB-XPW01	25-30	Eurofins	2021	Sum	84000	NA	NA	NA	NA	NA
CCR	E-SB-XPW01	25-30	Eurofins	2021	Total/NA	85000	NA	NA	NA	NA	NA
UA	AW-23	6-11.5	SGS	2023	Water Soluble Metals	180	0.32	1.1	13	89	5.9
UA	AW-23	6-11.5	SGS	2023	Exchangeable Metals	8.9	0.02	0.81	9.3	510	34
UA	AW-23	6-11.5	SGS	2023	Metals Bound to Carbonates	650	1.2	1.3	15	<32	NA
UA	AW-23	6-11.5	SGS	2023	Metals Bound to Fe and Mn Oxides	780	1.4	4.2	48	130	8.7
UA	AW-23	6-11.5	SGS	2023	Metals Bound to Organics	460	0.82	1.3	15	350	23
UA	AW-23	6-11.5	SGS	2023	Residual	54000	96	<0.9	NA	390	26
UA	AW-23	6-11.5	SGS	2023	Sum	56000	NA	8.7	NA	1500	NA
UA	AW-23	6-11.5	SGS	2023	Total	62000	NA	<1	NA	990	NA
UA	E-SB-05	25-30	SGS	2023	Water Soluble Metals	29	0.07	0.89	9.9	710	18
UA	E-SB-05	25-30	SGS	2023	Exchangeable Metals	9.8	0.02	0.54	6.0	520	13
UA	E-SB-05	25-30	SGS	2023	Metals Bound to Carbonates	250	0.63	1.9	21	<32	NA
UA	E-SB-05	25-30	SGS	2023	Metals Bound to Fe and Mn Oxides	690	1.7	4.5	50	220	5.6
UA	E-SB-05	25-30	SGS	2023	Metals Bound to Organics	960	2.4	1.2	13	2200	56
UA	E-SB-05	25-30	SGS	2023	Residual	38000	95	<0.7	NA	280	7.2
UA	E-SB-05	25-30	SGS	2023	Sum	40000	NA	9.0	NA	3900	NA
UA	E-SB-05	25-30	SGS	2023	Total	47000	NA	<1	NA	4700	NA

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Table 4-8. SEP Results for Iron, Manganese, Aluminum, Boron, and Sulfur

HSU	Location	Depth Range (ft bgs)	Analyst	Analysis Year	SEP Fraction	Iron		Manganese	
						Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)
UA	E-SB-07	27-30	SGS	2023	Water Soluble Metals	2.0	0.01	0.02	0.005
UA	E-SB-07	27-30	SGS	2023	Exchangeable Metals	61	0.18	15	4.5
UA	E-SB-07	27-30	SGS	2023	Metals Bound to Carbonates	800	2.4	100	30
UA	E-SB-07	27-30	SGS	2023	Metals Bound to Fe and Mn Oxides	2400	7.3	37	11
UA	E-SB-07	27-30	SGS	2023	Metals Bound to Organics	31	0.09	11	3.3
UA	E-SB-07	27-30	SGS	2023	Residual	30000	91	160	48
UA	E-SB-07	27-30	SGS	2023	Sum	33000	NA	330	NA
UA	E-SB-07	27-30	SGS	2023	Total	34000	NA	330	NA
UA	E-SB-15	35-40	SGS	2023	Water Soluble Metals	570	2.0	4.4	1.3
UA	E-SB-15	35-40	SGS	2023	Exchangeable Metals	460	1.6	9.0	2.6
UA	E-SB-15	35-40	SGS	2023	Metals Bound to Carbonates	1600	5.5	33	9.4
UA	E-SB-15	35-40	SGS	2023	Metals Bound to Fe and Mn Oxides	4700	16	110	31
UA	E-SB-15	35-40	SGS	2023	Metals Bound to Organics	47	0.16	14	4.0
UA	E-SB-15	35-40	SGS	2023	Residual	21000	72	180	51
UA	E-SB-15	35-40	SGS	2023	Sum	29000	NA	350	NA
UA	E-SB-15	35-40	SGS	2023	Total	27000	NA	320	NA
UA	E-SB-19	35-40	SGS	2023	Water Soluble Metals	78	0.17	0.74	0.11
UA	E-SB-19	35-40	SGS	2023	Exchangeable Metals	630	1.4	45	6.4
UA	E-SB-19	35-40	SGS	2023	Metals Bound to Carbonates	1100	2.4	300	43
UA	E-SB-19	35-40	SGS	2023	Metals Bound to Fe and Mn Oxides	3400	7.6	84	12
UA	E-SB-19	35-40	SGS	2023	Metals Bound to Organics	52	0.12	23	3.3
UA	E-SB-19	35-40	SGS	2023	Residual	40000	89	260	37
UA	E-SB-19	35-40	SGS	2023	Sum	45000	NA	700	NA
UA	E-SB-19	35-40	SGS	2023	Total	46000	NA	680	NA
PMP	E-SB-15	10-15	SGS	2023	Water Soluble Metals	120	0.30	0.61	0.22
PMP	E-SB-15	10-15	SGS	2023	Exchangeable Metals	15	0.04	10	3.5
PMP	E-SB-15	10-15	SGS	2023	Metals Bound to Carbonates	820	2.1	75	27
PMP	E-SB-15	10-15	SGS	2023	Metals Bound to Fe and Mn Oxides	2800	7.0	31	11
PMP	E-SB-15	10-15	SGS	2023	Metals Bound to Organics	240	0.60	13	4.6
PMP	E-SB-15	10-15	SGS	2023	Residual	36000	90	150	54
PMP	E-SB-15	10-15	SGS	2023	Sum	40000	NA	280	NA
PMP	E-SB-15	10-15	SGS	2023	Total	42000	NA	280	NA
BCU	E-SB-19	40-44	SGS	2023	Water Soluble Metals	61	0.11	0.75	0.11
BCU	E-SB-19	40-44	SGS	2023	Exchangeable Metals	84	0.15	12	1.7
BCU	E-SB-19	40-44	SGS	2023	Metals Bound to Carbonates	2200	4.0	55	8.0
BCU	E-SB-19	40-44	SGS	2023	Metals Bound to Fe and Mn Oxides	23000	42	340	49
BCU	E-SB-19	40-44	SGS	2023	Metals Bound to Organics	140	0.25	23	3.3
BCU	E-SB-19	40-44	SGS	2023	Residual	30000	55	250	36
BCU	E-SB-19	40-44	SGS	2023	Sum	55000	NA	690	NA
BCU	E-SB-19	40-44	SGS	2023	Total	56000	NA	650	NA

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Table 4-8. SEP Results for Iron, Manganese, Aluminum, Boron, and Sulfur

HSU	Location	Depth Range (ft bgs)	Analyst	Analysis Year	SEP Fraction	Aluminum		Boron		Sulfur	
						Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)
UA	E-SB-07	27-30	SGS	2023	Water Soluble Metals	1.5	0.003	<0.044	NA	<21	NA
UA	E-SB-07	27-30	SGS	2023	Exchangeable Metals	13	0.02	<0.054	NA	540	36
UA	E-SB-07	27-30	SGS	2023	Metals Bound to Carbonates	600	1.1	1.6	28	<31	NA
UA	E-SB-07	27-30	SGS	2023	Metals Bound to Fe and Mn Oxides	810	1.5	3.2	55	130	8.7
UA	E-SB-07	27-30	SGS	2023	Metals Bound to Organics	300	0.57	1.0	17	320	21
UA	E-SB-07	27-30	SGS	2023	Residual	51000	96	<0.9	NA	520	35
UA	E-SB-07	27-30	SGS	2023	Sum	53000	NA	5.8	NA	1500	NA
UA	E-SB-07	27-30	SGS	2023	Total	55000	NA	<1	NA	1300	NA
UA	E-SB-15	35-40	SGS	2023	Water Soluble Metals	260	0.39	1.5	23	<21	2.1
UA	E-SB-15	35-40	SGS	2023	Exchangeable Metals	10	0.01	<0.053	NA	530	53
UA	E-SB-15	35-40	SGS	2023	Metals Bound to Carbonates	1000	1.5	0.93	15	<31	NA
UA	E-SB-15	35-40	SGS	2023	Metals Bound to Fe and Mn Oxides	1900	2.9	2.8	44	<31	NA
UA	E-SB-15	35-40	SGS	2023	Metals Bound to Organics	210	0.32	1.2	19	280	28
UA	E-SB-15	35-40	SGS	2023	Residual	63000	95	<0.9	NA	240	24
UA	E-SB-15	35-40	SGS	2023	Sum	66000	NA	6.4	NA	1000	NA
UA	E-SB-15	35-40	SGS	2023	Total	66000	NA	<1	NA	650	NA
UA	E-SB-19	35-40	SGS	2023	Water Soluble Metals	270	0.42	0.66	8.7	<22	NA
UA	E-SB-19	35-40	SGS	2023	Exchangeable Metals	10	0.01	<0.054	NA	490	45
UA	E-SB-19	35-40	SGS	2023	Metals Bound to Carbonates	870	1.3	1.6	21	<31	NA
UA	E-SB-19	35-40	SGS	2023	Metals Bound to Fe and Mn Oxides	1100	1.7	4.1	54	32	2.9
UA	E-SB-19	35-40	SGS	2023	Metals Bound to Organics	330	0.51	1.2	16	290	26
UA	E-SB-19	35-40	SGS	2023	Residual	62000	95	<0.9	NA	290	26
UA	E-SB-19	35-40	SGS	2023	Sum	65000	NA	7.6	NA	1100	NA
UA	E-SB-19	35-40	SGS	2023	Total	71000	NA	<1	NA	1300	NA
PMP	E-SB-15	10-15	SGS	2023	Water Soluble Metals	130	0.23	2.7	19	360	21
PMP	E-SB-15	10-15	SGS	2023	Exchangeable Metals	13	0.02	1.1	7.9	540	32
PMP	E-SB-15	10-15	SGS	2023	Metals Bound to Carbonates	380	0.67	3.5	25	<32	NA
PMP	E-SB-15	10-15	SGS	2023	Metals Bound to Fe and Mn Oxides	540	0.95	5.5	39	130	7.6
PMP	E-SB-15	10-15	SGS	2023	Metals Bound to Organics	650	1.1	1.3	9.3	610	36
PMP	E-SB-15	10-15	SGS	2023	Residual	56000	98	<0.9	NA	42	2.5
PMP	E-SB-15	10-15	SGS	2023	Sum	57000	NA	14	NA	1700	NA
PMP	E-SB-15	10-15	SGS	2023	Total	65000	NA	<1	NA	1500	NA
BCU	E-SB-19	40-44	SGS	2023	Water Soluble Metals	210	0.31	0.89	11	200	14
BCU	E-SB-19	40-44	SGS	2023	Exchangeable Metals	62	0.09	0.54	6.8	540	39
BCU	E-SB-19	40-44	SGS	2023	Metals Bound to Carbonates	1000	1.5	1.3	16	<32	NA
BCU	E-SB-19	40-44	SGS	2023	Metals Bound to Fe and Mn Oxides	1500	2.2	4.2	53	130	9.3
BCU	E-SB-19	40-44	SGS	2023	Metals Bound to Organics	200	0.30	1.0	13	350	25
BCU	E-SB-19	40-44	SGS	2023	Residual	64000	96	<0.9	NA	180	13
BCU	E-SB-19	40-44	SGS	2023	Sum	67000	NA	7.9	NA	1400	NA
BCU	E-SB-19	40-44	SGS	2023	Total	74000	NA	<1	NA	1200	NA

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Table 4-8. SEP Results for Iron, Manganese, Aluminum, Boron, and Sulfur

HSU	Location	Depth Range (ft bgs)	Analyst	Analysis Year	SEP Fraction	Iron		Manganese	
						Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)
BCU	E-SB-05	51-56	SGS	2023	Water Soluble Metals	170	0.41	1.6	0.24
BCU	E-SB-05	51-56	SGS	2023	Exchangeable Metals	24	0.06	9.1	1.4
BCU	E-SB-05	51-56	SGS	2023	Metals Bound to Carbonates	2400	5.9	130	19
BCU	E-SB-05	51-56	SGS	2023	Metals Bound to Fe and Mn Oxides	11000	27	270	40
BCU	E-SB-05	51-56	SGS	2023	Metals Bound to Organics	110	0.27	31	4.6
BCU	E-SB-05	51-56	SGS	2023	Residual	28000	68	230	34
BCU	E-SB-05	51-56	SGS	2023	Sum	41000	NA	670	NA
BCU	E-SB-05	51-56	SGS	2023	Total	45000	NA	710	NA
BCU	E-SB-07	59-64	SGS	2023	Water Soluble Metals	100	0.31	0.94	0.29
BCU	E-SB-07	59-64	SGS	2023	Exchangeable Metals	14	0.04	10	3.1
BCU	E-SB-07	59-64	SGS	2023	Metals Bound to Carbonates	1100	3.4	33	10
BCU	E-SB-07	59-64	SGS	2023	Metals Bound to Fe and Mn Oxides	4800	15	67	21
BCU	E-SB-07	59-64	SGS	2023	Metals Bound to Organics	49	0.15	13	4.1
BCU	E-SB-07	59-64	SGS	2023	Residual	26000	81	200	63
BCU	E-SB-07	59-64	SGS	2023	Sum	32000	NA	320	NA
BCU	E-SB-07	59-64	SGS	2023	Total	31000	NA	340	NA

Notes:

Values below detection limits not included in percent of sum calculation or figures
NA = not applicable
< = below method detection limit
SEP = sequential extraction procedure
ft bgs = feet below ground surface
mg/kg = milligrams per kilogram
% = percent
HSU = hydrostratigraphic unit
CCR = coal combustion residual
UA = uppermost aquifer
PMP = potential migration pathway
BCU = bedrock confining unit
Total = total metals, 2023 data analyzed by SGS, 2021 data analyzed by Eurofins. Full total metal analysis presented in Attachments 2 and 3
Percentages may not sum to 100 for each fraction due to results below the reporting limit and rounding
2023 data was converted from mg/L to mg/kg based on provided sample weights and volumes

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Table 4-8. SEP Results for Iron, Manganese, Aluminum, Boron, and Sulfur

HSU	Location	Depth Range (ft bgs)	Analyst	Analysis Year	SEP Fraction	Aluminum		Boron		Sulfur	
						Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)	Concentration (mg/kg)	Percent of Sum (%)
BCU	E-SB-05	51-56	SGS	2023	Water Soluble Metals	220	0.35	0.90	13	160	9.4
BCU	E-SB-05	51-56	SGS	2023	Exchangeable Metals	42	0.07	<0.055	NA	580	34
BCU	E-SB-05	51-56	SGS	2023	Metals Bound to Carbonates	970	1.6	1.9	27	<32	NA
BCU	E-SB-05	51-56	SGS	2023	Metals Bound to Fe and Mn Oxides	940	1.5	2.9	41	160	9.4
BCU	E-SB-05	51-56	SGS	2023	Metals Bound to Organics	270	0.44	1.3	18	620	36
BCU	E-SB-05	51-56	SGS	2023	Residual	60000	97	<0.9	NA	140	8.2
BCU	E-SB-05	51-56	SGS	2023	Sum	62000	NA	7.1	NA	1700	NA
BCU	E-SB-05	51-56	SGS	2023	Total	70000	NA	<1	NA	1800	NA
BCU	E-SB-07	59-64	SGS	2023	Water Soluble Metals	320	0.46	1.5	17	87	7.3
BCU	E-SB-07	59-64	SGS	2023	Exchangeable Metals	52	0.07	<0.053	NA	560	47
BCU	E-SB-07	59-64	SGS	2023	Metals Bound to Carbonates	970	1.4	1.9	21	<31	NA
BCU	E-SB-07	59-64	SGS	2023	Metals Bound to Fe and Mn Oxides	2100	3.0	4.4	49	<31	NA
BCU	E-SB-07	59-64	SGS	2023	Metals Bound to Organics	260	0.37	1.1	12	280	23
BCU	E-SB-07	59-64	SGS	2023	Residual	67000	96	<0.9	NA	270	23
BCU	E-SB-07	59-64	SGS	2023	Sum	70000	NA	8.9	NA	1200	NA
BCU	E-SB-07	59-64	SGS	2023	Total	79000	NA	<1	NA	710	NA

Notes:

Values below detection limits not included in percent of sum calculation or figures
NA = not applicable
< = below method detection limit
SEP = sequential extraction procedure
ft bgs = feet below ground surface
mg/kg = milligrams per kilogram
% = percent
HSU = hydrostratigraphic unit
CCR = coal combustion residual
UA = uppermost aquifer
PMP = potential migration pathway
BCU = bedrock confining unit
Total = total metals, 2023 data analyzed by SGS, 2021 data analyzed by Eurofins. Full total metal analysis presented in Appendix <<XX>>
Percentages may not sum to 100 for each fraction due to results below the reporting limit and rounding
2023 data was converted from mg/L to mg/kg based on provided sample weights and volumes

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	pH (field) (SU)	Turbidity, field (NTU)	Alkalinity, total (mg/L)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Aluminum, total (mg/L)
AP05D	2/10/2021	BCU	7.71	3.9	620	125.8	0.33	--
AP05D	3/8/2021	BCU	7.25	27.53	790	-67.3	0.20	--
AP05D	3/24/2021	BCU	7.60	0	640	-54.0	6.13	--
AP05D	4/15/2021	BCU	7.42	36.6	1000	-97.9	0.43	--
AP05D	5/7/2021	BCU	7.66	323	990	-106.0	1.50	--
AP05S	2/27/2020	UA	6.70	518	850	-102.0	0.20	--
AP05S	9/1/2020	UA	6.86	466	--	-118.0	0.14	--
AP05S	2/10/2021	UA	6.94	15.05	820	8.3	0.19	--
AP05S	2/23/2021	UA	6.82	1410	880	-120.0	0.50	--
AP05S	3/8/2021	UA	6.79	447.42	840	-85.9	0.11	--
AP05S	3/24/2021	UA	6.32	275.87	840	-26.3	0.17	--
AP05S	4/13/2021	UA	6.96	380	820	-138.0	0.06	--
AP05S	5/7/2021	UA	6.84	271	820	-112.0	0.72	--
AP05S	6/16/2021	UA	6.90	2780	880	-201.0	0.12	--
AP05S	6/29/2021	UA	6.88	2500	840	-152.0	0.30	--
AP05S	7/22/2021	UA	6.97	1450	840	-122.0	0.20	--
AP05S	8/30/2021	UA	6.78	3050	820	-132.0	0.04	--
AP05S	2/16/2022	UA	6.68	3050	800	-115.0	0.29	--
AP05S	7/25/2022	UA	6.73	1000	--	-154.0	1.50	--
AP05S	2/28/2023	UA	7.01	1000	660	-87.0	1.20	--
AP05S	6/14/2023	UA	6.85	1900	850	-151.0	0.06	3.1
AP05S	8/23/2023	UA	6.88	39.7	840	-133.0	1.30	0.49
AP05S	11/6/2023	UA	6.80	531	800	-127.0	1.50	--
AP07D	2/10/2021	BCU	8.16	21.09	580	128.3	6.63	--
AP07D	3/8/2021	BCU	7.82	6827.08	610	30.9	7.44	--
AP07D	3/24/2021	BCU	7.48	13949.9	680	9.5	5.54	--
AP07D	4/13/2021	BCU	7.82	1620	690	-129.0	0.26	--
AP07D	5/5/2021	BCU	7.88	635	700	-168.0	0.00	--
AP07D	7/22/2021	BCU	7.54	1930	740	47.4	3.60	--
AP07S	2/10/2021	PMP	6.85	16.19	320	80.3	0.76	--
AP07S	3/4/2021	PMP	6.66	12.03	320	79.5	0.69	--
AP07S	3/24/2021	PMP	6.23	0	340	26.4	0.43	--
AP07S	4/13/2021	PMP	6.77	146	540	29.9	0.60	--
AP07S	5/5/2021	PMP	6.63	1240	590	20.9	0.61	--
AP07S	6/16/2021	PMP	6.55	27.5	600	21.8	1.60	--
AP07S	6/28/2021	PMP	6.85	34.3	580	55.8	2.20	--
AP07S	7/22/2021	PMP	6.62	591	550	16.5	1.20	--
AP07S	2/28/2023	PMP	7.13	1000	280	100.0	6.80	--
AP07S	6/15/2023	PMP	6.82	901	490	61.5	2.00	2.7
AP07S	8/28/2023	PMP	6.95	101	360	44.0	9.80	0.48
AP07S	11/3/2023	PMP	7.50	2.9	310	-56.0	0.00	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Arsenic, total (mg/L)	Barium, total (mg/L)	Boron, total (mg/L)	Calcium, total (mg/L)	Carbon, total organic (mg/L)	Chloride, total (mg/L)	Iron, total (mg/L)	Iron, dissolved (mg/L)
AP05D	2/10/2021	BCU	<0.001	0.44	1.10	22	--	230	0.28	--
AP05D	3/8/2021	BCU	0.0017	0.82	1.30	28	--	260	0.38	--
AP05D	3/24/2021	BCU	0.0012	0.43	1.00	21	--	240	0.065	--
AP05D	4/15/2021	BCU	0.0018	1.6	1.70	33	--	410	1.3	--
AP05D	5/7/2021	BCU	0.0035	1.3	1.60	30	--	510	6	--
AP05S	2/27/2020	UA	0.0088	1.4	0.31	170	--	40	--	--
AP05S	9/1/2020	UA	0.003	1.2	0.38	110	--	41	--	--
AP05S	2/10/2021	UA	0.0016	0.56	0.26	110	--	38	6	--
AP05S	2/23/2021	UA	0.0059	1.3	0.39	120	--	47	--	--
AP05S	3/8/2021	UA	0.0022	1.1	0.39	110	--	45	14	--
AP05S	3/24/2021	UA	0.0024	1	0.31	110	--	45	15	--
AP05S	4/13/2021	UA	0.0026	1.2	0.34	99	--	42	18	--
AP05S	5/7/2021	UA	0.0044	1.2	0.36	120	--	43	27	--
AP05S	6/16/2021	UA	0.01	1.7	0.35	170	--	47	75	--
AP05S	6/29/2021	UA	0.0066	1.3	0.36	120	--	56	40	--
AP05S	7/22/2021	UA	0.012	1.4	0.42	160	--	44	80	--
AP05S	8/30/2021	UA	0.0072	1.2	0.33	140	--	44	--	--
AP05S	2/16/2022	UA	0.0039	1.2	0.34	110	--	48	--	--
AP05S	7/25/2022	UA	0.014	1.8	0.35	190	--	49	--	--
AP05S	2/28/2023	UA	0.0073	0.94	0.34	120	--	33	--	--
AP05S	6/14/2023	UA	0.0036	1.1	0.33	110	21	46	20	9
AP05S	8/23/2023	UA	0.001	0.83	0.32	100	22	41	9.7	8.9
AP05S	11/6/2023	UA	0.0027	1	0.33	110	--	46	--	--
AP07D	2/10/2021	BCU	0.0049	0.31	1.30	16	--	500	0.79	--
AP07D	3/8/2021	BCU	0.036	2.6	1.40	90	--	550	390	--
AP07D	3/24/2021	BCU	0.033	4.1	1.20	78	--	830	420	--
AP07D	4/13/2021	BCU	0.0088	1.3	1.30	18	--	710	49	--
AP07D	5/5/2021	BCU	0.057	8.6	1.40	58	--	820	630	--
AP07D	7/22/2021	BCU	0.0044	1.2	1.80	18	--	700	31	--
AP07S	2/10/2021	PMP	<0.001	0.064	5.80	120	--	80	0.35	--
AP07S	3/4/2021	PMP	<0.001	0.08	6.20	130	--	74	3.9	--
AP07S	3/24/2021	PMP	<0.001	0.065	5.80	120	--	79	0.19	--
AP07S	4/13/2021	PMP	<0.001	0.14	7.30	230	--	190	2.9	--
AP07S	5/5/2021	PMP	<0.001	0.15	8.30	260	--	110	6.2	--
AP07S	6/16/2021	PMP	<0.001	0.12	7.40	280	--	120	2.2	--
AP07S	6/28/2021	PMP	<0.001	0.12	10.00	280	--	130	1.8	--
AP07S	7/22/2021	PMP	<0.001	0.13	12.00	260	--	130	2.4	--
AP07S	2/28/2023	PMP	0.0021	0.087	7.90	130	--	73	--	--
AP07S	6/15/2023	PMP	0.0011	0.11	18.00	240	2.6	76	6	0.05
AP07S	8/28/2023	PMP	<0.00069	0.073	9.40	160	2.4	83	1.2	0.087
AP07S	11/3/2023	PMP	<0.00069	0.048	8.20	130	--	73	--	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Ferrous Iron, dissolved (mg/L)	Lithium, total (mg/L)	Magnesium, total (mg/L)	Manganese, total (mg/L)	Manganese, dissolved (mg/L)	Methane, total (mg/L)	Molybdenum, total (mg/L)
AP05D	2/10/2021	BCU	--	0.065	11	0.036	--	--	0.017
AP05D	3/8/2021	BCU	--	0.073	12	0.092	--	--	0.017
AP05D	3/24/2021	BCU	--	0.063	11	0.012	--	--	0.016
AP05D	4/15/2021	BCU	--	0.13	13	0.031	--	--	0.0029
AP05D	5/7/2021	BCU	--	0.077	12	0.092	--	--	0.0057
AP05S	2/27/2020	UA	--	0.059	73	--	--	--	0.0026
AP05S	9/1/2020	UA	--	0.036	--	--	--	--	<0.001
AP05S	2/10/2021	UA	--	0.028	47	0.26	--	--	<0.001
AP05S	2/23/2021	UA	--	0.044	50	--	--	--	0.002
AP05S	3/8/2021	UA	--	0.039	45	0.25	--	--	0.004
AP05S	3/24/2021	UA	--	0.033	45	0.25	--	--	<0.001
AP05S	4/13/2021	UA	--	0.04	42	0.29	--	--	<0.001
AP05S	5/7/2021	UA	--	0.037	47	0.39	--	--	0.0013
AP05S	6/16/2021	UA	--	0.068	70	1.5	--	--	0.0029
AP05S	6/29/2021	UA	--	0.065	53	0.71	--	--	0.002
AP05S	7/22/2021	UA	--	0.071	69	1.7	--	--	0.0034
AP05S	8/30/2021	UA	--	0.051	59	--	--	--	0.0027
AP05S	2/16/2022	UA	--	0.04	46	--	--	--	0.0012
AP05S	7/25/2022	UA	--	0.074	--	--	--	--	0.0046
AP05S	2/28/2023	UA	--	0.039	54	--	--	--	0.0021
AP05S	6/14/2023	UA	>6	0.035	50	0.4	0.19	10400	<0.00079
AP05S	8/23/2023	UA	>6	0.027	46	0.26	0.23	14800	<0.00074
AP05S	11/6/2023	UA	--	0.032	48	--	--	--	<0.00082
AP07D	2/10/2021	BCU	--	0.053	6.3	0.07	--	--	0.011
AP07D	3/8/2021	BCU	--	0.41	96	5.7	--	--	0.01
AP07D	3/24/2021	BCU	--	0.49	110	5.7	--	--	0.0092
AP07D	4/13/2021	BCU	--	0.15	19	0.62	--	--	0.015
AP07D	5/5/2021	BCU	--	0.72	120	5.9	--	--	0.015
AP07D	7/22/2021	BCU	--	0.12	14	0.35	--	--	0.0087
AP07S	2/10/2021	PMP	--	<0.02	45	0.4	--	--	<0.001
AP07S	3/4/2021	PMP	--	<0.01	47	0.51	--	--	0.0017
AP07S	3/24/2021	PMP	--	<0.02	46	0.43	--	--	<0.001
AP07S	4/13/2021	PMP	--	<0.02	89	0.89	--	--	0.001
AP07S	5/5/2021	PMP	--	<0.02	99	1.1	--	--	0.0023
AP07S	6/16/2021	PMP	--	<0.02	110	1.1	--	--	<0.001
AP07S	6/28/2021	PMP	--	<0.02	110	1.1	--	--	<0.001
AP07S	7/22/2021	PMP	--	<0.02	110	1.2	--	--	<0.001
AP07S	2/28/2023	PMP	--	<0.0067	49	--	--	--	0.0035
AP07S	6/15/2023	PMP	0.097	<0.0088	93	0.93	0.9	<10.0	0.0012
AP07S	8/28/2023	PMP	0.25	<0.0061	57	0.51	0.4	<10.0	0.0011
AP07S	11/3/2023	PMP	--	<0.005	49	--	--	--	0.001

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Potassium, total (mg/L)	Radium 226 + Radium 228, total (pCi/L)	Silicon, total (ug/L)	Sodium, total (mg/L)	Sulfate, total (mg/L)	Sulfide, total (mg/L)
AP05D	2/10/2021	BCU	8.5	1.21	--	390	40	--
AP05D	3/8/2021	BCU	8.4	1.19	--	450	32	--
AP05D	3/24/2021	BCU	8.6	0.997	--	390	43	--
AP05D	4/15/2021	BCU	8.6	2.75	--	680	1.6	--
AP05D	5/7/2021	BCU	10	3.75	--	760	1.3	--
AP05S	2/27/2020	UA	6.8	2.85	--	190	<1.0	--
AP05S	9/1/2020	UA	--	3.16	--	--	<1.0	--
AP05S	2/10/2021	UA	3.2	0.773	--	160	1.2	--
AP05S	2/23/2021	UA	5.1	2.9	--	180	<1.0	--
AP05S	3/8/2021	UA	4.6	2.7	--	190	<1.0	--
AP05S	3/24/2021	UA	4.1	4.48	--	190	2.2	--
AP05S	4/13/2021	UA	4.6	2.66	--	190	5	--
AP05S	5/7/2021	UA	6.6	3.38	--	190	2.7	--
AP05S	6/16/2021	UA	6.8	9.64	--	180	1.8	--
AP05S	6/29/2021	UA	4.7	8.25	--	180	1.6	--
AP05S	7/22/2021	UA	6.2	6.09	--	180	2.5	--
AP05S	8/30/2021	UA	5.5	9.63	--	180	1.4	--
AP05S	2/16/2022	UA	4.9	4.4	--	200	3.3	--
AP05S	7/25/2022	UA	--	4	--	--	2.4	--
AP05S	2/28/2023	UA	4.6	3.12	--	180	14	--
AP05S	6/14/2023	UA	4.5	4.53	28000	200	3.1	<2
AP05S	8/23/2023	UA	3.8	1.4	21000	180	5.6	0.4
AP05S	11/6/2023	UA	4.3	3.94	--	180	<0.18	--
AP07D	2/10/2021	BCU	4.8	0.268	--	580	130	--
AP07D	3/8/2021	BCU	23	12.2	--	690	96	--
AP07D	3/24/2021	BCU	26	19.4	--	760	51	--
AP07D	4/13/2021	BCU	10	4.24	--	740	54	--
AP07D	5/5/2021	BCU	62	23	--	930	47	--
AP07D	7/22/2021	BCU	9.7	1.68	--	890	100	--
AP07S	2/10/2021	PMP	0.46	0.123	--	54	160	--
AP07S	3/4/2021	PMP	1.3	1.22	--	56	150	--
AP07S	3/24/2021	PMP	0.38	0.207	--	52	160	--
AP07S	4/13/2021	PMP	0.89	0.336	--	50	430	--
AP07S	5/5/2021	PMP	1.6	1.2	--	51	420	--
AP07S	6/16/2021	PMP	0.76	1.82	--	49	440	--
AP07S	6/28/2021	PMP	0.8	1.85	--	58	410	--
AP07S	7/22/2021	PMP	0.93	1.4	--	62	480	--
AP07S	2/28/2023	PMP	1.4	0.782	--	63	180	--
AP07S	6/15/2023	PMP	1.2	1.2	13000	73	480	<2
AP07S	8/28/2023	PMP	0.59	1.26	7600	59	240	<2
AP07S	11/3/2023	PMP	0.48	1.02	--	63	180	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	pH (field) (SU)	Turbidity, field (NTU)	Alkalinity, total (mg/L)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Aluminum, total (mg/L)
AP08	2/28/2020	CCR	12.00	251	490	-97.2	0.56	--
AP09	2/28/2020	CCR	11.90	3430	500	-278.0	0.31	--
APW-01	6/17/2021	UA	6.86	2000	340	-103.0	0.63	--
APW-01	6/29/2021	UA	6.80	3560	320	-95.6	24.00	--
APW-01	7/22/2021	UA	6.91	3280	340	-135.0	0.09	--
APW-01	6/14/2023	UA	7.03	160.62	340	-197.3	0.15	<0.019
APW-01	8/23/2023	UA	6.50	16.9	390	-83.0	2.80	1.1
APW-01	11/6/2023	UA	6.91	490	360	-97.0	2.70	--
APW-02	2/10/2021	UCF	7.04	1.24	490	-104.2	0.22	--
APW-02	3/3/2021	UCF	6.99	34.33	490	-76.8	0.17	--
APW-02	3/24/2021	UCF	6.47	249.42	520	-41.6	0.30	--
APW-02	4/13/2021	UCF	6.92	123	510	-93.7	1.50	--
APW-02	5/6/2021	UCF	6.82	71.1	520	-118.0	0.67	--
APW-03	2/10/2021	UCF	6.80	106.14	880	-111.2	0.14	--
APW-03	3/4/2021	UCF	6.62	67.28	860	-52.9	0.19	--
APW-03	3/24/2021	UCF	6.36	0	910	-51.7	0.23	--
APW-03	4/13/2021	UCF	6.77	732	900	-128.0	0.23	--
APW-03	5/7/2021	UCF	6.78	595	860	-106.0	0.98	--
APW-04	2/10/2021	UCF	6.89	141.35	550	-89.8	0.18	--
APW-04	3/4/2021	UCF	6.85	131.41	540	-55.0	0.21	--
APW-04	3/22/2021	UCF	6.89	514.43	520	-50.9	0.21	--
APW-04	4/13/2021	UCF	6.83	1300	520	-123.0	0.26	--
APW-04	5/7/2021	UCF	6.84	114	450	-125.0	0.19	--
AW-01	11/18/2022	PMP	6.86	11.53	520	88.0	0.67	--
AW-01	12/15/2022	PMP	7.29	4095.8	680	-163.4	0.71	--
AW-01	1/10/2023	PMP	6.84	37.2	440	-129.9	0.46	--
AW-01	2/28/2023	PMP	6.98	1000	290	-89.0	1.10	--
AW-01	6/14/2023	PMP	6.82	196	720	-72.0	0.15	0.075
AW-01	8/22/2023	PMP	6.64	8.5	760	-95.0	0.51	0.076
AW-01	11/6/2023	PMP	6.76	304	700	-83.0	1.80	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Arsenic, total (mg/L)	Barium, total (mg/L)	Boron, total (mg/L)	Calcium, total (mg/L)	Carbon, total organic (mg/L)	Chloride, total (mg/L)	Iron, total (mg/L)	Iron, dissolved (mg/L)
AP08	2/28/2020	CCR	0.047	0.11	12.00	71	--	94	--	--
AP09	2/28/2020	CCR	0.17	8.3	5.30	320	--	90	--	--
APW-01	6/17/2021	UA	0.025	0.12	0.69	190	--	210	31	--
APW-01	6/29/2021	UA	0.023	0.19	0.71	180	--	160	50	--
APW-01	7/22/2021	UA	0.018	0.13	0.84	180	--	160	33	--
APW-01	6/14/2023	UA	0.0079	0.064	1.10	170	1.7	120	9.5	9
APW-01	8/23/2023	UA	0.0065	0.069	1.00	170	1.9	130	11	8.5
APW-01	11/6/2023	UA	0.014	0.085	1.10	170	--	120	--	--
APW-02	2/10/2021	UCF	<0.001	0.15	0.05	100	--	12	6.7	--
APW-02	3/3/2021	UCF	<0.001	0.17	0.07	120	--	10	11	--
APW-02	3/24/2021	UCF	<0.001	0.17	0.05	120	--	12	11	--
APW-02	4/13/2021	UCF	0.0012	0.19	0.11	130	--	9.7	11	--
APW-02	5/6/2021	UCF	<0.001	0.16	0.13	120	--	13	11	--
APW-03	2/10/2021	UCF	<0.001	0.26	0.15	160	--	27	7	--
APW-03	3/4/2021	UCF	<0.001	0.3	0.13	180	--	28	8.8	--
APW-03	3/24/2021	UCF	<0.001	0.3	0.13	170	--	28	8.2	--
APW-03	4/13/2021	UCF	0.0011	0.35	0.14	200	--	28	11	--
APW-03	5/7/2021	UCF	0.0011	0.34	0.14	200	--	33	10	--
APW-04	2/10/2021	UCF	0.0089	0.34	0.56	160	--	170	26	--
APW-04	3/4/2021	UCF	0.0094	0.38	0.60	180	--	180	30	--
APW-04	3/22/2021	UCF	0.0064	0.33	0.63	180	--	230	25	--
APW-04	4/13/2021	UCF	0.016	0.5	0.54	180	--	220	52	--
APW-04	5/7/2021	UCF	0.0054	0.33	0.69	200	--	350	23	--
AW-01	11/18/2022	PMP	0.017	0.14	0.09	190	--	13	--	--
AW-01	12/15/2022	PMP	0.0015	0.1	0.07	150	--	19	--	--
AW-01	1/10/2023	PMP	0.0071	0.12	0.08	170	--	14	--	--
AW-01	2/28/2023	PMP	0.02	0.17	1.10	180	--	110	--	--
AW-01	6/14/2023	PMP	0.0063	0.14	0.07	180	5.4	10	9.4	6.7
AW-01	8/22/2023	PMP	0.0051	0.13	0.09	190	5.4	12	12	7.3
AW-01	11/6/2023	PMP	0.012	0.14	0.09	190	--	10	--	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Ferrous Iron, dissolved (mg/L)	Lithium, total (mg/L)	Magnesium, total (mg/L)	Manganese, total (mg/L)	Manganese, dissolved (mg/L)	Methane, total (mg/L)	Molybdenum, total (mg/L)
AP08	2/28/2020	CCR	--	0.56	1.3	--	--	--	4.4
AP09	2/28/2020	CCR	--	0.35	48	--	--	--	1.3
APW-01	6/17/2021	UA	--	0.028	84	2.8	--	--	0.0025
APW-01	6/29/2021	UA	--	0.032	83	3.4	--	--	0.0023
APW-01	7/22/2021	UA	--	<0.02	83	2.8	--	--	0.0024
APW-01	6/14/2023	UA	--	<0.0077	78	1.8	1.8	<10.0	0.0013
APW-01	8/23/2023	UA	>6	<0.0096	77	1.7	1.6	35.7	0.0013
APW-01	11/6/2023	UA	--	<0.012	76	--	--	--	0.0019
APW-02	2/10/2021	UCF	--	<0.02	42	0.56	--	--	<0.001
APW-02	3/3/2021	UCF	--	<0.02	45	0.61	--	--	<0.001
APW-02	3/24/2021	UCF	--	<0.02	45	0.54	--	--	<0.001
APW-02	4/13/2021	UCF	--	<0.02	47	0.75	--	--	<0.001
APW-02	5/6/2021	UCF	--	<0.02	45	0.62	--	--	<0.001
APW-03	2/10/2021	UCF	--	<0.02	72	0.39	--	--	<0.001
APW-03	3/4/2021	UCF	--	0.018	71	0.42	--	--	<0.001
APW-03	3/24/2021	UCF	--	<0.02	73	0.37	--	--	<0.001
APW-03	4/13/2021	UCF	--	<0.02	77	0.47	--	--	<0.001
APW-03	5/7/2021	UCF	--	<0.02	77	0.43	--	--	<0.001
APW-04	2/10/2021	UCF	--	<0.02	66	1.2	--	--	0.0034
APW-04	3/4/2021	UCF	--	0.012	73	1.3	--	--	0.0046
APW-04	3/22/2021	UCF	--	<0.02	74	1.2	--	--	0.0015
APW-04	4/13/2021	UCF	--	<0.02	76	1.4	--	--	0.0049
APW-04	5/7/2021	UCF	--	<0.02	76	1.3	--	--	0.0014
AW-01	11/18/2022	PMP	--	<0.02	86	--	--	--	0.0033
AW-01	12/15/2022	PMP	--	<0.02	64	--	--	--	0.0029
AW-01	1/10/2023	PMP	--	<0.0059	73	--	--	--	0.0051
AW-01	2/28/2023	PMP	--	<0.018	82	--	--	--	0.0022
AW-01	6/14/2023	PMP	>6	<0.005	78	3.6	3.7	982	0.0034
AW-01	8/22/2023	PMP	6.3	<0.006	79	3.9	3.7	2680	0.0041
AW-01	11/6/2023	PMP	--	<0.007	84	--	--	--	0.0034

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Potassium, total (mg/L)	Radium 226 + Radium 228, total (pCi/L)	Silicon, total (ug/L)	Sodium, total (mg/L)	Sulfate, total (mg/L)	Sulfide, total (mg/L)
AP08	2/28/2020	CCR	140	2.05	--	260	360	--
AP09	2/28/2020	CCR	92	1.09	--	290	260	--
APW-01	6/17/2021	UA	1.8	1.62	--	55	300	--
APW-01	6/29/2021	UA	2.7	4.15	--	45	280	--
APW-01	7/22/2021	UA	2.1	1.73	--	48	300	--
APW-01	6/14/2023	UA	0.44	--	7600	57	290	<2
APW-01	8/23/2023	UA	0.79	0.737	9600	53	300	<2
APW-01	11/6/2023	UA	1.3	3.7	--	53	290	--
APW-02	2/10/2021	UCF	0.67	0.207	--	35	1.4	--
APW-02	3/3/2021	UCF	0.72	0.836	--	36	1.4	--
APW-02	3/24/2021	UCF	0.71	0.578	--	34	5.7	--
APW-02	4/13/2021	UCF	0.89	0.0707	--	35	11	--
APW-02	5/6/2021	UCF	0.76	0.365	--	34	10	--
APW-03	2/10/2021	UCF	1.2	0.37	--	82	<1.0	--
APW-03	3/4/2021	UCF	1.3	1.1	--	78	2	--
APW-03	3/24/2021	UCF	1.2	0.756	--	82	3.5	--
APW-03	4/13/2021	UCF	1.4	0.547	--	87	7.1	--
APW-03	5/7/2021	UCF	1.6	1.38	--	85	8.7	--
APW-04	2/10/2021	UCF	1.8	0.551	--	66	20	--
APW-04	3/4/2021	UCF	1.7	1.18	--	70	32	--
APW-04	3/22/2021	UCF	1.6	0.748	--	75	42	--
APW-04	4/13/2021	UCF	2.1	3.85	--	65	43	--
APW-04	5/7/2021	UCF	1.8	0.553	--	76	58	--
AW-01	11/18/2022	PMP	0.32	0.449	--	18	41	--
AW-01	12/15/2022	PMP	0.54	0.288	--	17	43	--
AW-01	1/10/2023	PMP	0.98	0	--	22	41	--
AW-01	2/28/2023	PMP	2.1	2.77	--	49	280	--
AW-01	6/14/2023	PMP	0.3	0.773	8500	18	52	<2
AW-01	8/22/2023	PMP	0.33	1.13	8200	17	52	<2
AW-01	11/6/2023	PMP	0.77	4.72	--	18	50	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	pH (field) (SU)	Turbidity, field (NTU)	Alkalinity, total (mg/L)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Aluminum, total (mg/L)
AW-05	2/27/2020	UA	7.00	922	400	51.4	3.80	--
AW-05	6/17/2021	UA	6.98	186	420	-42.2	0.64	--
AW-05	6/28/2021	UA	7.04	39.2	410	6.8	0.80	--
AW-05	7/22/2021	UA	7.06	19	420	-35.6	0.73	--
AW-05	2/28/2023	UA	7.24	1000	340	162.0	3.90	--
AW-05	6/15/2023	UA	6.96	1000	410	95.0	0.27	5.4
AW-05	8/28/2023	UA	7.01	697	390	26.0	0.49	4.4
AW-05	11/6/2023	UA	6.85	699	350	-42.0	1.50	--
AW-06	2/27/2020	UA	7.00	119	440	16.2	2.40	--
AW-06	8/31/2020	UA	7.27	36	--	-42.6	5.40	--
AW-06	2/23/2021	UA	7.07	1650	490	-30.1	2.00	--
AW-06	8/30/2021	UA	7.11	319	450	-93.4	0.60	--
AW-06	2/16/2022	UA	6.84	600	400	-49.5	0.51	--
AW-06	7/25/2022	UA	7.17	1.49	--	-96.5	0.37	--
AW-06	2/28/2023	UA	7.39	1000	400	-65.0	1.60	--
AW-06	6/14/2023	UA	7.09	340	500	-99.0	1.40	0.49
AW-06	8/28/2023	UA	7.00	36.3	480	-85.0	2.00	0.55
AW-06	11/6/2023	UA	7.41	609	480	-91.0	1.60	--
AW-08	2/27/2020	UA	6.93	33.5	700	-140.0	0.23	--
AW-08	9/1/2020	UA	7.07	3.3	--	-149.0	0.07	--
AW-08	2/10/2021	UA	7.11	2.51	650	-103.9	0.26	--
AW-08	2/23/2021	UA	6.91	1310	720	-144.0	0.46	--
AW-08	3/5/2021	UA	6.91	3.75	600	-64.0	0.33	--
AW-08	3/24/2021	UA	6.34	1.32	660	-83.6	0.28	--
AW-08	4/13/2021	UA	6.77	500	710	-154.0	0.64	--
AW-08	5/7/2021	UA	7.02	59.8	640	-156.0	1.70	--
AW-08	6/16/2021	UA	7.01	87.9	710	-152.0	3.50	--
AW-08	6/28/2021	UA	7.00	133	700	-98.8	7.90	--
AW-08	7/21/2021	UA	6.86	16.9	720	-126.0	0.00	--
AW-08	8/30/2021	UA	7.15	<0.0	680	-150.0	7.90	--
AW-08	2/16/2022	UA	6.99	3.13	650	-86.9	8.30	--
AW-08	7/25/2022	UA	7.33	1.15	--	-112.0	9.50	--
AW-08	2/28/2023	UA	8.92	11.9	620	-133.0	1.60	--
AW-08	6/14/2023	UA	7.09	<0.0	710	-141.0	8.20	0.058
AW-08	8/28/2023	UA	6.93	116	690	-120.0	12.00	0.034
AW-08	11/6/2023	UA	7.32	1000	940	-150.0	0.07	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Arsenic, total (mg/L)	Barium, total (mg/L)	Boron, total (mg/L)	Calcium, total (mg/L)	Carbon, total organic (mg/L)	Chloride, total (mg/L)	Iron, total (mg/L)	Iron, dissolved (mg/L)
AW-05	2/27/2020	UA	0.032	0.4	1.80	170	--	81	--	--
AW-05	6/17/2021	UA	0.0039	0.12	2.60	160	--	110	5.7	--
AW-05	6/28/2021	UA	0.0035	0.11	3.10	170	--	69	5.2	--
AW-05	7/22/2021	UA	0.0032	0.11	2.90	150	--	67	4.3	--
AW-05	2/28/2023	UA	0.0068	0.21	4.50	170	--	78	--	--
AW-05	6/15/2023	UA	0.0045	0.16	3.60	170	1.9	71	14	2.9
AW-05	8/28/2023	UA	0.0033	0.13	8.60	180	1.6	78	12	4.4
AW-05	11/6/2023	UA	0.0032	0.11	11.00	180	--	81	--	--
AW-06	2/27/2020	UA	0.0053	0.21	0.12	110	--	33	--	--
AW-06	8/31/2020	UA	0.0024	0.15	0.12	100	--	34	--	--
AW-06	2/23/2021	UA	0.026	0.4	0.13	130	--	36	--	--
AW-06	8/30/2021	UA	0.0029	0.16	0.11	110	--	35	--	--
AW-06	2/16/2022	UA	0.0047	0.18	0.12	110	--	37	--	--
AW-06	7/25/2022	UA	0.0017	0.15	0.11	110	--	40	--	--
AW-06	2/28/2023	UA	0.0064	0.19	0.18	110	--	31	--	--
AW-06	6/14/2023	UA	0.003	0.16	0.12	100	4.5	35	2.5	0.96
AW-06	8/28/2023	UA	0.0052	0.19	0.13	120	3.9	33	11	0.62
AW-06	11/6/2023	UA	0.0044	0.18	0.15	110	--	37	--	--
AW-08	2/27/2020	UA	0.019	0.23	0.11	140	--	16	--	--
AW-08	9/1/2020	UA	0.0086	0.17	0.17	130	--	16	--	--
AW-08	2/10/2021	UA	0.0081	0.16	0.12	130	--	17	14	--
AW-08	2/23/2021	UA	0.018	0.28	0.12	150	--	5.2	--	--
AW-08	3/5/2021	UA	0.0065	0.18	0.17	140	--	16	19	--
AW-08	3/24/2021	UA	0.0063	0.16	0.10	130	--	20	13	--
AW-08	4/13/2021	UA	0.024	0.33	0.19	150	--	14	42	--
AW-08	5/7/2021	UA	0.014	0.24	0.12	150	--	14	32	--
AW-08	6/16/2021	UA	0.024	0.27	0.18	150	--	15	35	--
AW-08	6/28/2021	UA	0.018	0.24	0.13	150	--	17	28	--
AW-08	7/21/2021	UA	0.02	0.26	0.11	140	--	14	32	--
AW-08	8/30/2021	UA	0.018	0.25	0.09	150	--	18	--	--
AW-08	2/16/2022	UA	0.018	0.23	0.10	140	--	17	--	--
AW-08	7/25/2022	UA	0.0073	0.16	0.10	140	--	18	--	--
AW-08	2/28/2023	UA	0.011	0.2	0.10	140	--	14	--	--
AW-08	6/14/2023	UA	0.01	0.19	0.09	140	9.8	16	16	7.3
AW-08	8/28/2023	UA	0.0098	0.19	0.12	140	9.5	15	17	16
AW-08	11/6/2023	UA	0.088	5.8	0.35	760	--	20	--	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Ferrous Iron, dissolved (mg/L)	Lithium, total (mg/L)	Magnesium, total (mg/L)	Manganese, total (mg/L)	Manganese, dissolved (mg/L)	Methane, total (mg/L)	Molybdenum, total (mg/L)
AW-05	2/27/2020	UA	--	0.053	78	--	--	--	0.004
AW-05	6/17/2021	UA	--	0.024	70	1.9	--	--	0.0022
AW-05	6/28/2021	UA	--	<0.02	78	1.5	--	--	0.0018
AW-05	7/22/2021	UA	--	<0.02	71	1.8	--	--	0.002
AW-05	2/28/2023	UA	--	0.025	82	--	--	--	0.0026
AW-05	6/15/2023	UA	3	<0.017	82	1.9	1.4	<10.0	0.0023
AW-05	8/28/2023	UA	4.2	<0.017	81	2.1	1.6	<10.0	0.0025
AW-05	11/6/2023	UA	--	<0.013	92	--	--	--	0.0022
AW-06	2/27/2020	UA	--	0.02	44	--	--	--	0.0049
AW-06	8/31/2020	UA	--	<0.02	--	--	--	--	0.0046
AW-06	2/23/2021	UA	--	0.033	56	--	--	--	0.0063
AW-06	8/30/2021	UA	--	<0.02	46	--	--	--	0.0053
AW-06	2/16/2022	UA	--	<0.02	45	--	--	--	0.0045
AW-06	7/25/2022	UA	--	0.011	--	--	--	--	0.0046
AW-06	2/28/2023	UA	--	<0.012	45	--	--	--	0.0053
AW-06	6/14/2023	UA	0.55	<0.012	45	0.57	0.44	<10.0	0.0049
AW-06	8/28/2023	UA	2.2	<0.013	46	1.4	0.23	<10.0	0.006
AW-06	11/6/2023	UA	--	<0.014	49	--	--	--	0.0047
AW-08	2/27/2020	UA	--	<0.02	57	--	--	--	0.0051
AW-08	9/1/2020	UA	--	<0.02	--	--	--	--	0.0023
AW-08	2/10/2021	UA	--	<0.02	55	1.1	--	--	0.0015
AW-08	2/23/2021	UA	--	<0.02	59	--	--	--	0.0033
AW-08	3/5/2021	UA	--	<0.02	59	1.3	--	--	0.0051
AW-08	3/24/2021	UA	--	<0.02	57	1.3	--	--	0.0056
AW-08	4/13/2021	UA	--	<0.02	57	1.5	--	--	0.0027
AW-08	5/7/2021	UA	--	<0.02	57	1.3	--	--	0.0025
AW-08	6/16/2021	UA	--	<0.02	59	1.4	--	--	0.0041
AW-08	6/28/2021	UA	--	<0.02	61	1.3	--	--	0.0017
AW-08	7/21/2021	UA	--	<0.02	57	1.3	--	--	0.0014
AW-08	8/30/2021	UA	--	<0.02	59	--	--	--	0.0017
AW-08	2/16/2022	UA	--	<0.02	59	--	--	--	0.002
AW-08	7/25/2022	UA	--	0.016	--	--	--	--	0.0019
AW-08	2/28/2023	UA	--	<0.0097	58	--	--	--	0.0018
AW-08	6/14/2023	UA	>6	<0.0099	59	1.1	1.1	3530	0.0016
AW-08	8/28/2023	UA	>6	<0.013	56	1	1	5070	0.0018
AW-08	11/6/2023	UA	--	0.66	450	--	--	--	0.014

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Potassium, total (mg/L)	Radium 226 + Radium 228, total (pCi/L)	Silicon, total (ug/L)	Sodium, total (mg/L)	Sulfate, total (mg/L)	Sulfide, total (mg/L)
AW-05	2/27/2020	UA	7.7	0.809	--	68	270	--
AW-05	6/17/2021	UA	1.1	0.801	--	63	330	--
AW-05	6/28/2021	UA	1	0.14	--	70	290	--
AW-05	7/22/2021	UA	0.81	3.77	--	64	300	--
AW-05	2/28/2023	UA	3.2	1.44	--	76	320	--
AW-05	6/15/2023	UA	2	3.09	19000	74	350	<2
AW-05	8/28/2023	UA	1.8	0.0965	17000	79	460	<2
AW-05	11/6/2023	UA	1.3	0.465	--	91	5.7	--
AW-06	2/27/2020	UA	1.6	0.242	--	55	23	--
AW-06	8/31/2020	UA	--	0.945	--	--	25	--
AW-06	2/23/2021	UA	2.8	1.97	--	44	27	--
AW-06	8/30/2021	UA	0.88	0.982	--	49	28	--
AW-06	2/16/2022	UA	0.74	1.04	--	57	25	--
AW-06	7/25/2022	UA	--	0.679	--	--	24	--
AW-06	2/28/2023	UA	0.84	0.489	--	57	22	--
AW-06	6/14/2023	UA	0.78	0.91	11000	59	21	<2
AW-06	8/28/2023	UA	0.57	0.107	11000	41	27	<2
AW-06	11/6/2023	UA	1	0.785	--	60	23	--
AW-08	2/27/2020	UA	1.6	0.933	--	62	<1.0	--
AW-08	9/1/2020	UA	--	0.124	--	--	2.3	--
AW-08	2/10/2021	UA	1.6	0.158	--	56	<1.0	--
AW-08	2/23/2021	UA	2.2	1.82	--	58	<1.0	--
AW-08	3/5/2021	UA	1.6	0.291	--	64	3.2	--
AW-08	3/24/2021	UA	1.7	0.251	--	58	3.9	--
AW-08	4/13/2021	UA	2.3	0.416	--	59	<1.0	--
AW-08	5/7/2021	UA	1.5	0.0155	--	61	1.5	--
AW-08	6/16/2021	UA	1.5	0.139	--	57	<1.0	--
AW-08	6/28/2021	UA	1.4	0.568	--	62	1.5	--
AW-08	7/21/2021	UA	1.3	0.589	--	56	<1.0	--
AW-08	8/30/2021	UA	1.4	0.33	--	56	<1.0	--
AW-08	2/16/2022	UA	1.5	1.2	--	62	<1.0	--
AW-08	7/25/2022	UA	--	1.09	--	--	0.94	--
AW-08	2/28/2023	UA	1.4	0.261	--	63	<0.35	--
AW-08	6/14/2023	UA	1.5	0.815	14000	61	<0.18	<2
AW-08	8/28/2023	UA	1.5	0.434	14000	61	<0.18	<2
AW-08	11/6/2023	UA	41	29.1	--	93	<0.18	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	pH (field) (SU)	Turbidity, field (NTU)	Alkalinity, total (mg/L)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Aluminum, total (mg/L)
AW-09	2/27/2020	UA	6.90	135	720	-114.0	1.00	--
AW-09	8/31/2020	UA	6.93	352	--	-115.0	1.80	--
AW-09	2/23/2021	UA	6.89	485	760	-123.0	1.10	--
AW-09	8/30/2021	UA	7.00	480	710	-175.0	0.38	--
AW-09	2/16/2022	UA	6.88	138	660	-105.0	1.70	--
AW-09	7/25/2022	UA	6.98	1.6	--	-146.0	0.44	--
AW-09	2/28/2023	UA	7.02	77.2	750	-130.0	1.00	--
AW-09	6/12/2023	UA	6.89	67.2	790	-122.0	1.70	0.11
AW-09	8/29/2023	UA	7.12	177	720	-94.0	4.50	1.2
AW-09	11/6/2023	UA	7.07	234	750	-110.0	1.80	--
AW-10	2/27/2020	UA	6.76	863	1100	-127.0	0.04	--
AW-10	8/31/2020	UA	6.81	375	--	-135.0	0.05	--
AW-10	2/23/2021	UA	6.91	740	1100	-138.0	0.00	--
AW-10	3/23/2021	UA	6.82	1610.37	1100	-55.7	0.13	--
AW-10	8/30/2021	UA	6.96	509	1000	-176.0	0.00	--
AW-10	2/16/2022	UA	6.97	32.8	960	-153.0	0.00	--
AW-10	7/25/2022	UA	7.08	4.87	--	-122.0	2.00	--
AW-10	2/28/2023	UA	7.00	1000	1100	-89.0	0.82	--
AW-10	6/13/2023	UA	6.91	991	1000	-151.0	0.01	1.2
AW-10	8/28/2023	UA	6.42	<0.0	990	-111.0	0.00	5.3
AW-10	11/6/2023	UA	7.31	520	980	-125.0	1.60	--
AW-11	2/27/2020	UA	6.72	2400	960	-152.0	0.00	--
AW-11	8/31/2020	UA	6.92	170	--	-163.0	0.01	--
AW-11	2/23/2021	UA	6.96	582	960	-140.0	0.00	--
AW-11	8/30/2021	UA	6.90	269	900	-132.0	0.72	--
AW-11	2/16/2022	UA	6.86	95.7	900	-161.0	0.00	--
AW-11	7/25/2022	UA	6.94	2.8	--	-140.0	0.04	--
AW-11	2/28/2023	UA	7.17	1000	990	-103.0	0.91	--
AW-11	6/13/2023	UA	7.03	329	1000	-160.0	0.10	0.3
AW-11	8/28/2023	UA	6.29	100	900	-96.0	0.24	0.46
AW-11	11/3/2023	UA	6.87	169	980	-148.0	1.90	--
AW-12	2/11/2021	UA	6.79	531.09	760	-113.5	0.10	--
AW-12	3/4/2021	UA	6.76	6.58	750	-65.1	0.07	--
AW-12	3/24/2021	UA	6.45	48.1	760	-57.8	0.09	--
AW-12	4/12/2021	UA	7.01	139	750	-89.6	0.09	--
AW-12	5/7/2021	UA	6.97	3.07	750	-128.0	0.91	--
AW-13	2/11/2021	UA	6.86	133.66	950	-90.2	0.15	--
AW-13	3/4/2021	UA	6.73	46.94	940	-28.8	0.05	--
AW-13	3/23/2021	UA	6.70	112.4	960	-48.2	0.09	--
AW-13	4/12/2021	UA	6.85	1200	940	-86.0	0.14	--
AW-13	5/7/2021	UA	6.82	30.1	880	-96.5	0.08	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Arsenic, total (mg/L)	Barium, total (mg/L)	Boron, total (mg/L)	Calcium, total (mg/L)	Carbon, total organic (mg/L)	Chloride, total (mg/L)	Iron, total (mg/L)	Iron, dissolved (mg/L)
AW-09	2/27/2020	UA	0.017	0.46	0.24	130	--	24	--	--
AW-09	8/31/2020	UA	0.02	0.46	0.26	120	--	26	--	--
AW-09	2/23/2021	UA	0.017	0.46	0.28	140	--	8.1	--	--
AW-09	8/30/2021	UA	0.018	0.46	0.24	130	--	27	--	--
AW-09	2/16/2022	UA	0.012	0.37	0.25	120	--	28	--	--
AW-09	7/25/2022	UA	0.017	0.47	0.25	130	--	30	--	--
AW-09	2/28/2023	UA	0.012	0.2	0.10	140	--	26	--	--
AW-09	6/12/2023	UA	0.01	0.29	0.26	120	21	29	16	11
AW-09	8/29/2023	UA	0.017	0.39	0.31	120	21	28	20	13
AW-09	11/6/2023	UA	0.024	0.43	0.31	120	--	29	--	--
AW-10	2/27/2020	UA	0.011	1.2	0.46	140	--	83	--	--
AW-10	8/31/2020	UA	0.014	1.3	0.54	140	--	88	--	--
AW-10	2/23/2021	UA	0.01	1	0.55	130	--	110	--	--
AW-10	3/23/2021	UA	0.0095	0.98	0.50	130	--	96	14	--
AW-10	8/30/2021	UA	0.011	1.1	0.49	130	--	94	--	--
AW-10	2/16/2022	UA	0.0099	0.98	0.46	130	--	92	--	--
AW-10	7/25/2022	UA	0.0099	1	0.46	140	--	100	--	--
AW-10	2/28/2023	UA	0.016	1.3	0.52	140	--	85	--	--
AW-10	6/13/2023	UA	0.0099	0.99	0.46	130	20	89	16	9.8
AW-10	8/28/2023	UA	0.013	1.1	0.50	140	20	86	27	14
AW-10	11/6/2023	UA	0.012	1	0.47	140	--	84	--	--
AW-11	2/27/2020	UA	0.013	1.3	0.22	170	--	30	--	--
AW-11	8/31/2020	UA	0.011	0.77	0.21	150	--	29	--	--
AW-11	2/23/2021	UA	0.011	0.98	0.25	160	--	33	--	--
AW-11	8/30/2021	UA	0.011	0.93	0.23	160	--	32	--	--
AW-11	2/16/2022	UA	0.0099	1.1	0.23	150	--	35	--	--
AW-11	7/25/2022	UA	0.0094	1	0.23	160	--	39	--	--
AW-11	2/28/2023	UA	0.013	1.1	0.24	170	--	30	--	--
AW-11	6/13/2023	UA	0.0099	0.94	0.24	160	23	33	23	17
AW-11	8/28/2023	UA	0.011	0.87	0.24	170	24	32	28	21
AW-11	11/3/2023	UA	0.011	0.84	0.26	160	--	33	--	--
AW-12	2/11/2021	UA	0.0021	1.4	0.27	130	--	43	14	--
AW-12	3/4/2021	UA	0.0026	1.5	0.24	120	--	41	12	--
AW-12	3/24/2021	UA	0.0025	1.4	0.21	120	--	45	13	--
AW-12	4/12/2021	UA	0.0068	1.5	0.23	130	--	39	14	--
AW-12	5/7/2021	UA	0.0038	1.5	0.26	140	--	34	15	--
AW-13	2/11/2021	UA	0.013	1.5	0.30	140	--	80	16	--
AW-13	3/4/2021	UA	0.0098	1.2	0.29	140	--	74	11	--
AW-13	3/23/2021	UA	0.012	1.3	0.28	140	--	89	13	--
AW-13	4/12/2021	UA	0.014	1.3	0.27	140	--	81	12	--
AW-13	5/7/2021	UA	0.014	1.4	0.30	150	--	86	12	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Ferrous Iron, dissolved (mg/L)	Lithium, total (mg/L)	Magnesium, total (mg/L)	Manganese, total (mg/L)	Manganese, dissolved (mg/L)	Methane, total (mg/L)	Molybdenum, total (mg/L)
AW-09	2/27/2020	UA	--	0.023	53	--	--	--	0.012
AW-09	8/31/2020	UA	--	0.022	--	--	--	--	0.016
AW-09	2/23/2021	UA	--	0.034	57	--	--	--	0.018
AW-09	8/30/2021	UA	--	<0.02	54	--	--	--	0.012
AW-09	2/16/2022	UA	--	<0.02	52	--	--	--	0.014
AW-09	7/25/2022	UA	--	0.013	--	--	--	--	0.014
AW-09	2/28/2023	UA	--	<0.013	59	--	--	--	0.0019
AW-09	6/12/2023	UA	>6	<0.015	51	1.6	1.5	23700	0.021
AW-09	8/29/2023	UA	>6	<0.019	50	1.6	1.6	38800	0.021
AW-09	11/6/2023	UA	--	<0.017	50	--	--	--	0.021
AW-10	2/27/2020	UA	--	0.065	67	--	--	--	0.0012
AW-10	8/31/2020	UA	--	0.051	--	--	--	--	<0.001
AW-10	2/23/2021	UA	--	0.047	63	--	--	--	<0.001
AW-10	3/23/2021	UA	--	0.04	60	0.19	--	--	<0.001
AW-10	8/30/2021	UA	--	0.038	65	--	--	--	<0.001
AW-10	2/16/2022	UA	--	0.04	63	--	--	--	<0.001
AW-10	7/25/2022	UA	--	0.033	--	--	--	--	0.00097
AW-10	2/28/2023	UA	--	0.043	66	--	--	--	0.0012
AW-10	6/13/2023	UA	>6	0.037	65	0.21	0.14	65500	0.0012
AW-10	8/28/2023	UA	>6	0.048	65	0.34	0.16	68200	0.0011
AW-10	11/6/2023	UA	--	0.058	74	--	--	--	0.0019
AW-11	2/27/2020	UA	--	0.029	71	--	--	--	0.0028
AW-11	8/31/2020	UA	--	0.025	--	--	--	--	0.0021
AW-11	2/23/2021	UA	--	0.024	67	--	--	--	0.0016
AW-11	8/30/2021	UA	--	<0.02	70	--	--	--	0.0018
AW-11	2/16/2022	UA	--	0.023	67	--	--	--	<0.001
AW-11	7/25/2022	UA	--	0.019	--	--	--	--	0.0011
AW-11	2/28/2023	UA	--	0.031	75	--	--	--	0.0032
AW-11	6/13/2023	UA	>6	<0.018	71	0.68	0.54	47300	0.0014
AW-11	8/28/2023	UA	>6	0.021	72	0.77	0.54	33500	0.0017
AW-11	11/3/2023	UA	--	<0.018	72	--	--	--	0.002
AW-12	2/11/2021	UA	--	0.036	58	0.32	--	--	0.023
AW-12	3/4/2021	UA	--	0.028	58	0.35	--	--	0.0048
AW-12	3/24/2021	UA	--	0.026	60	0.33	--	--	0.0037
AW-12	4/12/2021	UA	--	0.031	62	0.38	--	--	0.0048
AW-12	5/7/2021	UA	--	0.025	62	0.37	--	--	0.004
AW-13	2/11/2021	UA	--	0.033	67	0.28	--	--	0.0028
AW-13	3/4/2021	UA	--	0.03	60	0.25	--	--	0.0015
AW-13	3/23/2021	UA	--	0.029	63	0.19	--	--	<0.001
AW-13	4/12/2021	UA	--	0.036	65	0.19	--	--	0.0014
AW-13	5/7/2021	UA	--	0.03	64	0.15	--	--	<0.001

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Potassium, total (mg/L)	Radium 226 + Radium 228, total (pCi/L)	Silicon, total (ug/L)	Sodium, total (mg/L)	Sulfate, total (mg/L)	Sulfide, total (mg/L)
AW-09	2/27/2020	UA	2.8	1.51	--	120	<1.0	--
AW-09	8/31/2020	UA	--	1.43	--	--	<1.0	--
AW-09	2/23/2021	UA	3.5	1.01	--	110	<1.0	--
AW-09	8/30/2021	UA	1.9	0.876	--	110	<1.0	--
AW-09	2/16/2022	UA	2.1	1.34	--	130	<1.0	--
AW-09	7/25/2022	UA	--	0.803	--	--	<0.18	--
AW-09	2/28/2023	UA	1.4	1.12	--	64	<0.23	--
AW-09	6/12/2023	UA	2.1	0.23	17000	130	<0.18	<2
AW-09	8/29/2023	UA	2.3	1.52	19000	130	<0.22	<2
AW-09	11/6/2023	UA	2.3	1.35	--	140	<0.18	--
AW-10	2/27/2020	UA	6.4	2.19	--	280	<1.0	--
AW-10	8/31/2020	UA	--	3.43	--	--	<1.0	--
AW-10	2/23/2021	UA	4.2	3.1	--	270	<1.0	--
AW-10	3/23/2021	UA	3.5	1.77	--	260	<1.0	--
AW-10	8/30/2021	UA	3.9	3.21	--	270	<1.0	--
AW-10	2/16/2022	UA	3.9	2.52	--	300	<1.0	--
AW-10	7/25/2022	UA	--	2.16	--	--	<0.18	--
AW-10	2/28/2023	UA	4.2	1.57	--	290	<0.18	--
AW-10	6/13/2023	UA	3.8	2.95	15000	280	<0.18	<2
AW-10	8/28/2023	UA	4.2	4.03	22000	270	<0.18	<2
AW-10	11/6/2023	UA	5.2	3.58	--	260	<0.18	--
AW-11	2/27/2020	UA	3.7	3.68	--	160	<1.0	--
AW-11	8/31/2020	UA	--	1.52	--	--	<1.0	--
AW-11	2/23/2021	UA	2.8	2.46	--	140	<1.0	--
AW-11	8/30/2021	UA	2.7	2.31	--	150	<1.0	--
AW-11	2/16/2022	UA	2.7	2.79	--	160	<1.0	--
AW-11	7/25/2022	UA	--	0.756	--	--	<0.18	--
AW-11	2/28/2023	UA	3.9	2.25	--	150	<0.18	--
AW-11	6/13/2023	UA	2.7	2.29	17000	160	<0.18	<2
AW-11	8/28/2023	UA	2.9	2.45	18000	160	<0.18	<2
AW-11	11/3/2023	UA	2.8	1.94	--	160	<0.18	--
AW-12	2/11/2021	UA	4.9	1.62	--	120	2.8	--
AW-12	3/4/2021	UA	3.1	0.828	--	120	<1.0	--
AW-12	3/24/2021	UA	3	0.846	--	120	<1.0	--
AW-12	4/12/2021	UA	3.6	1.87	--	120	1.2	--
AW-12	5/7/2021	UA	3.1	1.24	--	130	<1.0	--
AW-13	2/11/2021	UA	3.8	3.05	--	200	3.2	--
AW-13	3/4/2021	UA	3.5	3.02	--	180	2	--
AW-13	3/23/2021	UA	3.1	2.98	--	190	1.4	--
AW-13	4/12/2021	UA	3.4	1.39	--	190	<1.0	--
AW-13	5/7/2021	UA	2.9	3.14	--	200	<1.0	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	pH (field) (SU)	Turbidity, field (NTU)	Alkalinity, total (mg/L)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Aluminum, total (mg/L)
AW-14	2/11/2021	UA	7.00	473.16	960	-85.8	0.21	--
AW-14	3/4/2021	UA	6.90	85.82	1000	-80.7	0.08	--
AW-14	3/22/2021	UA	6.92	88.76	1000	-79.4	0.08	--
AW-14	4/12/2021	UA	6.85	67.7	1000	-127.0	0.10	--
AW-14	5/6/2021	UA	6.81	67	1000	-146.0	0.83	--
AW-14	6/28/2021	UA	6.78	30.6	1000	-150.0	0.06	--
AW-14	7/21/2021	UA	6.65	40.4	1000	-131.0	0.00	--
AW-14	2/28/2023	UA	6.98	261	980	-63.0	1.10	--
AW-14	6/13/2023	UA	6.88	10.4	1000	-152.0	0.14	0.089
AW-14	8/23/2023	UA	6.99	<0.0	1100	-132.0	1.10	0.21
AW-14	11/3/2023	UA	6.76	330	1000	-128.0	1.60	--
AW-15	2/12/2021	UA	6.84	24.42	990	-81.8	0.20	--
AW-15	3/5/2021	UA	6.73	78.33	1000	-47.7	0.16	--
AW-15	3/22/2021	UA	6.82	383.49	1000	-51.5	0.60	--
AW-15	5/6/2021	UA	6.59	30.6	1000	-118.0	0.53	--
AW-15	6/17/2021	UA	--	--	780	--	--	--
AW-15	2/27/2023	UA	6.75	107	890	-102.0	1.00	--
AW-15	6/12/2023	UA	6.63	46.5	1100	-101.0	0.27	0.047
AW-15	8/23/2023	UA	6.78	<0.0	1000	-140.0	0.45	0.054
AW-15	11/2/2023	UA	6.98	2.5	1000	-95.0	0.00	--
AW-15	11/17/2023	UA	--	--		--	--	--
AW-15C	2/12/2021	BCU	6.95	155.28	990	-84.2	0.16	--
AW-15C	3/4/2021	BCU	6.84	110.74	1000	-76.4	0.10	--
AW-15C	3/22/2021	BCU	6.69	782.44	1100	-36.5	0.08	--
AW-15C	4/13/2021	BCU	7.00	0.67	1000	-53.6	0.01	--
AW-15C	5/6/2021	BCU	6.84	33.2	1000	-99.3	0.72	--
AW-15C	7/21/2021	BCU	6.81	30.1	990	-85.0	0.00	--
AW-15S	2/12/2021	PMP	6.99	702.02	480	62.9	1.79	--
AW-15S	3/4/2021	PMP	7.07	24.77	490	-3.5	0.67	--
AW-15S	3/22/2021	PMP	6.92	73.06	500	50.1	0.52	--
AW-15S	4/26/2021	PMP	6.97	0.89	450	7.1	1.10	--
AW-15S	5/6/2021	PMP	6.73	38.4	500	64.5	0.89	--
AW-15S	6/17/2021	PMP	6.65	32.1	510	-47.1	0.47	--
AW-15S	6/29/2021	PMP	6.92	23.3	450	117.0	0.24	--
AW-15S	7/21/2021	PMP	6.63	326	500	-5.0	0.00	--
AW-15S	2/27/2023	PMP	6.81	78	400	117.0	0.64	--
AW-15S	6/12/2023	PMP	6.65	29.1	510	38.0	6.00	<0.013
AW-15S	8/23/2023	PMP	6.92	<0.0	510	-29.0	0.35	0.046
AW-15S	11/2/2023	PMP	6.96	1.6	500	1.0	0.00	--
AW-15S	11/17/2023	PMP	--	--		--	--	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Arsenic, total (mg/L)	Barium, total (mg/L)	Boron, total (mg/L)	Calcium, total (mg/L)	Carbon, total organic (mg/L)	Chloride, total (mg/L)	Iron, total (mg/L)	Iron, dissolved (mg/L)
AW-14	2/11/2021	UA	0.0064	0.63	0.21	170	--	28	13	--
AW-14	3/4/2021	UA	0.011	0.59	0.19	170	--	26	15	--
AW-14	3/22/2021	UA	0.011	0.63	0.18	170	--	37	19	--
AW-14	4/12/2021	UA	0.01	0.7	0.17	170	--	24	22	--
AW-14	5/6/2021	UA	0.0096	0.75	0.19	180	--	25	23	--
AW-14	6/28/2021	UA	0.009	0.76	0.17	180	--	26	23	--
AW-14	7/21/2021	UA	0.0085	0.75	0.17	170	--	25	23	--
AW-14	2/28/2023	UA	0.015	0.72	0.18	170	--	21	--	--
AW-14	6/13/2023	UA	0.0078	0.8	0.18	180	33	24	18	16
AW-14	8/23/2023	UA	0.0052	0.84	0.18	170	32	24	18	15
AW-14	11/3/2023	UA	0.0041	0.83	0.24	170	--	28	--	--
AW-15	2/12/2021	UA	0.0023	2.1	0.57	130	--	49	8.2	--
AW-15	3/5/2021	UA	0.0037	2	0.43	140	--	43	11	--
AW-15	3/22/2021	UA	0.0041	1.7	0.47	140	--	51	10	--
AW-15	5/6/2021	UA	0.0058	1.8	0.43	140	--	41	12	--
AW-15	6/17/2021	UA	0.0063	1.4	0.30	140	--	38	16	--
AW-15	2/27/2023	UA	0.0035	1.8	0.37	140	--	32	--	--
AW-15	6/12/2023	UA	0.002	1.9	0.36	140	31	35	10	8.3
AW-15	8/23/2023	UA	0.0013	1.8	0.37	140	29	34	9.8	8.9
AW-15	11/2/2023	UA	0.0018	1.9	0.40	140	--	34	--	--
AW-15	11/17/2023	UA	--	--	--	--	--	--	--	--
AW-15C	2/12/2021	BCU	0.0059	3.1	0.81	99	--	92	8.6	--
AW-15C	3/4/2021	BCU	0.0038	3.6	0.73	110	--	55	6.8	--
AW-15C	3/22/2021	BCU	0.0035	3.2	0.60	110	--	59	5.7	--
AW-15C	4/13/2021	BCU	0.011	2.9	0.68	92	--	110	8.7	--
AW-15C	5/6/2021	BCU	0.0056	3.4	0.63	110	--	63	5.5	--
AW-15C	7/21/2021	BCU	0.0064	3.6	0.69	99	--	72	6	--
AW-15S	2/12/2021	PMP	0.0043	0.22	5.50	250	--	50	23	--
AW-15S	3/4/2021	PMP	0.001	0.11	5.40	270	--	47	2.4	--
AW-15S	3/22/2021	PMP	0.001	0.1	6.20	260	--	42	3.1	--
AW-15S	4/26/2021	PMP	<0.001	0.1	5.40	270	--	41	1.8	--
AW-15S	5/6/2021	PMP	<0.001	0.098	5.80	270	--	40	0.9	--
AW-15S	6/17/2021	PMP	<0.001	0.093	5.70	270	--	37	0.39	--
AW-15S	6/29/2021	PMP	<0.001	0.097	5.40	260	--	39	0.52	--
AW-15S	7/21/2021	PMP	0.0015	0.11	6.10	260	--	38	3.5	--
AW-15S	2/27/2023	PMP	0.0018	0.081	5.90	260	--	28	--	--
AW-15S	6/12/2023	PMP	<0.00069	0.075	6.70	280	3.4	31	0.12	0.033
AW-15S	8/23/2023	PMP	<0.00069	0.087	5.70	270	3.7	31	0.8	0.055
AW-15S	11/2/2023	PMP	<0.00069	0.084	6.00	270	--	30	--	--
AW-15S	11/17/2023	PMP	--	--	--	--	--	--	--	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Ferrous Iron, dissolved (mg/L)	Lithium, total (mg/L)	Magnesium, total (mg/L)	Manganese, total (mg/L)	Manganese, dissolved (mg/L)	Methane, total (mg/L)	Molybdenum, total (mg/L)
AW-14	2/11/2021	UA	--	0.027	66	0.98	--	--	0.046
AW-14	3/4/2021	UA	--	0.023	62	1	--	--	0.022
AW-14	3/22/2021	UA	--	0.02	65	0.92	--	--	0.0044
AW-14	4/12/2021	UA	--	0.025	67	0.86	--	--	0.0037
AW-14	5/6/2021	UA	--	<0.02	65	0.73	--	--	<0.001
AW-14	6/28/2021	UA	--	0.029	72	0.73	--	--	<0.001
AW-14	7/21/2021	UA	--	<0.02	67	0.66	--	--	<0.001
AW-14	2/28/2023	UA	--	<0.017	66	--	--	--	0.019
AW-14	6/13/2023	UA	>6	<0.014	70	0.41	0.41	42600	0.0039
AW-14	8/23/2023	UA	>6	<0.016	69	0.42	0.37	44700	0.0014
AW-14	11/3/2023	UA	--	<0.016	69	--	--	--	0.0018
AW-15	2/12/2021	UA	--	0.049	50	0.099	--	--	0.001
AW-15	3/5/2021	UA	--	0.041	53	0.14	--	--	<0.001
AW-15	3/22/2021	UA	--	0.039	54	0.15	--	--	<0.001
AW-15	5/6/2021	UA	--	0.033	52	0.13	--	--	<0.001
AW-15	6/17/2021	UA	--	0.041	66	0.41	--	--	0.0031
AW-15	2/27/2023	UA	--	0.027	57	--	--	--	<0.00074
AW-15	6/12/2023	UA	>6	0.03	58	0.085	0.078	48500	<0.00074
AW-15	8/23/2023	UA	>6	0.028	59	0.079	0.072	67200	<0.00074
AW-15	11/2/2023	UA	--	0.029	59	--	--	--	<0.00074
AW-15	11/17/2023	UA	--	--	--	--	--	--	--
AW-15C	2/12/2021	BCU	--	0.06	41	0.17	--	--	0.0088
AW-15C	3/4/2021	BCU	--	0.058	45	0.098	--	--	0.0082
AW-15C	3/22/2021	BCU	--	0.056	44	0.086	--	--	0.0014
AW-15C	4/13/2021	BCU	--	0.062	37	0.16	--	--	0.0059
AW-15C	5/6/2021	BCU	--	0.047	42	0.067	--	--	0.0016
AW-15C	7/21/2021	BCU	--	0.045	43	0.063	--	--	0.0011
AW-15S	2/12/2021	PMP	--	0.032	82	0.65	--	--	0.0042
AW-15S	3/4/2021	PMP	--	<0.02	80	0.48	--	--	0.0043
AW-15S	3/22/2021	PMP	--	<0.02	80	0.4	--	--	0.0033
AW-15S	4/26/2021	PMP	--	<0.02	73	0.64	--	--	0.0034
AW-15S	5/6/2021	PMP	--	<0.02	78	0.43	--	--	0.0034
AW-15S	6/17/2021	PMP	--	0.021	81	0.67	--	--	0.0031
AW-15S	6/29/2021	PMP	--	<0.02	82	0.69	--	--	0.0033
AW-15S	7/21/2021	PMP	--	<0.02	83	0.69	--	--	0.003
AW-15S	2/27/2023	PMP	--	<0.013	82	--	--	--	0.003
AW-15S	6/12/2023	PMP	0.11	<0.013	84	0.87	0.81	<10.0	0.003
AW-15S	8/23/2023	PMP	0.43	<0.014	88	0.9	0.67	13	0.0027
AW-15S	11/2/2023	PMP	--	<0.014	88	--	--	--	0.0035
AW-15S	11/17/2023	PMP	--	--	--	--	--	--	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Potassium, total (mg/L)	Radium 226 + Radium 228, total (pCi/L)	Silicon, total (ug/L)	Sodium, total (mg/L)	Sulfate, total (mg/L)	Sulfide, total (mg/L)
AW-14	2/11/2021	UA	4	2.69	--	170	54	--
AW-14	3/4/2021	UA	3.2	2.67	--	150	26	--
AW-14	3/22/2021	UA	2.7	2.38	--	140	10	--
AW-14	4/12/2021	UA	2.7	2.36	--	130	3	--
AW-14	5/6/2021	UA	2.5	1.99	--	130	<1.0	--
AW-14	6/28/2021	UA	2.4	3.66	--	150	1.7	--
AW-14	7/21/2021	UA	2.3	1.94	--	140	<1.0	--
AW-14	2/28/2023	UA	2.5	1.3	--	150	5.7	--
AW-14	6/13/2023	UA	2.3	3.46	22000	150	2.9	<2
AW-14	8/23/2023	UA	2.4	3.53	23000	150	1.8	<2
AW-14	11/3/2023	UA	3.1	1.87	--	150	6.5	--
AW-15	2/12/2021	UA	4.9	2.96	--	220	1	--
AW-15	3/5/2021	UA	5.5	5.14	--	230	<1.0	--
AW-15	3/22/2021	UA	5.1	6.89	--	220	<1.0	--
AW-15	5/6/2021	UA	5.3	4.14	--	210	<1.0	--
AW-15	6/17/2021	UA	3.4	1.49	--	140	<1.0	--
AW-15	2/27/2023	UA	3.9	7.65	--	210	<0.18	--
AW-15	6/12/2023	UA	4.2	3.8	17000	210	<0.18	<2
AW-15	8/23/2023	UA	4.2	6.12	17000	200	<0.18	0.4
AW-15	11/2/2023	UA	4.4	5.52	--	220	<0.21	--
AW-15	11/17/2023	UA	--	--	--	--	--	--
AW-15C	2/12/2021	BCU	10	4.84	--	290	3.1	--
AW-15C	3/4/2021	BCU	9.1	7.49	--	280	<1.0	--
AW-15C	3/22/2021	BCU	8.6	7.52	--	270	<1.0	--
AW-15C	4/13/2021	BCU	12	5.25	--	310	1.9	--
AW-15C	5/6/2021	BCU	9.4	4.68	--	260	<1.0	--
AW-15C	7/21/2021	BCU	9.5	4.92	--	280	<1.0	--
AW-15S	2/12/2021	PMP	3	0.74	--	53	480	--
AW-15S	3/4/2021	PMP	1.4	1.08	--	53	510	--
AW-15S	3/22/2021	PMP	1.4	0.236	--	54	520	--
AW-15S	4/26/2021	PMP	1	--	--	46	550	--
AW-15S	5/6/2021	PMP	0.88	0.532	--	49	540	--
AW-15S	6/17/2021	PMP	0.84	0.229	--	48	550	--
AW-15S	6/29/2021	PMP	0.8	0.582	--	48	560	--
AW-15S	7/21/2021	PMP	1	1.09	--	49	570	--
AW-15S	2/27/2023	PMP	0.69	1.99	--	52	510	--
AW-15S	6/12/2023	PMP	0.54	0.203	7600	57	590	<2
AW-15S	8/23/2023	PMP	0.76	1.02	8700	51	570	<2
AW-15S	11/2/2023	PMP	0.84	1.7	--	55	550	--
AW-15S	11/17/2023	PMP	--	--	--	--	--	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	pH (field) (SU)	Turbidity, field (NTU)	Alkalinity, total (mg/L)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Aluminum, total (mg/L)
AW-16	2/11/2021	UA	6.83	0	1100	-69.5	0.28	--
AW-16	3/3/2021	UA	6.83	146.26	1100	-63.7	0.13	--
AW-16	3/24/2021	UA	6.40	0	1200	-40.7	0.14	--
AW-16	4/23/2021	UA	6.83	3.19	1200	-99.4	0.52	--
AW-16	5/5/2021	UA	6.70	312	1100	-107.0	0.08	--
AW-16	6/24/2021	UA	6.62	0	1100	-100.0	2.00	--
AW-16	6/29/2021	UA	6.83	18.8	1100	-108.0	0.01	--
AW-16	7/21/2021	UA	6.85	38.9	1100	-136.0	0.16	--
AW-16	2/28/2023	UA	6.83	29.3	1100	-94.0	0.97	--
AW-16	6/12/2023	UA	6.51	77.4	1100	-101.0	0.51	0.074
AW-16	8/21/2023	UA	6.96	9.7	1200	-120.0	0.12	0.036
AW-16	11/2/2023	UA	6.71	<0.0	1100	-126.0	0.86	--
AW-16	11/17/2023	UA	--	--		--	--	--
AW-17	2/11/2021	UA	6.99	182.23	840	-103.9	0.25	--
AW-17	3/3/2021	UA	6.83	461.55	860	-86.3	0.20	--
AW-17	3/23/2021	UA	6.21	11.33	890	-35.6	0.18	--
AW-17	4/23/2021	UA	6.93	110	950	-136.0	0.23	--
AW-17	5/5/2021	UA	6.79	79.6	910	-133.0	0.13	--
AW-17	6/24/2021	UA	6.57	44.1	900	-96.0	2.60	--
AW-17	6/29/2021	UA	6.87	751	850	-130.0	0.03	--
AW-17	7/21/2021	UA	6.96	245	900	-157.0	0.40	--
AW-17	2/28/2023	UA	6.90	869	900	-108.0	0.36	--
AW-17	6/13/2023	UA	7.05	124	880	-111.0	0.69	0.55
AW-17	8/21/2023	UA	6.95	140	890	-106.0	1.30	0.47
AW-17	11/1/2023	UA	6.80	118	890	-115.0	0.88	--
AW-18	2/11/2021	UA	7.04	100.59	680	-70.8	0.36	--
AW-18	3/3/2021	UA	7.04	217.05	800	-112.8	0.25	--
AW-18	3/23/2021	UA	6.39	329.72	690	-69.4	0.15	--
AW-18	4/13/2021	UA	6.87	81.4	780	-136.0	0.32	--
AW-18	5/5/2021	UA	6.86	48.4	810	-164.0	0.11	--
AW-18	6/23/2021	UA	6.89	8.23	800	-142.0	0.12	--
AW-18	6/29/2021	UA	6.93	20.1	500	-144.0	0.14	--
AW-18	7/21/2021	UA	6.96	60	790	-149.0	0.02	--
AW-18	2/27/2023	UA	6.93	499	640	-94.0	0.77	--
AW-18	6/14/2023	UA	6.73	218	800	-105.0	1.70	0.83
AW-18	8/22/2023	UA	6.59	29.3	800	-119.0	1.00	0.45
AW-18	11/1/2023	UA	6.84	149	780	-111.0	0.88	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Arsenic, total (mg/L)	Barium, total (mg/L)	Boron, total (mg/L)	Calcium, total (mg/L)	Carbon, total organic (mg/L)	Chloride, total (mg/L)	Iron, total (mg/L)	Iron, dissolved (mg/L)
AW-16	2/11/2021	UA	0.0013	1.4	0.52	130	--	59	6	--
AW-16	3/3/2021	UA	0.0015	1.4	0.54	140	--	53	5.8	--
AW-16	3/24/2021	UA	<0.001	1.3	0.49	130	--	53	5.3	--
AW-16	4/23/2021	UA	0.0016	1.2	0.45	140	--	55	7.8	--
AW-16	5/5/2021	UA	0.0016	1.3	0.50	140	--	53	7.7	--
AW-16	6/24/2021	UA	0.0018	1.2	0.54	150	--	49	8	--
AW-16	6/29/2021	UA	0.002	1.1	0.51	140	--	54	10	--
AW-16	7/21/2021	UA	0.002	1.2	0.56	130	--	56	8.5	--
AW-16	2/28/2023	UA	0.0022	1.3	0.49	140	--	46	--	--
AW-16	6/12/2023	UA	0.0017	1.3	0.45	150	33	50	11	6.9
AW-16	8/21/2023	UA	<0.00069	1.1	0.44	140	34	51	8.3	6.1
AW-16	11/2/2023	UA	0.0012	1.1	0.42	150	--	48	--	--
AW-16	11/17/2023	UA	--	--	--	--	--	--	--	--
AW-17	2/11/2021	UA	0.0064	1.2	0.48	100	--	56	18	--
AW-17	3/3/2021	UA	0.0079	1.2	0.44	120	--	52	28	--
AW-17	3/23/2021	UA	0.0052	1.1	0.43	100	--	60	15	--
AW-17	4/23/2021	UA	0.0054	1	0.40	110	--	57	18	--
AW-17	5/5/2021	UA	0.0053	1.1	0.44	110	--	55	14	--
AW-17	6/24/2021	UA	0.0052	1	0.46	110	--	59	13	--
AW-17	6/29/2021	UA	0.0058	1.1	0.44	110	--	55	21	--
AW-17	7/21/2021	UA	0.0051	1.2	0.48	100	--	56	14	--
AW-17	2/28/2023	UA	0.0061	1.2	0.42	110	--	47	--	--
AW-17	6/13/2023	UA	0.0045	1.1	0.40	110	30	53	13	9.3
AW-17	8/21/2023	UA	0.0032	1	0.41	110	30	54	12	8.7
AW-17	11/1/2023	UA	0.0036	0.97	0.42	100	--	53	--	--
AW-18	2/11/2021	UA	0.0037	0.6	2.70	110	--	69	21	--
AW-18	3/3/2021	UA	0.0095	1	1.00	140	--	75	55	--
AW-18	3/23/2021	UA	0.0059	0.59	3.00	110	--	64	37	--
AW-18	4/13/2021	UA	0.005	0.85	1.60	110	--	80	37	--
AW-18	5/5/2021	UA	0.0055	0.97	0.96	140	--	81	42	--
AW-18	6/23/2021	UA	0.0051	1	1.20	140	--	88	26	--
AW-18	6/29/2021	UA	0.0031	1.4	0.41	130	--	74	27	--
AW-18	7/21/2021	UA	0.0033	1.1	1.30	120	--	85	22	--
AW-18	2/27/2023	UA	0.008	1.8	0.38	140	--	81	--	--
AW-18	6/14/2023	UA	0.0033	1.3	1.30	120	14	97	17	16
AW-18	8/22/2023	UA	0.0026	1.3	1.20	130	14	91	18	16
AW-18	11/1/2023	UA	0.0042	1.5	0.33	120	--	89	--	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Ferrous Iron, dissolved (mg/L)	Lithium, total (mg/L)	Magnesium, total (mg/L)	Manganese, total (mg/L)	Manganese, dissolved (mg/L)	Methane, total (mg/L)	Molybdenum, total (mg/L)
AW-16	2/11/2021	UA	--	0.045	54	0.056	--	--	<0.001
AW-16	3/3/2021	UA	--	0.045	55	0.047	--	--	<0.001
AW-16	3/24/2021	UA	--	0.046	55	0.045	--	--	<0.001
AW-16	4/23/2021	UA	--	0.036	51	0.059	--	--	<0.001
AW-16	5/5/2021	UA	--	0.039	55	0.052	--	--	<0.001
AW-16	6/24/2021	UA	--	0.1	58	0.059	--	--	<0.001
AW-16	6/29/2021	UA	--	0.043	58	0.08	--	--	<0.001
AW-16	7/21/2021	UA	--	0.036	57	0.066	--	--	<0.001
AW-16	2/28/2023	UA	--	0.037	59	--	--	--	<0.00074
AW-16	6/12/2023	UA	5.2	0.031	61	0.078	0.05	60400	<0.00074
AW-16	8/21/2023	UA	>6	0.032	60	0.066	0.047	59000	<0.00074
AW-16	11/2/2023	UA	--	0.029	63	--	--	--	<0.00074
AW-16	11/17/2023	UA	--	--	--	--	--	--	--
AW-17	2/11/2021	UA	--	0.071	42	0.27	--	--	0.0024
AW-17	3/3/2021	UA	--	0.057	45	0.34	--	--	0.003
AW-17	3/23/2021	UA	--	0.043	42	0.16	--	--	0.0014
AW-17	4/23/2021	UA	--	0.041	39	0.19	--	--	0.0017
AW-17	5/5/2021	UA	--	0.04	41	0.14	--	--	0.0012
AW-17	6/24/2021	UA	--	0.094	43	0.14	--	--	<0.001
AW-17	6/29/2021	UA	--	0.064	45	0.25	--	--	0.0015
AW-17	7/21/2021	UA	--	0.039	42	0.14	--	--	0.0016
AW-17	2/28/2023	UA	--	0.034	45	--	--	--	<0.00078
AW-17	6/13/2023	UA	>6	0.031	44	0.13	0.099	59600	<0.00074
AW-17	8/21/2023	UA	>6	0.034	43	0.12	0.094	70800	<0.00074
AW-17	11/1/2023	UA	--	0.033	41	--	--	--	<0.00074
AW-18	2/11/2021	UA	--	0.11	43	0.62	--	--	0.022
AW-18	3/3/2021	UA	--	0.13	55	0.96	--	--	0.022
AW-18	3/23/2021	UA	--	0.062	42	0.53	--	--	0.027
AW-18	4/13/2021	UA	--	0.067	47	0.51	--	--	0.011
AW-18	5/5/2021	UA	--	0.055	54	0.55	--	--	0.0071
AW-18	6/23/2021	UA	--	0.093	56	0.4	--	--	0.0044
AW-18	6/29/2021	UA	--	0.07	55	0.34	--	--	0.0051
AW-18	7/21/2021	UA	--	0.039	51	0.37	--	--	0.0033
AW-18	2/27/2023	UA	--	0.035	59	--	--	--	0.0051
AW-18	6/14/2023	UA	>6	0.022	52	0.26	0.25	46200	0.0026
AW-18	8/22/2023	UA	>6	0.025	59	0.26	0.24	49500	0.0032
AW-18	11/1/2023	UA	--	0.027	55	--	--	--	0.0015

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Potassium, total (mg/L)	Radium 226 + Radium 228, total (pCi/L)	Silicon, total (ug/L)	Sodium, total (mg/L)	Sulfate, total (mg/L)	Sulfide, total (mg/L)
AW-16	2/11/2021	UA	5.5	5.73	--	270	<1.0	--
AW-16	3/3/2021	UA	5.9	7.02	--	260	<1.0	--
AW-16	3/24/2021	UA	5.5	7.46	--	240	<1.0	--
AW-16	4/23/2021	UA	5.3	4.69	--	230	<1.0	--
AW-16	5/5/2021	UA	5.6	5.52	--	250	<1.0	--
AW-16	6/24/2021	UA	5.5	4.41	--	260	<1.0	--
AW-16	6/29/2021	UA	4.5	5.84	--	230	<1.0	--
AW-16	7/21/2021	UA	5.2	4.77	--	240	<1.0	--
AW-16	2/28/2023	UA	4.9	3.13	--	260	3.4	--
AW-16	6/12/2023	UA	4.6	3.74	18000	250	<0.18	0.4
AW-16	8/21/2023	UA	4.8	3.95	20000	240	<0.61	0.4
AW-16	11/2/2023	UA	4.7	3.93	--	260	<0.81	--
AW-16	11/17/2023	UA	--	--	--	--	--	--
AW-17	2/11/2021	UA	5.4	2.91	--	210	<1.0	--
AW-17	3/3/2021	UA	5.7	3.57	--	220	<1.0	--
AW-17	3/23/2021	UA	4.8	2.41	--	200	<1.0	--
AW-17	4/23/2021	UA	5.5	2.33	--	190	<1.0	--
AW-17	5/5/2021	UA	5.3	3.1	--	210	<1.0	--
AW-17	6/24/2021	UA	5.2	2.85	--	220	<1.0	--
AW-17	6/29/2021	UA	5.5	2.8	--	210	<1.0	--
AW-17	7/21/2021	UA	5.1	2.98	--	210	<1.0	--
AW-17	2/28/2023	UA	4.5	3.46	--	230	<0.18	--
AW-17	6/13/2023	UA	4.3	2.97	18000	220	<0.18	<2
AW-17	8/21/2023	UA	4.5	2.64	18000	210	<0.22	<2
AW-17	11/1/2023	UA	4.2	2.75	--	210	<0.18	--
AW-18	2/11/2021	UA	4.4	2.68	--	130	23	--
AW-18	3/3/2021	UA	6.6	4.7	--	150	6.5	--
AW-18	3/23/2021	UA	3.5	2.82	--	130	28	--
AW-18	4/13/2021	UA	5.4	1.29	--	150	12	--
AW-18	5/5/2021	UA	5.4	2.23	--	150	4	--
AW-18	6/23/2021	UA	4.4	2.86	--	160	3.2	--
AW-18	6/29/2021	UA	6.6	3.42	--	190	12	--
AW-18	7/21/2021	UA	4.5	2.34	--	150	4.6	--
AW-18	2/27/2023	UA	5	3.69	--	210	10	--
AW-18	6/14/2023	UA	3.5	2.92	18000	170	7.7	<2
AW-18	8/22/2023	UA	4.2	6.06	16000	190	6.9	<2
AW-18	11/1/2023	UA	4.5	4.06	--	200	8.2	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	pH (field) (SU)	Turbidity, field (NTU)	Alkalinity, total (mg/L)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Aluminum, total (mg/L)
AW-19	2/11/2021	UA	6.96	396.76	450	-55.5	0.34	--
AW-19	3/3/2021	UA	7.10	444.93	450	-37.9	0.52	--
AW-19	3/23/2021	UA	6.43	97.72	460	9.6	0.26	--
AW-19	4/12/2021	UA	6.86	20.7	450	-59.5	1.40	--
AW-19	5/5/2021	UA	7.07	111	440	-90.4	0.91	--
AW-19	6/23/2021	UA	6.99	0.95	440	-61.9	0.87	--
AW-19	6/29/2021	UA	7.11	14.7	680	-79.1	0.85	--
AW-19	7/21/2021	UA	7.20	18.9	320	-111.0	0.44	--
AW-19	2/27/2023	UA	7.00	185	380	20.0	1.90	--
AW-19	6/14/2023	UA	6.94	27.9	490	-52.0	2.30	1.4
AW-19	8/22/2023	UA	6.49	24.6	480	-57.0	0.96	0.75
AW-19	11/1/2023	UA	7.05	79.1	460	-66.0	1.00	--
AW-20	2/11/2021	UA	6.80	144.03	610	-52.9	0.25	--
AW-20	3/3/2021	UA	6.94	51.89	590	-41.5	0.12	--
AW-20	3/23/2021	UA	6.44	21.92	600	-1.2	0.19	--
AW-20	4/12/2021	UA	6.87	4.52	590	-62.2	1.30	--
AW-20	5/5/2021	UA	6.87	37.8	590	-93.2	0.70	--
AW-20	6/15/2023	UA	7.04	44.93	550	-178.1	1.90	0.74
AW-20	8/22/2023	UA	6.24	18.6	600	-60.0	0.54	0.12
AW-20	11/1/2023	UA	6.95	94.2	580	-77.0	0.80	--
AW-21	2/11/2021	UA	7.16	17.85	160	-92.6	1.09	--
AW-21	3/3/2021	UA	7.25	0	150	-38.5	0.28	--
AW-21	3/23/2021	UA	6.68	11.06	160	1.6	0.30	--
AW-21	4/12/2021	UA	7.16	17.4	150	-18.3	1.90	--
AW-21	5/5/2021	UA	7.18	37.7	150	-40.6	0.55	--
AW-21	6/23/2021	UA	7.25	33.7	150	-26.5	0.93	--
AW-21	6/29/2021	UA	7.25	14.9	160	-36.9	0.85	--
AW-21	7/21/2021	UA	7.35	39.9	150	9.5	1.90	--
AW-21	2/28/2023	UA	7.99	125	160	227.0	6.70	--
AW-21	6/14/2023	UA	7.12	6.4	190	-28.0	2.70	0.1
AW-21	8/22/2023	UA	6.53	15	180	130.0	7.70	0.05
AW-21	11/2/2023	UA	7.16	20	160	46.0	2.40	--
AW-21	11/17/2023	UA	--	--		--	--	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Arsenic, total (mg/L)	Barium, total (mg/L)	Boron, total (mg/L)	Calcium, total (mg/L)	Carbon, total organic (mg/L)	Chloride, total (mg/L)	Iron, total (mg/L)	Iron, dissolved (mg/L)
AW-19	2/11/2021	UA	0.016	0.23	2.90	110	--	81	9.5	--
AW-19	3/3/2021	UA	0.02	0.24	2.70	120	--	80	11	--
AW-19	3/23/2021	UA	0.014	0.2	2.60	110	--	88	5.6	--
AW-19	4/12/2021	UA	0.016	0.18	2.50	110	--	77	4.9	--
AW-19	5/5/2021	UA	0.015	0.18	2.60	120	--	86	4.9	--
AW-19	6/23/2021	UA	0.016	0.18	2.50	120	--	88	3.3	--
AW-19	6/29/2021	UA	0.0075	0.19	2.60	110	--	80	1.7	--
AW-19	7/21/2021	UA	0.0092	0.18	2.80	110	--	86	1.9	--
AW-19	2/27/2023	UA	0.022	0.37	2.90	130	--	69	--	--
AW-19	6/14/2023	UA	0.015	0.2	2.30	120	2.2	82	4.8	2.9
AW-19	8/22/2023	UA	0.012	0.2	2.90	120	2.2	79	3.6	2.6
AW-19	11/1/2023	UA	0.01	0.19	3.20	120	--	77	--	--
AW-20	2/11/2021	UA	0.012	0.15	2.30	150	--	90	11	--
AW-20	3/3/2021	UA	0.013	0.13	2.20	170	--	89	9	--
AW-20	3/23/2021	UA	0.011	0.13	2.30	160	--	89	7.8	--
AW-20	4/12/2021	UA	0.012	0.13	2.10	160	--	87	7.1	--
AW-20	5/5/2021	UA	0.012	0.14	2.20	160	--	93	7.9	--
AW-20	6/15/2023	UA	0.013	0.14	3.10	160	4.1	85	7.4	5.9
AW-20	8/22/2023	UA	0.011	0.14	3.40	160	4	88	6.3	6
AW-20	11/1/2023	UA	0.012	0.14	3.10	150	--	87	--	--
AW-21	2/11/2021	UA	<0.001	0.079	12.00	110	--	100	1.9	--
AW-21	3/3/2021	UA	0.0011	0.063	11.00	120	--	96	1.2	--
AW-21	3/23/2021	UA	0.0011	0.08	12.00	110	--	99	2.2	--
AW-21	4/12/2021	UA	0.0016	0.085	11.00	110	--	100	3.4	--
AW-21	5/5/2021	UA	0.0011	0.067	11.00	120	--	96	1.7	--
AW-21	6/23/2021	UA	0.0022	0.062	12.00	120	--	93	1.7	--
AW-21	6/29/2021	UA	0.0013	0.075	11.00	110	--	95	2.5	--
AW-21	7/21/2021	UA	0.0015	0.075	12.00	110	--	100	2.6	--
AW-21	2/28/2023	UA	0.0027	0.058	13.00	110	--	80	--	--
AW-21	6/14/2023	UA	0.0018	0.059	8.70	110	1.4	97	0.69	0.46
AW-21	8/22/2023	UA	<0.00069	0.058	12.00	120	1.6	83	0.3	0.23
AW-21	11/2/2023	UA	<0.00097	0.051	12.00	120	--	97	--	--
AW-21	11/17/2023	UA	--	--	--	--	--	--	--	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Ferrous Iron, dissolved (mg/L)	Lithium, total (mg/L)	Magnesium, total (mg/L)	Manganese, total (mg/L)	Manganese, dissolved (mg/L)	Methane, total (mg/L)	Molybdenum, total (mg/L)
AW-19	2/11/2021	UA	--	0.033	50	0.48	--	--	0.0097
AW-19	3/3/2021	UA	--	0.025	53	0.49	--	--	0.0052
AW-19	3/23/2021	UA	--	<0.02	50	0.4	--	--	0.0034
AW-19	4/12/2021	UA	--	<0.02	49	0.36	--	--	0.004
AW-19	5/5/2021	UA	--	<0.02	49	0.37	--	--	0.0043
AW-19	6/23/2021	UA	--	0.023	53	0.34	--	--	0.0036
AW-19	6/29/2021	UA	--	0.021	50	0.36	--	--	0.0035
AW-19	7/21/2021	UA	--	<0.02	49	0.38	--	--	0.0033
AW-19	2/27/2023	UA	--	<0.015	58	--	--	--	0.0055
AW-19	6/14/2023	UA	2.7	<0.011	55	0.39	0.37	17.1	0.0039
AW-19	8/22/2023	UA	>6	<0.012	55	0.32	0.33	17.2	0.0036
AW-19	11/1/2023	UA	--	<0.011	54	--	--	--	0.0041
AW-20	2/11/2021	UA	--	0.027	60	0.36	--	--	0.0028
AW-20	3/3/2021	UA	--	<0.02	62	0.33	--	--	0.0028
AW-20	3/23/2021	UA	--	<0.02	60	0.3	--	--	0.0025
AW-20	4/12/2021	UA	--	0.021	59	0.31	--	--	0.0022
AW-20	5/5/2021	UA	--	<0.02	59	0.32	--	--	0.0026
AW-20	6/15/2023	UA	--	<0.014	63	0.27	0.25	28.7	0.0027
AW-20	8/22/2023	UA	5.7	<0.014	61	0.26	0.25	30.2	0.0024
AW-20	11/1/2023	UA	--	<0.016	59	--	--	--	0.0023
AW-21	2/11/2021	UA	--	<0.02	35	0.92	--	--	0.019
AW-21	3/3/2021	UA	--	<0.02	35	0.9	--	--	0.024
AW-21	3/23/2021	UA	--	<0.02	35	0.88	--	--	0.018
AW-21	4/12/2021	UA	--	<0.02	37	0.92	--	--	0.021
AW-21	5/5/2021	UA	--	<0.02	35	0.91	--	--	0.02
AW-21	6/23/2021	UA	--	<0.02	38	0.84	--	--	0.015
AW-21	6/29/2021	UA	--	<0.02	37	0.81	--	--	0.016
AW-21	7/21/2021	UA	--	<0.02	36	0.77	--	--	0.016
AW-21	2/28/2023	UA	--	<0.005	34	--	--	--	0.029
AW-21	6/14/2023	UA	1.4	<0.005	36	0.8	0.78	<10.0	0.017
AW-21	8/22/2023	UA	>6	<0.0064	38	0.68	0.71	<10.0	0.029
AW-21	11/2/2023	UA	--	<0.005	39	--	--	--	0.028
AW-21	11/17/2023	UA	--	--	--	--	--	--	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Potassium, total (mg/L)	Radium 226 + Radium 228, total (pCi/L)	Silicon, total (ug/L)	Sodium, total (mg/L)	Sulfate, total (mg/L)	Sulfide, total (mg/L)
AW-19	2/11/2021	UA	2.1	0.483	--	53	28	--
AW-19	3/3/2021	UA	1.9	0.795	--	54	26	--
AW-19	3/23/2021	UA	1.1	0.129	--	50	29	--
AW-19	4/12/2021	UA	1.1	0.492	--	48	29	--
AW-19	5/5/2021	UA	1.1	0.882	--	52	33	--
AW-19	6/23/2021	UA	0.88	0.658	--	55	37	--
AW-19	6/29/2021	UA	0.9	2.15	--	52	36	--
AW-19	7/21/2021	UA	0.88	0.458	--	52	38	--
AW-19	2/27/2023	UA	1.5	1.59	--	56	46	--
AW-19	6/14/2023	UA	1.2	0.471	14000	54	52	<2
AW-19	8/22/2023	UA	1	1.75	11000	52	55	<2
AW-19	11/1/2023	UA	0.9	0.982	--	54	57	--
AW-20	2/11/2021	UA	1.8	0.606	--	60	48	--
AW-20	3/3/2021	UA	1.3	0.515	--	63	45	--
AW-20	3/23/2021	UA	1	1.38	--	58	43	--
AW-20	4/12/2021	UA	0.9	1.17	--	60	39	--
AW-20	5/5/2021	UA	1.1	0.448	--	62	41	--
AW-20	6/15/2023	UA	1.1	--	11000	68	57	<2
AW-20	8/22/2023	UA	0.98	2.04	10000	64	59	<2
AW-20	11/1/2023	UA	1.2	1.72	--	64	55	--
AW-21	2/11/2021	UA	0.58	0.645	--	56	250	--
AW-21	3/3/2021	UA	0.32	0.493	--	57	240	--
AW-21	3/23/2021	UA	0.5	0.223	--	52	250	--
AW-21	4/12/2021	UA	0.77	0.83	--	53	41	--
AW-21	5/5/2021	UA	0.44	0.237	--	55	230	--
AW-21	6/23/2021	UA	0.43	1.08	--	58	250	--
AW-21	6/29/2021	UA	0.53	0.645	--	55	250	--
AW-21	7/21/2021	UA	0.54	1	--	57	260	--
AW-21	2/28/2023	UA	3.4	0.642	--	60	240	--
AW-21	6/14/2023	UA	2	0.326	5900	55	240	<2
AW-21	8/22/2023	UA	3.8	0.936	5500	59	280	<2
AW-21	11/2/2023	UA	1.6	1.26	--	62	260	--
AW-21	11/17/2023	UA	--	--	--	--	--	--

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	pH (field) (SU)	Turbidity, field (NTU)	Alkalinity, total (mg/L)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Aluminum, total (mg/L)
AW-22	2/12/2021	UA	7.01	47.29	520	-73.7	1.00	--
AW-22	3/3/2021	UA	6.93	5951.54	520	-89.6	0.09	--
AW-22	3/23/2021	UA	6.54	0	540	-51.3	0.08	--
AW-22	4/23/2021	UA	6.92	4.17	540	-99.3	0.59	--
AW-22	5/5/2021	UA	6.88	292	510	-122.0	0.19	--
AW-23	11/21/2022	UA	6.96	3.27	280	102.4	0.22	--
AW-23	12/16/2022	UA	6.62	5.85	340	22.6	0.16	--
AW-23	1/10/2023	UA	6.91	0	380	-60.4	0.14	--
AW-23	6/14/2023	UA	6.92	35.3	360	-32.5	0.27	0.049
AW-23	8/23/2023	UA	6.82	133	390	-34.0	0.44	0.99
AW-23	11/3/2023	UA	6.80	1000	380	108.0	2.10	--
EMW-05	11/18/2022	UA	--	--	490	--	--	--
EMW-05	12/15/2022	UA	6.46	86.08	600	65.7	2.22	--
EMW-05	1/10/2023	UA	6.63	82.1	400	12.3	1.86	--
EMW-05	6/15/2023	UA	7.01	3.09	610	-76.6	3.84	0.27
EMW-05	8/28/2023	UA	6.82	70.5	600	52.0	1.00	0.23
EMW-05	11/3/2023	UA	7.13	32.8	620	27.0	0.01	--
P002	2/12/2021	UCF	6.60	25.79	740	-30.8	0.64	--
P002	3/3/2021	UCF	6.80	19.89	710	-4.6	0.25	--
P002	3/23/2021	UCF	6.31	6.77	760	21.5	0.39	--
P002	4/13/2021	UCF	6.79	18.1	740	-50.1	0.86	--
P002	5/4/2021	UCF	6.79	20.7	720	-55.7	0.89	--
XPW01A	2/11/2021	CCR	11.97	6.02	430	-175.9	0.53	--
XPW01A	3/4/2021	CCR	11.44	0	75	-39.0	0.32	--
XPW01A	3/23/2021	CCR	11.19	0	100	-101.5	0.17	--
XPW01A	4/12/2021	CCR	11.90	0.72	75	-69.2	2.90	--
XPW01A	5/4/2021	CCR	11.90	6.3	75	-73.0	0.95	--
XPW01A	7/21/2021	CCR	11.80	0.01	75	-111.0	1.10	--
XPW01A	2/28/2023	CCR	11.80	52.9	75	54.0	4.20	--
XPW01A	6/12/2023	CCR	11.90	<0.0	100	-125.0	2.20	4.2
XPW01A	8/21/2023	CCR	11.60	<0.0	75	29.0	1.40	4.1

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Arsenic, total (mg/L)	Barium, total (mg/L)	Boron, total (mg/L)	Calcium, total (mg/L)	Carbon, total organic (mg/L)	Chloride, total (mg/L)	Iron, total (mg/L)	Iron, dissolved (mg/L)
AW-22	2/12/2021	UA	0.0043	0.76	0.32	78	--	40	15	--
AW-22	3/3/2021	UA	0.0029	0.8	0.23	82	--	39	14	--
AW-22	3/23/2021	UA	0.0016	0.73	0.23	77	--	39	11	--
AW-22	4/23/2021	UA	0.0032	0.99	0.33	110	--	42	14	--
AW-22	5/5/2021	UA	0.0017	0.8	0.38	80	--	40	12	--
AW-23	11/21/2022	UA	<0.001	0.032	0.58	130	--	42	--	--
AW-23	12/16/2022	UA	<0.001	0.027	0.48	130	--	46	--	--
AW-23	1/10/2023	UA	0.0012	0.027	0.55	130	--	50	--	--
AW-23	6/14/2023	UA	<0.00085	0.031	0.49	140	2	41	0.37	0.12
AW-23	8/23/2023	UA	<0.00069	0.045	0.55	140	2.4	49	2.2	0.53
AW-23	11/3/2023	UA	0.0025	0.31	0.60	140	--	35	--	--
EMW-05	11/18/2022	UA	0.0013	0.069	0.67	160	--	28	--	--
EMW-05	12/15/2022	UA	0.0012	0.079	0.77	170	--	20	--	--
EMW-05	1/10/2023	UA	0.02	0.65	0.32	230	--	29	--	--
EMW-05	6/15/2023	UA	0.0011	0.07	0.75	190	2.7	23	0.57	0.15
EMW-05	8/28/2023	UA	<0.00079	0.062	1.00	190	3.1	18	0.77	<0.0065
EMW-05	11/3/2023	UA	<0.00069	0.053	1.50	180	--	20	--	--
P002	2/12/2021	UCF	0.0046	0.11	1.40	170	--	78	5.3	--
P002	3/3/2021	UCF	0.0071	0.1	1.10	180	--	70	7.3	--
P002	3/23/2021	UCF	0.0062	0.096	1.20	170	--	71	6.8	--
P002	4/13/2021	UCF	0.0084	0.097	1.20	170	--	74	9.4	--
P002	5/4/2021	UCF	0.0079	0.1	1.20	180	--	69	10	--
XPW01A	2/11/2021	CCR	0.069	0.04	18.00	39	--	93	0.44	--
XPW01A	3/4/2021	CCR	0.082	0.031	15.00	39	--	83	0.085	--
XPW01A	3/23/2021	CCR	0.072	0.028	15.00	36	--	91	0.02	--
XPW01A	4/12/2021	CCR	0.088	0.029	16.00	38	--	93	0.16	--
XPW01A	5/4/2021	CCR	0.079	0.034	17.00	51	--	47	0.081	--
XPW01A	7/21/2021	CCR	0.096	0.032	19.00	52	--	96	0.023	--
XPW01A	2/28/2023	CCR	0.12	0.034	19.00	57	--	86	--	--
XPW01A	6/12/2023	CCR	0.12	0.031	21.00	58	4	97	0.027	0.013
XPW01A	8/21/2023	CCR	0.12	0.031	18.00	58	3.8	97	0.028	<0.00072

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Ferrous Iron, dissolved (mg/L)	Lithium, total (mg/L)	Magnesium, total (mg/L)	Manganese, total (mg/L)	Manganese, dissolved (mg/L)	Methane, total (mg/L)	Molybdenum, total (mg/L)
AW-22	2/12/2021	UA	--	0.023	34	0.26	--	--	0.0015
AW-22	3/3/2021	UA	--	0.022	33	0.21	--	--	0.0013
AW-22	3/23/2021	UA	--	0.022	33	0.17	--	--	0.0017
AW-22	4/23/2021	UA	--	<0.02	39	0.21	--	--	0.0021
AW-22	5/5/2021	UA	--	<0.02	32	0.16	--	--	<0.001
AW-23	11/21/2022	UA	--	<0.02	51	--	--	--	0.0011
AW-23	12/16/2022	UA	--	<0.02	46	--	--	--	0.0017
AW-23	1/10/2023	UA	--	<0.016	50	--	--	--	<0.00096
AW-23	6/14/2023	UA	--	<0.01	52	0.79	0.68	<10.0	<0.00092
AW-23	8/23/2023	UA	0.46	<0.013	55	0.92	0.86	<10.0	<0.00074
AW-23	11/3/2023	UA	--	0.038	59	--	--	--	<0.00098
EMW-05	11/18/2022	UA	--	<0.02	79	--	--	--	0.0019
EMW-05	12/15/2022	UA	--	<0.02	70	--	--	--	0.0017
EMW-05	1/10/2023	UA		0.092	110	--	--	--	0.004
EMW-05	6/15/2023	UA	--	<0.0063	85	0.27	0.96	<10.0	0.002
EMW-05	8/28/2023	UA	0.066	<0.0087	79	0.45	0.22	<10.0	0.0013
EMW-05	11/3/2023	UA	--	<0.0058	83	--	--	--	0.001
P002	2/12/2021	UCF	--	<0.02	77	1.6	--	--	0.0016
P002	3/3/2021	UCF	--	<0.02	77	1.7	--	--	0.0017
P002	3/23/2021	UCF	--	<0.02	79	1.7	--	--	0.0017
P002	4/13/2021	UCF	--	<0.02	76	1.8	--	--	0.0017
P002	5/4/2021	UCF	--	<0.02	79	1.9	--	--	0.002
XPW01A	2/11/2021	CCR	--	0.64	0.16	0.011	--	--	4
XPW01A	3/4/2021	CCR	--	0.57	<0.1	0.0012	--	--	5
XPW01A	3/23/2021	CCR	--	0.61	<0.1	<0.001	--	--	4.6
XPW01A	4/12/2021	CCR	--	0.64	<0.1	<0.001	--	--	4.3
XPW01A	5/4/2021	CCR	--	0.67	0.11	0.0012	--	--	3.8
XPW01A	7/21/2021	CCR	--	0.72	<0.1	<0.001	--	--	3.3
XPW01A	2/28/2023	CCR	--	0.68	<0.035	--	--	--	3.2
XPW01A	6/12/2023	CCR	0.13	0.66	<0.021	0.0011	<0.00023	951	3.2
XPW01A	8/21/2023	CCR	<0.02	0.66	<0.011	<0.00085	<0.00023	888	3

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Potassium, total (mg/L)	Radium 226 + Radium 228, total (pCi/L)	Silicon, total (ug/L)	Sodium, total (mg/L)	Sulfate, total (mg/L)	Sulfide, total (mg/L)
AW-22	2/12/2021	UA	2.3	1.55	--	110	<1.0	--
AW-22	3/3/2021	UA	2.1	1	--	110	<1.0	--
AW-22	3/23/2021	UA	1.8	1.12	--	100	<1.0	--
AW-22	4/23/2021	UA	2.3	2.37	--	130	<1.0	--
AW-22	5/5/2021	UA	1.9	2.13	--	110	<1.0	--
AW-23	11/21/2022	UA	0.66	0.365	--	51	200	--
AW-23	12/16/2022	UA	0.61	0.204	--	52	200	--
AW-23	1/10/2023	UA	1.1	0.666	--	59	190	--
AW-23	6/14/2023	UA	0.69	--	7000	56	200	<2
AW-23	8/23/2023	UA	1.1	0.803	9100	64	230	<2
AW-23	11/3/2023	UA	5.3	1.85	--	47	180	--
EMW-05	11/18/2022	UA	0.51	0.479	--	22	120	--
EMW-05	12/15/2022	UA	1.1	1.53	--	17	120	--
EMW-05	1/10/2023	UA	7.1	1.33	--	21	130	--
EMW-05	6/15/2023	UA	0.48	--	7800	23	120	<2
EMW-05	8/28/2023	UA	0.39	0.499	8300	21	130	<2
EMW-05	11/3/2023	UA	0.29	0.519	--	22	130	--
P002	2/12/2021	UCF	0.16	0.166	--	42	1.1	--
P002	3/3/2021	UCF	<0.1	0.4	--	42	1.2	--
P002	3/23/2021	UCF	0.14	0.195	--	39	1.2	--
P002	4/13/2021	UCF	<0.1	0.124	--	42	<1.0	--
P002	5/4/2021	UCF	<0.1	0.0443	--	42	<1.0	--
XPW01A	2/11/2021	CCR	250	0.256	--	120	210	--
XPW01A	3/4/2021	CCR	280	0.275	--	130	210	--
XPW01A	3/23/2021	CCR	270	0.261	--	120	210	--
XPW01A	4/12/2021	CCR	270	0.233	--	110	220	--
XPW01A	5/4/2021	CCR	250	0.425	--	120	210	--
XPW01A	7/21/2021	CCR	250	0.604	--	120	230	--
XPW01A	2/28/2023	CCR	240	--	--	120	220	--
XPW01A	6/12/2023	CCR	250	0.076	14000	110	210	<2
XPW01A	8/21/2023	CCR	250	1.01	14000	100	230	0.4

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	pH (field) (SU)	Turbidity, field (NTU)	Alkalinity, total (mg/L)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Aluminum, total (mg/L)
XPW02	2/11/2021	CCR	12.24	15.7	700	-131.4	0.22	--
XPW02	3/3/2021	CCR	11.93	0	120	-155.1	0.14	--
XPW02	3/23/2021	CCR	11.59	0	120	-124.9	0.16	--
XPW02	4/12/2021	CCR	12.20	0.58	120	-104.0	1.20	--
XPW02	5/4/2021	CCR	12.20	20.9	120	-103.0	1.10	--
XPW02	7/22/2021	CCR	12.10	9.97	100	-197.0	0.53	--
XPW02	2/28/2023	CCR	12.20	19.8	120	-148.0	1.60	--
XPW02	6/13/2023	CCR	12.30	8.8	200	-113.0	1.30	9.3
XPW02	8/22/2023	CCR	11.90	<0.0	100	-89.0	2.50	9.2
XPW03	2/11/2021	CCR	11.91	0	450	-293.3	0.25	--
XPW03	3/3/2021	CCR	11.66	0	120	-226.3	0.44	--
XPW03	3/23/2021	CCR	11.22	0	75	-180.8	0.23	--
XPW03	4/12/2021	CCR	12.00	0.14	100	-185.0	0.91	--
XPW03	5/4/2021	CCR	12.00	23.2	75	-196.0	0.69	--
XPW03	7/22/2021	CCR	11.70	3.07	100	-205.0	0.84	--
XPW03	2/28/2023	CCR	11.90	78.1	120	-51.0	2.60	--
XPW03	6/13/2023	CCR	11.90	5	120	-199.0	3.70	9.5
XPW03	8/28/2023	CCR	11.80	21.2	100	-70.0	1.70	8.9

Notes:

-- = not measured
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> = maximum detection limit
mg/L = milligrams per liter
SU= standard units
NTU = Nephelometric Turbidity unit
mV= millivolts
ug/L = micrograms per liter
pCi/L = picocuries per liter
HSU = hydrostratigraphic unit
CCR = coal combustion residual
UA = uppermost aquifer
PMP = potential migration pathway
BCU = bedrock confining unit

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Arsenic, total (mg/L)	Barium, total (mg/L)	Boron, total (mg/L)	Calcium, total (mg/L)	Carbon, total organic (mg/L)	Chloride, total (mg/L)	Iron, total (mg/L)	Iron, dissolved (mg/L)
XPW02	2/11/2021	CCR	0.13	0.022	15.00	40	--	110	0.3	--
XPW02	3/3/2021	CCR	0.16	0.017	14.00	37	--	110	0.053	--
XPW02	3/23/2021	CCR	0.15	0.017	16.00	37	--	120	0.023	--
XPW02	4/12/2021	CCR	0.18	0.015	13.00	27	--	110	0.033	--
XPW02	5/4/2021	CCR	0.18	0.022	15.00	29	--	120	0.14	--
XPW02	7/22/2021	CCR	0.2	0.018	14.00	28	--	130	0.069	--
XPW02	2/28/2023	CCR	0.17	0.038	16.00	37	--	100	--	--
XPW02	6/13/2023	CCR	0.17	0.018	17.00	36	7.2	120	0.045	0.017
XPW02	8/22/2023	CCR	0.17	0.02	15.00	32	6.8	110	0.1	<0.00072
XPW03	2/11/2021	CCR	0.026	0.071	5.40	50	--	96	0.09	--
XPW03	3/3/2021	CCR	0.028	0.066	4.90	53	--	91	0.072	--
XPW03	3/23/2021	CCR	0.027	0.063	5.30	49	--	250	0.021	--
XPW03	4/12/2021	CCR	0.027	0.067	5.00	51	--	93	0.016	--
XPW03	5/4/2021	CCR	0.027	0.07	5.50	52	--	86	0.12	--
XPW03	7/22/2021	CCR	0.025	0.065	7.00	52	--	94	0.055	--
XPW03	2/28/2023	CCR	0.027	0.12	5.70	61	--	93	--	--
XPW03	6/13/2023	CCR	0.025	0.079	5.60	61	4.1	130	0.075	<0.0056
XPW03	8/28/2023	CCR	0.024	0.069	5.50	59	4.2	100	0.013	<0.00072

Notes:

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mV= millivolts
ug/L = micrograms per liter
pCi/L = picocuries per liter
HSU = hydrostratigraphic unit
CCR = coal combustion residual
UA = uppermost aquifer
PMP = potential migration pathway
BCU = bedrock confining unit

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Ferrous Iron, dissolved (mg/L)	Lithium, total (mg/L)	Magnesium, total (mg/L)	Manganese, total (mg/L)	Manganese, dissolved (mg/L)	Methane, total (mg/L)	Molybdenum, total (mg/L)
XPW02	2/11/2021	CCR	--	0.34	0.13	0.0064	--	--	2.9
XPW02	3/3/2021	CCR	--	0.33	0.15	0.0031	--	--	3.2
XPW02	3/23/2021	CCR	--	0.32	<0.1	<0.001	--	--	2.8
XPW02	4/12/2021	CCR	--	0.34	<0.1	<0.001	--	--	2.9
XPW02	5/4/2021	CCR	--	0.3	0.13	0.0093	--	--	3.3
XPW02	7/22/2021	CCR	--	0.32	0.12	0.0017	--	--	3
XPW02	2/28/2023	CCR	--	0.31	0.23	--	--	--	3.2
XPW02	6/13/2023	CCR	0.035	0.29	<0.037	<0.00085	<0.00023	145	3.2
XPW02	8/22/2023	CCR	6.5	0.29	<0.067	0.0014	<0.00023	155	2.9
XPW03	2/11/2021	CCR	--	0.18	0.11	0.0019	--	--	3.1
XPW03	3/3/2021	CCR	--	0.16	0.1	0.0013	--	--	3.6
XPW03	3/23/2021	CCR	--	0.18	<0.1	<0.001	--	--	3.1
XPW03	4/12/2021	CCR	--	0.17	<0.1	<0.001	--	--	3.6
XPW03	5/4/2021	CCR	--	0.16	<0.1	0.0015	--	--	3.8
XPW03	7/22/2021	CCR	--	0.17	<0.1	0.0011	--	--	3.3
XPW03	2/28/2023	CCR	--	0.13	0.36	--	--	--	3.1
XPW03	6/13/2023	CCR	0.084	0.12	<0.063	0.0023	<0.00023	920	3.2
XPW03	8/28/2023	CCR	5.5	0.12	<0.1	<0.00085	<0.00023	826	3.2

Notes:

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mV= millivolts
ug/L = micrograms per liter
pCi/L = picocuries per liter
HSU = hydrostratigraphic unit
CCR = coal combustion residual
UA = uppermost aquifer
PMP = potential migration pathway
BCU = bedrock confining unit

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Table 5-1. Groundwater Analytical Data

Well ID	Date	HSU	Potassium, total (mg/L)	Radium 226 + Radium 228, total (pCi/L)	Silicon, total (ug/L)	Sodium, total (mg/L)	Sulfate, total (mg/L)	Sulfide, total (mg/L)
XPW02	2/11/2021	CCR	100	0.548	--	620	800	--
XPW02	3/3/2021	CCR	110	0.179	--	710	840	--
XPW02	3/23/2021	CCR	110	0.101	--	760	890	--
XPW02	4/12/2021	CCR	110	0.464	--	730	880	--
XPW02	5/4/2021	CCR	120	0.133	--	690	950	--
XPW02	7/22/2021	CCR	120	0.427	--	800	970	--
XPW02	2/28/2023	CCR	110	--	--	730	930	--
XPW02	6/13/2023	CCR	120	0.481	20000	1100	1100	<2
XPW02	8/22/2023	CCR	110	1.12	21000	770	1100	<2
XPW03	2/11/2021	CCR	75	0.194	--	240	270	--
XPW03	3/3/2021	CCR	83	0.349	--	250	280	--
XPW03	3/23/2021	CCR	83	0.065	--	260	300	--
XPW03	4/12/2021	CCR	77	0.208	--	240	290	--
XPW03	5/4/2021	CCR	80	0.213	--	240	280	--
XPW03	7/22/2021	CCR	74	0.211	--	250	270	--
XPW03	2/28/2023	CCR	68	--	--	230	260	--
XPW03	6/13/2023	CCR	72	0.897	8200	240	290	0.8
XPW03	8/28/2023	CCR	68	0.261	8100	230	310	0.8

Notes:

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ug/L = micrograms per liter
pCi/L = picocuries per liter
HSU = hydrostratigraphic unit
CCR = coal combustion residual
UA = uppermost aquifer
PMP = potential migration pathway
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FIGURES

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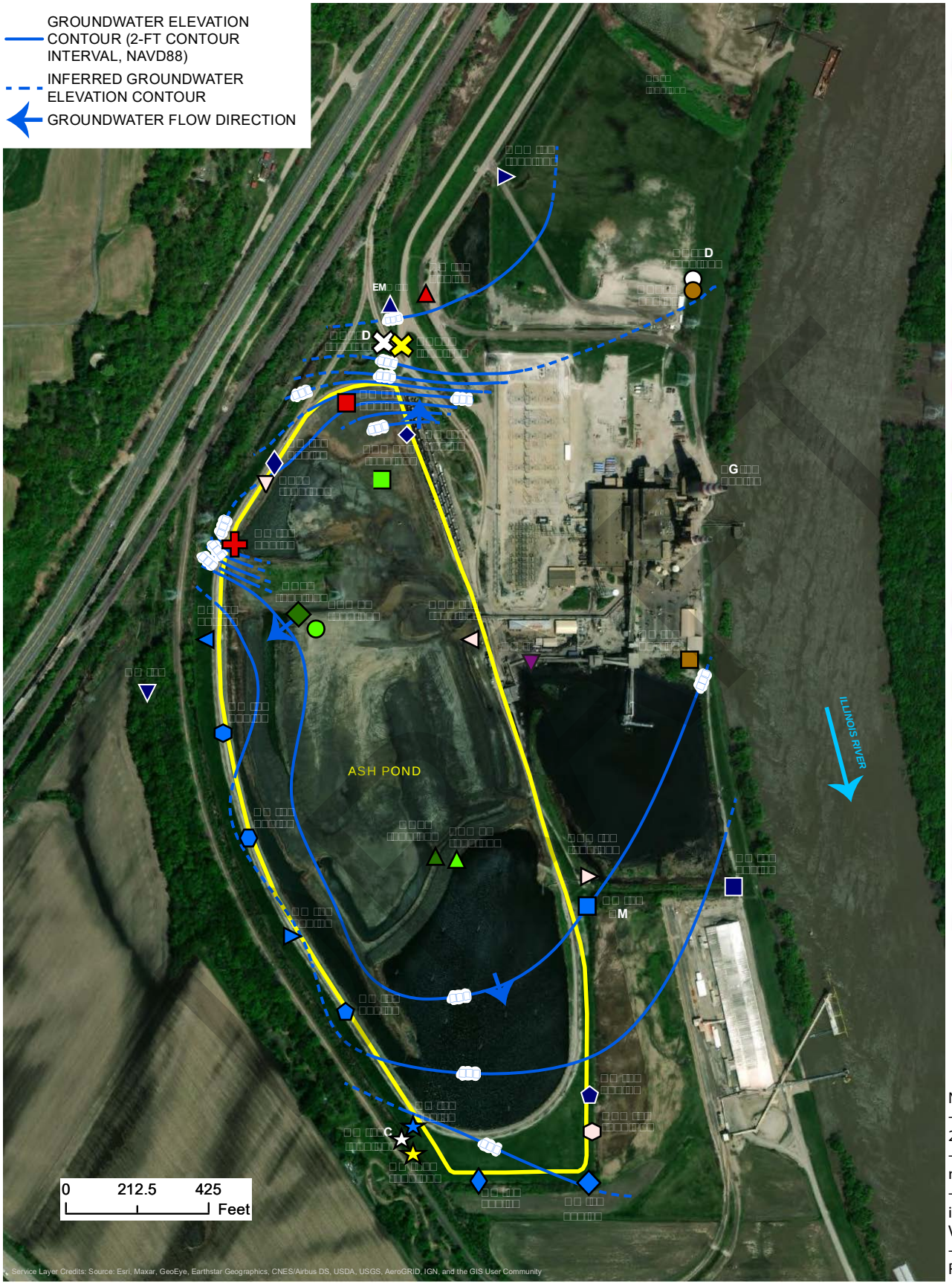
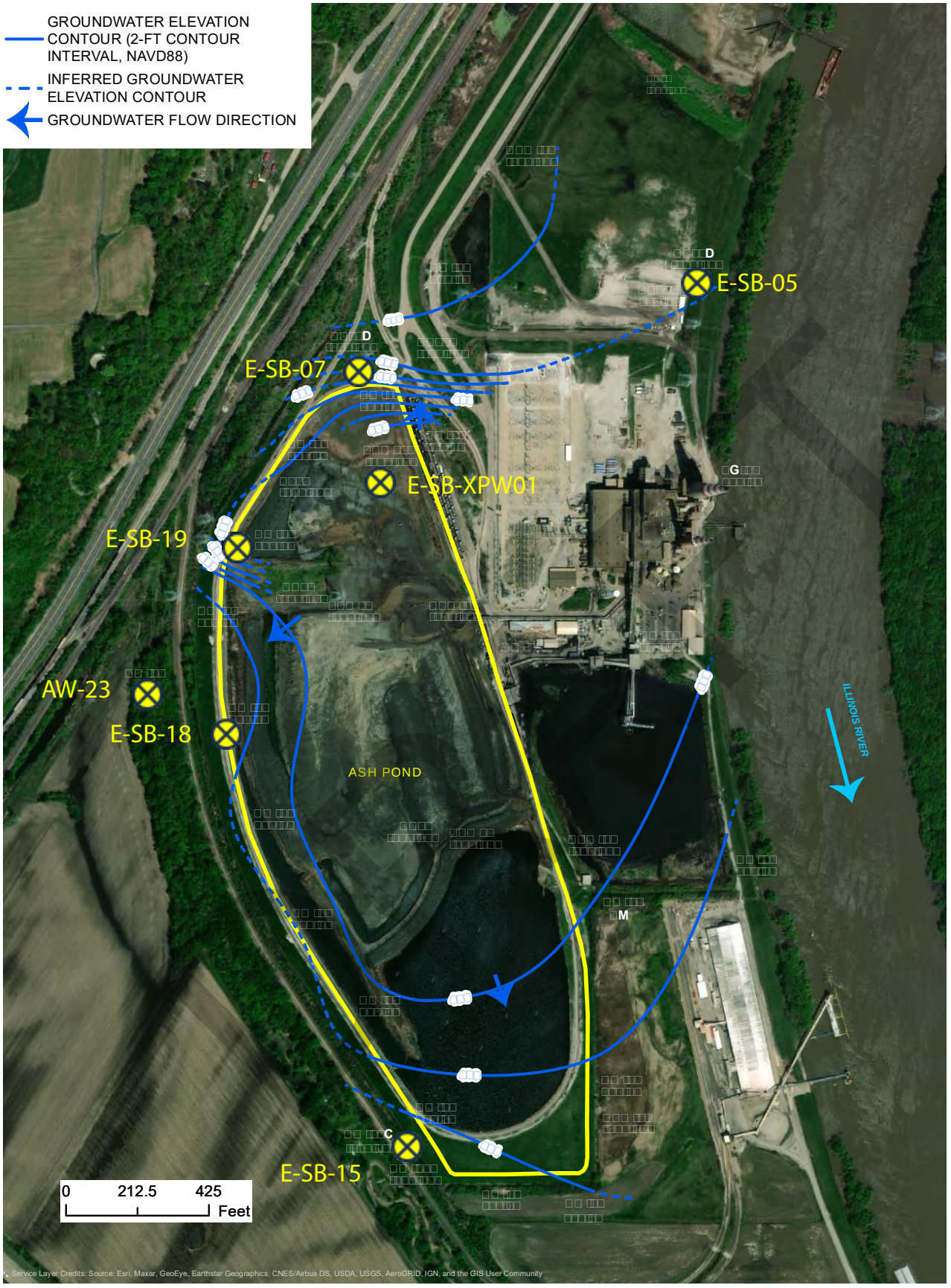


Notes:
-Contours from February 2021.
-Parenthesis indicates well not used in contouring
-Elevation contours shown in feet, North American Vertical Datum of 1988
-Figure adapted from Ramboll 2021

LIFECYCLEGEO

Title: Edwards Ash Pond Well Locations and Hydrogeology		
Project Name: Edwards - Ash Pond Evaluation	Project Number: [23RAM01-1] Vistra CCR	Figure: 2-1
Client Name: Ramboll Americas Engineering Solutions, Inc.	Date: 02/08/2024	

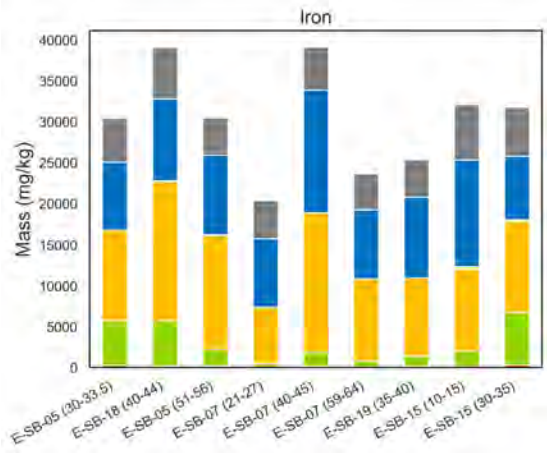


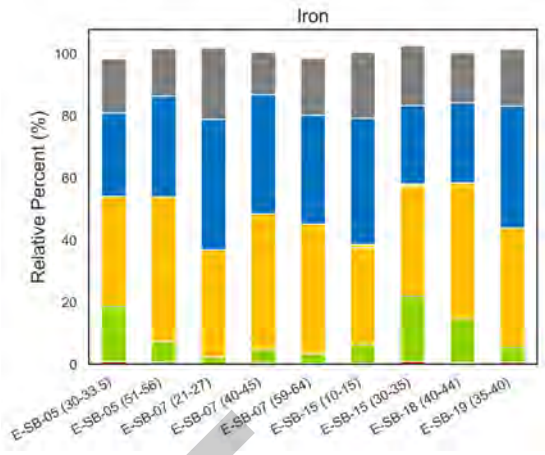
Notes:
-Contours from February 2021.
-Parenthesis indicates well not used in contouring
-Elevation contours shown in feet, North American Vertical Datum of 1988
-Figure adapted from Ramboll 2021

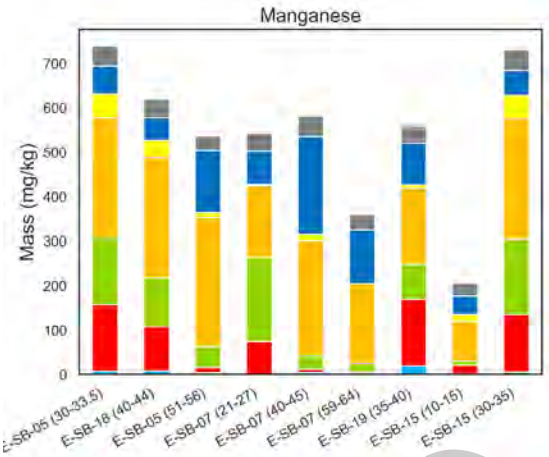
LIFECYCLEGEO

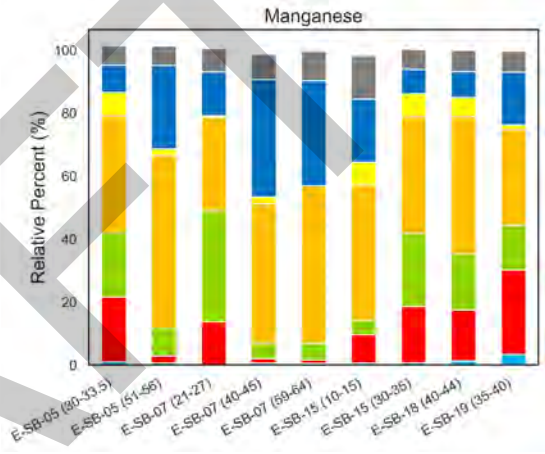
Title
Edwards Ash Pond Soil Boring Locations and Hydrogeology

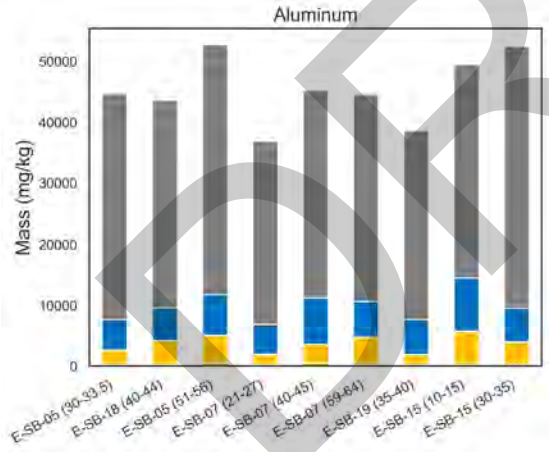
Project Name	Project Number	Figure
Edwards - Ash Pond Evaluation	[23RAM01-1] Vistra CCR	4-1
Client Name	Date	
Ramboll Americas Engineering Solutions, Inc.	02/08/2024	

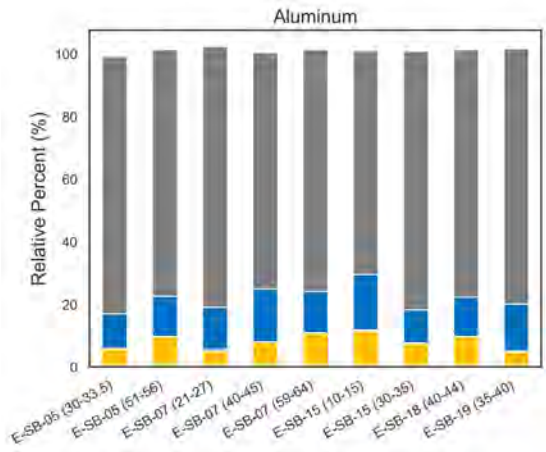












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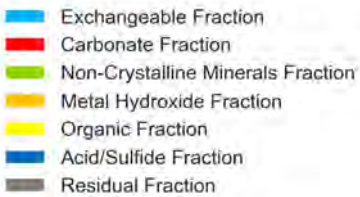
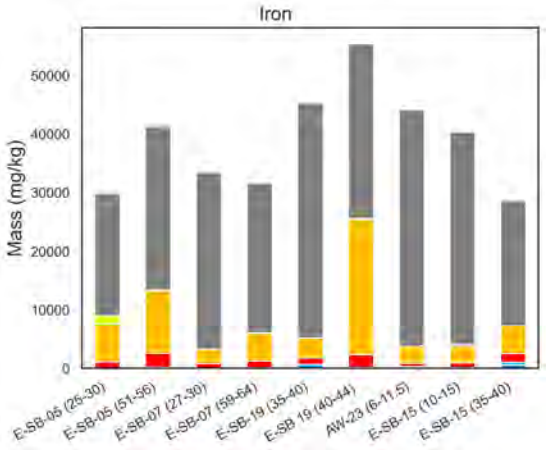
Notes:

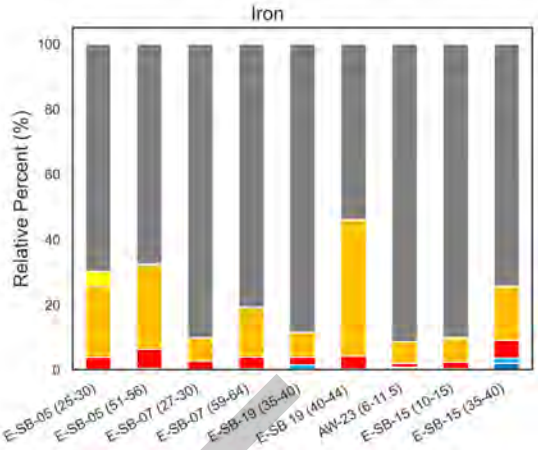
- SEP results from Eurofins (2021) analysis.
- Non-detects are removed from the analysis.
- The percentages for each individual fraction may not sum to 100 due to results below the reporting limit and rounding.

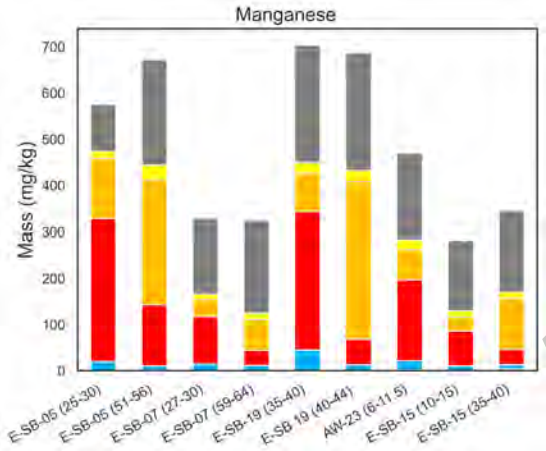


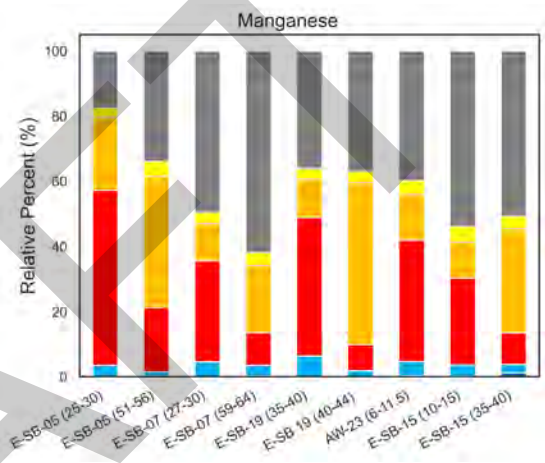
LIFECYCLEGEO

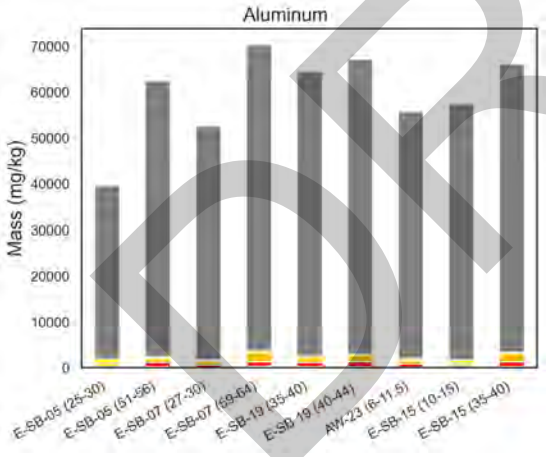
Title: Edwards Ash Pond 2021 SEP results			
Project Name: Edwards - Ash Pond Evaluation		Project Number: [23RAM01-1] Vistra CCR	Figure: 4-2a
Client Name: Ramboll Americas Engineering Solutions, Inc.		Date: 02/08/2024	

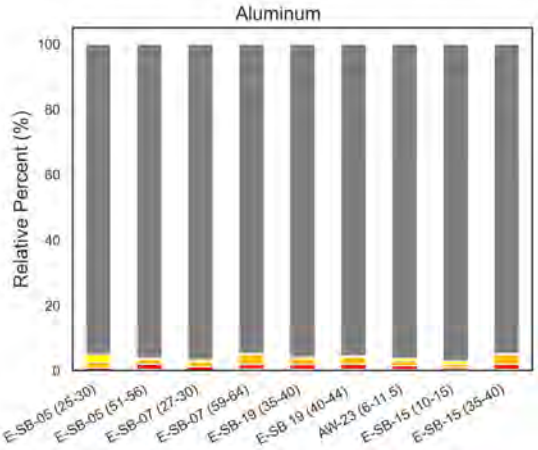












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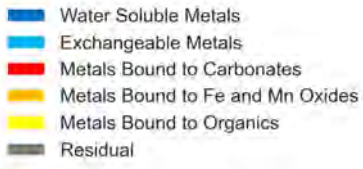
Notes:

-SEP results from SGS (2023) analysis.
-Non-detects are removed from the analysis.
-The percentages for each individual fraction may not sum to 100 due to results below the reporting limit and rounding.



LIFECYCLEGEO

Title: Edwards Ash Pond 2023 SEP results

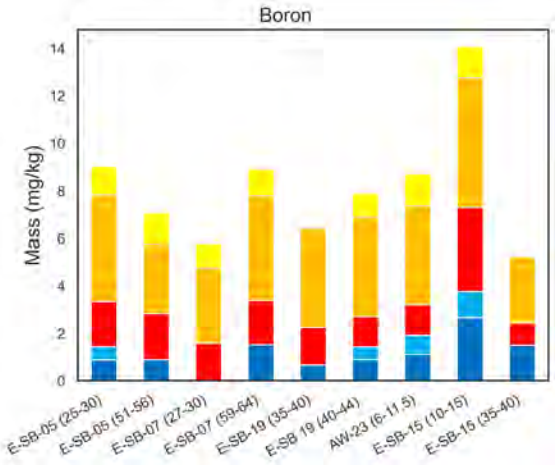
Project Name: Edwards - Ash Pond Evaluation

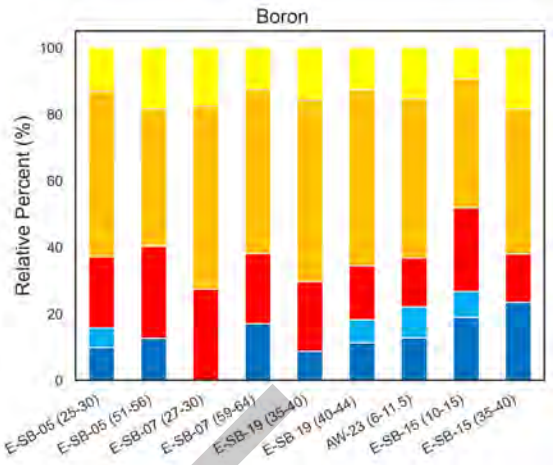
Project Number: [23RAM01-1] Vistra CCR

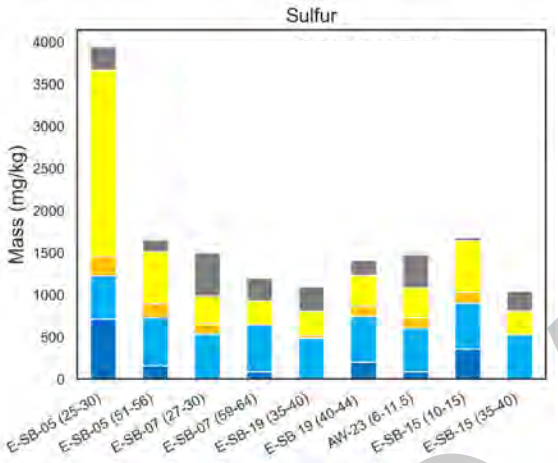
Figure: 4-2b

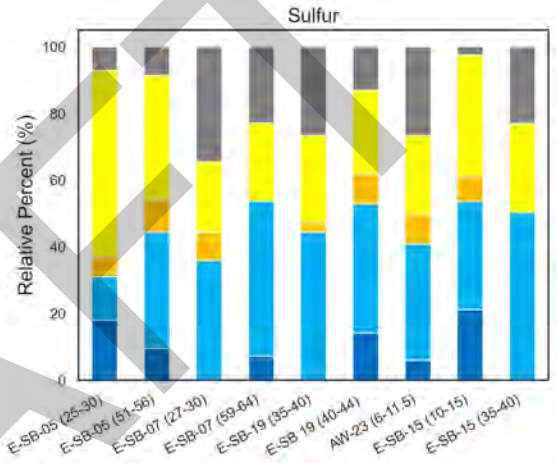
Client Name: Ramboll Americas Engineering Solutions, Inc.

Date: 02/08/2024









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Notes:

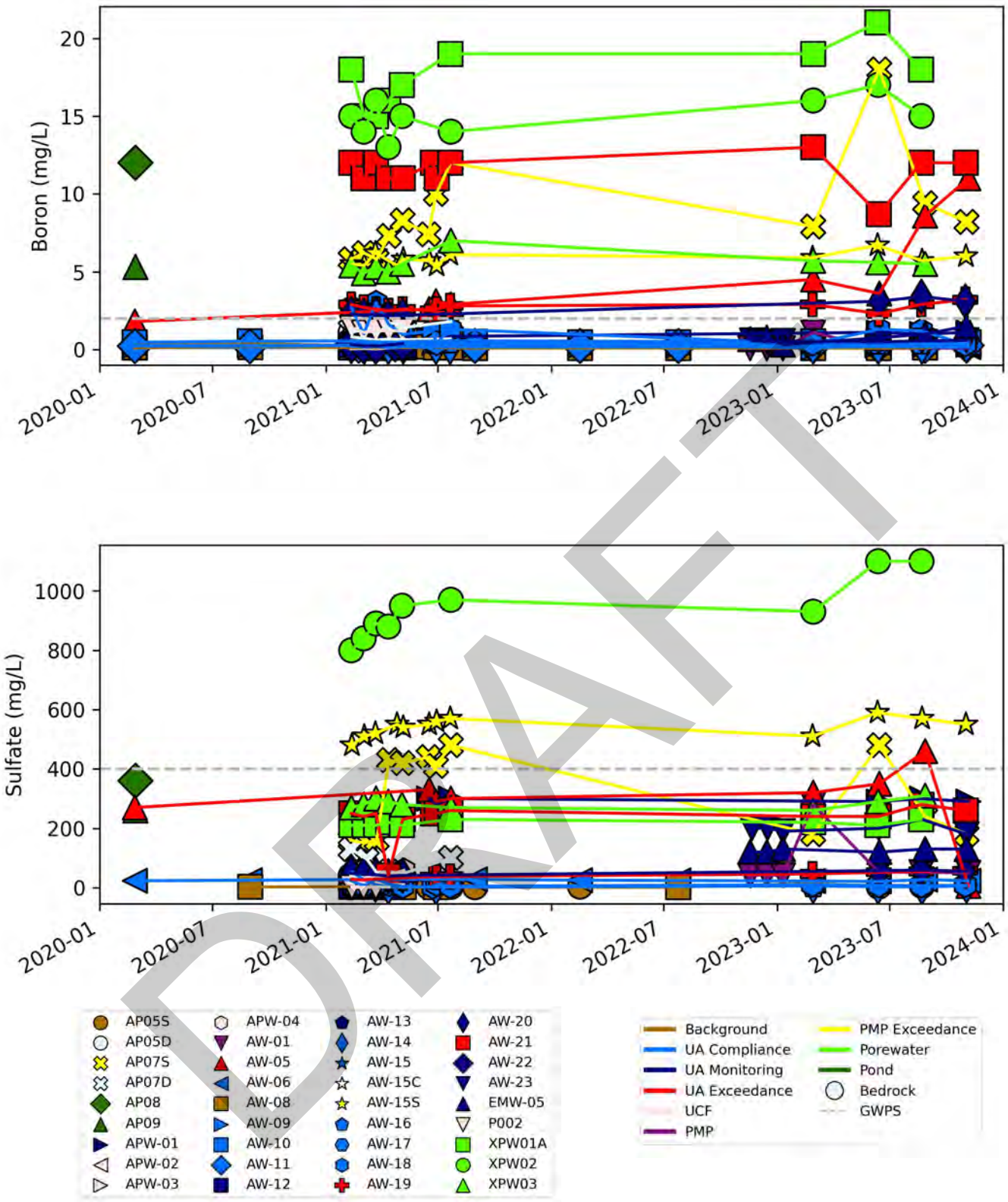
-SEP results from SGS (2023) analysis.
-Non-detects are removed from the analysis.
-The percentages for each individual fraction may not sum to 100 due to results below the reporting limit and rounding.

SEP Fraction

- Water Soluble Metals
- Exchangeable Metals
- Metals Bound to Carbonates
- Metals Bound to Fe and Mn Oxides
- Metals Bound to Organics
- Residual

LIFECYCLEGEO

Title: Edwards Ash Pond 2023 SEP results			
Project Name: Edwards - Ash Pond Evaluation		Project Number: [23RAM01-1] Vistra CCR	Figure: 4-2b
Client Name: Ramboll Americas Engineering Solutions, Inc.		Date: 02/08/2024	



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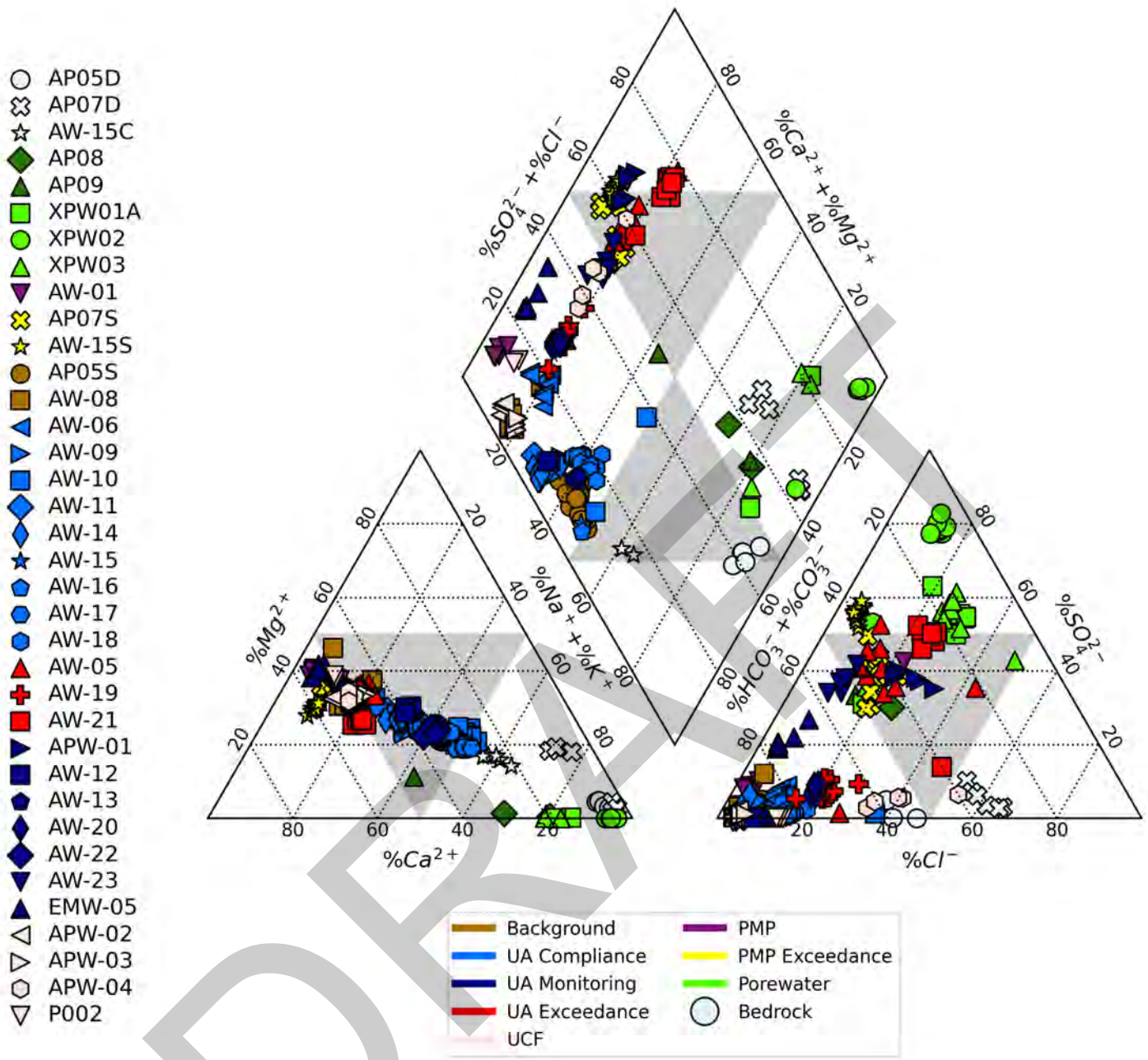
Notes:

- Gray symbols indicate BCU samples

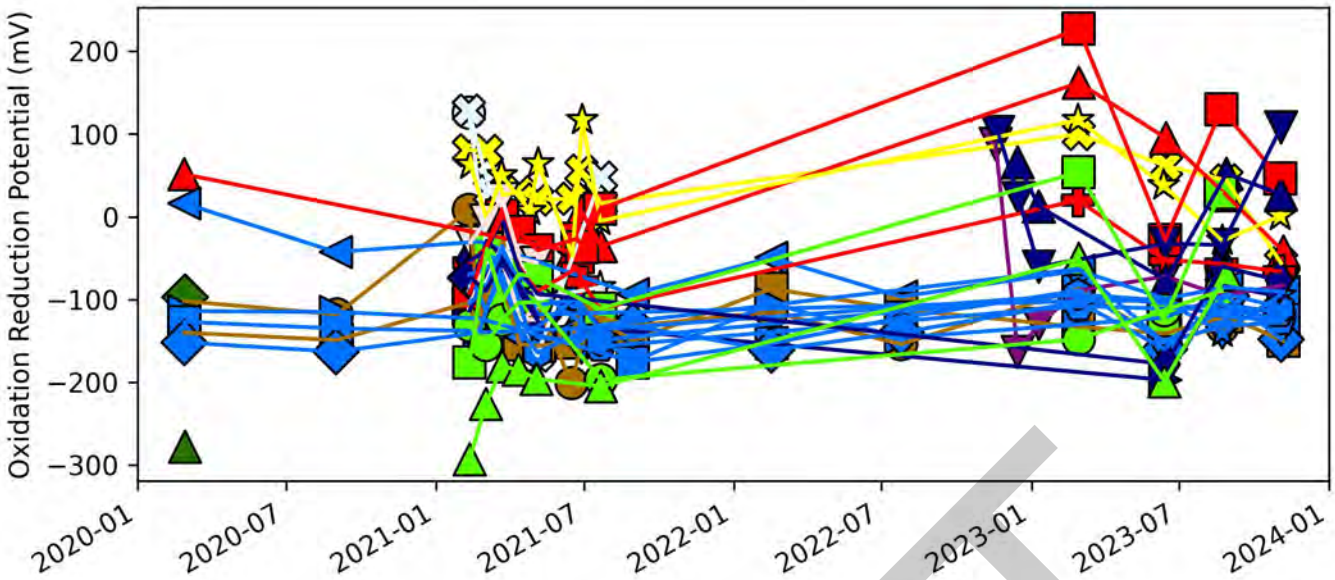
LIFECYCLEGEO	Title: Edwards Ash Pond Sulfate and Boron Time Series		
	Project Name: Edwards - Ash Pond Evaluation	Project Number: [23RAM01-1] Vistra CCR	Figure: 5-1
	Client Name: Ramboll Americas Engineering Solutions, Inc.	Date: 02/07/2024	

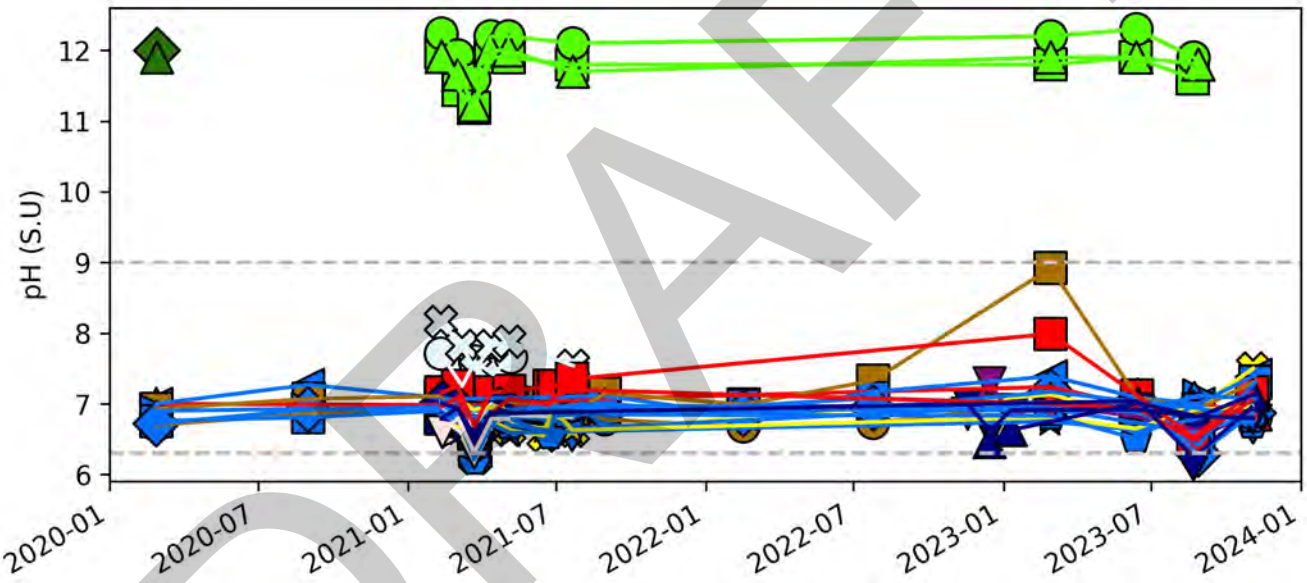


DRAFT

Notes:
- Gray symbols indicate BCU samples

LIFECYCLEGEO	Title: Edwards Ash Pond Piper Diagram		
	Project Name: Edwards - Ash Pond Evaluation	Project Number: [23RAM01-1] Vistra CCR	Figure: 5-2
	Client Name: Ramboll Americas Engineering Solutions, Inc.	Date: 02/08/2024	





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AP05S
AP05D
AP07S
AP07D
AP08
AP09
APW-01
APW-02
APW-03
APW-04
AW-01
AW-05
AW-06
AW-08
AW-09
AW-10
AW-11
AW-12
AW-13
AW-14
AW-15
AW-15C
AW-15S
AW-16
AW-17
AW-18
AW-19
AW-20
AW-21
AW-22
AW-23
EMW-05
P002
XPW01A
XPW02
XPW03

Background
UA Compliance
UA Monitoring
UA Exceedance
UCF
PMP
PMP Exceedance
Porewater
Pond
Bedrock
GWPS

Notes:
- Gray symbols indicate BCU samples

LIFECYCLEGEO

Title
Edwards Ash Pond Oxidation Reduction Potential and pH Time Series

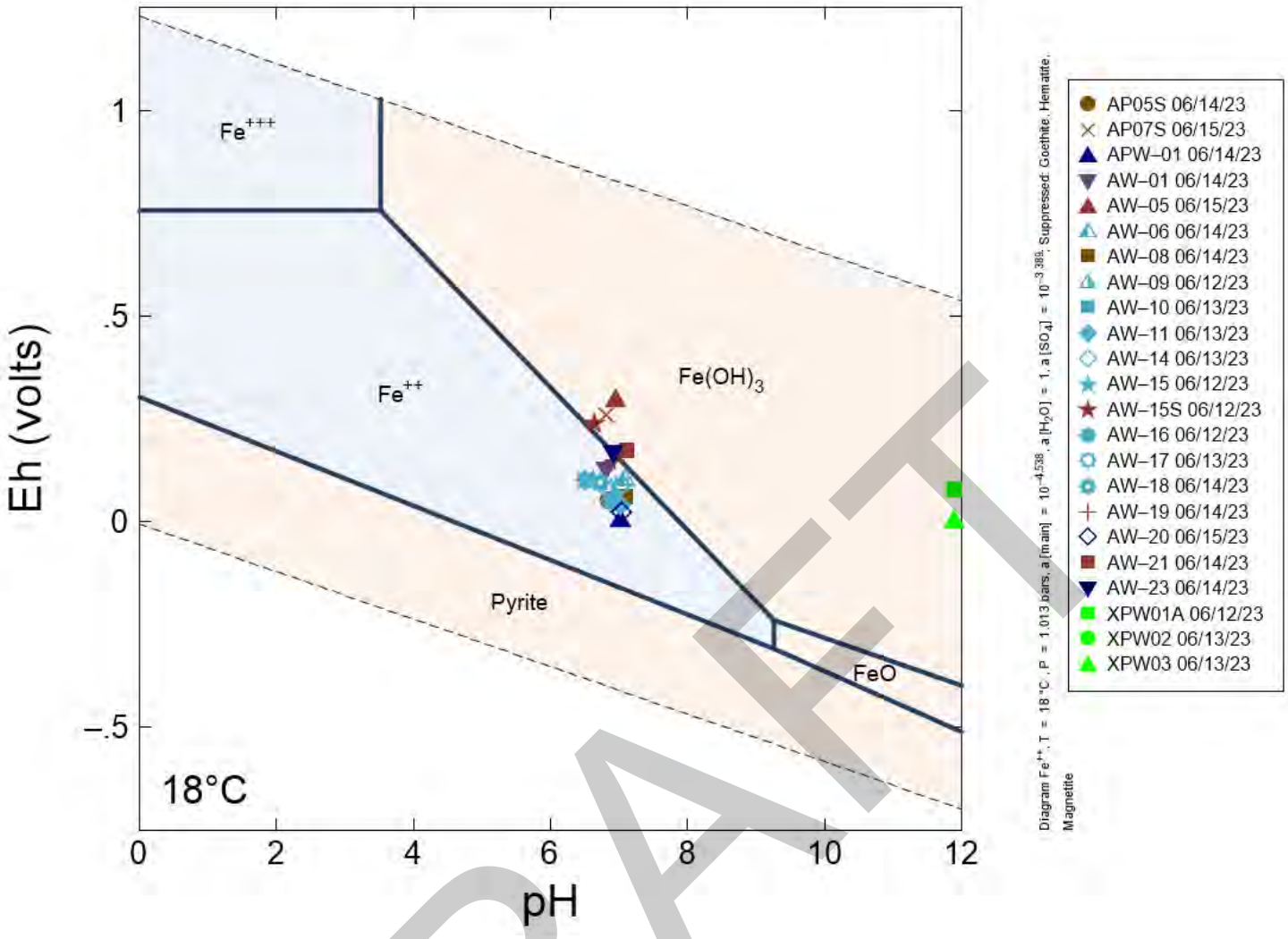
Project Name
Edwards - Ash Pond Evaluation

Project Number
[23RAM01-1] Vistra CCR

Figure
5-3

Client Name
Ramboll Americas Engineering Solutions, Inc.

Date
02/08/2024

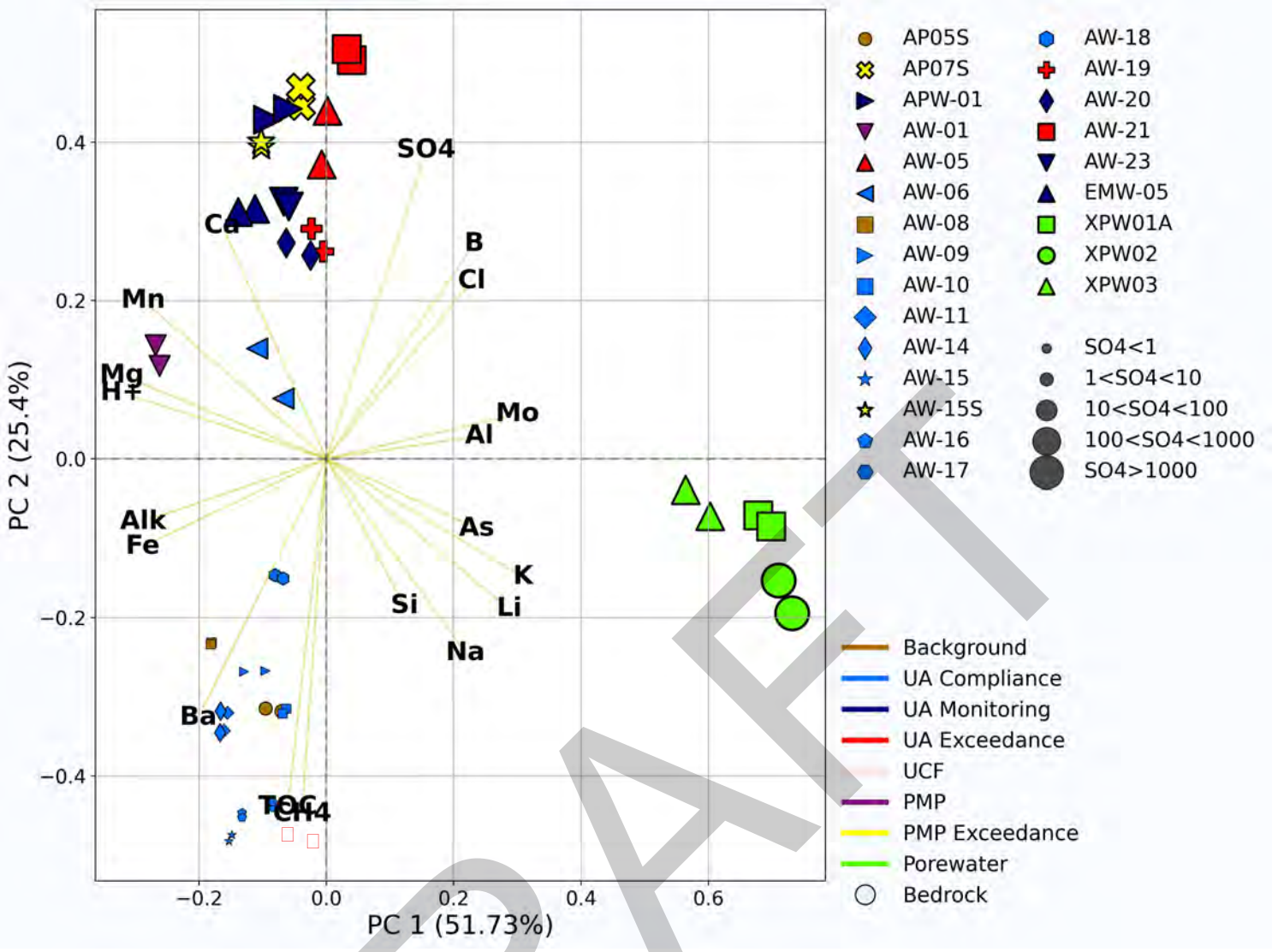


Notes:

- Data from June 2023
- Plot produced using average of measured groundwater temperatures

DRAFT

LIFECYCLEGEO	Title: Edwards Ash Pond Pourbaix Diagram		
	Project Name: Edwards - Ash Pond Evaluation	Project Number: [23RAM01-1] Vistra CCR	Figure: 5-4
	Client Name: Ramboll Americas Engineering Solutions, Inc.	Date: 02/08/2024	



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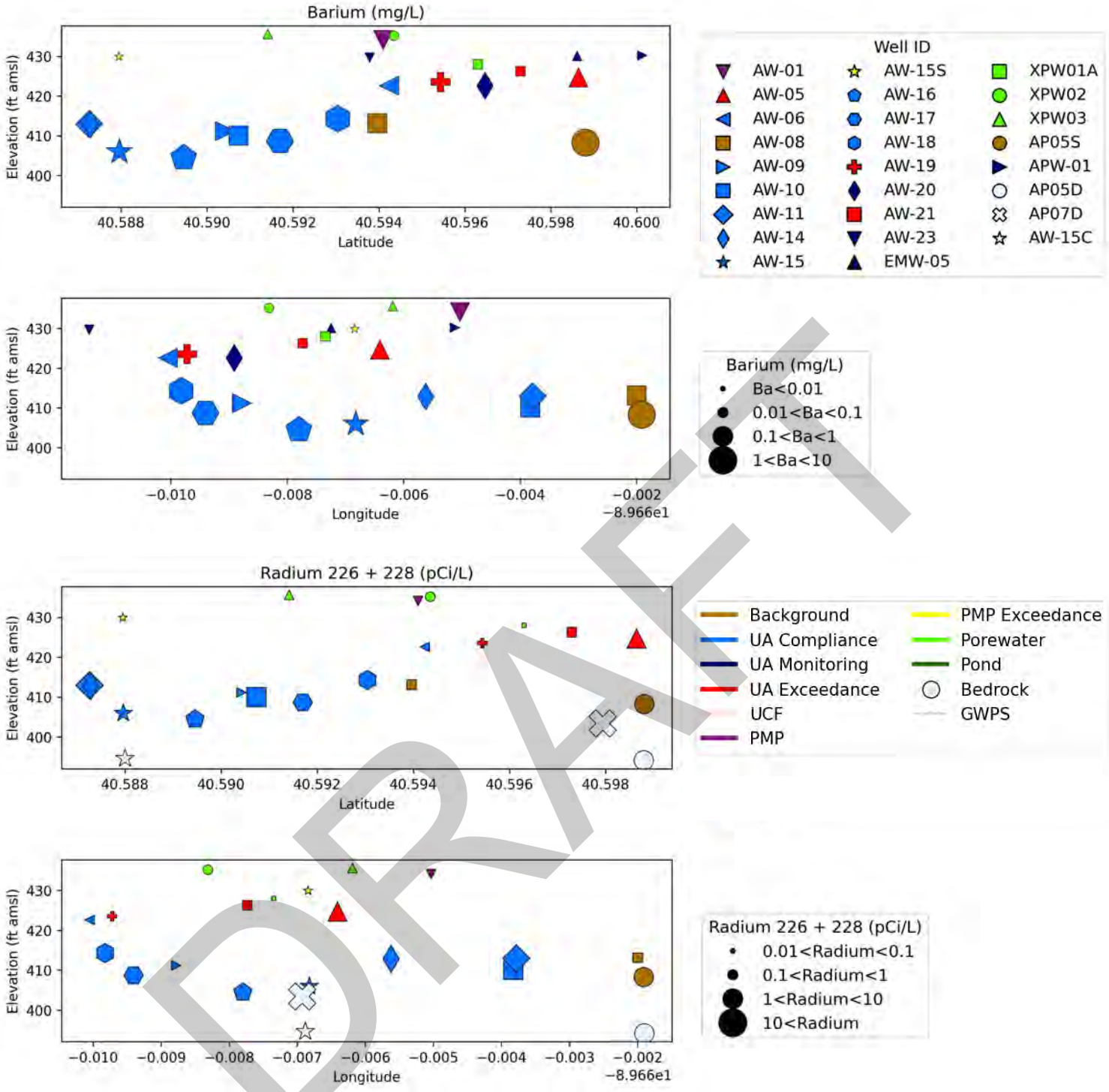
Notes:

- Data from June and August 2023.
- See abbreviation list for full analyte names.
- TOC vector
- CH4 vector

LIFECYCLEGEO	Title: Edwards Ash Pond Principal Component Analysis		
	Project Name: Edwards - Ash Pond Evaluation	Project Number: [23RAM01-1] Vistra CCR	Figure: 5-5
	Client Name: Ramboll Americas Engineering Solutions, Inc.	Date: 02/08/2024	



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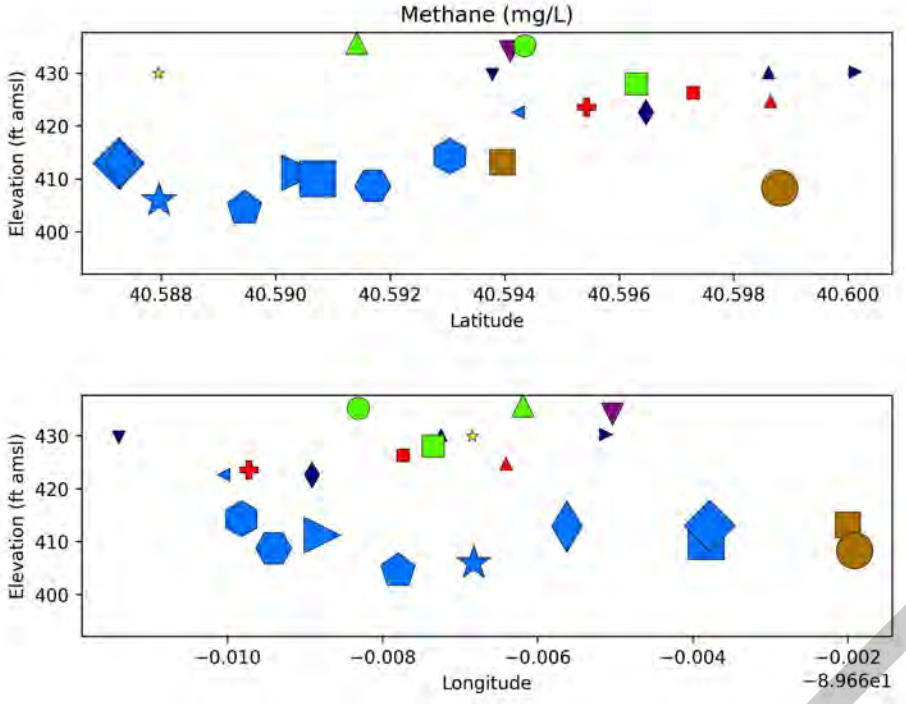
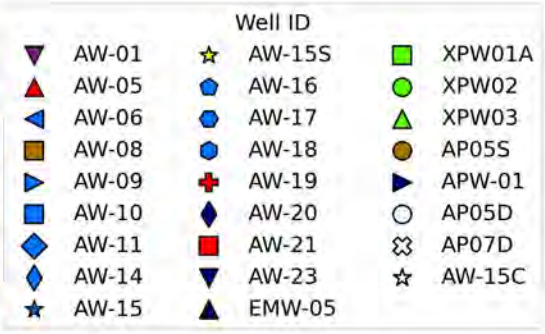
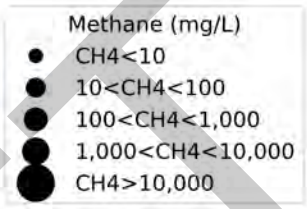
Notes:

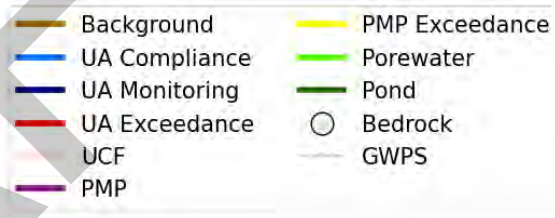
- BCU data from May 2021
- All other data from June 2023
- Gray symbols indicate BCU samples
- Depth measurements referenced to North American Vertical Datum of 1988 (NAVD88)

LIFECYCLEGEO	Title: Edwards Ash Pond Barium and Radium 226+228		
	Project Name: Edwards - Ash Pond Evaluation	Project Number: [23RAM01-1] Vistra CCR	Figure: 5-6
	Client Name: Ramboll Americas Engineering Solutions, Inc.	Date: 02/08/2024	









Notes:

- Data from June 2023
- Depth measurements referenced to North American Vertical Datum of 1988 (NAVD88)

DRAFT

LIFECYCLEGEO

Title: Edwards Ash Pond Methane by Depth and Location

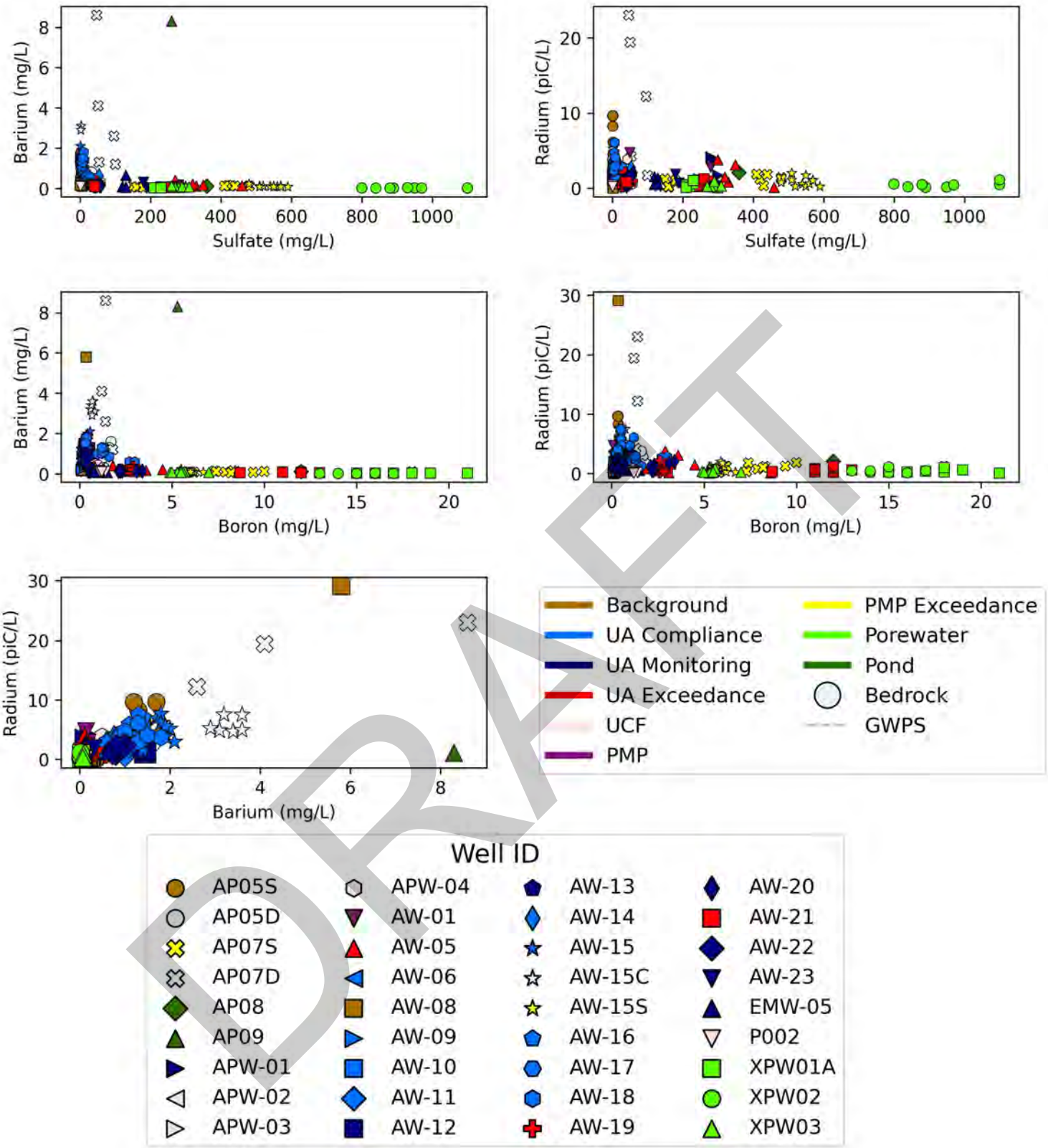
Project Name: Edwards - Ash Pond Evaluation

Project Number: [23RAM01-1] Vistra CCR

Figure: 5-7

Client Name: Ramboll Americas Engineering Solutions, Inc.

Date: 02/08/2024



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Notes:

- Data from 2020 through November 2023
- Radium is Radium 226 + 228
- Gray symbols indicate BCU samples

LIFECYCLEGEO

Title: Edwards Ash Pond Boron, Sulfate, Barium, Radium Scatterplots			
Project Name: Edwards - Ash Pond Evaluation		Project Number: [23RAM01-1] Vistra CCR	Figure: 5-8
Client Name: Ramboll Americas Engineering Solutions, Inc.		Date: 02/08/2024	

ATTACHMENT 1

Monitored Natural Attenuation Field Investigation Status Update, Ash Pond (CCR Unit 301) Edwards Power Plant, Peoria County, Illinois

DRAFT

TECHNICAL MEMORANDUM

DATE March 1, 2022

TO David Mitchell, Stu Cravens, Vic Modeer
Illinois Power Resources Generating, LLC

CC Brian Hennings - Ramboll

FROM Jeffrey Ingram, Patrick J. Behling - Golder Associates USA Inc **EMAIL JIngram@golder.com**

MONITORED NATURAL ATTENUATION FIELD INVESTIGATION STATUS UPDATE, EDWARDS ASH POND (CCR UNIT 301) EDWARDS POWER PLANT, PEORIA COUNTY, ILLINOIS

DRAFT

1.0 INTRODUCTION AND BACKGROUND

The following Technical Memorandum summarizes the results received from the Monitored Natural Attenuation (MNA) Field Investigation completed by Golder Associates USA Inc (Golder) for the Edwards Ash Pond (EAP or Site) located at the Edwards Power Plant (EPP) operated by Illinois Power Resources Generating, LLC (IPRG) in Peoria County, Illinois. Data collected as a part of this investigation will be an integral part of the MNA Feasibility Demonstration for the EAP and will be used for IPRG's Illinois Part 845 Coal Combustion Residual (CCR) compliance program. A Site plan showing the EAP, existing Part 845 monitoring wells, and the MNA boring locations is provided in **Figure 1**.

This memorandum only includes laboratory analytical data that has been received to date. Once the desorption and leachability data are received and reviewed, Golder will update this memorandum.

2.0 PROJECT SCOPE OF WORK

As part of the MNA Feasibility Demonstration, Golder completed the following activities as part of this Field Investigation:

- Screened for potential underground utilities in the vicinity of the proposed borings prior to completing any drilling or ground disturbance activities.
- Advanced a total of six (6) soil borings ranging in depth from 40 to 64 feet below ground surface (ft bgs).
- Collected ten (10) soil samples from six (6) soil borings.
- Collected groundwater samples from four (4) existing monitoring wells.

NOTE: MEMORANDUM WAS PROVIDED IN DRAFT, NO FINAL VERSION WAS COMPLETED. INFORMATION WITHIN BODY AND BORING LOGS ARE UNSIGNED BUT SIGNIFICANT CHANGES ARE UNLIKELY. LABORATORY REPORTS ARE SIGNED, AND THEREFORE CONSIDERED FINAL.

Golder Associates USA Inc.
701 Emerson Road, Suite 250, Creve Coeur, Missouri, 63141 T: +1 314 984 8800 F: +1 314 984-8770

3.0 FIELD INVESTIGATION

3.1 Private Utility Locate

Prior to conducting any work onsite, Golder reviewed Site plans/drawings provided by IPGC and/or Site representatives and met with Site representatives to assist in identifying underground utility locations in the vicinity of the proposed borings. Golder also sub-contracted with GPRS to provide ground penetrating radar (GPR) and electromagnetic (EM) tracing services to screen the proposed boring locations in the field. All boring locations were cleared by GPRS personnel before drilling commenced.

3.2 Drilling and Aquifer Solids Testing

Drilling was completed by Cascade Environmental Drilling using a roto-sonic drill rig under direct supervision of a Golder Geologist. Continuous soil core samples were obtained at each borehole location and were logged in the field by Golder personnel. Soils were classified according to the Unified Soil Classification System (USCS) and in accordance with the standard Golder Soil Logging Technical Procedure.

During the field investigation, six (6) soil borings were advanced at the locations shown on **Figure 1**. Soil boring logs are provided in **Appendix A**. The following units were encountered during the field investigation (Ramboll, 2021):

- Potential Migration Pathway – This zone is made up of the Upper Cahokia Formation and is generally low permeability silts and clays with varying degrees of saturation on site. The contact between the potential migration pathway and uppermost aquifer ranges from 419 feet above mean sea level (ft msl) to 428 ft msl in the borings completed for this investigation. Samples from this unit are shown in **Table 1**.
- Uppermost Aquifer – This thin (generally less than 4 feet thick) zone is made up of material of the Lower Cahokia Formation, consisting of moderately permeable silts and clays with occasional sand and gravel. Since the moderately permeable materials are not present throughout the entirety of site, the uppermost aquifer is interpreted to directly overlie bedrock in those areas. The contact for the uppermost aquifer and bedrock unit ranges from 404 ft msl to 425 ft msl in the borings completed for this investigation. Samples from this unit are shown in **Table 1**.
- Bedrock Confining Unit – This unit consists of low permeability shales and siltstones of the Carbondale and Modesto Formations. The majority of borings were terminated in bedrock, therefore, evaluation of the full thickness of the unit was not completed as part of this investigation. Samples from this unit are shown in **Table 1**.

Ten (10) soil samples were collected for laboratory analysis from the soil borings (see **Figure 1** for sample location). Details regarding collected samples are included in **Table 1**.

Table 1: Laboratory Sample Locations and Intervals

Borehole ID	Sample ID	Sample Depth (ft bgs)	Soil Type / Geologic Unit Sampled
E-SB-05	E-SB-05 (30.0 – 33.5)	30.0 – 33.5	Silty Clay / Uppermost Aquifer

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Borehole ID	Sample ID	Sample Depth (ft bgs)	Soil Type / Geologic Unit Sampled
	E-SB-05 (51.0 – 56.0)	51.0 – 56.0	Siltstone / Bedrock Confining Unit
E-SB-07	E-SB-07 (21.0 – 27.0)	21.0 – 27.0	Clayey Sand / Uppermost Aquifer
	E-SB-07 (40.0 – 45.0)	40.0 – 45.0	Shale / Bedrock Confining Unit
	E-SB-07 (59.0 – 64.0)	59.0 – 64.0	Siltstone / Bedrock Confining Unit
E-SB-15	E-SB-15 (10.0 – 15.0)	10.0 – 15.0	Silty Clay / Potential Migration Pathway
	E-SB-15 (30.0 – 35.0)	30.0 – 35.0	Silty Clay / Uppermost Aquifer
E-SB-18	E-SB-18 (40.0 – 44.0)	40.0 – 44.0	Silty Clay / Uppermost Aquifer
E-SB-19	E-SB-19 (35.0 – 40.0)	35.0 – 40.0	Silty Clay / Uppermost Aquifer
E-SB-XPW01	E-SB-XPW01 (25.0 – 30.0)	25.0 – 30.0	CCR

Notes
1) ft bgs – feet below ground surface.
2) CCR – Coal Combustion Residuals.

3.2.1 Soil Laboratory Analysis

Soil samples collected during the field investigation were placed in clean containers and properly labeled with sample location, depth, project name, sampler initials, analyses to be performed, date, and time of collection. Sample information was logged on a chain of custody (COC) and shipped to the following laboratories analysis:

- Eurofins TestAmerica for 7 Step Sequential Extraction;
- SiREM for the Batch Testing, Total Metals, Rietveld X-Ray Diffraction (XRD), leachability, Cation Exchange Capacity (CEC), and Total Organic Carbon (TOC) analyses.

The following laboratory analyses were conducted for each soil sample:

- 6010B 7-step sequential extraction (Aluminum, Arsenic, Barium, Boron, Calcium, Cobalt, Iron, Lead, Lithium, Manganese, Molybdenum, Selenium);

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- EPA 6010B for Total Metals (Aluminum, Arsenic, Barium, Boron, Calcium, Cobalt, Iron, Lead, Lithium, Manganese, Molybdenum, Selenium);
- Bulk Mineralogy by Reitveld XRD Analysis;
- Cation Exchange Capacity (CEC) Analysis;
- Total Organic Carbon Analysis; and,
- SPLP Method 1312 Leachability Test (for CCR source samples only).

Available results from this analysis are provided in **Attachments B – E**. Results for the leachability and desorption testing have not yet been received and are not included in this Technical Memorandum.

3.2.2 Borehole Survey

On September 23, 2021, IngenAE completed a survey of the boring locations including the longitude/latitude of and elevation of each borehole location. Survey information is included in the boring logs in **Appendix F**.

3.3 Groundwater Sampling

Groundwater sampling was completed by Golder personnel concurrently with drilling activities. Four (4) previously existing monitoring wells were sampled (see **Figure 1** for sample locations). Groundwater sample collection locations for the MNA evaluation are included in **Table 2**.

Table 2: Groundwater Sample Locations

Well ID	Adjacent Borehole Sample
AP-05S (background)	E-SB-05 (30.0 – 33.5)
AW-15S	E-SB-15 (10.0 – 15.0)
AW-15	E-SB-15 (30.0 – 35.0)
AW-19	E-SB-19 (35.0 – 40.0)

3.3.1 Groundwater Sample Laboratory Analysis

Groundwater samples collected during the field investigation were placed in clean containers and properly labeled with well ID, project name, sampler initials, analyses to be performed, date, and time of collection. Sample information was logged on a chain of custody (COC) and shipped to SiREM Laboratories to be included in batch testing analysis along with soil samples collected at adjacent boreholes. Groundwater sampling results are provided in **Appendix G**. Batch testing results are included in **Appendix H**.

4.0 CLOSING

Golder appreciates the opportunity to serve as your consultant on this project. If you have any questions concerning this technical memorandum or need additional information, please contact the undersigned.

DRAFT

Golder Associates USA Inc.

UNSIGNED DRAFT **UNSIGNED DRAFT**

Jeffrey Ingram
Senior Consultant, Geologist

Patrick J. Behling
Practice Leader

BTT/JSI/PJB

Attachments: Figure 1 – Edwards Power Plant Monitored Natural Attenuation Boring and Groundwater Sample Locations
Appendix A - Soil Boring Logs
Appendix B - Eurofins TestAmerica Laboratory Data
Appendix C - Bulk Mineralogy by Rietveld XRD Analysis
Appendix D - Cation Exchange Capacity Analysis
Appendix E - SGS Soil Analysis
Appendix F - Borehole Survey
Appendix G - Groundwater Sampling Results
Appendix H - Batch Testing Results

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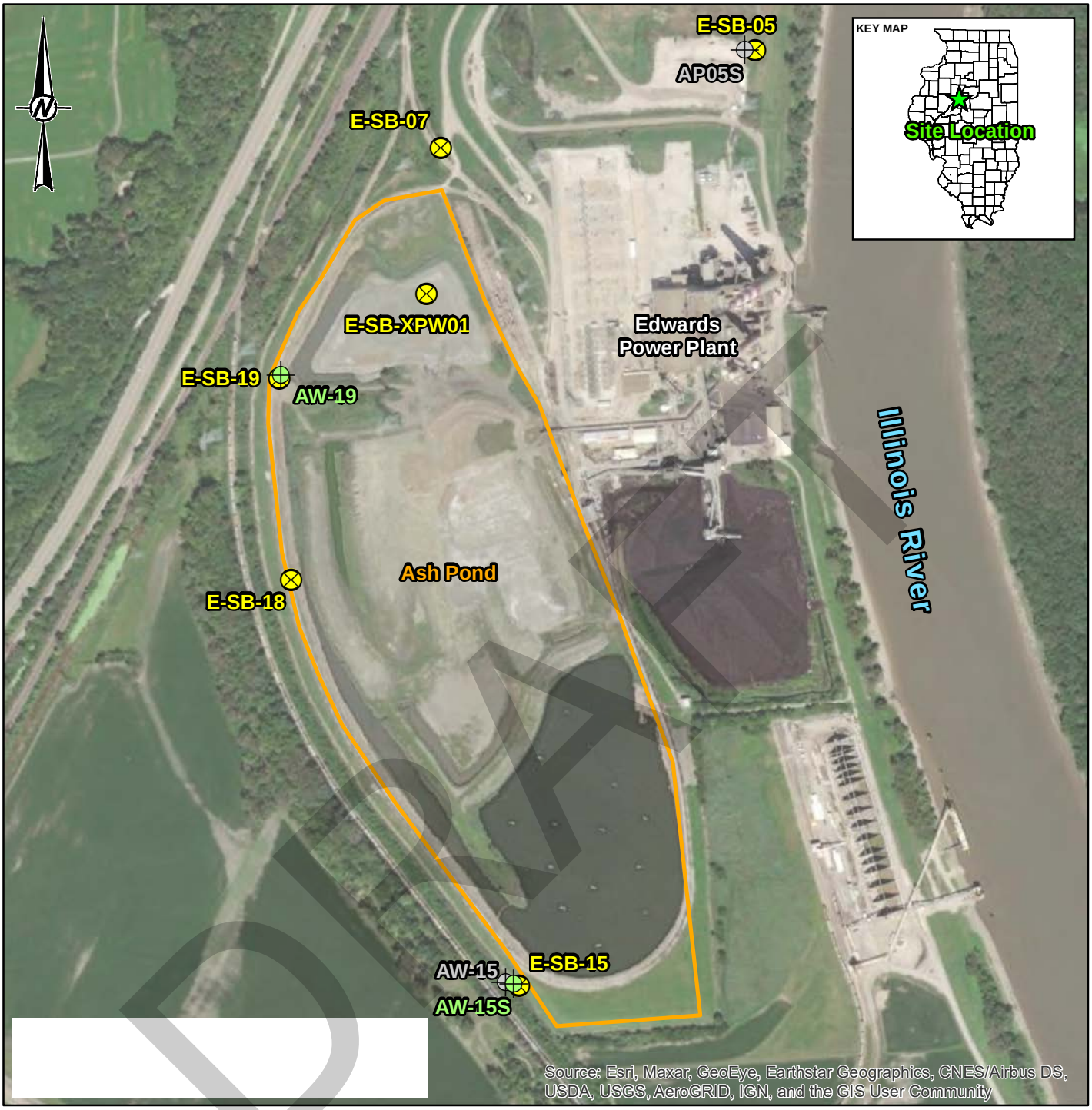
Figures



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LEGEND

- Ash Pond
- MNA Soil Boring Location
- Groundwater Sampling Location - Part 845 Well With Potential Exceedances
- Groundwater Sampling Location - Part 845 Well With No Potential Exceedances

0 2,000 Feet

REFERENCE(S)

1. RAMBOLL 2021, TABLE 2 SUMMARY OF POTENTIAL EXCEEDANCES.
2. RAMBOLL 2021, GROUNDWATER MONITORING PLAN, ASH POND, EDWARDS POWER PLANT, BARTONVILLE, ILLINOIS.

NOTE(S)

1. SOIL BORING LOCATIONS SURVEYED BY INGENAE ON SEPTEMBER 23, 2021.

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC.

PROJECT
EDWARDS POWER PLANT MNA FEASABILITY STUDY

TITLE
EDWARDS POWER PLANT MONITORED NATURAL ATTENUATION BORING AND GROUNDWATER SAMPLE LOCATIONS

CONSULTANT
WSP GOLDER

YYYY-MM-DD	2022-02-21
DESIGNED	BTT
PREPARED	BTT
REVIEWED	GTM
APPROVED	PJB

PROJECT NO.	PHASE	REV.	FIGURE
21454831	0002	0	1

PATH: C:\Users\BTalbert\Golder Associates\21454831 Vistra IL MNA Part 845 Support - Project Files\5 Technical Work\Phase2 - Edwards\2-10-Figures\Report Figures\Edwards - Soil_GW_Sample_Locations.mxd PRINTED ON: 2022-02-23 AT: 7:38:49 AM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
1 in
0

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APPENDIX A

Soil Boring Logs

RECORD OF BOREHOLE E-SB-05

PROJECT: Part 845 MNA Evaluation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 8/30/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,432,419.27 E: 2,436,748.91

ELEVATION: 440.98
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
0	6 Sonic	(0.0-10.0) (CL) SILTY CLAY, medium plasticity fines, some fine poorly graded sub-rounded sand, trace organics (roots); dusky brown (5YR 2/2); cohesive, w~PL, stiff.	ML			1	SO	7.0 / 10.0	(0.0) Run #1, Poor recovery due to material falling out of core barrel during recovery.
5		(7.0) Same As Above (SAA) except, no organics (roots) dark yellowish brown (10YR 4/2).			434.0 7.0				
10	6 Sonic	(10.0-12.0) (ML) CLAYEY SILT, non-plastic to low plasticity fines, trace fine sub-rounded sand; light olive gray (5YR 5.2); cohesive, w<PL, firm.	ML		431.0 10.0				
		(12.0-30.0) (CL) SILTY CLAY, low to medium plasticity fines, trace fine sub-rounded sand; light olive gray (5Y 5/2) with light brown (5YR 6/4) mottling; cohesive, w~PL, soft.			429.0 12.0	2	SO	10.0 / 10.0	
15									
20	6 Sonic		CL			3	SO	10.0 / 10.0	
25		(28.0) SAA except, firm.			413.0 28.0				
30		Log continued on next page			411.0				

DRAFT

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

WSP GOLDER

RECORD OF BOREHOLE E-SB-05

PROJECT: Part 845 MNA Evaluation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 8/30/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,432,419.27 E: 2,436,748.91

ELEVATION: 440.98
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
30	6 Sonic	(12.0-30.0) (CL) SILTY CLAY, low to medium plasticity fines, trace fine sub-rounded sand; light olive gray (5Y 5/2) with light brown (5YR 6/4) mottling; cohesive, w~PL, soft. *(Continued)* (30.0) SAA except, trace fine sub-rounded sand.	CL		30.0 407.5				(30.0-35.0) Silty clay sample collected at 16:50 - 8/30/2021.
		(33.5-60.0) Highly weathered (W4), thickly bedded to very thickly bedded, medium light gray (N6), fine, non-porous to faintly porous, weak rock (R2), SILTSTONE [CARBONDALE FORMATION].			33.5				
35						4	SO	10.0 / 10.0	
40									
45						5	SO	10.0 / 10.0	
50									(51.0-56.0) Siltstone sample collected at 17:20 - 8/30/2021.
55						6	SO	10.0 / 10.0	
60					381.0				

Log continued on next page

DRAFT

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

RECORD OF BOREHOLE E-SB-05

PROJECT: Part 845 MNA Evaluation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 8/30/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,432,419.27 E: 2,436,748.91

ELEVATION: 440.98
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
60		END OF BORING AT 60.0 FEET BELOW GROUND SURFACE.			60.0				
65									
70									
75									
80									
85									
90									

DRAFT

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

WSP GOLDER

RECORD OF BOREHOLE E-SB-07

SHEET 1 of 3

PROJECT: Part 845 MNA Evaluation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 8/30/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,432,098.87 E: 2,435,352.83

ELEVATION: 458.40
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
0	6 Sonic	(0.0-3.0) (GW) FILL, sandy GRAVEL, fine to coarse well graded sub-angular to sub-rounded gravel, fine to coarse sub-angular to sub-rounded sand; grayish orange pink (5YR 7/2) and white (N9); non-cohesive, dry, very loose.	GW		455.4 3.0				
		(3.0-10.0) (CL) sandy SILTY CLAY, low to medium plasticity fines, fine poorly graded sub-rounded sand; dusky yellowish brown (10YR 2/2); cohesive, w~PL, stiff.							
5		(5.0) Same As Above (SAA) except, dark yellowish brown (10YR 4/2), firm.	CL		453.4 5.0	1	SO	8.0 10.0	
10		(10.0-21.0) (CL) SILTY CLAY, low to medium plasticity fines, some fine poorly graded sub-rounded sand; dark yellowish brown (10YR 4/2); cohesive, w~PL, firm.			448.4 10.0				
15						2	SO	10.0 10.0	
20					437.4				
	6 Sonic	(21.0-27.0) (SC) CLAYEY SAND, fine poorly graded sub-rounded sand, low to medium plasticity fines; moderate olive brown (5Y 4/4); non-cohesive, moist, compact.	SC		21.0				(21.0-27.0) Clayey sand sample collected at 13:20 - 8/30/2021.
25					431.4	3	SO	20.0 20.0	
		(27.0-37.0) (CL) sandy SILTY CLAY, low to medium plasticity fines, fine poorly graded sub-rounded sand; moderate olive brown (5Y 4/4); cohesive, w~PL, firm.	CL		27.0				
30		Log continued on next page							

DRAFT

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

WSP GOLDER

GOLDER STL RECORD OF BOREHOLE MWD NEWTON.GPJ GLDR_CO.GDT 2/21/22

RECORD OF BOREHOLE E-SB-07

PROJECT: Part 845 MNA Evaluation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant
DRILLING METHOD: 6" Sonic
DRILLING DATE: 8/30/2021
DRILL RIG: Terra Sonic 150CC
DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,432,098.87 E: 2,435,352.83
ELEVATION: 458.40
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
30	6 Sonic	(27.0-37.0) (CL) sandy SILTY CLAY, low to medium plasticity fines, fine poorly graded sub-rounded sand; moderate olive brown (5Y 4/4); cohesive, w~PL, firm. *(Continued)*	CL						
35						3	SO	20.0 / 20.0	
					421.4				
		(37.0-40.0) Moderately weathered (W3), thickly bedded to very thickly bedded, pale yellowish brown (10YR 6/2) to dark yellowish orange (10YR 6/6), fine grained, non-porous to faintly porous, weak rock (R2), SILTSTONE [CARBONDALE FORMATION].			37.0				
					418.4				
40	6 Sonic	(40.0-49.0) Moderately weathered (W3), thinly laminated to laminated, medium light gray (N6), very fine grained, non-porous to faintly porous, weak rock (R2), SHALE [CARBONDALE FORMATION].			40.0				(40.0-45.0) Shale sample collected at 14:05 - 8/30/2021.
45						4	SO	10.0 / 10.0	
					409.4				
		(49.0-64.0) Highly weathered (W4), thickly bedded to very thickly bedded, medium light gray (N6), fine, non-porous to faintly porous, weak rock (R2), SILTSTONE [CARBONDALE FORMATION].			49.0				
50	6 Sonic	(52.0) SAA except, moderately weathered (W3).			406.4 / 52.0	5	SO	5.0 / 5.0	
55	6 Sonic	(55.0) SAA except, light gray (N7)			403.4 / 55.0	6	SO	9.0 / 9.0	(59.0-64.0) Siltstone sample collected at 14:45 - 8/30/2021.
60		Log continued on next page							

DRAFT

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon
LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

WSP GOLDER

RECORD OF BOREHOLE E-SB-07

PROJECT: Part 845 MNA Evaluation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 8/30/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,432,098.87 E: 2,435,352.83

ELEVATION: 458.40
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
60	6 Sonic	(49.0-64.0) Highly weathered (W4), thickly bedded to very thickly bedded, medium light gray (N6), fine, non-porous to faintly porous, weak rock (R2), SILTSTONE [CARBONDALE FORMATION]. *(Continued)*				6	SO	9.0 / 9.0	
					394.4				
		END OF BORING AT 64.0 FEET BELOW GROUND SURFACE.			64.0				
65									
70									
75									
80									
85									
90									

DRAFT

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

WSP GOLDER

RECORD OF BOREHOLE E-SB-15

PROJECT: Part 845 MNA Evaluation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 8/31/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,428,434.09 E: 2,435,420.64

ELEVATION: 439.08
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
0	6 Sonic	(0.0-20.0) (CL) SILTY CLAY, low to medium plasticity fines, trace fine sub-rounded sand; dusky yellowish brown (10YR 2/2) with light brown (5YR 5/6) mottling; cohesive, w~PL, stiff.	CL			1	SO	10.0 / 10.0	
10					429.1 / 10.0				(10.0-15.0) Silty clay sample collected at 15:40 - 8/31/2021.
	6 Sonic	(10.0) Same As Above (SAA) except, medium dark gray (N4).				2	SO	10.0 / 10.0	
20					419.1 / 20.0				
	6 Sonic	(20.0-30.0) (CL) sandy SILTY CLAY, low to medium plasticity fines, fine poorly graded sub-rounded sand; light olive gray (5Y 5/2); cohesive, w~PL, soft.	CL			3	SO	10.0 / 10.0	
30					409.1				

Log continued on next page

DRAFT

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

WSP GOLDER

RECORD OF BOREHOLE E-SB-15

PROJECT: Part 845 MNA Evaluation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 8/31/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,428,434.09 E: 2,435,420.64

ELEVATION: 439.08
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
30	6 Sonic	(30.0-35.0) (CL) SILTY CLAY, medium plasticity fines, trace fine sub-rounded sand; medium light gray (N6); cohesive, w>PL, firm.	CL		30.0				(30.0-35.0) Silty clay sample collected at 16:20 - 8/31/2021.
35		(35.0-40.0) Highly weathered (W4), thinly laminated to laminated, medium light gray (N6), very fine, non-porous to faintly porous, weak rock (R2), SHALE [CARBONDALE FORMATION].			404.1 35.0	4	SO	10.0 10.0	
40		END OF BORING AT 40.0 FEET BELOW GROUND SURFACE.			399.1 40.0				
45									
50									
55									
60									

DRAFT

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

WSP GOLDER

GOLDER STL RECORD OF BOREHOLE MWD NEWTON.GPJ GLDR_CO.GDT 2/21/22

RECORD OF BOREHOLE E-SB-18

SHEET 1 of 2

PROJECT: Part 845 MNA Evaluation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 8/31/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,430,269.65 E: 2,434,564.52

ELEVATION: 459.99
INCLINATION: -90

DEPTH (feet)	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	NUMBER	TYPE	REC / ATT	REMARKS
0	6 Sonic	(0.0-1.0) FILL - (SP) SAND, fine poorly graded sub-rounded sand, some fine to coarse well graded sub-rounded gravel, trace non-plastic fines; medium brown (5YR 4/4); non-cohesive, dry, loose.	SP		459.0 / 1.0				
		(1.0-7.1) CCR - (ML) SILT, non-plastic fines, some fine poorly graded sub-rounded sand, trace fine sub-rounded gravel; dark gray (N3), ASH; non-cohesive, dry, loose.	ML						
5						1	SO	8.0 / 10.0	
		(7.1-32.0) (CL) SILTY CLAY, low to medium plasticity fines, trace fine sub-rounded sand, trace fine sub-rounded gravel, trace organics (roots and shells); moderate brown (5YR 4/4) with light brown (5YR 5/6) mottling; cohesive, w~PL, firm.			452.9 / 7.1				
10		(10.0) Same As Above (SAA) except, except no roots.			450.0 / 10.0				
15			CL			2	SO	8.0 / 10.0	
20		(20.0) SAA except, light olive gray (5Y 5/2).			440.0 / 20.0				
25	6 Sonic					3	SO	10.0 / 10.0	
		(29.0) SAA except, no mottling.			431.0 / 29.0				
30		Log continued on next page							

DRAFT

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

WSP GOLDER

RECORD OF BOREHOLE E-SB-18

PROJECT: Part 845 MNA Evaluation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 8/31/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,430,269.65 E: 2,434,564.52

ELEVATION: 459.99
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
30	6 Sonic	(7.1-32.0) (CL) SILTY CLAY, low to medium plasticity fines, trace fine sub-rounded sand, trace fine sub-rounded gravel, trace organics (roots and shells); moderate brown (5YR 4/4) with light brown (5YR 5/6) mottling; cohesive, w~PL, firm. *(Continued)*	CL		428.0				
		(32.0-35.0) (ML) sandy CLAYEY SILT, non-plastic to low plasticity fines, fine poorly graded sub-rounded sand, trace fine gravel, trace organics (wood); light olive gray (5Y 5/2); cohesive, w<PL, very soft.	ML		32.0 425.0				
35		(35.0-44.0) (CL) SILTY CLAY, low to medium plasticity fines, trace fine sub-rounded sand; light olive gray (5Y 5/2); cohesive, w~PL, firm.	CL		35.0	4	SO	10.0 10.0	
40					416.0				(40.0-44.0) Silty clay sample collected at 11:45 - 8/31/2021.
	6 Sonic	(44.0-55.0) Moderately weathered (N3), thinly laminated to laminated, medium light gray (N6), very fine grained, non-porous to porous, weak rock (R2), SHALE [CARBONDALE FORMATION].			44.0	5	SO	15.0 15.0	
45									
50									
55					405.0				
		END OF BORING AT 55.0 FEET BELOW GROUND SURFACE.			55.0				
60									

DRAFT

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

WSP GOLDER

RECORD OF BOREHOLE E-SB-19

PROJECT: Part 845 MNA Evaluation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 8/31/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,431,150.52 E: 2,434,576.77

ELEVATION: 458.41
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
0	6 Sonic	(0.0-1.0) FILL - (SP) SAND, fine poorly graded sub-rounded sand, some fine to coarse well graded sub-rounded gravel, trace non-plastic fines; medium brown (5YR 4/4); non-cohesive, dry, loose.	SP		457.4 1.0				
		(1.0-7.0) CCR - (ML) SILTY SAND, fine poorly graded sub-rounded sand, non-plastic fines; dark gray (N3), ASH; non-cohesive, dry, loose.	ML						
5		(6.0) Same As Above (SAA) except, moist.			452.4 6.0	1	SO	10.0 10.0	
		(7.0-23.0) (CL) SILTY CLAY, low to medium plasticity fines, trace fine sub-rounded sand, trace fine sub-rounded gravel; light olive gray (5Y 5/2); cohesive, w~PL, stiff.			451.4 7.0				
10									
15			CL			2	SO	10.0 10.0	
20									(20.0) Run #3, Poor recovery due to material falling out of core barrel during recovery. Appears to be SAA.
					435.4				
		(23.0-27.5) (SC) CLAYEY SAND, fine poorly graded sub-rounded sand, low to medium plasticity fines, some fine sub-rounded gravel; dark brown (5Y 2/2); non-cohesive, moist, compact.			23.0				
25	6 Sonic		SC			3	SO	5.5 10.0	
					430.9				
		(27.5-35.0) (CL) SILTY CLAY, medium to high plasticity fines, trace fine sub-rounded sand, trace fine sub-rounded gravel; dusky yellowish brown (10YR 2/2); cohesive, w>PL, stiff.	CL		27.5				
30					428.4				

Log continued on next page

DRAFT

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

WSP GOLDER

GOLDER STL RECORD OF BOREHOLE MWD NEWTON.GPJ GLDR_CO.GDT 2/21/22

RECORD OF BOREHOLE E-SB-19

PROJECT: Part 845 MNA Evaluation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 8/31/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,431,150.52 E: 2,434,576.77

ELEVATION: 458.41
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
30	6 Sonic	(27.5-35.0) (CL) SILTY CLAY, medium to high plasticity fines, trace fine sub-rounded sand, trace fine sub-rounded gravel; dusky yellowish brown (10YR 2/2); cohesive, w>PL, stiff. *(Continued)* (30.0) SAA except, light olive gray (5Y 5/2); soft.	CL		30.0 423.4				
35		(35.0-40.0) (CL) SILTY CLAY, low to medium plasticity fines, trace fine sub-rounded sand, trace fine sub-rounded gravel; dark yellowish brown (10YR 4/2); cohesive, w~PL, soft.	CL		35.0 418.4	4	SO	14.0 14.0	(35.0-40.0) Silty clay sample collected at 10:00 - 8/31/2021.
40		(40.0-44.0) Moderately weathered (N3), laminated to thinly laminated, medium light gray (N6), very fine grainded, non-porous to faintly porous, weak rock (R2), SHALE [CARBONDALE FORMATION].			40.0 414.4				
		END OF BORING AT 44.0 FEET BELOW GROUND SURFACE.			44.0				
45									
50									
55									
60									

DRAFT

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

WSP GOLDER

RECORD OF BOREHOLE E-SB-XPW01

PROJECT: Part 845 MNA Evaluation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 8/31/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,431,467.42 E: 2,435,243.55

ELEVATION: 460.83
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
0	6 Sonic	(0.0-7.0) CCR - (ML&SW) gravelly SILT & SAND, non-plastic fines, fine poorly graded sub-rounded sand, fine poorly graded rounded gravel; dark gray (N3), ASH; non-cohesive, dry, loose.	ML&sw						
5						1	SO	10.0 / 10.0	
		(6.5) Same As Above (SAA) except, moist.			454.3 / 6.5				
		(7.0-10.0) FILL - (CL) gravelly SILTY CLAY, low to medium plasticity fines, fine poorly graded sub-rounded gravel; dusky yellowish brown (10YR 2/2); cohesive, w~PL, firm.	CL		453.8 / 7.0				
10	6 Sonic	(10.0-23.0) CCR - (ML&SP) SILT & SAND, non-plastic fines, fine sub-rounded sand, trace sub-rounded gravel; grayish black (N2), ASH; non-cohesive, wet, very loose.	ML&SP		450.8 / 10.0				
15						2	SO	10.0 / 10.0	
20		(20.0) SAA except, some fine sub-rounded gravel.			440.8 / 20.0				
		(23.0-30.0) CCR - (ML&SW) gravelly SILT & SAND, non-plastic fines, fine sub-rounded sand, fine rounded gravel; grayish black (N2), ASH; non-cohesive, dry, loose.	ML&sw		437.8 / 23.0				
25	6 Sonic					3	SO	9.0 / 10.0	(25.0-30.0) CCR sample collected at 13:50 - 8/31/2021.
30					430.8				

Log continued on next page

DRAFT

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

RECORD OF BOREHOLE E-SB-XPW01

PROJECT: Part 845 MNA Evaluation
PROJECT NUMBER: 21454831.0002
LOCATION: Edwards Power Plant

DRILLING METHOD: 6" Sonic
DRILLING DATE: 8/31/2021
DRILL RIG: Terra Sonic 150CC

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 1,431,467.42 E: 2,435,243.55

ELEVATION: 460.83
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC / ATT	REMARKS
30	6 Sonic	(30.0-40.0) NO RECOVERY.			30.0	4	SO	0.0 / 10.0	(30.0) Run #4, No recovery. Over saturated material falls out of core barrel upon retreival of sample.
40		END OF BORING AT 40.0 FEET BELOW GROUND SURFACE.			420.8 / 40.0				

DRAFT

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade Environmental
DRILLER: D. Gordon

LOGGED: BTT
CHECKED: EMS
REVIEWED: PJB

WSP GOLDER

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APPENDIX B

Eurofins TestAmerica Laboratory Data

eurofins | Environment Testing America



ANALYTICAL REPORT

Eurofins Knoxville
5815 Middlebrook Pike
Knoxville, TN 37921
Tel: (865)291-3000

Laboratory Job ID: 140-24457-1
Client Project/Site: Edwards Power Station - Illinois

For:
Golder Associates Inc.
701 Emerson Road
Suite 250
Creve Coeur, Missouri 63141

Attn: Jeffrey Ingram

Ryan Henry

Authorized for release by:
2/4/2022 2:54:55 PM

Ryan Henry, Project Manager I
(865)291-3000
williamr.henry@eurofinset.com

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LINKS

Review your project results through TotalAccess

Have a Question? Ask The Expert

Visit us at: www.eurofinsus.com/Env

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

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Qualifiers

Metals

Qualifier	Qualifier Description
*-	LCS and/or LCSD is outside acceptance limits, low biased.
*1	LCS/LCSD RPD exceeds control limits.
B	Compound was found in the blank and sample.
F5	Duplicate RPD exceeds limit, and one or both sample results are less than 5 times RL, and the absolute difference between results is < the upper reporting limits for both.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
L	A negative instrument reading had an absolute value greater than the reporting limit

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

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Job ID: 140-24457-1

Laboratory: Eurofins Knoxville

Narrative

Job Narrative
140-24457-1

Receipt
The samples were received on 9/2/2021 at 9:45am and arrived in good condition, and where required, properly preserved and on ice. The temperature of the cooler at receipt was 1.2º C.

Metals
7 Step Sequential Extraction Procedure

These soil samples were prepared and analyzed using Eurofins TestAmerica Knoxville standard operating procedure KNOX-MT-0008, "7 Step Sequential Extraction Procedure". SW-846 Method 6010B as incorporated in Eurofins TestAmerica Knoxville standard operating procedure KNOX-MT-0007 was used to perform the final instrument analyses.

An aliquot of each sample was sequentially extracted using the steps listed below:

· Step 1 - Exchangeable Fraction: A 5 gram aliquot of sample was extracted with 25 mL of 1M magnesium sulfate (MgSO4), centrifuged and filtered. 5 mL of the resulting leachate was digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
· Step 2 - Carbonate Fraction: The sample residue from step 1 was extracted with 25 mL of 1M sodium acetate/acetic acid (NaOAc/HOAc) at pH 5, centrifuged and filtered. 5 mL of the resulting leachate was digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
· Step 3 - Non-crystalline Materials Fraction: The sample residue from step 2 was extracted with 25 mL of 0.2M ammonium oxalate (pH 3), centrifuged and filtered. 5 mL of the resulting leachate was digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
· Step 4 - Metal Hydroxide Fraction: The sample residue from step 3 was extracted with 25 mL of 1M hydroxylamine hydrochloride solution in 25% v/v acetic acid, centrifuged and filtered. 5 mL of the resulting leachate was digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
· Step 5 - Organic-bound Fraction: The sample residue from step 4 was extracted three times with 25 mL of 5% sodium hypochlorite (NaClO) at pH 9.5, centrifuged and filtered. The resulting leachates were combined and 5 mL were digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
· Step 6 - Acid/Sulfide Fraction: The sample residue from step 5 was extracted with 25 mL of a 3:1:2 v/v solution of HCl-HNO3-H2O, centrifuged and filtered. 5 mL of the resulting leachate was diluted to 50 mL with reagent water and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
· Step 7 - Residual Fraction: A 1.0 g aliquot of the sample residue from step 6 was digested using HF, HNO3, HCl and H3BO3. The digestate was analyzed by ICP using method 6010B. Results are reported in mg/kg on a dry weight basis.

In addition, a 1.0 g aliquot of the original sample was digested using HF, HNO3, HCl and H3BO3. The digestate was analyzed by ICP using method 6010B. Total metal results are reported in mg/kg on a dry weight basis.

Results were calculated using the following equation:

Result, µg/g or mg/Kg, dry weight = (C × V × V1 × D) / (W × S × V2)

Where:
C = Concentration from instrument readout, µg/mL
V = Final volume of digestate, mL
D = Instrument dilution factor
V1 = Total volume of leachate, mL
V2 = Volume of leachate digested, mL
W = Wet weight of sample, g
S = Percent solids/100

A method blank, laboratory control sample and laboratory control sample duplicate were prepared and analyzed with each SEP step in

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Job ID: 140-24457-1 (Continued)

Laboratory: Eurofins Knoxville (Continued)

order to provide information about both the presence of elements of interest in the extraction solutions, and the recovery of elements of interest from the extraction solutions. Results outside of laboratory QC limits do not reflect out of control performance, but rather the effect of the extraction solution upon the analyte.

A laboratory sample duplicate was prepared and analyzed with each batch of samples in order to provide information regarding the reproducibility of the procedure.

SEP Report Notes:

The final report lists the results for each step, the result for the total digestion of the sample, and a sum of the results of steps 1 through 7 by element.

Magnesium was not reported for step 1 because the extraction solution for this step (magnesium sulfate) contains high levels of magnesium. Sodium was not reported for steps 2 and 5 since the extraction solutions for these steps contain high levels of sodium. The sum of steps 1 through 7 is much higher than the total result for sodium and magnesium due to the magnesium and sodium introduced by the extraction solutions.

The digestates for steps 1, 2 and 5 were analyzed at a dilution due to instrument problems caused by the high solids content of the digestates. The reporting limits were adjusted accordingly.

Method 6010B: The serial dilution performed for the following sample associated with batch 140-58419 was outside control limits: (140-24457-A-8-C SD ^25)

Method 6010B: The following samples were diluted due to the nature of the sample matrix: E-SB-07 (21-27) (140-24457-1), E-SB-07 (40-45) (140-24457-2), E-SB-07 (59-64) (140-24457-3), E-SB-05 (30-33.5) (140-24457-4), E-SB-05 (51-56) (140-24457-5), E-SB-19 (35-40) (140-24457-6), E-SB-18 (40-44) (140-24457-7), E-SB-XPW01 (25-30) (140-24457-8), E-SB-15 (10-15) (140-24457-9) and E-SB-15 (30-35) (140-24457-10). Elevated reporting limits (RLs) are provided for aluminum, barium and calcium.

Method 6010B: Due to sample matrix effect on the internal standard (ISTD), a dilution was required for the following sample: E-SB-XPW01 (25-30) (140-24457-8).

Method 6010B: The following samples were diluted to bring the concentration of target analytes within the calibration range: E-SB-07 (40-45) (140-24457-2) and E-SB-XPW01 (25-30) (140-24457-8). Elevated reporting limits (RLs) are provided for iron.

Method 6010B: The following samples were diluted due to the presence of titanium which interferes with Cobalt and Lead: E-SB-07 (40-45) (140-24457-2), E-SB-07 (59-64) (140-24457-3), E-SB-05 (51-56) (140-24457-5) and E-SB-XPW01 (25-30) (140-24457-8). Elevated reporting limits (RLs) are provided.

Method 6010B: The following samples were diluted due to the presence of Iron which interferes with Arsenic and Selenium: E-SB-07 (40-45) (140-24457-2) and E-SB-XPW01 (25-30) (140-24457-8). Elevated reporting limits (RLs) are provided.

Method 6010B: The following samples were diluted due to the presence of Aluminum which interferes with Lead: E-SB-07 (40-45) (140-24457-2), E-SB-07 (59-64) (140-24457-3), E-SB-05 (30-33.5) (140-24457-4), E-SB-05 (51-56) (140-24457-5), E-SB-19 (35-40) (140-24457-6), E-SB-18 (40-44) (140-24457-7), E-SB-15 (10-15) (140-24457-9) and E-SB-15 (30-35) (140-24457-10). Elevated reporting limits (RLs) are provided.

Method 6010B: The following samples were diluted due to the presence of silicon which interferes with Arsenic, Lead and Selenium: E-SB-07 (21-27) (140-24457-1), E-SB-07 (40-45) (140-24457-2), E-SB-07 (59-64) (140-24457-3), E-SB-05 (30-33.5) (140-24457-4), E-SB-05 (51-56) (140-24457-5), E-SB-19 (35-40) (140-24457-6), E-SB-18 (40-44) (140-24457-7) and E-SB-15 (30-35) (140-24457-10). Elevated reporting limits (RLs) are provided.

Method 6010B SEP: The serial dilution performed for the following sample associated with batch 140-57991 was outside control limits: (140-24457-A-8-K SD ^15)

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Job ID: 140-24457-1 (Continued)

Laboratory: Eurofins Knoxville (Continued)

Method 6010B SEP: The method blank for step 1 has manganese result above the reporting limit.

(MB 140-56440/14-B ^4)

Method 6010B SEP: The laboratory control sample duplicate (LCSD) recovered outside advisory limits for Barium.

(LCSD 140-56818/3-B)

Method 6010B SEP: The following sample was diluted to bring the concentration of target analyte, Iron, within the calibration range: E-SB-XPW01 (25-30) (140-24457-8). Elevated reporting limits (RLs) are provided.

Method 6010B SEP: The following sample was diluted due to the presence of Iron which interferes with Arsenic and Selenium: E-SB-XPW01 (25-30) (140-24457-8). Elevated reporting limits (RLs) are provided.

Method 6010B SEP: The % RPD for the LCSD for manganese was outside acceptance limits.

(LCSD 140-56926/3-B ^5)

Method 6010B SEP: The sample duplicate (DUP) precision for preparation batch 140-56604 and 140-56654 and analytical batch 140-58290 was outside control limits. Sample matrix interference and/or non-homogeneity are suspected because the associated laboratory control sample / laboratory control sample duplicate (LCS/LCSD) precision was within acceptance limits.

Method 6010B SEP: The serial dilution performed for the following samples associated with batch 140-58328 was outside control limits: (140-24457-A-8-AA SD ^10) and (140-24457-A-8-AA SD ^5)

Method 6010B SEP: The following samples were diluted due to the presence of titanium which interferes with Cobalt and Lead: E-SB-07 (40-45) (140-24457-2), E-SB-07 (59-64) (140-24457-3), E-SB-05 (51-56) (140-24457-5), E-SB-19 (35-40) (140-24457-6), E-SB-18 (40-44) (140-24457-7), E-SB-XPW01 (25-30) (140-24457-8) and E-SB-15 (30-35) (140-24457-10). Elevated reporting limits (RLs) are provided.

Method 6010B SEP: The following samples were diluted due to the presence of silicon which interferes with Arsenic, Lead and Selenium: E-SB-05 (30-33.5) (140-24457-4), E-SB-05 (51-56) (140-24457-5), E-SB-19 (35-40) (140-24457-6), E-SB-18 (40-44) (140-24457-7), E-SB-15 (10-15) (140-24457-9) and E-SB-15 (30-35) (140-24457-10). Elevated reporting limits (RLs) are provided.

Method 6010B SEP: The following sample was diluted to bring the concentration of target analyte, iron, within the calibration range: E-SB-XPW01 (25-30) (140-24457-8). Elevated reporting limits (RLs) are provided.

Method 6010B SEP: The following sample was diluted due to the presence of Iron which interferes with Arsenic and Selenium: E-SB-XPW01 (25-30) (140-24457-8). Elevated reporting limits (RLs) are provided.

Method 6010B SEP: The following samples were diluted due to the nature of the sample matrix: E-SB-07 (21-27) (140-24457-1), E-SB-07 (40-45) (140-24457-2), E-SB-07 (59-64) (140-24457-3), E-SB-05 (30-33.5) (140-24457-4), E-SB-05 (51-56) (140-24457-5), E-SB-19 (35-40) (140-24457-6), E-SB-18 (40-44) (140-24457-7), E-SB-XPW01 (25-30) (140-24457-8), E-SB-15 (10-15) (140-24457-9) and E-SB-15 (30-35) (140-24457-10). Elevated reporting limits (RLs) are provided for aluminum, barium and calcium.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

General Chemistry
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

DRAFT

Sample Summary

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
140-24457-1	E-SB-07 (21-27)	Solid	08/30/21 13:20	09/02/21 09:45
140-24457-2	E-SB-07 (40-45)	Solid	08/30/21 14:05	09/02/21 09:45
140-24457-3	E-SB-07 (59-64)	Solid	08/30/21 14:45	09/02/21 09:45
140-24457-4	E-SB-05 (30-33.5)	Solid	08/30/21 16:50	09/02/21 09:45
140-24457-5	E-SB-05 (51-56)	Solid	08/30/21 17:20	09/02/21 09:45
140-24457-6	E-SB-19 (35-40)	Solid	08/31/21 10:00	09/02/21 09:45
140-24457-7	E-SB-18 (40-44)	Solid	08/31/21 11:45	09/02/21 09:45
140-24457-8	E-SB-XPW01 (25-30)	Solid	08/31/21 13:50	09/02/21 09:45
140-24457-9	E-SB-15 (10-15)	Solid	08/31/21 15:40	09/02/21 09:45
140-24457-10	E-SB-15 (30-35)	Solid	08/31/21 16:20	09/02/21 09:45

DRAFT

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-07 (21-27)

Date Collected: 08/30/21 13:20
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-1

Matrix: Solid
Percent Solids: 81.5

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		49	7.9	mg/Kg	☼	12/02/21 12:30	01/17/22 11:30	4
Arsenic	ND		2.5	0.64	mg/Kg	☼	12/02/21 12:30	01/17/22 11:30	4
Barium	**2.3**	**J**	12	0.59	mg/Kg	☼	12/02/21 12:30	01/17/22 11:30	4
Boron	ND		49	49	mg/Kg	☼	12/02/21 12:30	01/17/22 11:30	4
Calcium	**1500**	**B**	1200	9.3	mg/Kg	☼	12/02/21 12:30	01/17/22 11:30	4
Cobalt	ND		12	0.22	mg/Kg	☼	12/02/21 12:30	01/17/22 11:30	4
Iron	ND		25	14	mg/Kg	☼	12/02/21 12:30	01/17/22 11:30	4
Lead	ND		2.5	0.54	mg/Kg	☼	12/02/21 12:30	01/17/22 11:30	4
Lithium	ND		12	0.74	mg/Kg	☼	12/02/21 12:30	01/17/22 11:30	4
Manganese	ND		3.7	0.15	mg/Kg	☼	12/02/21 12:30	01/17/22 11:30	4
Molybdenum	ND		9.8	0.40	mg/Kg	☼	12/02/21 12:30	01/17/22 11:30	4
Selenium	ND		2.5	0.83	mg/Kg	☼	12/02/21 12:30	01/17/22 11:30	4

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**13**	**J**	37	5.9	mg/Kg	☼	12/07/21 09:37	01/17/22 15:03	3
Arsenic	ND		1.8	0.48	mg/Kg	☼	12/07/21 09:37	01/17/22 15:03	3
Barium	**1.5**	**J**	9.2	0.44	mg/Kg	☼	12/07/21 09:37	01/17/22 15:03	3
Boron	ND		37	37	mg/Kg	☼	12/07/21 09:37	01/17/22 15:03	3
Calcium	**3100**		920	8.1	mg/Kg	☼	12/07/21 09:37	01/17/22 15:03	3
Cobalt	ND		9.2	0.23	mg/Kg	☼	12/07/21 09:37	01/17/22 15:03	3
Iron	**13**	**J**	18	11	mg/Kg	☼	12/07/21 09:37	01/17/22 15:03	3
Lead	**1.4**	**J**	1.8	0.41	mg/Kg	☼	12/07/21 09:37	01/17/22 15:03	3
Lithium	ND		9.2	0.55	mg/Kg	☼	12/07/21 09:37	01/17/22 15:03	3
Manganese	**74**		2.8	1.0	mg/Kg	☼	12/07/21 09:37	01/17/22 15:03	3
Molybdenum	ND		7.4	0.30	mg/Kg	☼	12/07/21 09:37	01/17/22 15:03	3
Selenium	**1.4**	**J B**	1.8	0.63	mg/Kg	☼	12/07/21 09:37	01/17/22 15:03	3

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**210**		12	2.6	mg/Kg	☼	12/09/21 11:51	01/26/22 11:10	1
Arsenic	**0.52**	**J**	0.61	0.16	mg/Kg	☼	12/09/21 11:51	01/26/22 11:10	1
Barium	**5.0**	***-**	3.1	0.15	mg/Kg	☼	12/09/21 11:51	01/26/22 11:10	1
Boron	ND		12	12	mg/Kg	☼	12/09/21 11:51	01/26/22 11:10	1
Calcium	**13**	**J**	310	1.8	mg/Kg	☼	12/09/21 11:51	01/26/22 11:10	1
Cobalt	**1.8**	**J**	3.1	0.055	mg/Kg	☼	12/09/21 11:51	01/26/22 11:10	1
Iron	**440**		6.1	3.6	mg/Kg	☼	12/09/21 11:51	01/26/22 11:10	1
Lead	ND		0.61	0.14	mg/Kg	☼	12/09/21 11:51	01/26/22 11:10	1
Lithium	ND		3.1	0.18	mg/Kg	☼	12/09/21 11:51	01/26/22 11:10	1
Manganese	**190**	**B**	0.92	0.033	mg/Kg	☼	12/09/21 11:51	01/26/22 11:10	1
Molybdenum	ND		2.5	0.10	mg/Kg	☼	12/09/21 11:51	01/26/22 11:10	1
Selenium	ND		0.61	0.21	mg/Kg	☼	12/09/21 11:51	01/26/22 11:10	1

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**1600**		12	2.0	mg/Kg	☼	12/13/21 09:30	01/26/22 13:01	1
Arsenic	**2.2**	**B**	0.61	0.27	mg/Kg	☼	12/13/21 09:30	01/26/22 13:01	1
Barium	**30**		3.1	0.15	mg/Kg	☼	12/13/21 09:30	01/26/22 13:01	1
Boron	ND		12	12	mg/Kg	☼	12/13/21 09:30	01/26/22 13:01	1
Calcium	**5300**		310	2.7	mg/Kg	☼	12/13/21 09:30	01/26/22 13:01	1

DRAFT

Client Sample ID: E-SB-07 (21-27)

Date Collected: 08/30/21 13:20
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-1

Matrix: Solid
Percent Solids: 81.5

Method: 6010B SEP - SEP Metals (ICP) - Step 4 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cobalt	3.7		3.1	0.065	mg/Kg	☼	12/13/21 09:30	01/26/22 13:01	1
Iron	6900		6.1	3.6	mg/Kg	☼	12/13/21 09:30	01/26/22 13:01	1
Lead	5.7		0.61	0.14	mg/Kg	☼	12/13/21 09:30	01/26/22 13:01	1
Lithium	2.6	J	3.1	0.18	mg/Kg	☼	12/13/21 09:30	01/26/22 13:01	1
Manganese	160		0.92	0.16	mg/Kg	☼	12/13/21 09:30	01/26/22 13:01	1
Molybdenum	0.15	J	2.5	0.10	mg/Kg	☼	12/13/21 09:30	01/26/22 13:01	1
Selenium	ND		0.61	0.58	mg/Kg	☼	12/13/21 09:30	01/26/22 13:01	1

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	140	J	180	29	mg/Kg	☼	12/15/21 10:40	01/26/22 14:25	5
Arsenic	ND		9.2	2.3	mg/Kg	☼	12/15/21 10:40	01/26/22 14:25	5
Barium	7.2	J	46	2.2	mg/Kg	☼	12/15/21 10:40	01/26/22 14:25	5
Boron	ND		180	180	mg/Kg	☼	12/15/21 10:40	01/26/22 14:25	5
Calcium	4500	J B	4600	14	mg/Kg	☼	12/15/21 10:40	01/26/22 14:25	5
Cobalt	ND		46	0.74	mg/Kg	☼	12/15/21 10:40	01/26/22 14:25	5
Iron	ND		92	54	mg/Kg	☼	12/15/21 10:40	01/26/22 14:25	5
Lead	ND		9.2	2.0	mg/Kg	☼	12/15/21 10:40	01/26/22 14:25	5
Lithium	5.1	J B	46	2.7	mg/Kg	☼	12/15/21 10:40	01/26/22 14:25	5
Manganese	3.1	J *1	14	2.3	mg/Kg	☼	12/15/21 10:40	01/26/22 14:25	5
Molybdenum	ND		37	1.5	mg/Kg	☼	12/15/21 10:40	01/26/22 14:25	5
Selenium	ND		9.2	3.2	mg/Kg	☼	12/15/21 10:40	01/26/22 14:25	5

Method: 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	4900		12	2.0	mg/Kg	☼	12/15/21 17:10	01/26/22 16:00	1
Arsenic	2.2		0.61	0.18	mg/Kg	☼	12/15/21 17:10	01/26/22 16:00	1
Barium	8.8		3.1	0.15	mg/Kg	☼	12/15/21 17:10	01/26/22 16:00	1
Boron	ND		12	12	mg/Kg	☼	12/15/21 17:10	01/26/22 16:00	1
Calcium	1600		310	2.6	mg/Kg	☼	12/15/21 17:10	01/26/22 16:00	1
Cobalt	2.6	J	3.1	0.056	mg/Kg	☼	12/15/21 17:10	01/26/22 16:00	1
Iron	8400		6.1	3.6	mg/Kg	☼	12/15/21 17:10	01/26/22 16:00	1
Lead	2.5		0.61	0.14	mg/Kg	☼	12/15/21 17:10	01/26/22 16:00	1
Lithium	6.1		3.1	0.18	mg/Kg	☼	12/15/21 17:10	01/26/22 16:00	1
Manganese	75		0.92	0.31	mg/Kg	☼	12/15/21 17:10	01/26/22 16:00	1
Molybdenum	ND		2.5	0.12	mg/Kg	☼	12/15/21 17:10	01/26/22 16:00	1
Selenium	0.35	J	0.61	0.21	mg/Kg	☼	12/15/21 17:10	01/26/22 16:00	1

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	30000		120	20	mg/Kg	☼	12/18/21 15:38	01/27/22 12:30	10
Arsenic	1.5	B	0.61	0.16	mg/Kg	☼	12/18/21 15:38	01/27/22 13:37	1
Barium	220		31	0.56	mg/Kg	☼	12/18/21 15:38	01/27/22 12:30	10
Calcium	1300		310	3.2	mg/Kg	☼	12/18/21 15:38	01/27/22 13:37	1
Cobalt	0.45	J	3.1	0.032	mg/Kg	☼	12/18/21 15:38	01/27/22 13:37	1
Iron	4600		6.1	5.0	mg/Kg	☼	12/18/21 15:38	01/27/22 13:37	1
Lead	1.4		0.61	0.14	mg/Kg	☼	12/18/21 15:38	01/27/22 13:37	1
Lithium	14		3.1	0.18	mg/Kg	☼	12/18/21 15:38	01/27/22 13:37	1
Manganese	40		0.92	0.14	mg/Kg	☼	12/18/21 15:38	01/27/22 13:37	1
Molybdenum	ND		2.5	0.10	mg/Kg	☼	12/18/21 15:38	01/27/22 13:37	1

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Client Sample ID: E-SB-07 (21-27)

Date Collected: 08/30/21 13:20
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-1

Matrix: Solid
Percent Solids: 81.5

Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		0.61	0.21	mg/Kg	☼	12/18/21 15:38	01/27/22 13:37	1

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	36000		10	1.6	mg/Kg			02/04/22 13:55	1
Arsenic	6.4		0.50	0.13	mg/Kg			02/04/22 13:55	1
Barium	280		2.5	0.12	mg/Kg			02/04/22 13:55	1
Calcium	17000		250	0.74	mg/Kg			02/04/22 13:55	1
Cobalt	8.5		2.5	0.023	mg/Kg			02/04/22 13:55	1
Iron	20000		5.0	4.1	mg/Kg			02/04/22 13:55	1
Lead	11		0.50	0.11	mg/Kg			02/04/22 13:55	1
Lithium	28		2.5	0.15	mg/Kg			02/04/22 13:55	1
Manganese	540		0.75	0.052	mg/Kg			02/04/22 13:55	1
Molybdenum	0.15	J	2.0	0.082	mg/Kg			02/04/22 13:55	1
Selenium	1.7		0.50	0.17	mg/Kg			02/04/22 13:55	1

Method: 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	53000		120	20	mg/Kg	☼	12/01/21 08:54	01/31/22 11:28	10
Arsenic	7.9	B	1.2	0.32	mg/Kg	☼	12/01/21 08:54	01/31/22 14:02	2
Barium	400		31	0.56	mg/Kg	☼	12/01/21 08:54	01/31/22 11:28	10
Calcium	21000	B	3100	32	mg/Kg	☼	12/01/21 08:54	01/31/22 11:28	10
Cobalt	6.2		3.1	0.032	mg/Kg	☼	12/01/21 08:54	01/31/22 12:34	1
Iron	17000		6.1	5.0	mg/Kg	☼	12/01/21 08:54	01/31/22 12:34	1
Lead	11		1.2	0.27	mg/Kg	☼	12/01/21 08:54	01/31/22 14:02	2
Lithium	21		3.1	0.18	mg/Kg	☼	12/01/21 08:54	01/31/22 12:34	1
Manganese	400		0.92	0.14	mg/Kg	☼	12/01/21 08:54	01/31/22 12:34	1
Molybdenum	0.34	J B	2.5	0.10	mg/Kg	☼	12/01/21 08:54	01/31/22 12:34	1
Selenium	1.4		1.2	0.42	mg/Kg	☼	12/01/21 08:54	01/31/22 14:02	2

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Client Sample ID: E-SB-07 (40-45)
Date Collected: 08/30/21 14:05
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-2
Matrix: Solid
Percent Solids: 93.6

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		43	6.8	mg/Kg	☼	12/02/21 12:30	01/17/22 11:35	4
Arsenic	ND		2.1	0.56	mg/Kg	☼	12/02/21 12:30	01/17/22 11:35	4
Barium	**0.72**	**J**	11	0.51	mg/Kg	☼	12/02/21 12:30	01/17/22 11:35	4
Boron	ND		43	43	mg/Kg	☼	12/02/21 12:30	01/17/22 11:35	4
Calcium	**480**	**J B**	1100	8.1	mg/Kg	☼	12/02/21 12:30	01/17/22 11:35	4
Cobalt	ND		11	0.19	mg/Kg	☼	12/02/21 12:30	01/17/22 11:35	4
Iron	ND		21	12	mg/Kg	☼	12/02/21 12:30	01/17/22 11:35	4
Lead	ND		2.1	0.47	mg/Kg	☼	12/02/21 12:30	01/17/22 11:35	4
Lithium	ND		11	0.64	mg/Kg	☼	12/02/21 12:30	01/17/22 11:35	4
Manganese	**4.0**	**B**	3.2	0.13	mg/Kg	☼	12/02/21 12:30	01/17/22 11:35	4
Molybdenum	ND		8.5	0.35	mg/Kg	☼	12/02/21 12:30	01/17/22 11:35	4
Selenium	ND		2.1	0.73	mg/Kg	☼	12/02/21 12:30	01/17/22 11:35	4

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**94**		32	5.1	mg/Kg	☼	12/07/21 09:37	01/17/22 15:08	3
Arsenic	ND		1.6	0.42	mg/Kg	☼	12/07/21 09:37	01/17/22 15:08	3
Barium	**0.42**	**J**	8.0	0.38	mg/Kg	☼	12/07/21 09:37	01/17/22 15:08	3
Boron	ND		32	32	mg/Kg	☼	12/07/21 09:37	01/17/22 15:08	3
Calcium	**120**	**J**	800	7.1	mg/Kg	☼	12/07/21 09:37	01/17/22 15:08	3
Cobalt	ND		8.0	0.20	mg/Kg	☼	12/07/21 09:37	01/17/22 15:08	3
Iron	**150**		16	9.3	mg/Kg	☼	12/07/21 09:37	01/17/22 15:08	3
Lead	**2.3**		1.6	0.35	mg/Kg	☼	12/07/21 09:37	01/17/22 15:08	3
Lithium	ND		8.0	0.48	mg/Kg	☼	12/07/21 09:37	01/17/22 15:08	3
Manganese	**7.4**		2.4	0.90	mg/Kg	☼	12/07/21 09:37	01/17/22 15:08	3
Molybdenum	ND		6.4	0.26	mg/Kg	☼	12/07/21 09:37	01/17/22 15:08	3
Selenium	**1.2**	**J B**	1.6	0.54	mg/Kg	☼	12/07/21 09:37	01/17/22 15:08	3

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**370**		11	2.2	mg/Kg	☼	12/09/21 11:51	01/26/22 11:15	1
Arsenic	**0.28**	**J**	0.53	0.14	mg/Kg	☼	12/09/21 11:51	01/26/22 11:15	1
Barium	**3.2**	***-**	2.7	0.13	mg/Kg	☼	12/09/21 11:51	01/26/22 11:15	1
Boron	ND		11	11	mg/Kg	☼	12/09/21 11:51	01/26/22 11:15	1
Calcium	**6.2**	**J**	270	1.6	mg/Kg	☼	12/09/21 11:51	01/26/22 11:15	1
Cobalt	**0.22**	**J**	2.7	0.048	mg/Kg	☼	12/09/21 11:51	01/26/22 11:15	1
Iron	**1700**		5.3	3.1	mg/Kg	☼	12/09/21 11:51	01/26/22 11:15	1
Lead	**0.23**	**J**	0.53	0.12	mg/Kg	☼	12/09/21 11:51	01/26/22 11:15	1
Lithium	**0.37**	**J**	2.7	0.16	mg/Kg	☼	12/09/21 11:51	01/26/22 11:15	1
Manganese	**30**	**B**	0.80	0.029	mg/Kg	☼	12/09/21 11:51	01/26/22 11:15	1
Molybdenum	ND		2.1	0.088	mg/Kg	☼	12/09/21 11:51	01/26/22 11:15	1
Selenium	ND		0.53	0.18	mg/Kg	☼	12/09/21 11:51	01/26/22 11:15	1

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**3100**		11	1.7	mg/Kg	☼	12/13/21 09:30	01/26/22 13:06	1
Arsenic	**1.1**	**B**	0.53	0.24	mg/Kg	☼	12/13/21 09:30	01/26/22 13:06	1
Barium	**22**		2.7	0.13	mg/Kg	☼	12/13/21 09:30	01/26/22 13:06	1
Boron	ND		11	11	mg/Kg	☼	12/13/21 09:30	01/26/22 13:06	1
Calcium	**2100**		270	2.4	mg/Kg	☼	12/13/21 09:30	01/26/22 13:06	1

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Client Sample ID: E-SB-07 (40-45)
Date Collected: 08/30/21 14:05
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-2
Matrix: Solid
Percent Solids: 93.6

Method: 6010B SEP - SEP Metals (ICP) - Step 4 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cobalt	5.1		2.7	0.057	mg/Kg	☼	12/13/21 09:30	01/26/22 13:06	1
Iron	17000		5.3	3.1	mg/Kg	☼	12/13/21 09:30	01/26/22 13:06	1
Lead	4.4		0.53	0.12	mg/Kg	☼	12/13/21 09:30	01/26/22 13:06	1
Lithium	9.0		2.7	0.16	mg/Kg	☼	12/13/21 09:30	01/26/22 13:06	1
Manganese	260		0.80	0.14	mg/Kg	☼	12/13/21 09:30	01/26/22 13:06	1
Molybdenum	ND		2.1	0.088	mg/Kg	☼	12/13/21 09:30	01/26/22 13:06	1
Selenium	1.2		0.53	0.50	mg/Kg	☼	12/13/21 09:30	01/26/22 13:06	1

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	41	J	160	25	mg/Kg	☼	12/15/21 10:40	01/26/22 14:30	5
Arsenic	ND		8.0	2.0	mg/Kg	☼	12/15/21 10:40	01/26/22 14:30	5
Barium	19	J	40	1.9	mg/Kg	☼	12/15/21 10:40	01/26/22 14:30	5
Boron	ND		160	160	mg/Kg	☼	12/15/21 10:40	01/26/22 14:30	5
Calcium	480	J B	4000	12	mg/Kg	☼	12/15/21 10:40	01/26/22 14:30	5
Cobalt	ND		40	0.64	mg/Kg	☼	12/15/21 10:40	01/26/22 14:30	5
Iron	ND		80	47	mg/Kg	☼	12/15/21 10:40	01/26/22 14:30	5
Lead	ND		8.0	1.8	mg/Kg	☼	12/15/21 10:40	01/26/22 14:30	5
Lithium	5.7	J B	40	2.4	mg/Kg	☼	12/15/21 10:40	01/26/22 14:30	5
Manganese	13	*1	12	2.0	mg/Kg	☼	12/15/21 10:40	01/26/22 14:30	5
Molybdenum	ND		32	1.3	mg/Kg	☼	12/15/21 10:40	01/26/22 14:30	5
Selenium	ND		8.0	2.8	mg/Kg	☼	12/15/21 10:40	01/26/22 14:30	5

Method: 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	7600		11	1.7	mg/Kg	☼	12/15/21 17:10	01/26/22 16:05	1
Arsenic	1.3		0.53	0.16	mg/Kg	☼	12/15/21 17:10	01/26/22 16:05	1
Barium	32		2.7	0.13	mg/Kg	☼	12/15/21 17:10	01/26/22 16:05	1
Boron	ND		11	11	mg/Kg	☼	12/15/21 17:10	01/26/22 16:05	1
Calcium	380		270	2.2	mg/Kg	☼	12/15/21 17:10	01/26/22 16:05	1
Cobalt	8.1		2.7	0.049	mg/Kg	☼	12/15/21 17:10	01/26/22 16:05	1
Iron	15000		5.3	3.1	mg/Kg	☼	12/15/21 17:10	01/26/22 16:05	1
Lead	2.3		0.53	0.12	mg/Kg	☼	12/15/21 17:10	01/26/22 16:05	1
Lithium	16		2.7	0.16	mg/Kg	☼	12/15/21 17:10	01/26/22 16:05	1
Manganese	220		0.80	0.27	mg/Kg	☼	12/15/21 17:10	01/26/22 16:05	1
Molybdenum	ND		2.1	0.11	mg/Kg	☼	12/15/21 17:10	01/26/22 16:05	1
Selenium	0.68		0.53	0.18	mg/Kg	☼	12/15/21 17:10	01/26/22 16:05	1

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	34000		110	17	mg/Kg	☼	12/18/21 15:38	01/27/22 12:35	10
Arsenic	1.4	B	0.53	0.14	mg/Kg	☼	12/18/21 15:38	01/27/22 13:42	1
Barium	170		27	0.49	mg/Kg	☼	12/18/21 15:38	01/27/22 12:35	10
Calcium	100	J	270	2.8	mg/Kg	☼	12/18/21 15:38	01/27/22 13:42	1
Cobalt	1.3	J	5.3	0.056	mg/Kg	☼	12/18/21 15:38	01/27/22 15:18	2
Iron	5300		5.3	4.4	mg/Kg	☼	12/18/21 15:38	01/27/22 13:42	1
Lead	ND		1.1	0.24	mg/Kg	☼	12/18/21 15:38	01/27/22 15:18	2
Lithium	16		2.7	0.16	mg/Kg	☼	12/18/21 15:38	01/27/22 13:42	1
Manganese	47		0.80	0.12	mg/Kg	☼	12/18/21 15:38	01/27/22 13:42	1
Molybdenum	ND		2.1	0.088	mg/Kg	☼	12/18/21 15:38	01/27/22 13:42	1

DRAFT

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-07 (40-45)

Date Collected: 08/30/21 14:05
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-2

Matrix: Solid
Percent Solids: 93.6

Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		0.53	0.18	mg/Kg	☼	12/18/21 15:38	01/27/22 13:42	1

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	45000		10	1.6	mg/Kg			02/04/22 13:55	1
Arsenic	4.1		0.50	0.13	mg/Kg			02/04/22 13:55	1
Barium	240		2.5	0.12	mg/Kg			02/04/22 13:55	1
Calcium	3600		250	0.74	mg/Kg			02/04/22 13:55	1
Cobalt	15		2.5	0.023	mg/Kg			02/04/22 13:55	1
Iron	39000		5.0	4.1	mg/Kg			02/04/22 13:55	1
Lead	9.3		0.50	0.11	mg/Kg			02/04/22 13:55	1
Lithium	47		2.5	0.15	mg/Kg			02/04/22 13:55	1
Manganese	590		0.75	0.052	mg/Kg			02/04/22 13:55	1
Molybdenum	ND		2.0	0.082	mg/Kg			02/04/22 13:55	1
Selenium	3.1		0.50	0.17	mg/Kg			02/04/22 13:55	1

Method: 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	76000		110	17	mg/Kg	☼	12/01/21 08:54	01/31/22 11:33	10
Arsenic	4.0	B	1.1	0.28	mg/Kg	☼	12/01/21 08:54	01/31/22 14:07	2
Barium	390		27	0.49	mg/Kg	☼	12/01/21 08:54	01/31/22 11:33	10
Calcium	4000	B	2700	28	mg/Kg	☼	12/01/21 08:54	01/31/22 11:33	10
Cobalt	12		5.3	0.056	mg/Kg	☼	12/01/21 08:54	01/31/22 14:07	2
Iron	37000		11	8.8	mg/Kg	☼	12/01/21 08:54	01/31/22 14:07	2
Lead	7.4		1.1	0.24	mg/Kg	☼	12/01/21 08:54	01/31/22 14:07	2
Lithium	42		2.7	0.16	mg/Kg	☼	12/01/21 08:54	01/31/22 12:40	1
Manganese	440		0.80	0.12	mg/Kg	☼	12/01/21 08:54	01/31/22 12:40	1
Molybdenum	ND		2.1	0.088	mg/Kg	☼	12/01/21 08:54	01/31/22 12:40	1
Selenium	2.0		1.1	0.36	mg/Kg	☼	12/01/21 08:54	01/31/22 14:07	2

DRAFT

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-07 (59-64)

Date Collected: 08/30/21 14:45
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-3

Matrix: Solid
Percent Solids: 91.2

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		44	7.0	mg/Kg	☼	12/02/21 12:30	01/17/22 11:40	4
Arsenic	ND		2.2	0.57	mg/Kg	☼	12/02/21 12:30	01/17/22 11:40	4
Barium	**0.61**	**J**	11	0.53	mg/Kg	☼	12/02/21 12:30	01/17/22 11:40	4
Boron	ND		44	44	mg/Kg	☼	12/02/21 12:30	01/17/22 11:40	4
Calcium	**220**	**J B**	1100	8.3	mg/Kg	☼	12/02/21 12:30	01/17/22 11:40	4
Cobalt	ND		11	0.20	mg/Kg	☼	12/02/21 12:30	01/17/22 11:40	4
Iron	ND		22	13	mg/Kg	☼	12/02/21 12:30	01/17/22 11:40	4
Lead	ND		2.2	0.48	mg/Kg	☼	12/02/21 12:30	01/17/22 11:40	4
Lithium	ND		11	0.66	mg/Kg	☼	12/02/21 12:30	01/17/22 11:40	4
Manganese	**1.7**	**J B**	3.3	0.14	mg/Kg	☼	12/02/21 12:30	01/17/22 11:40	4
Molybdenum	ND		8.8	0.36	mg/Kg	☼	12/02/21 12:30	01/17/22 11:40	4
Selenium	ND		2.2	0.75	mg/Kg	☼	12/02/21 12:30	01/17/22 11:40	4

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**76**		33	5.3	mg/Kg	☼	12/07/21 09:37	01/17/22 15:23	3
Arsenic	ND		1.6	0.43	mg/Kg	☼	12/07/21 09:37	01/17/22 15:23	3
Barium	**0.39**	**J**	8.2	0.39	mg/Kg	☼	12/07/21 09:37	01/17/22 15:23	3
Boron	ND		33	33	mg/Kg	☼	12/07/21 09:37	01/17/22 15:23	3
Calcium	**90**	**J**	820	7.2	mg/Kg	☼	12/07/21 09:37	01/17/22 15:23	3
Cobalt	ND		8.2	0.21	mg/Kg	☼	12/07/21 09:37	01/17/22 15:23	3
Iron	**84**		16	9.5	mg/Kg	☼	12/07/21 09:37	01/17/22 15:23	3
Lead	**3.0**		1.6	0.36	mg/Kg	☼	12/07/21 09:37	01/17/22 15:23	3
Lithium	ND		8.2	0.49	mg/Kg	☼	12/07/21 09:37	01/17/22 15:23	3
Manganese	**3.9**		2.5	0.92	mg/Kg	☼	12/07/21 09:37	01/17/22 15:23	3
Molybdenum	ND		6.6	0.27	mg/Kg	☼	12/07/21 09:37	01/17/22 15:23	3
Selenium	ND		1.6	0.56	mg/Kg	☼	12/07/21 09:37	01/26/22 09:51	3

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**280**		11	2.3	mg/Kg	☼	12/09/21 11:51	01/26/22 11:20	1
Arsenic	**0.53**	**J**	0.55	0.14	mg/Kg	☼	12/09/21 11:51	01/26/22 11:20	1
Barium	**2.9**	***-**	2.7	0.13	mg/Kg	☼	12/09/21 11:51	01/26/22 11:20	1
Boron	ND		11	11	mg/Kg	☼	12/09/21 11:51	01/26/22 11:20	1
Calcium	**6.4**	**J**	270	1.6	mg/Kg	☼	12/09/21 11:51	01/26/22 11:20	1
Cobalt	**0.23**	**J**	2.7	0.049	mg/Kg	☼	12/09/21 11:51	01/26/22 11:20	1
Iron	**740**		5.5	3.2	mg/Kg	☼	12/09/21 11:51	01/26/22 11:20	1
Lead	**0.31**	**J**	0.55	0.12	mg/Kg	☼	12/09/21 11:51	01/26/22 11:20	1
Lithium	**0.40**	**J**	2.7	0.16	mg/Kg	☼	12/09/21 11:51	01/26/22 11:20	1
Manganese	**19**	**B**	0.82	0.030	mg/Kg	☼	12/09/21 11:51	01/26/22 11:20	1
Molybdenum	ND		2.2	0.090	mg/Kg	☼	12/09/21 11:51	01/26/22 11:20	1
Selenium	ND		0.55	0.19	mg/Kg	☼	12/09/21 11:51	01/26/22 11:20	1

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**4400**		11	1.8	mg/Kg	☼	12/13/21 09:30	01/26/22 13:11	1
Arsenic	**1.0**	**B**	0.55	0.24	mg/Kg	☼	12/13/21 09:30	01/26/22 13:11	1
Barium	**20**		2.7	0.13	mg/Kg	☼	12/13/21 09:30	01/26/22 13:11	1
Boron	ND		11	11	mg/Kg	☼	12/13/21 09:30	01/26/22 13:11	1
Calcium	**1000**		270	2.4	mg/Kg	☼	12/13/21 09:30	01/26/22 13:11	1

DRAFT

Client Sample ID: E-SB-07 (59-64)
Date Collected: 08/30/21 14:45
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-3
Matrix: Solid
Percent Solids: 91.2

Method: 6010B SEP - SEP Metals (ICP) - Step 4 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cobalt	6.9		2.7	0.058	mg/Kg	☼	12/13/21 09:30	01/26/22 13:11	1
Iron	10000		5.5	3.2	mg/Kg	☼	12/13/21 09:30	01/26/22 13:11	1
Lead	4.7		0.55	0.12	mg/Kg	☼	12/13/21 09:30	01/26/22 13:11	1
Lithium	13		2.7	0.16	mg/Kg	☼	12/13/21 09:30	01/26/22 13:11	1
Manganese	180		0.82	0.14	mg/Kg	☼	12/13/21 09:30	01/26/22 13:11	1
Molybdenum	ND		2.2	0.090	mg/Kg	☼	12/13/21 09:30	01/26/22 13:11	1
Selenium	0.84		0.55	0.52	mg/Kg	☼	12/13/21 09:30	01/26/22 13:11	1

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	40	J	160	26	mg/Kg	☼	12/15/21 10:40	01/26/22 14:35	5
Arsenic	ND		8.2	2.1	mg/Kg	☼	12/15/21 10:40	01/26/22 14:35	5
Barium	30	J	41	2.0	mg/Kg	☼	12/15/21 10:40	01/26/22 14:35	5
Boron	ND		160	160	mg/Kg	☼	12/15/21 10:40	01/26/22 14:35	5
Calcium	170	J B	4100	12	mg/Kg	☼	12/15/21 10:40	01/26/22 14:35	5
Cobalt	ND		41	0.66	mg/Kg	☼	12/15/21 10:40	01/26/22 14:35	5
Iron	ND		82	48	mg/Kg	☼	12/15/21 10:40	01/26/22 14:35	5
Lead	ND		8.2	1.8	mg/Kg	☼	12/15/21 10:40	01/26/22 14:35	5
Lithium	6.1	J B	41	2.4	mg/Kg	☼	12/15/21 10:40	01/26/22 14:35	5
Manganese	ND	*1	12	2.0	mg/Kg	☼	12/15/21 10:40	01/26/22 14:35	5
Molybdenum	ND		33	1.4	mg/Kg	☼	12/15/21 10:40	01/26/22 14:35	5
Selenium	ND		8.2	2.9	mg/Kg	☼	12/15/21 10:40	01/26/22 14:35	5

Method: 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	5800		11	1.8	mg/Kg	☼	12/15/21 17:10	01/26/22 16:10	1
Arsenic	0.99		0.55	0.16	mg/Kg	☼	12/15/21 17:10	01/26/22 16:10	1
Barium	24		2.7	0.13	mg/Kg	☼	12/15/21 17:10	01/26/22 16:10	1
Boron	ND		11	11	mg/Kg	☼	12/15/21 17:10	01/26/22 16:10	1
Calcium	85	J	270	2.3	mg/Kg	☼	12/15/21 17:10	01/26/22 16:10	1
Cobalt	4.8		2.7	0.050	mg/Kg	☼	12/15/21 17:10	01/26/22 16:10	1
Iron	8400		5.5	3.2	mg/Kg	☼	12/15/21 17:10	01/26/22 16:10	1
Lead	1.3		0.55	0.12	mg/Kg	☼	12/15/21 17:10	01/26/22 16:10	1
Lithium	12		2.7	0.16	mg/Kg	☼	12/15/21 17:10	01/26/22 16:10	1
Manganese	120		0.82	0.27	mg/Kg	☼	12/15/21 17:10	01/26/22 16:10	1
Molybdenum	ND		2.2	0.11	mg/Kg	☼	12/15/21 17:10	01/26/22 16:10	1
Selenium	0.37	J	0.55	0.19	mg/Kg	☼	12/15/21 17:10	01/26/22 16:10	1

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	34000		110	18	mg/Kg	☼	12/18/21 15:38	01/27/22 12:39	10
Arsenic	1.4	B	0.55	0.14	mg/Kg	☼	12/18/21 15:38	01/27/22 13:47	1
Barium	170		27	0.50	mg/Kg	☼	12/18/21 15:38	01/27/22 12:39	10
Calcium	62	J	270	2.9	mg/Kg	☼	12/18/21 15:38	01/27/22 13:47	1
Cobalt	0.76	J	5.5	0.057	mg/Kg	☼	12/18/21 15:38	01/27/22 15:23	2
Iron	4400		5.5	4.5	mg/Kg	☼	12/18/21 15:38	01/27/22 13:47	1
Lead	ND		1.1	0.24	mg/Kg	☼	12/18/21 15:38	01/27/22 15:23	2
Lithium	15		2.7	0.16	mg/Kg	☼	12/18/21 15:38	01/27/22 13:47	1
Manganese	34		0.82	0.12	mg/Kg	☼	12/18/21 15:38	01/27/22 13:47	1
Molybdenum	ND		2.2	0.090	mg/Kg	☼	12/18/21 15:38	01/27/22 13:47	1

DRAFT

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-07 (59-64)

Date Collected: 08/30/21 14:45
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-3

Matrix: Solid
Percent Solids: 91.2

Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		0.55	0.19	mg/Kg	☼	12/18/21 15:38	01/27/22 13:47	1

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**44000**		10	1.6	mg/Kg			02/04/22 13:55	1
Arsenic	**3.9**		0.50	0.13	mg/Kg			02/04/22 13:55	1
Barium	**250**		2.5	0.12	mg/Kg			02/04/22 13:55	1
Calcium	**1700**		250	0.74	mg/Kg			02/04/22 13:55	1
Cobalt	**13**		2.5	0.023	mg/Kg			02/04/22 13:55	1
Iron	**24000**		5.0	4.1	mg/Kg			02/04/22 13:55	1
Lead	**9.4**		0.50	0.11	mg/Kg			02/04/22 13:55	1
Lithium	**46**		2.5	0.15	mg/Kg			02/04/22 13:55	1
Manganese	**360**		0.75	0.052	mg/Kg			02/04/22 13:55	1
Molybdenum	ND		2.0	0.082	mg/Kg			02/04/22 13:55	1
Selenium	**1.2**		0.50	0.17	mg/Kg			02/04/22 13:55	1

Method: 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**76000**		110	18	mg/Kg	☼	12/01/21 08:54	01/31/22 11:37	10
Arsenic	**3.9**	**B**	1.1	0.29	mg/Kg	☼	12/01/21 08:54	01/31/22 14:13	2
Barium	**400**		27	0.50	mg/Kg	☼	12/01/21 08:54	01/31/22 11:37	10
Calcium	**1500**	**B**	270	2.9	mg/Kg	☼	12/01/21 08:54	01/31/22 12:45	1
Cobalt	**11**		5.5	0.057	mg/Kg	☼	12/01/21 08:54	01/31/22 14:13	2
Iron	**21000**		5.5	4.5	mg/Kg	☼	12/01/21 08:54	01/31/22 12:45	1
Lead	**8.7**		1.1	0.24	mg/Kg	☼	12/01/21 08:54	01/31/22 14:13	2
Lithium	**42**		2.7	0.16	mg/Kg	☼	12/01/21 08:54	01/31/22 12:45	1
Manganese	**300**		0.82	0.12	mg/Kg	☼	12/01/21 08:54	01/31/22 12:45	1
Molybdenum	ND		2.2	0.090	mg/Kg	☼	12/01/21 08:54	01/31/22 12:45	1
Selenium	**1.3**		1.1	0.37	mg/Kg	☼	12/01/21 08:54	01/31/22 14:13	2

DRAFT

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-05 (30-33.5)

Date Collected: 08/30/21 16:50
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-4

Matrix: Solid
Percent Solids: 72.1

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		55	8.9	mg/Kg	☼	12/02/21 12:30	01/17/22 11:44	4
Arsenic	ND		2.8	0.72	mg/Kg	☼	12/02/21 12:30	01/17/22 11:44	4
Barium	**1.3**	**J**	14	0.67	mg/Kg	☼	12/02/21 12:30	01/17/22 11:44	4
Boron	ND		55	55	mg/Kg	☼	12/02/21 12:30	01/17/22 11:44	4
Calcium	**2000**	**B**	1400	11	mg/Kg	☼	12/02/21 12:30	01/17/22 11:44	4
Cobalt	ND		14	0.25	mg/Kg	☼	12/02/21 12:30	01/17/22 11:44	4
Iron	ND		28	16	mg/Kg	☼	12/02/21 12:30	01/17/22 11:44	4
Lead	ND		2.8	0.61	mg/Kg	☼	12/02/21 12:30	01/17/22 11:44	4
Lithium	ND		14	0.83	mg/Kg	☼	12/02/21 12:30	01/17/22 11:44	4
Manganese	**7.2**	**B**	4.2	0.17	mg/Kg	☼	12/02/21 12:30	01/17/22 11:44	4
Molybdenum	ND		11	0.45	mg/Kg	☼	12/02/21 12:30	01/17/22 11:44	4
Selenium	ND		2.8	0.94	mg/Kg	☼	12/02/21 12:30	01/17/22 11:44	4

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**22**	**J**	42	6.7	mg/Kg	☼	12/07/21 09:37	01/17/22 15:28	3
Arsenic	ND		2.1	0.54	mg/Kg	☼	12/07/21 09:37	01/17/22 15:28	3
Barium	**4.6**	**J**	10	0.50	mg/Kg	☼	12/07/21 09:37	01/17/22 15:28	3
Boron	ND		42	42	mg/Kg	☼	12/07/21 09:37	01/17/22 15:28	3
Calcium	**11000**		1000	9.1	mg/Kg	☼	12/07/21 09:37	01/17/22 15:28	3
Cobalt	**1.4**	**J**	10	0.26	mg/Kg	☼	12/07/21 09:37	01/17/22 15:28	3
Iron	**250**		21	12	mg/Kg	☼	12/07/21 09:37	01/17/22 15:28	3
Lead	**2.0**	**J**	2.1	0.46	mg/Kg	☼	12/07/21 09:37	01/17/22 15:28	3
Lithium	ND		10	0.62	mg/Kg	☼	12/07/21 09:37	01/17/22 15:28	3
Manganese	**150**		3.1	1.2	mg/Kg	☼	12/07/21 09:37	01/17/22 15:28	3
Molybdenum	ND		8.3	0.34	mg/Kg	☼	12/07/21 09:37	01/17/22 15:28	3
Selenium	ND		2.1	0.71	mg/Kg	☼	12/07/21 09:37	01/26/22 09:56	3

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**210**		14	2.9	mg/Kg	☼	12/09/21 11:51	01/26/22 11:25	1
Arsenic	**1.7**		0.69	0.18	mg/Kg	☼	12/09/21 11:51	01/26/22 11:25	1
Barium	**6.8**	***-**	3.5	0.17	mg/Kg	☼	12/09/21 11:51	01/26/22 11:25	1
Boron	ND		14	14	mg/Kg	☼	12/09/21 11:51	01/26/22 11:25	1
Calcium	**16**	**J**	350	2.1	mg/Kg	☼	12/09/21 11:51	01/26/22 11:25	1
Cobalt	**1.6**	**J**	3.5	0.062	mg/Kg	☼	12/09/21 11:51	01/26/22 11:25	1
Iron	**5500**		6.9	4.0	mg/Kg	☼	12/09/21 11:51	01/26/22 11:25	1
Lead	ND		0.69	0.15	mg/Kg	☼	12/09/21 11:51	01/26/22 11:25	1
Lithium	ND		3.5	0.21	mg/Kg	☼	12/09/21 11:51	01/26/22 11:25	1
Manganese	**150**	**B**	1.0	0.037	mg/Kg	☼	12/09/21 11:51	01/26/22 11:25	1
Molybdenum	**0.20**	**J**	2.8	0.11	mg/Kg	☼	12/09/21 11:51	01/26/22 11:25	1
Selenium	**0.38**	**J**	0.69	0.24	mg/Kg	☼	12/09/21 11:51	01/26/22 11:25	1

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**2400**		14	2.2	mg/Kg	☼	12/13/21 09:30	01/26/22 13:16	1
Arsenic	**2.0**	**B**	0.69	0.30	mg/Kg	☼	12/13/21 09:30	01/26/22 13:16	1
Barium	**34**		3.5	0.17	mg/Kg	☼	12/13/21 09:30	01/26/22 13:16	1
Boron	ND		14	14	mg/Kg	☼	12/13/21 09:30	01/26/22 13:16	1
Calcium	**14000**		350	3.0	mg/Kg	☼	12/13/21 09:30	01/26/22 13:16	1

DRAFT

Client Sample ID: E-SB-05 (30-33.5)
Date Collected: 08/30/21 16:50
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-4
Matrix: Solid
Percent Solids: 72.1

Method: 6010B SEP - SEP Metals (ICP) - Step 4 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cobalt	3.4	J	3.5	0.073	mg/Kg	☼	12/13/21 09:30	01/26/22 13:16	1
Iron	11000		6.9	4.0	mg/Kg	☼	12/13/21 09:30	01/26/22 13:16	1
Lead	7.0		0.69	0.15	mg/Kg	☼	12/13/21 09:30	01/26/22 13:16	1
Lithium	7.2		3.5	0.21	mg/Kg	☼	12/13/21 09:30	01/26/22 13:16	1
Manganese	270		1.0	0.18	mg/Kg	☼	12/13/21 09:30	01/26/22 13:16	1
Molybdenum	0.16	J	2.8	0.11	mg/Kg	☼	12/13/21 09:30	01/26/22 13:16	1
Selenium	1.1		0.69	0.65	mg/Kg	☼	12/13/21 09:30	01/26/22 13:16	1

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	40	J	210	33	mg/Kg	☼	12/15/21 10:40	01/26/22 14:40	5
Arsenic	ND		10	2.6	mg/Kg	☼	12/15/21 10:40	01/26/22 14:40	5
Barium	35	J	52	2.5	mg/Kg	☼	12/15/21 10:40	01/26/22 14:40	5
Boron	ND		210	210	mg/Kg	☼	12/15/21 10:40	01/26/22 14:40	5
Calcium	11000	B	5200	15	mg/Kg	☼	12/15/21 10:40	01/26/22 14:40	5
Cobalt	0.91	J	52	0.83	mg/Kg	☼	12/15/21 10:40	01/26/22 14:40	5
Iron	ND		100	61	mg/Kg	☼	12/15/21 10:40	01/26/22 14:40	5
Lead	ND		10	2.3	mg/Kg	☼	12/15/21 10:40	01/26/22 14:40	5
Lithium	7.1	J B	52	3.0	mg/Kg	☼	12/15/21 10:40	01/26/22 14:40	5
Manganese	54	*1	16	2.6	mg/Kg	☼	12/15/21 10:40	01/26/22 14:40	5
Molybdenum	ND		42	1.7	mg/Kg	☼	12/15/21 10:40	01/26/22 14:40	5
Selenium	ND		10	3.6	mg/Kg	☼	12/15/21 10:40	01/26/22 14:40	5

Method: 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	5000		14	2.2	mg/Kg	☼	12/15/21 17:10	01/26/22 16:15	1
Arsenic	1.7		0.69	0.21	mg/Kg	☼	12/15/21 17:10	01/26/22 16:15	1
Barium	37		3.5	0.17	mg/Kg	☼	12/15/21 17:10	01/26/22 16:15	1
Boron	ND		14	14	mg/Kg	☼	12/15/21 17:10	01/26/22 16:15	1
Calcium	2000		350	2.9	mg/Kg	☼	12/15/21 17:10	01/26/22 16:15	1
Cobalt	2.2	J	3.5	0.064	mg/Kg	☼	12/15/21 17:10	01/26/22 16:15	1
Iron	8300		6.9	4.0	mg/Kg	☼	12/15/21 17:10	01/26/22 16:15	1
Lead	2.6		0.69	0.15	mg/Kg	☼	12/15/21 17:10	01/26/22 16:15	1
Lithium	6.7		3.5	0.21	mg/Kg	☼	12/15/21 17:10	01/26/22 16:15	1
Manganese	63		1.0	0.35	mg/Kg	☼	12/15/21 17:10	01/26/22 16:15	1
Molybdenum	ND		2.8	0.14	mg/Kg	☼	12/15/21 17:10	01/26/22 16:15	1
Selenium	0.32	J	0.69	0.24	mg/Kg	☼	12/15/21 17:10	01/26/22 16:15	1

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	37000		140	22	mg/Kg	☼	12/18/21 15:38	01/27/22 12:44	10
Arsenic	1.6	B	1.4	0.36	mg/Kg	☼	12/18/21 15:38	01/27/22 15:28	2
Barium	280		35	0.64	mg/Kg	☼	12/18/21 15:38	01/27/22 12:44	10
Calcium	1700		350	3.6	mg/Kg	☼	12/18/21 15:38	01/27/22 13:52	1
Cobalt	0.23	J	3.5	0.036	mg/Kg	☼	12/18/21 15:38	01/27/22 13:52	1
Iron	5400		6.9	5.7	mg/Kg	☼	12/18/21 15:38	01/27/22 13:52	1
Lead	0.72	J	1.4	0.30	mg/Kg	☼	12/18/21 15:38	01/27/22 15:28	2
Lithium	16		3.5	0.21	mg/Kg	☼	12/18/21 15:38	01/27/22 13:52	1
Manganese	45		1.0	0.15	mg/Kg	☼	12/18/21 15:38	01/27/22 13:52	1
Molybdenum	ND		2.8	0.11	mg/Kg	☼	12/18/21 15:38	01/27/22 13:52	1

DRAFT

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-05 (30-33.5)

Date Collected: 08/30/21 16:50
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-4

Matrix: Solid
Percent Solids: 72.1

Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		1.4	0.47	mg/Kg	☼	12/18/21 15:38	01/27/22 15:28	2

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	45000		10	1.6	mg/Kg			02/04/22 13:55	1
Arsenic	7.0		0.50	0.13	mg/Kg			02/04/22 13:55	1
Barium	400		2.5	0.12	mg/Kg			02/04/22 13:55	1
Calcium	42000		250	0.74	mg/Kg			02/04/22 13:55	1
Cobalt	9.8		2.5	0.023	mg/Kg			02/04/22 13:55	1
Iron	31000		5.0	4.1	mg/Kg			02/04/22 13:55	1
Lead	12		0.50	0.11	mg/Kg			02/04/22 13:55	1
Lithium	37		2.5	0.15	mg/Kg			02/04/22 13:55	1
Manganese	730		0.75	0.052	mg/Kg			02/04/22 13:55	1
Molybdenum	0.35	J	2.0	0.082	mg/Kg			02/04/22 13:55	1
Selenium	1.8		0.50	0.17	mg/Kg			02/04/22 13:55	1

Method: 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	64000		140	22	mg/Kg	☼	12/01/21 08:54	01/31/22 11:42	10
Arsenic	8.2	B	1.4	0.36	mg/Kg	☼	12/01/21 08:54	01/31/22 14:18	2
Barium	470		35	0.64	mg/Kg	☼	12/01/21 08:54	01/31/22 11:42	10
Calcium	53000	B	3500	36	mg/Kg	☼	12/01/21 08:54	01/31/22 11:42	10
Cobalt	6.8		3.5	0.036	mg/Kg	☼	12/01/21 08:54	01/31/22 12:51	1
Iron	23000		6.9	5.7	mg/Kg	☼	12/01/21 08:54	01/31/22 12:51	1
Lead	12		1.4	0.30	mg/Kg	☼	12/01/21 08:54	01/31/22 14:18	2
Lithium	31		3.5	0.21	mg/Kg	☼	12/01/21 08:54	01/31/22 12:51	1
Manganese	550		1.0	0.15	mg/Kg	☼	12/01/21 08:54	01/31/22 12:51	1
Molybdenum	0.65	J B	2.8	0.11	mg/Kg	☼	12/01/21 08:54	01/31/22 12:51	1
Selenium	1.8		1.4	0.47	mg/Kg	☼	12/01/21 08:54	01/31/22 14:18	2

DRAFT

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-05 (51-56)

Date Collected: 08/30/21 17:20
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-5

Matrix: Solid
Percent Solids: 89.9

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	9.7	J	44	7.1	mg/Kg	☼	12/02/21 12:30	01/17/22 11:49	4
Arsenic	ND		2.2	0.58	mg/Kg	☼	12/02/21 12:30	01/17/22 11:49	4
Barium	0.93	J	11	0.53	mg/Kg	☼	12/02/21 12:30	01/17/22 11:49	4
Boron	ND		44	44	mg/Kg	☼	12/02/21 12:30	01/17/22 11:49	4
Calcium	550	J B	1100	8.4	mg/Kg	☼	12/02/21 12:30	01/17/22 11:49	4
Cobalt	ND		11	0.20	mg/Kg	☼	12/02/21 12:30	01/17/22 11:49	4
Iron	ND		22	13	mg/Kg	☼	12/02/21 12:30	01/17/22 11:49	4
Lead	ND		2.2	0.49	mg/Kg	☼	12/02/21 12:30	01/17/22 11:49	4
Lithium	ND		11	0.67	mg/Kg	☼	12/02/21 12:30	01/17/22 11:49	4
Manganese	3.4	B	3.3	0.14	mg/Kg	☼	12/02/21 12:30	01/17/22 11:49	4
Molybdenum	ND		8.9	0.36	mg/Kg	☼	12/02/21 12:30	01/17/22 11:49	4
Selenium	ND		2.2	0.76	mg/Kg	☼	12/02/21 12:30	01/17/22 11:49	4

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	110		33	5.3	mg/Kg	☼	12/07/21 09:37	01/17/22 15:33	3
Arsenic	ND		1.7	0.43	mg/Kg	☼	12/07/21 09:37	01/17/22 15:33	3
Barium	0.75	J	8.3	0.40	mg/Kg	☼	12/07/21 09:37	01/17/22 15:33	3
Boron	ND		33	33	mg/Kg	☼	12/07/21 09:37	01/17/22 15:33	3
Calcium	370	J	830	7.3	mg/Kg	☼	12/07/21 09:37	01/17/22 15:33	3
Cobalt	0.47	J	8.3	0.21	mg/Kg	☼	12/07/21 09:37	01/17/22 15:33	3
Iron	180		17	9.7	mg/Kg	☼	12/07/21 09:37	01/17/22 15:33	3
Lead	3.8		1.7	0.37	mg/Kg	☼	12/07/21 09:37	01/17/22 15:33	3
Lithium	0.53	J	8.3	0.50	mg/Kg	☼	12/07/21 09:37	01/17/22 15:33	3
Manganese	12		2.5	0.93	mg/Kg	☼	12/07/21 09:37	01/17/22 15:33	3
Molybdenum	ND		6.7	0.27	mg/Kg	☼	12/07/21 09:37	01/17/22 15:33	3
Selenium	ND		1.7	0.57	mg/Kg	☼	12/07/21 09:37	01/26/22 10:01	3

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	380		11	2.3	mg/Kg	☼	12/09/21 11:51	01/26/22 11:30	1
Arsenic	0.76		0.56	0.14	mg/Kg	☼	12/09/21 11:51	01/26/22 11:30	1
Barium	3.8	*-	2.8	0.13	mg/Kg	☼	12/09/21 11:51	01/26/22 11:30	1
Boron	ND		11	11	mg/Kg	☼	12/09/21 11:51	01/26/22 11:30	1
Calcium	7.0	J	280	1.7	mg/Kg	☼	12/09/21 11:51	01/26/22 11:30	1
Cobalt	0.63	J	2.8	0.050	mg/Kg	☼	12/09/21 11:51	01/26/22 11:30	1
Iron	2000		5.6	3.2	mg/Kg	☼	12/09/21 11:51	01/26/22 11:30	1
Lead	ND		0.56	0.12	mg/Kg	☼	12/09/21 11:51	01/26/22 11:30	1
Lithium	0.47	J	2.8	0.17	mg/Kg	☼	12/09/21 11:51	01/26/22 11:30	1
Manganese	47	B	0.83	0.030	mg/Kg	☼	12/09/21 11:51	01/26/22 11:30	1
Molybdenum	ND		2.2	0.091	mg/Kg	☼	12/09/21 11:51	01/26/22 11:30	1
Selenium	0.19	J	0.56	0.19	mg/Kg	☼	12/09/21 11:51	01/26/22 11:30	1

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	4500		11	1.8	mg/Kg	☼	12/13/21 09:30	01/26/22 13:21	1
Arsenic	1.0	B	0.56	0.24	mg/Kg	☼	12/13/21 09:30	01/26/22 13:21	1
Barium	36		2.8	0.13	mg/Kg	☼	12/13/21 09:30	01/26/22 13:21	1
Boron	ND		11	11	mg/Kg	☼	12/13/21 09:30	01/26/22 13:21	1
Calcium	2700		280	2.4	mg/Kg	☼	12/13/21 09:30	01/26/22 13:21	1

DRAFT

Client Sample ID: E-SB-05 (51-56)
Date Collected: 08/30/21 17:20
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-5
Matrix: Solid
Percent Solids: 89.9

Method: 6010B SEP - SEP Metals (ICP) - Step 4 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cobalt	6.4		2.8	0.059	mg/Kg	☼	12/13/21 09:30	01/26/22 13:21	1
Iron	14000		5.6	3.2	mg/Kg	☼	12/13/21 09:30	01/26/22 13:21	1
Lead	5.5		0.56	0.12	mg/Kg	☼	12/13/21 09:30	01/26/22 13:21	1
Lithium	13		2.8	0.17	mg/Kg	☼	12/13/21 09:30	01/26/22 13:21	1
Manganese	290		0.83	0.14	mg/Kg	☼	12/13/21 09:30	01/26/22 13:21	1
Molybdenum	ND		2.2	0.091	mg/Kg	☼	12/13/21 09:30	01/26/22 13:21	1
Selenium	1.1		0.56	0.52	mg/Kg	☼	12/13/21 09:30	01/26/22 13:21	1

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	37	J	170	26	mg/Kg	☼	12/15/21 10:40	01/26/22 14:45	5
Arsenic	ND		8.3	2.1	mg/Kg	☼	12/15/21 10:40	01/26/22 14:45	5
Barium	7.3	J	42	2.0	mg/Kg	☼	12/15/21 10:40	01/26/22 14:45	5
Boron	ND		170	170	mg/Kg	☼	12/15/21 10:40	01/26/22 14:45	5
Calcium	390	J B	4200	12	mg/Kg	☼	12/15/21 10:40	01/26/22 14:45	5
Cobalt	1.5	J	42	0.67	mg/Kg	☼	12/15/21 10:40	01/26/22 14:45	5
Iron	ND		83	49	mg/Kg	☼	12/15/21 10:40	01/26/22 14:45	5
Lead	ND		8.3	1.8	mg/Kg	☼	12/15/21 10:40	01/26/22 14:45	5
Lithium	7.3	J B	42	2.4	mg/Kg	☼	12/15/21 10:40	01/26/22 14:45	5
Manganese	11	J *1	13	2.1	mg/Kg	☼	12/15/21 10:40	01/26/22 14:45	5
Molybdenum	ND		33	1.4	mg/Kg	☼	12/15/21 10:40	01/26/22 14:45	5
Selenium	ND		8.3	2.9	mg/Kg	☼	12/15/21 10:40	01/26/22 14:45	5

Method: 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	6700		11	1.8	mg/Kg	☼	12/15/21 17:10	01/26/22 16:20	1
Arsenic	1.3		0.56	0.17	mg/Kg	☼	12/15/21 17:10	01/26/22 16:20	1
Barium	12		2.8	0.13	mg/Kg	☼	12/15/21 17:10	01/26/22 16:20	1
Boron	ND		11	11	mg/Kg	☼	12/15/21 17:10	01/26/22 16:20	1
Calcium	140	J	280	2.3	mg/Kg	☼	12/15/21 17:10	01/26/22 16:20	1
Cobalt	5.7		2.8	0.051	mg/Kg	☼	12/15/21 17:10	01/26/22 16:20	1
Iron	9700		5.6	3.2	mg/Kg	☼	12/15/21 17:10	01/26/22 16:20	1
Lead	1.8		0.56	0.12	mg/Kg	☼	12/15/21 17:10	01/26/22 16:20	1
Lithium	13		2.8	0.17	mg/Kg	☼	12/15/21 17:10	01/26/22 16:20	1
Manganese	140		0.83	0.28	mg/Kg	☼	12/15/21 17:10	01/26/22 16:20	1
Molybdenum	ND		2.2	0.11	mg/Kg	☼	12/15/21 17:10	01/26/22 16:20	1
Selenium	0.44	J	0.56	0.19	mg/Kg	☼	12/15/21 17:10	01/26/22 16:20	1

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	41000		110	18	mg/Kg	☼	12/18/21 15:38	01/27/22 12:49	10
Arsenic	1.8	B	1.1	0.29	mg/Kg	☼	12/18/21 15:38	01/27/22 15:33	2
Barium	220		28	0.51	mg/Kg	☼	12/18/21 15:38	01/27/22 12:49	10
Calcium	100	J	280	2.9	mg/Kg	☼	12/18/21 15:38	01/27/22 14:07	1
Cobalt	0.50	J	5.6	0.058	mg/Kg	☼	12/18/21 15:38	01/27/22 15:33	2
Iron	4600		5.6	4.6	mg/Kg	☼	12/18/21 15:38	01/27/22 14:07	1
Lead	ND		1.1	0.24	mg/Kg	☼	12/18/21 15:38	01/27/22 15:33	2
Lithium	17		2.8	0.17	mg/Kg	☼	12/18/21 15:38	01/27/22 14:07	1
Manganese	33		0.83	0.12	mg/Kg	☼	12/18/21 15:38	01/27/22 14:07	1
Molybdenum	ND		2.2	0.091	mg/Kg	☼	12/18/21 15:38	01/27/22 14:07	1

DRAFT

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-05 (51-56)

Date Collected: 08/30/21 17:20
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-5

Matrix: Solid
Percent Solids: 89.9

Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		1.1	0.38	mg/Kg	☼	12/18/21 15:38	01/27/22 15:33	2

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**52000**		10	1.6	mg/Kg			02/04/22 13:55	1
Arsenic	**4.8**		0.50	0.13	mg/Kg			02/04/22 13:55	1
Barium	**280**		2.5	0.12	mg/Kg			02/04/22 13:55	1
Calcium	**4300**		250	0.74	mg/Kg			02/04/22 13:55	1
Cobalt	**15**		2.5	0.023	mg/Kg			02/04/22 13:55	1
Iron	**30000**		5.0	4.1	mg/Kg			02/04/22 13:55	1
Lead	**11**		0.50	0.11	mg/Kg			02/04/22 13:55	1
Lithium	**51**		2.5	0.15	mg/Kg			02/04/22 13:55	1
Manganese	**530**		0.75	0.052	mg/Kg			02/04/22 13:55	1
Molybdenum	ND		2.0	0.082	mg/Kg			02/04/22 13:55	1
Selenium	**1.7**		0.50	0.17	mg/Kg			02/04/22 13:55	1

Method: 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**95000**		110	18	mg/Kg	☼	12/01/21 08:54	01/31/22 11:47	10
Arsenic	**9.6**	**B**	1.1	0.29	mg/Kg	☼	12/01/21 08:54	01/31/22 14:23	2
Barium	**480**		28	0.51	mg/Kg	☼	12/01/21 08:54	01/31/22 11:47	10
Calcium	**4200**	**B**	2800	29	mg/Kg	☼	12/01/21 08:54	01/31/22 11:47	10
Cobalt	**16**		5.6	0.058	mg/Kg	☼	12/01/21 08:54	01/31/22 14:23	2
Iron	**27000**		5.6	4.6	mg/Kg	☼	12/01/21 08:54	01/31/22 12:57	1
Lead	**12**		1.1	0.24	mg/Kg	☼	12/01/21 08:54	01/31/22 14:23	2
Lithium	**49**		2.8	0.17	mg/Kg	☼	12/01/21 08:54	01/31/22 12:57	1
Manganese	**460**		0.83	0.12	mg/Kg	☼	12/01/21 08:54	01/31/22 12:57	1
Molybdenum	**0.31**	**J B**	2.2	0.091	mg/Kg	☼	12/01/21 08:54	01/31/22 12:57	1
Selenium	**1.8**		1.1	0.38	mg/Kg	☼	12/01/21 08:54	01/31/22 14:23	2

DRAFT

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-19 (35-40)
Date Collected: 08/31/21 10:00
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-6
Matrix: Solid
Percent Solids: 81.8

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		49	7.8	mg/Kg	☼	12/02/21 12:30	01/17/22 11:54	4
Arsenic	ND		2.4	0.64	mg/Kg	☼	12/02/21 12:30	01/17/22 11:54	4
Barium	**1.2**	**J**	12	0.59	mg/Kg	☼	12/02/21 12:30	01/17/22 11:54	4
Boron	ND		49	49	mg/Kg	☼	12/02/21 12:30	01/17/22 11:54	4
Calcium	**950**	**J B**	1200	9.3	mg/Kg	☼	12/02/21 12:30	01/17/22 11:54	4
Cobalt	ND		12	0.22	mg/Kg	☼	12/02/21 12:30	01/17/22 11:54	4
Iron	ND		24	14	mg/Kg	☼	12/02/21 12:30	01/17/22 11:54	4
Lead	ND		2.4	0.54	mg/Kg	☼	12/02/21 12:30	01/17/22 11:54	4
Lithium	ND		12	0.73	mg/Kg	☼	12/02/21 12:30	01/17/22 11:54	4
Manganese	**19**	**B**	3.7	0.15	mg/Kg	☼	12/02/21 12:30	01/17/22 11:54	4
Molybdenum	ND		9.8	0.40	mg/Kg	☼	12/02/21 12:30	01/17/22 11:54	4
Selenium	**0.86**	**J**	2.4	0.83	mg/Kg	☼	12/02/21 12:30	01/17/22 11:54	4

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**40**		37	5.9	mg/Kg	☼	12/07/21 09:37	01/17/22 15:38	3
Arsenic	ND		1.8	0.48	mg/Kg	☼	12/07/21 09:37	01/17/22 15:38	3
Barium	**1.2**	**J**	9.2	0.44	mg/Kg	☼	12/07/21 09:37	01/17/22 15:38	3
Boron	ND		37	37	mg/Kg	☼	12/07/21 09:37	01/17/22 15:38	3
Calcium	**1500**		920	8.1	mg/Kg	☼	12/07/21 09:37	01/17/22 15:38	3
Cobalt	ND		9.2	0.23	mg/Kg	☼	12/07/21 09:37	01/17/22 15:38	3
Iron	**160**		18	11	mg/Kg	☼	12/07/21 09:37	01/17/22 15:38	3
Lead	**2.6**		1.8	0.40	mg/Kg	☼	12/07/21 09:37	01/17/22 15:38	3
Lithium	ND		9.2	0.55	mg/Kg	☼	12/07/21 09:37	01/17/22 15:38	3
Manganese	**150**		2.8	1.0	mg/Kg	☼	12/07/21 09:37	01/17/22 15:38	3
Molybdenum	ND		7.3	0.30	mg/Kg	☼	12/07/21 09:37	01/17/22 15:38	3
Selenium	ND		1.8	0.62	mg/Kg	☼	12/07/21 09:37	01/26/22 10:06	3

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**200**		12	2.6	mg/Kg	☼	12/09/21 11:51	01/26/22 11:45	1
Arsenic	**0.40**	**J**	0.61	0.16	mg/Kg	☼	12/09/21 11:51	01/26/22 11:45	1
Barium	**2.5**	**J *-**	3.1	0.15	mg/Kg	☼	12/09/21 11:51	01/26/22 11:45	1
Boron	ND		12	12	mg/Kg	☼	12/09/21 11:51	01/26/22 11:45	1
Calcium	**11**	**J**	310	1.8	mg/Kg	☼	12/09/21 11:51	01/26/22 11:45	1
Cobalt	**0.37**	**J**	3.1	0.055	mg/Kg	☼	12/09/21 11:51	01/26/22 11:45	1
Iron	**1200**		6.1	3.5	mg/Kg	☼	12/09/21 11:51	01/26/22 11:45	1
Lead	ND		0.61	0.13	mg/Kg	☼	12/09/21 11:51	01/26/22 11:45	1
Lithium	**0.20**	**J**	3.1	0.18	mg/Kg	☼	12/09/21 11:51	01/26/22 11:45	1
Manganese	**79**	**B**	0.92	0.033	mg/Kg	☼	12/09/21 11:51	01/26/22 11:45	1
Molybdenum	ND		2.4	0.10	mg/Kg	☼	12/09/21 11:51	01/26/22 11:45	1
Selenium	ND		0.61	0.21	mg/Kg	☼	12/09/21 11:51	01/26/22 11:45	1

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**1600**		12	2.0	mg/Kg	☼	12/13/21 09:30	01/26/22 13:26	1
Arsenic	**2.3**	**B**	0.61	0.27	mg/Kg	☼	12/13/21 09:30	01/26/22 13:26	1
Barium	**35**		3.1	0.15	mg/Kg	☼	12/13/21 09:30	01/26/22 13:26	1
Boron	ND		12	12	mg/Kg	☼	12/13/21 09:30	01/26/22 13:26	1
Calcium	**13000**		310	2.7	mg/Kg	☼	12/13/21 09:30	01/26/22 13:26	1

DRAFT

Client Sample ID: E-SB-19 (35-40)

Date Collected: 08/31/21 10:00
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-6

Matrix: Solid
Percent Solids: 81.8

Method: 6010B SEP - SEP Metals (ICP) - Step 4 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cobalt	4.2		3.1	0.065	mg/Kg	☼	12/13/21 09:30	01/26/22 13:26	1
Iron	9600		6.1	3.5	mg/Kg	☼	12/13/21 09:30	01/26/22 13:26	1
Lead	5.3		0.61	0.13	mg/Kg	☼	12/13/21 09:30	01/26/22 13:26	1
Lithium	4.3		3.1	0.18	mg/Kg	☼	12/13/21 09:30	01/26/22 13:26	1
Manganese	170		0.92	0.16	mg/Kg	☼	12/13/21 09:30	01/26/22 13:26	1
Molybdenum	0.33	J	2.4	0.10	mg/Kg	☼	12/13/21 09:30	01/26/22 13:26	1
Selenium	0.89		0.61	0.57	mg/Kg	☼	12/13/21 09:30	01/26/22 13:26	1

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	99	J	180	29	mg/Kg	☼	12/15/21 10:40	01/26/22 15:00	5
Arsenic	ND		9.2	2.3	mg/Kg	☼	12/15/21 10:40	01/26/22 15:00	5
Barium	11	J	46	2.2	mg/Kg	☼	12/15/21 10:40	01/26/22 15:00	5
Boron	ND		180	180	mg/Kg	☼	12/15/21 10:40	01/26/22 15:00	5
Calcium	10000	B	4600	13	mg/Kg	☼	12/15/21 10:40	01/26/22 15:00	5
Cobalt	ND		46	0.73	mg/Kg	☼	12/15/21 10:40	01/26/22 15:00	5
Iron	ND		92	54	mg/Kg	☼	12/15/21 10:40	01/26/22 15:00	5
Lead	ND		9.2	2.0	mg/Kg	☼	12/15/21 10:40	01/26/22 15:00	5
Lithium	7.0	J B	46	2.7	mg/Kg	☼	12/15/21 10:40	01/26/22 15:00	5
Manganese	8.0	J *1	14	2.3	mg/Kg	☼	12/15/21 10:40	01/26/22 15:00	5
Molybdenum	ND		37	1.5	mg/Kg	☼	12/15/21 10:40	01/26/22 15:00	5
Selenium	ND		9.2	3.2	mg/Kg	☼	12/15/21 10:40	01/26/22 15:00	5

Method: 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	5700		12	2.0	mg/Kg	☼	12/15/21 17:10	01/26/22 16:25	1
Arsenic	2.1		0.61	0.18	mg/Kg	☼	12/15/21 17:10	01/26/22 16:25	1
Barium	13		3.1	0.15	mg/Kg	☼	12/15/21 17:10	01/26/22 16:25	1
Boron	ND		12	12	mg/Kg	☼	12/15/21 17:10	01/26/22 16:25	1
Calcium	3100		310	2.6	mg/Kg	☼	12/15/21 17:10	01/26/22 16:25	1
Cobalt	3.7		3.1	0.056	mg/Kg	☼	12/15/21 17:10	01/26/22 16:25	1
Iron	9800		6.1	3.5	mg/Kg	☼	12/15/21 17:10	01/26/22 16:25	1
Lead	2.5		0.61	0.13	mg/Kg	☼	12/15/21 17:10	01/26/22 16:25	1
Lithium	8.5		3.1	0.18	mg/Kg	☼	12/15/21 17:10	01/26/22 16:25	1
Manganese	94		0.92	0.31	mg/Kg	☼	12/15/21 17:10	01/26/22 16:25	1
Molybdenum	ND		2.4	0.12	mg/Kg	☼	12/15/21 17:10	01/26/22 16:25	1
Selenium	0.45	J	0.61	0.21	mg/Kg	☼	12/15/21 17:10	01/26/22 16:25	1

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	31000		120	20	mg/Kg	☼	12/18/21 15:38	01/27/22 12:54	10
Arsenic	1.6	B	1.2	0.32	mg/Kg	☼	12/18/21 15:38	01/27/22 15:38	2
Barium	220		31	0.56	mg/Kg	☼	12/18/21 15:38	01/27/22 12:54	10
Calcium	1300		310	3.2	mg/Kg	☼	12/18/21 15:38	01/27/22 14:13	1
Cobalt	0.35	J	6.1	0.064	mg/Kg	☼	12/18/21 15:38	01/27/22 15:38	2
Iron	4600		6.1	5.0	mg/Kg	☼	12/18/21 15:38	01/27/22 14:13	1
Lead	0.58	J	1.2	0.27	mg/Kg	☼	12/18/21 15:38	01/27/22 15:38	2
Lithium	14		3.1	0.18	mg/Kg	☼	12/18/21 15:38	01/27/22 14:13	1
Manganese	38		0.92	0.13	mg/Kg	☼	12/18/21 15:38	01/27/22 14:13	1
Molybdenum	ND		2.4	0.10	mg/Kg	☼	12/18/21 15:38	01/27/22 14:13	1

DRAFT

Client Sample ID: E-SB-19 (35-40)

Date Collected: 08/31/21 10:00
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-6

Matrix: Solid
Percent Solids: 81.8

Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		1.2	0.42	mg/Kg	☼	12/18/21 15:38	01/27/22 15:38	2

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	38000		10	1.6	mg/Kg			02/04/22 13:55	1
Arsenic	6.4		0.50	0.13	mg/Kg			02/04/22 13:55	1
Barium	280		2.5	0.12	mg/Kg			02/04/22 13:55	1
Calcium	30000		250	0.74	mg/Kg			02/04/22 13:55	1
Cobalt	8.7		2.5	0.023	mg/Kg			02/04/22 13:55	1
Iron	25000		5.0	4.1	mg/Kg			02/04/22 13:55	1
Lead	11		0.50	0.11	mg/Kg			02/04/22 13:55	1
Lithium	34		2.5	0.15	mg/Kg			02/04/22 13:55	1
Manganese	560		0.75	0.052	mg/Kg			02/04/22 13:55	1
Molybdenum	0.33	J	2.0	0.082	mg/Kg			02/04/22 13:55	1
Selenium	2.2		0.50	0.17	mg/Kg			02/04/22 13:55	1

Method: 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	54000		120	20	mg/Kg	☼	12/01/21 08:54	01/31/22 11:51	10
Arsenic	6.5	B	1.2	0.32	mg/Kg	☼	12/01/21 08:54	01/31/22 14:28	2
Barium	380		31	0.56	mg/Kg	☼	12/01/21 08:54	01/31/22 11:51	10
Calcium	32000	B	3100	32	mg/Kg	☼	12/01/21 08:54	01/31/22 11:51	10
Cobalt	5.5		3.1	0.032	mg/Kg	☼	12/01/21 08:54	01/31/22 13:12	1
Iron	18000		6.1	5.0	mg/Kg	☼	12/01/21 08:54	01/31/22 13:12	1
Lead	11		1.2	0.27	mg/Kg	☼	12/01/21 08:54	01/31/22 14:28	2
Lithium	24		3.1	0.18	mg/Kg	☼	12/01/21 08:54	01/31/22 13:12	1
Manganese	360		0.92	0.13	mg/Kg	☼	12/01/21 08:54	01/31/22 13:12	1
Molybdenum	0.52	J B	2.4	0.10	mg/Kg	☼	12/01/21 08:54	01/31/22 13:12	1
Selenium	1.9		1.2	0.42	mg/Kg	☼	12/01/21 08:54	01/31/22 14:28	2

DRAFT

Client Sample ID: E-SB-18 (40-44)

Date Collected: 08/31/21 11:45
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-7

Matrix: Solid
Percent Solids: 70.1

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		57	9.1	mg/Kg	☼	12/02/21 12:30	01/17/22 11:59	4
Arsenic	ND		2.9	0.74	mg/Kg	☼	12/02/21 12:30	01/17/22 11:59	4
Barium	**0.81**	**J**	14	0.68	mg/Kg	☼	12/02/21 12:30	01/17/22 11:59	4
Boron	ND		57	57	mg/Kg	☼	12/02/21 12:30	01/17/22 11:59	4
Calcium	**2100**	**B**	1400	11	mg/Kg	☼	12/02/21 12:30	01/17/22 11:59	4
Cobalt	ND		14	0.26	mg/Kg	☼	12/02/21 12:30	01/17/22 11:59	4
Iron	ND		29	17	mg/Kg	☼	12/02/21 12:30	01/17/22 11:59	4
Lead	**0.75**	**J**	2.9	0.63	mg/Kg	☼	12/02/21 12:30	01/17/22 11:59	4
Lithium	ND		14	0.86	mg/Kg	☼	12/02/21 12:30	01/17/22 11:59	4
Manganese	**7.9**	**B**	4.3	0.18	mg/Kg	☼	12/02/21 12:30	01/17/22 11:59	4
Molybdenum	ND		11	0.47	mg/Kg	☼	12/02/21 12:30	01/17/22 11:59	4
Selenium	ND		2.9	0.97	mg/Kg	☼	12/02/21 12:30	01/17/22 11:59	4

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**18**	**J**	43	6.8	mg/Kg	☼	12/07/21 09:37	01/17/22 15:43	3
Arsenic	ND		2.1	0.56	mg/Kg	☼	12/07/21 09:37	01/17/22 15:43	3
Barium	**4.1**	**J**	11	0.51	mg/Kg	☼	12/07/21 09:37	01/17/22 15:43	3
Boron	ND		43	43	mg/Kg	☼	12/07/21 09:37	01/17/22 15:43	3
Calcium	**9500**		1100	9.4	mg/Kg	☼	12/07/21 09:37	01/17/22 15:43	3
Cobalt	**0.76**	**J**	11	0.27	mg/Kg	☼	12/07/21 09:37	01/17/22 15:43	3
Iron	**200**		21	12	mg/Kg	☼	12/07/21 09:37	01/17/22 15:43	3
Lead	**1.9**	**J**	2.1	0.47	mg/Kg	☼	12/07/21 09:37	01/17/22 15:43	3
Lithium	ND		11	0.64	mg/Kg	☼	12/07/21 09:37	01/17/22 15:43	3
Manganese	**100**		3.2	1.2	mg/Kg	☼	12/07/21 09:37	01/17/22 15:43	3
Molybdenum	ND		8.6	0.35	mg/Kg	☼	12/07/21 09:37	01/17/22 15:43	3
Selenium	ND		2.1	0.73	mg/Kg	☼	12/07/21 09:37	01/26/22 10:11	3

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**220**		14	3.0	mg/Kg	☼	12/09/21 11:51	01/26/22 11:50	1
Arsenic	**1.6**		0.71	0.19	mg/Kg	☼	12/09/21 11:51	01/26/22 11:50	1
Barium	**3.6**	***-**	3.6	0.17	mg/Kg	☼	12/09/21 11:51	01/26/22 11:50	1
Boron	ND		14	14	mg/Kg	☼	12/09/21 11:51	01/26/22 11:50	1
Calcium	**12**	**J**	360	2.1	mg/Kg	☼	12/09/21 11:51	01/26/22 11:50	1
Cobalt	**1.5**	**J**	3.6	0.064	mg/Kg	☼	12/09/21 11:51	01/26/22 11:50	1
Iron	**5500**		7.1	4.1	mg/Kg	☼	12/09/21 11:51	01/26/22 11:50	1
Lead	ND		0.71	0.16	mg/Kg	☼	12/09/21 11:51	01/26/22 11:50	1
Lithium	ND		3.6	0.21	mg/Kg	☼	12/09/21 11:51	01/26/22 11:50	1
Manganese	**110**	**B**	1.1	0.039	mg/Kg	☼	12/09/21 11:51	01/26/22 11:50	1
Molybdenum	**0.26**	**J**	2.9	0.12	mg/Kg	☼	12/09/21 11:51	01/26/22 11:50	1
Selenium	**0.38**	**J**	0.71	0.24	mg/Kg	☼	12/09/21 11:51	01/26/22 11:50	1

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**3900**		14	2.3	mg/Kg	☼	12/13/21 09:30	01/26/22 13:31	1
Arsenic	**2.9**	**B**	0.71	0.31	mg/Kg	☼	12/13/21 09:30	01/26/22 13:31	1
Barium	**37**		3.6	0.17	mg/Kg	☼	12/13/21 09:30	01/26/22 13:31	1
Boron	ND		14	14	mg/Kg	☼	12/13/21 09:30	01/26/22 13:31	1
Calcium	**10000**		360	3.1	mg/Kg	☼	12/13/21 09:30	01/26/22 13:31	1

DRAFT

Client Sample ID: E-SB-18 (40-44)
Date Collected: 08/31/21 11:45
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-7
Matrix: Solid
Percent Solids: 70.1

Method: 6010B SEP - SEP Metals (ICP) - Step 4 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cobalt	5.6		3.6	0.076	mg/Kg	☼	12/13/21 09:30	01/26/22 13:31	1
Iron	17000		7.1	4.1	mg/Kg	☼	12/13/21 09:30	01/26/22 13:31	1
Lead	8.9		0.71	0.16	mg/Kg	☼	12/13/21 09:30	01/26/22 13:31	1
Lithium	9.9		3.6	0.21	mg/Kg	☼	12/13/21 09:30	01/26/22 13:31	1
Manganese	270		1.1	0.19	mg/Kg	☼	12/13/21 09:30	01/26/22 13:31	1
Molybdenum	0.28	J	2.9	0.12	mg/Kg	☼	12/13/21 09:30	01/26/22 13:31	1
Selenium	1.5		0.71	0.67	mg/Kg	☼	12/13/21 09:30	01/26/22 13:31	1

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	50	J	210	34	mg/Kg	☼	12/15/21 10:40	01/26/22 15:05	5
Arsenic	2.7	J	11	2.7	mg/Kg	☼	12/15/21 10:40	01/26/22 15:05	5
Barium	23	J	53	2.6	mg/Kg	☼	12/15/21 10:40	01/26/22 15:05	5
Boron	ND		210	210	mg/Kg	☼	12/15/21 10:40	01/26/22 15:05	5
Calcium	5800	B	5300	16	mg/Kg	☼	12/15/21 10:40	01/26/22 15:05	5
Cobalt	1.2	J	53	0.86	mg/Kg	☼	12/15/21 10:40	01/26/22 15:05	5
Iron	93	J	110	63	mg/Kg	☼	12/15/21 10:40	01/26/22 15:05	5
Lead	ND		11	2.4	mg/Kg	☼	12/15/21 10:40	01/26/22 15:05	5
Lithium	8.2	J B	53	3.1	mg/Kg	☼	12/15/21 10:40	01/26/22 15:05	5
Manganese	38	*1	16	2.6	mg/Kg	☼	12/15/21 10:40	01/26/22 15:05	5
Molybdenum	ND		43	1.8	mg/Kg	☼	12/15/21 10:40	01/26/22 15:05	5
Selenium	ND		11	3.7	mg/Kg	☼	12/15/21 10:40	01/26/22 15:05	5

Method: 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	5400		14	2.3	mg/Kg	☼	12/15/21 17:10	01/26/22 16:30	1
Arsenic	2.2		0.71	0.21	mg/Kg	☼	12/15/21 17:10	01/26/22 16:30	1
Barium	98		3.6	0.17	mg/Kg	☼	12/15/21 17:10	01/26/22 16:30	1
Boron	ND		14	14	mg/Kg	☼	12/15/21 17:10	01/26/22 16:30	1
Calcium	540		360	3.0	mg/Kg	☼	12/15/21 17:10	01/26/22 16:30	1
Cobalt	2.3	J	3.6	0.066	mg/Kg	☼	12/15/21 17:10	01/26/22 16:30	1
Iron	10000		7.1	4.1	mg/Kg	☼	12/15/21 17:10	01/26/22 16:30	1
Lead	2.6		0.71	0.16	mg/Kg	☼	12/15/21 17:10	01/26/22 16:30	1
Lithium	6.2		3.6	0.21	mg/Kg	☼	12/15/21 17:10	01/26/22 16:30	1
Manganese	51		1.1	0.36	mg/Kg	☼	12/15/21 17:10	01/26/22 16:30	1
Molybdenum	0.14	J	2.9	0.14	mg/Kg	☼	12/15/21 17:10	01/26/22 16:30	1
Selenium	0.36	J	0.71	0.24	mg/Kg	☼	12/15/21 17:10	01/26/22 16:30	1

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	34000		140	23	mg/Kg	☼	12/18/21 15:38	01/27/22 13:08	10
Arsenic	2.0	B	1.4	0.37	mg/Kg	☼	12/18/21 15:38	01/27/22 15:43	2
Barium	240		36	0.66	mg/Kg	☼	12/18/21 15:38	01/27/22 13:08	10
Calcium	970		360	3.7	mg/Kg	☼	12/18/21 15:38	01/27/22 14:18	1
Cobalt	0.62	J	7.1	0.074	mg/Kg	☼	12/18/21 15:38	01/27/22 15:43	2
Iron	6300		7.1	5.8	mg/Kg	☼	12/18/21 15:38	01/27/22 14:18	1
Lead	0.51	J	1.4	0.31	mg/Kg	☼	12/18/21 15:38	01/27/22 15:43	2
Lithium	18		3.6	0.21	mg/Kg	☼	12/18/21 15:38	01/27/22 14:18	1
Manganese	42		1.1	0.16	mg/Kg	☼	12/18/21 15:38	01/27/22 14:18	1
Molybdenum	0.14	J	2.9	0.12	mg/Kg	☼	12/18/21 15:38	01/27/22 14:18	1

DRAFT

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-18 (40-44)

Date Collected: 08/31/21 11:45
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-7

Matrix: Solid
Percent Solids: 70.1

Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		1.4	0.48	mg/Kg	☼	12/18/21 15:38	01/27/22 15:43	2

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	43000		10	1.6	mg/Kg			02/04/22 13:55	1
Arsenic	11		0.50	0.13	mg/Kg			02/04/22 13:55	1
Barium	400		2.5	0.12	mg/Kg			02/04/22 13:55	1
Calcium	29000		250	0.74	mg/Kg			02/04/22 13:55	1
Cobalt	12		2.5	0.023	mg/Kg			02/04/22 13:55	1
Iron	39000		5.0	4.1	mg/Kg			02/04/22 13:55	1
Lead	15		0.50	0.11	mg/Kg			02/04/22 13:55	1
Lithium	43		2.5	0.15	mg/Kg			02/04/22 13:55	1
Manganese	620		0.75	0.052	mg/Kg			02/04/22 13:55	1
Molybdenum	0.82	J	2.0	0.082	mg/Kg			02/04/22 13:55	1
Selenium	2.3		0.50	0.17	mg/Kg			02/04/22 13:55	1

Method: 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	72000		140	23	mg/Kg	☼	12/01/21 08:54	01/31/22 11:56	10
Arsenic	10	B	1.4	0.37	mg/Kg	☼	12/01/21 08:54	01/31/22 14:33	2
Barium	550		36	0.66	mg/Kg	☼	12/01/21 08:54	01/31/22 11:56	10
Calcium	40000	B	3600	37	mg/Kg	☼	12/01/21 08:54	01/31/22 11:56	10
Cobalt	8.3		3.6	0.037	mg/Kg	☼	12/01/21 08:54	01/31/22 13:18	1
Iron	28000		7.1	5.8	mg/Kg	☼	12/01/21 08:54	01/31/22 13:18	1
Lead	14		1.4	0.31	mg/Kg	☼	12/01/21 08:54	01/31/22 14:33	2
Lithium	38		3.6	0.21	mg/Kg	☼	12/01/21 08:54	01/31/22 13:18	1
Manganese	490		1.1	0.16	mg/Kg	☼	12/01/21 08:54	01/31/22 13:18	1
Molybdenum	0.95	J B	2.9	0.12	mg/Kg	☼	12/01/21 08:54	01/31/22 13:18	1
Selenium	2.3		1.4	0.48	mg/Kg	☼	12/01/21 08:54	01/31/22 14:33	2

DRAFT

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-XPW01 (25-30)

Date Collected: 08/31/21 13:50
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-8

Matrix: Solid
Percent Solids: 61.3

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		65	10	mg/Kg	☼	12/02/21 12:30	01/17/22 14:23	4
Arsenic	ND		3.3	0.85	mg/Kg	☼	12/02/21 12:30	01/17/22 14:23	4
Barium	**4.6**	**J**	16	0.78	mg/Kg	☼	12/02/21 12:30	01/17/22 14:23	4
Boron	ND		65	65	mg/Kg	☼	12/02/21 12:30	01/17/22 14:23	4
Calcium	**5000**	**B**	1600	12	mg/Kg	☼	12/02/21 12:30	01/17/22 14:23	4
Cobalt	ND		16	0.29	mg/Kg	☼	12/02/21 12:30	01/17/22 14:23	4
Iron	ND		33	19	mg/Kg	☼	12/02/21 12:30	01/17/22 14:23	4
Lead	ND		3.3	0.72	mg/Kg	☼	12/02/21 12:30	01/17/22 14:23	4
Lithium	ND		16	0.98	mg/Kg	☼	12/02/21 12:30	01/17/22 14:23	4
Manganese	**0.92**	**J B**	4.9	0.20	mg/Kg	☼	12/02/21 12:30	01/17/22 14:23	4
Molybdenum	**1.0**	**J**	13	0.54	mg/Kg	☼	12/02/21 12:30	01/17/22 14:23	4
Selenium	ND		3.3	1.1	mg/Kg	☼	12/02/21 12:30	01/17/22 14:23	4

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**2900**		49	7.8	mg/Kg	☼	12/07/21 09:37	01/17/22 15:48	3
Arsenic	**23**		2.4	0.64	mg/Kg	☼	12/07/21 09:37	01/17/22 15:48	3
Barium	**5.8**	**J**	12	0.59	mg/Kg	☼	12/07/21 09:37	01/17/22 15:48	3
Boron	**590**		49	49	mg/Kg	☼	12/07/21 09:37	01/17/22 15:48	3
Calcium	**23000**		1200	11	mg/Kg	☼	12/07/21 09:37	01/17/22 15:48	3
Cobalt	**0.53**	**J**	12	0.31	mg/Kg	☼	12/07/21 09:37	01/17/22 15:48	3
Iron	**2600**		24	14	mg/Kg	☼	12/07/21 09:37	01/17/22 15:48	3
Lead	**32**		2.4	0.54	mg/Kg	☼	12/07/21 09:37	01/17/22 15:48	3
Lithium	**1.8**	**J**	12	0.73	mg/Kg	☼	12/07/21 09:37	01/17/22 15:48	3
Manganese	**320**		3.7	1.4	mg/Kg	☼	12/07/21 09:37	01/17/22 15:48	3
Molybdenum	**3.3**	**J**	9.8	0.40	mg/Kg	☼	12/07/21 09:37	01/17/22 15:48	3
Selenium	**2.1**	**J B**	2.4	0.83	mg/Kg	☼	12/07/21 09:37	01/26/22 10:16	3

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**4700**		16	3.4	mg/Kg	☼	12/09/21 11:51	01/26/22 11:55	1
Arsenic	**11**		0.82	0.21	mg/Kg	☼	12/09/21 11:51	01/26/22 11:55	1
Barium	**6.0**	***-**	4.1	0.20	mg/Kg	☼	12/09/21 11:51	01/26/22 11:55	1
Boron	**100**		16	16	mg/Kg	☼	12/09/21 11:51	01/26/22 11:55	1
Calcium	**11**	**J**	410	2.4	mg/Kg	☼	12/09/21 11:51	01/26/22 11:55	1
Cobalt	**0.89**	**J**	4.1	0.073	mg/Kg	☼	12/09/21 11:51	01/26/22 11:55	1
Iron	**2400**		8.2	4.7	mg/Kg	☼	12/09/21 11:51	01/26/22 11:55	1
Lead	**0.52**	**J**	0.82	0.18	mg/Kg	☼	12/09/21 11:51	01/26/22 11:55	1
Lithium	**1.4**	**J**	4.1	0.24	mg/Kg	☼	12/09/21 11:51	01/26/22 11:55	1
Manganese	**150**	**B**	1.2	0.044	mg/Kg	☼	12/09/21 11:51	01/26/22 11:55	1
Molybdenum	**1.7**	**J**	3.3	0.13	mg/Kg	☼	12/09/21 11:51	01/26/22 11:55	1
Selenium	**0.60**	**J**	0.82	0.28	mg/Kg	☼	12/09/21 11:51	01/26/22 11:55	1

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**4900**		16	2.6	mg/Kg	☼	12/13/21 09:30	01/26/22 17:19	1
Arsenic	**4.4**	**B**	0.82	0.36	mg/Kg	☼	12/13/21 09:30	01/26/22 17:19	1
Barium	**9.6**		4.1	0.20	mg/Kg	☼	12/13/21 09:30	01/26/22 17:19	1
Boron	**76**		16	16	mg/Kg	☼	12/13/21 09:30	01/26/22 17:19	1
Calcium	**12000**		410	3.6	mg/Kg	☼	12/13/21 09:30	01/26/22 17:19	1

DRAFT

Client Sample ID: E-SB-XPW01 (25-30)

Date Collected: 08/31/21 13:50
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-8

Matrix: Solid
Percent Solids: 61.3

Method: 6010B SEP - SEP Metals (ICP) - Step 4 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cobalt	3.6	J	4.1	0.087	mg/Kg	☼	12/13/21 09:30	01/26/22 17:19	1
Iron	12000		8.2	4.7	mg/Kg	☼	12/13/21 09:30	01/26/22 17:19	1
Lead	83		0.82	0.18	mg/Kg	☼	12/13/21 09:30	01/26/22 17:19	1
Lithium	5.1		4.1	0.24	mg/Kg	☼	12/13/21 09:30	01/26/22 17:19	1
Manganese	150		1.2	0.21	mg/Kg	☼	12/13/21 09:30	01/26/22 17:19	1
Molybdenum	1.6	J	3.3	0.13	mg/Kg	☼	12/13/21 09:30	01/26/22 17:19	1
Selenium	0.96		0.82	0.77	mg/Kg	☼	12/13/21 09:30	01/26/22 17:19	1

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		240	38	mg/Kg	☼	12/15/21 10:40	01/26/22 15:10	5
Arsenic	ND		12	3.1	mg/Kg	☼	12/15/21 10:40	01/26/22 15:10	5
Barium	63		61	2.9	mg/Kg	☼	12/15/21 10:40	01/26/22 15:10	5
Boron	ND		240	240	mg/Kg	☼	12/15/21 10:40	01/26/22 15:10	5
Calcium	9400	B	6100	18	mg/Kg	☼	12/15/21 10:40	01/26/22 15:10	5
Cobalt	ND		61	0.98	mg/Kg	☼	12/15/21 10:40	01/26/22 15:10	5
Iron	ND		120	72	mg/Kg	☼	12/15/21 10:40	01/26/22 15:10	5
Lead	ND		12	2.7	mg/Kg	☼	12/15/21 10:40	01/26/22 15:10	5
Lithium	8.4	J B	61	3.6	mg/Kg	☼	12/15/21 10:40	01/26/22 15:10	5
Manganese	ND	*1	18	3.0	mg/Kg	☼	12/15/21 10:40	01/26/22 15:10	5
Molybdenum	ND		49	2.0	mg/Kg	☼	12/15/21 10:40	01/26/22 15:10	5
Selenium	ND		12	4.2	mg/Kg	☼	12/15/21 10:40	01/26/22 15:10	5

Method: 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	4700		16	2.6	mg/Kg	☼	12/15/21 17:10	01/26/22 16:35	1
Arsenic	5.6		1.6	0.49	mg/Kg	☼	12/15/21 17:10	01/26/22 17:24	2
Barium	110		4.1	0.20	mg/Kg	☼	12/15/21 17:10	01/26/22 16:35	1
Boron	20		16	16	mg/Kg	☼	12/15/21 17:10	01/26/22 16:35	1
Calcium	4500		410	3.4	mg/Kg	☼	12/15/21 17:10	01/26/22 16:35	1
Cobalt	5.4		4.1	0.075	mg/Kg	☼	12/15/21 17:10	01/26/22 16:35	1
Iron	53000		16	9.5	mg/Kg	☼	12/15/21 17:10	01/26/22 17:24	2
Lead	30		0.82	0.18	mg/Kg	☼	12/15/21 17:10	01/26/22 16:35	1
Lithium	3.7	J	4.1	0.24	mg/Kg	☼	12/15/21 17:10	01/26/22 16:35	1
Manganese	78		1.2	0.41	mg/Kg	☼	12/15/21 17:10	01/26/22 16:35	1
Molybdenum	1.1	J	3.3	0.16	mg/Kg	☼	12/15/21 17:10	01/26/22 16:35	1
Selenium	2.7		1.6	0.55	mg/Kg	☼	12/15/21 17:10	01/26/22 17:24	2

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	67000		160	26	mg/Kg	☼	12/18/21 15:38	01/27/22 13:13	10
Arsenic	7.0	B	1.6	0.42	mg/Kg	☼	12/18/21 15:38	01/27/22 15:48	2
Barium	270		41	0.75	mg/Kg	☼	12/18/21 15:38	01/27/22 13:13	10
Calcium	9000		4100	42	mg/Kg	☼	12/18/21 15:38	01/27/22 13:13	10
Cobalt	18	J	20	0.21	mg/Kg	☼	12/18/21 15:38	01/27/22 15:53	5
Iron	80000		16	13	mg/Kg	☼	12/18/21 15:38	01/27/22 15:48	2
Lead	240		4.1	0.90	mg/Kg	☼	12/18/21 15:38	01/27/22 15:53	5
Lithium	43		4.1	0.24	mg/Kg	☼	12/18/21 15:38	01/27/22 14:23	1
Manganese	150		1.2	0.18	mg/Kg	☼	12/18/21 15:38	01/27/22 14:23	1
Molybdenum	1.3	J	3.3	0.13	mg/Kg	☼	12/18/21 15:38	01/27/22 14:23	1

DRAFT

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-XPW01 (25-30)

Date Collected: 08/31/21 13:50
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-8

Matrix: Solid
Percent Solids: 61.3

Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND	L	1.6	0.55	mg/Kg	☼	12/18/21 15:38	01/27/22 15:48	2

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	84000		10	1.6	mg/Kg			02/04/22 13:55	1
Arsenic	51		0.50	0.13	mg/Kg			02/04/22 13:55	1
Barium	470		2.5	0.12	mg/Kg			02/04/22 13:55	1
Calcium	63000		250	0.74	mg/Kg			02/04/22 13:55	1
Cobalt	28		2.5	0.023	mg/Kg			02/04/22 13:55	1
Iron	150000		5.0	4.1	mg/Kg			02/04/22 13:55	1
Lead	390		0.50	0.11	mg/Kg			02/04/22 13:55	1
Lithium	63		2.5	0.15	mg/Kg			02/04/22 13:55	1
Manganese	850		0.75	0.052	mg/Kg			02/04/22 13:55	1
Molybdenum	10		2.0	0.082	mg/Kg			02/04/22 13:55	1
Selenium	6.4		0.50	0.17	mg/Kg			02/04/22 13:55	1

Method: 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	85000		160	26	mg/Kg	☼	12/01/21 08:54	01/31/22 12:11	10
Arsenic	49	B	4.1	1.1	mg/Kg	☼	12/01/21 08:54	01/31/22 14:39	5
Barium	460		41	0.75	mg/Kg	☼	12/01/21 08:54	01/31/22 12:11	10
Calcium	71000	B	4100	42	mg/Kg	☼	12/01/21 08:54	01/31/22 12:11	10
Cobalt	26		20	0.21	mg/Kg	☼	12/01/21 08:54	01/31/22 14:39	5
Iron	150000		41	33	mg/Kg	☼	12/01/21 08:54	01/31/22 14:39	5
Lead	330		4.1	0.90	mg/Kg	☼	12/01/21 08:54	01/31/22 14:39	5
Lithium	59		20	1.2	mg/Kg	☼	12/01/21 08:54	01/31/22 14:39	5
Manganese	840		6.1	0.90	mg/Kg	☼	12/01/21 08:54	01/31/22 14:39	5
Molybdenum	10	J B	16	0.67	mg/Kg	☼	12/01/21 08:54	01/31/22 14:39	5
Selenium	10		4.1	1.4	mg/Kg	☼	12/01/21 08:54	01/31/22 14:39	5

DRAFT

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-15 (10-15)

Date Collected: 08/31/21 15:40
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-9

Matrix: Solid
Percent Solids: 65.0

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		62	9.8	mg/Kg	☼	12/02/21 12:30	01/17/22 14:33	4
Arsenic	ND		3.1	0.80	mg/Kg	☼	12/02/21 12:30	01/17/22 14:33	4
Barium	**1.2**	**J**	15	0.74	mg/Kg	☼	12/02/21 12:30	01/17/22 14:33	4
Boron	ND		62	62	mg/Kg	☼	12/02/21 12:30	01/17/22 14:33	4
Calcium	**2600**	**B**	1500	12	mg/Kg	☼	12/02/21 12:30	01/17/22 14:33	4
Cobalt	ND		15	0.28	mg/Kg	☼	12/02/21 12:30	01/17/22 14:33	4
Iron	ND		31	18	mg/Kg	☼	12/02/21 12:30	01/17/22 14:33	4
Lead	**0.87**	**J**	3.1	0.68	mg/Kg	☼	12/02/21 12:30	01/17/22 14:33	4
Lithium	ND		15	0.92	mg/Kg	☼	12/02/21 12:30	01/17/22 14:33	4
Manganese	**1.2**	**J B**	4.6	0.19	mg/Kg	☼	12/02/21 12:30	01/17/22 14:33	4
Molybdenum	ND		12	0.50	mg/Kg	☼	12/02/21 12:30	01/17/22 14:33	4
Selenium	ND		3.1	1.0	mg/Kg	☼	12/02/21 12:30	01/17/22 14:33	4

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**12**	**J**	46	7.4	mg/Kg	☼	12/07/21 09:37	01/17/22 15:58	3
Arsenic	ND		2.3	0.60	mg/Kg	☼	12/07/21 09:37	01/17/22 15:58	3
Barium	**1.2**	**J**	12	0.55	mg/Kg	☼	12/07/21 09:37	01/17/22 15:58	3
Boron	ND		46	46	mg/Kg	☼	12/07/21 09:37	01/17/22 15:58	3
Calcium	**1400**		1200	10	mg/Kg	☼	12/07/21 09:37	01/17/22 15:58	3
Cobalt	**0.63**	**J**	12	0.29	mg/Kg	☼	12/07/21 09:37	01/17/22 15:58	3
Iron	**100**		23	13	mg/Kg	☼	12/07/21 09:37	01/17/22 15:58	3
Lead	**2.9**		2.3	0.51	mg/Kg	☼	12/07/21 09:37	01/17/22 15:58	3
Lithium	ND		12	0.69	mg/Kg	☼	12/07/21 09:37	01/17/22 15:58	3
Manganese	**19**		3.5	1.3	mg/Kg	☼	12/07/21 09:37	01/17/22 15:58	3
Molybdenum	ND		9.2	0.38	mg/Kg	☼	12/07/21 09:37	01/17/22 15:58	3
Selenium	ND		2.3	0.78	mg/Kg	☼	12/07/21 09:37	01/26/22 10:26	3

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**320**		15	3.2	mg/Kg	☼	12/09/21 11:51	01/26/22 12:04	1
Arsenic	**1.1**		0.77	0.20	mg/Kg	☼	12/09/21 11:51	01/26/22 12:04	1
Barium	**2.7**	**J *-**	3.8	0.18	mg/Kg	☼	12/09/21 11:51	01/26/22 12:04	1
Boron	ND		15	15	mg/Kg	☼	12/09/21 11:51	01/26/22 12:04	1
Calcium	**18**	**J**	380	2.3	mg/Kg	☼	12/09/21 11:51	01/26/22 12:04	1
Cobalt	**1.1**	**J**	3.8	0.069	mg/Kg	☼	12/09/21 11:51	01/26/22 12:04	1
Iron	**1900**		7.7	4.5	mg/Kg	☼	12/09/21 11:51	01/26/22 12:04	1
Lead	**0.75**	**J**	0.77	0.17	mg/Kg	☼	12/09/21 11:51	01/26/22 12:04	1
Lithium	ND		3.8	0.23	mg/Kg	☼	12/09/21 11:51	01/26/22 12:04	1
Manganese	**9.8**	**B**	1.2	0.042	mg/Kg	☼	12/09/21 11:51	01/26/22 12:04	1
Molybdenum	**0.14**	**J**	3.1	0.13	mg/Kg	☼	12/09/21 11:51	01/26/22 12:04	1
Selenium	**0.37**	**J**	0.77	0.26	mg/Kg	☼	12/09/21 11:51	01/26/22 12:04	1

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**5300**		15	2.5	mg/Kg	☼	12/13/21 09:30	01/26/22 14:00	1
Arsenic	**1.8**	**B**	0.77	0.34	mg/Kg	☼	12/13/21 09:30	01/26/22 14:00	1
Barium	**15**		3.8	0.18	mg/Kg	☼	12/13/21 09:30	01/26/22 14:00	1
Boron	ND		15	15	mg/Kg	☼	12/13/21 09:30	01/26/22 14:00	1
Calcium	**2100**		380	3.4	mg/Kg	☼	12/13/21 09:30	01/26/22 14:00	1

DRAFT

Client Sample ID: E-SB-15 (10-15)
Date Collected: 08/31/21 15:40
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-9
Matrix: Solid
Percent Solids: 65.0

Method: 6010B SEP - SEP Metals (ICP) - Step 4 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cobalt	7.7		3.8	0.082	mg/Kg	☼	12/13/21 09:30	01/26/22 14:00	1
Iron	10000		7.7	4.5	mg/Kg	☼	12/13/21 09:30	01/26/22 14:00	1
Lead	12		0.77	0.17	mg/Kg	☼	12/13/21 09:30	01/26/22 14:00	1
Lithium	14		3.8	0.23	mg/Kg	☼	12/13/21 09:30	01/26/22 14:00	1
Manganese	90		1.2	0.20	mg/Kg	☼	12/13/21 09:30	01/26/22 14:00	1
Molybdenum	ND		3.1	0.13	mg/Kg	☼	12/13/21 09:30	01/26/22 14:00	1
Selenium	1.0		0.77	0.72	mg/Kg	☼	12/13/21 09:30	01/26/22 14:00	1

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	130	J	230	36	mg/Kg	☼	12/15/21 10:40	01/26/22 15:20	5
Arsenic	ND		12	2.9	mg/Kg	☼	12/15/21 10:40	01/26/22 15:20	5
Barium	73		58	2.8	mg/Kg	☼	12/15/21 10:40	01/26/22 15:20	5
Boron	ND		230	230	mg/Kg	☼	12/15/21 10:40	01/26/22 15:20	5
Calcium	460	J B	5800	17	mg/Kg	☼	12/15/21 10:40	01/26/22 15:20	5
Cobalt	1.7	J	58	0.92	mg/Kg	☼	12/15/21 10:40	01/26/22 15:20	5
Iron	320		120	68	mg/Kg	☼	12/15/21 10:40	01/26/22 15:20	5
Lead	ND		12	2.5	mg/Kg	☼	12/15/21 10:40	01/26/22 15:20	5
Lithium	8.9	J B	58	3.4	mg/Kg	☼	12/15/21 10:40	01/26/22 15:20	5
Manganese	15	J *1	17	2.8	mg/Kg	☼	12/15/21 10:40	01/26/22 15:20	5
Molybdenum	ND		46	1.9	mg/Kg	☼	12/15/21 10:40	01/26/22 15:20	5
Selenium	ND		12	4.0	mg/Kg	☼	12/15/21 10:40	01/26/22 15:20	5

Method: 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	8700		15	2.5	mg/Kg	☼	12/15/21 17:10	01/26/22 16:59	1
Arsenic	2.0		0.77	0.23	mg/Kg	☼	12/15/21 17:10	01/26/22 16:59	1
Barium	72		3.8	0.18	mg/Kg	☼	12/15/21 17:10	01/26/22 16:59	1
Boron	ND		15	15	mg/Kg	☼	12/15/21 17:10	01/26/22 16:59	1
Calcium	150	J	380	3.2	mg/Kg	☼	12/15/21 17:10	01/26/22 16:59	1
Cobalt	2.7	J	3.8	0.071	mg/Kg	☼	12/15/21 17:10	01/26/22 16:59	1
Iron	13000		7.7	4.5	mg/Kg	☼	12/15/21 17:10	01/26/22 16:59	1
Lead	2.5		0.77	0.17	mg/Kg	☼	12/15/21 17:10	01/26/22 16:59	1
Lithium	8.3		3.8	0.23	mg/Kg	☼	12/15/21 17:10	01/26/22 16:59	1
Manganese	42		1.2	0.38	mg/Kg	☼	12/15/21 17:10	01/26/22 16:59	1
Molybdenum	ND		3.1	0.15	mg/Kg	☼	12/15/21 17:10	01/26/22 16:59	1
Selenium	0.65	J	0.77	0.26	mg/Kg	☼	12/15/21 17:10	01/26/22 16:59	1

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	35000		150	25	mg/Kg	☼	12/18/21 15:38	01/27/22 13:23	10
Arsenic	1.9	B	1.5	0.40	mg/Kg	☼	12/18/21 15:38	01/27/22 16:26	2
Barium	200		38	0.71	mg/Kg	☼	12/18/21 15:38	01/27/22 13:23	10
Calcium	340	J	380	4.0	mg/Kg	☼	12/18/21 15:38	01/27/22 14:34	1
Cobalt	0.37	J	3.8	0.040	mg/Kg	☼	12/18/21 15:38	01/27/22 14:34	1
Iron	6800		7.7	6.3	mg/Kg	☼	12/18/21 15:38	01/27/22 14:34	1
Lead	ND		1.5	0.34	mg/Kg	☼	12/18/21 15:38	01/27/22 16:26	2
Lithium	20		3.8	0.23	mg/Kg	☼	12/18/21 15:38	01/27/22 14:34	1
Manganese	29		1.2	0.17	mg/Kg	☼	12/18/21 15:38	01/27/22 14:34	1
Molybdenum	0.14	J	3.1	0.13	mg/Kg	☼	12/18/21 15:38	01/27/22 14:34	1

DRAFT

Client Sample ID: E-SB-15 (10-15)

Date Collected: 08/31/21 15:40
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-9

Matrix: Solid
Percent Solids: 65.0

Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		1.5	0.52	mg/Kg	☼	12/18/21 15:38	01/27/22 16:26	2

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	49000		10	1.6	mg/Kg			02/04/22 13:55	1
Arsenic	6.8		0.50	0.13	mg/Kg			02/04/22 13:55	1
Barium	360		2.5	0.12	mg/Kg			02/04/22 13:55	1
Calcium	7000		250	0.74	mg/Kg			02/04/22 13:55	1
Cobalt	14		2.5	0.023	mg/Kg			02/04/22 13:55	1
Iron	32000		5.0	4.1	mg/Kg			02/04/22 13:55	1
Lead	19		0.50	0.11	mg/Kg			02/04/22 13:55	1
Lithium	51		2.5	0.15	mg/Kg			02/04/22 13:55	1
Manganese	210		0.75	0.052	mg/Kg			02/04/22 13:55	1
Molybdenum	0.28	J	2.0	0.082	mg/Kg			02/04/22 13:55	1
Selenium	2.1		0.50	0.17	mg/Kg			02/04/22 13:55	1

Method: 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	91000		150	25	mg/Kg	☼	12/01/21 08:54	01/31/22 12:20	10
Arsenic	6.2	B	0.77	0.20	mg/Kg	☼	12/01/21 08:54	01/31/22 13:35	1
Barium	560		38	0.71	mg/Kg	☼	12/01/21 08:54	01/31/22 12:20	10
Calcium	7700	B	3800	40	mg/Kg	☼	12/01/21 08:54	01/31/22 12:20	10
Cobalt	9.9		3.8	0.040	mg/Kg	☼	12/01/21 08:54	01/31/22 13:35	1
Iron	27000		7.7	6.3	mg/Kg	☼	12/01/21 08:54	01/31/22 13:35	1
Lead	18		1.5	0.34	mg/Kg	☼	12/01/21 08:54	01/31/22 15:03	2
Lithium	51		3.8	0.23	mg/Kg	☼	12/01/21 08:54	01/31/22 13:35	1
Manganese	170		1.2	0.17	mg/Kg	☼	12/01/21 08:54	01/31/22 13:35	1
Molybdenum	0.58	J B	3.1	0.13	mg/Kg	☼	12/01/21 08:54	01/31/22 13:35	1
Selenium	2.5		0.77	0.26	mg/Kg	☼	12/01/21 08:54	01/31/22 13:35	1

DRAFT

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-15 (30-35)

Date Collected: 08/31/21 16:20
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-10

Matrix: Solid
Percent Solids: 65.1

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		61	9.8	mg/Kg	☼	12/02/21 12:30	01/17/22 14:38	4
Arsenic	ND		3.1	0.80	mg/Kg	☼	12/02/21 12:30	01/17/22 14:38	4
Barium	**1.5**	**J**	15	0.74	mg/Kg	☼	12/02/21 12:30	01/17/22 14:38	4
Boron	ND		61	61	mg/Kg	☼	12/02/21 12:30	01/17/22 14:38	4
Calcium	**2200**	**B**	1500	12	mg/Kg	☼	12/02/21 12:30	01/17/22 14:38	4
Cobalt	ND		15	0.28	mg/Kg	☼	12/02/21 12:30	01/17/22 14:38	4
Iron	ND		31	18	mg/Kg	☼	12/02/21 12:30	01/17/22 14:38	4
Lead	ND		3.1	0.68	mg/Kg	☼	12/02/21 12:30	01/17/22 14:38	4
Lithium	ND		15	0.92	mg/Kg	☼	12/02/21 12:30	01/17/22 14:38	4
Manganese	**4.9**	**B**	4.6	0.19	mg/Kg	☼	12/02/21 12:30	01/17/22 14:38	4
Molybdenum	ND		12	0.50	mg/Kg	☼	12/02/21 12:30	01/17/22 14:38	4
Selenium	ND		3.1	1.0	mg/Kg	☼	12/02/21 12:30	01/17/22 14:38	4

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**20**	**J**	46	7.4	mg/Kg	☼	12/07/21 09:37	01/17/22 16:03	3
Arsenic	ND		2.3	0.60	mg/Kg	☼	12/07/21 09:37	01/26/22 10:46	3
Barium	**4.1**	**J**	12	0.55	mg/Kg	☼	12/07/21 09:37	01/17/22 16:03	3
Boron	ND		46	46	mg/Kg	☼	12/07/21 09:37	01/17/22 16:03	3
Calcium	**9700**		1200	10	mg/Kg	☼	12/07/21 09:37	01/17/22 16:03	3
Cobalt	**2.4**	**J**	12	0.29	mg/Kg	☼	12/07/21 09:37	01/26/22 10:46	3
Iron	**280**		23	13	mg/Kg	☼	12/07/21 09:37	01/17/22 16:03	3
Lead	**2.1**	**J**	2.3	0.51	mg/Kg	☼	12/07/21 09:37	01/26/22 10:46	3
Lithium	**0.71**	**J**	12	0.69	mg/Kg	☼	12/07/21 09:37	01/17/22 16:03	3
Manganese	**130**		3.5	1.3	mg/Kg	☼	12/07/21 09:37	01/17/22 16:03	3
Molybdenum	ND		9.2	0.38	mg/Kg	☼	12/07/21 09:37	01/26/22 10:46	3
Selenium	ND		2.3	0.78	mg/Kg	☼	12/07/21 09:37	01/26/22 10:46	3

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**260**		15	3.2	mg/Kg	☼	12/09/21 11:51	01/26/22 12:09	1
Arsenic	**2.5**		0.77	0.20	mg/Kg	☼	12/09/21 11:51	01/26/22 12:09	1
Barium	**7.7**	***-**	3.8	0.18	mg/Kg	☼	12/09/21 11:51	01/26/22 12:09	1
Boron	ND		15	15	mg/Kg	☼	12/09/21 11:51	01/26/22 12:09	1
Calcium	**19**	**J**	380	2.3	mg/Kg	☼	12/09/21 11:51	01/26/22 12:09	1
Cobalt	**2.1**	**J**	3.8	0.069	mg/Kg	☼	12/09/21 11:51	01/26/22 12:09	1
Iron	**6500**		7.7	4.5	mg/Kg	☼	12/09/21 11:51	01/26/22 12:09	1
Lead	ND		0.77	0.17	mg/Kg	☼	12/09/21 11:51	01/26/22 12:09	1
Lithium	ND		3.8	0.23	mg/Kg	☼	12/09/21 11:51	01/26/22 12:09	1
Manganese	**170**	**B**	1.2	0.041	mg/Kg	☼	12/09/21 11:51	01/26/22 12:09	1
Molybdenum	**0.15**	**J**	3.1	0.13	mg/Kg	☼	12/09/21 11:51	01/26/22 12:09	1
Selenium	**0.47**	**J**	0.77	0.26	mg/Kg	☼	12/09/21 11:51	01/26/22 12:09	1

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**3600**		15	2.5	mg/Kg	☼	12/13/21 09:30	01/26/22 14:05	1
Arsenic	**2.3**	**B**	0.77	0.34	mg/Kg	☼	12/13/21 09:30	01/26/22 14:05	1
Barium	**24**		3.8	0.18	mg/Kg	☼	12/13/21 09:30	01/26/22 14:05	1
Boron	ND		15	15	mg/Kg	☼	12/13/21 09:30	01/26/22 14:05	1
Calcium	**12000**		380	3.4	mg/Kg	☼	12/13/21 09:30	01/26/22 14:05	1

DRAFT

Client Sample ID: E-SB-15 (30-35)
Date Collected: 08/31/21 16:20
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-10
Matrix: Solid
Percent Solids: 65.1

Method: 6010B SEP - SEP Metals (ICP) - Step 4 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cobalt	3.9		3.8	0.081	mg/Kg	☼	12/13/21 09:30	01/26/22 14:05	1
Iron	11000		7.7	4.5	mg/Kg	☼	12/13/21 09:30	01/26/22 14:05	1
Lead	8.3		0.77	0.17	mg/Kg	☼	12/13/21 09:30	01/26/22 14:05	1
Lithium	10		3.8	0.23	mg/Kg	☼	12/13/21 09:30	01/26/22 14:05	1
Manganese	270		1.2	0.20	mg/Kg	☼	12/13/21 09:30	01/26/22 14:05	1
Molybdenum	0.14	J	3.1	0.13	mg/Kg	☼	12/13/21 09:30	01/26/22 14:05	1
Selenium	1.2		0.77	0.72	mg/Kg	☼	12/13/21 09:30	01/26/22 14:05	1

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	98	J	230	36	mg/Kg	☼	12/15/21 10:40	01/26/22 15:26	5
Arsenic	3.2	J	12	2.9	mg/Kg	☼	12/15/21 10:40	01/26/22 15:26	5
Barium	39	J	58	2.8	mg/Kg	☼	12/15/21 10:40	01/26/22 15:26	5
Boron	ND		230	230	mg/Kg	☼	12/15/21 10:40	01/26/22 15:26	5
Calcium	11000	B	5800	17	mg/Kg	☼	12/15/21 10:40	01/26/22 15:26	5
Cobalt	1.7	J	58	0.92	mg/Kg	☼	12/15/21 10:40	01/26/22 15:26	5
Iron	200		120	68	mg/Kg	☼	12/15/21 10:40	01/26/22 15:26	5
Lead	ND		12	2.5	mg/Kg	☼	12/15/21 10:40	01/26/22 15:26	5
Lithium	7.8	J B	58	3.4	mg/Kg	☼	12/15/21 10:40	01/26/22 15:26	5
Manganese	53	*1	17	2.8	mg/Kg	☼	12/15/21 10:40	01/26/22 15:26	5
Molybdenum	ND		46	1.9	mg/Kg	☼	12/15/21 10:40	01/26/22 15:26	5
Selenium	ND		12	4.0	mg/Kg	☼	12/15/21 10:40	01/26/22 15:26	5

Method: 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	5500		15	2.5	mg/Kg	☼	12/15/21 17:10	01/26/22 17:04	1
Arsenic	2.0		0.77	0.23	mg/Kg	☼	12/15/21 17:10	01/26/22 17:04	1
Barium	62		3.8	0.18	mg/Kg	☼	12/15/21 17:10	01/26/22 17:04	1
Boron	ND		15	15	mg/Kg	☼	12/15/21 17:10	01/26/22 17:04	1
Calcium	1100		380	3.2	mg/Kg	☼	12/15/21 17:10	01/26/22 17:04	1
Cobalt	2.0	J	3.8	0.071	mg/Kg	☼	12/15/21 17:10	01/26/22 17:04	1
Iron	7800		7.7	4.5	mg/Kg	☼	12/15/21 17:10	01/26/22 17:04	1
Lead	2.5		0.77	0.17	mg/Kg	☼	12/15/21 17:10	01/26/22 17:04	1
Lithium	6.7		3.8	0.23	mg/Kg	☼	12/15/21 17:10	01/26/22 17:04	1
Manganese	56		1.2	0.38	mg/Kg	☼	12/15/21 17:10	01/26/22 17:04	1
Molybdenum	ND		3.1	0.15	mg/Kg	☼	12/15/21 17:10	01/26/22 17:04	1
Selenium	ND		0.77	0.26	mg/Kg	☼	12/15/21 17:10	01/26/22 17:04	1

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	43000		150	25	mg/Kg	☼	12/18/21 15:38	01/27/22 13:28	10
Arsenic	2.1	B	1.5	0.40	mg/Kg	☼	12/18/21 15:38	01/27/22 16:31	2
Barium	320		38	0.71	mg/Kg	☼	12/18/21 15:38	01/27/22 13:28	10
Calcium	1700		380	4.0	mg/Kg	☼	12/18/21 15:38	01/27/22 14:39	1
Cobalt	0.27	J	7.7	0.080	mg/Kg	☼	12/18/21 15:38	01/27/22 16:31	2
Iron	6000		7.7	6.3	mg/Kg	☼	12/18/21 15:38	01/27/22 14:39	1
Lead	1.1	J	1.5	0.34	mg/Kg	☼	12/18/21 15:38	01/27/22 16:31	2
Lithium	19		3.8	0.23	mg/Kg	☼	12/18/21 15:38	01/27/22 14:39	1
Manganese	47		1.2	0.17	mg/Kg	☼	12/18/21 15:38	01/27/22 14:39	1
Molybdenum	0.13	J	3.1	0.13	mg/Kg	☼	12/18/21 15:38	01/27/22 14:39	1

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Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: E-SB-15 (30-35)

Date Collected: 08/31/21 16:20
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-10

Matrix: Solid
Percent Solids: 65.1

Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		1.5	0.52	mg/Kg	☼	12/18/21 15:38	01/27/22 16:31	2

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	52000		10	1.6	mg/Kg			02/04/22 13:55	1
Arsenic	12		0.50	0.13	mg/Kg			02/04/22 13:55	1
Barium	460		2.5	0.12	mg/Kg			02/04/22 13:55	1
Calcium	37000		250	0.74	mg/Kg			02/04/22 13:55	1
Cobalt	12		2.5	0.023	mg/Kg			02/04/22 13:55	1
Iron	31000		5.0	4.1	mg/Kg			02/04/22 13:55	1
Lead	14		0.50	0.11	mg/Kg			02/04/22 13:55	1
Lithium	45		2.5	0.15	mg/Kg			02/04/22 13:55	1
Manganese	730		0.75	0.052	mg/Kg			02/04/22 13:55	1
Molybdenum	0.42	J	2.0	0.082	mg/Kg			02/04/22 13:55	1
Selenium	1.7		0.50	0.17	mg/Kg			02/04/22 13:55	1

Method: 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	69000		150	25	mg/Kg	☼	12/01/21 08:54	01/31/22 12:25	10
Arsenic	11	B	1.5	0.40	mg/Kg	☼	12/01/21 08:54	01/31/22 15:09	2
Barium	490		38	0.71	mg/Kg	☼	12/01/21 08:54	01/31/22 12:25	10
Calcium	35000	B	3800	40	mg/Kg	☼	12/01/21 08:54	01/31/22 12:25	10
Cobalt	8.4		3.8	0.040	mg/Kg	☼	12/01/21 08:54	01/31/22 13:40	1
Iron	26000		7.7	6.3	mg/Kg	☼	12/01/21 08:54	01/31/22 13:40	1
Lead	13		1.5	0.34	mg/Kg	☼	12/01/21 08:54	01/31/22 15:09	2
Lithium	38		3.8	0.23	mg/Kg	☼	12/01/21 08:54	01/31/22 13:40	1
Manganese	520		1.2	0.17	mg/Kg	☼	12/01/21 08:54	01/31/22 13:40	1
Molybdenum	0.83	J B	3.1	0.13	mg/Kg	☼	12/01/21 08:54	01/31/22 13:40	1
Selenium	2.6		1.5	0.52	mg/Kg	☼	12/01/21 08:54	01/31/22 15:09	2

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Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Prep: 3010A

SEP: Exchangeable

Analyte	RL	MDL	Units
Aluminum	10	1.6	mg/Kg
Arsenic	0.50	0.13	mg/Kg
Barium	2.5	0.12	mg/Kg
Boron	10	10	mg/Kg
Calcium	250	1.9	mg/Kg
Cobalt	2.5	0.045	mg/Kg
Iron	5.0	2.9	mg/Kg
Lead	0.50	0.11	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.031	mg/Kg
Molybdenum	2.0	0.082	mg/Kg
Selenium	0.50	0.17	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Prep: 3010A

SEP: Carbonate

Analyte	RL	MDL	Units
Aluminum	10	1.6	mg/Kg
Arsenic	0.50	0.13	mg/Kg
Barium	2.5	0.12	mg/Kg
Boron	10	10	mg/Kg
Calcium	250	2.2	mg/Kg
Cobalt	2.5	0.063	mg/Kg
Iron	5.0	2.9	mg/Kg
Lead	0.50	0.11	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.28	mg/Kg
Molybdenum	2.0	0.082	mg/Kg
Selenium	0.50	0.17	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Prep: 3010A

SEP: Non-Crystalline

Analyte	RL	MDL	Units
Aluminum	10	2.1	mg/Kg
Arsenic	0.50	0.13	mg/Kg
Barium	2.5	0.12	mg/Kg
Boron	10	10	mg/Kg
Calcium	250	1.5	mg/Kg
Cobalt	2.5	0.045	mg/Kg
Iron	5.0	2.9	mg/Kg
Lead	0.50	0.11	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.027	mg/Kg
Molybdenum	2.0	0.082	mg/Kg
Selenium	0.50	0.17	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Prep: 3010A

SEP: Metal Hydroxide

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Default Detection Limits

Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Prep: 3010A

SEP: Metal Hydroxide

Analyte	RL	MDL	Units
Aluminum	10	1.6	mg/Kg
Arsenic	0.50	0.22	mg/Kg
Barium	2.5	0.12	mg/Kg
Boron	10	10	mg/Kg
Calcium	250	2.2	mg/Kg
Cobalt	2.5	0.053	mg/Kg
Iron	5.0	2.9	mg/Kg
Lead	0.50	0.11	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.13	mg/Kg
Molybdenum	2.0	0.082	mg/Kg
Selenium	0.50	0.47	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Prep: 3010A

SEP: Organic-Bound

Analyte	RL	MDL	Units
Aluminum	30	4.7	mg/Kg
Arsenic	1.5	0.38	mg/Kg
Barium	7.5	0.36	mg/Kg
Boron	30	30	mg/Kg
Calcium	750	2.2	mg/Kg
Cobalt	7.5	0.12	mg/Kg
Iron	15	8.8	mg/Kg
Lead	1.5	0.33	mg/Kg
Lithium	7.5	0.44	mg/Kg
Manganese	2.3	0.37	mg/Kg
Molybdenum	6.0	0.25	mg/Kg
Selenium	1.5	0.52	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 6

SEP: Acid/Sulfide

Analyte	RL	MDL	Units
Aluminum	10	1.6	mg/Kg
Arsenic	0.50	0.15	mg/Kg
Barium	2.5	0.12	mg/Kg
Boron	10	10	mg/Kg
Calcium	250	2.1	mg/Kg
Cobalt	2.5	0.046	mg/Kg
Iron	5.0	2.9	mg/Kg
Lead	0.50	0.11	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.25	mg/Kg
Molybdenum	2.0	0.099	mg/Kg
Selenium	0.50	0.17	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Prep: Residual

Analyte	RL	MDL	Units
Aluminum	10	1.6	mg/Kg

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Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Prep: Residual

Analyte	RL	MDL	Units
Arsenic	0.50	0.13	mg/Kg
Barium	2.5	0.046	mg/Kg
Calcium	250	2.6	mg/Kg
Cobalt	2.5	0.026	mg/Kg
Iron	5.0	4.1	mg/Kg
Lead	0.50	0.11	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.11	mg/Kg
Molybdenum	2.0	0.082	mg/Kg
Selenium	0.50	0.17	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	RL	MDL	Units
Aluminum	10	1.6	mg/Kg
Arsenic	0.50	0.13	mg/Kg
Barium	2.5	0.12	mg/Kg
Calcium	250	0.74	mg/Kg
Cobalt	2.5	0.023	mg/Kg
Iron	5.0	4.1	mg/Kg
Lead	0.50	0.11	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.052	mg/Kg
Molybdenum	2.0	0.082	mg/Kg
Selenium	0.50	0.17	mg/Kg

Method: 6010B - SEP Metals (ICP) - Total

Prep: Total

Analyte	RL	MDL	Units
Aluminum	10	1.6	mg/Kg
Arsenic	0.50	0.13	mg/Kg
Barium	2.5	0.046	mg/Kg
Calcium	250	2.6	mg/Kg
Cobalt	2.5	0.026	mg/Kg
Iron	5.0	4.1	mg/Kg
Lead	0.50	0.11	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.11	mg/Kg
Molybdenum	2.0	0.082	mg/Kg
Selenium	0.50	0.17	mg/Kg

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Method: 6010B - SEP Metals (ICP) - Total

Lab Sample ID: MB 140-56470/14-A
Matrix: Solid
Analysis Batch: 58419

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 56470

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		10	1.6	mg/Kg		12/01/21 08:54	01/31/22 11:13	1
Arsenic	0.194	J	0.50	0.13	mg/Kg		12/01/21 08:54	01/31/22 11:13	1
Barium	ND		2.5	0.046	mg/Kg		12/01/21 08:54	01/31/22 11:13	1
Calcium	10.0	J	250	2.6	mg/Kg		12/01/21 08:54	01/31/22 11:13	1
Cobalt	ND		2.5	0.026	mg/Kg		12/01/21 08:54	01/31/22 11:13	1
Iron	ND		5.0	4.1	mg/Kg		12/01/21 08:54	01/31/22 11:13	1
Lead	ND		0.50	0.11	mg/Kg		12/01/21 08:54	01/31/22 11:13	1
Lithium	ND		2.5	0.15	mg/Kg		12/01/21 08:54	01/31/22 11:13	1
Manganese	ND		0.75	0.11	mg/Kg		12/01/21 08:54	01/31/22 11:13	1
Molybdenum	0.104	J	2.0	0.082	mg/Kg		12/01/21 08:54	01/31/22 11:13	1
Selenium	ND		0.50	0.17	mg/Kg		12/01/21 08:54	01/31/22 11:13	1

Lab Sample ID: LCS 140-56470/12-A
Matrix: Solid
Analysis Batch: 58419

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 56470

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Aluminum	100	96.6		mg/Kg		97	80 - 120
Arsenic	5.00	5.22		mg/Kg		104	80 - 120
Barium	5.00	5.00		mg/Kg		100	80 - 120
Calcium	2500	2500		mg/Kg		100	80 - 120
Chromium	10.0	10.7		mg/Kg		107	80 - 120
Cobalt	5.00	5.22		mg/Kg		104	80 - 125
Iron	50.0	51.7		mg/Kg		103	80 - 120
Lead	5.00	5.24		mg/Kg		105	80 - 120
Lithium	5.00	4.93		mg/Kg		99	80 - 120
Manganese	5.00	5.40		mg/Kg		108	80 - 120
Molybdenum	25.0	26.3		mg/Kg		105	80 - 125
Selenium	7.50	7.36		mg/Kg		98	80 - 120

Lab Sample ID: LCSD 140-56470/13-A
Matrix: Solid
Analysis Batch: 58419

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 56470

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	100	98.5		mg/Kg		98	80 - 120	2	30
Arsenic	5.00	5.13		mg/Kg		103	80 - 120	2	30
Barium	5.00	5.04		mg/Kg		101	80 - 120	1	30
Calcium	2500	2540		mg/Kg		101	80 - 120	1	30
Chromium	10.0	10.4		mg/Kg		104	80 - 120	2	30
Cobalt	5.00	5.07		mg/Kg		101	80 - 125	3	30
Iron	50.0	52.7		mg/Kg		105	80 - 120	2	30
Lead	5.00	5.04		mg/Kg		101	80 - 120	4	30
Lithium	5.00	4.93		mg/Kg		99	80 - 120	0	30
Manganese	5.00	5.24		mg/Kg		105	80 - 120	3	30
Molybdenum	25.0	25.8		mg/Kg		103	80 - 125	2	30
Selenium	7.50	7.11		mg/Kg		95	80 - 120	4	30

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Method: 6010B - SEP Metals (ICP) - Total (Continued)

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Analysis Batch: 58419

Client Sample ID: E-SB-XPW01 (25-30)
Prep Type: Total/NA
Prep Batch: 56470

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Aluminum	85000		80600		mg/Kg	☼	5	30
Barium	460		425		mg/Kg	☼	8	30
Calcium	71000	B	69200		mg/Kg	☼	3	30

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Analysis Batch: 58419

Client Sample ID: E-SB-XPW01 (25-30)
Prep Type: Total/NA
Prep Batch: 56470

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Arsenic	49	B	48.9		mg/Kg	☼	0.3	30
Cobalt	26		25.8		mg/Kg	☼	0.5	30
Iron	150000		148000		mg/Kg	☼	0.6	30
Lead	330		329		mg/Kg	☼	0.4	30
Lithium	59		59.1		mg/Kg	☼	0.3	30
Manganese	840		846		mg/Kg	☼	0.2	30
Molybdenum	10	J B	10.2	J	mg/Kg	☼	0.4	30
Selenium	10		10.9		mg/Kg	☼	5	30

Method: 6010B SEP - SEP Metals (ICP)

Lab Sample ID: MB 140-56440/14-B ^4
Matrix: Solid
Analysis Batch: 57991

Client Sample ID: Method Blank
Prep Type: Step 1
Prep Batch: 56613

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		40	6.4	mg/Kg		12/02/21 12:30	01/17/22 11:15	4
Arsenic	ND		2.0	0.52	mg/Kg		12/02/21 12:30	01/17/22 11:15	4
Barium	ND		10	0.48	mg/Kg		12/02/21 12:30	01/17/22 11:15	4
Boron	ND		40	40	mg/Kg		12/02/21 12:30	01/17/22 11:15	4
Calcium	27.2	J	1000	7.6	mg/Kg		12/02/21 12:30	01/17/22 11:15	4
Cobalt	ND		10	0.18	mg/Kg		12/02/21 12:30	01/17/22 11:15	4
Iron	ND		20	12	mg/Kg		12/02/21 12:30	01/17/22 11:15	4
Lead	ND		2.0	0.44	mg/Kg		12/02/21 12:30	01/17/22 11:15	4
Lithium	ND		10	0.60	mg/Kg		12/02/21 12:30	01/17/22 11:15	4
Manganese	103		3.0	0.12	mg/Kg		12/02/21 12:30	01/17/22 11:15	4
Molybdenum	ND		8.0	0.33	mg/Kg		12/02/21 12:30	01/17/22 11:15	4
Selenium	ND		2.0	0.68	mg/Kg		12/02/21 12:30	01/17/22 11:15	4

Lab Sample ID: LCS 140-56440/12-B ^5
Matrix: Solid
Analysis Batch: 57991

Client Sample ID: Lab Control Sample
Prep Type: Step 1
Prep Batch: 56613

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Aluminum	100	103		mg/Kg		103	80 - 120
Arsenic	5.00	4.52		mg/Kg		90	80 - 120
Barium	5.00	5.02	J	mg/Kg		100	80 - 120
Boron	50.0	ND		mg/Kg		97	
Calcium	2500	2490		mg/Kg		100	80 - 120
Chromium	10.0	9.71		mg/Kg		97	80 - 120

DRAFT

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCS 140-56440/12-B ^5
Matrix: Solid
Analysis Batch: 57991

Client Sample ID: Lab Control Sample
Prep Type: Step 1
Prep Batch: 56613

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Cobalt			5.00	4.90	J	mg/Kg		98	80 - 120		
Iron			50.0	50.6		mg/Kg		101	80 - 120		
Lead			5.00	5.15		mg/Kg		103	80 - 120		
Lithium			5.00	5.35	J	mg/Kg		107	80 - 120		
Manganese			5.00	5.39		mg/Kg		108	80 - 120		
Molybdenum			25.0	26.0		mg/Kg		104	80 - 120		
Selenium			7.50	7.93		mg/Kg		106	80 - 120		

Lab Sample ID: LCSD 140-56440/13-B ^5
Matrix: Solid
Analysis Batch: 57991

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 1
Prep Batch: 56613

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum			100	109		mg/Kg		109	80 - 120	6	30
Arsenic			5.00	4.74		mg/Kg		95	80 - 120	5	30
Barium			5.00	5.25	J	mg/Kg		105	80 - 120	4	30
Boron			50.0	ND		mg/Kg		98		1	
Calcium			2500	2540		mg/Kg		102	80 - 120	2	30
Chromium			10.0	9.93		mg/Kg		99	80 - 120	2	30
Cobalt			5.00	5.01	J	mg/Kg		100	80 - 120	2	30
Iron			50.0	51.8		mg/Kg		104	80 - 120	3	30
Lead			5.00	4.97		mg/Kg		99	80 - 120	4	30
Lithium			5.00	5.32	J	mg/Kg		106	80 - 120	1	30
Manganese			5.00	5.38		mg/Kg		108	80 - 120	0	30
Molybdenum			25.0	26.4		mg/Kg		105	80 - 120	2	30
Selenium			7.50	7.72		mg/Kg		103	80 - 120	3	30

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Analysis Batch: 57991

Client Sample ID: E-SB-XPW01 (25-30)
Prep Type: Step 1
Prep Batch: 56613

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Aluminum	ND			ND		mg/Kg	☼			NC	30
Arsenic	ND			ND		mg/Kg	☼			NC	30
Barium	4.6	J		4.51	J	mg/Kg	☼			2	30
Boron	ND			ND		mg/Kg	☼			NC	
Calcium	5000	B		4730		mg/Kg	☼			6	30
Cobalt	ND			ND		mg/Kg	☼			NC	30
Iron	ND			ND		mg/Kg	☼			NC	30
Lead	ND			ND		mg/Kg	☼			NC	30
Lithium	ND			ND		mg/Kg	☼			NC	30
Manganese	0.92	J B		0.800	J	mg/Kg	☼			14	30
Molybdenum	1.0	J		0.979	J	mg/Kg	☼			6	30
Selenium	ND			1.44	J	mg/Kg	☼			NC	30

DRAFT

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: MB 140-56604/1-C ^3
Matrix: Solid
Analysis Batch: 57991

Client Sample ID: Method Blank
Prep Type: Step 2
Prep Batch: 56654

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		30	4.8	mg/Kg		12/07/21 09:37	01/17/22 14:48	3
Arsenic	ND		1.5	0.39	mg/Kg		12/07/21 09:37	01/17/22 14:48	3
Barium	ND		7.5	0.36	mg/Kg		12/07/21 09:37	01/17/22 14:48	3
Boron	ND		30	30	mg/Kg		12/07/21 09:37	01/17/22 14:48	3
Calcium	ND		750	6.6	mg/Kg		12/07/21 09:37	01/17/22 14:48	3
Cobalt	ND		7.5	0.19	mg/Kg		12/07/21 09:37	01/17/22 14:48	3
Iron	ND		15	8.7	mg/Kg		12/07/21 09:37	01/17/22 14:48	3
Lead	ND		1.5	0.33	mg/Kg		12/07/21 09:37	01/17/22 14:48	3
Lithium	ND		7.5	0.45	mg/Kg		12/07/21 09:37	01/17/22 14:48	3
Manganese	ND		2.3	0.84	mg/Kg		12/07/21 09:37	01/17/22 14:48	3
Molybdenum	ND		6.0	0.25	mg/Kg		12/07/21 09:37	01/17/22 14:48	3
Selenium	0.824	J	1.5	0.51	mg/Kg		12/07/21 09:37	01/17/22 14:48	3

Lab Sample ID: LCS 140-56604/2-C ^5
Matrix: Solid
Analysis Batch: 57991

Client Sample ID: Lab Control Sample
Prep Type: Step 2
Prep Batch: 56654

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Aluminum	100	ND		mg/Kg		-2	
Arsenic	5.00	3.15		mg/Kg		63	60 - 120
Barium	5.00	2.23	J	mg/Kg		45	30 - 60
Boron	50.0	ND		mg/Kg		87	
Calcium	2500	733	J	mg/Kg		29	10 - 40
Chromium	10.0	8.43		mg/Kg		84	60 - 120
Cobalt	5.00	4.34	J	mg/Kg		87	80 - 120
Iron	50.0	ND		mg/Kg		8	
Lead	5.00	4.36		mg/Kg		87	70 - 120
Lithium	5.00	4.62	J	mg/Kg		92	80 - 120
Manganese	5.00	4.74		mg/Kg		95	80 - 120
Molybdenum	25.0	20.1		mg/Kg		81	70 - 120
Selenium	7.50	7.10		mg/Kg		95	70 - 120

Lab Sample ID: LCSD 140-56604/3-C ^5
Matrix: Solid
Analysis Batch: 57991

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 2
Prep Batch: 56654

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	100	ND		mg/Kg		-0.8		77	
Arsenic	5.00	3.32		mg/Kg		66	60 - 120	5	30
Barium	5.00	2.36	J	mg/Kg		47	30 - 60	6	30
Boron	50.0	ND		mg/Kg		91		4	
Calcium	2500	780	J	mg/Kg		31	10 - 40	6	30
Chromium	10.0	8.58		mg/Kg		86	60 - 120	2	30
Cobalt	5.00	4.51	J	mg/Kg		90	80 - 120	4	30
Iron	50.0	ND		mg/Kg		8		4	
Lead	5.00	4.61		mg/Kg		92	70 - 120	6	30
Lithium	5.00	4.55	J	mg/Kg		91	80 - 120	1	30
Manganese	5.00	4.96		mg/Kg		99	80 - 120	5	30
Molybdenum	25.0	20.7		mg/Kg		83	70 - 120	3	30

DRAFT

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCSD 140-56604/3-C ^5
Matrix: Solid
Analysis Batch: 57991

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 2
Prep Batch: 56654

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Selenium			7.50	7.34		mg/Kg		98	70 - 120	3	30

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Analysis Batch: 57991

Client Sample ID: E-SB-XPW01 (25-30)
Prep Type: Step 2
Prep Batch: 56654

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Aluminum	2900			3050		mg/Kg	☼			4	
Arsenic	23			22.8		mg/Kg	☼			0.8	30
Barium	5.8	J		5.92	J	mg/Kg	☼			2	30
Boron	590			596		mg/Kg	☼			1	
Calcium	23000			22500		mg/Kg	☼			1	30
Cobalt	0.53	J		0.514	J	mg/Kg	☼			4	30
Iron	2600			2590		mg/Kg	☼			0.7	
Lead	32			33.3		mg/Kg	☼			4	30
Lithium	1.8	J		1.92	J	mg/Kg	☼			6	30
Manganese	320			318		mg/Kg	☼			1	30
Molybdenum	3.3	J		3.33	J	mg/Kg	☼			1	30

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: E-SB-XPW01 (25-30)
Prep Type: Step 2
Prep Batch: 56654

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Selenium	2.1	J B		1.32	J F5	mg/Kg	☼			46	30

Lab Sample ID: MB 140-56818/1-B
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Method Blank
Prep Type: Step 3
Prep Batch: 56824

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		10	2.1	mg/Kg		12/09/21 11:51	01/26/22 10:56	1
Arsenic	ND		0.50	0.13	mg/Kg		12/09/21 11:51	01/26/22 10:56	1
Barium	ND		2.5	0.12	mg/Kg		12/09/21 11:51	01/26/22 10:56	1
Boron	ND		10	10	mg/Kg		12/09/21 11:51	01/26/22 10:56	1
Calcium	ND		250	1.5	mg/Kg		12/09/21 11:51	01/26/22 10:56	1
Cobalt	ND		2.5	0.045	mg/Kg		12/09/21 11:51	01/26/22 10:56	1
Iron	ND		5.0	2.9	mg/Kg		12/09/21 11:51	01/26/22 10:56	1
Lead	ND		0.50	0.11	mg/Kg		12/09/21 11:51	01/26/22 10:56	1
Lithium	ND		2.5	0.15	mg/Kg		12/09/21 11:51	01/26/22 10:56	1
Manganese	0.0970	J	0.75	0.027	mg/Kg		12/09/21 11:51	01/26/22 10:56	1
Molybdenum	ND		2.0	0.082	mg/Kg		12/09/21 11:51	01/26/22 10:56	1
Selenium	ND		0.50	0.17	mg/Kg		12/09/21 11:51	01/26/22 10:56	1

Lab Sample ID: LCS 140-56818/2-B
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Lab Control Sample
Prep Type: Step 3
Prep Batch: 56824

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Aluminum			100	83.5		mg/Kg		84	80 - 120		

DRAFT

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCS 140-56818/2-B
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Lab Control Sample
Prep Type: Step 3
Prep Batch: 56824

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	5.00	4.93		mg/Kg		99	80 - 120
Barium	5.00	3.82		mg/Kg		76	70 - 120
Boron	50.0	50.4		mg/Kg		101	
Calcium	2500	28.3	J	mg/Kg		1	
Chromium	10.0	10.5		mg/Kg		105	80 - 120
Cobalt	5.00	4.73		mg/Kg		95	80 - 120
Iron	50.0	52.4		mg/Kg		105	80 - 120
Lead	5.00	ND		mg/Kg		0	
Lithium	5.00	5.03		mg/Kg		101	80 - 120
Manganese	5.00	4.87		mg/Kg		97	80 - 120
Molybdenum	25.0	24.9		mg/Kg		100	80 - 120
Selenium	7.50	7.49		mg/Kg		100	80 - 120

Lab Sample ID: LCSD 140-56818/3-B
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 3
Prep Batch: 56824

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	100	88.0		mg/Kg		88	80 - 120	5	30
Arsenic	5.00	4.78		mg/Kg		96	80 - 120	3	30
Barium	5.00	3.21	*-	mg/Kg		64	70 - 120	17	30
Boron	50.0	49.9		mg/Kg		100		1	
Calcium	2500	23.3	J	mg/Kg		0.9		19	
Chromium	10.0	10.4		mg/Kg		104	80 - 120	1	30
Cobalt	5.00	4.38		mg/Kg		88	80 - 120	8	30
Iron	50.0	51.6		mg/Kg		103	80 - 120	2	30
Lead	5.00	ND		mg/Kg		0		NC	
Lithium	5.00	4.93		mg/Kg		99	80 - 120	2	30
Manganese	5.00	4.53		mg/Kg		91	80 - 120	7	30
Molybdenum	25.0	24.4		mg/Kg		98	80 - 120	2	30
Selenium	7.50	7.27		mg/Kg		97	80 - 120	3	30

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: E-SB-XPW01 (25-30)
Prep Type: Step 3
Prep Batch: 56824

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Aluminum	4700		4510		mg/Kg	☼	3	30
Arsenic	11		11.2		mg/Kg	☼	1	30
Barium	6.0	*-	6.29	*-	mg/Kg	☼	5	30
Boron	100		104		mg/Kg	☼	4	
Calcium	11	J	10.7	J	mg/Kg	☼	7	
Cobalt	0.89	J	0.847	J	mg/Kg	☼	5	30
Iron	2400		2300		mg/Kg	☼	5	30
Lead	0.52	J	0.367	J	mg/Kg	☼	34	
Lithium	1.4	J	1.37	J	mg/Kg	☼	1	30
Manganese	150	B	141		mg/Kg	☼	7	30
Molybdenum	1.7	J	1.73	J	mg/Kg	☼	0.7	30
Selenium	0.60	J	0.625	J	mg/Kg	☼	4	30

DRAFT

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: MB 140-56871/1-B
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Method Blank
Prep Type: Step 4
Prep Batch: 56879

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		10	1.6	mg/Kg		12/13/21 09:30	01/26/22 12:37	1
Arsenic	0.387	J	0.50	0.22	mg/Kg		12/13/21 09:30	01/26/22 12:37	1
Barium	ND		2.5	0.12	mg/Kg		12/13/21 09:30	01/26/22 12:37	1
Boron	ND		10	10	mg/Kg		12/13/21 09:30	01/26/22 12:37	1
Calcium	ND		250	2.2	mg/Kg		12/13/21 09:30	01/26/22 12:37	1
Cobalt	ND		2.5	0.053	mg/Kg		12/13/21 09:30	01/26/22 12:37	1
Iron	ND		5.0	2.9	mg/Kg		12/13/21 09:30	01/26/22 12:37	1
Lead	ND		0.50	0.11	mg/Kg		12/13/21 09:30	01/26/22 12:37	1
Lithium	ND		2.5	0.15	mg/Kg		12/13/21 09:30	01/26/22 12:37	1
Manganese	ND		0.75	0.13	mg/Kg		12/13/21 09:30	01/26/22 12:37	1
Molybdenum	ND		2.0	0.082	mg/Kg		12/13/21 09:30	01/26/22 12:37	1
Selenium	ND		0.50	0.47	mg/Kg		12/13/21 09:30	01/26/22 12:37	1

Lab Sample ID: LCS 140-56871/2-B
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Lab Control Sample
Prep Type: Step 4
Prep Batch: 56879

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Aluminum	100	96.3		mg/Kg		96	80 - 120
Arsenic	5.00	5.27		mg/Kg		105	80 - 130
Barium	5.00	4.97		mg/Kg		99	80 - 120
Boron	50.0	47.8		mg/Kg		96	
Calcium	2500	2450		mg/Kg		98	80 - 120
Chromium	10.0	10.0		mg/Kg		100	80 - 120
Cobalt	5.00	4.95		mg/Kg		99	80 - 120
Iron	50.0	51.0		mg/Kg		102	80 - 120
Lead	5.00	4.83		mg/Kg		97	80 - 120
Lithium	5.00	4.89		mg/Kg		98	80 - 120
Manganese	5.00	5.20		mg/Kg		104	80 - 120
Molybdenum	25.0	26.0		mg/Kg		104	80 - 120
Selenium	7.50	ND		mg/Kg		5	

Lab Sample ID: LCSD 140-56871/3-B
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 4
Prep Batch: 56879

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	100	109		mg/Kg		109	80 - 120	12	30
Arsenic	5.00	5.88		mg/Kg		118	80 - 130	11	30
Barium	5.00	5.63		mg/Kg		113	80 - 120	12	30
Boron	50.0	54.0		mg/Kg		108		12	
Calcium	2500	2770		mg/Kg		111	80 - 120	12	30
Chromium	10.0	11.4		mg/Kg		114	80 - 120	13	30
Cobalt	5.00	5.60		mg/Kg		112	80 - 120	12	30
Iron	50.0	57.2		mg/Kg		114	80 - 120	11	30
Lead	5.00	5.48		mg/Kg		110	80 - 120	13	30
Lithium	5.00	5.40		mg/Kg		108	80 - 120	10	30
Manganese	5.00	5.84		mg/Kg		117	80 - 120	12	30
Molybdenum	25.0	29.4		mg/Kg		118	80 - 120	12	30

DRAFT

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCSD 140-56871/3-B
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 4
Prep Batch: 56879

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Selenium			7.50	0.474	J	mg/Kg		6		22	

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: E-SB-XPW01 (25-30)
Prep Type: Step 4
Prep Batch: 56879

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Aluminum	4900			4870		mg/Kg	☼			0.1	30
Arsenic	4.4	B		4.63		mg/Kg	☼			6	30
Barium	9.6			8.70		mg/Kg	☼			10	30
Boron	76			79.4		mg/Kg	☼			4	
Calcium	12000			12200		mg/Kg	☼			0.2	30
Cobalt	3.6	J		3.47	J	mg/Kg	☼			5	30
Iron	12000			12100		mg/Kg	☼			1	30
Lead	83			79.1		mg/Kg	☼			5	30
Lithium	5.1			4.71		mg/Kg	☼			7	30
Manganese	150			146		mg/Kg	☼			2	30
Molybdenum	1.6	J		1.63	J	mg/Kg	☼			0.7	30
Selenium	0.96			0.982		mg/Kg	☼			2	

Lab Sample ID: MB 140-56926/1-B ^5
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Method Blank
Prep Type: Step 5
Prep Batch: 57076

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		150	24	mg/Kg		12/15/21 10:40	01/26/22 14:10	5
Arsenic	ND		7.5	1.9	mg/Kg		12/15/21 10:40	01/26/22 14:10	5
Barium	ND		38	1.8	mg/Kg		12/15/21 10:40	01/26/22 14:10	5
Boron	ND		150	150	mg/Kg		12/15/21 10:40	01/26/22 14:10	5
Calcium	15.4	J	3800	11	mg/Kg		12/15/21 10:40	01/26/22 14:10	5
Cobalt	ND		38	0.60	mg/Kg		12/15/21 10:40	01/26/22 14:10	5
Iron	ND		75	44	mg/Kg		12/15/21 10:40	01/26/22 14:10	5
Lead	ND		7.5	1.7	mg/Kg		12/15/21 10:40	01/26/22 14:10	5
Lithium	2.79	J	38	2.2	mg/Kg		12/15/21 10:40	01/26/22 14:10	5
Manganese	ND		11	1.9	mg/Kg		12/15/21 10:40	01/26/22 14:10	5
Molybdenum	ND		30	1.3	mg/Kg		12/15/21 10:40	01/26/22 14:10	5
Selenium	ND		7.5	2.6	mg/Kg		12/15/21 10:40	01/26/22 14:10	5

Lab Sample ID: LCS 140-56926/2-B ^5
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Lab Control Sample
Prep Type: Step 5
Prep Batch: 57076

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Aluminum			300	ND		mg/Kg		-0.6			
Arsenic			15.0	11.6		mg/Kg		77	60 - 100		
Barium			15.0	9.23	J	mg/Kg		62	40 - 70		
Boron			150	171		mg/Kg		114			
Calcium			7500	2390	J	mg/Kg		32	20 - 50		
Chromium			30.0	34.6		mg/Kg		115	80 - 130		

DRAFT

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCS 140-56926/2-B ^5
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Lab Control Sample
Prep Type: Step 5
Prep Batch: 57076

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Cobalt	15.0	1.10	J	mg/Kg		7	1 - 60
Iron	150	ND		mg/Kg		2	
Lead	15.0	8.54		mg/Kg		57	40 - 80
Lithium	15.0	18.8	J	mg/Kg		126	80 - 150
Manganese	15.0	2.27	J	mg/Kg		15	1 - 60
Molybdenum	75.0	56.6		mg/Kg		75	60 - 100
Selenium	22.5	26.3		mg/Kg		117	80 - 140

Lab Sample ID: LCSD 140-56926/3-B ^5
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 5
Prep Batch: 57076

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	300	ND		mg/Kg		2		404	
Arsenic	15.0	11.2		mg/Kg		75	60 - 100	3	30
Barium	15.0	9.50	J	mg/Kg		63	40 - 70	3	30
Boron	150	165		mg/Kg		110		4	
Calcium	7500	2360	J	mg/Kg		31	20 - 50	1	30
Chromium	30.0	32.8		mg/Kg		109	80 - 130	5	30
Cobalt	15.0	0.998	J	mg/Kg		7	1 - 60	9	30
Iron	150	ND		mg/Kg		0.7		80	
Lead	15.0	9.25		mg/Kg		62	40 - 80	8	30
Lithium	15.0	18.9	J	mg/Kg		126	80 - 150	0	30
Manganese	15.0	3.67	J *1	mg/Kg		24	1 - 60	47	30
Molybdenum	75.0	53.9		mg/Kg		72	60 - 100	5	30
Selenium	22.5	24.4		mg/Kg		108	80 - 140	8	30

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: E-SB-XPW01 (25-30)
Prep Type: Step 5
Prep Batch: 57076

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Aluminum	ND		ND		mg/Kg	☼	NC	
Arsenic	ND		ND		mg/Kg	☼	NC	30
Barium	63		60.3	J	mg/Kg	☼	4	30
Boron	ND		ND		mg/Kg	☼	NC	
Calcium	9400	B	9430		mg/Kg	☼	0.4	30
Cobalt	ND		ND		mg/Kg	☼	NC	30
Iron	ND		ND		mg/Kg	☼	NC	
Lead	ND		ND		mg/Kg	☼	NC	30
Lithium	8.4	J B	8.80	J	mg/Kg	☼	4	30
Manganese	ND	*1	5.20	J *1	mg/Kg	☼	NC	30
Molybdenum	ND		ND		mg/Kg	☼	NC	30
Selenium	ND		ND		mg/Kg	☼	NC	30

DRAFT

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: MB 140-57110/1-A
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Method Blank
Prep Type: Step 6
Prep Batch: 57110

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		10	1.6	mg/Kg		12/15/21 17:10	01/26/22 15:36	1
Arsenic	ND		0.50	0.15	mg/Kg		12/15/21 17:10	01/26/22 15:36	1
Barium	ND		2.5	0.12	mg/Kg		12/15/21 17:10	01/26/22 15:36	1
Boron	ND		10	10	mg/Kg		12/15/21 17:10	01/26/22 15:36	1
Calcium	ND		250	2.1	mg/Kg		12/15/21 17:10	01/26/22 15:36	1
Cobalt	ND		2.5	0.046	mg/Kg		12/15/21 17:10	01/26/22 15:36	1
Iron	ND		5.0	2.9	mg/Kg		12/15/21 17:10	01/26/22 15:36	1
Lead	ND		0.50	0.11	mg/Kg		12/15/21 17:10	01/26/22 15:36	1
Lithium	ND		2.5	0.15	mg/Kg		12/15/21 17:10	01/26/22 15:36	1
Manganese	ND		0.75	0.25	mg/Kg		12/15/21 17:10	01/26/22 15:36	1
Molybdenum	ND		2.0	0.099	mg/Kg		12/15/21 17:10	01/26/22 15:36	1
Selenium	ND		0.50	0.17	mg/Kg		12/15/21 17:10	01/26/22 15:36	1

Lab Sample ID: LCS 140-57110/2-A
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Lab Control Sample
Prep Type: Step 6
Prep Batch: 57110

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Aluminum	100	105		mg/Kg		105	80 - 120
Arsenic	5.00	5.34		mg/Kg		107	80 - 120
Barium	5.00	5.39		mg/Kg		108	80 - 120
Boron	50.0	54.7		mg/Kg		109	
Calcium	2500	2670		mg/Kg		107	80 - 120
Chromium	10.0	11.0		mg/Kg		110	80 - 120
Cobalt	5.00	5.39		mg/Kg		108	80 - 120
Iron	50.0	53.9		mg/Kg		108	80 - 120
Lead	5.00	5.39		mg/Kg		108	80 - 120
Lithium	5.00	5.12		mg/Kg		102	80 - 120
Manganese	5.00	5.58		mg/Kg		112	80 - 120
Molybdenum	25.0	27.7		mg/Kg		111	80 - 120
Selenium	7.50	7.96		mg/Kg		106	80 - 120

Lab Sample ID: LCSD 140-57110/3-A
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 6
Prep Batch: 57110

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	100	106		mg/Kg		106	80 - 120	1	30
Arsenic	5.00	5.39		mg/Kg		108	80 - 120	1	30
Barium	5.00	5.45		mg/Kg		109	80 - 120	1	30
Boron	50.0	55.3		mg/Kg		111		1	
Calcium	2500	2700		mg/Kg		108	80 - 120	1	30
Chromium	10.0	11.0		mg/Kg		110	80 - 120	1	30
Cobalt	5.00	5.47		mg/Kg		109	80 - 120	1	30
Iron	50.0	54.7		mg/Kg		109	80 - 120	1	30
Lead	5.00	5.46		mg/Kg		109	80 - 120	1	30
Lithium	5.00	5.27		mg/Kg		105	80 - 120	3	30
Manganese	5.00	5.63		mg/Kg		113	80 - 120	1	30
Molybdenum	25.0	28.2		mg/Kg		113	80 - 120	2	30

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Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCSD 140-57110/3-A
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 6
Prep Batch: 57110

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Selenium			7.50	8.12		mg/Kg		108	80 - 120	2	30

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: E-SB-XPW01 (25-30)
Prep Type: Step 6
Prep Batch: 57110

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Aluminum	4700			5210		mg/Kg	☼			10	30
Barium	110			124		mg/Kg	☼			8	30
Boron	20			22.6		mg/Kg	☼			13	
Calcium	4500			4790		mg/Kg	☼			7	30
Cobalt	5.4			5.84		mg/Kg	☼			7	30
Lead	30			32.6		mg/Kg	☼			9	30
Lithium	3.7	J		4.17		mg/Kg	☼			13	30
Manganese	78			80.6		mg/Kg	☼			3	30
Molybdenum	1.1	J		1.17	J	mg/Kg	☼			9	30

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Analysis Batch: 58290

Client Sample ID: E-SB-XPW01 (25-30)
Prep Type: Step 6
Prep Batch: 57110

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Arsenic	5.6			5.81		mg/Kg	☼			4	30
Iron	53000			54700		mg/Kg	☼			4	30
Selenium	2.7			2.90		mg/Kg	☼			6	30

Lab Sample ID: MB 140-57211/1-A
Matrix: Solid
Analysis Batch: 58328

Client Sample ID: Method Blank
Prep Type: Step 7
Prep Batch: 57211

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		10	1.6	mg/Kg		12/18/21 15:38	01/27/22 12:10	1
Arsenic	0.138	J	0.50	0.13	mg/Kg		12/18/21 15:38	01/27/22 12:10	1
Barium	ND		2.5	0.046	mg/Kg		12/18/21 15:38	01/27/22 12:10	1
Calcium	ND		250	2.6	mg/Kg		12/18/21 15:38	01/27/22 12:10	1
Cobalt	ND		2.5	0.026	mg/Kg		12/18/21 15:38	01/27/22 12:10	1
Iron	ND		5.0	4.1	mg/Kg		12/18/21 15:38	01/27/22 12:10	1
Lead	ND		0.50	0.11	mg/Kg		12/18/21 15:38	01/27/22 12:10	1
Lithium	ND		2.5	0.15	mg/Kg		12/18/21 15:38	01/27/22 12:10	1
Manganese	ND		0.75	0.11	mg/Kg		12/18/21 15:38	01/27/22 12:10	1
Molybdenum	ND		2.0	0.082	mg/Kg		12/18/21 15:38	01/27/22 12:10	1
Selenium	ND		0.50	0.17	mg/Kg		12/18/21 15:38	01/27/22 12:10	1

Lab Sample ID: LCS 140-57211/2-A
Matrix: Solid
Analysis Batch: 58328

Client Sample ID: Lab Control Sample
Prep Type: Step 7
Prep Batch: 57211

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Aluminum			100	97.0		mg/Kg		97	80 - 120		
Arsenic			5.00	5.17		mg/Kg		103	80 - 120		

DRAFT

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCS 140-57211/2-A
Matrix: Solid
Analysis Batch: 58328

Client Sample ID: Lab Control Sample
Prep Type: Step 7
Prep Batch: 57211

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Barium	5.00	5.20		mg/Kg		104	80 - 120
Calcium	2500	2510		mg/Kg		100	80 - 120
Chromium	10.0	10.4		mg/Kg		104	80 - 120
Cobalt	5.00	5.17		mg/Kg		103	80 - 125
Iron	50.0	52.1		mg/Kg		104	80 - 120
Lead	5.00	5.22		mg/Kg		104	80 - 120
Lithium	5.00	5.04		mg/Kg		101	80 - 120
Manganese	5.00	5.29		mg/Kg		106	80 - 120
Molybdenum	25.0	25.3		mg/Kg		101	80 - 125
Selenium	7.50	7.23		mg/Kg		96	80 - 120

Lab Sample ID: LCSD 140-57211/3-A
Matrix: Solid
Analysis Batch: 58328

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 7
Prep Batch: 57211

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	100	97.9		mg/Kg		98	80 - 120	1	30
Arsenic	5.00	5.22		mg/Kg		104	80 - 120	1	30
Barium	5.00	5.14		mg/Kg		103	80 - 120	1	30
Calcium	2500	2520		mg/Kg		101	80 - 120	1	30
Chromium	10.0	10.3		mg/Kg		103	80 - 120	1	30
Cobalt	5.00	5.14		mg/Kg		103	80 - 125	1	30
Iron	50.0	54.2		mg/Kg		108	80 - 120	4	30
Lead	5.00	5.19		mg/Kg		104	80 - 120	1	30
Lithium	5.00	4.94		mg/Kg		99	80 - 120	2	30
Manganese	5.00	5.29		mg/Kg		106	80 - 120	0	30
Molybdenum	25.0	25.5		mg/Kg		102	80 - 125	1	30
Selenium	7.50	7.10		mg/Kg		95	80 - 120	2	30

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Analysis Batch: 58328

Client Sample ID: E-SB-XPW01 (25-30)
Prep Type: Step 7
Prep Batch: 57211

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Aluminum	67000		61600		mg/Kg	☼	9	30
Barium	270		246		mg/Kg	☼	8	30
Calcium	9000		8460		mg/Kg	☼	6	30

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Analysis Batch: 58328

Client Sample ID: E-SB-XPW01 (25-30)
Prep Type: Step 7
Prep Batch: 57211

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Lithium	43		40.6		mg/Kg	☼	5	30
Manganese	150		138		mg/Kg	☼	7	30
Molybdenum	1.3	J	1.40	J	mg/Kg	☼	7	30

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Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Analysis Batch: 58328

Client Sample ID: E-SB-XPW01 (25-30)
Prep Type: Step 7
Prep Batch: 57211

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Arsenic	7.0	B	6.76		mg/Kg	☼	3	30
Iron	80000		74800		mg/Kg	☼	6	30
Selenium	ND	L	ND	L	mg/Kg	☼	NC	30

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Analysis Batch: 58328

Client Sample ID: E-SB-XPW01 (25-30)
Prep Type: Step 7
Prep Batch: 57211

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Cobalt	18	J	16.7	J	mg/Kg	☼	6	30
Lead	240		216		mg/Kg	☼	11	30

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Metals

SEP Batch: 56440

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 1	Solid	Exchangeable	
140-24457-2	E-SB-07 (40-45)	Step 1	Solid	Exchangeable	
140-24457-3	E-SB-07 (59-64)	Step 1	Solid	Exchangeable	
140-24457-4	E-SB-05 (30-33.5)	Step 1	Solid	Exchangeable	
140-24457-5	E-SB-05 (51-56)	Step 1	Solid	Exchangeable	
140-24457-6	E-SB-19 (35-40)	Step 1	Solid	Exchangeable	
140-24457-7	E-SB-18 (40-44)	Step 1	Solid	Exchangeable	
140-24457-8	E-SB-XPW01 (25-30)	Step 1	Solid	Exchangeable	
140-24457-9	E-SB-15 (10-15)	Step 1	Solid	Exchangeable	
140-24457-10	E-SB-15 (30-35)	Step 1	Solid	Exchangeable	
MB 140-56440/14-B ^4	Method Blank	Step 1	Solid	Exchangeable	
LCS 140-56440/12-B ^5	Lab Control Sample	Step 1	Solid	Exchangeable	
LCSD 140-56440/13-B ^5	Lab Control Sample Dup	Step 1	Solid	Exchangeable	
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 1	Solid	Exchangeable	

Prep Batch: 56470

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Total/NA	Solid	Total	
140-24457-2	E-SB-07 (40-45)	Total/NA	Solid	Total	
140-24457-3	E-SB-07 (59-64)	Total/NA	Solid	Total	
140-24457-4	E-SB-05 (30-33.5)	Total/NA	Solid	Total	
140-24457-5	E-SB-05 (51-56)	Total/NA	Solid	Total	
140-24457-6	E-SB-19 (35-40)	Total/NA	Solid	Total	
140-24457-7	E-SB-18 (40-44)	Total/NA	Solid	Total	
140-24457-8	E-SB-XPW01 (25-30)	Total/NA	Solid	Total	
140-24457-9	E-SB-15 (10-15)	Total/NA	Solid	Total	
140-24457-10	E-SB-15 (30-35)	Total/NA	Solid	Total	
MB 140-56470/14-A	Method Blank	Total/NA	Solid	Total	
LCS 140-56470/12-A	Lab Control Sample	Total/NA	Solid	Total	
LCSD 140-56470/13-A	Lab Control Sample Dup	Total/NA	Solid	Total	
140-24457-8 DU	E-SB-XPW01 (25-30)	Total/NA	Solid	Total	

SEP Batch: 56604

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 2	Solid	Carbonate	
140-24457-2	E-SB-07 (40-45)	Step 2	Solid	Carbonate	
140-24457-3	E-SB-07 (59-64)	Step 2	Solid	Carbonate	
140-24457-4	E-SB-05 (30-33.5)	Step 2	Solid	Carbonate	
140-24457-5	E-SB-05 (51-56)	Step 2	Solid	Carbonate	
140-24457-6	E-SB-19 (35-40)	Step 2	Solid	Carbonate	
140-24457-7	E-SB-18 (40-44)	Step 2	Solid	Carbonate	
140-24457-8	E-SB-XPW01 (25-30)	Step 2	Solid	Carbonate	
140-24457-9	E-SB-15 (10-15)	Step 2	Solid	Carbonate	
140-24457-10	E-SB-15 (30-35)	Step 2	Solid	Carbonate	
MB 140-56604/1-C ^3	Method Blank	Step 2	Solid	Carbonate	
LCS 140-56604/2-C ^5	Lab Control Sample	Step 2	Solid	Carbonate	
LCSD 140-56604/3-C ^5	Lab Control Sample Dup	Step 2	Solid	Carbonate	
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 2	Solid	Carbonate	

DRAFT

Metals

Prep Batch: 56613

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 1	Solid	3010A	56440
140-24457-2	E-SB-07 (40-45)	Step 1	Solid	3010A	56440
140-24457-3	E-SB-07 (59-64)	Step 1	Solid	3010A	56440
140-24457-4	E-SB-05 (30-33.5)	Step 1	Solid	3010A	56440
140-24457-5	E-SB-05 (51-56)	Step 1	Solid	3010A	56440
140-24457-6	E-SB-19 (35-40)	Step 1	Solid	3010A	56440
140-24457-7	E-SB-18 (40-44)	Step 1	Solid	3010A	56440
140-24457-8	E-SB-XPW01 (25-30)	Step 1	Solid	3010A	56440
140-24457-9	E-SB-15 (10-15)	Step 1	Solid	3010A	56440
140-24457-10	E-SB-15 (30-35)	Step 1	Solid	3010A	56440
MB 140-56440/14-B ^4	Method Blank	Step 1	Solid	3010A	56440
LCS 140-56440/12-B ^5	Lab Control Sample	Step 1	Solid	3010A	56440
LCSD 140-56440/13-B ^5	Lab Control Sample Dup	Step 1	Solid	3010A	56440
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 1	Solid	3010A	56440

Prep Batch: 56654

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 2	Solid	3010A	56604
140-24457-2	E-SB-07 (40-45)	Step 2	Solid	3010A	56604
140-24457-3	E-SB-07 (59-64)	Step 2	Solid	3010A	56604
140-24457-4	E-SB-05 (30-33.5)	Step 2	Solid	3010A	56604
140-24457-5	E-SB-05 (51-56)	Step 2	Solid	3010A	56604
140-24457-6	E-SB-19 (35-40)	Step 2	Solid	3010A	56604
140-24457-7	E-SB-18 (40-44)	Step 2	Solid	3010A	56604
140-24457-8	E-SB-XPW01 (25-30)	Step 2	Solid	3010A	56604
140-24457-9	E-SB-15 (10-15)	Step 2	Solid	3010A	56604
140-24457-10	E-SB-15 (30-35)	Step 2	Solid	3010A	56604
MB 140-56604/1-C ^3	Method Blank	Step 2	Solid	3010A	56604
LCS 140-56604/2-C ^5	Lab Control Sample	Step 2	Solid	3010A	56604
LCSD 140-56604/3-C ^5	Lab Control Sample Dup	Step 2	Solid	3010A	56604
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 2	Solid	3010A	56604

SEP Batch: 56818

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 3	Solid	Non-Crystalline	
140-24457-2	E-SB-07 (40-45)	Step 3	Solid	Non-Crystalline	
140-24457-3	E-SB-07 (59-64)	Step 3	Solid	Non-Crystalline	
140-24457-4	E-SB-05 (30-33.5)	Step 3	Solid	Non-Crystalline	
140-24457-5	E-SB-05 (51-56)	Step 3	Solid	Non-Crystalline	
140-24457-6	E-SB-19 (35-40)	Step 3	Solid	Non-Crystalline	
140-24457-7	E-SB-18 (40-44)	Step 3	Solid	Non-Crystalline	
140-24457-8	E-SB-XPW01 (25-30)	Step 3	Solid	Non-Crystalline	
140-24457-9	E-SB-15 (10-15)	Step 3	Solid	Non-Crystalline	
140-24457-10	E-SB-15 (30-35)	Step 3	Solid	Non-Crystalline	
MB 140-56818/1-B	Method Blank	Step 3	Solid	Non-Crystalline	
LCS 140-56818/2-B	Lab Control Sample	Step 3	Solid	Non-Crystalline	
LCSD 140-56818/3-B	Lab Control Sample Dup	Step 3	Solid	Non-Crystalline	
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 3	Solid	Non-Crystalline	

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Metals

Prep Batch: 56824

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 3	Solid	3010A	56818
140-24457-2	E-SB-07 (40-45)	Step 3	Solid	3010A	56818
140-24457-3	E-SB-07 (59-64)	Step 3	Solid	3010A	56818
140-24457-4	E-SB-05 (30-33.5)	Step 3	Solid	3010A	56818
140-24457-5	E-SB-05 (51-56)	Step 3	Solid	3010A	56818
140-24457-6	E-SB-19 (35-40)	Step 3	Solid	3010A	56818
140-24457-7	E-SB-18 (40-44)	Step 3	Solid	3010A	56818
140-24457-8	E-SB-XPW01 (25-30)	Step 3	Solid	3010A	56818
140-24457-9	E-SB-15 (10-15)	Step 3	Solid	3010A	56818
140-24457-10	E-SB-15 (30-35)	Step 3	Solid	3010A	56818
MB 140-56818/1-B	Method Blank	Step 3	Solid	3010A	56818
LCS 140-56818/2-B	Lab Control Sample	Step 3	Solid	3010A	56818
LCSD 140-56818/3-B	Lab Control Sample Dup	Step 3	Solid	3010A	56818
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 3	Solid	3010A	56818

SEP Batch: 56871

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 4	Solid	Metal Hydroxide	
140-24457-2	E-SB-07 (40-45)	Step 4	Solid	Metal Hydroxide	
140-24457-3	E-SB-07 (59-64)	Step 4	Solid	Metal Hydroxide	
140-24457-4	E-SB-05 (30-33.5)	Step 4	Solid	Metal Hydroxide	
140-24457-5	E-SB-05 (51-56)	Step 4	Solid	Metal Hydroxide	
140-24457-6	E-SB-19 (35-40)	Step 4	Solid	Metal Hydroxide	
140-24457-7	E-SB-18 (40-44)	Step 4	Solid	Metal Hydroxide	
140-24457-8	E-SB-XPW01 (25-30)	Step 4	Solid	Metal Hydroxide	
140-24457-9	E-SB-15 (10-15)	Step 4	Solid	Metal Hydroxide	
140-24457-10	E-SB-15 (30-35)	Step 4	Solid	Metal Hydroxide	
MB 140-56871/1-B	Method Blank	Step 4	Solid	Metal Hydroxide	
LCS 140-56871/2-B	Lab Control Sample	Step 4	Solid	Metal Hydroxide	
LCSD 140-56871/3-B	Lab Control Sample Dup	Step 4	Solid	Metal Hydroxide	
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 4	Solid	Metal Hydroxide	

Prep Batch: 56879

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 4	Solid	3010A	56871
140-24457-2	E-SB-07 (40-45)	Step 4	Solid	3010A	56871
140-24457-3	E-SB-07 (59-64)	Step 4	Solid	3010A	56871
140-24457-4	E-SB-05 (30-33.5)	Step 4	Solid	3010A	56871
140-24457-5	E-SB-05 (51-56)	Step 4	Solid	3010A	56871
140-24457-6	E-SB-19 (35-40)	Step 4	Solid	3010A	56871
140-24457-7	E-SB-18 (40-44)	Step 4	Solid	3010A	56871
140-24457-8	E-SB-XPW01 (25-30)	Step 4	Solid	3010A	56871
140-24457-9	E-SB-15 (10-15)	Step 4	Solid	3010A	56871
140-24457-10	E-SB-15 (30-35)	Step 4	Solid	3010A	56871
MB 140-56871/1-B	Method Blank	Step 4	Solid	3010A	56871
LCS 140-56871/2-B	Lab Control Sample	Step 4	Solid	3010A	56871
LCSD 140-56871/3-B	Lab Control Sample Dup	Step 4	Solid	3010A	56871
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 4	Solid	3010A	56871

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Metals

SEP Batch: 56926

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 5	Solid	Organic-Bound	
140-24457-2	E-SB-07 (40-45)	Step 5	Solid	Organic-Bound	
140-24457-3	E-SB-07 (59-64)	Step 5	Solid	Organic-Bound	
140-24457-4	E-SB-05 (30-33.5)	Step 5	Solid	Organic-Bound	
140-24457-5	E-SB-05 (51-56)	Step 5	Solid	Organic-Bound	
140-24457-6	E-SB-19 (35-40)	Step 5	Solid	Organic-Bound	
140-24457-7	E-SB-18 (40-44)	Step 5	Solid	Organic-Bound	
140-24457-8	E-SB-XPW01 (25-30)	Step 5	Solid	Organic-Bound	
140-24457-9	E-SB-15 (10-15)	Step 5	Solid	Organic-Bound	
140-24457-10	E-SB-15 (30-35)	Step 5	Solid	Organic-Bound	
MB 140-56926/1-B ^5	Method Blank	Step 5	Solid	Organic-Bound	
LCS 140-56926/2-B ^5	Lab Control Sample	Step 5	Solid	Organic-Bound	
LCSD 140-56926/3-B ^5	Lab Control Sample Dup	Step 5	Solid	Organic-Bound	
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 5	Solid	Organic-Bound	

Prep Batch: 57076

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 5	Solid	3010A	56926
140-24457-2	E-SB-07 (40-45)	Step 5	Solid	3010A	56926
140-24457-3	E-SB-07 (59-64)	Step 5	Solid	3010A	56926
140-24457-4	E-SB-05 (30-33.5)	Step 5	Solid	3010A	56926
140-24457-5	E-SB-05 (51-56)	Step 5	Solid	3010A	56926
140-24457-6	E-SB-19 (35-40)	Step 5	Solid	3010A	56926
140-24457-7	E-SB-18 (40-44)	Step 5	Solid	3010A	56926
140-24457-8	E-SB-XPW01 (25-30)	Step 5	Solid	3010A	56926
140-24457-9	E-SB-15 (10-15)	Step 5	Solid	3010A	56926
140-24457-10	E-SB-15 (30-35)	Step 5	Solid	3010A	56926
MB 140-56926/1-B ^5	Method Blank	Step 5	Solid	3010A	56926
LCS 140-56926/2-B ^5	Lab Control Sample	Step 5	Solid	3010A	56926
LCSD 140-56926/3-B ^5	Lab Control Sample Dup	Step 5	Solid	3010A	56926
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 5	Solid	3010A	56926

SEP Batch: 57110

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 6	Solid	Acid/Sulfide	
140-24457-2	E-SB-07 (40-45)	Step 6	Solid	Acid/Sulfide	
140-24457-3	E-SB-07 (59-64)	Step 6	Solid	Acid/Sulfide	
140-24457-4	E-SB-05 (30-33.5)	Step 6	Solid	Acid/Sulfide	
140-24457-5	E-SB-05 (51-56)	Step 6	Solid	Acid/Sulfide	
140-24457-6	E-SB-19 (35-40)	Step 6	Solid	Acid/Sulfide	
140-24457-7	E-SB-18 (40-44)	Step 6	Solid	Acid/Sulfide	
140-24457-8	E-SB-XPW01 (25-30)	Step 6	Solid	Acid/Sulfide	
140-24457-9	E-SB-15 (10-15)	Step 6	Solid	Acid/Sulfide	
140-24457-10	E-SB-15 (30-35)	Step 6	Solid	Acid/Sulfide	
MB 140-57110/1-A	Method Blank	Step 6	Solid	Acid/Sulfide	
LCS 140-57110/2-A	Lab Control Sample	Step 6	Solid	Acid/Sulfide	
LCSD 140-57110/3-A	Lab Control Sample Dup	Step 6	Solid	Acid/Sulfide	
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 6	Solid	Acid/Sulfide	

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Metals

Prep Batch: 57211

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 7	Solid	Residual	
140-24457-2	E-SB-07 (40-45)	Step 7	Solid	Residual	
140-24457-3	E-SB-07 (59-64)	Step 7	Solid	Residual	
140-24457-4	E-SB-05 (30-33.5)	Step 7	Solid	Residual	
140-24457-5	E-SB-05 (51-56)	Step 7	Solid	Residual	
140-24457-6	E-SB-19 (35-40)	Step 7	Solid	Residual	
140-24457-7	E-SB-18 (40-44)	Step 7	Solid	Residual	
140-24457-8	E-SB-XPW01 (25-30)	Step 7	Solid	Residual	
140-24457-9	E-SB-15 (10-15)	Step 7	Solid	Residual	
140-24457-10	E-SB-15 (30-35)	Step 7	Solid	Residual	
MB 140-57211/1-A	Method Blank	Step 7	Solid	Residual	
LCS 140-57211/2-A	Lab Control Sample	Step 7	Solid	Residual	
LCSD 140-57211/3-A	Lab Control Sample Dup	Step 7	Solid	Residual	
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 7	Solid	Residual	

Analysis Batch: 57991

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 1	Solid	6010B SEP	56613
140-24457-1	E-SB-07 (21-27)	Step 2	Solid	6010B SEP	56654
140-24457-2	E-SB-07 (40-45)	Step 1	Solid	6010B SEP	56613
140-24457-2	E-SB-07 (40-45)	Step 2	Solid	6010B SEP	56654
140-24457-3	E-SB-07 (59-64)	Step 1	Solid	6010B SEP	56613
140-24457-3	E-SB-07 (59-64)	Step 2	Solid	6010B SEP	56654
140-24457-4	E-SB-05 (30-33.5)	Step 1	Solid	6010B SEP	56613
140-24457-4	E-SB-05 (30-33.5)	Step 2	Solid	6010B SEP	56654
140-24457-5	E-SB-05 (51-56)	Step 1	Solid	6010B SEP	56613
140-24457-5	E-SB-05 (51-56)	Step 2	Solid	6010B SEP	56654
140-24457-6	E-SB-19 (35-40)	Step 1	Solid	6010B SEP	56613
140-24457-6	E-SB-19 (35-40)	Step 2	Solid	6010B SEP	56654
140-24457-7	E-SB-18 (40-44)	Step 1	Solid	6010B SEP	56613
140-24457-7	E-SB-18 (40-44)	Step 2	Solid	6010B SEP	56654
140-24457-8	E-SB-XPW01 (25-30)	Step 1	Solid	6010B SEP	56613
140-24457-8	E-SB-XPW01 (25-30)	Step 2	Solid	6010B SEP	56654
140-24457-9	E-SB-15 (10-15)	Step 1	Solid	6010B SEP	56613
140-24457-9	E-SB-15 (10-15)	Step 2	Solid	6010B SEP	56654
140-24457-10	E-SB-15 (30-35)	Step 1	Solid	6010B SEP	56613
140-24457-10	E-SB-15 (30-35)	Step 2	Solid	6010B SEP	56654
MB 140-56440/14-B ^4	Method Blank	Step 1	Solid	6010B SEP	56613
MB 140-56604/1-C ^3	Method Blank	Step 2	Solid	6010B SEP	56654
LCS 140-56440/12-B ^5	Lab Control Sample	Step 1	Solid	6010B SEP	56613
LCS 140-56604/2-C ^5	Lab Control Sample	Step 2	Solid	6010B SEP	56654
LCSD 140-56440/13-B ^5	Lab Control Sample Dup	Step 1	Solid	6010B SEP	56613
LCSD 140-56604/3-C ^5	Lab Control Sample Dup	Step 2	Solid	6010B SEP	56654
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 1	Solid	6010B SEP	56613
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 2	Solid	6010B SEP	56654

Analysis Batch: 58290

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 3	Solid	6010B SEP	56824
140-24457-1	E-SB-07 (21-27)	Step 4	Solid	6010B SEP	56879
140-24457-1	E-SB-07 (21-27)	Step 5	Solid	6010B SEP	57076

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Metals (Continued)

Analysis Batch: 58290 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 6	Solid	6010B SEP	57110
140-24457-2	E-SB-07 (40-45)	Step 3	Solid	6010B SEP	56824
140-24457-2	E-SB-07 (40-45)	Step 4	Solid	6010B SEP	56879
140-24457-2	E-SB-07 (40-45)	Step 5	Solid	6010B SEP	57076
140-24457-2	E-SB-07 (40-45)	Step 6	Solid	6010B SEP	57110
140-24457-3	E-SB-07 (59-64)	Step 2	Solid	6010B SEP	56654
140-24457-3	E-SB-07 (59-64)	Step 3	Solid	6010B SEP	56824
140-24457-3	E-SB-07 (59-64)	Step 4	Solid	6010B SEP	56879
140-24457-3	E-SB-07 (59-64)	Step 5	Solid	6010B SEP	57076
140-24457-3	E-SB-07 (59-64)	Step 6	Solid	6010B SEP	57110
140-24457-4	E-SB-05 (30-33.5)	Step 2	Solid	6010B SEP	56654
140-24457-4	E-SB-05 (30-33.5)	Step 3	Solid	6010B SEP	56824
140-24457-4	E-SB-05 (30-33.5)	Step 4	Solid	6010B SEP	56879
140-24457-4	E-SB-05 (30-33.5)	Step 5	Solid	6010B SEP	57076
140-24457-4	E-SB-05 (30-33.5)	Step 6	Solid	6010B SEP	57110
140-24457-5	E-SB-05 (51-56)	Step 2	Solid	6010B SEP	56654
140-24457-5	E-SB-05 (51-56)	Step 3	Solid	6010B SEP	56824
140-24457-5	E-SB-05 (51-56)	Step 4	Solid	6010B SEP	56879
140-24457-5	E-SB-05 (51-56)	Step 5	Solid	6010B SEP	57076
140-24457-5	E-SB-05 (51-56)	Step 6	Solid	6010B SEP	57110
140-24457-6	E-SB-19 (35-40)	Step 2	Solid	6010B SEP	56654
140-24457-6	E-SB-19 (35-40)	Step 3	Solid	6010B SEP	56824
140-24457-6	E-SB-19 (35-40)	Step 4	Solid	6010B SEP	56879
140-24457-6	E-SB-19 (35-40)	Step 5	Solid	6010B SEP	57076
140-24457-6	E-SB-19 (35-40)	Step 6	Solid	6010B SEP	57110
140-24457-7	E-SB-18 (40-44)	Step 2	Solid	6010B SEP	56654
140-24457-7	E-SB-18 (40-44)	Step 3	Solid	6010B SEP	56824
140-24457-7	E-SB-18 (40-44)	Step 4	Solid	6010B SEP	56879
140-24457-7	E-SB-18 (40-44)	Step 5	Solid	6010B SEP	57076
140-24457-7	E-SB-18 (40-44)	Step 6	Solid	6010B SEP	57110
140-24457-8	E-SB-XPW01 (25-30)	Step 2	Solid	6010B SEP	56654
140-24457-8	E-SB-XPW01 (25-30)	Step 3	Solid	6010B SEP	56824
140-24457-8	E-SB-XPW01 (25-30)	Step 4	Solid	6010B SEP	56879
140-24457-8	E-SB-XPW01 (25-30)	Step 5	Solid	6010B SEP	57076
140-24457-8	E-SB-XPW01 (25-30)	Step 6	Solid	6010B SEP	57110
140-24457-8	E-SB-XPW01 (25-30)	Step 6	Solid	6010B SEP	57110
140-24457-9	E-SB-15 (10-15)	Step 2	Solid	6010B SEP	56654
140-24457-9	E-SB-15 (10-15)	Step 3	Solid	6010B SEP	56824
140-24457-9	E-SB-15 (10-15)	Step 4	Solid	6010B SEP	56879
140-24457-9	E-SB-15 (10-15)	Step 5	Solid	6010B SEP	57076
140-24457-9	E-SB-15 (10-15)	Step 6	Solid	6010B SEP	57110
140-24457-10	E-SB-15 (30-35)	Step 2	Solid	6010B SEP	56654
140-24457-10	E-SB-15 (30-35)	Step 3	Solid	6010B SEP	56824
140-24457-10	E-SB-15 (30-35)	Step 4	Solid	6010B SEP	56879
140-24457-10	E-SB-15 (30-35)	Step 5	Solid	6010B SEP	57076
140-24457-10	E-SB-15 (30-35)	Step 6	Solid	6010B SEP	57110
MB 140-56818/1-B	Method Blank	Step 3	Solid	6010B SEP	56824
MB 140-56871/1-B	Method Blank	Step 4	Solid	6010B SEP	56879
MB 140-56926/1-B ^5	Method Blank	Step 5	Solid	6010B SEP	57076
MB 140-57110/1-A	Method Blank	Step 6	Solid	6010B SEP	57110
LCS 140-56818/2-B	Lab Control Sample	Step 3	Solid	6010B SEP	56824

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Metals (Continued)

Analysis Batch: 58290 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
LCS 140-56871/2-B	Lab Control Sample	Step 4	Solid	6010B SEP	56879
LCS 140-56926/2-B ^5	Lab Control Sample	Step 5	Solid	6010B SEP	57076
LCS 140-57110/2-A	Lab Control Sample	Step 6	Solid	6010B SEP	57110
LCSD 140-56818/3-B	Lab Control Sample Dup	Step 3	Solid	6010B SEP	56824
LCSD 140-56871/3-B	Lab Control Sample Dup	Step 4	Solid	6010B SEP	56879
LCSD 140-56926/3-B ^5	Lab Control Sample Dup	Step 5	Solid	6010B SEP	57076
LCSD 140-57110/3-A	Lab Control Sample Dup	Step 6	Solid	6010B SEP	57110
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 2	Solid	6010B SEP	56654
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 3	Solid	6010B SEP	56824
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 4	Solid	6010B SEP	56879
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 5	Solid	6010B SEP	57076
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 6	Solid	6010B SEP	57110
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 6	Solid	6010B SEP	57110

Analysis Batch: 58328

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Step 7	Solid	6010B SEP	57211
140-24457-1	E-SB-07 (21-27)	Step 7	Solid	6010B SEP	57211
140-24457-2	E-SB-07 (40-45)	Step 7	Solid	6010B SEP	57211
140-24457-2	E-SB-07 (40-45)	Step 7	Solid	6010B SEP	57211
140-24457-2	E-SB-07 (40-45)	Step 7	Solid	6010B SEP	57211
140-24457-3	E-SB-07 (59-64)	Step 7	Solid	6010B SEP	57211
140-24457-3	E-SB-07 (59-64)	Step 7	Solid	6010B SEP	57211
140-24457-3	E-SB-07 (59-64)	Step 7	Solid	6010B SEP	57211
140-24457-4	E-SB-05 (30-33.5)	Step 7	Solid	6010B SEP	57211
140-24457-4	E-SB-05 (30-33.5)	Step 7	Solid	6010B SEP	57211
140-24457-4	E-SB-05 (30-33.5)	Step 7	Solid	6010B SEP	57211
140-24457-5	E-SB-05 (51-56)	Step 7	Solid	6010B SEP	57211
140-24457-5	E-SB-05 (51-56)	Step 7	Solid	6010B SEP	57211
140-24457-5	E-SB-05 (51-56)	Step 7	Solid	6010B SEP	57211
140-24457-6	E-SB-19 (35-40)	Step 7	Solid	6010B SEP	57211
140-24457-6	E-SB-19 (35-40)	Step 7	Solid	6010B SEP	57211
140-24457-6	E-SB-19 (35-40)	Step 7	Solid	6010B SEP	57211
140-24457-7	E-SB-18 (40-44)	Step 7	Solid	6010B SEP	57211
140-24457-7	E-SB-18 (40-44)	Step 7	Solid	6010B SEP	57211
140-24457-7	E-SB-18 (40-44)	Step 7	Solid	6010B SEP	57211
140-24457-8	E-SB-XPW01 (25-30)	Step 7	Solid	6010B SEP	57211
140-24457-8	E-SB-XPW01 (25-30)	Step 7	Solid	6010B SEP	57211
140-24457-8	E-SB-XPW01 (25-30)	Step 7	Solid	6010B SEP	57211
140-24457-8	E-SB-XPW01 (25-30)	Step 7	Solid	6010B SEP	57211
140-24457-9	E-SB-15 (10-15)	Step 7	Solid	6010B SEP	57211
140-24457-9	E-SB-15 (10-15)	Step 7	Solid	6010B SEP	57211
140-24457-9	E-SB-15 (10-15)	Step 7	Solid	6010B SEP	57211
140-24457-10	E-SB-15 (30-35)	Step 7	Solid	6010B SEP	57211
140-24457-10	E-SB-15 (30-35)	Step 7	Solid	6010B SEP	57211
140-24457-10	E-SB-15 (30-35)	Step 7	Solid	6010B SEP	57211
MB 140-57211/1-A	Method Blank	Step 7	Solid	6010B SEP	57211
LCS 140-57211/2-A	Lab Control Sample	Step 7	Solid	6010B SEP	57211
LCSD 140-57211/3-A	Lab Control Sample Dup	Step 7	Solid	6010B SEP	57211
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 7	Solid	6010B SEP	57211
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 7	Solid	6010B SEP	57211

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Metals (Continued)

Analysis Batch: 58328 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 7	Solid	6010B SEP	57211
140-24457-8 DU	E-SB-XPW01 (25-30)	Step 7	Solid	6010B SEP	57211

Analysis Batch: 58419

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Total/NA	Solid	6010B	56470
140-24457-1	E-SB-07 (21-27)	Total/NA	Solid	6010B	56470
140-24457-1	E-SB-07 (21-27)	Total/NA	Solid	6010B	56470
140-24457-2	E-SB-07 (40-45)	Total/NA	Solid	6010B	56470
140-24457-2	E-SB-07 (40-45)	Total/NA	Solid	6010B	56470
140-24457-2	E-SB-07 (40-45)	Total/NA	Solid	6010B	56470
140-24457-3	E-SB-07 (59-64)	Total/NA	Solid	6010B	56470
140-24457-3	E-SB-07 (59-64)	Total/NA	Solid	6010B	56470
140-24457-3	E-SB-07 (59-64)	Total/NA	Solid	6010B	56470
140-24457-4	E-SB-05 (30-33.5)	Total/NA	Solid	6010B	56470
140-24457-4	E-SB-05 (30-33.5)	Total/NA	Solid	6010B	56470
140-24457-4	E-SB-05 (30-33.5)	Total/NA	Solid	6010B	56470
140-24457-5	E-SB-05 (51-56)	Total/NA	Solid	6010B	56470
140-24457-5	E-SB-05 (51-56)	Total/NA	Solid	6010B	56470
140-24457-5	E-SB-05 (51-56)	Total/NA	Solid	6010B	56470
140-24457-6	E-SB-19 (35-40)	Total/NA	Solid	6010B	56470
140-24457-6	E-SB-19 (35-40)	Total/NA	Solid	6010B	56470
140-24457-6	E-SB-19 (35-40)	Total/NA	Solid	6010B	56470
140-24457-7	E-SB-18 (40-44)	Total/NA	Solid	6010B	56470
140-24457-7	E-SB-18 (40-44)	Total/NA	Solid	6010B	56470
140-24457-7	E-SB-18 (40-44)	Total/NA	Solid	6010B	56470
140-24457-8	E-SB-XPW01 (25-30)	Total/NA	Solid	6010B	56470
140-24457-8	E-SB-XPW01 (25-30)	Total/NA	Solid	6010B	56470
140-24457-9	E-SB-15 (10-15)	Total/NA	Solid	6010B	56470
140-24457-9	E-SB-15 (10-15)	Total/NA	Solid	6010B	56470
140-24457-9	E-SB-15 (10-15)	Total/NA	Solid	6010B	56470
140-24457-10	E-SB-15 (30-35)	Total/NA	Solid	6010B	56470
140-24457-10	E-SB-15 (30-35)	Total/NA	Solid	6010B	56470
140-24457-10	E-SB-15 (30-35)	Total/NA	Solid	6010B	56470
MB 140-56470/14-A	Method Blank	Total/NA	Solid	6010B	56470
LCS 140-56470/12-A	Lab Control Sample	Total/NA	Solid	6010B	56470
LCSD 140-56470/13-A	Lab Control Sample Dup	Total/NA	Solid	6010B	56470
140-24457-8 DU	E-SB-XPW01 (25-30)	Total/NA	Solid	6010B	56470
140-24457-8 DU	E-SB-XPW01 (25-30)	Total/NA	Solid	6010B	56470

Analysis Batch: 58599

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Sum of Steps 1-7	Solid	6010B SEP	
140-24457-2	E-SB-07 (40-45)	Sum of Steps 1-7	Solid	6010B SEP	
140-24457-3	E-SB-07 (59-64)	Sum of Steps 1-7	Solid	6010B SEP	
140-24457-4	E-SB-05 (30-33.5)	Sum of Steps 1-7	Solid	6010B SEP	
140-24457-5	E-SB-05 (51-56)	Sum of Steps 1-7	Solid	6010B SEP	
140-24457-6	E-SB-19 (35-40)	Sum of Steps 1-7	Solid	6010B SEP	
140-24457-7	E-SB-18 (40-44)	Sum of Steps 1-7	Solid	6010B SEP	
140-24457-8	E-SB-XPW01 (25-30)	Sum of Steps 1-7	Solid	6010B SEP	
140-24457-9	E-SB-15 (10-15)	Sum of Steps 1-7	Solid	6010B SEP	

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Metals (Continued)

Analysis Batch: 58599 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-10	E-SB-15 (30-35)	Sum of Steps 1-7	Solid	6010B SEP	

General Chemistry

Analysis Batch: 53527

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-1	E-SB-07 (21-27)	Total/NA	Solid	Moisture	
140-24457-2	E-SB-07 (40-45)	Total/NA	Solid	Moisture	
140-24457-3	E-SB-07 (59-64)	Total/NA	Solid	Moisture	
140-24457-4	E-SB-05 (30-33.5)	Total/NA	Solid	Moisture	
140-24457-5	E-SB-05 (51-56)	Total/NA	Solid	Moisture	
140-24457-6	E-SB-19 (35-40)	Total/NA	Solid	Moisture	
140-24457-7	E-SB-18 (40-44)	Total/NA	Solid	Moisture	
140-24457-8	E-SB-XPW01 (25-30)	Total/NA	Solid	Moisture	

Analysis Batch: 53579

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-24457-9	E-SB-15 (10-15)	Total/NA	Solid	Moisture	
140-24457-10	E-SB-15 (30-35)	Total/NA	Solid	Moisture	
140-24457-9 DU	E-SB-15 (10-15)	Total/NA	Solid	Moisture	

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Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Client Sample ID: E-SB-07 (21-27)
Lab Sample ID: 140-24457-1
Date Collected: 08/30/21 13:20
Matrix: Solid
Date Received: 09/02/21 09:45

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			58599	02/04/22 13:55	DKW	TAL KNX
	Instrument ID: NOEQUIP									
Total/NA	Analysis	Moisture		1			53527	09/08/21 10:48	LDP	TAL KNX
	Instrument ID: NOEQUIP									

Client Sample ID: E-SB-07 (21-27)
Lab Sample ID: 140-24457-1
Date Collected: 08/30/21 13:20
Matrix: Solid
Date Received: 09/02/21 09:45
Percent Solids: 81.5

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		10			58419	01/31/22 11:28	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		1			58419	01/31/22 12:34	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		2			58419	01/31/22 14:02	KNC	TAL KNX
	Instrument ID: DUO									
Step 1	SEP	Exchangeable			5 g	25 mL	56440	11/30/21 13:09	JMD	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	56613	12/02/21 12:30	MAC	TAL KNX
Step 1	Analysis	6010B SEP		4			57991	01/17/22 11:30	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			57991	01/17/22 15:03	JMD	TAL KNX
	Instrument ID: DUO									
Step 3	SEP	Non-Crystalline			5 g	25 mL	56818	12/08/21 11:40	MAC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	56824	12/09/21 11:51	MAC	TAL KNX
Step 3	Analysis	6010B SEP		1			58290	01/26/22 11:10	JMD	TAL KNX
	Instrument ID: DUO									
Step 4	SEP	Metal Hydroxide			5 g	25 mL	56871	12/09/21 10:26	MAC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	56879	12/13/21 09:30	MAC	TAL KNX
Step 4	Analysis	6010B SEP		1			58290	01/26/22 13:01	JMD	TAL KNX
	Instrument ID: DUO									
Step 5	SEP	Organic-Bound			5 g	75 mL	56926	12/10/21 15:00	MAC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	57076	12/15/21 10:40	MAC	TAL KNX
Step 5	Analysis	6010B SEP		5			58290	01/26/22 14:25	JMD	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		1			58290	01/26/22 16:00	JMD	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		10			58328	01/27/22 12:30	KNC	TAL KNX
	Instrument ID: DUO									

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Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Client Sample ID: E-SB-07 (21-27)
Lab Sample ID: 140-24457-1
Date Collected: 08/30/21 13:20
Matrix: Solid
Date Received: 09/02/21 09:45
Percent Solids: 81.5

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		1			58328	01/27/22 13:37	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: E-SB-07 (40-45)
Lab Sample ID: 140-24457-2
Date Collected: 08/30/21 14:05
Matrix: Solid
Date Received: 09/02/21 09:45

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			58599	02/04/22 13:55	DKW	TAL KNX
	Instrument ID: NOEQUIP									
Total/NA	Analysis	Moisture		1			53527	09/08/21 10:48	LDP	TAL KNX
	Instrument ID: NOEQUIP									

Client Sample ID: E-SB-07 (40-45)
Lab Sample ID: 140-24457-2
Date Collected: 08/30/21 14:05
Matrix: Solid
Date Received: 09/02/21 09:45
Percent Solids: 93.6

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		10			58419	01/31/22 11:33	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		1			58419	01/31/22 12:40	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		2			58419	01/31/22 14:07	KNC	TAL KNX
	Instrument ID: DUO									
Step 1	SEP	Exchangeable			5 g	25 mL	56440	11/30/21 13:09	JMD	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	56613	12/02/21 12:30	MAC	TAL KNX
Step 1	Analysis	6010B SEP		4			57991	01/17/22 11:35	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			57991	01/17/22 15:08	JMD	TAL KNX
	Instrument ID: DUO									
Step 3	SEP	Non-Crystalline			5 g	25 mL	56818	12/08/21 11:40	MAC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	56824	12/09/21 11:51	MAC	TAL KNX
Step 3	Analysis	6010B SEP		1			58290	01/26/22 11:15	JMD	TAL KNX
	Instrument ID: DUO									
Step 4	SEP	Metal Hydroxide			5 g	25 mL	56871	12/09/21 10:26	MAC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	56879	12/13/21 09:30	MAC	TAL KNX
Step 4	Analysis	6010B SEP		1			58290	01/26/22 13:06	JMD	TAL KNX
	Instrument ID: DUO									

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Client Sample ID: E-SB-07 (40-45)

Lab Sample ID: 140-24457-2

Date Collected: 08/30/21 14:05
Matrix: Solid
Date Received: 09/02/21 09:45
Percent Solids: 93.6

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 5	SEP	Organic-Bound			5 g	75 mL	56926	12/10/21 15:00	MAC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	57076	12/15/21 10:40	MAC	TAL KNX
Step 5	Analysis	6010B SEP		5			58290	01/26/22 14:30	JMD	TAL KNX
	Instrument ID:	DUO								
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		1			58290	01/26/22 16:05	JMD	TAL KNX
	Instrument ID:	DUO								
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		10			58328	01/27/22 12:35	KNC	TAL KNX
	Instrument ID:	DUO								
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		1			58328	01/27/22 13:42	KNC	TAL KNX
	Instrument ID:	DUO								
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		2			58328	01/27/22 15:18	KNC	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: E-SB-07 (59-64)

Lab Sample ID: 140-24457-3

Date Collected: 08/30/21 14:45
Matrix: Solid
Date Received: 09/02/21 09:45

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			58599	02/04/22 13:55	DKW	TAL KNX
	Instrument ID:	NOEQUIP								
Total/NA	Analysis	Moisture		1			53527	09/08/21 10:48	LDP	TAL KNX
	Instrument ID:	NOEQUIP								

Client Sample ID: E-SB-07 (59-64)

Lab Sample ID: 140-24457-3

Date Collected: 08/30/21 14:45
Matrix: Solid
Date Received: 09/02/21 09:45
Percent Solids: 91.2

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		10			58419	01/31/22 11:37	KNC	TAL KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		1			58419	01/31/22 12:45	KNC	TAL KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		2			58419	01/31/22 14:13	KNC	TAL KNX
	Instrument ID:	DUO								
Step 1	SEP	Exchangeable			5 g	25 mL	56440	11/30/21 13:09	JMD	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	56613	12/02/21 12:30	MAC	TAL KNX
Step 1	Analysis	6010B SEP		4			57991	01/17/22 11:40	JMD	TAL KNX
	Instrument ID:	DUO								

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Client Sample ID: E-SB-07 (59-64)

Lab Sample ID: 140-24457-3

Date Collected: 08/30/21 14:45
Matrix: Solid
Date Received: 09/02/21 09:45
Percent Solids: 91.2

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			57991	01/17/22 15:23	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			58290	01/26/22 09:51	JMD	TAL KNX
	Instrument ID: DUO									
Step 3	SEP	Non-Crystalline			5 g	25 mL	56818	12/08/21 11:40	MAC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	56824	12/09/21 11:51	MAC	TAL KNX
Step 3	Analysis	6010B SEP		1			58290	01/26/22 11:20	JMD	TAL KNX
	Instrument ID: DUO									
Step 4	SEP	Metal Hydroxide			5 g	25 mL	56871	12/09/21 10:26	MAC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	56879	12/13/21 09:30	MAC	TAL KNX
Step 4	Analysis	6010B SEP		1			58290	01/26/22 13:11	JMD	TAL KNX
	Instrument ID: DUO									
Step 5	SEP	Organic-Bound			5 g	75 mL	56926	12/10/21 15:00	MAC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	57076	12/15/21 10:40	MAC	TAL KNX
Step 5	Analysis	6010B SEP		5			58290	01/26/22 14:35	JMD	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		1			58290	01/26/22 16:10	JMD	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		10			58328	01/27/22 12:39	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		1			58328	01/27/22 13:47	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		2			58328	01/27/22 15:23	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: E-SB-05 (30-33.5)

Lab Sample ID: 140-24457-4

Date Collected: 08/30/21 16:50
Matrix: Solid
Date Received: 09/02/21 09:45

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			58599	02/04/22 13:55	DKW	TAL KNX
	Instrument ID: NOEQUIP									
Total/NA	Analysis	Moisture		1			53527	09/08/21 10:48	LDP	TAL KNX
	Instrument ID: NOEQUIP									

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Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Client Sample ID: E-SB-05 (30-33.5)
Date Collected: 08/30/21 16:50
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-4
Matrix: Solid
Percent Solids: 72.1

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		10			58419	01/31/22 11:42	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		1			58419	01/31/22 12:51	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		2			58419	01/31/22 14:18	KNC	TAL KNX
	Instrument ID: DUO									
Step 1	SEP	Exchangeable			5 g	25 mL	56440	11/30/21 13:09	JMD	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	56613	12/02/21 12:30	MAC	TAL KNX
Step 1	Analysis	6010B SEP		4			57991	01/17/22 11:44	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			57991	01/17/22 15:28	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			58290	01/26/22 09:56	JMD	TAL KNX
	Instrument ID: DUO									
Step 3	SEP	Non-Crystalline			5 g	25 mL	56818	12/08/21 11:40	MAC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	56824	12/09/21 11:51	MAC	TAL KNX
Step 3	Analysis	6010B SEP		1			58290	01/26/22 11:25	JMD	TAL KNX
	Instrument ID: DUO									
Step 4	SEP	Metal Hydroxide			5 g	25 mL	56871	12/09/21 10:26	MAC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	56879	12/13/21 09:30	MAC	TAL KNX
Step 4	Analysis	6010B SEP		1			58290	01/26/22 13:16	JMD	TAL KNX
	Instrument ID: DUO									
Step 5	SEP	Organic-Bound			5 g	75 mL	56926	12/10/21 15:00	MAC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	57076	12/15/21 10:40	MAC	TAL KNX
Step 5	Analysis	6010B SEP		5			58290	01/26/22 14:40	JMD	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		1			58290	01/26/22 16:15	JMD	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		10			58328	01/27/22 12:44	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		1			58328	01/27/22 13:52	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		2			58328	01/27/22 15:28	KNC	TAL KNX
	Instrument ID: DUO									

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Client Sample ID: E-SB-05 (51-56)

Lab Sample ID: 140-24457-5

Date Collected: 08/30/21 17:20

Matrix: Solid

Date Received: 09/02/21 09:45

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			58599	02/04/22 13:55	DKW	TAL KNX
	Instrument ID: NOEQUIP									
Total/NA	Analysis	Moisture		1			53527	09/08/21 10:48	LDP	TAL KNX
	Instrument ID: NOEQUIP									

Client Sample ID: E-SB-05 (51-56)

Lab Sample ID: 140-24457-5

Date Collected: 08/30/21 17:20

Matrix: Solid

Date Received: 09/02/21 09:45

Percent Solids: 89.9

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		10			58419	01/31/22 11:47	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		1			58419	01/31/22 12:57	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		2			58419	01/31/22 14:23	KNC	TAL KNX
	Instrument ID: DUO									
Step 1	SEP	Exchangeable			5 g	25 mL	56440	11/30/21 13:09	JMD	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	56613	12/02/21 12:30	MAC	TAL KNX
Step 1	Analysis	6010B SEP		4			57991	01/17/22 11:49	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			57991	01/17/22 15:33	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			58290	01/26/22 10:01	JMD	TAL KNX
	Instrument ID: DUO									
Step 3	SEP	Non-Crystalline			5 g	25 mL	56818	12/08/21 11:40	MAC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	56824	12/09/21 11:51	MAC	TAL KNX
Step 3	Analysis	6010B SEP		1			58290	01/26/22 11:30	JMD	TAL KNX
	Instrument ID: DUO									
Step 4	SEP	Metal Hydroxide			5 g	25 mL	56871	12/09/21 10:26	MAC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	56879	12/13/21 09:30	MAC	TAL KNX
Step 4	Analysis	6010B SEP		1			58290	01/26/22 13:21	JMD	TAL KNX
	Instrument ID: DUO									
Step 5	SEP	Organic-Bound			5 g	75 mL	56926	12/10/21 15:00	MAC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	57076	12/15/21 10:40	MAC	TAL KNX
Step 5	Analysis	6010B SEP		5			58290	01/26/22 14:45	JMD	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		1			58290	01/26/22 16:20	JMD	TAL KNX
	Instrument ID: DUO									

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Client Sample ID: E-SB-05 (51-56)

Lab Sample ID: 140-24457-5

Date Collected: 08/30/21 17:20
Matrix: Solid
Date Received: 09/02/21 09:45
Percent Solids: 89.9

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		10			58328	01/27/22 12:49	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		1			58328	01/27/22 14:07	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		2			58328	01/27/22 15:33	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: E-SB-19 (35-40)

Lab Sample ID: 140-24457-6

Date Collected: 08/31/21 10:00
Matrix: Solid
Date Received: 09/02/21 09:45

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			58599	02/04/22 13:55	DKW	TAL KNX
	Instrument ID: NOEQUIP									
Total/NA	Analysis	Moisture		1			53527	09/08/21 10:48	LDP	TAL KNX
	Instrument ID: NOEQUIP									

Client Sample ID: E-SB-19 (35-40)

Lab Sample ID: 140-24457-6

Date Collected: 08/31/21 10:00
Matrix: Solid
Date Received: 09/02/21 09:45
Percent Solids: 81.8

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		10			58419	01/31/22 11:51	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		1			58419	01/31/22 13:12	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		2			58419	01/31/22 14:28	KNC	TAL KNX
	Instrument ID: DUO									
Step 1	SEP	Exchangeable			5 g	25 mL	56440	11/30/21 13:09	JMD	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	56613	12/02/21 12:30	MAC	TAL KNX
Step 1	Analysis	6010B SEP		4			57991	01/17/22 11:54	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			57991	01/17/22 15:38	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			58290	01/26/22 10:06	JMD	TAL KNX
	Instrument ID: DUO									

DRAFT

Client Sample ID: E-SB-19 (35-40)

Lab Sample ID: 140-24457-6

Date Collected: 08/31/21 10:00

Matrix: Solid

Date Received: 09/02/21 09:45

Percent Solids: 81.8

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 3	SEP	Non-Crystalline			5 g	25 mL	56818	12/08/21 11:40	MAC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	56824	12/09/21 11:51	MAC	TAL KNX
Step 3	Analysis	6010B SEP		1			58290	01/26/22 11:45	JMD	TAL KNX
	Instrument ID: DUO									
Step 4	SEP	Metal Hydroxide			5 g	25 mL	56871	12/09/21 10:26	MAC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	56879	12/13/21 09:30	MAC	TAL KNX
Step 4	Analysis	6010B SEP		1			58290	01/26/22 13:26	JMD	TAL KNX
	Instrument ID: DUO									
Step 5	SEP	Organic-Bound			5 g	75 mL	56926	12/10/21 15:00	MAC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	57076	12/15/21 10:40	MAC	TAL KNX
Step 5	Analysis	6010B SEP		5			58290	01/26/22 15:00	JMD	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		1			58290	01/26/22 16:25	JMD	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		10			58328	01/27/22 12:54	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		1			58328	01/27/22 14:13	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		2			58328	01/27/22 15:38	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: E-SB-18 (40-44)

Lab Sample ID: 140-24457-7

Date Collected: 08/31/21 11:45

Matrix: Solid

Date Received: 09/02/21 09:45

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			58599	02/04/22 13:55	DKW	TAL KNX
	Instrument ID: NOEQUIP									
Total/NA	Analysis	Moisture		1			53527	09/08/21 10:48	LDP	TAL KNX
	Instrument ID: NOEQUIP									

Client Sample ID: E-SB-18 (40-44)

Lab Sample ID: 140-24457-7

Date Collected: 08/31/21 11:45

Matrix: Solid

Date Received: 09/02/21 09:45

Percent Solids: 70.1

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		10			58419	01/31/22 11:56	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		1			58419	01/31/22 13:18	KNC	TAL KNX
	Instrument ID: DUO									

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Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Client Sample ID: E-SB-18 (40-44)
Date Collected: 08/31/21 11:45
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-7
Matrix: Solid
Percent Solids: 70.1

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		2			58419	01/31/22 14:33	KNC	TAL KNX
	Instrument ID: DUO									
Step 1	SEP	Exchangeable			5 g	25 mL	56440	11/30/21 13:09	JMD	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	56613	12/02/21 12:30	MAC	TAL KNX
Step 1	Analysis	6010B SEP		4			57991	01/17/22 11:59	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			57991	01/17/22 15:43	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			58290	01/26/22 10:11	JMD	TAL KNX
	Instrument ID: DUO									
Step 3	SEP	Non-Crystalline			5 g	25 mL	56818	12/08/21 11:40	MAC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	56824	12/09/21 11:51	MAC	TAL KNX
Step 3	Analysis	6010B SEP		1			58290	01/26/22 11:50	JMD	TAL KNX
	Instrument ID: DUO									
Step 4	SEP	Metal Hydroxide			5 g	25 mL	56871	12/09/21 10:26	MAC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	56879	12/13/21 09:30	MAC	TAL KNX
Step 4	Analysis	6010B SEP		1			58290	01/26/22 13:31	JMD	TAL KNX
	Instrument ID: DUO									
Step 5	SEP	Organic-Bound			5 g	75 mL	56926	12/10/21 15:00	MAC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	57076	12/15/21 10:40	MAC	TAL KNX
Step 5	Analysis	6010B SEP		5			58290	01/26/22 15:05	JMD	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		1			58290	01/26/22 16:30	JMD	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		10			58328	01/27/22 13:08	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		1			58328	01/27/22 14:18	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		2			58328	01/27/22 15:43	KNC	TAL KNX
	Instrument ID: DUO									

DRAFT

Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Client Sample ID: E-SB-XPW01 (25-30)
Lab Sample ID: 140-24457-8
Date Collected: 08/31/21 13:50
Matrix: Solid
Date Received: 09/02/21 09:45

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			58599	02/04/22 13:55	DKW	TAL KNX
	Instrument ID: NOEQUIP									
Total/NA	Analysis	Moisture		1			53527	09/08/21 10:48	LDP	TAL KNX
	Instrument ID: NOEQUIP									

Client Sample ID: E-SB-XPW01 (25-30)
Lab Sample ID: 140-24457-8
Date Collected: 08/31/21 13:50
Matrix: Solid
Date Received: 09/02/21 09:45
Percent Solids: 61.3

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		10			58419	01/31/22 12:11	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		5			58419	01/31/22 14:39	KNC	TAL KNX
	Instrument ID: DUO									
Step 1	SEP	Exchangeable			5 g	25 mL	56440	11/30/21 13:09	JMD	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	56613	12/02/21 12:30	MAC	TAL KNX
Step 1	Analysis	6010B SEP		4			57991	01/17/22 14:23	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			57991	01/17/22 15:48	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			58290	01/26/22 10:16	JMD	TAL KNX
	Instrument ID: DUO									
Step 3	SEP	Non-Crystalline			5 g	25 mL	56818	12/08/21 11:40	MAC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	56824	12/09/21 11:51	MAC	TAL KNX
Step 3	Analysis	6010B SEP		1			58290	01/26/22 11:55	JMD	TAL KNX
	Instrument ID: DUO									
Step 4	SEP	Metal Hydroxide			5 g	25 mL	56871	12/09/21 10:26	MAC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	56879	12/13/21 09:30	MAC	TAL KNX
Step 4	Analysis	6010B SEP		1			58290	01/26/22 17:19	JMD	TAL KNX
	Instrument ID: DUO									
Step 5	SEP	Organic-Bound			5 g	75 mL	56926	12/10/21 15:00	MAC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	57076	12/15/21 10:40	MAC	TAL KNX
Step 5	Analysis	6010B SEP		5			58290	01/26/22 15:10	JMD	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		1			58290	01/26/22 16:35	JMD	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		2			58290	01/26/22 17:24	JMD	TAL KNX
	Instrument ID: DUO									

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Client Sample ID: E-SB-XPW01 (25-30)
Lab Sample ID: 140-24457-8

Date Collected: 08/31/21 13:50
Matrix: Solid
Date Received: 09/02/21 09:45
Percent Solids: 61.3

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		10			58328	01/27/22 13:13	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		1			58328	01/27/22 14:23	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		2			58328	01/27/22 15:48	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		5			58328	01/27/22 15:53	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: E-SB-15 (10-15)
Lab Sample ID: 140-24457-9

Date Collected: 08/31/21 15:40
Matrix: Solid
Date Received: 09/02/21 09:45

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			58599	02/04/22 13:55	DKW	TAL KNX
	Instrument ID: NOEQUIP									
Total/NA	Analysis	Moisture		1			53579	09/09/21 10:14	LDP	TAL KNX
	Instrument ID: NOEQUIP									

Client Sample ID: E-SB-15 (10-15)
Lab Sample ID: 140-24457-9

Date Collected: 08/31/21 15:40
Matrix: Solid
Date Received: 09/02/21 09:45
Percent Solids: 65.0

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		10			58419	01/31/22 12:20	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		1			58419	01/31/22 13:35	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		2			58419	01/31/22 15:03	KNC	TAL KNX
	Instrument ID: DUO									
Step 1	SEP	Exchangeable			5 g	25 mL	56440	11/30/21 13:09	JMD	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	56613	12/02/21 12:30	MAC	TAL KNX
Step 1	Analysis	6010B SEP		4			57991	01/17/22 14:33	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			57991	01/17/22 15:58	JMD	TAL KNX
	Instrument ID: DUO									

DRAFT

Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Client Sample ID: E-SB-15 (10-15)
Lab Sample ID: 140-24457-9
Date Collected: 08/31/21 15:40
Matrix: Solid
Date Received: 09/02/21 09:45
Percent Solids: 65.0

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			58290	01/26/22 10:26	JMD	TAL KNX
	Instrument ID: DUO									
Step 3	SEP	Non-Crystalline			5 g	25 mL	56818	12/08/21 11:40	MAC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	56824	12/09/21 11:51	MAC	TAL KNX
Step 3	Analysis	6010B SEP		1			58290	01/26/22 12:04	JMD	TAL KNX
	Instrument ID: DUO									
Step 4	SEP	Metal Hydroxide			5 g	25 mL	56871	12/09/21 10:26	MAC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	56879	12/13/21 09:30	MAC	TAL KNX
Step 4	Analysis	6010B SEP		1			58290	01/26/22 14:00	JMD	TAL KNX
	Instrument ID: DUO									
Step 5	SEP	Organic-Bound			5 g	75 mL	56926	12/10/21 15:00	MAC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	57076	12/15/21 10:40	MAC	TAL KNX
Step 5	Analysis	6010B SEP		5			58290	01/26/22 15:20	JMD	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		1			58290	01/26/22 16:59	JMD	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		10			58328	01/27/22 13:23	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		1			58328	01/27/22 14:34	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		2			58328	01/27/22 16:26	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: E-SB-15 (30-35)
Lab Sample ID: 140-24457-10
Date Collected: 08/31/21 16:20
Matrix: Solid
Date Received: 09/02/21 09:45

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			58599	02/04/22 13:55	DKW	TAL KNX
	Instrument ID: NOEQUIP									
Total/NA	Analysis	Moisture		1			53579	09/09/21 10:14	LDP	TAL KNX
	Instrument ID: NOEQUIP									

DRAFT

Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Client Sample ID: E-SB-15 (30-35)
Date Collected: 08/31/21 16:20
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-10
Matrix: Solid
Percent Solids: 65.1

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		10			58419	01/31/22 12:25	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		1			58419	01/31/22 13:40	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		2			58419	01/31/22 15:09	KNC	TAL KNX
	Instrument ID: DUO									
Step 1	SEP	Exchangeable			5 g	25 mL	56440	11/30/21 13:09	JMD	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	56613	12/02/21 12:30	MAC	TAL KNX
Step 1	Analysis	6010B SEP		4			57991	01/17/22 14:38	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			57991	01/17/22 16:03	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			58290	01/26/22 10:46	JMD	TAL KNX
	Instrument ID: DUO									
Step 3	SEP	Non-Crystalline			5 g	25 mL	56818	12/08/21 11:40	MAC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	56824	12/09/21 11:51	MAC	TAL KNX
Step 3	Analysis	6010B SEP		1			58290	01/26/22 12:09	JMD	TAL KNX
	Instrument ID: DUO									
Step 4	SEP	Metal Hydroxide			5 g	25 mL	56871	12/09/21 10:26	MAC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	56879	12/13/21 09:30	MAC	TAL KNX
Step 4	Analysis	6010B SEP		1			58290	01/26/22 14:05	JMD	TAL KNX
	Instrument ID: DUO									
Step 5	SEP	Organic-Bound			5 g	75 mL	56926	12/10/21 15:00	MAC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	57076	12/15/21 10:40	MAC	TAL KNX
Step 5	Analysis	6010B SEP		5			58290	01/26/22 15:26	JMD	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		1			58290	01/26/22 17:04	JMD	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		10			58328	01/27/22 13:28	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		1			58328	01/27/22 14:39	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		2			58328	01/27/22 16:31	KNC	TAL KNX
	Instrument ID: DUO									

DRAFT

Lab Chronicle

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Client Sample ID: Method Blank
Date Collected: N/A
Date Received: N/A

Lab Sample ID: MB 140-56440/14-B ^4
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 1	SEP	Exchangeable			5 g	25 mL	56440	11/30/21 13:09	JMD	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	56613	12/02/21 12:30	MAC	TAL KNX
Step 1	Analysis	6010B SEP		4			57991	01/17/22 11:15	JMD	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank
Date Collected: N/A
Date Received: N/A

Lab Sample ID: MB 140-56470/14-A
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		1			58419	01/31/22 11:13	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank
Date Collected: N/A
Date Received: N/A

Lab Sample ID: MB 140-56604/1-C ^3
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			57991	01/17/22 14:48	JMD	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank
Date Collected: N/A
Date Received: N/A

Lab Sample ID: MB 140-56818/1-B
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 3	SEP	Non-Crystalline			5 g	25 mL	56818	12/08/21 11:40	MAC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	56824	12/09/21 11:51	MAC	TAL KNX
Step 3	Analysis	6010B SEP		1			58290	01/26/22 10:56	JMD	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank
Date Collected: N/A
Date Received: N/A

Lab Sample ID: MB 140-56871/1-B
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 4	SEP	Metal Hydroxide			5 g	25 mL	56871	12/09/21 10:26	MAC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	56879	12/13/21 09:30	MAC	TAL KNX
Step 4	Analysis	6010B SEP		1			58290	01/26/22 12:37	JMD	TAL KNX
	Instrument ID: DUO									

DRAFT

Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Client Sample ID: Method Blank
Lab Sample ID: MB 140-56926/1-B ^5
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 5	SEP	Organic-Bound			5 g	75 mL	56926	12/10/21 15:00	MAC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	57076	12/15/21 10:40	MAC	TAL KNX
Step 5	Analysis	6010B SEP		5			58290	01/26/22 14:10	JMD	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: Method Blank
Lab Sample ID: MB 140-57110/1-A
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		1			58290	01/26/22 15:36	JMD	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: Method Blank
Lab Sample ID: MB 140-57211/1-A
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		1			58328	01/27/22 12:10	KNC	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample
Lab Sample ID: LCS 140-56440/12-B ^5
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 1	SEP	Exchangeable			5 g	25 mL	56440	11/30/21 13:09	JMD	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	56613	12/02/21 12:30	MAC	TAL KNX
Step 1	Analysis	6010B SEP		5			57991	01/17/22 11:20	JMD	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample
Lab Sample ID: LCS 140-56470/12-A
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		1			58419	01/31/22 11:18	KNC	TAL KNX
	Instrument ID:	DUO								

DRAFT

Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Client Sample ID: Lab Control Sample
Lab Sample ID: LCS 140-56604/2-C ^5
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		5			57991	01/17/22 14:53	JMD	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample
Lab Sample ID: LCS 140-56818/2-B
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 3	SEP	Non-Crystalline			5 g	25 mL	56818	12/08/21 11:40	MAC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	56824	12/09/21 11:51	MAC	TAL KNX
Step 3	Analysis	6010B SEP		1			58290	01/26/22 11:01	JMD	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample
Lab Sample ID: LCS 140-56871/2-B
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 4	SEP	Metal Hydroxide			5 g	25 mL	56871	12/09/21 10:26	MAC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	56879	12/13/21 09:30	MAC	TAL KNX
Step 4	Analysis	6010B SEP		1			58290	01/26/22 12:42	JMD	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample
Lab Sample ID: LCS 140-56926/2-B ^5
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 5	SEP	Organic-Bound			5 g	75 mL	56926	12/10/21 15:00	MAC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	57076	12/15/21 10:40	MAC	TAL KNX
Step 5	Analysis	6010B SEP		5			58290	01/26/22 14:15	JMD	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample
Lab Sample ID: LCS 140-57110/2-A
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		1			58290	01/26/22 15:41	JMD	TAL KNX
	Instrument ID: DUO									

DRAFT

Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Client Sample ID: Lab Control Sample
Lab Sample ID: LCS 140-57211/2-A
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		1			58328	01/27/22 12:15	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample Dup
Lab Sample ID: LCSD 140-56440/13-B ^5
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 1	SEP	Exchangeable			5 g	25 mL	56440	11/30/21 13:09	JMD	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	56613	12/02/21 12:30	MAC	TAL KNX
Step 1	Analysis	6010B SEP		5			57991	01/17/22 11:25	JMD	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample Dup
Lab Sample ID: LCSD 140-56470/13-A
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		1			58419	01/31/22 11:23	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample Dup
Lab Sample ID: LCSD 140-56604/3-C ^5
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		5			57991	01/17/22 14:58	JMD	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample Dup
Lab Sample ID: LCSD 140-56818/3-B
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 3	SEP	Non-Crystalline			5 g	25 mL	56818	12/08/21 11:40	MAC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	56824	12/09/21 11:51	MAC	TAL KNX
Step 3	Analysis	6010B SEP		1			58290	01/26/22 11:05	JMD	TAL KNX
	Instrument ID: DUO									

DRAFT

Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Client Sample ID: Lab Control Sample Dup
Lab Sample ID: LCSD 140-56871/3-B
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 4	SEP	Metal Hydroxide			5 g	25 mL	56871	12/09/21 10:26	MAC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	56879	12/13/21 09:30	MAC	TAL KNX
Step 4	Analysis	6010B SEP		1			58290	01/26/22 12:46	JMD	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample Dup
Lab Sample ID: LCSD 140-56926/3-B ^5
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 5	SEP	Organic-Bound			5 g	75 mL	56926	12/10/21 15:00	MAC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	57076	12/15/21 10:40	MAC	TAL KNX
Step 5	Analysis	6010B SEP		5			58290	01/26/22 14:20	JMD	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample Dup
Lab Sample ID: LCSD 140-57110/3-A
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		1			58290	01/26/22 15:45	JMD	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample Dup
Lab Sample ID: LCSD 140-57211/3-A
Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		1			58328	01/27/22 12:20	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: E-SB-XPW01 (25-30)
Lab Sample ID: 140-24457-8 DU
Date Collected: 08/31/21 13:50
Matrix: Solid
Date Received: 09/02/21 09:45
Percent Solids: 61.3

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		10			58419	01/31/22 12:15	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1 g	50 mL	56470	12/01/21 08:54	MAC	TAL KNX
Total/NA	Analysis	6010B		5			58419	01/31/22 14:44	KNC	TAL KNX
	Instrument ID: DUO									

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Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Client Sample ID: E-SB-XPW01 (25-30)
Date Collected: 08/31/21 13:50
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-8 DU
Matrix: Solid
Percent Solids: 61.3

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 1	SEP	Exchangeable			5 g	25 mL	56440	11/30/21 13:09	JMD	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	56613	12/02/21 12:30	MAC	TAL KNX
Step 1	Analysis	6010B SEP		4			57991	01/17/22 14:28	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			57991	01/17/22 15:53	JMD	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5 g	25 mL	56604	12/03/21 09:00	MAC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	56654	12/07/21 09:37	MAC	TAL KNX
Step 2	Analysis	6010B SEP		3			58290	01/26/22 10:21	JMD	TAL KNX
	Instrument ID: DUO									
Step 3	SEP	Non-Crystalline			5 g	25 mL	56818	12/08/21 11:40	MAC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	56824	12/09/21 11:51	MAC	TAL KNX
Step 3	Analysis	6010B SEP		1			58290	01/26/22 11:59	JMD	TAL KNX
	Instrument ID: DUO									
Step 4	SEP	Metal Hydroxide			5 g	25 mL	56871	12/09/21 10:26	MAC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	56879	12/13/21 09:30	MAC	TAL KNX
Step 4	Analysis	6010B SEP		1			58290	01/26/22 13:41	JMD	TAL KNX
	Instrument ID: DUO									
Step 5	SEP	Organic-Bound			5 g	75 mL	56926	12/10/21 15:00	MAC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	57076	12/15/21 10:40	MAC	TAL KNX
Step 5	Analysis	6010B SEP		5			58290	01/26/22 15:15	JMD	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		1			58290	01/26/22 16:40	JMD	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5 g	250 mL	57110	12/15/21 17:10	MAC	TAL KNX
Step 6	Analysis	6010B SEP		2			58290	01/26/22 17:29	JMD	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		10			58328	01/27/22 13:18	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		1			58328	01/27/22 14:28	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		2			58328	01/27/22 16:12	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1 g	50 mL	57211	12/18/21 15:38	MAC	TAL KNX
Step 7	Analysis	6010B SEP		5			58328	01/27/22 16:17	KNC	TAL KNX
	Instrument ID: DUO									

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Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Client Sample ID: E-SB-15 (10-15)
Date Collected: 08/31/21 15:40
Date Received: 09/02/21 09:45

Lab Sample ID: 140-24457-9 DU
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			53579	09/09/21 10:14	LDP	TAL KNX
	Instrument ID: NOEQUIP									

Laboratory References:
TAL KNX = Eurofins Knoxville, 5815 Middlebrook Pike, Knoxville, TN 37921, TEL (865)291-3000

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Accreditation/Certification Summary

Client: Golder Associates Inc.
Job ID: 140-24457-1
Project/Site: Edwards Power Station - Illinois

Laboratory: Eurofins Knoxville

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	Identification Number	Expiration Date
	AFCEE	N/A	
ANAB	Dept. of Defense ELAP	L2311	02-13-22
ANAB	Dept. of Energy	L2311.01	02-13-22
ANAB	ISO/IEC 17025	L2311	02-13-22
Arkansas DEQ	State	88-0688	06-17-22
California	State	2423	06-30-22
Colorado	State	TN00009	02-28-22
Connecticut	State	PH-0223	09-30-23
Florida	NELAP	E87177	06-30-22
Georgia (DW)	State	906	12-11-22
Hawaii	State	NA	12-11-22
Kansas	NELAP	E-10349	10-31-22
Kentucky (DW)	State	90101	12-31-22
Louisiana	NELAP	83979	06-30-22
Louisiana (DW)	State	LA019	12-31-22
Maryland	State	277	03-31-22
Michigan	State	9933	12-11-22
Nevada	State	TN00009	07-31-22
New Hampshire	NELAP	299919	01-17-23
New Jersey	NELAP	TN001	06-30-22
New York	NELAP	10781	03-31-22
North Carolina (DW)	State	21705	07-31-22
North Carolina (WW/SW)	State	64	12-31-22
Ohio VAP	State	CL0059	06-02-23
Oklahoma	State	9415	08-31-22
Oregon	NELAP	TNI0189	12-31-22
Pennsylvania	NELAP	68-00576	12-31-22
Tennessee	State	02014	12-11-22
Texas	NELAP	T104704380-18-12	08-31-22
US Fish & Wildlife	US Federal Programs	058448	07-31-22
USDA	US Federal Programs	P330-19-00236	08-20-22
Utah	NELAP	TN00009	07-31-22
Virginia	NELAP	460176	09-14-22
Washington	State	C593	01-19-23
West Virginia (DW)	State	9955C	12-31-22
West Virginia DEP	State	345	04-30-22
Wisconsin	State	998044300	08-31-22

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Method Summary

Client: Golder Associates Inc.
Project/Site: Edwards Power Station - Illinois

Job ID: 140-24457-1

Method	Method Description	Protocol	Laboratory
6010B	SEP Metals (ICP) - Total	SW846	TAL KNX
6010B SEP	SEP Metals (ICP)	SW846	TAL KNX
Moisture	Percent Moisture	EPA	TAL KNX
3010A	Preparation, Total Metals	SW846	TAL KNX
Acid/Sulfide	Sequential Extraction Procedure, Acid/Sulfide Fraction	TAL-KNOX	TAL KNX
Carbonate	Sequential Extraction Procedure, Carbonate Fraction	TAL-KNOX	TAL KNX
Exchangeable	Sequential Extraction Procedure, Exchangeable Fraction	TAL-KNOX	TAL KNX
Metal Hydroxide	Sequential Extraction Procedure, Metal Hydroxide Fraction	TAL-KNOX	TAL KNX
Non-Crystalline	Sequential Extraction Procedure, Non-crystalline Materials	TAL-KNOX	TAL KNX
Organic-Bound	Sequential Extraction Procedure, Organic Bound Fraction	TAL-KNOX	TAL KNX
Residual	Sequential Extraction Procedure, Residual Fraction	TAL-KNOX	TAL KNX
Total	Preparation, Total Material	TAL-KNOX	TAL KNX

Protocol References:

EPA = US Environmental Protection Agency

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

TAL-KNOX = TestAmerica Laboratories, Knoxville, Facility Standard Operating Procedure.

Laboratory References:

TAL KNX = Eurofins Knoxville, 5815 Middlebrook Pike, Knoxville, TN 37921, TEL (865)291-3000

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Eurofins TestAmerica, Knoxville
5815 Middlebrook F
Knoxville, TN 3792
Phone: 865-291-3000 Fax: 865-584-4315

Chain of Custody R ord

eurofins | Environ esting America

Client Information	Sampler: B. Talbert	Lab PM: Henry, Ryan	Carrier Tracking No(s):	COC No: 140-9736-2903.2
Client Contact: Jeffrey Ingram	Phone: 636-485-8185	E-Mail: williamr.henry@eurofinset.com	State of Origin: IL	Page: Page 2 of 2
Company: Golder Associates Inc.	PWSID:			Job #:
Address: 13515 Barrett Parkway Drive Suite 260	Due Date Requested:			
City: Ballwin	TAT Requested (days):			
State, Zip: MO, 63021	Compliance Project: \ Yes \ No			
Phone: 314-984-8800(Tel) 636-724-9323(Fax)	PO #: Purchase Order not required			
Email: Jeffrey_Ingram@golder.com	WO #:			
Project Name: Edwards ~~Kincaid~~ Power Station - Illinois	Project #: 14006434			
Site:	SSOW#:			

Analysis Requested

Preservation Codes:

A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Z - other (specify)

140-24457 Chain of Custody

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	6010B - Select Total Metals	6010B_SEP - SEP	Total Numb	Special Instructions/Note:
			Preservation Code:		X	X	N	N	X	
E-SB-07(21-27)	8-30-21	1320	G	S				/		
E-SB-07(40-45)		1405						/		CUSTODY SEALS INTACT
E-SB-07(59-64)		1445						/		RECEIVED AT AT 1.) /CT1.2C
E-SB-05 (30-33.5)		1650						/		AND 9-2-21
E-SB-05(51-56)		1720						/		1 COOLER FED X#
E-SB-19 (35-40)	8-31-21	1000						/		283232938733 PD
E-SB-18 (40-44)		1145						/		
E-SB-XPW01(25-30)		1350						/		
E-SB-15 (10-15)		1540						/		
E-SB-15 (30-35)		1620						/		

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:

Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Brendan Talbert	9-1-2021 @ 1800	Golder		9.2.21 09:45	EST KNX
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: \ Yes \ No | Custody Seal No.:

Cooler Temperature(s) °C and Other Remarks:

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2/4/2022

EUROFINS/TESTAMERICA KNOXVILLE SAMPLE RECEIPT/CONDITION UPON RECEIPT ANOMALY CHECKLIST

Log In Number:

Review Items	Yes	No	NA	If No, what was the problem?
1. Are the shipping containers intact?	✓		✓	☐ **Containers, Broken**
2. Were ambient air containers received intact?			✓	☐ Checked in lab
3. The coolers/containers custody seal if present, is it intact?	✓			☐ Yes ☐ NA
4. Is the cooler temperature within limits? (> freezing temp. of water to 6 °C, VOST: 10°C) Thermometer ID : 5671 Correction factor: +0.1°C	✓			☐ **Cooler Out of Temp, Client Contacted, Proceed/Cancel** ☐ **Cooler Out of Temp, Same Day Receipt**
5. Were all of the sample containers received intact?	✓			☐ **Containers, Broken**
6. Were samples received in appropriate containers?	✓			☐ **Containers, Improper; Client Contacted; Proceed/Cancel**
7. Do sample container labels match COC? (IDs, Dates, Times)	✓			☐ **COC & Samples Do Not Match** ☐ **COC Incorrect/Incomplete** ☐ **COC Not Received**
8. Were all of the samples listed on the COC received?	✓			☐ **Sample Received, Not on COC** ☐ **Sample on COC, Not Received**
9. Is the date/time of sample collection noted?	✓			☐ **COC; No Date/Time; Client Contacted**
10. Was the sampler identified on the COC?	✓			☐ **Sampler Not Listed on COC**
11. Is the client and project name/# identified?	✓			☐ **COC Incorrect/Incomplete**
12. Are tests/parameters listed for each sample?	✓			☐ **COC No tests on COC**
13. Is the matrix of the samples noted?	✓			☐ **COC Incorrect/Incomplete**
14. Was COC relinquished? (Signed/Dated/Timed)	✓			☐ **COC Incorrect/Incomplete**
15. Were samples received within holding time?	✓			☐ **Holding Time - Receipt**
16. Were samples received with correct chemical preservative (excluding Encore)?			✓	☐ **pH Adjusted, pH Included (See box 16A)** ☐ **Incorrect Preservative**
17. Were VOA samples received without headspace?			✓	☐ **Headspace (VOA only)**
18. Did you check for residual chlorine, if necessary? (e.g. 1613B, 1668) Chlorine test strip lot number:			✓	☐ **Residual Chlorine**
19. For 1613B water samples is pH<9?			✓	☐ If no, notify lab to adjust
20. For rad samples was sample activity info. Provided?			✓	☐ Project missing info

Comments/Actions Taken

Labeling Verified by: **Date:**

pH test strip lot number:

	Box 16A: pH Preservation	Box 18A: Residual Chlorine
Preservative:		
Lot Number:		
Exp Date:		
Analyst:		
Date:		
Time:		

Project #: PM Instructions:

Sample Receiving Associate: Date: 9.2.21

QA026R32.doc, 062719

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APPENDIX C

Bulk Mineralogy by Rietveld XRD Analysis

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*Environmental Services*
Project Number/ LIMS No.	*Custom XRD/MI4503-NOV21*
Sample Receipt:	*November 3, 2021*
Sample Analysis:	*November 8, 2021*
Reporting Date:	*November 11, 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)

DRAFT

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

ACCREDITATION: SGS Natural Resources Lakefield is accredited to the requirements of ISO/IEC 17025 for specific tests as listed on our scope of accreditation, including geochemical, mineralogical and trade mineral tests. To view a list of the accredited methods, please visit the following website and search SGS Canada Inc. - Minerals: https://www.scc.ca/en/search/palcan.

Method Summary

The Rietveld Method of Mineral Identification by XRD (ME-LR-MIN-MET-MN-D05) method used by SGS Natural Resources is accredited to the requirements of ISO/IEC 17025.

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

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.

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WARNING: The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

Summary of Rietveld Quantitative Analysis X-Ray Diffraction Results

Mineral/Compound	E-SB-07 (21.0-27.0)	E-SB-07 (40.0-45.0)	E-SB-07 (59.0-64.0)	E-SB-05 (30.0-33.5)	E-SB-05 (51.0-56.0)	E-SB-19 (35.0-40.0)	E-SB-18 (40.0-44.0)	E-SB-XPW01 (25.0-30.0)	E-SB-15 (10.0-15.0)	E-SB-15 (30.0-35.0)
	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)
Quartz	59.7	44.9	43.6	39.0	38.7	46.8	34.6	10.4	38.6	37.0
Albite	8.6	14.7	15.6	9.6	15.0	12.0	10.0	-	12.1	11.6
Microcline	9.3	2.9	3.4	9.8	4.3	7.5	8.8	-	10.7	10.2
Chlorite	3.4	8.1	9.4	4.5	7.5	4.8	5.2	-	5.8	4.5
Muscovite	8.8	22.4	22.5	16.3	24.1	14.5	17.8	-	16.8	15.5
Biotite	1.5	2.5	3.8	1.9	3.7	2.2	2.1	-	2.6	2.6
Ankerite	2.5	0.0	0.0	3.5	0.1	2.6	3.5	-	1.5	3.3
Dolomite	4.4	0.0	0.0	8.5	0.8	7.7	6.7	-	3.5	6.5
Calcite	0.9	0.4	0.5	4.6	0.3	0.0	3.5	2.7	0.7	2.0
Siderite	0.0	3.1	0.2	1.0	5.0	1.0	1.1	-	0.2	0.7
Hematite	0.4	0.0	0.0	0.1	0.0	0.1	0.2	23.0	0.0	0.2
Magnetite	0.1	0.3	0.3	0.6	0.4	0.3	0.0	25.5	0.1	0.0
Ilmenite	0.1	0.1	0.0	0.0	0.1	0.0	0.0	-	0.0	0.1
Rutile	0.3	0.7	0.6	0.7	0.3	0.5	0.5	0.2	1.0	0.5
Diopside	-	-	-	-	-	-	1.4	-	0.6	0.7
Actinolite	-	-	-	-	-	-	0.3	-	0.2	0.4
Epidote	-	-	-	-	-	-	0.3	-	0.4	0.4
Kaolinite	-	-	-	-	-	-	4.0	-	5.1	3.8
Mullite	-	-	-	-	-	-	-	8.7	-	-
Anorthite	-	-	-	-	-	-	-	29.6	-	-
TOTAL	100	100	100	100	100	100	100	100	100	100

Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identified by the analyst and not included in the refinement calculation for the sample.

The weight percent quantities indicated have been normalized to a sum of 100%. The quantity of amorphous material has not been determined.

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Mineral List

Mineral/Compound	Formula
Quartz	SiO_2
Albite	$NaAlSi_3O_8$
Microcline	$KAlSi_3O_8$
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$
Ankerite	$CaFe(CO_3)_2$
Dolomite	$CaMg(CO_3)_2$
Calcite	$CaCO_3$
Siderite	$FeCO_3$
Hematite	Fe_2O_3
Magnetite	Fe_3O_4
Ilmenite	$FeTiO_3$
Rutile	TiO_2
Diopside	$CaMgSi_2O_6$
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$
Epidote	$Ca_2(Al,Fe)Al_2O(SiO_4)(Si_2O_7)(OH)$
Kaolinite	$Al_2Si_2O_5(OH)_4$
Mullite	$\sim Al_6Si_3O_{15}$
Anorthite	$CaAl_2Si_2O_8$

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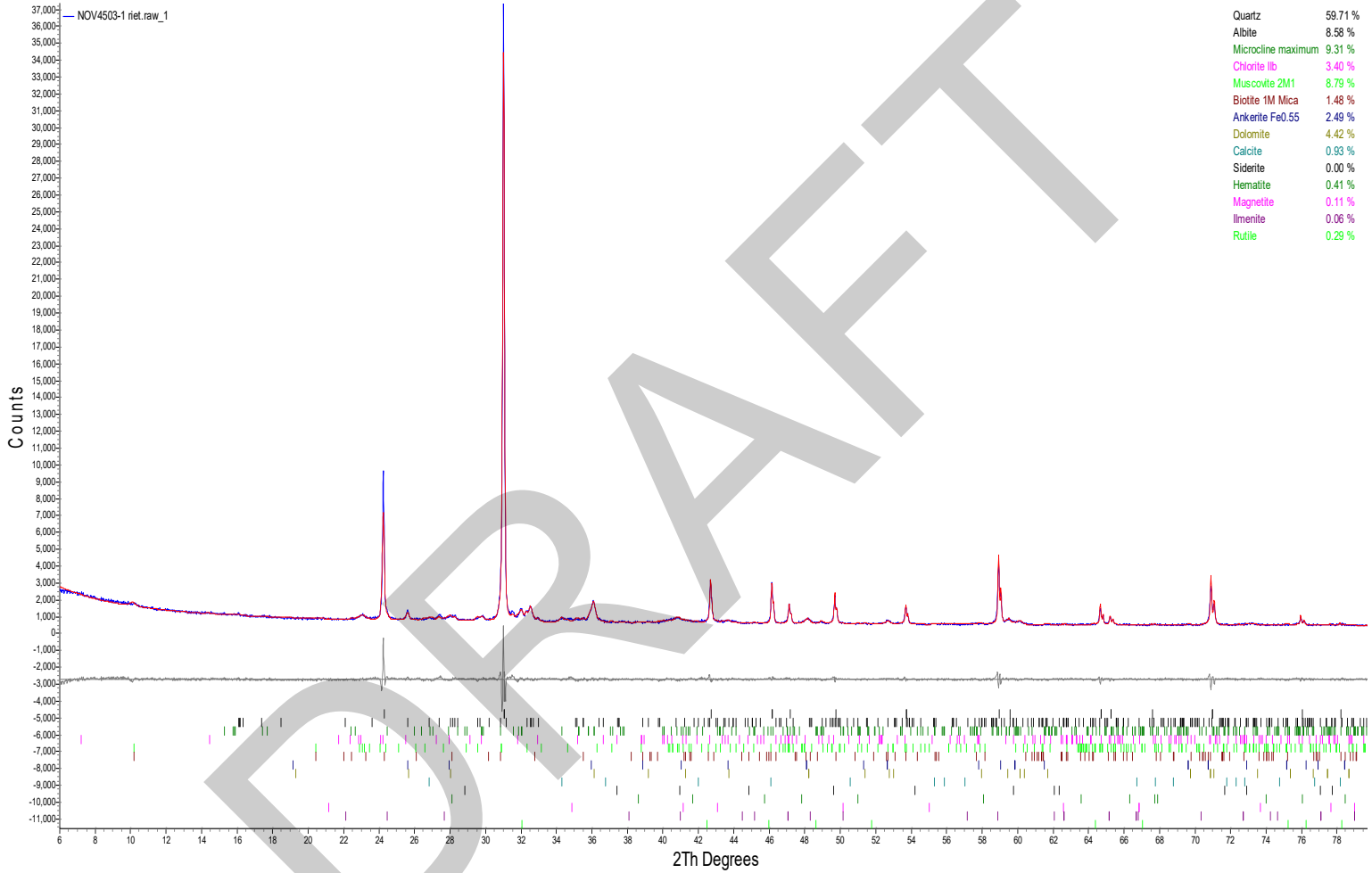
E-SB-07 (21.0-27.0)



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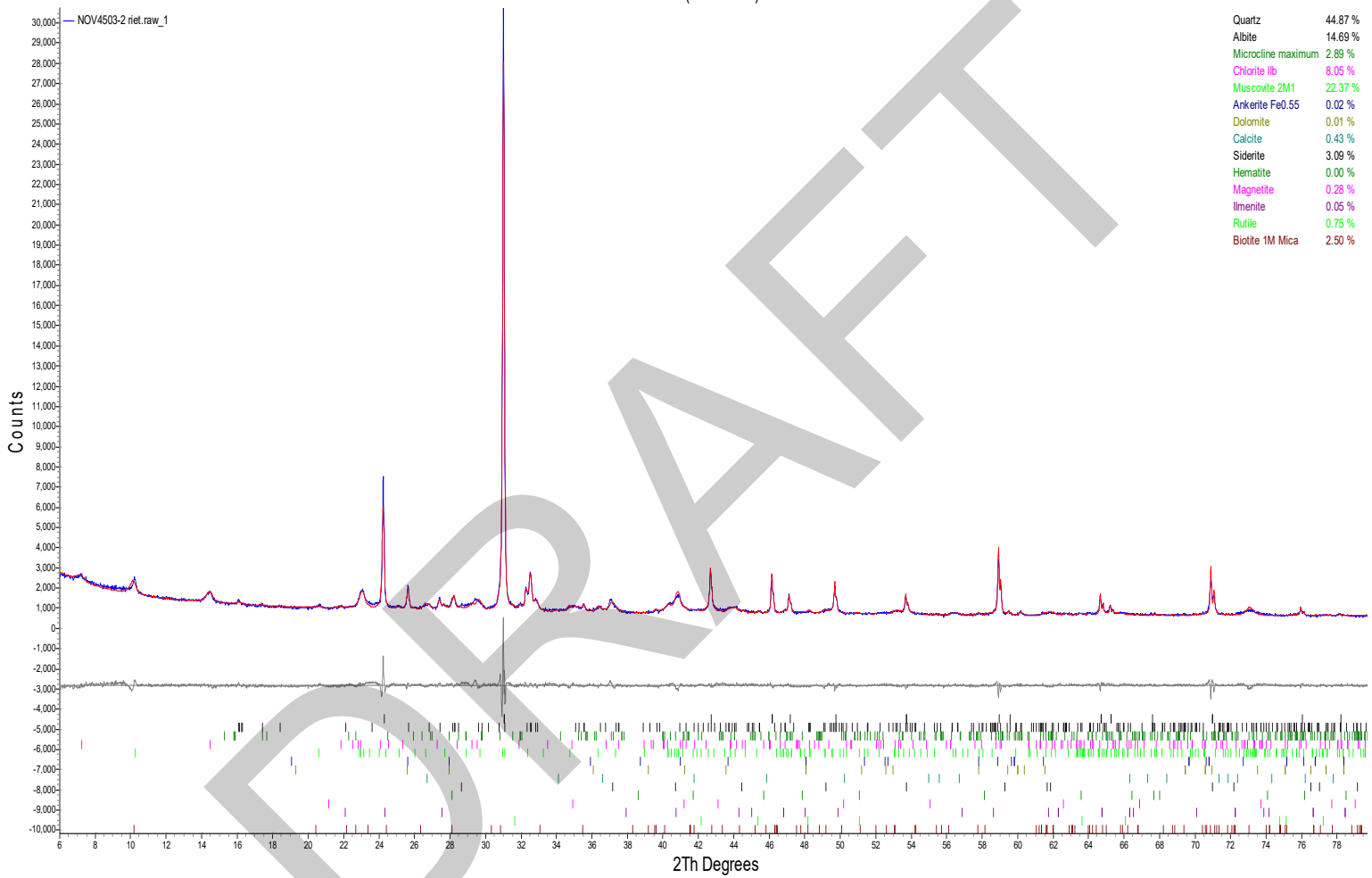
E-SB-07 (40.0-45.0)



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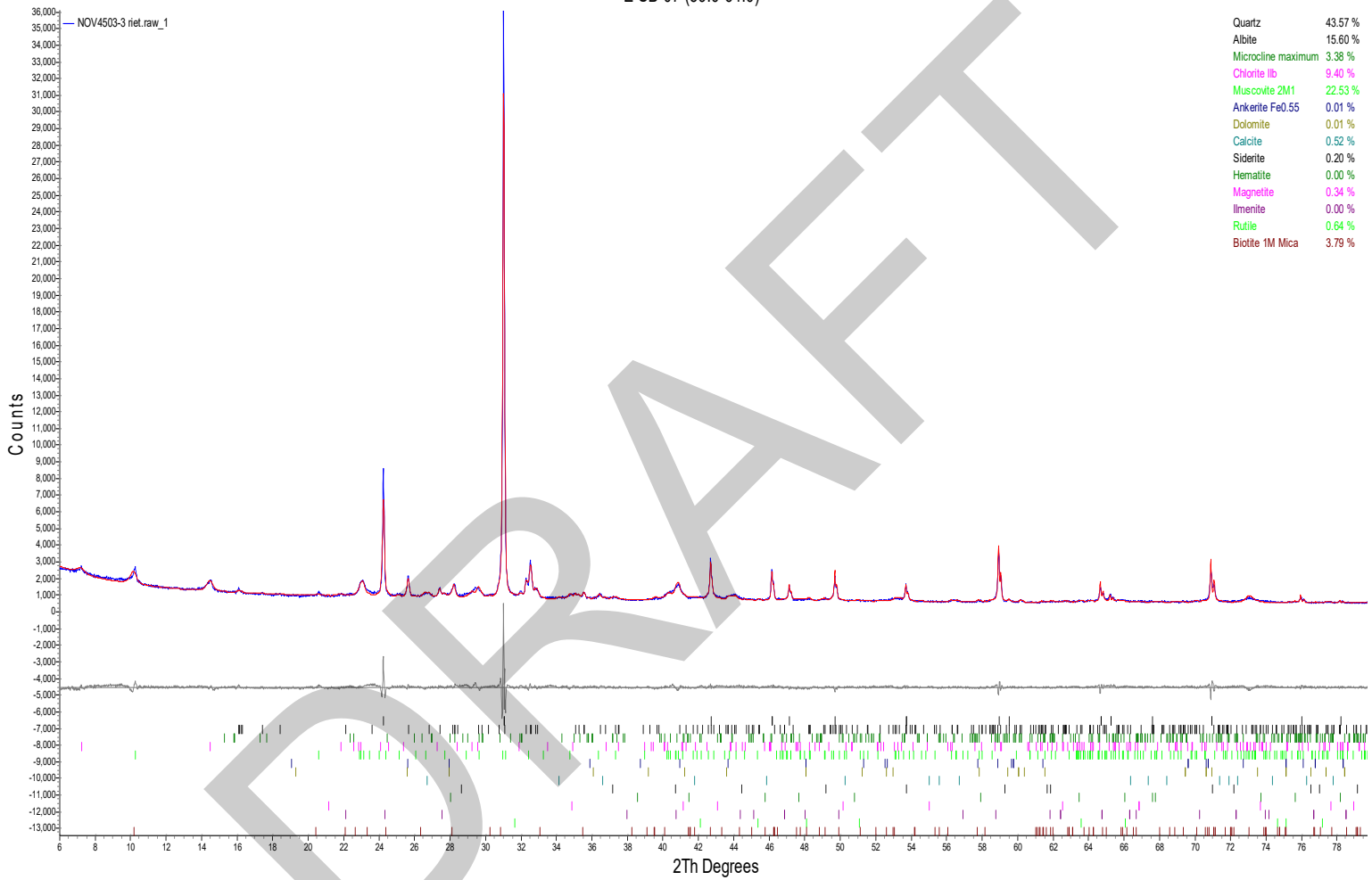
E-SB-07 (59.0-64.0)



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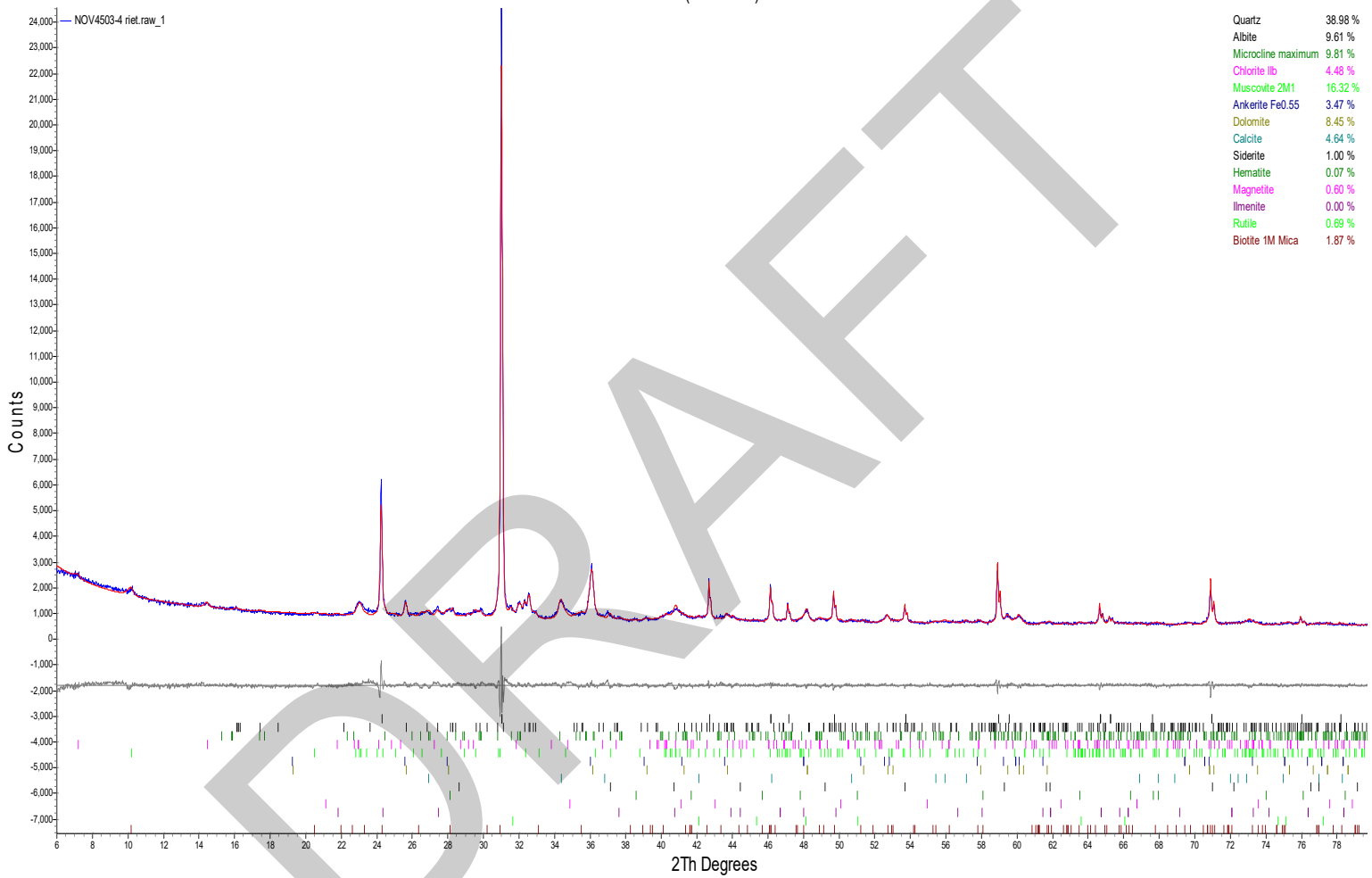
E-SB-05 (30.0-33.5)



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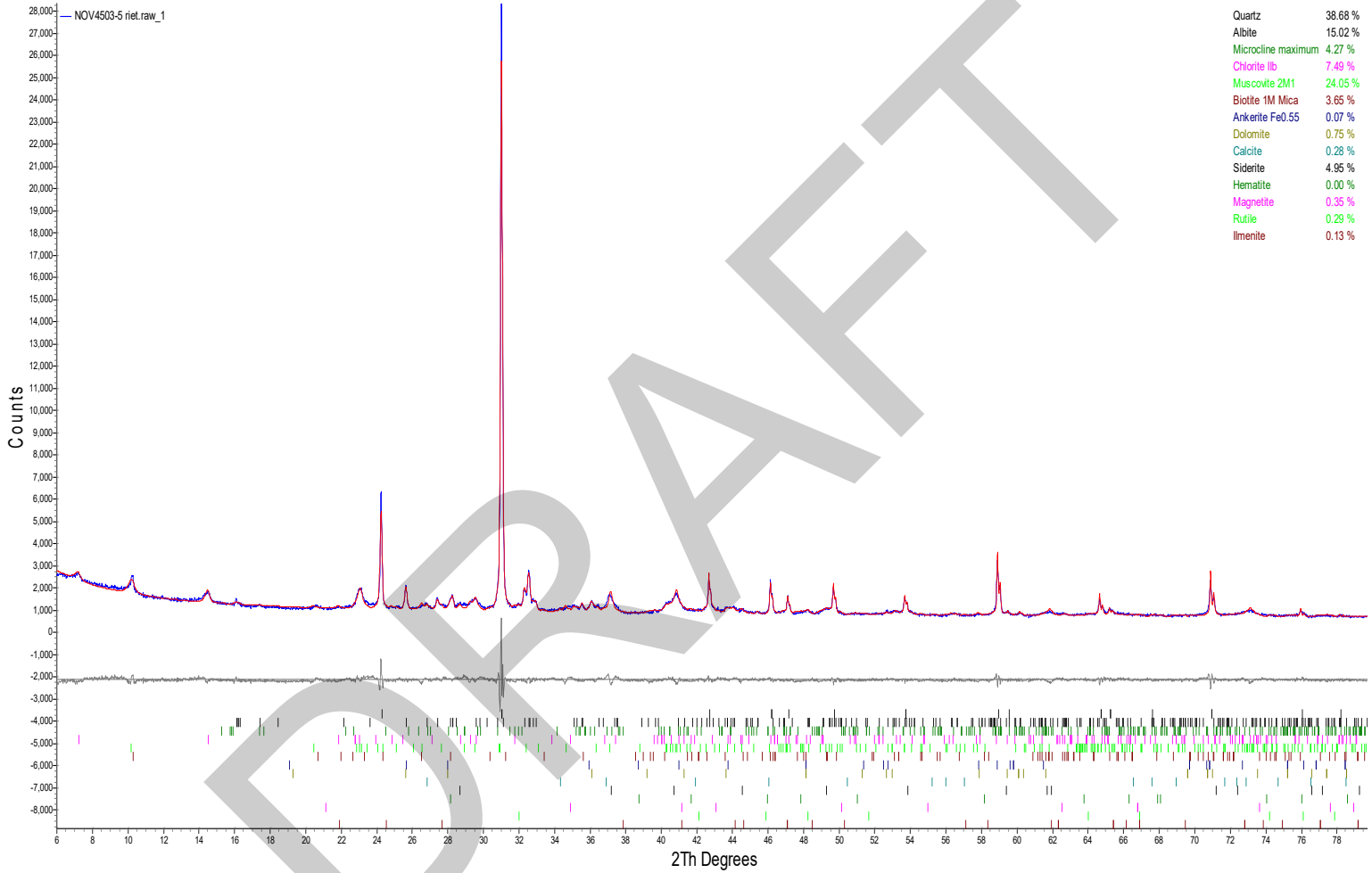
E-SB-05 (51.0-56.0)



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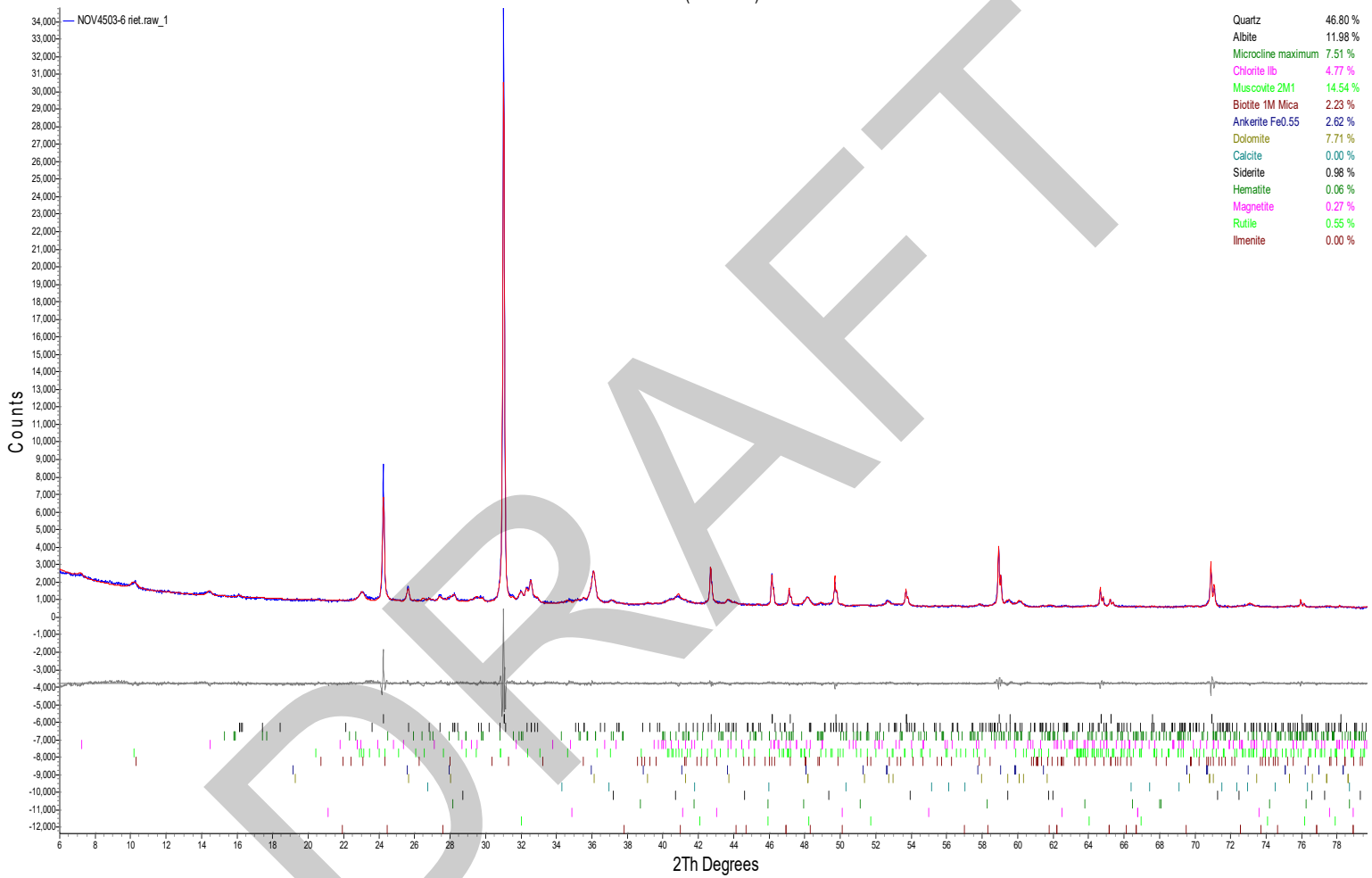
E-SB-19 (35.0-40.0)



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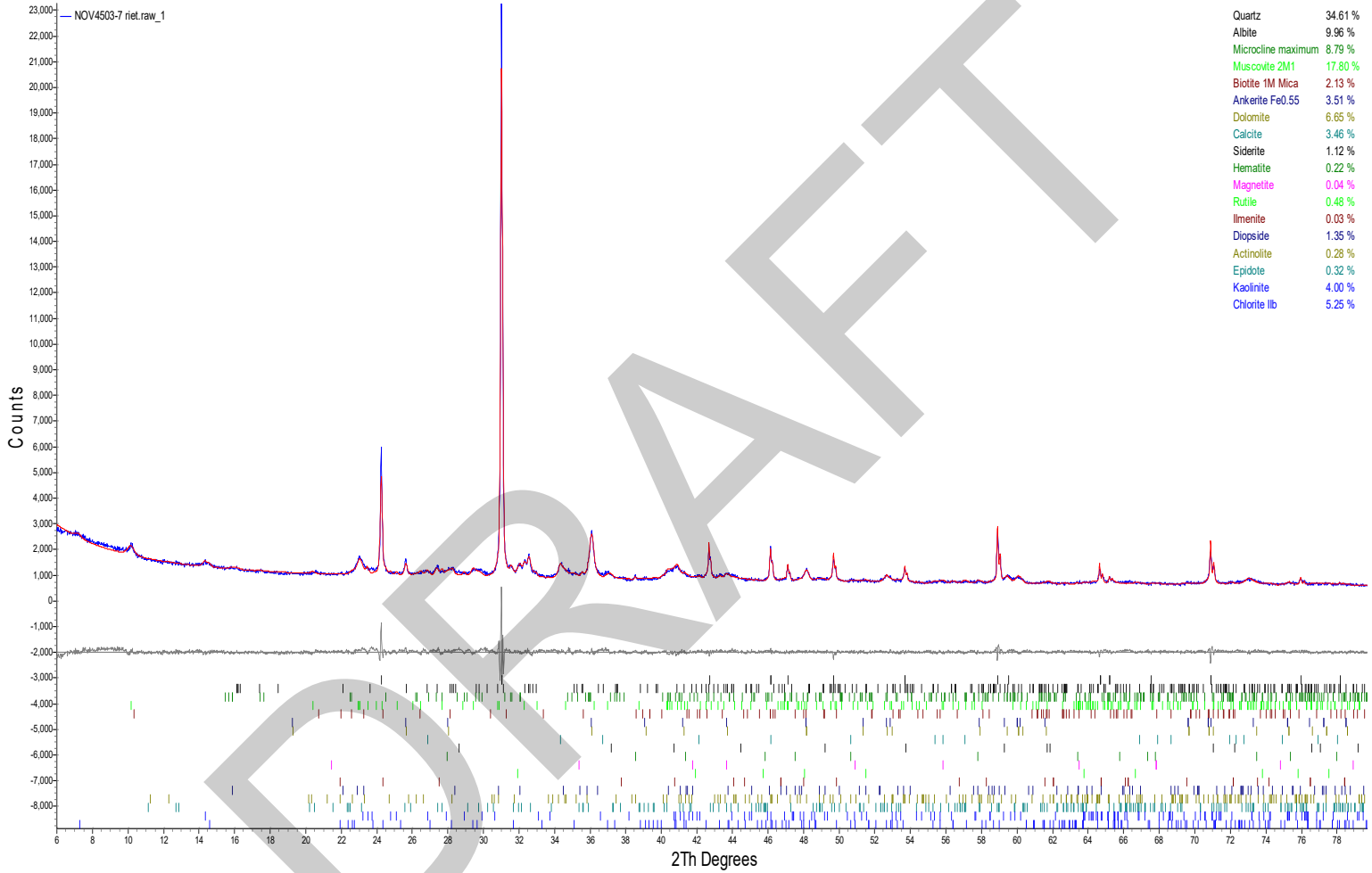
E-SB-18 (40.0-44.0)



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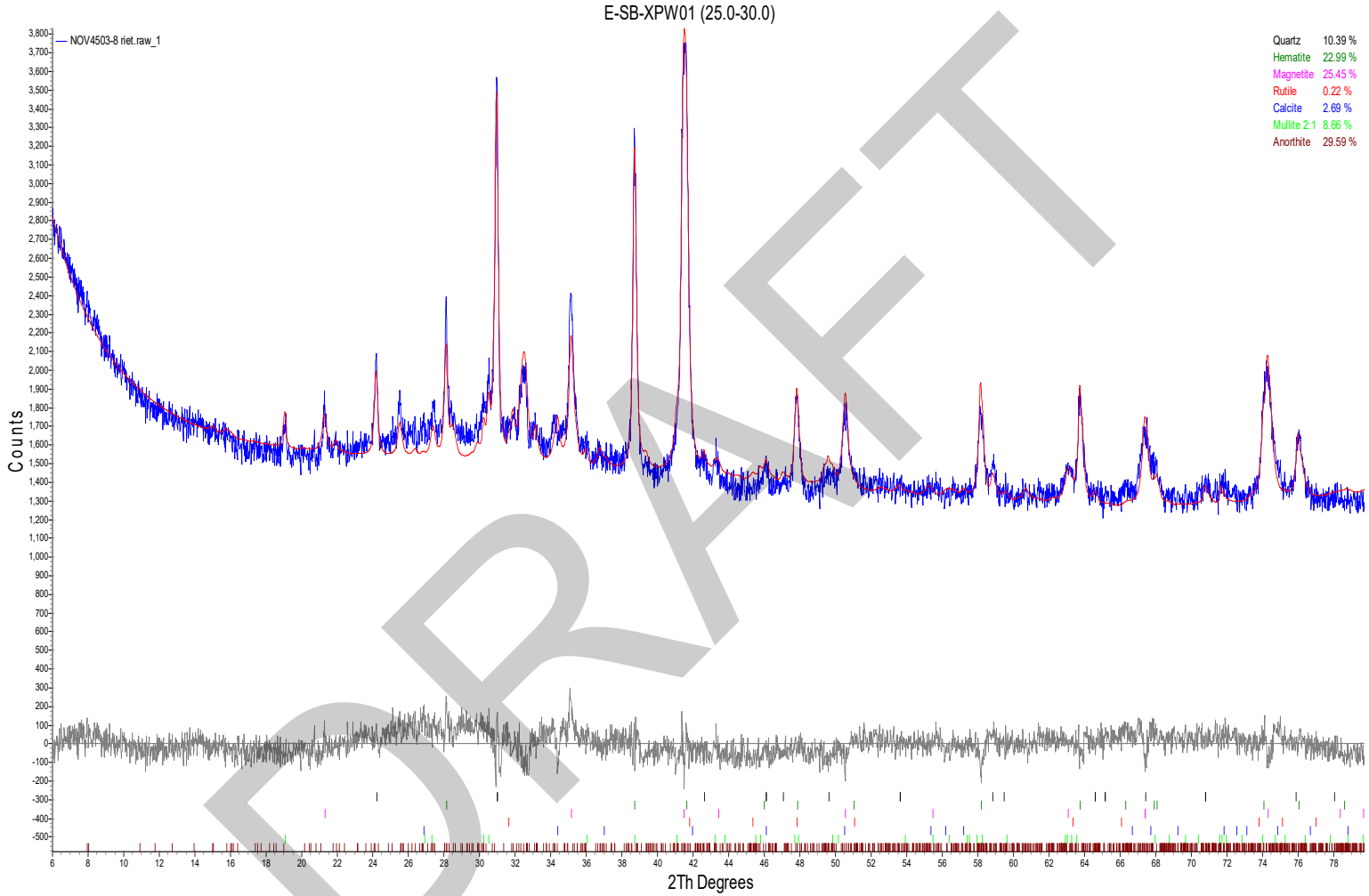
E-SB-XPW01 (25.0-30.0)
NOV4503-8 riet.raw_1
Quartz 10.39 %
Hematite 22.99 %
Magnetite 25.45 %
Rutile 0.22 %
Calcite 2.69 %
Mullite 2:1 8.66 %
Anorthite 29.59 %
Counts
2Th Degrees

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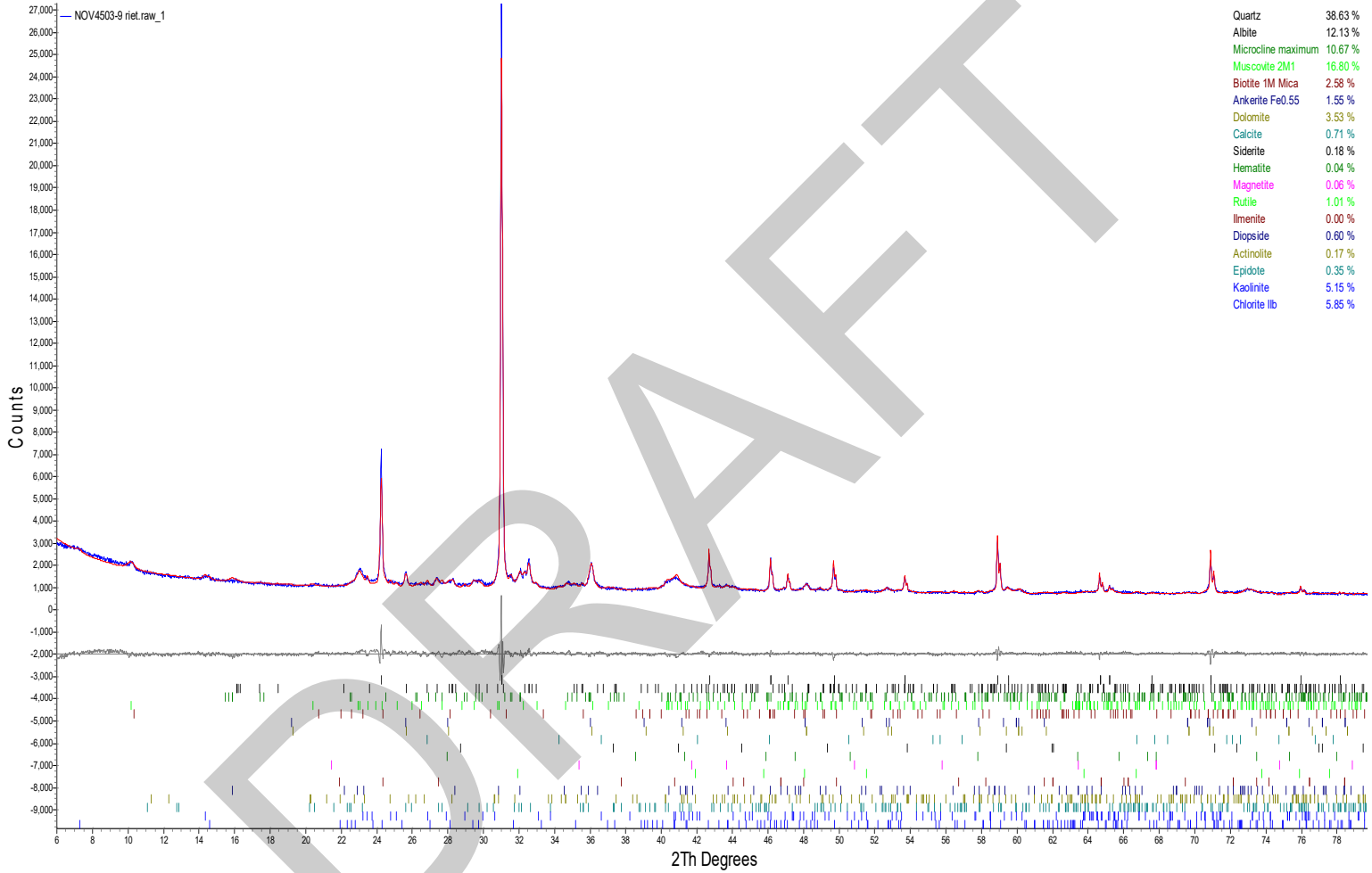
E-SB-15 (10.0-15.0)



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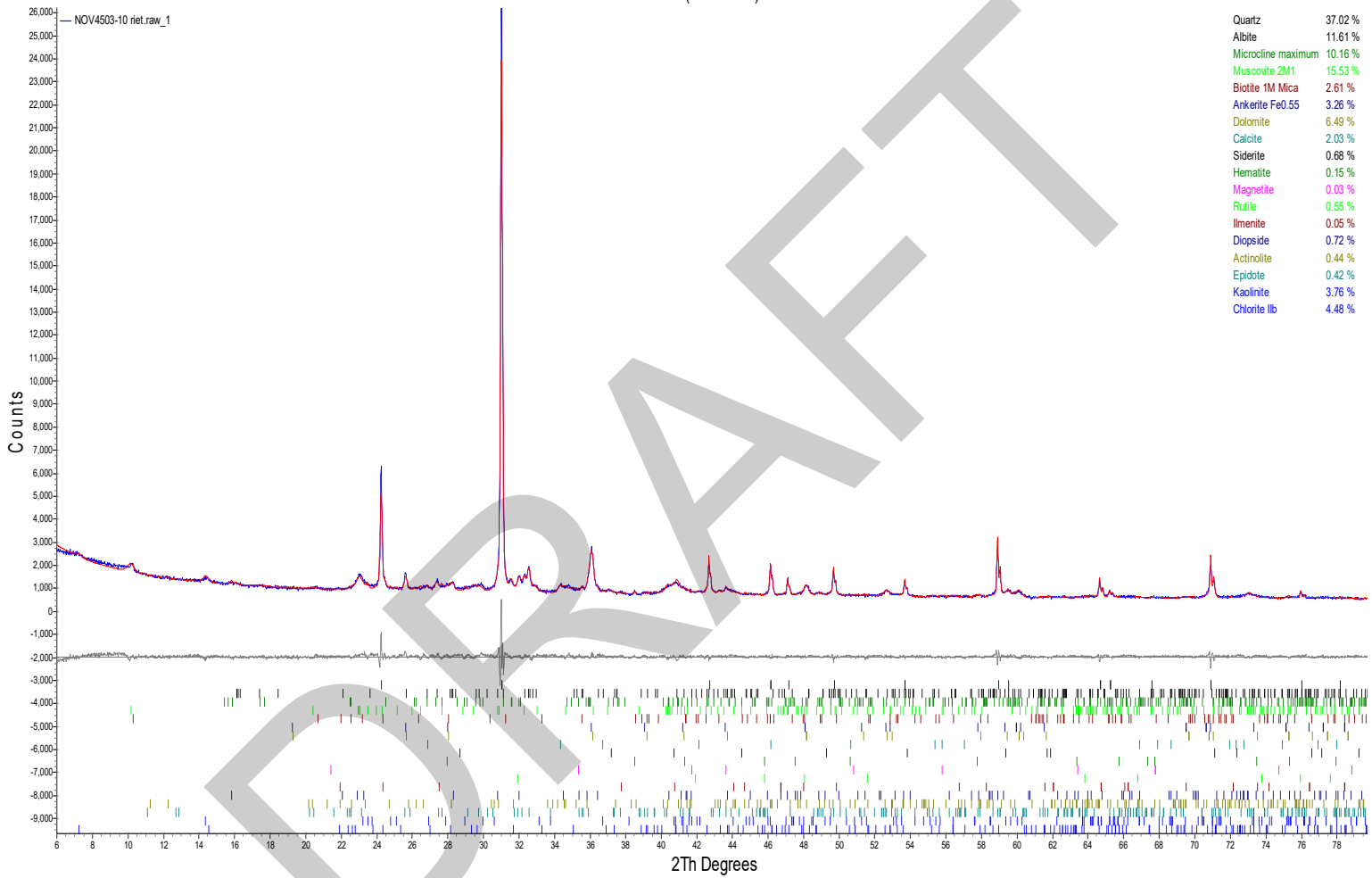
E-SB-15 (30.0-35.0)



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SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Project : Edwards MNA

02-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. : 07 October 2021
LR Report: **CA14145-OCT21**
Reference: P.O# 800003210A

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

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Analysis	1: Analysis Start Date	3: Analysis Completed Date	5: E-SB-07 (21.0-27.0)	6: E-SB-07 (40.0-45.0)	7: E-SB-07 (59.0-64.0)	8: E-SB-05 (30.0-33.5)	9: E-SB-05 (51.0-56.0)
Sample Date & Time			06-Oct-21 10:00	06-Oct-21 10:15	06-Oct-21 10:30	06-Oct-21 10:45	06-Oct-21 11:00
SiO2 [%]	26-Oct-21	27-Oct-21	73.2	64.5	67.2	53.8	58.8
Al2O3 [%]	26-Oct-21	27-Oct-21	7.23	15.1	15.3	10.8	14.9
Fe2O3 [%]	26-Oct-21	27-Oct-21	2.85	6.16	4.21	4.79	7.34
MgO [%]	26-Oct-21	27-Oct-21	2.07	1.95	1.70	3.44	2.61
CaO [%]	26-Oct-21	27-Oct-21	3.41	0.55	0.28	6.85	1.73
Na2O [%]	26-Oct-21	27-Oct-21	0.87	1.47	1.66	0.91	1.36
K2O [%]	26-Oct-21	27-Oct-21	1.91	2.61	2.65	2.35	2.70
TiO2 [%]	26-Oct-21	27-Oct-21	0.44	1.02	1.03	0.64	0.90
P2O5 [%]	26-Oct-21	27-Oct-21	0.08	0.13	0.14	0.17	0.16
MnO [%]	26-Oct-21	27-Oct-21	0.06	0.06	0.04	0.08	0.10
Cr2O3 [%]	26-Oct-21	27-Oct-21	< 0.01	0.02	< 0.01	< 0.01	0.01
V2O5 [%]	26-Oct-21	27-Oct-21	< 0.01	0.02	0.02	0.02	0.02
LOI [%]	26-Oct-21	27-Oct-21	6.78	6.17	4.58	15.5	8.80
Sum [%]	26-Oct-21	27-Oct-21	98.9	99.7	98.8	99.4	99.4

Analysis	10: E-SB-19 (35.0-40.0)	11: E-SB-18 (40.0-44.0)	12: E-SB-XPW01 (25.0-30.0)	13: E-SB-15 (10.0-15.0)	14: E-SB-15 (30.0-35.0)
Sample Date & Time	06-Oct-21 11:15	06-Oct-21 11:30	06-Oct-21 11:45	06-Oct-21 12:00	06-Oct-21 12:15
SiO2 [%]	60.9	46.9	37.6	59.7	56.0
Al2O3 [%]	10.6	10.2	13.9	14.3	11.7
Fe2O3 [%]	4.69	6.42	25.9	6.54	4.31
MgO [%]	3.85	4.11	0.76	2.24	3.14
CaO [%]	4.78	8.95	8.26	2.31	4.64
Na2O [%]	1.10	0.74	0.35	0.77	0.95
K2O [%]	2.16	1.97	1.32	2.85	2.53
TiO2 [%]	0.68	0.56	0.80	0.78	0.71
P2O5 [%]	0.12	0.14	0.07	0.31	0.14

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00026978

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SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Project : Edwards MNA

LR Report : **CA14145-OCT21**

Analysis	10: E-SB-19 (35.0-40.0)	11: E-SB-18 (40.0-44.0)	12: E-SB-XPW01 (25.0-30.0)	13: E-SB-15 (10.0-15.0)	14: E-SB-15 (30.0-35.0)
MnO [%]	0.08	0.10	0.09	0.04	0.08
Cr2O3 [%]	< 0.01	< 0.01	0.02	0.01	0.01
V2O5 [%]	0.01	0.01	0.04	0.02	0.02
LOI [%]	10.5	19.3	10.2	11.0	15.3
Sum [%]	99.5	99.4	99.3	100.9	99.5

DRAFT

Catharine Arnold

CHARTERED CATHARINE ARNOLD CHEMIST

Catharine Arnold, B.Sc., C.Chem
Project Specialist,
Environment, Health & Safety

OnLine LIMS

0002697897

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APPENDIX D

Cation Exchange Capacity Analysis

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Analysis Report
GS21-05061

F402001 SGS LAKEFIELD RESEARCH
PO BOX 4300
185 CONCESSION STREET
LAKEFIELD, ONTARIO ON K0L 2H0
CANADA

Received : 04-Nov-2021
Completed : 11-Nov-2021
Order Reference : Lisa/Catharine - ESB07...ESB15

Laboratory ID:	GS21-05061.001	GS21-05061.002	GS21-05061.003	GS21-05061.004
Client Sample #:	E-SB-07(21.0-27.0)	E-SB-07(40.0-45.0)	E-SB-07(59.0-64.0)	E-SB-05(30.0-33.5)
Description:	CA14146-OCT21			
CEC Actual (meq/100g)	25.70	12.16	11.18	30.59

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NOTE:
The analysis report above refers to the time and place of testing, and strictly to the supplied sample(s) only, without reference to any other matter. This report does not evidence or refer to any consignment or shipment or/and SGS sampling and inspection.

Report File Reference Number: 0000198573

Signed and dated in Guelph, ON
On 11-Nov-2021

For and on behalf of SGS Canada Inc., Agriculture and Food

Jack Legg, CCA-ON, 4R NMS
Branch Manager, Agronomist

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Analysis Report
GS21-05061

F402001 SGS LAKEFIELD RESEARCH
PO BOX 4300
185 CONCESSION STREET
LAKEFIELD, ONTARIO ON K0L 2H0
CANADA

Received : 04-Nov-2021
Completed : 11-Nov-2021
Order Reference : Lisa/Catharine - ESB07...ESB15

Laboratory ID:	GS21-05061.005	GS21-05061.006	GS21-05061.007	GS21-05061.008
Client Sample #:	E-SB-05(51.0-56.0)	E-SB-19(35.0-40.0)	E-SB-18(40.0-44.0)	E-SB-XPW01(25.0-30.0)
Description:				
CEC Actual (meq/100g)	19.28	20.95	36.47	86.50

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NOTE:
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Report File Reference Number: 0000198573

Signed and dated in Guelph, ON
On 11-Nov-2021

For and on behalf of SGS Canada Inc., Agriculture and Food

Jack Legg, CCA-ON, 4R NMS
Branch Manager, Agronomist

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Analysis Report
GS21-05061

F402001 SGS LAKEFIELD RESEARCH
PO BOX 4300
185 CONCESSION STREET
LAKEFIELD, ONTARIO ON K0L 2H0
CANADA

Received : 04-Nov-2021
Completed : 11-Nov-2021
Order Reference : Lisa/Catharine - ESB07...ESB15

Laboratory ID:	GS21-05061.009	GS21-05061.010
Client Sample #:	E-SB-15(10.0-15.0)	E-SB-15(30.0-35.0)
Description:		
CEC Actual (meq/100g)	25.73	20.83

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Report File Reference Number: 0000198573

Signed and dated in Guelph, ON
On 11-Nov-2021

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Jack Legg, CCA-ON, 4R NMS
Branch Manager, Agronomist

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APPENDIX E

SGS Soil Analysis

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Project : Edwards MNA

11-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. : 07 October 2021
LR Report: **CA14143-OCT21**
Reference: P.O# 800003210A

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Completed Date	4: Analysis Completed Time	5: E-SB-07 (21.0-27.0)	6: E-SB-07 (40.0-45.0)
Sample Date & Time					06-Oct-21 10:00	06-Oct-21 10:15
SO4 [%]	02-Nov-21	20:59	04-Nov-21	17:00	< 0.1	< 0.1
B [g/t]	11-Nov-21	10:26	11-Nov-21	10:26	< 40	47
TOC [%]	18-Oct-21	08:11	18-Oct-21	10:55	0.366	0.626
Ag [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	< 0.5	< 0.5
Al [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	36000	67000
As [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	5.0	2.5
Ba [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	390	480
Be [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	0.95	2
Bi [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	0.13	0.24
Ca [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	24000	3800
Cd [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	0.22	0.04
Co [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	9	17
Cr [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	20	25
Cu [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	11	22
Fe [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	22000	45000
K [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	16000	20000
Li [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	18	46
Mg [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	13000	11000
Mn [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	490	510
Mo [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	0.5	0.2
Na [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	6200	10000
Ni [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	19	40
P [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	340	550
Pb [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	16	14
Sb [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	< 0.8	< 0.8
Se [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	< 0.7	< 0.7
Sn [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	< 6	< 6

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OnLine LIMS

0002709869

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SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Project : Edwards MNA

LR Report : **CA14143-OCT21**

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Completed Date	4: Analysis Completed Time	5: E-SB-07 (21.0-27.0)	6: E-SB-07 (40.0-45.0)
Sr [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	110	92
Ti [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	2000	3600
Tl [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	0.44	0.53
U [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	1.61	2.32
V [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	48	100
Y [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	13.2	17.2
Zn [µg/g]	20-Oct-21	17:57	22-Oct-21	11:22	43	76

Analysis	7: E-SB-07 (59.0-64.0)	8: E-SB-05 (30.0-33.5)	9: E-SB-05 (51.0-56.0)	10: E-SB-19 (35.0-40.0)	11: E-SB-18 (40.0-44.0)
Sample Date & Time	06-Oct-21 10:30	06-Oct-21 10:45	06-Oct-21 11:00	06-Oct-21 11:15	06-Oct-21 11:30
SO4 [%]	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
B [g/t]	49	< 40	51	< 40	< 40
TOC [%]	0.154	2.42	1.12	0.528	2.60
Ag [µg/g]	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Al [µg/g]	70000	52000	72000	52000	50000
As [µg/g]	3.5	9.3	11	6.4	12
Ba [µg/g]	450	500	460	410	720
Be [µg/g]	2	1	2	1	2
Bi [µg/g]	0.28	0.24	0.30	0.24	0.24
Ca [µg/g]	2200	47000	12000	34000	62000
Cd [µg/g]	0.02	0.46	0.24	0.28	0.59
Co [µg/g]	17	13	20	13	14
Cr [µg/g]	23	31	42	50	63
Cu [µg/g]	25	21	25	33	22
Fe [µg/g]	31000	35000	55000	35000	48000
K [µg/g]	21000	19000	22000	18000	17000
Li [µg/g]	48	34	48	30	33
Mg [µg/g]	10000	20000	16000	24000	24000
Mn [µg/g]	340	680	870	600	850
Mo [µg/g]	0.1	1.2	0.6	1.0	1.7
Na [µg/g]	12000	6300	10000	8000	5100
Ni [µg/g]	41	32	43	31	32
P [µg/g]	610	680	710	500	580
Pb [µg/g]	16	19	18	16	19
Sb [µg/g]	< 0.8	< 0.8	0.9	< 0.8	< 0.8
Se [µg/g]	< 0.7	0.7	< 0.7	0.8	0.8
Sn [µg/g]	< 6	< 6	< 6	< 6	< 6
Sr [µg/g]	110	130	110	110	120
Ti [µg/g]	3700	2500	3300	2900	2400

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00027068

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SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Project : Edwards MNA

LR Report : **CA14143-OCT21**

Analysis	7: E-SB-07 (59.0-64.0)	8: E-SB-05 (30.0-33.5)	9: E-SB-05 (51.0-56.0)	10: E-SB-19 (35.0-40.0)	11: E-SB-18 (40.0-44.0)
Tl [µg/g]	0.53	0.61	0.56	0.51	0.54
U [µg/g]	2.28	2.48	2.61	2.13	2.46
V [µg/g]	100	86	110	84	82
Y [µg/g]	17.9	18.2	21.3	18.6	18.2
Zn [µg/g]	77	84	89	68	86

Analysis	12: E-SB-XPW01 (25.0-30.0)	13: E-SB-15 (10.0-15.0)	14: E-SB-15 (30.0-35.0)
Sample Date & Time	06-Oct-21 11:45	06-Oct-21 12:00	06-Oct-21 12:15
SO4 [%]	0.7	< 0.1	< 0.1
B [g/t]	896	54	43
TOC [%]	3.62	1.10	1.64
Ag [µg/g]	0.6	< 0.5	< 0.5
Al [µg/g]	71000	68000	57000
As [µg/g]	50	5.6	13
Ba [µg/g]	450	540	550
Be [µg/g]	21	2	2
Bi [µg/g]	0.44	0.36	0.32
Ca [µg/g]	59000	16000	33000
Cd [µg/g]	17	0.45	0.51
Co [µg/g]	37	17	15
Cr [µg/g]	170	35	36
Cu [µg/g]	78	26	26
Fe [µg/g]	200000	49000	32000
K [µg/g]	11000	22000	21000
Li [µg/g]	55	45	37
Mg [µg/g]	4800	14000	19000
Mn [µg/g]	810	340	630
Mo [µg/g]	12	1.0	1.2
Na [µg/g]	2600	5600	6900
Ni [µg/g]	130	40	36
P [µg/g]	280	1300	620
Pb [µg/g]	350	24	21
Sb [µg/g]	8.0	< 0.8	< 0.8
Se [µg/g]	3.0	1.2	0.8
Sn [µg/g]	< 6	< 6	< 6
Sr [µg/g]	170	110	130
Ti [µg/g]	4600	3600	3400
Tl [µg/g]	3	0.83	0.66
U [µg/g]	10.4	2.87	2.67

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OnLine LIMS

00027068

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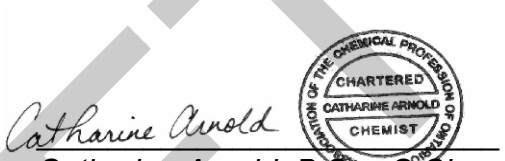
Test method information available upon request. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples. SGS Canada Inc. Environment-Health & Safety statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Project : Edwards MNA

LR Report : **CA14143-OCT21**

Analysis	12: E-SB-XPW01 (25.0-30.0)	13: E-SB-15 (10.0-15.0)	14: E-SB-15 (30.0-35.0)
V [µg/g]	200	99	87
Y [µg/g]	40.4	22.6	20.5
Zn [µg/g]	1700	120	90



Catharine Arnold, B.Sc., C.Chem
Project Specialist,
Environment, Health & Safety

DRAFT

OnLine LIMS

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Test method information available upon request. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples. SGS Canada Inc. Environment-Health & Safety statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

00027068869

DRAFT

APPENDIX F

Borehole Survey

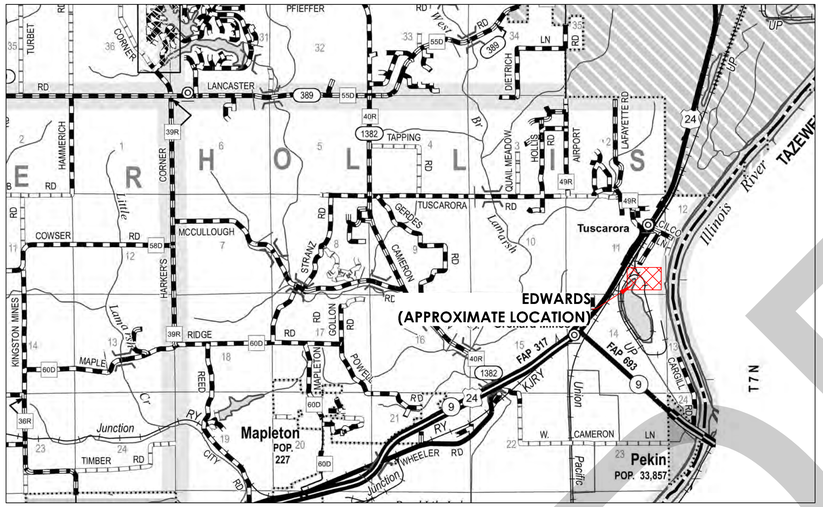
Luminant

ILLINOIS POWER RESOURCES GENERATING, LLC.
EDWARDS POWER STATION
DECEMBER 2020 TOPOGRAPHY

BARTONVILLE, ILLINOIS

ADDRESS
7800 S. CILCO LN.
BARTONVILLE, ILLINOIS 61607

VISTRA ENERGY



PROJECT LOCATION MAP
N.T.S.



VICINITY MAP
N.T.S.

LIST OF DRAWINGS

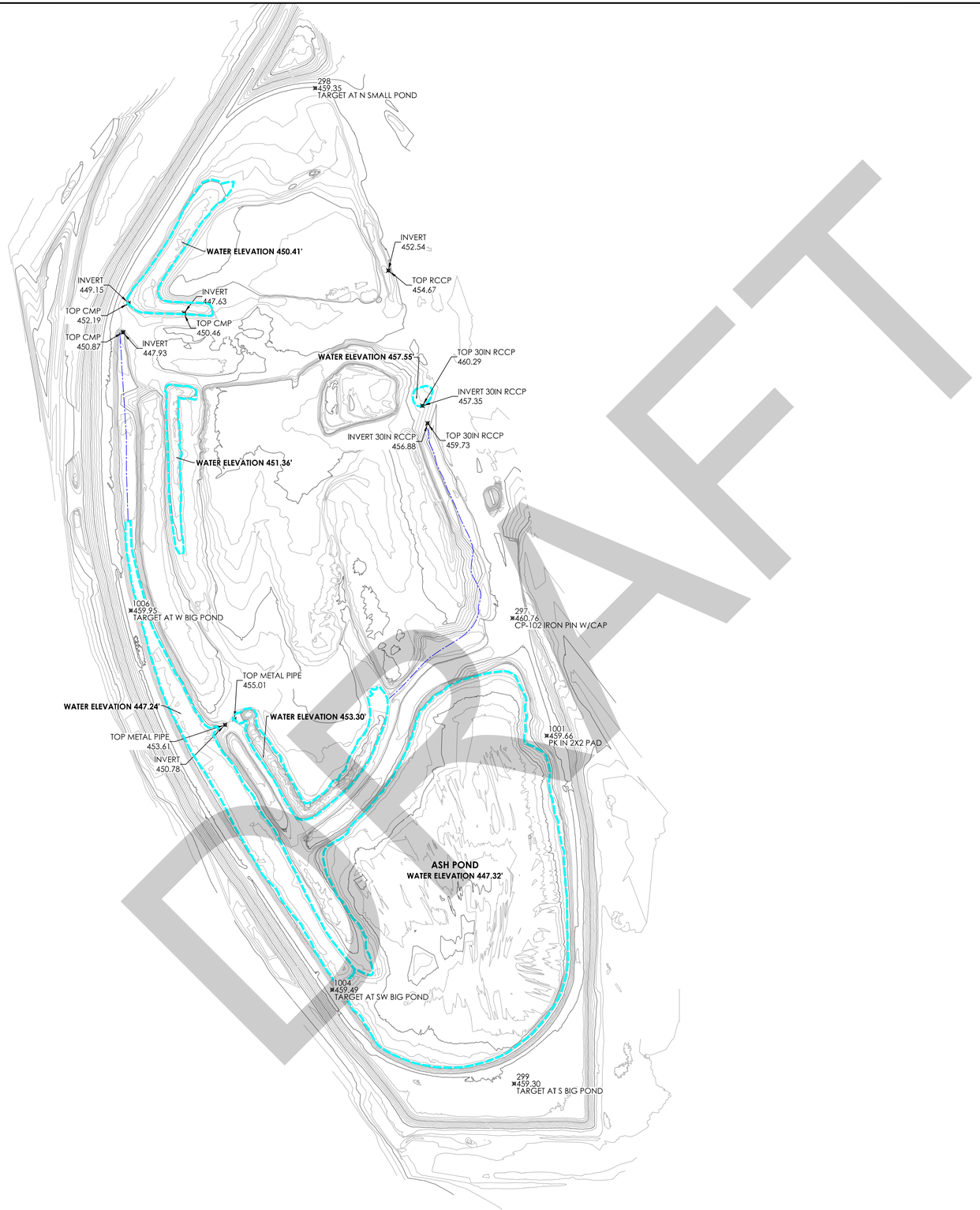
1 - COVER SHEET
2 - EXISTING TOPOGRAPHY EAST ASH POND
3 - AERIAL PHOTOGRAPHY EAST ASH POND

DRAFT

PREPARED BY:

IngenAE

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



DRAFT

0' 200' 400'

LEGEND

- EXISTING CONTOUR (2' INTERVAL)
- EXISTING CONTOUR (10' INTERVAL)
- LIMITS OF BATHYMETRIC SURVEY
- APPROXIMATE CREEK CENTERLINE

NOTES:

1. THIS EXHIBIT REPRESENTS A TOPOGRAPHIC FIELD SURVEY AND IS NOT INTENDED TO BE A BOUNDARY SURVEY.
2. EXISTING CONTOURS SHOWN ARE FROM AERIAL DRONE SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 12/01/2020 AND TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/9/2020.
3. NO UNDERGROUND OR OVERHEAD UTILITIES WERE LOCATED DURING THIS SURVEY.
4. THE ACCUMULATED DATA FROM AERIAL DRONE SURVEY, GROUND TRUTHING FIELD DATA COLLECTION SURVEYS AND TOPOGRAPHIC/BATHYMETRIC SURVEYS USED TO PRODUCE THE TOPOGRAPHIC DRAWING AS SHOWN HEREON IS BASED ON ILLINOIS STATE PLANE COORDINATE-ZONE WEST NAD 1983 AND NAVD 88 ELEVATION DATUM.

AERIAL TARGET POINT TABLE

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
297	1430025.4	2435960.5	460.77	CP-102 IRON PIN W/CAP
298	1431902.5	2435261.5	459.35	TARGET AT N SMALL POND
299	1428376.4	2435966.1	459.30	TARGET AT S BIG POND
1001	1429609.0	2436081.7	459.66	PK IN 2X2 PAD
1004	1428709.0	2435321.7	459.49	TARGET AT SW BIG POND
1006	1430052.4	2434608.2	459.95	TARGET AT W BIG POND

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

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

Luminant

Project Name & Location:

EDWARDS
POWER STATION

7800 S. CILCO LN.
BARTONVILLE, IL 61607

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Drawing Name:

EXISTING TOPOGRAPHY ASH POND 1

Date: 9/28/2021	Project No.
Type: SITE	Drawing No. 2
Drawn By: CB	
Approved By: BH	
Scale: AS NOTED	



EMW-02

EMW-03

AW-12

N

0' 200' 400'

LEGEND

- LIMITS OF BATHYMETRIC SURVEY
- WELL NAME
- BORING NAME

NOTES:

1. EXISTING AERIAL SHOWN ARE FROM AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 12-01-2020.
2. THE WELL LOCATIONS AND ELEVATIONS, BORING LOCATIONS AND BENCHMARK DATA WAS RETRIEVED IN A SUBSEQUENT SURVEY DONE BY INGENAE DATED FEBRUARY 10, 2021.

BORING LOCATION POINT TABLE

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
3515	1428434.09	2435420.64	439.08	E-SB-15
3516	1430269.65	2434564.52	459.99	E-SB-18
3517	1431150.52	2434576.77	458.41	E-SB-19
3520	1431467.42	2435243.55	460.83	E-SB-XPW01
3525	1432098.87	2435352.83	458.40	E-SB-07
3528	1432419.27	2436748.91	440.98	E-SB-05

SURVEY PERFORMED BY INGENAE SEPT. 23, 2021

WELL LOCATION POINT TABLE

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
3494	1430685.26	2435889.03	464.43	AW-01 TOP PVC WELL
			462.29	AW-01 GROUND
			464.78	AW-01 TOP METAL CASING
4005	1431872.71	2436663.77	458.10	EMW-02 TOP PVC WELL
			455.40	EMW-02 GROUND
			458.38	EMW-02 TOP METAL CASING
4002	1431630.17	2436732.63	461.51	EMW-03 TOP PVC WELL
			458.95	EMW-03 GROUND
			461.97	EMW-03 TOP METAL CASING
3500	1432463.94	2435244.94	456.75	EMW-04 TOP PVC WELL
			454.51	EMW-04 GROUND
			457.29	EMW-04 TOP METAL CASING
3502	1432325.51	2435264.90	457.94	EMW-05 TOP PVC WELL
			455.78	EMW-05 GROUND
			458.40	EMW-05 TOP METAL CASING

SURVEY PERFORMED BY INGENAE ON SEPT. 23, 2021

WELL LOCATION POINT TABLE

POINT #	LATITUDE	LONGITUDE	DESCRIPTION
3494	40° 35' 38.75338"	89° 39' 54.11930"	AW-01
4005	40° 35' 50.44422"	89° 39' 43.98889"	EMW-02
4002	40° 35' 48.04334"	89° 39' 43.11351"	EMW-03
3500	40° 35' 56.36532"	89° 40' 02.33824"	EMW-04
3502	40° 35' 54.99767"	89° 40' 02.08969"	EMW-05

SURVEY PERFORMED BY INGENAE ON SEPT. 23, 2021

AERIAL TARGET POINT TABLE

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
297	1430025.4	2435960.5	460.77	CP-102 IRON PIN W/CAP
298	1431902.5	2435261.5	459.35	TARGET AT N SMALL POND
299	1428376.4	2435966.1	459.30	TARGET AT S BIG POND
1001	1429609.0	2436081.7	459.66	PK IN 2X2 PAD
1004	1428709.0	2435321.7	459.49	TARGET AT SW BIG POND
1006	1430052.4	2434608.2	459.95	TARGET AT W BIG POND

WELL LOCATION POINT TABLE

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
1018	1429585.5	2436922.9	441.16	AW-12 GROUND
1016	1429585.5	2436922.9	444.31	AW-12 TOP METAL CASING
1017	1429585.5	2436922.9	443.80	AW-12 TOP PVC WELL
1001	1428600.7	2436267.2	438.67	AW-13 GROUND
1002	1428600.7	2436267.2	441.67	AW-13 TOP METAL CASING
1003	1428600.7	2436267.2	441.26	AW-13 TOP PVC WELL
1004	1428201.1	2435739.9	436.83	AW-14 GROUND
1005	1428201.1	2435739.9	439.99	AW-14 TOP METAL CASING
1006	1428201.1	2435739.9	439.40	AW-14 TOP PVC WELL
1012	1428445.0	2435405.1	438.95	AW-15 GROUND
1011	1428445.0	2435405.1	442.02	AW-15 TOP METAL CASING
1010	1428445.0	2435405.1	441.51	AW-15 TOP PVC WELL
1015	1428458.1	2435388.2	437.62	AW-15C GROUND
1013	1428458.1	2435388.2	440.67	AW-15C TOP METAL CASING
1014	1428458.1	2435388.2	440.02	AW-15C TOP PVC WELL
1007	1428441.6	2435399.8	437.92	AW-15S GROUND
1008	1428441.6	2435399.8	441.29	AW-15S TOP METAL CASING
1009	1428441.6	2435399.8	440.71	AW-15S TOP PVC WELL
1021	1428987.3	2435130.5	459.45	AW-16 GROUND
1019	1428987.3	2435130.5	462.46	AW-16 TOP METAL CASING
1020	1428987.3	2435130.5	461.79	AW-16 TOP PVC WELL
1024	1429801.1	2434680.2	459.69	AW-17 GROUND
1022	1429801.1	2434680.2	462.76	AW-17 TOP METAL CASING
1023	1429801.1	2434680.2	462.10	AW-17 TOP PVC WELL
1027	1430291.0	2434561.4	460.28	AW-18 GROUND
1025	1430291.0	2434561.4	463.32	AW-18 TOP METAL CASING
1026	1430291.0	2434561.4	462.65	AW-18 TOP PVC WELL
1030	1431161.8	2434584.7	458.53	AW-19 TOP GROUND
1028	1431161.8	2434584.7	461.14	AW-19 TOP TOP METAL CASING
1029	1431161.8	2434584.7	460.74	AW-19 TOP TOP PVC WELL
1033	1431540.0	2434807.4	459.08	AW-20 GROUND
1031	1431540.0	2434807.4	461.57	AW-20 TOP METAL CASING
1032	1431540.0	2434807.4	461.48	AW-20 TOP PVC WELL
1039	1431842.4	2435132.3	458.28	AW-21 GROUND
1037	1431842.4	2435132.3	460.84	AW-21 TOP METAL CASING
1038	1431842.4	2435132.3	460.61	AW-21 TOP PVC WELL
1048	1431677.1	2435397.4	460.30	AW-22 GROUND
1046	1431677.1	2435397.4	463.90	AW-22 TOP METAL CASING
1047	1431677.1	2435397.4	463.19	AW-22 TOP PVC WELL
1036	1431454.4	2434759.8	458.70	EDW-P002 GROUND
1034	1431454.4	2434759.8	461.11	EDW-P002 TOP METAL CASING
1035	1431454.4	2434759.8	460.39	EDW-P002 TOP PVC WELL
1051	1431483.3	2435242.4	460.99	XPW-01A GROUND
1049	1431483.3	2435242.4	464.42	XPW-01A TOP METAL CASING
1050	1431483.3	2435242.4	464.16	XPW-01A TOP PVC WELL
1042	1430769.4	2434978.0	471.16	XPW-02 GROUND
1040	1430769.4	2434978.0	474.46	XPW-02 TOP METAL CASING
1041	1430769.4	2434978.0	473.79	XPW-02 TOP PVC WELL
1045	1429703.7	2435574.0	462.62	XPW-03 GROUND
1043	1429703.7	2435574.0	466.56	XPW-03 TOP METAL CASING
1044	1429703.7	2435574.0	466.04	XPW-03 TOP PVC WELL

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12		
13		

Luminant

Project Name & Location:

EDWARDS
POWER STATION

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Drawing Name:

AERIAL PHOTOGRAPHY ASH POND 1

Date: 9/28/2021	Project No.
Type: SITE	Drawing No. 3
Drawn By: CB	
Approved By: BH	
Scale: AS NOTED	

DRAFT

APPENDIX G

Groundwater Sampling Results

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Env ICP-MS Metals Dissolved

Project : 800003210A

21-October-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. : 07 October 2021
LR Report: **CA14147-OCT21**
Reference: Edwards MNA

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: AP-05S	6: AW-15	7: AW-19
Sample Date & Time					06-Oct-21 13:00	06-Oct-21 13:15	06-Oct-21 13:00
Temp Upon Receipt [°C]	---	---	---	---	10.0	10.0	10.0
As (diss) [mg/L]	14-Oct-21	18:38	15-Oct-21	14:30	0.0005	0.0019	0.0017
B (diss) [mg/L]	14-Oct-21	18:38	15-Oct-21	14:30	0.364	0.570	2.64
Li (diss) [mg/L]	14-Oct-21	18:38	15-Oct-21	14:30	0.0324	0.0454	0.0106
TOC [mg/L]	08-Oct-21	18:36	14-Oct-21	12:12	20	22	3
Cl (diss) [mg/L]	16-Oct-21	00:38	18-Oct-21	09:44	48	52	88
SO4 (diss) [mg/L]	16-Oct-21	00:38	19-Oct-21	15:30	0.8	< 0.2	43

DRAFT

Catharine Arnold

CHARTERED CHEMICAL PROFESSION OF ONTARIO CATHARINE ARNOLD CHEMIST

Catharine Arnold, B.Sc., C.Chem
Project Specialist,
Environment, Health & Safety

OnLine LIMS

0002684943

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SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Project : 800003210A

05-November-2021

SiREM Laboratory
Attn : Michael Healey

130 Stone Road W, Guelph
Canada, N1G 3Z2
Phone: 519-822-2265, Fax:519-822-3151

Date Rec. : 04 November 2021
LR Report: **CA14100-NOV21**
Reference: Edwards MNA

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: AP-05S	6: AW-15	7: AW-19
Sample Date & Time							
Temp Upon Receipt [°C]	---	---	---	---	4.0	4.0	4.0
Ag (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	< 0.00005	< 0.00005	< 0.00005
Al (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.006	0.001	0.001
Ba (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.449	2.32	0.155
Be (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	< 0.000007	< 0.000007	< 0.000007
Bi (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	< 0.00001	0.00001	< 0.00001
Ca (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	103	111	121
Cd (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	< 0.000003	< 0.000003	0.000015
Co (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.00107	0.00115	0.000604
Cr (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.00082	0.00121	0.00103
Cu (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	< 0.0002	< 0.0002	0.0007
Fe (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.080	0.066	0.020
K (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	4.29	7.63	0.864
Mg (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	40.8	41.6	49.1
Mn (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.157	0.0391	0.361
Mo (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.00020	0.00043	0.00368
Na (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	189	245	53.0
Ni (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.0007	0.0005	0.0160
Pb (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	< 0.00009	< 0.00009	< 0.00009
Sb (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	< 0.0009	< 0.0009	< 0.0009
S (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	1	1	16
Se (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.00019	0.00024	0.00007
Sn (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	< 0.00006	< 0.00006	< 0.00006
Sr (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.571	0.937	0.237
Ti (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.00022	0.00021	0.00005
Tl (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	< 0.000005	< 0.000005	< 0.000005
U (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.000019	0.000082	0.000365

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OnLine LIMS

0002702134

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SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Project : 800003210A

LR Report : **CA14100-NOV21**

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Completed Date	4: Analysis Completed Time	5: AP-05S	6: AW-15	7: AW-19
V (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.00038	0.00127	0.00004
W (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.00006	0.00003	0.00002
Y (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	< 0.00002	< 0.00002	0.00003
Zn (diss) [mg/L]	14-Oct-21	18:38	04-Nov-21	17:10	0.004	0.002	0.010

Full dissolved metals scan for samples originally reproted as CA14147-OCT21. All metals included in this scan.

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Catharine Arnold, B.Sc., C.Chem
Project Specialist,
Environment, Health & Safety

OnLine LIMS

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APPENDIX H

Batch Testing Results

SIREM
ATTN: Michael Healey
130 Stone Road West
Guelph ON N1G 3Z2

Date Received: 21-JAN-22
Report Date: 25-JAN-22 15:02 (MT)
Version: FINAL

Client Phone: 519-822-2265

Certificate of Analysis

Lab Work Order #: L2680648

Project P.O. #: NOT SUBMITTED
Job Reference: EDWARDS MNA
C of C Numbers:
Legal Site Desc:

DRAFT

Gayle Braun
Senior Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2680648-1 AW-15S-1 Sampled By: J.L. on 21-JAN-22 @ 09:00 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.069	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	12.5	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.49	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	395	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-2 AW-15S-2 Sampled By: J.L. on 21-JAN-22 @ 09:15 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.074	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	12.5	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.48	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	392	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-3 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 2:1-1 Sampled By: J.L. on 21-JAN-22 @ 09:30 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.385	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	4.6	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.15	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	266	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-4 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 2:1-2 Sampled By: J.L. on 21-JAN-22 @ 09:45 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.319	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	4.4	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.12	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	274	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-5 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:1-1 Sampled By: J.L. on 21-JAN-22 @ 10:00 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.227	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	6.5	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.21	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	313	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-6 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:5-1 Sampled By: J.L. on 21-JAN-22 @ 10:30 Matrix:							

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* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2680648-6 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:5-1 Sampled By: J.L. on 21-JAN-22 @ 10:30 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.133	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	10.0	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.36	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	375	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-7 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:5-2 Sampled By: J.L. on 21-JAN-22 @ 10:45 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.121	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	10.3	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.36	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	370	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-8 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:10-1 Sampled By: J.L. on 21-JAN-22 @ 11:00 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.117	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	11.0	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.42	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	382	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-9 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:10-2 Sampled By: J.L. on 21-JAN-22 @ 11:15 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.110	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	11.5	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.43	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	375	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-10 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:20-1 Sampled By: J.L. on 21-JAN-22 @ 11:30 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.098	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	12.1	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.45	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	393	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-11 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:20-2 Sampled By: J.L. on 21-JAN-22 @ 11:45 Matrix:							

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* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2680648-11 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:20-2 Sampled By: J.L. on 21-JAN-22 @ 11:45 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.114	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	11.9	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.44	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	383	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-12 AW-19-1 Sampled By: J.L. on 21-JAN-22 @ 12:00 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.048	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	11.9	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.48	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	375	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-13 AW-19-2 Sampled By: J.L. on 21-JAN-22 @ 12:15 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.049	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	12.1	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.51	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	390	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-14 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 2:1-1 Sampled By: J.L. on 21-JAN-22 @ 12:30 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.268	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	4.3	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.11	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	270	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-15 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 2:1-2 Sampled By: J.L. on 21-JAN-22 @ 12:45 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.510	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	4.4	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.15	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	269	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-16 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:1-1 Sampled By: J.L. on 21-JAN-22 @ 13:00 Matrix:							

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* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2680648-16 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:1-1 Sampled By: J.L. on 21-JAN-22 @ 13:00 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.243	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	6.6	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.24	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	314	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-17 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:1-2 Sampled By: J.L. on 21-JAN-22 @ 13:15 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.321	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	6.3	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.22	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	308	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-18 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:5-1 Sampled By: J.L. on 21-JAN-22 @ 13:30 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.159	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	9.5	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.36	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	358	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-19 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:5-2 Sampled By: J.L. on 21-JAN-22 @ 13:45 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.191	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	9.7	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.38	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	360	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-20 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:10-1 Sampled By: J.L. on 21-JAN-22 @ 14:00 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.172	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	10.3	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.40	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	365	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-21 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:10-2 Sampled By: J.L. on 21-JAN-22 @ 14:15 Matrix:							

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* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2680648-21 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:10-2 Sampled By: J.L. on 21-JAN-22 @ 14:15 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704656
Barium (Ba)-Dissolved	0.144	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	11.3	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.45	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	389	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-22 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:20-1 Sampled By: J.L. on 21-JAN-22 @ 14:30 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704656
Barium (Ba)-Dissolved	0.112	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	11.9	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.46	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	381	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-23 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:20-2 Sampled By: J.L. on 21-JAN-22 @ 12:45 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704656
Barium (Ba)-Dissolved	0.155	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	11.5	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.47	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	387	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380

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* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2680648-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2680648-21, -22, -23
Matrix Spike	Boron (B)-Dissolved	MS-B	L2680648-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Boron (B)-Dissolved	MS-B	L2680648-21, -22, -23
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L2680648-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L2680648-21, -22, -23
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2680648-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2680648-21, -22, -23

Sample Parameter Qualifier key listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
MET-D-CCMS-WT	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

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Quality Control Report

Workorder: L2680648 Report Date: 25-JAN-22

Client: SIREM
130 Stone Road West
Guelph ON N1G 3Z2
Contact: Michael Healey

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R5705380								
WG3687838-4 DUP		**WG3687838-3**						
Barium (Ba)-Dissolved		0.385	0.390		mg/L	1.2	20	24-JAN-22
Boron (B)-Dissolved		4.6	4.5		mg/L	0.1	20	24-JAN-22
Lithium (Li)-Dissolved		0.15	0.14		mg/L	4.5	20	24-JAN-22
Sulfur (S)-Dissolved		266	273		mg/L	2.8	20	24-JAN-22
WG3687839-4 DUP		**WG3687839-3**						
Barium (Ba)-Dissolved		0.144	0.149		mg/L	3.5	20	24-JAN-22
Boron (B)-Dissolved		11.3	11.2		mg/L	1.3	20	24-JAN-22
Lithium (Li)-Dissolved		0.45	0.42		mg/L	6.4	20	24-JAN-22
Sulfur (S)-Dissolved		389	387		mg/L	0.6	20	24-JAN-22
WG3687838-2 LCS								
Barium (Ba)-Dissolved			98.3		%		80-120	24-JAN-22
Boron (B)-Dissolved			94.3		%		80-120	24-JAN-22
Lithium (Li)-Dissolved			108.0		%		80-120	24-JAN-22
Sulfur (S)-Dissolved			103.0		%		80-120	24-JAN-22
WG3687839-2 LCS								
Barium (Ba)-Dissolved			98.4		%		80-120	24-JAN-22
Boron (B)-Dissolved			95.6		%		80-120	24-JAN-22
Lithium (Li)-Dissolved			107.1		%		80-120	24-JAN-22
Sulfur (S)-Dissolved			100.8		%		80-120	24-JAN-22
WG3687838-1 MB								
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	24-JAN-22
Boron (B)-Dissolved			<0.010		mg/L		0.01	24-JAN-22
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	24-JAN-22
Sulfur (S)-Dissolved			<0.50		mg/L		0.5	24-JAN-22
WG3687839-1 MB								
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	24-JAN-22
Boron (B)-Dissolved			<0.010		mg/L		0.01	24-JAN-22
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	24-JAN-22
Sulfur (S)-Dissolved			<0.50		mg/L		0.5	24-JAN-22
WG3687838-5 MS		**WG3687838-6**						
Barium (Ba)-Dissolved			N/A	MS-B	%		-	24-JAN-22
Boron (B)-Dissolved			N/A	MS-B	%		-	24-JAN-22
Lithium (Li)-Dissolved			N/A	MS-B	%		-	24-JAN-22
Sulfur (S)-Dissolved			N/A	MS-B	%		-	24-JAN-22
WG3687839-5 MS		**WG3687839-6**						

DRAFT

Quality Control Report

Client: SIREM
130 Stone Road West
Guelph ON N1G 3Z2
Contact: Michael Healey

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R5705380								
WG3687839-5 MS		**WG3687839-6**						
Barium (Ba)-Dissolved			N/A	MS-B	%		-	24-JAN-22
Boron (B)-Dissolved			N/A	MS-B	%		-	24-JAN-22
Lithium (Li)-Dissolved			N/A	MS-B	%		-	24-JAN-22
Sulfur (S)-Dissolved			N/A	MS-B	%		-	24-JAN-22

DRAFT

Quality Control Report

Workorder: L2680648 Report Date: 25-JAN-22

Client: SIREM
130 Stone Road West
Guelph ON N1G 3Z2
Contact: Michael Healey

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

DRAFT

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2680648-COFC

COC Number: 16 -

Page 1 of 2

Report To		Report Format / Distribution	
Company:	SiREM	Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Contact:	Rachel Hallman, Michael Healey	Quality Control (QC) Report with Report	☐ Yes ☐ No
Address:	130 Stone Rd W Guelph, Ontario, Canada, N1G 3Z2	☐ Criteria on Report - provide details below if box checked	
Phone:	519-822-2265	Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
		Email 1 or Fax	rhallman@siremlab.com
Invoice To	Same as Report To ☐ Yes ☑ No	Email 2	mhealey@siremlab.com
	Copy of Invoice with Report ☐ Yes ☑ No	Invoice Distribution	
Company:	SiREM	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Contact:	Karen Broersma, kbroersma@geosyntec.com	Email 1 or Fax	accountspayablecan@siremlab.com
Project Information		Email 2	
ALS Quote #:		Oil and Gas Required Fields (client use)	
Job #:	Edwards MNA	Approver ID:	Cost Center:
PO / AFE:		GL Account:	Routing Code
LSD:		Activity Code:	
ALS Lab Work Order # (lab use only)	L2680648	Location:	
ALS Contact:	Gayle Braun	Sampler:	J. Linkletter

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Dissolved Metals (incl. B, Li, Ba and S)	F/P	Number of Containers
	AW-15S-1	21-Jan-22	9:00	Water	P		1
	AW-15S-2	21-Jan-22	9:15	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 2:1-1	21-Jan-22	9:30	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 2:1-2	21-Jan-22	9:45	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:1-1	21-Jan-22	10:00	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:1-2	21-Jan-22	10:15	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:5-1	21-Jan-22	10:30	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:5-2	21-Jan-22	10:45	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:10-1	21-Jan-22	11:00	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:10-2	21-Jan-22	11:15	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:20-1	21-Jan-22	11:30	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:20-2	21-Jan-22	11:45	Water	P		1

R ☐ Regular (Standard TAT if received by 3 pm - business days) - No priority (Rush Turnaround Time (TAT) is not available for all tests)
P ☑ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Specify Date Required for E2,E or P:

Analysis Request
Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

Drinking Water (DW) Samples[1] (client use)
Are samples taken from a Regulated DW System? ☐ Yes ☑ No
Are samples for human drinking water use? ☐ Yes ☑ No

Special Instructions / Specify Criteria to add on report (client Use)

SHIPMENT RELEASE (client use)
Released by: | Date: 21 Jan 22 | Time: 6:30 PM

INITIAL SHIPMENT RECEPTION (lab use only)
Received by: | Date: | Time:

SAMPLE CONDITION AS RECEIVED (lab use only)
Frozen ☐ | Ice packs Yes ☑ No ☐ | Cooling Initiated ☐ | SIF Observations Yes ☐ No ☐ | Custody seal intact Yes ☐ No ☐
INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C: 4.4

FINAL SHIPMENT RECEPTION (lab use only)
Received by: | Date: 6/1/22 | Time: 10:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

DRAFT

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2680648-COFC

COC Number: 16 -

Page 2 of 2

Report To		**Report Format / Distribution**	
Company:	SiREM	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	
Contact:	Rachel Hallman, Michael Healey	Quality Control (QC) Report with Report ☐ Yes ☐ No	
Address:	130 Stone Rd W Guelph, Ontario, Canada, N1G 3Z2	☐ Criteria on Report - provide details below if box checked	
Phone:	519-822-2265	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
		Email 1 or Fax: rhallman@siremlab.com	
		Email 2: mhealey@siremlab.com	
Invoice To	Same as Report To ☐ Yes ☑ No	**Invoice Distribution**	
	Copy of Invoice with Report ☐ Yes ☑ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Company:	SiREM	Email 1 or Fax: accountspayablecan@siremlab.com	
Contact:	Karen Broersma, kbroersma@geosyntec.com	Email 2:	
Project Information		**Oil and Gas Required Fields (client use)**	
ALS Quote #:		Approver ID:	Cost Center:
Job #:	Edwards MNA	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)	L2680648-COFC	**ALS Contact:** Gayle Braun	**Sampler:** J. Linkletter

Turnaround Time (TAT) Option (Rush Turnaround Time (TAT) is not available for all tests)

- R ☐ [illegible] if received by 3 pm - business days)
- P ☑ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
- E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
- E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge

Specify Date Required for E2,E or P:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	F/P	Dissolved Metals (incl. B, Li, Ba and S)	Number of Containers
	AW-19-1	21-Jan-22	12:00	Water	P		1
	AW-19-2	21-Jan-22	12:15	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 2:1-1	21-Jan-22	12:30	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 2:1-2	21-Jan-22	12:45	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:1-1	21-Jan-22	13:00	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:1-2	21-Jan-22	13:15	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:5-1	21-Jan-22	13:30	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:5-2	21-Jan-22	13:45	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:10-1	21-Jan-22	14:00	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:10-2	21-Jan-22	14:15	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:20-1	21-Jan-22	14:30	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:20-2	21-Jan-22	14:45	Water	P		1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ Yes ☑ No

Are samples for human drinking water use? ☐ Yes ☑ No

Special Instructions / Specify Criteria to add on report (client Use)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice packs Yes ☒ No ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			19.4		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time: 5:30 pm	Received by:	Date:	Time:	Received by:	Date: 01/21/22	Time: 18:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

ALS COC 0226 v09 Front/04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

DRAFT

SIREM
ATTN: Michael Healey
130 Stone Road West
Guelph ON N1G 3Z2

Date Received: 15-JAN-22
Report Date: 18-JAN-22 09:03 (MT)
Version: FINAL

Client Phone: 519-822-2265

Certificate of Analysis

Lab Work Order #: L2679139

Project P.O. #: NOT SUBMITTED
Job Reference: EDWARDS
C of C Numbers:
Legal Site Desc:

DRAFT

Gayle Braun
Senior Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2679139-1 AW-15S-1A Sampled By: R.S. on 14-JAN-22 @ 15:00 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					16-JAN-22	R5697192
Barium (Ba)-Dissolved	0.307	DLHC	0.010	mg/L	16-JAN-22	17-JAN-22	R5697850
Boron (B)-Dissolved	12.4	DLHC	1.0	mg/L	16-JAN-22	17-JAN-22	R5697850
Lithium (Li)-Dissolved	0.47	DLHC	0.10	mg/L	16-JAN-22	17-JAN-22	R5697850
Sulfur (S)-Dissolved	390	DLHC	50	mg/L	16-JAN-22	17-JAN-22	R5697850
L2679139-2 AW-15S-2A Sampled By: R.S. on 14-JAN-22 @ 15:15 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					16-JAN-22	R5697192
Barium (Ba)-Dissolved	0.355	DLHC	0.010	mg/L	16-JAN-22	17-JAN-22	R5697850
Boron (B)-Dissolved	12.7	DLHC	1.0	mg/L	16-JAN-22	17-JAN-22	R5697850
Lithium (Li)-Dissolved	0.48	DLHC	0.10	mg/L	16-JAN-22	17-JAN-22	R5697850
Sulfur (S)-Dissolved	397	DLHC	50	mg/L	16-JAN-22	17-JAN-22	R5697850
L2679139-3 AW-19-1A Sampled By: R.S. on 14-JAN-22 @ 15:30 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					16-JAN-22	R5697192
Barium (Ba)-Dissolved	0.220	DLHC	0.010	mg/L	16-JAN-22	17-JAN-22	R5697850
Boron (B)-Dissolved	11.6	DLHC	1.0	mg/L	16-JAN-22	17-JAN-22	R5697850
Lithium (Li)-Dissolved	0.46	DLHC	0.10	mg/L	16-JAN-22	17-JAN-22	R5697850
Sulfur (S)-Dissolved	386	DLHC	50	mg/L	16-JAN-22	17-JAN-22	R5697850
L2679139-4 AW-19-2A Sampled By: R.S. on 14-JAN-22 @ 15:45 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					16-JAN-22	R5697192
Barium (Ba)-Dissolved	0.273	DLHC	0.010	mg/L	16-JAN-22	17-JAN-22	R5697850
Boron (B)-Dissolved	11.9	DLHC	1.0	mg/L	16-JAN-22	17-JAN-22	R5697850
Lithium (Li)-Dissolved	0.45	DLHC	0.10	mg/L	16-JAN-22	17-JAN-22	R5697850
Sulfur (S)-Dissolved	380	DLHC	50	mg/L	16-JAN-22	17-JAN-22	R5697850

DRAFT

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2679139-1, -2, -3, -4
Matrix Spike	Boron (B)-Dissolved	MS-B	L2679139-1, -2, -3, -4
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L2679139-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2679139-1, -2, -3, -4

Sample Parameter Qualifier key listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
MET-D-CCMS-WT	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

DRAFT

Quality Control Report

Workorder: L2679139 Report Date: 18-JAN-22

Client: SIREM
130 Stone Road West
Guelph ON N1G 3Z2
Contact: Michael Healey

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R5697850								
WG3685604-4 DUP		**WG3685604-3**						
Barium (Ba)-Dissolved		0.307	0.321		mg/L	4.3	20	17-JAN-22
Boron (B)-Dissolved		12.4	12.6		mg/L	1.3	20	17-JAN-22
Lithium (Li)-Dissolved		0.47	0.45		mg/L	4.5	20	17-JAN-22
Sulfur (S)-Dissolved		390	392		mg/L	0.7	20	17-JAN-22
WG3685604-2 LCS								
Barium (Ba)-Dissolved			103.3		%		80-120	17-JAN-22
Boron (B)-Dissolved			94.5		%		80-120	17-JAN-22
Lithium (Li)-Dissolved			99.4		%		80-120	17-JAN-22
Sulfur (S)-Dissolved			98.7		%		80-120	17-JAN-22
WG3685604-1 MB								
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	17-JAN-22
Boron (B)-Dissolved			<0.010		mg/L		0.01	17-JAN-22
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	17-JAN-22
Sulfur (S)-Dissolved			<0.50		mg/L		0.5	17-JAN-22
WG3685604-5 MS		**WG3685604-6**						
Barium (Ba)-Dissolved			N/A	MS-B	%		-	17-JAN-22
Boron (B)-Dissolved			N/A	MS-B	%		-	17-JAN-22
Lithium (Li)-Dissolved			N/A	MS-B	%		-	17-JAN-22
Sulfur (S)-Dissolved			N/A	MS-B	%		-	17-JAN-22

DRAFT

Quality Control Report

Workorder: L2679139 Report Date: 18-JAN-22

Client: SIREM
130 Stone Road West
Guelph ON N1G 3Z2
Contact: Michael Healey

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

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Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

DRAFT

Chain of Custody (COC) / Analytical Request Form

COC Number: 16 -

Page 1 of 1

Canada Toll Free: 1 800 668 987

here

L2679139-COFC

www.alsglobal.com

Report To		Report Format / Distribution	
Company:	SiREM	Select Report Format:	
Contact:	Rachel Hallman, Michael Healey	Quality Control (QC) Report with Report	☐ Yes ☐ No
Address:	130 Research Lane, Suite 2 Guelph, Ontario, Canada, N1G 5G3	☐ Criteria on Report - provide details below if box checked	
Phone:	519-822-2265	Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
		Email 1 or Fax	rhallman@siremlab.com
		Email 2	mhealey@siremlab.com
Invoice To	Same as Report To ☐ Yes ☐ No	**Invoice Distribution**	
	Copy of Invoice with Report ☐ Yes ☐ No	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Company:	SiREM	Email 1 or Fax	kbroersma@geosyntec.com
Contact:	Karen Broersma, kbroersma@geosyntec.com	Email 2	
Project Information		**Oil and Gas Required Fields (client use)**	
ALS Quote #:		Approver ID:	Cost Center:
Job #:	Edwards	GL Account	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)	L2679139	**ALS Contact:**	**Sampler:** Rita Schofield

Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)

- (standard TAT if received by 3 pm - business days)
- P ☑ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
- E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
- E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge

Specify Date Required for E2,E or P:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	F/P	Dissolved Metals (incl. B, SO4, Li, Ba, Cl & analysis)	Number of Containers
	AW-15S-1a	14-Jan-22	3:00	Water	P		1
	AW-15S-2a	14-Jan-22	3:15	Water	P		1
	AW-19-1a	14-Jan-22	3:30	Water	P		1
	AW-19-2a	14-Jan-22	3:45	Water	P		1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ Yes ☑ No

Are samples for human drinking water use? ☐ Yes ☑ No

Special Instructions / Specify Criteria to add on report (client Use)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐	
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by	Date	Time
	14 Jan 22	4:00pm					Jan 15/22	8:00

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-FM-0326e v09 Front/04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

DRAFT

ATTACHMENT 2

SGS Analysis Report (SEP Data)

DRAFT

SGS proposal: IBD
SGS project #: 2267

Sample receipt date: 13-Dec-22
Report date: 18-Apr-23

Version: Final

Customer details

Name:	Lain Glossop
Address:	SGS Mineralogy

Project reference:

P.O. number:

COC:

ANALYSIS REPORT

SGS WO: 3

Report Distribution

Name	Email
Lain Glossop	
Kim Gibbs	

Special notes:

Tessier sequential extraction

Mineralogy LIMS: MI7009-NOV22
Project: CA20I-00000-211-19465-01

DRAFT

3260 Production Way
Burnaby - British Columbia - V5A 4W4
Phone: 604-638-2349 FAX: 604-444-5486

ANALYSIS REPORT

Method Summaries *Test method information available upon request.*

S(T) and C(T): Total sulfur and total carbon by LECO, Method CSA06V
S(SO4): Sulfate by HCl digestion with ICP finish, Method CSA07V
S(S2-): Sulfide by calculation of S(T) - S(SO4)

TIC: Total inorganic carbon by coulometry, Method CSB02V
AP: Acid generating potential based on sulfide sulfur
NP: Modified neutralisation potential by excess acid addition and back titration to pH 8.3
Net NP: Net neutralisation potential = NP - AP
NPR: Neutralisation potential ratio = NP/AP

Metals by Aqua regia digest with ICP-OES/MS finish, Method ICP21B20/ICM21B20
Metals by multi-acid digest with ICP-OES/MS finish, Method ICP40Q12/IMS40Q12
Tessier Sequential Extraction - method available on request

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Preliminary Data

Noelene Ahern - Manager: ARD

Final Data Approval

Noelene Ahern - Manager: ARD

DRAFT

Tessier Extraction

Water Soluble Metals
Reagent: 15 mL of Nanopure Distilled Water

Sample			E-SB-05 (51-56) Water Soluble	E-SB-07 (59-64) Water Soluble	E-SB-15 (35-40) Water Soluble
Sample weight (g)			1.0020	1.0373	1.0472
Reagent volume (mL)			15	15	15.0
Volume analysed (after wash dilution and preservation) (mL)			22.5	22.5	22.5
Final diluted solution weight (g)			23.19	22.06	21.32
Parameter	**Units**	**RDL**			
Hardness CaCO3	mg/L	0.05	22.7	18.1	41.8
Aluminum Al	mg/L	0.001	10	14.9	11.9
Antimony Sb	mg/L	0.0009	< 0.009	< 0.009	< 0.009
Arsenic As	mg/L	0.0002	< 0.002	0.004	0.003
Barium Ba	mg/L	0.00002	0.0964	0.088	0.0556
Beryllium Be	mg/L	0.000007	0.00052	0.00067	0.00048
Bismuth Bi	mg/L	0.00001	< 0.0001	0.0002	< 0.0001
Boron B	mg/L	0.002	0.04	0.07	0.07
Cadmium Cd	mg/L	0.000003	0.00003	< 0.00003	0.00013
Calcium Ca	mg/L	0.01	4.5	0.6	9.1
Chromium Cr	mg/L	0.00008	0.0191	0.0198	0.0639
Cobalt Co	mg/L	0.000004	0.00273	0.00241	0.00436
Copper Cu	mg/L	0.0002	0.029	0.037	0.025
Iron Fe	mg/L	0.007	7.5	4.71	26.4
Lead Pb	mg/L	0.00009	0.0037	0.0057	0.0068
Lithium Li	mg/L	0.0001	0.012	0.01	0.019
Magnesium Mg	mg/L	0.001	2.79	3.94	4.66
Manganese Mn	mg/L	0.00001	0.0694	0.0435	0.203
Mercury Hg	ug/L	0.01	0.01	0.01	< 0.01
Molybdenum Mo	mg/L	0.00004	0.008	0.0016	0.009
Nickel Ni	mg/L	0.0001	0.01	0.009	0.061
Phosphorus P	mg/L	0.003	< 0.03	0.04	0.23
Potassium K	mg/L	0.003	16	9.04	6.36
Selenium Se	mg/L	0.00004	0.001	0.002	0.0064
Silicon Si	mg/L	0.02	16.8	22.8	26.6
Silver Ag	mg/L	0.00005	< 0.0005	< 0.0005	< 0.0005
Sodium Na	mg/L	0.01	7.4	12.9	2.5
Strontium Sr	mg/L	0.00002	0.0386	0.0198	0.0194
Sulphur (S)	mg/L	1	7	4	< 1
Thallium Tl	mg/L	0.000005	< 0.00005	< 0.00005	< 0.00005
Tin Sn	mg/L	0.00006	0.0012	0.0013	0.0031
Titanium Ti	mg/L	0.00005	0.197	0.236	0.286
Uranium U	mg/L	0.000002	0.0004	0.00024	0.00059
Vanadium V	mg/L	0.00001	0.0193	0.0367	0.0265
Zinc Zn	mg/L	0.002	0.04	0.03	0.05
Zirconium Zr	mg/L	0.002	< 0.02	< 0.02	< 0.02

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Tessier Extraction

Water Soluble Metals
Reagent: 15 mL of Nanopure Distilled Water

Sample			E-SB-07 (37-30) Water Soluble	E-SB--15 (10-15) Water Soluble	E-SB-19 (35-40) Water Soluble	AW-23 (6-11.5) Water Soluble
Sample weight (g)			1.0245	1.0102	1.0188	1.0152
Reagent volume (mL)			15.0	15.0	15.0	15.0
Volume analysed (after wash dilution and preservation) (mL)			22.5	22.5	22.5	22.5
Final diluted solution weight (g)			22.18	22.17	22.33	22.88
Parameter	**Units**	**RDL**				
Hardness CaCO3	mg/L	0.05	5.4	73.3	8.5	51.8
Aluminum Al	mg/L	0.001	0.07	6.02	12.3	8.13
Antimony Sb	mg/L	0.0009	< 0.009	< 0.009	< 0.009	< 0.009
Arsenic As	mg/L	0.0002	< 0.002	< 0.002	0.007	0.002
Barium Ba	mg/L	0.00002	0.0021	0.0474	0.0486	0.0534
Beryllium Be	mg/L	0.000007	< 0.00007	0.00028	0.00052	0.00037
Bismuth Bi	mg/L	0.00001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Boron B	mg/L	0.002	< 0.02	0.12	0.03	0.05
Cadmium Cd	mg/L	0.000003	< 0.00003	0.00015	< 0.00003	0.00008
Calcium Ca	mg/L	0.01	1.4	18.6	0.7	10.5
Chromium Cr	mg/L	0.00008	0.011	0.0102	0.0175	0.0146
Cobalt Co	mg/L	0.000004	0.00048	0.00148	0.00193	0.00211
Copper Cu	mg/L	0.0002	< 0.002	0.017	0.011	0.017
Iron Fe	mg/L	0.007	0.09	5.34	3.53	8.91
Lead Pb	mg/L	0.00009	< 0.0009	0.0035	0.0057	0.0031
Lithium Li	mg/L	0.0001	< 0.001	0.018	0.009	0.022
Magnesium Mg	mg/L	0.001	0.46	6.11	1.67	4.95
Manganese Mn	mg/L	0.00001	0.0007	0.0274	0.0333	0.0804
Mercury Hg	ug/L	0.01	0.02	0.01	< 0.01	0.01
Molybdenum Mo	mg/L	0.00004	0.0042	0.0057	0.005	0.0071
Nickel Ni	mg/L	0.0001	0.008	0.006	0.006	0.007
Phosphorus P	mg/L	0.003	12.7	0.09	0.11	0.09
Potassium K	mg/L	0.003	0.2	7.5	11	4.59
Selenium Se	mg/L	0.00004	< 0.0004	0.0065	0.002	0.0051
Silicon Si	mg/L	0.02	< 0.2	16.1	20.5	16.6
Silver Ag	mg/L	0.00005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Sodium Na	mg/L	0.01	14.7	3.1	4.7	3.5
Strontium Sr	mg/L	0.00002	0.0079	0.0332	0.0146	0.022
Sulphur (S)	mg/L	1	< 1	16	< 1	4
Thallium Tl	mg/L	0.000005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Tin Sn	mg/L	0.00006	5.43	0.0013	0.0013	0.0029
Titanium Ti	mg/L	0.00005	0.0028	0.18	0.527	0.212
Uranium U	mg/L	0.000002	0.00007	0.00148	0.00039	0.00094
Vanadium V	mg/L	0.00001	0.0003	0.0174	0.0332	0.0189
Zinc Zn	mg/L	0.002	0.02	0.03	0.03	0.03
Zirconium Zr	mg/L	0.002	< 0.02	< 0.02	0.02	< 0.02

DRAFT

Tessier Extraction

Water Soluble Metals Reagent: 15 mL of Nanopure Distilled Water					
Sample			**E-SB 19 (40-44) Water Soluble**	**E-SB-05 (52-30) Water Soluble**	**Blank Water Soluble**
Sample weight (g)			1.0115	1.0138	0.0000
Reagent volume (mL)			15.0	15.0	15
Volume analysed (after wash dilution and preservation) (mL)			22.5	22.5	22.5
Final diluted solution weight (g)			22.07	22.32	23.18
Parameter	**Units**	**RDL**			
Hardness CaCO3	mg/L	0.05	19.4	138	2.4
Aluminum Al	mg/L	0.001	9.44	1.3	< 0.01
Antimony Sb	mg/L	0.0009	< 0.009	< 0.009	< 0.009
Arsenic As	mg/L	0.0002	< 0.002	< 0.002	< 0.002
Barium Ba	mg/L	0.00002	0.0475	0.0377	0.0036
Beryllium Be	mg/L	0.000007	0.00035	< 0.00007	< 0.00007
Bismuth Bi	mg/L	0.00001	< 0.0001	< 0.0001	< 0.0001
Boron B	mg/L	0.002	0.04	0.04	< 0.02
Cadmium Cd	mg/L	0.000003	< 0.00003	0.00005	< 0.00003
Calcium Ca	mg/L	0.01	1.3	41.9	< 0.1
Chromium Cr	mg/L	0.00008	0.0125	0.0078	0.0449
Cobalt Co	mg/L	0.000004	0.00121	0.00061	0.00139
Copper Cu	mg/L	0.0002	0.005	0.012	0.011
Iron Fe	mg/L	0.007	2.76	1.93	25.4
Lead Pb	mg/L	0.00009	0.0024	< 0.0009	< 0.0009
Lithium Li	mg/L	0.0001	0.013	0.01	< 0.001
Magnesium Mg	mg/L	0.001	1.78	8.1	0.57
Manganese Mn	mg/L	0.00001	0.0336	0.0352	0.174
Mercury Hg	ug/L	0.01	< 0.01	< 0.01	< 0.01
Molybdenum Mo	mg/L	0.00004	0.0029	0.0076	0.0047
Nickel Ni	mg/L	0.0001	0.004	0.003	0.059
Phosphorus P	mg/L	0.003	< 0.03	< 0.03	< 0.03
Potassium K	mg/L	0.003	16.1	9.39	0.09
Selenium Se	mg/L	0.00004	< 0.0004	0.001	< 0.0004
Silicon Si	mg/L	0.02	13.4	5	< 0.2
Silver Ag	mg/L	0.00005	< 0.0005	< 0.0005	< 0.0005
Sodium Na	mg/L	0.01	4.7	5.4	< 0.1
Strontium Sr	mg/L	0.00002	0.0096	0.0762	< 0.0008
Sulphur (S)	mg/L	1	9	32	< 1
Thallium Tl	mg/L	0.000005	< 0.00005	< 0.00005	< 0.00005
Tin Sn	mg/L	0.00006	0.0018	< 0.0006	0.0018
Titanium Ti	mg/L	0.00005	0.366	0.027	0.001
Uranium U	mg/L	0.000002	0.00017	0.00157	0.00002
Vanadium V	mg/L	0.00001	0.0175	0.0048	0.0009
Zinc Zn	mg/L	0.002	0.03	0.03	0.02
Zirconium Zr	mg/L	0.002	< 0.02	< 0.02	< 0.02

DRAFT

Tessier Extraction

Exchangeable Metals
Reagent: 15 mL of 1 M MgCl2 (pH 7)

Sample			E-SB-05 (51-56) Exchangable	E-SB-07 (59-64) Exchangable	E-SB-15 (35-40) Exchangable
Reagent volume (mL)			15	15	15
Volume analysed (after wash dilution and preservation) (mL)			27.5	27.5	27.5
Final diluted solution weight (g)			28.555	29.685	29.3
Parameter	**Units**	**RDL**			
Hardness CaCO3	mg/L	0.05	38900	40800	43600
Aluminum Al	mg/L	0.001	1.52	1.96	0.36
Antimony Sb	mg/L	0.0009	< 0.009	< 0.009	< 0.009
Arsenic As	mg/L	0.0002	0.003	0.002	0.004
Barium Ba	mg/L	0.00002	2.82	0.78	0.277
Beryllium Be	mg/L	0.000007	< 0.00007	0.0001	< 0.00007
Bismuth Bi	mg/L	0.00001	< 0.0001	< 0.0001	< 0.0001
Boron B	mg/L	0.002	< 0.02	< 0.02	< 0.02
Cadmium Cd	mg/L	0.000003	0.00056	< 0.00003	0.00017
Calcium Ca	mg/L	0.01	66.8	12.7	19
Chromium Cr	mg/L	0.00008	0.0216	0.0198	0.0532
Cobalt Co	mg/L	0.000004	0.00257	0.00176	0.00273
Copper Cu	mg/L	0.0002	0.015	0.28	0.12
Iron Fe	mg/L	0.007	0.89	0.51	17.4
Lead Pb	mg/L	0.00009	< 0.0009	< 0.0009	0.0011
Lithium Li	mg/L	0.0001	0.021	0.027	0.023
Magnesium Mg	mg/L	0.001	9430	9920	10600
Manganese Mn	mg/L	0.00001	0.333	0.394	0.341
Mercury Hg	ug/L	0.01	< 0.01	< 0.01	< 0.01
Molybdenum Mo	mg/L	0.00004	0.0041	0.0023	0.0078
Nickel Ni	mg/L	0.0001	0.005	0.004	0.034
Phosphorus P	mg/L	0.003	< 0.03	< 0.03	< 0.03
Potassium K	mg/L	0.003	17.4	25.6	20
Selenium Se	mg/L	0.00004	0.0008	< 0.0004	< 0.0004
Silicon Si	mg/L	0.02	3.9	4.2	2.1
Silver Ag	mg/L	0.00005	< 0.0005	0.0008	0.0009
Sodium Na	mg/L	0.01	3.1	13.4	3.5
Strontium Sr	mg/L	0.00002	0.44	0.303	0.114
Sulphur (S)	mg/L	1	21	21	20
Thallium Tl	mg/L	0.000005	0.00013	0.00007	0.00012
Tin Sn	mg/L	0.00006	0.0025	0.0022	0.0019
Titanium Ti	mg/L	0.00005	0.0759	0.11	0.0047
Uranium U	mg/L	0.000002	0.00182	0.00029	0.00021
Vanadium V	mg/L	0.00001	0.0114	0.011	0.0097
Zinc Zn	mg/L	0.002	0.02	0.07	0.04
Zirconium Zr	mg/L	0.002	< 0.02	< 0.02	< 0.02

DRAFT

Tessier Extraction

Exchangeable Metals
Reagent: 15 mL of 1 M MgCl2 (pH 7)

Sample			E-SB-07 (37-30) Exchangable	E-SB-15 (10-15) Exchangable	E-SB-19 (35-40) Exchangable	AW-23 (6-11.5) Exchangable	E-SB 19 (40-44) Exchangable
Reagent volume (mL)			15	15	15	15	15
Volume analysed (after wash dilution and preservation) (mL)			27.5	27.5	27.5	27.5	27.5
Final diluted solution weight (g)			29.32	29.78	29.50	28.58	28.90
Parameter	**Units**	**RDL**					
Hardness CaCO3	mg/L	0.05	29500	41300	41500	39600	38900
Aluminum Al	mg/L	0.001	0.47	0.46	0.36	0.33	2.27
Antimony Sb	mg/L	0.0009	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009
Arsenic As	mg/L	0.0002	0.002	0.003	0.004	0.003	< 0.002
Barium Ba	mg/L	0.00002	0.555	1.16	0.908	1.35	1.11
Beryllium Be	mg/L	0.000007	< 0.00007	< 0.00007	< 0.00007	< 0.00007	0.00012
Bismuth Bi	mg/L	0.00001	< 0.0001	< 0.0001	< 0.0001	0.0001	< 0.0001
Boron B	mg/L	0.002	< 0.02	0.04	< 0.02	0.03	0.02
Cadmium Cd	mg/L	0.000003	0.00363	0.00709	0.00101	0.00228	0.00003
Calcium Ca	mg/L	0.01	97.9	147	76.2	146	23.6
Chromium Cr	mg/L	0.00008	0.0254	0.0177	0.0589	0.0205	0.0258
Cobalt Co	mg/L	0.000004	0.00358	0.00295	0.00316	0.00328	0.00139
Copper Cu	mg/L	0.0002	0.008	0.018	0.022	0.011	0.104
Iron Fe	mg/L	0.007	2.29	0.56	23.2	5.44	3.08
Lead Pb	mg/L	0.00009	< 0.0009	< 0.0009	< 0.0009	< 0.0009	< 0.0009
Lithium Li	mg/L	0.0001	0.015	0.013	0.019	0.023	0.026
Magnesium Mg	mg/L	0.001	7150	9970	10000	9550	9430
Manganese Mn	mg/L	0.00001	0.556	0.358	1.66	0.741	0.448
Mercury Hg	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Molybdenum Mo	mg/L	0.00004	0.009	0.0037	0.0102	0.0034	0.0022
Nickel Ni	mg/L	0.0001	0.009	0.009	0.069	0.022	0.01
Phosphorus P	mg/L	0.003	< 0.03	< 0.03	< 0.03	0.04	< 0.03
Potassium K	mg/L	0.003	11.8	11.5	18	11.3	21.4
Selenium Se	mg/L	0.00004	0.0011	0.002	0.001	0.0031	< 0.0004
Silicon Si	mg/L	0.02	3.1	2.6	2.5	2.4	4.5
Silver Ag	mg/L	0.00005	< 0.0005	< 0.0005	0.0057	0.0027	0.0094
Sodium Na	mg/L	0.01	2.1	2.3	1.7	1.9	1.9
Strontium Sr	mg/L	0.00002	0.178	0.245	0.163	0.282	0.118
Sulphur (S)	mg/L	1	20	20	18	19	20
Thallium Tl	mg/L	0.000005	< 0.00005	< 0.00005	0.00005	< 0.00005	0.00007
Tin Sn	mg/L	0.00006	0.0024	0.0034	0.0031	0.0045	0.0022
Titanium Ti	mg/L	0.00005	0.0127	0.01	0.0143	0.0094	0.123
Uranium U	mg/L	0.000002	0.00056	0.002	0.00098	0.00277	0.00028
Vanadium V	mg/L	0.00001	0.01	0.0103	0.0112	0.0078	0.0118
Zinc Zn	mg/L	0.002	0.03	0.03	0.03	0.03	0.04
Zirconium Zr	mg/L	0.002	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

DRAFT

Tessier Extraction

Exchangeable Metals Reagent: 15 mL of 1 M MgCl2 (pH 7)				
Sample			**E-SB-05 (52-30) Exchangable**	**Blank Exchangable**
Reagent volume (mL)			15	15
Volume analysed (after wash dilution and preservation) (mL)			27.5	27.5
Final diluted solution weight (g)			28.85	28.52
Parameter	**Units**	**RDL**		
Hardness CaCO3	mg/L	0.05	42200	30600
Aluminum Al	mg/L	0.001	0.36	0.02
Antimony Sb	mg/L	0.0009	< 0.009	< 0.009
Arsenic As	mg/L	0.0002	0.003	0.003
Barium Ba	mg/L	0.00002	0.778	0.0046
Beryllium Be	mg/L	0.000007	< 0.00007	< 0.00007
Bismuth Bi	mg/L	0.00001	< 0.0001	< 0.0001
Boron B	mg/L	0.002	0.02	< 0.02
Cadmium Cd	mg/L	0.000003	0.003	< 0.00003
Calcium Ca	mg/L	0.01	179	1.7
Chromium Cr	mg/L	0.00008	0.0156	0.0599
Cobalt Co	mg/L	0.000004	0.00109	0.00094
Copper Cu	mg/L	0.0002	0.008	0.011
Iron Fe	mg/L	0.007	0.45	20.8
Lead Pb	mg/L	0.00009	< 0.0009	0.001
Lithium Li	mg/L	0.0001	0.011	0.001
Magnesium Mg	mg/L	0.001	10200	7420
Manganese Mn	mg/L	0.00001	0.724	0.149
Mercury Hg	ug/L	0.01	< 0.01	< 0.01
Molybdenum Mo	mg/L	0.00004	0.0034	0.0071
Nickel Ni	mg/L	0.0001	0.003	0.059
Phosphorus P	mg/L	0.003	0.08	< 0.03
Potassium K	mg/L	0.003	9.92	1.91
Selenium Se	mg/L	0.00004	0.0022	< 0.0004
Silicon Si	mg/L	0.02	2.2	< 0.2
Silver Ag	mg/L	0.00005	< 0.0005	0.0076
Sodium Na	mg/L	0.01	1.5	1.3
Strontium Sr	mg/L	0.00002	0.376	0.003
Sulphur (S)	mg/L	1	19	22
Thallium Tl	mg/L	0.000005	0.00008	< 0.00005
Tin Sn	mg/L	0.00006	0.0016	0.0035
Titanium Ti	mg/L	0.00005	0.0078	0.0006
Uranium U	mg/L	0.000002	0.00278	0.00003
Vanadium V	mg/L	0.00001	0.0077	0.0082
Zinc Zn	mg/L	0.002	0.03	0.03
Zirconium Zr	mg/L	0.002	< 0.02	< 0.02

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Tessier Extraction

Metals Bound to Carbonates
Reagent: 15 mL of 1 M NaOAc (adjusted to pH 5.0 with Acetic Acid)

Sample			E-SB-05 (51-56) Bound to carbonate	E-SB-07 (59-64) Bound to carbonate	E-SB-15 (35-40) Bound to carbonate
Reagent volume (mL)			15	15	15
Volume analysed (after wash dilution and preservation) (mL)			32.5	32.5	32.5
Final diluted solution weight (g)			32.95	32.99	33.1
Parameter	**Units**	**RDL**			
Hardness CaCO3	mg/L	0.05	1450	324	323
Aluminum Al	mg/L	0.001	29.91	31.1	32.25
Antimony Sb	mg/L	0.0009	< 0.009	< 0.009	< 0.009
Arsenic As	mg/L	0.0002	0.011	0.016	0.013
Barium Ba	mg/L	0.00002	3	1.35	0.7
Beryllium Be	mg/L	0.000007	0.00587	0.00548	0.0049
Bismuth Bi	mg/L	0.00001	0.0028	0.0031	0.0034
Boron B	mg/L	0.002	0.06	0.06	0.03
Cadmium Cd	mg/L	0.000003	0.00169	0.0001	0.00025
Calcium Ca	mg/L	0.01	283	6	10
Chromium Cr	mg/L	0.00008	0.179	0.525	1.05
Cobalt Co	mg/L	0.000004	0.0935	0.0252	0.0249
Copper Cu	mg/L	0.0002	0.586	1.4	0.625
Iron Fe	mg/L	0.007	74.85	36.15	50.24
Lead Pb	mg/L	0.00009	0.106	0.114	0.174
Lithium Li	mg/L	0.0001	0.052	0.049	0.045
Magnesium Mg	mg/L	0.001	180	75	72.4
Manganese Mn	mg/L	0.00001	4.08	1.04	1.07
Mercury Hg	ug/L	0.01	< 0.01	< 0.01	< 0.01
Molybdenum Mo	mg/L	0.00004	0.0056	0.0084	0.003
Nickel Ni	mg/L	0.0001	0.097	0.069	0.088
Phosphorus P	mg/L	0.003	0.23	0.09	0.28
Potassium K	mg/L	0.003	14.12	16.03	15.26
Selenium Se	mg/L	0.00004	0.0021	0.0038	0.0014
Silicon Si	mg/L	0.02	30	26	25
Silver Ag	mg/L	0.00005	< 0.0005	< 0.0005	< 0.0005
Sodium Na	mg/L	0.01	9260	9640	9930
Strontium Sr	mg/L	0.00002	0.234	0.111	0.0534
Sulphur (S)	mg/L	1	< 10	< 10	< 10
Thallium Tl	mg/L	0.000005	0.00008	0.0001	0.00006
Tin Sn	mg/L	0.00006	0.0023	0.0083	0.0013
Titanium Ti	mg/L	0.00005	0.015	0.0535	0.0263
Uranium U	mg/L	0.000002	0.0043	0.00426	0.00458
Vanadium V	mg/L	0.00001	0.0754	0.0528	0.0658
Zinc Zn	mg/L	0.002	0.31	0.32	0.21
Zirconium Zr	mg/L	0.002	< 0.02	< 0.02	< 0.02

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Tessier Extraction

Metals Bound to Carbonates
Reagent: 15 mL of 1 M NaOAc (adjusted to pH 5.0 with Acetic Acid)

Sample			E-SB-07 (37-30) Bound to carbonate	E-SB-15 (10-15) Bound to carbonate	E-SB-19 (35-40) Bound to carbonate	AW-23 (6-11.5) Bound to carbonate	E-SB-19 (40-44) Bound to carbonate
Reagent volume (mL)			15	15	15	15	15
Volume analysed (after wash dilution and preservation) (mL)			32.5	32.5	32.5	32.5	32.5
Final diluted solution weight (g)			32.31	32.16	32.41	33.33	33.13
Parameter	**Units**	**RDL**					
Hardness CaCO3	mg/L	0.05	2390	2910	998	2560	352
Aluminum Al	mg/L	0.001	19.03	11.77	27.18	20.43	31.65
Antimony Sb	mg/L	0.0009	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009
Arsenic As	mg/L	0.0002	0.005	0.007	0.016	0.005	0.004
Barium Ba	mg/L	0.00002	1.15	1.72	1.53	2.19	1.33
Beryllium Be	mg/L	0.000007	0.00466	0.00727	0.00536	0.00621	0.00521
Bismuth Bi	mg/L	0.00001	0.0008	0.0017	0.0008	0.0011	0.0042
Boron B	mg/L	0.002	0.05	0.11	0.05	0.04	0.04
Cadmium Cd	mg/L	0.000003	0.00547	0.0117	0.00179	0.00307	0.00008
Calcium Ca	mg/L	0.01	386	302	154	245	13
Chromium Cr	mg/L	0.00008	0.589	0.22	0.72	0.156	0.195
Cobalt Co	mg/L	0.000004	0.0399	0.0575	0.0353	0.0541	0.0214
Copper Cu	mg/L	0.0002	0.374	0.29	0.299	0.381	0.534
Iron Fe	mg/L	0.007	25.33	25.36	33.17	16.59	68.43
Lead Pb	mg/L	0.00009	0.093	0.0995	0.0696	0.0872	0.13
Lithium Li	mg/L	0.0001	0.028	0.028	0.04	0.032	0.046
Magnesium Mg	mg/L	0.001	346	525	149	474	77.9
Manganese Mn	mg/L	0.00001	3.23	2.34	9.32	5.48	1.72
Mercury Hg	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Molybdenum Mo	mg/L	0.00004	0.0021	0.0034	0.0056	0.0028	0.0073
Nickel Ni	mg/L	0.0001	0.075	0.109	0.078	0.06	0.054
Phosphorus P	mg/L	0.003	0.31	0.53	0.15	0.29	0.13
Potassium K	mg/L	0.003	8.49	10.53	12.06	8.8	13.98
Selenium Se	mg/L	0.00004	0.0022	0.0044	0.0028	0.0022	0.0014
Silicon Si	mg/L	0.02	27	25	29	28	26
Silver Ag	mg/L	0.00005	< 0.0005	< 0.0005	< 0.0005	0.0008	< 0.0005
Sodium Na	mg/L	0.01	8590	9820	8950	9170	9320
Strontium Sr	mg/L	0.00002	0.153	0.226	0.0815	0.152	0.0439
Sulphur (S)	mg/L	1	< 10	< 10	< 10	< 10	< 10
Thallium Tl	mg/L	0.000005	0.00007	0.00007	< 0.00005	< 0.00005	< 0.00005
Tin Sn	mg/L	0.00006	0.0019	0.0027	0.005	0.0012	0.0017
Titanium Ti	mg/L	0.00005	0.0114	0.0362	0.0116	0.0098	0.0239
Uranium U	mg/L	0.000002	0.00376	0.0132	0.00404	0.00719	0.00349
Vanadium V	mg/L	0.00001	0.0412	0.0672	0.0397	0.0151	0.0678
Zinc Zn	mg/L	0.002	0.21	0.26	0.16	0.19	0.18
Zirconium Zr	mg/L	0.002	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

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Tessier Extraction

Metals Bound to Carbonates Reagent: 15 mL of 1 M NaOAc (adjusted to pH 5.0 with Acetic Acid)				
Sample			**E-SB-05 (52-30) Bound to carbonate**	**Blank Bound to carbonate**
Reagent volume (mL)			15	15
Volume analysed (after wash dilution and preservation) (mL)			32.5	32.5
Final diluted solution weight (g)			26.42	33.42
Parameter	**Units**	**RDL**		
Hardness CaCO3	mg/L	0.05	4020	1
Aluminum Al	mg/L	0.001	7.75	0.02
Antimony Sb	mg/L	0.0009	< 0.009	< 0.009
Arsenic As	mg/L	0.0002	0.009	< 0.002
Barium Ba	mg/L	0.00002	1.42	0.002
Beryllium Be	mg/L	0.000007	0.00447	< 0.00007
Bismuth Bi	mg/L	0.00001	0.0006	< 0.0001
Boron B	mg/L	0.002	0.06	< 0.02
Cadmium Cd	mg/L	0.000003	0.00601	< 0.00003
Calcium Ca	mg/L	0.01	1120	0
Chromium Cr	mg/L	0.00008	0.358	0.004
Cobalt Co	mg/L	0.000004	0.0704	< 0.00004
Copper Cu	mg/L	0.0002	0.0895	< 0.002
Iron Fe	mg/L	0.007	34.2	0.16
Lead Pb	mg/L	0.00009	0.0573	< 0.0009
Lithium Li	mg/L	0.0001	0.022	0.002
Magnesium Mg	mg/L	0.001	294	0.18
Manganese Mn	mg/L	0.00001	9.61	0.0075
Mercury Hg	ug/L	0.01	< 0.01	< 0.01
Molybdenum Mo	mg/L	0.00004	0.0062	0.002
Nickel Ni	mg/L	0.0001	0.106	0.001
Phosphorus P	mg/L	0.003	0.53	< 0.03
Potassium K	mg/L	0.003	6.99	2.78
Selenium Se	mg/L	0.00004	0.002	0.0007
Silicon Si	mg/L	0.02	22	0
Silver Ag	mg/L	0.00005	< 0.0005	0.0065
Sodium Na	mg/L	0.01	6800	9600
Strontium Sr	mg/L	0.00002	0.955	< 0.0008
Sulphur (S)	mg/L	1	< 10	< 10
Thallium Tl	mg/L	0.000005	0.00009	< 0.00005
Tin Sn	mg/L	0.00006	0.0012	0.0015
Titanium Ti	mg/L	0.00005	0.045	0.0005
Uranium U	mg/L	0.000002	0.0093	0.00005
Vanadium V	mg/L	0.00001	0.0373	0.0002
Zinc Zn	mg/L	0.002	0.41	0.02
Zirconium Zr	mg/L	0.002	< 0.02	< 0.02

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Tessier Extraction

Metals Bound to Fe and Mn Oxides
Reagent: 15 mL of 0.04M NH2OH. HCl in 25% HOAc

Sample			E-SB-05 (51-56) Bound to Fe&Mn Oxides	E-SB-07 (59-64) Bound to Fe&Mn Oxides	E-SB-15 (35-40) Bound to Fe&Mn Oxides
Reagent volume (mL)			15	15	15
Volume analysed (after wash dilution and preservation) (mL)			32.5	32.5	32.5
Final diluted solution weight (g)			32.79	31.585	31.9
Parameter	**Units**	**RDL**			
Hardness CaCO3	mg/L	0.05	620	190	177
Aluminum Al	mg/L	0.001	29	66.8	61.5
Antimony Sb	mg/L	0.0009	< 0.009	< 0.009	< 0.009
Arsenic As	mg/L	0.0002	0.015	0.015	0.018
Barium Ba	mg/L	0.00002	0.655	0.283	0.206
Beryllium Be	mg/L	0.000007	0.00765	0.0109	0.00929
Bismuth Bi	mg/L	0.00001	0.0021	0.0028	0.0015
Boron B	mg/L	0.002	0.09	0.14	0.09
Cadmium Cd	mg/L	0.000003	0.00078	0.0001	0.00026
Calcium Ca	mg/L	0.01	124	17	20
Chromium Cr	mg/L	0.00008	0.3	0.835	0.789
Cobalt Co	mg/L	0.000004	0.0492	0.092	0.0768
Copper Cu	mg/L	0.0002	0.117	0.323	0.183
Iron Fe	mg/L	0.007	329	152	152
Lead Pb	mg/L	0.00009	0.0747	0.0677	0.083
Lithium Li	mg/L	0.0001	0.0805	0.195	0.173
Magnesium Mg	mg/L	0.001	75.5	35.9	30.6
Manganese Mn	mg/L	0.00001	8.32	2.14	3.54
Mercury Hg	ug/L	0.01	0.01	0.03	0.03
Molybdenum Mo	mg/L	0.00004	0.0243	0.006	0.00515
Nickel Ni	mg/L	0.0001	0.111	0.256	0.223
Phosphorus P	mg/L	0.003	1.76	3.49	3.48
Potassium K	mg/L	0.003	6.31	9.57	8.47
Selenium Se	mg/L	0.00004	0.00242	0.00285	0.00237
Silicon Si	mg/L	0.02	24.5	46.1	43.4
Silver Ag	mg/L	0.00005	0.00019	0.00286	0.00424
Sodium Na	mg/L	0.01	64.7	71.6	62.4
Strontium Sr	mg/L	0.00002	0.155	0.102	0.0794
Sulphur (S)	mg/L	1	5	< 1	< 1
Thallium Tl	mg/L	0.000005	0.0002	0.0002	0.0002
Tin Sn	mg/L	0.00006	0.00149	0.00366	0.00108
Titanium Ti	mg/L	0.00005	0.0122	0.0175	0.0162
Uranium U	mg/L	0.000002	0.00312	0.00246	0.00307
Vanadium V	mg/L	0.00001	0.119	0.125	0.116
Zinc Zn	mg/L	0.002	0.249	0.38	0.328
Zirconium Zr	mg/L	0.002	0.01	0.011	0.012

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Tessier Extraction

Metals Bound to Fe and Mn Oxides
Reagent: 15 mL of 0.04M NH2OH. HCl in 25% HOAc

Sample			E-SB-07 (37-30) Bound to Fe&Mn Oxides	E-SB-15 (10-15) Bound to Fe&Mn Oxides	E-SB-19 (35-40) Bound to Fe&Mn Oxides	AW-23 (6-11.5) Bound to Fe&Mn Oxides	E-SB 19 (40-44) Bound to Fe&Mn Oxides
Reagent volume (mL)			15	15	15	15	15
Volume analysed (after wash dilution and preservation) (mL)			32.5	32.5	32.5	32.5	32.5
Final diluted solution weight (g)			31.5	33.49	32.26	32.33	32.55
Parameter	**Units**	**RDL**					
Hardness CaCO3	mg/L	0.05	653	712	255	425	525
Aluminum Al	mg/L	0.001	25.5	16.8	35.7	24.3	47.7
Antimony Sb	mg/L	0.0009	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009
Arsenic As	mg/L	0.0002	0.009	0.008	0.008	0.008	0.007
Barium Ba	mg/L	0.00002	0.254	0.423	0.265	0.401	0.303
Beryllium Be	mg/L	0.000007	0.00782	0.0114	0.00969	0.0106	0.0158
Bismuth Bi	mg/L	0.00001	0.0013	0.0023	0.0012	0.0016	0.0027
Boron B	mg/L	0.002	0.1	0.17	0.13	0.13	0.13
Cadmium Cd	mg/L	0.000003	0.00345	0.00507	0.00106	0.00201	0.00022
Calcium Ca	mg/L	0.01	126	131	43	71	75
Chromium Cr	mg/L	0.00008	0.565	0.273	0.6	0.835	0.875
Cobalt Co	mg/L	0.000004	0.0736	0.0909	0.0803	0.074	0.0841
Copper Cu	mg/L	0.0002	0.251	0.162	0.184	0.264	0.161
Iron Fe	mg/L	0.007	74.6	87.8	107	91.1	717
Lead Pb	mg/L	0.00009	0.0902	0.138	0.0532	0.0986	0.0946
Lithium Li	mg/L	0.0001	0.0918	0.117	0.127	0.119	0.105
Magnesium Mg	mg/L	0.001	82.1	93.6	36.1	60.1	82.2
Manganese Mn	mg/L	0.00001	1.17	0.97	2.62	2.04	10.6
Mercury Hg	ug/L	0.01	0.02	0.02	0.02	0.03	0.02
Molybdenum Mo	mg/L	0.00004	0.0326	0.00397	0.004	0.0246	0.0709
Nickel Ni	mg/L	0.0001	0.193	0.234	0.192	0.184	0.152
Phosphorus P	mg/L	0.003	1.86	2.81	1.15	1.12	2.17
Potassium K	mg/L	0.003	5.57	5.31	6.46	5.31	9.08
Selenium Se	mg/L	0.00004	0.00322	0.0077	0.00223	0.0044	0.00229
Silicon Si	mg/L	0.02	32.3	37.4	33.2	33	34.5
Silver Ag	mg/L	0.00005	0.00427	0.00263	0.00924	0.00438	0.00378
Sodium Na	mg/L	0.01	249	517	91.8	433	59.3
Strontium Sr	mg/L	0.00002	0.0795	0.0864	0.0605	0.0755	0.127
Sulphur (S)	mg/L	1	4	4	1	4	4
Thallium Tl	mg/L	0.000005	0.0001	0.00027	0.00012	0.00006	0.0002
Tin Sn	mg/L	0.00006	0.00199	0.00147	0.00128	0.00119	0.00215
Titanium Ti	mg/L	0.00005	0.009	0.00886	0.00841	0.00776	0.0228
Uranium U	mg/L	0.000002	0.0045	0.00637	0.00394	0.00505	0.00426
Vanadium V	mg/L	0.00001	0.114	0.181	0.104	0.181	0.372
Zinc Zn	mg/L	0.002	0.343	0.354	0.296	0.334	0.336
Zirconium Zr	mg/L	0.002	0.011	0.012	0.012	0.011	0.01

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Tessier Extraction

Metals Bound to Fe and Mn Oxides
Reagent: 15 mL of 0.04M NH2OH. HCl in 25% HOAc

Sample			E-SB-05 (52-30) Bound to Fe&Mn Oxides	Blank Bound to Fe&Mn Oxides
Reagent volume (mL)			15	15
Volume analysed (after wash dilution and preservation) (mL)			32.5	32.5
Final diluted solution weight (g)			28.17	33.01
Parameter	**Units**	**RDL**		
Hardness CaCO3	mg/L	0.05	2140	< 0.5
Aluminum Al	mg/L	0.001	21.6	0.02
Antimony Sb	mg/L	0.0009	< 0.009	< 0.009
Arsenic As	mg/L	0.0002	0.031	< 0.002
Barium Ba	mg/L	0.00002	0.496	< 0.0008
Beryllium Be	mg/L	0.000007	0.0103	< 0.00007
Bismuth Bi	mg/L	0.00001	0.0031	< 0.0001
Boron B	mg/L	0.002	0.14	< 0.02
Cadmium Cd	mg/L	0.000003	0.00247	< 0.00003
Calcium Ca	mg/L	0.01	454	< 0.1
Chromium Cr	mg/L	0.00008	0.445	0.0055
Cobalt Co	mg/L	0.000004	0.0965	0.00004
Copper Cu	mg/L	0.0002	0.0592	0.0013
Iron Fe	mg/L	0.007	203	0.073
Lead Pb	mg/L	0.00009	0.203	0.00043
Lithium Li	mg/L	0.0001	0.11	0.0058
Magnesium Mg	mg/L	0.001	244	0.019
Manganese Mn	mg/L	0.00001	4.06	0.0005
Mercury Hg	ug/L	0.01	0.01	< 0.01
Molybdenum Mo	mg/L	0.00004	0.0225	0.00391
Nickel Ni	mg/L	0.0001	0.241	0.0023
Phosphorus P	mg/L	0.003	2.83	0.027
Potassium K	mg/L	0.003	5.32	< 0.009
Selenium Se	mg/L	0.00004	0.00526	0.00082
Silicon Si	mg/L	0.02	35.6	0.03
Silver Ag	mg/L	0.00005	0.00206	0.00014
Sodium Na	mg/L	0.01	236	0.1
Strontium Sr	mg/L	0.00002	0.249	0.00026
Sulphur (S)	mg/L	1	7	5
Thallium Tl	mg/L	0.000005	0.00053	0.00002
Tin Sn	mg/L	0.00006	0.00128	0.00175
Titanium Ti	mg/L	0.00005	0.0281	0.00067
Uranium U	mg/L	0.000002	0.00716	0.00014
Vanadium V	mg/L	0.00001	0.277	0.00021
Zinc Zn	mg/L	0.002	0.756	0.033
Zirconium Zr	mg/L	0.002	0.008	0.002

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Tessier Extraction

Metals Bound to Organics
Reagent: 3 mL of 0.02 M HNO3 + 5 mL 30% H2O2
+ 5 mL 1.2 M NH4OAc in 20% HNO3

Sample			E-SB-05 (51-56) Bound in Organics	E-SB-07 (59-64) Bound in Organics	E-SB-15 (35-40) Bound in Organics
Reagent volume (mL)			15	15	15
Volume analysed (after wash dilution and preservation) (mL) (Vol. is approximate)			37.5	37.5	37.5
Final diluted solution weight (g)			36.325	36.37	36.8
Parameter	**Units**	**RDL**			
Hardness CaCO3	mg/L	0.05	71.5	52.7	49.4
Aluminum Al	mg/L	0.001	8.36	8.25	6.73
Antimony Sb	mg/L	0.0009	< 0.0009	< 0.0009	< 0.0009
Arsenic As	mg/L	0.0002	0.0033	0.0029	0.0025
Barium Ba	mg/L	0.00002	0.406	0.129	0.0908
Beryllium Be	mg/L	0.000007	0.00094	0.0009	0.00053
Bismuth Bi	mg/L	0.00001	0.00002	0.00002	0.00133
Boron B	mg/L	0.002	0.04	0.036	0.038
Cadmium Cd	mg/L	0.000003	0.00134	0.00008	0.00024
Calcium Ca	mg/L	0.01	10.4	6.35	6.8
Chromium Cr	mg/L	0.00008	0.0349	0.0738	0.0722
Cobalt Co	mg/L	0.000004	0.034	0.0349	0.024
Copper Cu	mg/L	0.0002	2.78	0.205	0.0875
Iron Fe	mg/L	0.007	3.34	1.55	1.52
Lead Pb	mg/L	0.00009	0.00947	0.00765	0.00641
Lithium Li	mg/L	0.0001	0.0553	0.0705	0.0638
Magnesium Mg	mg/L	0.001	11	8.96	7.87
Manganese Mn	mg/L	0.00001	0.952	0.413	0.436
Mercury Hg	ug/L	0.01	< 0.01	< 0.01	< 0.01
Molybdenum Mo	mg/L	0.00004	0.0477	0.00473	0.00531
Nickel Ni	mg/L	0.0001	0.0638	0.0768	0.0589
Phosphorus P	mg/L	0.003	0.19	0.37	0.46
Potassium K	mg/L	0.003	2.5	3.5	2.84
Selenium Se	mg/L	0.00004	0.00941	0.00193	0.00228
Silicon Si	mg/L	0.02	12.2	13.9	13.8
Silver Ag	mg/L	0.00005	0.00207	0.00164	0.0012
Sodium Na	mg/L	0.01	18.1	17.2	17.2
Strontium Sr	mg/L	0.00002	0.0341	0.0343	0.0308
Sulphur (S)	mg/L	1	19	9	9
Thallium Tl	mg/L	0.000005	0.00028	0.00023	0.0002
Tin Sn	mg/L	0.00006	0.0113	0.0101	0.0117
Titanium Ti	mg/L	0.00005	0.0334	0.108	0.0954
Uranium U	mg/L	0.000002	0.001	0.00075	0.0007
Vanadium V	mg/L	0.00001	0.0023	0.0491	0.0467
Zinc Zn	mg/L	0.002	0.28	0.122	0.142
Zirconium Zr	mg/L	0.002	0.002	< 0.002	0.008

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Tessier Extraction

Metals Bound to Organics
Reagent: 3 mL of 0.02 M HNO3 + 5 mL 30% H2O2
+ 5 mL 1.2 M NH4OAc in 20% HNO3

Sample			E-SB-07 (37-30) Bound in Organics	E-SB-15 (10-15) Bound in Organics	E-SB-19 (35-40) Bound in Organics	AW-23 (6-11.5) Bound in Organics	E-SB 19 (40-44) Bound in Organics
Reagent volume (mL)			15	15	15	15	15
Volume analysed (after wash dilution and preservation) (mL) (Vol. is approximate)			37.5	37.5	37.5	37.5	37.5
Final diluted solution weight (g)			36.5	36.71	36.04	36.89	37.30
Parameter	**Units**	**RDL**					
Hardness CaCO3	mg/L	0.05	130	192	63	126	54.5
Aluminum Al	mg/L	0.001	9.5	20.1	10.5	14.5	6.37
Antimony Sb	mg/L	0.0009	< 0.0009	< 0.0009	< 0.0009	< 0.0009	< 0.0009
Arsenic As	mg/L	0.0002	0.0032	0.0047	0.0046	0.005	0.0009
Barium Ba	mg/L	0.00002	0.243	0.398	0.225	0.507	0.132
Beryllium Be	mg/L	0.000007	0.00104	0.00155	0.00099	0.0017	0.00091
Bismuth Bi	mg/L	0.00001	0.00003	0.00004	0.00005	0.00005	0.00001
Boron B	mg/L	0.002	0.032	0.041	0.038	0.042	0.031
Cadmium Cd	mg/L	0.000003	0.00052	0.0009	0.00024	0.0005	0.00012
Calcium Ca	mg/L	0.01	23.4	32.8	9.77	20.7	6.16
Chromium Cr	mg/L	0.00008	0.177	0.209	0.129	0.23	0.0337
Cobalt Co	mg/L	0.000004	0.0252	0.0445	0.0271	0.0316	0.019
Copper Cu	mg/L	0.0002	0.0396	0.292	0.0171	0.101	0.178
Iron Fe	mg/L	0.007	0.98	7.55	1.64	1.93	4.32
Lead Pb	mg/L	0.00009	0.00942	0.0161	0.0058	0.0133	0.00568
Lithium Li	mg/L	0.0001	0.0398	0.0559	0.0515	0.0503	0.0498
Magnesium Mg	mg/L	0.001	17.4	26.7	9.39	18.1	9.51
Manganese Mn	mg/L	0.00001	0.356	0.408	0.706	0.618	0.726
Mercury Hg	ug/L	0.01	0.02	< 0.01	< 0.01	0.02	< 0.01
Molybdenum Mo	mg/L	0.00004	0.0119	0.0113	0.0151	0.0951	0.00346
Nickel Ni	mg/L	0.0001	0.0929	0.17	0.0811	0.109	0.0338
Phosphorus P	mg/L	0.003	0.46	0.61	0.3	0.29	0.16
Potassium K	mg/L	0.003	2.7	2.92	2.83	2.8	2.33
Selenium Se	mg/L	0.00004	0.0085	0.03	0.0046	0.0159	0.00169
Silicon Si	mg/L	0.02	18.9	23.6	16.3	20.2	10.3
Silver Ag	mg/L	0.00005	0.00114	0.00072	0.00177	0.00353	0.002
Sodium Na	mg/L	0.01	22.1	32.5	18.4	34.9	16.7
Strontium Sr	mg/L	0.00002	0.0384	0.048	0.0315	0.0453	0.0214
Sulphur (S)	mg/L	1	10	19	9	11	11
Thallium Tl	mg/L	0.000005	0.00019	0.00025	0.00017	0.00017	0.00024
Tin Sn	mg/L	0.00006	0.00923	0.0407	0.0127	0.0128	0.00848
Titanium Ti	mg/L	0.00005	0.116	0.294	0.0928	0.129	0.0593
Uranium U	mg/L	0.000002	0.00055	0.00239	0.00189	0.00095	0.00054
Vanadium V	mg/L	0.00001	0.101	0.152	0.0843	0.173	0.0102
Zinc Zn	mg/L	0.002	0.091	0.243	0.097	0.12	0.098
Zirconium Zr	mg/L	0.002	< 0.002	0.011	< 0.002	0.003	< 0.002

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Tessier Extraction

Metals Bound to Organics Reagent: 3 mL of 0.02 M HNO3 + 5 mL 30% H2O2 + 5 mL 1.2 M NH4OAc in 20% HNO3				
Sample			**E-SB-05 (52-30) Bound in Organics**	**Blank Bound in Organics**
Reagent volume (mL)			15	15
Volume analysed (after wash dilution and preservation) (mL) (Vol. is approximate)			37.5	37.5
Final diluted solution weight (g)			36.01	39.06
Parameter	**Units**	**RDL**		
Hardness CaCO3	mg/L	0.05	214	5.4
Aluminum Al	mg/L	0.001	29.9	0.073
Antimony Sb	mg/L	0.0009	< 0.0009	< 0.0009
Arsenic As	mg/L	0.0002	0.0076	0.0003
Barium Ba	mg/L	0.00002	0.195	0.00219
Beryllium Be	mg/L	0.000007	0.00128	0.00001
Bismuth Bi	mg/L	0.00001	0.00002	0.00001
Boron B	mg/L	0.002	0.037	0.008
Cadmium Cd	mg/L	0.000003	0.0003	0.00001
Calcium Ca	mg/L	0.01	42	1.54
Chromium Cr	mg/L	0.00008	0.189	0.0126
Cobalt Co	mg/L	0.000004	0.0519	0.00035
Copper Cu	mg/L	0.0002	0.755	0.002
Iron Fe	mg/L	0.007	42.2	0.07
Lead Pb	mg/L	0.00009	0.0108	0.00072
Lithium Li	mg/L	0.0001	0.0497	0.0002
Magnesium Mg	mg/L	0.001	26.6	0.37
Manganese Mn	mg/L	0.00001	0.482	0.0016
Mercury Hg	ug/L	0.01	0.02	< 0.01
Molybdenum Mo	mg/L	0.00004	0.0703	0.00711
Nickel Ni	mg/L	0.0001	0.158	0.0087
Phosphorus P	mg/L	0.003	0.69	13.3
Potassium K	mg/L	0.003	1.68	0.19
Selenium Se	mg/L	0.00004	0.0294	0.00106
Silicon Si	mg/L	0.02	20.3	0.11
Silver Ag	mg/L	0.00005	0.00166	0.00018
Sodium Na	mg/L	0.01	22.3	16.7
Strontium Sr	mg/L	0.00002	0.0522	0.00848
Sulphur (S)	mg/L	1	69	< 1
Thallium Tl	mg/L	0.000005	0.00083	< 0.000005
Tin Sn	mg/L	0.00006	0.00711	7.69
Titanium Ti	mg/L	0.00005	0.526	0.00257
Uranium U	mg/L	0.000002	0.00242	0.00009
Vanadium V	mg/L	0.00001	0.0997	0.00016
Zinc Zn	mg/L	0.002	0.225	0.025
Zirconium Zr	mg/L	0.002	0.004	< 0.002

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SGS proposal: IBD
SGS project #: 2267

Sample receipt date: 13-Dec-23
Report date: 18-Apr-23

Version: Final

Metals - Multi-Acid Digestion with ICP-OES/MS Finish

Test Units Method Code	Residual wt g	Aluminum µg/g	Antimony µg/g	Arsenic µg/g	Boron µg/g	Barium µg/g	Beryllium µg/g	Bismuth µg/g	Cadmium µg/g	Calcium µg/g	Chromium µg/g	Cobalt µg/g	Copper µg/g	Iron µg/g	Lead µg/g	Lithium µg/g	Magnesium µg/g
Lower detection		3	0.8	0.5	1	0.01	0.02	0.09	0.02	3	0.5	0.01	0.1	3	0.05	2	3
Sample ID																	
E-SB-05 (51-56) Residue	0.8468	71000	< 0.8	7.7	< 1	460	2.1	0.1	0.03	1700	63	12.0	37	33000	8	59	9200
E-SB-07 (59-64) Residue	0.9466	73000	< 0.8	3.5	< 1	410	2.1	0.1	< 0.02	990	76	12.0	20	28000	8	56	8600
E-SB-15 (35-40) Residue	0.9666	68000	< 0.8	3.2	< 1	370	1.8	< 0.09	< 0.02	1100	76	9.7	14	23000	7	46	7100
E-SB-07 (37-30) Residue	0.8826	59000	< 0.8	5.4	< 1	470	1.7	0.19	0.05	2800	73	8.7	24	35000	15	46	6200
E-SB-15 (10-15) Residue	0.8534	66000	1.40	4.1	< 1	460	2.1	0.22	0.04	2000	78	10.0	37	43000	17	63	8200
E-SB-19 (35-40) Residue	0.9280	68000	< 0.8	7.1	< 1	420	2.1	0.22	0.02	1400	97	12.0	20	44000	11	53	7700
AW-23 (6-11.5) Residue	0.9081	60000	0.90	8.1	< 1	430	2.0	0.22	0.06	1900	90	11.0	32	45000	16	58	6900
E-SB 19 (40-44) Residue	0.8887	73000	< 0.8	3.1	< 1	390	2.3	< 0.09	< 0.02	1400	77	16.0	19	34000	8	62	9800
E-SB-05 (52-30) Residue	0.6819	56000	< 0.8	10	< 1	490	1.8	0.18	0.02	2700	67	7.1	30	31000	15	57	7200

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Test Units Method Code	Manganese µg/g	Molybdenum µg/g	Nickel µg/g	Phosphorus µg/g	Potassium µg/g	Selenium µg/g	Tin µg/g	Silver µg/g	Sodium µg/g	Strontium µg/g	Sulfur µg/g	Thallium µg/g	Titanium µg/g	Uranium µg/g	Vanadium µg/g	Zinc µg/g	Zirconium µg/g
Lower detection	0.1	0.1	0.1	3	3	0.1	6	0.5	3	0.02		0.02	0.1	0.002	1	0.7	0.03
Sample ID																	
E-SB-05 (51-56) Residue	270	4.7	33	1100	23000	< 0.1	260	< 0.5	9800	86	170.0	0.5	4500	2.5	100	68	270
E-SB-07 (59-64) Residue	220	0.4	31	990	22000	< 0.1	230	< 0.5	11000	82	300.0	0.5	5300	2.4	94	63	310
E-SB-15 (35-40) Residue	190	0.3	26	910	19000	< 0.1	210	< 0.5	11000	77	260.0	0.4	5000	2.3	81	55	300
E-SB-07 (37-30) Residue	190	0.6	26	1200	24000	0.1	250	< 0.5	7300	98	600.0	0.7	4000	2.5	81	78	260
E-SB-15 (10-15) Residue	180	0.6	29	1200	27000	0.3	240	< 0.5	5500	83	50.0	1.1	3700	2.8	110	110	210
E-SB-19 (35-40) Residue	280	0.8	34	950	22000	0.2	230	< 0.5	9000	79	320.0	0.6	4700	2.6	93	74	250
AW-23 (6-11.5) Residue	210	3.5	33	1200	22000	0.2	250	< 0.5	6300	84	440.0	0.8	4000	2.4	100	89	230
E-SB 19 (40-44) Residue	290	2.5	38	970	21000	< 0.1	230	< 0.5	9900	80	210.0	0.5	4800	2.1	94	74	270
E-SB-05 (52-30) Residue	150	3.7	23	1300	25000	< 0.1	290	0.6	6900	92	420.0	0.8	3900	2.7	97	67	220

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ATTACHMENT 3

Evaluation of Partition Coefficient Results, Ash Pond (CCR Unit 301) Edwards Power Plant, Peoria County, Illinois

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WSP GOLDER

ECHIC MEMRD M

D E March 30, 2022 **r** 21454831

David Mitchell, Stu Cravens, Vic Modeer
Illinois Power Resources Generating, LLC

CC Brian Henning - Ramboll

FR M Golder Associates USA Inc. **EM I r I r d r**

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ED RD ER E RI C I I I

I R D C I

Illinois Power Resource Generating, LLC (IPRG) operates the Edwards Power Plant (EPP) located in Peoria County, Illinois. The Edwards Ash Pond (EAP or Site), Illinois Environmental Protection Agency [IEPA] ID No. W1438050005 - 01) is a 91-acre unlined surface impoundment used to manage coal combustion residuals (CCRs) at the EPP. The EAP is regulated under Part 845 *"Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments"* (State CCR Rule or Part 845) which was promulgated by the Illinois Pollution Control Board (IPCB) on April 21, 2021. WSP Golder (Golder) is assisting IPRG with Part 845 compliance at the Site.

IPRG is currently preparing a Construction Permit application for the EAP as required under Section 845.220. As a 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 application for the EAP (Burns and McDonnell, 2021). In the Operating Permit (October 2021), Ramboll Americas Engineering Solutions, Inc. (Ramboll) identified potential GWPS exceedances for several compounds potentially associated with the EAP, including barium, boron, lithium, sulfate and total dissolved solids (TDS). Batch adsorption testing was conducted to generate site-specific partition coefficient results for these parameters for use in the groundwater models. This Technical Memorandum summarizes the results of the batch adsorption testing.

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In August 2021, Golder conducted a field investigation at the EPP which included the completion of six (6) soil/rock borings ranging in depth from 40 to 64 feet below ground surface. As a 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.

B D r

Gr d r ID	ID	r R
AW-15S	E-SB-05 (30.0-33.5 ft bgs)	2:1
		1:1

G d r I
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Gr□□□d□ □□r□□□ □□□ID□	□□□□□□ □□□ID□	□□□□□ □□r R□□□□□
		1:5
		1:10
		1:20
AW-19	E-SB-05 (30.0-33.5 ft bgs)	2:1
		1:1
		1:5
		1:10
		1:20

Notes:

1) Ft bgs – Feet below ground surface

Site-specific partitioning coefficients were determined for contaminants of interest (COIs) identified based on statical evaluation of potential groundwater exceedances calculated at the Site: barium, boron, lithium, and sulfate (Burns & McDonnell, 2021). Two groundwater samples (AW-15S and AW-19) and one soil sample (E-SB-05) were used for batch attenuation testing at various ratios (Table 1). For each treatment, 0.1 L of groundwater was brought in contact with an amount of soil (0.2 to 2 kg, depending on the ratio) over a seven-day period. Each contact water/soil microcosm was amended (spiked) with barium hydroxide, boric acid, sodium chloride, lithium chloride, and sodium sulfate to a target concentration of barium, boron, lithium, and sulfate, respectively (Table 2). After the seven-day contact period, COI concentrations were analyzed in the contact water. The control samples (i.e., groundwater samples AW-15S and AW-19) were only analyzed at the initiation of testing. 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.

□□□□□□□□M□r□□□□□ □□□ □□d□ □□□□□d□r□□□□□□□□□r□□□□□□r□C□l□□

C□l□	□□ □□d□ □□□□	□□r□□□C□□□□□r□□□□□□ □□□□
Barium	1.75 mL of a 1 g/L $Ba(OH)_2 \cdot 8H_2O$ solution	0.5
Boron	36.43 mL of a 2 g/L H_3BO_3 solution	12
Lithium	5.97 mL of a 1 g/L LiCl solution	0.5
Sulfate	1769.5 mg of Na_2SO_4	1,100

Notes:

1) Mg/L – milligrams per liter
2) $Ba(OH)_2 \cdot 8H_2O$ - barium hydroxide
3) H_3BO_3 - boric acid
4) LiCl - lithium chloride
5) Na_2SO_4 - sodium sulfate

The results of batch attenuation testing (Tables 3 and 4) were used to calculate the following adsorption isotherms for each COI:

- Linear: $q_e = K_D * C_e$

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- Langmuir: $C_e/q_e = 1/(K_L * q_m) + C_e/q_m$
- Freundlich: $\log(q_e) = \log(K_F) + (1/n)\log(C_e)$

Where

K_D, K_L, and K_F = the linear, Langmuir, and Freundlich partition coefficients, respectively (in liters per kilogram; L/kg).

q_e = concentration of the adsorbate in soil

C_e = aqueous concentration of the adsorbate

q_m = 1/slope in the linear expression of the isotherm

n = non-linearity constant

[illegible]

Figures that show the linear, Langmuir, and Freundlich isotherms for each COI are provided in Appendix A. The partition coefficient values for AW-15S and AW-19 are presented in Tables 5 and 6, respectively. The results of the batch adsorption testing can be summarized as follows:

- **B[illegible]**: The calculated K_D and K_L values for both AW-15S and AW-19 were negative (AW-15S: -22.9 and -6.5E+8 L/kg; AW-19: -12.4 and -8.5E+8 L/kg), indicating an inverse relationship between the concentration of barium in solution and the concentration of barium in soil. The K_F values for AW-15S and AW-19 were 736 and 738 L/kg, respectively. For comparison, in Strenge and Peterson (1989), partition coefficients for barium range from 53 to 16,000 L/kg, depending on pH conditions and the amount of sorbent (i.e. clay, organic matter, and iron and aluminum oxyhydroxide) present.
- **B[illegible]**: Calculated K_D values for AW-15S and AW-19 were 1.50 and -0.19 L/kg, respectively, K_L values 3.8E+4 and -2E+5 L/kg, respectively, and K_F values 82 and 215 L/kg, respectively. In Strenge and Peterson (1989), partition coefficients for boron range from 0.19 to 1.3 L/kg, depending on pH conditions and the amount of sorbent present.
- [illegible]: Calculated K_D values for AW-15S and AW-19 were 1.89 and -1.27 L/kg, respectively, K_L values 2.6E+8 and -2.4E+8 L/kg, respectively, and K_F values 234 and 230 L/kg, respectively. In Strenge and Peterson (1989), partition coefficients for lithium range from 0 to 0.8 L/kg, depending on pH conditions and the amount of sorbent present.
- [illegible]: Calculated K_D values for AW-15S and AW-19 were 0.47 and -1.0 L/kg, respectively, and K_L values 778 and -2,950 L/kg, respectively. The K_F values for AW-15S and AW-19 were 63 and 1.2 L/kg, respectively. In Strenge and Peterson (1989), partition coefficients for sulfate are 0.0 L/kg, regardless of pH conditions and the amount of sorbent present.
- **[illegible]**: Generally, after the seven-day contact time, the pH of each contact water was consistent with the pH of the control (6.95 to 6.96), ranging from 6.83 to 6.99 across the batch tests. The redox value of the control sample after the seven-day contact time was +65 mV for AW-15S and +51 for AW-19. The redox value of contact water ranged from -71 to +71 mV across treatments.

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REFERENCES

Burns & McDonnell, 2021. Initial Operating Permit Edwards Power Plant Ash Pond.

Strenge, D. and Peterson, S. 1989. Chemical Data Bases for the Multimedia Environmental Pollutant Assessment System (MEPAS) (No. PNL-7145). Pacific Northwest Lab., Richland, WA (USA).

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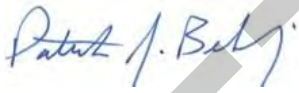
Golder appreciates the opportunity to serve as your consultant on this project. If you have any questions concerning this technical memorandum or need additional information, please contact the undersigned.

Golder Associates USA Inc.





Jeffrey Ingram

Senior Consultant, Geologist

Pat Behling

Practice Leader

CK/CK/JSI/PJB

Attachments Appendix A – Partition Coefficient Graphs

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Table 3: Batch Attenuation Testing Results, AW-15S

Geologic Material Sample ID	Treatment	Date	Day	Replicate	Dissolved Barium	Dissolved Boron	Dissolved Lithium	Dissolved Sulfate	pH	ORP
					mg/L	mg/L	mg/L	mg/L	SU	mV
	Groundwater Only Control	1/14/2022	0	AW-15S-1a	0.31	12	0.47	390	7.07	202
				AW-15S-2a	0.36	13	0.48	397	7.06	181
				Average Concentration (mg/L)	**0.33**	**13**	**0.48**	**394**	**7.07**	**192**
		1/21/2022	7	AW-15S-1a	0.069	13	0.49	395	6.95	64
				AW-15S-2a	0.074	13	0.48	392	6.96	66
				Average Concentration (mg/L)	**0.072**	**13**	**0.49**	**394**	**6.96**	**65**
AW-15S E-SB-05 (30.0-33.5)	2:1 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-15S 2:1-1	0.39	4.6	0.15	266	6.89	-60
				E-SB-05 (30.0-33.5): AW-15S 2:1-2	0.32	4.4	0.12	274	6.93	-75
				Average Concentration (mg/L)	**0.35**	**4.5**	**0.14**	**270**	**6.91**	**-68**
	1:1 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-15S 1:1-1	0.23	6.5	0.21	313	6.83	-68
				E-SB-05 (30.0-33.5): AW-15S 1:1-2	--	--	--	--	--	--
				Average Concentration (mg/L)	**0.23**	**6.5**	**0.21**	**313**	**6.83**	**-68**
	1:5 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-15S 1:5-1	0.13	10	0.36	375	6.89	15
				E-SB-05 (30.0-33.5): AW-15S 1:5-2	0.12	10	0.36	370	6.86	72
				Average Concentration (mg/L)	**0.13**	**10**	**0.36**	**373**	**6.88**	**44**
	1:10 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-15S 1:10-1	0.12	11	0.42	382	6.91	73
				E-SB-05 (30.0-33.5): AW-15S 1:10-2	0.11	12	0.43	375	6.94	68
				Average Concentration (mg/L)	**0.11**	**11**	**0.43**	**379**	**6.93**	**71**
	1:20 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-15S 1:20-1	0.10	12	0.45	393	6.99	96
				E-SB-05 (30.0-33.5): AW-15S 1:20-2	0.11	12	0.44	383	6.96	42
				Average Concentration (mg/L)	**0.11**	**12**	**0.45**	**388**	**6.98**	**69**

Notes:
1) mg/L- Miligrams per liter
2) SU - Standard Units
3) mV -milivolts
4) ORP - Oxidation Reduction Potential

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Table 4: Batch Attenuation Testing Results, AW-19

Geologic Material Sample ID	Treatment	Date	Day	Replicate	Dissolved Barium	Dissolved Boron	Dissolved Lithium	Dissolved Sulfate	pH	ORP
					mg/L	mg/L	mg/L	mg/L	SU	mV
	Groundwater Only Control	1/14/2022	0	AW-19-1a	0.22	12	0.46	386	7.08	156
				AW-19-2a	0.27	12	0.45	380	7.07	133
				Average Concentration (mg/L)	**0.25**	**12**	**0.46**	**383**	**7.08**	**145**
		1/21/2022	7	AW-19-1a	0.048	12	0.48	375	6.98	39
				AW-19-2a	0.049	12	0.51	390	6.92	62
				Average Concentration (mg/L)	**0.049**	**12**	**0.50**	**383**	**6.95**	**51**
AW-19 E-SB-05 (30.0-33.5)	2:1 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-19 2:1-1	0.27	4.3	0.11	270	6.93	-58
				E-SB-05 (30.0-33.5): AW-19 2:1-2	0.51	4.4	0.15	269	6.94	-71
				Average Concentration (mg/L)	**0.39**	**4.4**	**0.13**	**270**	**6.94**	**-65**
	1:1 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-19 1:1-1	0.24	6.6	0.24	314	6.98	-60
				E-SB-05 (30.0-33.5): AW-19 1:1-2	0.32	6.3	0.22	308	6.99	-82
				Average Concentration (mg/L)	**0.28**	**6.5**	**0.23**	**311**	**6.99**	**-71**
	1:5 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-19 1:5-1	0.16	10	0.36	358	6.92	-42
				E-SB-05 (30.0-33.5): AW-19 1:5-2	0.19	10	0.38	360	6.95	-32
				Average Concentration (mg/L)	**0.18**	**10**	**0.37**	**359**	**6.94**	**-37**
	1:10 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-19 1:10-1	0.17	10	0.40	365	6.92	-48
				E-SB-05 (30.0-33.5): AW-19 1:10-2	0.14	11	0.45	389	6.95	-52
				Average Concentration (mg/L)	**0.16**	**11**	**0.43**	**377**	**6.94**	**-50**
	1:20 Soil:Water Ratio	1/14/2022	0							
		1/21/2022	7	E-SB-05 (30.0-33.5): AW-19 1:20-1	0.11	12	0.46	381	7.00	-3
				E-SB-05 (30.0-33.5): AW-19 1:20-2	0.16	12	0.47	387	6.97	-45
				Average Concentration (mg/L)	**0.13**	**12**	**0.47**	**384**	**6.99**	**-24**

Notes:
1) mg/L- Miligrams per liter
2) SU - Standard Units
3) mV -milivolts
4) ORP - Oxidation Reduction Potential

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Table 5: Partition Coefficient Results, AW-15S

Analyte	Isotherm	Variable	With Soil Mass
Barium	Raw Data R^2		0.46
	Linear K_D (L/kg)		-22.85
	Langmuir	R^2	1.00
		q_m (mg/g)	0.498
		K_L (L/kg)	-6.48E+08
	Freundlich	R^2	0.55
		1/n	-0.01
		K_F (L/kg)	736.03
Boron	Raw Data R^2		0.99
	Linear K_D (L/kg)		1.50
	Langmuir	R^2	0.79
		q_m (mg/g)	0.068
		K_L (L/kg)	3.79E+04
	Freundlich	R^2	0.98
		1/n	0.764
		K_F (L/kg)	82.21
Lithium	Raw Data R^2		0.80
	Linear K_D (L/kg)		1.89
	Langmuir	R^2	1.00
		q_m (mg/g)	0.035
		K_L (L/kg)	2.58E+08
	Freundlich	R^2	0.79
		1/n	0.014
		K_F (L/kg)	234.30
Sulfate	Raw Data R^2		0.54
	Linear K_D (L/kg)		0.47
	Langmuir	R^2	0.07
		q_m (mg/g)	0.88
		K_L (L/kg)	7.78E+02
	Freundlich	R^2	0.56
		1/n	0.8
		K_F (L/kg)	63.43

Note(s):
K_D: linear partition coefficient
K_L: Langmuir partition coefficient
K_F: Freundlich partition coefficient
qm: 1/slope in the linear expression of the isotherm
n: non-linearity constant

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Table 6: Partition Coefficient Results, AW-19

Analyte	Isotherm	Variable	With Soil Mass
Barium	Raw Data R^2		0.51
	Linear K_D (L/kg)		-12.44
	Langmuir	R^2	1.00
		q_m (mg/g)	0.498
		K_L (L/kg)	-8.45E+08
	Freundlich	R^2	0.62
		1/n	-0.007
		K_F (L/kg)	737.55
Boron	Raw Data R^2		0.01
	Linear K_D (L/kg)		-0.19
	Langmuir	R^2	0.35
		q_m (mg/g)	0.002
		K_L (L/kg)	-1.99E+05
	Freundlich	R^2	0.07
		1/n	-0.578
		K_F (L/kg)	215.36
Lithium	Raw Data R^2		0.19
	Linear K_D (L/kg)		-1.27
	Langmuir	R^2	1.00
		q_m (mg/g)	0.034
		K_L (L/kg)	-2.37E+08
	Freundlich	R^2	0.119
		1/n	-0.008
		K_F (L/kg)	230.26
Sulfate	Raw Data R^2		0.28
	Linear K_D (L/kg)		-1.00
	Langmuir	R^2	0.16
		q_m (mg/g)	-0.021
		K_L (L/kg)	-2.95E+03
	Freundlich	R^2	0.16
		1/n	2.40
		K_F (L/kg)	1.16

Note(s):
K_D: linear partition coefficient
K_L: Langmuir partition coefficient
K_F: Freundlich partition coefficient
qm: 1/slope in the linear expression of the isotherm
n: non-linearity constant

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Partition Coefficient Graphs

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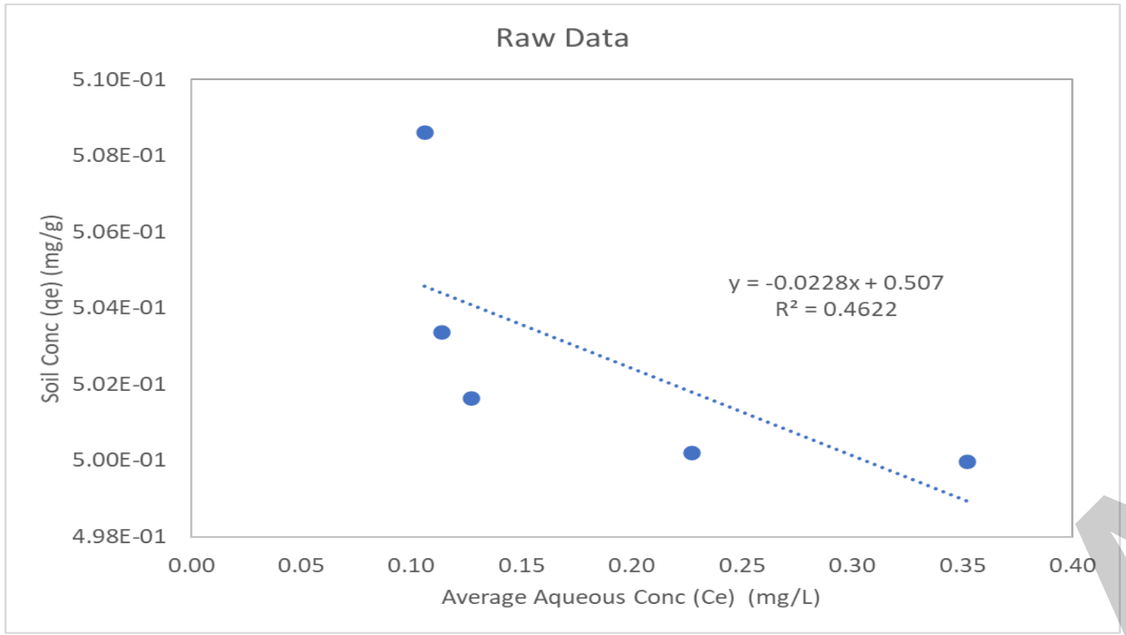

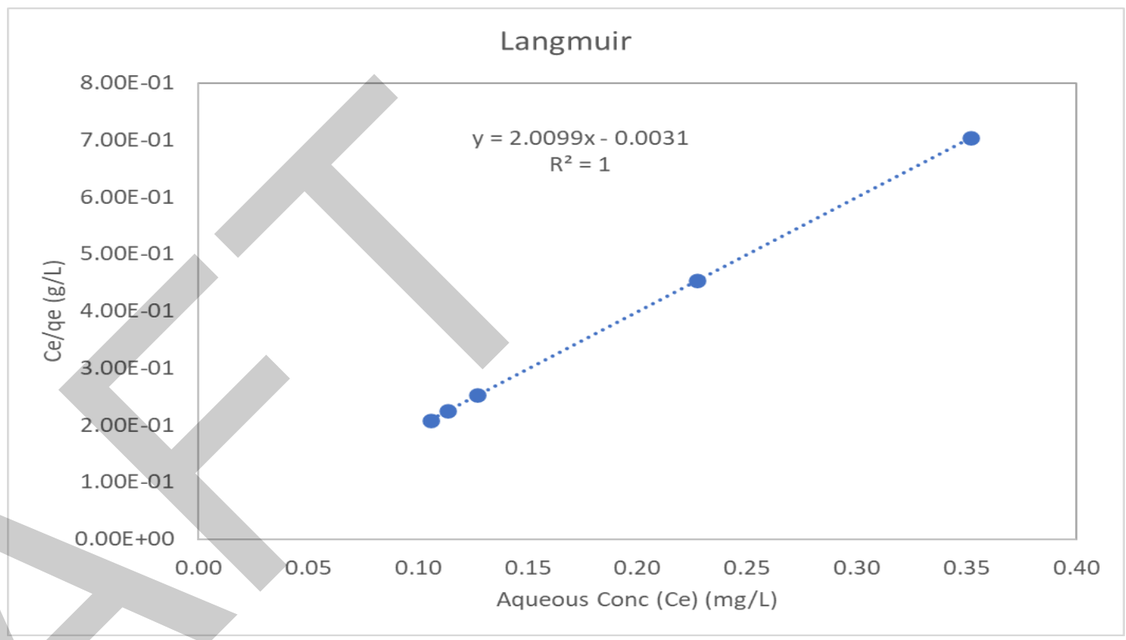

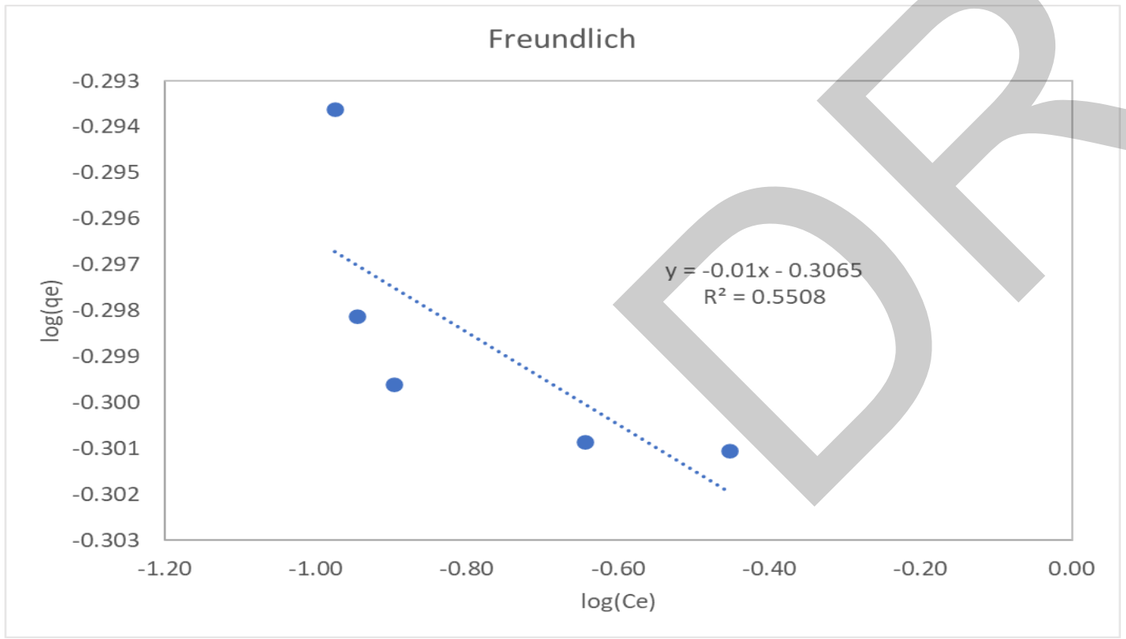

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Note(s):
mg/L: milligrams per liter
mg/g: milligrams per gram
g/L: grams per liter
Ce: aqueous concentration of the adsorbate

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GOLDER

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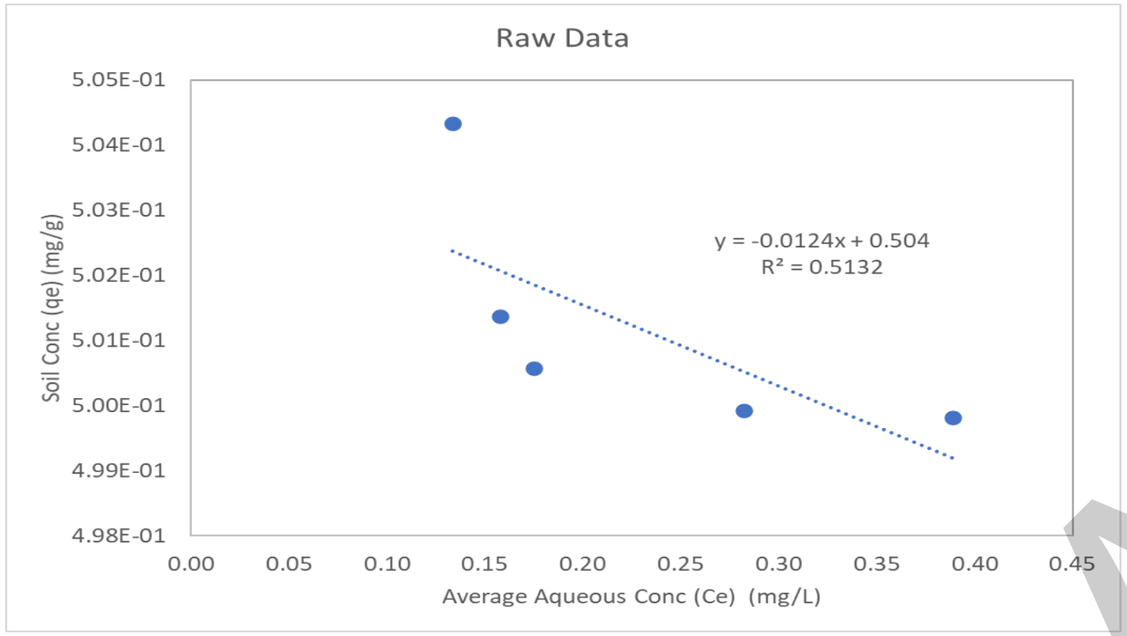

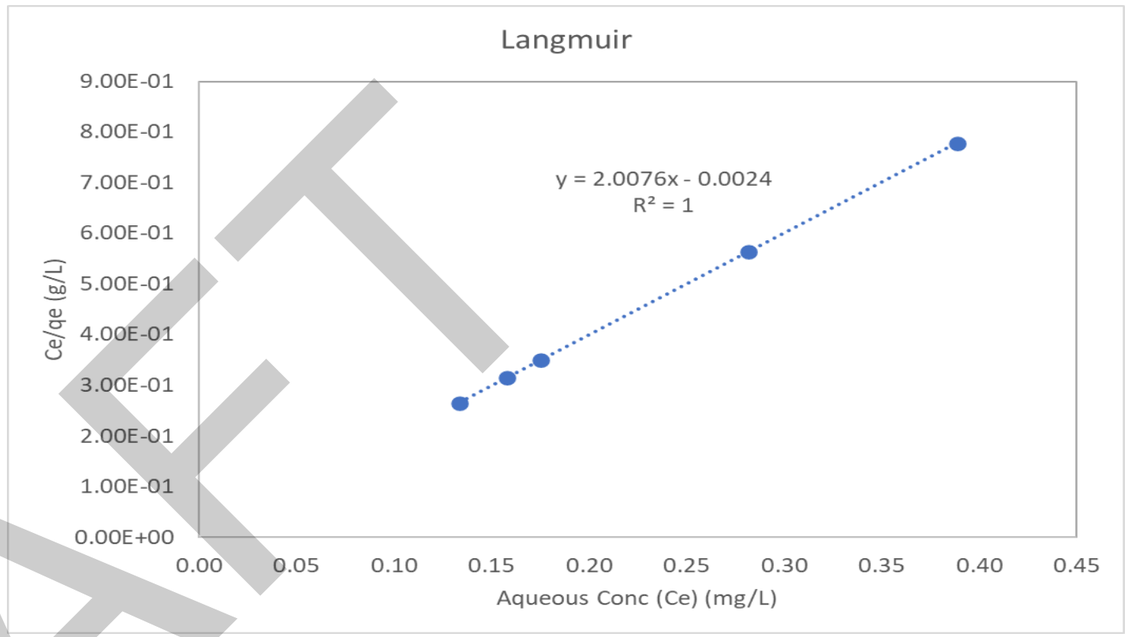

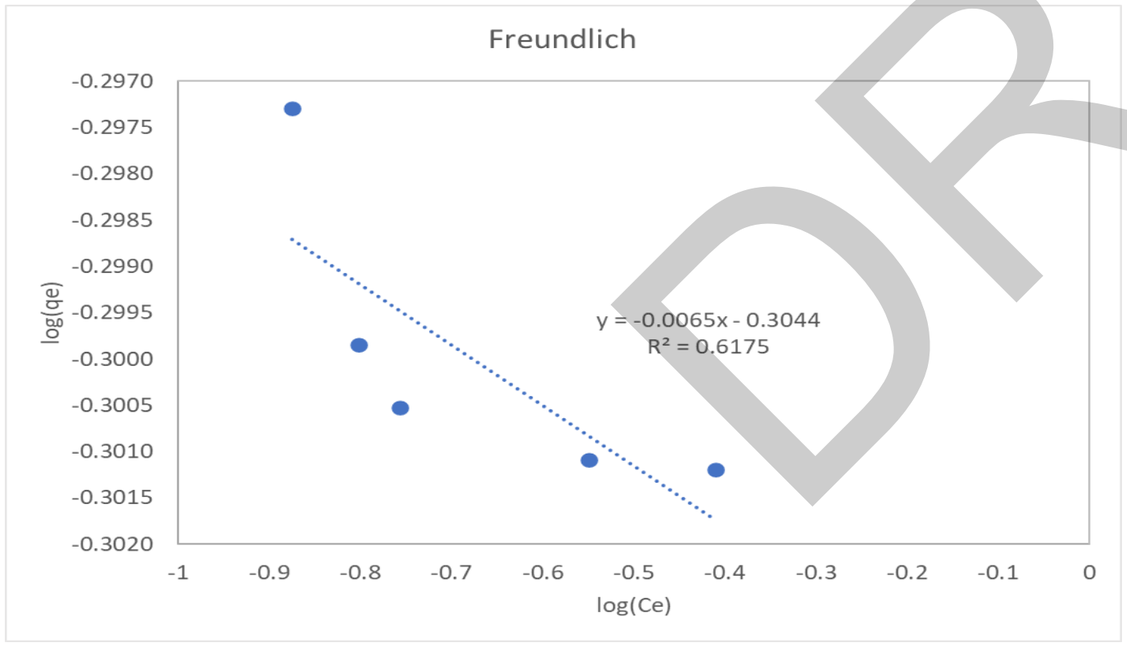

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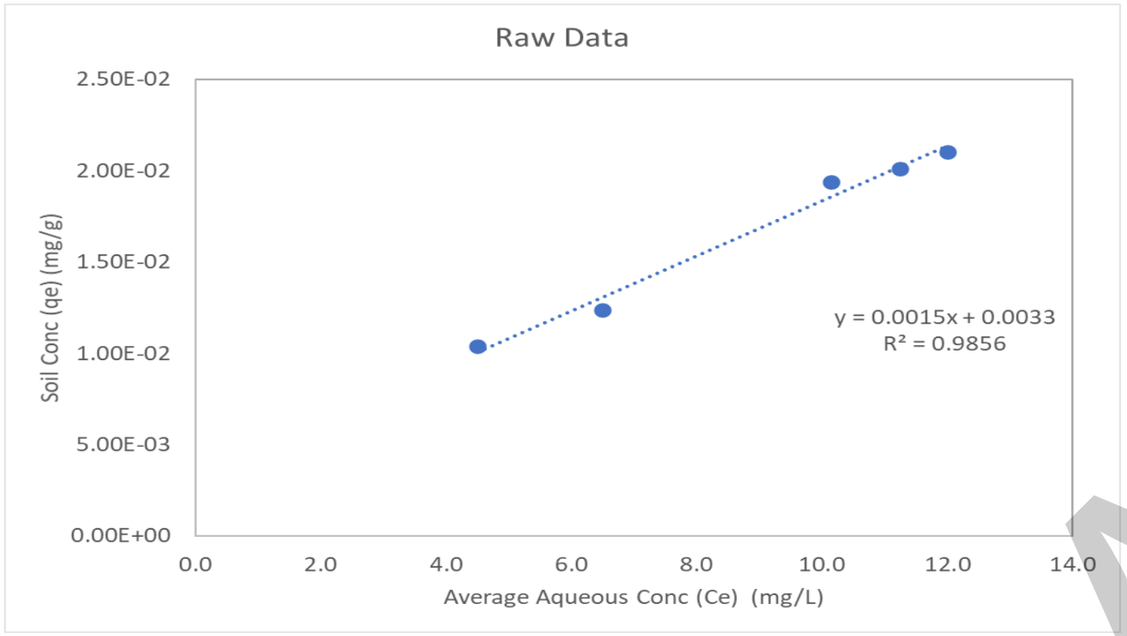

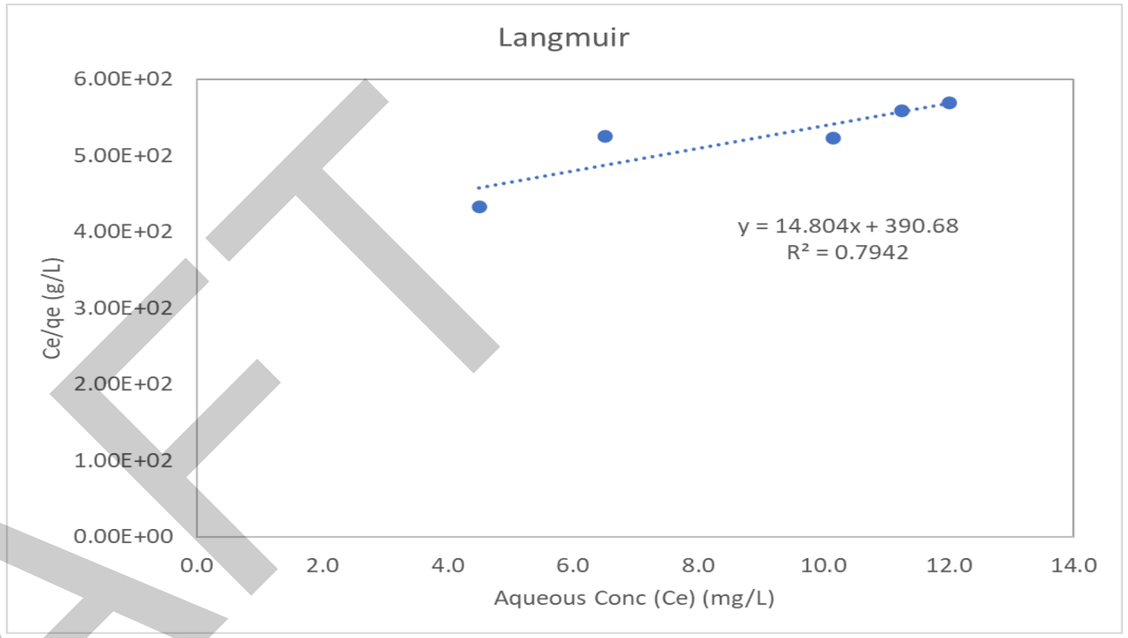

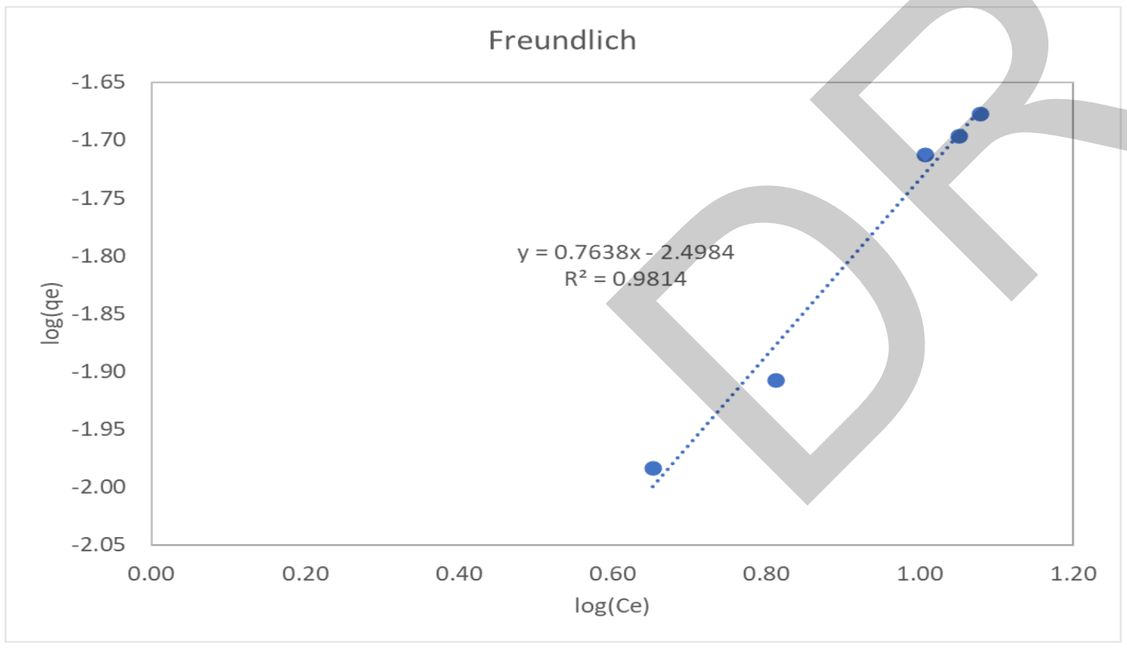

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Note(s):
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mg/g: milligrams per gram
g/L: grams per liter
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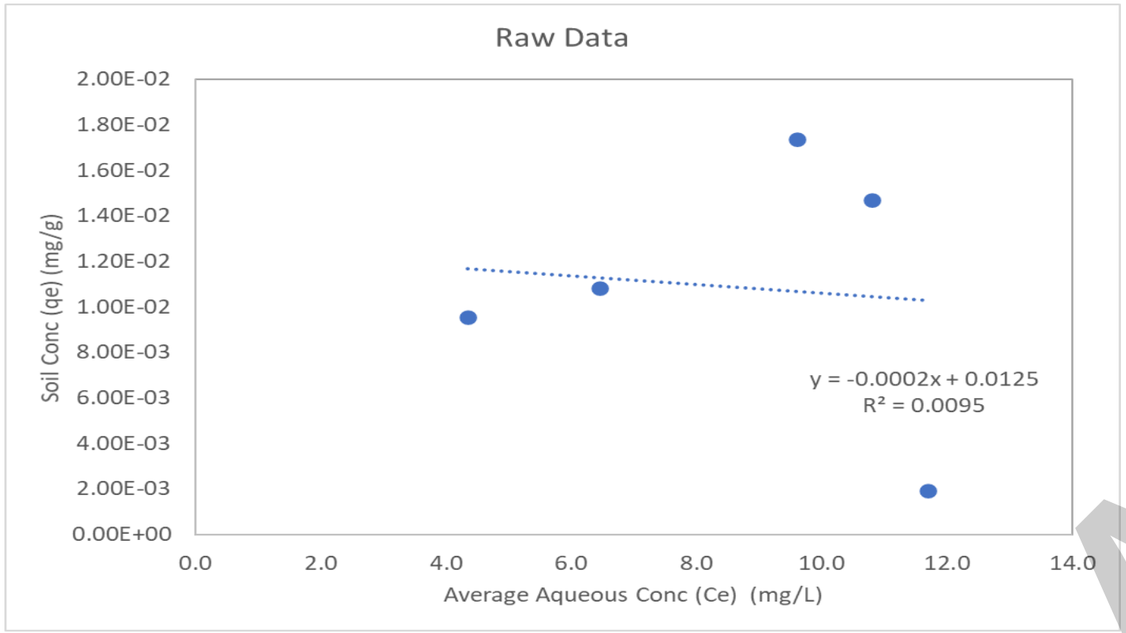

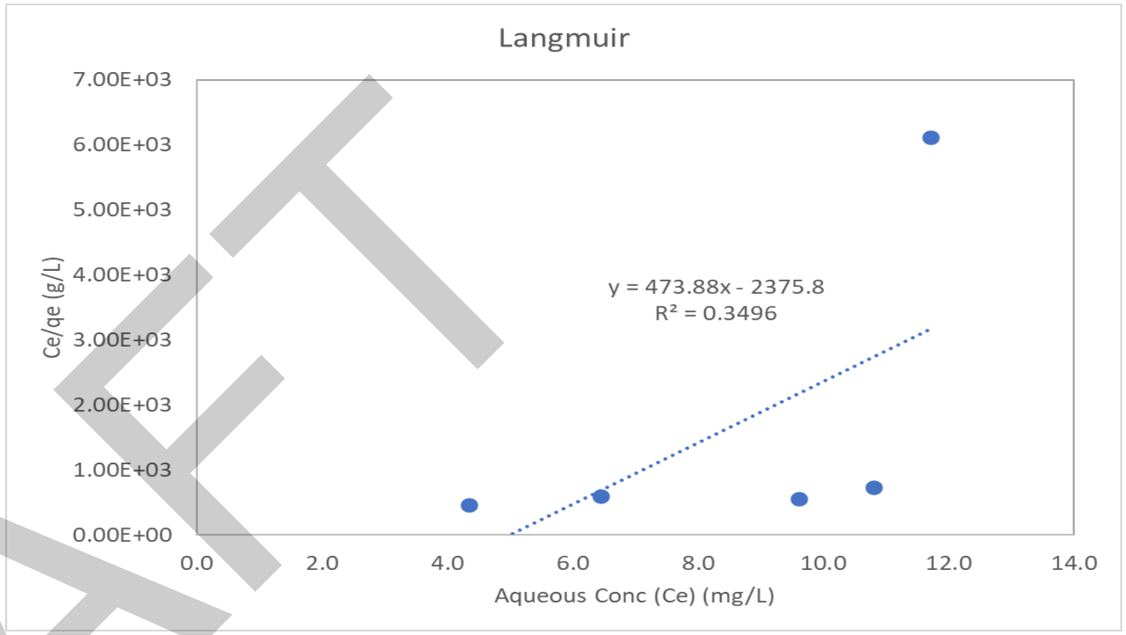

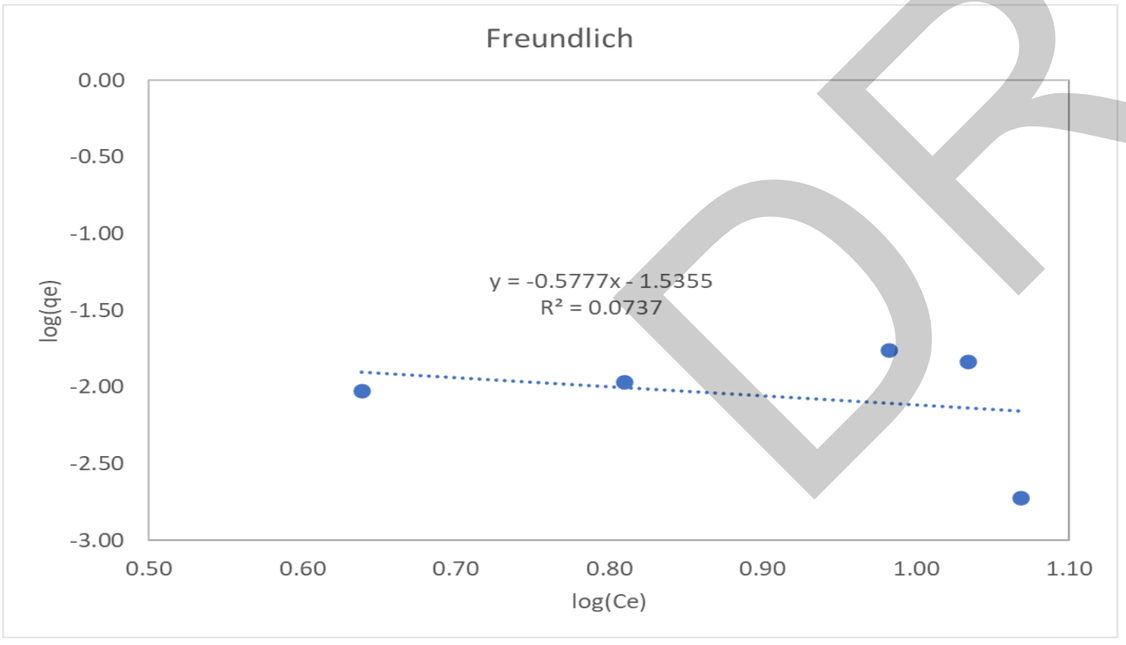

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PROJECT NO.	PHASE	REV.	FIGURE
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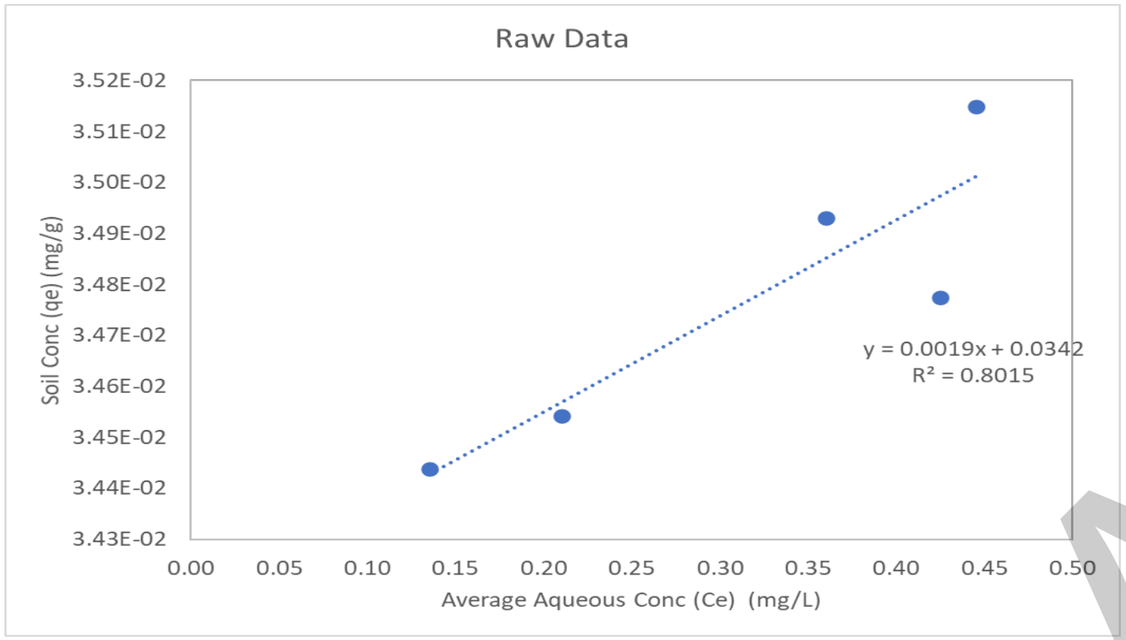

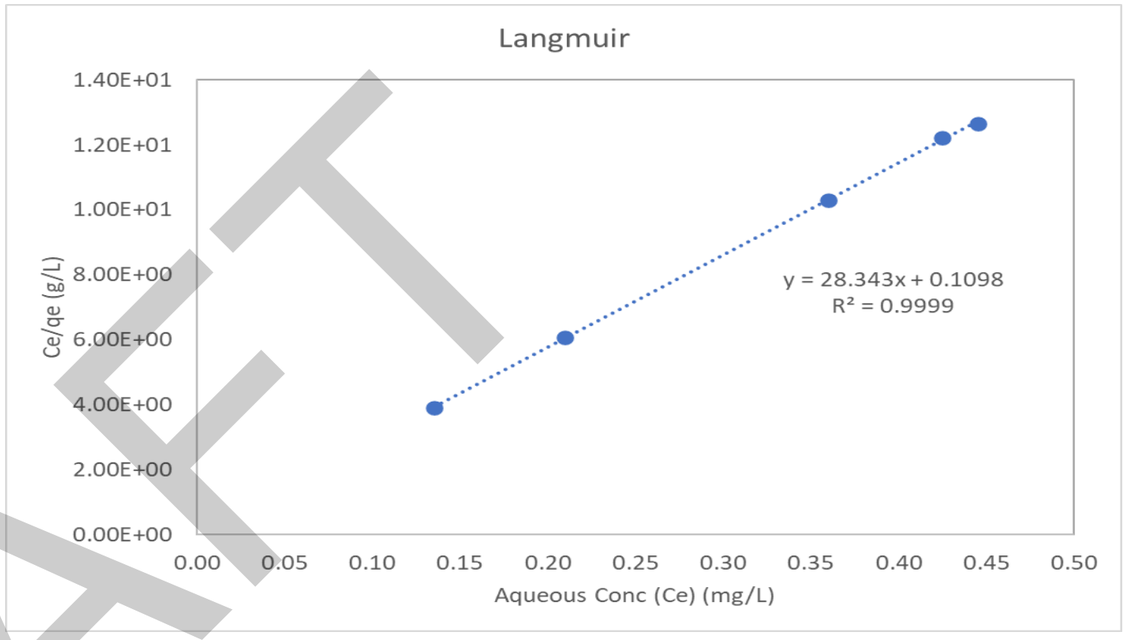

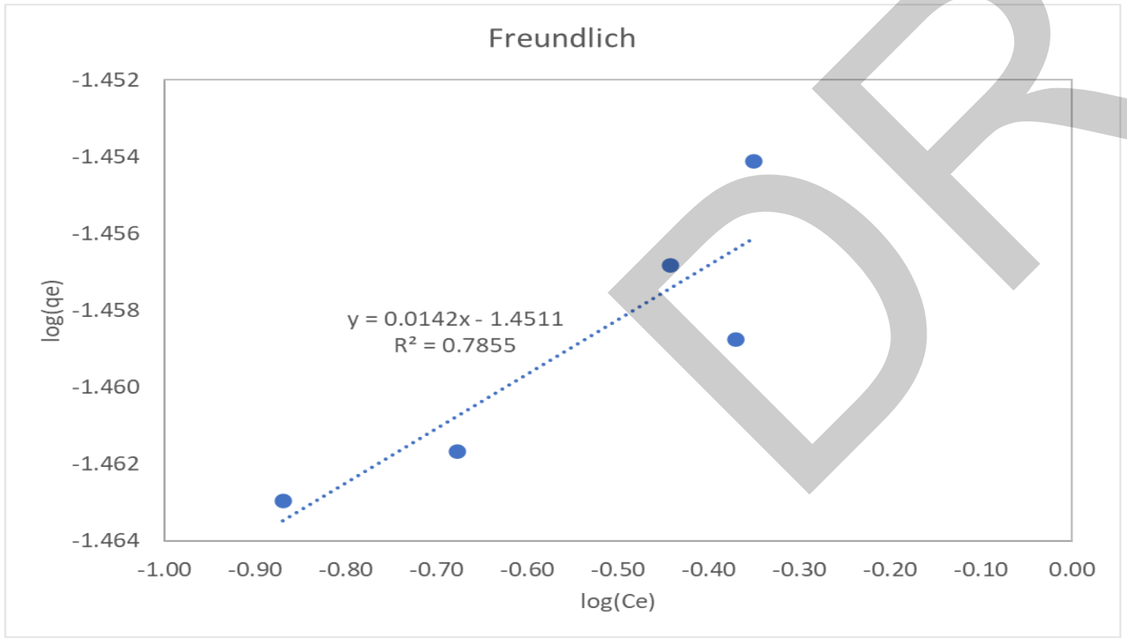

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PROJECT NO.	PHASE	REV.	FIGURE
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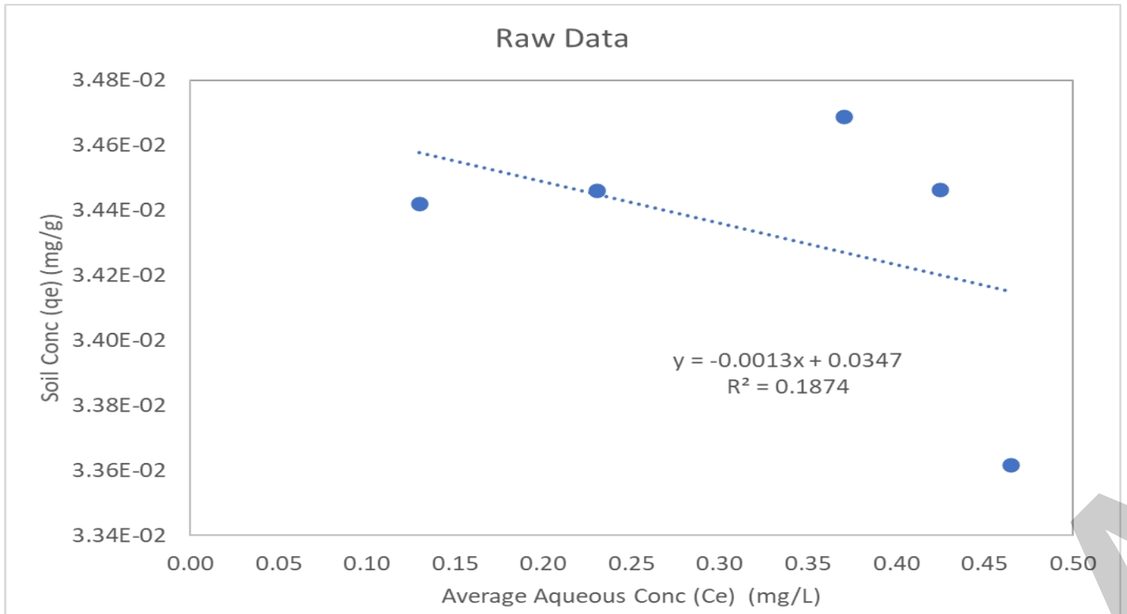

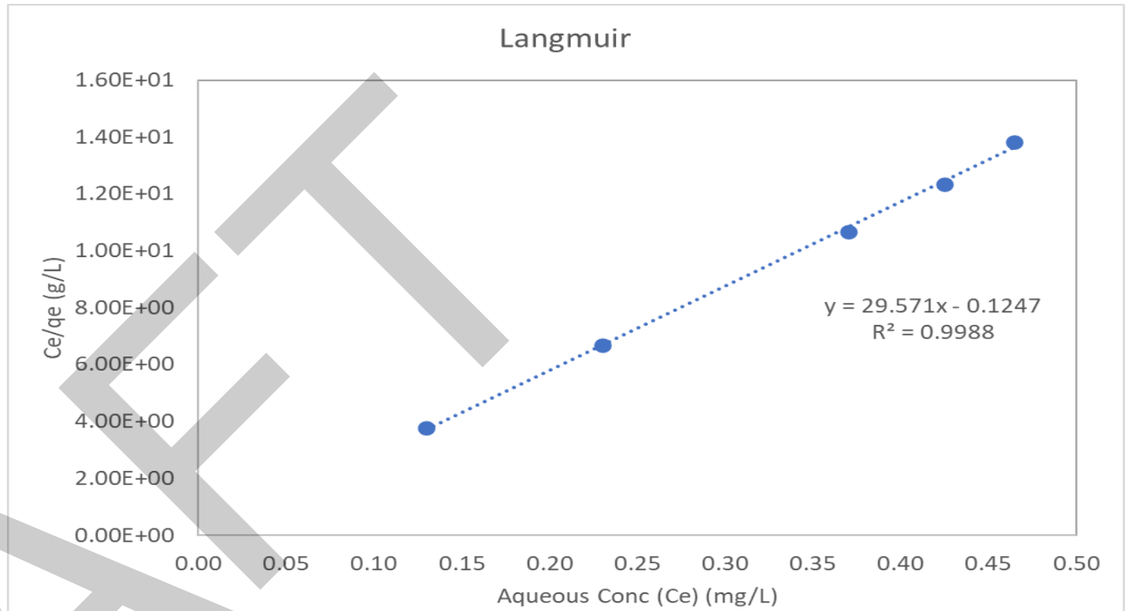

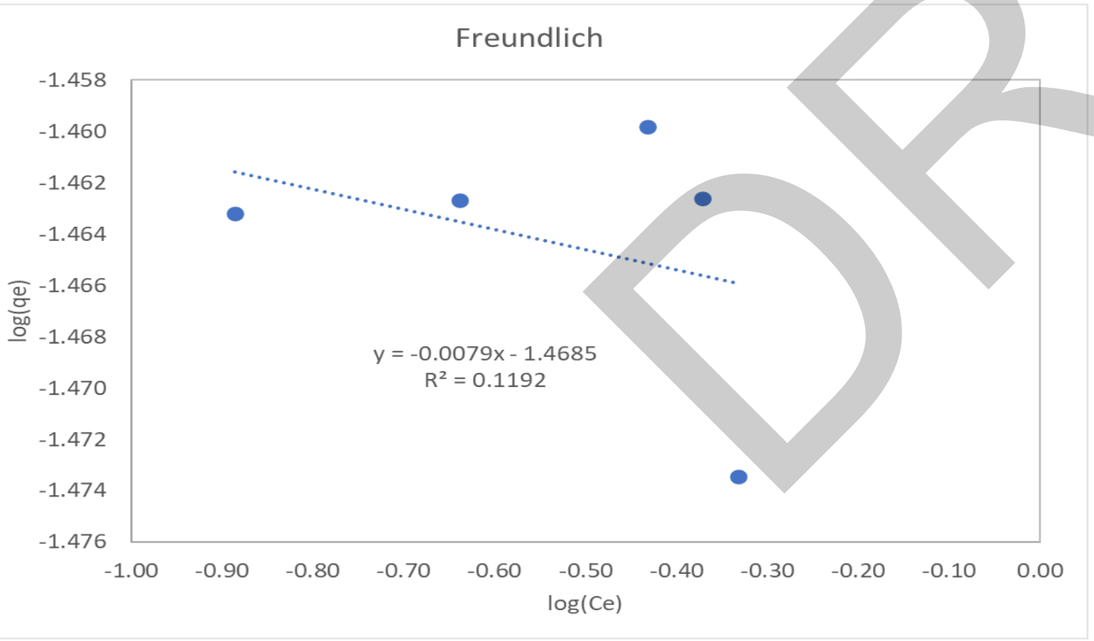

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PROJECT NO.	PHASE	REV.	FIGURE
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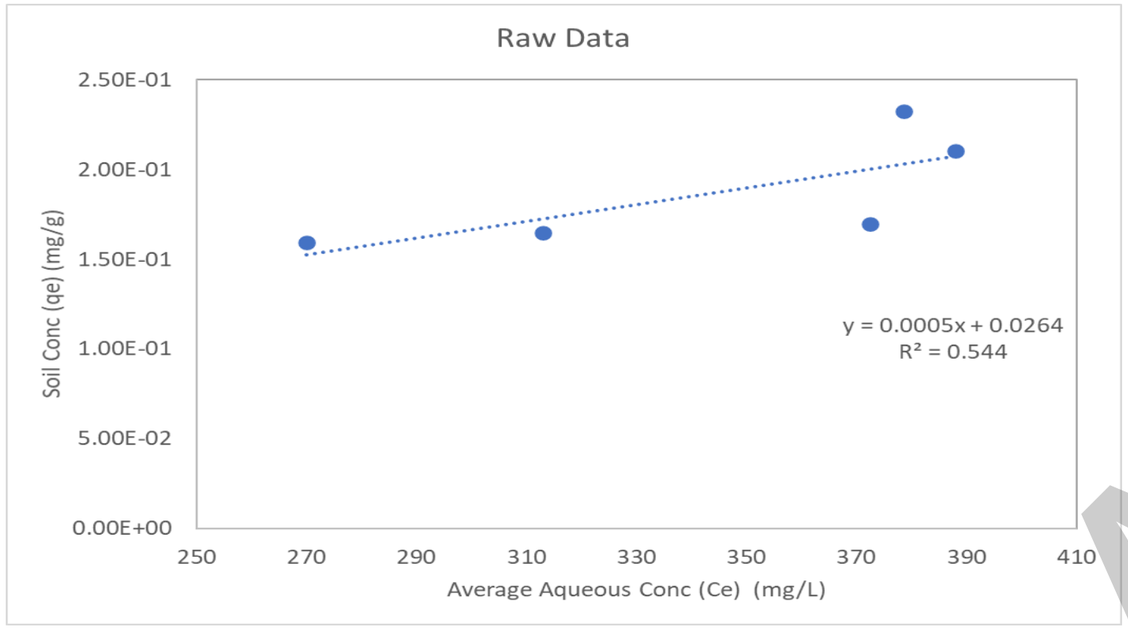

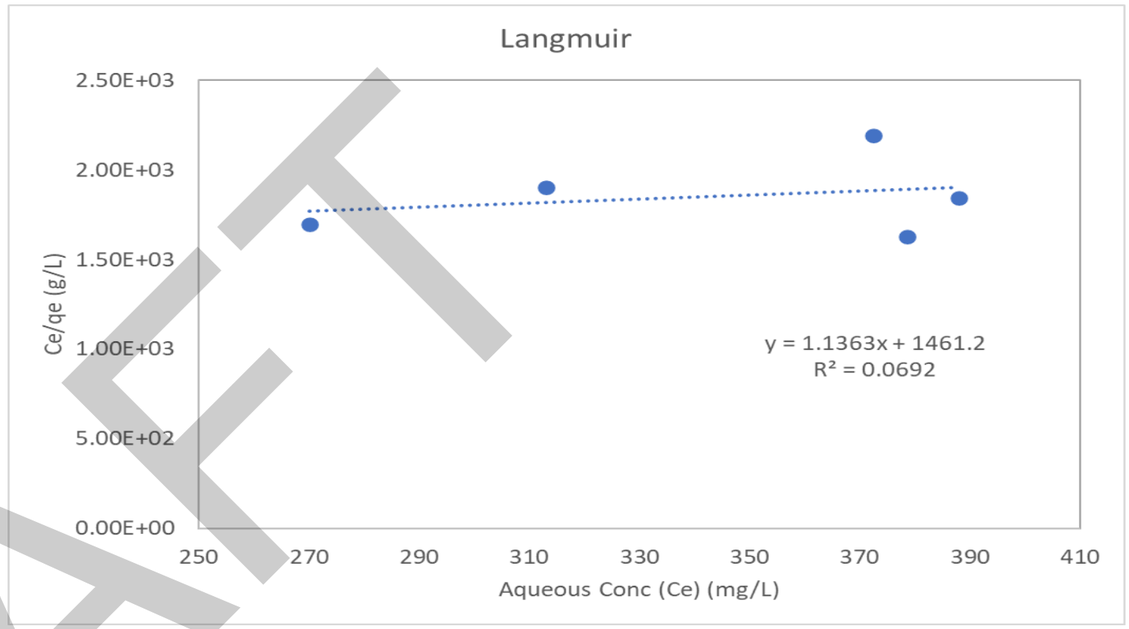

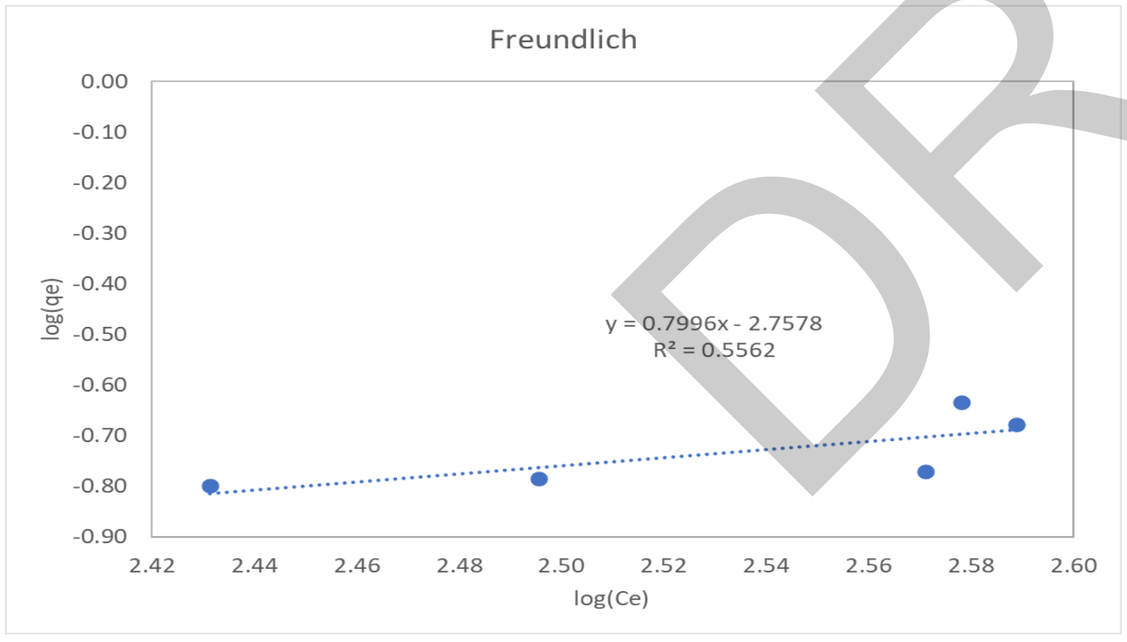

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PROJECT NO.	PHASE	REV.	FIGURE
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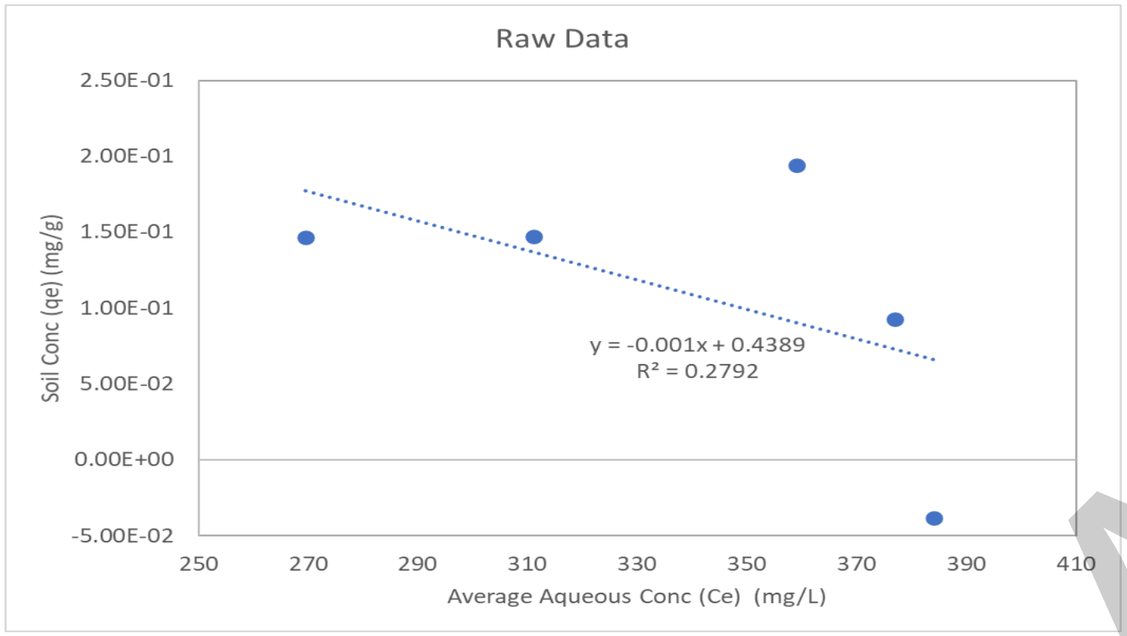

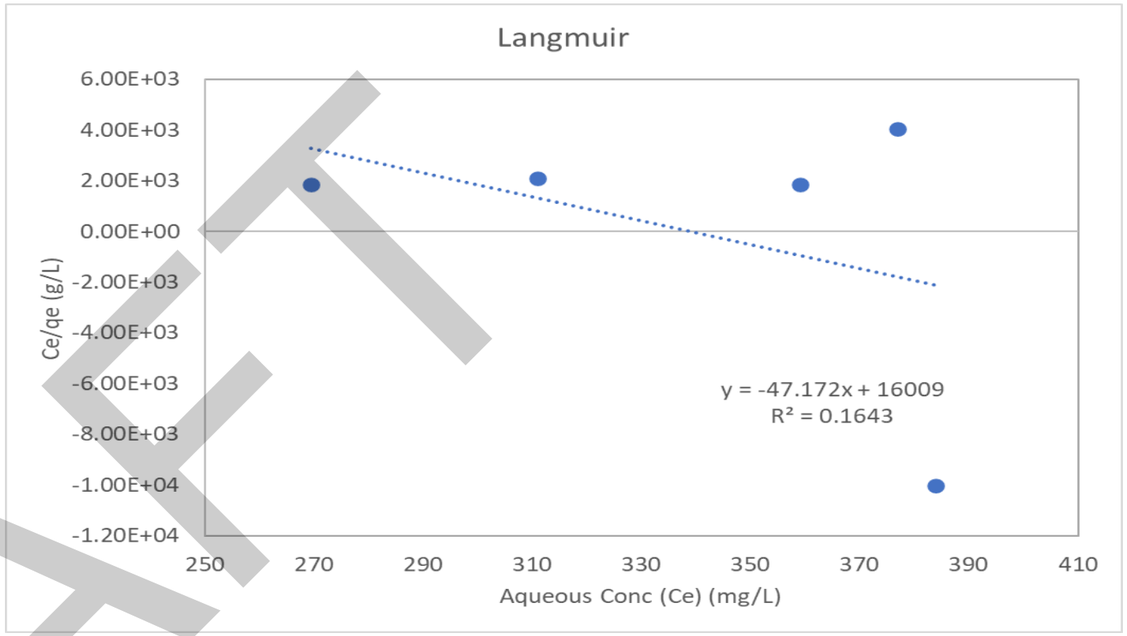

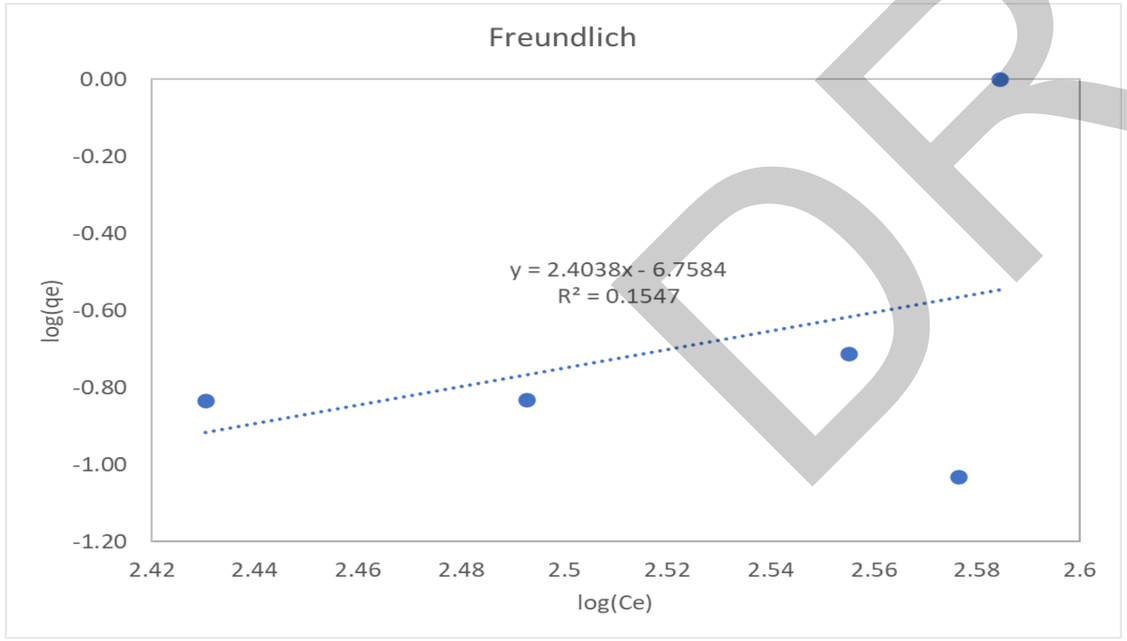

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Note(s):
mg/L: milligrams per liter
mg/g: milligrams per gram
g/L: grams per liter
Ce: aqueous concentration of the adsorbate

CLIENT
ILLIONIS POWER RESOURCES GENERATING, LLC
EDWARDS ASH POND (CCR UNIT 301)

CONSULTANT
GOLDER

PROJECT
EVALUATION OF PARTITION COEFFICIENT RESULTS EAP

TITLE
□□ □□□□□□F□□E□□□R□I□□□C□EFFICIE□□□

PROJECT NO.	PHASE	REV.	FIGURE
21454831	002	0	A-8

SIREM
ATTN: Michael Healey
130 Stone Road West
Guelph ON N1G 3Z2

Date Received: 21-JAN-22
Report Date: 25-JAN-22 15:02 (MT)
Version: FINAL

Client Phone: 519-822-2265

Certificate of Analysis

Lab Work Order #: L2680648

Project P.O. #: NOT SUBMITTED
Job Reference: EDWARDS MNA
C of C Numbers:
Legal Site Desc:

DRAFT

Gayle Braun
Senior Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2680648-1 AW-15S-1 Sampled By: J.L. on 21-JAN-22 @ 09:00 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.069	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	12.5	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.49	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	395	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-2 AW-15S-2 Sampled By: J.L. on 21-JAN-22 @ 09:15 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.074	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	12.5	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.48	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	392	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-3 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 2:1-1 Sampled By: J.L. on 21-JAN-22 @ 09:30 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.385	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	4.6	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.15	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	266	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-4 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 2:1-2 Sampled By: J.L. on 21-JAN-22 @ 09:45 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.319	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	4.4	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.12	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	274	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-5 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:1-1 Sampled By: J.L. on 21-JAN-22 @ 10:00 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.227	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	6.5	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.21	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	313	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-6 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:5-1 Sampled By: J.L. on 21-JAN-22 @ 10:30 Matrix:							

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* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2680648-6 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:5-1 Sampled By: J.L. on 21-JAN-22 @ 10:30 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.133	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	10.0	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.36	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	375	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-7 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:5-2 Sampled By: J.L. on 21-JAN-22 @ 10:45 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.121	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	10.3	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.36	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	370	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-8 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:10-1 Sampled By: J.L. on 21-JAN-22 @ 11:00 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.117	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	11.0	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.42	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	382	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-9 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:10-2 Sampled By: J.L. on 21-JAN-22 @ 11:15 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.110	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	11.5	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.43	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	375	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-10 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:20-1 Sampled By: J.L. on 21-JAN-22 @ 11:30 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.098	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	12.1	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.45	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	393	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-11 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:20-2 Sampled By: J.L. on 21-JAN-22 @ 11:45 Matrix:							

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* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2680648-11 E-SB-05 (SSZ/UA) (30.0-33.5) : AW-15S 1:20-2 Sampled By: J.L. on 21-JAN-22 @ 11:45 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.114	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	11.9	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.44	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	383	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-12 AW-19-1 Sampled By: J.L. on 21-JAN-22 @ 12:00 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.048	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	11.9	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.48	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	375	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-13 AW-19-2 Sampled By: J.L. on 21-JAN-22 @ 12:15 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.049	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	12.1	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.51	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	390	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-14 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 2:1-1 Sampled By: J.L. on 21-JAN-22 @ 12:30 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.268	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	4.3	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.11	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	270	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-15 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 2:1-2 Sampled By: J.L. on 21-JAN-22 @ 12:45 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.510	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	4.4	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.15	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	269	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-16 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:1-1 Sampled By: J.L. on 21-JAN-22 @ 13:00 Matrix:							

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* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2680648-16 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:1-1 Sampled By: J.L. on 21-JAN-22 @ 13:00 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.243	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	6.6	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.24	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	314	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-17 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:1-2 Sampled By: J.L. on 21-JAN-22 @ 13:15 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.321	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	6.3	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.22	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	308	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-18 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:5-1 Sampled By: J.L. on 21-JAN-22 @ 13:30 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.159	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	9.5	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.36	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	358	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-19 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:5-2 Sampled By: J.L. on 21-JAN-22 @ 13:45 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.191	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	9.7	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.38	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	360	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-20 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:10-1 Sampled By: J.L. on 21-JAN-22 @ 14:00 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704658
Barium (Ba)-Dissolved	0.172	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	10.3	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.40	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	365	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-21 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:10-2 Sampled By: J.L. on 21-JAN-22 @ 14:15 Matrix:							

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* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2680648-21 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:10-2 Sampled By: J.L. on 21-JAN-22 @ 14:15 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704656
Barium (Ba)-Dissolved	0.144	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	11.3	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.45	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	389	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-22 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:20-1 Sampled By: J.L. on 21-JAN-22 @ 14:30 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704656
Barium (Ba)-Dissolved	0.112	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	11.9	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.46	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	381	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380
L2680648-23 E-SB-05 (SSZ/UA) (30.0-33.5) : AW19 1:20-2 Sampled By: J.L. on 21-JAN-22 @ 12:45 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					23-JAN-22	R5704656
Barium (Ba)-Dissolved	0.155	DLHC	0.010	mg/L	23-JAN-22	24-JAN-22	R5705380
Boron (B)-Dissolved	11.5	DLHC	1.0	mg/L	23-JAN-22	24-JAN-22	R5705380
Lithium (Li)-Dissolved	0.47	DLHC	0.10	mg/L	23-JAN-22	24-JAN-22	R5705380
Sulfur (S)-Dissolved	387	DLHC	50	mg/L	23-JAN-22	24-JAN-22	R5705380

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* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2680648-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2680648-21, -22, -23
Matrix Spike	Boron (B)-Dissolved	MS-B	L2680648-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Boron (B)-Dissolved	MS-B	L2680648-21, -22, -23
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L2680648-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L2680648-21, -22, -23
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2680648-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2680648-21, -22, -23

Sample Parameter Qualifier key listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
MET-D-CCMS-WT	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

DRAFT

Quality Control Report

Workorder: L2680648 Report Date: 25-JAN-22

Client: SIREM
130 Stone Road West
Guelph ON N1G 3Z2
Contact: Michael Healey

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R5705380								
WG3687838-4 DUP		**WG3687838-3**						
Barium (Ba)-Dissolved		0.385	0.390		mg/L	1.2	20	24-JAN-22
Boron (B)-Dissolved		4.6	4.5		mg/L	0.1	20	24-JAN-22
Lithium (Li)-Dissolved		0.15	0.14		mg/L	4.5	20	24-JAN-22
Sulfur (S)-Dissolved		266	273		mg/L	2.8	20	24-JAN-22
WG3687839-4 DUP		**WG3687839-3**						
Barium (Ba)-Dissolved		0.144	0.149		mg/L	3.5	20	24-JAN-22
Boron (B)-Dissolved		11.3	11.2		mg/L	1.3	20	24-JAN-22
Lithium (Li)-Dissolved		0.45	0.42		mg/L	6.4	20	24-JAN-22
Sulfur (S)-Dissolved		389	387		mg/L	0.6	20	24-JAN-22
WG3687838-2 LCS								
Barium (Ba)-Dissolved			98.3		%		80-120	24-JAN-22
Boron (B)-Dissolved			94.3		%		80-120	24-JAN-22
Lithium (Li)-Dissolved			108.0		%		80-120	24-JAN-22
Sulfur (S)-Dissolved			103.0		%		80-120	24-JAN-22
WG3687839-2 LCS								
Barium (Ba)-Dissolved			98.4		%		80-120	24-JAN-22
Boron (B)-Dissolved			95.6		%		80-120	24-JAN-22
Lithium (Li)-Dissolved			107.1		%		80-120	24-JAN-22
Sulfur (S)-Dissolved			100.8		%		80-120	24-JAN-22
WG3687838-1 MB								
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	24-JAN-22
Boron (B)-Dissolved			<0.010		mg/L		0.01	24-JAN-22
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	24-JAN-22
Sulfur (S)-Dissolved			<0.50		mg/L		0.5	24-JAN-22
WG3687839-1 MB								
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	24-JAN-22
Boron (B)-Dissolved			<0.010		mg/L		0.01	24-JAN-22
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	24-JAN-22
Sulfur (S)-Dissolved			<0.50		mg/L		0.5	24-JAN-22
WG3687838-5 MS		**WG3687838-6**						
Barium (Ba)-Dissolved			N/A	MS-B	%		-	24-JAN-22
Boron (B)-Dissolved			N/A	MS-B	%		-	24-JAN-22
Lithium (Li)-Dissolved			N/A	MS-B	%		-	24-JAN-22
Sulfur (S)-Dissolved			N/A	MS-B	%		-	24-JAN-22
WG3687839-5 MS		**WG3687839-6**						

DRAFT

Quality Control Report

Client: SIREM
130 Stone Road West
Guelph ON N1G 3Z2
Contact: Michael Healey

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R5705380								
WG3687839-5 MS		**WG3687839-6**						
Barium (Ba)-Dissolved			N/A	MS-B	%		-	24-JAN-22
Boron (B)-Dissolved			N/A	MS-B	%		-	24-JAN-22
Lithium (Li)-Dissolved			N/A	MS-B	%		-	24-JAN-22
Sulfur (S)-Dissolved			N/A	MS-B	%		-	24-JAN-22

DRAFT

Quality Control Report

Workorder: L2680648 Report Date: 25-JAN-22

Client: SIREM
130 Stone Road West
Guelph ON N1G 3Z2
Contact: Michael Healey

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

DRAFT

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2680648-COFC

COC Number: 16 -

Page 1 of 2

Report To		Report Format / Distribution	
Company:	SiREM	Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Contact:	Rachel Hallman, Michael Healey	Quality Control (QC) Report with Report	☐ Yes ☐ No
Address:	130 Stone Rd W Guelph, Ontario, Canada, N1G 3Z2	☐ Criteria on Report - provide details below if box checked	
Phone:	519-822-2265	Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
		Email 1 or Fax	rhallman@siremlab.com
Invoice To	Same as Report To ☐ Yes ☑ No	Email 2	mhealey@siremlab.com
	Copy of Invoice with Report ☐ Yes ☑ No	Invoice Distribution	
Company:	SiREM	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Contact:	Karen Broersma, kbroersma@geosyntec.com	Email 1 or Fax	accountspayablecan@siremlab.com
Project Information		Email 2	
ALS Quote #:		Oil and Gas Required Fields (client use)	
Job #:	Edwards MNA	Approver ID:	Cost Center:
PO / AFE:		GL Account:	Routing Code
LSD:		Activity Code:	
ALS Lab Work Order # (lab use only)	L2680648	Location:	
ALS Contact:	Gayle Braun	Sampler:	J. Linkletter

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Dissolved Metals (incl. B, Li, Ba and S)	F/P	Number of Containers
	AW-15S-1	21-Jan-22	9:00	Water	P		1
	AW-15S-2	21-Jan-22	9:15	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 2:1-1	21-Jan-22	9:30	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 2:1-2	21-Jan-22	9:45	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:1-1	21-Jan-22	10:00	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:1-2	21-Jan-22	10:15	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:5-1	21-Jan-22	10:30	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:5-2	21-Jan-22	10:45	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:10-1	21-Jan-22	11:00	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:10-2	21-Jan-22	11:15	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:20-1	21-Jan-22	11:30	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW-15S 1:20-2	21-Jan-22	11:45	Water	P		1

R ☐ Regular (Standard TAT if received by 3 pm - business days) - No priority (Rush Turnaround Time (TAT) is not available for all tests)
P ☑ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Specify Date Required for E2,E or P:

Analysis Request
Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

Drinking Water (DW) Samples[1] (client use)
Are samples taken from a Regulated DW System? ☐ Yes ☑ No
Are samples for human drinking water use? ☐ Yes ☑ No

Special Instructions / Specify Criteria to add on report (client Use)

SHIPMENT RELEASE (client use)
Released by: | Date: 21 Jan 22 | Time: 6:30 PM

INITIAL SHIPMENT RECEPTION (lab use only)
Received by: | Date: | Time:

SAMPLE CONDITION AS RECEIVED (lab use only)
Frozen ☐ | Ice packs Yes ☑ No ☐ | Cooling Initiated ☐ | SIF Observations Yes ☐ No ☐ | Custody seal intact Yes ☐ No ☐
INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C: 4.4

FINAL SHIPMENT RECEPTION (lab use only)
Received by: | Date: 6/1/22 | Time: 10:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

DRAFT

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2680648-COFC

COC Number: 16 -

Page 2 of 2

Report To		**Report Format / Distribution**	
Company:	SiREM	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	
Contact:	Rachel Hallman, Michael Healey	Quality Control (QC) Report with Report ☐ Yes ☐ No	
Address:	130 Stone Rd W Guelph, Ontario, Canada, N1G 3Z2	☐ Criteria on Report - provide details below if box checked	
Phone:	519-822-2265	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
		Email 1 or Fax: rhallman@siremlab.com	
		Email 2: mhealey@siremlab.com	
Invoice To	Same as Report To ☐ Yes ☑ No	**Invoice Distribution**	
	Copy of Invoice with Report ☐ Yes ☑ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Company:	SiREM	Email 1 or Fax: accountspayablecan@siremlab.com	
Contact:	Karen Broersma, kbroersma@geosyntec.com	Email 2:	
Project Information		**Oil and Gas Required Fields (client use)**	
ALS Quote #:		Approver ID:	Cost Center:
Job #:	Edwards MNA	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)	L2680648-COFC	**ALS Contact:** Gayle Braun	**Sampler:** J. Linkletter

Turnaround Time (TAT) Option (Rush Turnaround Time (TAT) is not available for all tests)

- R ☐ [illegible] if received by 3 pm - business days)
- P ☑ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
- E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
- E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge

Specify Date Required for E2,E or P:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	F/P	Dissolved Metals (incl. B, Li, Ba and S)	Number of Containers
	AW-19-1	21-Jan-22	12:00	Water	P		1
	AW-19-2	21-Jan-22	12:15	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 2:1-1	21-Jan-22	12:30	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 2:1-2	21-Jan-22	12:45	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:1-1	21-Jan-22	13:00	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:1-2	21-Jan-22	13:15	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:5-1	21-Jan-22	13:30	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:5-2	21-Jan-22	13:45	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:10-1	21-Jan-22	14:00	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:10-2	21-Jan-22	14:15	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:20-1	21-Jan-22	14:30	Water	P		1
	E-SB-05 (SSZ/UA) (30.0-33.5): AW19 1:20-2	21-Jan-22	14:45	Water	P		1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ Yes ☑ No

Are samples for human drinking water use? ☐ Yes ☑ No

Special Instructions / Specify Criteria to add on report (client Use)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice packs Yes ☒ No ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			19.4		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time: 5:30 pm	Received by:	Date:	Time:	Received by:	Date: 01/21/22	Time: 18:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

ALS COC 0226 v09 Front/04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

DRAFT

SIREM
ATTN: Michael Healey
130 Stone Road West
Guelph ON N1G 3Z2

Date Received: 15-JAN-22
Report Date: 18-JAN-22 09:03 (MT)
Version: FINAL

Client Phone: 519-822-2265

Certificate of Analysis

Lab Work Order #: L2679139

Project P.O. #: NOT SUBMITTED
Job Reference: EDWARDS
C of C Numbers:
Legal Site Desc:

DRAFT

Gayle Braun
Senior Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2679139-1 AW-15S-1A Sampled By: R.S. on 14-JAN-22 @ 15:00 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					16-JAN-22	R5697192
Barium (Ba)-Dissolved	0.307	DLHC	0.010	mg/L	16-JAN-22	17-JAN-22	R5697850
Boron (B)-Dissolved	12.4	DLHC	1.0	mg/L	16-JAN-22	17-JAN-22	R5697850
Lithium (Li)-Dissolved	0.47	DLHC	0.10	mg/L	16-JAN-22	17-JAN-22	R5697850
Sulfur (S)-Dissolved	390	DLHC	50	mg/L	16-JAN-22	17-JAN-22	R5697850
L2679139-2 AW-15S-2A Sampled By: R.S. on 14-JAN-22 @ 15:15 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					16-JAN-22	R5697192
Barium (Ba)-Dissolved	0.355	DLHC	0.010	mg/L	16-JAN-22	17-JAN-22	R5697850
Boron (B)-Dissolved	12.7	DLHC	1.0	mg/L	16-JAN-22	17-JAN-22	R5697850
Lithium (Li)-Dissolved	0.48	DLHC	0.10	mg/L	16-JAN-22	17-JAN-22	R5697850
Sulfur (S)-Dissolved	397	DLHC	50	mg/L	16-JAN-22	17-JAN-22	R5697850
L2679139-3 AW-19-1A Sampled By: R.S. on 14-JAN-22 @ 15:30 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					16-JAN-22	R5697192
Barium (Ba)-Dissolved	0.220	DLHC	0.010	mg/L	16-JAN-22	17-JAN-22	R5697850
Boron (B)-Dissolved	11.6	DLHC	1.0	mg/L	16-JAN-22	17-JAN-22	R5697850
Lithium (Li)-Dissolved	0.46	DLHC	0.10	mg/L	16-JAN-22	17-JAN-22	R5697850
Sulfur (S)-Dissolved	386	DLHC	50	mg/L	16-JAN-22	17-JAN-22	R5697850
L2679139-4 AW-19-2A Sampled By: R.S. on 14-JAN-22 @ 15:45 Matrix: WATER							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					16-JAN-22	R5697192
Barium (Ba)-Dissolved	0.273	DLHC	0.010	mg/L	16-JAN-22	17-JAN-22	R5697850
Boron (B)-Dissolved	11.9	DLHC	1.0	mg/L	16-JAN-22	17-JAN-22	R5697850
Lithium (Li)-Dissolved	0.45	DLHC	0.10	mg/L	16-JAN-22	17-JAN-22	R5697850
Sulfur (S)-Dissolved	380	DLHC	50	mg/L	16-JAN-22	17-JAN-22	R5697850

DRAFT

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2679139-1, -2, -3, -4
Matrix Spike	Boron (B)-Dissolved	MS-B	L2679139-1, -2, -3, -4
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L2679139-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2679139-1, -2, -3, -4

Sample Parameter Qualifier key listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
MET-D-CCMS-WT	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

DRAFT

Quality Control Report

Workorder: L2679139 Report Date: 18-JAN-22

Client: SIREM
130 Stone Road West
Guelph ON N1G 3Z2
Contact: Michael Healey

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R5697850								
WG3685604-4 DUP		**WG3685604-3**						
Barium (Ba)-Dissolved		0.307	0.321		mg/L	4.3	20	17-JAN-22
Boron (B)-Dissolved		12.4	12.6		mg/L	1.3	20	17-JAN-22
Lithium (Li)-Dissolved		0.47	0.45		mg/L	4.5	20	17-JAN-22
Sulfur (S)-Dissolved		390	392		mg/L	0.7	20	17-JAN-22
WG3685604-2 LCS								
Barium (Ba)-Dissolved			103.3		%		80-120	17-JAN-22
Boron (B)-Dissolved			94.5		%		80-120	17-JAN-22
Lithium (Li)-Dissolved			99.4		%		80-120	17-JAN-22
Sulfur (S)-Dissolved			98.7		%		80-120	17-JAN-22
WG3685604-1 MB								
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	17-JAN-22
Boron (B)-Dissolved			<0.010		mg/L		0.01	17-JAN-22
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	17-JAN-22
Sulfur (S)-Dissolved			<0.50		mg/L		0.5	17-JAN-22
WG3685604-5 MS		**WG3685604-6**						
Barium (Ba)-Dissolved			N/A	MS-B	%		-	17-JAN-22
Boron (B)-Dissolved			N/A	MS-B	%		-	17-JAN-22
Lithium (Li)-Dissolved			N/A	MS-B	%		-	17-JAN-22
Sulfur (S)-Dissolved			N/A	MS-B	%		-	17-JAN-22

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Quality Control Report

Workorder: L2679139 Report Date: 18-JAN-22

Client: SIREM
130 Stone Road West
Guelph ON N1G 3Z2
Contact: Michael Healey

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

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Chain of Custody (COC) / Analytical Request Form

COC Number: 16 -

Page 1 of 1

Canada Toll Free: 1 800 668 987

here

L2679139-COFC

www.alsglobal.com

Report To		Report Format / Distribution	
Company:	SiREM	Select Report Format:	
Contact:	Rachel Hallman, Michael Healey	Quality Control (QC) Report with Report	☐ Yes ☐ No
Address:	130 Research Lane, Suite 2 Guelph, Ontario, Canada, N1G 5G3	☐ Criteria on Report - provide details below if box checked	
Phone:	519-822-2265	Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
		Email 1 or Fax	rhallman@siremlab.com
		Email 2	mhealey@siremlab.com
Invoice To	Same as Report To ☐ Yes ☐ No	**Invoice Distribution**	
	Copy of Invoice with Report ☐ Yes ☐ No	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Company:	SiREM	Email 1 or Fax	kbroersma@geosyntec.com
Contact:	Karen Broersma, kbroersma@geosyntec.com	Email 2	
Project Information		**Oil and Gas Required Fields (client use)**	
ALS Quote #:		Approver ID:	Cost Center:
Job #:	Edwards	GL Account	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)	L2679139	**ALS Contact:**	**Sampler:** Rita Schofield

Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)

- (standard TAT if received by 3 pm - business days)
- P ☑ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
- E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
- E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge

Specify Date Required for E2,E or P:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	F/P	Dissolved Metals (incl. B, SO4, Li, Ba, Cl & analysis)	Number of Containers
	AW-15S-1a	14-Jan-22	3:00	Water	P		1
	AW-15S-2a	14-Jan-22	3:15	Water	P		1
	AW-19-1a	14-Jan-22	3:30	Water	P		1
	AW-19-2a	14-Jan-22	3:45	Water	P		1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ Yes ☑ No

Are samples for human drinking water use? ☐ Yes ☑ No

Special Instructions / Specify Criteria to add on report (client Use)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐	
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by	Date	Time
	14 Jan 22	4:00pm					Jan 15/22	8:00

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-FM-0326e v09 Front/04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

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Appendix E

Groundwater Polishing Evaluation Report

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GROUNDWATER POLISHING EVALUATION REPORT

EDWARDS ASH POND

DRAFT

Submitted to:

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

Submitted by:

Life Cycle Geo, LLC
729 Main Street
Longmont, Colorado 80501

23RAM01-1
March 28, 2025

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ATTACHMENTS

Attachment A Operating permit network map and potentiometric surface August 2023
Attachment B PHREEQC input file and thermodynamic database
Attachment C Details of geochemical model parameterization
Attachment D PHREEQC model output
Attachment E Sensitivity testing parameterization and model output

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ACRONYMS AND ABBREVIATIONS

BCU	Bedrock Confining Unit
CAAA	Corrective Actions Alternative Analysis
CCR	Coal combustion residuals
COCs	Constituents of concern
GCSM	Geochemical conceptual site model
GWPS	Groundwater protection standards
I.A.C.	Illinois Administrative Code
IEPA	Illinois Environmental Protection Agency
EDW AP	Edwards Ash Pond
ORP	oxidation-reduction potential
PMP	Potential migration pathway
SEP	Sequential extraction
S.U.	Standard units
TDS	Total dissolved solids
UA	Uppermost Aquifer
UCF	Upper Cahokia Formation
USCU	Upper Semi-Confining Aquifer
USGS	United States Geological Survey
USEPA	United States Environmental Agency

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EXECUTIVE SUMMARY

This document has been prepared as an attachment to the Corrective Actions Alternative Analysis (CAAA) prepared by Gradient for Edwards Power Plant, Edwards Ash Pond (EDW AP). The constituents of concern (COCs) addressed in this document are boron and sulfate, 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 EDW AP.

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.

Results from the speciation modeling show that a substantial proportion of boron and some sulfate are retained on the solid phase under current conditions. Reaction modeling results indicate that limited remobilization of COCs back to the groundwater phase will occur as conditions return to background. Simulations show a minor increase in adsorbent mineral masses is possible and adsorbent minerals are anticipated to be stable. The precipitation of barite is additionally predicted, providing a further stable sink for sulfate. These results suggest that the changing geochemical conditions that come with the "return to background" are overall unlikely to cause the observed time to reach the GWPS to be longer than estimated by the groundwater flow and transport model.

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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 Edwards Ash 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.

Sensitivity assessment suggests that the observed time to achieve the boron GWPS could be longer than currently modeled results as a function of changing redox conditions, such that strongly reducing conditions (i.e., more chemically reduced than currently observed in the background groundwater) may result in more extensive boron remobilization from the solid phase. Such conditions are not expected based on the current understanding of likely post-closure hydrologic conditions but are assessed with this modeling exercise to aid the establishment of adaptive management monitoring criteria. 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 Actions Alternatives Analysis (CAAA) prepared by Gradient for Edwards Power Plant Ash Pond (EDW AP). The purpose of the CAAA is to holistically evaluate potentially viable corrective actions to remediate groundwater and achieve compliance with groundwater protection standards (GWPSs) for all monitored parameters under Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845.600. The constituents of concern (COCs) addressed in this document are boron and sulfate, which have been identified as having exceedances of the site-specific GWPSs 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 EDW AP.[2]

Groundwater polishing processes include both physical and chemical mechanisms within the subsurface which reduce the concentrations of COCs in the groundwater. Physical components of groundwater polishing, including advection, dilution, and dispersion, are assessed by groundwater flow and transport modeling (Groundwater Modeling Technical Memorandum[3]). 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 EDW AP are evaluated herein using a geochemical modeling-based approach informed by site-specific data. This report uses geochemical modeling to evaluate the influence of chemical mechanisms on groundwater polishing under current conditions and after source control implementation.

The groundwater flow and transport model (Groundwater Modeling Technical Memorandum[4]) estimated the time for boron (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 constituent distribution. This geochemical modeling effort supports the assessment of

[2] The Human Health and Ecological Risk Assessment serves as Appendix A of the CAAA to which this report is attached.
[3] The Groundwater Modeling Technical Memorandum serves as Appendix B of the CAAA Supporting Information Report; the CAAA Supporting Information Report serves as Appendix B of the CAAA to which this report is attached.
[4] Ibid.

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groundwater polishing as a component of the proposed corrective action by evaluating the potential for chemical attenuation of COCs 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 foundation for understanding groundwater chemistry to inform adaptive site management as a key component of the Corrective Action Groundwater Monitoring Plan[5].

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 facility is located between Mapleton and Bartonville in Peoria County and is situated along the Illinois River (Ramboll, 2021). The facility is a 91-acre unlined surface impoundment that began operating in 1960 and was retired in 2022 (Ramboll, 2021).

A groundwater monitoring network was proposed in the Operating Permit Application (Burns and McDonnell, 2021) 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 EDW AP unit. The proposed groundwater monitoring network is shown in **Attachment A**. The monitoring network consists of 15 compliance monitoring wells (AP07S, AW-01, AW-05, AW-06, AW-09, AW-10, AW-11, AW-14, AW-15, AW-15S, AW-16, AW-17, AW-18, AW-19, and AW-21) and two background wells (AP05S and AW-08).

The geology underlying the Site in the vicinity of the EDW AP consists of three distinct hydrostratigraphic units (Ramboll, 2021):

- **Upper Cahokia Formation (UCF)/Potential Migration Pathway (PMP):** Low permeability clays and silts comprise the Upper Cahokia Formation. This unit also includes discontinuous lenses of sand, sandy clay to clayey sand, and sandy silt. The saturated and unconfined sandy lenses within the UCF have been identified as a PMP. The thickness of the UCF ranges between 5 and 40 feet (ft) in the vicinity of the Ash Pond.
- **Uppermost Aquifer (UA):** Thin (generally less than four feet in thickness), moderate permeability sand, silty sand, and clayey gravel material within the Lower Cahokia Formation, and bedrock interface, including weathered shale bedrock where present. In locations where higher permeability materials and coarser grained materials are absent, the UA is interpreted as the interface between the Lower Cahokia Formation and weathered bedrock of the Carbondale and Modesto Formations.
- **Bedrock Confining Unit (BCU):** This confining layer consists of thick and low permeability shales and siltstones of the Carbondale and Modesto Formations.

Groundwater within the UA flows predominantly to the west in the central portion of the AP towards a former channel of the Illinois River, and to the south/southeast in the southern end of the AP. There is a minor component in the northernmost portion of the AP where groundwater in the UA and PMP flows to the north and northwest (Ramboll, 2021). Both background wells are screened within the UA and are generally

[5] The Corrective Action Groundwater Monitoring Program serves as Appendix B.1 to the Construction Permit Application.

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deeper than most other UA wells but are considered upgradient of the unit based on observed flow patterns. Groundwater flow occurs primarily in the more permeable zones within the LCF in the UA (Ramboll, 2021), though the vertical and horizontal hydraulic gradients are dynamic at the EDW AP and are predicted to shift in response to dewatering and closure. A map showing current groundwater flow direction at the site is shown in **Attachment A**. Identified Exceedances of GWPS

The following GWPS exceedances at compliance groundwater monitoring wells likely attributable to the EDW AP were observed from 2023 Q2 through 2023 Q4 (Ramboll, 2024):

- Boron – Observed at monitoring wells AP07S, AW-05, AW-15S, AW-19, and AW-21.
- Sulfate – Observed at monitoring well AW-15S.

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.

Boron is identified above the GWPS in both the UA and the PMP. Boron exceedances are found in the UA to the north and northwest of the unit and in the PMP to the north and south of the unit. Sulfate exceedances only occur south of the unit in the PMP. The boron and sulfate exceedances are identified in shallow groundwater above the approximate elevation of 420 feet North American Vertical Datum of 1988 (NAVD88).

Modeling parameters with observed exceedances is appropriate to the scope of the CAAA. Modeling these parameters is conservative because they represent the most widespread and persistent exceedances at EDW AP. Additionally, the selected remedy, which 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 4, 2025. Once implemented and completed, the selected remedy will attain the GWPSs.

2.2 GEOCHEMICAL CONCEPTUAL SITE MODEL

A Geochemical Conceptual Site Model (GCSM)[6] was developed for EDW AP 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 submitted to IEPA on June 4, 2024 (Ramboll, 2024) in accordance with 35 I.A.C. § 845.650(d)(1) and provided again in full as Appendix D of the CAAA to which this report is attached.

The main findings of the GCSM are summarized as follows:

- Where observed in shallow groundwater at concentrations above the GWPS, concentrations of boron and sulfate are indicative of impacts by CCR porewater.

[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.

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- Oxidation and reduction potential (ORP) shows a distinct pattern above and below the elevation of 420 ft NAVD88, the approximate elevation at which a redox transition appears to occur. The locations with exceedances of either boron and/or sulfate are all within the shallower elevation of the aquifer and are generally more oxidizing. The deeper background waters have a more reducing signature.
- The background groundwater, and more generally the deep groundwater, at the EDW AP has measurable methane and sulfide, indicating potentially more reduced conditions than estimated by ORP measurements.
- Groundwater pH is neutral and generally stable within the range of 6 to 8 S.U. independent of location, lithology, or exceedance status. This stable pH indicates groundwater is well buffered against change, likely due to the widespread presence of carbonate minerals in the aquifer solids which buffer pH within this range.
- The key finding from the aquifer solids assessment is that adsorptive minerals such as iron and aluminum hydroxides are present in the aquifer solids and have currently bound both boron and sulfate within the reactive fraction of the solid matrix.

The geochemical characterization data demonstrate that some degree of attenuation of the exceedance constituents by the aquifer solids has occurred in the past, most notably through adsorption to both iron and aluminum hydroxide mineral phases. However, the vertical and horizontal hydraulic gradients are dynamic at the EDW AP and are predicted to shift in response to dewatering and closure, which could in turn drive a shifting redox condition in the shallow UA groundwater. A shift in redox conditions, particularly toward reducing conditions, could impact the long-term stability of attenuating minerals.

The following section describes the application of a geochemical modeling assessment conducted to evaluate the stability of the attenuation mechanism(s) under a return to background following source control as well as evaluate the impact of extreme reducing conditions on aquifer solid and boron and sulfate concentrations.

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 to 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[7], which is based on hydraulic properties of the aquifer and does not take into account chemical interactions of boron within the hydrologic unit.

[7] The Groundwater Modeling Technical Memorandum serves as Appendix B of the Corrective Action Supporting Information Report; the Corrective Action Supporting Information Report serves as Appendix B of the CAAA to which this report is attached.

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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 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 groundwater polishing as an appropriate remedy for the site by evaluating dominant geochemical reactions that may occur at time scales relevant to groundwater flow, including adsorption and certain mineral dissolution/precipitation (i.e., iron and aluminum (hydr)oxides, carbonates, and some sulfates) as identified in the GCSM[8]. The model therefore includes those parameters that are expected to contribute to those reactions (as discussed below) and does not include every constituent of the solid phase and groundwater in order to capture "the salient aspects of the system's behavior without introducing unnecessary complexity" (USEPA, 2015). This model is therefore a semi-quantitative estimation of chemical behavior in the subsurface rather than a prediction of groundwater quality, consistent with USEPA guidance that geochemical modeling "is often most helpful for identifying relative changes in contaminant speciation and distribution" (USEPA, 2015).

3.1.1 MODEL SET-UP

Inputs to the model include solid phase composition, downgradient groundwater composition for wells with exceedances of any COC, and background groundwater composition. The data included for model parameterization is summarized in **Table 3-1** and detailed below. The PHREEQC input file and modified MINTEQ v4 database are provided in **Attachment B**. All data used in the model and discussed below are provided in the Nature and Extent Report.[9]

[8] The GCSM is a component of the Nature and Extent Report previously submitted to IEPA (Ramboll 2024) and is provided as Appendix D of the CAAA to which this report is attached.
[9] 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

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3.1.1.1 Solid Phase Inputs

Iron hydroxide (ferrihydrite) and aluminum hydroxide (gibbsite) are widespread in the environment and are known to act as sorbing phases for many groundwater constituents, including boron and sulfate (Dzombak and Morel, 1990; Karamalidis and Dzombak, 2010). Site-specific data support the occurrence of both in site solids. Model input concentrations for ferrihydrite and goethite were derived using site-specific sequential extraction procedure (SEP) data (details provided in **Attachment C**). SEP data were available from two solid phase samples of the PMP and from four samples of the UA. Metal oxide concentrations representing the 25th percentile, median (50th percentile), and 75th percentile of the observed data were used to test the sensitivity of the model to the amount of sorbing phase present. Both ferrihydrite and goethite were allowed to dissolve or precipitate in the reactive 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 in excess, and model input concentrations were based on site-specific X-ray diffraction (XRD) results. Both calcite and dolomite were allowed to dissolve or precipitate in the reactive 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 may therefore 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 an initial concentration provided.

3.1.1.2 Aqueous Inputs

In addition to the COCs, the following parameters are included to capture the expected attenuation and mobilization mechanisms (see **Section 2.3**):

- Temperature, pH, and redox (represented in the model as pe[10])
- Major ions: Carbonate and bicarbonate 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[11]

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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).

[10] See **Appendix C** for details.

[11] 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.

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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 (details provided in **Attachment C**). For downgradient wells with exceedances of the COCs (**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 pooled data from both background locations (see **Section 2.1**).

3.2 RESULTS AND DISCUSSION

Modeling outputs are presented in full in **Attachment D** and discussed below.

3.2.1 SPECIATION MODELING

Results of the speciation modeling are presented in **Figure 3-1 through Figure 3-4**. Model results indicate the majority of boron (on the order of 75 to 98 percent [%]; Figure 3-1) and a lesser proportion of sulfate (on the order of 5 to 60%; Figure 3-2) present in the aquifer are likely sorbed to the mineral surfaces and are not mobile in groundwater under current conditions. The sensitivity assessment conducted using a range of adsorbent mass indicated that the amount of sorbing phase modeled does influence the proportion of boron and sulfate predicted to be sorbed to the mineral surfaces. However, these results are broadly consistent with conclusions presented in the GCSM which confirmed adsorption of both boron and sulfate has occurred in association with the oxidized mineral surfaces found in the underlying soils (based on site-specific SEP results). These results in combination are interpreted to confirm that chemical attenuation has occurred at the site under the current conditions.

3.2.2 REACTION MODELING

In the reaction modeling, the solid phase generated during the speciation modeling phase is reacted iteratively with background groundwater. The reaction modeling results represent the geochemical conditions expected after the source is controlled during which a trailing geochemical gradient may be created (SRNL, 2011). Two reaction models are discussed here including (1) the base case and (2) supplemental sensitivity analysis.

1. The base case utilized measured average background groundwater quality to assess the most likely conditions after source control implementation based on measured values (Section 3.2.2.1).

2. Supplemental sensitivity analysis was designed to assess the effect of lowering ORP beyond what is currently measured on attenuating phase stability and COC mobilization (Section 3.2.2.2). This assessment was conducted to assess the potential consequence of strongly reduced groundwater on previously attenuated constituent mass, specifically to address the uncertainty related to the apparent redox disequilibrium inferred based on the measured sulfide and methane in the groundwater and discussed in the GCSM.

3.2.2.1 Base Case

Table 3-2 presents the results of the base case reaction modeling and shows the modeled mass of ferrihydrite and gibbsite during each reaction, the change in mass from the previous step, and the percent

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of total mass that change represents. The changes in ferrihydrite quantities are positive, indicating that ferrihydrite may precipitate and will remain stable as conditions return towards background groundwater quality. The mass of gibbsite does not change for most locations, though the model does predict a minor decrease in AW-21. This indicates gibbsite is predominately stable as conditions return to background groundwater quality. In both cases, the change during each reaction step represents less than 0.01% to 0.06% of the total mass available, indicating that any changes in ferrihydrite or gibbsite mass would likely be minor as conditions return to background.

Barite is predicted to precipitate based on model simulations and would therefore additionally limit the transport of sulfate. Barite mass is predicted to increase in the first reaction model and decrease in the second, suggesting a temporary sink for sulfate over time. In all cases, the modeled mass of sulfate removal via barite was relatively low in comparison to the adsorbed fraction (Figure 3-4, Attachment D).

The base case reaction model results show both boron and sulfate attenuation by adsorption to the aquifer solids is likely to be sustained upon return to background. Although most simulations demonstrate a small proportion of boron is released during the first reaction step, sorption to the solid phase is predicted to rebound during the second reaction step. Boron concentrations approach the GWPS during the first reaction and largely achieve GWPS during the second reaction step for most conditions evaluated. The reaction modeling for AW-21 for all sensitivity tests did reflect a concentration of boron above GWPS (**Figure 3-2**) after the second reaction step, indicating that under some circumstances, there may be discrete areas where a residual trailing gradient is observed. These results suggest overall that the trailing gradient will not be persistent over the long-term.

Sulfate sorption was demonstrated to decrease with each reaction step; however, for all conditions evaluated, sulfate concentrations are predicted to drop below the GWPS during the first reaction step, indicating the likelihood of a persistent attenuation of sulfate in all areas of the site (**Figure 3-2**) with little indicated potential for a trailing gradient.

3.2.2.2 Supplemental Sensitivity

Redox condition is often estimated using groundwater ORP measured in the field. However, ORP can be influenced by multiple reactions and can be an incomplete measure of redox if disequilibrium exists in the aquifer. The background groundwater, and more generally the deep groundwater, at the EDW AP have measurable methane and sulfide, indicating potentially more reduced conditions than estimated by field ORP measurements. The introduction of reduced groundwaters to downgradient aquifer solids could promote ferrihydrite dissolution and potentially remobilize boron and sulfate. Due to the presence of measurable methane and sulfide in the background waters, supplemental sensitivity testing was conducted to assess the impact of more extreme reducing conditions on aquifer solids and boron and sulfate concentrations (Attachment E).

Numerical modeling results from the base case model indicate that reactions with a redox condition established from measured background ORP are unlikely to influence mineral stability or time to reach the GWPS (Section 3.2.2.1). Numerical modeling model results from the redox sensitivity testing indicate substantially more reducing (i.e., lower ORP) conditions do present the possibility for dissolution of iron and/or aluminum hydroxides to occur, and that dissolution of hydroxide minerals does have a resulting influence on boron attenuation and time to reach the GWPS (results described in Attachment E). While the probability of reduced redox conditions is considered to be low based on current conditions and anticipated

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future conditions, future monitoring of redox conditions should be emphasized within the context of adaptive management. Redox conditions are assessed holistically through measurement of multiple redox-sensitive parameters, often including parameters such as ORP, dissolved oxygen, dissolved iron and manganese, sulfide, and methane.

4 CONCLUSIONS

This report evaluated the contribution of chemical mechanisms to groundwater polishing using 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 COC attenuation as groundwater quality returns to background conditions.

Results from the speciation modeling show that a substantial proportion of boron and sulfate are retained on the solid phase under current conditions. Base case reaction modeling results indicate that substantial remobilization of COCs back to the groundwater phase is unlikely as conditions return to background. Simulations show a minor increase in adsorbent mineral masses is possible and solid sorbing phases are anticipated to be stable. Notably the precipitation of barite is also simulated, which provides a further sink for sulfate. These data suggest that the changing geochemical conditions that come with the “return to background” are overall unlikely to cause a longer observed time to reach the GWPS. A sensitivity test of the background groundwater ORP suggests that more reducing conditions have the potential to influence mineral stability and time to achieve the GWPS. Future work should include monitoring of redox conditions. These results will inform corrective action groundwater monitoring and adaptive management, critical components of every corrective action considered in the CAAA.

5 REFERENCES

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TABLES

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Table 3-1. Summary of geochemical model inputs.

Model Component	Parameters	Data source(s)
Solid Phase	Iron (hydr)oxides, aluminum (hydr)oxides	Site-specific concentrations from sequential extraction data
	Calcite and dolomite	X-ray diffraction results
Downgradient groundwater (COC exceedance locations)	Boron, 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 representative wells using data collected in Q2 2023

[1]See Section 3.1.1.2 for details.

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Table 3-2. Response of sorbing phases.

Parameter	HSU	Location	Summary Type	Speciation	First Reaction			Second Reaction		
				mg/kg	mg/kg	Δ mg/kg	%	mg/kg	Δ mg/kg	%
Barite	PMP	AP07S	25p	<0.1	<0.1	<0.1	NA	<0.1	<0.1	NA
			median	<0.1	<0.1	<0.1	NA	<0.1	<0.1	NA
			75p	<0.1	0.09	0.09	NA	<0.1	-0.09	<0.01
Barite	PMP	AW-15S	25p	<0.1	0.15	0.15	NA	<0.1	-0.15	<0.01
			median	<0.1	0.27	0.27	NA	<0.1	-0.27	<0.01
			75p	<0.1	0.33	0.33	NA	<0.1	-0.33	<0.01
Barite	UA	AW-05	25p	<0.1	0.25	0.25	NA	<0.1	-0.25	<0.01
			median	<0.1	0.29	0.29	NA	<0.1	-0.29	<0.01
			75p	<0.1	0.30	0.30	NA	0.02	-0.28	<0.01
Barite	UA	AW-19	25p	<0.1	0.00	0.00	NA	<0.1	<0.1	NA
			median	<0.1	0.00	0.00	NA	<0.1	<0.1	NA
			75p	<0.1	0.00	0.00	NA	<0.1	<0.1	NA
Barite	UA	AW-21	25p	<0.1	0.35	0.35	NA	<0.1	-0.35	<0.01
			median	<0.1	0.37	0.37	NA	0.09	-0.28	<0.01
			75p	<0.1	0.37	0.37	NA	0.19	-0.19	<0.01
Ferrihydrite	PMP	AP07S	25p	2990	2990	0.06	<0.01	2990	0.23	<0.01
			median	3890	3890	0.04	<0.01	3890	0.19	<0.01
			75p	4710	4710	0.03	<0.01	4710	0.13	<0.01
Ferrihydrite	PMP	AW-15S	25p	2990	2990	0.02	<0.01	2990	0.14	<0.01
			median	3890	3890	0.01	<0.01	3890	0.05	<0.01
			75p	4710	4710	0.01	<0.01	4710	0.03	<0.01
Ferrihydrite	UA	AW-05	25p	10600	10600	0.55	<0.01	10600	1.29	0.01
			median	12800	12800	0.49	<0.01	12800	1.07	<0.01
			75p	13400	13400	0.42	<0.01	13400	0.84	<0.01
Ferrihydrite	UA	AW-19	25p	10600	10600	4.67	0.04	10600	3.03	0.03
			median	12800	12800	5.15	0.04	12900	3.00	0.02
			75p	13400	13400	5.33	0.04	13400	2.84	0.02
Ferrihydrite	UA	AW-21	25p	10600	10600	0.28	<0.01	10600	1.19	0.01
			median	12800	12800	0.22	<0.01	12800	0.77	<0.01
			75p	13400	13400	0.18	<0.01	13400	0.53	<0.01
Gibbsite	PMP	AP07S	25p	7090	7090	-0.001	<0.01	7090	<0.1	<0.01
			median	9810	9810	-0.001	<0.01	9810	<0.1	<0.01
			75p	12500	12500	-0.001	<0.01	12500	<0.1	<0.01
Gibbsite	PMP	AW-15S	25p	7090	7090	<0.01	<0.01	7090	<0.1	<0.01
			median	9810	9810	<0.01	<0.01	9810	<0.1	<0.01
			75p	12500	12500	<0.01	<0.01	12500	<0.1	<0.01
Gibbsite	UA	AW-05	25p	6520	6520	-0.001	<0.01	6520	<0.1	<0.01
			median	8560	8560	-0.001	<0.01	8560	<0.1	<0.01
			75p	10600	10600	-0.001	<0.01	10600	<0.1	<0.01
Gibbsite	UA	AW-19	25p	6520	6520	<0.1	<0.01	6520	<0.1	<0.01
			median	8560	8560	<0.1	<0.01	8560	<0.1	<0.01
			75p	10600	10600	<0.1	<0.01	10600	<0.1	<0.01
Gibbsite	UA	AW-21	25p	6520	6520	-0.001	<0.01	6520	-0.001	<0.01
			median	8560	8560	-0.001	<0.01	8560	-0.001	<0.01
			75p	10600	10600	-0.001	<0.01	10600	-0.001	<0.01

Notes: HSU – Hydrostratigraphic Units; UA – Upper Aquifer; PMP – Potential Migration Pathway
25p – 25th percentile; 75p – 75th percentile; NA – not applicable or not measured
mg/kg – milligrams per kilograms; Δ mg/kg – change in milligrams per kilograms; % - percent

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FIGURES

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Figure 3-1: Speciation Model Results for Boron

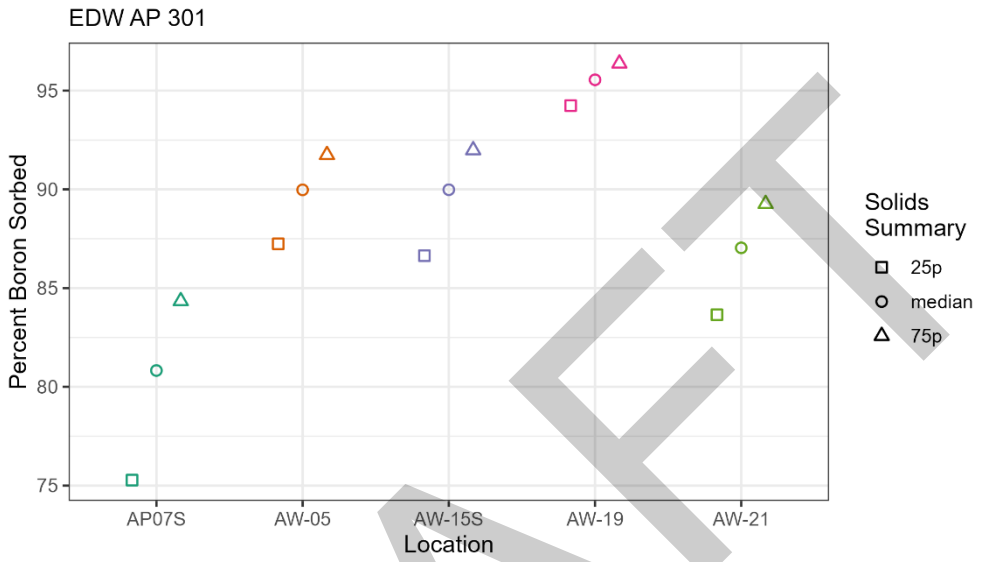

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Figure 3-2: Speciation Model Results for Sulfate

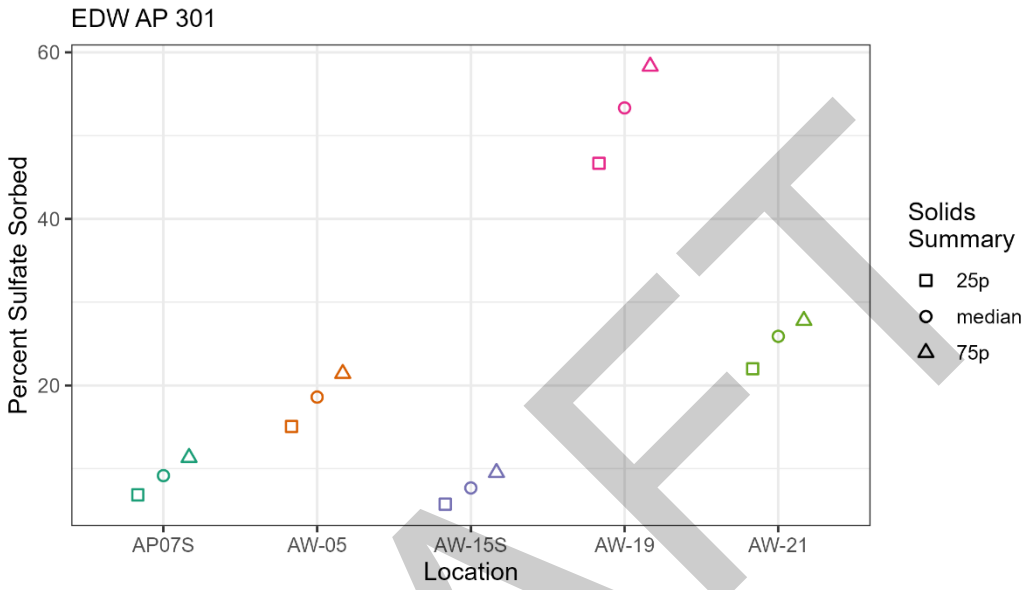

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Figure 3-3: Speciation and Reaction Model Results for Boron

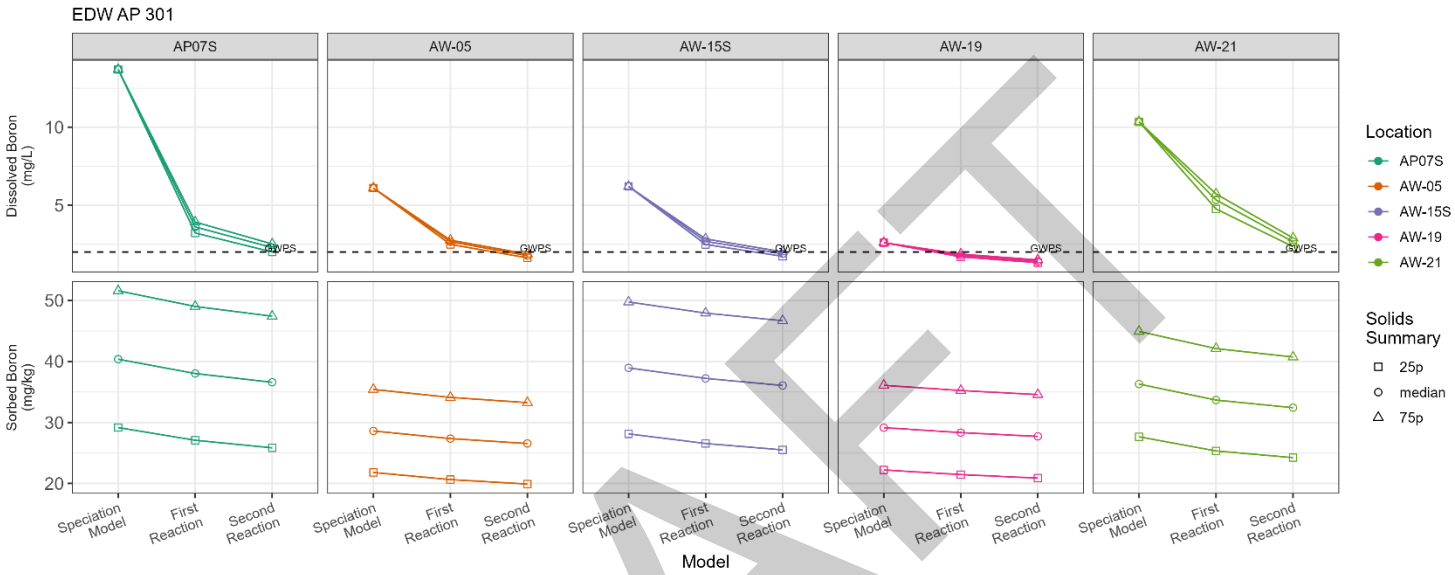

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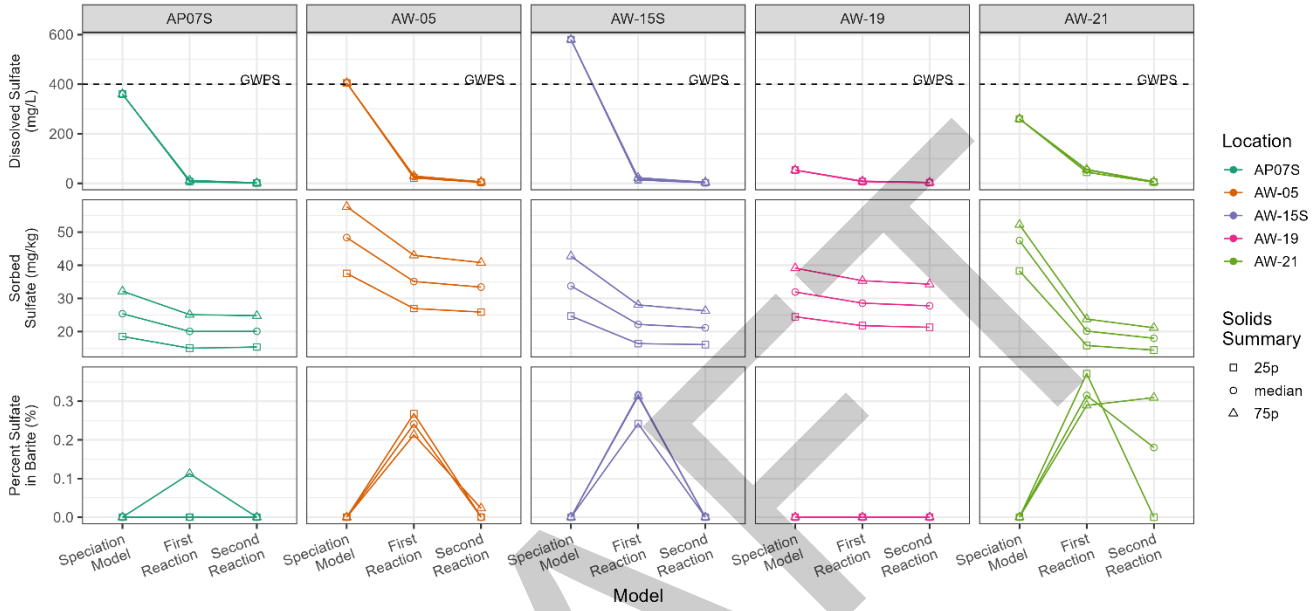
Figure 3-4: Speciation and Reaction Model Results for Sulfate



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ATTACHMENT A

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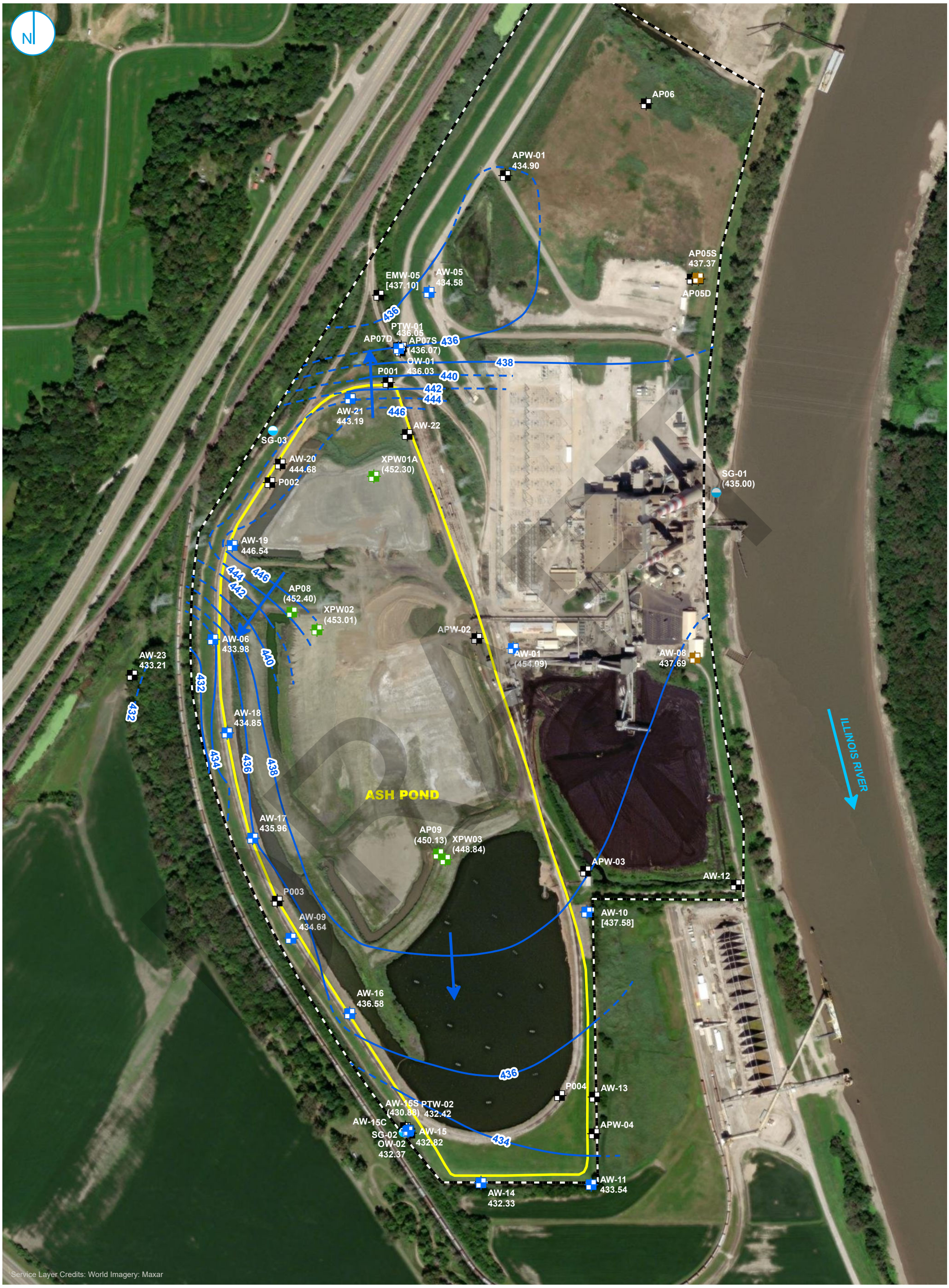

COMPLIANCE MONITORING WELL
BACKGROUND MONITORING WELL
PORE WATER WELL
STAFF GAGE, RIVER
MONITORING WELL

REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY
GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
INFERRED GROUNDWATER ELEVATION CONTOUR
GROUNDWATER FLOW DIRECTION

0 212.5 425 Feet

NOTES
1. ELEVATIONS IN PARENTHESES WERE NOT USED FOR CONTOURING.
2. ELEVATION CONTOURS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. ELEVATIONS IN BRACKETS WERE OBTAINED OUTSIDE OF THE 24-HOUR PERIOD FROM INITIATION OF DEPTH TO GROUNDWATER MEASUREMENTS BUT WITHIN THE SAME SAMPLING EVENT.

POTENTIOMETRIC SURFACE MAP AUGUST 21, 2023

2023 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT ASH POND

EDWARDS POWER PLANT
BARTONVILLE, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

ATTACHMENT B

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25th Percentile Metal Oxides/No Charge Balance

```
SELECTED_OUTPUT 1
-file EDW_845_301_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 #AP07S (C - PMP)
redox pe
units mg/l
density 1
pH 6.885
pe 4.49
temp 20.6
S(6) 360 as SO4
B 13.7
Li 0.00745
As 0.0007225
C(4) 255 as CO3
Cl 79.5
F 0.183
Ca 200
Mg 75
Na 66
K 0.895
Ba 0.0915
Si 7.65
P 0.04
Mn 0.65
Fe 0.0685
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.000835
Cr 0.0072
Co 0.0036
Pb 0.00205
Mo 0.00115
Se 0.00037
end

SOLUTION 2 #AW-15S (C - PMP)
redox pe
units mg/l
density 1
```

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pH 6.785
pe 3.68
temp 20.45
S(6) 580 as SO4
B 6.2
Li 0.0135
As 0.000345
C(4) 306 as CO3
Cl 31
F 0.152
Ca 275
Mg 86
Na 54
K 0.65
Ba 0.081
Si 8
P 0.034
Mn 0.74
Fe 0.044
Al 0.00735
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00054
Pb 0.00011
Mo 0.00285
Se 0.001085
end

SOLUTION 3 #AW-05 (C - UA)
redox pe
units mg/l
density 1
pH 6.985
pe 4.565
temp 22.65
S(6) 405 as SO4
B 6.1
Li 0.017
As 0.0039
C(4) 240 as CO3
Cl 74.5
F 0.1695
Ca 175
Mg 81.5
Na 76.5
K 1.9
Ba 0.145
Si 10
P 0.022
Mn 1.5
Fe 3.65
Al 0.0007

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Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.00865
Co 0.00585
Pb 0.00405
Mo 0.0024
Se 0.00037
end

SOLUTION 4 #AW-19 (C - UA)
redox pe
units mg/l
density 1
pH 6.715
pe 2.695
temp 18.5
S(6) 53.5 as SO4
B 2.6
Li 0.0115
As 0.0135
C(4) 291 as CO3
Cl 80.5
F 0.2895
Ca 120
Mg 55
Na 53
K 1.1
Ba 0.2
Si 10.5
P 0.00395
Mn 0.35
Fe 2.75
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.0014
Pb 0.00129
Mo 0.00375
Se 0.00037
end

SOLUTION 5 #AW-21 (C - UA)
redox pe
units mg/l
density 1
pH 6.825
pe 4.53
temp 18
S(6) 260 as SO4
B 10.35
Li 0.00445
As 0.0010725

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```
C(4) 111 as CO3
Cl 90
F 0.3075
Ca 115
Mg 37
Na 57
K 2.9
Ba 0.0585
Si 5.6
P 0.00395
Mn 0.745
Fe 0.345
Al 0.00195
Sb 0.000885
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.000595
Pb 0.00011
Mo 0.023
Se 0.002085
end

EQUILIBRIUM_PHASES 1 #AP07S (C - PMP) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.13
Ferrihydrite 0 0.04
Calcite 0 0.1
Dolomite(ordered) 0 0.3

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 #AW-15S (C - PMP) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.13
Ferrihydrite 0 0.04
Calcite 0 0.1
Dolomite(ordered) 0 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 #AW-05 (C - UA) - 25p
Barite 0 0
```

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```
Gypsum 0 0
Gibbsite 0 0.16
Ferrihydrite 0 0.19
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 3
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 3
save surface 3
end

EQUILIBRIUM_PHASES 4 #AW-19 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.16
Ferrihydrite 0 0.19
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 4
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 4
save surface 4
end

EQUILIBRIUM_PHASES 5 #AW-21 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.16
Ferrihydrite 0 0.19
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 5
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 5
save surface 5
end

SOLUTION 6 #average background
redox pe
units mg/l
density 1
pH 6.905
pe 1.2
temp 19.65
S(6) 1.595
B 0.22
Li 0.02
As 0.0067
```

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```
C(4) 464.5
Cl 28.5 charge
F 0.08095
Ca 125
Mg 53
Na 120.5
K 2.65
Ba 0.51
Si 16.5
P 1.545
Mn 0.615
Fe 8.95
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00067
Pb 0.00023
Mo 0.001195
Se 0.00037

SAVE solution 6

end

#FIRST REACTION

#AP07S (C - PMP) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#AP07S (C - PMP) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#AW-15S (C - PMP) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#AW-15S (C - PMP) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
```

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```
SAVE surface 2
end

#AW-05 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#AW-05 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#AW-19 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#AW-19 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#AW-21 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end

#AW-21 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end
```

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25th Percentile Metal Oxides/Charge Balance on Chloride

```
SELECTED_OUTPUT 1
-file EDW_845_301_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 #AP07S (C - PMP)
redox pe
units mg/l
density 1
pH 6.885
pe 4.49
temp 20.6
S(6) 360 as SO4
B 13.7
Li 0.00745
As 0.0007225
C(4) 255 as CO3
Cl 79.5 charge
F 0.183
Ca 200
Mg 75
Na 66
K 0.895
Ba 0.0915
Si 7.65
P 0.04
Mn 0.65
Fe 0.0685
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.000835
Cr 0.0072
Co 0.0036
Pb 0.00205
Mo 0.00115
Se 0.00037
end

SOLUTION 2 #AW-15S (C - PMP)
redox pe
units mg/l
density 1
```

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pH 6.785
pe 3.68
temp 20.45
S(6) 580 as SO4
B 6.2
Li 0.0135
As 0.000345
C(4) 306 as CO3
Cl 31 charge
F 0.152
Ca 275
Mg 86
Na 54
K 0.65
Ba 0.081
Si 8
P 0.034
Mn 0.74
Fe 0.044
Al 0.00735
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00054
Pb 0.00011
Mo 0.00285
Se 0.001085
end

SOLUTION 3 #AW-05 (C - UA)
redox pe
units mg/l
density 1
pH 6.985
pe 4.565
temp 22.65
S(6) 405 as SO4
B 6.1
Li 0.017
As 0.0039
C(4) 240 as CO3
Cl 74.5 charge
F 0.1695
Ca 175
Mg 81.5
Na 76.5
K 1.9
Ba 0.145
Si 10
P 0.022
Mn 1.5
Fe 3.65
Al 0.0007

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Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.00865
Co 0.00585
Pb 0.00405
Mo 0.0024
Se 0.00037
end

SOLUTION 4 #AW-19 (C - UA)
redox pe
units mg/l
density 1
pH 6.715
pe 2.695
temp 18.5
S(6) 53.5 as SO4
B 2.6
Li 0.0115
As 0.0135
C(4) 291 as CO3
Cl 80.5 charge
F 0.2895
Ca 120
Mg 55
Na 53
K 1.1
Ba 0.2
Si 10.5
P 0.00395
Mn 0.35
Fe 2.75
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.0014
Pb 0.00129
Mo 0.00375
Se 0.00037
end

SOLUTION 5 #AW-21 (C - UA)
redox pe
units mg/l
density 1
pH 6.825
pe 4.53
temp 18
S(6) 260 as SO4
B 10.35
Li 0.00445
As 0.0010725

DRAFT

```
C(4) 111 as CO3
Cl 90 charge
F 0.3075
Ca 115
Mg 37
Na 57
K 2.9
Ba 0.0585
Si 5.6
P 0.00395
Mn 0.745
Fe 0.345
Al 0.00195
Sb 0.000885
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.000595
Pb 0.00011
Mo 0.023
Se 0.002085
end

EQUILIBRIUM_PHASES 1 #AP07S (C - PMP) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.13
Ferrihydrite 0 0.04
Calcite 0 0.1
Dolomite(ordered) 0 0.3

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 #AW-15S (C - PMP) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.13
Ferrihydrite 0 0.04
Calcite 0 0.1
Dolomite(ordered) 0 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 #AW-05 (C - UA) - 25p
Barite 0 0
```

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```
Gypsum 0 0
Gibbsite 0 0.16
Ferrihydrite 0 0.19
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 3
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 3
save surface 3
end

EQUILIBRIUM_PHASES 4 #AW-19 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.16
Ferrihydrite 0 0.19
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 4
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 4
save surface 4
end

EQUILIBRIUM_PHASES 5 #AW-21 (C - UA) - 25p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.16
Ferrihydrite 0 0.19
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 5
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 5
save surface 5
end

SOLUTION 6 #average background
redox pe
units mg/l
density 1
pH 6.905
pe 1.2
temp 19.65
S(6) 1.595
B 0.22
Li 0.02
As 0.0067
```

DRAFT

```
C(4) 464.5
Cl 28.5 charge
F 0.08095
Ca 125
Mg 53
Na 120.5
K 2.65
Ba 0.51
Si 16.5
P 1.545
Mn 0.615
Fe 8.95
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00067
Pb 0.00023
Mo 0.001195
Se 0.00037

SAVE solution 6

end

#FIRST REACTION

#AP07S (C - PMP) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#AP07S (C - PMP) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#AW-15S (C - PMP) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#AW-15S (C - PMP) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
```

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```
SAVE surface 2
end

#AW-05 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#AW-05 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#AW-19 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#AW-19 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#AW-21 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end

#AW-21 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end
```

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75th Percentile Metal Oxides/No Charge Balance

```
SELECTED_OUTPUT 1
-file EDW_845_301_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 #AP07S (C - PMP)
redox pe
units mg/l
density 1
pH 6.885
pe 4.49
temp 20.6
S(6) 360 as SO4
B 13.7
Li 0.00745
As 0.0007225
C(4) 255 as CO3
Cl 79.5
F 0.183
Ca 200
Mg 75
Na 66
K 0.895
Ba 0.0915
Si 7.65
P 0.04
Mn 0.65
Fe 0.0685
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.000835
Cr 0.0072
Co 0.0036
Pb 0.00205
Mo 0.00115
Se 0.00037
end

SOLUTION 2 #AW-15S (C - PMP)
redox pe
units mg/l
density 1
```

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pH 6.785
pe 3.68
temp 20.45
S(6) 580 as SO4
B 6.2
Li 0.0135
As 0.000345
C(4) 306 as CO3
Cl 31
F 0.152
Ca 275
Mg 86
Na 54
K 0.65
Ba 0.081
Si 8
P 0.034
Mn 0.74
Fe 0.044
Al 0.00735
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00054
Pb 0.00011
Mo 0.00285
Se 0.001085
end

SOLUTION 3 #AW-05 (C - UA)
redox pe
units mg/l
density 1
pH 6.985
pe 4.565
temp 22.65
S(6) 405 as SO4
B 6.1
Li 0.017
As 0.0039
C(4) 240 as CO3
Cl 74.5
F 0.1695
Ca 175
Mg 81.5
Na 76.5
K 1.9
Ba 0.145
Si 10
P 0.022
Mn 1.5
Fe 3.65
Al 0.0007

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Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.00865
Co 0.00585
Pb 0.00405
Mo 0.0024
Se 0.00037
end

SOLUTION 4 #AW-19 (C - UA)
redox pe
units mg/l
density 1
pH 6.715
pe 2.695
temp 18.5
S(6) 53.5 as SO4
B 2.6
Li 0.0115
As 0.0135
C(4) 291 as CO3
Cl 80.5
F 0.2895
Ca 120
Mg 55
Na 53
K 1.1
Ba 0.2
Si 10.5
P 0.00395
Mn 0.35
Fe 2.75
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.0014
Pb 0.00129
Mo 0.00375
Se 0.00037
end

SOLUTION 5 #AW-21 (C - UA)
redox pe
units mg/l
density 1
pH 6.825
pe 4.53
temp 18
S(6) 260 as SO4
B 10.35
Li 0.00445
As 0.0010725

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```
C(4) 111 as CO3
Cl 90
F 0.3075
Ca 115
Mg 37
Na 57
K 2.9
Ba 0.0585
Si 5.6
P 0.00395
Mn 0.745
Fe 0.345
Al 0.00195
Sb 0.000885
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.000595
Pb 0.00011
Mo 0.023
Se 0.002085
end

EQUILIBRIUM_PHASES 1 #AP07S (C - PMP) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.23
Ferrihydrite 0 0.063
Calcite 0 0.1
Dolomite(ordered) 0 0.3

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 #AW-15S (C - PMP) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.23
Ferrihydrite 0 0.063
Calcite 0 0.1
Dolomite(ordered) 0 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 #AW-05 (C - UA) - 75p
Barite 0 0
```

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```
Gypsum 0 0
Gibbsite 0 0.26
Ferrihydrite 0 0.24
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 3
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 3
save surface 3
end

EQUILIBRIUM_PHASES 4 #AW-19 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.26
Ferrihydrite 0 0.24
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 4
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 4
save surface 4
end

EQUILIBRIUM_PHASES 5 #AW-21 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.26
Ferrihydrite 0 0.24
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 5
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 5
save surface 5
end

SOLUTION 6 #average background
redox pe
units mg/l
density 1
pH 6.905
pe 1.2
temp 19.65
S(6) 1.595
B 0.22
Li 0.02
As 0.0067
```

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```
C(4) 464.5
Cl 28.5 charge
F 0.08095
Ca 125
Mg 53
Na 120.5
K 2.65
Ba 0.51
Si 16.5
P 1.545
Mn 0.615
Fe 8.95
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00067
Pb 0.00023
Mo 0.001195
Se 0.00037

SAVE solution 6

end

#FIRST REACTION

#AP07S (C - PMP) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#AP07S (C - PMP) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#AW-15S (C - PMP) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#AW-15S (C - PMP) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
```

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```
SAVE surface 2
end

#AW-05 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#AW-05 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#AW-19 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#AW-19 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#AW-21 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end

#AW-21 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end
```

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75th Percentile Metal Oxides/Charge Balance on Chloride

```
SELECTED_OUTPUT 1
-file EDW_845_301_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 #AP07S (C - PMP)
redox pe
units mg/l
density 1
pH 6.885
pe 4.49
temp 20.6
S(6) 360 as SO4
B 13.7
Li 0.00745
As 0.0007225
C(4) 255 as CO3
Cl 79.5 charge
F 0.183
Ca 200
Mg 75
Na 66
K 0.895
Ba 0.0915
Si 7.65
P 0.04
Mn 0.65
Fe 0.0685
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.000835
Cr 0.0072
Co 0.0036
Pb 0.00205
Mo 0.00115
Se 0.00037
end

SOLUTION 2 #AW-15S (C - PMP)
redox pe
units mg/l
density 1
```

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pH 6.785
pe 3.68
temp 20.45
S(6) 580 as SO4
B 6.2
Li 0.0135
As 0.000345
C(4) 306 as CO3
Cl 31 charge
F 0.152
Ca 275
Mg 86
Na 54
K 0.65
Ba 0.081
Si 8
P 0.034
Mn 0.74
Fe 0.044
Al 0.00735
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00054
Pb 0.00011
Mo 0.00285
Se 0.001085
end

SOLUTION 3 #AW-05 (C - UA)
redox pe
units mg/l
density 1
pH 6.985
pe 4.565
temp 22.65
S(6) 405 as SO4
B 6.1
Li 0.017
As 0.0039
C(4) 240 as CO3
Cl 74.5 charge
F 0.1695
Ca 175
Mg 81.5
Na 76.5
K 1.9
Ba 0.145
Si 10
P 0.022
Mn 1.5
Fe 3.65
Al 0.0007

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```
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.00865
Co 0.00585
Pb 0.00405
Mo 0.0024
Se 0.00037
end
SOLUTION 4 #AW-19 (C - UA)
redox pe
units mg/l
density 1
pH 6.715
pe 2.695
temp 18.5
S(6) 53.5 as SO4
B 2.6
Li 0.0115
As 0.0135
C(4) 291 as CO3
Cl 80.5 charge
F 0.2895
Ca 120
Mg 55
Na 53
K 1.1
Ba 0.2
Si 10.5
P 0.00395
Mn 0.35
Fe 2.75
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.0014
Pb 0.00129
Mo 0.00375
Se 0.00037
end
SOLUTION 5 #AW-21 (C - UA)
redox pe
units mg/l
density 1
pH 6.825
pe 4.53
temp 18
S(6) 260 as SO4
B 10.35
Li 0.00445
As 0.0010725
```

DRAFT

```
C(4) 111 as CO3
Cl 90 charge
F 0.3075
Ca 115
Mg 37
Na 57
K 2.9
Ba 0.0585
Si 5.6
P 0.00395
Mn 0.745
Fe 0.345
Al 0.00195
Sb 0.000885
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.000595
Pb 0.00011
Mo 0.023
Se 0.002085
end

EQUILIBRIUM_PHASES 1 #AP07S (C - PMP) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.23
Ferrihydrite 0 0.063
Calcite 0 0.1
Dolomite(ordered) 0 0.3

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 #AW-15S (C - PMP) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.23
Ferrihydrite 0 0.063
Calcite 0 0.1
Dolomite(ordered) 0 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 #AW-05 (C - UA) - 75p
Barite 0 0
```

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```
Gypsum 0 0
Gibbsite 0 0.26
Ferrihydrite 0 0.24
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 3
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 3
save surface 3
end

EQUILIBRIUM_PHASES 4 #AW-19 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.26
Ferrihydrite 0 0.24
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 4
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 4
save surface 4
end

EQUILIBRIUM_PHASES 5 #AW-21 (C - UA) - 75p
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.26
Ferrihydrite 0 0.24
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 5
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 5
save surface 5
end

SOLUTION 6 #average background
redox pe
units mg/l
density 1
pH 6.905
pe 1.2
temp 19.65
S(6) 1.595
B 0.22
Li 0.02
As 0.0067
```

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```
C(4) 464.5
Cl 28.5 charge
F 0.08095
Ca 125
Mg 53
Na 120.5
K 2.65
Ba 0.51
Si 16.5
P 1.545
Mn 0.615
Fe 8.95
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00067
Pb 0.00023
Mo 0.001195
Se 0.00037

SAVE solution 6

end

#FIRST REACTION

#AP07S (C - PMP) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#AP07S (C - PMP) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#AW-15S (C - PMP) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#AW-15S (C - PMP) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
```

DRAFT

```
SAVE surface 2
end

#AW-05 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#AW-05 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#AW-19 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#AW-19 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#AW-21 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end

#AW-21 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end
```

DRAFT

Median Metal Oxides/No Charge Balance

```
SELECTED_OUTPUT 1
-file EDW_845_301_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 #AP07S (C - PMP)
redox pe
units mg/l
density 1
pH 6.885
pe 4.49
temp 20.6
S(6) 360 as SO4
B 13.7
Li 0.00745
As 0.0007225
C(4) 255 as CO3
Cl 79.5
F 0.183
Ca 200
Mg 75
Na 66
K 0.895
Ba 0.0915
Si 7.65
P 0.04
Mn 0.65
Fe 0.0685
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.000835
Cr 0.0072
Co 0.0036
Pb 0.00205
Mo 0.00115
Se 0.00037
end

SOLUTION 2 #AW-15S (C - PMP)
redox pe
units mg/l
density 1
```

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pH 6.785
pe 3.68
temp 20.45
S(6) 580 as SO4
B 6.2
Li 0.0135
As 0.000345
C(4) 306 as CO3
Cl 31
F 0.152
Ca 275
Mg 86
Na 54
K 0.65
Ba 0.081
Si 8
P 0.034
Mn 0.74
Fe 0.044
Al 0.00735
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00054
Pb 0.00011
Mo 0.00285
Se 0.001085
end

SOLUTION 3 #AW-05 (C - UA)
redox pe
units mg/l
density 1
pH 6.985
pe 4.565
temp 22.65
S(6) 405 as SO4
B 6.1
Li 0.017
As 0.0039
C(4) 240 as CO3
Cl 74.5
F 0.1695
Ca 175
Mg 81.5
Na 76.5
K 1.9
Ba 0.145
Si 10
P 0.022
Mn 1.5
Fe 3.65
Al 0.0007

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Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.00865
Co 0.00585
Pb 0.00405
Mo 0.0024
Se 0.00037
end

SOLUTION 4 #AW-19 (C - UA)
redox pe
units mg/l
density 1
pH 6.715
pe 2.695
temp 18.5
S(6) 53.5 as SO4
B 2.6
Li 0.0115
As 0.0135
C(4) 291 as CO3
Cl 80.5
F 0.2895
Ca 120
Mg 55
Na 53
K 1.1
Ba 0.2
Si 10.5
P 0.00395
Mn 0.35
Fe 2.75
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.0014
Pb 0.00129
Mo 0.00375
Se 0.00037
end

SOLUTION 5 #AW-21 (C - UA)
redox pe
units mg/l
density 1
pH 6.825
pe 4.53
temp 18
S(6) 260 as SO4
B 10.35
Li 0.00445
As 0.0010725

DRAFT

```
C(4) 111 as CO3
Cl 90
F 0.3075
Ca 115
Mg 37
Na 57
K 2.9
Ba 0.0585
Si 5.6
P 0.00395
Mn 0.745
Fe 0.345
Al 0.00195
Sb 0.000885
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.000595
Pb 0.00011
Mo 0.023
Se 0.002085
end

EQUILIBRIUM_PHASES 1 #AP07S (C - PMP) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.18
Ferrihydrite 0 0.052
Calcite 0 0.1
Dolomite(ordered) 0 0.3

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 #AW-15S (C - PMP) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.18
Ferrihydrite 0 0.052
Calcite 0 0.1
Dolomite(ordered) 0 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 #AW-05 (C - UA) - median
Barite 0 0
```

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```
Gypsum 0 0
Gibbsite 0 0.21
Ferrihydrite 0 0.23
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 3
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 3
save surface 3
end

EQUILIBRIUM_PHASES 4 #AW-19 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.21
Ferrihydrite 0 0.23
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 4
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 4
save surface 4
end

EQUILIBRIUM_PHASES 5 #AW-21 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.21
Ferrihydrite 0 0.23
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 5
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 5
save surface 5
end

SOLUTION 6 #average background
redox pe
units mg/l
density 1
pH 6.905
pe 1.2
temp 19.65
S(6) 1.595
B 0.22
Li 0.02
As 0.0067
```

DRAFT

```
C(4) 464.5
Cl 28.5 charge
F 0.08095
Ca 125
Mg 53
Na 120.5
K 2.65
Ba 0.51
Si 16.5
P 1.545
Mn 0.615
Fe 8.95
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00067
Pb 0.00023
Mo 0.001195
Se 0.00037

SAVE solution 6

end

#FIRST REACTION

#AP07S (C - PMP) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#AP07S (C - PMP) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#AW-15S (C - PMP) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#AW-15S (C - PMP) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
```

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```
SAVE surface 2
end

#AW-05 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#AW-05 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#AW-19 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#AW-19 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#AW-21 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end

#AW-21 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end
```

DRAFT

Median Metal Oxides/Charge Balance on Chloride

```
SELECTED_OUTPUT 1
-file EDW_845_301_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 #AP07S (C - PMP)
redox pe
units mg/l
density 1
pH 6.885
pe 4.49
temp 20.6
S(6) 360 as SO4
B 13.7
Li 0.00745
As 0.0007225
C(4) 255 as CO3
Cl 79.5 charge
F 0.183
Ca 200
Mg 75
Na 66
K 0.895
Ba 0.0915
Si 7.65
P 0.04
Mn 0.65
Fe 0.0685
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.000835
Cr 0.0072
Co 0.0036
Pb 0.00205
Mo 0.00115
Se 0.00037
end

SOLUTION 2 #AW-15S (C - PMP)
redox pe
units mg/l
density 1
```

DRAFT

pH 6.785
pe 3.68
temp 20.45
S(6) 580 as SO4
B 6.2
Li 0.0135
As 0.000345
C(4) 306 as CO3
Cl 31 charge
F 0.152
Ca 275
Mg 86
Na 54
K 0.65
Ba 0.081
Si 8
P 0.034
Mn 0.74
Fe 0.044
Al 0.00735
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00054
Pb 0.00011
Mo 0.00285
Se 0.001085
end

SOLUTION 3 #AW-05 (C - UA)
redox pe
units mg/l
density 1
pH 6.985
pe 4.565
temp 22.65
S(6) 405 as SO4
B 6.1
Li 0.017
As 0.0039
C(4) 240 as CO3
Cl 74.5 charge
F 0.1695
Ca 175
Mg 81.5
Na 76.5
K 1.9
Ba 0.145
Si 10
P 0.022
Mn 1.5
Fe 3.65
Al 0.0007

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Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.00865
Co 0.00585
Pb 0.00405
Mo 0.0024
Se 0.00037
end

SOLUTION 4 #AW-19 (C - UA)
redox pe
units mg/l
density 1
pH 6.715
pe 2.695
temp 18.5
S(6) 53.5 as SO4
B 2.6
Li 0.0115
As 0.0135
C(4) 291 as CO3
Cl 80.5 charge
F 0.2895
Ca 120
Mg 55
Na 53
K 1.1
Ba 0.2
Si 10.5
P 0.00395
Mn 0.35
Fe 2.75
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.0014
Pb 0.00129
Mo 0.00375
Se 0.00037
end

SOLUTION 5 #AW-21 (C - UA)
redox pe
units mg/l
density 1
pH 6.825
pe 4.53
temp 18
S(6) 260 as SO4
B 10.35
Li 0.00445
As 0.0010725

DRAFT

```
C(4) 111 as CO3
Cl 90 charge
F 0.3075
Ca 115
Mg 37
Na 57
K 2.9
Ba 0.0585
Si 5.6
P 0.00395
Mn 0.745
Fe 0.345
Al 0.00195
Sb 0.000885
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.000595
Pb 0.00011
Mo 0.023
Se 0.002085
end

EQUILIBRIUM_PHASES 1 #AP07S (C - PMP) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.18
Ferrihydrite 0 0.052
Calcite 0 0.1
Dolomite(ordered) 0 0.3

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 #AW-15S (C - PMP) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.18
Ferrihydrite 0 0.052
Calcite 0 0.1
Dolomite(ordered) 0 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 #AW-05 (C - UA) - median
Barite 0 0
```

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```
Gypsum 0 0
Gibbsite 0 0.21
Ferrihydrite 0 0.23
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 3
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 3
save surface 3
end

EQUILIBRIUM_PHASES 4 #AW-19 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.21
Ferrihydrite 0 0.23
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 4
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 4
save surface 4
end

EQUILIBRIUM_PHASES 5 #AW-21 (C - UA) - median
Barite 0 0
Gypsum 0 0
Gibbsite 0 0.21
Ferrihydrite 0 0.23
Calcite 0 0.4
Dolomite(ordered) 0 0.7

SURFACE 5
Hfo_wOH Ferrihydrite equilibrium_phase 0.2 53400
Hfo_sOH Ferrihydrite equilibrium_phase 0.005 53400
Hao_OH Gibbsite equilibrium_phase 0.033 2496
-equil 5
save surface 5
end

SOLUTION 6 #average background
redox pe
units mg/l
density 1
pH 6.905
pe 1.2
temp 19.65
S(6) 1.595
B 0.22
Li 0.02
As 0.0067
```

DRAFT

```
C(4) 464.5
Cl 28.5 charge
F 0.08095
Ca 125
Mg 53
Na 120.5
K 2.65
Ba 0.51
Si 16.5
P 1.545
Mn 0.615
Fe 8.95
Al 0.0007
Sb 0.000215
Be 0.000295
Cd 0.00037
Cr 0.0014
Co 0.00067
Pb 0.00023
Mo 0.001195
Se 0.00037

SAVE solution 6

end

#FIRST REACTION

#AP07S (C - PMP) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#AP07S (C - PMP) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 1
USE SURFACE 1
SAVE equilibrium_phases 1
SAVE surface 1
end

#AW-15S (C - PMP) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
SAVE surface 2
end

#AW-15S (C - PMP) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 2
USE SURFACE 2
SAVE equilibrium_phases 2
```

DRAFT

```
SAVE surface 2
end

#AW-05 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#AW-05 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 3
USE SURFACE 3
SAVE equilibrium_phases 3
SAVE surface 3
end

#AW-19 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#AW-19 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 4
USE SURFACE 4
SAVE equilibrium_phases 4
SAVE surface 4
end

#AW-21 (C - UA) - First Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end

#AW-21 (C - UA) - Second Reaction
USE SOLUTION 6
USE EQUILIBRIUM_PHASES 5
USE SURFACE 5
SAVE equilibrium_phases 5
SAVE surface 5
end
```

DRAFT

Database

```
#$Id: minteq.v4.dat 12387 2017-02-09 16:41:47Z dlpark $
SOLUTION_MASTER_SPECIES
Alkalinity CO3-2 2.0 HCO3 61.0173
E e- 0 0 0
O H2O 0 O 16.00
O(-2) H2O 0 O
O(0) O2 0 O
Ag Ag+ 0.0 Ag 107.868
Al Al+3 0.0 Al 26.9815
As H3AsO4 -1.0 As 74.9216
As(3) H3AsO3 0.0 As
As(5) H3AsO4 -1.0 As
B H3BO3 0.0 B 10.81
Ba Ba+2 0.0 Ba 137.33
Be Be+2 0.0 Be 9.0122
Br Br- 0.0 Br 79.904
C CO3-2 2.0 CO3 12.0111
C(4) CO3-2 2.0 CO3 12.0111
Cyanide Cyanide- 1.0 Cyanide 26.0177
Dom_a Dom_a 0.0 C 12.0111
Dom_b Dom_b 0.0 C 12.0111
Dom_c Dom_c 0.0 C 12.0111
Ca Ca+2 0.0 Ca 40.078
Cd Cd+2 0.0 Cd 112.41
Cl Cl- 0.0 Cl 35.453
Co Co+3 -1.0 Co 58.9332
Co(2) Co+2 0.0 Co
Co(3) Co+3 -1.0 Co
Cr CrO4-2 1.0 Cr 51.996
Cr(2) Cr+2 0.0 Cr
Cr(3) Cr(OH)2+ 0.0 Cr
Cr(6) CrO4-2 1.0 Cr
Cu Cu+2 0.0 Cu 63.546
Cu(1) Cu+ 0.0 Cu
Cu(2) Cu+2 0.0 Cu
F F- 0.0 F 18.9984
Fe Fe+3 -2.0 Fe 55.847
Fe(2) Fe+2 0.0 Fe
Fe(3) Fe+3 -2.0 Fe
H H+ -1.0 H 1.0079
H(0) H2 0 H
H(1) H+ -1.0 H
Hg Hg(OH)2 0.0 Hg 200.59
Hg(0) Hg 0.0 Hg
Hg(1) Hg2+2 0.0 Hg
Hg(2) Hg(OH)2 0.0 Hg
I I- 0.0 I 126.904
K K+ 0.0 K 39.0983
Li Li+ 0.0 Li 6.941
Mg Mg+2 0.0 Mg 24.305
Mn Mn+3 0.0 Mn 54.938
```

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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

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```
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

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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

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```
# 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
```

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```
-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+
```

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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

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#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

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# 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
```

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-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+

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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

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#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

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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

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-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+

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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

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#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

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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

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-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

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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

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#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

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# 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
```

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-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

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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

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#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

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```
# 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
```

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-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

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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

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#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

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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

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-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

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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

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#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

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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

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-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-

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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

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#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

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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

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-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

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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

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#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

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# 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
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-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+

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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

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#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

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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

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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

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#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

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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

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-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

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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

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#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

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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

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-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

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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

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#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

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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

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-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+

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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

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#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

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```
# 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
```

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-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

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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

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#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

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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

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-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-

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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

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#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

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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

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-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

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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

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#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

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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

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-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

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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

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#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

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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

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-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+

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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

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#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

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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

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-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+

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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

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#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

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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

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-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

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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

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#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

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# 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
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-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)+

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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

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#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

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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

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-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

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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

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#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

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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

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-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

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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

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#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

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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

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-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+

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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

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#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

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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

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-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

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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

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#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

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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

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-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

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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

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#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

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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

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-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)

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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

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#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

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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

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-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

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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

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#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
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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

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-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

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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

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#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

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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

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-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)-

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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

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#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

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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

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-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

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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

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#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

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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

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-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)-

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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

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#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

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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

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-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

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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

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#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

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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

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-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+

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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

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#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

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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

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-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

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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

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#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

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# 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
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-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

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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

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#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

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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

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-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)+

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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

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#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

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```
# 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
```

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-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

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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

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#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

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```
# 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
```

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-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

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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

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#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

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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

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-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)+

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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

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#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

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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

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-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)+

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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

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#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

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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

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-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)

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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

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#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

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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

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-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)

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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

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#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

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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

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-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)

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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

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#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

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```
# 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-
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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

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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-

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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

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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-

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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

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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-

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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

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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

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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

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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

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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

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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

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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

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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+

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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

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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+

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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

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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-

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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

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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+

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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

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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

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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

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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-

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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

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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

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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

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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

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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

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(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+

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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

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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

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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

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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+

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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

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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

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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

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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

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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

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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

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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+

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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:

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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

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```
# 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+
```

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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:

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#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

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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

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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:

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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:

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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

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```
# 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
```

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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

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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)

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```
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
```

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ATTACHMENT C

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ATTACHMENT C. DETAILS OF GEOCHEMICAL MODEL PARAMETERIZATION

INTRODUCTION

This appendix to the Groundwater Polishing Report for the Edwards Power Plant Ash Pond 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 data is fully documented in the Nature and Extent Report[1].

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 and sulfate. Input concentrations for iron and aluminum (hydr)oxides were derived using sequential extraction procedure (SEP) data. SEP methods are described in the Geochemical Conceptual Site Model (GCSM)[2] Section 4 and 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). As described in the GCSM, the SEP used for these samples included a more reactive non-crystalline metal oxide fraction and a less reactive metal hydroxide fraction.

Sorption of inorganic constituents to iron (hydr)oxides in the MINTEQ v4 database[3] is represented by the hydrous ferric oxide (HFO) thermodynamic data set presented in Dzombak and Morel (1990). HFO is a non-crystalline iron hydroxide phase with high surface area. Therefore, the mass of iron extracted in the non-crystalline SEP fraction is used in the HFO model input. Crystalline metal oxides are also capable of sorbing inorganic constituents although they typically have a lower surface area available for sorption. Because magnetite was observed in X-ray diffraction (XRD) results from site, 10% of the iron concentration (which represents the lower surface area, consistent with Appelo and Postma, 2005) from the metal hydroxide fraction was included in the HFO model input.

Sorption of inorganic constituents to aluminum (hydr)oxides is represented by the hydrous aluminum oxide (HAO) thermodynamic data presented in Karamalidis and Dzombak (2010), Goldberg and Glaubig (1985) (boron), and Kitadai et al. (2018) (sulfate). These sorption data are based on gibbsite, a nearly ubiquitous crystalline aluminum hydroxide mineral (Karamalidis and Dzombak 2010). Because gibbsite is a more crystalline hydroxide, the mass of aluminum extracted in the crystalline SEP fraction is used in the HAO input in the model.

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[1] The Nature and Extent Report was previously submitted to IEPA (Ramboll 2024) and provided with relevant updates as Appendix D of the CAAA to which this report is attached.

[2] Ibid.; the GCSM is an appendix of the Nature and Extent Report.

[3] 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.

SEP data were available from four solid phase samples for the Uppermost Aquifer (UA) and two solid phase samples were available from the Potential Migration Pathway (PMP). In thermodynamic modeling, the amount of sorbing phase present is one of the dominant controls on the concentration of constituents sorbed. 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 based on the 25th percentile, median (i.e., 50th percentile), and 75th percentile of the SEP results for iron and aluminum.

The quantities of HFO and HAO in the model are represented by ferrihydrite and gibbsite, 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). SEP results were used to calculate the quantities of HFO and HAO because there are often environmentally relevant masses of iron and aluminum (hydr)oxides within solids that are not sufficiently crystalline to be characterized by other methods (e.g. X-ray diffraction [XRD]). Additionally, the SEP analysis can detect a much lower constituent concentration than is typically attainable by XRD. SEP 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 of aqueous phase. The concentrations of iron and aluminum reported in SEP results (**Table C-1**) 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 liter [L] of water) was calculated by:

$$Solid\ Mass\ In\ Model\ (kg) = \frac{(1-\phi)}{\phi} \times \frac{1000\ cm^3\ water}{L\ water} \times 1\ L\ water\ \times \rho\ (\frac{g}{cm^3}) \times \frac{1\ kg\ solid}{1000\ g\ solid}$$

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 (**Table C-1**) represent the median of measurements each hydrostratigraphic unit as reported in the Hydrogeologic Characterization Report[4].

Moles of ferrihydrite and gibbsite were determined using the SEP concentration 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 based on the mineral formula. Ferrihydrite and gibbsite were allowed to precipitate or dissolve in the flushing phase of the model to evaluate the impact of closure on sorbing phase availability.

Barite and gypsum are common sulfate minerals that have the potential to form under ambient environmental conditions. Neither mineral was detected in XRD results for the site. Therefore, barite and gypsum did not have initial concentrations in the model but were allowed to precipitate or dissolve during flushing.

[4] The Hydrogeologic Characterization Report was previously submitted to IEPA as part of the Closure Permit Application and is provided as Appendix B.3 to the Construction Permit Application.

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AQUEOUS INPUTS

In addition to the COCs, 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, calcium, magnesium, sulfate: 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 (silicon oxide) and phosphate are oxyanions that compete with sulfate/boron for sorbing sites.
- Aluminum, iron, and manganese: As discussed above, iron and aluminum form reactive metal (hydr)oxide minerals which have high capacities for sorbing other ions on their surfaces. Although sorption to manganese oxides was not considered in this model, manganese behaves similarly to iron and is included for completeness.
- Remaining constituents regulated under 35 IAC § 845.600[5]: Although these parameters are not subject to corrective action at KIN AP, they are included in the model for completeness to assess reactions such as competition for available adsorption sites.

Values for pe (derived from ORP) and carbonate ion concentrations were calculated from values previously reported in the analytical data according to the following methods.

Groundwater ORP is used to calculate pe, a non-dimension scale of redox potential. First, the field-measured ORP was converted to Eh, the redox potential normalized to the standard hydrogen electrode. The following equation provided in the Horiba water quality meter instruction manual[6] was used:

$$Eh = ORP + 206 - 0.7*(T - 25)$$

Where both Eh and ORP are in volts (V) and T is temperature in degrees Celsius. Eh is then converted to pe:

$$pe = (Eh * F) / (2.303 * R * T)$$

Where:

F = Faraday constant (96,500 Joules (J) / V-equivalent)

R = Molar gas constant (8.31 J / Kelvin (K)-mole)

T = temperature in Kelvin

Data reported for groundwater at the site included 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

[5] 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.

[6] https://static.horiba.com/fileadmin/Horiba/Products/Process_and_Environmental/Water_Pollution/Instruction_Manuals/U-50/U-50_Manual.pdf

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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 median values 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 both background locations.

The charge imbalance of the initial solution was less than 30% for all samples. The results presented in the Groundwater Polishing Report represent the model results using charge balancing on chloride.

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Table C-1. Summary of Solid Phase Parameters
Attachment C. Details of Geochemical Model Parameterization
Edwards Ash Pond
Edwards Power Plant
Bartonville, IL

Hydrostratigraphic Unit	Porosity	Dry Density (g/cm3)	Solid Mass In Model (kg)	Metal Summary Statistic	Iron		Aluminum	
					mg/kg	moles	mg/kg	moles
PMP[1]	0.49	1.37	1.43	25th Percentile	1573	0.04	2525	0.13
				Median	2015	0.05	3450	0.18
				75th Percentile	2458	0.06	4375	0.23
UA[2]	0.44	1.50	1.91	25th Percentile	5490	0.19	2200	0.16
				Median	6600	0.23	3000	0.21
				75th Percentile	7000	0.24	3675	0.26

Notes:
1. Table 2-1 in 2021 HCR; includes samples from AP07S and AW-15S
2. Table 2-1 in 2021 HCR; includes samples from AW-05, AW-19, and AW-21
g/cm^3 = grams per cubic centimeter
kg = kilograms
mg/kg = milligrams per kilogram dry weight

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ATTACHMENT D

Attachment D. PHREEQC modeling output
Groundwater Polishing Report
Ash Pond
Edwards Power Plant
Bartonville, IL

Location	Location Description	Model	Charge Balance	Solids Summary	pH	pe	charge	pct_err	S(6)	B	Li	As	C(4)	Cl
AP07S	C - PMP	Initial Soln	TRUE	25p	6.88	4.49	-1.02e-10	-3.05e-07	0.00375	0.00127	1.07e-06	9.65e-09	0.00425	0.00817
AW-15S	C - PMP	Initial Soln	TRUE	25p	6.79	3.68	3.29e-14	8.57e-11	0.00605	0.000574	1.95e-06	4.61e-09	0.00511	0.00723
AW-05	C - UA	Initial Soln	TRUE	25p	6.99	4.57	8.21e-15	2.50e-11	0.00422	0.000565	2.45e-06	5.21e-08	0.00400	0.00716
AW-19	C - UA	Initial Soln	TRUE	25p	6.71	2.69	6.80e-18	2.71e-14	0.000557	0.000241	1.66e-06	1.80e-07	0.00485	0.00837
AW-21	C - UA	Initial Soln	TRUE	25p	6.83	4.53	-4.57e-12	-2.25e-08	0.00271	0.000958	6.42e-07	1.43e-08	0.00185	0.00454
AP07S	C - PMP	Speciation Model	TRUE	25p	6.88	4.49	-1.02e-10	-3.05e-07	0.00375	0.00127	1.07e-06	9.65e-09	0.00425	0.00817
AW-15S	C - PMP	Speciation Model	TRUE	25p	6.79	3.68	3.29e-14	8.56e-11	0.00605	0.000574	1.95e-06	4.61e-09	0.00511	0.00723
AW-05	C - UA	Speciation Model	TRUE	25p	6.99	4.57	1.00e-14	3.05e-11	0.00422	0.000565	2.45e-06	5.21e-08	0.00400	0.00716
AW-19	C - UA	Speciation Model	TRUE	25p	6.71	2.69	5.28e-18	2.11e-14	0.000557	0.000241	1.66e-06	1.80e-07	0.00485	0.00837
AW-21	C - UA	Speciation Model	TRUE	25p	6.83	4.53	-4.60e-12	-2.26e-08	0.00271	0.000958	6.42e-07	1.43e-08	0.00185	0.00454
AP07S	C - PMP	First Reaction	TRUE	25p	6.98	0.440	-8.13e-05	-2.50e-01	6.93e-05	0.000298	2.88e-06	2.57e-08	0.00788	0.00996
AP07S	C - PMP	Second Reaction	TRUE	25p	6.97	0.114	-4.02e-05	-1.23e-01	1.12e-05	0.000185	2.88e-06	4.47e-08	0.00806	0.00996
AW-15S	C - PMP	First Reaction	TRUE	25p	6.96	0.713	-1.22e-04	-3.69e-01	0.000139	0.000230	2.88e-06	8.08e-09	0.00815	0.00996
AW-15S	C - PMP	Second Reaction	TRUE	25p	6.97	0.282	-4.84e-05	-1.48e-01	2.22e-05	0.000160	2.88e-06	1.23e-08	0.00814	0.00996
AW-05	C - UA	First Reaction	TRUE	25p	7.04	0.341	6.94e-05	0.219	0.000226	0.000230	2.88e-06	1.01e-07	0.00683	0.00995
AW-05	C - UA	Second Reaction	TRUE	25p	7.01	0.142	-8.77e-05	-2.75e-01	3.99e-05	0.000151	2.88e-06	1.46e-07	0.00747	0.00996
AW-19	C - UA	First Reaction	TRUE	25p	6.95	0.356	0.000298	0.896	7.01e-05	0.000156	2.88e-06	4.95e-07	0.00824	0.00996
AW-19	C - UA	Second Reaction	TRUE	25p	6.96	0.226	-1.48e-05	-4.48e-02	2.64e-05	0.000122	2.88e-06	5.52e-07	0.00822	0.00996
AW-21	C - UA	First Reaction	TRUE	25p	7.09	0.392	0.000351	1.11	0.000462	0.000441	2.88e-06	6.60e-08	0.00599	0.00995
AW-21	C - UA	Second Reaction	TRUE	25p	7.04	0.214	-1.07e-04	-3.42e-01	4.74e-05	0.000217	2.88e-06	9.93e-08	0.00702	0.00995
AP07S	C - PMP	Initial Soln	TRUE	75p	6.88	4.49	-1.02e-10	-3.05e-07	0.00375	0.00127	1.07e-06	9.65e-09	0.00425	0.00817
AW-15S	C - PMP	Initial Soln	TRUE	75p	6.79	3.68	3.29e-14	8.57e-11	0.00605	0.000574	1.95e-06	4.61e-09	0.00511	0.00723
AW-05	C - UA	Initial Soln	TRUE	75p	6.99	4.57	8.21e-15	2.50e-11	0.00422	0.000565	2.45e-06	5.21e-08	0.00400	0.00716
AW-19	C - UA	Initial Soln	TRUE	75p	6.71	2.69	6.80e-18	2.71e-14	0.000557	0.000241	1.66e-06	1.80e-07	0.00485	0.00837
AW-21	C - UA	Initial Soln	TRUE	75p	6.83	4.53	-4.57e-12	-2.25e-08	0.00271	0.000958	6.42e-07	1.43e-08	0.00185	0.00454
AP07S	C - PMP	Speciation Model	TRUE	75p	6.88	4.49	-1.02e-10	-3.05e-07	0.00375	0.00127	1.07e-06	9.65e-09	0.00425	0.00817
AW-15S	C - PMP	Speciation Model	TRUE	75p	6.79	3.68	3.29e-14	8.56e-11	0.00605	0.000574	1.95e-06	4.61e-09	0.00511	0.00723
AW-05	C - UA	Speciation Model	TRUE	75p	6.99	4.57	1.00e-14	3.05e-11	0.00422	0.000565	2.45e-06	5.21e-08	0.00400	0.00716
AW-19	C - UA	Speciation Model	TRUE	75p	6.71	2.69	5.28e-18	2.11e-14	0.000557	0.000241	1.66e-06	1.80e-07	0.00485	0.00837
AW-21	C - UA	Speciation Model	TRUE	75p	6.83	4.53	-4.60e-12	-2.26e-08	0.00271	0.000958	6.42e-07	1.43e-08	0.00185	0.00454
AP07S	C - PMP	First Reaction	TRUE	75p	6.99	0.650	-1.31e-04	-4.03e-01	0.000121	0.000363	2.88e-06	2.19e-08	0.00778	0.00996
AP07S	C - PMP	Second Reaction	TRUE	75p	6.97	0.323	-7.93e-05	-2.43e-01	2.22e-05	0.000233	2.88e-06	3.05e-08	0.00804	0.00996
AW-15S	C - PMP	First Reaction	TRUE	75p	6.96	0.973	-2.06e-04	-6.20e-01	0.000233	0.000263	2.88e-06	7.29e-09	0.00814	0.00996
AW-15S	C - PMP	Second Reaction	TRUE	75p	6.97	0.567	-8.95e-05	-2.73e-01	4.57e-05	0.000186	2.88e-06	8.87e-09	0.00816	0.00996
AW-05	C - UA	First Reaction	TRUE	75p	7.05	0.434	5.39e-05	0.170	0.000307	0.000255	2.88e-06	9.32e-08	0.00670	0.00995
AW-05	C - UA	Second Reaction	TRUE	75p	7.02	0.254	-1.22e-04	-3.83e-01	6.26e-05	0.000173	2.88e-06	1.23e-07	0.00732	0.00995
AW-19	C - UA	First Reaction	TRUE	75p	6.95	0.382	0.000359	1.07	9.17e-05	0.000172	2.88e-06	4.86e-07	0.00825	0.00996
AW-19	C - UA	Second Reaction	TRUE	75p	6.96	0.268	-2.46e-05	-7.47e-02	3.78e-05	0.000138	2.88e-06	5.28e-07	0.00824	0.00996
AW-21	C - UA	First Reaction	TRUE	75p	7.10	0.504	0.000436	1.38	0.000581	0.000530	2.88e-06	6.03e-08	0.00579	0.00995
AW-21	C - UA	Second Reaction	TRUE	75p	7.06	0.323	-1.39e-04	-4.48e-01	7.07e-05	0.000268	2.88e-06	8.41e-08	0.00677	0.00995
AP07S	C - PMP	Initial Soln	TRUE	median	6.88	4.49	-1.02e-10	-3.05e-07	0.00375	0.00127	1.07e-06	9.65e-09	0.00425	0.00817
AW-15S	C - PMP	Initial Soln	TRUE	median	6.79	3.68	3.29e-14	8.57e-11	0.00605	0.000574	1.95e-06	4.61e-09	0.00511	0.00723
AW-05	C - UA	Initial Soln	TRUE	median	6.99	4.57	8.21e-15	2.50e-11	0.00422	0.000565	2.45e-06	5.21e-08	0.00400	0.00716
AW-19	C - UA	Initial Soln	TRUE	median	6.71	2.69	6.80e-18	2.71e-14	0.000557	0.000241	1.66e-06	1.80e-07	0.00485	0.00837
AW-21	C - UA	Initial Soln	TRUE	median	6.83	4.53	-4.57e-12	-2.25e-08	0.00271	0.000958	6.42e-07	1.43e-08	0.00185	0.00454
AP07S	C - PMP	Speciation Model	TRUE	median	6.88	4.49	-1.02e-10	-3.05e-07	0.00375	0.00127	1.07e-06	9.65e-09	0.00425	0.00817
AW-15S	C - PMP	Speciation Model	TRUE	median	6.79	3.68	3.29e-14	8.56e-11	0.00605	0.000574	1.95e-06	4.61e-09	0.00511	0.00723
AW-05	C - UA	Speciation Model	TRUE	median	6.99	4.57	1.00e-14	3.05e-11	0.00422	0.000565	2.45e-06	5.21e-08	0.00400	0.00716
AW-19	C - UA	Speciation Model	TRUE	median	6.71	2.69	5.28e-18	2.11e-14	0.000557	0.000241	1.66e-06	1.80e-07	0.00485	0.00837
AW-21	C - UA	Speciation Model	TRUE	median	6.83	4.53	-4.60e-12	-2.26e-08	0.00271	0.000958	6.42e-07	1.43e-08	0.00185	0.00454
AP07S	C - PMP	First Reaction	TRUE	median	6.98	0.559	-1.07e-04	-3.29e-01	9.60e-05	0.000334	2.88e-06	2.32e-08	0.00783	0.00996
AP07S	C - PMP	Second Reaction	TRUE	median	6.97	0.227	-6.08e-05	-1.86e-01	1.63e-05	0.000211	2.88e-06	3.54e-08	0.00805	0.00996
AW-15S	C - PMP	First Reaction	TRUE	median	6.96	0.862	-1.65e-04	-4.97e-01	0.000188	0.000248	2.88e-06	7.56e-09	0.00815	0.00996
AW-15S	C - PMP	Second Reaction	TRUE	median	6.97	0.441	-6.97e-05	-2.12e-01	3.37e-05	0.000175	2.88e-06	9.92e-09	0.00815	0.00996
AW-05	C - UA	First Reaction	TRUE	median	7.05	0.394	8.30e-05	0.261	0.000278	0.000246	2.88e-06	9.52e-08	0.00672	0.00995
AW-05	C - UA	Second Reaction	TRUE	median	7.02	0.203	-1.06e-04	-3.33e-01	5.26e-05	0.000164	2.88e-06	1.30e-07	0.00735	0.00995
AW-19	C - UA	First Reaction	TRUE	median	6.95	0.380	0.000357	1.07	8.35e-05	0.000165	2.88e-06	4.87e-07	0.00824	0.00996
AW-19	C - UA	Second Reaction	TRUE	median	6.96	0.259	-1.80e-05	-5.47e-02	3.28e-05	0.000131	2.88e-06	5.33e-07	0.00824	0.00996
AW-21	C - UA	First Reaction	TRUE	median	7.10	0.452	0.000430	1.36	0.000558	0.000494	2.88e-06	6.15e-08	0.00582	0.00995
AW-21	C - UA	Second Reaction	TRUE	median	7.06	0.267	-1.21e-04	-3.88e-01	6.20e-05	0.000246	2.88e-06	8.82e-08	0.00681	0.00995
AP07S	C - PMP	Initial Soln	FALSE	25p	6.88	4.49	0.00593	21.7	0.00375	0.00127	1.07e-06	9.65e-09	0.00425	0.00224
AW-15S	C - PMP	Initial Soln	FALSE	25p	6.79	3.68	0.00636	20.0	0.00605	0.000574	1.95e-06	4.61e-09	0.00511	0.000876
AW-05	C - UA	Initial Soln	FALSE	25p	6.99	4.57	0.00506	18.3	0.00422	0.000565	2.45e-06	5.21e-08	0.00400	0.00210
AW-19	C - UA	Initial Soln	FALSE	25p	6.71	2.69	0.00610	32.2	0.000557	0.000241	1.66e-06	1.80e-07	0.00485	0.00227
AW-21	C - UA	Initial Soln	FALSE	25p	6.83	4.53	0.00200	10.9	0.00271	0.000958	6.42e-07	1.43e-08	0.00185	0.00254
AP07S	C - PMP	Speciation Model	FALSE	25p	6.88	4.49	0.00593	21.7	0.00375	0.00127	1.07e-06	9.65e-09	0.00425	0.00224
AW-15S	C - PMP	Speciation Model	FALSE	25p	6.79	3.68	0.00636	20.0	0.00605	0.000574	1.95e-06	4.61e-09	0.00511	0.000876
AW-05	C - UA	Speciation Model	FALSE	25p	6.99	4.57	0.00506	18.3	0.00422	0.000565	2.45e-06	5.21e-08	0.00400	0.00210
AW-19	C - UA	Speciation Model	FALSE	25p	6.71	2.69	0.00610	32.2	0.000557	0.000241	1.66e-06	1.80e-07	0.00485	0.00227
AW-21	C - UA	Speciation Model	FALSE	25p	6.83	4.53	0.00200	10.9	0.00271	0.000958	6.42e-07	1.43e-08	0.00185	0.00254
AP07S	C - PMP	First Reaction	FALSE	25p	6.98	0.430	-8.00e-05	-2.46e-01	6.56e-05	0.000297	2.88e-06	2.71e-08	0.00788	0.00996
AP07S	C - PMP	Second Reaction	FALSE	25p	6.97	0.109	-3.93e-05	-1.20e-01	1.08e-05	0.000185	2.88e-06	4.74e-08	0.00806	0.00996
AW-15S	C - PMP	First Reaction	FALSE	25p	6.96	0.709	-1.16e-04	-3.53e-01	0.000135	0.000229	2.88e-06	8.47e-09	0.00814	0.00996
AW-15S	C - PMP	Second Reaction	FALSE	25p	6.97	0.280	-4.79e-05	-1.46e-01	2.18e-05	0.000159	2.88e-06	1.29e-08	0.00814	0.00996
AW-05	C - UA	First Reaction	FALSE	25p	7.04	0.334	4.26e-05	0.134	0.000223	0.000229	2.88e-06	1.05e-07	0.00683	0.00995
AW-05	C - UA	Second Reaction	FALSE	25p	7.01	0.140	-8.86e-05	-2.78e-01	3.97e-05	0.000150	2.88e-06	1.53e-07	0.00746	0.00996
AW-19	C - UA	First Reaction	FALSE	25p	6.95	0.345	0.000245	0.737	6.75e-05	0.000153	2.88e-06	5.26e-07	0.00824	0.00996
AW-19	C - UA	Second Reaction	FALSE	25p	6.96	0.222	-1.59e-05	-4.84e-02	2.62e-05	0.000119	2.88e-06	5.83e-07	0.00822	0.00996
AW-21	C - UA	First Reaction	FALSE	25p	7.09	0.390	0.000325	1.03	0.000463	0.000442	2.88e-06	6.74e-08	0.00599	0.00995
AW-21	C - UA	Second Reaction	FALSE	25p	7.04	0.213	-1.08e-04	-3.45e-01	4.74e-05	0.000217	2.88e-06	1.01e-07	0.00702	0.00995
AP07S	C - PMP	Initial Soln	FALSE	75p	6.88	4.49	0.00593	21.7	0.00375	0.00127	1.07e-06	9.65e-09	0.00425	0.00224
AW-15S	C - PMP	Initial Soln	FALSE	75p	6.79	3.68	0.00636	20.0	0.00605	0.000574	1.95e-06	4.61e-09	0.00511	0.000876
AW-05	C - UA	Initial Soln	FALSE	75p	6.99	4.57	0.00506	18.3	0.00422	0.000565	2.45e-06	5.21e-08	0.00400	0.00210
AW-19	C - UA	Initial Soln	FALSE	75p	6.71	2.69	0.00610	32.2	0.000557	0.000241	1.66e-06	1.80e-07	0.00485	0.00227
AW-21	C - UA	Initial Soln	FALSE	75p	6.83	4.53	0.00200	10.9	0.00271	0.000958	6.42e-07	1.43e-08	0.00185	0.00254
AP07S	C - PMP	Speciation Model	FALSE	75p	6.88	4.49	0.00593	21.7	0.00375	0.00127	1.07e-06	9.65e-09	0.00425	0.00224
AW-15S	C - PMP	Speciation Model	FALSE	75p	6.79	3.68	0.00636	20.0	0.00605	0.000574	1.95e-06	4.61e-09	0.00511	0.000876
AW-05	C - UA	Speciation Model	FALSE	75p	6.99	4.57	0.00506	18.3	0.00422	0.000565	2.45e-06	5.21e-08	0.00400	0.00210
AW-19	C - UA	Speciation Model	FALSE	75p	6.71	2.69	0.00610	32.2	0.000557	0.000241	1.66e-06	1.80e-07	0.00485	0.00227
AW-21	C - UA	Speciation Model	FALSE	75p	6.83	4.53	0.00200	10.9	0.00271	0.000958	6.42e-07	1.43e-08	0.00185	0.00254
AP07S	C - PMP	First Reaction	FALSE	75p	6.99	0.639	-1.27e-04	-3.90e-01	0.000115	0.000363	2.88e-06	2.30e-08	0.00777	0.00996
AP07S	C - PMP	Second Reaction	FALSE	75p	6.97	0.315	-7.80e-05	-2.39e-01	2.12e-05	0.000233	2.88e-06	3.23e-08	0.00804	0.00996
AW-15S	C - PMP	First Reaction	FALSE	75p	6.96	0.968	-1.94e-04	-5.85e-01	0.000225	0.000261	2.88e-06	7.64e-09	0.00813	0.00996
AW-15S	C - PMP	Second Reaction	FALSE	75p	6.97	0.563	-8.84e-05	-2.69e-01	4.48e-05	0.000186	2.88e-06	9.32e-09	0.00815	0.00996
AW-05	C - UA	First Reaction	FALSE	75p	7.05	0.425	2.64e-05	0.0832	0.000301	0.000254	2.88e-06	9.74e-08	0.00669	0.00995
AW-05	C - UA	Second Reaction	FALSE	75p	7.02	0.249	-1.23e-04	-3.86e-01	6.20e-05	0.000173	2.88e-06	1.28e-07	0.00731	0.00995
AW-19	C - UA	First Reaction	FALSE	75p	6.95	0.367	0.000299	0.894	8.73e-05	0.000168	2.88e-06	5.18e-07	0.00825	0.00996
AW-19	C - UA	Second Reaction	FALSE	75p	6.96	0.260	-2.58e-05	-7.82e-02	3.71e-05	0.000136	2.88e-06	5.60e-07	0.00824	0.00996
AW-21	C - UA	First Reaction	FALSE	75p	7.10	0.500	0.000406	1.28	0.000582	0.000531	2.88e-06	6.16e-08	0.00579	0.00995
AW-21	C - UA	Second Reaction	FALSE	75p	7.06	0.322	-1.40e-04	-4.52e-01	7.05e-05	0.000268	2.88e-06	8.58e-08	0.00676	0.00995
AP07S	C - PMP	Initial Soln	FALSE	median	6.88	4.49	0.00593	21.7	0.00375	0.00127	1.07e-06	9.65e-09	0.00425	0.00224
AW-15S	C - PMP	Initial Soln	FALSE	median	6.79	3.68	0.00636	20.0	0.00605	0.000574	1.95e-06	4.61e-09	0.00511	0.000876
AW-05	C - UA	Initial Soln	FALSE	median	6.99	4.57	0.00506	18.3	0.00422	0.000565	2.45e-06	5.21e-08	0.00400	0.00210
AW-19	C - UA	Initial Soln	FALSE	median	6.71	2.69	0.00610	32.2	0.000557	0.000241	1.66e-06	1.80e-07	0.00485	0.00227
AW-21	C - UA	Initial Soln	FALSE	median	6.83	4.53	0.00200	10.9	0.00271	0.000958	6.42e-07	1.43e-08	0.00185	0.00254
AP07S	C - PMP	Speciation Model	FALSE	median	6.88	4.49	0.00593	21.7	0.00375	0.00127	1.07e-06	9.65e-09	0.00425	0.00224
AW-15S	C - PMP	Speciation Model	FALSE	median	6.79	3.68	0.00636	20.0	0.00605	0.000574	1.95e-06	4.61e-09	0.00511	0.000876
AW-05	C - UA	Speciation Model	FALSE	median	6.99	4.57	0.00506	18.3	0.00422	0.000565	2.45e-06	5.21e-08	0.00400	0.00210
AW-19	C - UA	Speciation Model	FALSE	median	6.71	2.69	0.00610	32.2	0.000557	0.000241	1.66e-06	1.80e-07	0.00485	0.00227
AW-21	C - UA	Speciation Model	FALSE	median	6.83	4.53	0.00200	10.9	0.00271	0.000958	6.42e-07	1.43e-08	0.00185	0.00254
AP07S	C - PMP	First Reaction	FALSE	median	6.99	0.549	-1.04e-04	-3.21e-01	9.08e-05	0.000334	2.88e-06	2.44e-08	0.00782	0.00996
AP07S	C - PMP	Second Reaction	FALSE	median	6.97	0.220	-5.96e-05	-1.83e-01	1.56e-05	0.000211	2.88e-06	3.75e-08	0.00805	0.00996
AW-15S	C - PMP	First Reaction	FALSE	median	6.96	0.857	-1.56e-04	-4.71e-01	0.000182	0.000247	2.88e-06	7.92e-09	0.00814	0.00996
AW-15S	C - PMP	Second Reaction	FALSE	median	6.97	0.438	-6.88e-05	-2.10e-01	3.30e-05	0.000175	2.88e-06	1.04e-08	0.00815	0.00996
AW-05	C - UA	First Reaction	FALSE	median	7.05	0.385	5.26e-05	0.166	0.000274	0.000245	2.88e-06	9.95e-08	0.00672	0.00995
AW-05	C - UA	Second Reaction	FALSE	median	7.02	0.199	-1.07e-04	-3.37e-01	5.22e-05	0.000163	2.88e-06	1.36e-07	0.00734	0.00995
AW-19	C - UA	First Reaction	FALSE	median	6.95	0.366	0.000295	0.884	8.00e-05	0.000161	2.88e-06	5.18e-07	0.00825	0.00996
AW-19	C - UA	Second Reaction	FALSE	median	6.96	0.252	-1.96e-05	-5.95e-02	3.24e-05	0.000128	2.88e-06	5.65e-07	0.00824	0.00996
AW-21	C - UA	First Reaction	FALSE	median	7.10	0.449	0.000400	1.26	0.000559	0.000496	2.88e-06	6.28e-08	0.00582	0.00995
AW-21	C - UA	Second Reaction	FALSE	median	7.06	0.266	-1.22e-04	-3.93e-01	6.19e-05	0.000246	2.88e-06	9.00e-08	0.00681	0.00995

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)

DRAFT

Attachment D. PHRE
Groundwater Polishi
Ash Pond
Edwards Power Plant
Bartonville, IL

Location	F	Ca	Mg	Na	K	Ba	Si	P	Mn	Fe	Al	Sb	Be	Cd
AP07S	9.64e-06	0.00500	0.00309	0.00287	2.29e-05	6.67e-07	0.000127	1.29e-06	1.18e-05	1.23e-06	2.60e-08	1.77e-09	3.28e-08	7.44e-09
AW-15S	8.01e-06	0.00687	0.00354	0.00235	1.66e-05	5.91e-07	0.000133	1.10e-06	1.35e-05	7.89e-07	2.73e-07	1.77e-09	3.28e-08	3.30e-09
AW-05	8.93e-06	0.00437	0.00336	0.00333	4.86e-05	1.06e-06	0.000167	7.11e-07	2.73e-05	6.54e-05	2.60e-08	1.77e-09	3.28e-08	3.30e-09
AW-19	1.52e-05	0.00300	0.00226	0.00231	2.82e-05	1.46e-06	0.000175	1.28e-07	6.38e-06	4.93e-05	2.60e-08	1.77e-09	3.28e-08	3.29e-09
AW-21	1.62e-05	0.00287	0.00152	0.00248	7.42e-05	4.26e-07	9.33e-05	1.28e-07	1.36e-05	6.18e-06	7.23e-08	7.27e-09	3.28e-08	3.29e-09
AP07S	9.64e-06	0.00500	0.00309	0.00287	2.29e-05	6.67e-07	0.000127	1.29e-06	1.18e-05	1.23e-06	2.60e-08	1.77e-09	3.28e-08	7.44e-09
AW-15S	8.01e-06	0.00687	0.00354	0.00235	1.66e-05	5.91e-07	0.000133	1.10e-06	1.35e-05	7.89e-07	2.73e-07	1.77e-09	3.28e-08	3.30e-09
AW-05	8.93e-06	0.00437	0.00336	0.00333	4.86e-05	1.06e-06	0.000167	7.11e-07	2.73e-05	6.54e-05	2.60e-08	1.77e-09	3.28e-08	3.30e-09
AW-19	1.52e-05	0.00300	0.00226	0.00231	2.82e-05	1.46e-06	0.000175	1.28e-07	6.38e-06	4.93e-05	2.60e-08	1.77e-09	3.28e-08	3.29e-09
AW-21	1.62e-05	0.00287	0.00152	0.00248	7.42e-05	4.26e-07	9.33e-05	1.28e-07	1.36e-05	6.18e-06	7.23e-08	7.27e-09	3.28e-08	3.29e-09
AP07S	9.64e-06	0.00500	0.00309	0.00287	2.29e-05	6.67e-07	0.000127	1.29e-06	1.18e-05	1.23e-06	2.60e-08	1.77e-09	3.28e-08	7.44e-09
AW-15S	8.01e-06	0.00687	0.00354	0.00235	1.66e-05	5.91e-07	0.000133	1.10e-06	1.35e-05	7.89e-07	2.73e-07	1.77e-09	3.28e-08	3.30e-09
AW-05	8.93e-06	0.00437	0.00336	0.00333	4.86e-05	1.06e-06	0.000167	7.11e-07	2.73e-05	6.54e-05	2.60e-08	1.77e-09	3.28e-08	3.30e-09
AW-19	1.52e-05	0.00300	0.00226	0.00231	2.82e-05	1.46e-06	0.000175	1.28e-07	6.38e-06	4.93e-05	2.60e-08	1.77e-09	3.28e-08	3.29e-09
AW-21	1.62e-05	0.00287	0.00152	0.00248	7.42e-05	4.26e-07	9.33e-05	1.28e-07	1.36e-05	6.18e-06	7.23e-08	7.27e-09	3.28e-08	3.29e-09
AP07S	4.24e-06	0.00299	0.00258	0.00525	6.78e-05	3.16e-06	0.000189	2.80e-06	1.07e-05	1.99e-05	3.55e-08	1.77e-09	3.56e-08	4.62e-09
AP07S	4.20e-06	0.00299	0.00258	0.00525	6.78e-05	4.27e-06	0.000209	3.23e-06	1.14e-05	4.60e-05	3.49e-08	1.77e-09	3.73e-08	5.87e-09
AW-15S	4.27e-06	0.00310	0.00267	0.00525	6.78e-05	1.67e-06	0.000157	2.11e-06	1.09e-05	1.14e-05	3.43e-08	1.77e-09	3.71e-08	2.66e-09
AW-15S	4.21e-06	0.00303	0.00261	0.00525	6.78e-05	5.75e-06	0.000169	2.43e-06	1.17e-05	2.80e-05	3.45e-08	1.77e-09	2.64e-08	3.52e-09
AW-05	4.26e-06	0.00293	0.00253	0.00525	6.78e-05	1.23e-06	0.000219	1.22e-06	1.34e-05	2.12e-05	3.88e-08	1.77e-09	3.64e-08	2.97e-09
AW-05	4.20e-06	0.00287	0.00248	0.00525	6.78e-05	6.00e-06	0.000252	1.36e-06	1.22e-05	3.87e-05	3.72e-08	1.77e-09	4.22e-08	3.93e-09
AW-19	4.68e-06	0.00317	0.00273	0.00525	6.78e-05	3.67e-06	0.000195	3.67e-07	1.03e-05	4.87e-05	3.38e-08	1.77e-09	2.24e-08	3.19e-09
AW-19	4.23e-06	0.00304	0.00262	0.00525	6.78e-05	3.71e-06	0.000193	4.29e-07	1.12e-05	5.76e-05	3.43e-08	1.77e-09	2.17e-08	3.45e-09
AW-21	4.38e-06	0.00301	0.00259	0.00525	6.78e-05	6.52e-07	0.000148	6.09e-07	1.07e-05	1.29e-05	4.21e-08	1.77e-09	2.91e-08	2.45e-09
AW-21	4.21e-06	0.00277	0.00240	0.00525	6.78e-05	5.21e-06	0.000187	7.28e-07	1.13e-05	2.51e-05	3.93e-08	1.77e-09	3.60e-08	2.77e-09
AP07S	9.64e-06	0.00500	0.00309	0.00287	2.29e-05	6.67e-07	0.000127	1.29e-06	1.18e-05	1.23e-06	2.60e-08	1.77e-09	3.28e-08	7.44e-09
AW-15S	8.01e-06	0.00687	0.00354	0.00235	1.66e-05	5.91e-07	0.000133	1.10e-06	1.35e-05	7.89e-07	2.73e-07	1.77e-09	3.28e-08	3.30e-09
AW-05	8.93e-06	0.00437	0.00336	0.00333	4.86e-05	1.06e-06	0.000167	7.11e-07	2.73e-05	6.54e-05	2.60e-08	1.77e-09	3.28e-08	3.30e-09
AW-19	1.52e-05	0.00300	0.00226	0.00231	2.82e-05	1.46e-06	0.000175	1.28e-07	6.38e-06	4.93e-05	2.60e-08	1.77e-09	3.28e-08	3.29e-09
AW-21	1.62e-05	0.00287	0.00152	0.00248	7.42e-05	4.26e-07	9.33e-05	1.28e-07	1.36e-05	6.18e-06	7.23e-08	7.27e-09	3.28e-08	3.29e-09
AP07S	9.64e-06	0.00500	0.00309	0.00287	2.29e-05	6.67e-07	0.000127	1.29e-06	1.18e-05	1.23e-06	2.60e-08	1.77e-09	3.28e-08	7.44e-09
AW-15S	8.01e-06	0.00687	0.00354	0.00235	1.66e-05	5.91e-07	0.000133	1.10e-06	1.35e-05	7.89e-07	2.73e-07	1.77e-09	3.28e-08	3.30e-09
AW-05	8.93e-06	0.00437	0.00336	0.00333	4.86e-05	1.06e-06	0.000167	7.11e-07	2.73e-05	6.54e-05	2.60e-08	1.77e-09	3.28e-08	3.30e-09
AW-19	1.52e-05	0.00300	0.00226	0.00231	2.82e-05	1.46e-06	0.000175	1.28e-07	6.38e-06	4.93e-05	2.60e-08	1.77e-09	3.28e-08	3.29e-09
AW-21	1.62e-05	0.00287	0.00152	0.00248	7.42e-05	4.26e-07	9.33e-05	1.28e-07	1.36e-05	6.18e-06	7.23e-08	7.27e-09	3.28e-08	3.29e-09
AP07S	4.24e-06	0.00299	0.00258	0.00525	6.78e-05	3.16e-06	0.000189	2.80e-06	1.07e-05	1.99e-05	3.55e-08	1.77e-09	3.56e-08	4.62e-09
AP07S	4.20e-06	0.00299	0.00258	0.00525	6.78e-05	4.27e-06	0.000209	3.23e-06	1.14e-05	4.60e-05	3.49e-08	1.77e-09	3.73e-08	5.87e-09
AW-15S	4.27e-06	0.00310	0.00267	0.00525	6.78e-05	1.67e-06	0.000157	2.11e-06	1.09e-05	1.14e-05	3.43e-08	1.77e-09	3.71e-08	2.66e-09
AW-15S	4.21e-06	0.00303	0.00261	0.00525	6.78e-05	5.75e-06	0.000169	2.43e-06	1.17e-05	2.80e-05	3.45e-08	1.77e-09	2.64e-08	3.52e-09
AW-05	4.26e-06	0.00293	0.00253	0.00525	6.78e-05	1.23e-06	0.000219	1.22e-06	1.34e-05	2.12e-05	3.88e-08	1.77e-09	3.64e-08	2.97e-09
AW-05	4.20e-06	0.00287	0.00248	0.00525	6.78e-05	6.00e-06	0.000252	1.36e-06	1.22e-05	3.87e-05	3.72e-08	1.77e-09	4.22e-08	3.93e-09
AW-19	4.68e-06	0.00317	0.00273	0.00525	6.78e-05	3.67e-06	0.000195	3.67e-07	1.03e-05	4.87e-05	3.38e-08	1.77e-09	2.24e-08	3.19e-09
AW-19	4.23e-06	0.00304	0.00262	0.00525	6.78e-05	3.71e-06	0.000193	4.29e-07	1.12e-05	5.76e-05	3.43e-08	1.77e-09	2.17e-08	3.45e-09
AW-21	4.38e-06	0.00301	0.00259	0.00525	6.78e-05	6.52e-07	0.000148	6.09e-07	1.07e-05	1.29e-05	4.21e-08	1.77e-09	2.91e-08	2.45e-09
AW-21	4.21e-06	0.00277	0.00240	0.00525	6.78e-05	5.21e-06	0.000187	7.28e-07	1.13e-05	2.51e-05	3.93e-08	1.77e-09	3.60e-08	2.77e-09
AP07S	9.64e-06	0.00500	0.00309	0.00287	2.29e-05	6.67e-07	0.000127	1.29e-06	1.18e-05	1.23e-06	2.60e-08	1.77e-09	3.28e-08	7.44e-09
AW-15S	8.01e-06	0.00687	0.00354	0.00235	1.66e-05	5.91e-07	0.000133	1.10e-06	1.35e-05	7.89e-07	2.73e-07	1.77e-09	3.28e-08	3.30e-09
AW-05	8.93e-06	0.00437	0.00336	0.00333	4.86e-05	1.06e-06	0.000167	7.11e-07	2.73e-05	6.54e-05	2.60e-08	1.77e-09	3.28e-08	3.30e-09
AW-19	1.52e-05	0.00300	0.00226	0.00231	2.82e-05	1.46e-06	0.000175	1.28e-07	6.38e-06	4.93e-05	2.60e-08	1.77e-09	3.28e-08	3.29e-09
AW-21	1.62e-05	0.00287	0.00152	0.00248	7.42e-05	4.26e-07	9.33e-05	1.28e-07	1.36e-05	6.18e-06	7.23e-08	7.27e-09	3.28e-08	3.29e-09
AP07S	9.64e-06	0.00500	0.00309	0.00287	2.29e-05	6.67e-07	0.000127	1.29e-06	1.18e-05	1.23e-06	2.60e-08	1.77e-09	3.28e-08	7.44e-09
AW-15S	8.01e-06	0.00687	0.00354	0.00235	1.66e-05	5.91e-07	0.000133	1.10e-06	1.35e-05	7.89e-07	2.73e-07	1.77e-09	3.28e-08	3.30e-09
AW-05	8.93e-06	0.00437	0.00336	0.00333	4.86e-05	1.06e-06	0.000167	7.11e-07	2.73e-05	6.54e-05	2.60e-08	1.77e-09	3.28e-08	3.30e-09
AW-19	1.52e-05	0.00300	0.00226	0.00231	2.82e-05	1.46e-06	0.000175	1.28e-07	6.38e-06	4.93e-05	2.60e-08	1.77e-09	3.28e-08	3.29e-09
AW-21	1.62e-05	0.00287	0.00152	0.00248	7.42e-05	4.26e-07	9.33e-05	1.28e-07	1.36e-05	6.18e-06	7.23e-08	7.27e-09	3.28e-08	3.29e-09
AP07S	4.24e-06	0.00299	0.00258	0.00525	6.78e-05	3.16e-06	0.000189	2.80e-06	1.07e-05	1.99e-05	3.55e-08	1.77e-09	3.56e-08	4.62e-09
AP07S	4.20e-06	0.00299	0.00258	0.00525	6.78e-05	4.27e-06	0.000209	3.23e-06	1.14e-05	4.60e-05	3.49e-08	1.77e-09	3.73e-08	5.87e-09
AW-15S	4.27e-06	0.00310	0.00267	0.00525	6.78e-05	1.67e-06	0.000157	2.11e-06	1.09e-05	1.14e-05	3.43e-08	1.77e-09	3.71e-08	2.66e-09
AW-15S	4.21e-06	0.00303	0.00261	0.00525	6.78e-05	5.75e-06	0.000169	2.43e-06	1.17e-05	2.80e-05	3.45e-08	1.77e-09	2.64e-08	3.52e-09
AW-05	4.26e-06	0.00293	0.00253	0.00525	6.78e-05	1.23e-06	0.000219	1.22e-06	1.34e-05	2.12e-05	3.88e-08	1.77e-09	3.64e-08	2.97e-09
AW-05	4.20e-06	0.00287	0.00248	0.00525	6.78e-05	6.00e-06	0.000252	1.36e-06	1.22e-05	3.87e-05	3.72e-08	1.77e-09	4.22e-08	3.93e-09
AW-19	4.68e-06	0.00317	0.00273	0.00525	6.78e-05	3.67e-06	0.000195	3.67e-07	1.03e-05	4.87e-05	3.38e-08	1.77e-09	2.24e-08	3.19e-09
AW-19	4.23e-06	0.00304	0.00262	0.00525	6.78e-05	3.71e-06	0.000193	4.29e-07	1.12e-05	5.76e-05	3.43e-08	1.77e-09	2.17e-08	3.45e-09
AW-21	4.38e-06	0.00301	0.00259	0.00525	6.78e-05	6.52e-07	0.000148	6.09e-07	1.07e-05	1.29e-05	4.21e-08	1.77e-09	2.91e-08	2.45e-09
AW-21	4.21e-06	0.00277	0.00240	0.00525	6.78e-05	5.21e-06	0.000187	7.28e-07	1.13e-05	2.51e-05	3.93e-08	1.77e-09	3.60e-08	2.77e-09
AP07S	9.64e-06	0.00500	0.00309	0.00287	2.29e-05	6.67e-07	0.000127	1.29e-06	1.18e-05	1.23e-06	2.60e-08	1.77e-09	3.28e-08	7.44e-09
AW-15S	8.01e-06	0.00687	0.00354	0.00235	1.66e-05	5.91e-07	0.000133	1.10e-06	1.35e-05	7.89e-07	2.73e-07	1.77e-09	3.28e-08	3.30e-09
AW-05	8.93e-06	0.00437	0.00336	0.00333	4.86e-05	1.06e-06	0.000167	7.11e-07	2.73e-05	6.54e-05	2.60e-08	1.77e-09	3.28e-08	3.30e-09
AW-19	1.52e-05	0.00300	0.00226	0.00231	2.82e-05	1.46e-06	0.000175	1.28e-07	6.38e-06	4.93e-05	2.60e-08	1.77e-09	3.28e-08	3.29e-09
AW-21	1.62e-05	0.00287	0.00152	0.00248	7.42e-05	4.26e-07	9.33e-05	1.28e-07	1.36e-05	6.18e-06	7.23e-08	7.27e-09	3.28e-08	3.29e-09
AP07S	4.24e-06	0.00299	0.00258	0.00525	6.78e-05	3.71e-06	0.000192	2.91e-06	1.09e-05	2.55e-05	3.54e-08	1.77e-09	3.56e-08	6.23e-09
AP07S	4.21e-06	0.00298	0.00258	0.00525	6.78e-05	3.72e-06	0.000213	3.43e-06	1.14e-05	5.85e-05	3.49e-08	1.77e-09	3.69e-08	8.07e-09
AW-15S	4.27e-06	0.00309	0.00266	0.00525	6.78e-05	2.14e-06	0.000159	2.19e-06	1.11e-05	1.48e-05	3.44e-08	1.77e-09	2.68e-08	3.59e-09
AW-15S	4.22e-06	0.00302	0.00260	0.00525	6.78e-05	5.28e-06	0.000173	2.59e-06	1.17e-05	3.74e-05	3.45e-08	1.77e-09	2.60e-08	5.00e-09
AW-05	4.26e-06	0.00292	0.00252	0.00525	6.78e-05	1.37e-06	0.000219	1.24e-06	1.32e-05	2.37e-05	3.88e-08	1.77e-09	3.64e-08	3.70e-09
AW-05	4.21e-06	0.00287	0.00248	0.00525	6.78e-05	6.05e-06	0.000253	1.38e-06	1.21e-05	4.44e-05	3.71e-08	1.77e-09	4.23e-08	4.98e-09
AW-19	4.59e-06	0.00315	0.00271	0.00525	6.78e-05	3.68e-06	0.000194	3.74e-07	1.05e-05	4.98e-05	3.38e-08	1.77e-09	2.22e-08	4.21e-09
AW-19	4.23e-06	0.00304	0.00262	0.00525	6.78e-05	3.71e-06	0.000192	4.38e-07	1.12e-05	5.95e-05	3.43e-08	1.77e-09	2.16e-08	4.55e-09
AW-21	4.35e-06	0.00299	0.00258	0.00525	6.78e-05	6.76e-07	0.000149	6.17e-07	1.08e-05	1.47e-05	4.20e-08	1.77e-09	2.92e-08	2.61e-09
AW-21	4.21e-06	0.00278	0.00240	0.00525	6.78e-05	5.96e-06	0.000189	7.40e-07	1.14e-05	2.92e-05	3.92e-08	1.77e-09	3.63e-08	3.05e-09

NOTES:
All model results are
pH and pe (standarc
charge (equivalents
Results beginning w
Results beginning w

Attachment D. PHRE
Groundwater Polishi
Ash Pond
Edwards Power Plant
Bartonville, IL

Location	Cr	Co	Pb	Mo	Se	Hfo_s	Hfo_w	Hao_	m_Hfo_wOH	m_Hfo_wOH2+	m_Hfo_ wOHSO4-2	m_Hfo_wSO4-	m_Hfo_ wOSi(OH)3	m_Hfo_ wOSiO(OH)2-
AP07S	1.39e-07	6.12e-08	9.90e-09	1.20e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-15S	2.70e-08	9.18e-09	5.32e-10	2.97e-08	1.38e-08	0	0	0	0	0	0	0	0	0
AW-05	1.67e-07	9.94e-08	1.96e-08	2.50e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-19	2.69e-08	2.38e-08	6.23e-09	3.91e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-21	2.69e-08	1.01e-08	5.31e-10	2.40e-07	2.64e-08	0	0	0	0	0	0	0	0	0
AP07S	1.39e-07	6.12e-08	9.90e-09	1.20e-08	4.69e-09	0.000200	0.00800	0.00429	0.000415	0.000356	3.22e-05	1.38e-05	0.00101	0.000727
AW-15S	2.70e-08	9.18e-09	5.32e-10	2.97e-08	1.38e-08	0.000200	0.00800	0.00429	0.000366	0.000380	4.59e-05	2.39e-05	0.000936	0.000556
AW-05	1.67e-07	9.94e-08	1.96e-08	2.50e-08	4.69e-09	0.000950	0.0380	0.00528	0.00193	0.00149	0.000132	5.14e-05	0.00615	0.00489
AW-19	2.69e-08	2.38e-08	6.23e-09	3.91e-08	4.69e-09	0.000950	0.0380	0.00528	0.00165	0.00210	2.14e-05	1.37e-05	0.00551	0.00266
AW-21	2.69e-08	1.01e-08	5.31e-10	2.40e-07	2.64e-08	0.000950	0.0380	0.00528	0.00306	0.00217	0.000406	0.000145	0.00545	0.00473
AP07S	1.38e-07	3.98e-08	1.16e-08	1.64e-08	2.38e-08	0.000200	0.00800	0.00429	0.000285	0.000258	2.58e-07	1.17e-07	0.00108	0.000737
AP07S	1.43e-07	5.28e-08	1.56e-08	1.38e-08	1.25e-07	0.000200	0.00800	0.00429	0.000271	0.000258	3.65e-08	1.75e-08	0.00114	0.000734
AW-15S	1.91e-08	7.75e-09	8.14e-10	2.59e-08	2.18e-08	0.000200	0.00800	0.00429	0.000312	0.000301	5.39e-07	2.61e-07	0.000978	0.000625
AW-15S	1.85e-08	1.16e-08	1.19e-09	1.64e-08	2.12e-07	0.000200	0.00800	0.00429	0.000306	0.000310	7.51e-08	3.82e-08	0.00105	0.000642
AW-05	1.88e-07	8.81e-08	2.79e-08	3.10e-08	3.06e-08	0.000950	0.0380	0.00528	0.00144	0.00113	4.24e-06	1.68e-06	0.00622	0.00487
AW-05	2.24e-07	1.23e-07	3.97e-08	2.45e-08	3.12e-07	0.000950	0.0380	0.00528	0.00127	0.00105	7.00e-07	2.89e-07	0.00635	0.00475
AW-19	1.78e-08	2.46e-08	1.03e-08	7.35e-08	8.03e-08	0.000950	0.0380	0.00528	0.00146	0.00174	8.75e-07	5.21e-07	0.00543	0.00282
AW-19	1.75e-08	2.70e-08	1.12e-08	4.66e-08	2.11e-07	0.000951	0.0380	0.00528	0.00148	0.00174	3.27e-07	1.93e-07	0.00546	0.00286
AW-21	2.23e-08	6.71e-09	8.54e-10	9.22e-07	1.52e-07	0.000950	0.0380	0.00528	0.00182	0.00125	1.16e-05	4.00e-06	0.00543	0.00487
AW-21	2.83e-08	8.47e-09	1.15e-09	6.66e-07	1.71e-06	0.000950	0.0380	0.00528	0.00148	0.00111	1.04e-06	3.89e-07	0.00568	0.00469
AP07S	1.39e-07	6.12e-08	9.90e-09	1.20e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-15S	2.70e-08	9.18e-09	5.32e-10	2.97e-08	1.38e-08	0	0	0	0	0	0	0	0	0
AW-05	1.67e-07	9.94e-08	1.96e-08	2.50e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-19	2.69e-08	2.38e-08	6.23e-09	3.91e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-21	2.69e-08	1.01e-08	5.31e-10	2.40e-07	2.64e-08	0	0	0	0	0	0	0	0	0
AP07S	1.39e-07	6.12e-08	9.90e-09	1.20e-08	4.69e-09	0.000315	0.0126	0.00759	0.000654	0.000561	5.06e-05	2.18e-05	0.00160	0.00115
AW-15S	2.70e-08	9.18e-09	5.32e-10	2.97e-08	1.38e-08	0.000315	0.0126	0.00759	0.000577	0.000598	7.23e-05	3.76e-05	0.00147	0.000876
AW-05	1.67e-07	9.94e-08	1.96e-08	2.50e-08	4.69e-09	0.00120	0.0480	0.00858	0.00244	0.00189	0.000167	6.49e-05	0.00777	0.00618
AW-19	2.69e-08	2.38e-08	6.23e-09	3.91e-08	4.69e-09	0.00120	0.0480	0.00858	0.00208	0.00265	2.71e-05	1.73e-05	0.00696	0.00336
AW-21	2.69e-08	1.01e-08	5.31e-10	2.40e-07	2.64e-08	0.00120	0.0480	0.00858	0.00386	0.00274	0.000513	0.000183	0.00688	0.00597
AP07S	1.36e-07	3.78e-08	1.09e-08	1.76e-08	9.36e-09	0.000315	0.0126	0.00759	0.000461	0.000407	7.47e-07	3.31e-07	0.00166	0.00116
AP07S	1.44e-07	4.84e-08	1.41e-08	1.46e-08	7.77e-08	0.000315	0.0126	0.00759	0.000434	0.000401	1.24e-07	5.75e-08	0.00173	0.00116
AW-15S	1.93e-08	7.05e-09	7.43e-10	3.04e-08	2.03e-08	0.000315	0.0126	0.00759	0.000497	0.000471	1.49e-06	7.10e-07	0.00149	0.000973
AW-15S	1.89e-08	9.37e-09	9.83e-10	1.95e-08	2.97e-08	0.000315	0.0126	0.00759	0.000489	0.000478	2.68e-07	1.31e-07	0.00158	0.000995
AW-05	1.81e-07	8.42e-08	2.65e-08	3.24e-08	1.29e-08	0.00120	0.0480	0.00858	0.00187	0.00146	7.40e-06	2.89e-06	0.00782	0.00618
AW-05	2.13e-07	1.12e-07	3.61e-08	2.67e-08	1.10e-07	0.00120	0.0480	0.00858	0.00166	0.00135	1.41e-06	5.75e-07	0.00798	0.00604
AW-19	1.80e-08	2.49e-08	1.06e-08	7.95e-08	6.39e-08	0.00120	0.0480	0.00858	0.00184	0.00219	1.45e-06	8.66e-07	0.00685	0.00355
AW-19	1.76e-08	2.69e-08	1.15e-08	5.40e-08	1.72e-07	0.00120	0.0480	0.00858	0.00186	0.00219	5.92e-07	3.50e-07	0.00688	0.00360
AW-21	2.13e-08	7.13e-09	8.82e-10	9.71e-07	9.11e-08	0.00120	0.0480	0.00858	0.00240	0.00162	1.90e-05	6.42e-06	0.00678	0.00620
AW-21	2.62e-08	8.13e-09	1.10e-09	7.66e-07	4.08e-07	0.00120	0.0480	0.00858	0.00198	0.00144	2.02e-06	7.37e-07	0.00707	0.00599
AP07S	1.39e-07	6.12e-08	9.90e-09	1.20e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-15S	2.70e-08	9.18e-09	5.32e-10	2.97e-08	1.38e-08	0	0	0	0	0	0	0	0	0
AW-05	1.67e-07	9.94e-08	1.96e-08	2.50e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-19	2.69e-08	2.38e-08	6.23e-09	3.91e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-21	2.69e-08	1.01e-08	5.31e-10	2.40e-07	2.64e-08	0	0	0	0	0	0	0	0	0
AP07S	1.39e-07	6.12e-08	9.90e-09	1.20e-08	4.69e-09	0.000260	0.0104	0.00594	0.000539	0.000463	4.18e-05	1.80e-05	0.00132	0.000945
AW-15S	2.70e-08	9.18e-09	5.32e-10	2.97e-08	1.38e-08	0.000260	0.0104	0.00594	0.000476	0.000494	5.97e-05	3.11e-05	0.00122	0.000723
AW-05	1.67e-07	9.94e-08	1.96e-08	2.50e-08	4.69e-09	0.00115	0.0460	0.00693	0.00233	0.00181	0.000160	6.22e-05	0.00744	0.00592
AW-19	2.69e-08	2.38e-08	6.23e-09	3.91e-08	4.69e-09	0.00115	0.0460	0.00693	0.00199	0.00254	2.60e-05	1.66e-05	0.00667	0.00322
AW-21	2.69e-08	1.01e-08	5.31e-10	2.40e-07	2.64e-08	0.00115	0.0460	0.00693	0.00370	0.00263	0.000492	0.000175	0.00659	0.00572
AP07S	1.37e-07	3.85e-08	1.12e-08	1.70e-08	1.17e-08	0.000260	0.0104	0.00594	0.000376	0.000335	4.79e-07	2.14e-07	0.00139	0.000959
AP07S	1.44e-07	5.06e-08	1.48e-08	1.42e-08	1.31e-07	0.000260	0.0104	0.00594	0.000355	0.000333	7.27e-08	3.41e-08	0.00145	0.000954
AW-15S	1.92e-08	7.30e-09	7.69e-10	2.84e-08	2.05e-08	0.000260	0.0104	0.00594	0.000409	0.000390	9.74e-07	4.66e-07	0.00125	0.000807
AW-15S	1.87e-08	1.02e-08	1.07e-09	1.80e-08	6.62e-08	0.000260	0.0104	0.00594	0.000401	0.000398	1.57e-07	7.79e-08	0.00133	0.000827
AW-05	1.83e-07	8.50e-08	2.68e-08	3.21e-08	1.75e-08	0.00115	0.0460	0.00693	0.00178	0.00139	6.42e-06	2.51e-06	0.00750	0.00592
AW-05	2.16e-07	1.16e-07	3.72e-08	2.63e-08	1.91e-07	0.00115	0.0460	0.00693	0.00158	0.00129	1.13e-06	4.63e-07	0.00766	0.00578
AW-19	1.79e-08	2.46e-08	1.03e-08	7.85e-08	6.52e-08	0.00115	0.0460	0.00693	0.00176	0.00210	1.26e-06	7.55e-07	0.00657	0.00340
AW-19	1.76e-08	2.67e-08	1.12e-08	5.26e-08	1.85e-07	0.00115	0.0460	0.00693	0.00179	0.00210	4.93e-07	2.91e-07	0.00659	0.00345
AW-21	2.15e-08	6.83e-09	8.50e-10	9.62e-07	1.05e-07	0.00115	0.0460	0.00693	0.00228	0.00154	1.74e-05	5.90e-06	0.00651	0.00593
AW-21	2.65e-08	8.08e-09	1.09e-09	7.48e-07	7.85e-07	0.00115	0.0460	0.00693	0.00188	0.00138	1.69e-06	6.19e-07	0.00680	0.00573
AP07S	1.39e-07	6.12e-08	9.90e-09	1.20e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-15S	2.70e-08	9.18e-09	5.32e-10	2.97e-08	1.38e-08	0	0	0	0	0	0	0	0	0
AW-05	1.67e-07	9.94e-08	1.96e-08	2.50e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-19	2.69e-08	2.38e-08	6.23e-09	3.91e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-21	2.69e-08	1.01e-08	5.31e-10	2.40e-07	2.64e-08	0	0	0	0	0	0	0	0	0
AP07S	1.39e-07	6.12e-08	9.90e-09	1.20e-08	4.69e-09	0.000200	0.00800	0.00429	0.000413	0.000354	3.28e-05	1.41e-05	0.00101	0.000727
AW-15S	2.70e-08	9.18e-09	5.32e-10	2.97e-08	1.38e-08	0.000200	0.00800	0.00429	0.000365	0.000377	4.68e-05	2.42e-05	0.000932	0.000557
AW-05	1.67e-07	9.94e-08	1.96e-08	2.50e-08	4.69e-09	0.000950	0.0380	0.00528	0.00192	0.00149	0.000134	5.20e-05	0.00613	0.00488
AW-19	2.69e-08	2.38e-08	6.23e-09	3.91e-08	4.69e-09	0.000950	0.0380	0.00528	0.00164	0.00209	2.18e-05	1.39e-05	0.00547	0.00265
AW-21	2.69e-08	1.01e-08	5.31e-10	2.40e-07	2.64e-08	0.000950	0.0380	0.00528	0.00305	0.00216	0.000410	0.000146	0.00544	0.00472
AP07S	1.39e-07	4.33e-08	1.25e-08	1.66e-08	2.61e-08	0.000200	0.00800	0.00429	0.000286	0.000259	2.42e-07	1.10e-07	0.00108	0.000734
AP07S	1.45e-07	5.71e-08	1.67e-08	1.38e-08	1.26e-07	0.000200	0.00800	0.00429	0.000271	0.000259	3.49e-08	1.68e-08	0.00114	0.000731
AW-15S	1.92e-08	8.28e-09	8.62e-10	2.65e-08	2.23e-08	0.000200	0.00800	0.00429	0.000313	0.000303	5.20e-07	2.52e-07	0.000977	0.000623
AW-15S	1.86e-08	1.23e-08	1.26e-09	1.65e-08	2.18e-07	0.000200	0.00800	0.00429	0.000306	0.000311	7.33e-08	3.73e-08	0.00105	0.000640
AW-05	1.89e-07	9.20e-08	2.88e-08	3.16e-08	3.30e-08	0.000950	0.0380	0.00528	0.00144	0.00114	4.15e-06	1.65e-06	0.00621	0.00484
AW-05	2.26e-07	1.29e-07	4.09e-08	2.50e-08	3.20e-07	0.000950	0.0380	0.00528	0.00127	0.00106	6.90e-07	2.87e-07	0.00634	0.00472
AW-19	1.81e-08	2.59e-08	1.07e-08	7.66e-08	9.13e-08	0.000950	0.0380	0.00528	0.00146	0.00175	8.29e-07	4.97e-07	0.00541	0.00279
AW-19	1.78e-08	2.84e-08	1.16e-08	4.80e-08	2.17e-07	0.000951	0.0380	0.00528	0.00148	0.00175	3.20e-07	1.90e-07	0.00545	0.00284
AW-21	2.24e-08	6.91e-09	8.80e-10	9.37e-07	1.55e-07	0.000950	0.0380	0.00528	0.00182	0.00125	1.16e-05	4.00e-06	0.00542	0.00486
AW-21	2.83e-08	8.73e-09	1.18e-09	6.75e-07	1.73e-06	0.000950	0.0380	0.00528	0.00148	0.00111	1.03e-06	3.88e-07	0.00567	0.00468
AP07S	1.39e-07	6.12e-08	9.90e-09	1.20e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-15S	2.70e-08	9.18e-09	5.32e-10	2.97e-08	1.38e-08	0	0	0	0	0	0	0	0	0
AW-05	1.67e-07	9.94e-08	1.96e-08	2.50e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-19	2.69e-08	2.38e-08	6.23e-09	3.91e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-21	2.69e-08	1.01e-08	5.31e-10	2.40e-07	2.64e-08	0	0	0	0	0	0	0	0	0
AP07S	1.39e-07	6.12e-08	9.90e-09	1.20e-08	4.69e-09	0.000315	0.0126	0.00759	0.000651	0.000557	5.16e-05	2.21e-05	0.00159	0.00114
AW-15S	2.70e-08	9.18e-09	5.32e-10	2.97e-08	1.38e-08	0.000315	0.0126	0.00759	0.000575	0.000594	7.37e-05	3.82e-05	0.00147	0.000877
AW-05	1.67e-07	9.94e-08	1.96e-08	2.50e-08	4.69e-09	0.00120	0.0480	0.00858	0.00243	0.00188	0.000169	6.56e-05	0.00774	0.00616
AW-19	2.69e-08	2.38e-08	6.23e-09	3.91e-08	4.69e-09	0.00120	0.0480	0.00858	0.00207	0.00264	2.75e-05	1.76e-05	0.00691	0.00334
AW-21	2.69e-08	1.01e-08	5.31e-10	2.40e-07	2.64e-08	0.00120	0.0480	0.00858	0.00385	0.00273	0.000518	0.000184	0.00687	0.00597
AP07S	1.37e-07	4.11e-08	1.18e-08	1.79e-08	9.67e-09	0.000315	0.0126	0.00759	0.000462	0.000409	7.03e-07	3.12e-07	0.00166	0.00116
AP07S	1.46e-07	5.26e-08	1.52e-08	1.48e-08	8.47e-08	0.000315	0.0126	0.00759	0.000434	0.000403	1.18e-07	5.48e-08	0.00173	0.00115
AW-15S	1.94e-08	7.52e-09	7.86e-10	3.12e-08	2.06e-08	0.000315	0.0126	0.00759	0.000498	0.000473	1.44e-06	6.85e-07	0.00149	0.000970
AW-15S	1.90e-08	1.00e-08	1.04e-09	1.98e-08	3.06e-08	0.000315	0.0126	0.00759	0.000490	0.000480	2.61e-07	1.28e-07	0.00158	0.000992
AW-05	1.82e-07	8.81e-08	2.74e-08	3.33e-08	1.38e-08	0.00120	0.0480	0.00858	0.00187	0.00147	7.20e-06	2.83e-06	0.00781	0.00615
AW-05	2.15e-07	1.18e-07	3.74e-08	2.73e-08	1.17e-07	0.00120	0.0480	0.00858	0.00166	0.00136	1.38e-06	5.67e-07	0.00797	0.00601
AW-19	1.83e-08	2.63e-08	1.11e-08	8.30e-08	7.63e-08	0.00120	0.0480	0.00858	0.00184	0.00221	1.36e-06	8.15e-07	0.00683	0.00351
AW-19	1.79e-08	2.83e-08	1.19e-08	5.58e-08	1.86e-07	0.00120	0.0480	0.00858	0.00186	0.00221	5.72e-07	3.40e-07	0.00685	0.00356
AW-21	2.14e-08	7.36e-09	9.09e-10	9.88e-07	9.24e-08	0.00120	0.0480	0.00858	0.00240	0.00162	1.89e-05	6.41e-06	0.00677	0.00618
AW-21	2.62e-08	8.40e-09	1.13e-09	7.78e-07	4.18e-07	0.00120	0.0480	0.00858	0.00199	0.00145	2.01e-06	7.34e-07	0.00707	0.00598
AP07S	1.39e-07	6.12e-08	9.90e-09	1.20e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-15S	2.70e-08	9.18e-09	5.32e-10	2.97e-08	1.38e-08	0	0	0	0	0	0	0	0	0
AW-05	1.67e-07	9.94e-08	1.96e-08	2.50e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-19	2.69e-08	2.38e-08	6.23e-09	3.91e-08	4.69e-09	0	0	0	0	0	0	0	0	0
AW-21	2.69e-08	1.01e-08	5.31e-10	2.40e-07	2.64e-08	0	0	0	0	0	0	0	0	0
AP07S	1.39e-07	6.12e-08	9.90e-09	1.20e-08	4.69e-09	0.000260	0.0104	0.00594	0.000537	0.000460	4.26e-05	1.83e-05	0.00131	0.000945
AW-15S	2.70e-08	9.18e-09	5.32e-10	2.97e-08	1.38e-08	0.000260	0.0104	0.00594	0.000474	0.000490	6.08e-05	3.15e-05	0.00121	0.000724
AW-05	1.67e-07	9.94e-08	1.96e-08	2.50e-08	4.69e-09	0.00115	0.0460	0.00693	0.00233	0.00180	0.000162	6.29e-05	0.00741	0.00591
AW-19	2.69e-08	2.38e-08	6.23e-09	3.91e-08	4.69e-09	0.00115	0.0460	0.00693	0.00198	0.00253	2.64e-05	1.69e-05	0.00663	0.00320
AW-21	2.69e-08	1.01e-08	5.31e-10	2.40e-07	2.64e-08	0.00115	0.0460	0.00693	0.00369	0.00262	0.000496	0.000177	0.00658	0.00572
AP07S	1.38e-07	4.19e-08	1.20e-08	1.74e-08	1.24e-08	0.000260	0.0104	0.00594	0.000377	0.000337	4.51e-07	2.02e-07	0.00138	0.000955
AP07S	1.46e-07	5.49e-08	1.59e-08	1.43e-08	1.37e-07	0.000260	0.0104	0.00594	0.000356	0.000334	6.93e-08	3.27e-08	0.00145	0.000950
AW-15S	1.94e-08	7.80e-09	8.14e-10	2.91e-08	2.09e-08	0.000260	0.0104	0.00594	0.000410	0.000391	9.39e-07	4.50e-07	0.00125	0.000804
AW-15S	1.89e-08	1.09e-08	1.13e-09	1.83e-08	6.91e-08	0.000260	0.0104	0.00594	0.000402	0.000399	1.53e-07	7.62e-08	0.00133	0.000824
AW-05	1.84e-07	8.88e-08	2.76e-08	3.30e-08	1.88e-08	0.00115	0.0460	0.00693	0.00179	0.00140	6.27e-06	2.46e-06	0.00749	0.00589
AW-05	2.18e-07	1.21e-07	3.84e-08	2.68e-08	2.00e-07	0.00115	0.0460	0.00693	0.00158	0.00130	1.11e-06	4.58e-07	0.00765	0.00575
AW-19	1.82e-08	2.58e-08	1.08e-08	8.19e-08	7.60e-08	0.00115	0.0460	0.00693	0.00177	0.00212	1.19e-06	7.15e-07	0.00654	0.00337
AW-19	1.79e-08	2.81e-08	1.16e-08	5.43e-08	1.96e-07	0.00115	0.0460	0.00693	0.00179	0.00212	4.79e-07	2.85e-07	0.00657	0.00342
AW-21	2.15e-08	7.05e-09	8.76e-10	9.79e-07	1.07e-07	0.00115	0.0460	0.00693	0.00228	0.00155	1.74e-05	5.90e-06	0.00650	0.00592
AW-21	2.66e-08	8.33e-09	1.13e-09	7.59e-07	7.99e-07	0.00115	0.0460	0.00693	0.00188	0.00138	1.68e-06	6.17e-07	0.00679	0.00572

NOTES:
All model results are
pH and pe (standarc
charge (equivalents
Results beginning w
Results beginning w

Attachment D. PHRE
Groundwater Polishi
Ash Pond
Edwards Power Plant
Bartonville, IL

Location	m_Hfo_ wHCO3	m_Hfo_ wCO3-	m_Hfo_ wPO4-2	m_Hfo_ wHPO4-	m_Hfo_ wH2PO4	m_Hfo_ sCO3-	m_Hfo_ sHCO3	m_Hfo_ sHPO4-	m_Hfo_ sH2BO3	m_Hfo_ sH2PO4	m_Hfo_ sOSi(OH)3	m_Hfo_ sOSi(OH)2-	m_Hfo_ sOHSO4-2	m_Hfo_ sSO4-
AP07S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-15S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AP07S	0.00269	0.000532	0.000149	0.000307	1.07e-05	1.91e-08	9.67e-08	1.10e-08	7.90e-11	3.86e-10	3.64e-08	2.61e-08	1.16e-09	4.98e-10
AW-15S	0.00335	0.000547	0.000103	0.000256	1.08e-05	9.82e-08	6.00e-07	4.60e-08	1.58e-10	1.95e-09	1.68e-07	9.98e-08	8.24e-09	4.29e-09
AW-05	0.0102	0.00224	0.000337	0.000627	1.98e-05	5.61e-08	2.56e-07	1.57e-08	1.14e-10	4.97e-10	1.54e-07	1.23e-07	3.31e-09	1.29e-09
AW-19	0.0160	0.00213	4.97e-05	0.000152	7.91e-06	3.76e-07	2.82e-06	2.69e-08	2.92e-10	1.40e-09	9.72e-07	4.70e-07	3.79e-09	2.42e-09
AW-21	0.00937	0.00224	0.000223	0.000380	1.10e-05	2.89e-07	1.21e-06	4.90e-08	1.57e-09	1.42e-09	7.02e-07	6.09e-07	5.24e-08	1.86e-08
AP07S	0.00284	0.000534	0.000158	0.000343	1.26e-05	1.99e-08	1.06e-07	1.27e-08	1.32e-11	4.69e-10	4.02e-08	2.74e-08	9.58e-12	4.34e-12
AP07S	0.00280	0.000497	0.000166	0.000379	1.48e-05	1.81e-08	1.02e-07	1.38e-08	7.59e-12	5.37e-10	4.13e-08	2.67e-08	1.33e-12	6.35e-13
AW-15S	0.00333	0.000586	0.000123	0.000284	1.12e-05	1.05e-07	5.95e-07	5.08e-08	5.35e-11	1.99e-09	1.75e-07	1.12e-07	9.63e-11	4.66e-11
AW-15S	0.00323	0.000542	0.000132	0.000320	1.32e-05	9.61e-08	5.73e-07	5.68e-08	3.60e-11	2.34e-09	1.87e-07	1.14e-07	1.33e-11	6.77e-12
AW-05	0.0111	0.00238	0.000350	0.000662	2.13e-05	6.03e-08	2.80e-07	1.68e-08	3.48e-11	5.39e-10	1.58e-07	1.23e-07	1.07e-10	4.25e-11
AW-05	0.0114	0.00234	0.000355	0.000703	2.36e-05	5.81e-08	2.82e-07	1.74e-08	1.98e-11	5.86e-10	1.58e-07	1.18e-07	1.74e-11	7.18e-12
AW-19	0.0161	0.00230	6.50e-05	0.000185	8.98e-06	3.72e-07	2.61e-06	3.00e-08	1.54e-10	1.45e-09	8.80e-07	4.56e-07	1.42e-10	8.45e-11
AW-19	0.0159	0.00230	7.81e-05	0.000220	1.06e-05	3.67e-07	2.54e-06	3.51e-08	1.19e-10	1.68e-09	8.71e-07	4.56e-07	5.21e-11	3.07e-11
AW-21	0.0112	0.00276	0.000246	0.000406	1.14e-05	3.51e-07	1.42e-06	5.17e-08	4.24e-10	1.45e-09	6.91e-07	6.20e-07	1.48e-09	5.09e-10
AW-21	0.0118	0.00268	0.000251	0.000449	1.36e-05	3.43e-07	1.51e-06	5.75e-08	1.71e-10	1.75e-09	7.28e-07	6.01e-07	1.33e-10	4.98e-11
AP07S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-15S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AP07S	0.00424	0.000837	0.000235	0.000484	1.69e-05	3.01e-08	1.52e-07	1.74e-08	1.24e-10	6.08e-10	5.74e-08	4.12e-08	1.82e-09	7.84e-10
AW-15S	0.00527	0.000862	0.000162	0.000404	1.71e-05	1.55e-07	9.46e-07	7.24e-08	2.49e-10	3.06e-09	2.65e-07	1.57e-07	1.30e-08	6.75e-09
AW-05	0.0129	0.00283	0.000426	0.000792	2.50e-05	7.09e-08	3.24e-07	1.99e-08	1.44e-10	6.27e-10	1.95e-07	1.55e-07	4.19e-09	1.63e-09
AW-19	0.0202	0.00269	6.28e-05	0.000192	9.99e-06	4.74e-07	3.57e-06	3.39e-08	3.69e-10	1.76e-09	1.23e-06	5.93e-07	4.78e-09	3.06e-09
AW-21	0.0118	0.00283	0.000282	0.000480	1.39e-05	3.65e-07	1.53e-06	6.19e-08	1.99e-09	1.79e-09	8.87e-07	7.70e-07	6.61e-08	2.36e-08
AP07S	0.00450	0.000865	0.000245	0.000519	1.86e-05	3.22e-08	1.67e-07	1.93e-08	2.59e-11	6.94e-10	6.19e-08	4.32e-08	2.78e-11	1.23e-11
AP07S	0.00447	0.000821	0.000251	0.000557	2.10e-05	3.01e-08	1.64e-07	2.04e-08	1.54e-11	7.70e-10	6.37e-08	4.24e-08	4.55e-12	2.11e-12
AW-15S	0.00530	0.000951	0.000188	0.000426	1.65e-05	1.70e-07	9.50e-07	7.64e-08	9.74e-11	2.95e-09	2.68e-07	1.74e-07	2.68e-10	1.27e-10
AW-15S	0.00520	0.000903	0.000197	0.000463	1.84e-05	1.61e-07	9.26e-07	8.24e-08	6.76e-11	3.28e-09	2.81e-07	1.77e-07	4.77e-11	2.34e-11
AW-05	0.0139	0.00302	0.000441	0.000825	2.62e-05	7.64e-08	3.51e-07	2.09e-08	5.01e-11	6.63e-10	1.98e-07	1.56e-07	1.87e-10	7.31e-11
AW-05	0.0143	0.00297	0.000444	0.000868	2.88e-05	7.41e-08	3.56e-07	2.16e-08	2.98e-11	7.19e-10	1.99e-07	1.51e-07	3.51e-11	1.43e-11
AW-19	0.0204	0.00290	7.87e-05	0.000225	1.09e-05	4.69e-07	3.29e-06	3.64e-08	2.14e-10	1.77e-09	1.11e-06	5.73e-07	2.34e-10	1.40e-10
AW-19	0.0202	0.00291	9.19e-05	0.000260	1.25e-05	4.63e-07	3.21e-06	4.13e-08	1.70e-10	1.98e-09	1.09e-06	5.72e-07	9.41e-11	5.56e-11
AW-21	0.0139	0.00351	0.000310	0.000502	1.38e-05	4.45e-07	1.77e-06	6.37e-08	6.70e-10	1.75e-09	8.60e-07	7.87e-07	2.41e-09	8.15e-10
AW-21	0.0147	0.00342	0.000313	0.000546	1.62e-05	4.38e-07	1.88e-06	6.98e-08	2.83e-10	2.07e-09	9.05e-07	7.66e-07	2.58e-10	9.43e-11
AP07S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-15S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AP07S	0.00350	0.000691	0.000194	0.000399	1.40e-05	2.48e-08	1.26e-07	1.43e-08	1.03e-10	5.02e-10	4.74e-08	3.40e-08	1.50e-09	6.47e-10
AW-15S	0.00435	0.000712	0.000134	0.000333	1.41e-05	1.28e-07	7.81e-07	5.98e-08	2.05e-10	2.53e-09	2.18e-07	1.30e-07	1.07e-08	5.57e-09
AW-05	0.0124	0.00271	0.000408	0.000759	2.40e-05	6.79e-08	3.10e-07	1.90e-08	1.38e-10	6.01e-10	1.87e-07	1.49e-07	4.01e-09	1.56e-09
AW-19	0.0194	0.00258	6.02e-05	0.000184	9.58e-06	4.55e-07	3.42e-06	3.25e-08	3.53e-10	1.69e-09	1.18e-06	5.69e-07	4.58e-09	2.93e-09
AW-21	0.0113	0.00271	0.000270	0.000480	1.33e-05	3.49e-07	1.46e-06	5.93e-08	1.90e-09	1.72e-09	8.50e-07	7.38e-07	6.34e-08	2.26e-08
AP07S	0.00371	0.000706	0.000203	0.000435	1.58e-05	2.63e-08	1.38e-07	1.62e-08	1.95e-11	5.87e-10	5.15e-08	3.57e-08	1.78e-11	7.96e-12
AP07S	0.00367	0.000666	0.000210	0.000472	1.80e-05	2.43e-08	1.34e-07	1.73e-08	1.14e-11	6.58e-10	5.30e-08	3.49e-08	2.66e-12	1.25e-12
AW-15S	0.00436	0.000776	0.000157	0.000358	1.39e-05	1.39e-07	7.80e-07	6.41e-08	7.56e-11	2.49e-09	2.23e-07	1.44e-07	1.74e-10	8.34e-11
AW-15S	0.00426	0.000730	0.000166	0.000394	1.59e-05	1.30e-07	7.57e-07	7.02e-08	5.20e-11	2.83e-09	2.36e-07	1.47e-07	2.79e-11	1.39e-11
AW-05	0.0133	0.00289	0.000423	0.000792	2.52e-05	7.32e-08	3.37e-07	2.00e-08	4.60e-11	6.38e-10	1.90e-07	1.50e-07	1.62e-10	6.36e-11
AW-05	0.0137	0.00285	0.000426	0.000835	2.78e-05	7.07e-08	3.40e-07	2.08e-08	2.67e-11	6.91e-10	1.90e-07	1.44e-07	2.81e-11	1.15e-11
AW-19	0.0195	0.00278	7.60e-05	0.000217	1.05e-05	4.51e-07	3.16e-06	3.52e-08	1.97e-10	1.71e-09	1.06e-06	5.51e-07	2.05e-10	1.22e-10
AW-19	0.0193	0.00279	8.91e-05	0.000252	1.21e-05	4.45e-07	3.08e-06	4.02e-08	1.55e-10	1.93e-09	1.05e-06	5.51e-07	7.86e-11	4.64e-11
AW-21	0.0134	0.00336	0.000297	0.000483	1.33e-05	4.27e-07	1.70e-06	6.13e-08	5.95e-10	1.69e-09	8.27e-07	7.54e-07	2.21e-09	7.50e-10
AW-21	0.0141	0.00327	0.000300	0.000527	1.57e-05	4.19e-07	1.80e-06	6.74e-08	2.46e-10	2.01e-09	8.70e-07	7.33e-07	2.16e-10	7.92e-11
AP07S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-15S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AP07S	0.00269	0.000534	0.000150	0.000308	1.07e-05	1.90e-08	9.58e-08	1.10e-08	7.78e-11	3.82e-10	3.59e-08	2.59e-08	1.17e-09	5.00e-10
AW-15S	0.00335	0.000550	0.000104	0.000257	1.08e-05	9.80e-08	5.96e-07	4.59e-08	1.56e-10	1.93e-09	1.66e-07	9.91e-08	8.34e-09	4.32e-09
AW-05	0.0102	0.00224	0.000338	0.000628	1.98e-05	5.58e-08	2.54e-07	1.56e-08	1.12e-10	4.92e-10	1.52e-07	1.21e-07	3.33e-09	1.29e-09
AW-19	0.0160	0.00213	4.97e-05	0.000152	7.90e-06	3.70e-07	2.78e-06	2.64e-08	2.85e-10	1.37e-09	9.51e-07	4.60e-07	3.78e-09	2.42e-09
AW-21	0.00937	0.00224	0.000224	0.000381	1.10e-05	2.88e-07	1.20e-06	4.89e-08	1.56e-09	1.41e-09	6.98e-07	6.06e-07	5.26e-08	1.87e-08
AP07S	0.00284	0.000533	0.000158	0.000345	1.27e-05	1.95e-08	1.04e-07	1.26e-08	1.30e-11	4.66e-10	3.95e-08	2.69e-08	8.88e-12	4.04e-12
AP07S	0.00280	0.000496	0.000166	0.000381	1.49e-05	1.78e-08	1.00e-07	1.37e-08	7.48e-12	5.33e-10	4.07e-08	2.62e-08	1.25e-12	6.01e-13
AW-15S	0.00333	0.000585	0.000123	0.000286	1.12e-05	1.04e-07	5.91e-07	5.06e-08	5.29e-11	1.99e-09	1.73e-07	1.10e-07	9.22e-11	4.47e-11
AW-15S	0.00323	0.000541	0.000132	0.000322	1.33e-05	9.51e-08	5.69e-07	5.66e-08	3.57e-11	2.34e-09	1.85e-07	1.13e-07	1.29e-11	6.57e-12
AW-05	0.0111	0.00237	0.000350	0.000664	2.14e-05	5.93e-08	2.76e-07	1.66e-08	3.43e-11	5.34e-10	1.55e-07	1.21e-07	1.04e-10	4.12e-11
AW-05	0.0114	0.00233	0.000355	0.000705	2.38e-05	5.71e-08	2.78e-07	1.73e-08	1.95e-11	5.82e-10	1.55e-07	1.16e-07	1.69e-11	7.02e-12
AW-19	0.0161	0.00228	6.46e-05	0.000186	9.05e-06	3.62e-07	2.55e-06	2.95e-08	1.48e-10	1.44e-09	8.60e-07	4.43e-07	1.32e-10	7.90e-11
AW-19	0.0159	0.00228	7.76e-05	0.000220	1.06e-05	3.57e-07	2.49e-06	3.44e-08	1.15e-10	1.66e-09	8.51e-07	4.43e-07	5.00e-11	2.97e-11
AW-21	0.0112	0.00276	0.000247	0.000407	1.14e-05	3.49e-07	1.42e-06	5.16e-08	4.23e-10	1.45e-09	6.87e-07	6.15e-07	1.47e-09	5.06e-10
AW-21	0.0118	0.00267	0.000251	0.000450	1.37e-05	3.41e-07	1.50e-06	5.75e-08	1.71e-10	1.75e-09	7.24e-07	5.97e-07	1.32e-10	4.95e-11
AP07S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-15S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AP07S	0.00424	0.000841	0.000236	0.000485	1.69e-05	3.00e-08	1.51e-07	1.73e-08	1.23e-10	6.02e-10	5.65e-08	4.08e-08	1.84e-09	7.88e-10
AW-15S	0.00527	0.000867	0.000164	0.000406	1.71e-05	1.54e-07	9.39e-07	7.22e-08	2.46e-10	3.04e-09	2.62e-07	1.56e-07	1.31e-08	6.80e-09
AW-05	0.0129	0.00283	0.000427	0.000793	2.50e-05	7.04e-08	3.21e-07	1.97e-08	1.42e-10	6.22e-10	1.92e-07	1.53e-07	4.20e-09	1.63e-09
AW-19	0.0202	0.00269	6.28e-05	0.000192	9.98e-06	4.67e-07	3.51e-06	3.34e-08	3.61e-10	1.73e-09	1.20e-06	5.81e-07	4.78e-09	3.05e-09
AW-21	0.0118	0.00283	0.000283	0.000482	1.39e-05	3.64e-07	1.52e-06	6.18e-08	1.97e-09	1.79e-09	8.81e-07	7.66e-07	6.65e-08	2.36e-08
AP07S	0.00450	0.000863	0.000246	0.000521	1.88e-05	3.16e-08	1.65e-07	1.91e-08	2.56e-11	6.89e-10	6.09e-08	4.24e-08	2.58e-11	1.14e-11
AP07S	0.00447	0.000819	0.000252	0.000560	2.12e-05	2.96e-08	1.62e-07	2.02e-08	1.52e-11	7.65e-10	6.26e-08	4.16e-08	4.26e-12	1.98e-12
AW-15S	0.00530	0.000949	0.000189	0.000429	1.66e-05	1.69e-07	9.42e-07	7.62e-08	9.64e-11	2.95e-09	2.65e-07	1.72e-07	2.56e-10	1.22e-10
AW-15S	0.00520	0.000901	0.000198	0.000465	1.86e-05	1.59e-07	9.19e-07	8.22e-08	6.70e-11	3.28e-09	2.79e-07	1.75e-07	4.62e-11	2.27e-11
AW-05	0.0139	0.00301	0.000441	0.000827	2.64e-05	7.51e-08	3.46e-07	2.06e-08	4.93e-11	6.57e-10	1.95e-07	1.53e-07	1.80e-10	7.04e-11
AW-05	0.0143	0.00296	0.000443	0.000870	2.90e-05	7.28e-08	3.51e-07	2.14e-08	2.93e-11	7.14e-10	1.96e-07	1.48e-07	3.40e-11	1.39e-11
AW-19	0.0203	0.00288	7.83e-05	0.000225	1.10e-05	4.56e-07	3.22e-06	3.57e-08	2.04e-10	1.74e-09	1.08e-06	5.56e-07	2.15e-10	1.29e-10
AW-19	0.0202	0.00289	9.14e-05	0.000260	1.26e-05	4.50e-07	3.14e-06	4.05e-08	1.64e-10	1.96e-09	1.07e-06	5.55e-07	8.91e-11	5.30e-11
AW-21	0.0139	0.00350	0.000311	0.000503	1.38e-05	4.43e-07	1.76e-06	6.36e-08	6.69e-10	1.75e-09	8.56e-07	7.81e-07	2.39e-09	8.10e-10
AW-21	0.0147	0.00341	0.000313	0.000548	1.63e-05	4.35e-07	1.87e-06	6.97e-08	2.82e-10	2.07e-09	9.00e-07	7.61e-07	2.55e-10	9.35e-11
AP07S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-15S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AP07S	0.00350	0.000695	0.000195	0.000401	1.40e-05	2.47e-08	1.25e-07	1.43e-08	1.01e-10	4.97e-10	4.67e-08	3.36e-08	1.52e-09	6.50e-10
AW-15S	0.00435	0.000716	0.000135	0.000335	1.41e-05	1.27e-07	7.75e-07	5.96e-08	2.03e-10	2.51e-09	2.16e-07	1.29e-07	1.08e-08	5.61e-09
AW-05	0.0124	0.00272	0.000410	0.000760	2.40e-05	6.75e-08	3.08e-07	1.89e-08	1.36e-10	5.96e-10	1.84e-07	1.47e-07	4.03e-09	1.56e-09
AW-19	0.0194	0.00258	6.02e-05	0.000184	9.56e-06	4.48e-07	3.36e-06	3.20e-08	3.45e-10	1.66e-09	1.15e-06	5.57e-07	4.58e-09	2.93e-09
AW-21	0.0113	0.00272	0.000271	0.000462	1.33e-05	3.48e-07	1.46e-06	5.92e-08	1.89e-09	1.71e-09	8.45e-07	7.34e-07	6.37e-08	2.27e-08
AP07S	0.00371	0.000704	0.000204	0.000437	1.59e-05	2.58e-08	1.36e-07	1.60e-08	1.92e-11	5.83e-10	5.07e-08	3.50e-08	1.65e-11	7.40e-12
AP07S	0.00367	0.000664	0.000211	0.000475	1.82e-05	2.39e-08	1.32e-07	1.71e-08	1.13e-11	6.53e-10	5.21e-08	3.42e-08	2.50e-12	1.18e-12
AW-15S	0.00436	0.000775	0.000157	0.000360	1.40e-05	1.38e-07	7.74e-07	6.40e-08	7.48e-11	2.49e-09	2.21e-07	1.43e-07	1.67e-10	7.99e-11
AW-15S	0.00426	0.000728	0.000166	0.000397	1.60e-05	1.28e-07	7.51e-07	7.00e-08	5.15e-11	2.83e-09	2.34e-07	1.45e-07	2.70e-11	1.34e-11
AW-05	0.0133	0.00288	0.000422	0.000795	2.54e-05	7.19e-08	3.32e-07	1.98e-08	4.53e-11	6.33e-10	1.87e-07	1.47e-07	1.56e-10	6.14e-11
AW-05	0.0137	0.00284	0.000426	0.000837	2.80e-05	6.95e-08	3.36e-07	2.05e-08	2.63e-11	6.86e-10	1.87e-07	1.41e-07	2.73e-11	1.12e-11
AW-19	0.0195	0.00276	7.56e-05	0.000217	1.06e-05	4.39e-07	3.10e-06	3.45e-08	1.89e-10	1.69e-09	1.04e-06	5.35e-07	1.89e-10	1.14e-10
AW-19	0.0193	0.00277	8.86e-05	0.000252	1.22e-05	4.33e-07	3.02e-06	3.94e-08	1.49e-10	1.90e-09	1.03e-06	5.34e-07	7.49e-11	4.46e-11
AW-21	0.0134	0.00335	0.000298	0.000484	1.34e-05	4.24e-07	1.69e-06	6.12e-08	5.95e-10	1.69e-09	8.22e-07	7.49e-07	2.20e-09	7.46e-10
AW-21	0.0141	0.00327	0.000301	0.000528	1.58e-05	4.16e-07	1.80e-06	6.73e-08	2.45e-10	2.01e-09	8.65e-07	7.28e-07	2.14e-10	7.86e-11

NOTES:
All model results are
pH and pe (standarc
charge (equivalents
Results beginning w
Results beginning w

Attachment D. PHRE
Groundwater Polishi
Ash Pond
Edwards Power Plant
Bartonville, IL

Location	m_Hao_ SO4-	m_Hao_ OHSO4-2	m_Hao_ H2BO3	m_Hao_ H3BO4-	Ferrihydrite	d_Ferrihydrite	Gibbsite	d_Gibbsite	Barite	d_Barite	Calcite	d_Calcite	Dolomite (ordered)	d_Dolomite (ordered)
AP07S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-15S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AP07S	2.25e-14	0.000230	0.00386	1.85e-10	0.0400	0	0.130	0	0	0	0.100	0	0.300	0
AW-15S	5.73e-14	0.000298	0.00373	9.06e-11	0.0400	0	0.130	0	0	0	0.100	0	0.300	0
AW-05	4.48e-14	0.000565	0.00386	2.28e-10	0.190	0	0.160	0	0	0	0.400	0	0.700	0
AW-19	4.45e-14	0.000453	0.00394	1.87e-10	0.190	0	0.160	0	0	0	0.400	0	0.700	0
AW-21	3.03e-14	0.000213	0.00490	1.61e-10	0.190	0	0.160	0	0	0	0.400	0	0.700	0
AP07S	5.00e-15	0.000223	0.00359	7.48e-10	0.0400	7.51e-07	0.130	-9.26e-09	0	0	0.101	0.000555	0.300	-4.22e-04
AP07S	2.56e-15	0.000229	0.00342	1.43e-09	0.0400	3.06e-06	0.130	-8.90e-09	0	0	0.101	0.000509	0.299	-3.68e-04
AW-15S	8.68e-15	0.000243	0.00352	4.61e-10	0.0400	2.22e-07	0.130	-8.42e-09	9.29e-07	9.29e-07	0.101	0.000527	0.300	-4.76e-04
AW-15S	4.01e-15	0.000239	0.00338	9.42e-10	0.0400	1.81e-06	0.130	-8.60e-09	0	-9.29e-07	0.101	0.000478	0.299	-3.66e-04
AW-05	1.40e-14	0.000531	0.00366	6.49e-10	0.190	9.76e-06	0.160	-1.24e-08	2.05e-06	2.05e-06	0.400	0.000494	0.700	-2.87e-04
AW-05	7.55e-15	0.000515	0.00353	1.13e-09	0.190	2.31e-05	0.160	-1.07e-08	0	-2.05e-06	0.401	0.000454	0.700	-2.13e-04
AW-19	1.06e-14	0.000433	0.00380	7.26e-10	0.190	8.36e-05	0.160	-7.91e-09	0	0	0.401	0.000692	0.699	-7.27e-04
AW-19	7.06e-15	0.000424	0.00370	1.04e-09	0.190	5.42e-05	0.160	-8.37e-09	0	0	0.401	0.000509	0.699	-4.17e-04
AW-21	1.08e-14	0.000300	0.00449	5.83e-10	0.190	4.97e-06	0.160	-1.54e-08	2.90e-06	2.90e-06	0.401	0.000868	0.699	-7.21e-04
AW-21	5.28e-15	0.000286	0.00430	1.09e-09	0.190	2.13e-05	0.160	-1.23e-08	0	-2.90e-06	0.401	0.000422	0.699	-1.00e-04
AP07S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-15S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AP07S	3.97e-14	0.000407	0.00683	3.27e-10	0.0630	0	0.230	0	0	0	0.100	0	0.300	0
AW-15S	1.01e-13	0.000527	0.00659	1.60e-10	0.0630	0	0.230	0	0	0	0.100	0	0.300	0
AW-05	7.28e-14	0.000918	0.00628	3.70e-10	0.240	0	0.260	0	0	0	0.400	0	0.700	0
AW-19	7.23e-14	0.000736	0.00640	3.05e-10	0.240	0	0.260	0	0	0	0.400	0	0.700	0
AW-21	4.93e-14	0.000346	0.00797	2.61e-10	0.240	0	0.260	0	0	0	0.400	0	0.700	0
AP07S	1.03e-14	0.000373	0.00649	1.10e-09	0.0630	4.31e-07	0.230	-9.50e-09	5.57e-07	5.57e-07	0.101	0.000582	0.300	-4.53e-04
AP07S	5.54e-15	0.000369	0.00628	1.96e-09	0.0630	1.80e-06	0.230	-8.90e-09	0	-5.57e-07	0.101	0.000493	0.299	-3.58e-04
AW-15S	1.85e-14	0.000416	0.00635	6.68e-10	0.0630	1.80e-07	0.230	-8.38e-09	2.04e-06	2.04e-06	0.101	0.000554	0.299	-5.35e-04
AW-15S	9.25e-15	0.000391	0.00618	1.22e-09	0.0630	3.77e-07	0.230	-8.51e-09	0	-2.04e-06	0.101	0.000449	0.299	-3.53e-04
AW-05	2.47e-14	0.000847	0.00605	9.70e-10	0.240	7.49e-06	0.260	-1.29e-08	2.49e-06	2.49e-06	0.401	0.000501	0.700	-3.09e-04
AW-05	1.40e-14	0.000812	0.00589	1.60e-09	0.240	1.51e-05	0.260	-1.12e-08	2.00e-07	-2.29e-06	0.401	0.000419	0.700	-1.59e-04
AW-19	1.90e-14	0.000703	0.00625	1.08e-09	0.240	9.54e-05	0.260	-7.80e-09	0	0	0.401	0.000747	0.699	-8.14e-04
AW-19	1.30e-14	0.000683	0.00613	1.51e-09	0.240	5.08e-05	0.260	-8.29e-09	0	0	0.401	0.000499	0.699	-4.17e-04
AW-21	1.70e-14	0.000449	0.00747	9.23e-10	0.240	3.22e-06	0.260	-1.61e-08	3.06e-06	3.06e-06	0.401	0.00101	0.699	-9.13e-04
AW-21	8.77e-15	0.000419	0.00722	1.61e-09	0.240	9.44e-06	0.260	-1.34e-08	1.53e-06	-1.53e-06	0.401	0.000392	0.699	-3.08e-05
AP07S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-15S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AP07S	3.11e-14	0.000318	0.00535	2.56e-10	0.0520	0	0.180	0	0	0	0.100	0	0.300	0
AW-15S	7.93e-14	0.000412	0.00516	1.25e-10	0.0520	0	0.180	0	0	0	0.100	0	0.300	0
AW-05	5.88e-14	0.000742	0.00507	2.99e-10	0.230	0	0.210	0	0	0	0.400	0	0.700	0
AW-19	5.84e-14	0.000594	0.00517	2.46e-10	0.230	0	0.210	0	0	0	0.400	0	0.700	0
AW-21	3.98e-14	0.000279	0.00643	2.11e-10	0.230	0	0.210	0	0	0	0.400	0	0.700	0
AP07S	7.57e-15	0.000298	0.00504	9.28e-10	0.0520	5.30e-07	0.180	-9.38e-09	0	0	0.101	0.000568	0.300	-4.38e-04
AP07S	3.94e-15	0.000299	0.00485	1.72e-09	0.0520	2.54e-06	0.180	-8.89e-09	0	0	0.101	0.000500	0.299	-3.63e-04
AW-15S	1.34e-14	0.000329	0.00493	5.68e-10	0.0520	1.92e-07	0.180	-8.39e-09	1.64e-06	1.64e-06	0.101	0.000540	0.299	-5.07e-04
AW-15S	6.45e-15	0.000315	0.00478	1.09e-09	0.0520	6.99e-07	0.180	-8.54e-09	0	-1.64e-06	0.101	0.000461	0.299	-3.59e-04
AW-05	1.95e-14	0.000691	0.00485	8.05e-10	0.230	8.73e-06	0.210	-1.28e-08	2.36e-06	2.36e-06	0.401	0.000501	0.700	-3.05e-04
AW-05	1.07e-14	0.000665	0.00471	1.36e-09	0.230	1.92e-05	0.210	-1.11e-08	0	-2.36e-06	0.401	0.000432	0.700	-1.75e-04
AW-19	1.49e-14	0.000568	0.00502	8.97e-10	0.230	9.23e-05	0.210	-7.82e-09	0	0	0.401	0.000732	0.699	-7.93e-04
AW-19	1.00e-14	0.000553	0.00491	1.27e-09	0.230	5.37e-05	0.210	-8.31e-09	0	0	0.401	0.000503	0.699	-4.19e-04
AW-21	1.42e-14	0.000378	0.00597	7.44e-10	0.230	4.00e-06	0.210	-1.60e-08	3.03e-06	3.03e-06	0.401	0.000967	0.699	-8.63e-04
AW-21	7.11e-15	0.000356	0.00575	1.35e-09	0.230	1.38e-05	0.210	-1.32e-08	7.60e-07	-2.27e-06	0.401	0.000398	0.699	-4.33e-05
AP07S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-15S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AP07S	2.24e-14	0.000225	0.00386	1.82e-10	0.0400	0	0.130	0	0	0	0.100	0	0.300	0
AW-15S	5.70e-14	0.000291	0.00372	8.90e-11	0.0400	0	0.130	0	0	0	0.100	0	0.300	0
AW-05	4.50e-14	0.000565	0.00385	2.26e-10	0.190	0	0.160	0	0	0	0.400	0	0.700	0
AW-19	4.49e-14	0.000456	0.00391	1.86e-10	0.190	0	0.160	0	0	0	0.400	0	0.700	0
AW-21	3.02e-14	0.000209	0.00490	1.59e-10	0.190	0	0.160	0	0	0	0.400	0	0.700	0
AP07S	4.86e-15	0.000223	0.00358	7.69e-10	0.0400	8.13e-07	0.130	-9.28e-09	0	0	0.101	0.000551	0.300	-4.15e-04
AP07S	2.51e-15	0.000229	0.00342	1.46e-09	0.0400	3.21e-06	0.130	-8.91e-09	0	0	0.101	0.000510	0.299	-3.69e-04
AW-15S	8.54e-15	0.000242	0.00352	4.67e-10	0.0400	2.27e-07	0.130	-8.44e-09	8.40e-07	8.40e-07	0.101	0.000520	0.300	-4.67e-04
AW-15S	3.97e-15	0.000239	0.00338	9.50e-10	0.0400	1.88e-06	0.130	-8.60e-09	0	-8.40e-07	0.101	0.000478	0.299	-3.66e-04
AW-05	1.39e-14	0.000536	0.00364	6.55e-10	0.190	1.04e-05	0.160	-1.25e-08	2.03e-06	2.03e-06	0.400	0.000488	0.700	-2.72e-04
AW-05	7.56e-15	0.000520	0.00351	1.13e-09	0.190	2.42e-05	0.160	-1.07e-08	0	-2.03e-06	0.401	0.000454	0.700	-2.12e-04
AW-19	1.05e-14	0.000439	0.00378	7.35e-10	0.190	9.19e-05	0.160	-7.96e-09	0	0	0.401	0.000690	0.699	-7.09e-04
AW-19	7.12e-15	0.000430	0.00368	1.04e-09	0.190	5.56e-05	0.160	-8.38e-09	0	0	0.401	0.000509	0.699	-4.16e-04
AW-21	1.08e-14	0.000300	0.00449	5.84e-10	0.190	5.10e-06	0.160	-1.54e-08	2.90e-06	2.90e-06	0.401	0.000867	0.699	-7.14e-04
AW-21	5.28e-15	0.000286	0.00430	1.09e-09	0.190	2.17e-05	0.160	-1.24e-08	0	-2.90e-06	0.401	0.000422	0.699	-9.96e-05
AP07S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-15S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AP07S	3.96e-14	0.000399	0.00683	3.22e-10	0.0630	0	0.230	0	0	0	0.100	0	0.300	0
AW-15S	1.01e-13	0.000515	0.00659	1.57e-10	0.0630	0	0.230	0	0	0	0.100	0	0.300	0
AW-05	7.31e-14	0.000917	0.00625	3.67e-10	0.240	0	0.260	0	0	0	0.400	0	0.700	0
AW-19	7.29e-14	0.000741	0.00635	3.02e-10	0.240	0	0.260	0	0	0	0.400	0	0.700	0
AW-21	4.91e-14	0.000340	0.00797	2.58e-10	0.240	0	0.260	0	0	0	0.400	0	0.700	0
AP07S	1.00e-14	0.000373	0.00649	1.13e-09	0.0630	4.61e-07	0.230	-9.53e-09	3.80e-07	3.80e-07	0.101	0.000574	0.300	-4.41e-04
AP07S	5.42e-15	0.000370	0.00628	2.00e-09	0.0630	1.95e-06	0.230	-8.91e-09	0	-3.80e-07	0.101	0.000494	0.299	-3.58e-04
AW-15S	1.82e-14	0.000414	0.00635	6.78e-10	0.0630	1.81e-07	0.230	-8.40e-09	1.99e-06	1.99e-06	0.101	0.000541	0.299	-5.20e-04
AW-15S	9.15e-15	0.000390	0.00618	1.23e-09	0.0630	3.91e-07	0.230	-8.52e-09	0	-1.99e-06	0.101	0.000449	0.299	-3.53e-04
AW-05	2.46e-14	0.000855	0.00602	9.80e-10	0.240	8.07e-06	0.260	-1.30e-08	2.47e-06	2.47e-06	0.400	0.000491	0.700	-2.89e-04
AW-05	1.40e-14	0.000820	0.00587	1.61e-09	0.240	1.60e-05	0.260	-1.12e-08	1.23e-07	-2.34e-06	0.401	0.000419	0.700	-1.58e-04
AW-19	1.87e-14	0.000713	0.00620	1.10e-09	0.240	0.000107	0.260	-7.86e-09	0	0	0.401	0.000741	0.699	-7.90e-04
AW-19	1.30e-14	0.000694	0.00609	1.52e-09	0.240	5.26e-05	0.260	-8.31e-09	0	0	0.401	0.000500	0.699	-4.17e-04
AW-21	1.69e-14	0.000449	0.00747	9.25e-10	0.240	3.32e-06	0.260	-1.62e-08	3.06e-06	3.06e-06	0.401	0.00101	0.699	-9.04e-04
AW-21	8.76e-15	0.000419	0.00722	1.62e-09	0.240	9.68e-06	0.260	-1.34e-08	1.52e-06	-1.54e-06	0.401	0.000392	0.699	-2.98e-05
AP07S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-15S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AW-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AP07S	3.10e-14	0.000312	0.00534	2.52e-10	0.0520	0	0.180	0	0	0	0.100	0	0.300	0
AW-15S	7.90e-14	0.000403	0.00516	1.23e-10	0.0520	0	0.180	0	0	0	0.100	0	0.300	0
AW-05	5.91e-14	0.000741	0.00505	2.96e-10	0.230	0	0.210	0	0	0	0.400	0	0.700	0
AW-19	5.89e-14	0.000598	0.00513	2.44e-10	0.230	0	0.210	0	0	0	0.400	0	0.700	0
AW-21	3.97e-14	0.000275	0.00643	2.08e-10	0.230	0	0.210	0	0	0	0.400	0	0.700	0
AP07S	7.36e-15	0.000298	0.00503	9.54e-10	0.0520	5.69e-07	0.180	-9.41e-09	0	0	0.101	0.000562	0.300	-4.28e-04
AP07S	3.86e-15	0.000300	0.00484	1.76e-09	0.0520	2.70e-06	0.180	-8.89e-09	0	0	0.101	0.000501	0.299	-3.64e-04
AW-15S	1.31e-14	0.000328	0.00493	5.75e-10	0.0520	1.95e-07	0.180	-8.41e-09	1.57e-06	1.57e-06	0.101	0.000530	0.300	-4.94e-04
AW-15S	6.39e-15	0.000314	0.00478	1.10e-09	0.0520	7.31e-07	0.180	-8.55e-09	0	-1.57e-06	0.101	0.000461	0.299	-3.59e-04
AW-05	1.94e-14	0.000697	0.00483	8.13e-10	0.230	9.37e-06	0.210	-1.29e-08	2.34e-06	2.34e-06	0.400	0.000493	0.700	-2.86e-04
AW-05	1.07e-14	0.000671	0.00469	1.37e-09	0.230	2.02e-05	0.210	-1.11e-08	0	-2.34e-06	0.401	0.000432	0.700	-1.73e-04
AW-19	1.48e-14	0.000576	0.00499	9.11e-10	0.230	0.000102	0.210	-7.88e-09	0	0	0.401	0.000728	0.699	-7.72e-04
AW-19	1.01e-14	0.000562	0.00488	1.27e-09	0.230	5.53e-05	0.210	-8.32e-09	0	0	0.401	0.000504	0.699	-4.19e-04
AW-21	1.42e-14	0.000378	0.00597	7.45e-10	0.230	4.12e-06	0.210	-1.60e-08	3.04e-06	3.04e-06	0.401	0.000966	0.699	-8.56e-04
AW-21	7.10e-15	0.000356	0.00575	1.35e-09	0.230	1.41e-05	0.210	-1.32e-08	7.57e-07	-2.28e-06	0.401	0.000398	0.699	-4.24e-05

NOTES:
All model results are
pH and pe (standar
charge (equivalents
Results beginning w
Results beginning w

DRAFT

Attachment D. PHRE
Groundwater Polishi
Ash Pond
Edwards Power Plant
Bartonville, IL

Location	Gypsum	d_Gypsum	si_Ferrihydrite	si_Gibbsite	si_Barite	si_Calcite	si_Dolomite (ordered)	si_Gypsum
AP07S	0	0	1.89	-9.87e-02	0.749	-2.27e-01	-5.77e-01	-8.78e-01
AW-15S	0	0	0.885	0.966	0.851	-1.86e-01	-5.72e-01	-6.12e-01
AW-05	0	0	3.90	-2.10e-01	0.978	-1.72e-01	-3.43e-01	-8.89e-01
AW-19	0	0	1.56	-6.68e-02	0.386	-5.32e-01	-1.14e+00	-1.78e+00
AW-21	0	0	2.40	0.372	0.594	-8.68e-01	-1.97e+00	-1.11e+00
AP07S	0	0	1.89	-9.87e-02	0.749	-2.27e-01	-5.77e-01	-8.78e-01
AW-15S	0	0	0.885	0.966	0.851	-1.86e-01	-5.72e-01	-6.12e-01
AW-05	0	0	3.90	-2.10e-01	0.978	-1.72e-01	-3.43e-01	-8.89e-01
AW-19	0	0	1.56	-6.68e-02	0.386	-5.32e-01	-1.14e+00	-1.78e+00
AW-21	0	0	2.40	0.372	0.594	-8.68e-01	-1.97e+00	-1.11e+00
AP07S	0	0	0	0	-1.72e-01	0	0	-2.72e+00
AP07S	0	0	0	0	-9.67e-01	0	0	-3.52e+00
AW-15S	0	0	0	0	0	0	0	-2.41e+00
AW-15S	0	0	0	0	-5.72e-01	0	0	-3.21e+00
AW-05	0	0	0	0	0	0	0	-2.21e+00
AW-05	0	0	0	0	-2.15e-01	0	0	-2.97e+00
AW-19	0	0	0	0	-1.81e-01	0	0	-2.71e+00
AW-19	0	0	0	0	-5.95e-01	0	0	-3.14e+00
AW-21	0	0	0	0	0	0	0	-1.90e+00
AW-21	0	0	0	0	-7.60e-02	0	0	-2.90e+00
AP07S	0	0	1.89	-9.87e-02	0.749	-2.27e-01	-5.77e-01	-8.78e-01
AW-15S	0	0	0.885	0.966	0.851	-1.86e-01	-5.72e-01	-6.12e-01
AW-05	0	0	3.90	-2.10e-01	0.978	-1.72e-01	-3.43e-01	-8.89e-01
AW-19	0	0	1.56	-6.68e-02	0.386	-5.32e-01	-1.14e+00	-1.78e+00
AW-21	0	0	2.40	0.372	0.594	-8.68e-01	-1.97e+00	-1.11e+00
AP07S	0	0	1.89	-9.87e-02	0.749	-2.27e-01	-5.77e-01	-8.78e-01
AW-15S	0	0	0.885	0.966	0.851	-1.86e-01	-5.72e-01	-6.12e-01
AW-05	0	0	3.90	-2.10e-01	0.978	-1.72e-01	-3.43e-01	-8.89e-01
AW-19	0	0	1.56	-6.68e-02	0.386	-5.32e-01	-1.14e+00	-1.78e+00
AW-21	0	0	2.40	0.372	0.594	-8.68e-01	-1.97e+00	-1.11e+00
AP07S	0	0	0	0	0	0	0	-2.48e+00
AP07S	0	0	0	0	-6.07e-01	0	0	-3.22e+00
AW-15S	0	0	0	0	0	0	0	-2.19e+00
AW-15S	0	0	0	0	-1.66e-01	0	0	-2.90e+00
AW-05	0	0	0	0	0	0	0	-2.08e+00
AW-05	0	0	0	0	0	0	0	-2.77e+00
AW-19	0	0	0	0	-6.72e-02	0	0	-2.59e+00
AW-19	0	0	0	0	-4.40e-01	0	0	-2.98e+00
AW-21	0	0	0	0	0	0	0	-1.80e+00
AW-21	0	0	0	0	0	0	0	-2.73e+00
AP07S	0	0	1.89	-9.87e-02	0.749	-2.27e-01	-5.77e-01	-8.78e-01
AW-15S	0	0	0.885	0.966	0.851	-1.86e-01	-5.72e-01	-6.12e-01
AW-05	0	0	3.90	-2.10e-01	0.978	-1.72e-01	-3.43e-01	-8.89e-01
AW-19	0	0	1.56	-6.68e-02	0.386	-5.32e-01	-1.14e+00	-1.78e+00
AW-21	0	0	2.40	0.372	0.594	-8.68e-01	-1.97e+00	-1.11e+00
AP07S	0	0	1.89	-9.87e-02	0.749	-2.27e-01	-5.77e-01	-8.78e-01
AW-15S	0	0	0.885	0.966	0.851	-1.86e-01	-5.72e-01	-6.12e-01
AW-05	0	0	3.90	-2.10e-01	0.978	-1.72e-01	-3.43e-01	-8.89e-01
AW-19	0	0	1.56	-6.68e-02	0.386	-5.32e-01	-1.14e+00	-1.78e+00
AW-21	0	0	2.40	0.372	0.594	-8.68e-01	-1.97e+00	-1.11e+00
AP07S	0	0	0	0	-3.07e-02	0	0	-2.58e+00
AP07S	0	0	0	0	-8.03e-01	0	0	-3.35e+00
AW-15S	0	0	0	0	0	0	0	-2.28e+00
AW-15S	0	0	0	0	-3.30e-01	0	0	-3.03e+00
AW-05	0	0	0	0	0	0	0	-2.12e+00
AW-05	0	0	0	0	-7.08e-02	0	0	-2.85e+00
AW-19	0	0	0	0	-1.08e-01	0	0	-2.63e+00
AW-19	0	0	0	0	-5.01e-01	0	0	-3.04e+00
AW-21	0	0	0	0	0	0	0	-1.82e+00
AW-21	0	0	0	0	0	0	0	-2.78e+00
AP07S	0	0	1.90	-9.59e-02	0.768	-2.14e-01	-5.52e-01	-8.61e-01
AW-15S	0	0	0.898	0.969	0.869	-1.75e-01	-5.50e-01	-5.97e-01
AW-05	0	0	3.90	-2.07e-01	0.995	-1.62e-01	-3.22e-01	-8.75e-01
AW-19	0	0	1.58	-6.37e-02	0.411	-5.13e-01	-1.10e+00	-1.75e+00
AW-21	0	0	2.40	0.373	0.603	-8.62e-01	-1.95e+00	-1.10e+00
AP07S	0	0	1.90	-9.59e-02	0.768	-2.14e-01	-5.52e-01	-8.61e-01
AW-15S	0	0	0.898	0.969	0.869	-1.75e-01	-5.50e-01	-5.97e-01
AW-05	0	0	3.90	-2.07e-01	0.995	-1.62e-01	-3.22e-01	-8.75e-01
AW-19	0	0	1.58	-6.37e-02	0.411	-5.13e-01	-1.10e+00	-1.75e+00
AW-21	0	0	2.40	0.373	0.603	-8.62e-01	-1.95e+00	-1.10e+00
AP07S	0	0	0	0	-1.96e-01	0	0	-2.75e+00
AP07S	0	0	0	0	-9.83e-01	0	0	-3.53e+00
AW-15S	0	0	0	0	0	0	0	-2.43e+00
AW-15S	0	0	0	0	-5.89e-01	0	0	-3.22e+00
AW-05	0	0	0	0	0	0	0	-2.22e+00
AW-05	0	0	0	0	-2.19e-01	0	0	-2.97e+00
AW-19	0	0	0	0	-1.97e-01	0	0	-2.72e+00
AW-19	0	0	0	0	-5.99e-01	0	0	-3.14e+00
AW-21	0	0	0	0	0	0	0	-1.90e+00
AW-21	0	0	0	0	-7.59e-02	0	0	-2.90e+00
AP07S	0	0	1.90	-9.59e-02	0.768	-2.14e-01	-5.52e-01	-8.61e-01
AW-15S	0	0	0.898	0.969	0.869	-1.75e-01	-5.50e-01	-5.97e-01
AW-05	0	0	3.90	-2.07e-01	0.995	-1.62e-01	-3.22e-01	-8.75e-01
AW-19	0	0	1.58	-6.37e-02	0.411	-5.13e-01	-1.10e+00	-1.75e+00
AW-21	0	0	2.40	0.373	0.603	-8.62e-01	-1.95e+00	-1.10e+00
AP07S	0	0	1.90	-9.59e-02	0.768	-2.14e-01	-5.52e-01	-8.61e-01
AW-15S	0	0	0.898	0.969	0.869	-1.75e-01	-5.50e-01	-5.97e-01
AW-05	0	0	3.90	-2.07e-01	0.995	-1.62e-01	-3.22e-01	-8.75e-01
AW-19	0	0	1.58	-6.37e-02	0.411	-5.13e-01	-1.10e+00	-1.75e+00
AW-21	0	0	2.40	0.373	0.603	-8.62e-01	-1.95e+00	-1.10e+00
AP07S	0	0	0	0	0	0	0	-2.50e+00
AP07S	0	0	0	0	-6.45e-01	0	0	-3.24e+00
AW-15S	0	0	0	0	0	0	0	-2.20e+00
AW-15S	0	0	0	0	-1.79e-01	0	0	-2.91e+00
AW-05	0	0	0	0	0	0	0	-2.09e+00
AW-05	0	0	0	0	0	0	0	-2.78e+00
AW-19	0	0	0	0	-8.79e-02	0	0	-2.61e+00
AW-19	0	0	0	0	-4.49e-01	0	0	-2.99e+00
AW-21	0	0	0	0	0	0	0	-1.80e+00
AW-21	0	0	0	0	0	0	0	-2.73e+00
AP07S	0	0	1.90	-9.59e-02	0.768	-2.14e-01	-5.52e-01	-8.61e-01
AW-15S	0	0	0.898	0.969	0.869	-1.75e-01	-5.50e-01	-5.97e-01
AW-05	0	0	3.90	-2.07e-01	0.995	-1.62e-01	-3.22e-01	-8.75e-01
AW-19	0	0	1.58	-6.37e-02	0.411	-5.13e-01	-1.10e+00	-1.75e+00
AW-21	0	0	2.40	0.373	0.603	-8.62e-01	-1.95e+00	-1.10e+00
AP07S	0	0	1.90	-9.59e-02	0.768	-2.14e-01	-5.52e-01	-8.61e-01
AW-15S	0	0	0.898	0.969	0.869	-1.75e-01	-5.50e-01	-5.97e-01
AW-05	0	0	3.90	-2.07e-01	0.995	-1.62e-01	-3.22e-01	-8.75e-01
AW-19	0	0	1.58	-6.37e-02	0.411	-5.13e-01	-1.10e+00	-1.75e+00
AW-21	0	0	2.40	0.373	0.603	-8.62e-01	-1.95e+00	-1.10e+00
AP07S	0	0	0	0	-5.46e-02	0	0	-2.60e+00
AP07S	0	0	0	0	-8.20e-01	0	0	-3.37e+00
AW-15S	0	0	0	0	0	0	0	-2.30e+00
AW-15S	0	0	0	0	-3.44e-01	0	0	-3.04e+00
AW-05	0	0	0	0	0	0	0	-2.13e+00
AW-05	0	0	0	0	-7.53e-02	0	0	-2.85e+00
AW-19	0	0	0	0	-1.25e-01	0	0	-2.65e+00
AW-19	0	0	0	0	-5.07e-01	0	0	-3.05e+00
AW-21	0	0	0	0	0	0	0	-1.82e+00
AW-21	0	0	0	0	0	0	0	-2.79e+00

NOTES:
All model results are
pH and pe (standar
charge (equivalents
Results beginning w
Results beginning w

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ATTACHMENT E

ATTACHMENT E. SENSITIVITY TESTING PARAMETERIZATION AND MODEL OUTPUT

INTRODUCTION

This attachment to the Groundwater Polishing Report for the Edwards Power Plant Ash Pond (EDW AP) provides detailed information regarding the results of sensitivity testing. The background groundwater at the EDW AP has a lower redox condition (represented by oxidation reduction potential [ORP]) than downgradient groundwater but a higher redox than is typical for water containing highly reduced species such as methane and hydrogen sulfide. Return to background conditions may thus result in more reduced conditions downgradient than indicated by the measured ORP alone, which may influence the long-term stability of attenuating mineral phases, ferrihydrite in particular, and thus, the long-term sorption capacity of the aquifer. Sensitivity testing was conducted to assess the impact of more chemically reduced redox condition on aquifer sorption capacity.

SUPPLEMENTAL SENSITIVITY TESTING

Additional modeling was conducted using the solid and aqueous phase setup described in Attachment C. A chemically reduced redox condition was simulated using a constant redox potential (input to geochemical model as electron potential [pe]) in two downgradient locations with boron exceedances (AP07S and AW-15S) and running ten reaction steps. As described in Attachment C, the solid surfaces were initially reacted with downgradient water from AP07S and AW-15S, respectively, then interacted with background groundwater at constant (reducing) pe for the remaining reaction steps. This was repeated for a pe equal to background conditions (pe=1.11), and for subsequently lower pe (-1, -2, and -3). The lower pe scenarios are tested to account for redox conditions typically indicative of the highly reduced species methane and hydrogen sulfide, both of which have been detected in the deeper groundwater and background groundwater. Results are presented in Table E-1.

BASE CASE RESULTS

In simulations where the model pe was fixed at measured background levels (pe=1.11), ferrihydrite concentrations increased, indicating minor amounts of mineral precipitation, while gibbsite concentrations decreased slightly. Sulfate concentrations are below the groundwater protection standard (GWPS) during the first reaction and remain so for the subsequent simulations. Boron concentrations fall below the GWPS during the second and third reaction steps for AW-15S and AP07S, respectively, and remain so for the subsequent simulations. This indicates that pe conditions similar to measured background will not influence the long-term mineral stability and will likely not impact the time to reach the GWPS for both sulfate and boron.

SUPPLEMENTAL SENSITIVITY TEST RESULTS

In the remaining scenarios where the pe is moderately to strongly reducing, ferrihydrite concentrations decrease, with more dissolution occurring at subsequently lower pe conditions. Gibbsite concentrations do not change. In all scenarios, sulfate concentrations are well below the GWPS during the first reaction and remain so for all simulations. Boron concentrations, however, take longer to reach the GWPS. For AP07S boron does not reach the GWPS until reaction step four, five, and eight for pe -1, -2, and -3 scenarios, respectively. For AW-15S, boron reaches the GWPS in reaction step three for pe conditions -1 and -2 and

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reaction step five for pe condition -3. This is likely indicating that boron sorbed to ferrihydrite is released as ferrihydrite dissolution is occurring.

While these scenarios simulate a pe condition not currently observed in the background groundwaters, the presence of highly reduced species indicates extremely reducing conditions may be possible. This highly reduced condition is therefore identified as a potential future condition, which could elongate the time to reach the GWPS. The probability of this occurring is, however, considered to be relatively low, as a redox condition as low as that modeled in the supplemental sensitivity has not been directly measured in the background groundwater. Future groundwater monitoring should include the redox condition, with primary emphasis on redox indicators including ORP, dissolved oxygen, dissolved iron and manganese, sulfide, and methane concentrations.

REFERENCES

Appelo C.A.J. and Postma D. 2010. Geochemistry, Groundwater, and Pollution. 2nd Edition. A.A. Balkema Publishers, member of Taylor & Francis Group. The Netherlands.

Dzombak D.A. and Morel F.M.M. 1990. Surface Complexation Modeling: Hydrous Ferric Oxide. John Wiley & Sons, New York.

Goldberg S. and Glaubig R.A. 1985. Boron Adsorption on Aluminum and Iron Oxide Minerals. *Soil Science Society of America Journal* **49**(6):1374-1379.

Karamalidis A.K. and Dzombak D.A. 2010. Surface Complexation Modeling: Gibbsite. John Wiley & Sons, New York.

Kitadai N., Nishiuchi K, and Tanaka M. 2018. A comprehensive predictive model for sulfate adsorption on oxide minerals. *Geochimica et Cosmochimica Acta* **238**:150-168.

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729 Main Street, Longmont, CO 80501 720.550.0745 contact@lifecyclegeo.com www.lifecyclegeo.com

APPENDIX B
DRAWINGS AND MATERIALS SPECIFICATIONS FOR SELECTED REMEDY

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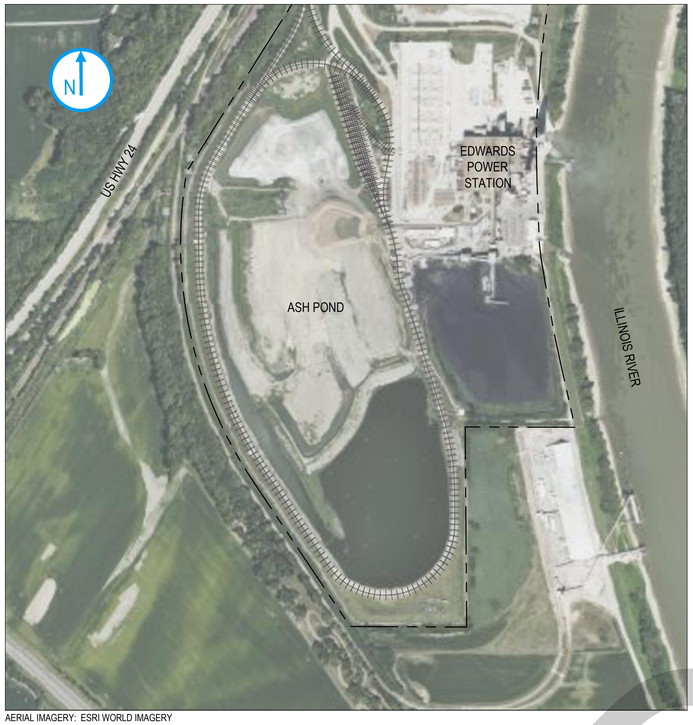
CORRECTIVE ACTION PLAN PERMIT-LEVEL DESIGN

Ash Pond

Edwards Power Plant, Bartonville, Illinois



AERIAL IMAGERY: ESRI WORLD IMAGERY

LOCATION MAP

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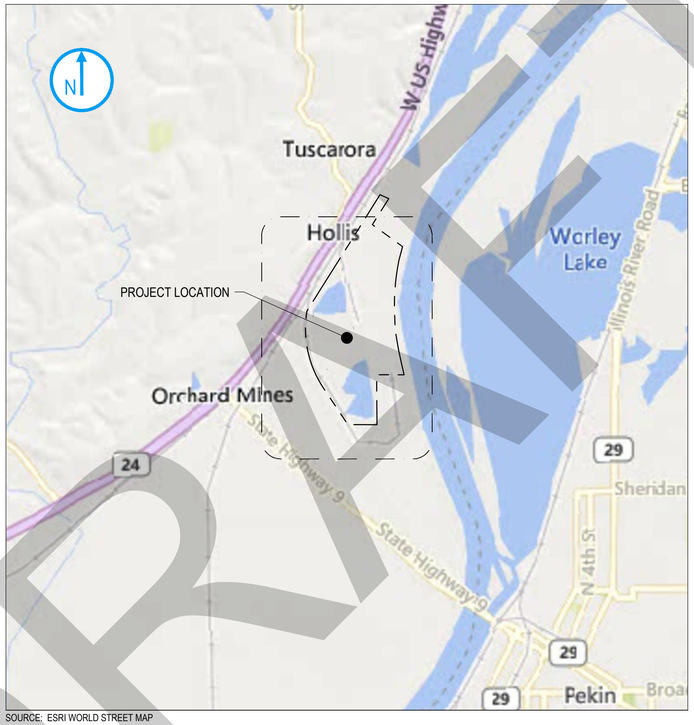
SCALE: 1"=500'



SOURCE: ESRI WORLD STREET MAP

VICINITY MAP

2000' 0 2000'

SCALE: 1"=2000'

SHEET INDEX

General	
G-000	Cover
Civil	
C-101	Overall Site Plan
C-201	North Groundwater Extraction Trench Enlarged Plan and Profile 1
C-202	North Groundwater Extraction Trench Enlarged Plan and Profile 2
C-203	North Groundwater Extraction Trench Typical Sections
C-301	South Groundwater Extraction Trench Enlarged Plan and Profile
C-302	South Groundwater Extraction Trench Typical Sections
C-401	Compressor Shed Detail
C-501	Trench and Collection Sump Detail
Process Mechanical	
P-001	System Process Flow Diagram

Illinois Power Resources Generating, LLC (IPRG)

Edwards Power Plant

7800 Cilco Lane

Peoria, IL 61607

April 2025

RAMBOLL

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

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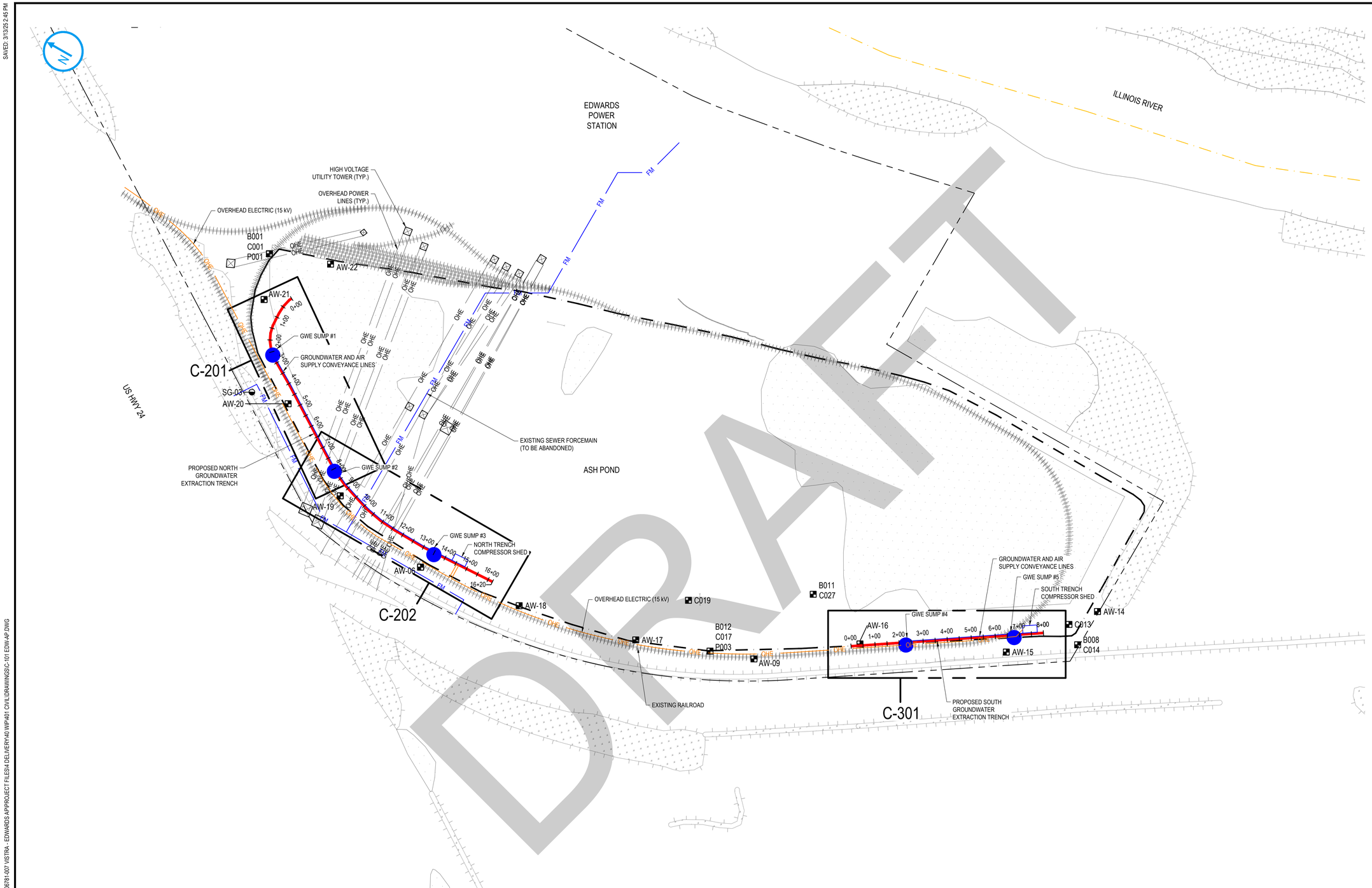

LEGEND

EXISTING

- APPROXIMATE SITE BOUNDARY
- APPROXIMATE LIMITS OF CCR UNITS
- WETLANDS
- BODY OF WATER (LAKE, POND, RAVINE, ETC.)
- RAILROAD
- FM — SEWER - FORCEMAIN
- OHE — OVERHEAD ELECTRIC
- HIGH VOLTAGE UTILITY TOWER
- STORMDRAIN, AND CULVERT
- BORING

PROPOSED

- GROUNDWATER EXTRACTION TRENCH
- GROUNDWATER EXTRACTION SUMP
- GROUNDWATER AND AIR SUPPLY CONVEYANCE LINES
- OHE — OVERHEAD ELECTRIC
- STRUCTURE

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NOTE:
1. EXISTING TOPOGRAPHY IS FROM AERIAL DRONE SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 12/01/2020 AND TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/09/2020.
2. SEWER FORCEMAIN LOCATION TAKEN FROM SANITARY SEWER FORCE MAIN PLAN DRAWING NUMBER CSK-010 DATED 2/19/07.
3. UTILITY TOWER LOCATIONS ARE APPROXIMATE.
4. TRENCHES TO BE INSTALLED DURING CLOSURE CONSTRUCTION. CLOSE COORDINATION WITH CLOSURE CONSTRUCTION IS REQUIRED FOR SEQUENCING TRENCH INSTALLATION WITH COVER CONSTRUCTION.
5. WETLANDS REPRESENTED AS PER ILLINOIS NATIONAL WETLANDS INVENTORY AND PER CREEK SURVEY DRAWINGS COMPLETED BY INGENAE, FEBRUARY 2022.

OVERALL SITE PLAN

200' 0 200'

SCALE: 1"=200'

PERMIT-LEVEL DESIGN NOT FOR CONSTRUCTION

DATE: ----

NO.	REV DATE	REVISION	INT.

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Project Details: **ILLINOIS POWER RESOURCES GENERATING, LLC (IPRG)** Edwards Power Plant 7800 Cilco Lane Peoria, IL 61607	Drawing Title: **OVERALL SITE PLAN**					RAMBOLL **RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.**
Location: Ash Pond	Designer / Professional Engineer Responsible: B. RICHTER					
Project Number: **1940106781-007**	Designed by: F. ACKERMAN	Drawn by: B. LEMMON	Checked by: B. RICHTER	Approved by: L. CARR	Date: April 2025	
Project Status: Corrective Action Plan Permit-Level Design	Drawing Number: **C-101**			Scale: AS NOTED	Sc: x	Rev.: x

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PLAN VIEW

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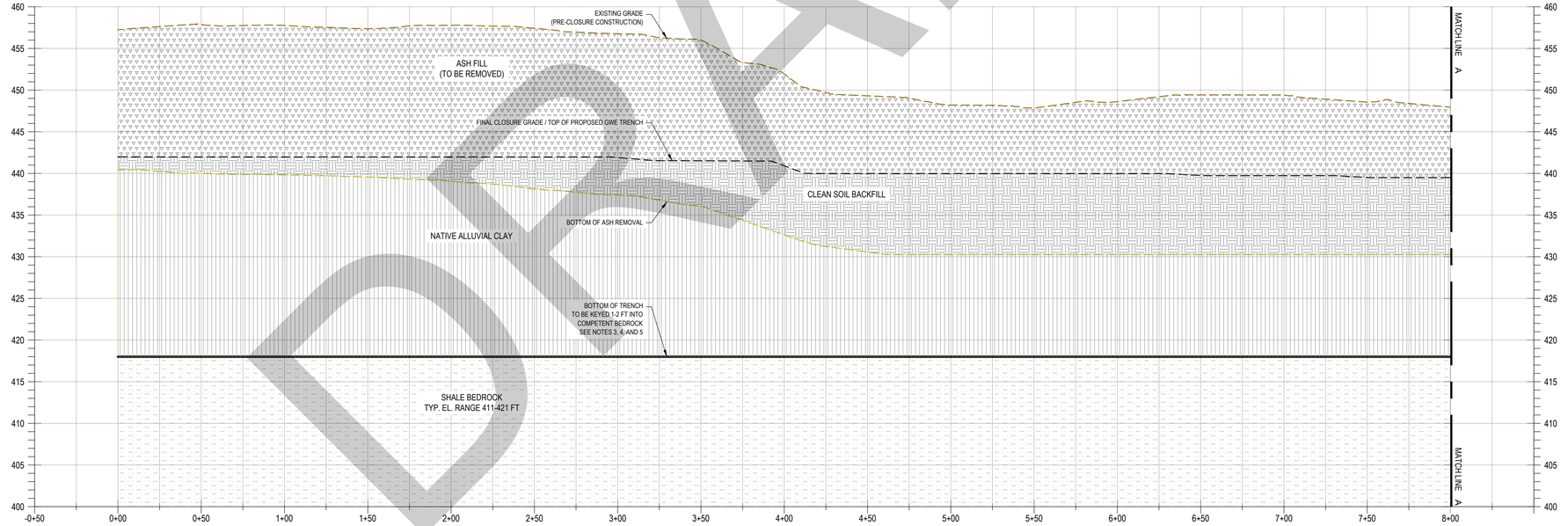
SCALE: 1"=40'



PROFILE STATION 0+00 TO 8+00

40' 0 40'

SCALE HORZ. 1" = 40'

8' 0 8'

SCALE: VERT. 1"=8'

LEGEND

EXISTING

- 360 — MAJOR CONTOUR
- 358 — MINOR CONTOUR
- APPROXIMATE SITE BOUNDARY
- RAILROAD
- FM — SEWER - FORCEMAIN
- OHE — OVERHEAD ELECTRIC
- HIGH VOLTAGE UTILITY TOWER
- STORMDRAIN, AND CULVERT
- BORING

PROPOSED

- GROUNDWATER EXTRACTION TRENCH
- GROUNDWATER EXTRACTION SUMP
- GROUNDWATER AND AIR SUPPLY CONVEYANCE LINES
- OHE — OVERHEAD ELECTRIC
- STRUCTURE
- X / C-000 — NON-TRENCH DETAIL
- X / C-000 — TRENCH SECTION DETAIL

NOTES:

1. THE NORTHERN EXTRACTION TRENCH WILL:
   a. HAVE A THICKNESS OF 2 TO 3 FEET
   b. RANGE IN DEPTH FROM 21 TO 31 FEET BELOW GROUND SURFACE
   c. BE KEYED 1-2 FT INTO BEDROCK, AS DETERMINED BY THE OBSERVATIONS OBTAINED DURING TRENCH INSTALLATION
   d. BE BACKFILLED WITH HIGH PERMEABILITY MATERIALS
   e. HAVE PERFORATED GROUNDWATER COLLECTION PIPE LAID IN THE TRENCH BASE AT AN APPROXIMATE 0.5 to 2% GRADE TO SLOPE TOWARDS THE COLLECTION SUMPS
   f. HAVE A TOTAL OF 3 COLLECTION SUMPS INSTALLED AT 300 TO 500 FOOT CENTERS
2. COLLECTION SUMPS WILL CONSIST OF A PIT TO HOLD EXTRACTED WATER, A PNEUMATIC PUMP AND A DISCHARGE PIPE THAT WILL CARRY EXTRACTED WATER TO AN EQUALIZATION TANK INTO A NEARBY COMPRESSOR SHED.
3. ALL SUBSURFACE MATERIAL INTERFACES ARE APPROXIMATE AND ARE BASED ON THE INTERPOLATION OF AVAILABLE INVESTIGATION DATA. ADDITIONAL SUBSURFACE INVESTIGATIONS WILL BE ADVANCED ALONG THE TRENCH PROFILES AS PART OF FUTURE PRE-DESIGN INVESTIGATION ACTIVITIES TO VERIFY MATERIAL INTERFACES AND REFINE THE DESIGN PROFILE.
4. THE EXTRACTION TRENCH DESIGN WILL BE FURTHER REFINED AS PART OF FINAL DESIGN ACTIVITIES THAT WILL BE INITIATED AFTER A CORRECTIVE ACTION CONSTRUCTION PERMIT HAS BEEN ISSUED FOR THE ASH POND. THESE ACTIVITIES MAY INCLUDE, BUT ARE NOT LIMITED TO, THE COLLECTION OF ADDITIONAL SITE SURVEY AND/OR SUBSURFACE INVESTIGATION DATA, ADDITIONAL REFINED DESIGN EVALUATIONS, ADDITIONAL ENGINEERING ANALYSES, AND/OR PERMIT-RELATED CONSIDERATIONS. ELEMENTS OF THE EXTRACTION TRENCH DESIGN THAT WILL BE REFINED INCLUDE, BUT ARE NOT LIMITED TO, THE LIMITS OF DISTURBANCE, LIMITS OF THE FINAL COVER SYSTEM, TIE-IN DETAILS BETWEEN THE FINAL CLOSURE DESIGN AND THE EXTRACTION TRENCHES, TIE-IN DETAILS BETWEEN THE EXTRACTION TRENCHES AND STORMWATER MANAGEMENT FEATURES, AND THE EXTENT OF THE EXTRACTION TRENCHES.
5. FINAL DESIGN AND CONSTRUCTION OF THE PROPOSED GWE TRENCHES AND ASSOCIATED APPURTENANT STRUCTURES AND INFRASTRUCTURE WILL BE CLOSELY COORDINATED WITH THE AP CLOSURE CONSTRUCTION.

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PERMIT-LEVEL DESIGN
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Project Details: **ILLINOIS POWER RESOURCES GENERATING, LLC (IPRG)** Edwards Power Plant 7800 Cilco Lane Peoria, IL 61607	Drawing Title: **NORTH GROUNDWATER EXTRACTION TRENCH ENLARGED PLAN AND PROFILE 1**					RAMBOLL RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.
Location: Ash Pond	Designer / Professional Engineer Responsible: B. RICHTER					
Project Number: **1940106781-007**	Designed by: F. ACKERMAN	Drawn by: B. LEMMON	Checked by: B. RICHTER	Approved by: L. CARR	Date: April 2025	
Project Status: Corrective Action Plan Permit-Level Design	Drawing Number: **C-201**			Scale: AS NOTED	Sc: x	Rev.: x

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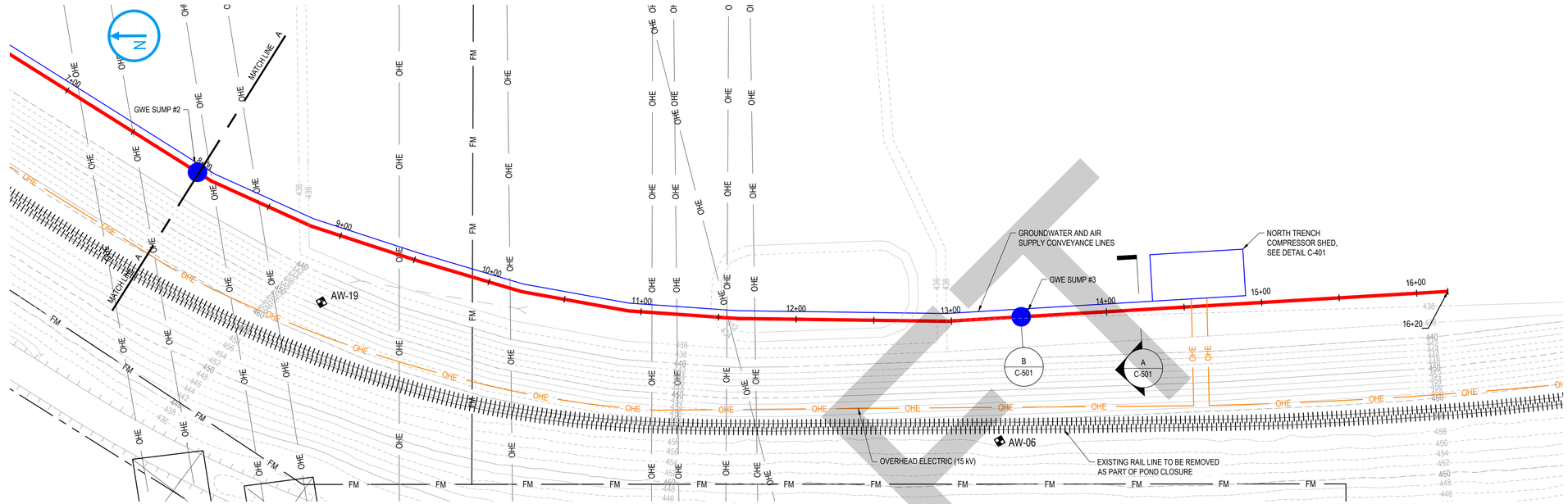

PLAN VIEW

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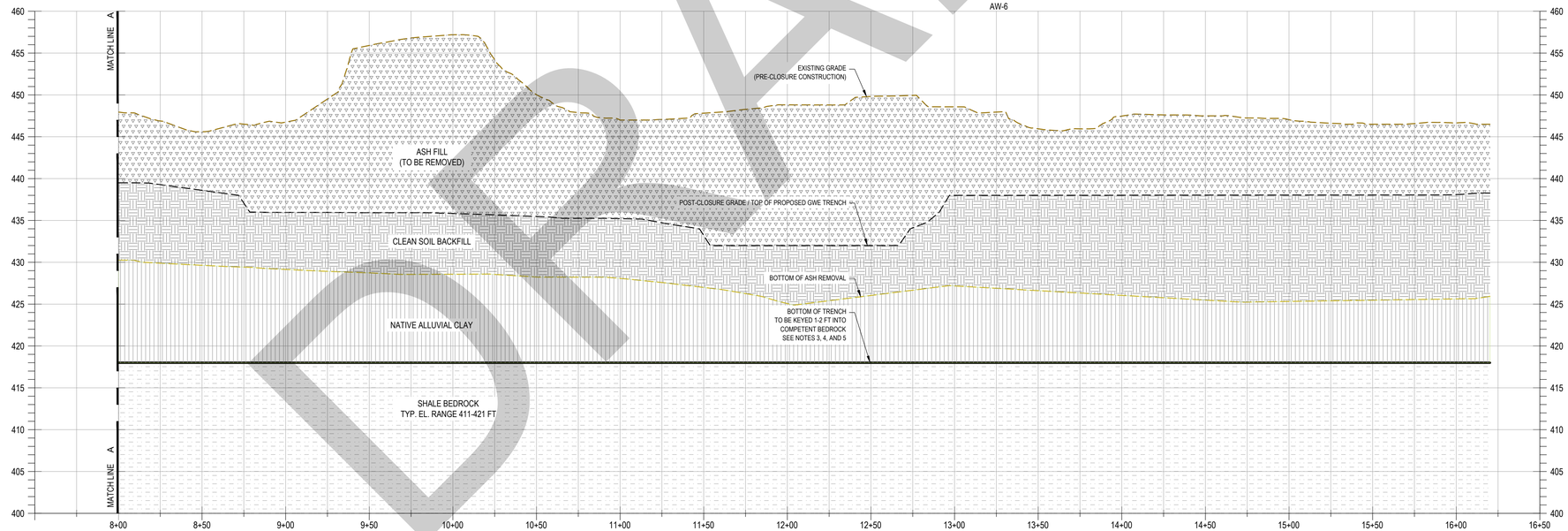
SCALE: 1"=40'



PROFILE STATION 8+00 TO 16+20

40' 0 40'

SCALE HORZ. 1" = 40'

8' 0 8'

SCALE: VERT. 1"=8'

LEGEND

EXISTING

- 360 — MAJOR CONTOUR
- 358 — MINOR CONTOUR
- APPROXIMATE SITE BOUNDARY
- RAILROAD
- FM — SEWER - FORCEMAIN
- OHE — OVERHEAD ELECTRIC
- HIGH VOLTAGE UTILITY TOWER
- STORMDRAIN, AND CULVERT
- BORING

PROPOSED

- GROUNDWATER EXTRACTION TRENCH
- GROUNDWATER EXTRACTION SUMP
- GROUNDWATER AND AIR SUPPLY CONVEYANCE LINES
- OHE — OVERHEAD ELECTRIC
- STRUCTURE
- X / C-000 — NON-TRENCH DETAIL
- X / C-000 — TRENCH SECTION DETAIL

NOTES:

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   a. HAVE A THICKNESS OF 2 TO 3 FEET
   b. RANGE IN DEPTH FROM 20 TO 25 FEET BELOW GROUND SURFACE
   c. BE KEYED 1-2 FT INTO BEDROCK, AS DETERMINED BY THE OBSERVATIONS OBTAINED DURING TRENCH INSTALLATION
   d. BE BACKFILLED WITH HIGH PERMEABILITY MATERIALS
   e. HAVE PERFORATED GROUNDWATER COLLECTION PIPE LAID IN THE TRENCH BASE AT AN APPROXIMATE 0.5 to 2% GRADE TO SLOPE TOWARDS THE COLLECTION SUMPS
   f. HAVE A TOTAL OF 3 COLLECTION SUMPS INSTALLED AT 300 TO 500 FOOT CENTERS
2. COLLECTION SUMPS WILL CONSIST OF A PIT TO HOLD EXTRACTED WATER, A PNEUMATIC PUMP AND A DISCHARGE PIPE THAT WILL CARRY EXTRACTED WATER TO AN EQUALIZATION TANK INTO A NEARBY COMPRESSOR SHED.
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DATE: ----

NO.	REV DATE	REVISION	INT.

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Project Details: **ILLINOIS POWER RESOURCES GENERATING, LLC (IPRG)** Edwards Power Plant 7800 Cilco Lane Peoria, IL 61607	Drawing Title: **NORTH GROUNDWATER EXTRACTION TRENCH ENLARGED PLAN AND PROFILE 2**				RAMBOLL **RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.**	
Location: Ash Pond	Designer / Professional Engineer Responsible: B. RICHTER					
Project Number **1940106781-007**	Designed by F. ACKERMAN	Drawn by B. LEMMON	Checked by B. RICHTER	Approved by L. CARR	Date April 2025	
Project Status: Corrective Action Plan Permit-Level Design	Drawing Number **C-202**			Scale AS NOTED	Sc x	Rev. x

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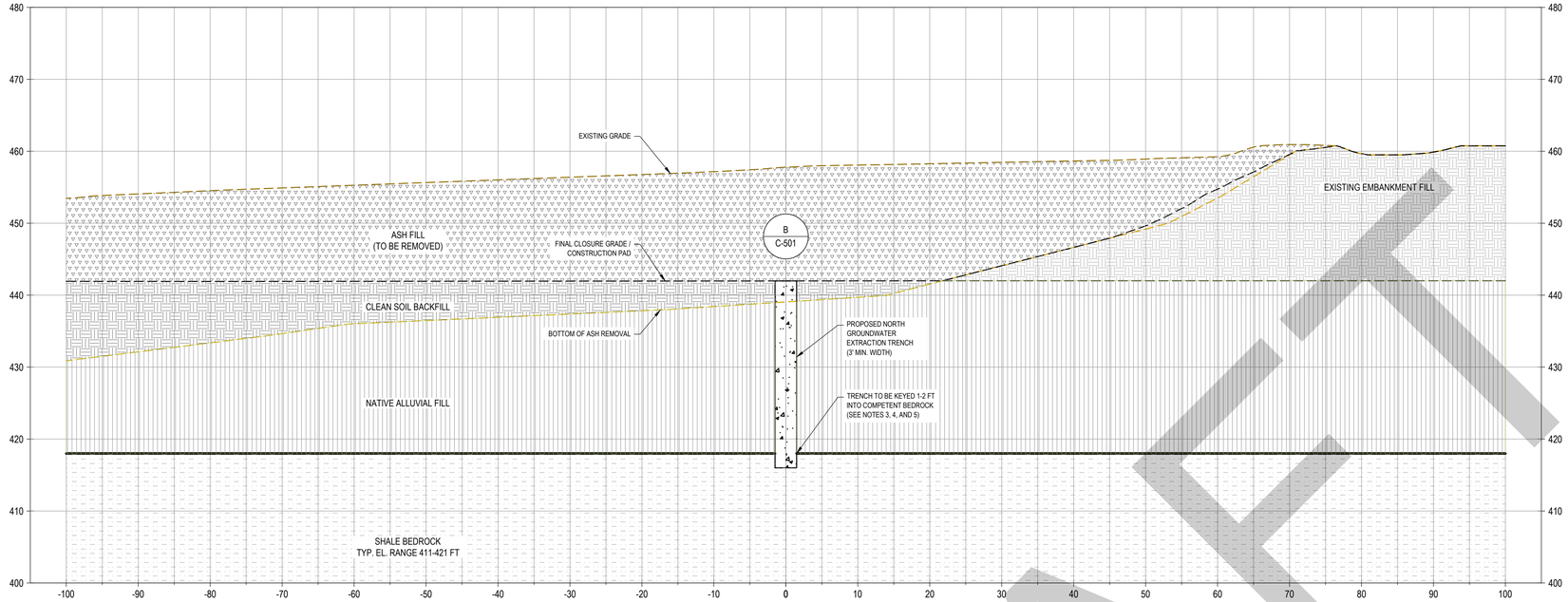

TYPICAL SECTION - 0+00 TO 4+00

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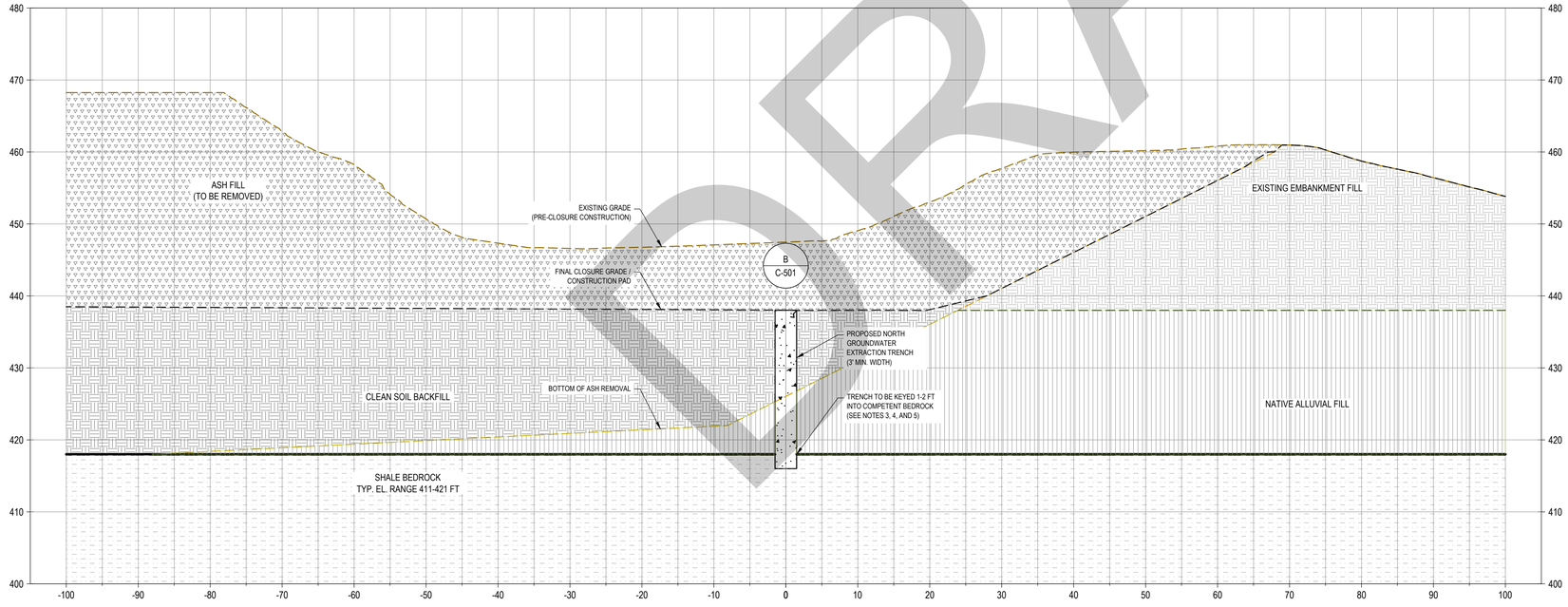
10' 0 10' — SCALE: VERT. 1"=10'



TYPICAL SECTION - 4+00 TO 16+20

10' 0 10' — SCALE HORZ. 1" = 10'

10' 0 10' — SCALE: VERT. 1"=10'

NOTES:

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NO.	REV DATE	REVISION	INT.

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PERMIT-LEVEL DESIGN
NOT FOR CONSTRUCTION

DATE: ----

Project Details: **ILLINOIS POWER RESOURCES GENERATING, LLC (IPRG)** Edwards Power Plant 7800 Cilco Lane Peoria, IL 61607	Drawing Title: **NORTH GROUNDWATER EXTRACTION TRENCH TYPICAL SECTIONS**				RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.
Location: Ash Pond	Designer / Professional Engineer Responsible: B. RICHTER				
Project Number: **1940106781-007**	Designed by: F. ACKERMAN	Drawn by: B. LEMMON	Checked by: B. RICHTER	Approved by: L. CARR	Date: April 2025
Project Status: Corrective Action Plan Permit-Level Design	Drawing Number: **C-203**			Scale: AS NOTED	Sc: X / Rev: X

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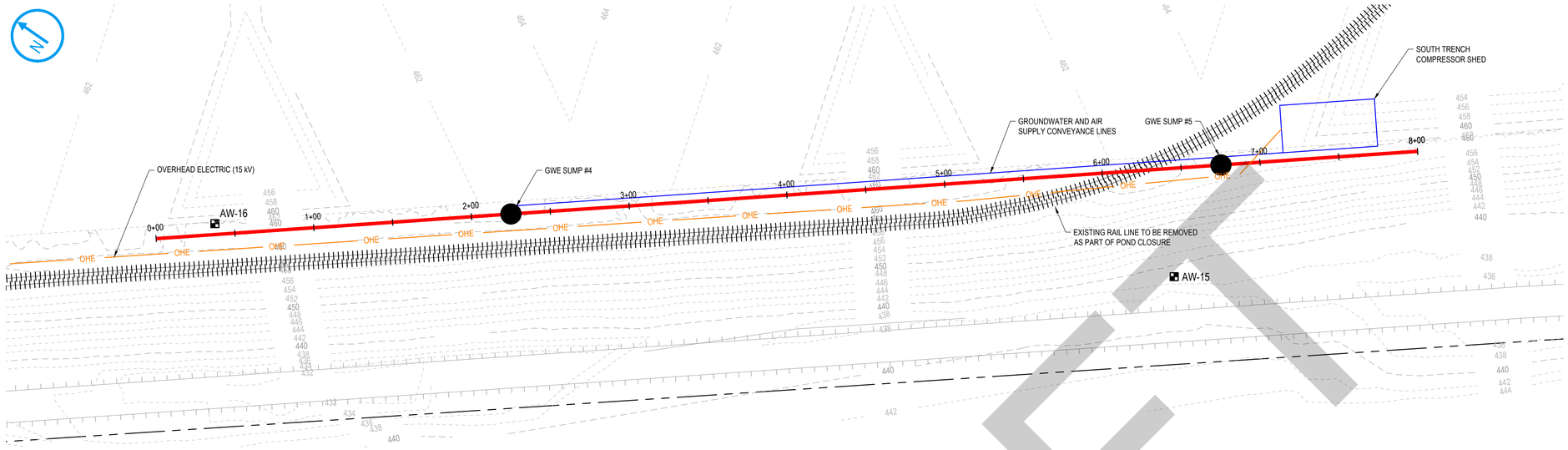
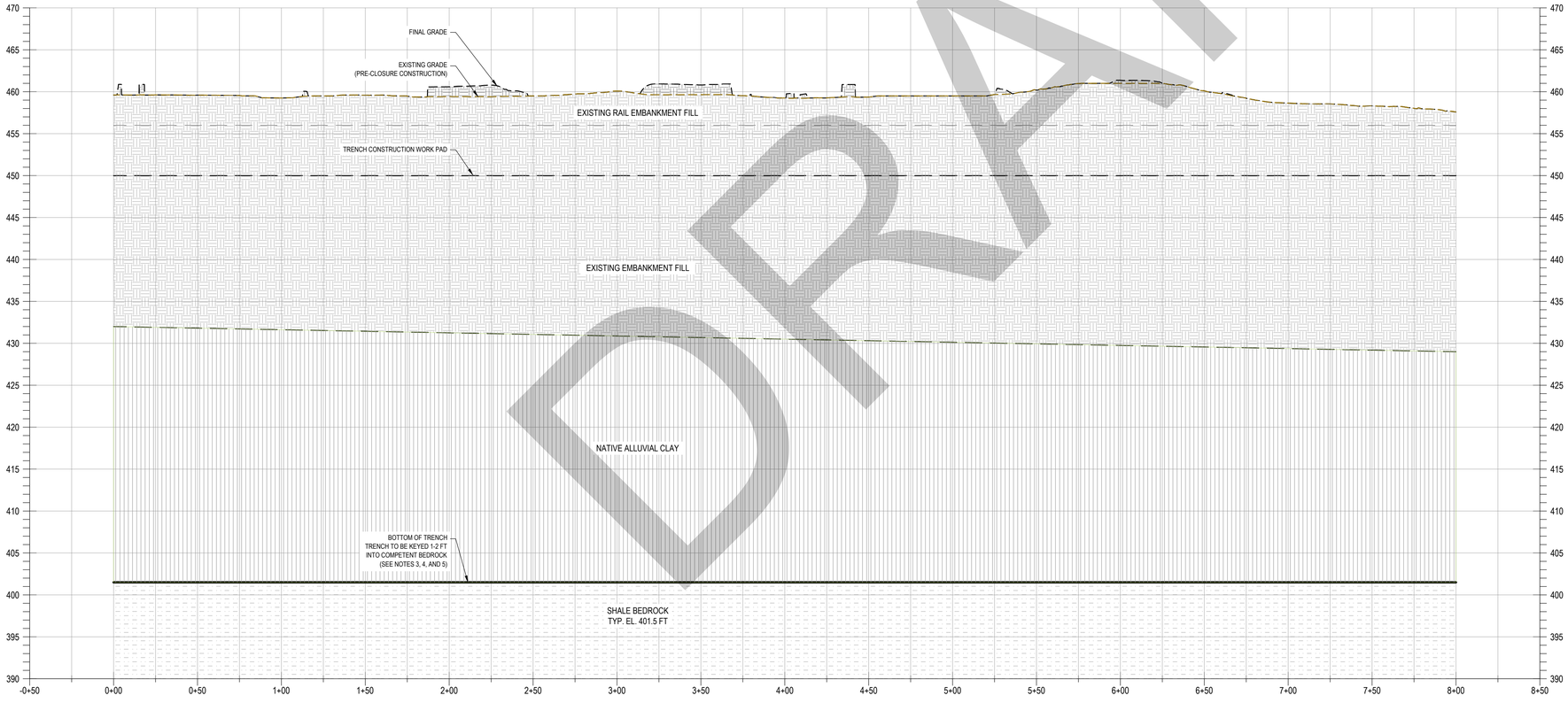


PLAN VIEW

40' 0 40'

SCALE: 1"=40'



PROFILE STATION 0+00 TO 8+00

40' 0 40'

SCALE HORZ. 1" = 40'

8' 0 8'

SCALE: VERT. 1"=8'

NOTES:

1. FINAL EMBANKMENT CONFIGURATION MUST BE COORDINATED WITH THE CLOSURE CONSTRUCTION CONTRACTOR.

LEGEND

EXISTING

- 360 — MAJOR CONTOUR
- 358 — MINOR CONTOUR
- APPROXIMATE SITE BOUNDARY
- RAILROAD
- FM — SEWER - FORCEMAIN
- OHE — OVERHEAD ELECTRIC
- HIGH VOLTAGE UTILITY TOWER
- STORMDRAIN, AND CULVERT
- BORING

PROPOSED

- GROUNDWATER EXTRACTION TRENCH
- GROUNDWATER EXTRACTION SUMP
- GROUNDWATER AND AIR SUPPLY CONVEYANCE LINES
- OHE — OVERHEAD ELECTRIC
- STRUCTURE
- X / C-000 — NON-TRENCH DETAIL
- X / C-000 — TRENCH SECTION DETAIL

NOTES:

1. THE NORTHERN EXTRACTION TRENCH WILL:
   a. HAVE A THICKNESS OF 2 TO 3 FEET
   b. DEPTH OF APPROXIMATELY 50 FEET BELOW GROUND SURFACE
   c. BE KEYED 1-2 FT INTO BEDROCK, AS DETERMINED BY THE OBSERVATIONS OBTAINED DURING TRENCH INSTALLATION
   d. BE BACKFILLED WITH HIGH PERMEABILITY MATERIALS
   e. HAVE PERFORATED GROUNDWATER COLLECTION PIPE LAID IN THE TRENCH BASE AT AN APPROXIMATE 0.5 to 2% GRADE TO SLOPE TOWARDS THE COLLECTION SUMPS
   f. HAVE A TOTAL OF 2 COLLECTION SUMPS INSTALLED AT 200 TO 500 FOOT CENTERS
2. COLLECTION SUMPS WILL CONSIST OF A PIT TO HOLD EXTRACTED WATER, A PNEUMATIC PUMP AND A DISCHARGE PIPE THAT WILL CARRY EXTRACTED WATER TO AN EQUALIZATION TANK INTO A NEARBY COMPRESSOR SHED.
3. ALL SUBSURFACE MATERIAL INTERFACES ARE APPROXIMATE AND ARE BASED ON THE INTERPOLATION OF AVAILABLE INVESTIGATION DATA. ADDITIONAL SUBSURFACE INVESTIGATIONS WILL BE ADVANCED ALONG THE TRENCH PROFILES AS PART OF FUTURE PRE-DESIGN INVESTIGATION ACTIVITIES TO VERIFY MATERIAL INTERFACES AND REFINE THE DESIGN PROFILE.
4. THE EXTRACTION TRENCH DESIGN WILL BE FURTHER REFINED AS PART OF FINAL DESIGN ACTIVITIES THAT WILL BE INITIATED AFTER A CORRECTIVE ACTION CONSTRUCTION PERMIT HAS BEEN ISSUED FOR THE ASH POND. THESE ACTIVITIES MAY INCLUDE, BUT ARE NOT LIMITED TO, THE COLLECTION OF ADDITIONAL SITE SURVEY AND/OR SUBSURFACE INVESTIGATION DATA, ADDITIONAL REFINED DESIGN EVALUATIONS, ADDITIONAL ENGINEERING ANALYSES, AND/OR PERMIT-RELATED CONSIDERATIONS. ELEMENTS OF THE EXTRACTION TRENCH DESIGN THAT WILL BE REFINED INCLUDE, BUT ARE NOT LIMITED TO, THE LIMITS OF DISTURBANCE, LIMITS OF THE FINAL COVER SYSTEM, TIE-IN DETAILS BETWEEN THE FINAL CLOSURE DESIGN AND THE EXTRACTION TRENCHES, TIE-IN DETAILS BETWEEN THE EXTRACTION TRENCHES AND STORMWATER MANAGEMENT FEATURES, AND THE EXTENT OF THE EXTRACTION TRENCHES.
5. FINAL DESIGN AND CONSTRUCTION OF THE PROPOSED GWE TRENCHES AND ASSOCIATED APPURTENANT STRUCTURES AND INFRASTRUCTURE WILL BE CLOSELY COORDINATED WITH THE AP CLOSURE CONSTRUCTION.

PERMIT-LEVEL DESIGN NOT FOR CONSTRUCTION

DATE: ----

NO.	REV DATE	REVISION	INT.

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Project Details: **ILLINOIS POWER RESOURCES GENERATING, LLC (IPRG)** Edwards Power Plant 7800 Cilco Lane Peoria, IL 61607	Drawing Title: **SOUTH GROUNDWATER EXTRACTION TRENCH ENLARGED PLAN AND PROFILE**				RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.
Location: Ash Pond	Designer / Professional Engineer Responsible: B. RICHTER				
Project Number: **1940106781-007**	Designed by: F. ACKERMAN	Drawn by: B. LEMMON	Checked by: B. RICHTER	Approved by: L. CARR	Date: April 2025
Project Status: Corrective Action Plan Permit-Level Design	Drawing Number: **C-301**			Scale: AS NOTED	Sc: X / Rev.: X

DRAFT

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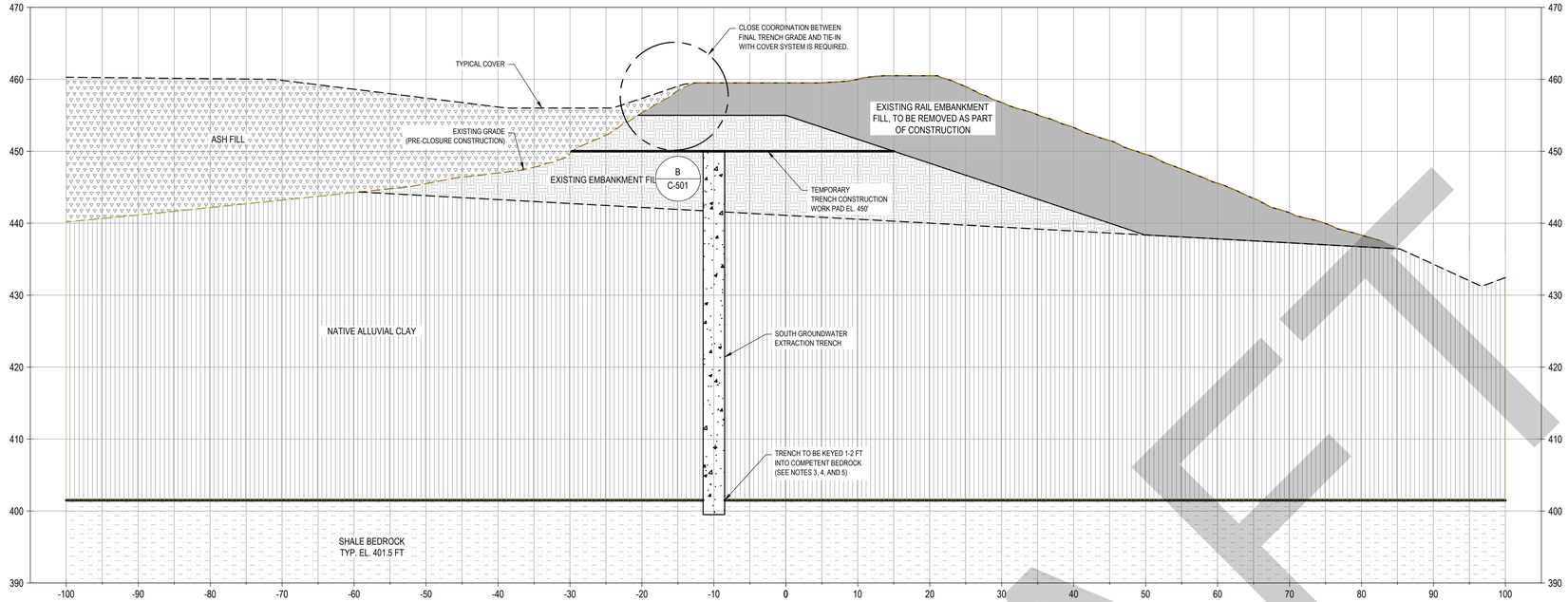
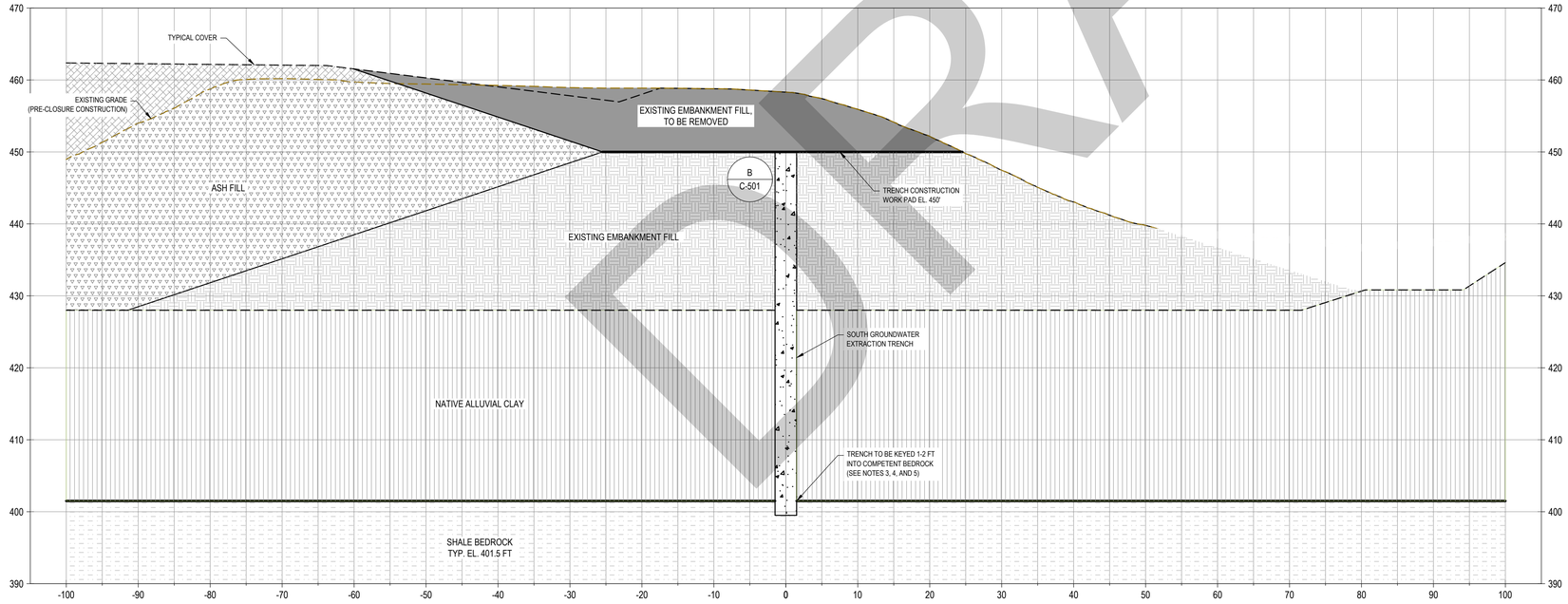
SAVED: 3/28/25 10:25 AM



TYPICAL SECTION - 0+00 TO 5+50

10' 0 10' — SCALE HORZ. 1" = 10'

10' 0 10' — SCALE: VERT. 1"=10'



TYPICAL SECTION - 5+50 TO 8+00

10' 0 10' — SCALE HORZ. 1" = 10'

10' 0 10' — SCALE: VERT. 1"=10'

NOTES:

1. THE NORTHERN EXTRACTION TRENCH WILL:
   a. HAVE A THICKNESS OF 2 TO 3 FEET
   b. DEPTH OF APPROXIMATELY 50 FEET BELOW GROUND SURFACE
   c. BE KEYED 1-2 FT INTO BEDROCK, AS DETERMINED BY THE OBSERVATIONS OBTAINED DURING TRENCH INSTALLATION
   d. BE BACKFILLED WITH HIGH PERMEABILITY MATERIALS
   e. HAVE PERFORATED GROUNDWATER COLLECTION PIPE LAID IN THE TRENCH BASE AT AN APPROXIMATE 0.5 to 2% GRADE TO SLOPE TOWARDS THE COLLECTION SUMPS
   f. HAVE A TOTAL OF 2 COLLECTION SUMPS INSTALLED AT 200 TO 500 FOOT CENTERS
2. COLLECTION SUMPS WILL CONSIST OF A PIT TO HOLD EXTRACTED WATER, A PNEUMATIC PUMP AND A DISCHARGE PIPE THAT WILL CARRY EXTRACTED WATER TO AN EQUALIZATION TANK INTO A NEARBY COMPRESSOR SHED.
3. ALL SUBSURFACE MATERIAL INTERFACES ARE APPROXIMATE AND ARE BASED ON THE INTERPOLATION OF AVAILABLE INVESTIGATION DATA. ADDITIONAL SUBSURFACE INVESTIGATIONS WILL BE ADVANCED ALONG THE TRENCH PROFILES AS PART OF FUTURE PRE-DESIGN INVESTIGATION ACTIVITIES TO VERIFY MATERIAL INTERFACES AND REFINE THE DESIGN PROFILE.
4. THE EXTRACTION TRENCH DESIGN WILL BE FURTHER REFINED AS PART OF FINAL DESIGN ACTIVITIES THAT WILL BE INITIATED AFTER A CORRECTIVE ACTION CONSTRUCTION PERMIT HAS BEEN ISSUED FOR THE ASH POND. THESE ACTIVITIES MAY INCLUDE, BUT ARE NOT LIMITED TO, THE COLLECTION OF ADDITIONAL SITE SURVEY AND/OR SUBSURFACE INVESTIGATION DATA, ADDITIONAL REFINED DESIGN EVALUATIONS, ADDITIONAL ENGINEERING ANALYSES, AND/OR PERMIT-RELATED CONSIDERATIONS. ELEMENTS OF THE EXTRACTION TRENCH DESIGN THAT WILL BE REFINED INCLUDE, BUT ARE NOT LIMITED TO, THE LIMITS OF DISTURBANCE, LIMITS OF THE FINAL COVER SYSTEM, TIE-IN DETAILS BETWEEN THE FINAL CLOSURE DESIGN AND THE EXTRACTION TRENCHES, TIE-IN DETAILS BETWEEN THE EXTRACTION TRENCHES AND STORMWATER MANAGEMENT FEATURES, AND THE EXTENT OF THE EXTRACTION TRENCHES.
5. FINAL DESIGN AND CONSTRUCTION OF THE PROPOSED GWE TRENCHES AND ASSOCIATED APPURTENANT STRUCTURES AND INFRASTRUCTURE WILL BE CLOSELY COORDINATED WITH THE AP CLOSURE CONSTRUCTION.

DRAFT

NO.	REV DATE	REVISION	INT.

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PERMIT-LEVEL DESIGN
NOT FOR CONSTRUCTION

DATE: ----

Project Details: **ILLINOIS POWER RESOURCES GENERATING, LLC (IPRG)** Edwards Power Plant 7800 Cilco Lane Peoria, IL 61607	Drawing Title: **SOUTH GROUNDWATER EXTRACTION TRENCH TYPICAL SECTIONS**				RAMBOLL **RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.**	
Location: Ash Pond	Designer / Professional Engineer Responsible: B. RICHTER					
Project Number **1940106781-007**	Designed by F. ACKERMAN	Drawn by B. LEMMON	Checked by B. RICHTER	Approved by L. CARR	Date April 2025	
Project Status Corrective Action Plan Permit-Level Design	Drawing Number **C-302**			Scale AS NOTED	Sc x	Rev. x

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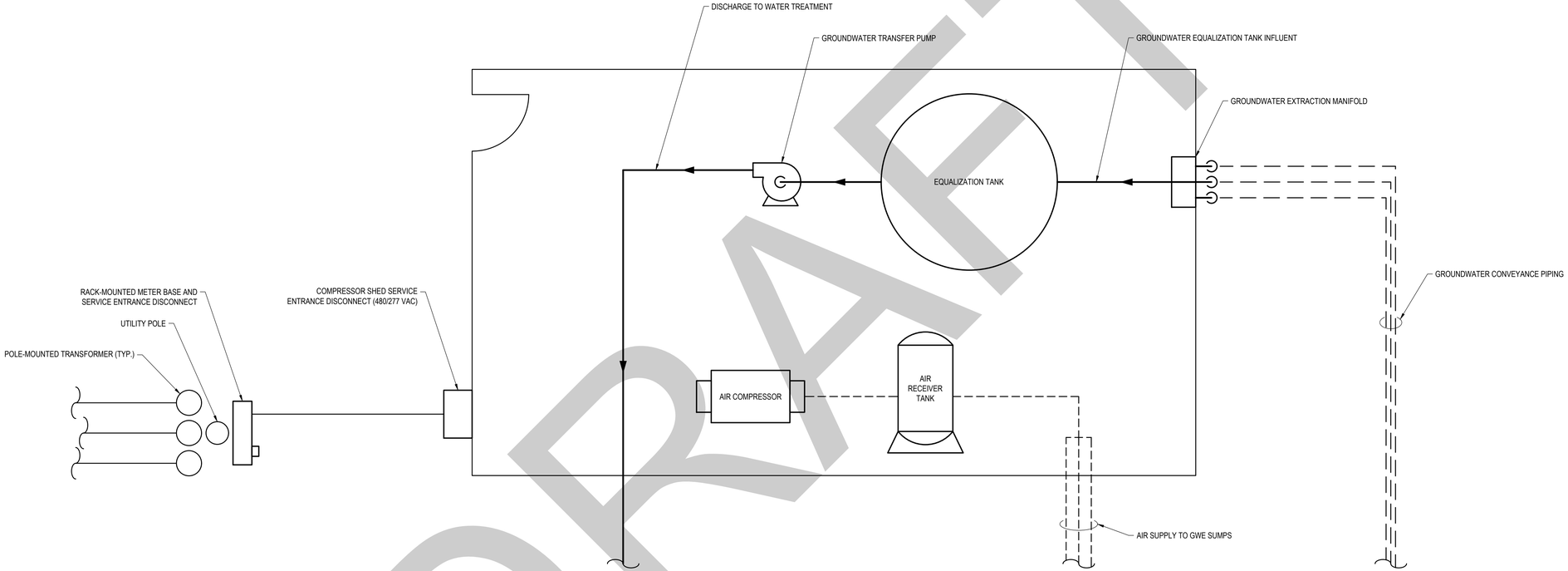
SAVED: 3/13/25 2:52 PM

NOTES:

1. FINAL DESIGN AND CONSTRUCTION OF THE PROPOSED GWE TRENCHES AND ASSOCIATED APPURTENANT STRUCTURES AND INFRASTRUCTURE WILL BE CLOSELY COORDINATED WITH THE AP CLOSURE CONSTRUCTION.



COMPRESSOR SHED DETAIL

NOT TO SCALE

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DATE: ----

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Project Details: **ILLINOIS POWER RESOURCES GENERATING, LLC (IPRG)** Edwards Power Plant 7800 Cilco Lane Peoria, IL 61607	Drawing Title: **COMPRESSOR SHED DETAIL**				RAMBOLL **RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.**	
Location: Ash Pond	Designer / Professional Engineer Responsible: B. RICHTER					
Project Number: **1940106781-007**	Designed by: C. GLIDDEN	Drawn by: B. LEMMON	Checked by: B. RICHTER	Approved by: L. CARR	Date: April 2025	
Project Status: Corrective Action Plan Permit-Level Design	Drawing Number: **C-401**			Scale: AS NOTED	Sc: x	Rev.: x

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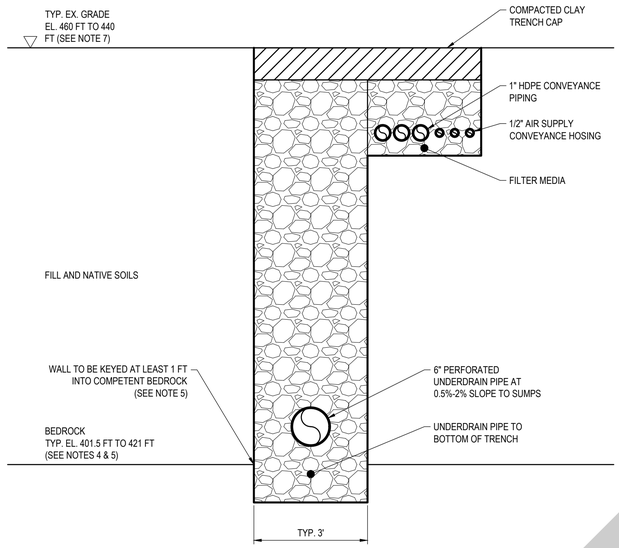
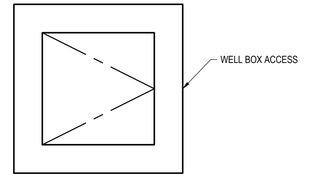
SAVED: 3/28/25 10:30 AM

NOTES:

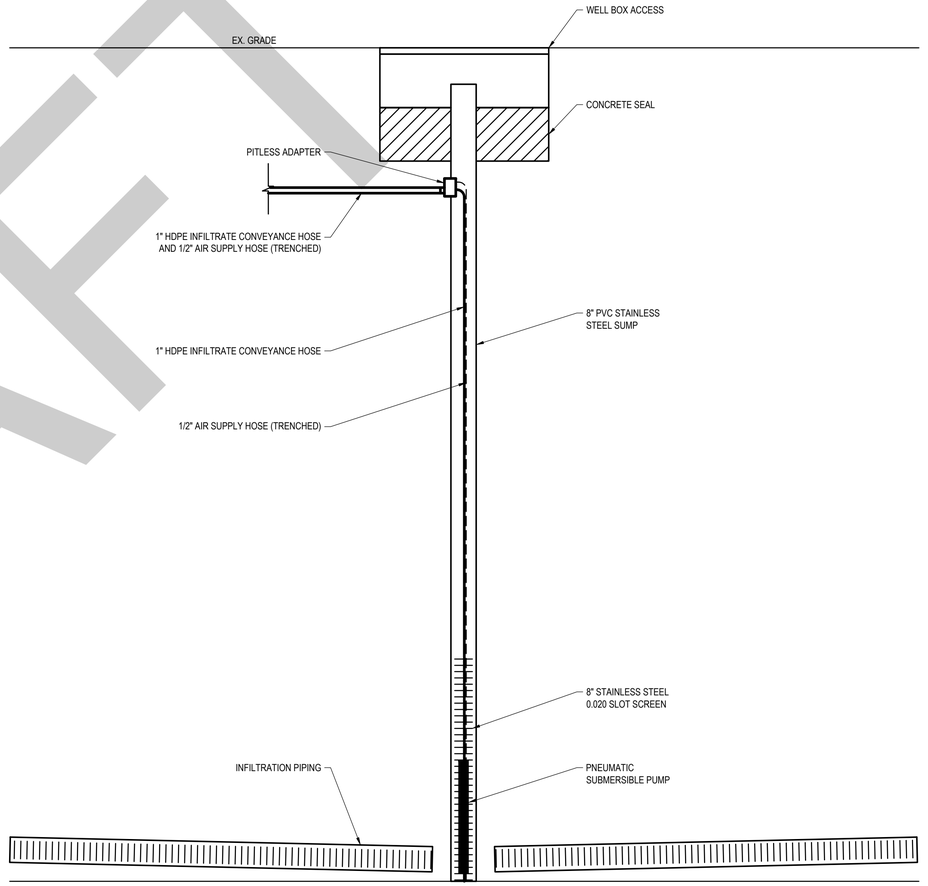
1. THE EXTRACTION TRENCHES WILL HAVE PERFORATED GROUNDWATER COLLECTION PIPE LAID IN THE TRENCH BASE AT AN APPROXIMATE 0.5 to 2% GRADE TO SLOPE TOWARDS THE COLLECTION SUMPS. COLLECTION SUMPS WILL BE INSTALLED AT 200 TO 500 FOOT CENTERS.
2. COLLECTION SUMPS WILL CONSIST OF A PIT TO HOLD EXTRACTED WATER, A PNEUMATIC PUMP AND A DISCHARGE PIPE THAT WILL CARRY EXTRACTED WATER TO AN EQUALIZATION TANK INTO A NEARBY COMPRESSOR SHED.
3. THE FINAL SURFACE COMPLETIONS MUST BE COORDINATED WITH THE CLOSURE CONSTRUCTION DESIGN.
4. ALL SUBSURFACE MATERIAL INTERFACES ARE APPROXIMATE AND ARE BASED ON THE INTERPOLATION OF AVAILABLE INVESTIGATION DATA. ADDITIONAL SUBSURFACE INVESTIGATIONS WILL BE ADVANCED ALONG THE TRENCH PROFILES AS PART OF FUTURE PRE-DESIGN INVESTIGATION ACTIVITIES TO VERIFY MATERIAL INTERFACES AND REFINE THE DESIGN PROFILE.
5. TYPICAL ELEVATION OF COMPETENT BEDROCK AT THE NORTH TRENCH RANGES FROM 411 FT TO 421 FT AND TYPICAL ELEVATION OF COMPETENT BEDROCK AT THE SOUTH TRENCH IS 401.5 FT.
6. FINAL DESIGN AND CONSTRUCTION OF THE PROPOSED GWE TRENCHES AND ASSOCIATED APPURTENANT STRUCTURES AND INFRASTRUCTURE WILL BE CLOSELY COORDINATED WITH THE AP CLOSURE CONSTRUCTION.
7. THE APPROXIMATE POST-CONSTRUCTION SURFACE GRADE IS 440 FT AT THE NORTH TRENCH AREA AND 460 FT AT THE SOUTH TRENCH AREA.



A TRENCH DETAIL
NOT TO SCALE



TOP PLAN



ELEVATION

B COLLECTION SUMP DETAIL
NOT TO SCALE

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NO.	REV DATE	REVISION	INT.

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PERMIT-LEVEL DESIGN
NOT FOR CONSTRUCTION
DATE: ----

Project Details: **ILLINOIS POWER RESOURCES GENERATING, LLC (IPRG)** Edwards Power Plant 7800 Cilco Lane Peoria, IL 61607	Drawing Title: **TRENCH AND COLLECTION SUMP DETAIL**			RAMBOLL **RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.**	
Location: Ash Pond	Designer / Professional Engineer Responsible: B. RICHTER				
Project Number **1940106781-007**	Designed by C. GLIDDEN	Drawn by B. LEMMON	Checked by B. RICHTER	Approved by L. CARR	Date April 2025
Project Status Corrective Action Plan Permit-Level Design	Drawing Number **C-501**			Scale AS NOTED	Sc x / Rev. x

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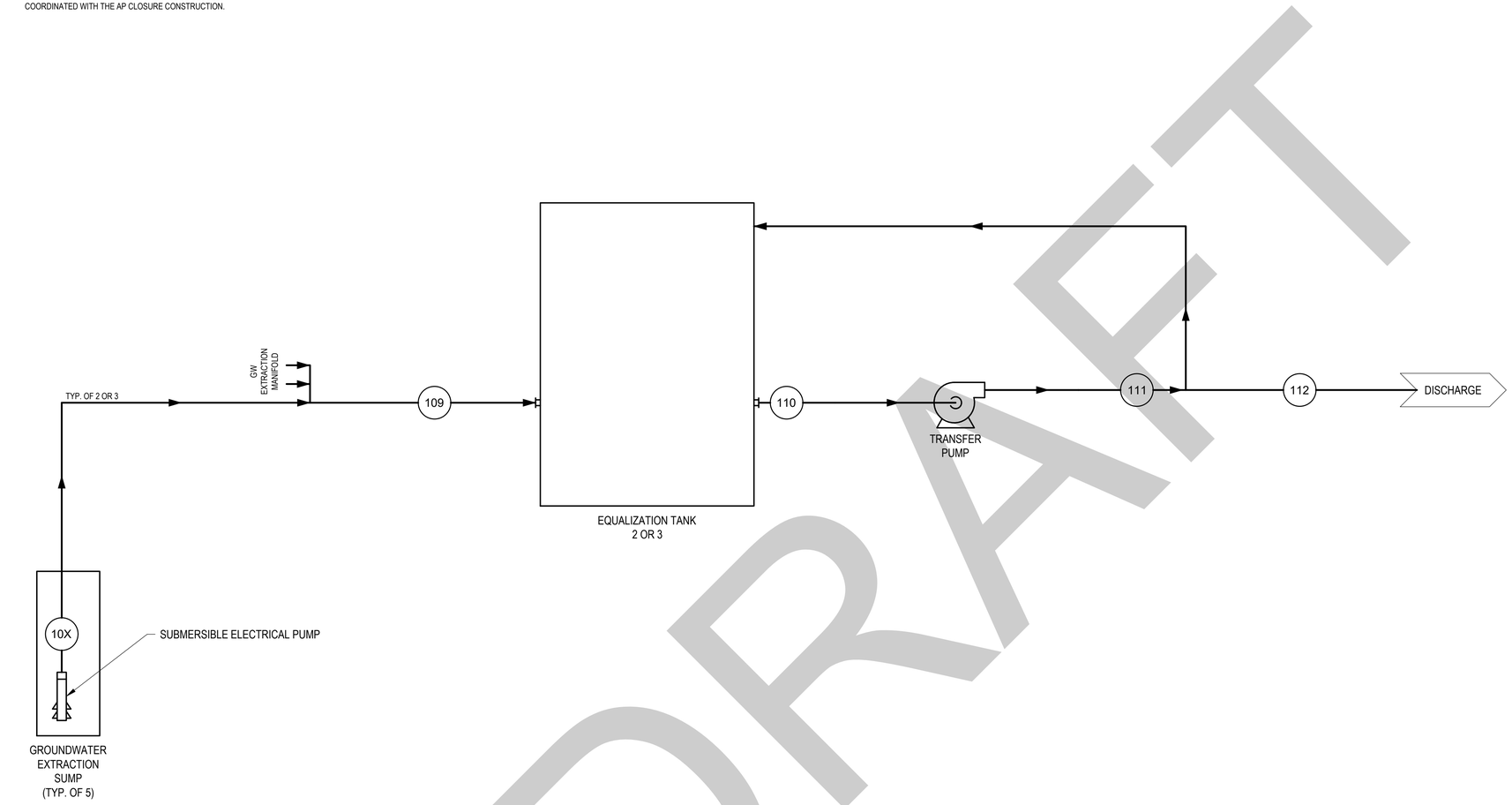
SAVED: 3/13/25 3:12 PM

NOTE:

1. SYSTEM EQUIPMENT CONFIGURATION, FLOW RATE, AND OTHER DETAILS MAY CHANGE ONCE THE HYDRAULIC MODEL IS UPDATED.

   GPM = GALLONS PER MINUTE
   GW = GROUNDWATER

2. FINAL DESIGN AND CONSTRUCTION OF THE PROPOSED GWE TRENCHES AND ASSOCIATED APPURTENANT STRUCTURES AND INFRASTRUCTURE WILL BE CLOSELY COORDINATED WITH THE AP CLOSURE CONSTRUCTION.



STREAM ID	10X	109	110	111	112	60X	601
DESIGN FLOW (GPM)	1-10	1-10	1-10	1-10	1-10	NA	NA
DESIGN FLOW (SCFM)	NA	NA	NA	NA	NA	2.5	7.5

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PERMIT-LEVEL DESIGN NOT FOR CONSTRUCTION

DATE: ----

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Project Details: **ILLINOIS POWER RESOURCES GENERATING, LLC (IPRG)** Edwards Power Plant 7800 Cilco Lane Peoria, IL 61607	Drawing Title: **SYSTEM PROCESS FLOW DIAGRAM**				RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.
Location: Ash Pond	Designer / Professional Engineer Responsible: B. RICHTER				
Project Number: **1940106781-007**	Designed by: C. GLIDDEN	Drawn by: B. LEMMON	Checked by: B. RICHTER	Approved by: L. CARR	Date: April 2025
Project Status: Corrective Action Plan Permit-Level Design	Drawing Number: **P-001**			Scale: AS NOTED	Sc: X / Rev: X

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