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SUPPLEMENTAL REMEDY SELECTION REPORT
AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
JEFFERSON COUNTY, MISSOURI

by
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for
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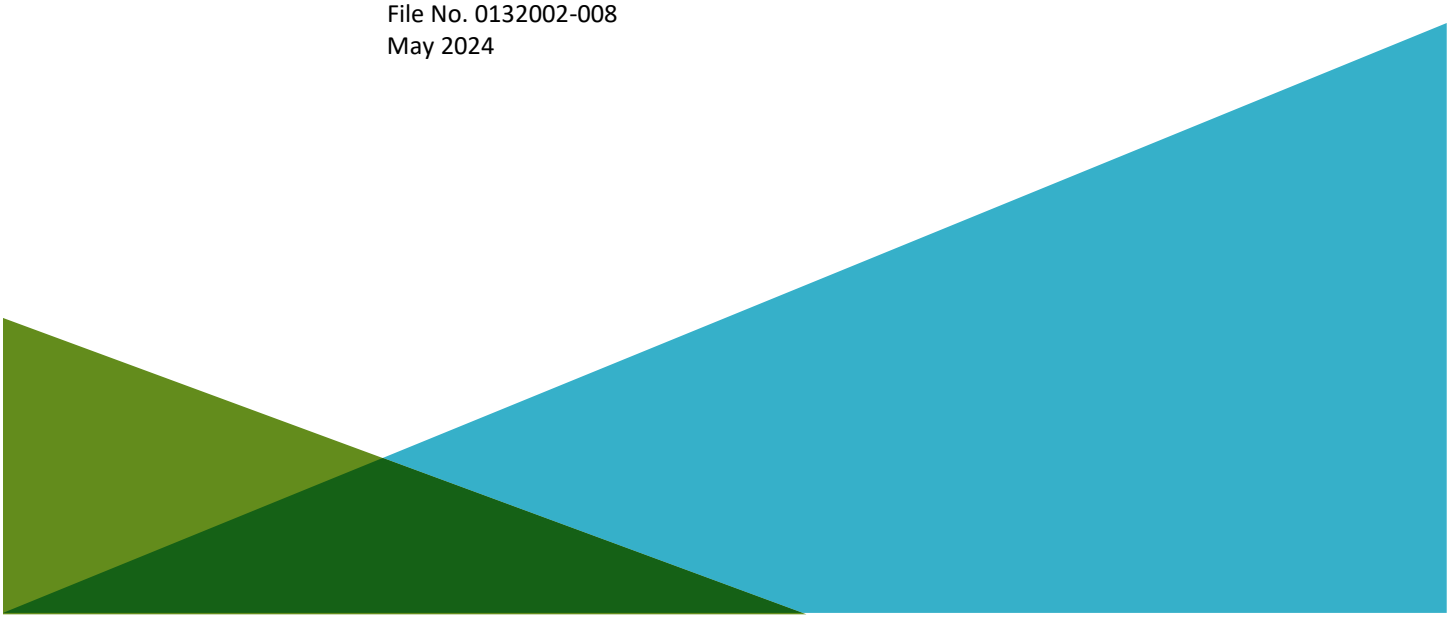


Table of Contents

List of Tables

List of Figures

List of Appendices

1. Introduction

1.1 PURPOSE

This Supplemental Remedy Selection Report (RSR) was prepared by Haley & Aldrich, Inc. on behalf of Union Electric Company d/b/a Ameren Missouri (Ameren) for the RCPA Coal Combustion Residuals (CCR) surface impoundment located at the Rush Island Energy Center (RIEC, Site) located in Jefferson County, Missouri. In accordance with requirements under the U.S. Environmental Protection Agency rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities* (CCR Rule) effective 17 April 2015, including subsequent revisions, a Corrective Measure Assessment (CMA) report for RIEC was prepared in May 2019 to evaluate six remedial alternatives against threshold criteria and balancing criteria outlined in the CCR Rule. An RSR for four of Ameren's CCR facilities, including RIEC, was prepared on 30 August 2019 and posted to the RIEC publicly available CCR website[1]. Ameren indicated in the 2019 RSR that it was actively exploring various groundwater treatment methodologies based on site-specific data and bench scale testing. Since preparation of the 2019 RSR, such technologies have proven to be effective. Ameren applied for and received from the Missouri Department of Natural Resources (MDNR) an underground injection control (UIC) permit authorizing groundwater extraction, treatment, and re-injection and has implemented the selected remedy and supplemental corrective measures. The intent of this Supplemental RSR is to document the corrective measures implemented since development of the 2019 RSR and the results of implementing those measures.

1.2 FACILITY DESCRIPTION

The RIEC property encompasses approximately 960 acres along the Mississippi River near the city of Festus in southeastern Jefferson County, Missouri. CCR was historically managed in an approximately 111-acre onsite CCR surface impoundment known as RCPA located in the southeastern portion of the Site (Figure 1). The RCPA was constructed in the mid-1970s, concurrent with development of the RIEC Site. Native soil from designated borrow areas and shallow excavations at the Site were used to build the earthen berms that encircle the RCPA. The surface impoundment was constructed by excavating alluvial deposits, which were used as fill material for the power block footprint and construction of related power plant structures.

Historically, the RIEC utilized the RCPA to actively manage approximately 65,000± tons of bottom ash and 150,000± tons of fly ash produced annually. Active wet sluicing of CCR to the RCPA terminated in 2018 following the Site's conversion to dry ash handling. Ameren initiated RCPA closure in August 2019 by dewatering free liquids, consolidating CCR material to provide stabilization and erosion control, armoring of berms, implementing stormwater controls, and installing low permeability capping. Such closure in place (CIP) activities involved drainage of free liquids, general stabilization of existing CCR, placement of general fill, and the installation of a low-permeability geomembrane final cover system over the CCR to minimize erosion and infiltration. RCPA closure was completed on 15 December 2020, thereby transitioning the RCPA into the post-closure care requirements of the CCR Rule. The estimated volume of CCR within the limits of the closed RCPA is approximately 12.7 million cubic yards.

[1] Documents referenced in this report as posted to the Ameren RIEC publicly available CCR website may be obtained at the following website address: https://www.ameren.com/company/environment-and-sustainability/managing-coal-combustion/ccr-compliance-reports/rush-island-energy-center

1.3 CCR RULE COMPLIANCE SUMMARY

CCR Rule groundwater monitoring has been performed in accordance with CCR Rule requirements outlined in the Code of Federal Regulations Title 40 (40 CFR) §257.90 through §257.95. The monitoring has been completed through a phased approach to allow for a graduated response [i.e., detection monitoring followed by assessment monitoring and then nature and extent (N&E) investigation, as applicable]:

- Monitoring wells were installed in October and November 2015. The CCR groundwater monitoring network includes two background wells and seven downgradient monitoring wells located around the perimeter of the RCPA and generally screened in the alluvial aquifer zone.
- Detection monitoring events occurred in 2017 and 2018, and results indicated concentrations of Appendix III constituents above Site-specific background values (i.e., statistically significant increases). As a result, an Assessment Monitoring Program was initiated for the RCPA.
- Assessment monitoring events initially occurred in April 2018 and subsequently in May, and November 2018, and results indicated concentrations of Appendix IV constituents arsenic and molybdenum at above Site-specific Groundwater Protection Standards (GWPSs) (i.e., statistically significant levels [SSLs]). As a result, a notification of the detection of SSLs above GWPSs was placed in the operating record and on the publicly available CCR website, and an investigation into the N&E of impacts to groundwater was initiated.
- N&E monitoring events occurred in November 2018 and July/August 2019. Results from the N&E investigation were summarized in the *2019 Annual Groundwater Monitoring and Corrective Action Report*. Those results formed the basis for the CMA report and original RSR and were used to select the Corrective Action Monitoring Well Network.

Two different groundwater monitoring networks are currently used to monitor conditions near the RCPA: the Detection and Assessment Monitoring Well Network (established under 40 CFR §257.91) and the Corrective Action Monitoring Well Network (established under 40 CFR §257.98). Monitoring of the two networks is conducted on a semiannual basis each year, generally simultaneously during the second and fourth quarters. A map displaying the locations of groundwater monitoring wells is provided as Figure 1.

Based on monitoring data available at the time, a CMA report for RIEC was prepared in May 2019, and a public meeting was held on 28 May 2019. A summary of verbal comments received during the public meeting and written comments received after the meeting is provided in Appendix A. After completion of the CMA report and solicitation of public comment, an RSR that identified the selected remedy for the RCPA (and CCR basins at three other Ameren facilities) was prepared in August 2019. Section 1.4 provides an overview of the 2019 RSR.

1.4 2019 SELECTION OF REMEDY REPORT SUMMARY

On 30 August 2019, Ameren prepared a report entitled *Remedy Selection Report - 40 CFR § 257.97 - Rush Island, Labadie, Sioux, and Meramec CCR Basins* (2019 RSR) that outlined the remedy selected for the RCPA and CCR basins at other sites (Appendix B). The 2019 RSR indicated that numerous technical evaluations informed the final remedy selection, including groundwater modeling; human health and ecological risk assessments; groundwater treatment assessments; onsite and offsite monitoring data; rail, barge, and truck transportation studies; and a deep excavation study report.

The remedy selected for the RCPA was outlined in the CMA report as Alternative 1 (CIP with low permeability capping and monitored natural attenuation [MNA]). The 2019 RSR outlined three phases to the selected remedy:

1. Source control, stabilization, and containment of CCR by installation of a low-permeability geomembrane cap (a minimum 1 x 10^{-7} centimeters per second [cm/sec] versus 1 x 10^{-5} cm/sec required by the CCR Rule).
2. Implement MNA of groundwater concentrations upon completion of source control to address limited and localized CCR-related impacts, including modeling evaluations.
3. Preparation of Annual Groundwater Monitoring and Corrective Action Reports that address the following:
    - Demonstration that the groundwater plume(s) are stable or decreasing and not expanding.
    - An ongoing summary of baseline and periodic geochemical analysis including groundwater chemistry, subsurface soils chemical composition, and mineralogy.
    - Determine Site-specific attenuation factors and rate of attenuation process.
    - Design a long-term performance monitoring program based on the specific attenuation mechanism to confirm concentration reductions and document trends.

In addition, the 2019 RSR also outlined potential supplemental corrective measures that may be considered to supplement groundwater concentration reductions that are expected to result from source control (including removal of free water and installation of a low-permeability cover system) and MNA. The 2019 RSR indicated those supplemental corrective measures may include groundwater treatment and summarized results from ongoing treatment studies. The 2019 RSR also concluded that the laboratory results indicate reduction of arsenic and molybdenum concentrations may be supported by pH level adjustment in soils and groundwater, use of chemical reduction (e.g., zero valence iron), and/or bioremediation. Consideration of potential supplemental corrective measures has followed an iterative process, ultimately resulting in a groundwater extraction, ex-situ treatment, and re-injection system being constructed downgradient to the east of the RCPA, as described in Section 2.1.

Since completion of the four-site 2019 RSR, annual groundwater monitoring and corrective action reports have continued to document the status of the RCPA groundwater monitoring and corrective action program, in accordance with 40 CFR §257.90(e). Substantial progress has been made in implementing the selected remedy and supplemental corrective measures for the RCPA. Section 2 documents remedy implementation progress achieved to-date, including remedy activities completed and the results of those completed activities.

2. Remedy Implementation Progress

2.1 SUMMARY OF IMPLEMENTED REMEDIAL ACTIVITIES

As summarized in Section 1.4, the selected remedy for the RCPA included source control through removal of free water and CIP using a low-permeability geomembrane final cover system, MNA, preparation of Annual Groundwater Monitoring and Corrective Action Reports, and potential supplemental corrective measures. In-text Table 1 below summarizes the timeline of remedial activities that have been implemented to-date for the RCPA.

Table 1 – Timeline of Remedy Implementation

Date	Activity
August 2019	2019 RSR completed (Appendix B)
August 2019	RCPA closure initiated (Appendix C)
December 2019	Preliminary treatability study results report developed to document findings from a three-phase treatability study for the remediation of arsenic, molybdenum, and other metals of concern. The treatability testing focused on refining the ex-situ remedial approach in order to finalize the pilot test design. (Appendix D)
January 2020	*2019 Groundwater Monitoring and Corrective Action Report* completed[1]
December 2020	RCPA closure completed (Appendix C)
January 2021	*2020 Groundwater Monitoring and Corrective Action Report* completed[1]
February 2021	In-field pilot groundwater treatability study initiated
April 2021	Post-closure MNA initiated, as documented in *2021 Groundwater Monitoring and Corrective Action Report*[1]
June 2021	In-field pilot groundwater treatability study completed
January 2022	Treatability study memorandum developed to document the final treatment design for ex-situ treatment based on results from extensive bench-scale laboratory treatability study and the 2021 in-field pilot study (Appendix D)
January 2022	*2021 Groundwater Monitoring and Corrective Action Report* completed[1]
February 2022	Groundwater extraction, treatment, and re-injection system became fully operational[2]
January 2023	Groundwater extraction, treatment, and re-injection system started producing at target flow rates[2]
January 2023	*2022 Groundwater Monitoring and Corrective Action Report* completed[1]
January 2024	*2023 Groundwater Monitoring and Corrective Action Report* completed[1]

[1] Annual groundwater monitoring and corrective action reports for the RCPA can be found on the Ameren RIEC publicly available CCR website

[2] After the system became fully operational in February 2022, system programming and maintenance were being adjusted to optimize system performance until target flow rates were achieved in January 2023.

In addition to development of routine annual reports that summarize groundwater monitoring and corrective action progress, the primary remedial activities that have been completed to-date include:

- RCPA source control through removal of free water and CIP using a low-permeability geomembrane final cover system
  - Initiated: August 2019
  - Completed: December 2020
- Post-closure MNA
  - Initiated: April 2021
  - Ongoing
- Extraction and ex-situ treatment of downgradient impacted groundwater and re-injection of treated groundwater within the same subsurface area of impact
  - Initiated: February 2022 (full operation)
  - Ongoing

An overview of the selected remedy, including locations at the Site where the selected remedy has been implemented, is provided in Figure 2.

Table 2 below summarizes pertinent details of the remedial activities implemented to-date for the RCPA.

Table 2 – Summary of Implemented Remedial Activity Details

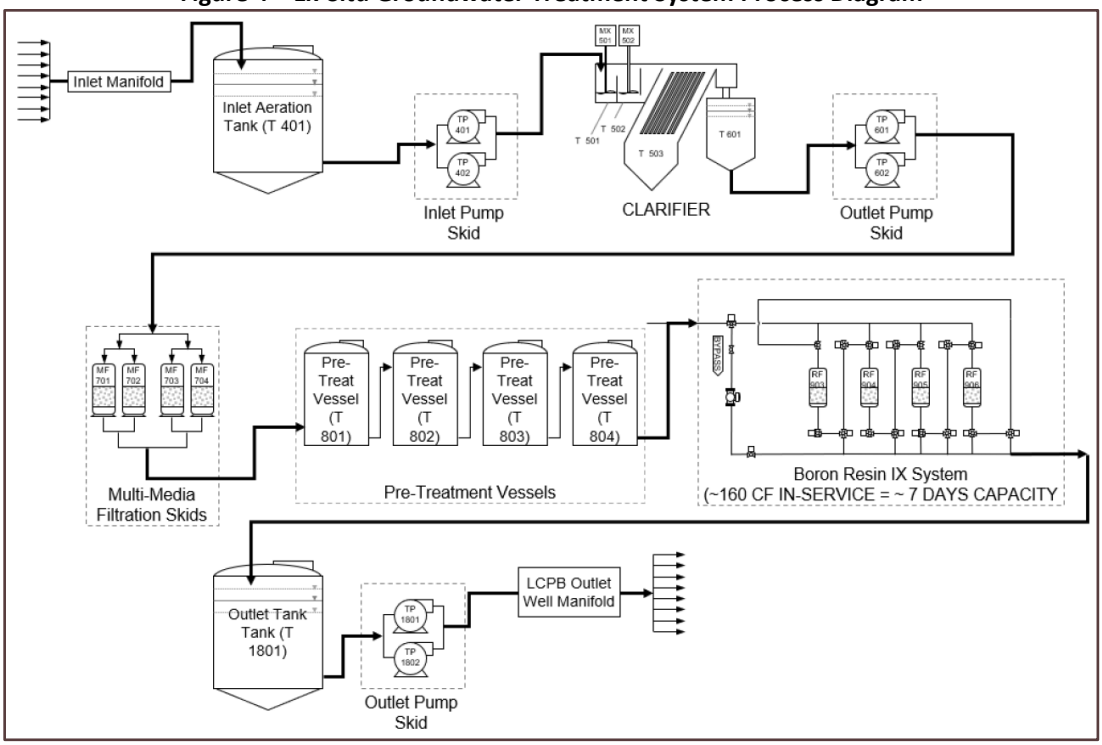
Remedial Activity	Details
RCPA Source Control	Ameren began closure of the RCPA and placed a "Notification of Intent to Close a CCR Unit and Certification for Final Cover Design System" onto its publicly available CCR website on 20 August 2019. RCPA source control entailed removing free water, closing the CCR in-place, and installing an engineered low-permeability geomembrane cover system over the RCPA to prevent infiltration and promote stormwater drainage. Substantial installation of the low-permeability cover system was completed on 15 December 2020. As certified in a closure statement dated 3 November 2021, RCPA closure was completed in substantial conformance with applicable closure design plans and specifications. The notification of intent to close, closure completion statement, and Closure and Post-Closure Plan for the RCPA are available on the RIEC publicly available CCR website and are attached to this report as Appendix C.
Post-Closure MNA	After substantial closure was completed in December 2020, post-closure MNA began with the April 2021 sampling event to address CCR-related impacts. Post-closure MNA includes monitoring of the Corrective Action Monitoring Well Network (Figure 1), and monitoring is ongoing semi-annually, generally during the second and fourth quarters of each year.
Groundwater Extraction, Ex-situ Treatment, and Re-injection System	After a series of treatability studies were completed to evaluate the feasibility and effectiveness of groundwater treatment near the RCPA, Ameren received an UIC permit (UI-0000043) and completed an in-field pilot study in 2021. Drilling of extraction and injection wells along the downgradient eastern side of the RCPA was completed in 2021, the system became fully operational in February 2022, and achievement of target system flow rates began in January 2023.

Table 2 – Summary of Implemented Remedial Activity Details	
Remedial Activity	**Details**
	The system includes a series of 28 groundwater extraction wells located along the downgradient eastern boundary of the RCPA where arsenic and molybdenum SSLs have been recorded in groundwater. Extracted groundwater is pumped to one of four treatment buildings, where the influent undergoes ex-situ treatment using chemical precipitation and selective-ion exchange. After the treatment process is complete, the effluent (at significantly reduced concentrations) is re-injected into the subsurface via a series of 28 groundwater injection wells located along the same portion of the downgradient eastern boundary of the RCPA (Figure 3). Well certification records for the 28 extraction wells and 28 injection wells are included in Appendix E.

Implementation of the remedy has followed an iterative and adaptive approach to considering potential supplemental corrective measures for the overall RCPA remedial strategy. As referenced in Appendix D, although the treatability studies were initially conducted under the assumption that results may be incorporated into in-situ groundwater treatment design considerations, evaluation of the potential for clogging from metals precipitation and considerations for treating boron led to a transition from an in-situ to an ex-situ conceptual treatment system approach for the RCPA.

Locations of the groundwater extraction wells, ex-situ treatment buildings, groundwater injection wells, and associated conveyance piping are shown on Figure 3. A process flow diagram for the ex-situ treatment is illustrated on Figure 4 below.

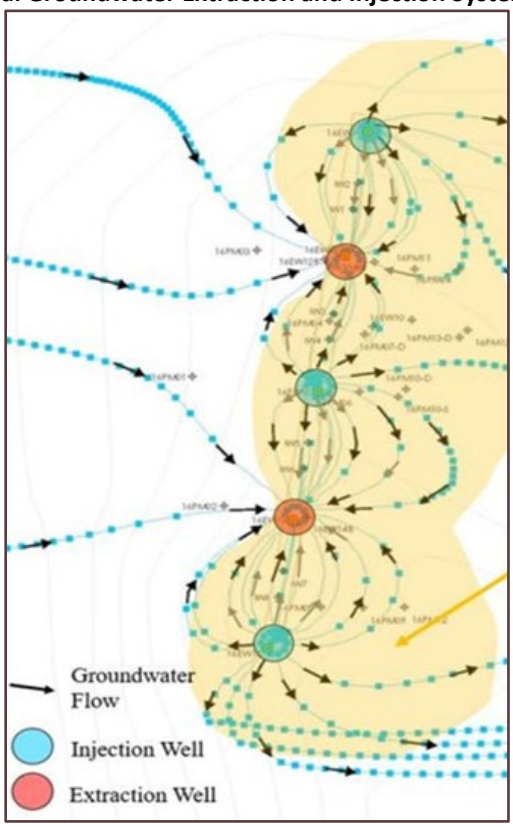
Figure 4 – Ex-Situ Groundwater Treatment System Process Diagram



Source: Figure 2 from 2023 Annual Groundwater Monitoring and Corrective Action Report. RCPA Surface Impoundment, Rush Island Energy Center, Jefferson County, Missouri, USA. 31 January 2024. Created by Loureiro Engineering Associates, Inc.

Figure 5 below provides a conceptual illustration of how a co-located series of groundwater extraction wells and injection wells (such as those installed and operating a RIEC) operates to form hydraulic groundwater control and treatment along a linear alignment perpendicular to downgradient groundwater flow.

Figure 5 – Conceptual Groundwater Extraction and Injection System Hydraulic Control



Source: ENVIRO Wiki
(https://www.enviro.wiki/index.php?title=Injection_Techniques_for_Liquid_Amendments)

For the RCPA groundwater treatment system, a total of 28 extraction wells, 28 injection wells, and four treatment buildings have been constructed and are operating downgradient to the east of the RCPA to provide hydraulic control of impacted groundwater. The groundwater capture zone for the system is based on annual flow conditions across the RCPA of 34 feet per year as documented in the *2018 Annual Groundwater Monitoring and Corrective Action Report*. This represents an average historical movement of a transport particle across the RCPA in an east/southeast direction toward the Mississippi River over a given calendar year. The average annual flow rate accounts for overall vector movement of that particle during normal, stagnant, flood, and low-level river stages throughout that calendar year. A combination of both extraction and injection wells to capture and control that movement is used to ensure a net-zero difference in overall groundwater flow conditions. Essentially, the groundwater that is removed for treatment is re-introduced in the same area; therefore, there is no change in overall groundwater flow conditions beyond the discrete zone of groundwater extraction and injection.

The design accounts for treating the volume of water within the effective porosity of that control area, which is approximately 34 feet wide by 800 feet long by 70 feet deep of water column for three of the four treatment buildings[2]. To be conservative, a 45-foot width and 32 percent effective porosity were used to estimate 6,000,000± gallons of water per building[3] per year for annual control. The well spacing and offset of the extraction well row and injection well row were modeled to reach a point of intermixing within 2 to 3 years. This resulted in eight extraction wells and eight injection wells per building for three treatment buildings and four extraction wells and four injection wells for one treatment building[4] in individual rows, with approximately 18 feet separating the row of extraction wells from the row of injection wells. Individual extraction wells are spaced approximately 120 feet on center. Individual injection wells are also spaced approximately 120 feet on center. The individual extraction wells are offset approximately 60 feet from the individual injection wells to maximize coverage. At eight extraction wells per building for three of the four buildings and four extraction wells for the fourth building with a 90 percent run time, the extraction rate per well equates to approximately 1.5 gallons per minute per extraction well.

The groundwater treatment system is designed to be controlled and operated physically at the Site or remotely. The system is controlled and operated by a touch screen interface with some automation routines to handle tasks that are required to operate remotely when the system is unattended. Remote access to the system can be achieved by the operator on a personal computer and via mobile phone. Remote access functionality for system controls and operations is nearly identical to managing physical system controls and operations at the Site; however, a remote operator does not have access to limited hand-operated switches which are required for some maintenance operations.

This remote access provides a wide range of functions including (but not limited to):

- Monitoring of real time data (e.g., gallons processed, system pressures, rate of flow in process piping, individual tank levels, system temperatures, water parameters such as pH and conductivity, valve open/closed status, and system alarms)
- Initiation of automation routines (e.g., sand media backwash, sludge transfer, resin media regeneration, holding tank recirculation/pH adjustments)
- Real time flow rate adjustments of the extraction wells, transfer pumps, and chemical dosing pumps
- Real time process changes such as:
  - Clear alarms and restart system, if needed
  - Change how often automation routines initiate, for example how often sludge should be transferred from a clarifier

[2] Treatment buildings 1, 2, and 4 are designed to capture an equivalent volume of water via eight extraction wells surrounding each building. Treatment building 3, which is located near MW-3 (Figure 3), receives inflows from four extraction wells. Therefore, treatment building 3 is designed to capture approximately one-half the volume of water compared to the other three treatment buildings (i.e., approximately 34 feet wide by 400 feet long by 70 feet deep of water column).

[3] Treatment building 3 treats about one-half the groundwater flow rate compared to other treatment buildings, or approximately 3,000,000± gallons of water annually.

[4] Treatment building 3, which is located near MW-3 (Figure 3), receives inflows from four extraction wells and discharges treated water to four injection wells.

- Increase/decrease how many gallons to use for a specific event i.e. sand media backwash
- Adjust distribution of treated water, i.e., how much water to place in storage versus discharge to well field
- Increase efficiency of resin media absorption by adjust of process water pH right before it enters the resin media

Evaluation of treatment system influent/effluent and groundwater monitoring results over the initial two years of full-scale system operations indicate removal of constituent mass and generally positive results, as described in Section 2.2.

2.2 SUMMARY OF REMEDIAL RESULTS

Completed RCPA source control (including removal of free water and installation of a low-permeability cover system), ongoing natural attenuation processes, and supplemental groundwater extraction and treatment have collectively contributed to a general reduction in constituent concentrations in groundwater near the RCPA.

Since the remedy for the RCPA was selected in 2019, annual groundwater monitoring and corrective action reports have documented progress in remedy implementation and summarized groundwater monitoring results[5]. As discussed in annual groundwater monitoring and corrective measures reports posted to the RIEC publicly available CCR website, implemented corrective measures are positively influencing groundwater downgradient of the RCPA.

RCPA groundwater treatment system influent and effluent data collected since January 2023 (when the treatment system started operating at target flow rates), clearly demonstrate significant reductions in primary CCR constituents as a result of the ex-situ treatment process (Figure 6A through Figure 6C below). Figure 6A through Figure 6C below illustrate that treatment system effluent (daily maximum) concentrations have remained below monthly average compliance limitations established in the MDNR UIC permit for effluent discharge to groundwater, which meet drinking water action levels for the primary Appendix IV constituents arsenic and molybdenum and primary Appendix III constituent boron.

[5] Individual monitoring well statistical evaluations are conducted for semiannual assessment and corrective action monitoring results for Appendix IV constituents. Those statistical analyses are documented in annual groundwater monitoring and corrective action reports posted on the publicly available CCR website.

Figure 6A – Ex-Situ Groundwater Treatment System
Influent and Effluent Data Plots - Arsenic

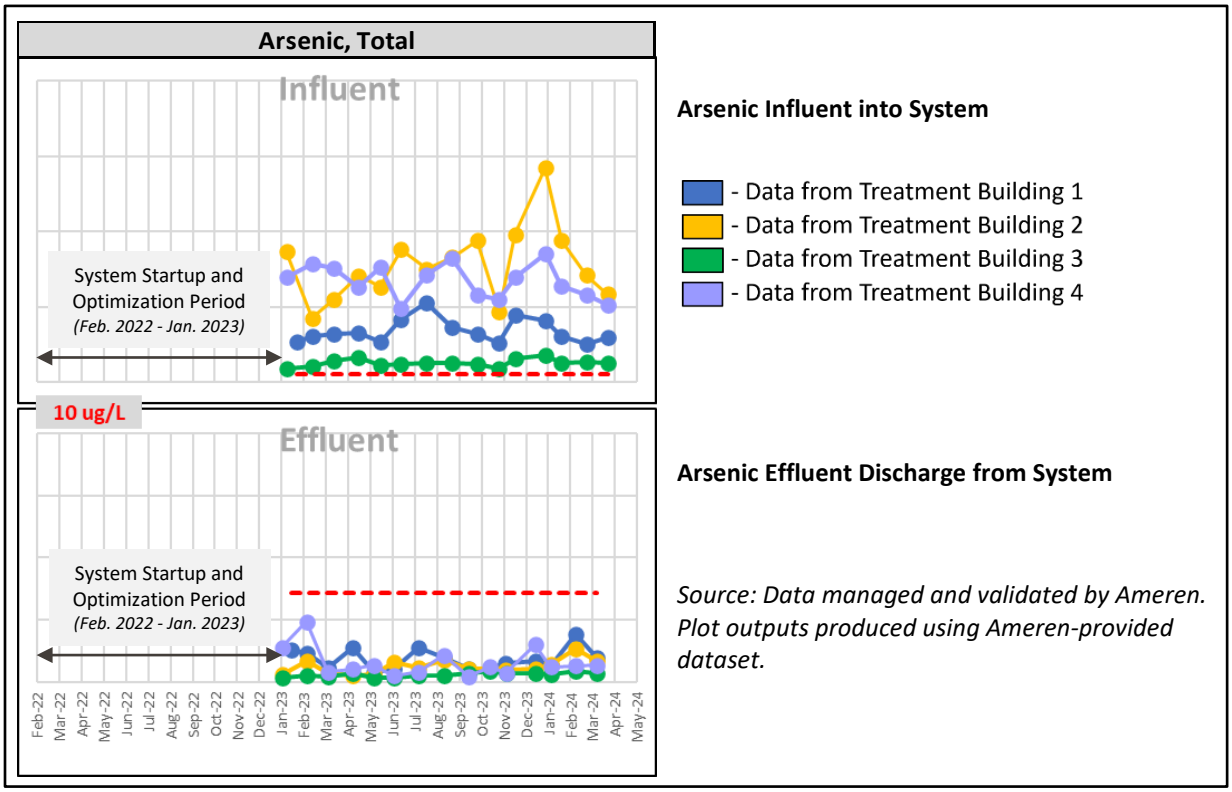


Figure 6B – Ex-Situ Groundwater Treatment System
Influent and Effluent Data Plots - Boron

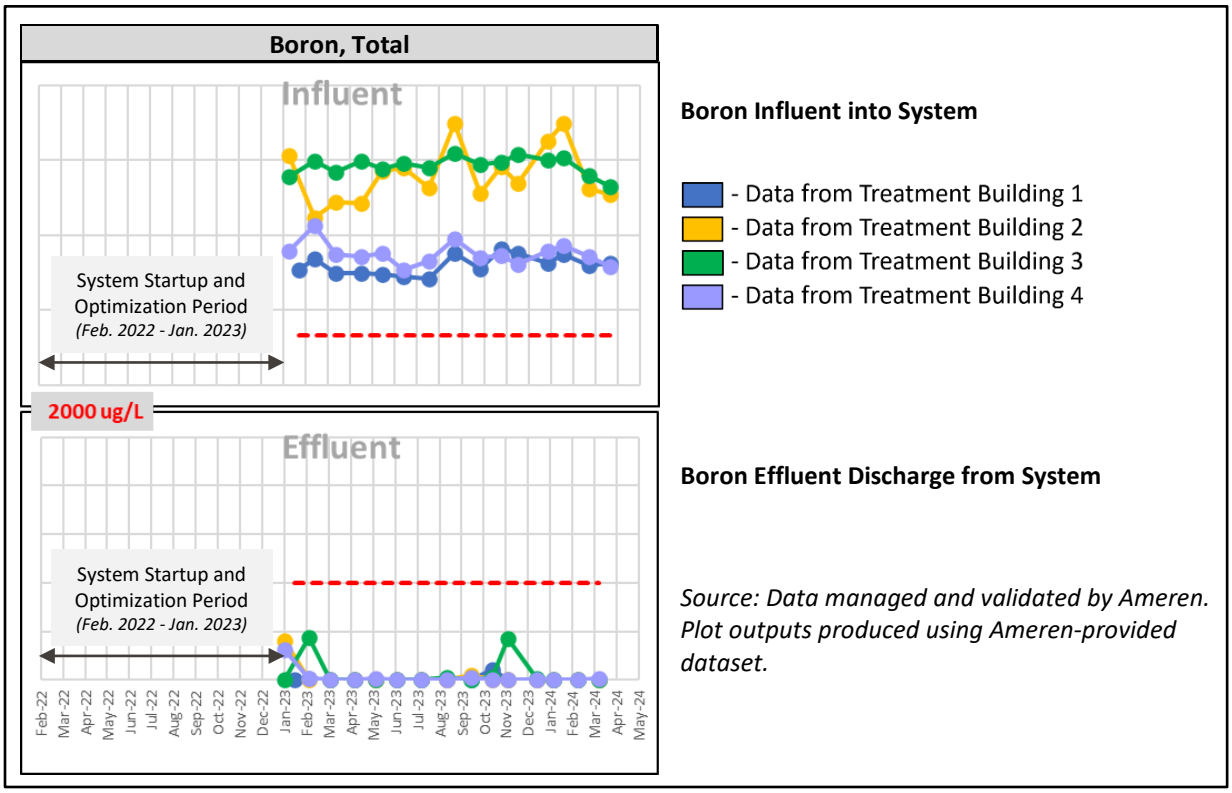
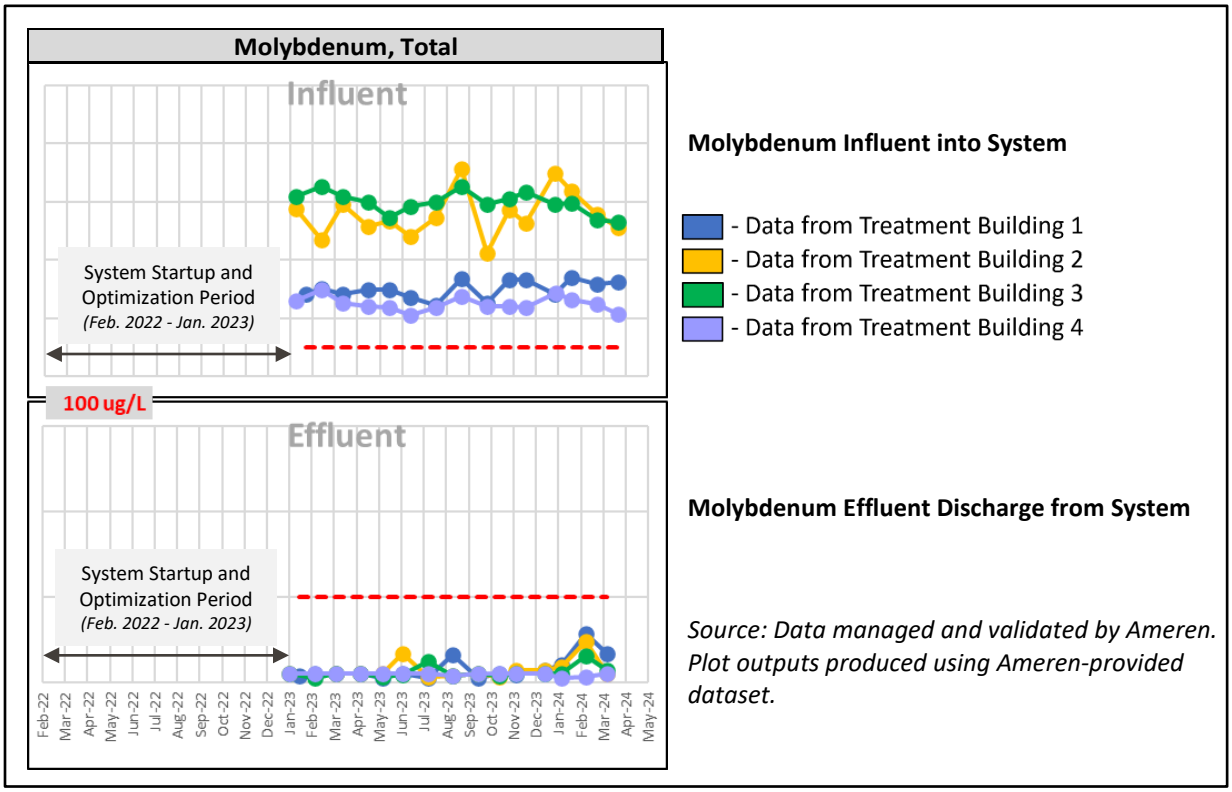
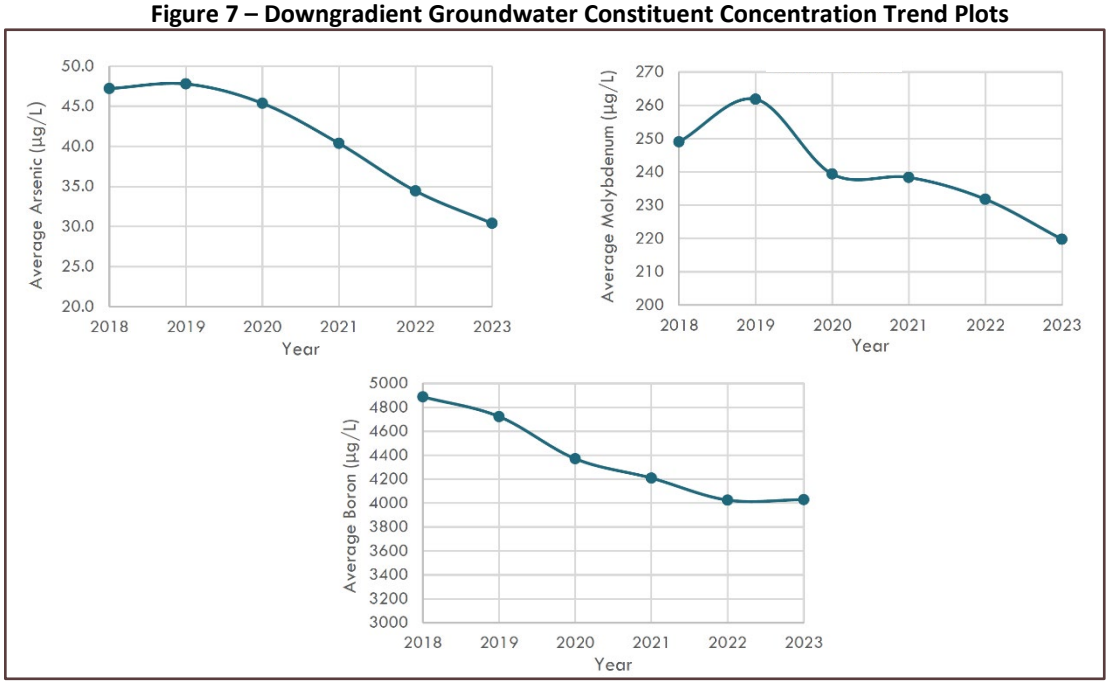


Figure 6C – Ex-Situ Groundwater Treatment System
Influent and Effluent Data Plots - Molybdenum



In addition to decreasing constituent concentrations recorded in ex-situ treatment system influent and effluent as a result of the treatment process, stable or decreasing constituent concentrations have been recorded in groundwater at many monitoring wells downgradient of the RCPA and groundwater treatment system since remedial activities have been implemented. Site groundwater monitoring data appear to support a general downward trend in total constituent mass in groundwater. For instance, the average concentrations for arsenic, molybdenum, and boron in groundwater at monitoring wells downgradient of the RCPA have shown predominately decreasing concentrations over time, as illustrated on Figure 7 below.

Figure 7 – Downgradient Groundwater Constituent Concentration Trend Plots



Source: Figures 4, 5, and 6 from 2023 Annual Groundwater Monitoring and Corrective Action Report. RCPA Surface Impoundment, Rush Island Energy Center, Jefferson County, Missouri, USA. 31 January 2024. Created by Rocksmith Geoengineering, LLC.

As illustrated on Figure 7 above, average concentrations in monitoring wells downgradient of the RCPA have decreased, with average concentration reductions as follows[6]:

- arsenic – decreased by 36 percent
- molybdenum – decreased by 12 percent
- boron – decreased by 18 percent

These results indicate that the corrective measures implemented to-date by Ameren are effectively contributing to constituent mass reductions in groundwater downgradient of the RCPA. As additional time passes since completion of RCPA source control and initiation of the downgradient groundwater treatment system, constituent mass and concentrations in downgradient groundwater are anticipated to continue decreasing. Furthermore, groundwater modeling for the site indicates constituent concentrations will decrease in the long-term.

2.3 SUMMARY OF ANTICIPATED SUPPLEMENTAL CORRECTIVE MEASURES

MNA and groundwater treatment by means of extraction, ex-situ treatment, and re-injection are ongoing for the RCPA. RCPA closure was completed in December 2020. No additional supplemental corrective measures are anticipated at this time.

[6] Based on calculations performed by Rocksmith Geoengineering, LLC, for data collected from 2018 to 2023.

2.4 DEMONSTRATION OF 40 CFR §257.97(B) REQUIREMENTS

In accordance with 40 CFR §257.97(b), a remedy must meet the following requirements (i.e., "threshold criteria"):

> *(1) Be protective of human health and the environment;*
>
> *(2) Achieve the groundwater protection standard pursuant to 40 CFR §257.95(h);*
>
> *(3) Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV [of the CCR Rule] into the environment;*
>
> *(4) Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems; and*
>
> *(5) Comply with certain standards for management of wastes as specified in [40 CFR] §257.98(d).*

In May 2019, Ameren completed the CMA Report for the RCPA and posted the report to its publicly available CCR website. The CMA Report considered six corrective measures alternatives, all of which were demonstrated to meet the threshold criteria listed above. The CMA Report also included the summary results of the assessment of numerous technical evaluations conducted, which include groundwater and geochemical modeling, human health and ecological risk assessments, and N&E of CCR constituents in groundwater assessments. Results of these technical evaluations indicated each of the six corrective measures alternatives effectively satisfied the requirements under 40 CFR §257.97(b), listed above.

In its 2019 RSR, Ameren selected CMA Alternative 1 (CIP with capping and MNA), noting that supplemental corrective measures were being evaluated and may be implemented as part of an iterative remedial strategy. Since completion of the CMA Report and 2019 RSR, Ameren has implemented a supplemental corrective measure for the RCPA in the form of a groundwater extraction, ex-situ treatment, and re-injection system along the downgradient (eastern) side of the RCPA, as described in Section 2.1. Although the specific details of this supplemental corrective measure were not directly evaluated in the CMA Report, groundwater pumping with ex-situ treatment was evaluated along with CIP with capping as a component of Alternative 4, which (like Alternative 1) were also considered to effectively satisfy the requirements under 40 CFR §257.97(b). The additional corrective measure of re-injecting treated water into the subsurface area of impact serves to enhance the rate of constituent concentration reductions in groundwater, prevents the need to collect and dispose of or discharge the treated water, and meets the requirements under 40 CFR §257.97(b).

Based on the prior CMA evaluation and consideration of the supplemental corrective measures implemented for the RCPA, the remedy implemented for the RCPA meets the requirements of the 40 CFR §257.97(b) threshold criteria. The groundwater extraction, ex-situ treatment, and re-injection system has been demonstrated to effectively reduce local constituent concentrations in groundwater downgradient to the east of the RCPA, as summarized in Section 2.2. These active remedial steps serve to supplement, or enhance, constituent concentration reductions already promoted by completed RCPA closure and ongoing natural attenuation processes.

2.5 DEMONSTRATION OF 40 CFR §257.97(C) CONSIDERATIONS

In accordance with 40 CFR §257.97(c), the owner of a CCR unit must consider the following evaluation factors (i.e., "balancing criteria") when selecting a remedy that satisfies the threshold criteria under 40 CFR §257.97(b):

> *(1) The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful based on consideration of the following:*
>
> *(i) Magnitude of reduction of existing risks;*
>
> *(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;*
>
> *(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance;*
>
> *(iv) Short-term risks that might be posed to the community or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal of contaminant;*
>
> *(v) Time until full protection is achieved;*
>
> *(vi) 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, or containment;*
>
> *(vii) Long-term reliability of the engineering and institutional controls; and*
>
> *(viii) Potential need for replacement of the remedy.*
>
> *(2) The effectiveness of the remedy in controlling the source to reduce further releases based on consideration of the following factors:*
>
> *(i) The extent to which containment practices will reduce further releases; and*
>
> *(ii) The extent to which treatment technologies may be used.*
>
> *(3) The ease or difficulty of implementing a potential remedy(s) based on consideration of the following types of factors:*
>
> *(i) Degree of difficulty associated with constructing the technology;*
>
> *(ii) Expected operational reliability of the technologies;*
>
> *(iii) Need to coordinate with and obtain necessary approvals and permits from other agencies;*
>
> *(iv) Availability of necessary equipment and specialists; and*
>
> *(v) Available capacity and location of needed treatment, storage, and disposal services.*
>
> *(4) The degree to which community concerns are addressed by a potential remedy(s).*

The CMA Report compared the six corrective measures alternatives relative to one another with respect to three of the four primary balancing criteria identified in the CCR Rule: long-term and short-term effectiveness, source control, and implementability. The fourth balancing criterion, community concerns, was considered after the public meeting was held on 28 May 2019 and the period of public comment was completed.

Similar to consideration of the threshold criteria under 40 CFR §257.97(b) discussed in Section 2.4, appropriate consideration of the balancing criteria under 40 CFR §257.97(c) for the implemented RCPA remedy should consider how the CMA Report evaluated Alternatives 1 and 4, collectively. In the CMA Report, Alternatives 1 and 4 received a "favorable" or "less favorable" rating for each of the balancing criteria, and the alternative received no "unfavorable" ratings under any of the balancing criteria. Based on the CMA favorability ratings for Alternatives 1 and 4, the implemented remedy (primarily a combination of Alternatives 1 and 4) is also considered relatively highly favorable.

Table 3 provides an evaluation of the implemented remedy against each of the balancing criteria outlined under 40 CFR §257.97(c). Based on the prior CMA evaluation and consideration of the supplemental corrective measures implemented for the RCPA, the remedy implemented for the RCPA effectively addresses the 40 CFR §257.97(c) balancing criteria, as documented in Table 3. The groundwater extraction, ex-situ treatment, and re-injection system has been demonstrated to effectively reduce local constituent concentrations in groundwater, as summarized in Section 2.2. These active remedial steps serve to supplement, or enhance, constituent concentration reductions already promoted by completed RCPA closure and ongoing natural attenuation processes.

2.6 SCHEDULE FOR IMPLEMENTING AND COMPLETING REMEDIAL ACTIVITIES

Section 2.1 summarizes remedial activities that have been implemented for the RCPA. Closure of the RCPA began in August 2019 and was completed in December 2020 (approximately 16 months), within the timeframe indicated in the 2019 RSR. After laboratory bench-scale testing indicated favorable results, Ameren conducted an in-field pilot study in 2021 for its groundwater extraction, ex-situ treatment, and re-injection system, which has been fully operating since February 2022 downgradient to the east of the RCPA. Evaluation of monitoring results and documentation of remedy implementation progress have been included in annual groundwater monitoring and corrective action reports. Preparation of annual reports will continue.

In accordance with 40 CFR §257.97(d), the owner of a CCR unit must specify schedule(s) for implementing and completing remedial activities, requiring completion of remedial activities within a reasonable timeframe that considers the following factors:

> *(1) Extent and nature of contamination, as determined by the characterization required under §257.95(g);*
>
> *(2) Reasonable probabilities of remedial technologies in achieving compliance with the groundwater protection standards established under §257.95(h) and other objectives of the Remedy;*
>
> *(3) Availability of treatment or disposal capacity for CCR managed during implementation of the remedy;*
>
> *(4) Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy;*
>
> *(5) Resource value of the aquifer including:*
>
> > *(i) Current and future uses;*
> >
> > *(ii) Proximity and withdrawal rate of users;*
> >
> > *(iii) Groundwater quantity and quality;*

(iv) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to CCR constituents;

(v) The hydrogeologic characteristic of the facility and surrounding land; and

(6) Other relevant factors.

Implementation of the selected remedy has been performed in an expeditious fashion, as summarized in Section 2.1. RCPA closure was completed in approximately 16 months. Closure of the RCPA by CIP allowed source control to be completed much sooner (approximately 30 years sooner, based on the CMA Report) than would have been possible with an alternative closure by removal (CBR) method, especially given the technical and logistical challenges with excavating near the Mississippi River.

The risk assessment report developed for the Site in 2018 concluded no unacceptable risk to human health and the environment associated with groundwater at the RCPA (Appendix F). Since completion of the risk assessment report, RCPA closure is complete, groundwater extraction and treatment are ongoing, and constituent concentration reductions have been observed. The potential for exposure of humans and the environment to CCR material that existed prior to RCPA closure has been mitigated by completion of RCPA closure and installation of an engineered final cover system. The final cover system was constructed quickly and allowed CCR material to remain onsite, thereby limiting the duration of potential exposure of humans or the environment to the CCR. Based on improved Site conditions since completion of the 2018 risk assessment report, conclusions from that risk assessment are validated.

As referenced in the 2018 risk assessment for RIEC (Appendix F), water supply wells recorded within a one-mile radius of the Site (generally located to the west) are upgradient of the RCPA and not affected by CCR constituent migration from the RCPA. Two onsite water supply wells are used to supply a potable water source to the RIEC. These wells are approximately 1,100 feet deep, cased to a depth of over 600 feet, and are entirely screened within the bedrock aquifer. Sample results from the onsite water supply wells indicate the wells are not affected by the RCPA.

Ex-situ treatment of impacted groundwater is occurring onsite and in a sustainable manner that allows the treated groundwater to be re-injected into the area of impacted groundwater downgradient to the east of the RCPA. Based on groundwater and geochemical modeling performed to-date, completed source control (including removal of free water and installation of a low-permeability cover system) and ongoing groundwater treatment through groundwater extraction and re-injection of treated groundwater (in conjunction with ongoing natural attenuation processes) are expected to reduce arsenic and molybdenum concentrations in groundwater to less than GWPSs within a reasonable timeframe.

Anticipated future remedy-related activities include:

- Extraction, ex-situ treatment, and re-injection of impacted groundwater downgradient to the east of the RCPA (ongoing).
- Semiannual corrective action monitoring (ongoing).
- Evaluation of corrective action effectiveness on CCR constituent concentrations in groundwater (ongoing).
- Annual groundwater monitoring and corrective action report development (ongoing).

Annual groundwater monitoring and corrective action reports will continue to document groundwater analytical results and constituent concentration trends over time. Updated Site data and available modeling results will be used to confirm whether achievement of GWPSs within a reasonable timeframe continues to be predicted based on implemented corrective action measures of source control combined with the groundwater extraction and treatment system (within the area of the system's influence) and MNA (outside the area of the system's influence). Supplemental or alternative corrective measures may continue to be considered if results or modeling indicate constituent concentration reductions are not occurring sufficient to achieve GWPSs within the anticipated timeframe. In such a case, the array of potential supplemental or alternative corrective measures that may be considered would likely be similar to the measures and alternatives developed and evaluated in the CMA report.

Based on the information outlined above, the remedy has been implemented and is anticipated to be completed in a manner consistent with consideration of the factors listed in 40 CFR §257.97(d).

3. Supplemental Remedy Selection Report Certification Statement

I, Steven F. Putrich, am a professional engineer and licensed in the state of Missouri. I have reviewed this Selection of Remedy report for the Ameren Missouri Rush Island Energy Center RCPA coal combustion residuals surface impoundment located in Jefferson County, Missouri. I hereby certify that this report has been prepared in general conformance with and meets the requirements of Title 40 Code of Federal Regulations (40 CFR) § 257.97 of the U. S. Environmental Protection Agency's Rule entitled "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities." 80 Fed. Reg. 21302 (17 April 2015) (promulgating 40 CFR § 257.61); 83 Fed. Reg. 36435 (30 July 2018) (amending 40 CFR § 257.61) (the CCR Rule).

Signed:_____
Certifying Engineer

Print Name:	Steven F. Putrich, P.E.
Missouri License No.:	2014035813
Title:	Project Principal
Company:	Haley & Aldrich, Inc.

Professional Engineers Seal:

5/7/2024

HALEY ALDRICH

TABLES

TABLE 3
EVALUATION OF IMPLEMENTED REMEDY – 40 CFR §257.97(c) REQUIREMENTS
SUPPLEMENTAL REMEDY SELECTION REPORT – RCPA
RUSH ISLAND ENERGY CENTER – JEFFERSON COUNTY, MISSOURI

General Description	Implemented Remedy[1] CIP with Capping, MNA, and Hydraulic Containment through Groundwater Pumping, Ex-situ Treatment, and Re-injection[1]
257.97(c)(1) The long and short term effectiveness and protectiveness of the remedy(s), along with the degree of certainty that the remedy will prove successful	
(i) Magnitude of reduction of existing risk	No unacceptable risk to human health and the environment exists based on the risk assessment in Appendix F and included in the CMA Report. The RCPA has been closed in place with a low-permeability engineered final cover system. The final cover system further contains the CCR material in the RCPA and reduces the risk of the CCR entering the environment. A groundwater extraction, ex-situ treatment, and re-injection system has also been constructed and is operating downgradient to the east of the RCPA and provides hydraulic containment of impacted groundwater.
(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy	The low-permeability final cover system for the RCPA contains the underlying CCR material and significantly reduces the infiltration of precipitation into the CCR. Further protection from further releases is also provided through use of the hydraulic containment provided by the operating groundwater extraction, ex-situ treatment, and re-injection system downgradient to the east of the RCPA. Therefore, the residual risks in terms of likelihood of further releases due to CCR remaining is considered low.
(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance	Long-term management of the implemented remedy includes limited O&M of the final cover system, monitoring wells, groundwater extraction wells, groundwater treatment buildings and associated equipment, re-injection wells, and associated system conveyances. The degree of long-term management required for the closed RCPA is reduced because an engineered synthetic turf and structured membrane composite final cover system (ClosureTurf®) was used instead of a traditional final cover system that includes a vegetative soil layer and grass (which would require relatively more O&M for mowing and erosion control management). After the groundwater extraction, ex-situ treatment, and re-injection system has sufficiently attained remedial objectives in the area downgradient to the east of the RCPA, MNA would involve relatively less long-term management.
(iv) Short-term risks that might be posed to the community or the environment during implementation of such a remedy	Since closure and groundwater treatment system construction activities have already been completed, potential short-term risks to the community or the environment are very limited. Also, the implemented remedy is entirely contained within the Site boundary, which greatly reduces any potential risks to the community or environment. Closure of the RCPA was completed via CIP in December 2020. CIP involves a relatively lower degree of short-term risks posed to the community or environment. Construction of the groundwater extraction, ex-situ treatment, and re-injection system is already complete, and full-scale operations have been ongoing since February 2022.
(v) Time until full protection is achieved	No unacceptable risk to human health or the environment exists based on the risk assessment in Appendix F and included in the CMA Report. Therefore, protection is already achieved. Based on modeling, completed source control and ongoing groundwater treatment through groundwater extraction and re-injection of treated groundwater (in conjunction with ongoing natural attenuation processes) are expected to reduce arsenic and molybdenum concentrations in groundwater to less than GWPSs within a reasonable timeframe.
(vi) 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, or containment	RCPA closure was completed in December 2020 via CIP, which substantially reduced the potential for exposure of humans and environmental receptors to remaining wastes during closure activities compared to CBR. The remaining CCR material is contained within a low-permeability engineered final cover system, which greatly limits the potential for post-closure exposure to the CCR. Limited potential for exposure of Site workers to secondary waste streams produced as part of the ex-situ groundwater treatment process exists; however, that potential for exposure is mitigated through use of proper personal protective equipment and best management practices.
(vii) Long-term reliability of the engineering and institutional controls	Closure of the RCPA by CIP has already been completed, and CIP is a proven long-term solution for CCR management. Extensive laboratory bench-scale testing and in-field pilot testing of the groundwater extraction, ex-situ treatment, and re-injection system were performed prior to full-scale operations began in February 2022. Results of the testing and ongoing groundwater monitoring indicate the system is able to effectively treat the primary Appendix IV constituents arsenic and molybdenum. Ongoing O&M of the system will be necessary, but with proper maintenance the system is anticipated to remain effective in treating impacted groundwater over the long-term.
(viii) Potential need for replacement of the remedy	The CIP method used to close the RCPA is considered permanent and effective at preventing CCR release into the environment and reducing infiltration of precipitation into the CCR. The groundwater extraction, ex-situ treatment, and re-injection system is an effective method for removing constituent mass in impacted groundwater and reducing constituent concentrations in groundwater downgradient to the east of the RCPA. Although groundwater modeling indicates arsenic and molybdenum concentrations are predicted to reduce to less than GWPSs within a reasonable timeframe, the system could be modified in the future if remedial objectives are not being met as expected.
257.97(c)(2) The Effectiveness of the Remedy in Controlling the Source to Reduce Further Releases	
(i) The extent to which containment practices will reduce further releases	RCPA closure was completed in December 2020 via CIP using a low-permeability final cover system that limits infiltration of precipitation into underlying CCR material and protects from future CCR releases through engineered containment of the underlying CCR material. The groundwater extraction, ex-situ treatment, and re-injection system also provides hydraulic containment of impacted groundwater downgradient to the east of the RCPA.
(ii) The extent to which treatment technologies may be used	The implemented remedy uses ex-situ treatment to reduce constituent concentrations in extracted groundwater prior to re-injecting the treated groundwater (at much lower constituent concentrations) into the same zone of impacted groundwater downgradient to the east of the RCPA. Chemical precipitation and selective-ion exchange are the primary treatment technologies used in the ex-situ treatment process. Whereas the CMA Report previously considered use of groundwater pumping and ex-situ treatment to be less favorable under this balancing criterion due to creation of a secondary waste stream, this evaluation considers the groundwater extraction, ex-situ treatment, and re-injection system most favorable due to operation of a system that has been proven effective at removing constituent mass and reducing constituent concentrations in groundwater based on results from completed laboratory bench-scale testing and in-field pilot testing and ongoing groundwater monitoring.
257.97(c)(3) The Ease or Difficulty of Implementing a Potential Remedy	
(i) Degree of difficulty associated with constructing the technology	The CIP method used to close the RCPA was substantially less difficult to implement than the alternative CBR or ISS methods that were considered unfavorable under this balancing criterion in the CMA Report due to technical and logistical challenges. The groundwater extraction, ex-situ treatment, and re-injection system involved a moderate degree of difficulty in constructing the system relative to MNA; however, full-scale operations have been ongoing since February 2022, and no further construction is anticipated at this time.
(ii) Expected operational reliability of the technologies	Closure of the RCPA is complete, and only ongoing O&M of the final cover system is necessary. Operation of the groundwater extraction, ex-situ treatment, and re-injection system is generally reliable, with temporary shutdowns necessary for routine or non-routine maintenance, repair, or replacement.
(iii) Need to coordinate with and obtain necessary approvals and permits from other agencies	Closure-related permitting and approvals were obtained to support RCPA closure by CIP, which required less permitting and approvals than the alternative CBR or ISS methods that were considered unfavorable under this balancing criterion in the CMA Report. After a series of treatability studies were completed to evaluate the feasibility and effectiveness of groundwater treatment near the RCPA, Ameren received an UIC permit UI-0000043 and completed an in-field pilot study in 2021. The groundwater extraction, ex-situ treatment, and re-injection system became fully operational downgradient to the east of the RCPA in February 2022.
(iv) Availability of necessary equipment and specialists	Equipment and specialist needs were less to support RCPA closure by CIP relative to the alternative CBR or ISS methods that were considered unfavorable under this balancing criterion in the CMA Report. Additional equipment and specialists were needed to perform laboratory bench-scale and in-field testing as well as construction of the groundwater extraction, ex-situ treatment, and re-injection system. That system became fully operational in February 2022, and limited staff are needed to support ongoing O&M of the system.
(v) Available capacity and location of needed treatment, storage, and disposal services	CIP of the RCPA allowed CCR material to remain on-Site and in-place, which would not have been possible under a CBR scenario. Re-injection of treated groundwater into the same zone of impacted groundwater downgradient to the east of the RCPA was a solution that allows the system to be self-contained, further reduces constituent concentrations in impacted groundwater, and prevents the need for disposal or discharge to surface water. Approximately 6.3 million gallons of water were treated in 2022, and approximately 11.6 million gallons of water were treated in 2023.

Notes:
[1] - The implemented remedy is a combination of the CMA Report's Alternative 1 and Alternative 4, with an additional corrective measure in the form of re-injecting the treated groundwater into the area of impacted groundwater downgradient to the east of the RCPA.

Abbreviations:
CBR = closure by removal
CCR = coal combustion residuals
CIP = closure in place
CMA = Corrective Measures Assessment
GWPS = Groundwater Protection Standard
ISS = in-situ stabilization
MNA = monitored natural attenuation
O&M = operations and maintenance
RCPA = RCPA surface impoundment (CCR unit)
UIC = Underground Injection Control

FIGURES

KEY MAP

Site Location

840000

840000

P29S
MW-B2
P29D
MW-B1
P30S
P31S
MW-1
P16S
P17S
P17I
P17D
MW-7 (R)
P10S
MW-2
P19S
P19I
P19D
RCPA
MW-3
P21S
P21I
P21D
MW-6
P22S
P22I
P22D
P05I
P05S
MW-5
MW-4
P01S

MISSISSIPPI RIVER

Source: Esri, Maxar, GeoEye
IGN, and the GIS User Comm

GROUNDWATER MONITORING WELL LOCATION MAP

SUPPLEMENTAL REMEDY SELECTION REPORT

HALEY ALDRICH

FIGURE 1

LEGEND

- Rush Island Energy Center Property Boundary
- RCPA - Closed Surface Impoundment

Monitoring Well Networks

- Corrective Action Monitoring Well
- RCPA Detection and Assessment Monitoring Well
- Monitoring Well Used for Water Levels Only

0 1,000 2,000 3,000 4,000
Feet

NOTE(S)
1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.

REFERENCE(S)
1.) AMEREN MISSOURI RUSH ISLAND ENERGY CENTER, RUSH ISLAND PROPERTY CONTROL MAP, JANUARY 2012.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2401 FEET.

CLIENT
AMEREN MISSOURI
RUSH ISLAND ENERGY CENTER

CONSULTANT
GOLDER

YYYY-MM-DD	2022-02-20
DESIGNED	JSI
PREPARED	ETF
REVIEWED	BTT
APPROVED	MNH

PROJECT
GROUNDWATER MONITORING PROGRAM

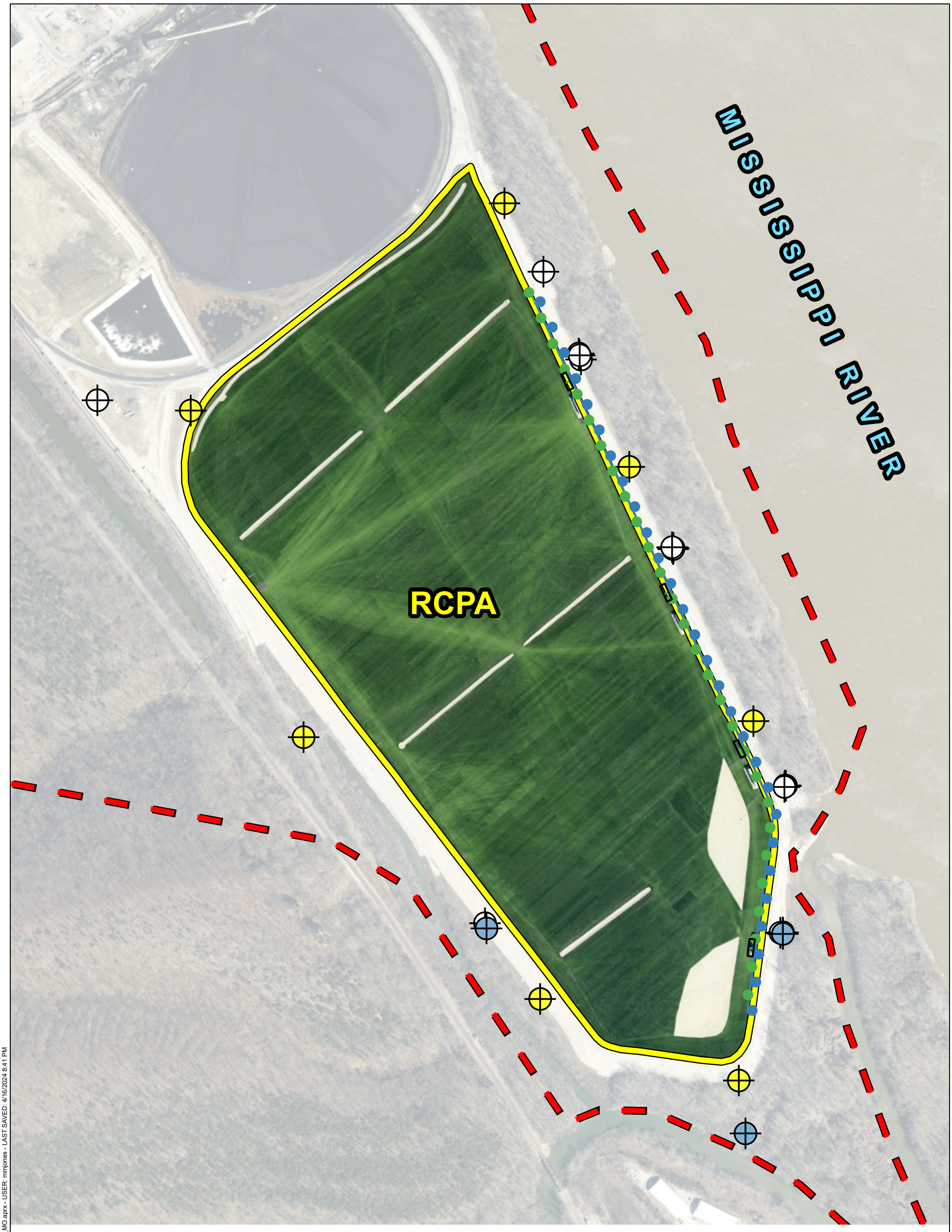
TITLE
RUSH ISLAND ENERGY CENTER GROUNDWATER MONITORING PROGRAMS AND WELL LOCATION MAP

PROJECT NO.	CONTROL	FIGURE
153140604	1240	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in

0



LEGEND

- GROUNDWATER INJECTION WELL
- GROUNDWATER EXTRACTION WELL
- INJECTION PIPING
- EXTRACTION PIPING

GROUNDWATER MONITORING WELL NETWORK

- CORRECTIVE ACTION MONITORING WELL
- RCPA DETECTION AND ASSESSMENT MONITORING WELL
- MONITORING WELL USED FOR WATER LEVELS ONLY

- EX-SITU GROUNDWATER TREATMENT BUILDING
- RCPA SURFACE IMPOUNDMENT (CLOSED)
- RUSH ISLAND ENERGY CENTER PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE AND WERE PROVIDED BY ROCKSMITH GEOENGINEERING, LLC AND LOUREIRO ENGINEERING ASSOCIATES, INC.

2. SEE FIGURE 1 FOR INDIVIDUAL MONITORING WELL IDENTIFICATION INFORMATION.

3. SEE FIGURE 3 FOR INDIVIDUAL EXTRACTION AND INJECTION WELL IDENTIFICATION INFORMATION.

4. AERIAL IMAGERY SOURCE: ESRI, 13 MARCH 2022

N

0 400 800

SCALE IN FEET

HALEY ALDRICH

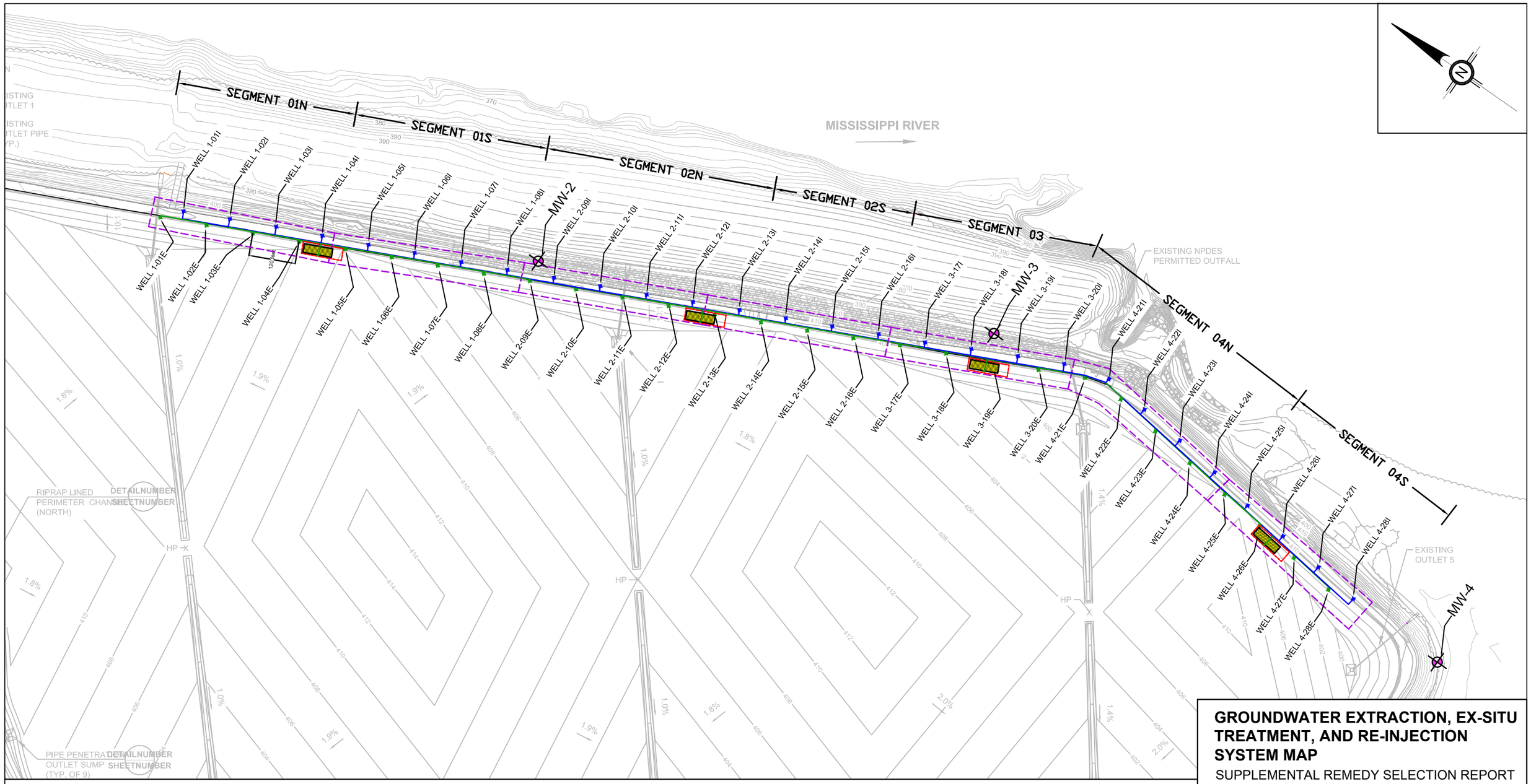
RUSH ISLAND ENERGY CENTER
JEFFERSON COUNTY, MISSOURI
SUPPLEMENTAL REMEDY SELECTION REPORT

SELECTED REMEDY OVERVIEW MAP

MAY 2024

FIGURE 2

GIS FILE PATH: \\haleyaldrich\share\CF\Projects\132002\GIS\132002_AMEREN_ASH_POND_MO.aprx - USER: mmjones - LAST SAVED: 4/16/2024 8:41 PM



LEGEND

- PROPOSED INJECTION WELLS
- PROPOSED EXTRACTION WELLS
- EQUIPMENT BUILDING (75 FT X 25 FT)
- BUILDING PAD (90 FT X 35 FT)
- INJECTION AND EXTRACTION WELL PIPING
- FULL-SCALE PUMP & TREAT BARRIER / SEGMENTS 01 TO 04

NOTES

1. MAP REFERENCE: FIGURE PROVIDED BY HALEY & ALDRICH, "PROPOSED TOP OF CLOSURETURF® PLAN", MARCH 2020.
2. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.

GROUNDWATER EXTRACTION, EX-SITU TREATMENT, AND RE-INJECTION SYSTEM MAP

SUPPLEMENTAL REMEDY SELECTION REPORT

HALEY ALDRICH

FIGURE 3

240 120 0 240

SCALE (FEET)

XDD ENVIRONMENTAL

SCALE: AS SHOWN	
DATE: APRIL 17, 2021	
PROJECT NO.: 21009	
CLIENT: AMEREN	
DRAWN BY: PC	
CHECKED BY: DI	
PROJ. MGMT. APPROVAL: DI	
TITLE:	WELL LAYOUT - PLAN VIEW RUSH ISLAND ENERGY CENTER FESTUS, MISSOURI
DRAWING NO.	04-001
REV.:	1

APPENDIX A
Response to 2019 CMA Public Comments

Response To Community Comments On Ameren Missouri Corrective Measures Assessments For Rush Island, Labadie, Sioux And Meramec Energy Centers

Contents

SUMMARY OVERVIEW

In May 2019, Ameren Missouri held public meetings regarding Corrective Measures Assessment (CMA) Reports for the Rush Island, Labadie, Meramec and Sioux Energy Centers. At those meetings and afterwards in written comments, the public raised a variety of concerns regarding CCR basins located at the energy centers. This Response to Community Comments addresses those concerns. In addition, Ameren Missouri ("Ameren") has performed additional technical analysis which has been posted on Ameren's CCR website along with this Response. Ameren summarizes key response items below:

- *Groundwater Impacts are Limited and No Risk to Public Health Exists.* Groundwater impacts at Ameren's energy centers are limited and localized in nature. Drinking water supplies, whether residential wells or adjacent rivers, are not impacted by the energy centers. Suggestions that Ameren has somehow "skewed" or misrepresented the data are inaccurate. *See* Section 2 and 3 and Attachments 1 and 2.

- *Excavation Delays Compliance with Groundwater Standards*. Several commenters argue that the only way to comply with the CCR Rule is to excavate the ash. Not true. Concentration levels will diminish over time due to installation of a geomembrane cap, the water table lowers, and pH conditions stabilize. Excavation requires the basins to remain open to ongoing infiltration. To address such comments, Ameren performed additional modeling analysis to assess groundwater impact at Rush Island under both containment and excavation scenarios. Containment results in a predicted return to standards in 2027, approximately 6-7 years post-closure, as compared to 2057 under an excavation scenario. *See* Section 11 and in Attachments 6 and 7. Concerns relating to groundwater compliance are addressed more expeditiously by promply closing and capping the ash basins and cutting off infiltration.

- *Trucking is Less Burdensome than Rail but Neither is Fast.* The Lochmueller Extraction & Transportation Study (CMA, Appendix C) described the logistics behind hauling CCR from the energy centers to a commercial landfill. Certain commenters took issue with that analysis and instead contend that railroad carrier CSX provides such services. Connecting to the CSX railroad would require multiple carriers, installation of onsite storage yards, nine dedicated, 100-car unit trains, and commercial landfill unloading facilites. No Illinois or Missouri landfill was identified as having adequate rail facilities. *See* Section 4 and Attachment 3.

- *The CCR Basins are Structurally Sound, Built to Withstand Extreme Weather Events*. Several commenters expressed concerns regarding the risk of "wash out" or "liquefaction" of the stored material should a flood or seismic event occur. All of Ameren's CCR units are protected by massive embankments designed to prevent failure. The potential for extreme events has been specifically considered and we have provided a stability analysis summary chart. *See* Section 5.

GENERAL COMMENTS

To the extent a number of commenters raised identical or similar issues, such comments are grouped by subject matter.

1. The Public Meetings Facilitated One-on-One Discussions and Were Designed to Foster Collaboration

The public meetings provided a forum to define the community concerns; promote one-on-one communication between Ameren and the community; and to foster collaboration. Ameren and its experts presented information about the CMAs and made themselves available to discuss questions and concerns expressed by those in attendance. Importantly, the CCR Rule does not specify a format for the public meeting nor does the rule require that specific responses be provided. The rule simply states that the remedy selection by the owner should consider the "degree to which community concerns are addressed by a potential remedy(s)." Nevertheless, Ameren believes responses to the concerns are important.

Ameren organized the public meetings with much thought and consideration. The meetings featured technical experts located at discrete stations who were available to discuss a number of topics relevant to the corrective measures options; groundwater data collection; risk assessment analysis; modeling analysis; the corrective measures assessment process; and dam safety issues. The goal was to maximize for the community one-on-one time with company representatives and the experts so the community could provide their input and present questions.

A number of commenters expressed frustration with the meeting time, a perceived lack of notice and a perceived lack of time to review the CMAs. Ameren wishes to address these concerns. First, as to notice, Ameren placed notices of the meeting on its CCR website and in a variety of media outlets (***St. Louis Community News, Festus Jefferson Leader and the Washington Missourian***) during the weeks of May 1 and May 9, 2019. Second, as to the CMAs, Ameren posted the CMA reports on its CCR webpage starting on May 16, 2019, with printed copies available at the meetings.[1] We note that there is no requirement to make the CMAs available prior to the meeting but Ameren chose to do so regardless. Indeed, social media postings by the Labadie Environmental Organization (LEO) and Sierra Club clearly reflect that local environmental activists were not only well aware of the meeting dates and times, but also of the CMA posting. In fact, activist groups had members attend each of the meetings. Lastly, as to the time of day, Ameren selected the afternoon and all of the meetings were well attended. For those who could not attend, Ameren received comments through a dedicated email address box and, as requested, posted the exhibits used at the meetings to the Ameren website following the meetings. Again, all of this is more than is required by the CCR Rule.

[1] The CMA reports were removed temporarily from the website on May 30, 2019, during an IT system migration but were re-posted the next day.

While the format did not include or facilitate speechmaking, the format was informational and not a "public relations event." The amount of direct questioning and explanation clearly resonated with many members of the community. Again, Ameren chose the format to provide the greatest amount of direct contact with company representatives and the technical experts. Videos taken by the environmental activists during the meetings demonstrate that attendees effectively utilized the question and answer approach.

2. <u>CCR Constituents Do Not Threaten Human Health or Drinking Water</u>

Some commenters expressed concern that CCR constituents in groundwater at Ameren's energy centers present a risk to drinking water sources and to public health. **Public or private drinking water supplies are not at risk from Ameren's CCR units.** As depicted in the charts below and as presented in numerous technical reports including the CMAs, the CCR units have not affected the bedrock aquifer that serves as a water source to residences located within the general vicinity of the Labadie and Rush Island energy centers. To the extent impacts from coal ash exist on Ameren's property and immediately adjacent to surface impoundments, the public has no direct or indirect access to such groundwater. Further, as presented in numerous technical reports including the CMAs, sampling results demonstrate that public drinking water sources that draw from the Meramec, Mississippi and Missouri Rivers are not impacted by Ameren's CCR units. As made clear in published risk assessments, where there is no exposure, there can be no risk.

More specifically, in calendar years 2012-2014, going beyond then existing or current regulatory requirements, Ameren installed offsite monitoring well networks at both Labadie and Rush Island in an effort to provide the community with data to address concerns about the sites' impact on their drinking water wells. Through these monitoring networks, Ameren evaluated groundwater quality, flow direction and water column height within the bedrock aquifers. So that representative samples were taken, the monitoring wells mirrored the actual depths of the residential wells. Groundwater elevations in residential wells are at a higher elevation than groundwater levels near the ash basins. Groundwater moves from the bluffs to the river valleys and **no physical mechanism exists** through which groundwater from Ameren's coal ash basins could travel uphill to domestic water supplies. This is true even under an extreme flood; hypothetically assuming river levels match the highest flood of record for 55 straight days. *See Golder Technical Memorandum dated June 26, 2019* attached hereto as **<u>Attachment 1</u>**.

Labadie – No Impact to Bedrock Aquifer

Do values from offsite well network exceed CCR Rule GWPS (Yes or No)

Analyte	UNITS	GWPS	September/October 2014 Samples							
			TGP-A	TGP-B	TGP-C	TGP-D	TGP-E	TGP-F	TGP-G	BW-1
Sample Date			9/9/2014	9/8/2014	10/3/2014	10/6/2014	9/8/2014	9/30/2014	9/3/2014	9/9/2014
ARSENIC, TOTAL	µg/L	42.6	NO	NO	NO	NO	NO	NO	NO	NO
BARIUM, TOTAL	µg/L	2,000	NO	NO	NO	NO	NO	NO	NO	NO
BERYLLIUM, TOTAL	µg/L	4	NO	NO	NO	NO	NO	NO	NO	NO
CADMIUM, TOTAL	µg/L	5	NO	NO	NO	NO	NO	NO	NO	NO
CHROMIUM, TOTAL	µg/L	100	NO	NO	NO	NO	NO	NO	NO	NO
COBALT, TOTAL	µg/L	6	NO	NO	NO	NO	NO	NO	NO	NO
FLUORIDE, TOTAL	µg/L	4	NO	NO	NO	NO	NO	NO	NO	NO
LEAD, TOTAL	µg/L	15	NO	NO	NO	NO	NO	NO	NO	NO
MERCURY, TOTAL	µg/L	2	NO	NO	NO	NO	NO	NO	NO	NO
MOLYBDENUM, TOTAL	µg/L	100	NO	NO	NO	NO	NO	NO	NO	NO
SELENIUM, TOTAL	µg/L	50	NO	NO	NO	NO	NO	NO	NO	NO
THALLIUM, TOTAL	µg/L	2	NO	NO	NO	NO	NO	NO	NO	NO

Notes:
1) µg/L – micrograms per liter, mg/L – milligrams per liter,
2) GWPS – Site-specific Groundwater Protection Standard applicable to Labadie CCR units

Rush Island – No Impact to Bedrock Aquifer

Do values from offsite well network exceed CCR Rule GWPS (Yes or No)

Analyte	UNITS	GWPS	TBW-1	TBW-2	TBW-3
Samples Collected in 2014					
ARSENIC, TOTAL	µg/L	30	NO	NO	NO
BARIUM, TOTAL	µg/L	2,000	NO	NO	NO
BERYLLIUM, TOTAL	µg/L	4	NO	NO	NO
CADMIUM, TOTAL	µg/L	5	NO	NO	NO
CHROMIUM, TOTAL	µg/L	100	NO	NO	NO
COBALT, TOTAL	µg/L	6	NO	NO	NO
FLUORIDE, TOTAL	µg/L	4,000	NO	NO	NO
LEAD, TOTAL	µg/L	15	NO	NO	NO
MERCURY, TOTAL	µg/L	2	NO	NO	NO
MOLYBDENUM, TOTAL	µg/L	100	NO	NO	NO
SELENIUM, TOTAL	µg/L	50	NO	NO	NO
THALLIUM, TOTAL	µg/L	2	NO	NO	NO

Notes:
1) µg/L – micrograms per liter.
2) GWPS – Site Specific Groundwater Protection Standard applicable to Rush CCR Unit.

With respect to St. Charles and St. Louis County communities located near the Sioux and Meramec energy centers, all residences are connected to public water suppliers that draw from

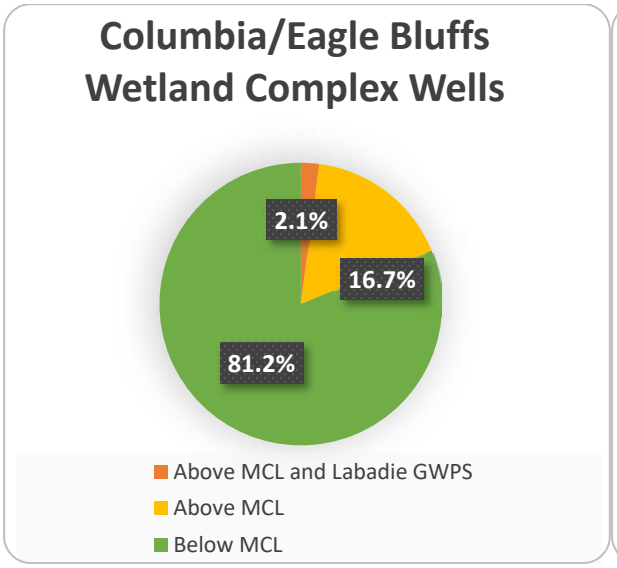
drinking water intakes located within the Missouri, Mississippi or Meramec Rivers and are miles away from the facilities. Extensive river sampling immediately adjacent, downstream and upstream from Ameren's facilities (again this sampling is over and above what is required by any rule), confirms that all such surface water samples (more than 250 sample locations and over 16,000 individual analyses) comply with federal and state drinking water standards. **Ameren's energy centers do not adversely impact those surface waterbodies.**

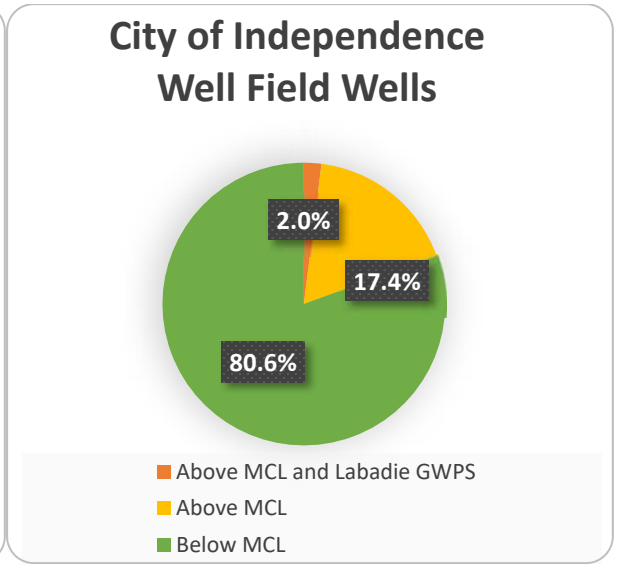
3. The Groundwater Protection Standards Set by Ameren are Protective and Comply with the CCR Rule

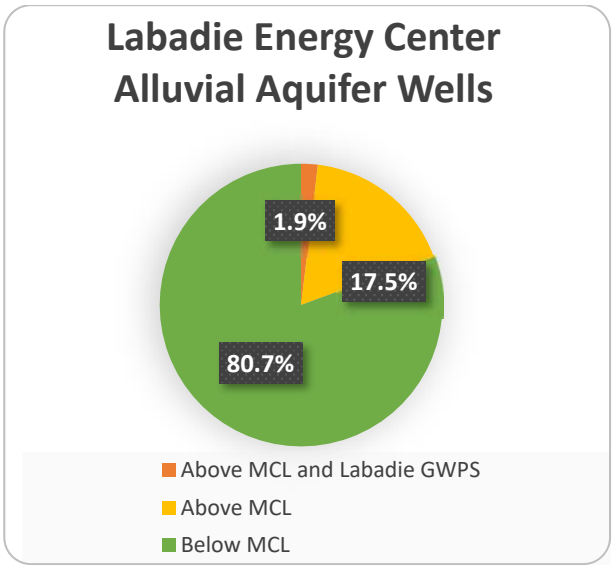
Groundwater impacts at Ameren's energy centers are limited in nature with more than 95% of assessment monitoring results statistically **below** site groundwater protection standards. This is good news. And yet, rather than being reassured by such results, activists instead argue in comments that Ameren "skewed" the data and calculated "abnormally high" background levels and, consequently, protection standards. Nothing could be further from the truth. The CCR Rule prescribes a specific process for the siting of wells, collecting data, and then statistically analyzing the results to calculate the Groundwater Protection Standards (GWPS) used in the CCR process. The CCR Rule requires that a licensed professional engineer certify all critical steps of the process and EPA has issued a Unified Guidance for determining the applicable statistical methodology, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities*, (Unified Guidance) EPA-530-F-09-020 (March 2009). The GWPS calculated for each site fully comply with the CCR Rule and Unified Guidance. Ameren's independent licensed professional engineer and hydrogeologist who certified the standards prepared an additional technical memorandum to address comments received from the Washington University Environmental Law Clinic (WUELC), **Attachment 2** to this response document.

Ameren also responds to additional more specific comments received on two naturally occurring constituents, arsenic and molybdenum. Those comments relate to the setting of GWPS for those constituents at Labadie and Rush Island. As to arsenic, contrary to the WUELC's claims that arsenic present in background wells emanates from Ameren's CCR units, naturally occurring levels of arsenic with concentrations above EPA standards are widespread within the Missouri River alluvial aquifer. In fact, the National Water Quality Monitoring Council (NWQMC) reports in a publicly available database that approximately 20% of groundwater samples collected near groundwater municipal well fields in Missouri (Columbia and Independence), have ambient arsenic levels above the MCL. As the charts below reflect (prepared using the NWQMC data), the data closely align with sampling results collected in the alluvial aquifer at Labadie. In other words, naturally occurring levels of arsenic are found within various locations in Missouri and such levels are consistent with background conditions found upgradient from Ameren's sites. But putting aside data from other locations in Missouri, it is important to note that the background wells at Labadie are ***more than one-mile upgradient/cross-gradient*** from the facility and located in an agricultural field ***unimpacted*** by CCR. Additionally, background wells at Rush Island are located north of the power plant building and upgradient/cross-gradient of the CCR unit.

Naturally Occurring/Non-CCR Arsenic Exist At Labadie and Other Municipal Sites







Golder calculated the arsenic GWPS using sixteen (16) data points per site, consisting of eight (8) baseline samples from each of the two background wells. Due to the spatial variability in the arsenic samples between the background wells (one with high results and one with low results), Golder used a statistical method consistent with EPA's Unified Guidance to calculate the GWPS. The remainder of this paragraph describes the statistical test used to determine a single background level where measured results vary. The terms used are standard statistical language, perhaps not familiar to the reader. Where spatial variability exists, Golder performed statistical outlier analysis, removed any outliers and then calculated a tolerance level. Because the background data varied spatially at both sites, the resulting GWPS is equal to the highest background value in each data set. Because the background data were not normally distributed for either site, the concentrations of 42.6 µg/L (Labadie) and 30 µg/L (Rush Island), respectively,

are from observed values, not outliers, and therefore are statistically part of the background population. In addition, it is clear from well logs that the selected background locations are not influenced by site operations due to their upgradient/cross-gradient locations and the limited groundwater concentrations of either boron or molybdenum, indicating the lack of CCR impact. As a result, and notwithstanding differences between the sample populations of the two wells at each site, the background data from the higher concentration wells must be considered. The higher concentrations in background wells at each site demonstrate that arsenic exists, unrelated to plant operations, representing a background condition that must be included in the statistical analysis of data.

As to molybdenum and based upon their comments, the Missouri Confluence Waterkeeper (Waterkeeper) seems to have misunderstood the purpose behind the Molybdenum Fact Sheet provided by Ameren at the public meetings. Molybdenum, while naturally occurring, is not a commonly known element and Ameren thought it would be helpful to provide a separate background fact sheet with each of its CMA reports to provide context for the public. The fact sheet notes that the Institute of Medicine of the National Academy of Sciences (NAS) defines molybdenum as an essential nutrient for human health. In addition to developing a Recommended Daily Allowance (RDA) that defines the amount of molybdenum needed to maintain good health, the NAS also developed an Upper Tolerable Limit for molybdenum, a limit that equates to a safe drinking water level of 600 µg/L. The Fact Sheet presented this value purely as a point of context; **Ameren knows and acknowledges that it is the GWPS that is used as the basis of decision making under the CCR Rule.**

Further, in 2018, EPA revised its regulations to designate a specific protection standard for molybdenum and adopted 100 ug/L for molybdenum. 83 Fed. Reg. 36435,36444 (June 30, 2018) (Emphasis added.) Importantly, EPA went on to say:

> "These levels were derived using the same methodology that EPA proposed to require States to use to establish alternative GWPS (*See* 83 Fed. Reg. 11598–11599, 11613). The methodology follows Agency guidelines for assessment of human health risks of an environmental pollutant. This means that **these GWPSs are expected to be concentrations to which the human population could be exposed to on a daily basis without an appreciable risk of deleterious effects during a lifetime**." *Id.* (Emphasis added.)

Ameren used the GWPS of 100 µg/L for molybdenum at all four of its facilities. While we agree with the Waterkeeper that EPA included molybdenum on its 2009 Contaminant Candidate List, 74 Fed. Reg. 51850,51852 (Oct. 8, 2009), no regulatory action has occurred in the intervening ***10-year period*** and where the EPA may go with this rulemaking is unknown.

4. Railing or Barging CCR from Ameren's Energy Centers is Neither Reliable Nor Economical

WUELC argues, seemingly based on a CSX marketing brochure that it references, that rail transport would avoid local impacts to the community inherent in truck hauling and therefore

rail is a viable option for transporting CCR for the offsite disposal. However, as the brochure notes, "CSX offers direct connections to numerous cement producers, fly ash and slag locations, and cement terminals **throughout the East Coast."** Ameren Missouri's energy centers are all located west of the Mississippi River.

Ameren receives coal via rail delivery and has extensive experience with the challenges associated with such transport mode. Ameren asked its transportation expert to expand its consideration of rail and barge in response to comments received. Set forth below are key considerations based on Ameren's experience and the Lochmueller Group review (**Attachment 3**):

- *Multiple Carriers.* Neither CSX nor its short-line rail partners have direct access to Ameren's energy centers. To connect to CSX at its Rose Lake Yard in East St. Louis, a unit train (a set of similar railcars that typically remain together in a dedicated train), would need to first transfer to the Terminal Railroad Association in St. Louis via the Burlington Northern (BNSF: Rush Island, Sioux) or Union Pacific railroads (UP: Meramec, Labadie).

- *Coal Trains Can't Be Repurposed.* Dedicated coal unit trains leave the the Powder River Coal Basin on a near-daily basis and travel directly to the energy centers via the UP or BN railroads, unload, and then return in a near-continuous loop. The train cars are specifically designed to carry and unload coal and are NOT designed to carry CCR.

- *Single Loop Rail Tracks Require Coal Delivery Prioritization.* The energy centers have single loop rail tracks that, in order to maintain reliable generating operations, must prioritize coal deliveries. The hauling of large volumes of CCR woud require separate onsite car storage areas known as "ladder tracks" and specialized, covered rail cars traveling in a "unit train". Sufficient or adequate property for ladder tracks may not be available at all locations such as Rush Island.

- *Carriers Control Haul Cycles, Not Shippers.* Unlike truck hauling, the carrier, not the shipper, controls the availability of locomotives and timing of shipments. In order to get to the CSX, the unit train would need to be staged on ladder tracks at the energy center until the originator carrier (UP or BNSF) is available to transport the unit train to a rail yard in St. Louis where a terminal railroad would then move the loaded unit train to CSX's Rose Lake yard located in East St. Louis. From there, the CSX would take possession of the unit cars and haul to a landfill with proper rail unloading facilities large enough to accommodate a unit train. Alternatively, the loaded unit train could be delivered to a train-to-truck transfer station located close to the disposal site where the CCR would be unloaded from rail cars and then hauled via truck to a landfill. Once emptied, the unit train cars would return via the reverse route (CSX, Terminal, and UP/BNSF railroads). The entire process entails multiple railroad crew exchanges.

- *Logistical Issues Impact Reliability of Rail*. Due to the haul cycles and load/unload times, a single unit, 100-car train is capable of transporting at most one load per week.

Nine (9) unit trains would be required to to maintain parity with trucking estimates of 5,000 tons per day. The cost of procuring such trainsets is approximately $90M ($100,000 per car x 9 unit trains). Interruptions with multiple railroad crews or service anywhere along the haul routes, rail yards or energy centers would disrupt shipments. Based on Ameren's experience with coal deliveries, it is highly unlikely that the rail carriers could consistently maintain such productivity.

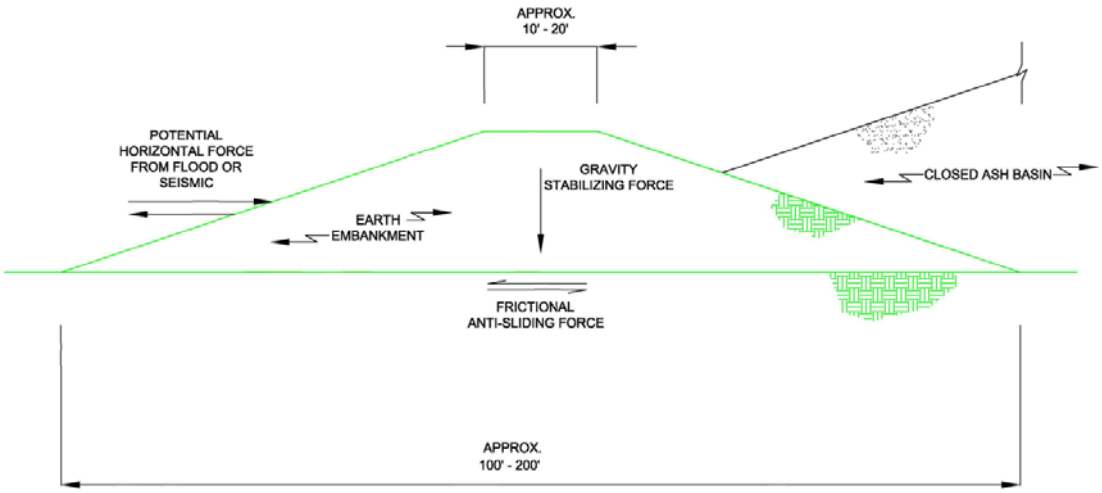
- Shipment via barge is not a viable option due to a lack of existing loading/unloading facilities and environmental concerns associated with large scale, long term shipments on unpredictable waterways.

5. <u>Ameren Ash Basins: Sound Structural Integrity Even Under Flood Conditions</u>

Several commenters expressed concerns that the in-place closure of CCR units could increase the risk of "wash out" or "liquefaction" of the stored material should a flood or seismic event occur. We understand these concerns. The CCR Rule specifically requires owners of ash basins and landfills to perform extensive structural and geotechnical analyses to verify the stability of such units during both normal operations and natural disasters. All of Ameren's CCR units have been inspected, evaluated and verified by third-party geotechnical engineering firms and are inspected weekly by specially-trained plant personnel and annually by Dam Safety specialists.

Ameren's coal ash basins are protected by massive embankments and designed to prevent failure. The potential for extreme events has been specifically considered. The embankment slopes have undergone rigorous evaluations as part of the CCR Rule's structural integrity requirements and are subject to weekly surveillance and monthly maintenance protocols. Engineering evaluations calculate the slope stability of the embankments and compare the driving forces within a cross-section of slope to the resisting forces and determining a factor of safety (FOS). Slope stability analysis includes multiple geotechnical borings and laboratory analysis to assess soil properties. Gravity forces tend to move the slope downward (driving force), while resisting forces derived from soil shear strength, tend to keep the slope in place. When the driving force on a slope is greater than the resisting force, sliding can occur. Ameren's embankments have broad foundations that are at least 4 to 6 times as wide as their height and narrow to a minimum of approximately 10 to 20 feet at their crests. This slope configuration functions as a solid pyramid designed to withstand flooding and seismic events. The diagram below depicts a typical configuration and illustrates the shear mass that would need to erode or otherwise be compromised before a "wash out" of compacted ash stored within the basin could occur.

EMBANKMENT SLOPES & FORCES



Lastly, the embankments surrounding the basins can withstand an estimated 7.0 to 8.0 magnitude earthquake. Both EPA and the Missouri Department of Natural Resources (MDNR) have published target safety factors for a variety of potential structural conditions and all of Ameren's CCR units meet or exceed those requirements.[2] The calculated FOS are expected to increase post-closure as surface waters are removed reducing internal force and pressures. In addition, an engineered cap and stormwater measures will prevent pooling on and within the basins.

SLOPE STABILITY ANALYSIS

	Condition	Target FOS	Minimum Calculated FOS
Labadie	**Major Flood Event**	1.40	1.52
	Steady State	1.50	1.64
	Liquefaction	1.20	1.27
	Slope with Seismic Forces	1.00	1.08

	Condition	Target FOS	Minimum Calculated FOS
Rush Island	**Major Flood Event**	1.40	1.42
	Steady State	1.50	1.51
	Liquefaction	1.20	1.29
	Slope with Seismic Forces	1.00	1.07

[2] 80 Fed. Reg. 214755-77

	Condition	Target FOS	Minimum Calculated FOS
Sioux	**Major Flood Event**	1.40	1.42
	Steady State	1.50	1.50
	Liquefaction	1.20	1.26
	Slope with Seismic Forces	1.00	1.12

	Condition	Target FOS	Minimum Calculated FOS
Meramec	**Major Flood Event**	1.4	1.62
	Steady State	1.5	1.71
	Liquefaction	1.2	1.62
	Slope with Seismic Forces	1.0	1.18

Lastly, closure design includes armoring the riverside of embankment slopes to mitigate erosion from floodwater rises and rapid draw down conditions. In addition to routine examinations, qualified Dam and Safety personnel inspect embankments before, during and after flood conditions to ensure proper ongoing maintenance. All of Ameren's ash pond embankments remain structurally sound following the recent 2019 floods crests.

6. <u>The WUELC Misconstrues the CCR Rule and Seeks to Create a New Standard</u>

WUELC's interpretation of the federal CCR rule as those rules relate to elimination of *"free liquids"* is simply misplaced. The requirement cited by WUELC is located within the closure provisions of the regulations that address the activity of drainage or dewatering, and subsequent stabilization of the CCR, to allow for the construction and installation of the final cover system. EPA specifically defined "f*ree liquids"* in relation to ambient pressure and temperature, a clear reference to removal of standing water as part of the draining/dewatering of a CCR basin in preparation for installation of a closure capping system in accordance with best engineering practices. Nowhere does the CCR Rule require draining or dewatering CCR impoundments at depth to meet the closure in place requirements.

The CCR rule requires that owners of CCR units meet two main performance criteria: contain the CCR waste mass in a covered, stabilized unit; and address impacted groundwater outside of the CCR unit boundaries. *See* 40 CFR §257.102 and §257.97, respectively. The rule does not require a compliance monitoring point *within* the waste that is contained in place. EPA

specifically authorized two closure options: removal or closure in place and EPA does not select, or even prefer, one to the other.[3]

By conflating CCR Rule performance standards, WUELC attempts to create a *new* performance standard, one that does not exist in the rule and in effect would mandate excavation regardless of environmental impact. WUELC's position is also in direct contradiction to the actual language of the rule and RCRA's governing standards of *"no reasonable probability of adverse effect on health or the environment.*" EPA found that monitoring groundwater throughout the active and post-closure periods and requiring the owner to perform appropriate corrective measures adequately addresses any groundwater impacts.

7. The Estimated Timeline for Excavation is Reasonable Given the Volumes and Complexity of an Excavation Project

Estimated timelines contained in the Lochmueller report are based on a number of factors including transportation related factors. Using Rush Island as an example, such factors include: volume of stored material including soil amendments; travel time and distance to disposal site; maximum daily haul rate (5,000 tons); 8-hour daily operation and a range of 115-192 days per year of operation (adjusted for equipment breakdown, weather, holidays, vacation, imperfect execution, etc.). The daily haul rate assumes a fleet of trucks making multiple roundtrips per day and that the landfill has capacity, manpower, and authority to accept the maximum daily load of trucks (192). Haul trucks leaving the site every 2.5 minutes would still take decades upon decades to complete the project. Even assuming a constant stream of available trucks, there is simply a practical limitation on how quickly an excavator can load a truck even if there were multiple trucks and multiple excavators onsite.

Furthermore, in addition to the transportation challenges outlined by Lochmueller, there are a number of construction-related issues associated with excavating large volumes of material adjacent to large river systems in alluvial (i.e., river deposited) sands and up to depths of approzimately 100 feet. To further explain the timeline for excavation, Reitz & Jens, a geotechnical engineering firm, examined the construction related issues identified by Lochmueller and supplemented the analysis. Reitz & Jens prepared a white paper outlining its analysis found here in **Attachment 4**. In its *Study of Deep Excavation*, Reitz & Jens notes the following:

- *Excavation Methods.* There are two principal methods of removal or excavation of the CCRs from the basins: 1) excavation in the "dry" by first pumping out the water to some depth below the excavation; or 2) excavation in the "wet" by dredging. Other

[3] "In practice, EPA does not routinely require complete removal of all contamination (that is, cleanup to 'background') from a closing unit even for hazardous waste units. Requiring CCR units to clean up soils to levels before the site was contaminated, would be more stringent than current hazardous waste policies. There is no basis in the current record to impose provisions for the remediation of CCR units that are more stringent than those imposed on hazardous wastes." 80 Fed. Reg. 21302, 21412.

than at the top 20-30 feet, the location of the basins would preclude large-scale excavation via "dry" techniques and the use of conventional equipment.

- *Conventional Dredging has an Adverse Impact on Groundwater.* Dredging with an open bucket (i.e., backhoe, dragline or clamshell) could result in suspension of particles in the remaining groundwater, and an increase in the hydraulic conductivity of the remaining CCR, both potentially causing additional release of contaminants to groundwater.

- *Specially Designed Equipment*. Due to these concerns, the only viable method identified by Reitz & Jens for deep excavation is a cutter-head dredge that would need to be specifically designed and manufactured for Ameren's sites. The unique dredge may pump approximately 14,000 gallons per minute and could remove up to 650 cubic yards of CCR per hour. A suction dredge may be used for depths up to 20 to 30 feet.

- *Construction and Permitting of Settling Basins.* To use the specially designed dredge, a large volume of water would need to be routed from the CCR unit to multiple lined settling ponds. These ponds currently do not exist and would require permitting from MDNR. After CCR settles in the ponds, the dredged material is excavated and dried to allow for overland hauling to a commercial landfill. This double-handling and drying process takes substantial space and time, increasing the costs substantially as well. Remaining water would need to be monitored, potentially treated, and discharged in accordance with regulatory requirements.

- *Dredging Operations Could Take a Decade or More.* It would take more than a decade of full-time dredging operation to remove the CCRs from the largest of Ameren Missouri's CCR units—this time estimate does not take into account permitting, construction activities, drying, double-handling of CCR, weather, maintenance, transportation of the CCR for disposal off-site and handling of the water that remains in the settling ponds.

With all of these considerations taken into account, Reitz & Jens' conclusions are consistent with the time estimates determined by Lochmueller in its transportation study. In no sense are Ameren's basins (total system in-place volume 31M tons) similar to the City of Columbia's three year, 90,000 ton excavation from a single, four (4) acre former farmer's pond. WUELC erroneously relies on this example to demonstrate the ease by which such a project could be executed without disclosing the dissimilarities between that site and Ameren's sites.

8. Closure Plans Posted on Ameren's Website Were Required by the CCR Rule and Do Not Indicate a Final Remedy has been Selected

Several commenters suggested that Ameren is disingenuous in even requesting comments on the CMAs because Ameren has announced previously its plans to close the CCR basins. Such comments ignore the fact that the CCR Rule required Ameren to post on its CCR

website closure and post-closure plans by October 2016, one year from the effective date of the CCR Rule. This federal requirement applied even though investigatory efforts were ongoing. (In fact, closure plans are required to be included with *applications* for *new* CCR units.)

Moreover, Ameren's approach continues to evolve through ongoing investigation and analysis, risk assessments and the corrective action options, including groundwater treatment, as outlined in the CMAs. The groundwater impacts observed at the CCR basins are few and localized in nature and do not pose a risk to human health even if the units were to remain open. Preliminary indications are that geochemical conditions within the alluvium are such that concentrations will reduce over time as pH levels stabilize.[4] In addition, Ameren is exploring a variety of treatment techniques that may reduce the amount of time needed to achieve groundwater protection standards at the designated compliance point (that is, the toe of the berm). That analysis will continue for several months.

In the meantime, Ameren has constructed wastewater treatment facilities at Rush Island and Labadie that isolate the ash basin systems and allow for the removal of surface waters from the basins. In fact, MDNR in a recently issued permit required Ameren to remove all standing surface water from the Rush Island CCR basin by this summer. The CCR Rule requires closure to commence shortly after the known final receipt of CCR. *40 CFR 257 §102.* For Labadie, Rush Island and Sioux, such "known final receipt" date is linked to the in-service dates for waste water treatment facilities. Even the most ardent environmental activist would have to concede that removing surface water reduces recharge into groundwater and that by eliminating the exposure of ponded ash to the elements, the environment benefits immensely. Having been very vocal about the ash basins for years, Ameren is surprised that activists now accuse it of moving too quickly.

SPECIFIC ISSUES RASIED BY COMMENTORS

9. "Litigation Risk" is not a CCR Rule Remedy Selection Factor

The first seven pages of the Waterkeeper's public comment contains a lengthy discussion on its view of legal issues that the United States Supreme Court may or may not entertain and the applicability or non-applicability of the Clean Water Act to CCR basins. None of that is relevant to CCR Rule requirements for remedy selection. No litigation has been brought by any person or entity regarding Ameren's CCR Units.

Furthermore, to the extent Waterkeeper suggests that Ameren should have solicited public comments before issuing its CMAs, they have clearly misread the CCR Rule requirements.

[4] A discussion of the behavior of metals in soil and groundwater can be found at **Attachment 5**.

10. Closure of the CCR Basins Will Control Source Material and Mitigate Groundwater Impacts

WUELC suggests that the only way Ameren can comply with the CCR Rule's closure performance standards is to excavate and remove all CCR, a positon rejected by EPA. In fact, EPA explicitly did not choose closure by removal over closure in place, indicating that both options, when done properly, are acceptable.

> *EPA did not propose to require clean closure nor to establish restrictions on the situations in which clean closure would be appropriate. As EPA acknowledged in the proposal, most facilities will likely not clean close their CCR units given the expense and difficulty of such an operation. Because clean closure is generally preferable from the standpoint of land re-use and redevelopment, EPA has explicitly identified this as an acceptable means of closing a CCR unit. However,* ***both methods*** *of closure (i.e., clean closure and closure with waste in place) can be* ***equally protective, provided they are conducted properly****. Thus, consistent with the proposal, the final rule* ***allows the owner or operator to determine*** *whether clean closure or closure with the waste in place is appropriate for their particular unit. EPA agrees that the RBCA [risk based corrective action] process, using recognized and generally accepted good engineering practices such as the ASTM Eco–RBCA process, can be a useful tool to evaluate whether waste removal is appropriate at the site. It is, however, not a prerequisite.*
>
> 80 Fed Reg at 21411-12 (emphasis added); *See also 80* Fed Reg at 21407.[5]

The CMAs step through the regulatory criteria for each of the considered remedial alternatives, all of which meets the requirements of 40 CFR §257.97. In addition, geochemical conditions across the sites indicate that concentration levels of the few parameters that exceed GWPS will reduce over time as infiltration is eliminated by installation of a cap, the water table lowers and pH conditions stabilize through a variety of natural in situ processes.[6] To optimize this process, Ameren is evaluating groundwater treatment options particularly for arsenic. Treatment methods for arsenic are well established.[7] While metals (unlike organics) cannot be destroyed, by changing the environmental conditions of the soil and groundwater, the leaching or dissolution of such metals can be reduced through the formation of stable minerals or by

[5] Contrary to WUELC assertions, the CCR Rule does not require returning CCR units to pre-construction conditions. EPA itself determined that was inappropriate, unnecessary, and would result in stricter standards than at hazardous waste sites. 80 Fed. Reg. 21302, 21412 **("There is no basis in the current record to impose provisions for the remediation of CCR units that are more stringent than those imposed on hazardous wastes.")**

[6] EPA specifically discussed that its lack of pH-specific data could impact its risk assessment. In its response to comments on the risk assessment, EPA indicates that pH-specific data, as well as other site-specific factors could yield site-specific remediation alternatives that cannot be addressed in a nationwide risk assessment. 80 Fed. Reg. 21302, 21434-37. Ameren is using site-specific data in the CMAs to make remedy comparisons that fit the unique nature of these surface impoundments.

[7] https://www.epa.gov/remedytech/arsenic-treatment-technologies-soil-waste-and-water.

binding such metals more strongly to other minerals. XDD has prepared a short description of this process, appended hereto as **Attachment 5**, *Behavior of Metals in Soil and Groundwater*.

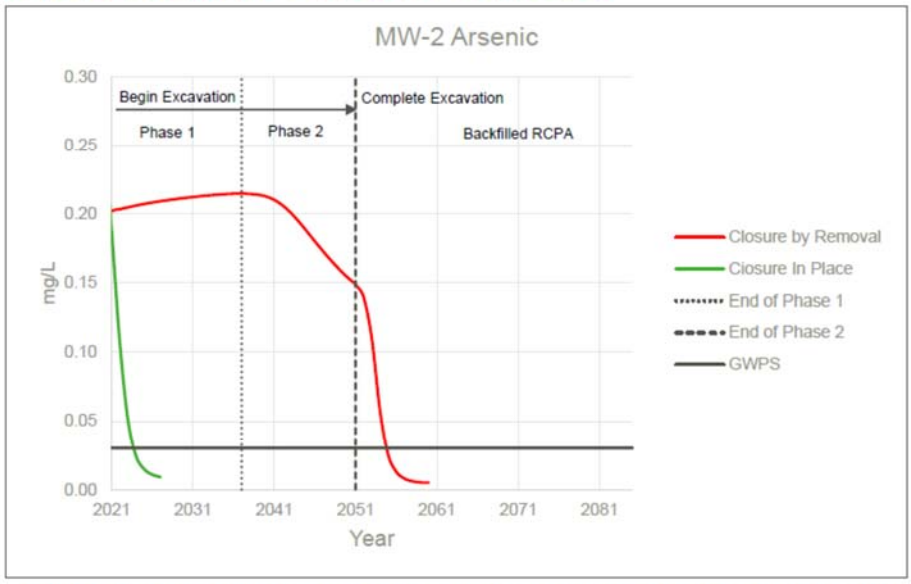
Predictive modeling also indicates that compliance with GWPS at the designated compliance point is achievable. Once that occurs and is confirmed by three years of groundwater monitoring, corrective actions are complete.

11. Excavation Would Delay Compliance Until After 2050

Several commenters believe that excavation is the only way to ensure compliance with GWPS. As the Lochmueller and Reitz & Jens reports make clear, excavation projects at these sites are complex, take decades to execute and will be a burden on local communities. During the entirety of the process, the ash basins remain open to weather, and recharge (contaminant loading due to infiltration from precipitation) to groundwater would continue during this entire period. Using Rush Island as an example, Ameren performed additional predictive modeling to illustrate the timeframe needed to come into compliance under an excavation scenario. (*See Golder Rush Island Closure by Removal Modeling,* **Attachment 6**). Under a containment/capping scenario, compliance with GWPS is predicted to occur in approximately 6-7 years post-closure (2027) as compared to thirty (30) or more years (2057) after beginning the excavation.

Modeling Results Indicate Excavation Delays Groundwater Compliance

RUSH ISLAND ENERGY CENTER



MW-2 (highest arsenic value in CCR Rule Well) is estimated to reach the GWPS 30 years sooner using closure in place vs closure by removal (Excavation)

12. Evaluation of Climate Change is Not Required by EPA

One commentor suggested that Ameren should have evaluated climate-related issues as part of its corrective measures assessment. EPA did not designate consideration of climate change as a requirement of the CCR Rule. However, to the extent precipitation events increase in severity or number as some climate models suggest, maintaining the proper Factors of Safety and structural stability of ash basins effectively counters those risks. Ameren addressed these issues in Section 5.

13. Transportation of Waste from Westlake Landfill has Less Impact on Community Due to Access Route and Volume

At the Westlake Landfill CERCLA Site in St. Louis, EPA recently ordered the **limited** excavation of **radioactive** material improperly sent to a sanitary landfill that due to its chemical composition set off subsurface fires. The proposed excavation is limited to approximately 1.5M in-place cubic yards (cy), located up to depths of 16 feet with deeper materials left in place at depths up to 89 feet below ground surface. EPA estimates the excavation will cost approximately $274M*. See Proposed Record of Decision Amendment Westlake Landfill Superfund Site (EPA, 2018).* The volumes proposed for excavation at Westlake are a fraction (5%) of the CCR material stored in Ameren's ash ponds (30M in-place cy; 41.3M with soil amendments) and would very likely also take the fraction of the time to transport off-site. Westlake Landfill is located in close proximity to interstate highways that function as major regional transportation arteries, thus minimizing disruption to local communities and neighborhoods. To Ameren's knowledge, specific transportation plans for Westlake have not been published.

Attachment List

1. **Golder Technical Memorandum dated June 26, 2019**
2. **Golder Response to CMA Public Comments Regarding Groundwater Protection Standards and Background Water Quality**
3. **Lochmueller Group Rail & Barge Transportation Assessment**
4. **Reitz & Jenz, Inc. Deep Excavation Analysis**
5. **XDD Behavior of Metals in Soil and Groundwater**
6. **Golder Rush Island Closure by Removal Groundwater Modeling**

TECHNICAL MEMORANDUM

DATE June 26, 2019 **Project No.** 153140601

TO Ameren Missouri

CC

FROM Mark Haddock, PE, RG **EMAIL mark_haddock@golder.com**

GROUNDWATER MODELING INDICATES NO IMPACT FROM LABADIE ENERGY CENTER CCR BASINS ON RESIDENTIAL WELLS EVEN UNDER EXTREME FLOOD CONDITIONS

Ameren Missouri (Ameren) recently held public meetings to discuss its Corrective Measures Assessment (CMA) as required under the United States Environmental Protection Agency's Coal Combustion Residual (CCR) Rule. In public comments raised either at these meetings or submitted to Ameren, members of the public questioned whether groundwater used by residential supply wells could be adversely impacted by CCR basins located at the Labadie Energy Center. The results of the modeling and testing conclude that bedrock groundwater quality in the residential areas of the bluffs is unaffected by CCR impacts to the alluvial aquifer based upon the following:

- The bedrock groundwater flow direction is consistently from high elevation areas (i.e. the bluffs) to low elevation areas (river bottoms).
- The closest community water supply well is located approximately two miles south of the LEC. Some individual wells are located within a mile of the LEC and all draw water from the bedrock aquifer in the bluffs area.
- Groundwater in the bedrock beneath the bluffs flows from the bluffs to the river valley areas, even under extreme river flood stage conditions. The higher groundwater levels in the bluffs prevent groundwater impacted by CCR on Ameren's property from travelling upgradient to residential water supplies.
- To assess groundwater flow under flood conditions, Golder modeled a worst case scenario (i.e. the 1993 flood of record (486.6 feet at the LEC), at a constant elevation and lasting for 55 straight days)[1]. The modeling results indicate that groundwater in the bluffs still flows in a northward direction, towards the Bottoms, and not vice versa.
- Multiple bedrock groundwater quality samples collected from wells in the bluffs area near the existing residential wells confirm that water quality is unaffected by CCR.

[1] In 1993, this peak elevation level lasted one day at Labadie.

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Below is a reproduction of a technical memorandum originally produced on August 5, 2015 regarding Golder's groundwater modeling analysis.

August 5, 2015 Golder Technical Memorandum on flood conditions groundwater modeling at LEC

1.0 INTRODUCTION AND BACKGROUND

At the request of Ameren Missouri (Ameren), Golder performed limited groundwater modeling for the Labadie Bottoms area in the vicinity of the Labadie Energy Center (LEC) located in Labadie, Missouri. The modeling was primarily intended to investigate movement of groundwater near the LEC for a flood condition in the Missouri River. The intent of the modeling was to investigate the potential for reversal of groundwater hydraulic gradient from the alluvial aquifer toward the bedrock aquifer located in the Bluffs area south of the LEC during and following a significant flood event. Specifically, the intent was to investigate the potential that groundwater flow in the alluvial aquifer was significantly reversed toward the bedrock aquifer due to flood conditions.

1.1 Modeling Software

Groundwater modeling was accomplished using MODFLOW 2000, a finite-difference numerical modeling code developed by the United States Geological Survey, and the most widely accepted groundwater modeling platform. MODFLOW 2000 is an updated version of the original MODFLOW code and incorporates improved functionality. Model development was facilitated by Groundwater Vistas, a graphical user interface used to develop the model domain, grid, properties, and to visualize model results.

1.2 Conceptual Model, Domain and Grid

The model domain was intended to model conditions in the alluvial aquifer under and near the LEC and the adjacent limestone bedrock aquifer to the south. The domain was approximately 47,000 feet by 35,000 feet, and was developed roughly parallel to the Missouri River (Figure 1). The model domain was rotated such that the northern model boundary corresponded approximately to the Missouri River. The southern boundary was set in the bedrock aquifer a sufficient distance away from the river so as to minimize boundary effects to the model output. The direction of groundwater flow has been determined to be generally from the bedrock aquifer toward the alluvial aquifer.

The total model thickness for the alluvial aquifer was set at 100 feet based on subsurface drilling information. The individual grid cells were 500 feet by 500 feet, and the model was split into four layers, each 25 feet thick, for increased computational resolution. The model layers were sloped with the top of the model set to 600 feet at the southern model boundary and to approximately 454 feet at the Missouri River, based on general topographic trends in both areas. Initial modeling was conducted with the model layers both horizontal and sloped as a comparison. However, early model runs indicated that preliminary results for the sloped layer configuration were more conservative (i.e., greater effect at the area of interest).

1.3 Boundary Conditions

The eastern and western boundaries of the domain were treated as essentially parallel to groundwater flow and therefore were considered to be no-flow boundaries. The southern and northern boundaries of the model domain were considered to be constant head boundaries. The model boundaries are shown on Figure 2.

Groundwater elevations in the bedrock aquifer near the bluffs and the alluvial aquifer were used to extrapolate the hydraulic gradient throughout the model domain to the south. The intent was that the model emulate the approximate groundwater elevations determined in the installed bedrock wells. In order to do this, the southern constant head boundary was set to 590 feet. It is important to note that the actual groundwater elevations at the southern domain boundary are not expected to be 590 feet at all locations, but this was done as a convenience to generate the anticipated groundwater elevations in the middle of the model and avoid boundary effects.

The northern constant head boundary was set to 455.4 feet to represent a typical stage of the Missouri River. This constant head boundary was increased to 486.6 feet to represent the flood event, as observed during the flood event of 1993. This was a historic severe flood event with water in the Missouri River above flood stage for 55 days, primarily at modest elevations. The peak elevation of the flood near the LEC was 486.6 feet and only lasted one day. However, the intent was to model a worst case flood scenario so the peak elevation was extended for the entire 55-day flood event.

The alluvial aquifer was modeled as a single unit with a hydraulic conductivity of 70 feet per day (ft/d) based on a mean value for the alluvial aquifer from the Detailed Site Investigation (DSI) (GREDELL Engineering Resources and Reitz & Jens, Inc., 2011) for the LEC. The bedrock aquifer was modeled as a single unit with a hydraulic conductivity of 3 ft/d, based on a published value for limestone from Todd (1980). Specific yield for the alluvium and bedrock aquifers were set at 0.3 and 0.14, respectively, based on published estimates from Anderson and Woessner (1992), and were also used to approximate porosity. Specific storage for the alluvium and bedrock aquifers was set to 2.3E-04 ft^{-1} and 1.1E-05 ft^{-1}, respectively, based on published estimates from Anderson and Woessner (1992).

2.0 STEADY STATE GROUNDWATER MODELING RESULTS

The model was initially run in steady state to generate the typical groundwater gradient and movement from the bedrock aquifer to the alluvial aquifer toward the Missouri River, as observed from direct measurements. A general comparison was made between the model estimated groundwater elevations in the bedrock aquifer and the measured groundwater elevations in the area of the bluffs. The model estimated groundwater elevations at the edge of the bluffs were approximately 460 feet, which closely approximates the measured groundwater elevations in this area (Figure 3).

3.0 TRANSIENT GROUNDWATER MODELING RESULTS

Golder was asked to model the effects of a significant flood event, comparable to the 1993 flood event of the Missouri River, on the groundwater movement in the alluvial aquifer. The 1993 flood saw an increase in river flows and levels above flood stage for a period of 55 days. The maximum river stage in the Missouri River near the Labadie Plant during this flood was 486.6 feet, an increase of approximately 31 feet over typical flows in the Missouri River in this area. Use of the peak flood elevation for the entire length of the flood was conducted to represent an extreme worst case scenario.

A transient model run was conducted in which the southern constant head boundary, representing the Missouri River, was set to 486.6 feet for 55 days, then was returned to the same level as in the steady state model run (455.4 feet). Three stress periods were simulated in the model run: Period 1 is the steady state condition with the Missouri River set to 455.4 feet, Period 2 is a transient, 55-day period with the Missouri River set to 486.6 feet, and Period 3 is a transient, 100-year period with the Missouri River

returned to 455.4 feet. Changes to water levels near a location of interest were monitored throughout the model run. This location of interest is a hypothetical monitoring well as shown on Figure 4.

Figure 4 shows the modeled groundwater level contours after the 55 day flood event. Modeled groundwater elevations near the limestone bluffs remained at approximately 460 feet at the end of the 55 day flood event, rising less than 0.5 foot (Figure 5). The groundwater divide, the area where the original hydraulic gradient from the bedrock aquifer and the hydraulic gradient from the alluvial aquifer meet, was located well north of the northern edge of the bluff area demonstrating no reversal of flow at the location of interest.

3.1 Particle Tracking

Particle tracking was conducted using the computer code MODPATH (Polluck, 1989). With this analysis, particles are placed in an area of the model to represent points in the groundwater system, and their flow paths through the groundwater system are traced by moving the particles along the vector of maximum velocity within each model cell. In this way, particle tracking can estimate the movement of groundwater under a simulated condition, in this case, a flood event on the Missouri River. Particles were started within the area of the Labadie Plant and tracked throughout the flood event and during the subsequent recovery period. The particles moved in toward the bedrock aquifer during the flood event, and for a period of about 100 days after the event, until the hydraulic gradient reversed again toward the Missouri River in response to the decrease in river stage. The total distance traveled in toward the bedrock aquifer is small (about 50 feet). This is consistent with independent calculations of the average groundwater flow velocity assuming the same parameters used in the model (Darcy's law equation for advection, Fetter, 1988).

4.0 SENSITIVITY ANALYSIS

Numerical modeling always involves a certain level of uncertainty in assigning model parameters. A sensitivity analysis was conducted in which model parameters were systematically varied to determine the variability in the model estimated response to the flood event, as shown in Table 1. The structure of the model runs remained unchanged, only the parameters indicated in Table 1 were modified. The model presented above in this report, model 1, is the preferred model because the model parameters are considered the most likely for the aquifer systems near the LEC. Four sensitivity runs, models 2 through 5, were conducted in which the hydraulic conductivity, storage, and porosity were deliberately altered to facilitate greater movement of groundwater. The results for all of these sensitivity runs were not consistent with reversal of flow at the location of interest.

The particle tracking analysis was repeated for sensitivity model run 5 because this model had the largest response at the monitoring well location. Particles released in the area of the Labadie Plant travel toward the bedrock aquifer for approximately 60 days and travel approximately 235 feet before the hydraulic gradient is again reversed back toward the Missouri River.

5.0 CONCLUSIONS

Groundwater modeling was conducted for an extreme worst case flood event, using the maximum elevation of the 1993 flood and carrying this elevation for the entire 55 days of this flood. The results of groundwater modeling did not indicate any reversal of groundwater flow at the location of interest. Groundwater flow was consistently from the bedrock aquifer to the alluvial aquifer based on the results of this model.

Attachments or Enclosures:

Table 1 – Groundwater Model Parameters

Figure 1 – Groundwater Model Domain Boundary and Model Grid

Figure 2 – No-flow and Constant Head Boundaries

Figure 3 – Pre-flood Groundwater Elevations

Figure 4 – Groundwater Model Domain Boundary and Resulting Groundwater Elevations

Figure 5 – Water Level Changes at Point of Interest

References

Anderson, Mary P., and Woessner, William W., 1992. Applied Groundwater Modeling – Simulation of Flow and Advective Transport.

Fetter, C.W., 1988. Applied Hydrogeology, Second Edition.

GREDELL Engineering Resources and Reitz & Jens, Inc. 2011. Detailed Site Investigation. Ameren Missouri Labadie Power Plant Proposed Utility Waste Disposal Area. Franklin County, Missouri. February 4, 2011.

Todd, David Keith, 1980. Groundwater Hydrology, Second Edition.

USGS 2000, Modflow-2000, the U.S. Geological Survey Modular Ground-Water Model – User Guide to Modularization Concepts and the Ground-Water Flow Process.

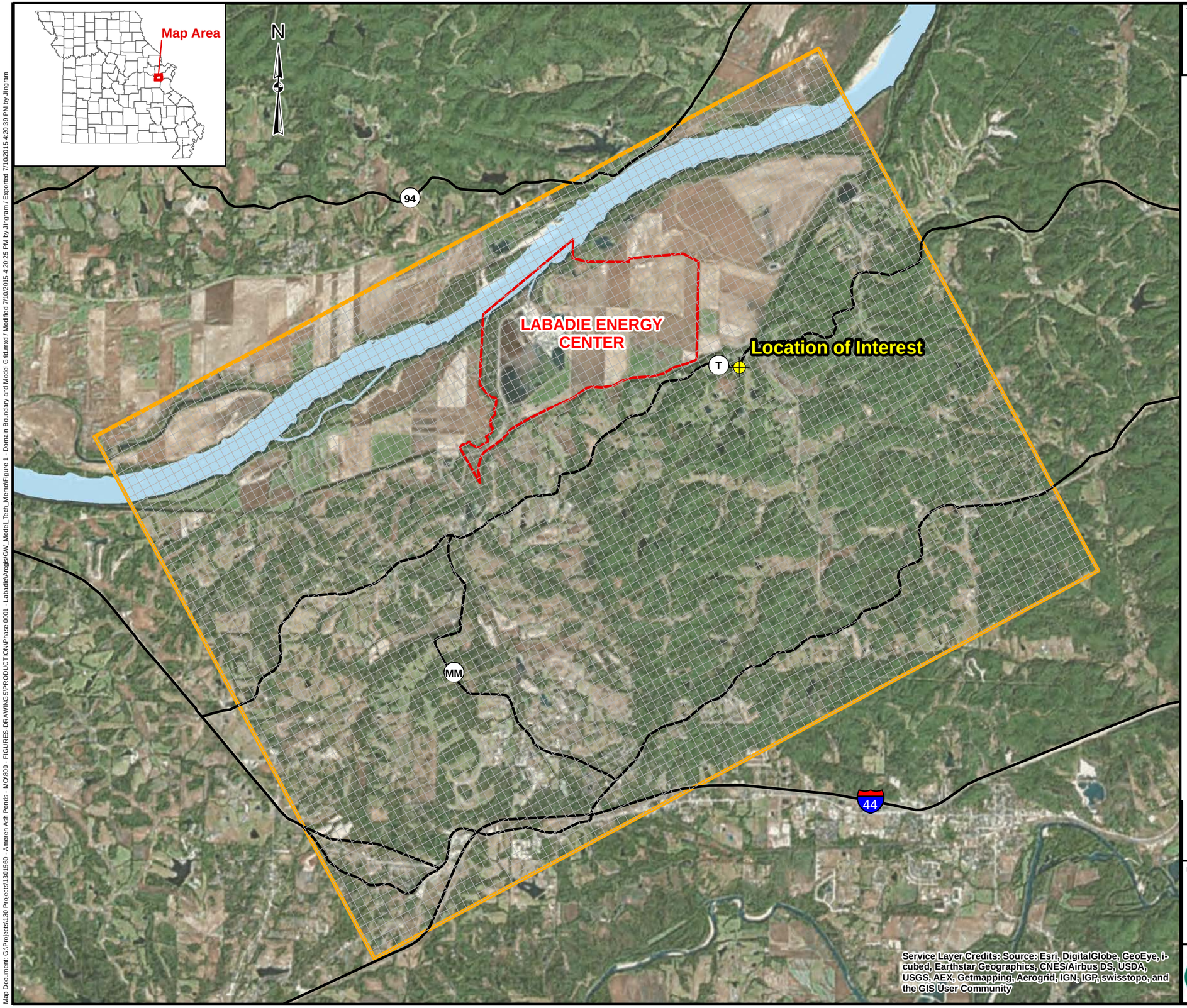
TABLES

Table 1
Groundwater Model Parameters
Labadie Energy Center, Franklin County, MO
Ameren Missouri

Model Number	Conductivity of Alluvium (feet/day)	Conductivity of Limestone (feet/day)	Specific Yield of Alluvium	Specific Yield of Limestone	Storativity of Alluvium ($feet^{-1}$)	Storativity of Limestone ($feet^{-1}$)	Model Results
1	70	3	0.3	0.14	2.30E-04	1.10E-05	Preferred
2	70	3	0.15	0.05	2.30E-04	1.10E-05	Sensitivity
3	70	10	0.15	0.05	2.30E-04	1.10E-05	Sensitivity
4	70	10	0.1	0.01	2.30E-04	1.10E-05	Sensitivity
5	120	10	0.1	0.01	2.30E-04	1.10E-05	Sensitivity

Prepared By: BS/JSI
Checked By: JS
Review By: JRS

FIGURES



TITLE

GROUNDWATER MODEL DOMAIN BOUNDARY AND MODEL GRID

LEGEND

- Labadie Energy Center Property Boundary
- Groundwater Model Domain
- Location of Interest

NOTES

1.) All boundaries and locations are approximate.

REFERENCES

1.) Ameren, 2011. Ameren Missouri Labadie Energy Center, Labadie Property Control Map, November 2011.
2.) MSDIS (Missouri Spatial Data Information Service) Database, 2014.
3.) MODFLOW groundwater modeling program.
4.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 5,000 10,000 Feet

PROJECT

Ameren

AMEREN MISSOURI LABADIE ENERGY CENTER
FRANKLIN COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Figure 1 - Domain Boundary and Model Grid.mxd
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CHECK	JS	7/10/2015	**Figure 1**
REVIEW	JRS	7/10/2015	

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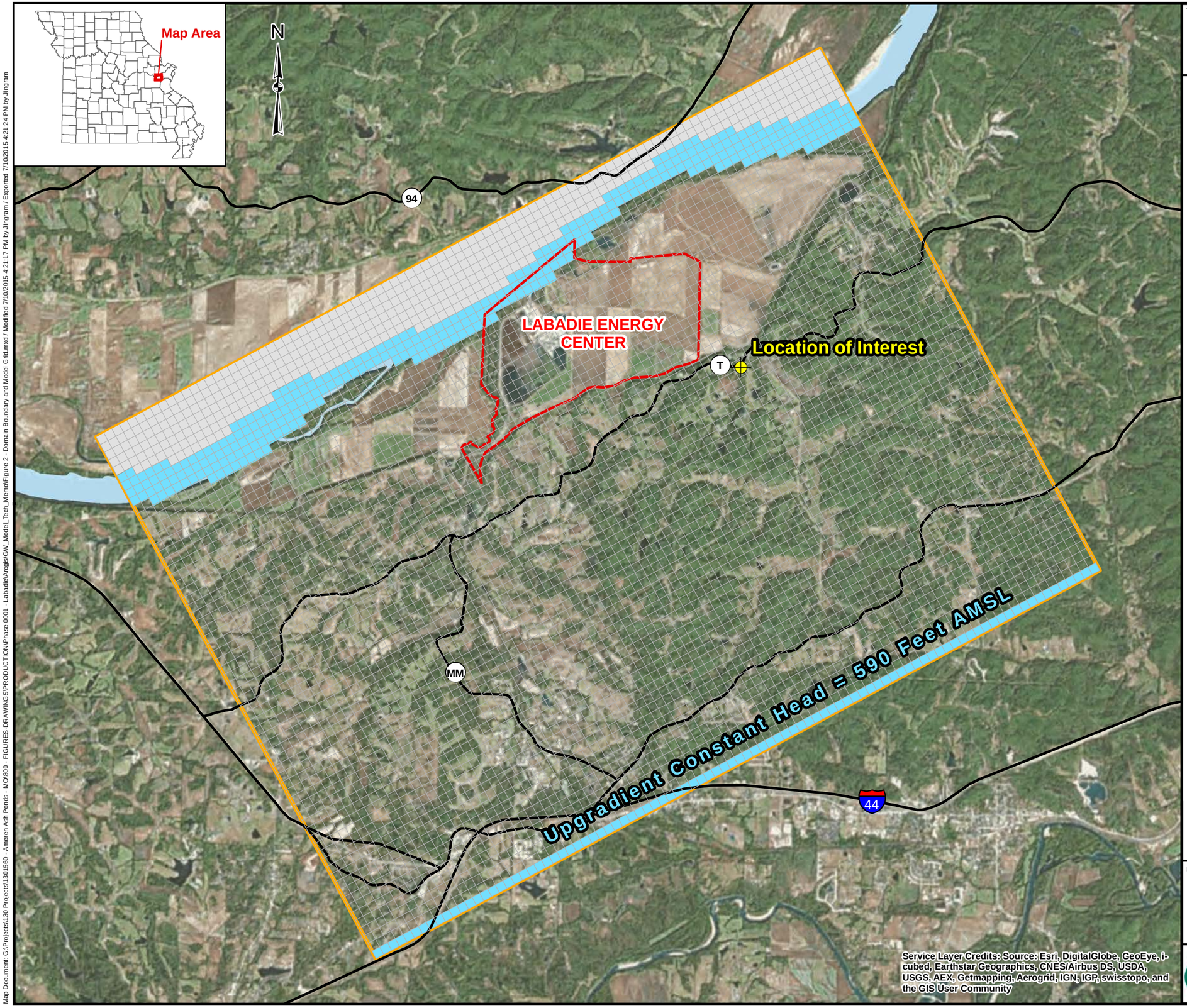

TITLE

NO-FLOW AND CONSTANT HEAD BOUNDARIES

LEGEND

- Labadie Energy Center Property Boundary
- Groundwater Model Domain
- Location of Interest
- Constant Head Boundaries
- No-Flow Boundaries

NOTES

1.) All boundaries and locations are approximate.
2.) Constant Head Boundaries are 455.4 feet AMSL under average conditions, 486.6 ft AMSL under extreme flood conditons (peak of the 1993 flood), and are 590 feet AMSL upgradient.
3.) AMSL - Above Mean Sea Level.

REFERENCES

1.) Ameren, 2011. Ameren Missouri Labadie Energy Center, Labadie Property Control Map, November 2011.
2.) MSDIS (Missouri Spatial Data Information Service) Database, 2014.
3.) MODFLOW groundwater modeling program.
4.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

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PROJECT

Ameren

AMEREN MISSOURI LABADIE ENERGY CENTER
FRANKLIN COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Figure 2 - Domain Boundary and Model Grid.mxd
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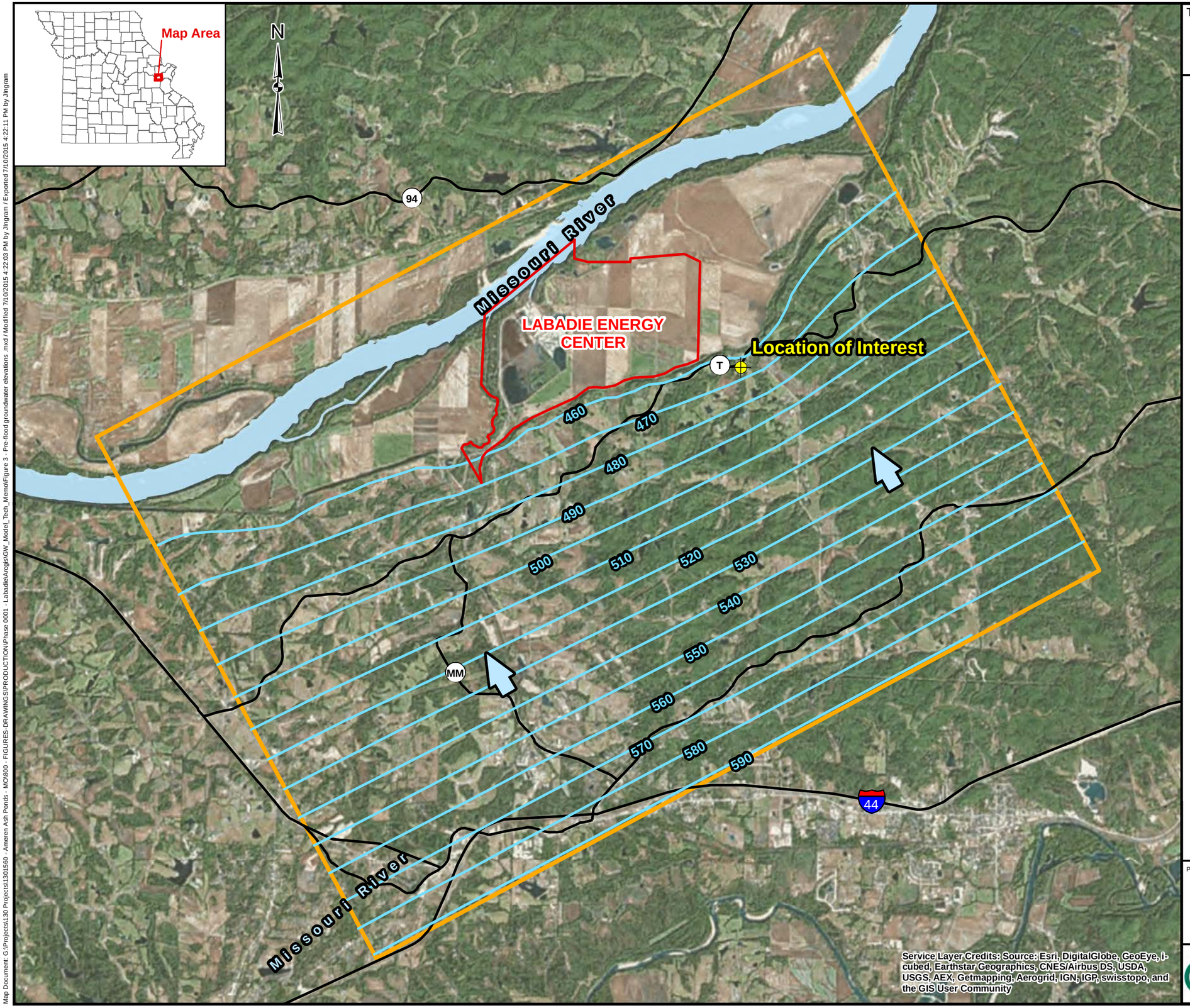

TITLE

PRE-FLOOD GROUNDWATER ELEVATIONS

LEGEND

- Labadie Energy Center Property Boundary
- Groundwater Model Domain
- Location of Interest
- Model Groundwater Elevation Contours
- Groundwater Flow Direction

NOTES

1.) All boundaries and locations are approximate.
2.) Model contour interval is 10 feet.
3.) Upgradient contours are used for generalized gradient and are not considered locally accurate.
4.) Model results reflect pre-flood river conditions.

REFERENCES

1.) Ameren, 2011. Ameren Missouri Labadie Energy Center, Labadie Property Control Map, November 2011.
2.) MSDIS (Missouri Spatial Data Information Service) Database, 2014.
3.) MODFLOW groundwater modeling program.
4.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

PROJECT

Ameren

AMEREN MISSOURI LABADIE ENERGY CENTER
FRANKLIN COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Figure 3 - Pre-flood groundwater elevations .mxd	
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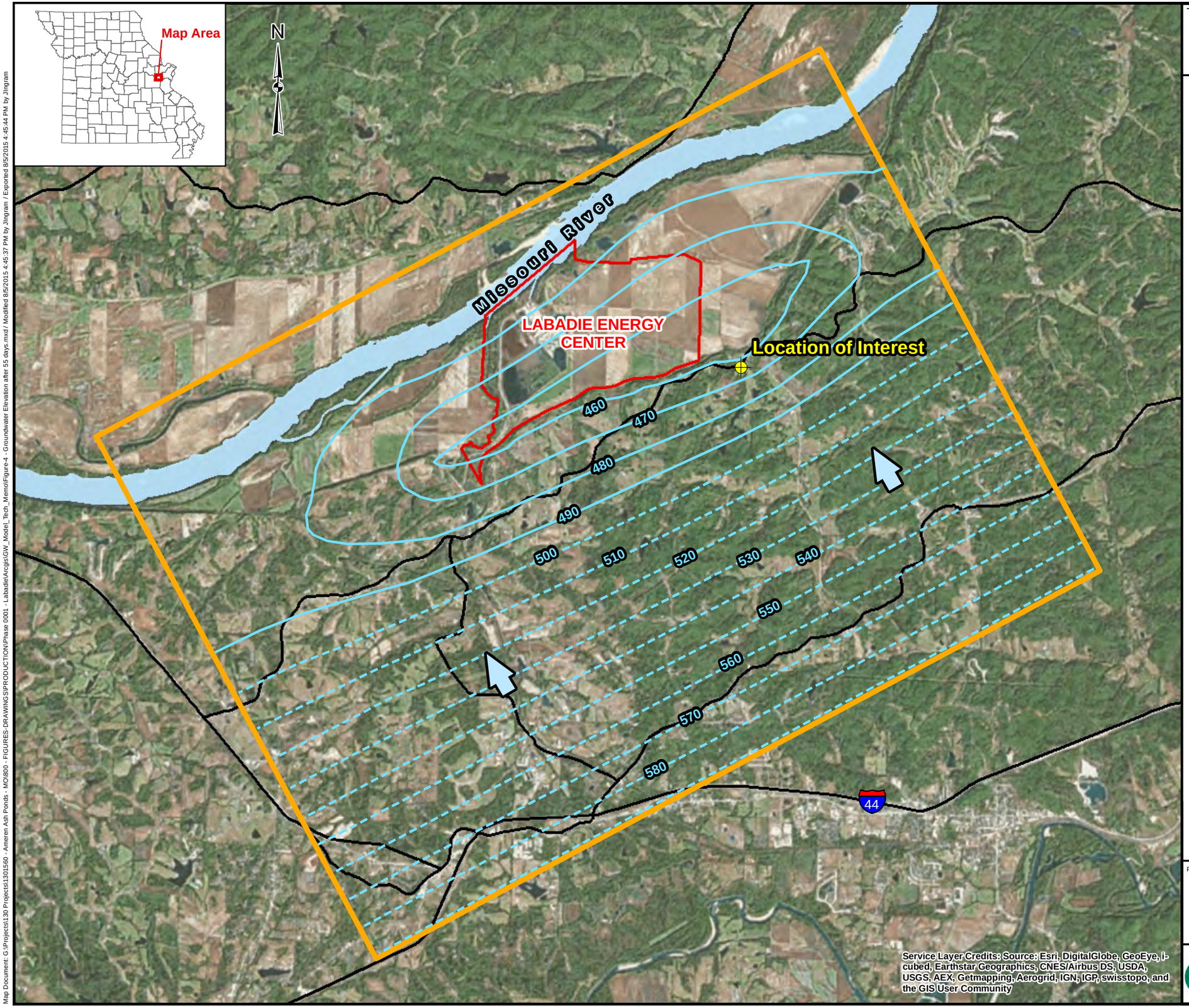
CHECK	JS	7/10/2015		
REVIEW	JRS	7/10/2015		

Map Document: G:\Projects\130 Projects\1301560 - Ameren Ash Ponds - MO\800 - FIGURES-DRAWINGS\PRODUCTION\Phase 0001 - LabadieArcgis\GW_Model_Tech_Memo\Figure 3 - Pre-flood groundwater elevations .mxd / Modified 7/10/2015 4:22:03 PM by Jingram / Exported 7/10/2015 4:22:11 PM by Jingram



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

TITLE

GROUNDWATER MODEL DOMAIN BOUNDARY AND RESULTING GROUNDWATER ELEVATIONS DURING FLOOD

LEGEND

- Labadie Energy Center Property Boundary
- Groundwater Model Domain
- Location of Interest
- Model Groundwater Elevation Contours
- Model Estimated Groundwater Elevation Contours
- Groundwater Flow Direction

NOTES

1.) All boundaries and locations are approximate.
2.) Model contour interval is 10 feet.
3.) Upgradient contours are used for generalized gradient and are not considered locally accurate.
4.) Model results reflect 55 continuous days of river level at 486.6 feet above mean sea level (peak level of the 1993 flood).

REFERENCES

1.) Ameren, 2011. Ameren Missouri Labadie Energy Center, Labadie Property Control Map, November 2011.
2.) MSDIS (Missouri Spatial Data Information Service) Database, 2014.
3.) MODFLOW groundwater modeling program.
4.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 5,000 10,000 Feet

PROJECT

AMEREN MISSOURI LABADIE ENERGY CENTER
FRANKLIN COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560		Figure-	- Groundwater Elevation after 55 days.mxd	
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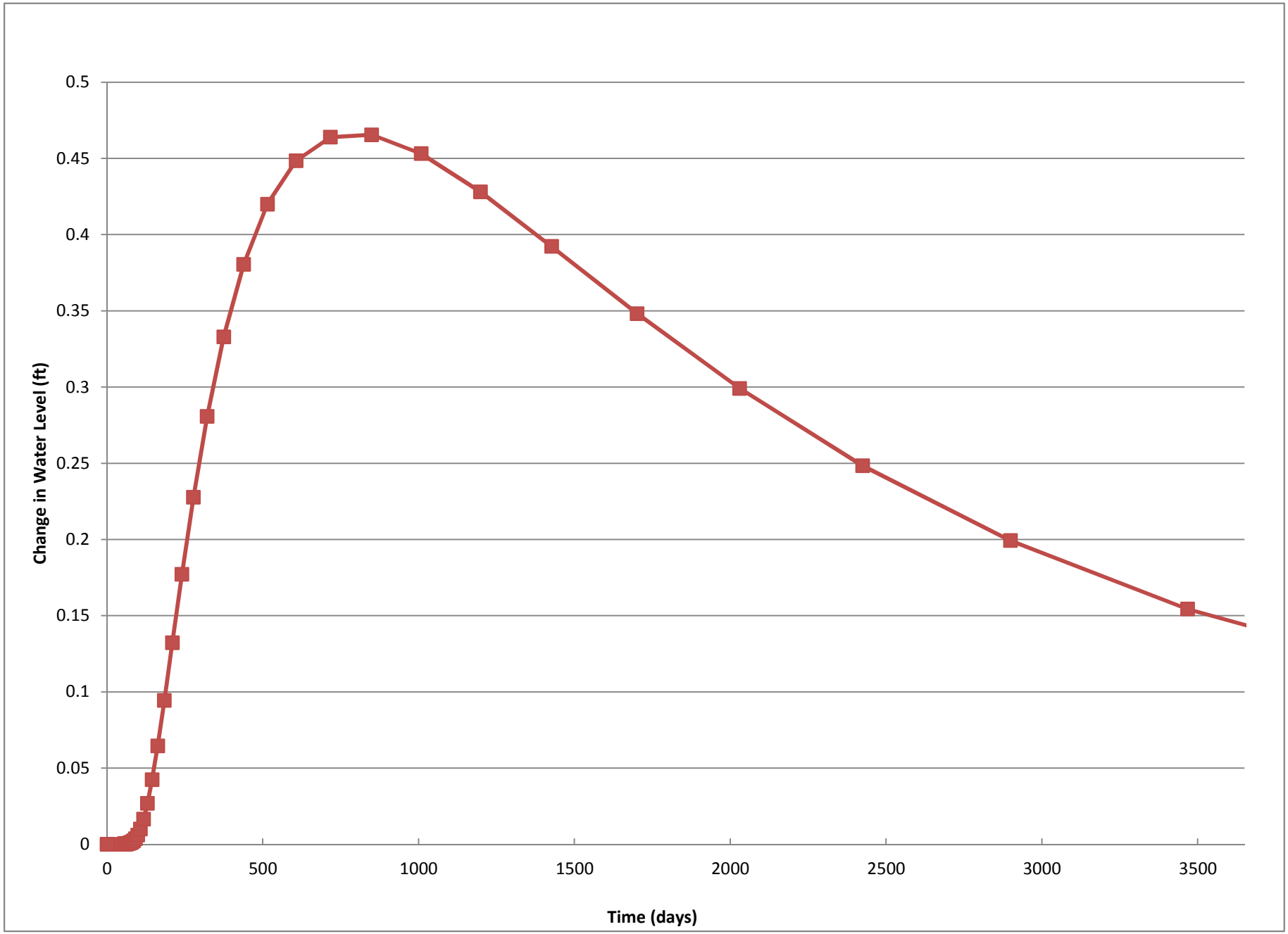
CHECK	JRS	6/16/2015		
REVIEW	MNH	6/17/2015		

Map Document: G:\Projects\130 Projects\1301560 - Ameren Ash Ponds - MO\800 - FIGURES-DRAWINGS\PRODUCTION\Phase 0001 - LabadieArcgis\GW_Model_Tech_MemoFigure-4 - Groundwater Elevation after 55 days.mxd / Modified 8/5/2015 4:45:37 PM by JIngram / Exported 8/5/2015 4:45:44 PM by JIngram

Figure 5
Water Level Changes at Point of Interest
Labadie Energy Center, Franklin County, MO
Ameren Missouri



TECHNICAL MEMORANDUM

DATE June 20, 2019 **Project No.** 1531410601

TO Ameren Missouri

CC

FROM Golder Associates Inc. **EMAIL Mhaddock@golder.com**

RESPONSE TO CMA PUBLIC COMMETNS REGARDING GROUNDWATER PROTECTION STANDARDS AND BACKGROUND WATER QUALITY

1.0 INTRODUCTION

This Technical Memorandum discusses the methods, procedures, and reasoning used to calculate the Groundwater Protection Standards (GWPS) at the Rush Island Energy Center (RIEC) and the Labadie Energy Center (LEC), as well as a brief review of publicly available data regarding arsenic in the alluvial aquifer of the Missouri River in Missouri. Recent public comments to the Corrective Measures Assessment reports (CMAs) have suggested that the calculation of the GWPS for arsenic have "skewed" the results of the monitoring evaluation and rendered the groundwater monitoring networks incapable of detecting arsenic contamination, biasing the CMAs against clean closure. This Technical Memorandum discusses the specific requirements of the CCR Rule that Golder has followed, the best practices for statistical evaluation as outlined in the United States Environmental Protection Agency's (USEPA) Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (Unified Guidance), the locations of the background monitoring wells at the Labadie Energy Center (LEC) and Rush Island Energy Center (RIEC), and the presence of existing and naturally occurring arsenic in the alluvial aquifers of the Missouri and Mississippi River valleys.

2.0 LOCATION OF BACKGROUND MONITORING WELLS

The location of background wells is one of the most important factors in developing an effective monitoring well network. Section 257.91(a)(1) of the CCR Rule outlines the location requirements of background monitoring wells for a monitoring well network. The requirements are as follows:

(1) Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit. A determination of background quality may include sampling of wells that are not hydraulically upgradient of the CCR management area where: (i) Hydrogeologic conditions do not allow the owner or operator of the CCR unit to determine what wells are hydraulically upgradient; or (ii) Sampling at other wells will provide an indication of background groundwater quality that is as representative or more representative than that provided by the upgradient wells;

The CCR Rule requirements have been carefully followed and the locations selected for background monitoring wells accurately represent quality of background groundwater that has not been affected by a CCR unit.

2.1 Background Wells at the Labadie Energy Center

The background monitoring wells for the LCPA ash basin at the LEC are BMW-1D and BMW-2D and two other wells, BMW-1S and BMW-2S provide background monitoring for the LCPB ash basin. An aerial image with the

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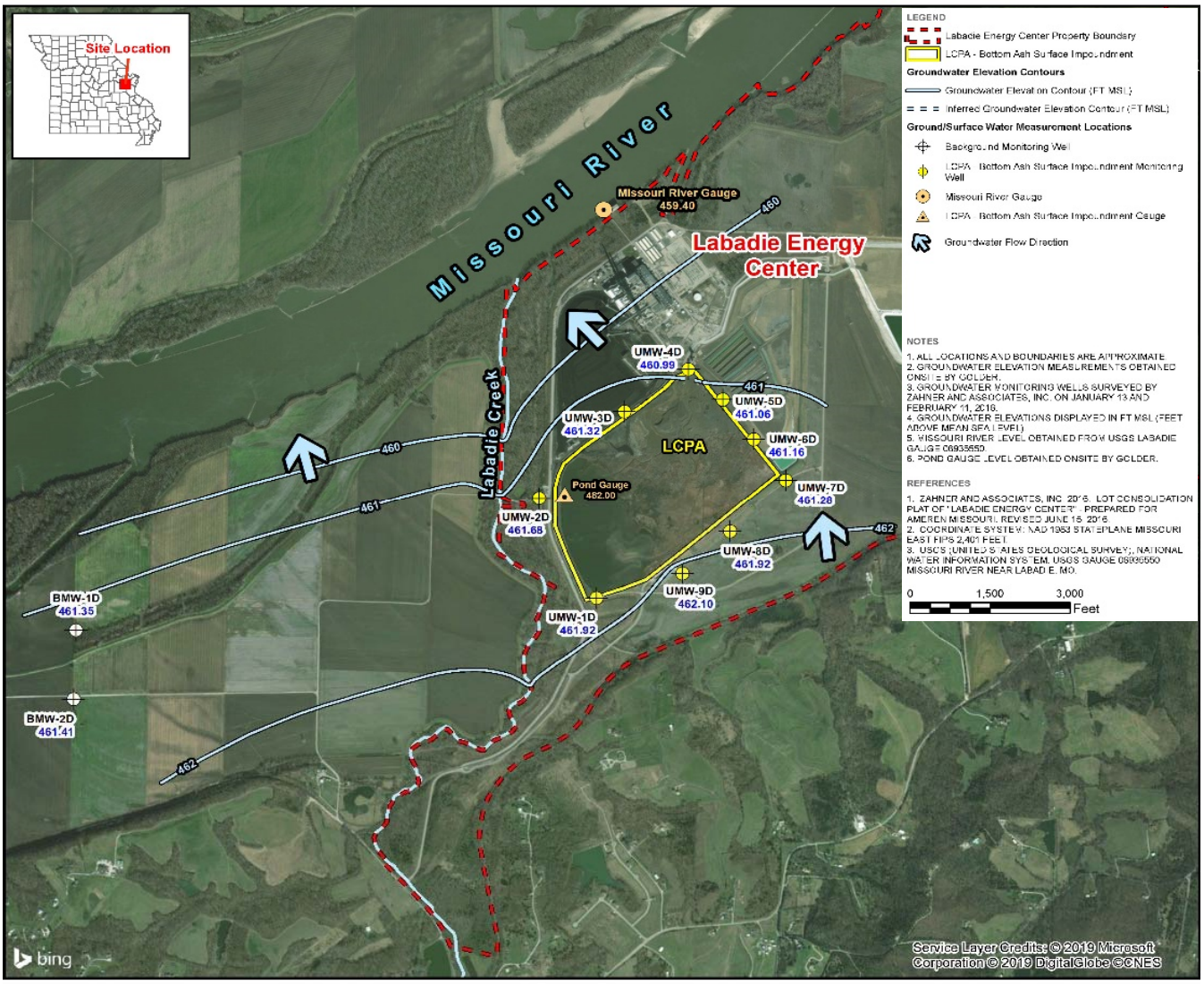

Figure 1: Labadie Monitoring Well Location and Groundwater Flow Map

location of the LCPA, the monitoring wells, and a representative groundwater flow map from 2018 is provided in Figure 1. The background monitoring wells are located approximately 1.5 miles west/southwest of the LCPA and 2,000 to 3,000 feet south of the Missouri River. These locations are upgradient and cross-gradient from the CCR at LCPA. Each of these two locations have shallow and deep zone wells (4 total) used for LCPB and LCPA monitoring purposes.

Groundwater flow within the alluvial aquifer is dynamic and can be influenced by seasonal changes in the water level of the Missouri River. Overall, as discussed in the annual reports (publicly available on Ameren website at https://www.ameren.com/company/environment-and-sustainability/managing-coal-combustion/ccr-compliance-reports), groundwater flows from the bluffs area toward the Missouri River at a rate of approximately 20 feet per year. Based on the upgradient/cross-gradient location of the background wells at LEC and the sampling results

from these wells, there are no CCR impacts from the LCPA or the operation of the LEC in these wells and they are representative of un-impacted, background groundwater quality.

Background concentrations of arsenic in these wells have ranged from 0.12 µg/L to 42.6 µg/L and the spatial variability of concentrations is evident - at one location the deep well exhibits the highest concentration and at the other well-pair location the shallow well has the highest arsenic value. Spatial variability in these concentrations is the result of the heterogeneous makeup of the alluvial aquifer porous media and geochemical interactions of the aquifer media with groundwater. The alluvial aquifer is naturally composed of fine to coarse-grained sediments and clasts derived from soil and rock sources up the river basin that can contain arsenic and metallic minerals, as described in Section 4 below.

2.2 Background Wells at the Rush Island Energy Center

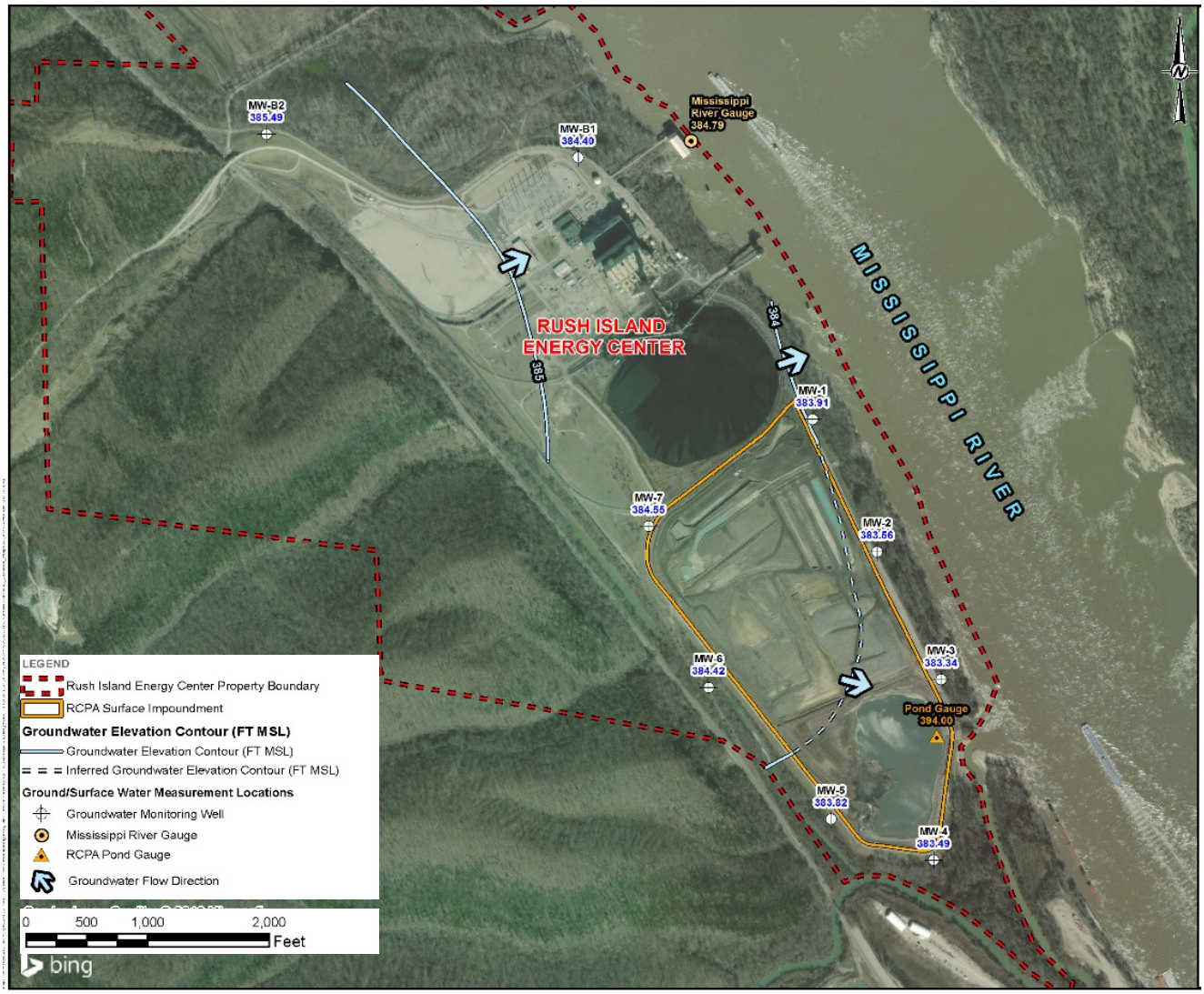

Figure 2: Rush Island Monitoring Well Location and Groundwater Flow Map

The background monitoring wells for the RCPA ash basin are MW-B1 and MW-B2. In addition, two monitoring wells from the 2014 Detailed Site Investigation (DSI) are present within 50 feet of MW-B2. These two wells

include a shallow zone well (P29S) and a deep zone well (P29D). An aerial image of the location of the RCPA, the monitoring wells, and a representative groundwater flow map from 2018 are provided in Figure 2. The background monitoring wells are located approximately 2,500 to 4,500 feet north/northwest of the RCPA and 600 to 2,000 feet west of the Mississippi River. These wells are upgradient and cross-gradient from the CCR at RCPA.

Groundwater flow within the alluvial aquifer at the RIEC is also dynamic and can be influenced by seasonal changes in the water level of the Mississippi River. Overall, as discussed in the annual reports (publicly available on Ameren website at https://www.ameren.com/company/environment-and-sustainability/managing-coal-combustion/ccr-compliance-reports), groundwater flows easterly toward the Mississippi River. Based on the upgradient/cross-gradient location of the background wells at RIEC and the sampling results from these wells, there are no impacts from the RCPA or the operation of the RIEC in these wells and they are representative of un-impacted, background groundwater quality.

Background concentrations of arsenic in these wells have ranged from 1.9 to 30 µg/L in CCR Rule wells (MW-B1 and MW-B2) and from 1.1 to 51.7 µg/L in the DSI wells (P29S and P29D). Spatial variability in these concentrations is evident as the highest and lowest concentrations are in nested wells (P29S, and P29D) located 4,500 feet north of the RCPA. This variability in background concentrations is the result of the heterogeneous makeup of the alluvial aquifer porous media and geochemical interactions of the aquifer media with groundwater. The alluvial aquifer is naturally composed of fine to coarse-grained sediments and clasts derived from soil and rock sources upriver that can contain arsenic and metallic minerals, as further described in Section 4 below.

3.0 STATISTICAL METHODS AND CALCULATION OF THE GWPS

As required by the CCR Rule, prior to October 17th, 2017 Ameren posted a Statistical Method Certification (SMC) to its publicly available website for each of its CCR Units. These SMC's describe the statistical methods to be used for each CCR Unit for Detection and Assessment Monitoring. The methods included in the SMCs were selected because they comply with the requirements of the CCR Rule and are consistent with methods recommended in the USEPA Unified Guidance, which is specifically referenced as a statistical guidance document in the CCR Rule.

As required by the CCR Rule, once assessment monitoring is triggered at a site, site-specific GWPS must be calculated for each of the detected Appendix IV parameters. Following standard practice, the CCR Rule also requires that the site-specific GWPS be derived from either: (1) the United States Environmental Protection Agency's (USEPA) maximum contaminant levels (MCL), (2) health-based standards which were adopted by USEPA in July 2018 for Cobalt, Lead, Lithium, and Molybdenum, or (3) un-impacted background concentrations, for situations where the un-impacted background concentrations are higher than the MCL. Using these methods, the GWPS for arsenic at the LCPA was set at 42.6 µg/L, while the arsenic GWPS for the RCPA is 30.0 µg/L.

As outlined in the SMCs for both the LCPA and the RCPA, following the establishment of the GWPS, assessment monitoring statistics were performed using an interwell confidence interval method to compare results from downgradient/compliance monitoring wells with the GWPS. The confidence interval method used to evaluate Appendix IV results from both the LCPA and RCPA are consistent with the methods recommended in the Unified Guidance.

In summary, the methods used for the calculation of the GWPS at the LEC and RIEC, as well as the resulting GWPS values, follow standard practice in groundwater monitoring and are consistent with the CCR Rule and the USEPA Unified Guidance.

4.0 EXAMPLES OF NATURALLY OCCURING ARSENIC IN MISSOURI

There are numerous reports and publications that discuss the presence of naturally occurring arsenic in Missouri. Arsenic has been reported to occur in groundwater in Missouri from both naturally occurring and anthropogenic sources (https://health.mo.gov/living/environment/ privatedrinkingwater /contaminants.php). Additionally, as provided in the risk assessment reports for Labadie and Rush Island, United States Geological Survey (USGS) soil and groundwater maps by the United States Geological Survey (USGS) for arsenic in the groundwater and soils shows that arsenic is naturally present in our environment (USGS Reports available at https://mrdata.usgs. gov/geochem/doc/ averages/ countydata.htm and http://water.usgs.gov/nawqa/trace/pubs/ geo_v46n11 /fig2.html, Ameren risk assessment report available at https://www.ameren. com/company/environment-and-sustainability/managing-coal-combustion/water-quality).

The National Water Quality Monitoring Council's (NWQMC) Water Quality Portal (available at https://www.waterqualitydata.us/) summarizes data from the USGS, the USEPA, and the NWQMC databases. The NWQMC database includes arsenic results from a total of 1,215 groundwater samples for wells located upgradient of the LEC within the Missouri River alluvial aquifer. These 1,215 samples are from wells located just upstream of the LEC to the confluence of the Kansas and Missouri River in Kansas City, Missouri. The 1,215 samples consist of: 351 samples from the Independence Well Field near Independence Missouri, 852 samples are from the Columbia/Eagle Bluffs Wetland Complex wells, and the remaining 12 samples from various locations in the identified area. This is an extensive dataset. A USGS report on the data for Independence Missouri is available at https://pubs.er.usgs.gov/publication/sir20105232 and USGS Reports for the Columbia/Eagle Bluffs Wetland Complex wells are available at https://pubs.er.usgs.gov/publication/wri024227. Arsenic values within these samples ranged from non-detect (<0.022 ug/L) to 72 µg/L, with an average concentration of 6.7 µg/L.

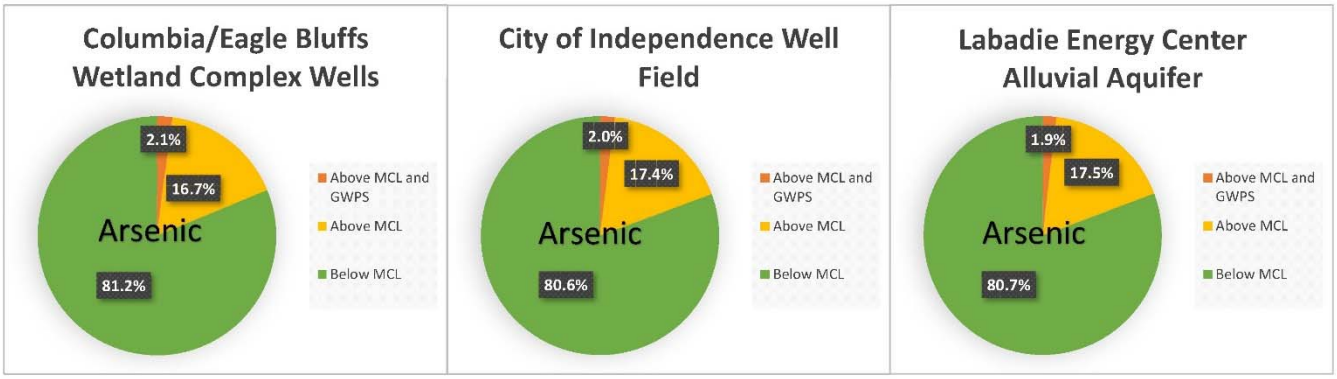

Figure 3: Comparison of Missouri River Alluvial Aquifer Groundwater Arsenic Concentrations – Public Data and Labadie Results

Figure 3 compares the publicly available groundwater arsenic data in upgradient Missouri River alluvial aquifer settings to the Labadie background and monitoring well results, which ranged from non-detect (<0.052 µg/L) to 69.5 µg/L in CCR Rule monitoring wells, with an average concentration of 6.6 µg/L. Overall, the results at the upgradient locations in Missouri are nearly identical to those at the LEC with around 80% of the samples being below the MCL and 20% above the MCL. These data demonstrate that arsenic concentrations above the MCL

are not unusual in the Missouri River alluvial aquifer and are primarily from naturally occurring sources or, potentially, from anthropogenic sources that are unrelated to CCR and power plant operations.

Additionally, using the NWQMC Water Quality Portal (available at https://www.waterqualitydata.us/) from the confluence of the Mississippi and Missouri Rivers to the RIEC there are 99 arsenic groundwater sampling locations with published data from the alluvial aquifer of the Mississippi River. Arsenic test results from these published well samples range from non-detect (<1.0 µg/L) to 39 µg/L with 4 sampling locations reporting arsenic concentrations greater than the MCL and 2 locations with concentrations over the site-specific GWPS for the RIEC. These levels are similar to background arsenic concentrations at the RIEC and further support that the concentrations in background wells are derived from naturally occurring or non-CCR anthropogenic sources of arsenic in the Mississippi River alluvial aquifer.

Additional comments to the CMA's make note that boron is a clear indicator of CCR impacts, which is acknowledged by EPRI (2012) documentation that boron is "*Typically present in leachate, non-reactive and mobile in common hydrogeological environments, and not a common anthropogenic contaminant*." The public comments also attempt to draw a correlation between the arsenic concentrations present onsite and boron concentrations. Since boron is not detected in background groundwater wells, this absence further supports the case that the arsenic observed in background wells is not from a CCR source and is naturally occurring, likely derived from sulfide minerals present in the aquifer.

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ADDENDUM

Rush Island, Meramec, Labadie and Sioux Ash Pond Closure: Rail & Barge Transportation Assessment July 9, 2019

Lochmueller Group previously completed a planning-level assessment of the costs and logistics associated with extracting, stabilizing, and transporting coal combustion residuals (CCR) from existing ash ponds at the Rush Island, Meramec, Labadie, and Sioux Energy Centers to offsite landfills. Trucking is the most flexible and cost-effective mode of transporting CCR, given the relatively short distances (50 miles or less) between each energy center and the preferred landfill locations. The purpose of this addendum is to evaluate in detail the rail and barge transportation modes.

Rail and Barge Overview

Rail and barge typically become more cost-efficient than trucking over longer distances. In fact, the average barge trip length along the Mississippi River waterway system is 513 miles, which is indicative of the long distances that waterway freight commonly travels.

As compared to the highway network, the geographical reach of the rail and barge networks is limited. As such, payloads transported by rail and barge are commonly picked up by truck at the origin and delivered by truck to the destination, with intermediate transloads on and off trains and barges. Over short distances, the cost and time for these transloads renders rail and barge non-competitive with truck hauling.

To maintain parity with truck hauling, CCR transport by rail would require specialized rail cars fully lined with covers to prevent material escape (coal delivery trains are not suited for CCR removal). As such, these trains would be dedicated for CCR transportation and would run full to landfills and return empty. Such specialized rail cars are expensive and cost approximately $100,000 per car. Rail cars for each 100-car unit train are estimated to cost $10M.

CSX is a Class 1 railroad with acknowledged CCR transport capabilities. However, CSX does not directly serve any of Ameren's energy centers. For CSX to be a CCR hauler for Ameren, carrier transfers would be required involving the Class 1 serving each site (UP or BNSF). This would probably occur using the St. Louis Terminal Railroad (TRRA) as an intermediary to transfer train cars from UP and BNSF yards in Missouri to the CSX Rose Lake Yard in East St. Louis, Illinois. In total, the use of three separate carriers and multiple train yards would increase the complexity, cost, and haul cycle under the CSX option. Service disruptions would also be a concern, as Ameren would have little control over the means or methods of rail transport.

Given the carrier transfer process described above, a single 100-car unit train is assumed to be capable of transporting approximately one load every two weeks, although the actual timeframe depends on the landfill destination. To maintain the previously assumed CCR removal rates and assuming the 2-week roundtrip haul, unit trains would need to be loaded at each energy center one to four times per week dictating two to eight CCR unit trains in the cycle for each site. The capital expense to acquire a sufficient number of rail cars to support such haul cycles at Ameren's four energy centers would be approximately $90M.

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Rail and barge transportation is more susceptible to disruptions, particularly due to flooding events that can close rivers and rail lines for extended periods. In addition, congestion on rail lines and in rail yards and at lock and dams affects the reliability of these modes. Barges also present a unique environmental and safety concern. In 2018, 15 coal barges broke loose on the Monongahela River near Pittsburg with two of the barges sinking and at least one spilling coal into the river. The leakage or spillage of CCR into waterways would have environmental ramifications. Given the sensitivities surrounding CCR generally, barging is simply not a desirable transport mode.

Ameren Energy Centers

As previously noted, each energy center has the potential for direct rail and barge loading. However, there are site constraints at each location that would hamper rail or barge operations, as follows:

Rush Island

The site currently has a rail loop off the BNSF line for unloading coal trains. A full 12-hours is required to unload a coal train and the site receives about one train per day. Hence, the existing rail spur is fully utilized and does not have capacity to temporarily store or load CCR trains.

It would be necessary to construct dedicated tracks for loading CCR unit trains known as “ladder track”. The site does not have space for such a facility, so land would need to be acquired or leased from an adjacent property owner or from the BNSF itself to construct a loading area. Since the loading would occur off-site, CCR would need to be trucked to the rail loading area.

Additionally, the BNSF mainline consists of a flood-prone single track. The line has been inoperable due to multiple flooding events in 2019 alone. Due to the single track, northbound and southbound trains must pass at sidings to maintain two-way operation. This significantly diminishes the capacity of the line. It is uncertain if existing BNSF operations can accommodate additional train volume. The addition of CCR train operations could disrupt coal delivery, impacting power generation and ultimately service to customers.

Rush Island does not presently have barge loading capabilities. Ameren would need to construct barge-loading facilities in the Mississippi River along with conveyors to transport the CCR from land to the barge loading area. This would require permits from multiple agencies, including the Army Corps of Engineers and US Coast Guard. This section of the Mississippi River is very active and the ability to obtain regulatory approvals for CCR removal by barge is uncertain.

Meramec

Similar to Rush Island, Meramec is located along a single-track mainline, which is operated by the UP. It is uncertain if existing UP operations can accommodate additional train volume, as this line has the same challenges maintaining two-way operations as the BNSF line. This line is also prone to closure due to flooding.

Concerning barge transportation, Meramec has barge loading facilities in place. However, environmental and safety concerns with barge transportation persist, in terms of the potential for CCR to leak or spill from barges into waterways or for barges to break away.

Labadie

Both the UP (and BNSF via trackage rights) and Central Midland Railroad (CMR) – a short line railroad running between St. Louis and Union – operate in proximity to the Labadie site. However, CMR's line sale contract contains a service restriction prohibiting the CMR line from serving the Labadie facility. That restriction was upheld by the Surface Transportation Board (STB Dockets NOR 42126, FD 33508, FD 33537, served Feb. 27, 2013). The UP presently delivers two loaded coal trains per day to Labadie.

The site's existing rail infrastructure is fully committed to unloading coal trains and would not have capacity to temporarily store or load CCR trains. Therefore, it would be necessary to construct dedicated tracks for loading CCR unit trains on site. Given the site's location in the Missouri River flood plain, such a facility would be subject to permitting and approval from numerous regulatory authorities, which could delay or prohibit construction.

Barge transportation on the Missouri River is considerably less reliable than on the Mississippi River. There are no lock and dams along the Missouri River; water levels are highly susceptible to rainfall and spring snowpack melt in the Rocky Mountains; and the Army Corps of Engineers has not consistently maintained a navigation channel. In recent years, the barging "season" has been at most six months per year. Given these issues, barge transportation would not be a reliable mode for removing CCR from Labadie.

In addition, the Labadie site does not presently have barge loading capabilities. Ameren would need to construct docking facilities along with conveyors to transport the CCR from land to the barge loading area. This would require permits from multiple agencies, including the Army Corps of Engineers and US Coast Guard. With the river not being navigable for half of the year, pursuit of permits and capital expenditures for barge loading facilities would not be economically viable.

Sioux

The site is located along a single-track BNSF line, which is also prone to closure due to flooding and two-way volume constrained. Similar to the other sites, existing on-site rail infrastructure is dedicated to unloading coal trains. Dedicated tracks for loading a CCR unit train would need to be constructed to facilitate removal of CCR by rail.

The Sioux site does not presently have barge-loading capabilities and Ameren would need to construct docking facilities along with conveyors to transport the CCR from land to the barge loading area. This would require permits from multiple agencies, including the Army Corps of Engineers and US Coast Guard. The environmentally sensitive nature of this section of the Mississippi River – influenced by the presence of wetlands, recreation and parks along the river, and eagle habitats – would further encumber the permitting process.

Potential Landfill Destinations

To avoid the need to transload CCR from rail or barge to trucks to reach the final destination, Lochmueller reviewed landfills located in proximity to rail lines or waterways to determine if facilities are in place to enable direct unloading of CCR from rail or barge. Sites across Missouri and Illinois (excluding the Chicago area) were reviewed using location information provided by each state's environmental agency.

While several landfills were discovered along active rail lines, none appears to have active rail unloading capabilities in place. The Five Oaks Recycling and Disposal located near Taylorville, Illinois had a rail unloading spur at one time, although it seems to have fallen into disuse. Moreover, if reactivated, it would not have the ability to store long CCR unit trains and would need to be extended.

Similarly, no landfills were discovered with unloading capabilities along waterways. It is our understanding that such facilities may exist in other states. However, the increase in travel distance to access those facilities would likely render them cost-prohibitive for purposes of CCR removal from these four sites.

Study of Deep Excavation at Ameren Missouri Energy Centers

INTRODUCTION

In response to questions raised at recent public meetings held by Ameren Missouri (Ameren), Reitz & Jens was asked to prepare a white paper that discusses the methods and implications of deep excavation and removal of Coal Combustion Residuals (CCRs) from the surface impoundments ("basins") located at Ameren's four coal-fired energy centers. The technical review presented in this paper is applicable in general to a deep excavation below the water table at the Sioux, Labadie and Rush Island Energy Centers[1]; specific characteristics of each individual energy center or CCR unit are not addressed.

GENERAL DESCRIPTION OF CCR BASINS

The principal characteristics of the CCR basins at each of Ameren Missouri's energy centers are:

1. The basins are built both below and above grade (that is "partially-incised") in alluvial sands in close proximity to a major river (Mississippi River or Missouri River). The basins were created by dredging the sands in the vicinity of each plant to obtain fill material to raise the actual area of the power plant building and appurtenant facilities to above flood levels of the adjacent river. The excavation was then repurposed to manage CCRs generated from the plant. The CCRs were generally placed in the excavation by sluicing (deposited by flowing water). At some point in the history of each plant, large perimeter berms were constructed around the basins. This is illustrated below:

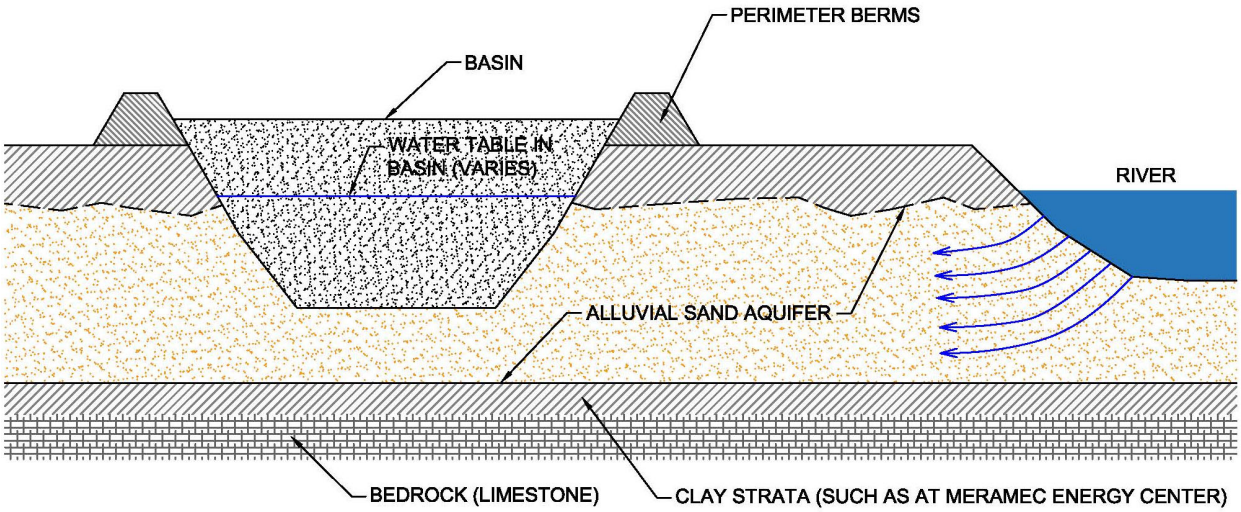


Figure 1 – Illustration of General Construction of CCR Basins (not to scale)

2. The size, depth and proximity to large rivers all impact the method of potential excavation. These basins are relatively large – up to 165 acres – compared to many CCR units at other power plants.

[1] At normal river levels, most of the CCR basins at the Meramec Energy Center are above the water table and are excluded from this description.

The basins are relatively deep – up to 100 feet. Some basins, such as at the Rush Island Energy Center, extend close to the underlying bedrock.

3. The removal process of the ponded CCR is more difficult than traditional soils and would require specialized equipment and management prior to transport to a landfill. The characteristics of the CCRs vary from plant to plant and also depend upon the nature of the CCR – fly ash, bottom ash, and other coal combustion byproducts. Fly ash tends to hold water and will not drain by gravity alone such as in a pile; it typically requires some mechanical grading or agitation. Bottom ash is more like sand and will drain more freely. In addition, CCRs are lighter in weight than soils and compressible. Near the surface of the basins CCRs are generally in a loose state due to their placement via sluicing. At greater depths within the basins, CCRs generally compress and become more dense due to settlement from the weight of the upper CCRs. CCRs become less permeable with increasing density, that is, limiting the volume and velocity of water that may move through the CCRs. Eventually, fly ash may become as impermeable as fine-grain soils.

The principal characteristics of the CCR basins listed above are the determining factors in the feasibility of excavation at Ameren's Energy Centers and could differ from that observed at other power plants which may have burned coal or built basins with different characteristics.

PRINCIPAL METHODS OF EXCAVATION

There are two principal methods of removal or excavation of the CCRs from the basins: 1) excavation in the "dry" by first pumping out the water (i.e. "dewatering") to some depth below the excavation; or 2) excavation in the "wet" by dredging, which is how the basins were excavated originally. The "dredge" may be a backhoe with an extended arm and bucket, a crane with a dragline bucket, or a crane with a clam-shell bucket. Another type of dredge is the suction dredge which pumps the material and water to a disposal site. Small suction dredges have been used in CCR basins at other power plants, but they are limited to about 20 to 30 feet deep. Because of the greater depths, removing CCRs from Ameren's basins would require a cutter-head dredge, such as pictured below.

Figure 2 – Illustration of Cutter-Head Suction Dredge

The cutter-head dredge is designed to break through and remove compacted or cemented CCRs and, due to the depths of Ameren's basins, would need to be specially manufactured. The dredge would pump approximately 14,000 gallons per minute and could remove up to about 650 cubic yards of CCR per hour.

EXCAVATION IN THE "DRY"

Complete removal of water from the CCR basin prior to excavation may not be practical or technically feasible using either deep wells or cutoff walls. The volume of water requiring handling would be tremendous because the basins are in a sand aquifer near a major river as illustrated in Figure 1.

To keep water from filling the excavation would require concentric rectangles or "rings" of deep wells installed at close spacings and completely encircling each basin, with each well pumping hundreds of gallons per minute. The use of a deep well system to dewater the basins creates a number of technical and environmental problems:

1. Space limitations around the basins could impede or preclude the installation of such a large system of concentric wells around each basin. Each concentric system of wells must be separated from the next system by 15 feet or more for equipment and maintenance. Also, a stable slope must be maintained in the sand between each system as the excavation progresses. Therefore, the outside limits of the wells and excavation would need to extend well beyond the existing limits of the basin. The basins are in close proximity to each plant and operational facilities, such as railroad tracks, tanks, and buildings.

2. The drawdown would pull CCR-impacted water from the basin; therefore, a tremendous volume of water would have to be managed and/or treated, requiring a large water treatment plant to be constructed on site[2].

3. Depending upon location, the drawdown of the groundwater table could potentially impact the surrounding environment, such as surrounding vegetation and crops, and potential settlement of the natural soils surrounding the basins. This could cause settlement of shallow foundations, roads, railroad tracks, adjacent river banks or levees, and utilities.

Therefore, in lieu of a concentric well system, a cutoff wall would need to be designed and constructed around each CCR basin to prevent the surrounding groundwater from flowing into the basin as it is pumped dry and excavated. For the Labadie Energy Center, the cutoff wall would have to be up to two (2) miles long and would extend to the bottom of the aquifer, up to 100 feet deep or deeper. Construction of the cutoff wall alone could take up to a year. The water removed during excavation of CCRs inside the cutoff wall would need to be treated.

Structural Stability: Cutoff Walls and Cofferdams

Slurry cutoffs, structural panel cutoffs or sheetpile walls alone would not be structurally adequate due to the tremendous hydrostatic pressure and lateral earth pressures that would occur on the outside of the cutoff wall as the interior CCRs are dewatered and excavated. Installation of deep wells around the outside of the

[2] Existing waste water treatment facilities are inadequate to manage the volume of water generated by a deep excavation project discussed here.

cutoff wall to reduce the hydrostatic pressure would create some of the same problems discussed above. A potential solution would be to install rows of tie-backs through the wall and into the underlying bedrock as the excavation progresses. This is illustrated in Figure 3 below:

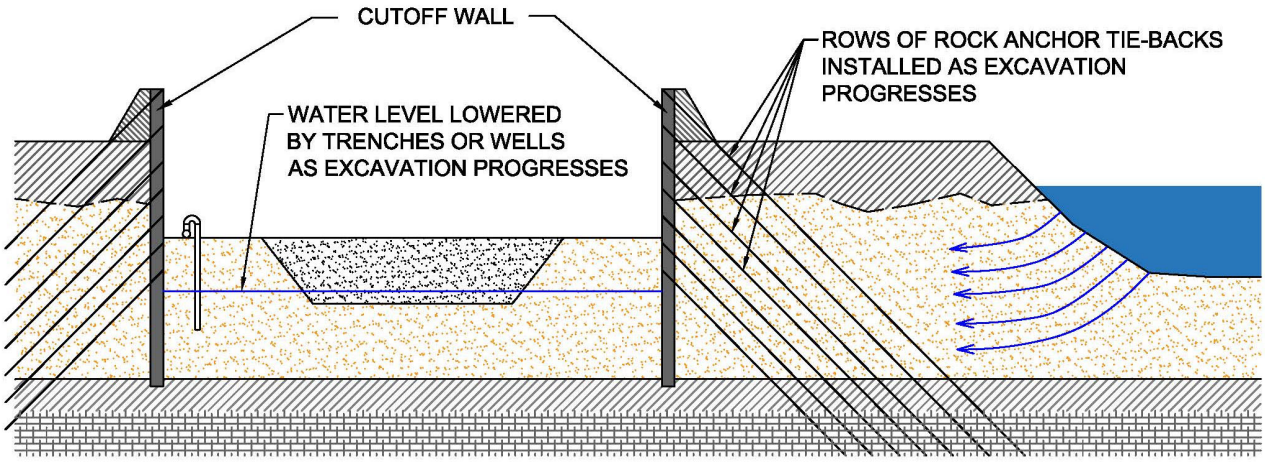


Figure 3 – Illustration of Cutoff Wall with Tie-Backs

There are several different methods of installing a structural concrete cutoff wall. One method is to excavate a deep trench, using a heavy mud slurry to keep the trench open in the sands. Reinforcing steel is then inserted into the trench, and the slurry is displaced by pumping concrete up from the bottom. An example is the structural concrete cutoff wall installed for the construction of the World Trade Center to hold back the water of the Hudson River.

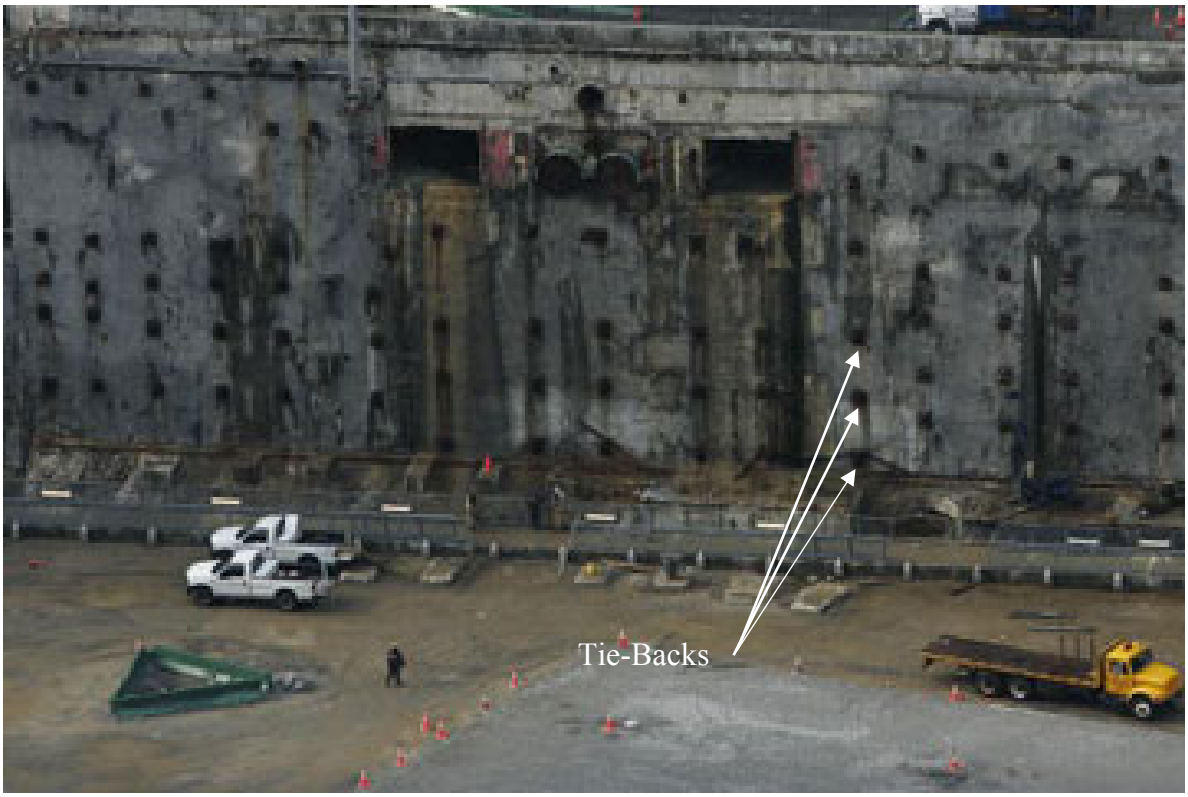


Figure 4 – Structural Concrete Cutoff Wall for the World Trade Center

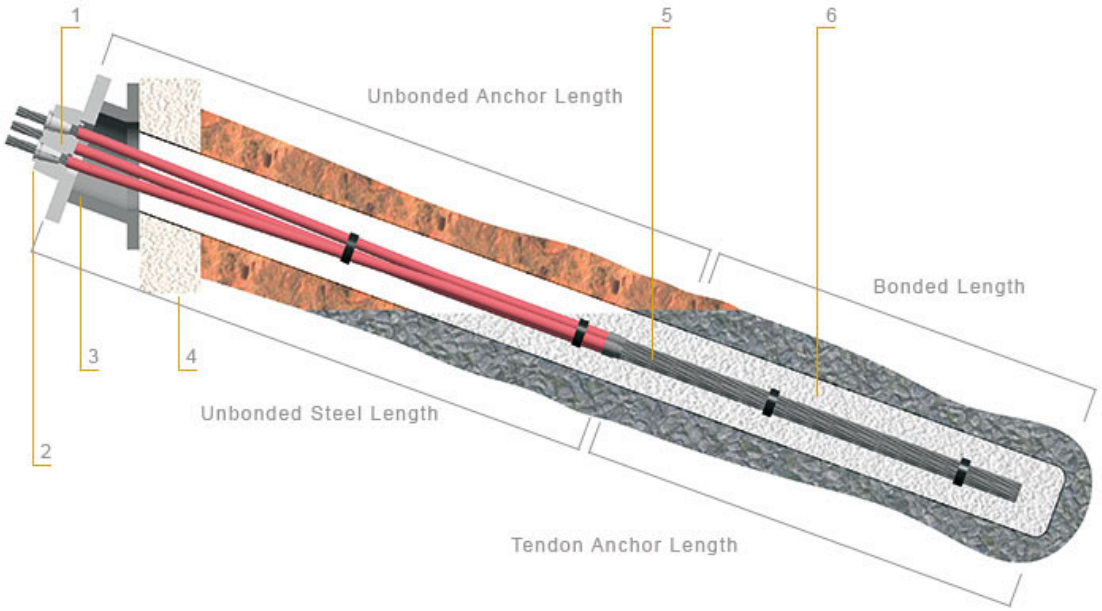


Figure 5 – Illustration of a Typical Rock Anchor Tie-Back

An illustration of a typical multi-stand rock anchor tie-back is shown in Figure 5. Tie-backs are installed by drilling in horizontal rows as the excavation progresses downward. Tie-backs ends can be seen in the photo of the cutoff wall in Figure 4. At some locations, the lengths of the upper tie-backs would need to be well over 100 feet to penetrate into the bedrock, such as at Labadie and Rush Island. The cost per tie-back could range from $10,000 to $40,000.

The construction of a structural concrete cutoff wall is problematic due to both the depths and the presence of large cobbles and boulders near the bedrock, such as at Labadie and Sioux Energy Centers. It is critical that the cutoff extend into the underlying clays where present, such as at Meramec, or into the bedrock, such as at Labadie and Rush Island. The cutoff has to be more than 90% sealed to have real effect at stopping the inflow of groundwater. Installation of hundreds to thousands of tie-backs as the excavation of the CCRs progresses would add years to the construction of the cutoff and the removal of the CCRs. The installation of the cutoff wall and tie-back rock anchors alone will add millions to tens of millions of dollars to the cost of removal of the CCRs by excavation in the dry.

Another type of cutoff sometimes used adjacent to a major river is a “cellular cofferdam.” This technique typically requires deep soil mixing, compaction grouting or drilled holes to make continuous lines of cylindrical columns to form a row of boxes or cells completely around each CCR basin. The width of the cells would have to be large to withstand the hydrostatic pressure and lateral earth pressures. This construction method requires a sufficient open area that may not exist at each energy center and is equally as expensive as a cutoff wall. The close proximity of the plant and appurtenances could be a limiting factor.

Treatment and Management of Water

As the excavation inside the cutoff walls progresses, water from the basin would need to be removed by temporary wells and trenches. This includes existing water and precipitation that falls over the years it

would take to complete the project. The water would have to be evaluated to determine regulatory status before the pumped water could be discharged. Assuming such water exceeds regulatory standards, a water treatment plant would need to be constructed on site to handle the volume.

Summary

Since removal and treatment of sufficient volumes of water would be very problematic, extremely time consuming, and exceedingly costly, excavation of CCRs in the basins in the "dry" is not practically feasible.

EXCAVATION BY DREDGING

Excavation by dredging eliminates many issues associated with the removal of the water from an area of deep alluvial sands adjacent to a major river. There are, however, a number of technical challenges that remain with dredging. First, excavation by dredging is done blindly under water. Therefore, removal of CCRs from a basin with a bottom liner should not be done because there would be a very high probability that the bottom liner would be damaged, causing more environmental harm than if the basin were closed with the CCRs in place. Secondly, dredging with an open bucket – such as with a backhoe, dragline or clamshell – could result in suspension of contaminants and an increase in the hydraulic conductivity of the CCRs, resulting in an increase in release from the unlined basin. Because of these limitations, the only viable method is a suction dredge. As stated above, a cutter-head dredge would be necessary for the deep basins.

A suction dredge discharges a slurry of water and CCRs from the basin. The volume is tremendous – on the order of 14,000 gallons per minute for a large cutter-head dredge. Due to the volume, and to allow the CCRs to settle out, the slurry would be piped into one or more lined settling ponds constructed on site. The settling ponds would need to be located adjacent to the CCR basin so that the decanted water could flow by gravity or pumped back into the CCR basin. Excess water, such as from precipitation, would have to be tested and evaluated to determine the treatment that would be required before the water could be discharged. However, at all of the energy centers, space immediately adjacent to the basins is limited. Accordingly, settling basins would need to be located away from the CCR basins complicating ongoing excavation activities with delays inherent to the pumping and settling process.

The dredged material would need to be excavated and dried sufficiently to allow overland hauling to a commercial landfill. This double-handling and drying processes requires substantially more space and time, as well as cost, to complete. We estimate that it would take 10 years or more of a continuous dredging operation to remove the CCRs from the largest of Ameren Missouri's CCR basins. This time estimate does not take into account permitting and construction of the settling ponds which would further delay the completion schedule. Delays for weather, equipment maintenance, double-handing, drying, and transporting the CCRs to a landfill have the potential to further increase project duration.

Stability of Interior Slopes

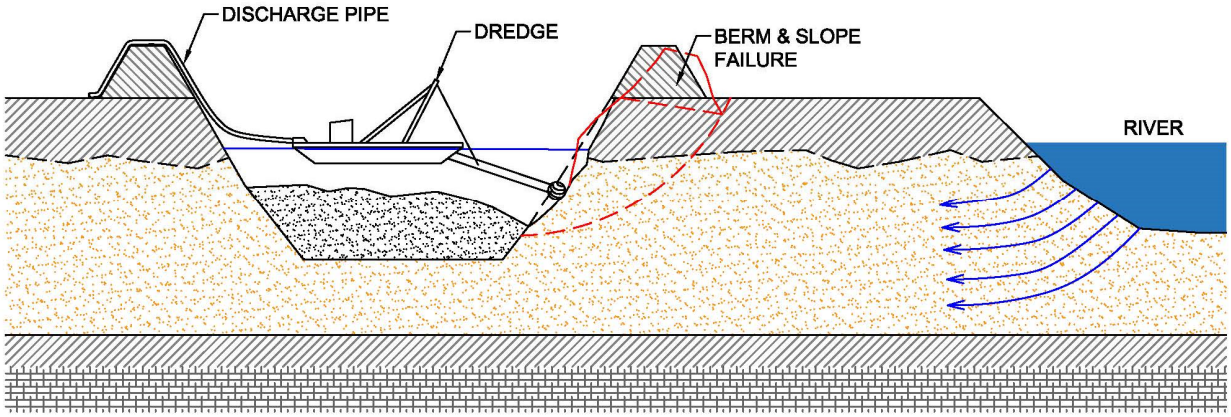


Figure 6 – Illustration of Problems with Stability of Interior Slopes

During an excavation project, the interior slopes of the basins have the potential to become unstable as illustrated in Figure 6. Instability is particularly problematic during a flood when water would be pushing on the perimeter berms. The basins were originally excavated by dredging, and the interior slopes were stable at that time. However, over time perimeter berms were constructed around the basins, in some cases after the deposition of the CCRs, to increase capacities and to protect against flooding. As excavation occurs, the interior slopes would become unstable unless the berms were removed. Removing the perimeter berms increases the risk that the basins would become flooded at high river stages. To prevent environmental risk associated with a flooded and unsecured CCR basin, new perimeter berms would need to be constructed far enough from the edge of the basin to prevent a slope failure and an uncontrolled release of CCR. Sufficient room may not exist at all energy centers to construct new temporary perimeter berms.

To ensure that all of the CCRs are removed, it is inevitable that some excavation will penetrate below the original bottom of the excavated basin and below the original interior side slopes. This would also cause instability of the interior side slopes. A failure of the perimeter of the partially-excavated basin has the potential to result in an uncontrolled release of CCR, particularly on the side adjacent to the river. An unstable slope would also be a major safety hazard for the construction and possibly for the adjacent energy center and operations. To mitigate such risks, temporary retaining walls with tie-backs may need to be constructed.

Completion of Project

Following completion of the excavation, the water remaining in each basin would have to be evaluated for compliance with regulatory water quality standards (GWPS) and some remedial clean-up activities would probably be required for each of the settling basins. After the water in each basin meets the required regulatory standards, the hole could be filled. Dredged sand from the adjacent river would likely be used for fill material because the excavation would contain water.

TECHNICAL MEMORANDUM

TO: AMEREN MISSOURI

FROM: XDD ENVIRONMENTAL, GOLDER ASSOCIATES INC.

SUBJECT: BEHAVIOR OF METALS IN SOIL AND GROUNDWATER

DATE: JULY 9, 2019

CC: SCHIFF HARDIN LLP

Metals are found naturally at varying concentrations in the minerals that make up our soil. As groundwater comes in contact with the soil, some metals leach from the soil, into the groundwater. The metals cannot be destroyed, but by changing environmental conditions of the soil and groundwater, the leaching (dissolution) can be reduced through the formation of more stable minerals or by being bound more strongly to other minerals.

Two major factors that affect the dissolved concentrations of metals in are the pH and the oxidation-reduction potential (ORP) of the water. pH is a measure of the acidic or alkaline nature of the water; strongly acidic water has a low pH (e.g., less than 4), while strong alkaline water has a pH typically greater than 10. ORP is a measurement of the tendency of a substance to oxidize or reduce another substance. Highly oxygenated water typically has a high ORP (greater than +200 millivolts), and highly reduced groundwater typically has an ORP less than 200 millivolts. The pH and ORP of the groundwater strongly influence the form of the metal present and the associated dissolution of the metals into groundwater.

Many metals increase in dissolved concentration when the groundwater is more acidic or more alkaline, because the minerals in the soils can dissolve under these conditions and the metals are released. Similarly, extremes in the ORP can also cause increases in dissolved metals due to the impact on the minerals. By optimizing pH and/or ORP levels, minerals within the groundwater and surrounding soils stabilize thereby reducing the dissolved concentrations of metals and creating more stable minerals that resist leaching / dissolution of the metals.

Groundwater conditions at Rush Island provide a useful illustration of this process. Upgradient of the ash basins, pH ranges from 6.0 to 8.5 in the shallow and deep groundwater zones to the north and west of the CCR unit (RCPA). On the downgradient side of the RCPA (eastern side), where pH is neutral, there are limited concentrations above the arsenic GWPS. However, as shown in Figures 1 and 2, on the downgradient side of the RCPA where the pH is higher than normal neutral conditions, arsenic concentrations are also present at elevated concentrations.

By optimizing natural processes, as one would do with a swimming pool, such as adjusting the pH level within the intermediate zone, a stabilization zone is created, and concentration levels are predicted to drop. Installation of an engineered cap system with a nearly impermeable geomembrane will effectively eliminate precipitation infiltration through the ash, which is a driving force behind the physical process that causes metal impacts to groundwater.

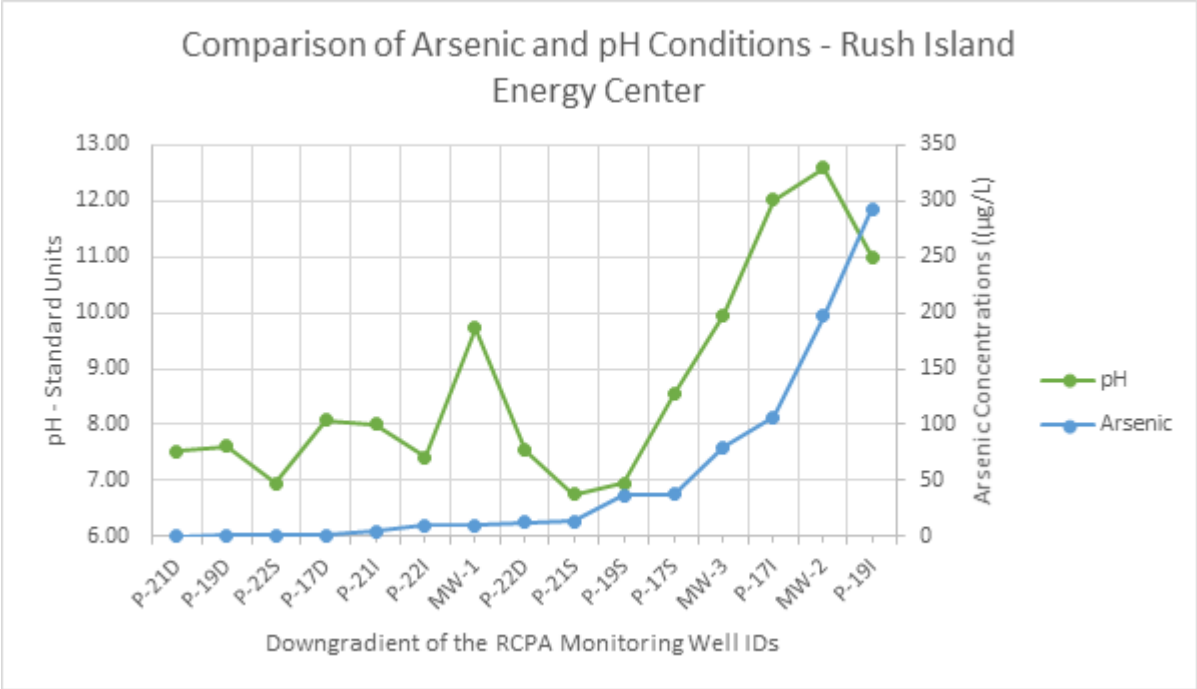
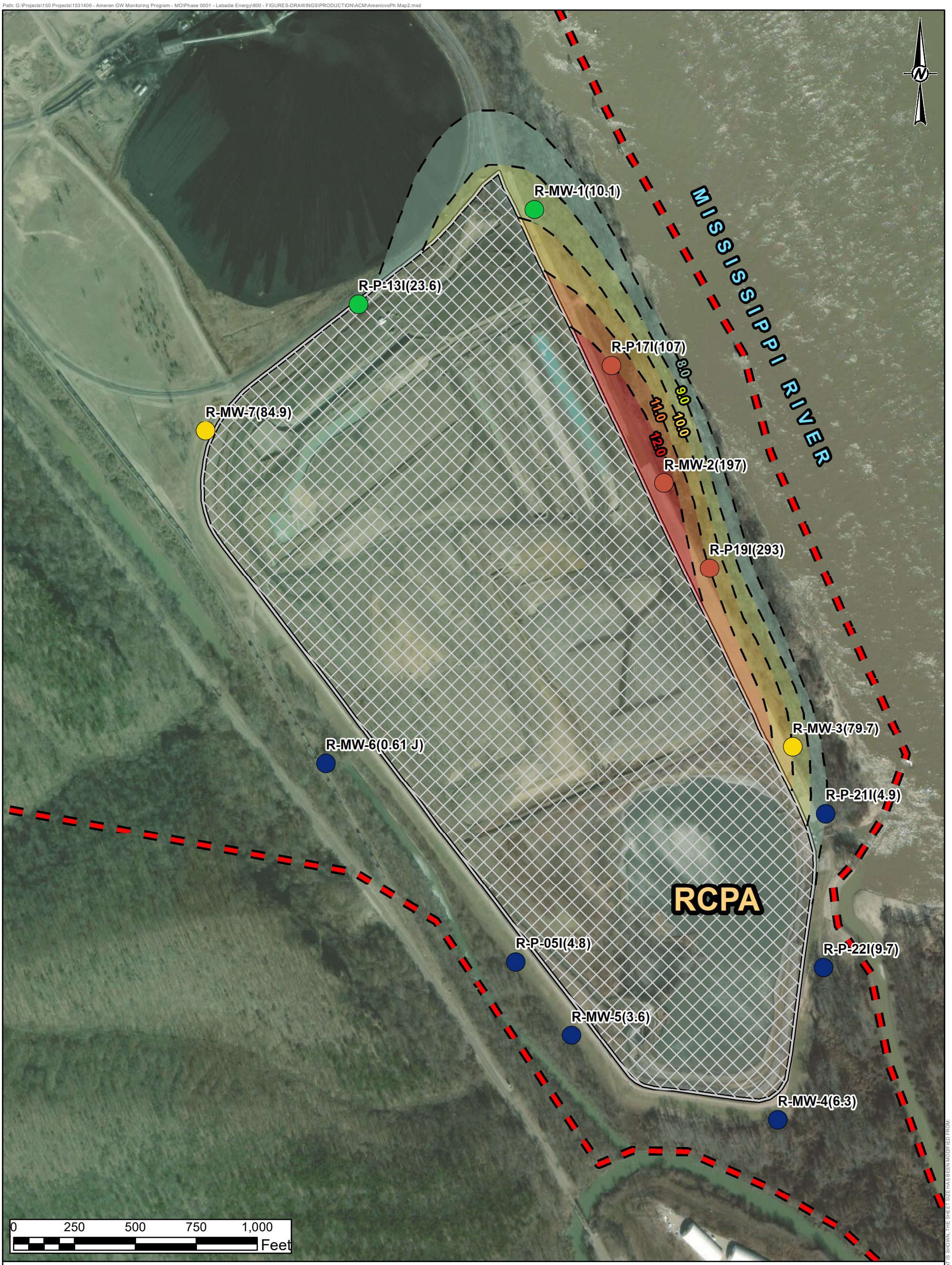


Figure 1 - Comparison of Arsenic and pH Conditions - Rush Island Energy Center

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0001 - Labadie Energy\800 - FIGURES-DRAWINGS\PRODUCTION\ACM\ArsenicvsPh Map2.mxd



LEGEND

- Rush Island Energy Center Property Boundary
- RCPA Surface Impoundment

November 2018 Arsenic Concentrations (µg/L)

- Greater than 100 µg/L (Above Site GWPS)
- Greater than 30 µg/L (Above Site GWPS)
- Greater than 10 µg/L (Above MCL, Below GWPS)
- Less than 10 µg/L (Below MCL)

pH concentration Zones (Standard Units)

- pH values less than 8.0 are not colored
- pH between 8.0 - 9.0
- pH between 9.0 - 10.0
- pH between 10.0 - 11.0
- pH between 11.0 - 12.0
- pH above 12.0

NOTES

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2. J - ESTIMATED CONCENTRATION ABOVE THE ADJUSTED METHOD DETECTION LIMIT AND BELOW THE ADJUSTED REPORTING LIMIT.
3. GWPS - GROUND WATER PROTECTION STANDARD (SITE SPECIFIC).

REFERENCE

1. AMEREN MISSOURI RUSH ISLAND ENERGY CENTER, RUSH ISLAND PROPERTY CONTROL MAP, JANUARY 2012.

CLIENT
AMEREN MISSOURI
RUSH ISLAND ENERGY CENTER

PROJECT
GROUNDWATER MONITORING PROGRAM

TITLE
NOVEMBER 2018 ARSENIC VS PH CONCENTRATION MAP INTERMEDIATE ZONE OF THE ALLUVIAL AQUIFER

CONSULTANT
GOLDER

YYYY-MM-DD	2019-07-02
PREPARED	JSI
DESIGN	JSI
REVIEW	EMS
APPROVED	MNH

PROJECT No. 153-140601
PHASE 0002
FIGURE 2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
1 in
0

GOLDER

Rush Island Closure by Removal Groundwater Modeling

June 27, 2019

AGENDA

Objective of Modeling 01

Construction/Assumptions of the Model 02

Modeling Results 03

Objective of the Model

RUSH ISLAND ENERGY CENTER

This modeling effort compared the estimated time to achieve groundwater concentrations below the Groundwater Protection Standard (GWPS) at monitoring wells around the RCPA. Modeling included updating the previous model(s) to simulate the effects of Closure by Removal (CBR) on the groundwater quality around the RCPA. These results were then compared with Closure in Place (CIP) to compare how long it would take to achieve GWPS at compliance wells in both scenarios.

Closure by Removal Modeling - Phases

Rush Island Energy Center

Phase 1 – Active Conditions	Active conditions were modeled the same way as previously reported. Assumed constant slurry recharge to the RCPA
Phase 2 – Dry CCR Removal	Removal of the top portion of the RCPA that would be above the static groundwater level after dewatering to static conditions.
Phase 3 – Wet CCR Removal	Removal of deeper portions of the RCPA were the CCRs are fully submerged.
Phase 4 – All CCR Removed and Backfilled	Modeling conditions after all CCR has been removed from the RCPA. Assumes fluvial sands/silts from the Mississippi River are to be used as backfill.

Phase – 1 Active Conditions

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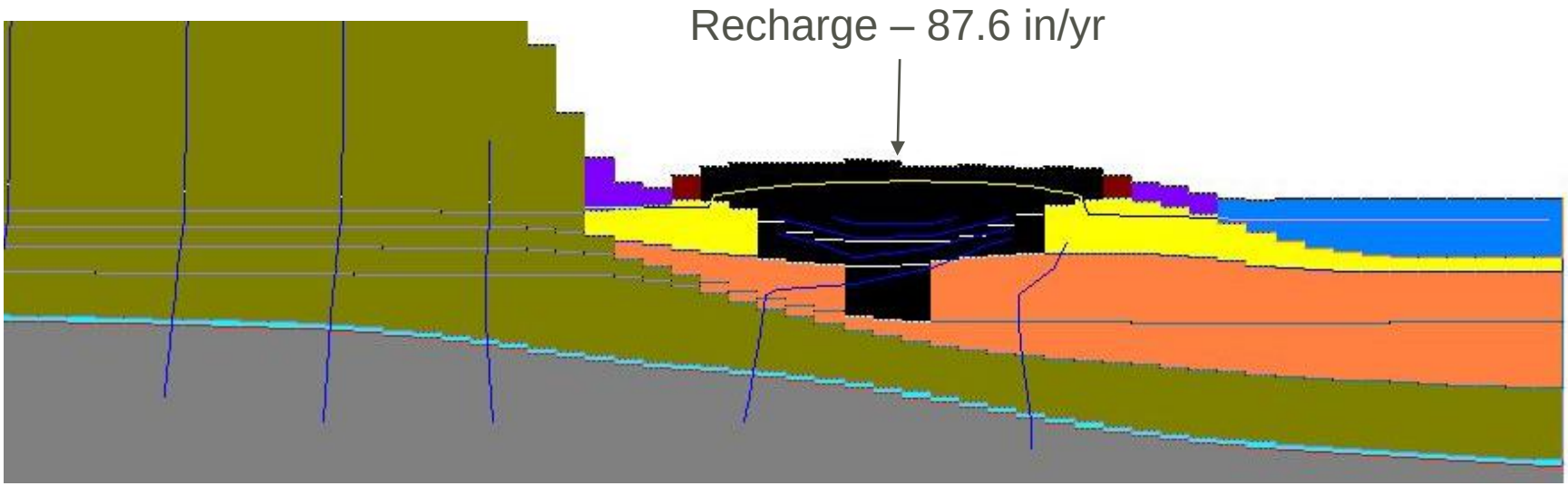

Active Conditions Assumptions

1. Same model(s) used as described in previous modeling report.
2. Recharge into RCPA 87.6 inches per year (i.e. Active Conditions).
3. Results in predicted mound in RCPA as measured in present conditions.

Phase 1 – 3D Model Design

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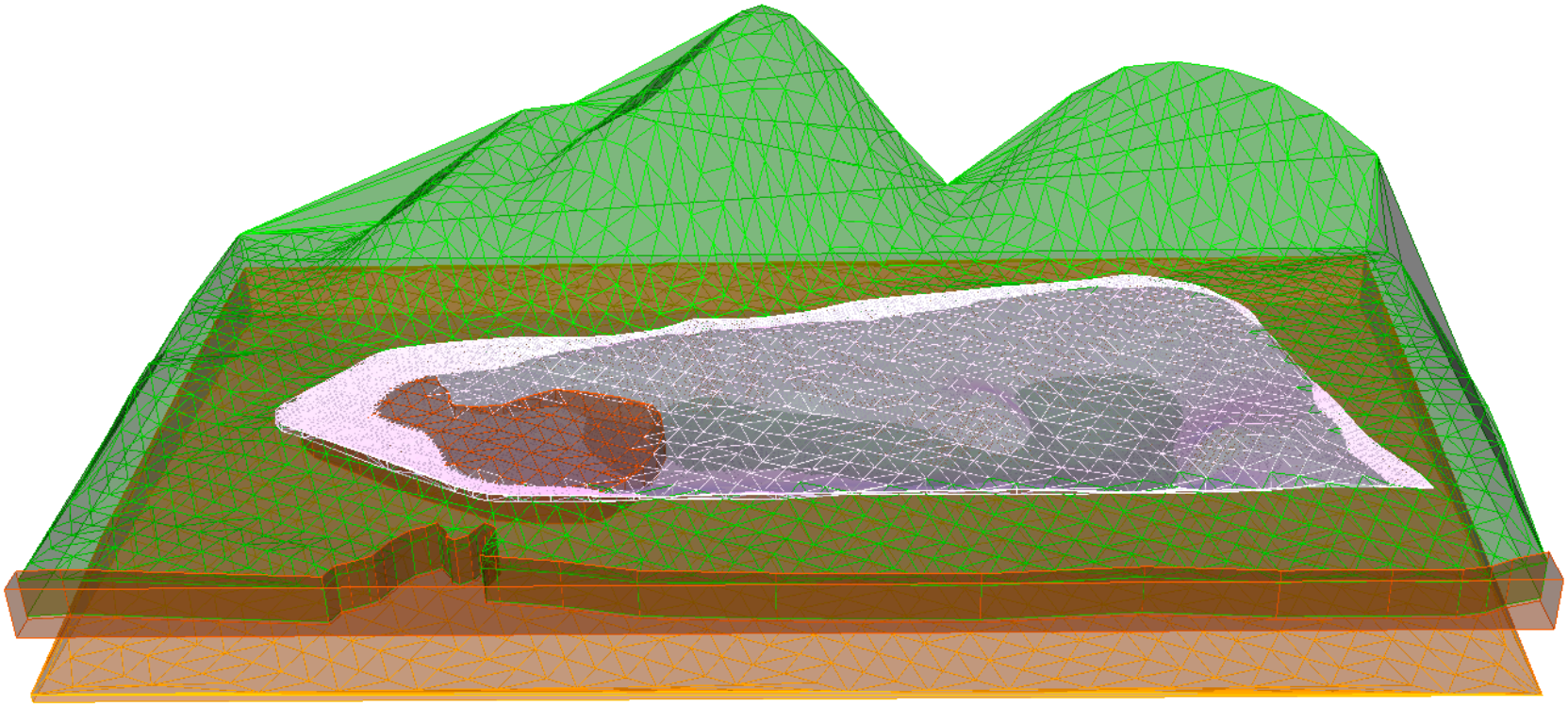
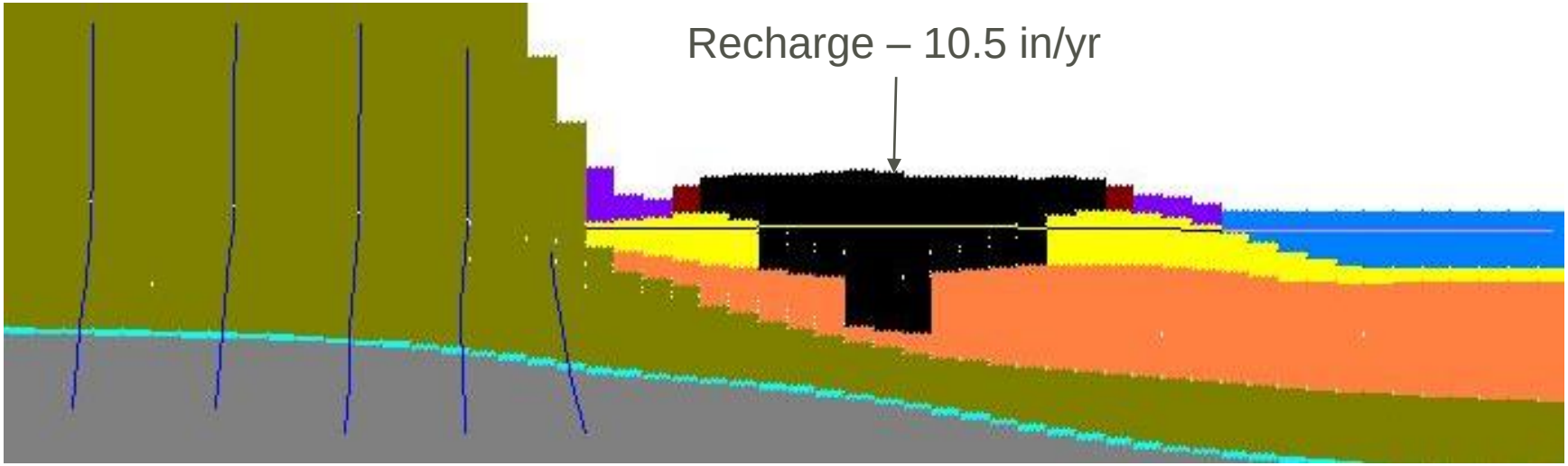


Phase 2 – Dry CCR Removal

RUSH ISLAND ENERGY CENTER



Dry CCR Removal Assumptions

1) Based on volume of CCR, it will take 16 years to excavate down the top 28 feet (dry excavation and partially wet excavation, based on lochmuller (2019) report).

2) Recharge into the pond will be less than active conditions, but higher than cap and closed conditions. The vertical conductivity (Kz) of the ash is estimated to be $1x10^{-5}$ cm/sec, so for a conservative approach, the value calculated in the help model for a $1x10^{-5}$ cm/s cap was used for recharge (10.5 in/yr) during this stage. This recharge rate causes a small mound in the RCPA of ~1-3 feet during this phase.

3) Removed polishing pond from southern portion of the RCPA.

Phase 2 – Model Design

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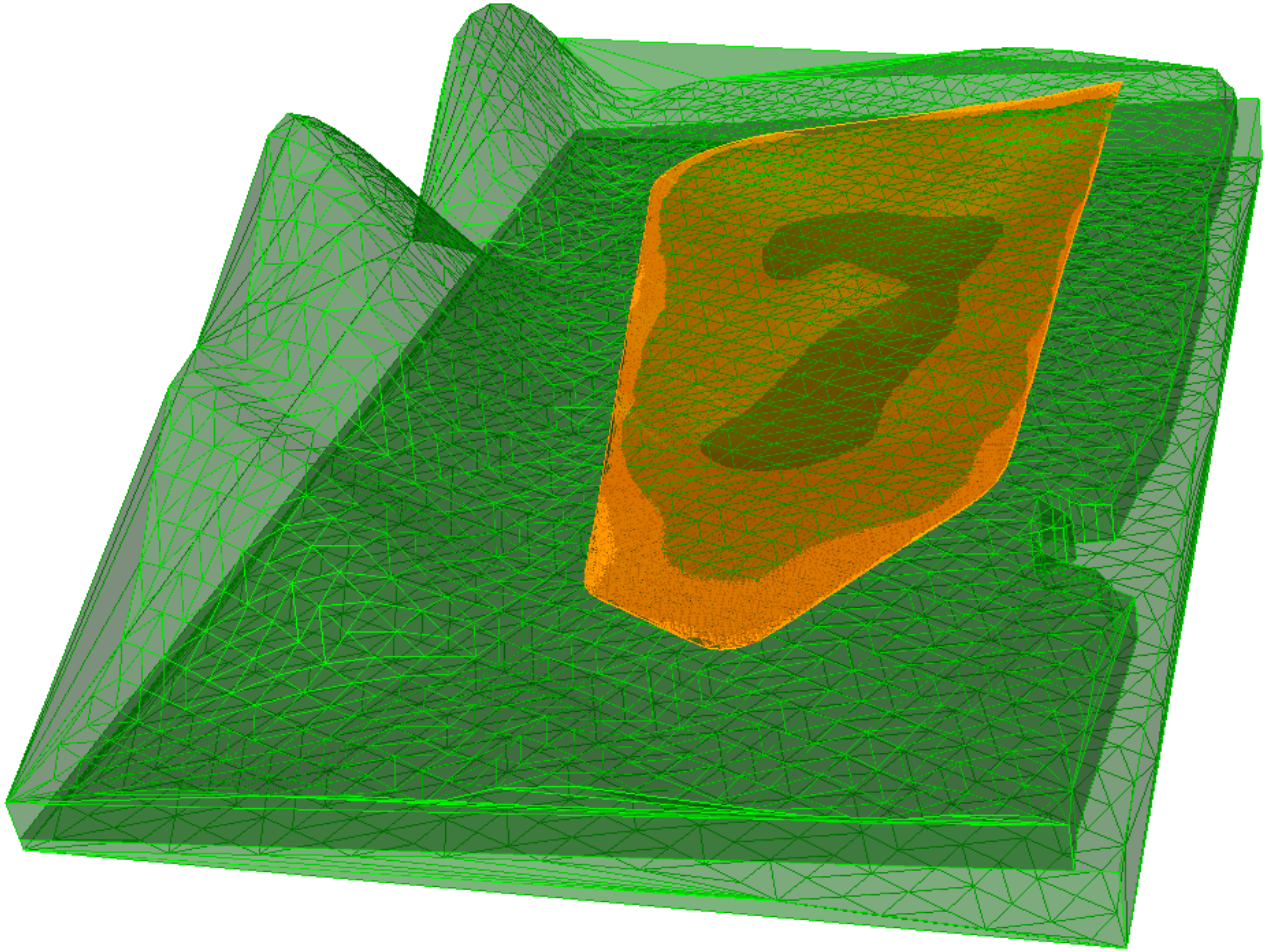
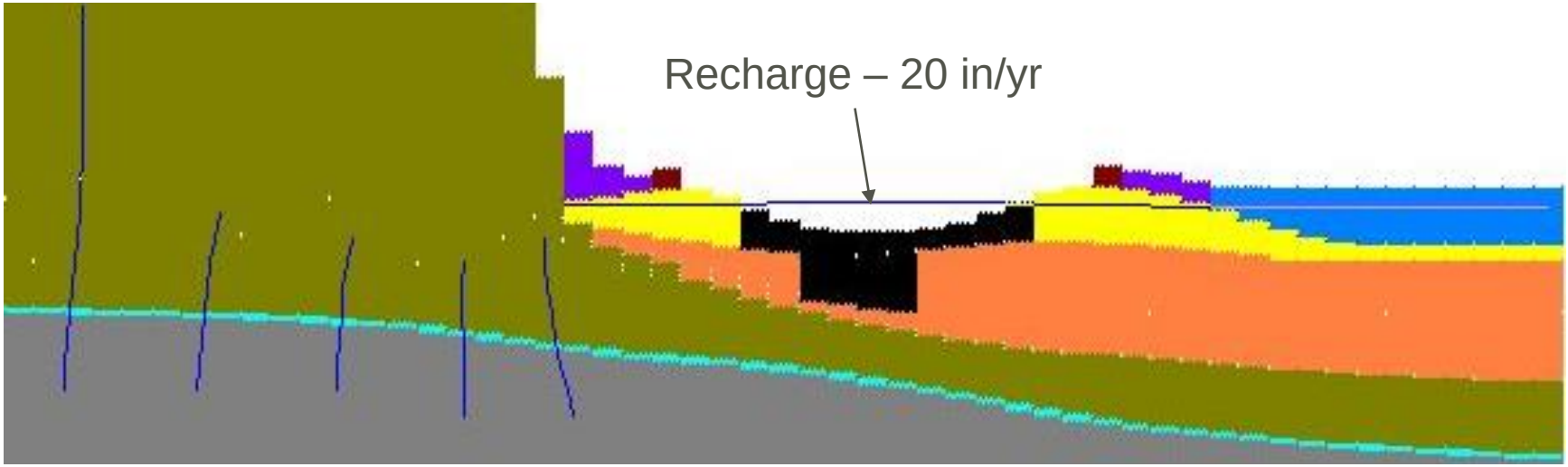


Phase 3 – Wet CCR Removal

RUSH ISLAND ENERGY CENTER



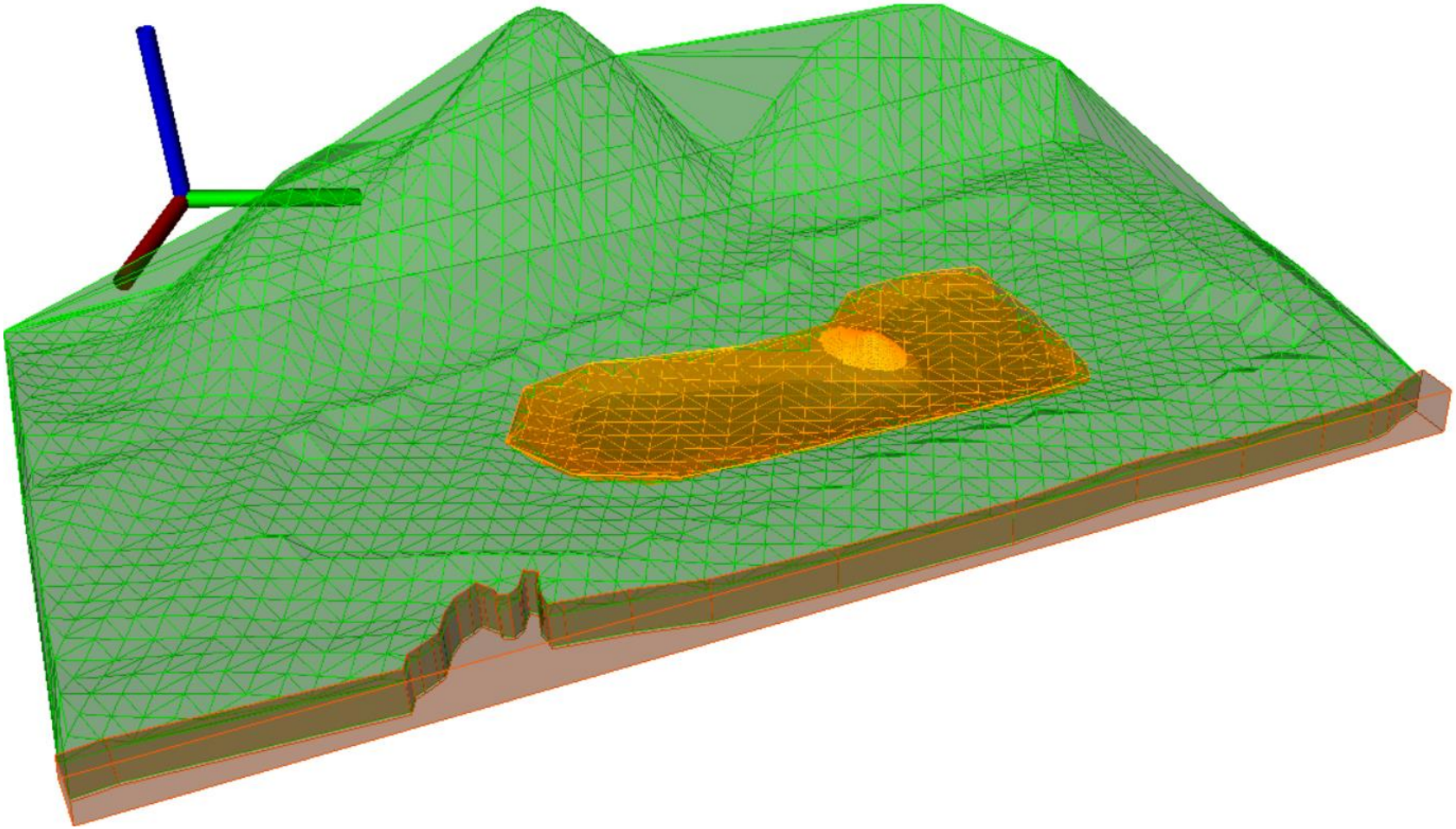
Wet CCR Removal Assumptions

1) Removed the upper portion of the CCR and treated resulting pit as an open hole.

2) Recharge was higher than the dry excavation stage, but less than the active conditions. It was assumed that there would be 43 in/year of rainfall (U.S. Climate Data, Festus). It was also assumed that the RCPA would evaporate similar to a lake, which according to U.S. Department of Commerce report, *Evaporation From Pans and Lakes*, a lake in Missouri can have ~23 inches a year in evaporation. Therefore, net annual recharge is expected to be ~20 inches/year. The rest of the water used for hydraulic dredging is assumed to be in a "closed" loop, and water used to pump the CCR out of the pond will be directed back to the RCPA after the materials are extracted.

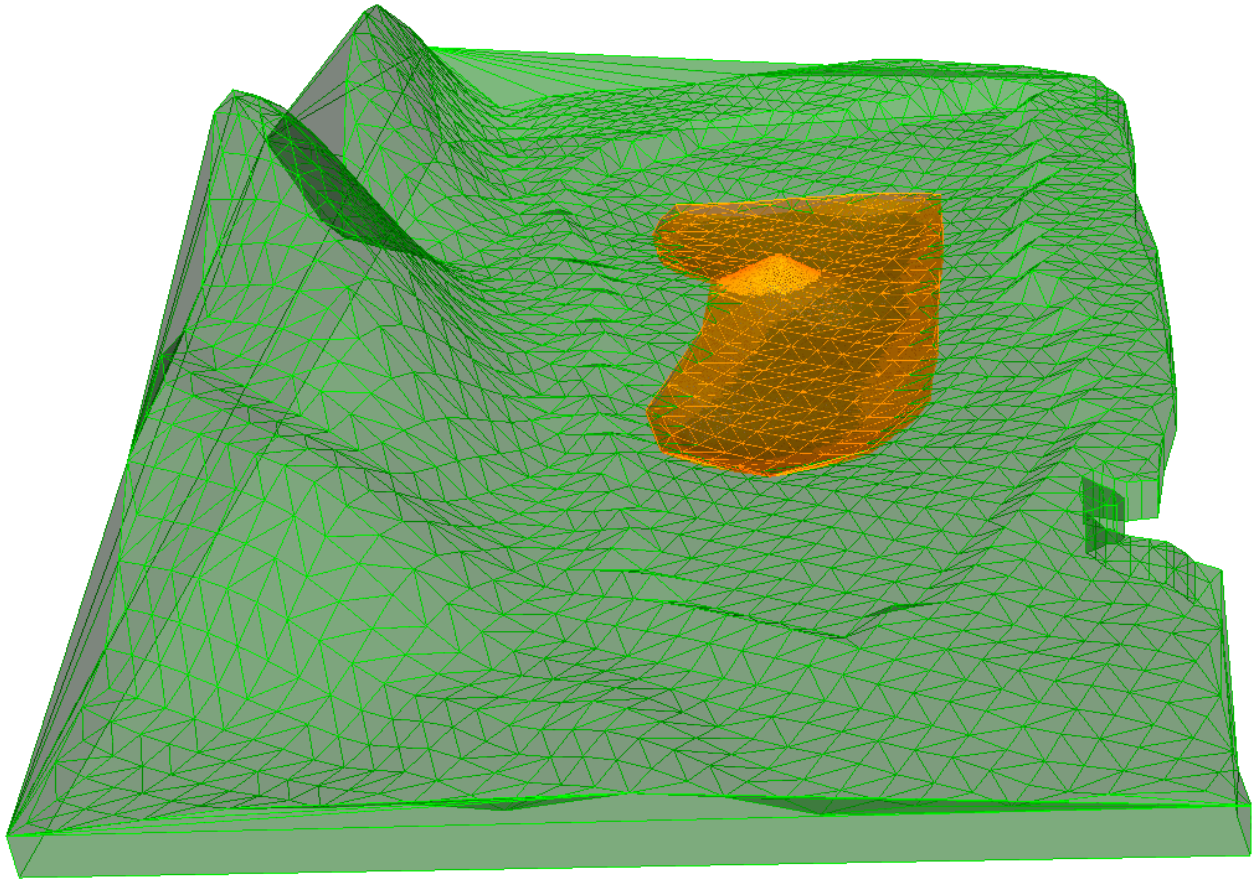
Phase 3 – Wet CCR Removal

RUSH ISLAND ENERGY CENTER



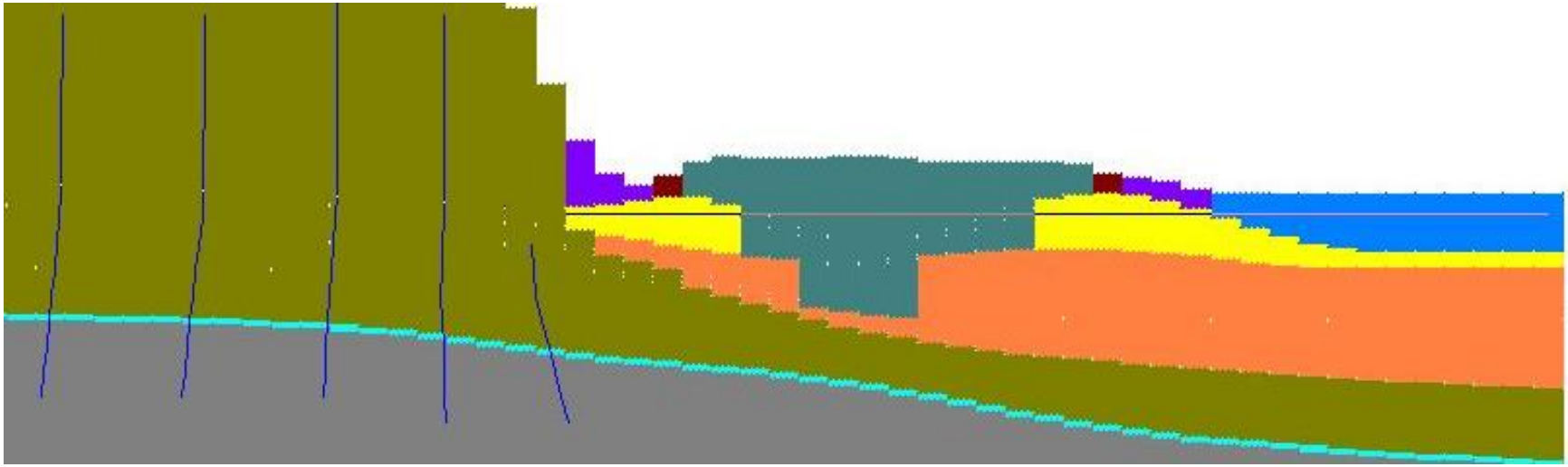
Phase 3 – Wet CCR Removal

RUSH ISLAND ENERGY CENTER



Phase 4 – Backfilled RCPA

RUSH ISLAND ENERGY CENTER



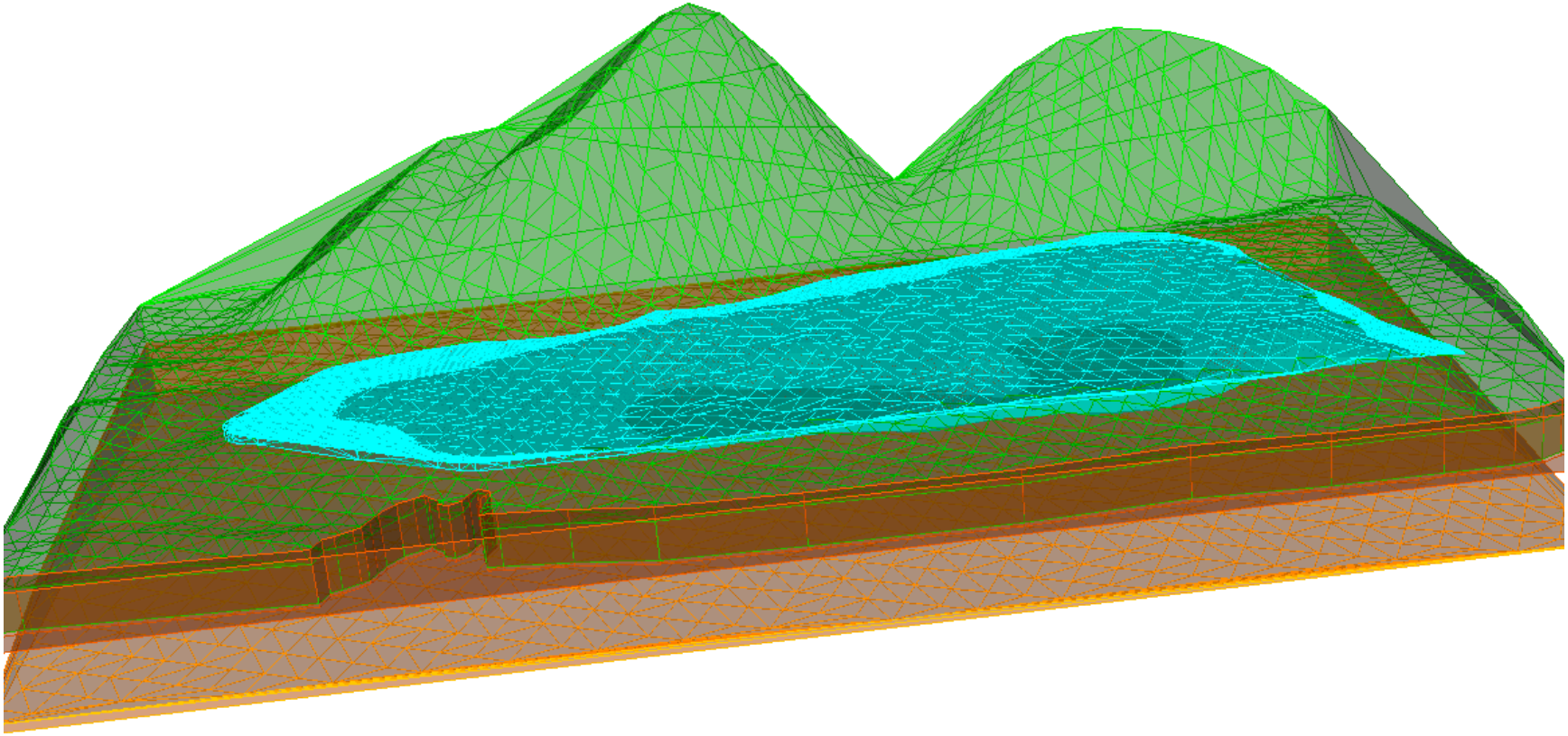
Backfilled RCPA Assumptions

1) Entire former RCPA backfilled with materials similar to the shallow alluvium onsite from dredging the Mississippi River (Lochmueller 2019). Material assumed to have a conductivity of 2.1 x 10^{-3} cm/sec (6 feet/day).

2) Recharge into the backfilled area was set equal to that estimated for the surrounding alluvial aquifer.

Phase 4 – Backfilled RCPA

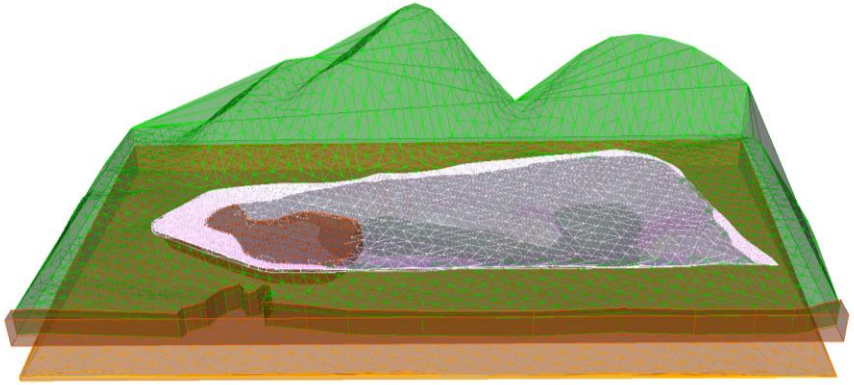
RUSH ISLAND ENERGY CENTER



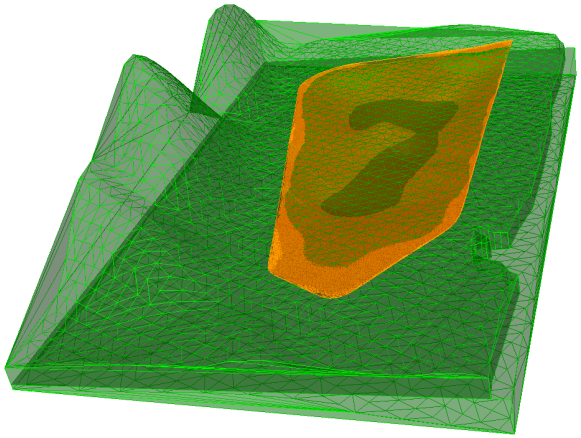
Phases of the Model

RUSH ISLAND ENERGY CENTER

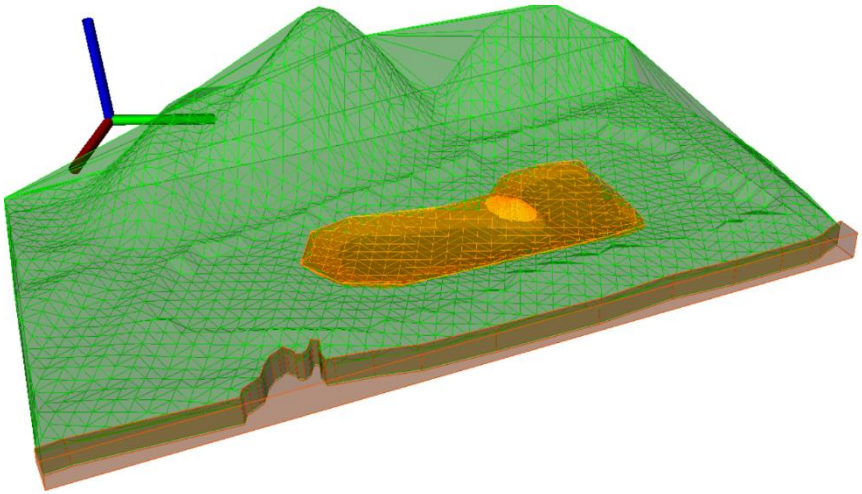
Phase 1 - Active



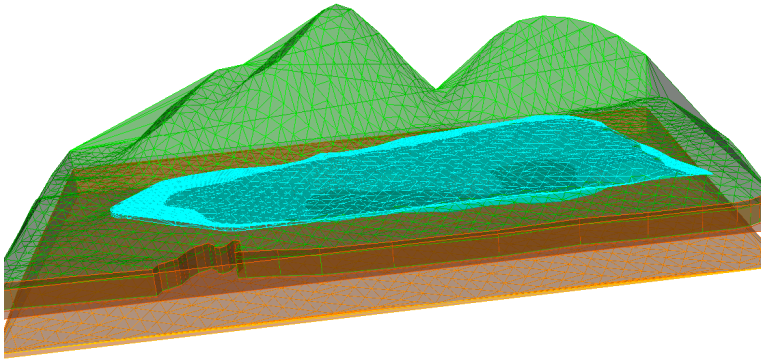
Phase 2 – Dry Removal



Phase 3 – Wet Removal

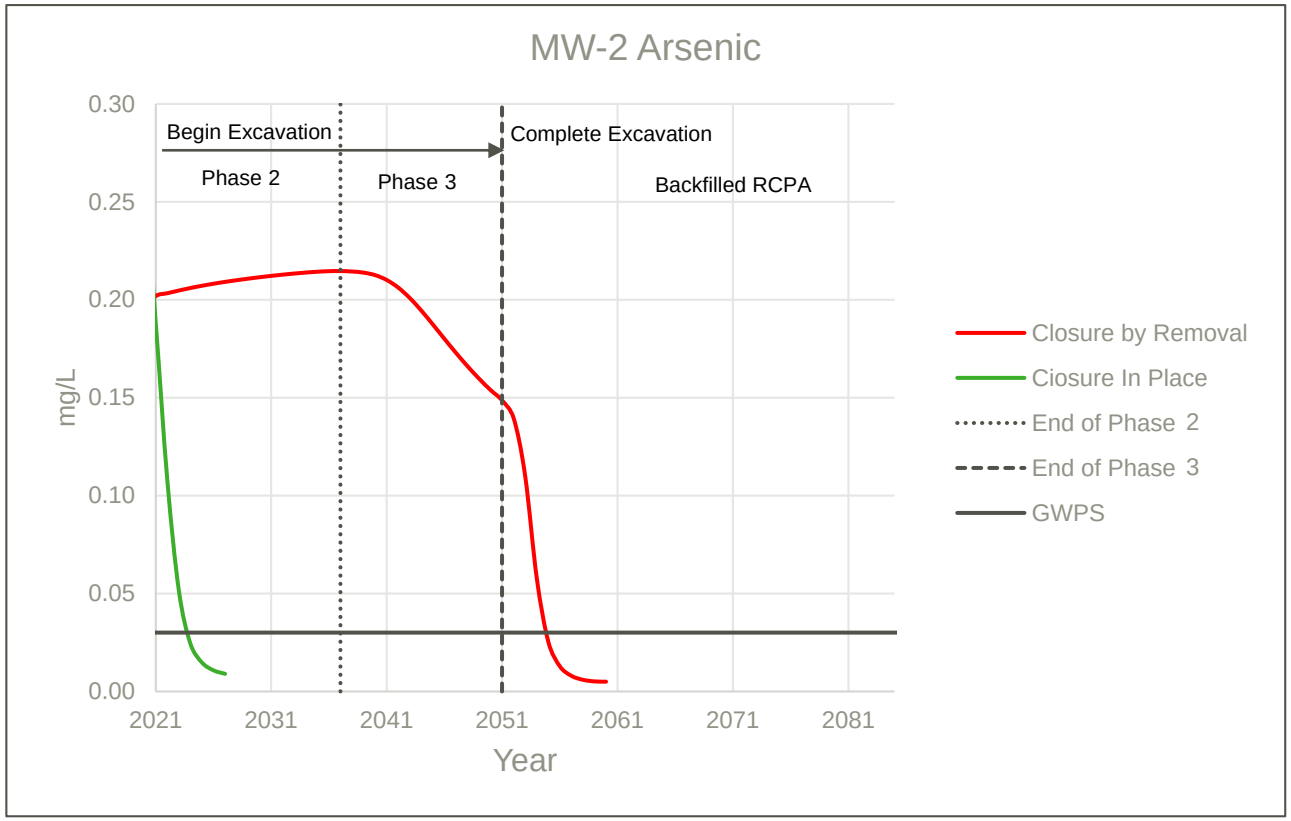


Phase 4 – Backfilled



Modeling Results Indicate Excavation Delays Groundwater Compliance

RUSH ISLAND ENERGY CENTER

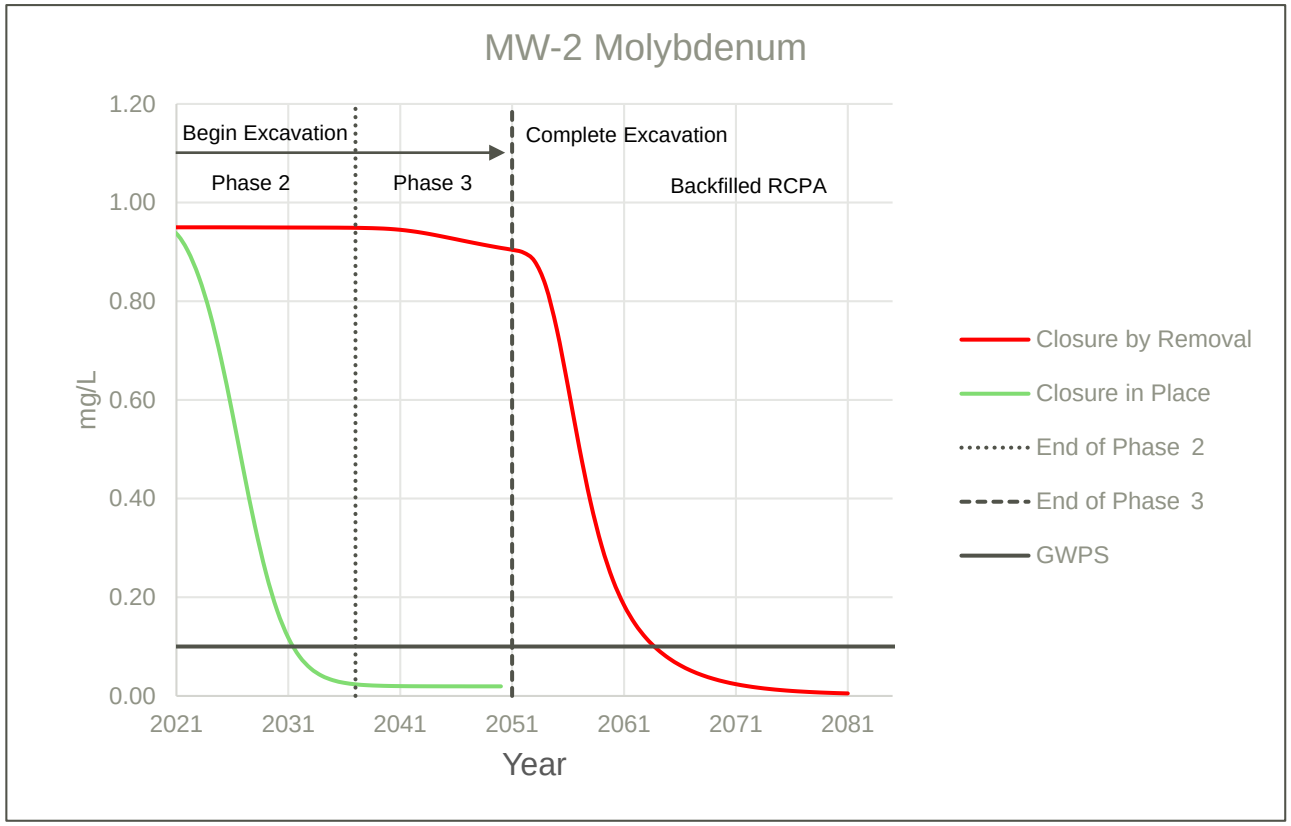


MW-2 (highest arsenic value in CCR Rule Well) is estimated to reach the GWPS 30 years sooner using closure in place vs closure by removal (Excavation)

Information on the closure by removal process is available in the Lochmueller (2019) and the Reitz & Jens (2019) reports

Modeling Results Indicate Excavation Delays Groundwater Compliance

RUSH ISLAND ENERGY CENTER



MW-2 is estimated to reach the GWPS 31 years sooner using closure in place vs closure by removal (Excavation)

GOLDER

Information on the closure by removal process is available in the Lochmueller (2019) and the Reitz & Jens (2019) reports

Explanation of Results

RUSH ISLAND ENERGY CENTER

Closure in Place reduces downgradient concentrations faster than Closure by Removal because:

- The 31-year time for CBR ash removal, during which rainfall drives outward migration of CCR impacts, adds contaminant loading and delays groundwater cleanup

APPENDIX B
2019 Remedy Selection Report

August 30, 2019

REMEDY SELECTION REPORT - 40 CFR § 257.97
RUSH ISLAND, LABADIE, SIOUX AND MERAMEC CCR BASINS

In May 2019, Ameren Missouri completed Corrective Measures Assessment (CMA) Reports for certain coal ash (CCR) basins located at the Rush Island, Labadie, Meramec, and Sioux energy centers. For each site, the CMAs considered a series of alternatives, all of which are protective of human health and the environment, control source material, minimize the potential for further releases and, over time, will attain site-specific groundwater protection standards. After sharing the CMAs publicly, Ameren Missouri solicited public input. In addition to the CMAs, Ameren Missouri and its consultants performed numerous technical evaluations, all of which help to inform the Company's remedy selection. Those evaluations include groundwater modeling; human health and ecological risk assessments; groundwater treatment assessments; onsite and offsite monitoring data; rail, barge and truck transportation studies; and a deep excavation study report.[1] The technical assessments, data and public input inform the evaluation of selection factors that has led to this final remedy selection.

Set forth below is a summary of Ameren Missouri's remedial plan that, when fully implemented and completed, will achieve CCR Rule requirements. As previously announced, Ameren Missouri intends to expeditiously close CCR basins at its energy centers by completing necessary steps to remove the basins from service and then installing an engineered cap system that exceeds, by more than two orders of magnitude, the federal regulatory requirements and, as modeling indicates, will minimize the limited and localized impact to groundwater observed at the CCR basins. In time, the sites will attain site-specific groundwater protection standards. As conditions stabilize after cover system installation, groundwater evaluations and monitoring will continue, and, as necessary, be modified. Ameren Missouri intends to implement the following corrective action measures in conjunction with the closure of CCR basins.

CORRECTIVE MEASURES REMEDIAL PLAN

CMA Reports Alternative 1: Source Control Through Installation of Low Permeable Cover System & Monitored Natural Attenuation

1. Source control, stabilization and containment of CCR by installation of a low-permeability geomembrane cap (a minimum 1 x 10 -7 centimeters per second (cm/sec) versus 1 x 10 -5 cm/sec required by the CCR Rule).

2. Once source control is achieved, monitor the natural attenuation (MNA) of groundwater concentrations to address limited and localized CCR-related impacts. Ongoing monitoring and modeling evaluations will document that concentrations are

[1] Technical assessments are appended to the CMA reports and/or to Ameren Missouri's Response to Public Concerns and all have been posted to Ameren's CCR website.

decreasing as modeled. MNA occurs due to naturally occurring processes within the aquifer.

3. Annual Groundwater *Monitoring and Corrective Action Reports* for each site will address the following:

   - Demonstrate that groundwater plume(s) are stable or decreasing and not expanding;

   - Contain an ongoing summary of baseline and periodic geochemical analysis including groundwater chemistry, subsurface soils chemical composition and mineralogy;

   - Determine site-specific attenuation factors and rate of attenuation process; and

   - Design a long-term performance monitoring program based on the specific attenuation mechanism to confirm concentration reductions and document trends.

The installation of a low-permeability, geomembrane cap system satisfies both the CCR Rule's basin closure requirements and can constitute an appropriate remedial corrective measure for groundwater impacts, as recently confirmed by the Missouri Department of Natural Resources (MDNR). A properly engineered and installed cap will practically eliminate the infiltration of water into the stored ash material. As summarized in the CMA reports, concentrations will reduce once the cap system stops recharge into the ash and groundwater conditions, such as pH levels, stabilize. Ameren Missouri will establish a long-term performance monitoring plan in accordance with the CCR Rule to document and confirm such reductions. MNA encompasses a variety of physical and chemical processes (biodegradation, sorption, dilution, chemical reactions and evaporation), which, under the right conditions, can immobilize metals in aquifer sediments. In addition to capping as a remedial corrective measure, both EPA and MDNR recognize MNA as a corrective action component for addressing inorganics (metals) in groundwater. *EPA Directive 9283.1-36 (2015); Section 644.143 RSMo (1999).* As MDNR notes, MNA is not a "no action" alternative and is complementary to source control measures. *(See Fact Sheet: MNA of Groundwater at Brownfields/Voluntary Cleanup Program Sites.)*

IMPLEMENTATION OF REMEDY

Under its current schedule, Ameren Missouri will close more than 67% (428 acres) of its CCR units by the end of 2020, with the remaining 33% by December 2023. Installation of a geomembrane cap at the energy centers will practically eliminate infiltration. Site preparation activities are underway at Rush Island and Labadie, with construction of the cap/cover systems occurring over the next 12 -18 months. Closure of additional basins at Meramec will occur in 2020 and 2021, with closure of remaining basins following the retirement of the energy center in 2023. At Sioux, use of the ash basins will terminate once wastewater and dry ash handling facilities are

completed in 2020. Set forth below are key milestones in the implementation of Ameren's remedial plans. Such schedule is subject to revision based upon each energy center's construction schedule, ongoing field investigations and, if needed, regulatory approvals.

Facility	Ash Basin Removed from Service	Ash Basin Cap System Completed	Performance Review: Groundwater & Cap System
Rush Island	04/2019	12/2020	Annual - Commencing 2021
Labadie	09/2019	12/2020	Annual - Commencing 2021
Sioux	12/2020	2021	Annual - Commencing 2023
Meramec	12/2022	2023	Annual - Commencing 2024

SUPPLEMENTAL CORRECTIVE MEASURES

In its laboratories, XDD, Ameren Missouri's environmental consultant, reproduced existing (i.e. pre-closure) groundwater and soil conditions so as to evaluate potential treatment methods to accelerate existing natural attenuation processes. Under appropriate conditions, metals can attenuate through precipitation, co-precipitation and/or sorption processes with subsurface soil minerals. XDD is evaluating potential treatment methods such as the use of pH adjustment, zero valent iron (ZVI), and bio-augmentation.[2] Laboratory results for arsenic and molybdenum, the primary contaminants of concern (COC) at some of Ameren's energy centers, indicate that through the adjustment of pH levels in subsurface soils and groundwater, groundwater protection standards (GWPS) can be met for each site[3] and that the use of chemical reduction (ZVI) and bioremediation may be helpful in the reduction process for these and other compounds.

Set forth below is a summary chart reflecting results from ongoing treatment studies. Boron is included for evaluation purposes even though under the Federal CCR Rule it is not currently an Appendix IV parameter.

[2] Ameren Missouri and XDD have experience with the use of ZVI and bio-augmentation at its Huster Substation property, a groundwater remediation project supervised by USEPA and MDNR, (CERCLA-07-2017-0129). Using a drill rig, XDD injected a slurry comprised of water and ZVI into subsurface soils and groundwater forming a reactive barrier that successfully contained groundwater contaminants that had migrated from the substation. In addition, ongoing degradation of source contaminants continues to occur through a bio-augmentation process consisting of the injection of feedstock into the sands of the aquifer.

[3] The slow groundwater flow rate at the Sioux energy center has allowed for the concentration of molybdenum at levels higher than those observed at the other energy centers. Such conditions however may be particularly conducive to the use of ZVI or bioremediation.

SUMMARY OF LABORATORY TREATMENT STUDIES

	Arsenic	Molybdenum	Boron	Lithium	Attenuation Mechanism
	mg/L				
pH 10		R/M5/M6		M6	P,C
pH 9	R				P,C
pH 8	R	M6			P,C
pH 7	R				P,C
pH 6	R/M5*/M6*	R/M5/M6/L/S			P,C
CaSx	R	R/M5/M6/L	M6	M5	P,C
Dissolved Iron (Anaerobic)	R	L			P,C
Dissolved Iron (Aerobic)	R	L			P,C
ZVI Injectable	R	R/M5/M6/L/S	L/S R/M5/M6	M5/M6	P,C
ZVI PRB	R	R/M5/M6/L	R/M5/M6	M5/M6	P,C
ZVI Injectable + Bio	R	R/M5/M6/L/S	R/M5/M6	M5/M6	P,C
ZVI Injectable pH 8 + Bio	R	R/L	R		P,C
ZVI PRB + Bio	R	M5/M6/L/S	S	M5/M6 L/S	P,C
ZVI PRB pH 8 + Bio	R	R/L	R	M6 L/S	P,C

Notes:

No Effect

Reduce

Increase

Attains Standard

Non-Detect

L = Labadie

S = Sioux

R = Rush Island

M5/M6 =Meramec monitoring wells

PRB = permeable reactive barrier

Injectable = iron particles at micro-scale; potentially applied through injection

Dissolved iron = 50 mg/L Iron(II) sulfate

CaSx = calcium polysulfide

P = Precipitation

C = Co-precipitation

* = arsenic was not detected in M5/M6 baseline despite being detected during quarterly sampling at M5. Results indicate arsenic would likely be removed under pH 6 conditions.

Additional pilot studies are needed to confirm that laboratory results can be replicated and appropriately scaled under field conditions. Assuming such confirmation, corrective action Measures may also include groundwater treatment to facilitate reductions. Field demonstrations and groundwater treatment applications could require a state-issued permit pursuant to *10 CSR 20-6.010*. Remedial actions are iterative in nature and Ameren Missouri (as part of the long-term performance monitoring program) will periodically evaluate then-existing groundwater conditions relative to GWPS and determine whether additional treatment measures are warranted.

APPENDIX C
RCPA Closure Completion Documentation

Rush Island Energy Center
Notification of Intent to Close a CCR Unit and Certification for Final Cover System Design

In accordance with 40 C.F.R. § 257.102(g), this is a notification of the intent to close CCR surface impoundment unit RCPA at the Rush Island Energy Center. Closure of RCPA will be performed in accordance with 40 C.F.R. § 257.102(d) by leaving CCR in place.

CERTIFICATION:

As a Professional Engineer in the state of Missouri, I do hereby certify to the best of my knowledge, information, and belief, that the final cover system design for the surface impoundment RCPA at Ameren Missouri's Rush Island Energy Center meets the final cover system requirements of 40 C.F.R. §257.102(d)(3).

Name: Steven F. Putrich

Signature: _____

Date: 20 August 2019

Registration Number: 2014035813

State of Registration: Missouri

Rush Island Energy Center
Closure Plan
Post-Closure Plan
for
CCR Surface Impoundment

TABLE OF CONTENTS

Page No.

1.0 INTRODUCTION

Pursuant to 40 CFR 257 (CCR Rule), specifically §257.102(b), the owner or operator of a Coal Combustion Residual (CCR) unit must prepare a written closure plan identifying the manner and timing of closure and, with respect to the installation method for the final cover system, describe the procedures to remove and decontaminate the unit or place a final cover system depending on closure method to meet the designated performance criteria set forth in the CCR Rule. In a related activity under §257.104(d) of the CCR Rule, the owner or operator must prepare an initial written post-closure plan describing monitoring and maintenance activities during the post-closure care period. This document contains both of these written plans and their associated certification statements.

There is one active CCR surface impoundment at the Rush Island Energy Center, referred to as the RCPA. The impoundment receives direct sluice bottom ash, wetted fly ash, and other plant process water and discharges through an NPDES permitted outfall. Appended hereto as Appendix A, is a locus map showing the location of the impoundment. Set forth below is a table identifying the impoundment, operational status and anticipated closure date. Such schedule is preliminary and subject to revision based upon operational needs, regulatory compliance, construction progress and/or budgetary constraints.

Table 1 – Rush Island Energy Center CCR Units

CCR Unit	CCR Type	Operational Status	Estimated Closure Start Date	Estimated Closure Completion Date
RCPA (Ash Pond)	Bottom Ash, Fly Ash	Active	2018	2023

Set forth below in Table 2 is Ameren Missouri's estimate of CCR materials within the unit along with the currently expected final cover area. Note that final cover area and volume is subject to change due to current operational activities and method of closure.

Table 2. Estimated CCR Inventory and Cover Area

CCR Unit	Estimated Inventory (CY)	Estimated Final Cover Area (Acres)
RCPA (Ash Pond)	12,725,000	111

Note: Estimated inventory based on Annual CCR Inspection dated January 7, 2016 which states total water and CCR volume as listed above. The maximum inventory assumes that all wet space of the impoundment is filled with CCR.

2.0 CLOSURE PLAN

Ameren intends to close the RCPA (Ash Pond) at the Rush Island Energy Center by capping and leaving the CCR materials in place as contemplated and authorized by the regulations. Set forth herein is the process by which Ameren Missouri will use to close the CCR impoundment at Rush Island.

This Closure Plan requires drainage (dewatering of free liquids) and general stabilization of the existing CCR material, placement of general fill, and the installation of a final cover system over the CCR material to minimize erosion and infiltration. The final cover grades will promote drainage and minimize cuts and fills (and associated construction costs). Stormwater on the final cover system will be conveyed to NPDES approved outfalls. A conceptual site plan and schematic grading plan for RCPA (Ash Pond) closure is presented in Appendix B for reference. Primary activities associated with closure of the impoundment are described below with the understanding that a more detailed engineering design has yet to be evaluated and completed.

2.1 Reroute Process Water/Piping Modifications and Equipment Removal

Once ash handling systems have been installed to cease placement of CCR in the RCPA (Ash Pond), and to preclude the probability of future impoundment of water, water systems and piping will be rerouted from this unit to other areas to prevent future discharge of plant service water systems or other drainage to the closed impoundment. In addition, any equipment previously used to manage CCR within the impoundment footprint will be removed as it is no longer needed for closure purposes.

2.2 Dewater Surface Water

Liquid from impoundments is removed either passively (e.g. gravity drainage) or actively (e.g. extraction wells, pumps or trenches). To dewater the unit, material can be moved and stockpiled to allow water to drain to sump areas where pumps will be utilized to discharge decant water through approved NDPES outfalls or to other water management systems at the facility. Recognized and generally accepted good engineering practices will be utilized in regards to determining when dewatering has been completed and stabilization of the remaining CCR and grading will commence.

2.3 Stabilization and Grading

The CCR Rule requires final cover systems for CCR units preclude the probability of future impoundment of water, sediment or slurry and the stabilization of wastes within an impoundment. The underlying CCR is considered stabilized when it is structurally suitable for use as a base layer and can accommodate construction activities. Stabilization techniques could include, but not be limited to, compaction via tracking by earth moving equipment or installation of a bridging layer.

Minimum design slopes are not established within the CCR Rule. However, in its Utility Waste Landfill Regulations, the Missouri Department of Natural Resources requires a minimum slope of one percent (1%) which Ameren Missouri will use as practicable for final slopes of the surface impoundments. Ameren Missouri will optimize the use of existing onsite CCR materials to achieve final grade and to enhance drainage. Additional import materials may be required to develop the necessary subgrade.

Any subgrade development, including use of CCR, will consist of placement in loose lifts of uniform thickness and then compacted. Final grades will then be cut and achieved prior to installation of the final cover system. The subgrade will be proofrolled to confirm suitable subgrade conditions exists. A conceptual grading plan schematic is provided in Appendix B.

2.4 Installation of Drainage and Stormwater Management

Stormwater management systems will be designed and constructed to adequately manage flow during peak discharge of the design flood event and collect and control runoff during the same design storm. Collection channels will include appropriate width, depth, sideslopes, and erosion controls as deemed appropriate during design.

2.5 Design and Install Cover System

Ameren will meet the final cover system minimum standards which include an 18-inch infiltration layer and 6 inches of topsoil to support the growth of vegetation. The final cover is also required to have permeability less than or equal to that of the bottom layer or no greater than 1×10^{-5} cm/sec, whichever is less. Alternative cover systems may be authorized provided that such design meets or exceeds the CCR Rule performance standards. Applicable geotechnical design will support the use of a particular final cover system. More details of the proposed options for the final cover system are provided in Section 3.0.

2.6 Closure Documentation

A construction quality assurance plan, engineering drawings, bid specifications and "as built" construction drawings will be developed to demonstrate that appropriate closure activities were successfully implemented. Additional closure documentation will include the following:

- The annual progress reports summarizing closure progress and projected closure activities:
- Notification of completion of closure will be completed within 60 days of the actual closure completion date.

The closure notices and progress reports will be placed in Rush Island's Operating Record; will be sent to the Director of Missouri Department of Natural Resources (MDNR) before close of business on the respective compliance dates; and will be placed on Ameren's CCR public website within 30 days of placing said information in the Operating Record.

Within 30 days following completion of closure of the CCR unit, Ameren shall record a notation on the deed to the RCPA property stating that the property has been used as a CCR unit and its use is restricted under the Post-Closure Care Plan and the post-closure care requirements.

3.0 FINAL COVER SYSTEM

A typical final cover system used for closure is comprised of earthen materials designed to a performance standard of no less than $1x10^{-5}$ cm/s permeability, and sufficient soil cover to support vegetative growth to minimize erosion. Synthetic materials may also be used to achieve the permeability standard.

A typical cross section of the final cover system is shown in Exhibit 2 below.

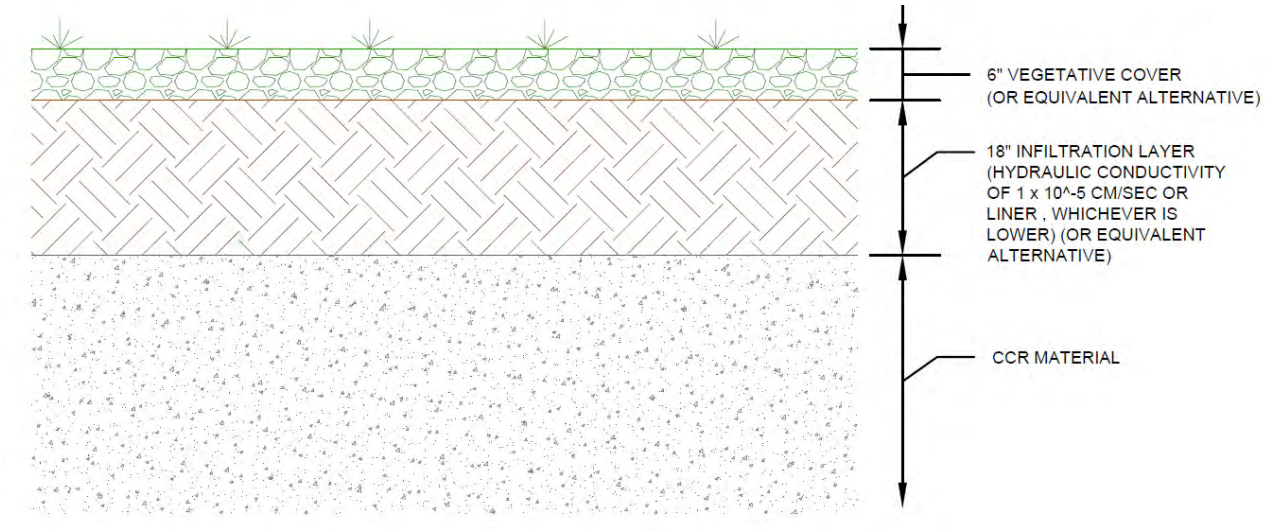


Exhibit 1 – Typical CCR Rule Compliant Final Cover System

3.1 Alternative Cover System

The CCR Rule authorizes the use of an alternative final cover system for closure, provided such system meets equivalent performance requirements. Alternative final systems comprised of synthetic turf material have demonstrated equivalence with the prescriptive final cover requirements in solid waste applications, and have been approved for use as final cover (primarily in landfill applications). MDNR has approved synthetic turf systems for use as interim covers for use at municipal solid waste landfills and we are evaluating their use for final cover. Benefits of an alternative cover system application include reduced cover system costs when soils would otherwise be required to be imported, reduced environmental impact from haul trucks, a potential reduced construction timeframe, improvements to stormwater discharge quality, ability to accommodate settling / subsidence, and reductions in post-closure care maintenance.

Consideration of an alternative cover system will be based on interviews with manufacturers, site visits and a field demonstration assessment. Each of the technologies considered by Ameren Missouri prevent contact of CCR materials with percolating rainwater, promote controlled runoff to stormwater detention systems, reduce borrow volume requirements and minimize maintenance. Performance considerations used to evaluate various synthetic products include the following: permeability, constructability, cost, installation time, thickness, puncture strength, wind resistance, flood resistance, CCR compatibility, vehicle traffic, storm flow velocity restrictions, maintenance, erosion control, and UV protection.

A typical cross section of an alternative cover system is set forth below. The particular example provided below is one option and other alternative scenarios and manufacturers or equals will be considered as deemed appropriate by Ameren.

Exhibit 2 – Example Alternative Synthetic Alternative Final Cover System (From Agru America Closure Solutions Brochure)

3.2 Settlement and Subsidence of Cover System

Settling and subsidence of the final cover system is considered to be minimal. Settlement on the impoundment occurs during consolidation of the CCR material, general fill material, or underlying natural subsoils under new loads from grading activities. A portion of the CCR material within the impoundments contains cemented material that will have minimal settlement. The saturated, un-cemented CCR material encountered will settle under the additional loading. This settlement, however, will occur for the duration of grading activities and is expected to be minimal after the final cover system is installed. General fill will be installed in a controlled manner to minimize post-cover system installation settlement.

Slope stability and mass stability of the covered-in-place material will be analyzed after completion of the final design, which will occur in the future as directed by Ameren. The stable cover system design concept will minimize the need for extensive future maintenance.

3.3 Method of Installation

In general, closure construction will consist of erosion and sediment control installation, clearing and grubbing, dewatering, grading and compaction of CCR, constructing a compacted clay layer and erosion layer or alternative cover system, installing stormwater controls, and performing final seeding and restoration.

4.0 PRELIMINARY WORK SCHEDULE

Ameren has developed a generic preliminary closure work schedule based on project milestones and estimated completion dates reflected in Table 1. Since this unit has not yet submitted an intent to initiate closure, the timing is generic as shown in Exhibit 3 below.

Ameren - Rush Island Ash Pond
Closure Schedule

Item #	Task Item	Completion Timeframe (months)														
		-8	-7	-6	-5	-4	-3	-2	-1		12	24	36	48	60	62
1	Prepare Construction Plans															
2	PE Design Certification															
3	Notice of Intent to Close															
4	MDNR Closure Approval															
5	Cease placing CCR															
6	Commence Closure															
7	Dewater Impoundment															
8	Final Cover Installation															
9	PE Closure Certification															
10	Notice of Closure															
11	Record Deed Notation															
12	Notice of Deed Recordation															

Exhibit 3 - Generic Closure Timeline

5.0 REGULATORY APPROVAL

To the extent closure activities impact stormwater conditions set forth in the current NPDES permit, Ameren will consult with the Agency as appropriate.

6.0 AMENDMENT TO CLOSURE PLAN

Ameren will assess the Closure Plan and amend the Plan whenever there is a change in operation of the CCR impoundment that would substantially affect the Plan or when unanticipated events necessitate a revision of the Plan either before or after closure activities have commenced.

The Closure Plan will be amended at least 60 days prior to a planned change in the operation of the facility or the CCR impoundment, or no later than 60 days after an unanticipated event requires the need to revise the Plan. If the closure plan needs to be revised after closure activities have commenced, the Plan will be revised no later than 30 days following the triggering event.

The amended Closure Plan will be placed in the facility operating record as required by the CCR Rule.

A record of amendments to the Closure Plan will be tracked below.

Version	Date	Description of Changes Made
1	10/13/2016	Initial Submittal
2	11/08/2016	Revised Closure Date in Table I/Revised Exhibit 3

7.0 CLOSURE PLAN CERTIFICATION

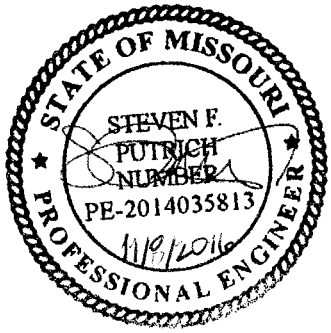
I certify that this Written Closure Plan for Ameren's RCPA (Ash Pond) CCR surface impoundment at the Rush Island Energy Center meets the USEPA's CCR Rule requirements of §257.102(b).

Signed: _____

Certifying Engineer

Print Name: Steven F. Putrich, P.E.
Missouri License No.: 2014035813
Title: Project Principal
Company: Haley & Aldrich, Inc.

Professional Engineer's Seal:



7.1 Final Cover System Certification

The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the design of the meets the requirements of this section.

I certify that this final cover system for Ameren's RCPA (Ash Pond) CCR surface impoundment at the Rush Island Energy Center meets the USEPA's CCR Rule requirements. of §257.102.

Signed: _____

Certifying Engineer

Print Name: Steven F. Putrich, P.E.
Missouri License No.: 2014035813
Title: Project Principal
Company: Haley & Aldrich, Inc.

Professional Engineer's Seal:

8.0 POST-CLOSURE PLAN

For CCR units closed by capping the CCR material in place, post-closure care is required in accordance with §257.104 for a minimum of thirty years per the CCR Rule. Ameren will also need to meet any additional post-closure care requirements set forth under MDNR regulations.

8.1 Activities

In accordance with §257.104(c) of the CCR Rule, Ameren will conduct post-closure care activities for 30 years following completion of closure activities of the RCPA (Ash Pond). This assumes that the site is not under groundwater monitoring assessment monitoring.

The final cover system including stormwater controls will be inspected on a yearly basis by appropriate personnel for settlement, seepage, erosion, scarps, sloughs, stormwater ponding on the final cover system, wind erosion, storm water erosion, animal burrows, and overall integrity of the final cover system. In addition, run-on and run-off controls will be inspected for signs of erosion and seepage. As determined necessary to maintain the structural integrity of the final cover system and storm water controls, the final cover system and its components will be repaired for any noted deficiencies.

No leachate collection system exists at the unit; therefore, there are no related post-closure requirements for that type of system.

During the post-closure care period, Ameren will maintain the integrity of the monitoring wells, bollards, well surface completion, and sampling equipment in secure and proper working condition for the required sampling intervals. The monitoring wells and sampling equipment will be inspected at each sampling event. Any identified damage or deficiency in the integrity of the monitoring wells or components will be repaired to maintain the integrity of the system. The monitoring wells will then be re-surveyed if surface completions are modified. Ameren will be developing the monitoring wells and certifying the system in documents under separate cover as required by the CCR Rule. Those documents should be reviewed for applicability and additional information during the post-closure care period.

8.2 Post-Closure Care Contact Information

The name, address, telephone number, and email address of the person or office to contact about the facility during the post-closure care period is as follows:

Name:	Ameren Missouri
Address:	1901 Chouteau Avenue St. Louis, Missouri 63103
Telephone Number:	(800) 552-7583
Email Address:	CCR@ameren.com

8.3 Planned Uses

Ameren currently has no planned uses for the CCR surface impoundment after closure has been completed. Ameren reserves the right to alter that planned use and will update this Closure Plan at that time.

8.4 Amendment to Post-Closure Plan

This initial Plan or any subsequent version of the Post-Closure Plan will be assessed and amended whenever there is a change in operation of the RCPA (Ash Pond) Pond that would substantially affect the Plan or when unanticipated events necessitate a revision of the Plan either before or after closure activities have commenced and been completed in accordance with §257.104(d)(3). Revisions to the Plan will be made in accordance with §257.104(d)(3)(iii).

Any amendments to the Plan will include written certification from a qualified professional engineer that the amendments to the Plan meet the requirements of the CCR Rule.

A record of amendments to the plan will be tracked below. The latest version of the Plan will be noted on the first page of the Plan.

Version	Date	Description of Changes Made
1	10/13/2016	Initial Issuance

8.5 Certification

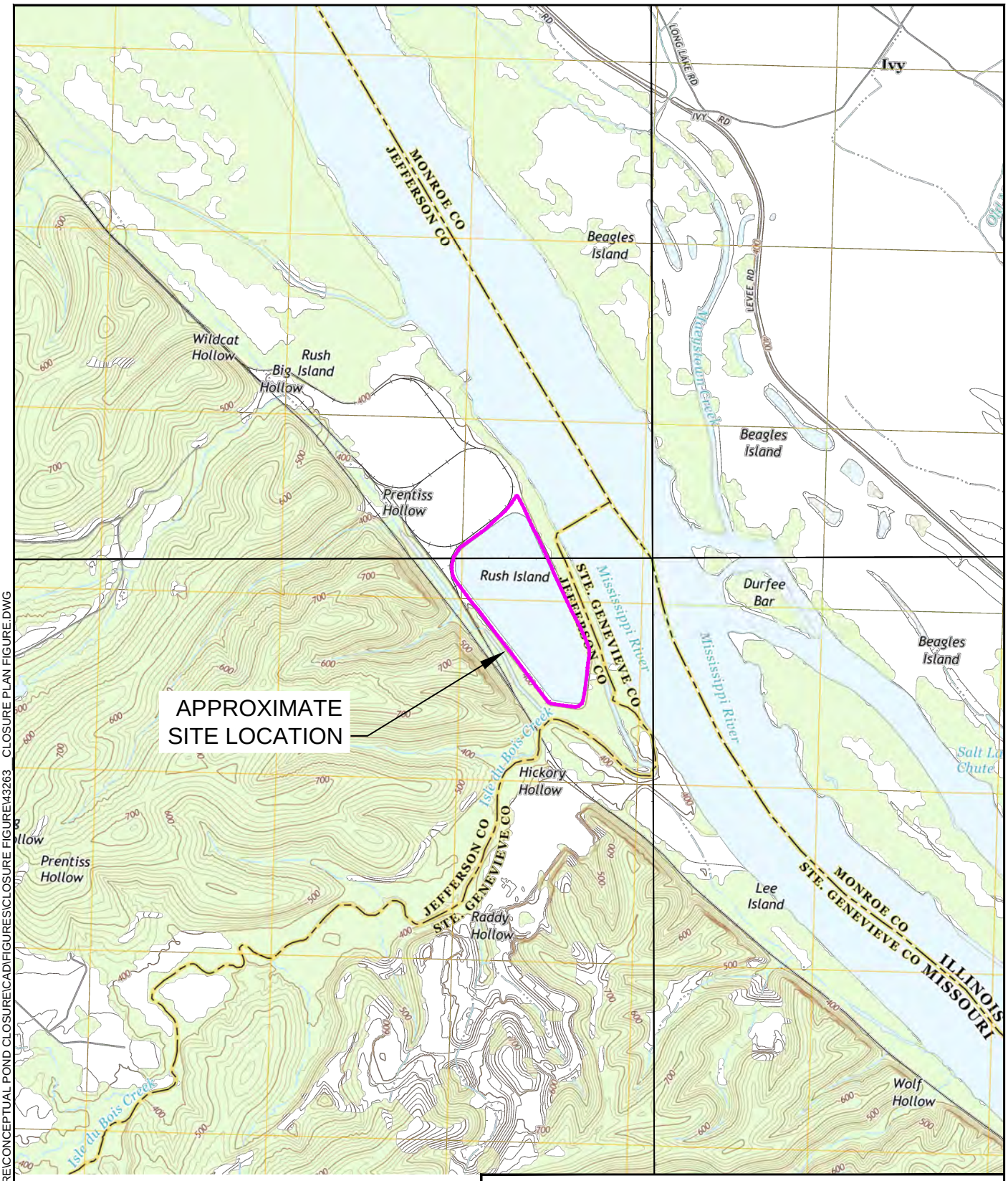
I certify that this initial Written Post-Closure Plan for Ameren's RCPA (Ash Pond) CCR surface impoundment at the Rush Island Energy Center meets the USEPA's Final CCR Rule requirements of §257.104(d).

Signed:_____
Certifying Engineer

Print Name:	Steven F. Putrich, P.E.
Missouri License No.:	2014035813
Title:	Project Principal
Company:	Haley & Aldrich, Inc.

Professional Engineer's Seal:

APPENDIX A – LOCATION MAP



NOTES

1. BACKGROUND MAPS ARE 7.5 MINUTE QUADRANGLE MAPS, DATED 2015.

0 2500 5000
SCALE IN FEET

HALEY ALDRICH

AMEREN MISSOURI
RUSH ISLAND ENERGY CENTER
RUSH ISLAND, MISSOURI

SITE LOCATION

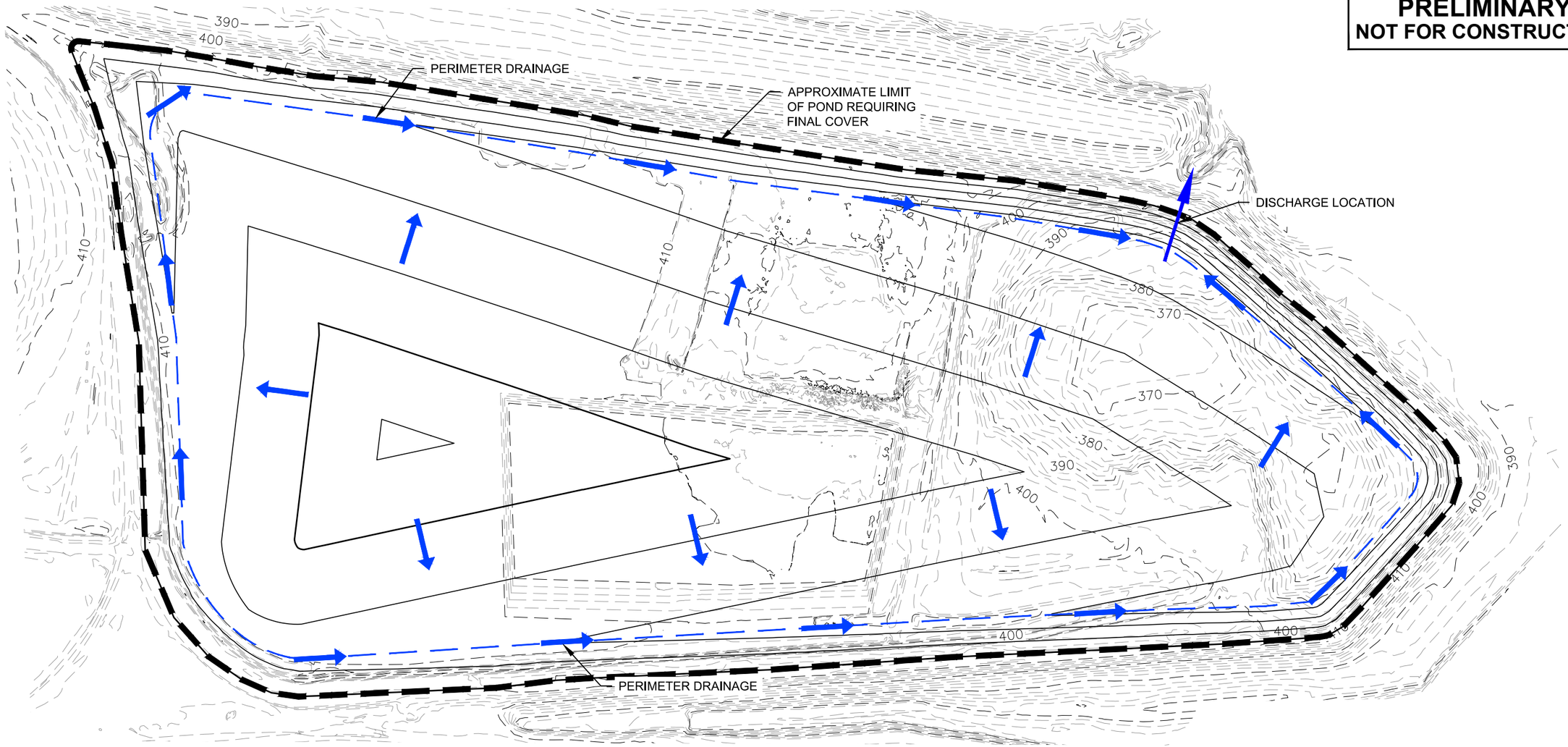
SCALE: AS SHOWN
OCTOBER 2016

FIGURE 1

BLEVINS, BRETT Printed: 10/4/2016 10:47 AM Layout: HA-FIG-A-P
G:\43263 AMEREN RI POND CLOSURE\CONCEPTUAL POND CLOSURE\CAD\FIGURES\CLOSURE FIGURE\43263 CLOSURE PLAN FIGURE.DWG

APPENDIX B – CONCEPTUAL CLOSURE PLAN SCHEMATIC

PRELIMINARY
NOT FOR CONSTRUCTION



THE LAYOUT AS SHOWN IS UNDER CONSIDERATION BY AMEREN AS A PRELIMINARY CLOSURE OPTION. THIS LAYOUT HAS NOT BEEN CHOSEN AS THE PREFERRED ASH POND CLOSURE OPTION, AND MORE DETAILED OPTIONS ANALYSIS AND DETAILED DESIGN WILL occur BEFORE A CLOSURE OPTION IS CHOSEN.

LEGEND

- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- APPROXIMATE LIMITS REQUIRING FINAL COVER

NOTES

1. EXISTING TOPOGRAPHY OF THE RUSH ISLAND ASH POND IS BASED ON A COMPOSITE OF THE FOLLOWING SURVEY INFORMATION AND APPROXIMATED ASH STOCKPILING INFORMATION: AN AERIAL SURVEY CONDUCTED BY KUCERA INTERNATIONAL, INC. ON OCTOBER 8TH, 2013 AND PROCESSED BY HENDERSON AERIAL SURVEY; SUPPLEMENTAL STOCKPILE TOPOGRAPHIC INFORMATION AS SURVEYED BY ZAHNER & ASSOCIATES, INC., FROM JANUARY 31, 2014 AND MARCH 26, 2014; AND APPROXIMATED ASH STOCKPILE INFORMATION BETWEEN THE DATE OF MOST RECENT TOPOGRAPHY THROUGH THE END OF JULY 2015. ADDITIONALLY, BASED ON PLANT KNOWLEDGE, THE NORTHEAST INTERIOR PORTION OF THE ASH POND WAS ASSUMED TO BE AND DEPICTED AS A RELATIVELY FLAT AREA AT AN ELEVATION OF 410 AMSL.

0 300 600
SCALE IN FEET

HALEY ALDRICH

AMEREN MISSOURI
RUSH ISLAND ENERGY CENTER
RUSH ISLAND, MISSOURI

CONCEPTUAL ASH POND CLOSURE SCHEMATIC

SCALE: AS SHOWN
OCTOBER 2016

FIGURE 2

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

MEMORANDUM

3 November 2021
File No. 0129530

TO: Ameren Missouri
Michael Wagstaff, P.E.

FROM: Haley & Aldrich, Inc.
Steven F. Putrich, P.E.
CCR Engineering Manager

SUBJECT: Closure Statement
RCPA CCR Surface Impoundment
Rush Island Energy Center
100 Big Hollow Road
Jefferson County, Missouri

As engineer of record for the design of the Ameren Missouri Rush Island Energy Center (RIEC) CCR Surface Impoundment (RCPA) closure located at 100 Big Hollow Road, Jefferson County Missouri, Haley & Aldrich, Inc. (Haley & Aldrich) is providing this closure statement. Based upon our professional opinion, the RCPA closure was completed in substantial conformance with the Haley & Aldrich closure design plans and specifications (Phase 1 and Phase 3 dated 20 May 2019, and 26 March 2020, respectively), except as noted in the as-built drawing sets (Phase 1 and 3 dated 22 September 2021 and 1 October 2021 respectively) ("Design Plans and Specifications"), and except as further detailed herein.

Ameren contracted the closure construction in two phases - Phase 1 and Phase 3, and reserved Phase 2 for the purchase of the ClosureTurf final cover product[1]. It should be noted that Haley & Aldrich was not contracted to and did not observe the construction of the subject closure or the dewatering, moving, grading, subgrade preparation, or compaction activities. We do, however, understand that Ameren engaged Geotechnology, LLC ("Geotechnology") to perform the construction monitoring and the required Construction Quality Assurance ("CQA") activities included in the project CQA plan prepared by Haley & Aldrich dated December 2019. Haley & Aldrich's Closure Statement is therefore reliant on the professional opinion of Geotechnology, as included in Geotechnology's CQA Report dated

[1] Phase 1 construction included alterations to the dam including the abandonment of the existing culverts, removal of the existing principal spillway inlet riser structure, abandoning the existing principal spillway outlet pipe, regrading of the existing ash within the impoundment so as to allow collected stormwater to discharge via new single or dual gravity outlet pipes at nine (9) locations around the perimeter of the impoundment, grading of a new access road onto the embankment, and incidental channel and slope erosion protection. Phase 3 construction consisted primarily of installation of a low-permeability Closure-Turf cap above the regraded ash and stormwater pipe outlet headwalls and flap gates at Outlets 4 & 5.

17 August 2021. In addition, we understand that Geotechnology's CQA Report accurately reflects the as-built conditions and the means and methods used by the contractor to achieve conformance with the Haley & Aldrich Design Plans and Specifications. In addition, any information related to the relationship between Mississippi River and RCPA water levels, associated storm events, and flood elevations used in support of the final cover design (i.e., uplift potential and ballasting, drainage, etc.) were generated by Ameren's hydrogeologic and engineering consultant Golder - Member of WSP, and Haley & Aldrich's statements herein regarding the cover system are reliant on that information in support of our closure cover design and as-built drawing sets.

Steven F. Putrich, PE

P.E. Seal License Number: PE2014035813

APPENDIX D
Treatability Study Documentation

December 31, 2019 *Via e-Mail* (bmiller2@ameren.com)

Ameren Services
1901 Chouteau Avenue
PO Box 66149, MC 6
St. Louis, MO 63166-6149

RE: Ashpond Metals Treatability Study Results

XDD Project No. 19005.00, 19005.01, 19010.00, and 19011.0

XDD ENVIRONMENTAL, LLC (XDD) appreciates the opportunity to provide Ameren Services (Ameren) with the results of the data evaluation, bench-scale treatability testing, and remedial technology evaluation to address elevated levels of arsenic (As), molybdenum (Mo), lithium (Li), boron (B), and other site metals in ashponds leachate / groundwater from the Rush Island Energy Center (RIEC), the Meramec Energy Center (MEC), the Labadie Energy Center (LEC), and the Sioux Energy Center (SEC). The bench-scale testing was performed in accordance with the scope of work described in XDD's *Proposal for Metals Treatability Study* dated February 12, 2019, *Proposal for Metals Treatability at the Labadie Energy Center* dated April 23, 2019, and *Proposal for Metals Treatability at the Sioux Energy Center* dated April 23, 2019, with modifications as noted in this report. The report herein includes preliminary results of the treatability testing for all sites with a final pilot study design approach for RIEC.

If you have any questions regarding the information presented in this report, please do not hesitate to call me at 314.609.3065.

Sincerely,

DEREK INGRAM

XDD Environmental

cc:

Michael Marley
Laurel Crawford
Bridget Cavanagh

ASHPOND METALS TREATABILITY STUDY RESULTS

Ameren Services

Prepared For:

AMEREN SERVICES
1901 CHOUTEAU AVENUE
PO BOX 66149, MC6
ST. LOUIS, MO 63166-6149

Prepared By:

22 MARIN WAY
STRATHAM, NH 03885
TEL: (603) 778-1100
FAX: (603) 778-2121

December 31, 2019

EXECUTIVE SUMMARY

XDD Environmental (XDD) was retained by Ameren Services (Ameren) to perform metals treatability studies for the remediation of arsenic, molybdenum, lithium, boron, and other metals of concern (MOC) from ashpond leachate / groundwater. Phase 1 of the three phases of treatability studies included a review of geological conditions and existing metals in leachate from four sites [Rush Island Energy Center (RIEC), Meramec Energy Center (MEC), Labadie Energy Center (LEC), and Sioux Energy Center (SEC)]. In addition, the Phase 1 involved literature research on possible treatment trains and chemical conditions favorable for the MOC remediation. The results from the Phase 1 study identified several possible in situ treatment technologies for further evaluation, including: pH adjustment, iron precipitation / coprecipitation, zero valent iron (ZVI), metals reducing geochemical conditions, and biological stimulation as possible approaches to be tested in the Phase 2 studies.

The Phase 2 studies evaluated the Phase 1 identified treatment approaches effectiveness for MOC remediation using site groundwaters and soils, mimicking an in situ treatment application. The primary objective of the Phase 2 testing was to determine which treatment approaches / changes to geochemical conditions would promote adsorption, precipitation, or coprecipitation of the MOC, without adversely affecting the dissolved and total MOC concentrations in groundwater or other metals present at the site. The tests were carried out for periods of one to eight weeks (depending on the technology under evaluation). Of the remedial approaches tested in Phase 2, microscale ZVI and pH reduction (to pH 6) were the only methods that treated arsenic and molybdenum (the two metals of greatest regulatory concern at RIEC) to the required criteria. The other remedial approaches tested had limited to no impact on the MOC in groundwater.

The results from the Phase 2 testing were to be used to refine Phase 3 testing and to develop the pilot test design for the RIEC site. However, prior to the Phase 3 testing, boron was changed from a secondary to a primary MOC. Microscale ZVI was the only technology that had been shown to remove boron from groundwater in the Phase 2 testing; additional research identified an ion-specific resin (resin) that could treat boron to the required criteria using an ex situ remedial approach. The addition of boron as a primary MOC, along with concerns with clogging of the aquifer from precipitation of site metals, and the complexity of in situ treatment of boron, resulted in a transition from an in situ to an ex situ treatment system conceptual treatment approach for all sites MOC. The primary concern /difference in the transition from in situ to ex situ treatment is the decreased treatment time; the available in situ treatment time based on site hydraulics is weeks to a month or more; ex situ treatment requires a few minutes to hours of reaction time to permit a practical and cost-effective remedial approach.

Accordingly, for the Phase 3 treatability studies, pH adjustment, microscale ZVI, and ferric chloride addition (added due to additional literature research on the decreased available reaction

timeframes for ex situ treatment) were tested for the treatment of arsenic and molybdenum in the RIEC groundwater, with polishing of the treated groundwater using resin for boron removal. The results of the Phase 3 testing identified pH adjustment, ferric chloride aided precipitation, sand filtration, and resin polishing as the most effective and reliable ex situ treatment option for RIEC groundwater.

Going forward, the results of the Phase 3 treatability testing for the RIEC groundwater will be used to guide the finalization of the treatability testing of the other sites ashpond leachate / groundwaters. Each of the individual sites unique water geochemical conditions, MOC, and hydraulics will require evaluation to ensure a reliable treatment approach design for each site.

TABLE OF CONTENTS

LIST OF TABLES

1.0 INTRODUCTION

XDD Environmental (XDD) was retained by Ameren Services (Ameren) to perform metals treatability studies on ashpond leachate / groundwater from four sites: Rush Island Energy Center (RIEC), Meramec Energy Center (MEC), Labadie Energy Center (LEC), and Sioux Energy Center (SEC). The primary objective of the studies was to evaluate potential remedial technologies for metals of concern (MOC) identified as part of the requirements of United States Environmental Protection Agency (USEPA) 40 CFR Part 257 "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule" (the CCR Rule). The CCR Rule requires owners or operators of existing CCR units to produce an Annual Groundwater Monitoring and Corrective Action Report (Annual Report) each year (§§ 257.90(e)). XDD was provided, through a third party, data from the annual reports, samples from compliance wells with previously identified elevated MOC concentrations, and applicable statistically determined action levels (target goals for MOC treatment) for each site.

The treatability studies were developed and completed using a conservative approach of testing groundwaters from the areas of highest MOC concentrations, with the understanding that proposed engineered caps for each site should result in reduced MOC groundwater concentrations over time. Though the MOC and regulatory concerns are similar at each site, site-specific groundwater geochemistry's and varying MOC concentrations required XDD to approach treatment for each site separately. This approach ensures certainty in the MOC treatment effectiveness based on the differing site conditions and MOC concentrations for each site. It also provides for information needed in developing a treatment train specific to each site to address the differing geochemical conditions.

Initially, the primary MOC at the sites (though not all present at all sites) were arsenic, molybdenum, and lithium. Other potential MOC carried through the studies for each site (though again not all present at all sites) included boron, lead, cobalt, and selenium. A key component of the study was to determine if a potential MOC treatment approach would affect other metals in site groundwater and soil in either a positive (reduced concentration) or negative (increased concentration) manner. Baseline MOC / metals concentrations for all four sites (five locations; two sample sets being studied at MEC due to the presence of localized lithium) are presented in **Table 1**. The initial conceptual remedial approach was to treat the metals in situ, taking advantage of the slow moving groundwaters at the sites (allowing weeks of treatment time for MOC removal to occur), and for the potential for the most cost-effective treatment.

Around June 2019, during the performance of the treatability studies, per direction from Ameren, boron was transitioned from a potential MOC to a primary MOC, to account for an anticipated revision in the CCR Rule compliance. With this transition, any remedial option would be required to include boron treatment to below the applicable action. The complexity of in situ treatment

of boron and its limited treatability options became a primary driver to change the conceptual treatment approach to ex situ treatment for the sites groundwaters.

This report focuses on the initial literature research conducted for all sites, initial treatability testing of the leachate / groundwater for all sites (for in situ treatment), then a refocus of the studies to consider ex situ treatment of the MOC (with boron added as a MOC), and finally the refinement of the treatment effectiveness and development of a MOC remedial approach for pilot testing at RIEC. The results from the additional treatability studies performed for RIEC will be used to guide refinement of the treatability studies and pilot test design for the other three sites (MEC, LEC, and SEC).

The three primary approaches for metals removal from groundwater are:

- **Precipitation**: Transformation of a dissolved species to a solid form, which can then settle out of suspension.
- **Coprecipitation with other minerals**: Transformation of a dissolved species to a solid form that combines with another material (such as iron), which can then then settle out of suspension.
- **Adsorption**: Introduction or production of a solid that will absorb the MOC from the groundwater.

The treatability studies for each site consisted of two phases; with a final / third phase conducted on RIEC only, at this time, each of the three phases of testing are described below:

- Phase 1 – Site Review and Data Evaluation for Preparation of the Treatability Study Design (**Appendix A**)
    - Compare site-specific data to each site's MOC target goals and develop a conceptual MOC remedial approach based on a summary of the site-specific geochemical and hydrological conditions.
    - Evaluate existing literature to identify potential remedial options for the MOC to be tested for each site.
- Phase 2 – Bench-Scale Treatability Study for In Situ Remediation of MOCs
    - Based on the literature review results from Phase 1, bench-scale reactors were developed, using site soil and groundwater, to evaluate promising in situ treatment technologies or treatment trains. Treatment options identified in the Phase 1 review included (**Table 2**):
        - pH adjustment

- Addition of calcium polysulfide (CaSx)
- Addition of dissolved iron
- Addition of microscale zero valent iron (ZVI)
- Addition of particle size ZVI
- Biodegradation / biostimulation in conjunction with ZVI.

- The focus of Phase 2 testing was to identify specific MOC removal methods from site groundwater over the course of a one month treatment period without adversely affecting other MOCs in the groundwater (e.g., mobilizing MOCs present on site soils). The one month treatment period was selected based on the groundwater flow rates from the proposed in situ treatment application area to the regulatory point of compliance; actual site-specific treatment periods will have some variance greater than this selected period.

- Phase 3 –Treatment Train Development for Ex Situ Remediation of the MOCs at RIEC
  - Per above, boron was added as a primary MOC during the Phase 2 testing timeframe. The limitation to the availability and the complexity of in situ remedial options for boron removal, along with concern for long-term aquifer clogging from MOC precipitation / coprecipitation, caused a change in the conceptual remedial approach for the sites from an in situ to an ex situ treatment train process. The primary consequence of the change was the available time for treatment of metals in an above-surface treatment train. For in situ remediation, a one month MOC treatment period was readily available for the sites; however, for practical and cost-effective ex situ MOC remediation, the treatment period would need to be reduced to minutes to a few hours, dependent upon groundwater extraction rates and storage limitations of the ex situ treatment processes.
  - Additional literature research suggested that the most reliable approach for removal of boron from groundwater was boron selective ion-exchange resins (resin)
  - Based on the RIEC Phase 2 treatability study results, ZVI and pH adjustment were identified as potential effective in situ remedial options for the initial MOCs at RIEC. One of the ZVI products tested in Phase 2 was effective on boron, though pH adjustment had no effect. Accordingly, the following column tests were conducted in the Phase 3 testing:
    - Initial groundwater pH adjustment, followed by passing groundwater through a column filled with a ZVI/sand mixture for treatment of arsenic

and molybdenum, with evaluation of the treatment effectiveness of that system for boron

- pH adjustment of groundwater to approximately pH 6, followed by passing the groundwater through a sand column for treatment of arsenic and molybdenum only
- Addition of a column filled with resin after the ZVI/sand column and the pH followed by sand column tests, for additional treatment of boron

o Based on the change to an ex situ remedial approach, requiring fast treatment periods (faster reaction kinetics), additional literature research identified the addition of ferric chloride to the groundwater as a potential approach for rapid arsenic removal through coagulation / flocculation / precipitation. The following additional tests were conducted to further evaluate ex situ treatment of arsenic and molybdenum:

- Initial groundwater pH adjustment, followed by the addition of ferric chloride, followed by settling of the developed precipitants and filtration to remove the suspended precipitants from the groundwater
- A resin filled column after the above filtration step for treatment of boron

Details on each of these three phases of treatment are provided in the following sections of this report.

2.0 PHASE 1 LITERATURE REVIEW

An extensive literature review was conducted for in situ treatment and general chemical behavior of the MOC prior to the selection of remedial options for consideration for the sites. The results of the literature review are presented in **Appendix A**. The literature review was necessary since the MOC precipitate, co-precipitate, or adsorb under varying geochemical conditions; however, these preferred MOC treatment geochemical conditions may result in increased mobility of other metals / MOC at the sites. The literature review identified the geochemical conditions that were either favorable for the MOC to be removed from the groundwater or would not negatively affect other MOC present. From this research, potential treatment trains were identified for remediating site MOC and for Phase 2 treatability testing.

3.0 PHASE 2 – TREATABILITY TESTING

3.1 Phase 2 Experimental Procedures

Based on the initial literature review, five mechanisms were identified as possible treatment approaches for the in situ removal of arsenic, molybdenum, and lithium from the sites groundwaters. The selection of arsenic, molybdenum, and lithium as the MOC was based on detections above the provided statistically-derived action levels for at least one of the four sites evaluated (**Table 1**). Boron was initially not on the list of primary MOC but as a metal being analyzed for since it does not have a current regulatory required action level. Boron was added as a primary MOC in the Phase 3 testing, per the request of Ameren and as a statistically-derived action level for each site was provided.

Below is a summary of each of the Phase 2 potential in situ approaches tested. A breakdown of the experimental setup for the approaches tested are presented in **Table 2**.

1. pH adjustment (7-day test)
    - For the pH adjustment, a range of pH of 6 to 10 was evaluated for RIEC to determine how the MOC concentrations would change as the pH decreased (at RIEC the initial pH in groundwater from monitoring well MW-2 was 11). Reduction and maintaining a pH of 6 resulted in arsenic and molybdenum removal after a week of treatment, without adversely affecting the concentrations of the other MOC present; therefore, this approach was maintained for testing of the other sites groundwaters.
2. Addition of calcium polysulfide (CaSx) (7-day test)
    - CaSx has been proven to reduce certain dissolved metal concentrations through forcing of reduced groundwater chemistry and subsequent metal sulfide formation. The dosage of CaSx used in these tests was based on a 1:2 mass of metals to mass of CaSx, with a 100 percent (%) safety factor (**Table 2**).
3. Addition of ferrous iron (4-week test)
    - The RIEC site groundwater samples have low concentrations of dissolved iron; dissolved iron is beneficial for the coprecipitation of certain MOC and as a sorbent for MOC. Dissolved iron (ferrous sulfate at 50 mg/L) was added to the site groundwater and soil. The test was conducted under both aerobic and anaerobic groundwater chemistries to determine if coprecipitation or sorption of the MOC can be induced.

4. Addition of ZVI (4-week test)
    - ZVI can also introduce dissolved iron, under anaerobic conditions, into groundwater for coprecipitation and possible adsorption of the MOC.
    - Two ZVI products were evaluated as potential remedial options: a microscale (7 micron) product, which is typically injected into the subsurface, and granular ZVI, which is commonly used in permeable reactive barriers (PRBs) (SR.25 particle size). Given the MOC concentrations present in site groundwater, ZVI dosages were established for the RIEC and MEC (MW-5 and MW-6) sites, based on manufacturer recommendations. While preliminary results from this approach suggested ZVI as a promising method for MOC removal, the required ZVI dosage was determined to be impractical for full-scale implementation. The ZVI dosage for the LEC and SEC site treatability tests were reduced to more practical dosage levels (see **Table 2**).
5. Biostimulation with ZVI addition (8-week test)
    - Test conditions, described in Test 4 above, were duplicated with the addition of food and nutrients, which are typically lacking in site groundwater and soils, to promote biotransformation of metals from a soluble to an insoluble form. Since biological processes are often slower than chemical processes, the biostimulated reactors were maintained for twice as long a treatment period as the ZVI only reactors (8 weeks vs. 4 weeks).

3.2 Phase 2 – Treatability Testing - Results

The results of the metals in groundwater analyses for the Phase 2 testing are presented in **Table 3** (RIEC), **Table 4** (MEC, MW-5), **Table 5** (MEC, MW-6), **Table 6** (LEC), and **Table 7** (SEC) for the in situ treatment approaches tested. The Phase 2 testing results suggest:

- A pH adjustment to 6 resulted in the reduction of arsenic and molybdenum to near action levels at all sites (Test 1).
- There was some benefit to using the granular size ZVI and a pH adjustment (reduction to 6) for the removal of arsenic and molybdenum (Test 4). Granular ZVI achieved action levels for arsenic and molybdenum for all sites, with the exception of molybdenum at SEC.
- There was minimal reduction in total metals concentrations for the tests conducted at a pH greater than 8 (Test 1).

- There was minimal reduction in MOCs as a result of treatment with CaSx, dissolved ferrous iron, or biostimulation (Tests 2, 3, and 5, respectively).
- Microscale ZVI was the only product tested that reduced boron to action levels for all sites, except for SEC.

Upon completion of the Phase 2 testing, per the request of Ameren, boron was added as a primary MOC with an action level of 4 mg/L. Of the approaches tested, microscale ZVI was the only approach that had a positive impact in reducing boron levels in groundwater. The literature research, supported by the phase 2 test results, suggests boron is most efficiently and reliably treated via ex situ filtration through a ion-selective resin. Given the addition of boron as a primary MOC and with concerns of long-term clogging of the site aquifers from metals precipitation, it was collectively decided to change the conceptual remedial approaches from an in situ to an ex situ treatment process. At this point in the testing (entering Phase 3), it was suggested by XDD and presented to Ameren, to focus on developing an ex situ remedial approach for RIEC to expedite the design and testing of a pilot scale system. The proposed Phase 3 treatability work and developed pilot test approach for RIEC would then be used to guide future Phase 3 testing and pilot test designs for the other sites (MEC, LEC, and SEC). An additional advantage of an ex situ remedial approach is the flexibility and ease of adjustment of an ex situ treatment system, given the variability in the groundwater geochemistry's and hydraulics across the four sites under evaluation. In addition, changes in site groundwater conditions are expected over time as both the consequences of the engineered cap placement and the potential ex situ treatment implementations stabilize, with respect to groundwater MOC concentrations.

4.0 PHASE 3 – TREATABILITY TESTING - RIEC

4.1 Phase 3 Experimental Procedures

The Phase 3 treatability testing focused on refining the ex situ remedial approach for RIEC and to finalize the RIEC pilot test design. The initial results from the Phase 2 testing for the in situ treatment of the MOC at RIEC, conducted in batch reactors with site groundwater and soil, supported that pH adjustment and the addition of ZVI were the most promising remedial options for treatment of arsenic and molybdenum (the primary MOC at RIEC) to action levels. The phase 3 testing consisted of a treatment train that was scaled, for the bench testing, using an ex situ conceptual pilot test design sized to fit within single or double Conex box (portable storage unit) treatment units, that could be positioned above ground at any of the sites.

The major design issue, refined in the Phase 3 testing, was the transition from the Phase 2 test results developed for an in situ treatment approach, to a reliable ex situ treatment train. For ex situ treatment to be practical and cost-effective the time of reaction (kinetics) to create

precipitants needs to be on the order of minutes to a few hours. For the in situ approaches tested in Phase 2, a month-long contact time was available between amendments addition and for precipitation of metals to occur (based on the site groundwater velocity and distance from the remedial implementation area to the compliance sampling locations). For the in situ reaction timeframe, batch reactors were ideal. The required reaction timeframes for the Phase 3 testing made it necessary to use columns in the test procedures and to scale the reactor sizes and groundwater flow rates to match the conceptual field pilot and full-scale Conex box remedial systems sizing.

The Phase 3 treatability tests were also scaled for site hydraulics, assuming a 200-ft long cross-sectional treatment length, perpendicular to impacted groundwater flow, at the RIEC. Site-specific groundwater modeling was performed to determine the full-scale groundwater capture / flow rates required to permit an approximate 6 to 12-month pilot test duration to demonstrate the effectiveness of the treatment train. The pilot test treatment results need to be reflected both within the ex situ treatment process sampling points but also in existing compliance monitoring wells located within and downgradient of the treatment system hydraulic capture zone. For the RIEC site, the projected pilot test groundwater flow rate was estimated at 8 gallons per minute (gpm) (2 gpm per well) which is approximately four times the projected full-scale required groundwater flow rate.

It was also initially estimated that the ex situ treatment vessels (either filters or settling tanks) within the proposed Conex box system would have to be on the order of 750 to 1,000 gallons maximum capacity to fit in the unit, and that the Phase 3 testing would need to have reaction timeframes (kinetics) that would match the available vessel sizing. To scale the pilot test treatment train conceptual design to the Phase 3 treatability study design, the treatability study columns were made 3-inch (in) long and 1.5-in in diameter, with a groundwater flow rate of 0.7 milliliters per minute (mL/min).

Based on the results of the literature research and the Phase 2 testing, the initial Phase 3 tests were conducted with pH adjustment to pH 6 for the RIEC groundwater. The pH adjusted groundwater was then passed through a sand filter (with a residence time of 40 minutes) for arsenic and molybdenum removal. The pH adjusted groundwater was also tested by adding dissolved iron either via a ZVI/sand filter or by the addition of ferric chloride. Ferric chloride was incorporated into the Phase 3 testing due to the potential faster reactions times to create metal precipitates, per the discussion in Section 1 of this report. The ferric chloride was added to the groundwater to a concentration of 40 mg/L, the ferric chloride treated groundwater was passed into a settling vessel with a residence time of 1.25 hours, the metals were allowed to precipitate and settle, and the treated groundwater was passed through either a bag or a sand filter.

Since pH adjustment and iron addition had proved ineffective at boron removal in the Phase 2 testing, a resin filter was added to the effluent of the pH and iron addition ex situ treatment processes tested to evaluate the resins effectiveness for boron removal given the RIEC groundwater geochemistry. The resin was added post pH and ferric chloride addition as the resin is relatively expensive and focusing its use on the boron only is considered an overall more cost-effective approach for the groundwater treatment.

4.2 Phase 3 – Treatability Testing – RIEC – Results

Ferric Chloride ($FeCl_3$) Addition

The ex situ treatment method that proved most successful and reliable in the Phase 3 testing for pilot and full-scale implementation at the RIEC site is the pH adjusted, $FeCl_3$ aided flocculation / removal of arsenic and molybdenum. Preliminary testing with the ZVI and pH adjustment, discussed below, helped guide the design of the $FeCl_3$ treatment train. Understanding that the resin can be successful at removing boron at the concentrations present at the RIEC, Phase 3 testing focused on arsenic and molybdenum removal and developing a removal approach that worked effectively in the available ex situ treatment timeframes.

A preliminary Phase 3 test was performed to evaluate varying dosages of $FeCl_3$ and pH adjustment specific to the treatment of the arsenic in the RIEC groundwater. A kinetics / rate of treatment / reaction test was conducted where $FeCl_3$ was added to the groundwater and allowed to react, flocculate / precipitate and settle out of the groundwater for periods of 1 hour, 3 hours, and 6 hours, prior to flowing the groundwater through a sand filter column (**Table 8**). Since arsenic(V) is the form of arsenic that coprecipitates more readily with iron, hydrogen peroxide was tested as an oxidizer to transform any arsenic(III) in the groundwater to arsenic(V), prior to removal with the $FeCl_3$ addition. The results from the preliminary $FeCl_3$ tests suggested that:

- Both arsenic and molybdenum can be reduced to concentrations at or below action levels, using $FeCl_3$ addition.
- An initial pH of 6 (prior to the addition of $FeCl_3$) caused faster settling of the precipitants than an initial pH of 4 (also, pH 6 was determined to be a more favorable pH for RIEC groundwater treatment, based on the Phase 2 test results).
- Higher $FeCl_3$ dosage (40 mg/L vs. 20 mg/L) provided greater removal of arsenic and molybdenum. Though the difference in $FeCl_3$ dosage performance for the RIEC groundwater was not significant, based on the concentrations detected in the groundwater and the applicable action levels for the MOC at the RIEC site. The dosage evaluation results were however considered beneficial for refinement of Phase 3 testing for the other sites.

- The additional of hydrogen peroxide did not improve the arsenic removal efficiency. However, a check on the arsenic form in groundwater at RIEC showed the arsenic to be predominantly arsenic(V), so the pre-oxidation step was not needed for RIEC.

The reaction time determined for the $FeCl_3$ coagulation and flocculation / precipitation and associated removal of arsenic and molybdenum from groundwater in the preliminary testing was adequate for the conceptual ex situ treatment approach.

Following the preliminary testing it was considered beneficial to run further testing to confirm the preliminary test results, and to optimize the pilot test design. Based on additional literature research, aeration of the groundwater prior to $FeCl_3$ addition was added as a treatment step. Additional treatability tests were conducted using pH adjustment of the RIEC groundwater to approximately 6, followed by addition of 40 mg/L of $FeCl_3$, followed by settling and filtration of precipitants using either sand or bag filters. The treated groundwater was then passed through the resin filter for boron removal. Results of these additional tests are presented in **Table 9**. Key observations and conclusions from the additional $FeCl_3$ testing are:

- Aeration of the groundwater prior to the addition of $FeCl_3$ accelerates the formation of precipitants.
- Influent pH should be close to pH of 6 at RIEC for optimal precipitant settling times.
- Higher $FeCl_3$ concentrations added to the groundwater appear to provide larger precipitant particles that settle faster. However, the higher dosage of $FeCl_3$ will also increase the sludge volume that will require additional disposal and may increase maintenance needs.
- 100-micron bag filters are insufficient to remove the arsenic particles in the groundwater (and reduce total arsenic concentrations to below action levels). Though 10-micron filters work effectively to meet action levels, the 10-micron filter is likely to cause operational issues in a pilot and full-scale system and is therefore not a preferred treatment option. Also, bag filters are unlikely to remove iron in the treated groundwater to below 2 mg/L, which may negatively impact the resin filter longevity.
- The sand filter was effective as a polishing step to reduce total arsenic and molybdenum concentrations to below action levels, while also decreasing total iron concentrations to approximately 0.3 mg/L. Sand filtration is therefore recommended for the pilot scale system.
- The resin filter is needed to remove boron from the groundwater to action levels. The resin operates optimally between a pH of 4 and 10. The $FeCl_3$ addition reduces the

groundwater pH to approximately 4 so pH adjustment back to pH 6 is recommended prior to resin treatment.

- Though total lead is reported in groundwater at RIEC below action levels, the $FeCl_3$ addition reduced the total lead concentration from 0.0057 mg/L to 0.0026 mg/L or lower, suggesting that $FeCl_3$ is a potential option at other sites for treatment of total lead levels which exceed action levels.

pH Adjustment followed by Resin Column Treatment

The Phase 2 pH adjustment only bench testing had proven effective for arsenic and molybdenum removal (though not boron) over a week-long treatment period in the presence of site soils. The Phase 3 tests included an evaluation of pH adjustment followed by the resin as an alternative RIEC treatment train. Since the resin is specially designed for boron removal, the manufacturer could not provide insight into its effectiveness, performance or sustainability for arsenic or molybdenum treatment, so it was assumed that pre-treatment to remove arsenic and molybdenum was still needed.

The columns tests were conducted by decreasing the pH of the RIEC groundwater to pH 5 then passing the pH adjusted groundwater through a sand filter sized to provide a hydraulic residence time of 40 minutes. The filtered groundwater was then passed through a resin column. Groundwater exiting the resin column were collected for analysis of MOC (**Table 10**). The analysis results showed that MOC action levels were achieved after Days 1 and 3 of treatment for all MOCs; however, breakthrough of arsenic occurred by Day 7.

Groundwater samples collected between the sand filter and the resin columns showed that the pH adjustment by itself did not effectively treat the arsenic or molybdenum in the groundwater, over the short treatment period available in the scaled ex situ treatment train. Consequently, it was determined that the resin was responsible for the removal of arsenic, molybdenum, and boron in the RIEC groundwater. A further review of the data and the procedures used in this test suggests that for pH adjustment to be successful for removing arsenic and molybdenum from the RIEC groundwater, the groundwater needs to be maintained at a reduced pH for longer than 40 minutes (the residence time in the tested columns). Hence, pH adjustment alone would not be a viable ex situ treatment approach as an ex situ treatment system design.

Further, while the resin was successful at temporarily removing arsenic, molybdenum, and boron, it was not designed for arsenic and molybdenum treatment, and the arsenic concentration reduction could not be sustained below REIC action levels for up to a week. This indicates that a large resin vessel and / or frequent regeneration of the resin would be needed for resin to be considered as a stand-alone treatment approach. Also, since the resin was not

designed to remove arsenic and molybdenum, it is unknown if the metals will desorb during the resin regeneration, in which case, the resin could be ineffective for further arsenic and molybdenum removal. The adsorption capacity of the resin for arsenic and molybdenum should only be considered as a safety factor in the final pilot test design, if the pretreatment for arsenic and molybdenum failed, but not as a stand-alone remedial option.

ZVI Column Testing

Since the microscale ZVI was identified in the Phase 2 tests as a possible approach for removing boron, arsenic, and molybdenum from the RIEC site groundwater, test columns were constructed using a mixture of the microscale ZVI and commercial sand (to allow the required flow through the column / ZVI, without clogging due to the ZVI microscale particle size). The columns were prepared using a 5:1 ratio of sand to microscale ZVI, and a 2:1 ratio of sand to microscale ZVI. The columns were operated for 7 days, with treated groundwater samples collected from the column effluent after 1, 3, and 7 days of treatment time (simulating groundwater treatment over a one week period through a pilot or full-scale 1,000-gallon capacity column / filter).

Table 11 presents the results of the ZVI column testing. The results show partial treatment of arsenic and molybdenum, though not to action levels. Both the 5:1 and 2:1 sand to ZVI dosed columns showed some treatment occurred the first day, but treatment effectiveness decreased by Days 3 and 7. Results for both the columns showed that concentrations did not decrease to action levels for arsenic, and results for only one column sample showed that molybdenum concentrations decreased to action levels (Day 1 of the 5:1 dose column). Boron concentrations did not change passing through the ZVI columns.

From the Phase 3 test results, it was determined that the ZVI treatment effectiveness (at the design sand to ZVI dosages) and the associated treatment longevity was questionable, and likely not reliable as a sustainable remedial option. To ensure the ZVI was being adequately evaluated, XDD had additional discussions with the ZVI vendor on the system design and effectiveness. It was determined that the recommendations by the vendor on how to use ZVI in an ex situ process was impractical for the site given the conceptual pilot test design constraints (action levels, MOC, flow rates, vessel sizing, etc.).

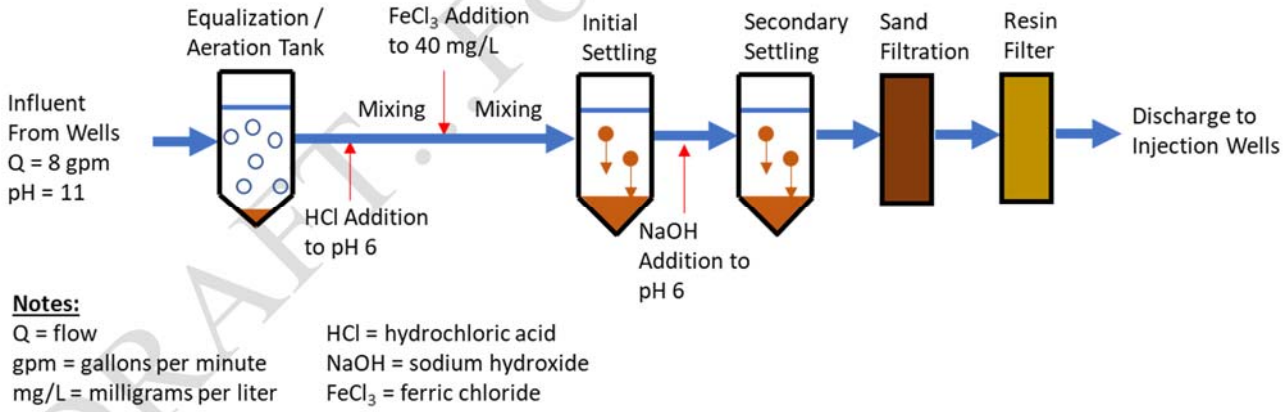
5.0 CONCLUSIONS AND RECOMMENDATIONS FROM TREATABILITY TESTING

Several potential treatment technologies were evaluated for the MOC at the sites. While ZVI and pH adjustment were the most promising remedial approaches from the Phase 2 testing for in situ treatment of the initially identified primary MOC, the subsequent addition of boron as a primary

MOC resulted in the requirement to transition to an ex situ remedial approach. Added benefits of the transition to an ex situ remedial approach are concerns with potential aquifer clogging from in situ MOC precipitation and the benefits of the flexibility in ex situ system design for varying site groundwater geochemistry's. The difference in available and practical treatment times (reaction kinetics) for in situ treatment versus ex situ treatment systems resulted in the elimination of the ZVI and pH adjustment alone technologies as viable ex situ remedial options and the evaluation of additional technologies for the MOC treatment.

Based on the results of the Phase 1 through Phase 3 treatability testing, the proposed treatment train identified for the RIEC pilot test is presented below in **Figure 1**. Modifications and optimizations to the treatment train will be evaluated during the pilot scale startup. The Phase 3 remedial approach refinement testing demonstrated that pH adjustment, followed by $FeCl_3$ aided coagulation/flocculation for arsenic and molybdenum treatment of the RIEC groundwater was effective and reliable. Boron removal requires the addition of an ion-specific resin following the $FeCl_3$ treatment. To expedite the arsenic and molybdenum removal, aeration of the groundwater prior to pH adjustment and the addition of 40 mg/L of $FeCl_3$ is required. The $FeCl_3$ reduces the groundwater pH to approximately 4 so pH adjustment back to pH 6 is recommended prior to resin treatment for boron removal.

Figure 1: Conceptual Treatment Train for Pilot Scale System at RIEC



Going forward, MEC, LEC, and SEC have similar MOC to RIEC (primarily molybdenum and boron) but with a few distinct deviations from the RIEC groundwater quality. The main points of difference that need to be considered in subsequent Phase 3 testing for the individual sites are:

- At MEC (monitoring well MW-6), lithium has been detected above action levels. The literature review performed during Phase 1 (**Appendix A**) suggests ZVI is a viable

remediation approach for lithium; it is suspected that $FeCl_3$ may also be effective at lithium removal.

- The boron concentration at SEC is above the manufacturer's maximum concentration recommendation for the resin (10 mg/L maximum vs. 22 to 25 mg/L measured at SEC). A recirculation method or resin vessels in series may be needed to reduce the boron concentration in SEC groundwater to meet action levels in the resin treated groundwater.
- SEC also has significantly higher molybdenum concentrations (3.05 mg/L) than RIEC (0.16 mg/L) so testing is needed to ensure $FeCl_3$ can be effective at removing molybdenum to action levels at these higher groundwater concentrations.
- Higher remediation system flow rates are likely to be encountered at some of the sites (in particular LEC) so refinement of the system hydraulics and available treatment timeframes need to be evaluated.
- The high pH at RIEC resulted in the need for an initial pH adjustment. This may not be necessary at the other locations, but confirmation tests should be performed.
- $FeCl_3$ flocculation / precipitation is facilitated with increased groundwater alkalinity. Additional alkalinity may be needed to be added to the treatment systems at the other sites to increase the rates of formation and settling of the precipitants.
- General groundwater geochemistry's are also likely to have subtle differences for the other sites. Testing is needed to provide confidence in the effectiveness of the treatment train at the other sites / locations.

The information gathered in the Phase 3 RIEC treatability testing will be used to guide the design of treatability testing and remedial approaches for the other three sites.

APPENDIX A: PHASE 1 LITERATURE REVIEW

Primary Metals of Concern

Arsenic

- Detected at 0.22 milligrams per liter (mg/L) (RIEC) and 0.02 mg/L (MEC, monitoring well MW-5). Arsenic was not detected at LEC, SEC, or at monitoring well MW-6 at MEC.
- Action levels are 0.030 mg/L (RIEC), 0.01 mg/L (MEC and SEC), and 0.0426 mg/L (LEC).
- Potential treatment methods include precipitation/coprecipitation, pH adjustment, adsorption, and ZVI/ZVI with carbon:
    - Speciation – trivalent arsenite [As (III)] is more soluble and mobile than pentavalent arsenate [As(V)].
    - Redox – arsenic is more readily mobilized under reducing conditions.
    - pH – mobility is lowest at pH 3 to 7, increases under very acidic or alkaline pH conditions.
    - Competing ions – phosphate and sulfate can limit arsenic adsorption and increase mobility.
    - Adsorption – iron oxides sorb arsenic and can greatly limit arsenic mobility.
    - Precipitation – formation of insoluble calcium arsenates can reduce leaching and mobility.
- Application of ferrous sulfate to soils has shown promise in reducing arsenic concentrations in groundwater at utility substation sites (EPRI, 2010).
    - Data review has shown that both RIEC and MEC lack iron – this indicates ZVI treatment may be promising.
- pH adjustment in trench application case study: The pH was raised from 1.93 to 7.9, leading to a reduction in groundwater arsenic concentrations from 35,000 micrograms per liter (µg/L) to <4 µg/L (EPRI, 2006).
- Summary of favorable conditions for arsenic removal:
    - pH range of 3 to 7, oxidizing conditions
    - Addition of Iron and calcium complexes
    - Low phosphate and sulfate concentrations

Molybdenum

- Detected at 0.16 mg/L (RIEC), 0.11 mg/L (MEC, monitoring well MW-5), 0.15 mg/L (MEC, monitoring well MW-6), 0.155 mg/L (LEC), and 3.05 mg/L (SEC).
- Action Level is 0.1 mg/L for all sites.
- Potential treatment methods include precipitation/coprecipitation, pH adjustment, adsorption, and ZVI/ZVI with carbon

- Molybdenum adsorption is highly pH-dependent. Peak adsorption for most sorbents (except maghemite nanoparticles) occurs at pH < 5 and limited adsorption occurs at pH > 8. In alkaline conditions, molybdenum behaves conservatively, and its dissolved concentration is controlled by precipitation, not adsorption, reactions (EPRI, 2011).
- Permeable Reactive Barrier (PRB)/ZVI/pH adjustment case study: Molybdenum was sequestered under reducing/oxidizing conditions with pH 7.3 to 10; effective for 15 months (reducing conditions sustained for 5 to 9 months) (Bellantoni, 2014).
- Summary of potential treatment options for molybdenum removal:
    - Maintaining a neutral or slightly alkaline pH with ZVI addition.

Lithium

- Detected at 0.12 mg/L (MEC, monitoring well MW-6), and either non-detect or below action levels at the other sites.
- Action Levels are 0.0647 mg/L (RIEC), 0.04 mg/L (MEC and SEC), and 0.055 mg/L (LEC).
- Potential treatment is limited to precipitation using ZVI PRBs.
- "Additional research is needed to evaluate, and possibly develop, in situ groundwater treatment technologies for lithium, specifically reagents for in situ injection or media for a permeable reactive barrier. Zeolites such as clinoptilolite and clays such as bentonite and kaolinite have been shown to exhibit lithium-sorbing characteristics in a laboratory setting, making these candidates for future in situ injection and PRB application studies" (EPRI, 2018).
- Summary of potential treatment options for lithium removal:
    - ZVI

Boron

- Detected at 3.85 mg/L (RIEC), 5.2 mg/L (MEC, monitoring well MW-5), 7.9 mg/L (MEC, monitoring well MW-6), 7.9 mg/L (LEC), 23.5 mg/L (SEC).
- Action Level is 4 mg/L for all sites.
- "Additional research is needed on the mechanisms of boron attenuation, both precipitation and adsorption, for a wider range of soil and mineral types, and in hydrogeologic environments typical of CCP management sites. While the literature suggests nonlinear sorption and some dependence on general soil type and pH, these relationships are not well understood. The same is true for competing ion effects, such as sulfate and fluoride. In addition, there are few field studies documenting boron attenuation at utility sites" (EPRI, 2005).

- "There is a need to measure boron sorption in the alkaline pH range associated with ash leachate, and to make these measurements with a wider range of soil and mineral types. Moreover, there are relatively few field-scale studies available on the fate and transport of boron derived from coal ash in groundwater. Studies based on site-specific sorption, hydrogeologic, and leaching data may yield a better understanding of the long-term impacts of boron from coal-combustion residues (EPRI, 2005)."
- Case study: pH adjustment to > 9.1 and the addition of proprietary ionizing agents resulted in 99% removal (sorption of boron complexes) (Kreinberg, 2017).
- Summary of potential treatment options for boron removal:
    - ZVI or boron specific ion-exchange resin (ex situ)

Metals of Concern Potentially Released as a Result of Treatment:

Cobalt

- Not detected in baseline samples collected at any of the sites.
- Action Level is 0.006 mg/L for all sites.
- Potential treatment methods include ZVI PRB and carbon substrate injections
    - Ontario ZVI case study: sulfate-reducing conditions (anaerobic, ORP <-250 mV), cobalt remediation achieved (reduction of ~260 parts per billion [ppb] to 40 ppb) (Pare, 2014, RPIC).

Lead

- Either reported below action levels or not detected in baseline samples collected at all sites.
- Action Level is 0.015 mg/L for all sites.
- Potential treatment methods include metal cation precipitation as sulfides, adsorption to iron corrosion products, pH adjustment using Acid-B Extra™ reagent (10%) (EPRI, 2006).
    - Success Mine PRB case study: Lead was reduced from 0.658 mg/L upgradient of the PRB to <0.002 mg/L downgradient of the PRB. The pH was buffered from 4.9 to 6.9 throughout the thickness of the barrier wall. PRB is anaerobic and creates conditions optimal for sulfate-reducing bacteria. Expected to provide treatment for 30 years (EPRI, 2006).
    - Case study at Gilt Edge Mine, SD: leachate pH was raised from 1.93 to 7.9, resulting in the following reductions in metals concentrations: arsenic from 35,000 µg/L to <4 µg/L, antimony from 500 µg/L to 10 µg/L, and lead from 390 µg/L to <10 µg/L (EPRI, 2006).

Selenium

- Not detected in baseline samples from any of the sites.
- Action Level is 0.05 mg/L for all sites.
- Potential treatment methods include reductive precipitation with oxidized iron minerals, adsorption to iron oxides, ZVI, and ZVI/carbon – many positive case studies (EPRI, 2006)
- Oxyanions (e.g., arsenic, chromium, selenium, molybdenum, vanadium, and sulfate) adsorb most strongly at low pH levels and cations (e.g., lead, cadmium, and nickel) adsorb most strongly at high pH levels.
- Like arsenic, selenium is generally present in predominantly two oxyanion forms in natural waters: Se (IV) as selenite ion SeO_3^{-2}, and Se (VI) as selenate ion SeO_4^{-2}. Selenite tends to dominate in impoundment settings when the source coal is bituminous or a mixture of bituminous and subbituminous, while selenate tends to predominate in landfill settings and when the source coal is subbituminous/lignite (EPRI, 2006). Selenate is generally soluble and mobile and is readily taken up by organisms and plants. Selenite is less soluble and mobile than selenate; therefore, reductive precipitation/coprecipitation of selenium could serve as a viable remediation approach. However, re-oxidation is a potential problem. Phytoremediation has also been reported and adsorption has been used.

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Tables

Table 1
Baseline Metal Concentrations and Action Levels
Ameren Services, Missouri

	Rush Island			Meramec MW-5			Meramec MW-6		
	Action Levels	Baseline/Baseline Dup		Action Levels	Baseline/Baseline Dup		Action Levels	Baseline/Baseline Dup	
	Total Metals (mg/L)								
Arsenic	0.03	0.22	0.22	0.01	0.020	0.020	0.01	0.005 U	0.005 U
Molybdenum	0.1	0.16	0.16	0.1	0.11	0.11	0.1	0.15	0.15
Boron	4	4.0	3.7	4	5.2	5.2	4	7.8	8.0
Lead	0.015	0.007	0.007	0.015	0.005 U	0.005 U	0.015	0.005 U	0.005 U
Cobalt	0.006	0.01 U	0.01 U	0.006	0.01 U	0.01 U	0.006	0.01 U	0.01 U
Selenium	0.05	0.01 U	0.01 U	0.05	0.01 U	0.01 U	0.05	0.01 U	0.01 U
Lithium	0.0647	0.06 U	0.06 U	0.04	0.06 U	0.06 U	0.04	0.12	0.12

	Labadie			Sioux		
	Action Levels	Baseline/Baseline Dup		Action Levels	Baseline/Baseline Dup	
	Total Metals (mg/L)					
Arsenic	0.0426	0.025 U	0.025 U	0.01	0.025 U	0.025 U
Molybdenum	0.1	0.15 J	0.16 J	0.1	3.20 J	2.90 J
Boron	4	7.7	8.1	4	25.0	22.0
Lead	0.015	0.025 U	0.025 U	0.015	0.025 U	0.025 U
Cobalt	0.006	0.05 U	0.05 U	0.006	0.05 U	0.05 U
Selenium	0.05	0.05 U	0.05 U	0.05	0.05 U	0.05 U
Lithium	0.055	0.019 J	0.016 J	0.04	0.029 J	0.020 J

Notes:

mg/L = milligrams per liter

U = not detected above the indicated reporting limit concentration

J = estimated value

Concentrations are at or below action level

Concentrations are between action level and reporting limit

Table 2
Summary of In Situ Test Conditions for Metal Treatability Study
Ameren Services, Missouri

Test Conditions				Rush Island			Meramec MW-5			Meramec MW-6		
Test condition	Soil (g)	Addition	Duration (week)	Amount	pH	Aerobic or Anaerobic	Amount	pH	Aerobic or Anaerobic	Amount	pH	Aerobic or Anaerobic
pH adjusted	48	HCl 36%	1	Varied	10, 9, 8, 7, 6	Aerobic	Varied	10, 8, 6	Aerobic	Varied	10, 8, 6	Aerobic
CaSx- No pH change	48	CaSx	1	2.1 mg		Aerobic	3.1 mg		Aerobic	5.5 mg		Aerobic
CaSx- pH adjusted	48	CaSx	1	2.1 mg	8	Aerobic	NA			NA		
Fe- anaerobic	48	Fe(II) sulfate	4	12 mg		Anaerobic	12 mg		Anaerobic	12 mg		Anaerobic
Fe -anaerobic- pH adjusted	48	Fe(II) sulfate	4	12 mg	8	Anaerobic	NA			NA		
Fe - aerobic	48	Fe(II) sulfate	4	12 mg		Aerobic	12 mg		Aerobic	12 mg		Aerobic
Fe - aerobic- pH adjusted	48	Fe(II) sulfate	4	12 mg	8	Aerobic	NA			NA		
ZVI (SR.2S)	48	SR.2S	4	96 mg		Anaerobic	96 mg		Anaerobic	96 mg		Anaerobic
ZVI (SR.2S)- pH adjusted	48	SR.2S + HCl	4	96 mg	8	Anaerobic	NA			NA		
ZVI (SR.2S)-Food	48	SR.2S + Food	8	96 mg		Anaerobic	96 mg		Anaerobic	96 mg		Anaerobic
ZVI (SR.2S)-Food- pH adjusted	48	SR.2S + Food + HCl	8	96 mg	8	Anaerobic	NA			NA		
ZVI (7 micron)	48	7 micron	4	96 mg		Anaerobic	96 mg		Anaerobic	96 mg		Anaerobic
ZVI (7 micron)- pH adjusted	48	7 micron + HCl	4	96 mg	8	Anaerobic	NA			NA		
ZVI (7 micron)- Food	48	7 micron + Food	8	96 mg		Anaerobic	96 mg		Anaerobic	96 mg		Anaerobic
ZVI (7 micron)- Food- pH adjusted	48	7 micron + Food + HCl	8	96 mg	8	Anaerobic	NA			NA		

Test Conditions				Labadie			Sioux		
Test condition	Soil (g)	Addition	Duration (week)	Amount	pH	Aerobic or Anaerobic	Amount	pH	Aerobic or Anaerobic
pH adjusted	48	HCl 36%	1	Varied	6	Aerobic	Varied	6	Aerobic
CaSx- No pH change	48	CaSx	1	0.09 mg		Aerobic	0.09 mg		Aerobic
CaSx- pH adjusted	48	CaSx	1	0.09 mg	7	Aerobic	NA		
Fe- anaerobic	48	Fe(II) sulfate	4	13.8 mg		Anaerobic	13.8 mg		Anaerobic
Fe -anaerobic- pH adjusted	48	Fe(II) sulfate	4	13.8 mg	7	Anaerobic	NA		
Fe - aerobic	48	Fe(II) sulfate	4	13.8 mg		Aerobic	13.8 mg		Aerobic
Fe - aerobic- pH adjusted	48	Fe(II) sulfate	4	13.8 mg	7	Aerobic	NA		
ZVI (SR.2S)	48	SR.2S	4	11 mg		Anaerobic	11mg		Anaerobic
ZVI (SR.2S)- pH adjusted	48	SR.2S + HCl	4	11 mg	7	Anaerobic	NA		
ZVI (SR.2S)-Food	48	SR.2S + Food	8	11 mg		Anaerobic	11mg		Anaerobic
ZVI (SR.2S)-Food- pH adjusted	48	SR.2S + Food + HCl	8	11 mg	7	Anaerobic	NA		
ZVI (7 micron)	48	7 micron	4	11 mg		Anaerobic	11mg		Anaerobic
ZVI (7 micron)- pH adjusted	48	7 micron + HCl	4	11 mg	7	Anaerobic	NA		
ZVI (7 micron)- Food	48	7 micron + Food	8	11 mg		Anaerobic	11mg		Anaerobic
ZVI (7 micron)- Food- pH adjusted	48	7 micron + Food + HCl	8	11 mg	7	Anaerobic	NA		

Notes:

SR.2S = particle size ZVI

ZVI = zero valent iron

7 micron = microscale ZVI

Food = lactate, EOL, cornsweet, and nutrients

NA = test condition not run

HCl = hydrochloric acid

CaSx = calcium polysulfide

Fe = iron (dissolved)

Table 3
Summary of Rush Island In Situ Total Metals Removal Performance
Rush Island Energy Center, Missouri

	Arsenic	Molybdenum	Boron	Lead	Cobalt	Selenium	Lithium
	mg/L						
Action Levels	0.03	0.1	4	0.015	0.006	0.05	0.065
Average of All Controls[1]	0.18	0.12	3.10	0.13	0.03 J*	0.03 J*	0.13
pH 10	0.17	0.12	3.05	0.08	0.02	0.02	0.07
pH 9	0.12	0.12	2.80	0.08	0.02	0.02	0.09
pH 8	0.10	0.13	3.15	0.05	0.01 J*	0.01 J*	0.06
pH 7	0.07	0.11	3.05	0.06	0.02	0.01	0.08
pH 6	0.02 J*	0.08	3.80	0.03 U	0.06 U	0.06 U	0.06 U
CaSx	0.23	0.12	3.60	0.08	0.07 U	0.07 U	0.07
CaSx pH7	0.05	0.14	3.75	0.03 U	0.06 U	0.06 U	0.04 J*
Dissolved Iron (Anaerobic)	0.20	0.13	3.20	0.11	0.05 U	0.05 U	0.11
Dissolved Iron pH 8 (Anaerobic)	0.11	0.14	3.20	0.08	0.05 U	0.05 U	0.06
Dissolved Iron (Aerobic)	0.19	0.13	3.05	0.13	0.05 U	0.05 U	0.10
Dissolved Iron pH 8 (Aerobic)	0.06	0.14	3.45	0.04 J*	0.05 U	0.05 U	0.13
ZVI Injectable	0.03 U	0.05 U	0.30	0.03 U	0.05 U	0.05 U	0.08 U
ZVI Injectable pH 8	0.03 U	0.05 U	0.13 J*	0.03 U	0.05 U	0.05 U	0.09 U
ZVI PRB	0.02 J*	0.39	3.60	0.03 U	0.05 U	0.05 U	0.04 U
ZVI PRB pH 8	0.03 U	0.04 J*	2.55	0.03 U	0.05 U	0.05 U	0.02 J
ZVI Injectable + Bio	0.025 U	0.05 U	0.32 J	0.025 U	0.05 U	0.05 U	0.06 U
ZVI Injectable pH 8 + Bio	0.025 U	0.05 U	0.07 J	0.025 U	0.05 U	0.05 U	NS
ZVI PRB + Bio	0.03 U	0.32 J	4.45 J	0.03 U	0.05 U	0.05 U	0.02 J
ZVI PRB pH 8 + Bio	0.03 U	0.05 U	2.20 J	0.03 U	0.05 U	0.05 U	0.04 J

Notes:

U = not detected above the indicated concentration

PRB = permeable reactive barrier

Injectable = iron particles at micro-scale; potentially applied through injection

Dissolved iron = 50 mg/L Iron(II) sulfate

NS = not sampled

CaSx = calcium polysulfide

At or below action level

Approaching action level

Above action level and increase relative to control

Non-detect but detection limit greater than action level

NA = no action level

mg/L = milligrams per liter

J* = half the detection limit was used for non-detect when duplicates had a detection and a non-detect.

pH adjustment testing was conducted over a 7-day test period. The native pH in monitoring well MW-2 was pH 11.

1) Average of All Controls = average of all controls used in the Phase 2 testing for Rush Island Energy Center

Table 4
Summary of Meramec MW-5 In Situ Total Metals Removal Performance
Meramec Energy Center, Missouri

	Arsenic	Molybdenum	Boron	Lead	Cobalt	Selenium	Lithium
	mg/L						
Action Levels	0.01	0.1	4	0.015	0.006	0.05	0.040
Average of All Controls[1]	0.034 J*	0.174	5.5	0.028 J*	0.062 U	0.062 U	0.028 J
pH 10	0.031	0.18	5.55	0.013	0.01 U	0.01 U	0.0285 J
pH 8	0.03	0.16	5.30	0.02	0.01 U	0.01 U	0.04 J
pH 6	0.029	0.11	5.6	0.027	0.01	0.01 U	0.049 J
CaSx	0.05 U	0.17	5.3	0.05 U	0.1 U	0.1 U	0.026 J
Dissolved Iron (Anaerobic)	0.039	0.18 J	4.8	0.035	0.05 U	0.05 U	0.029 J
Dissolved Iron (Aerobic)	0.031	0.17 J	4.6	0.03	0.05 U	0.05 U	0.03
ZVI Injectable	0.025 U	0.05 U	0.33	0.025 U	0.05 U	0.05 U	0.06 U
ZVI PRB	0.025 U	0.08	3.7	0.025 U	0.05 U	0.05 U	0.035 J
ZVI Injectable + Bio	0.05 U	0.1 U	0.31	0.05 U	0.1 U	0.1 U	NS
ZVI PRB + Bio	0.05 U	0.1 U	4.8 J	0.05 U	0.1 U	0.1 U	0.032 J

Notes:

U = not detected above the indicated concentration

PRB = permeable reactive barrier

Injectable = iron particles at micro-scale; potentially applied through injection

Dissolved iron = 50 mg/L Iron(II) sulfate

NS = not sampled

CaSx = calcium polysulfide

At or below action level

Approaching action level

Above action level and increase relative to control

Non-detect but detection limit greater than action level

NA = no action level

mg/L = milligrams per liter

J* = half the detection limit was used for non-detect when duplicates had a detection and a non-detect.

pH adjustment testing was conducted over a 7-day test period. The native pH in monitoring well MW-6 was approximately pH 7.5.

1) Average of All Controls = average of all controls used in the Phase 2 testing for Merimec Energy Center MW-5

Table 5
Summary of Meramec MW-6 In Situ Total Metals Removal Performance
Meramec Energy Center, Missouri

	Arsenic	Molybdenum	Boron	Lead	Cobalt	Selenium	Lithium
	mg/L						
Action Levels	0.01	0.1	4	0.015	0.006	0.05	0.040
Average of All Controls[1]	0.0259 J*	0.22 J	10.24 J	0.027 J*	0.062 U	0.062 U	0.128
pH 10	0.0285	0.215	10.5	0.0135	0.01 U	0.01 U	0.12
pH 8	0.013	0.18	11	0.016	0.01 U	0.01 U	0.15
pH 6	0.03	0.14	10	0.027	0.01	0.01 U	0.16
CaSx	0.05 U	0.19	10	0.05 U	0.1 U	0.1 U	0.12
Dissolved Iron (Anaerobic)	0.032	0.26 J	8.5	0.041	0.05 U	0.05 U	0.13
Dissolved Iron (Aerobic)	0.027	0.22 J	8.6	0.033	0.05 U	0.05 U	0.13
ZVI Injectable	0.025 U	0.05 U	0.69	0.025 U	0.05 U	0.05 U	0.5 U
ZVI PRB	0.025 U	0.05	6.5	0.025 U	0.05 U	0.05 U	0.11
ZVI Injectable + Bio	0.05 U	0.1 U	0.72	0.05 U	0.1 U	0.1 U	NS
ZVI PRB + Bio	0.05 U	0.1 U	8.5 J	0.05 U	0.1 U	0.1 U	0.1

Notes:

U = not detected above the indicated concentration

PRB = permeable reactive barrier

Injectable = iron particles at micro-scale; potentially applied through injection

Dissolved iron = 50 mg/L Iron(II) sulfate

CaSx = calcium polysulfide

mg/L = milligrams per liter

At or below action level

Approaching action level

Above action level and increase relative to control

Non-detect but detection limit greater than action level

NA = no action level

half the detection limit was used for non-detect when duplicates had a detection and a non-detect.

pH adjustment testing was conducted over a 7-day test period. The native pH in monitoring well MW-6 was approximately pH 7.6.

1) Average of All Controls = average of all controls used in the Phase 2 testing for Merimec Energy Center MW-6

Table 6
Summary of Labadie In Situ Total Metals Removal Performance
Labadie Energy Center, Missouri

	Arsenic	Molybdenum	Boron	Lead	Cobalt	Selenium	Lithium
	mg/L						
Action Levels	0.0426	0.1	4	0.015	0.006	0.05	0.055
Average of All Controls[1]	0.042 U	0.162 J	9.133 J	0.042 U	0.083 U	0.083 U	0.022 J*
pH 6	0.025 U	0.13 J	7.6	0.025 U	0.05 U	0.05 U	0.018 J
CaSx	0.025 U	0.16 J	7.5	0.025 U	0.05 U	0.05 U	0.016 J
CaSx pH7	0.025 U	0.13 J	7.6	0.025 U	0.05 U	0.05 U	0.017 J
Dissolved Iron (Anaerobic)	0.05 U	0.17	9.5	0.05 U	0.1 U	0.1 U	0.06 U
Dissolved Iron (Aerobic)	0.05 U	0.17	9.6	0.05 U	0.1 U	0.1 U	0.023 J
Dissolved Iron pH 7 (Anaerobic)	0.05 U	0.15	9.5	0.05 U	0.1 U	0.1 U	0.06 U
Dissolved Iron pH 7 (Aerobic)	0.05 U	0.16	9.7	0.05 U	0.1 U	0.1 U	0.06 U
ZVI Injectable	0.05 U	0.1 U	6.5	0.05 U	0.1 U	0.1 U	0.06 U
ZVI Injectable pH 7	0.05 U	0.1 U	6.3	0.05 U	0.1 U	0.1 U	0.06 U
ZVI PRB	0.05 U	0.1	9.3	0.05 U	0.1 U	0.1 U	0.06 U
ZVI PRB pH 7	0.05 U	0.1 U	8.9	0.05 U	0.1 U	0.1 U	0.022 J
ZVI Injectable + Bio	0.05 U	0.1 U	10 J	0.05 U	0.1 U	0.1 U	0.016 J
ZVI Injectable pH 7 + Bio	0.05 U	0.1 U	8.9 J	0.05 U	0.1 U	0.1 U	0.019 J
ZVI PRB + Bio	0.05 U	0.1 U	9.9 J	0.05 U	0.1 U	0.1 U	0.063 J
ZVI PRB pH 7 + Bio	0.05 U	0.1 U	9.2 J	0.05 U	0.1 U	0.1 U	0.038 U

Notes:

U = not detected above the indicated concentration

PRB = permeable reactive barrier

Injectable = iron particles at micro-scale; potentially applied through injection

Dissolved iron = 50 mg/L Iron(II) sulfate

CaSx = calcium polysulfide

mg/L = milligrams per liter

At or below action level

Approaching action level

Above action level and increase relative to control

Non-detect but detection limit greater than action level

NA = no action level

J* = half the detection limit was used for non-detect when duplicates had a detection and a non-detect.

pH adjustment testing was conducted over a 7-day test period. The native pH at Labadie was approximately pH 8.3.

1) Average of All Controls = average of all controls used in the Phase 2 testing for Labadie Energy Center

Table 7
Summary of Sioux In Situ Total Metals Removal Performance
Sioux Energy Center, Missouri

	Arsenic	Molybdenum	Boron	Lead	Cobalt	Selenium	Lithium
	mg/L						
Action Levels	0.01	0.1	4	0.015	0.006	0.05	0.040
Average of All Controls[1]	0.033 J*	2.867 J	26.7 J	0.065 J*	0.052 J*	0.083 U	0.049
pH 6	0.025 U	1.7 J	23	0.025 U	0.05 U	0.05 U	0.028 J
CaSx	0.025 U	2.7 J	21	0.025 U	0.05 U	0.05 U	0.025 J
Dissolved Iron (Anaerobic)	0.05 U	2.7	28	0.05 U	0.1 U	0.1 U	0.028 J
Dissolved Iron (Aerobic)	0.05 U	2.6	27	0.069	0.1 U	0.1 U	0.085
ZVI Injectable	0.05 U	0.1 U	23	0.05 U	0.1 U	0.1 U	0.06 U
ZVI PRB	0.05 U	0.81	26	0.05 U	0.1 U	0.1 U	0.024 J
ZVI Injectable + Bio	0.05 U	0.5 J	19 J	0.05 U	0.1 U	0.1 U	0.029 J
ZVI PRB + Bio	0.05 U	0.1 U	27 J	0.05 U	0.1 U	0.1 U	0.021 J

Notes:

U = not detected above the indicated concentration

PRB = permeable reactive barrier

Injectable = iron particles at micro-scale; potentially applied through injection

Dissolved iron = 50 mg/L Iron(II) sulfate

CaSx = calcium polysulfide

mg/L = milligrams per liter

J* = half the detection limit was used for non-detect when duplicates had a detection and a non-detect.

pH adjustment testing was conducted over a 7-day test period. The native pH at Sioux was approximately pH 7.8.

1) Average of All Controls = average of all controls used in the Phase 2 testing for Sioux Energy Center

At or below action level

Approaching action level

Above action level and increase relative to control

Non-detect but detection limit greater than action level

NA = no action level

Table 8
Summary of Preliminary Ferric Chloride Treatability Testing - Rush Island
Rush Island Energy Center, Missouri

	Arsenic			Molybdenum		
	1 hour [1]	3 hour [2]	6 hour [3]	1 hour [1]	3 hour [2]	6 hour [3]
	mg/L					
Action Level	0.03			0.1		
Total Metals						
Baseline	0.224			0.146		
20 mg/L $FeCl_3$, pH 6[4]	0.0072	0.0109	0.0126	0.0205	0.0241	0.0283
40 mg/L $FeCl_3$, pH 6[4]	0.0049	0.0059	0.0062	0.01 U	0.01 U	0.01 U
40 mg/L $FeCl_3$, pH 4[5]	0.0056	0.0085	0.0105	0.01 U	0.01 U	0.01 U
40 mg/L $FeCl_3$, 3% H_2O_2, pH 6[4,6]	0.0269	NM	NM	0.188	NM	NM

Notes:

U = not detected above the indicated concentration

mg/L = milligrams per liter

NM = not measured

$FeCl_3$ = ferric chloride

At or below action level

Approaching action level

Above action level and increase relative to baseline

Non-detect but detection limit greater than action level

1) 1 hour sample started collecting 1.5 hours after $FeCl_3$ added (flow through column started 0.5 hours after $FeCl_3$). Ended collection 3 hours after $FeCl_3$ added.

2) 3 hour sample started collecting 3.5 hours after $FeCl_3$ added. Ended collection 5 hours after $FeCl_3$ added.

3) 6 hour sample started collecting 5.5 hours after $FeCl_3$ added. Ended collection 7 hours after $FeCl_3$ added.

4) pH of 6 was the goal but after adding the $FeCl_3$, the 20 mg/L test was a pH of 4.65 and the 40 mg/L was a pH of 3.66. Did not measure the final pH of the H_2O_2 test.

5) pH of 4 was the goal but after adding the $FeCl_3$, the 0 mg/L test was a pH of 3.45.

6) this was the only sample that had a brownish tent to it in the effluent. The flocks had formed faster and seemed to settle out better than those without the H_2O_2. Bubbles noted in effluent of column.

Table 9
Summary of Ferric Chloride Continuous Flow Test - Rush Island
Rush Island Energy Center, Missouri

Sand Filter									
	Action Level	Influent	Intermediate			Effluent Sand Filter			
			19 hr	2 day	8 day*	Ave first 19 hr	19 hr	2 day	7 day
Total mg/L									
Arsenic	0.03	0.212	NM	NM	0.0288	0.0013	0.001	0.001 U	0.0107
Molybdenum	0.1	0.156	NM	NM	0.0267	0.01 U	0.01 U	0.01 U	0.0151
Lead	0.015	0.0057	NM	NM	0.0016	0.0026	0.0023	0.001 U	0.001 U
Lithium	0.0647	0.005 U	NM	NM	NM	0.005 U	0.005 U	0.005 U	NM
Iron	NA	0.0769	NM	NM	1.15	NM	NM	NM	0.299
Boron	4	4**	NM	NM	NM	NM	NM	NM	NM
Dissolved mg/L									
Arsenic	0.03	0.198	0.0019	0.0032	0.0219	0.001 U	0.001 U	0.001 U	0.0094
Molybdenum	0.1	0.144	0.01 U	0.01 U	0.0224	0.01 U	0.01 U	0.01 U	0.0136
Lead	0.015	0.0052	0.0022	0.0035	0.0014	0.0029	0.0027	0.001 U	0.001 U
Lithium	0.0647	0.005 U	0.005 U	0.005 U	NM	0.005 U	0.005 U	0.005 U	NM
Iron	NA	0.0552	NM	NM	0.831	NM	NM	NM	0.204
Boron	4	NM	NM	NM	NM	NM	NM	NM	NM

Filters - Mimic Resin Filtration Followed By Resin						
	Action Level	Influent	Effluent 100 micron filter - 3 Days	Effluent 10 micron filter - 3 Days	filter pH to 7.5 adjusted - 3 Days	Post Resin
Total mg/L						
Arsenic	0.03	0.212	0.0363	0.0023	NM	0.0016
Molybdenum	0.1	0.156	0.0257	0.01 U	NM	0.01 U
Lead	0.015	0.0057	NM	NM	NM	NM
Lithium	0.0647	0.005 U	NM	NM	NM	NM
Iron	NA	0.0769	4.41	2.69	NA	5.11
Boron	4	4**	NM	4**	NA	0.02 U
Dissolved mg/L						
Arsenic	0.03	0.198	0.0032	0.0016	0.001 U	0.0012
Molybdenum	0.1	0.144	0.01 U	0.01 U	0.01 U	0.01 U
Lead	0.015	0.0052	NM	NM	NM	NM
Lithium	0.0647	0.005 U	NM	NM	NM	NM
Iron	NA	0.0552	1.92	2.33	0.951	0.503
Boron	4	NM	NM	NM	NM	0.02 U

Notes:

U = not detected above the indicated concentration

mg/L = milligrams per liter

$FeCl_3$ = ferric chloride at 40 mg/L

NM = not measured

NA = not applicable. Not a metal of concern

hr = hour

Ave = average of the flow collected in the first 19 hours

Intermediate = collected after $FeCl_3$ has been added and mixed, and the flocculants are being settled

Rush Island water was adjusted to a pH of 5.8-6.0 prior to adding the $FeCl_3$ and had a final pH of 4.0-4.3.

Effluent water was adjusted to a pH of 6-8 prior to passing through the resin.

* = the total intermediate sample was passed through a 5 micron filter to simulate a bag filter.

** = results are internal XDD measurements using colorimetric Hach testing

At or below action level

Approaching action level

Above action level and increase relative to baseline

Non-detect but detection limit greater than action level

Table 10
Summary of pH Adjustment and Resin Column Testing - Rush Island
Rush Island Energy Center, Missouri

	Arsenic	Boron	Molybdenum
	mg/L		
Action Level	0.03	4	0.1
Total Metals			
Baseline	0.224	3.72	0.146
Day 1	0.0261	0.02 U	0.01 U
Day 3	0.0042	0.02 U	0.01 U
Day 7 - pH only	0.198	3.64	0.153
Day 7	0.0568	0.02 U	0.01 U
Dissolved Metals			
Baseline	0.211	3.39	0.14
Day 1	0.0242	0.02 U	0.01 U
Day 3	0.0032	0.02 U	0.01 U
Day 7 - pH only	0.189	3.27	0.142
Day 7	0.0525	0.02 U	0.01 U

Notes:

U = not detected above the indicated concentration

mg/L = milligrams per liter

pH was adjusted to 5

pH only = sample collected after pH adjustment and flowing through sand, but before the ion-specific resin

	At or below action level
	Approaching action level
	Above action level and increase relative to baseline
	Non-detect but detection limit greater than action level

Table 11
Summary of Zero Valent Iron Column Metals Removal - Rush Island
Rush Island Energy Center, Missouri

	Column Construction: 5 Parts Sand per 1 Part ZVI				Column Construction: 2 Parts Sand per 1 Part ZVI			
	Arsenic	**Boron**	**Iron**	**Molybdenum**	**Arsenic**	**Boron**	**Iron**	**Molybdenum**
	mg/L							
Action Level	0.03	4	--	0.1	0.03	4	--	0.1
Total Metals								
Baseline	0.195	3.84	0.0721	0.143	0.211	3.51	0.0817	0.148
Day 1	0.034	3.48	0.357	0.0954	0.0419	3.47	0.503	0.145
Day 3	0.114	3.86	0.0959	0.15	0.082	3.4	0.166	0.134
Day 7	0.113	3.9	0.15	0.151	0.089	3.51	0.11	0.143
Dissolved Metals								
Baseline	0.18	3.71	0.0614	0.139	0.212	3.47	0.0489	0.143
Day 1	0.025 U	3.117	0.047	0.0792	0.0439	3.42	0.04 U	0.143
Day 3	0.104	3.59	0.0569	0.134	0.0836	3.36	0.0702	0.133
Day 7	0.101	3.61	0.114	0.135	0.0898	3.34	0.0805	0.138

Notes:

U = not detected above the indicated concentration

ZVI = zero valent iron - micro-scale size

mg/L = milligrams per liter

At or below action level

Approaching action level

Above action level and increase relative to baseline

Non-detect but detection limit greater than action level

MEMORANDUM

To: Barbara Miller
(Ameren Missouri)

Date: January 6, 2022

From: XDD (DRAFT)

cc: Michael Marley (XDD)

RE: **Rush Island Treatability Memo**
Rush Island Energy Center
100 Big Hollow Road, Festus, MO

1.0 INTRODUCTION

XDD Environmental (XDD) was retained by Ameren Missouri (Ameren) to perform a metals treatability study for the remediation of metals of concern (MOC) from ash pond groundwater at the Rush Island Energy Center (RIEC) in Festus, MO. Groundwater is currently monitored as required by the United States Environmental Protection Agency (USEPA) in 40 CFR Part 257 "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule" (the CCR Rule), the facility's NPDES permit (No MO-000043), and the facilities UIC permit (UI-0000043). Groundwater is analyzed for metals via EPA Methods 200.7 and 200.8, alkalinity via SM Method 2320B, total dissolved solids via SM Method 2450C, ferric and ferrous iron via SM Method 3500, anions via EPA Method 300, and phosphorous via EPA Method 365.4. Based on statistical analysis, elevated levels of arsenic and molybdenum exceed site-specific groundwater protection standards (GWPS) established under the CCR Rule.

While metals cannot be destroyed, they can be susceptible to treatment and undergo changes in form to become either (a) less soluble; or (b) more sorbent and bind to particle surfaces. Both methods involve the physical removal of metals from the dissolved state (a very mobile state) to either a solid state or an adsorbed state. The three primary approaches for metals removal from groundwater are:

- Precipitation: Transformation of a dissolved species to a solid form, which can then settle out of suspension.
- Co-precipitation with other minerals: Transformation of a dissolved species to a solid form that combines with another material (such as iron), which can then settle out of suspension.
- Adsorption: Introduction or production of a solid that will absorb the MOC from the groundwater.

Where multiple metals are present, there is a potential that one metal can inadvertently affect

other metal(s) either positively (reduced dissolved concentration) or negatively (increased dissolved concentration). Therefore, a treatment chain consisting of a sequence of multiple technologies is often needed to address all metals of concern at a site. The focus of this study is on MOC which have regulatory action levels exceeded at RIEC downgradient of the ash pond.

Since the treated water will be injected into the extracted aquifer for hydraulic control, the treated water also will be required to meet groundwater permit levels for compounds such as sulfate and boron, along with the primary MOC (arsenic and molybdenum), which currently exceed permit discharge levels. The primary MOC at RIEC include arsenic and molybdenum.

This memo will address the treatability work performed for RIEC water to remove the two primary MOC along with an evaluation of sulfate and boron removal to meet the discharge permit levels. The treatability lab testing for RIEC was done in parallel with the treatability studies performed for Labadie Energy Center (LEC) and Sioux Energy Center (SEC). All three sites have overlap on treatment objectives and similar water chemistry; therefore, promising results at one site were used to guide treatment at the other two sites.

Preliminary evaluations focused on in-situ treatment options; however, due to concerns of precipitation clogging pore space thereby affecting subsurface flow conditions, along with the lack of available in-situ options for removing or stabilizing boron, the focus transitioned to ex-situ treatment options. This memo will focus on the ex-situ treatment options only. The findings presented will focus on RIEC but will include relevant results obtained from treatability tests from LEC and SEC.

2.0 TREATABILITY OBJECTIVE

The treatment objective for RIEC is to create hydraulic controls where groundwater is extracted along the flow path at the site to capture and contain the groundwater MOC plume. The water will then be treated above ground and reinjected between the extraction wells to create a hydraulic control that will minimize the extraction rate, maintain natural hydraulic flow, and prevent further migration of MOC from the ash pond groundwater. The focus of the treatability study is to remove the site MOC so that the water will meet the groundwater permit discharge levels. This will allow safe injection of the treated groundwater back into the aquifer from which it was extracted. For RIEC, the proposed treatment system must address arsenic, molybdenum, sulfate, and boron. The target discharge permit levels for these compounds are:

- arsenic = 10 micrograms per liter (µg/L)
- molybdenum = 100 µg/L
- sulfate = 250,000 µg/L
- boron = 2,000 µg/L

This memo will summarize the tests performed to address each compound, conditions under which each method was tested, how successful each remedial option was shown to be, and recommendations for full scale implementation.

2.1 Arsenic and Molybdenum

At RIEC, arsenic is the primary MOC that causes groundwater protection exceedances. The highest concentrations are greater than 10x the discharge permit limit (**Table 1**). The primary focus of arsenic removal is on its lower solubility formations at low pH ranges and its ability to coprecipitate with iron. Molybdenum is also present above permit discharge levels at RIEC with varying concentrations. Through testing, it was determined that processes shown to treat arsenic were also successful at removing molybdenum. The two MOC are therefore discussed in unison.

Tests were performed for precipitation at a pH of 5, filtering the water through zero valent iron (ZVI) columns, pH adjustment followed by ferric chloride ($FeCl_3$) precipitation, and pH adjustment followed by $FeCl_3$ and oxidative (hydrogen peroxide) precipitation.

2.1.1 pH adjustment

The pH adjustment process involved adjusting the pH of RIEC water to 5 using hydrochloric acid (HCl) followed by flow through a sand filter than a SIR-150 boron resin filter (see Section 2.2 for more information on SIR-150). Since the resin is specially designed for boron removal, it is not desirable to have the resin capacity exacerbated with high concentrations of other groundwater constituents. Samples were therefore collected prior to the resin to determine the effects of the pH adjustment to arsenic and molybdenum treatment (**Table 1, Test A,M-1**).

Groundwater samples collected between the sand filter and the resin columns showed that the pH adjustment followed by sand filtration did not effectively remove the arsenic and molybdenum in the groundwater to the discharge permit levels (**Table 1, Test A,M-1**). A further review of the data and the procedures used in this test suggests that, for pH adjustment to be successful for removing arsenic and molybdenum from RIEC groundwater, the groundwater needs to be maintained at a reduced pH for longer than 40 minutes (the residence time in the sand filter tested columns). Hence, pH adjustment alone would not be a viable ex-situ remedial approach.

2.1.2 ZVI Columns

Iron can precipitate molybdenum as a low-solubility iron-arsenic and iron-molybdenum. To test the feasibility of using a ZVI column to remove arsenic and molybdenum ex-situ, test columns were constructed using a mixture of the microscale ZVI and commercial sand. Microscale ZVI was tested

due to its highly reactive surface and increased potential to remove arsenic and molybdenum. The sand was added to allow the required flow through the ZVI column without clogging due to the microscale ZVI particle size. The columns were prepared using a 5:1 and 2:1 ratios of sand to microscale ZVI. The columns were operated for 7 days, with effluent groundwater samples collected from the column after 1, 3, and 7 days of flow.

The Day 7 results are shown on **Table 1 Tests A,M-2** (5:1 sand to ZVI ratio) and **A,M-3** (2:1 sand to ZVI ratio). The results show partial removal of arsenic and molybdenum, though not to action levels. Boron concentrations did not change passing through the ZVI columns though research suggested there may be a reduction. It was concluded that the ZVI removal effectiveness (at the design sand to ZVI dosages) was questionable, and likely not reliable as a sustainable remedial option.

2.1.3 Ferric Chloride Co-Precipitation

The ex-situ remediation method that proved most successful and reliable for arsenic and molybdenum treatment of groundwater is pH adjusted (using HCl) followed by $FeCl_3$ aided flocculation. Preliminary testing with the ZVI and pH adjustment, discussed above, helped guide the design of the $FeCl_3$ treatment train.

$FeCl_3$ testing was performed to determine reaction time needed (**Table 1 Tests A,M-4** to **A,M-12**), optimal pH ranges (**Table 1 Tests A,M-7** to **A,M-12**), optimal $FeCl_3$ dosage (**Table 1 Tests A,M-4** to **A,M-9**), and if oxidation through hydrogen peroxide addition could perform better (**Table 1 Test A,M-13**). A summary of the finding are:

- Both arsenic and molybdenum can be reduced to concentrations at or below action levels, using $FeCl_3$ addition.
- An initial pH of 6 (prior to the addition of $FeCl_3$) caused faster settling of the precipitants than an initial pH of 4.
- Higher $FeCl_3$ dosage (40 mg/L vs. 20 mg/L) provided greater removal of arsenic and molybdenum.
- The additional of hydrogen peroxide did not improve the arsenic removal efficiency.

The reaction time determined for the $FeCl_3$ coagulation and flocculation/precipitation and associated removal of arsenic and molybdenum from groundwater in the preliminary testing was adequate for the conceptual ex-situ remedial approach (an hour or less).

2.2 Boron

Resins and reverse osmosis are the primary methods used to remove boron from water sources. There is a low efficiency of treated water to wastewater using reverse osmosis, so the boron treatment has focused on resins. Three commercially available boron-removal resins were identified and tested; SIR-150, IRA-743, and PWA-10.

As discussed in Section 2.1.1, a pH of 5 adjusted water followed by a column of the SIR-150 was tested over 7 days. After 7 days of passing through the column, boron concentrations were still below the detection limit of 10 ug/L (**Table 1 Test B-1**). As shown in the sample collected between pH adjustment to 5 and the resin column (**Table 1 Test A,M-1**), arsenic and molybdenum were not treated by the pH adjustment showing that all the arsenic and molybdenum removed in **Table 1 Test B-1** is from attachment to the resin. By Day 7, arsenic began to break through and the resin showed visual discoloration.

While the resin beds in this treatability test were designed for a 15 minute residence time, when scaling the lab test to field application flow rates, the mass of resin was much larger than would be used in a site application. The breakthrough of arsenic after 7 days suggests that, given field-sized vessels, the resin utilization would be too high without pre-treatment for arsenic and molybdenum prior to resin filtration.

Subsequent testing used the procedure discussed in Section 2.1.3 prior to filtration through the resin beds. The process involved RIEC water adjusted to a pH of 6 with HCl followed by $FeCl_3$ (40 mg/L), settling, and sand filtration. The water was then passed through one of three columns containing SIR-150 (**Table 1 Test B-2**), IRA-743 (**Table 1 Test B-3**), or PWA-10 (**Table 1 Test B-4**). While all resins were capable of removing the boron and polishing the arsenic and molybdenum, SIR-150 showed the highest performance for sulfate removal. Additional temporal testing was performed on the SIR-150 and PWA-10 resins for sulfate removal along with surfactant coated zeolite (**Table 1 Tests B,S-1** to **B,S-24**). These tests are discussed further in Section 2.3.2.

2.3 Sulfate

2.3.1 Sorption and Precipitation

Sulfate can be precipitated out at high concentrations (thousands of milligrams per liter (mg/L) concentration ranges) but is difficult to reduce at lower concentrations (hundreds of mg/L concentration ranges). The primary approaches used for the lower level concentration of sulfate are reverse osmosis and resin removal. As mentioned for boron, there is a low efficiency of treated water to wastewater using reverse osmosis. The cost, maintenance, and waste stream of resins are such that it would be preferable to not rely on a second resin bed for sulfate removal which would result in a second resin waste stream. Other options discussed in literature were:

- sorption using
    - zeolite (**Table 1 Tests S-1, S-5, S-22**);
    - surfactant coated zeolite (**Table 1 Tests S-2, S-6, S-11, S-12, S-19** to **S-21**);
    - sodium chloride coated zeolite (**Table 1 Tests S-3, S-7, S-9, S-10**).
- precipitation using
    - limestone (**Table 1 Tests S-4, S-8**);
    - cement (**Table 1 Tests S-13** to **S-15**);
    - calcium hydroxide (**Table 1 Tests S-16** to **S-18**);
    - chitosan (**Table 1 Tests S-23** to **S-25**);
    - sodium aluminate (**Table 1 Test S-26**);
    - calcium aluminate (**Table 1 Test S-27**);
    - calcium aluminate cement (**Table 1 Test S-28**).

Since the success of these processes are sensitive to water quality and water chemistry (alkalinity, pH, total dissolved solids, etc.), several dosages, treatment train applications, product formulations, and pH ranges were tested to identify if there was a method to make them successful.

Of the methods and conditions tested, none were shown to greatly reduce the sulfate concentration relative to the baseline value.

2.3.2 Resin

Based on the results of RIEC pilot study which was conducted in parallel with the sulfate portion of the lab treatability testing, approximately 20% of the influent sulfate can be removed through the $FeCl_3$ coagulation/flocculation process and is removed after the sand filtration. This reduction brings the sulfate concentrations at RIEC below the discharge permit levels. In addition, the pilot study showed an average of 58% reduction in sulfate between the influent and post resin treatment (**Table 1 Tests P1** to **P20**).

Based on the lack of success of the options in Section 2.3.1 and the ability of the current proposed treatment train to treat RIEC sulfate concentrations to below discharge permit levels (250,000 µg/L), the best option would be to use the treatment train developed for arsenic and molybdenum to decrease the sulfate concentrations and then polish the water with the boron resin.

As mentioned in Section 2.2, there were three resins identified that could remove boron and preliminary results suggested that sulfate coated zeolite could reduce sulfate. Temporal testing was performed to evaluate the longevity of two of the resins (SIR-150 and PWA-10) and the surfactant

coated zeolite. Columns were constructed that were scaled to the proposed full scale vessel sizes for the lab defined flow rate and were run for 6 days. While the residence time and vessel sizing was scaled appropriately, due to water volume restraints, the surface area of vessel media to flow is an underestimate of the full scale system. Regardless, the design allowed for a comparison of the performance of the two resins and the surfactant coated zeolite. Based on the results, the SIR-150 resin (**Table 1 Tests B,S-19** to **B,S-24**) outperformed the PWA-10 resin (**Table 1 Tests B,S-1** to **B,S-6** and **B,S-13** to **B,S-18**) with lower magnitudes of breakthrough. The surfactant coated zeolite (**Table 1 Tests B,S-7** to **B,S-12**) was shown to be ineffective at treatment under the design residence times.

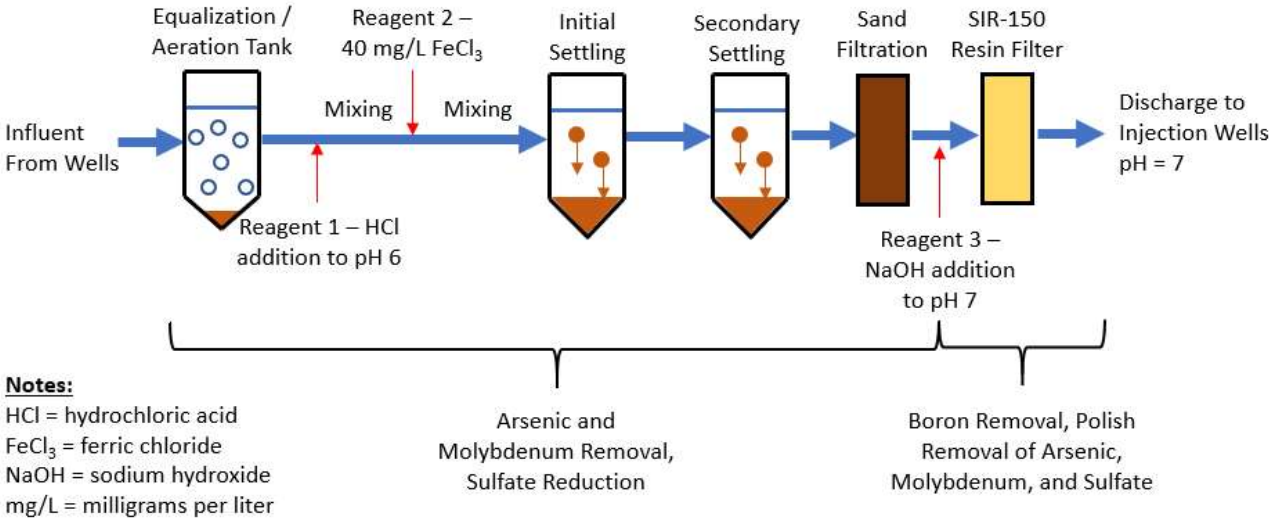
2.4 Final Design

Final temporal testing was performed with the entire treatment train operating for 7 days (pH adjustment to 6 using HCl, $FeCl_3$ addition at 40 mg/L, settling, sand filtration, and SIR-150 resin filtration). Based on additional literature research, aeration of the groundwater prior to $FeCl_3$ addition was added as a remedial step to assist in the formation of flocs. Results of these additional tests are presented in **Table 1 Test B-5**. The final design proposed in this memo was implemented for RIEC pilot study with results shown in **Table 1 Tests P-2, P-5, P-8, P-11, P-13, P-15, P-17,** and **P-20**. Key observations and conclusions from the treatability testing, pilot study, and additional $FeCl_3$ testing are:

- Aeration of the groundwater prior to the addition of $FeCl_3$ accelerates the formation of precipitants.
- The initial adjustment pH should be close to pH of 6 at RIEC for optimal arsenic and molybdenum removal and precipitant settling times.
- Higher $FeCl_3$ concentrations provided larger precipitant particles that settle faster.
- The sand filter was effective as a polishing step to remove unsettled flocs and reduce total arsenic and molybdenum concentrations to below action levels, while also decreasing total iron concentrations.
- The resin filter is needed to remove boron from the groundwater to action levels. The SIR-150 resin performed best of the resins tested. The SIR-150 resin operates optimally between a pH of 4 and 10.
- While removing boron from the groundwater, the resin also acts as a polishing tool for removal of residual arsenic, molybdenum, and additional reduction of sulfate.

The final proposed treatment design is shown in **Figure 1** below:

Figure 1: Proposed Treatment Process



Notes:
HCl = hydrochloric acid
$FeCl_3$ = ferric chloride
NaOH = sodium hydroxide
mg/L = milligrams per liter

Table 1
Summary of Rush Island Energy Center Treatability Testing
Rush Island Energy Center, Missouri

Test Condition Reference		Arsenic	Molybdenum	Sulfate	Boron
		ug/L			
	Permit Limits	10	100	250,000	2,000
	Baseline	220	160	230,000	3,850
	Average Pilot Influent	160	981	254,727	8,550
					Focus on Arsenic and Molybdenum Removal - RIEC
A,M-1	Adjust water to pH of 5 - Day 7	198	142	NM	3,270
A,M-2	Zero Valent Iron Column - 5 parts sand, 1 Part ZVI - Day 7	113	151	NM	3,900
A,M-3	Zero Valent Iron Column - 2 parts sand, 1 Part ZVI - Day 7	89	143	NM	3,510
A,M-4	Adjust water to pH 6, $FeCl_3$ (20 mg/L) - 1 hour reaction	7.2	20.5	NM	NM
A,M-5	Adjust water to pH 6, $FeCl_3$ (20 mg/L) - 3 hour reaction	10.9	24.1	NM	NM
A,M-6	Adjust water to pH 6, $FeCl_3$ (20 mg/L) - 6 hour reaction	12.6	28.3	NM	NM
A,M-7	Adjust water to pH 6, $FeCl_3$ (40 mg/L) - 1 hour reaction	4.9	<10	NM	NM
A,M-8	Adjust water to pH 6, $FeCl_3$ (40 mg/L) - 3 hour reaction	5.9	<10	NM	NM
A,M-9	Adjust water to pH 6, $FeCl_3$ (40 mg/L) - 6 hour reaction	6.2	<10	NM	NM
A,M-10	Adjust water to pH 4, $FeCl_3$ (40 mg/L) - 1 hour reaction	5.6	<10	NM	NM
A,M-11	Adjust water to pH 4, $FeCl_3$ (40 mg/L) - 3 hour reaction	8.5	<10	NM	NM
A,M-12	Adjust water to pH 4, $FeCl_3$ (40 mg/L) - 6 hour reaction	10.5	<10	NM	NM
A,M-13	Adjust water to pH 6, $FeCl_3$ (40 mg/L) and 3% H_2O_2 - 1 hour reaction	26.9	188	NM	NM
					Focus on Boron Removal - RIEC
B-1	Adjust water to pH of 5, SIR 150 Resin Column - Day 7	50.8	<20	NM	<10
B-2	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, SIR-150 Boron Resin	<5	<10	600	<10
B-3	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, IRA-743 Boron Resin	<5	<10	17,000	<10
B-4	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, PWA-10 Resin	<5	<10	4,400	<10
B-5	Adjusting water to pH of 6, $FeCl_3$ (40 mg/L), Sand Filter, SIR 150 Resin Column - System Operated 7 Days	1.6	<10	NM	<20
					Focus on Sulfate Removal - SEC
S-1	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Zeolite Filter	NM	180	380,000	14,000
S-2	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Surfactant Coated Zeolite Filter	NM	160	360,000	15,000
S-3	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, NaCl treated Zeolite Filter	NM	200	370,000	14,000
S-4	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Limestone Filter	NM	200	380,000	14,000
S-5	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, adjust to pH 10, Zeolite Filter	NM	220	390,000	14,000
S-6	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, adjust to pH 10, Surfactant Coated Zeolite Filter	NM	220	390,000	15,000
S-7	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, adjust to pH 10, NaCl treated Zeolite Filter	NM	200	360,000	13,000
S-8	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, adjust to pH 10, Limestone Filter	NM	220	390,000	14,000
S-9	Adjust water to pH6, NaCl Treated Zeolite Filter	NM	NM	430,000	1,500
S-10	NaCl Treated Zeolite Filter Only	NM	NM	420,000	1,600
S-11	Adjust water to pH 6, Surfactant Coated Zeolite Filter	NM	NM	270,000	540
S-12	Surfactant Coated Zeolite Filter Only	NM	NM	230,000	370
S-13	Adjust water to pH 6, $FeCl_3$ (80 mg/L - Bentonite to help settling), Sand Filter, 1:1 cement:sulfate molar ration (20 min mixing)	NM	NM	460,000	NM
S-14	Adjust water to pH 6, $FeCl_3$ (80 mg/L - Bentonite to help settling), Sand Filter, 1.5:1 cement:sulfate molar ration (20 min mixing)	NM	NM	470,000	NM
S-15	Adjust water to pH 6, $FeCl_3$ (80 mg/L - Bentonite to help settling), Sand Filter, 2:1 cement:sulfate molar ration (20 min mixing)	NM	NM	490,000	NM
S-16	Adjust water to pH 6, $FeCl_3$ (80 mg/L - Bentonite to help settling), Sand Filter, 1:1 $Ca(OH)_2$:sulfate molar ration (60 min mixing)	NM	NM	430,000	NM
S-17	Adjust water to pH 6, $FeCl_3$ (80 mg/L - Bentonite to help settling), Sand Filter, 3:1 $Ca(OH)_2$:sulfate molar ration (60 min mixing)	NM	NM	420,000	NM
S-18	Adjust water to pH 6, $FeCl_3$ (80 mg/L - Bentonite to help settling), Sand Filter, 5:1 $Ca(OH)_2$:sulfate molar ration (60 min mixing)	NM	NM	420,000	NM

Table 1
Summary of Rush Island Energy Center Treatability Testing
Rush Island Energy Center, Missouri

Test Condition Reference		Arsenic	Molybdenum	Sulfate	Boron
		ug/L			
	Permit Limits	10	100	250,000	2,000
	Baseline	220	160	230,000	3,850
	Average Pilot Influent	160	981	254,727	8,550
					Focus on Sulfate Removal - RIEC
S-19	DS-200 Zeolite Only	160	1,000	300,000	8,300
S-20	OC-300 Zeolite Only	150	1,100	360,000	9,100
S-21	HS-200 Zeolite Only	160	890	330,000	8,400
S-22	Clinoptilolite Zeolite Only	170	1,100	230,000	8,400
S-23	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Chitosan High MW (50 mg/L), adjust pH to 3.5, Mix for 1 hour	NM	NM	230,000	8,300
S-24	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Chitosan Medium MW (50 mg/L), adjust pH to 3.5, Mix for 1 hour	NM	NM	230,000	9,100
S-25	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Chitosan Low MW (50 mg/L), adjust pH to 3.5, Mix for 1 hour	NM	NM	230,000	9,400
S-26	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Sodium Aluminate at 2:1 molar ration with sulfate, adjust pH to 11.3, Mix for 1 hour	NM	NM	230,000	8,100
S-27	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Calcium Aluminate at 2:1 molar ration with sulfate, adjust pH to 11.3, Mix for 1 hour	NM	NM	230,000	8,200
S-28	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Calcium Aluminate Cement at 2:1 molar ration with sulfate, adjust pH to 11.3, Mix for 1 hour	NM	NM	230,000	8,100
					Focus on Sulfate and Boron Resin Removal - RIEC
B,S-1	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, PWA-10 Boron Resin - RIEC - 1 Day	<5	14	210,000	<10
B,S-2	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, PWA-10 Boron Resin - RIEC - 2 Day	<5	20	210,000	<10
B,S-3	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, PWA-10 Boron Resin - RIEC - 3 Day	<5	<10	220,000	180
B,S-4	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, PWA-10 Boron Resin - RIEC - 4 Day	<5	<10	220,000	3,400
B,S-5	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, PWA-10 Boron Resin - RIEC - 5 Day	<5	<10	220,000	7,300
B,S-6	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, PWA-10 Boron Resin - RIEC - 6 Day	<5	<10	220,000	9,100
B,S-7	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Surfactant Coated Zeolite - RIEC - 1 Day	<5	200	220,000	8,600
B,S-8	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Surfactant Coated Zeolite - RIEC - 2 Day	<5	200	220,000	9,100
B,S-9	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Surfactant Coated Zeolite - RIEC - 3 Day	<5	220	220,000	9,900
B,S-10	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Surfactant Coated Zeolite - RIEC - 4 Day	<5	220	220,000	9,400
B,S-11	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Surfactant Coated Zeolite - RIEC - 5 Day	<5	240	220,000	9,300
B,S-12	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, Surfactant Coated Zeolite - RIEC - 6 Day	<5	240	220,000	9,500
					Focus on Sulfate and Boron Resin Removal - SEC
B,S-13	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, PWA-10 Boron Resin - SEC - 1 Day	NM	<10	360,000	<10
B,S-14	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, PWA-10 Boron Resin - SEC - 2 Day	NM	<10	380,000	750
B,S-15	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, PWA-10 Boron Resin - SEC - 3 Day	NM	<10	370,000	8,600
B,S-16	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, PWA-10 Boron Resin - SEC - 4 Day	NM	<10	370,000	16,000
B,S-17	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, PWA-10 Boron Resin - SEC - 5 Day	NM	<10	380,000	19,000
B,S-18	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, PWA-10 Boron Resin - SEC - 6 Day	NM	<10	360,000	17,000
B,S-19	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, SIR-150 Boron Resin - SEC - 1 Day	NM	<10	330,000	<20
B,S-20	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, SIR-150 Boron Resin - SEC - 2 Day	NM	<10	370,000	30
B,S-21	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, SIR-150 Boron Resin - SEC - 3 Day	NM	<10	370,000	4,300
B,S-22	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, SIR-150 Boron Resin - SEC - 4 Day	NM	<10	380,000	13,000
B,S-23	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, SIR-150 Boron Resin - SEC - 5 Day	NM	<10	360,000	17,000
B,S-24	Adjust water to pH 6, $FeCl_3$ (40 mg/L), Sand Filter, SIR-150 Boron Resin - SEC - 6 Day	NM	<10	360,000	18,000

Table 1
Summary of Rush Island Energy Center Treatability Testing
Rush Island Energy Center, Missouri

Test Condition Reference		Arsenic	Molybdenum	Sulfate	Boron
		ug/L			
	Permit Limits	10	100	250,000	2,000
	Baseline	220	160	230,000	3,850
	Average Pilot Influent	160	981	254,727	8,550
					Pilot Study Results - RIEC
P-1	2/10/21 RIEC Pilot Influent	169	1,070	263,000	7,510
P-2	2/10/21 RIEC Pilot Post Resin Filter	6	14	8,000	<250
P-3	2/12/21 RIEC Pilot Influent	145	852	261,000	8,110
P-4	2/12/21 RIEC Pilot Post Sand Filter	65	349	253,000	2,230
P-5	2/12/21 RIEC Pilot Post Resin Filter	0.8	0.7	7,000	20
P-6	2/15/21 RIEC Pilot Influent	167	871	280,000	1,620
P-7	2/15/21 RIEC Pilot Post Sand Filter	16	93	228,000	7,530
P-8	2/15/21 RIEC Pilot Post Resin Filter	1	<5	63,000	<10
P-9	2/25/21 RIEC Pilot Influent	163	880	265,000	7,940
P-10	2/25/21 RIEC Pilot Post Sand Filter	33	134	237,000	NM
P-11	2/25/21 RIEC Pilot Post Resin Filter	2	10	208,000	<10
P-12	3/3/21 RIEC Pilot Influent	166	1,030	255,000	8,550
P-13	3/3/21 RIEC Pilot Post Resin Filter	8	6	212,000	<10
P-14	4/9/21 RIEC Pilot Influent	188	1,060	278,000	9,940
P-15	4/9/21 RIEC Pilot Post Resin Filter	8	33	128,000	62
P-16	5/7/21 RIEC Pilot Influent	167	946	228,000	8,710
P-17	5/7/21 RIEC Pilot Post Resin Filter	47	248	100,000	2,330
P-18	5/11/21 RIEC Pilot Influent	180	1,020	235,000	9,480
P-19	5/11/21 RIEC Pilot Post Sand Filter	<10	4	186,000	6,910
P-20	5/11/21 RIEC Pilot Post Resin Filter	98	8	136,000	NM

Notes and Abreviations:

RIEC = Rush Island Energy Center
SEC = Sioux Energy Center
NM = not measured
< = concentration is less than value
Red values exceed discharge permit limits
H_2O_2 = hydrogen peroxide
mg/L = milligrams per liter
ug/L = micrograms per liter
$Ca(OH)_2$ = calcium hydroxide
ZVI = zero valent iron
NaCl = sodium chloride
$FeCl_3$ = ferric chloride
A = arsenic treatment approach
M = molybdenum treatment approach
B = boron treatment approach
S = sulfate treatment approach
MW = molecular weight

APPENDIX E
Groundwater Extraction and Injection Well Certification Reports

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE / /

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	1-01E	06/30/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap ☐ Weep Hole

Elevation 412.63 FT.

ANNULAR SEAL

Length 50 FT.

☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:

Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH

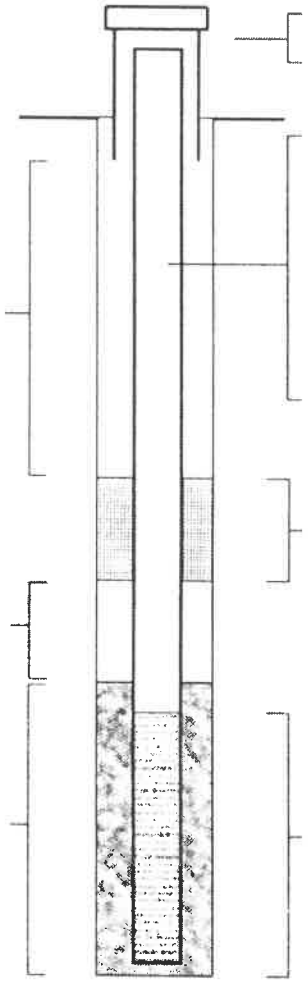
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK

58 FT.

LENGTH OF PRIMARY FILTER PACK

72 FT.



SURFACE COMPLETION

☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)

Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL

Length 5

☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN

Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)

Latitude 38 ° 7 ' 34 "
Longitude 90 ° 15 ' 26 "

SMALLEST ¼ LARGEST ¼ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)

☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)

☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	12	Silty clay to clay
12	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	1-02E	07/02/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap
☐ Weep Hole

Elevation 412.73 FT.

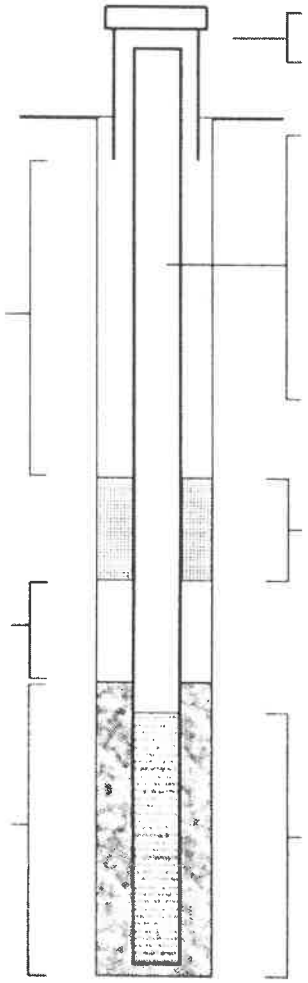
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips
☐ Pellets ☐ Granular
☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 26
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 33 "
Longitude 90 ° 15 ' 26 "

SMALLEST ¼ LARGEST ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	11	Silty clay to clay
10	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	1-03E	07/03/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap
☐ Weep Hole

Elevation 412.65 FT.

ANNULAR SEAL

Length 50 FT.

☐ Slurry ☐ Chips
☐ Pellets ☐ Granular
☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:

Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH

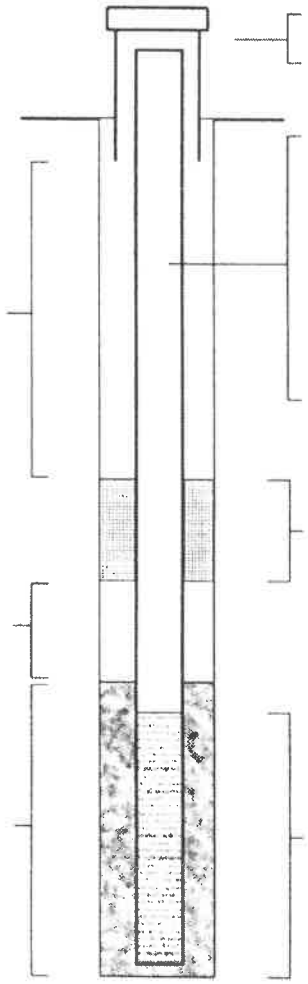
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK

58 FT.

LENGTH OF PRIMARY FILTER PACK

72 FT.



SURFACE COMPLETION

☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)

Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL

☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL

Length 5
☐ Chips ☑ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SCREEN

Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL

☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)

Latitude 38 ° 7 ' 32.5 "
Longitude 90 ° 15 ' 25 "

SMALLEST ____¼ LARGEST ____¼ ____¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)

☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)

☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	10	Silty clay to clay
10	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT. PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE / /

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314) 544-2555	1-04E	07/07/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P.O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap
☐ Weep Hole

Elevation 412.41 FT.

ANNULAR SEAL

Length 50 FT.

☐ Slurry ☐ Chips
☐ Pellets ☐ Granular
☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:

Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH

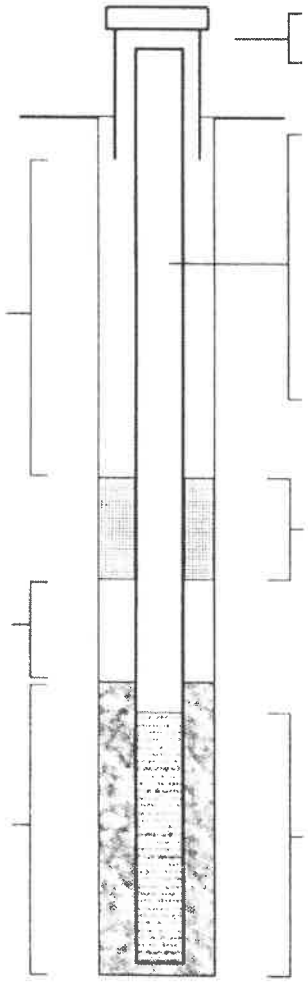
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK

58 FT.

LENGTH OF PRIMARY FILTER PACK

72 FT.



SURFACE COMPLETION

☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)

Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL

☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL

Length 5
☐ Chips ☑ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SCREEN

Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL

☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)

Latitude 38 ° 7 ' 31 "
Longitude 90 ° 15 ' 24 "

SMALLEST ¼ LARGEST ¼ ¼
Section Township North
Range ☐ E ☐ W

TYPE OF WELL (CHECK ONE)

☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)

☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	12	Silt clay to clay
12	130	Silty clay/sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

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OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	1-05E	07/08/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE
- ☑ Above Ground
- ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION
Length 2 FT.
Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED
Diameter 24 IN.
Length 2 FT.

SURFACE COMPLETION GROUT
- ☑ Concrete
- ☐ Other

☐ Locking Cap
☐ Weep Hole

Elevation 411.95 FT.

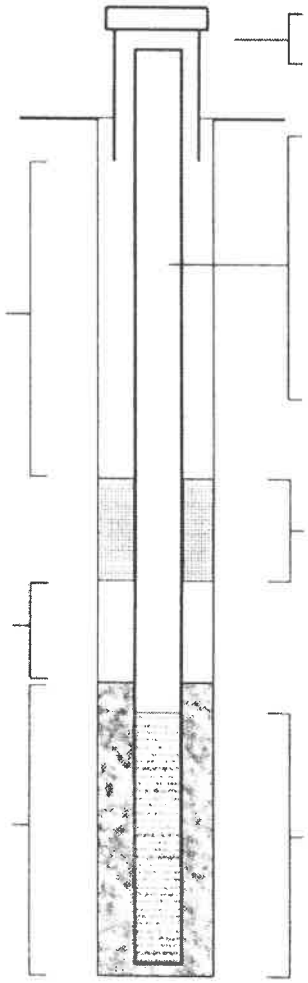
ANNULAR SEAL
Length 50 FT.
- ☐ Slurry ☐ Chips
- ☐ Pellets ☐ Granular
- ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 30.2 "
Longitude 19 ° 15 ' 24.0 "

SMALLEST ¼ LARGEST ¼ ¼
Section _____ Township _____ North
Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
- ☐ Direct Push ☑ Extraction ☐ Inclinometer
- ☐ Gas Migration ☐ Injection ☐ Lysimeter
- ☐ Observation ☐ Open Hole ☐ Other (specify)
- ☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
- ☐ Explosives ☐ Metals
- ☐ Pesticides/Herbicides ☐ Petroleum
- ☐ Radionuclides ☐ SVOCS
- ☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	11	Silty clay to clay
10	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
[signature]	003469M	07/28/2021		

MO 780-1415 (09-20)

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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

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OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	1-06E	07/09/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap ☐ Weep Hole

Elevation 411.77 FT.

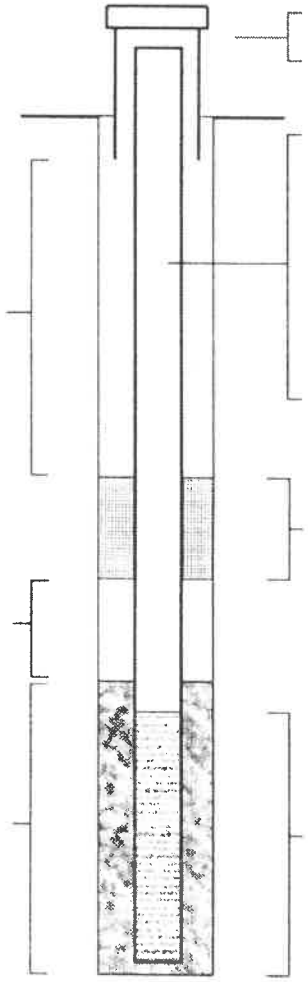
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 29.3 "
Longitude 91 ° 15 ' 23.5 "

SMALLEST ¼ ¼ ¼ LARGEST
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	12	Silty clay to clay
10	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT. PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

MO 780-1415 (09-20)

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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

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OWNER AND SITE INFORMATION

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Ameren Missouri	(314)-544-2555	1-07E	07/10/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
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NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap ☐ Weep Hole

Elevation 412.13 FT.

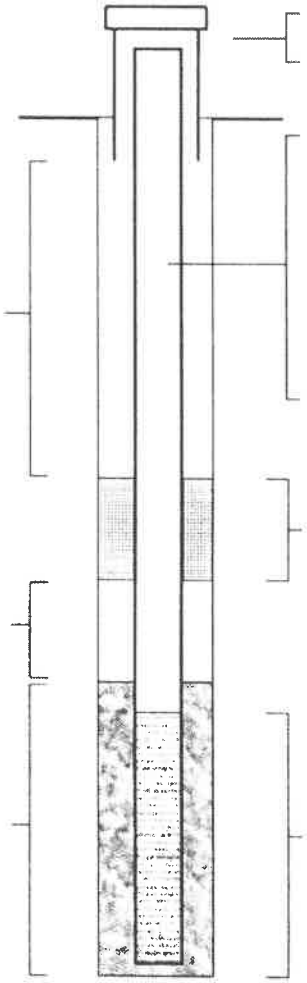
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 28.2 "
Longitude 90 ° 15 ' 22.8 "

SMALLEST ¼ LARGEST ¼ ¼
Section _____ Township _____ North
Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Silty clay to clay
10	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

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MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
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PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
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SURFACE COMPLETION

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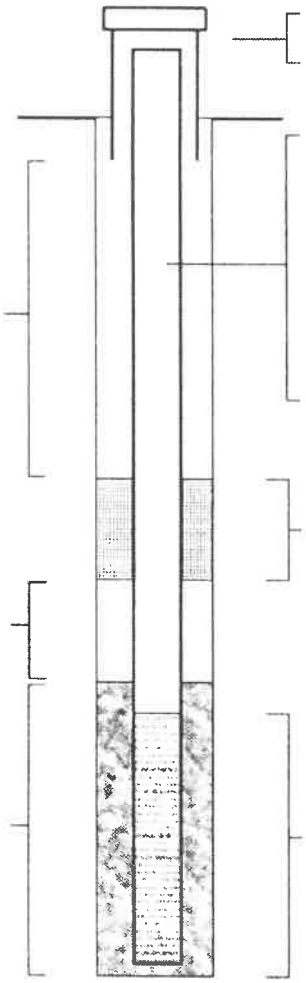
☐ Weep Hole



SURFACE COMPLETION: ☐ Steel ☐ Aluminum ☑ Plastic

Elevation 412.34 FT.

ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips
☐ Pellets ☐ Granular
☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 27.1 "
Longitude 90 ° 15 ' 22.2 "

SMALLEST ¼ LARGEST ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
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☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Silty clay to clay
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TOTAL DEPTH: 130 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.
PUMP INSTALLED: ☐ Yes ☑ No

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MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	2-09E	07/14/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap ☐ Weep Hole

Elevation 412.41 FT.

ANNULAR SEAL

Length 50 FT.

☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:

Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH

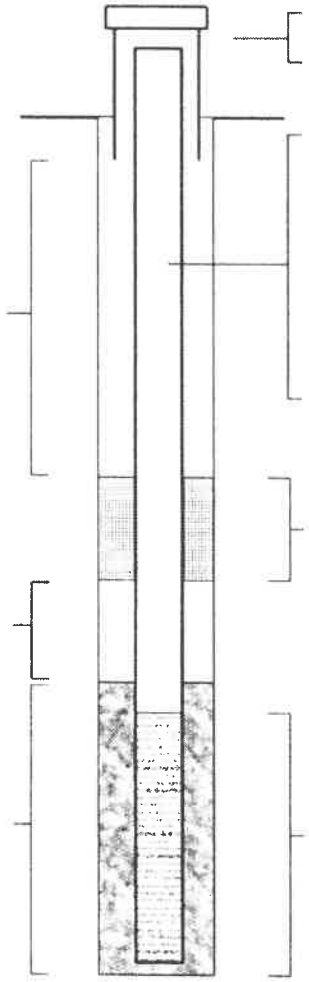
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK

58 FT.

LENGTH OF PRIMARY FILTER PACK

72 FT.



SURFACE COMPLETION

☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)

Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL

Length 5

☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN

Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)

Latitude 38 ° 7 ' 26.0 "
Longitude 90 ° 15 ' 21.5 "

SMALLEST ¼ LARGEST ¼ ¼
Section _____ Township _____ North
Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)

☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)

☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	10	Silty clay to clay
10	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

MO 780-1415 (09-20)

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GEOLOGICAL SURVEY PROGRAM

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SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

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DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap ☐ Weep Hole

Elevation 412.49 FT.

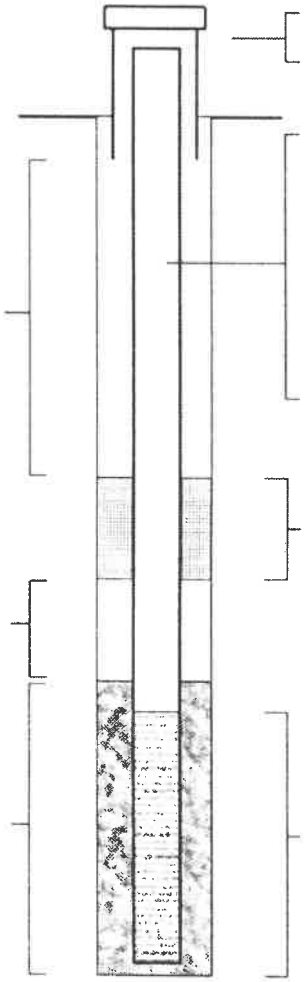
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 14
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 24.9 "
Longitude 90 ° 15 ' 20.9 "

SMALLEST ¼ LARGEST ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	10	Silty clay to clay
10	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT. PUMP INSTALLED: ☐ Yes ☑ No

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MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

MO 780-1415 (09-20)

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OWNER AND SITE INFORMATION

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Ameren Missouri	(314)-544-2555	2-11E	07/12/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
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John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap ☐ Weep Hole

Elevation 412.31 FT.

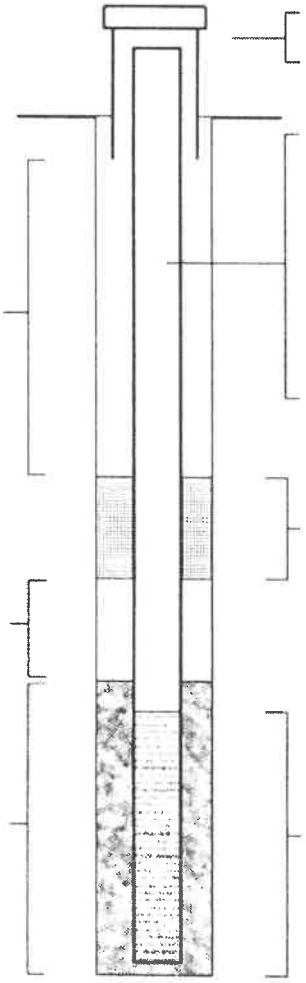
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 23.9 "
Longitude 90 ° 15 ' 20.2 "

SMALLEST ¼ LARGEST ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
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DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	11	Silty clay to clay
10	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

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[signature]	003469M	07/28/2021		

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Ameren Missouri	(314)-544-2555	2-12E	07/26/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

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DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap ☐ Weep Hole

Elevation 412.30 FT.

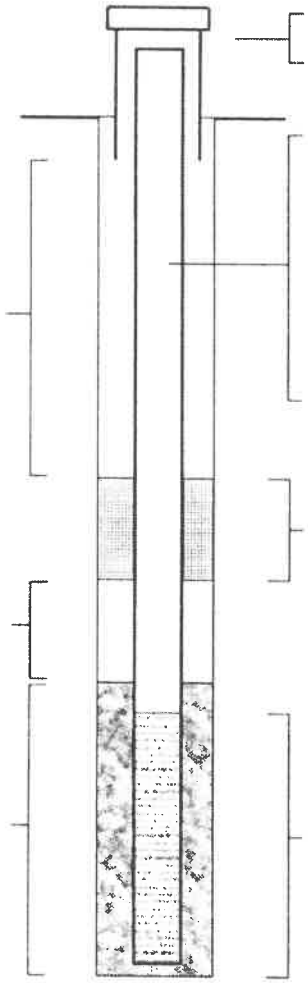
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

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For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

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Latitude 38 ° 7 ' 22.8 "
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SMALLEST ¼ LARGEST ¼ ¼
Section _____ Township _____ North
Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
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☐ Observation ☐ Open Hole ☐ Other (specify)
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MONITORING FOR (CHECK ALL THAT APPLY)
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DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	10	Silty clay to clay
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TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

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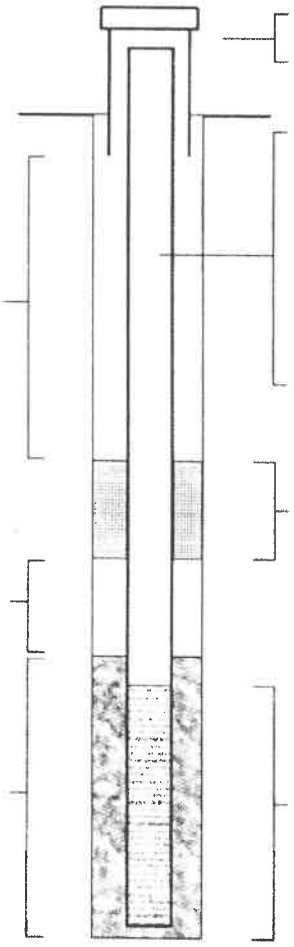

SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

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MO 780-1415 (09-20)

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GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	2-14E	07/23/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap ☐ Weep Hole

Elevation 412.03 FT.

ANNULAR SEAL

Length 50 FT.

☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:

Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH

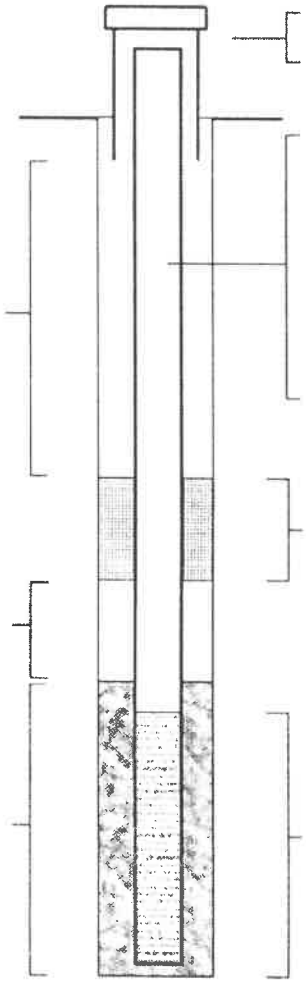
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK

58 FT.

LENGTH OF PRIMARY FILTER PACK

72 FT.



SURFACE COMPLETION

☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)

Riser/Casing Diameter 4 IN.
Riser/Casing Length 62 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL

Length 5

☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN

Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)

Latitude 38 ° 7 ' 20.7 "
Longitude 90 ° 15 ' 18.4 "

SMALLEST ¼ LARGEST ¼ ¼
Section _____ Township _____ North
Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)

☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)

☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Silty clay to clay
13	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
[signature]	003469M	07/28/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

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OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	2-15E	07/26/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap ☐ Weep Hole

Elevation 412.44 FT.

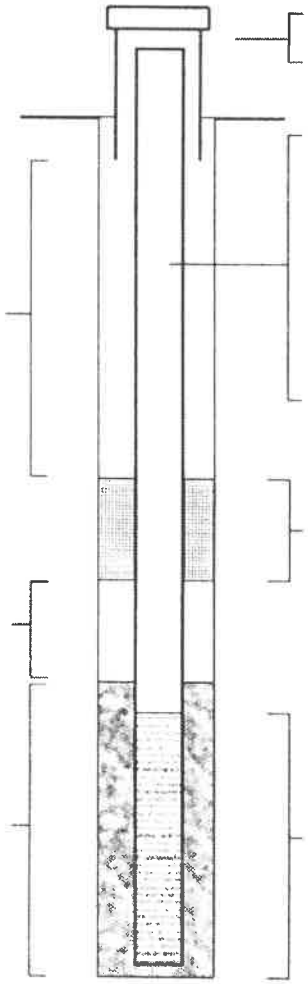
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 9
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 62 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 19.6 "
Longitude 90 ° 15 ' 17.76 "

SMALLEST ¼ LARGEST ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Silty clay to clay
13	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	09/01/2021		

MO 780-1415 (09-20)

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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

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OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	2-16E	07/27/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap
☐ Weep Hole

Elevation 412.30 FT.

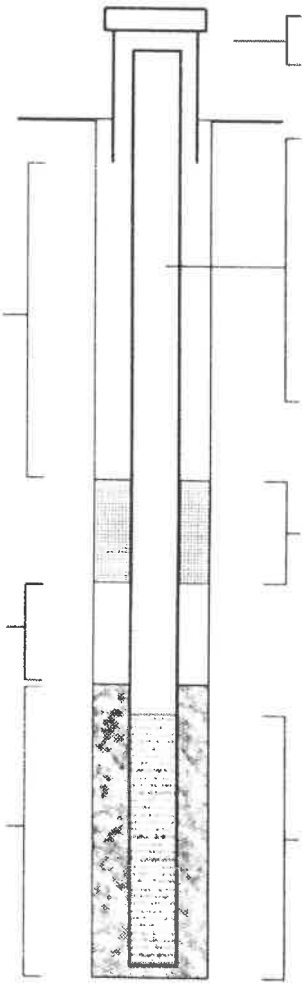
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips
☐ Pellets ☐ Granular
☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 9
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 62 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 18.6 "
Longitude 90 ° 15 ' 17.13 "

SMALLEST ¼ LARGEST ¼ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	12	Silty clay to clay
12	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.
PUMP INSTALLED: ☐ Yes ☑ No

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[signature]	003469M	07/28/2021		

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OWNER AND SITE INFORMATION

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Ameren Missouri	(314)-544-2555	3-17E	07/28/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
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LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap ☐ Weep Hole

Elevation 412.10 FT.

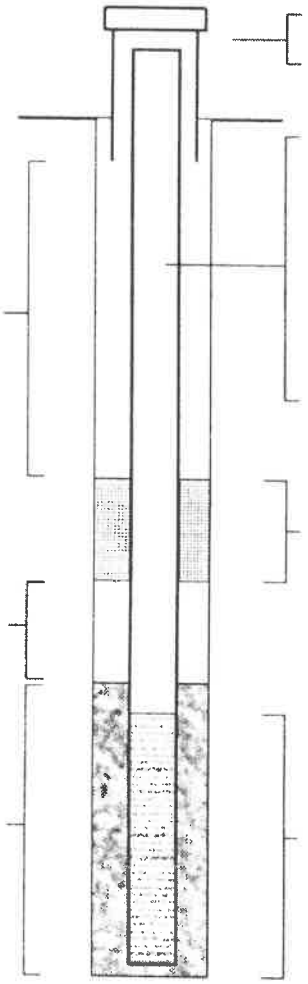
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 9
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 62 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 17.5 "
Longitude 90 ° 15 ' 16.5 "

SMALLEST ¼ LARGEST ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
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DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	12	Silty clay to clay
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TOTAL DEPTH: 130 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.
PUMP INSTALLED: ☐ Yes ☑ No

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GEOLOGICAL SURVEY PROGRAM

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PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
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Elevation 412.12 FT.

ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

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% of Bentonite Used 5
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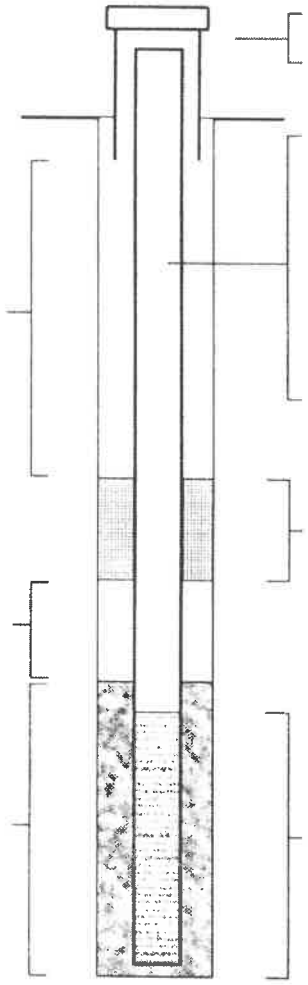

SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 62 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

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For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 16.413 "
Longitude 90 ° 15 ' 15.878 "

SMALLEST ¼ LARGEST ¼ ¼
Section _____ Township _____ North
Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
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☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
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0	13	Silty clay to clay
13	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

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MO 780-1415 (09-20)

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PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	3-19E	08/04/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap ☐ Weep Hole

Elevation 411.61 FT.

ANNULAR SEAL

Length 50 FT.

☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:

Bags of Cement Used 10
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH

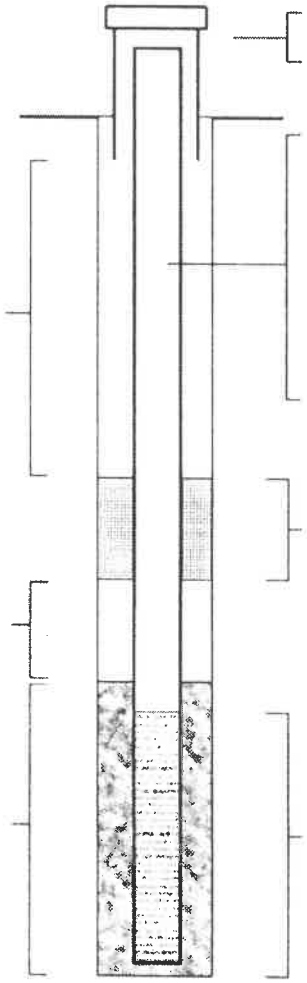
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK

57 FT.

LENGTH OF PRIMARY FILTER PACK

72 FT.



SURFACE COMPLETION

☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)

Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL

Length 5

☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN

Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 59 FT.

SCREEN MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)

Latitude 38 ° 7 ' 15.329 "
Longitude 90 ° 15 ' 15.232 "

SMALLEST ¼ LARGEST ¼ ¼
Section _____ Township _____ North
Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)

☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)

☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Silty clay to clay
13	130	Silty sand to sand with gravel

TOTAL DEPTH: 129 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	09/01/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	3-20E	08/18/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap ☐ Weep Hole

Elevation 411.75 FT.

ANNULAR SEAL

Length 50 FT.

☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:

Bags of Cement Used 8
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH

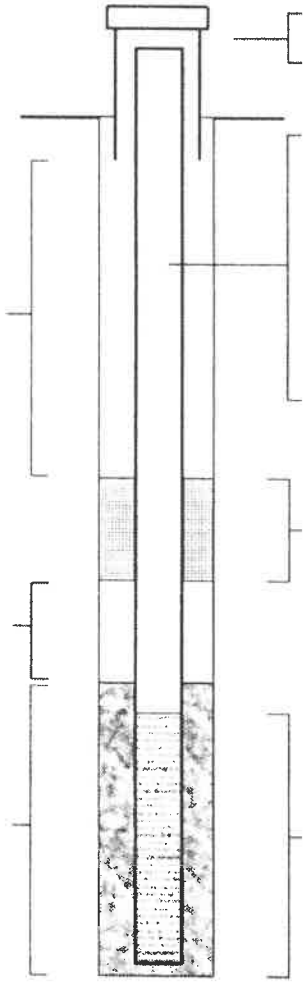
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK

58 FT.

LENGTH OF PRIMARY FILTER PACK

72 FT.



SURFACE COMPLETION

☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)

Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL

Length 5

☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN

Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)

Latitude 38 ° 7 ' 14.263 "
Longitude 90 ° 15 ' 14.67 "

SMALLEST ¼ LARGEST ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)

☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)

☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13.5	Silty clay to clay
13.5	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	09/01/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-21E	08/19/21

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap
☐ Weep Hole

Elevation 412.21 FT.

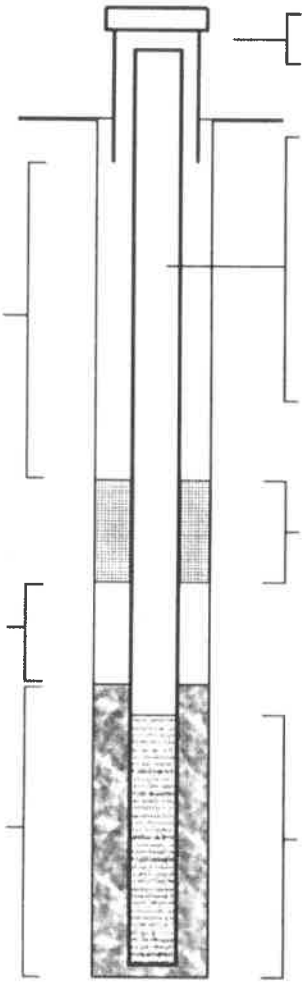
ANNULAR SEAL
Length 52 FT.
☐ Slurry ☐ Chips
☐ Pellets ☐ Granular
☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 8
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 61 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 13.1442 "
Longitude 90 ° 15 ' 14.4282 "

SMALLEST ¼ LARGEST ¼ ¼
Section _____ Township _____ North
Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13.5	Silty clay to clay
13.5	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL 47.8 FT.
PUMP INSTALLED ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
[signature]	003469M	12/10/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-22E	08/20/21

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap ☐ Weep Hole

Elevation 412 FT.

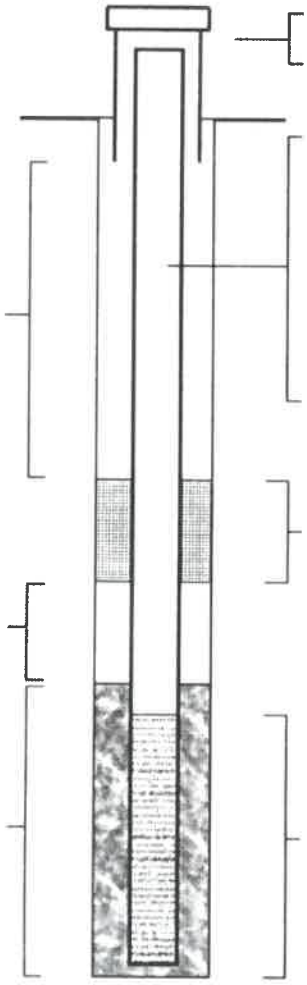
ANNULAR SEAL
Length 52 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 9
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 61 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 12.76 "
Longitude 90 ° 15 ' 14.33 "

SMALLEST ¼ LARGEST ¼ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	14	Silty clay to clay
14	130	Silty sand to sand with gravel (Wood hit at 46')

TOTAL DEPTH: 130 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: 48.2 FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
[signature]	003469M	12/10/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-23E	08/21/21

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap
☐ Weep Hole

Elevation 412.40 FT.

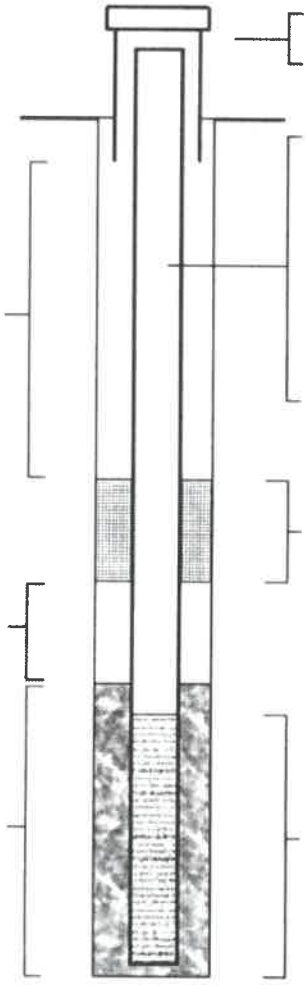
ANNULAR SEAL
Length 52 FT.
☐ Slurry ☐ Chips
☐ Pellets ☐ Granular
☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 13
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 61 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 10.8408 "
Longitude 90 ° 15 ' 14.655 "

SMALLEST ____¼ LARGEST ____¼ ____¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	14	Silty clay to clay
14	130	Silty sand to sand with gravel (Wood hit at 110' and 124')

TOTAL DEPTH: 130 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: 62.3 FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	12/10/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

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ENTERED	APPROVED	DATE	ROUTE / /

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-24E	08/24/21

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap
☐ Weep Hole

Elevation 411.96 FT.

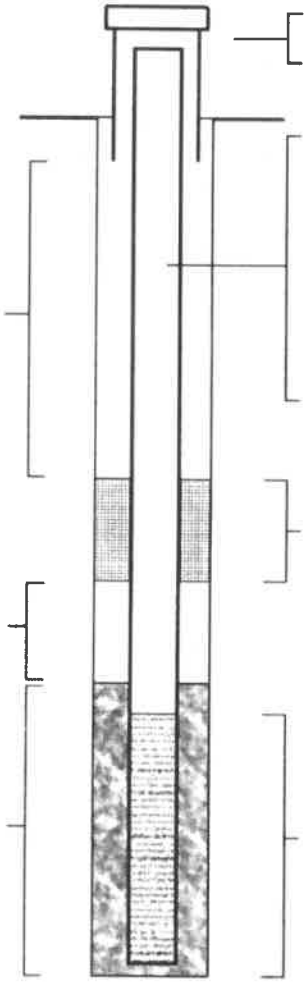
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips
☐ Pellets ☐ Granular
☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 18
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
56 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 59 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 58 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 9.6744 "
Longitude 90 ° 15 ' 14.835 "

SMALLEST ¼ LARGEST ¼ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	14	Silty clay to clay
14	128	Silty sand to sand with gravel (Wood hit at 110' and 124')

TOTAL DEPTH: 128 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: 63.9 FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	12/10/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-25E	08/25/21

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap
☐ Weep Hole

Elevation 412.03 FT.

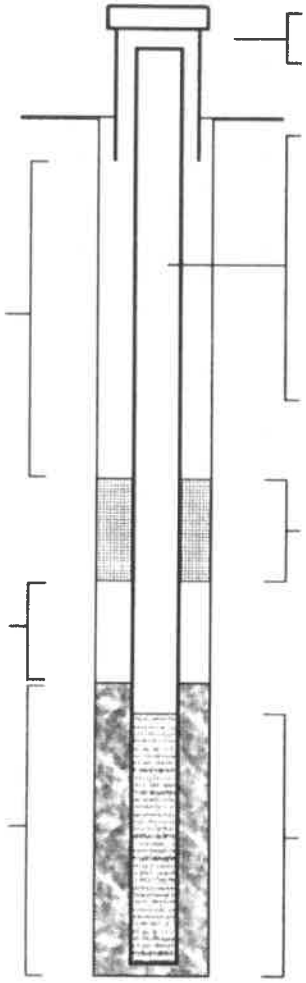
ANNULAR SEAL
Length 54 FT.
☐ Slurry ☐ Chips
☐ Pellets ☐ Granular
☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 18
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
60 FT.

LENGTH OF PRIMARY FILTER PACK
63 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 65 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 63 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 8.6262 "
Longitude 90 ° 15 ' 15.0186 "

SMALLEST ____¼ LARGEST ____¼ ____¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	14	Native to clay
14	123	Silty clay to Silty sar
		to sand with gravel
		to gravel with refusa

TOTAL DEPTH: 123 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: 48.2 FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	12/10/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-26E	09/07/21

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap
☐ Weep Hole

Elevation 412.14 FT.

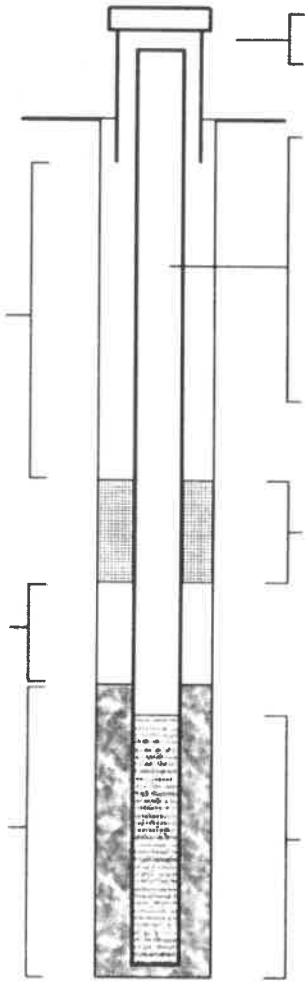
ANNULAR SEAL
Length 52 FT.
☐ Slurry ☐ Chips
☐ Pellets ☐ Granular
☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
62 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 61 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 7.3416 "
Longitude 90 ° 15 ' 15.2382 "

SMALLEST ¼ LARGEST ¼ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	14	Native to clay
14	120	Silty clay to Silty sar
		to sand with gravel
		to gravel with refusa

TOTAL DEPTH: 120 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: 48.8 FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	12/10/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

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REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-27E	09/09/21

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap
☐ Weep Hole

Elevation 411.57 FT.

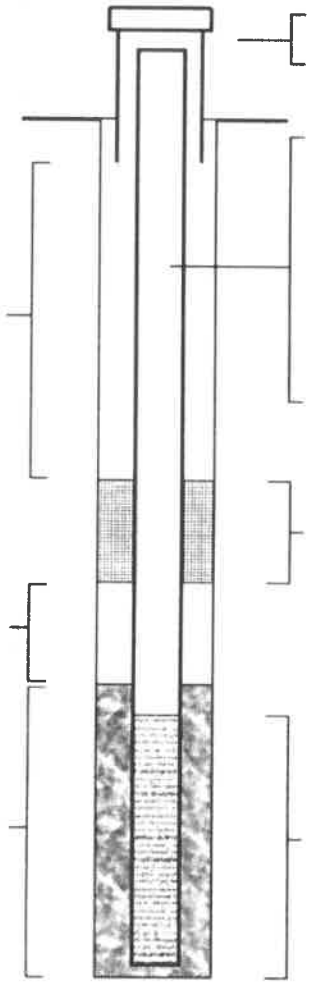
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips
☐ Pellets ☐ Granular
☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
56 FT.

LENGTH OF PRIMARY FILTER PACK
62 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 59 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 58 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 6.1572 "
Longitude 90 ° 15 ' 15.465 "

SMALLEST ¼ LARGEST ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Native to clay
13	118	Silty clay to Silty sar
		to sand with gravel
		to gravel with refusa

TOTAL DEPTH: 118 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	12/10/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-28E	09/20/21

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☑ Above Ground ☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☐ Locking Cap
☐ Weep Hole

Elevation 411.97 FT.

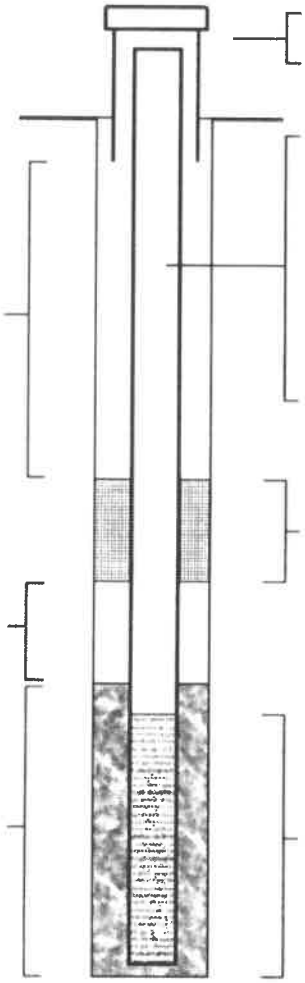
ANNULAR SEAL
Length 52 FT.
☐ Slurry ☐ Chips
☐ Pellets ☐ Granular
☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 10
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
57 FT.



SURFACE COMPLETION
☐ Steel ☐ Aluminum ☑ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 61 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 65 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)

Latitude 38 ° 7 ' 4.9758 "
Longitude 90 ° 15 ' 15.696 "

SMALLEST ¼ LARGEST ¼ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☑ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Native to clay
13	115	Silty clay to Silty sar
		to sand with gravel
		to gravel with refusa

TOTAL DEPTH: 115 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: 50.4 FT. PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
[signature]	003469M	12/10/2021		

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

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REFERENCE NO.		CHECK NO.	
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ENTERED	APPROVED	DATE	ROUTE / /

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314) 544-2555	1-01I	07/01/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P.O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE
- ☐ Above Ground
- ☑ Flush Mount
- ☑ Locking Cap
- ☐ Weep Hole

LENGTH AND DIAMETER OF SURFACE COMPLETION
- Length 2 FT.
- Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED
- Diameter 24 IN.
- Length 2 FT.

SURFACE COMPLETION GROUT
- ☑ Concrete
- ☐ Other

Elevation 409.69 FT.

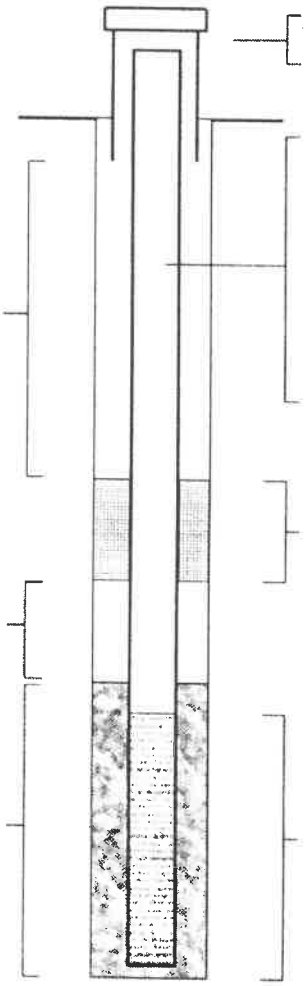
ANNULAR SEAL
- Length 50 FT.
- ☐ Slurry ☐ Chips
- ☐ Pellets ☐ Granular
- ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
- Bags of Cement Used 31
- % of Bentonite Used 5
- Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
- Riser/Casing Diameter 4 IN.
- Riser/Casing Length 60 FT.
- Diameter Of Drill Hole 9.25 IN.
- Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL
- Length 5
- ☐ Chips ☑ Pellets ☐ Granular
- ☐ Saturated Zone ☐ Hydrated

SCREEN
- Screen Diameter 4 IN.
- Screen Length 70 FT.
- Diameter Of Drill Hole 9.25 IN.
- Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
- Latitude 38 ° 7 ' 34 "
- Longitude 90 ° 15 ' 26 "

SMALLEST ¼ ¼ ¼ LARGEST
Section _____ Township _____ North
Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	10	Silt clay to clay
10	130	Silty clay/sand to sand with gravel

TOTAL DEPTH: 130 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314) 544-2555	1-02I	07/05/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P.O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 409.70 FT.

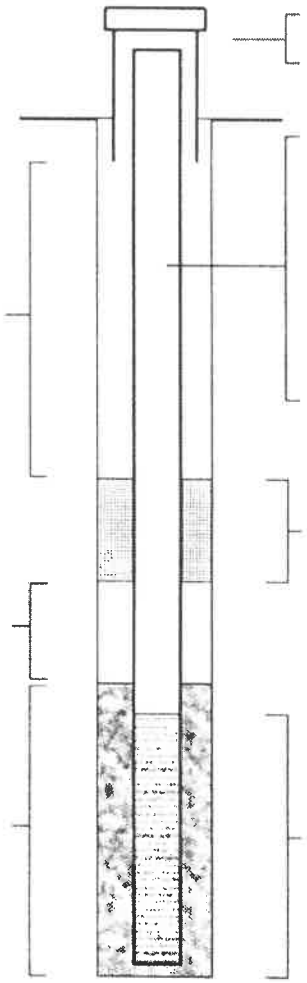
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 30
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 23 "
Longitude 90 ° 15 ' 26 "

SMALLEST ¼ LARGEST ¼ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	12	Silt clay to clay
12	130	Silty clay/sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
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PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

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OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314) 544-2555	1-03I	07/06/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P.O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

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John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 409.73 FT.

ANNULAR SEAL

Length 50 FT.

☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:

Bags of Cement Used 26

% of Bentonite Used 5

Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH

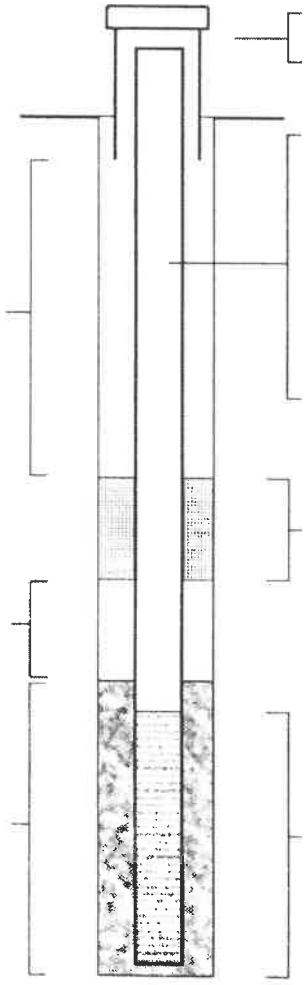
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK

58 FT.

LENGTH OF PRIMARY FILTER PACK

72 FT.



SURFACE COMPLETION

☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)

Riser/Casing Diameter 4 IN.

Riser/Casing Length 60 FT.

Diameter Of Drill Hole 9.25 IN.

Weight Or SDR# S80

MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL

Length 5

☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN

Screen Diameter 4 IN.

Screen Length 70 FT.

Diameter Of Drill Hole 9.25 IN.

Depth To Top 60 FT.

SCREEN MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)

Latitude 38 ° 7 ' 32 "

Longitude 90 ° 15 ' 25 "

SMALLEST ¼ LARGEST ¼ ¼

Section _____ Township _____ North

Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)

☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)

☐ Explosives ☐ Metals
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DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
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TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

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OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314) 544-2555	1-041	07/02/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P.O. Box 66149	St. Louis	MO	63166-6149

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Rush Island		

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John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

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SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 409.73 FT.

ANNULAR SEAL

Length 50 FT.

☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:

Bags of Cement Used 20
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SECONDARY FILTER PACK LENGTH

1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK

58 FT.

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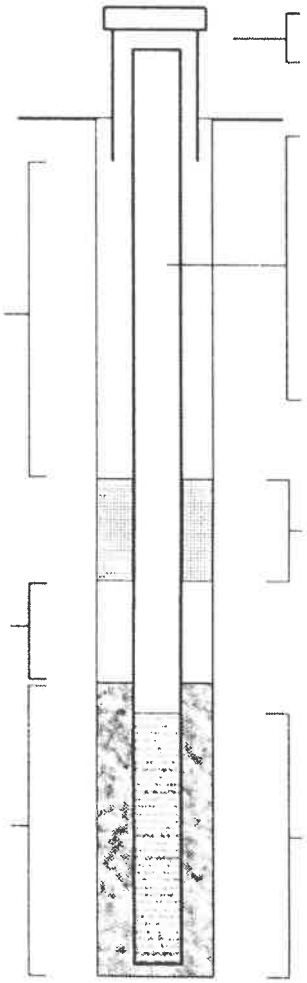
72 FT.



SURFACE COMPLETION

☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)

Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL

Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN

Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL

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LOCATION OF WELL (D/M/S FORMAT ONLY)

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☐ Direct Push ☐ Extraction ☐ Inclinometer
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☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)

☐ Explosives ☐ Metals
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DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
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TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

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MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
[signature]	003469M	07/28/2021		

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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

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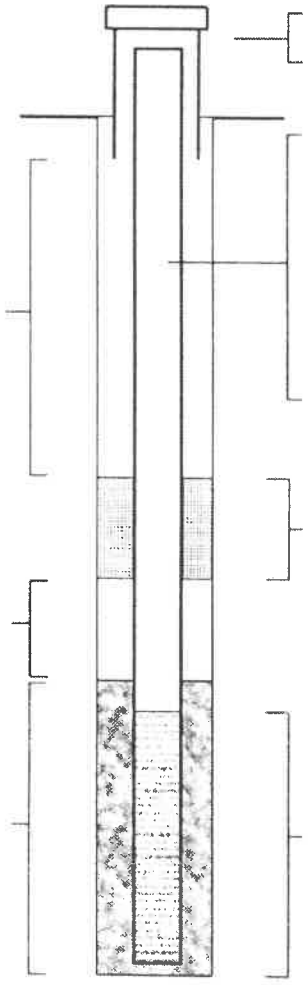

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RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
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SMALLEST ¼ LARGEST ¼ ¼
Section _____ Township _____ North
Range _____ ☐ E ☐ W

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	003469M	07/28/2021		

MO 780-1415 (09-20)

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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

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PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
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Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 409.58 FT.

ANNULAR SEAL

Length 50 FT.

☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:

Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH

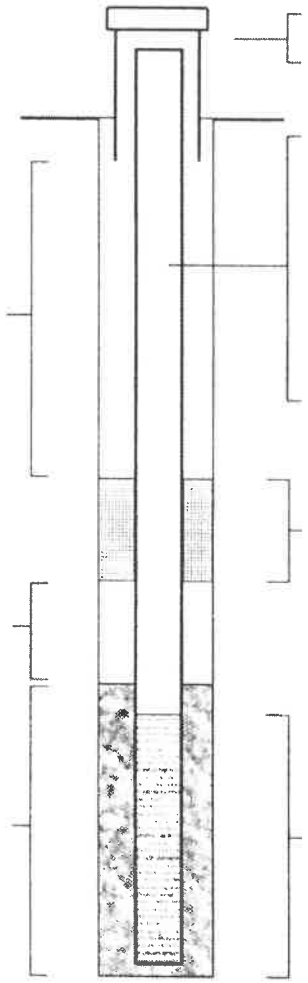
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK

58 FT.

LENGTH OF PRIMARY FILTER PACK

72 FT.



SURFACE COMPLETION

☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)

Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL

Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN

Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)

Latitude 38 ° 7 ' 28 "
Longitude 90 ° 15 ' 23 "

SMALLEST ¼ LARGEST ¼ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)

☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)

☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	11	Silt clay to clay
11	130	Silty clay/sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT. PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
[signature]	003469M	07/28/2021		

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314) 544-2555	1-07I	07/17/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P.O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 409.65 FT.

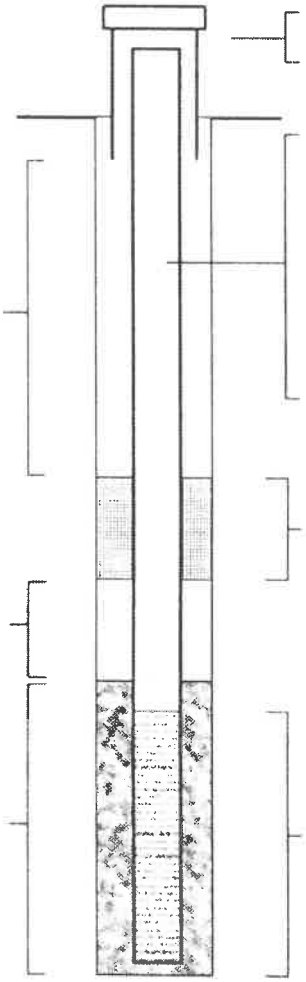
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 16
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

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SMALLEST ¼ LARGEST ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
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DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
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TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT. PUMP INSTALLED: ☐ Yes ☑ No

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MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

MO 780-1415 (09-20)

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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

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OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314) 544-2555	1-08I	07/19/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P.O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

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Length 50 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

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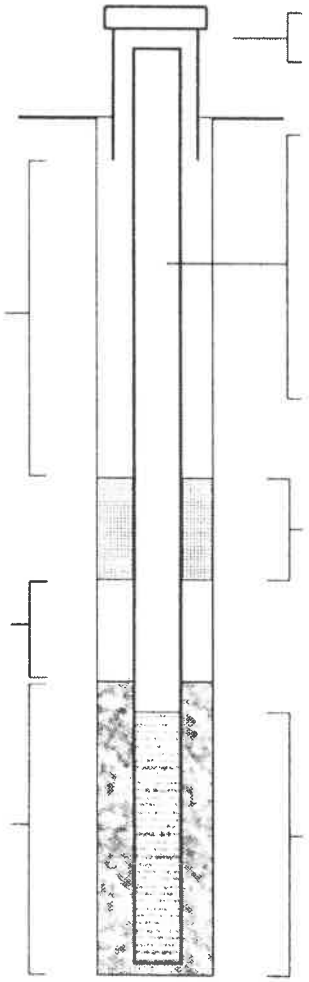
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
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SMALLEST ¼ LARGEST ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
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☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
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TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT. PUMP INSTALLED: ☐ Yes ☑ No

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MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
[signature]	003469M	07/28/2021		

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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

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OWNER AND SITE INFORMATION

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Ameren Missouri	(314) 544-2555	2-09I	07/20/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
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☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

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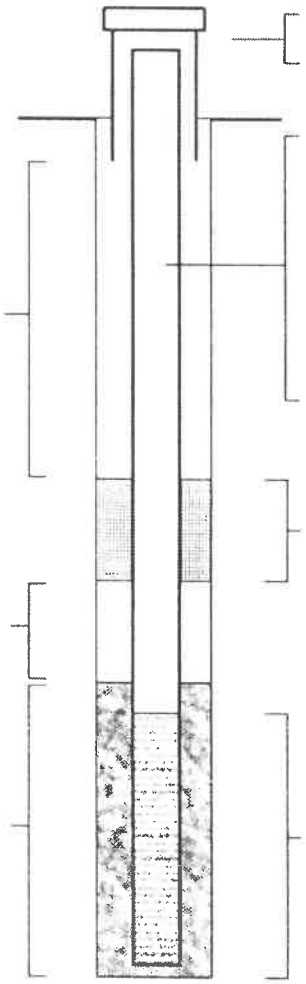

SURFACE COMPLETION
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RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
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Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
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MONITORING FOR (CHECK ALL THAT APPLY)
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TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

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MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

MO 780-1415 (09-20)

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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

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OWNER AND SITE INFORMATION

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PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
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NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
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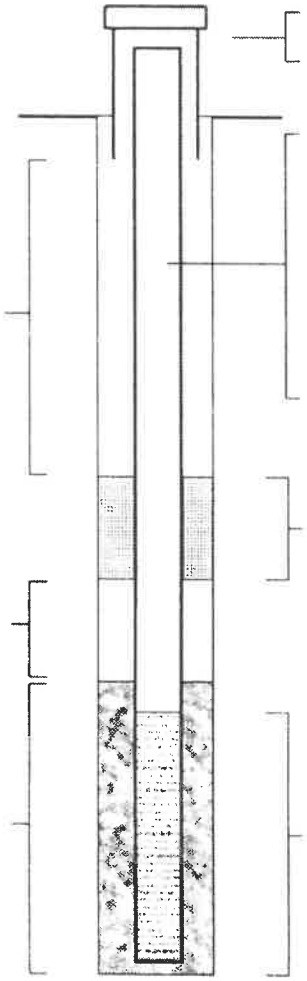

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Riser/Casing Diameter 4 IN.
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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

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ANNULAR SEAL

Length 50 FT.

☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:

Bags of Cement Used 18
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH

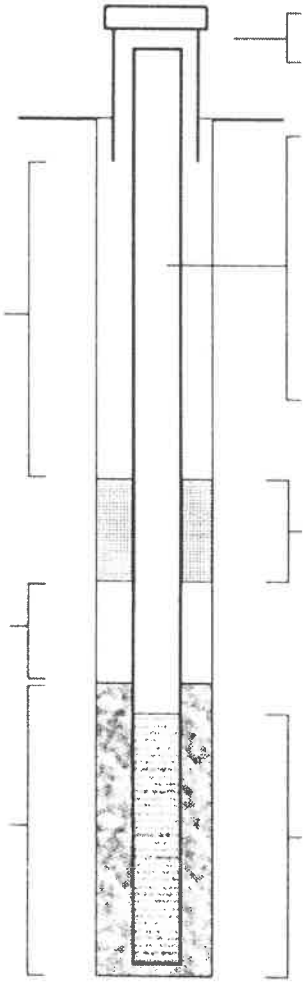
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK

58 FT.

LENGTH OF PRIMARY FILTER PACK

72 FT.



SURFACE COMPLETION

☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)

Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL

Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN

Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)

Latitude 38 ° 7 ' 23 "
Longitude 90 ° 15 ' 20 "

SMALLEST ¼ LARGEST ¼
Section Township North
Range ☐ E ☐ W

TYPE OF WELL (CHECK ONE)

☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)

☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	12	Silt clay to clay
12	130	Silty clay/sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	2-12I	07/25/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 409.07 FT.

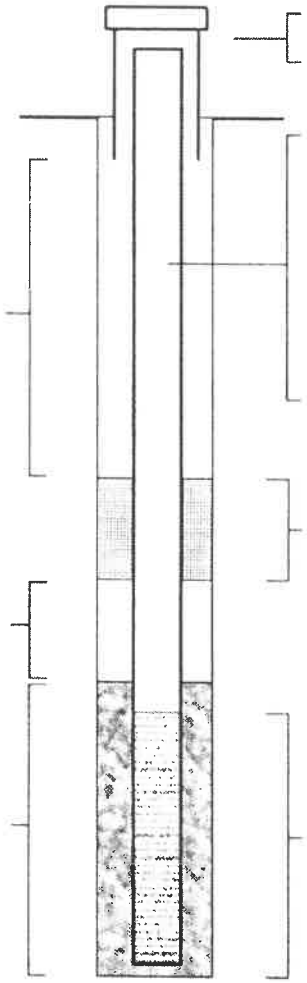
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 12
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 62 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 22.37 "
Longitude 90 ° 15 ' 19.17 "

SMALLEST ¼ LARGEST ¼ ¼
Section _____ Township _____ North
Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	12	Silty clay to clay
12	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	2-13I	07/24/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 409.70 FT.

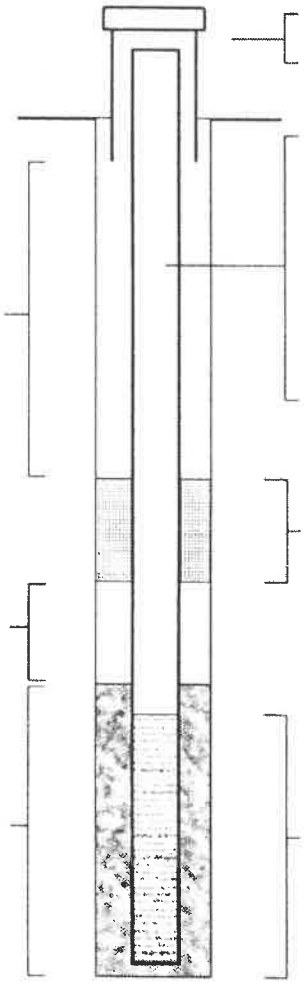
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 12
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 62 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 21.3 "
Longitude 90 ° 15 ' 18.5 "

SMALLEST ¼ LARGEST ¼ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	12.5	Silty clay to clay
12.5	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	07/28/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	2-141	07/30/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 409.61 FT.

ANNULAR SEAL

Length 50 FT.

☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:

Bags of Cement Used 12
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH

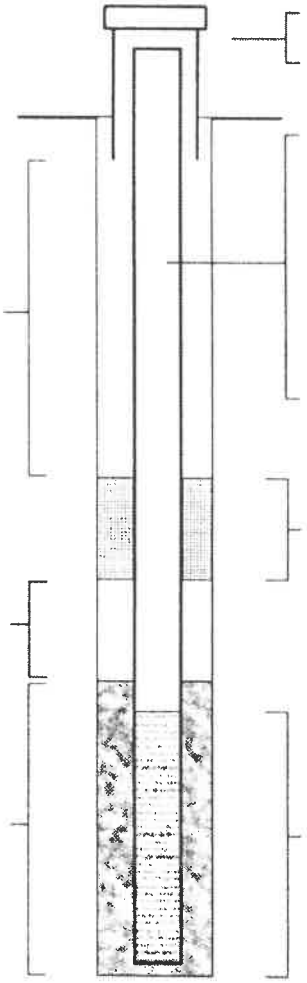
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK

58 FT.

LENGTH OF PRIMARY FILTER PACK

72 FT.



SURFACE COMPLETION

☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)

Riser/Casing Diameter 4 IN.
Riser/Casing Length 62 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL

Length 5

☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN

Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)

Latitude 38 ° 7 ' 20.2 "
Longitude 90 ° 15 ' 17.9 "

SMALLEST ____ ¼ LARGEST ____ ¼ ____ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)

☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)

☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Silty clay to clay
13	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT. PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	09/01/2021		

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	2-15I	07/31/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE
- ☐ Above Ground
- ☑ Flush Mount
- ☑ Locking Cap
- ☐ Weep Hole

LENGTH AND DIAMETER OF SURFACE COMPLETION
Length 2 FT.
Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED
Diameter 24 IN.
Length 2 FT.

SURFACE COMPLETION GROUT
- ☑ Concrete
- ☐ Other

Elevation 409.72 FT.

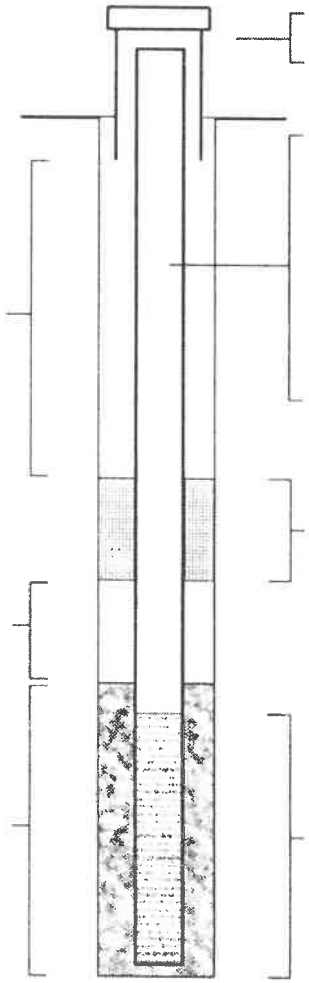
ANNULAR SEAL
Length 50 FT.
- ☐ Slurry ☐ Chips
- ☐ Pellets ☐ Granular
- ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 10
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 62 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC)
☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 19.1 "
Longitude 90 ° 15 ' 17.3 "

SMALLEST ¼ LARGEST ¼ ¼
Section _____ Township _____ North
Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
- ☐ Direct Push ☐ Extraction ☐ Inclinometer
- ☐ Gas Migration ☑ Injection ☐ Lysimeter
- ☐ Observation ☐ Open Hole ☐ Other (specify)
- ☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
- ☐ Explosives ☐ Metals
- ☐ Pesticides/Herbicides ☐ Petroleum
- ☐ Radionuclides ☐ SVOCS
- ☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	12.5	Silty clay to clay
12.5	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	09/01/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

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STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	2-16I	07/27/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 409 FT.

SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

ANNULAR SEAL
Length 52 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

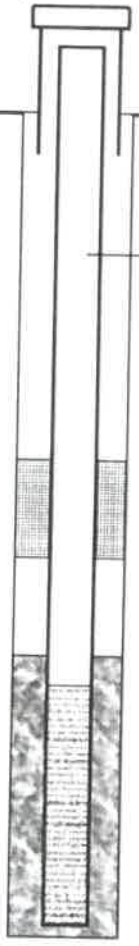
IF CEMENT/BENTONITE MIX:
Bags of Cement Used 9
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 18.069 "
Longitude 90 ° 15 ' 16.6464 "

SMALLEST ¼ LARGEST ¼ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	12	Silty clay to clay
12	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	09/01/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE / /

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	3-17I	08/02/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 409 FT.

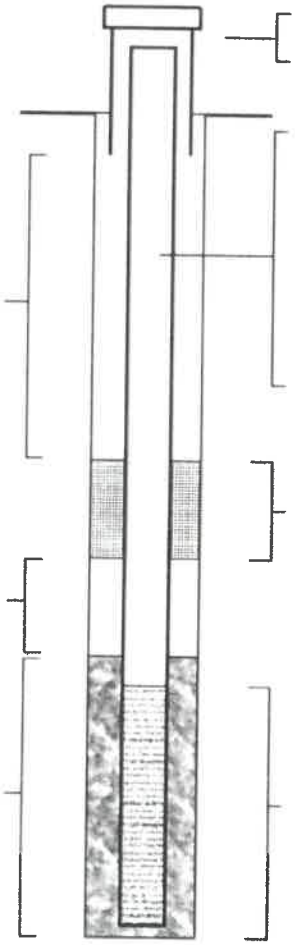
ANNULAR SEAL
Length 52 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 10
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 16.997 "
Longitude 90 ° 15 ' 16.025 "

SMALLEST ¼ LARGEST ¼ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	12.5	Silty clay to clay
12.5	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT.

☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	09/01/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE / /

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	3-18I	08/03/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 409 FT.

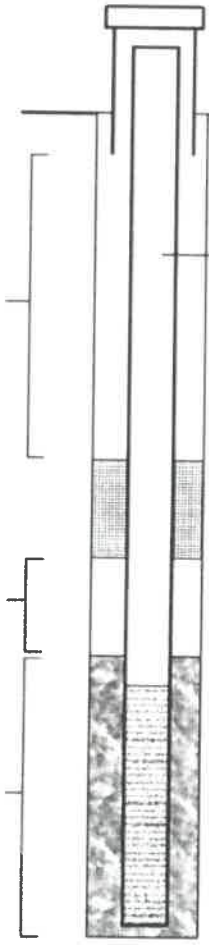
ANNULAR SEAL
Length 52 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 10
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 15.9198 "
Longitude 90 ° 15 ' 15.3792 "

SMALLEST ¼ LARGEST ¼ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Silty clay to clay
13	130	Silty sand to sand with gravel

TOTAL DEPTH: 130 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	09/01/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE / /

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	3-19I	08/05/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

SURFACE COMPLETION: ☑ Steel ☐ Aluminum ☐ Plastic

Elevation 409 FT.

ANNULAR SEAL

Length 52 FT.

☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:

Bags of Cement Used 10
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH

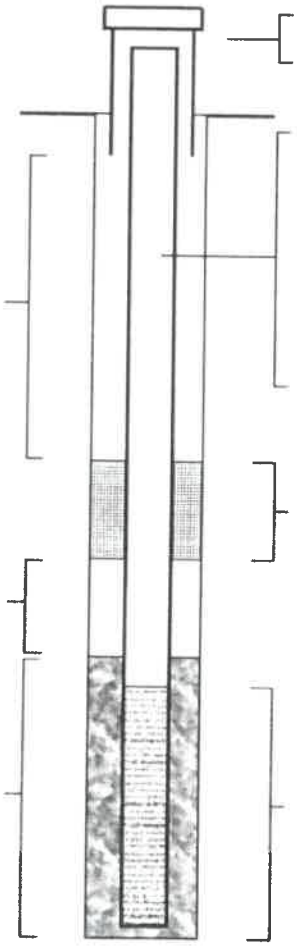
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK

58 FT.

LENGTH OF PRIMARY FILTER PACK

74 FT.



RISER OR CASING (IF OPEN HOLE COMPLETION)

Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL: ☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL

Length 5

☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN

Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL: ☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)

Latitude 38 ° 7 ' 14.851 "
Longitude 90 ° 15 ' 14.734 "

SMALLEST ¼ LARGEST ¼ ¼
Section _____ Township _____ North
Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)

☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)

☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Silty clay to clay
13	132	Silty sand to sand with gravel Heaving Sands @ 125'-130'

TOTAL DEPTH: 132 FT.

☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	09/01/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	3-20I	08/26/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 410.06 FT.

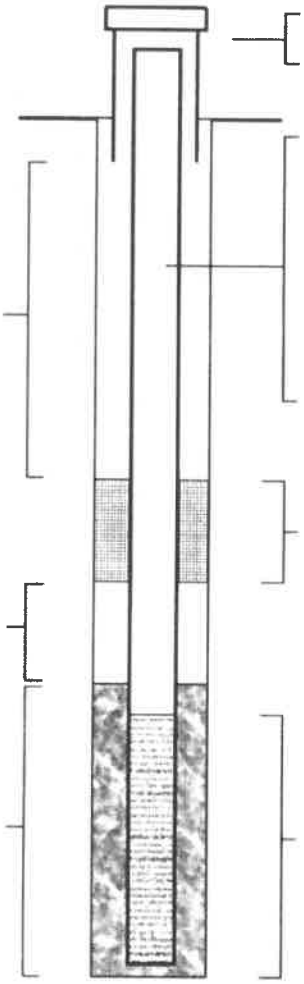
ANNULAR SEAL
Length 51 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 10
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
57 FT.

LENGTH OF PRIMARY FILTER PACK
74 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 59 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 59 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 13.7388 "
Longitude 90 ° 15 ' 14.3028 "

SMALLEST ¼ LARGEST ¼ ¼
Section _____ Township _____ North
Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Native soil to Clay
13	129	Silty clay to sand with gravel

TOTAL DEPTH: 129 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL 46.5 FT.
PUMP INSTALLED ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	12/10/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
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MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-21I	08/27/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 410.28 FT.

ANNULAR SEAL

Length 52 FT.

☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:

Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH

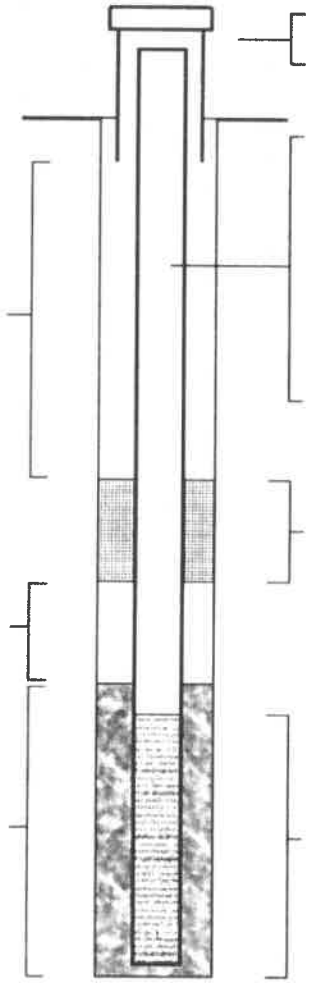
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK

58 FT.

LENGTH OF PRIMARY FILTER PACK

72 FT.



SURFACE COMPLETION

☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)

Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL

Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN

Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL

☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)

Latitude 38 ° 7 ' 12.5754 "
Longitude 90 ° 15 ' 14.1336 "

SMALLEST ¼ LARGEST ¼ ¼
Section _____ Township _____ North
Range _____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)

☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)

☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Native soil to Clay
13	130	Silty clay to sand with gravel

TOTAL DEPTH: 130 FT.

☐ *Boring Log Attached

STATIC WATER LEVEL: 48.2 FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	12/10/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE / /

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-22I	08/30/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 410.22 FT.

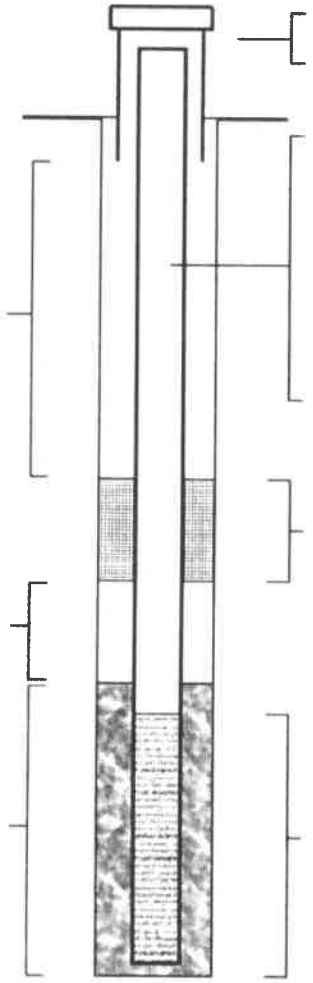
ANNULAR SEAL
Length 52 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 11.406 "
Longitude 90 ° 15 ' 14.3172 "

SMALLEST ¼ LARGEST ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Native soil to Clay
13	130	Silty clay to sand with gravel

TOTAL DEPTH: 130 FT.

☐ *Boring Log Attached

STATIC WATER LEVEL: 48.5 FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	12/10/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE / /

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-23I	09/01/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 410.08 FT.

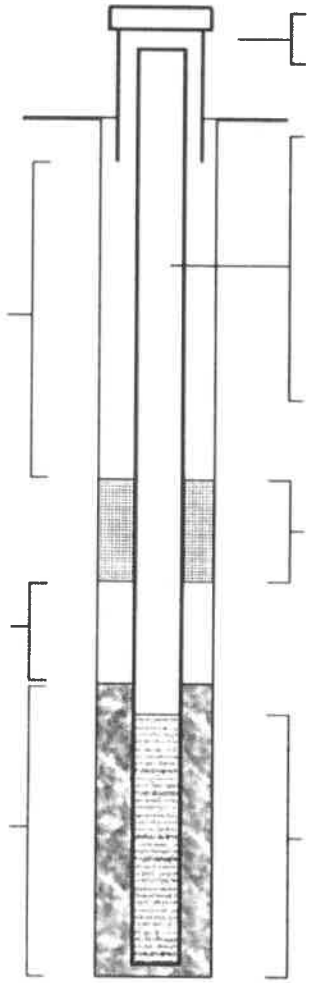
ANNULAR SEAL
Length 52 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 10.2324 "
Longitude 90 ° 15 ' 14.5188 "

SMALLEST ¼ LARGEST ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Native soil to Clay
13	130	Silty clay to sand with gravel

TOTAL DEPTH: 130 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.

PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
[signature]	003469M	12/10/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-24I	09/02/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 410.10 FT.

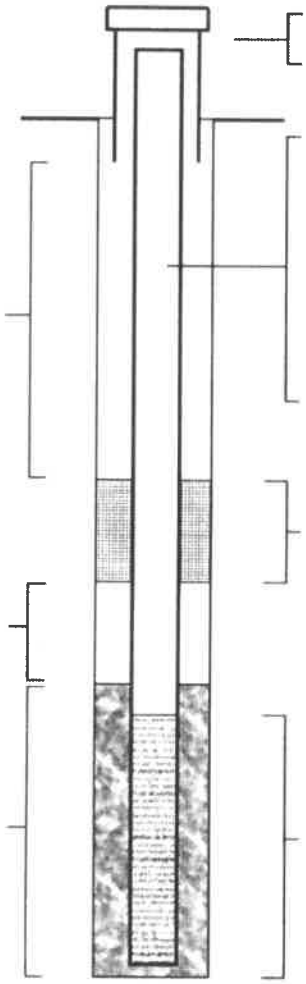
ANNULAR SEAL
Length 49 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 18
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
55 FT.

LENGTH OF PRIMARY FILTER PACK
72 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 57 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 70 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 57 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 9.0552 "
Longitude 90 ° 15 ' 14.7276 "

SMALLEST ____¼ LARGEST ____¼ ____¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Native soil to Clay
13	127	Silty clay to sand with gravel

TOTAL DEPTH: 127 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	12/10/2021		

MO 780-1415 (09-20)

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-25I	09/03/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 410 FT.

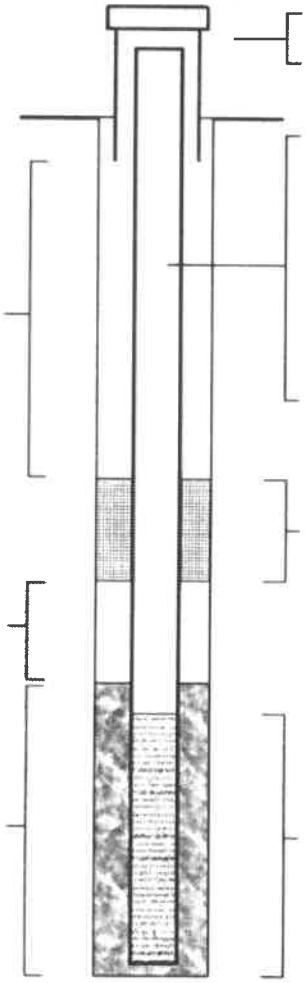
ANNULAR SEAL
Length 50 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 19
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
56 FT.

LENGTH OF PRIMARY FILTER PACK
67 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 58 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 65 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 58 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 7.8846 "
Longitude 90 ° 15 ' 14.9688 "

SMALLEST ____¼ ____¼ LARGEST ____¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Native soil to Clay
13	90	Silty clay to sand with gravel
90	123	Sand and Gravel Hard drilling lots of water

TOTAL DEPTH: 123 FT. ☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT. PUMP INSTALLED: ☐ Yes ☑ No

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
[signature]	003469M	12/10/2021		

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE / /

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-26I	09/21/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 410.06 FT.

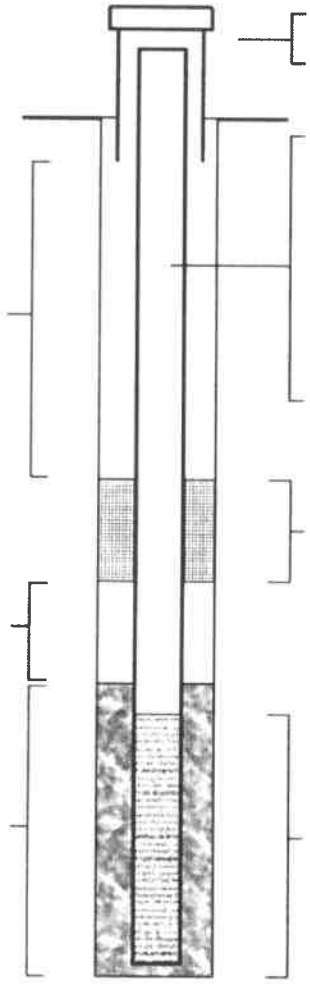
ANNULAR SEAL
Length 52 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 20
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
58 FT.

LENGTH OF PRIMARY FILTER PACK
62 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 60 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 6.711 "
Longitude 90 ° 15 ' 15.1014 "

SMALLEST ¼ LARGEST ¼ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Native soil to Clay
13	120	Silty clay to sand with gravel to Sand and Gravel Hard drilling lots of water

TOTAL DEPTH: 120 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	12/10/2021		

SEND COMPLETED FORM AND FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, PO BOX 250, ROLLA MO 65402
FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-27I	09/22/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 410.19 FT.

SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

ANNULAR SEAL
Length 49 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 57 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 16
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

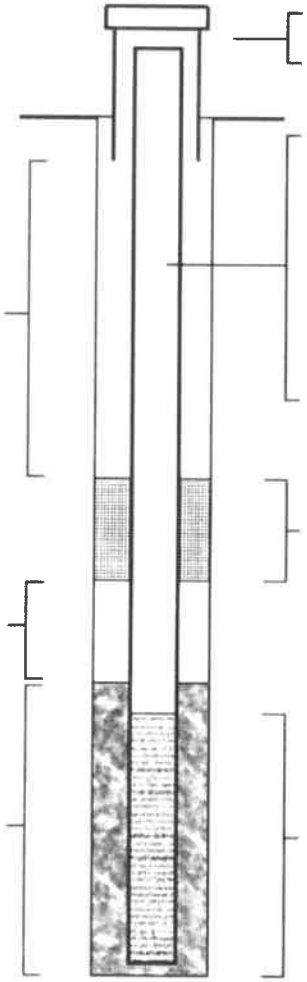
SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
55 FT.

LENGTH OF PRIMARY FILTER PACK
62 FT.

SCREEN
Screen Diameter 4 IN.
Screen Length 60 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 57 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other



For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 5.5416 "
Longitude 90 ° 15 ' 15.303 "

SMALLEST ____ ¼ ____ ¼ LARGEST ____ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13	Native soil to Clay
13	117	Silty clay to sand with gravel to Sand and Gravel Hard drilling lots of water

TOTAL DEPTH: 117 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: N/A FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	12/10/2021		

MO 780-1415 (09-20)

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FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION REPORT

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
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STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE / /

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER	WELL COMPLETION DATE
Ameren Missouri	(314)-544-2555	4-28I	09/23/2021

PROPERTY OWNER MAILING ADDRESS	CITY	STATE	ZIP CODE
One Ameren Plaza, 1901 Chouteau Avenue, P. O. Box 66149	St. Louis	MO	63166-6149

PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED	CITY	COUNTY
100 Big Hollow Road	Festus	Jefferson

NAME OF SITE, BUSINESS, OR CLEANUP PROJECT	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE)	VARIANCE NUMBER (IF ISSUED)
Rush Island		

PRIMARY CONTRACTOR NAME (PLEASE PRINT)	PERMIT NUMBER	
John C. Bostwick, R.G.	003839M	Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.

SURFACE COMPLETION

TYPE: ☐ Above Ground ☑ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION: Length 2 FT. Diameter 4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: Diameter 24 IN. Length 2 FT.

SURFACE COMPLETION GROUT: ☑ Concrete ☐ Other

☑ Locking Cap ☐ Weep Hole

Elevation 410.09 FT.

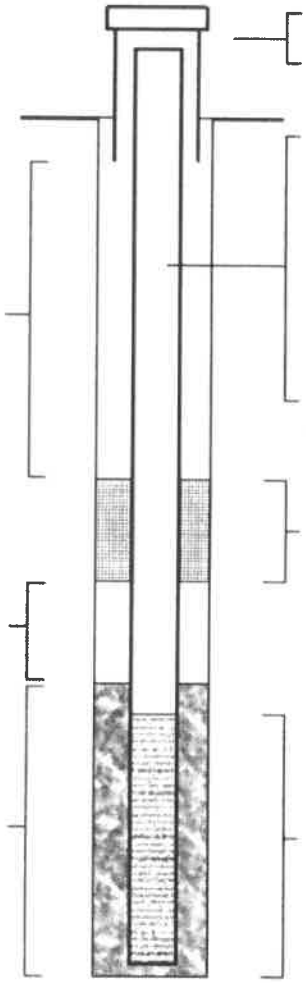
ANNULAR SEAL
Length 51 FT.
☐ Slurry ☐ Chips ☐ Pellets ☐ Granular ☑ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used 10
% of Bentonite Used 5
Water Used Per Bag 7-8 GAL.

SECONDARY FILTER PACK LENGTH
1 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
57 FT.

LENGTH OF PRIMARY FILTER PACK
57 FT.



SURFACE COMPLETION
☑ Steel ☐ Aluminum ☐ Plastic

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 4 IN.
Riser/Casing Length 59 FT.
Diameter Of Drill Hole 9.25 IN.
Weight Or SDR# S80

MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

BENTONITE SEAL
Length 5
☐ Chips ☑ Pellets ☐ Granular ☐ Saturated Zone ☐ Hydrated

SCREEN
Screen Diameter 4 IN.
Screen Length 55 FT.
Diameter Of Drill Hole 9.25 IN.
Depth To Top 59 FT.

SCREEN MATERIAL
☐ Steel ☑ Thermoplastic (PVC) ☐ Other

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 7 ' 4.3674 "
Longitude 90 ° 15 ' 15.5124 "

SMALLEST ¼ LARGEST ¼ ¼
Section ____ Township ____ North
Range ____ ☐ E ☐ W

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☑ Injection ☐ Lysimeter
☐ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer ☐ Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
0	13.5	Native soil to Clay
13.5	114	Silty clay to sand with gravel to Sand and Gravel Hard drilling lots of water

TOTAL DEPTH: 114 FT.
☐ *Boring Log Attached

STATIC WATER LEVEL: 47.5 FT.
PUMP INSTALLED: ☐ Yes ☑ No

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER	DATE	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER
	003469M	12/11/2021		

MO 780-1415 (09-20)

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FOR REGISTRATTION FEES, PLEASE SEE: https://dnr.mo.gov/pubs/pub2494.htm
PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov
RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells

APPENDIX F
2018 Risk Assessment Report

HALEY ALDRICH

www.haleyaldrich.com

REPORT ON

HUMAN HEALTH AND ECOLOGICAL ASSESSMENT OF THE RUSH ISLAND ENERGY CENTER

AMEREN MISSOURI
FESTUS, MISSOURI

by Haley & Aldrich, Inc.
Boston, Massachusetts

for Ameren Missouri
St. Louis, Missouri

File No. 130182-004
February 2018

1. Introduction

The Ameren Missouri Rush Island Energy Center ("RIEC") is a 1250 MW coal-fueled steam electrical power generating facility located along the Mississippi River below the Mississippi River bluffs near Festus, Jefferson County, Missouri. The facility has been in operation since 1976, where coal ash has been managed in an on-site impoundment, referred to as the RCPA, for more than four decades. Figure 1 shows the location of the facility, and the location of the RCPA.

The U.S. Environmental Protection Agency (USEPA) issued a final rule for "Disposal of Coal Combustion Residuals from Electric Utilities" in 2015 (the CCR Rule). One of the requirements in the CCR Rule is that utilities monitor groundwater at coal ash management facilities, and that the data be reported publicly. Ameren Missouri is complying with the CCR Rule, and has posted the required information on their publicly-available website: *https://www.ameren.com/Environment/ccr-rule-compliance*.

This Haley & Aldrich report is a companion document to the recently published 2017 Annual Groundwater Monitoring Report prepared by Golder Associates Inc. ("Golder") to provide interested reviewers with the information needed to interpret and meaningfully understand the groundwater monitoring data. Beyond the specific monitoring requirements of the CCR Rule, Ameren Missouri has also voluntarily taken the additional steps to determine if there has been any off-site impact to surface water from the operation of the RCPA. That work was presented in a 2014 AECOM report that is posted on Ameren's publicly available website: *https://www.ameren.com/Environment/managing-ccrs/ash-pond-closure*. In this report, Haley & Aldrich examines groundwater data reported under the CCR Rule, and the results of the surface water samples collected from the Mississippi River and Isle Du Bois Creek, which border the Rush Island Energy Center.

Ameren Missouri's comprehensive evaluation demonstrates that there are no adverse impacts resulting from coal ash management practices at the Rush Island Energy Center on human health or the environment from either surface water or groundwater uses. In fact, as described in Sections 6 and 7, concentration levels of constituents detected in the groundwater would need to be multiple orders of magnitude higher before such a risk could exist. Details about the evaluation are provided below.

2. Approach

The analysis presented in this report was conducted by evaluating the environmental setting of the Rush Island Energy Center, including its location and where ash management has occurred at the facility. Information on where groundwater is located at the facility, the rate(s) of groundwater flow, the direction(s) of groundwater flow, and where waterbodies may intercept groundwater flow was prepared by Golder, and is reviewed and summarized here.

A conceptual model was developed based on this physical setting information, and the model was used to identify what human populations could contact groundwater and/or surface water in the area of the facility. This information was also used to identify where ecological populations could come into contact with surface water. This conceptual model approach was used to identify where to collect surface water samples to allow evaluation of potential impact to the environment. Groundwater and surface water data are evaluated on a human health risk basis and an ecological risk basis.

Human health risk assessment is a process used to estimate the chance that contact with constituents in the environment may result in harm to people. Generally, there are four components to the process: (1) Hazard Identification, (2) Toxicity Assessment, (3) Exposure Assessment, and (4) Risk Characterization.

The USEPA develops "screening levels" of constituent concentrations in groundwater (and other media) that are considered to be protective of specific human exposures. These screening levels are referred to as "Risk-Based Screening Levels" or RSLs, and are published by USEPA and updated twice yearly[1]. In developing the screening levels, USEPA uses a specific target risk level (component 4) combined with an assumed exposure scenario (component 3) and toxicity information from USEPA (component 2) to derive an estimate of a concentration of a constituent in an environmental medium, for example groundwater, (component 1) that is protective of a person in that exposure scenario (for example, drinking water). Similarly, ecological screening levels for surface water are developed by Federal and State agencies to be protective of the wide range of potential aquatic ecological resources, or receptors.

Risk-based screening levels are designed to provide a conservative estimate of the concentration to which a receptor (human or ecological) can be exposed without experiencing adverse health effects. Due to the conservative methods used to derive risk-based screening levels, it can be assumed with reasonable certainty that concentrations below screening levels will not result in adverse health effects, and that no further evaluation is necessary. Concentrations above conservative risk-based screening levels do not necessarily indicate that a potential risk exists, but indicate that further evaluation may be warranted.

The surface water and groundwater data were evaluated using human health risk-based and ecological risk-based screening levels drawn from Federal and State sources. The screening levels are used to determine if the concentration levels of constituents could pose a risk to human health or the environment. The evaluation also considers whether constituents are present in groundwater and surface water above screening levels, and if so, if the results could be due to the ash management operations.

Conceptual Site Model

A conceptual site model is used to evaluate the potential for human or ecological exposure to constituents that may have been released to the environment. Some of the questions posed during the CSM evaluation include:

> What is the source? How can constituents be released from the source? What environmental media may be affected by constituent release? How and where do constituents travel within a medium? Is there a point where a receptor (human or ecological) could contact the constituents in the medium? Are the constituent concentrations high enough to potentially exert a toxic effect?

For the evaluation of the ash management operations at the Rush Island Energy Center, the coal ash stored in the RCPA is the potential source. Constituents present in the coal ash can be dissolved into infiltrating water (either from precipitation or from groundwater intrusion) and those constituents may then be present in shallow groundwater, also referred to as the alluvial aquifer. Constituents could move with groundwater as it flows, usually in a downgradient/downhill direction.

[1] USEPA Risk-Based Screening Levels (November 2017). http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

The constituents derived from the coal ash could then be introduced to adjacent surface water bodies; here, that could be the Mississippi River and/or Isle Du Bois Creek. Figure 1 shows the facility location and layout, and identifies direction of groundwater flow and the adjacent surface water bodies. Thus, the environmental media of interest for this evaluation are:

- Groundwater on the facility;
- Mississippi River surface water; and
- Isle Du Bois Creek surface water.

The direction of groundwater flow has been cataloged for many years at the RIEC. The direction and rate of flow can vary with Mississippi River stage but as Figure 1 shows, the direction of groundwater flow is mainly from the bluffs on the western side of the facility towards the Mississippi River, and Isle Du Bois Creek.

There are no on-site users of shallow groundwater adjacent to the RCPA. As documented in the 2014 AECOM Report, there are approximately 16 private wells recorded within a one-mile radius of the facility, and all are located west and upgradient of the facility (see Figure 2).

There are two deep water wells on facility property that are used to supply water to the RIEC. Water from these wells is used for potable purposes. These wells are approximately 1,100 feet deep, and are located upgradient and west of the RCPA (see Figure 2). They are cased to a depth of over 600 feet, and the screened interval, from which water is drawn, is located entirely in the bedrock aquifer, which is a different and deeper geologic unit than where the CCR monitoring wells are placed at the RCPA. Water from these deep wells is routed to a facility holding tank. Sampling of the holding tank is conducted according to the facility permit requirements. The results of that sampling are discussed later in this report.

Thus, with respect to the shallow aquifer, there are no users of the groundwater from that aquifer. In addition, groundwater samples from the bedrock plant water supply wells do not show evidence of CCR impacts (see discussion in Section 6).

The Mississippi River is a supply source for drinking water and the nearest public water supply intake is located approximately 30 miles downstream near City of Chester, Illinois. Isle Du Bois Creek flows into the Mississippi River but is not a source of drinking water.

The Mississippi River can be used for human recreation – wading, swimming, boating, fishing. Isle Du Bois Creek can also be used recreationally, though its small size would limit it mostly to wading.

Both the creek and the river serve as habitat for aquatic species – fish, amphibians, etc.

A depiction of the conceptual site model is shown in Figure 3.

Based on this conceptual site model and the facility setting shown in Figure 1, samples have been collected from each of these environmental media – groundwater, Mississippi River surface water, and Isle Du Bois Creek surface water. The samples have been analyzed for constituents that are commonly associated with coal ash, as discussed below. However, it is recognized by the USEPA that all of these constituents can also be naturally occurring and can be found in rocks, soils, water and sediments; thus, the challenge is to understand what the naturally occurring background levels are for these constituents. [See Attachment A for a more detailed discussion of the constituents present in coal ash and in our natural environment.] The CCR Rule requires sampling and analysis of upgradient and/or

background groundwater just for this reason. The same reasoning applies to the surface water, thus, when sampling surface water for this evaluation, samples were collected upstream to assess background conditions, and downstream to assess whether the facility may be having impact on surface water quality. The sampling is detailed in the next section.

To answer the question, "Are the constituent concentrations high enough to potentially exert a toxic effect?" health risk-based screening levels from Federal and State sources are used for comparison to the data. To be conservative, all data are compared to risk-based drinking water screening level levels, even though the closest downgradient drinking water intake is 30 miles downstream in the Mississippi River. All of the surface water data is also compared to risk-based human recreational screening levels, and to ecological screening levels.

Thus, this conceptual site model has guided the off-site sample collection, sample analysis, and the risk-based sample results evaluation that are provided in the following sections.

3. Sample Collection

Alluvial Aquifer Groundwater

Nine (9) groundwater monitoring wells were installed to evaluate shallow alluvial groundwater at the RCPA under the CCR Rule: seven monitoring wells were installed around the perimeter of the RCPA to assess groundwater conditions at the ash management area, and two monitoring wells were installed just north of the facility to assess background groundwater conditions. Figure 1 shows the locations of the monitoring wells. Each well is identified by a unique name. MW-1 through MW-7 are located around the perimeter of the RCPA, and MW-B1 and MW-B2 are the two background wells that are used to identify upgradient/background conditions in groundwater. Each groundwater monitoring well was sampled nine (9) times[2].

Bedrock Aquifer Groundwater

The deep bedrock groundwater used at the facility has been sampled from the facility holding tank for inorganics as required by MDNR 2010, 2012, 2015, and is scheduled to be sampled again in April 2018. However, to support the preparation of this report, two additional samples were collected from each of the two wells and analyzed in January 2018. The results are presented in Section 6.

Mississippi River

Surface water samples (not required by the CCR Rule for compliance) were collected by Golder from 6 locations in the Mississippi River in April 2014. These locations are shown on Figure 4. At each sample location, shallow samples were collected near the surface of the river. Where the depth of water was greater than four (4) feet, a second sample was collected mid-depth in the river.

To assess water conditions unaffected by facility operations, Golder sampled the Mississippi River at three (3) locations approximately 0.25 miles upstream of the facility (RI-R-4 through -6). Samples were collected to represent the following environments:

- Nearshore on the side closest to the Rush Island Energy Center (RI-R-4S), shallow depth;

[2] The CCR Rule requires eight (8) rounds of sampling events to establish baseline conditions in each well. Under the CCR Rule, the ninth sampling round is defined as the "Detection" sampling round.

- Midstream (RI-R-6S/M), shallow depth, and mid-depth; and
- Near midstream (RI-R-5S/M), shallow depth, and mid-depth.

Thus, a total of five (5) upstream samples were collected.

Golder also sampled three locations approximately 0.25 miles downstream of the facility (RI-R-1 through -3). The data from these locations are used to assess whether there is potential impact by the facility to river water quality. Similar to the upstream location, samples were collected to represent the following environments:

- Nearshore on the side closest to the Rush Island Energy Center (RI-R-1S), shallow depth;
- Midstream (RI-R-3S/M), shallow depth, and mid-depth; and
- Near midstream (RI-R-2S/M), shallow depth, and mid-depth.

Thus, a total of five (5) downstream samples were collected. In addition, an extra water sample was collected randomly from one of the locations, in this case an extra shallow sample was collected from the nearshore upstream location.

Isle Du Bois Creek

The Isle Du Bois Creek forms the southern border of the RIEC and is downgradient of the ash impoundment. Golder collected shallow surface water samples from nine (9) locations in the creek in April 2014. These locations are shown on Figure 4. Three locations are upstream of the facility, three locations are near the confluence of the creek with the Mississippi River, and three additional locations are midway between the upstream and downstream locations. All samples are shallow samples as the creek was not deep enough to collect a mid-depth sample. Samples were collected:

- Nearshore on the side closest to the Rush Island Energy Center;
- Midstream; and
- Near midstream.

Thus, a total of nine (9) surface water samples were collected. In addition, an extra water sample was collected randomly from one of the locations, in this case an extra shallow sample was collected from the nearshore downstream location.

4. Sample Analysis

The CCR Rule identifies the constituents that are included for groundwater testing; these are:

Boron	Antimony	Lead
Calcium	Arsenic	Lithium
Chloride	Barium	Mercury
pH	Beryllium	Molybdenum
Sulfate	Cadmium	Selenium
TDS	Chromium	Thallium
Fluoride	Cobalt	Radium 226/228

The CCR Rule requires eight (8) rounds of groundwater sampling and analysis – this was conducted for all wells to provide a baseline for current conditions. All eight rounds of groundwater samples collected

through June 2017 were analyzed for all constituents. Detection monitoring samples from an additional ninth round from November 2017 were analyzed for the constituents listed in the first column above (these are the Appendix III constituents under the CCR Rule – the remaining are referred to as Appendix IV constituents). The CCR Rule requires statistical methods be used to determine whether a statistically significant increase (SSI) above background exists for the first column constituents. If so, additional assessment monitoring could be required.

So as to create an appropriate dataset for comparison, the above parameters were also used for the surface water sample analysis except for chloride, TDS, lithium, and radium 226/228[3]. Two sets of analyses were conducted on the surface water samples. The samples were analyzed for the list above (referred to as the "total (unfiltered)" results), and then an aliquot of each sample was filtered to remove sediments/particulates and then analyzed (referred to as the "dissolved (filtered)" results). This is an important step for the analysis of surface water samples for two reasons:

- Surface water, especially in large rivers, can carry a large sediment load – the total (unfiltered results) include constituent concentrations that are associated with the sediment from upstream locations and not the water; and
- Some of the ecological screening levels used to evaluate the results apply only to dissolved (filtered) data.

The surface water samples were also analyzed for hardness, as some of the ecological screening levels are calculated based on site-specific hardness levels.

5. Risk-Based Screening Levels

A comprehensive set of risk-based screening levels have been compiled for this evaluation for the three types of potential exposures identified in the conceptual site model discussion above:

- Human health drinking water consumption;
- Human health recreational use of surface water; and
- Aquatic ecological receptors for surface water.

Table 1 provides the human health drinking water and recreational screening levels available from the State of Missouri sources and from Federal sources. Table 2 (Mississippi River) and Table 3 (Isle Du Bois Creek) provide the ecological screening levels.

Drinking Water Screening Levels

The Missouri State drinking water supply levels are essentially the same as the Federal primary drinking water standards, also known as Maximum Contaminant Levels or MCLs. The Missouri State groundwater screening levels provide some additional screening levels not included on their list of drinking water screening levels.

[3] Radium was not included in the surface water sampling as it was not detected in the facility's NPDES Outfall 002 samples. As discussed in Section 6, neither chloride nor TDS exhibited SSIs for the CCR Rule monitoring, and while lithium was detected above risk-based screening levels in one CCR Rule monitoring well (MW-4), those concentrations were lower than in the background well (MW-B1). Such locations are selected intentionally so as to avoid potential CCR impacts, and the presence of constituents in a background well is indicative of naturally occurring conditions.

In addition to the MCLs that are enforceable for municipal drinking water supplies, there are Federal secondary MCLs, or SMCLs, that are generally based on aesthetics (taste, color) and are not risk-based. The USEPA also provides risk-based screening levels (RSLs) for tapwater (drinking water).

The selected screening levels used to evaluate potential drinking water exposures are shown on Table 1. Missouri drinking water supply screening levels were used and supplemented with Federal MCLs, then the USEPA risk-based levels for tapwater (RSLs), and finally the Federal SMCLs.

It is important to note that the CCR Rule limits the evaluation of groundwater monitoring data of ash management areas to Federal MCLs or to a comparison with site-specific background. That comparison and evaluation is provided in the CCR Rule Groundwater Monitoring Report prepared by Golder, which this report supplements. The use of a more comprehensive set of screening levels in this evaluation provides a broader risk-based evaluation of the groundwater data than would be provided by the CCR Rule requirements.

Recreational Screening Levels

Table 1 provides the State of Missouri human health recreational screening levels, based on fish consumption. The Federal Ambient Water Quality Criteria (AWQC) for consumption of organisms are also provided. Both sources were used to identify the screening levels used in this analysis, as listed on Table 1. The drinking water screening levels used to evaluate surface water are protective for other recreational uses of the river such as swimming, wading, and boating. Note that this evaluation of other uses of surface water are above and beyond the requirements of the CCR Rule.

Ecological Screening Levels

The ecological risk-based screening levels for surface water are provided in Tables 2 and 3. As noted above, some of the screening levels are based on the hardness of the water. Therefore, Table 2 provides the screening levels for the Mississippi River based on its hardness data, and Table 3 provides the screening levels for Isle Du Bois Creek based on its hardness data. Note that this ecological evaluation of surface water is above and beyond the requirements of the CCR Rule.

6. Results

The level of analysis and comparison to risk-based screening levels presented below is above and beyond the requirements of the CCR Rule. The analysis of the groundwater results required by the CCR Rule is presented in the 2017 Groundwater Monitoring Annual Report: *https://www.ameren.com/Environment/managing-ccrs/ash-pond-closure*. This report serves to supplement that report by providing the risk-based analysis of groundwater and surface water, so that the groundwater results can be understood in their broader environmental context.

Alluvial Aquifer Groundwater – CCR Rule Evaluation

Ameren Missouri has filed on its website reports and notification required by the federal CCR Rule, as noted above, and additional reports will be prepared and posted on Ameren's website per the CCR Rule. The statistical analysis of the data has indicated an SSI for samples collected from monitoring wells MW-1, MW-2, MW-3, MW-4, MW-6, and MW-7 (see Figure 1) that monitor the shallow alluvial aquifer. Analytes exhibiting an SSI are a subset of the parameters identified in Section 4 and include pH, boron, fluoride, and sulfate.

The SSI values reflect a statistical evaluation that compares mathematically the results of the various rounds of samples to background water quality as required under the CCR rule. However, such values without further evaluation do not establish that there is an actual adverse impact to human health or the environment. The CSM process and screening analysis described in this report provides the relevant context for such groundwater monitoring results and whether the RCPA poses a true risk to human health and the environment. As explained in the remaining sections of this report, based upon surface water sampling data and the application of risk assessment principles uniformly adopted by USEPA and state environmental regulators including the Missouri Department of Natural Resources (MDNR), no such risk exists.

Alluvial Aquifer Groundwater – Risk-Based Evaluation

Groundwater data from all nine rounds of the shallow alluvial aquifer groundwater monitoring were compared to the human health risk-based drinking water screening levels required by the CCR Rule and those beyond the CCR Rule. Figure 1 shows that the monitoring wells are all located at the edge of the RCPA and, therefore, provide worst-case groundwater results.

Table 4 compares the results of all sampling rounds to human health drinking water screening levels. Analytical results greater than the screening level are provided; analytical results below the risk-based drinking water screening levels are indicated by "<". The vast majority of the results indicate concentration levels below the human health risk-based drinking water screening levels.

A limited number of parameters are above screening values for some, but not all, sampling events. MW-2 and MW-3 have the most results above the screening levels: these are for boron, pH, TDS, arsenic, and molybdenum. MW-4 also has a majority of results for boron, lithium and molybdenum above the screening levels.

The TDS (total dissolved solids) levels in MW-1, MW-2, and MW-3 are similar to the TDS levels above the screening level in background well BW-1. Similarly, the lithium levels in MW-4 are similar to the lithium levels above the screening level in background well BW-1. In fact, the highest level of lithium measured in any sample was in background monitoring well BW-1 (0.0647 mg/L). More detailed comparisons to background levels are provided in the CCR groundwater monitoring report.

The striking aspect of the analysis shown in Table 4 is how few results are above a conservative risk-based drinking water screening level for human health, given that the wells are located at the base of the ash management area, and the facility has been in operation for over 40 years[4]. Even for the very few results that may be above screening values for some of the sampling events, including the SSI results identified under the CCR Rule, there is no complete drinking water exposure pathway to groundwater. Where there is no exposure, there is no risk.

Bedrock Aquifer Groundwater – Risk-Based Evaluation

Table 13 provides the analytical results from groundwater samples collected from the two deep on-site water supply wells. The data are from 2010, 2012, 2015, and a sample collected in January 2018. The results indicate that chloride and TDS are above drinking water risk-based screening levels. Lithium is present at a concentration above the risk-based drinking water screening level, and the concentrations are higher than in the CCR well MW-4 and higher than in the CCR background well MW-B1. Boron and

[4] Out of the 1566 groundwater analyses conducted, only 152 results are above a drinking water screening level (see Table 4). Put another way, approximately 90% of the groundwater results for the CCR Rule monitoring wells located at the edge of the RCPA are below drinking water screening levels.

sulfate concentrations in the deep water supply wells are negligible, demonstrating that these wells are not affected by facility coal ash management operations[5].

Mississippi River

The comparison to risk-based screening levels of the analytical results for the Mississippi River are presented in Tables 5 through 7.

- Table 5 – Comparison to drinking water screening levels – No results are above risk-based screening levels for drinking water with the exception of pH; the pH results upstream and downstream are similar, thus, indicative of normal river conditions.
- Table 6 – Comparison to human health recreational screening levels – Only pH and total and dissolved concentrations of arsenic are above their screening levels. As described below, both the arsenic and pH results upstream and downstream are similar, thus, indicative of normal river conditions.
- Table 7 – Comparison to ecological screening levels – No results are above risk-based ecological screening levels with the exception of pH; the pH results upstream and downstream are similar, thus, indicative of normal river conditions.

There are no analytical results for the Mississippi River that above drinking water screening levels. While some of the pH results are outside of the human health recreational and ecological screening level range, the pH results are similar upstream and downstream.

Similarly, while arsenic concentrations in the river are slightly above the human health recreational screening levels, the concentrations are similar upstream and downstream indicating that the facility is not the source of the arsenic detected in the river. In fact, the concentrations of arsenic in all of the rivers sampled by Ameren for this evaluation (the Mississippi at Sioux, Meramec, and Rush Island; the Missouri River at Labadie and Sioux; and the Meramec River at Meramec) are all very similar with total results ranging from 0.0012 to 0.005 mg/L. This underscores the fact that arsenic is naturally occurring in our environment, as discussed in more detail in Attachment A.

Thus, the Mississippi River sampling results do not show evidence of impact of constituents derived from the RCPA. This is important in that the absence of concentrations above risk-based screening levels means that there is not a significant pathway of exposure.

Isle Du Bois Creek

The comparison to risk-based screening levels of the analytical results for Isle Du Bois Creek are presented in Tables 8 through 10.

- Table 8 – Comparison to drinking water screening levels – No results are above risk-based screening levels.
- Table 9 – Comparison to human health recreational screening levels – Only total concentrations of arsenic are above the screening level. The total arsenic results upstream and downstream are similar, thus, likely represent normal creek conditions.

[5] Lithium levels within the deep aquifer groundwater are unrelated to the CCR unit due to the lack of corresponding coal ash constituents (i.e., boron, sulfate etc.) and could reflect naturally occurring levels within the bedrock aquifer or a sampling artifact due to piping grease or other interferences.

- Table 10 – Comparison to ecological screening levels – No results are above risk-based screening levels.

There are no analytical results for Isle Du Bois Creek above drinking water or ecological screening levels. While arsenic concentrations in the creek are slightly above the human health recreational screening levels, the concentrations are similar upstream and downstream.

Thus, even this small water body immediately adjacent to the RCPA does not show evidence of risk to human health or the environment from ash management operations at the RCPA. This is important in that the absence of concentrations above risk-based screening levels means that there is not a significant pathway of exposure.

NPDES Outfall WET Testing Results

The outfall for the RCPA impoundment is identified as 002 and, shown on Figure 2, is located near where Isle Du Bois Creek meets the Mississippi River. This is a permitted outfall under the National Pollutant Discharge Elimination System (NPDES) program. The outfall effluent water is tested for toxicity on a periodic basis as required by the permit; the latest permit-required test was conducted in February 2005. WET (whole effluent toxicity) testing involves mixing the effluent water from Outfall 002 with Mississippi River water collected upstream to simulate mixing of the effluent upon discharge to the river. Tests are also conducted on the upstream Mississippi River water and on laboratory water. If the effluent treatment results are not statistically different from the control results, then the effluent is considered to have passed the WET test. Table 11 shows the results of the direct aquatic organism toxicity testing that is conducted using the outfall effluent. The results indicate no evidence of aquatic toxicity of the RCPA outfall effluent. This is a direct biological measure demonstrating the lack of toxicity of the Outfall 002 effluent.

7. Derivation of Risk-Based Screening Levels for Groundwater

The results presented here demonstrate that the 40-year history of ash management activities at the RCPA have not had an adverse effect on human health or the environment. While some groundwater results are above drinking water screening levels, there is no pathway of exposure to the on-site groundwater (i.e., the shallow alluvial groundwater is not used as a source of drinking water). For those waters where a theoretical pathway of exposure exists (i.e., the Isle Du Bois Creek and the Mississippi River), there is no evidence of impact and all samples are either below screening levels or consistent with background.

Ameren's facilities are located on major river systems with a massive and rapid river flow. In this section, we have attempted to illustrate how the groundwater – which is a fraction of the volume and flow rate of the river – may interact with a surface body under an assumed set of criteria and conditions (see Attachment B). Such an exercise in assumptions can help put in context whether a theoretical risk to public water supplies exists, particularly where, as here, actual surface water samples have been collected and evaluated.

However, impacts to groundwater does not mean that surface waters are impaired. The degree of interface between groundwater and surface waters is variable and complex and dependent upon a variety of factors including gradient and flow rate. It is possible, however, to determine the maximum concentration level that would need to be present on-site in groundwater and still be protective of the surface water environment, assuming gradient and flow rates are such that groundwater flows into the surface water. Groundwater and surface waters flow at very different rates and volumes. The

Mississippi River is the largest river system in North America and as depicted on Table 12 and Attachment B, when compared to groundwater, its dilution factor is greater than 100,000.

It is possible to calculate a protective screening level for groundwater based upon the amount of dilution that occurs under the above assumption. This calculated risk-based screening level for groundwater can be used to determine whether an on-site groundwater concentration level is protective of the river. Stated differently, at what concentration level does groundwater entering the river system pose a human health or ecological risk?

Table 12 is summarized below and shows the application of the dilution factor to calculate risk-based screening levels for the following parameters: boron, sulfate, TDS, antimony, arsenic, lead, lithium, and molybdenum. These Table 4 constituents have one or more monitoring well concentrations above the drinking water screening levels. For each constituent, the human health drinking water and recreational screening levels are presented as well as the ecological screening level. The lowest of the three screening levels is then identified for surface water. The dilution factor is then applied to this lowest screening level for surface water to result in the groundwater alternative risk-based screening level, which is what is shown in the table below.

This evaluation is not limited to only those constituents for which SSIs have been identified. The constituents listed here are those for which there is one or more groundwater result above a risk-based screening level[6].

CALCULATING RISK-BASED SCREENING LEVELS FOR GROUNDWATER BASED ON THE MISSISSIPPI RIVER (see Table 12)

	Estimated Dilution Factor for Mississippi River	100,000			
Constituents*	**Lowest of the Human Health and Ecological Screening Levels (mg/L)**	**Groundwater Risk-Based Screening Level (mg/L)****	**Maximum RIEC Groundwater Concentration (mg/L)**		**Ratio Between Groundwater Screening Level and the Maximum RIEC Groundwater Concentration**
Boron***	2	200000	15.7	R-MW-3	>12,000
Sulfate***	250	25000000	382	R-MW-1	>65,000
TDS	500	50000000	874	R-MW-2	>50,000
Antimony	0.006	600	0.0064	R-MW-2	>93,000
Arsenic	0.00014	14	0.257	R-MW-2	>50
Lead	0.0058	578	0.0177	R-MW-2	>32,000
Lithium	0.04	4000	0.0647	R-MW-B1	>61,000
Molybdenum	0.1	10000	0.943	R-MW-3	>10,000

*** A dilution factor is not directly applicable to pH, thus it is not included in this analysis.**
**** Where the Groundwater Risk-Based Screening Level = Screening Level x Dilution Factor.**
***** Constituents for which an SSI has been identified. Note that although an SSI was identified for boron and sulfate, these constituents are not present in surface water above the risk-based screening levels. Also note that although an SSI has been identified for fluoride, its concentrations in groundwater are below risk-based screening levels for drinking water.**

[6] Note that under the CCR Rule, statistically significant levels of Appendix IV constituents are determined after Assessment Monitoring has been conducted.

The groundwater alternative risk-based screening levels are calculated in units of milligrams of constituent per liter of water (mg/L). One mg/L is equivalent to one million parts per million.[7,8]

The table identifies the maximum groundwater concentration of each constituent detected in the RCPA monitoring wells. The comparison between the target levels and the maximum concentrations indicates that there is a wide margin of safety between the two values. This margin is shown in the last column of the table. To illustrate, concentration levels of arsenic and lead would need to be more than 50 and 32,000 times higher, respectively, than currently measured levels before an adverse impact in the river could occur.

This means that not only do the present concentrations of constituents in groundwater at the RCPA not pose a risk to human health or the environment, but even much higher concentrations would not be harmful.

8. Closure of the RCPA

Current plans for the facility are to close the RCPA.[9] Currently, closure of the RCPA is expected to be completed by 2022. Closure is estimated to reduce the movement of CCR constituents from the RCPA discharge (or flux) of water into the alluvial aquifer to groundwater by 90% or more. This reduction is the result of several factors: closure will cease the flow of water and ash to the RCPA, a cap will be installed that will limit infiltration of precipitation, and the closure plan includes stormwater run-on and run-off controls to route stormwater off of the capped area and away from the RCPA. It is likely that concentrations of constituents in groundwater downgradient from the RCPA will decrease post-closure.

9. Summary

This comprehensive evaluation demonstrates that there are no adverse impacts on human health from either surface water or groundwater uses resulting from coal ash management practices at the Rush Island Energy Center.

10. Attachments

TABLES

1 HUMAN HEALTH SCREENING LEVELS

2 ECOLOGICAL SCREENING LEVELS - MISSISSIPPI RIVER

3 ECOLOGICAL SCREENING LEVELS - ISLE DU BOIS CREEK

[7] Note that because the target level calculation is a mathematical exercise, certain results may not be applicable in the real world. For example, the result for sulfate is 25 million parts per million, which is not physically possible. However, what this means is that there is no level of sulfate that could be present in the groundwater at the RCPA that could result in a risk of harm to human health or the environment.

[8] A million parts per million is equivalent to 1 penny in $10,000 worth of pennies, 1 second in 11.5 days, or 1 inch in 15.8 miles.

[9] Importantly, the CCR Rule promulgated by USEPA in 2015 is both under appeal [Utility Solid Waste Activities, et al v. EPA, Docket No. 15-01219, DC Circuit Court of Appeals Sept 13, 2017, Letter from Pruitt to reconsider.] and is being reconsidered by the current Administration. Notwithstanding any proposed changes to the federal CCR Rule, Ameren Missouri intends to implement its closure plan and schedule.

FIGURES

ATTACHMENTS

TABLES

TABLE 1
HUMAN HEALTH SCREENING LEVELS
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

			Missouri State Water Quality Screening Levels (mg/L)			Federal Water Quality Screening Levels (mg/L)				Selected Screening Level (mg/L)	
Constituent	Abbreviation	CASRN	Human Health Fish Consumption (a)	Drinking Water Supply (a)	Groundwater (a)	USEPA AWQC Human Health Consumption of Organism Only (b)	MCLs (c)	SMCLs (c)	November 2017 USEPA Tapwater RSLs (d)	Drinking Water (e)	Recreational Use (f)
Antimony	Sb	7440-36-0	4.3	0.006	0.006	0.64	0.006	NA	0.0078 (m)	0.006	4.3
Arsenic	As	7440-38-2	NA	0.05	0.05	0.00014 (i)	0.01	NA	0.000052	0.05	0.00014
Barium	Ba	7440-39-3	NA	2	2	NA	2	NA	3.8	2	NA
Beryllium	Be	7440-41-7	NA	0.004	0.004	NA	0.004	NA	0.025	0.004	NA
Boron	B	7440-42-8	NA	NA	2	NA	NA	NA	4	4 (q)	NA
Cadmium	Cd	7440-43-9	NA	0.005	0.005	NA	0.005	NA	0.0092	0.005	NA
Calcium	Ca	7440-70-2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	Cl	7647-14-5	NA	250	NA	NA	NA	250	NA	250	NA
Chromium	Cr	16065-83-1 (g)	NA	0.1	0.1	NA	0.1 (j)	NA	22 (n)	0.1	NA
Cobalt	Co	7440-48-4	NA	NA	1	NA	NA	NA	0.006	0.006	NA
Fluoride	Fl	16984-48-8	NA	4	4	NA	4	2	0.8	4	NA
Lead	Pb	7439-92-1	NA	0.015	0.015	NA	0.015 (k)	NA	0.015	0.015	NA
Lithium	Li	7439-93-2	NA	NA	NA	NA	NA	NA	0.04	0.04	NA
Mercury	Hg	7487-94-7 (h)	NA	0.002	0.002	NA	0.002 (l)	NA	0.0057 (o)	0.002	NA
Molybdenum	Mo	7439-98-7	NA	NA	NA	NA	NA	NA	0.1	0.1	NA
Radium 226/228 (pCi/L)	Ra 226/228	RADIUM226228	NA	NA	NA	NA	5	NA	NA	5	NA
Selenium	Se	7782-49-2	NA	0.05	0.05	4.2	0.05	NA	0.1	0.05	4.2
Sulfate	SO4	7757-82-6	NA	250	NA	NA	NA	250	NA	250	NA
Thallium	Tl	7440-28-0	0.0063	0.002	0.002	0.00047	0.002	NA	0.0002 (p)	0.002	0.0063
Total Dissolved Solids	TDS	TDS	NA	NA	NA	NA	NA	500	NA	500	NA
pH (std)	--	PHFLD	NA	NA	NA	NA	NA	6.5 - 8.5	NA	6.5 - 8.5	NA

Notes:

AWQC - Ambient Water Quality Criteria.
CASRN - Chemical Abstracts Service Registry Number.
HI - Hazard Index (noncancer child).
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - not available.
pCi/L - picoCurie per liter.
RSL - Risk-based Screening Levels (USEPA).
TR - Target Risk (carcinogenic).
USEPA - United States Environmental Protection Agency.

(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. Updated January 29, 2014. Per 10 CSR 20-7.031(4)(B)(2), the criteria for Human Protection Fish Consumption apply to dissolved metals data. All other criteria apply to total concentrations.
http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed November 2014.
https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.
(c) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012.
http://water.epa.gov/drink/contaminants/index.cfm
(d) - USEPA Risk-Based Screening Levels (November 2017). Values for tapwater. HI = 1.0, TR = 1E-06.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(e) - The hierachy for selecting the Human Health Screening Level for Drinking Water is: Missouri State Water Quality Criteria for Drinking Water Supply (a); Federal USEPA MCL for Drinking Water (c); Federal June 2017 USEPA Tapwater RSL (d); Federal USEPA SMCL for Drinking Water (c).
(f) - The hierachy for selecting the Human Health Screening Level for Recreational Use is: Missouri State Water Quality Criteria for Human Health Fish Consumption (a); Federal USEPA AWQC for Human Health Consumption of Organism Only (b).
(g) - CAS number for Trivalent Chromium.
(h) - CAS number for Mercuric Chloride.
(i) - Value applies to inorganic form of arsenic only.
(j) - Value for Total Chromium.
(k) - Lead Treatment Technology Action Level is 0.015 mg/L.
(l) - Value for Inorganic Mercury.
(m) - RSL for Antimony (metallic) used for Antimony.
(n) - RSL for Chromium (III), Insoluble Salts used for Chromium.
(o) - RSL for Mercuric Chloride used for Mercury.
(p) - RSL for Thallium (Soluble Salts) used for Thallium.
(q) - RSL selected for Boron as the Missouri State Water Quality Groundwater screening level is based on irrigation.

TABLE 2
ECOLOGICAL SCREENING LEVELS - MISSISSIPPI RIVER
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

			Missouri State Water Quality Criteria (mg/L)						Federal Water Quality Criteria (mg/L)			
			Site-Specific Protection of Aquatic Life Acute (a)		Site-Specific Protection of Aquatic Life Chronic (a)		Irrigation (a)	Livestock Wildlife Watering (a)	Site-Specific USEPA Aquatic Life AWQC Freshwater Acute (b)		Site-Specific USEPA Aquatic Life AWQC Freshwater Chronic (b)	
Constituent	Abbreviation	CASRN	Total	Dissolved	Total	Dissolved	Total	Total	Total	Dissolved	Total	Dissolved
Antimony (c)	Sb	7440-36-0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	As	7440-38-2	NA	NA	NA	0.02	0.1	NA	0.34	0.34	0.15	0.15
Barium (c)	Ba	7440-39-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	Be	7440-41-7	NA	NA	NA	0.005	0.1	NA	NA	NA	NA	NA
Boron	B	7440-42-8	NA	NA	NA	NA	2	NA	NA	NA	NA	NA
Cadmium	Cd	7440-43-9	NA	0.010 (f)	NA	0.0004 (f)	NA	NA	0.0041 (f)	0.0037 (g)	0.0015 (f)	0.0013 (g)
Calcium (c)	Ca	7440-70-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	Cl	16887-00-6	NA	NA	NA	NA	NA	NA	860	NA	230	NA
Chromium	Cr	7440-47-3	NA	1.1 (e,g)	NA	0.14 (e,g)	0.1 (e)	NA	3.4 (e,g)	1.1 (e,h)	0.16 (e,g)	0.14 (e,h)
Cobalt	Co	7440-48-4	NA	NA	NA	NA	NA	1	NA	NA	NA	NA
Fluoride	Fl	16984-48-8	NA	NA	NA	NA	NA	4	NA	NA	NA	NA
Lead	Pb	7439-92-1	NA	0.15 (f)	NA	0.0058 (f)	NA	NA	0.22 (f)	0.15 (g)	0.0085 (f)	0.0058 (g)
Lithium (c)	Li	7439-93-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	Hg	7439-97-6	0.0024	NA	0.0005	NA	NA	NA	0.0016	0.0014	0.00091	0.00077
Molybdenum (c)	Mo	7439-98-7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	Se	7782-49-2	NA	NA	NA	0.005	NA	NA	0.013 (d)	0.013 (d)	0.005 (d)	0.005 (d)
Sulfate	SO4	14808-79-8	NA	NA	1583 (g,i)	NA	NA	NA	NA	NA	NA	NA
Thallium (c)	Tl	7440-28-0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Dissolved Solids (c)	TDS	TDS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

AWQC - USEPA Ambient Water Quality Criteria.
CASRN - Chemical Abstracts Service Registry Number.
CMC - Criterion Maximum Concentration
mg/L - milligram per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency

(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. January 29, 2014.
http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf. Total values provided.
Missouri State Protection of Aquatic Life Acute and Chronic values apply only to dissolved results (except mercury)
irrigation, livestock/wildlife watering, and mercury Aquatic Life Acute and Chronic values apply only to totals results

(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed December 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (f).
USEPA provides AWQC for both total and dissolved results.

(c) - Water quality criteria from the presented sources are not available for this constituent

(d) - Acute AWQC is equal to 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate respectively, and CMC1 and CMC2 are 185.9 ug/L and 12.82 ug/L, respectively. Calculated assuming that all selenium is present as selenate a likely overly conservative assumption.

(e) - Value for trivalent chromium used.

(f) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value for the Mississippi River of 217 mg/L as CaCO3 usec

(g) - Hardness dependent value for total metals adjusted for dissolved fraction. Site-specific total recoverable mean hardness value for the Mississippi River of 217 mg/L as CaCO3 used

(h) - Chloride dependent value (default chloride value of 25 mg/L is assumed) for the Mississippi River
When chloride is greater than or equal to 25 and less than or equal to 500 mg/L and hardness is between 100 and 500 mg/L
sulfate limit in mg/L = [1276.7 + 5.508 (hardness) − 1.457 (chloride)] * 0.65.

TABLE 3
ECOLOGICAL SCREENING LEVELS - ISLE DU BOIS CREEK
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

			Missouri State Water Quality Criteria (mg/L)						Federal Water Quality Criteria (mg/L)			
			Site-Specific Protection of Aquatic Life Acute (a)		Site-Specific Protection of Aquatic Life Chronic (a)		Irrigation (a)	Livestock Wildlife Watering (a)	Site-Specific USEPA Aquatic Life AWQC Freshwater Acute (b)		Site-Specific USEPA Aquatic Life AWQC Freshwater Chronic (b)	
Constituent	Abbreviation	CASRN	Total	Dissolved	Total	Dissolved	Total	Total	Total	Dissolved	Total	Dissolved
Antimony (c)	Sb	7440-36-0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	As	7440-38-2	NA	NA	NA	0.02	0.1	NA	0.34	0.34	0.15	0.15
Barium (c)	Ba	7440-39-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	Be	7440-41-7	NA	NA	NA	0.005	0.1	NA	NA	NA	NA	NA
Boron	B	7440-42-8	NA	NA	NA	NA	2	NA	NA	NA	NA	NA
Cadmium	Cd	7440-43-9	NA	0.013 (f)	NA	0.0005 (f)	NA	NA	0.0051 (f)	0.0046 (g)	0.0018 (f)	0.0015 (g)
Calcium (c)	Ca	7440-70-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	Cl	16887-00-6	NA	NA	NA	NA	NA	NA	860	NA	230	NA
Chromium	Cr	7440-47-3	NA	1.3 (e, g)	NA	0.17 (e, g)	0.1 (e)	NA	4.1 (e,g)	1.3 (e,h)	0.20 (e,g)	0.17 (e,h)
Cobalt	Co	7440-48-4	NA	NA	NA	NA	NA	1	NA	NA	NA	NA
Fluoride	Fl	16984-48-8	NA	NA	NA	NA	NA	4	NA	NA	NA	NA
Lead	Pb	7439-92-1	NA	0.19 (f)	NA	0.0074 (f)	NA	NA	0.29 (f)	0.19 (g)	0.0114 (f)	0.0074 (g)
Lithium (c)	Li	7439-93-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	Hg	7439-97-6	0.0024	NA	0.0005	NA	NA	NA	0.0016	0.0014	0.00091	0.00077
Molybdenum (c)	Mo	7439-98-7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	Se	7782-49-2	NA	NA	NA	0.005	NA	NA	0.013 (d)	0.013 (d)	0.005 (d)	0.005 (d)
Sulfate	SO4	14808-79-8	NA	NA	1784 (g,i)	NA	NA	NA	NA	NA	NA	NA
Thallium (c)	Tl	7440-28-0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Dissolved Solids (c)	TDS	TDS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

AWQC - USEPA Ambient Water Quality Criteria.
CASRN - Chemical Abstracts Service Registry Number.
CMC - Criterion Maximum Concentration
mg/L - milligram per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency

(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. January 29, 2014.
http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf. Total values provided.
Missouri State Protection of Aquatic Life Acute and Chronic values apply only to dissolved results (except mercury)
irrigation, livestock/wildlife watering, and mercury Aquatic Life Acute and Chronic values apply only to totals results

(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed December 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (f).
USEPA provides AWQC for both total and dissolved results.

(c) - Water quality criteria from the presented sources are not available for this constituent

(d) - Acute AWQC is equal to 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate respectively, and CMC1 and CMC2 are 185.9 ug/L and 12.82 ug/L, respectively. Calculated assuming that all selenium is present as selenate a likely overly conservative assumption.

(e) - Value for trivalent chromium used.

(f) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value the Isle Du Bois Creek of 273 mg/L as CaCO3 used

(g) - Hardness dependent value for total metals adjusted for dissolved fraction. Site-specific total recoverable mean hardness value for the Isle Du Bois Creek of 273 mg/L as CaCO3 used

(h) - Chloride dependent value (default chloride value of 25 mg/L is assumed) for the Isle Du Bois Creek
When chloride is greater than or equal to 25 and less than or equal to 500 mg/L and hardness is between 100 and 500 mg/L
sulfate limit in mg/L = [1276.7 + 5.508 (hardness) − 1.457 (chloride)] * 0.65.

TABLE 4
SUMMARY OF RCPA SURFACE IMPOUNDMENT GROUNDWATER MONITORING RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)																				
	Constituent	Boron	Calcium	Chloride	pH	Sulfate	TDS	Fluoride	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226/228
	HH DW SL	4	NA	250	6.5-8.5	250	500	4	0.006	0.05	2	0.004	0.005	0.1	0.006	0.015	0.04	0.002	0.1	0.05	0.002	5
Monitoring Well ID	**Sampling Event Date**	mg/L	mg/L	mg/L	S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
R-MW-1	Mar-16	<	<	<	9.5	341	554	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	9.7	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	9.4	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	9.7	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	10	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	9.6	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	9.4	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	9.5	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-17	<	<	<	NA	382	585	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
R-MW-2	Mar-16	<	<	<	10.8	266	795	<	<	0.257	<	<	<	<	<	<	<	<	0.15	<	<	<
	May-16	4.08	<	<	10.6	<	794	<	<	0.231	<	<	<	<	<	<	<	<	0.173	<	<	<
	Jul-16	<	<	<	10.4	310	855	<	<	0.238	<	<	<	<	<	<	<	<	0.197	<	<	<
	Sep-16	4.35	<	<	10.5	324	856	<	<	0.25	<	<	<	<	<	0.0177	<	<	0.183	<	<	<
	Nov-16	5.73	<	<	10.8	288	783	<	0.0064	0.257	<	<	<	<	<	<	<	<	0.201	<	<	<
	Jan-17	4.85	<	<	10.6	321	874	<	<	0.224	<	<	<	<	<	<	<	<	0.16	<	<	<
	Mar-17	5.06	<	<	10.4	292	829	<	<	0.217	<	<	<	<	<	<	<	<	0.168	<	<	<
	Jun-17	5.51	<	<	10.6	279	812	<	<	0.242	<	<	<	<	<	<	<	<	0.174	<	<	<
	Nov-17	5.65	<	<	NA	294	792	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
R-MW-3	Mar-16	15.6	<	<	9.6	<	688	<	<	<	<	<	<	<	<	<	<	<	0.943	<	<	<
	May-16	14.9	<	<	9.6	<	806	<	<	<	<	<	<	<	<	<	<	<	0.826	<	<	<
	Jul-16	14.1	<	<	9.5	<	705	<	<	0.064	<	<	<	<	<	<	<	<	0.811	<	<	<
	Sep-16	14.5	<	<	9.6	<	731	<	<	0.0743	<	<	<	<	<	<	<	<	0.804	<	<	<
	Nov-16	15.6	<	<	9.2	<	664	<	<	<	<	<	<	<	<	<	<	<	0.869	<	<	<
	Jan-17	14.5	<	<	9.6	<	718	<	<	0.072	<	<	<	<	<	<	<	<	0.697	<	<	<
	Mar-17	15.7	<	<	9.6	<	707	<	<	0.08	<	<	<	<	<	<	<	<	0.753	<	<	<
	Jun-17	14.9	<	<	9.7	<	719	<	<	0.0856	<	<	<	<	<	<	<	<	0.676	<	<	<
	Nov-17	15.4	<	<	NA	<	697	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
R-MW-4	Mar-16	4.2	<	<	<	<	<	<	<	<	<	<	<	<	<	<	0.0458	<	<	<	<	<
	May-16	4.07	<	<	<	<	<	<	<	<	<	<	<	<	<	<	0.0414	<	<	<	<	<
	Jul-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	0.0431	<	<	<	<	<
	Sep-16	4.35	<	<	<	<	<	<	<	<	<	<	<	<	<	<	0.0448	<	0.105	<	<	<
	Nov-16	4.45	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	0.109	<	<	<
	Jan-17	4.18	<	<	<	<	<	<	<	<	<	<	<	<	<	<	0.0446	<	<	<	<	<
	Mar-17	4.5	<	<	<	<	<	<	<	<	<	<	<	<	<	<	0.0457	<	0.103	<	<	<
	Jun-17	4.51	<	<	<	<	<	<	<	<	<	<	<	<	<	<	0.0441	<	0.133	<	<	<
	Nov-17	4.26	<	<	NA	<	<	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
R-MW-5	Mar-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-17	<	<	<	NA	<	<	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
R-MW-6	Mar-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-17	<	<	<	NA	<	<	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
R-MW-7	Mar-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	0.17	<	<	<
	May-16	<	<	<	<	<	<	<	<	0.0763	<	<	<	<	<	<	<	<	0.171	<	<	<
	Jul-16	<	<	<	<	<	<	<	<	0.0918	<	<	<	<	<	<	<	<	0.185	<	<	<
	Sep-16	<	<	<	<	<	<	<	<	0.0963	<	<	<	<	<	<	<	<	0.188	<	<	<
	Nov-16	<	<	<	<	<	<	<	<	0.0907	<	<	<	<	<	<	<	<	0.162	<	<	<
	Jan-17	<	<	<	<	<	<	<	<	0.0966	<	<	<	<	<	<	<	<	0.18	<	<	<
	Mar-17	<	<	<	<	<	<	<	<	0.0923	<	<	<	<	<	<	<	<	0.196	<	<	<
	Jun-17	<	<	<	<	<	<	<	<	0.105	<	<	<	<	<	<	<	<	0.152	<	<	<
	Nov-17	<	<	<	NA	<	<	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
R-MW-B1	Mar-16	<	<	<	<	<	677	<	<	<	<	<	<	<	<	<	0.0642	<	<	<	<	<
	May-16	<	<	<	<	<	757	<	<	<	<	<	<	<	<	<	0.0629	<	<	<	<	<
	Jul-16	<	<	<	<	<	712	<	<	<	<	<	<	<	<	<	0.0629	<	<	<	<	<
	Sep-16	<	<	<	<	<	733	<	<	<	<	<	<	<	<	<	0.0615	<	<	<	<	<
	Nov-16	<	<	<	<	<	658	<	<	<	<	<	<	<	<	<	0.0547	<	<	<	<	<
	Jan-17	<	<	<	<	<	704	<	<	<	<	<	<	<	<	<	0.0647	<	<	<	<	<
	Mar-17	<	<	<	<	<	681	<	<	<	<	<	<	<	<	<	0.0644	<	<	<	<	<
	Jun-17	<	<	<	<	<	664	<	<	<	<	<	<	<	<	<	0.0556	<	<	<	<	<
	Nov-17	<	<	<	NA	<	685	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4
SUMMARY OF RCPA SURFACE IMPOUNDMENT GROUNDWATER MONITORING RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)																			
	Constituent	Boron	Calcium	Chloride	pH	Sulfate	TDS	Fluoride	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226/228
	HH DW SL	4	NA	250	6.5-8.5	250	500	4	0.006	0.05	2	0.004	0.005	0.1	0.006	0.015	0.04	0.002	0.1	0.05	0.002	5
Monitoring Well ID	**Sampling Event Date**	mg/L	mg/L	mg/L	S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
R-MW-B2	Mar-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-17	<	<	<	NA	<	<	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Summary		24:81	0:81	0:81	24:72	10:81	29:81	0:81	1:72	20:72	0:72	0:72	0:72	0:72	0:72	1:72	15:72	0:72	28:72	0:72	0:72	0:72

Notes:
< - Less than the Human Health Drinking Water Screening Level.
DW - Drinking Water.
HH - Human Health.
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
RSL - Risk-Based Screening Level.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Drinking Water Supply.
Federal USEPA MCL for Drinking Water.
Federal November 2017 USEPA Tapwater RSL.
Federal USEPA SMCL for Drinking Water.

TABLE 5
SUMMARY OF MISSISSIPPI RIVER SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)																			
	Constituent	Boron		Calcium		Chloride	pH	Sulfate	TDS	Fluoride	Antimony		Arsenic		Barium		Beryllium		Cadmium		Chromium	
	Fraction	Total	Dissolved	Total	Dissolved	Total	Total	Total	Total	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
	HH DW SL	4	4	NA	NA	250	6.5-8.5	250	500	4	0.006	0.006	0.05	0.05	2	2	0.004	0.004	0.005	0.005	0.1	0.1
Sample Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
UPSTREAM																						
RI-R-4S	Apr-14	<	<	<	<	NA	6.14	<	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
RI-R-4S DUP	Apr-14	<	<	<	<	NA	6.14	<	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
RI-R-5S	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
RI-R-5M	Apr-14	<	<	<	<	NA	8.88	<	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
RI-R-6S	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
RI-R-6M	Apr-14	<	<	<	<	NA	8.76	<	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
DOWNSTREAM																						
RI-R-1S	Apr-14	<	<	<	<	NA	8.58	<	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
RI-R-2S	Apr-14	<	<	<	<	NA	8.56	<	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
RI-R-2M	Apr-14	<	<	<	<	NA	8.88	<	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
RI-R-3S	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
RI-R-3M	Apr-14	<	<	<	<	NA	8.93	<	NA	<	<	<	<	<	<	<	<	<	<	<	<	<

Notes:
< - Less than the Human Health Drinking Water Screening Level.
DW - Drinking Water.
HH - Human Health.
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
RSL - Risk-Based Screening Level.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Drinking Water Supply.
Federal USEPA MCL for Drinking Water.
Federal November 2017 USEPA Tapwater RSL.
Federal USEPA SMCL for Drinking Water.

TABLE 5
SUMMARY OF MISSISSIPPI RIVER SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)															
	Constituent	Cobalt		Lead		Lithium		Mercury		Molybdenum		Selenium		Thallium		Radium-226/228	Hardness
	Fraction	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total
	HH DW SL	0.006	0.006	0.015	0.015	0.04	0.04	0.002	0.002	0.1	0.1	0.05	0.05	0.002	0.002	5	NA
Sample Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	mg/L
UPSTREAM																	
RI-R-4S	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-4S DUP	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-5S	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-5M	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-6S	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-6M	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
DOWNSTREAM																	
RI-R-1S	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-2S	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-2M	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-3S	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-3M	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<

Notes:
< - Less than the Human Health Drinking Water Screening Level.
DW - Drinking Water.
HH - Human Health.
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
RSL - Risk-Based Screening Level.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Drinking Water Supply.
Federal USEPA MCL for Drinking Water.
Federal November 2017 USEPA Tapwater RSL.
Federal USEPA SMCL for Drinking Water.

TABLE 6
SUMMARY OF MISSISSIPPI RIVER SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH RECREATIONAL USE SCREENING LEVELS
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Human Health Recreational Use Screening (a)																			
	Constituent	Boron		Calcium		Chloride	pH	Sulfate	TDS	Fluoride	Antimony		Arsenic		Barium		Beryllium		Cadmium		Chromium	
	Fraction	Total	Dissolved	Total	Dissolved	Total	Total	Total	Total	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
	HH REC SL	NA	NA	NA	NA	NA	6.5-8.5	NA	500	NA	4.3	4.3	0.00014	0.00014	NA	NA	NA	NA	NA	NA	NA	NA
Sample Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
UPSTREAM																						
RI-R-4S	Apr-14	<	<	<	<	NA	6.14	<	NA	<	<	<	0.0021	0.001 J	<	<	<	<	<	<	<	<
RI-R-4S DUP	Apr-14	<	<	<	<	NA	6.14	<	NA	<	<	<	0.0028	0.0019 J	<	<	<	<	<	<	<	<
RI-R-5S	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	0.0019 J	0.0015 J	<	<	<	<	<	<	<	<
RI-R-5M	Apr-14	<	<	<	<	NA	8.88	<	NA	<	<	<	0.0025	0.0012 J	<	<	<	<	<	<	<	<
RI-R-6S	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	0.0023	0.0013 J	<	<	<	<	<	<	<	<
RI-R-6M	Apr-14	<	<	<	<	NA	8.76	<	NA	<	<	<	0.0021	0.0014 J	<	<	<	<	<	<	<	<
DOWNSTREAM																						
RI-R-1S	Apr-14	<	<	<	<	NA	8.58	<	NA	<	<	<	0.0028	0.0015 J	<	<	<	<	<	<	<	<
RI-R-2S	Apr-14	<	<	<	<	NA	8.56	<	NA	<	<	<	0.0021	0.0011 J	<	<	<	<	<	<	<	<
RI-R-2M	Apr-14	<	<	<	<	NA	8.88	<	NA	<	<	<	0.0024	0.0012 J	<	<	<	<	<	<	<	<
RI-R-3S	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	0.0024	0.0012 J	<	<	<	<	<	<	<	<
RI-R-3M	Apr-14	<	<	<	<	NA	8.93	<	NA	<	<	<	0.0022	0.0011 J	<	<	<	<	<	<	<	<

Notes:
< - Less than the Human Health Recreational Use Screening Level.
HH - Human Health.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
REC - Recreational Use.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

Qualifiers:
J - Value is estimated.

(a) - Recreational Use Screening Levels selected in Table 2 following the following hierarchy:
Missouri State Water Quality Criteria for Human Health Fish Consumption.
USEPA Ambient Water Quality Criteria for Human Health Consumption of Organism Only.

TABLE 6
SUMMARY OF MISSISSIPPI RIVER SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH RECREATIONAL USE SCREENING LEVELS
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Human Health Recreational Use Screening (a)															
	Constituent	Cobalt		Lead		Lithium		Mercury		Molybdenum		Selenium		Thallium		Radium-226/228	Hardness
	Fraction	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total
	HH REC SL	NA	NA	NA	NA	0.04	0.04	NA	NA	NA	NA	4.2	4.2	0.0063	0.0063	NA	NA
Sample Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	mg/L
UPSTREAM																	
RI-R-4S	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-4S DUP	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-5S	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-5M	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-6S	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-6M	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
DOWNSTREAM																	
RI-R-1S	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-2S	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-2M	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-3S	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-3M	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<

Notes:
< - Less than the Human Health Recreational Use Screening Level.
HH - Human Health.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
REC - Recreational Use.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

Qualifiers:
J - Value is estimated.

(a) - Recreational Use Screening Levels selected in Table 2 following the following hierarchy:
Missouri State Water Quality Criteria for Human Health Fish Consumption.
USEPA Ambient Water Quality Criteria for Human Health Consumption of Organism Only.

TABLE 7
SUMMARY OF MISSISSIPPI RIVER SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO ECOLOGICAL USE SCREENING LEVELS
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Ecological Screening (a)																		
	Constituent	Boron		Calcium		Chloride	pH	Sulfate	TDS	Fluoride	Antimony		Arsenic		Barium		Beryllium		Cadmium	
	Fraction	Total	Dissolved	Total	Dissolved	Total	Total	Total	Total	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
	ECO SL	2	2	NA	NA	230	6.5-8.5	1583	NA	4	NA	NA	0.15	0.15	NA	NA	0.1	0.1	0.0015	0.0015
Sample Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	S.U	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
UPSTREAM																				
RI-R-4S	Apr-14	<	<	<	<	NA	6.14	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-R-4S DUP	Apr-14	<	<	<	<	NA	6.14	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-R-5S	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-R-5M	Apr-14	<	<	<	<	NA	8.88	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-R-6S	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-R-6M	Apr-14	<	<	<	<	NA	8.76	<	NA	<	<	<	<	<	<	<	<	<	<	<
DOWNSTREAM																				
RI-R-1S	Apr-14	<	<	<	<	NA	8.58	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-R-2S	Apr-14	<	<	<	<	NA	8.56	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-R-2M	Apr-14	<	<	<	<	NA	8.88	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-R-3S	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-R-3M	Apr-14	<	<	<	<	NA	8.93	<	NA	<	<	<	<	<	<	<	<	<	<	<

Notes:
< - Less than the Ecological Screening Level.
ECO - Ecological.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Ecological Screening Levels selected in Table 2 following the following hierarchy:
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Chronic).
USEPA Aquatic Life Ambient Water Quality Criteria (Chronic).
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Acute).
USEPA Aquatic Life Ambient Water Quality Criteria (Acute).
Missouri State Water Quality Criteria for Irrigation.
Missouri State Water Quality Criteria for Livestock Wildlife Watering.

TABLE 7
SUMMARY OF MISSISSIPPI RIVER SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO ECOLOGICAL USE SCREENING LEVELS
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Ecological Screening (a)																	
	Constituent	Chromium		Cobalt		Lead		Lithium		Mercury		Molybdenum		Selenium		Thallium		Radium-226/228	Hardness
	Fraction	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total
Sample	**ECO SL**	0.162	0.162	1	1	0.009	0.009	NA	NA	0.0005	0.0005	NA	NA	0.005	0.005	NA	NA	NA	NA
LocationI ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	mg/L
UPSTREAM																			
RI-R-4S	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-4S DUP	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-5S	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-5M	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-6S	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-6M	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
DOWNSTREAM																			
RI-R-1S	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-2S	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-2M	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-3S	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-R-3M	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<

Notes:
< - Less than the Ecological Screening Level.
ECO - Ecological.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Ecological Screening Levels selected in Table 2 following the following hierarchy:
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Chronic).
USEPA Aquatic Life Ambient Water Quality Criteria (Chronic).
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Acute).
USEPA Aquatic Life Ambient Water Quality Criteria (Acute).
Missouri State Water Quality Criteria for Irrigation.
Missouri State Water Quality Criteria for Livestock Wildlife Watering.

TABLE 8
SUMMARY OF ISLE DU BOIS CREEK SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVEL
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)																			
	Constituent	Boron		Calcium		Chloride	pH	Sulfate	TDS	Fluoride	Antimony		Arsenic		Barium		Beryllium		Cadmium	
	Fraction	Total	Dissolved	Total	Dissolved	Total	Total	Total	Total	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample	**HH DW SL**	4	4	NA	NA	250	6.5-8.5	250	500	4	0.006	0.006	0.05	0.05	2	2	0.004	0.004	0.005	0.005
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	S.U	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
UPSTREAM																				
RI-C-7	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-C-8	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-C-9	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
ADJACENT																				
RI-C-4	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-C-5	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-C-6	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
DOWNSTREAM																				
RI-C-1	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-C-1 DUP	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-C-2	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-C-3	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<

Notes:

< - Less than the Human Health Drinking Water Screening Level.
DW - Drinking Water.
HH - Human Health.
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
RSL - Risk-Based Screening Level.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Drinking Water Supply.
Federal USEPA MCL for Drinking Water.
Federal November 2017 USEPA Tapwater RSL.
Federal USEPA SMCL for Drinking Water.

TABLE 8
SUMMARY OF ISLE DU BOIS CREEK SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVEL
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)																	
	Constituent	Chromium		Cobalt		Lead		Lithium		Mercury		Molybdenum		Selenium		Thallium		Radium-226/228	Hardness
	Fraction	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total
Sample	**HH DW SL**	0.1	0.1	0.006	0.006	0.015	0.015	0.04	0.04	0.002	0.002	0.1	0.1	0.05	0.05	0.002	0.002	5	NA
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	mg/L
UPSTREAM																			
RI-C-7	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-8	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-9	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
ADJACENT																			
RI-C-4	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-5	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-6	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
DOWNSTREAM																			
RI-C-1	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-1 DUP	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-2	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-3	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<

Notes:

< - Less than the Human Health Drinking Water Screening Level.
DW - Drinking Water.
HH - Human Health.
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
RSL - Risk-Based Screening Level.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Drinking Water Supply.
Federal USEPA MCL for Drinking Water.
Federal November 2017 USEPA Tapwater RSL.
Federal USEPA SMCL for Drinking Water.

TABLE 9
SUMMARY OF ISLE DU BOIS CREEK SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH RECREATIONAL USE SCREENING LEVELS
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Human Health Recreational Use Screening (a)																			
	Constituent	Boron		Calcium		Chloride	pH	Sulfate	TDS	Fluoride	Antimony		Arsenic		Barium		Beryllium		Cadmium		Chromium	
	Fraction	Total	Dissolved	Total	Dissolved	Total	Total	Total	Total	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
	HH REC SL	NA	NA	NA	NA	NA	6.5-8.5	NA	NA	NA	4.3	4.3	0.00014	0.00014	NA	NA	NA	NA	NA	NA	NA	NA
Sample Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
UPSTREAM																						
RI-C-7	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	0.0011 J	<	<	<	<	<	<	<	<	<
RI-C-8	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	0.00079 J	<	<	<	<	<	<	<	<	<
RI-C-9	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	0.0012 J	<	<	<	<	<	<	<	<	<
ADJACENT																						
RI-C-4	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	0.00091 J	<	<	<	<	<	<	<	<	<
RI-C-5	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	0.0012 J	<	<	<	<	<	<	<	<	<
RI-C-6	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
DOWNSTREAM																						
RI-C-1	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	0.0015 J	<	<	<	<	<	<	<	<	<
RI-C-1 DUP	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	0.0015 J	<	<	<	<	<	<	<	<	<
RI-C-2	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	0.0017 J	<	<	<	<	<	<	<	<	<
RI-C-3	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	0.0013 J	<	<	<	<	<	<	<	<	<

Notes:
< - Less than the Human Health Recreational Use Screening Level.
HH - Human Health.
mg/L - milligram per liter.
pCi/L - picoCurie per liter.
NA - Not Applicable/Not Analyzed.
REC - Recreational Use.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

Qualifiers:
J - Value is estimated.

(a) - Recreational Use Screening Levels selected in Table 2 following the following hierarchy:
Missouri State Water Quality Criteria for Human Health Fish Consumption.
USEPA Ambient Water Quality Criteria for Human Health Consumption of Organism Only.

TABLE 9
SUMMARY OF ISLE DU BOIS CREEK SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH RECREATIONAL USE SCREENING LEVELS
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Human Health Recreational Use Screening (a)															
	Constituent	Cobalt		Lead		Lithium		Mercury		Molybdenum		Selenium		Thallium		Radium-226+228	Hardness
	Fraction	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total
	HH REC SL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.2	4.2	0.0063	0.0063	NA	NA
Sample Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	mg/L
UPSTREAM																	
RI-C-7	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-8	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-9	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
ADJACENT																	
RI-C-4	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-5	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-6	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
DOWNSTREAM																	
RI-C-1	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-1 DUP	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-2	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-3	Apr-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<

Notes:
< - Less than the Human Health Recreational Use Screening Level.
HH - Human Health.
mg/L - milligram per liter.
pCi/L - picoCurie per liter.
NA - Not Applicable/Not Analyzed.
REC - Recreational Use.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

Qualifiers:
J - Value is estimated.

(a) - Recreational Use Screening Levels selected in Table 2 following the following hierarchy:
Missouri State Water Quality Criteria for Human Health Fish Consumption.
USEPA Ambient Water Quality Criteria for Human Health Consumption of Organism Only.

TABLE 10
SUMMARY OF ISLE DU BOIS CREEK SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO ECOLOGICAL SCREENING LEVEL!
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Ecological Screening (a)																	
	Constituent	Boron		Calcium		Chloride	pH	Sulfate	TDS	Fluoride	Antimony		Arsenic		Barium		Beryllium		Cadmium	
	Fraction	Total	Dissolved	Total	Dissolved	Total	Total	Total	Total	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample	**ECO SL**	2	2	NA	NA	230	6.5-8.5	1784	NA	4	NA	NA	0.15	0.02	NA	NA	0.1	0.005	0.0018	0.00049
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	S.U	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
UPSTREAM																				
RI-C-7	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-C-8	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-C-9	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
ADJACENT																				
RI-C-4	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-C-5	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-C-6	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
DOWNSTREAM																				
RI-C-1	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-C-1 DUP	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-C-2	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<
RI-C-3	Apr-14	<	<	<	<	NA	<	<	NA	<	<	<	<	<	<	<	<	<	<	<

Notes:
< - Less than the Ecological Screening Level.
ECO - Ecological.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Ecological Screening Levels selected in Table 3 following the following hierarchy:
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Chronic).
USEPA Aquatic Life Ambient Water Quality Criteria (Chronic).
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Acute).
USEPA Aquatic Life Ambient Water Quality Criteria (Acute).
Missouri State Water Quality Criteria for Irrigation.
Missouri State Water Quality Criteria for Livestock Wildlife Watering.

TABLE 10
SUMMARY OF ISLE DU BOIS CREEK SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO ECOLOGICAL SCREENING LEVEL!
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Ecological Screening (a)																	
	Constituent	Chromium		Cobalt		Lead		Lithium		Mercury		Molybdenum		Selenium		Thallium		Radium-226/228	Hardness
	Fraction	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total
Sample	**ECO SL**	0.196	0.17	1	1	0.011	0.0074	NA	NA	0.0005	0.00077	NA	NA	0.005	0.005	NA	NA	NA	NA
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	mg/L
UPSTREAM																			
RI-C-7	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-8	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-9	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
ADJACENT																			
RI-C-4	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-5	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-6	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
DOWNSTREAM																			
RI-C-1	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-1 DUP	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-2	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
RI-C-3	Apr-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<

Notes:
< - Less than the Ecological Screening Level.
ECO - Ecological.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Ecological Screening Levels selected in Table 3 following the following hierarchy:
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Chronic).
USEPA Aquatic Life Ambient Water Quality Criteria (Chronic).
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Acute).
USEPA Aquatic Life Ambient Water Quality Criteria (Acute).
Missouri State Water Quality Criteria for Irrigation.
Missouri State Water Quality Criteria for Livestock Wildlife Watering.

TABLE 11
SUMMARY OF WHOLE EFFLUENT TOXICITY TESTING RESULTS FOR NPDES OUTFALL 002 (a)
RUSH ISLAND ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

Sampling Event	Treatment	Percent Survival at 48 hours	
		Pimephales promelas	***Ceriodaphnia dubia***
Outfall 002			
February 2005 (a)	10% Effluent	98%	100%
	Reconstituted Control	100%	100%
	Upstream Control	98%	100%

Notes:
NPDES - Natural Pollutant Discharge Elimination System.

No significant difference (alpha = 0.05) between effluent and control survival data for the above test.
Effluent passes the test conducted in 2005.
10% Effluent - Outfall 002 effluent mixed with Mississippi River water.
Reconstituted Control - Laboratory reconstituted water.
Upstream Control - Mississippi River water.

(a) - Effluent samples collected on February 8, 2005.

TABLE 12
DERIVATION OF RISK-BASED SCREENING LEVELS FOR GROUNDWATER BASED ON THE MISSISSIPPI RIVER
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

			Estimated Dilution Factor (d) =		100,000			
Constituents	**HH DW SL (a) (mg/L)**	**HH REC SL (b) (mg/L)**	**ECO SL (c) (mg/L)**	**Lowest of the Human Health and Ecological Screening Levels (mg/L)**	**Groundwater Risk-Based Screening Level* (mg/L)**	**Maximum RIEC Groundwater Concentration (mg/L)**		**Ratio Between Groundwater Risk-Based Screening Level and the Maximum RIEC Groundwater Concentration**
Boron	4	NA	2	2	200000	15.7	R-MW-3	>12,000
Sulfate	250	NA	1582	250	25000000	382	R-MW-1	>65,000
Antimony	0.006	4.3	NA	0.006	600	0.0064	R-MW-2	>93,000
Arsenic	0.05	0.00014	0.02	0.00014	14	0.257	R-MW-2	>50
Lead	0.015	NA	0.0058	0.0058	578	0.0177	R-MW-2	>32,000
Lithium	0.04	NA	NA	0.04	4000	0.0647	R-MW-B1	>61,000
Molybdenum	0.1	NA	NA	0.1	10000	0.943	R-MW-3	>10,000
TDS	500	NA	NA	500	50000000	874	R-MW-2	>50,000

Notes:
* Where the Groundwater Risk-Based Screening Level = Screening Level x Dilution Factor.
ECO SL - Ecological Screening Level.
HH DW SL - Human Health Drinking Water Screening Level.
HH REC SL - Human Health Recreational Use Screening Level.
mg/L - milligram per liter.
NA - Not Available.

(a) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Drinking Water Supply.
Federal USEPA MCL for Drinking Water.
Federal November 2017 USEPA Tapwater RSL.
Federal USEPA SMCL for Drinking Water.
(b) - Recreational Use Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Human Health Fish Consumption.
USEPA Ambient Water Quality Criteria for Human Health Consumption of Organism Only.
(c) - Ecological Screening Levels selected in Table 2 following the following hierarchy:
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Chronic).
USEPA Aquatic Life Ambient Water Quality Criteria (Chronic).
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Acute).
USEPA Aquatic Life Ambient Water Quality Criteria (Acute).
Missouri State Water Quality Criteria for Irrigation.
Missouri State Water Quality Criteria for Livestock Wildlife Watering.
(d) - Estimated value, see text and Attachment B for derivation.

TABLE 13
SUMMARY OF ON-SITE DEEP WELL WATER COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a,b)																		
	Constituent	Boron	Calcium	Chloride	pH	Sulfate	TDS	Fluoride	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
	HH DW SL	4000	NA	250	6.5-8.5	250	500	4	6	50	200	4	5	100	6	15	40	2	100	50	2
Monitoring Well ID	**Sampling Event Date**	mg/L	mg/L	mg/L	S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Storage Tank	Apr-10	NA	<	<	<	<	<	<	<	<	<	<	<	<	NA	<	NA	<	NA	<	<
	Apr-12	NA	<	413	<	<	1022	<	<	<	<	<	<	<	NA	<	NA	<	NA	<	<
	Apr-15	NA	<	460	<	<	1020	<	<	<	<	<	<	<	NA	<	NA	<	NA	<	<
RI-Well-A	Jan-18	<	<	627	<	<	1140	<	<	<	<	<	<	<	<	<	137	<	<	<	<
RI-Well-B	Jan-18	<	<	417	<	<	868	<	<	<	<	<	<	<	<	<	112	<	<	<	<

Notes:
< - Less than the Human Health Drinking Water Screening Level.
DW - Drinking Water.
HH - Human Health.
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - Not applicable.
RSL - Regional Screening Level.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Numerical values were obtained from the Ameren Missouri Rush Island Energy Center, Jefferson County, Festus, MO.
(b) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Drinking Water Supply.
Federal USEPA MCL for Drinking Water.
Federal November 2017 USEPA Tapwater RSL.

FIGURES

LEGEND

- Rush Island Energy Center Property Boundary
- Length of Groundwater Discharge Used in the Dilution Factor Calculations
- RCPA Surface Impoundment

Groundwater Elevation Contours (FT MSL)

- Groundwater Elevation Contour (FT MSL)
- Inferred Groundwater Elevation Contour (FT MSL)

Ground/Surface Water Measurement Locations

- Groundwater Monitoring Well
- Mississippi River Gauge
- RCPA Pond Gauge
- Groundwater Flow Direction
- Surface Water Flow Direction

KEY MAP

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GROUNDWATER MONITORING WELLS SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON DECEMBER 1, 2015.
3.) GROUNDWATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
4.) GROUNDWATER ELEVATION MEASUREMENTS OBTAINED BY GOLDER ON JULY 14, 2017.
5.) MISSISSIPPI RIVER LEVEL PROVIDED BY AMEREN.
6.) POND LEVEL OBTAINED ONSITE BY GOLDER.

REFERENCES

1.) AMEREN MISSOURI RUSH ISLAND ENERGY CENTER, RUSH ISLAND PROPERTY CONTROL MAP, JANUARY 2012.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2401 FEET.

0 500 1,000 2,000 Feet

CLIENT
AMEREN MISSOURI
RUSH ISLAND ENERGY CENTER

PROJECT
AMEREN HYDROGEOLOGICAL CONSULTING

TITLE
ESTIMATED LENGTH OF DISCHARGE AND EXAMPLE GROUNDWATER FLOW MAP

CONSULTANT
Golder Associates

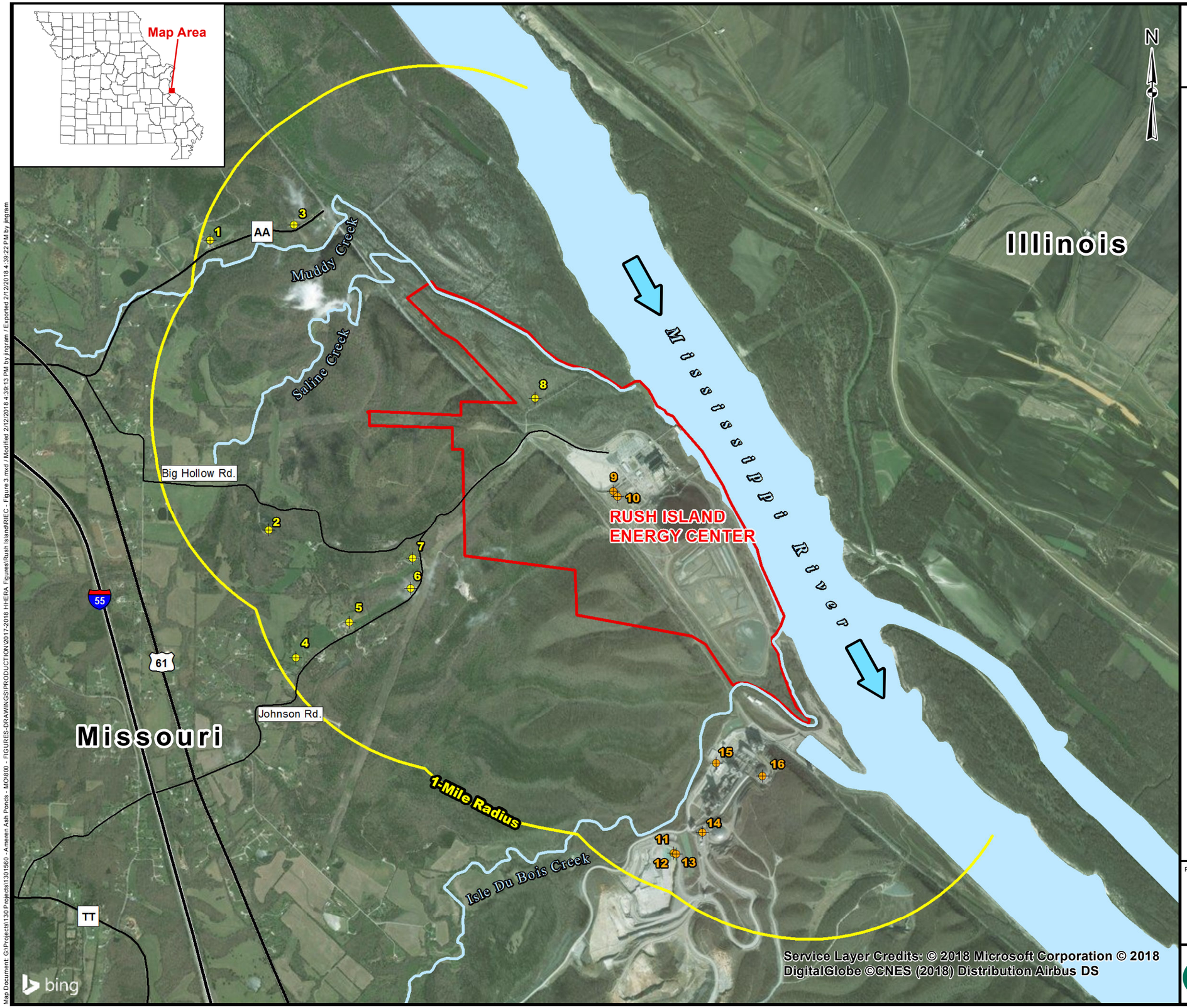
YYYY-MM-DD	2017-12-13
PREPARED	JSI
DESIGN	JSI
REVIEW	RJF
APPROVED	MNH

PROJECT No.
130-1560

FIGURE
1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 11in

Path: G:\Projects\130 Projects\1301560 - Ameren Ash Ponds - MO\800 - FIGURES-DRAWINGS\PRODUCTION\2017-2018 HHERA Figures\Rush Island\RIEC - Figure 1.mxd



TITLE

PRIVATE WELL LOCATIONS WITHIN 1-MILE RADIUS OF FACILITY BOUNDARY

LEGEND

- Rush Island Property Boundary
- Approximate 1-Mile Radius
- Non-Community Public Well
- Private Well
- Surface Water Flow Direction

NOTES

1.) All locations and boundaries are approximate.
2.) Figure displays all non-community public and private wells located near the Rush Island Energy Center property boundary in Jefferson and Ste. Genevieve Counties, Missouri, based on state well records.
3.) See Table 2 and Appendix B for more information on the wells located within one mile of the Rush Island Energy Center Property Boundary.
4.) Wells displayed outside of the 1-mile radius are plotted based on the address of the well from the MDNR well certification forms.
5.) MDNR - Missouri Department of Natural Resources.
6.) MSDIS - Missouri Spatial Data Information Service.
7.) GeoSTRAT - Geosciences Technical Resources Assessment Tool.

REFERENCES

1.) Ameren, 2012. Ameren Missouri Rush Island Energy Center, Rush Island Property Control Map, January 2012.
2.) CARES. 2013. Public Drinking Water System Reports. Center for Applied Research and Environmental Systems.
3.) MDNR. 2013a. Missouri Well Information Management System (WIMS), Wellhead Protection Program. Missouri Department of Natural Resources.
4.) MDNR. 2013b. Geologic Well Logs of Missouri, Water Resource Center. Missouri Department of Natural Resources.
5.) MDNR, 2014a. Geosciences Technical Resource Assessment Tool (GeoSTRAT). Missouri Department of Natural Resources.
6.) MEGA. 2007. Missouri Environmental Geology Atlas. A Collection of Statewide Geographic Information System Data.
7.) MSDIS. 2013. Missouri Spatial Data Information Service.
8.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 3,000 6,000
Feet

PROJECT

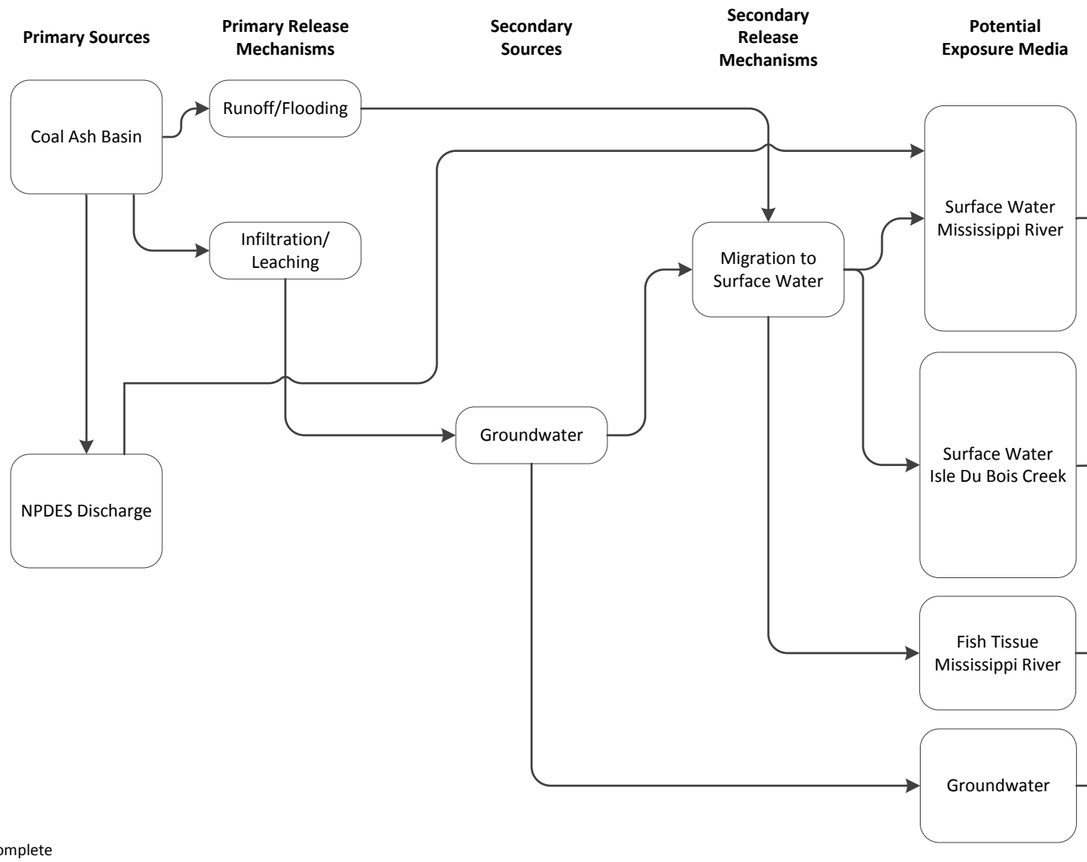
AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
JEFFERSON COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			RIEC - Figure 3.mxd
DESIGN	-	-	SCALE: AS SHOWN REV. 3
GIS	JSI	6/6/2014	
CHECK	MWD	6/7/2014	FIGURE 2
REVIEW	MNH	6/15/2014	

Map Document: G:\Projects\130 Projects\130 1560 - Ameren Ash Ponds - MO\800 - FIGURES-DRAWINGS\PRODUCTION\2017-2018 HHERA Figures\Rush Island\RIEC - Figure 3.mxd / Modified 2/12/2018 4:39:13 PM by jingram / Exported 2/12/2018 4:39:22 PM by jingram

FIGURE 3
CONCEPTUAL SITE MODEL
RUSH ISLAND ENERGY CENTER, JEFFERSON COUNTY, FESTUS, MO
AMEREN MISSOURI



	Potential Human Health Receptors					Potential Ecological Receptors
Potential Exposure Route	**Current/Future Off-Site Resident Adult/Child**	**Current/Future Off-Site Recreational Swimmer**	**Current/Future Off-Site Recreational Wader**	**Current/Future Off-Site Recreational Boater**	**Current/Future Off-Site Recreational Fisher**	**Aquatic Receptors**
Drinking Water Use	⊙ (a)	O	O	O	O	NA
Incidental Ingestion	O	⊙	⊙	⊙	⊙	NA
Dermal Contact	O	⊙	⊙	⊙	⊙	NA
Aquatic Exposure	NA	NA	NA	NA	NA	⊙
Drinking Water Use	O (b)	O	O	O	O	NA
Incidental Ingestion	O	O (c)	⊙	O (c)	O (c)	NA
Dermal Contact	O	O (c)	⊙	O (c)	O (c)	NA
Aquatic Exposure	NA	NA	NA	NA	NA	⊙
Ingestion	O	O	O	O	●	NA
Aquatic Exposure	NA	NA	NA	NA	NA	⊙
Drinking Water Use	O (d)	O	O	O	O	NA
Aquatic Exposure	NA	NA	NA	NA	NA	O (e)

Notes:

- ● Pathway potentially complete
- ⊙ Pathway potentially complete, but insignificant.
- O Pathway evaluated and found incomplete.

(a) The Mississippi River is used as a source of drinking water; the nearest downstream drinking water intake is 30 miles downstream at the Chester Intake in Illinois. All detected constituent concentrations are below drinking water screening levels.

(b) Isle Du Bois Creek is not used as a source of drinking water.

(c) The size of Isle Du Bois Creek precludes swimming, fishing and boating activities.

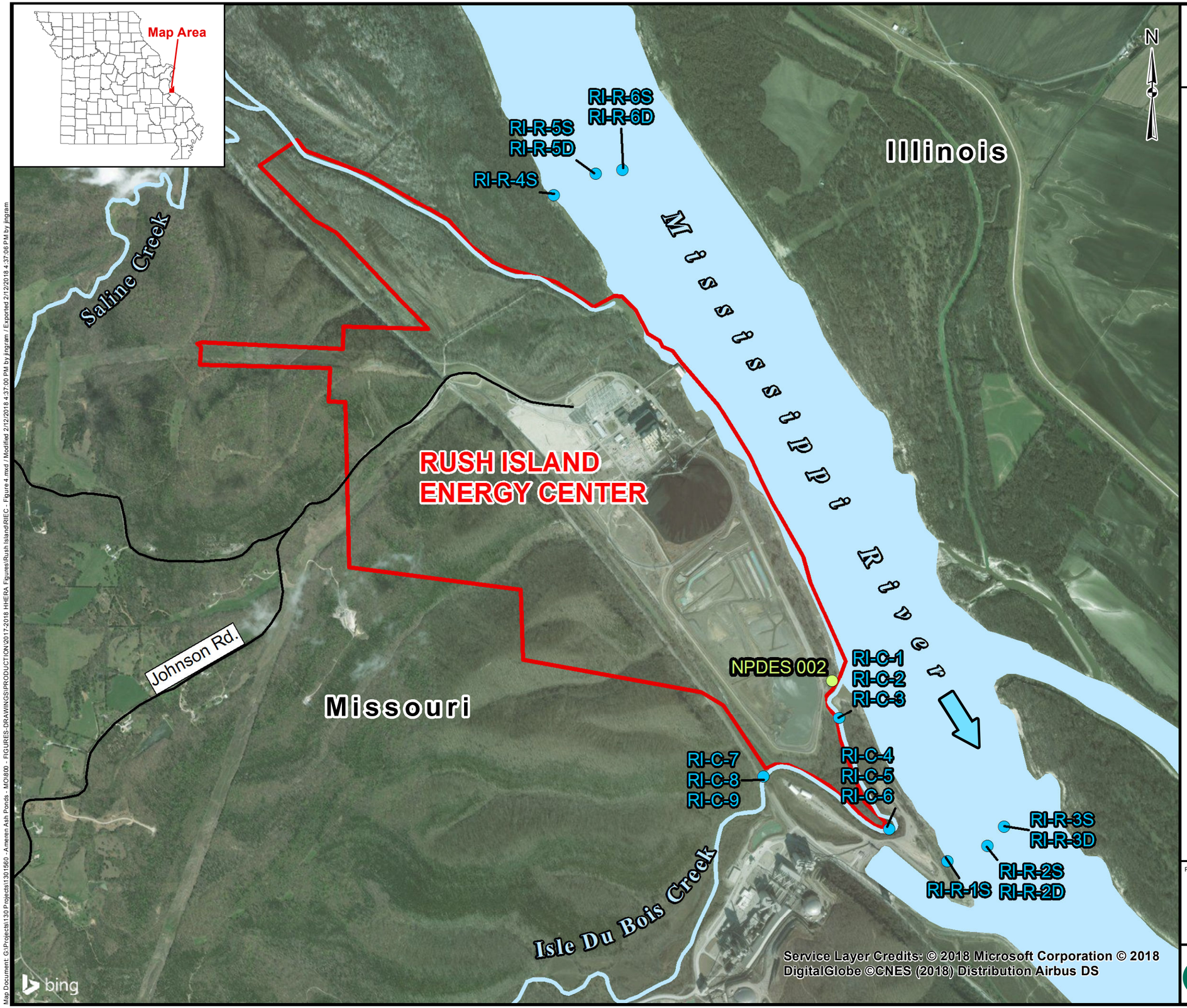
(d) The shallow alluvial aquifer in the vicinity of the RCPA is not used for drinking water purposes.

(e) Ecological Receptors are not exposed to groundwater.

NA – Not Applicable.

NPDES - National Pollutant Discharge Elimination System.

HALEY ALDRICH



TITLE

SURFACE WATER SAMPLING LOCATIONS

LEGEND

- Rush Island Property Boundary
- Surface Water Sample Location
- Ameren NPDES Outfall

NOTES

1.) All boundaries and locations are approximate.
2.) Sample locations for surface water samples were obtained during sampling using a Trimble GeoXH GPS unit.
3.) NPDES outfall location based on MEGA database.

REFERENCES

1.) Ameren, 2012. Ameren Missouri Rush Island Energy Center, Rush Island Property Control Map, January 2012.
2.) MEGA. 2007. Missouri Environmental Geology Atlas. A Collection of Statewide Geographic Information System Data.
3.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 2,000 4,000 Feet

PROJECT

Ameren

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
JEFFERSON COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			RIEC - Figure 4.mxd
DESIGN	-	-	SCALE: AS SHOWN REV. 3
GIS	JSI	6/4/2014	
CHECK	MWD	6/5/2014	FIGURE 4
REVIEW	MNH	6/15/2014	

ATTACHMENT A

Constituents Present in Coal Ash and in Our Natural Environment

Attachment A

Constituents Present in Coal Ash and in Our Natural Environment

It is important to understand what constituents are present in coal ash, which can be released to the environment, and to understand the natural occurrence of these constituents in our environment.

Coal is a type of sedimentary rock that is a natural component of the earth's crust and the inorganic minerals and elements it contains are also naturally occurring. It is the organic component of coal that burns and produces energy, and it is the inorganic minerals and elements that remain after combustion the make up the coal ash, or coal combustion products (CCPs).

A.1 Major, Minor and Trace Constituents in Coal Ash

All of the inorganic minerals and elements that are present in coal ash are also present in our natural environment. This is one fact that that the public seems either not to understand or will not acknowledge. **Figure A-1** shows the major and minor components of fly ash, bottom ash, volcanic ash, and shale. It is important to understand that the constituents that are the focus of many of the concerns expressed by the public about the toxicity of coal ash (e.g., lead, arsenic, mercury, cadmium, selenium, etc.) are trace elements, so called because they are present in such low concentrations (in the mg/kg or part per million (ppm) range). Together, the trace elements generally make up less than 1 percent of the total mass of these materials. To put these concentrations into context, a mg/kg or ppm is equivalent to:

- 1 penny in a large container holding $10,000 worth of pennies, or
- 1 second in 11.5 days, or
- 1 inch in 15.8 miles

These trace elements have been referred to by the public and even in the popular press as "toxic"—without any context provided for what this means. Moreover, claims have been made that there is no safe level of exposure to any of these elements.

This is simply not true, and there are two important facts that must be understood to put this in context. The first relates to background levels of constituents in our environment and the second relates to toxicity.

A.2 Background Levels in Soils

The first fact that must be understood is that all of the constituents present in coal ash occur naturally in our environment. U.S. Geological Survey (USGS) data demonstrate the presence of these constituents in the soils across the U.S. Prime examples include arsenic, lead, mercury and selenium. With respect to arsenic, **Figure A-2** shows the range of background levels of arsenic in soils across the U.S., as published by the USGS. The USGS is conducting a "national geochemical survey" to identify background levels of elements in soils in the U.S. (USGS, 2013). **Figures A-3 – A-6** provide maps prepared by the USGS demonstrating the naturally-occurring presence of other trace elements in soils in the U.S., including aluminum and copper (**Figure A-3**), iron and lead (**Figure A-4**), manganese and mercury (**Figure A-5**), and selenium and zinc (**Figure A-6**).

These soils are found in our backyards, schools, parks, etc., and because of their presence in soil, these constituents are also present in the foods we eat. Some of these constituents are present in

our vitamins, such as manganese and selenium. Thus, we are exposed to these trace elements in our natural environment every day, and in many ways.

A.3 Toxicity and Risk

The second fact is that all constituents and materials that we encounter in our natural environment can be toxic, but what determines whether a toxic effect actually occurs is how one is exposed to the constituent, the amount of material to which one may be exposed, and the timing and duration of that exposure. Without sufficient exposure the science tells us that there are no toxic effects. Put another way, when a toxic effect is demonstrated by a particular constituent, it is generally caused by high levels of exposure over a long-term duration. The fundamental principles here are:

- All constituents can exert toxic effects (from aspirin[1] to table salt to water to minerals).
- For such toxic effects to occur, exposure must occur at a sufficiently high level for a sufficiently long period of time.
- If there is no exposure, there is no risk.

A.4 Risk-Based Screening Levels

The U.S. Environmental Protection Agency (USEPA) uses information on the potential toxicity of constituents to identify concentrations of trace elements in soil in a residential setting that are considered by USEPA to be protective for humans (including sensitive groups) over a lifetime (USEPA, 2014c). Specifically, residential soil screening levels are levels that are protective of a child and adult's daily exposure to constituents present in soil or a solid matrix over a residential lifetime. In the context of regulatory decision making, at sites where constituent concentrations fall below these screening levels, no further action or study is warranted under the federal Superfund program. Missouri Department of Natural Resources also applies this concept to the development of screening levels in its Risk-Based Corrective Action program (MDNR, 2006).

Figure A-7 shows USEPA's residential soil screening levels for a variety of trace elements that are present in coal ash. USEPA considers it to be safe for children to be exposed to these concentrations of each of these trace elements in soils on a daily basis, throughout their lifetime. What this tells us is that by developing these residential soil screening levels, USEPA considers the presence of these levels of these constituents in soils to be safe for humans, even for exposure on a daily basis. It is, therefore, simply not true that there are no safe levels of exposure to these constituents.

A.5 Comparison of Coal Ash Constituent Concentrations to Risk-Based Screening Levels and Background

A comparison of constituent concentrations in coal ash, as reported by the USGS (USGS, 2011a) to USEPA's risk-based screening levels for residential soil indicates that with only a few exceptions, constituent concentrations in coal ash are below screening levels developed by the USEPA for residential soils, and are similar in concentration to background U.S. soils. Details of this evaluation are provided in the report titled "Coal Ash Material Safety: A Health Risk-Based Evaluation of USGS

[1] For example, if one takes two aspirin every four hours as directed, aspirin is not toxic. If one takes the entire bottle at once, the aspirin is very toxic.

Coal Ash Data from Five US Power Plants" (AECOM, 2012). The study is available at: http://www.acaa-usa.org/associations/8003/files/ACAA_CoalAshMaterialSafety_June2012.pdf.

Figure A-8 is an updated chart from this study comparing ranges of trace element concentrations in fly ash produced from coal from the Powder River Basin in Wyoming (the same type of coal used at Rush Island Energy Center) to USEPA screening levels, and to background levels in soils in the U.S. The USEPA screening levels for residential soils (USEPA, 2014c) are shown as the green vertical bars, the ranges for the Wyoming coal fly ash are shown in purple on top of the green vertical bars, and the ranges of background levels in U.S. soils are shown in the grey bars. What this figure shows is that all but one of the constituents are present in the Wyoming fly ash at concentrations that are below the USEPA residential soil screening levels; and for cobalt, the concentration range is only marginally above the screening level. As noted in detail in the report itself, the toxicity value upon which the USEPA soil screening level for cobalt is based is two levels of magnitude lower than what has been derived by other regulatory agencies; thus a much higher health protective soil screening level for cobalt exists. What the data also show is that constituent concentrations in coal ash are not that different from concentrations in soils in the U.S.

The results are similar for all of the coal ashes evaluated in the report (AECOM, 2012). The evaluation in the report included not only the simple comparison of constituent concentrations in coal ash to USEPA screening levels, but also provided a detailed cumulative risk screen for each coal ash data set to account for potential additive effects of combined exposures to the trace elements in coal ash. The results confirm the simple screening results, which indicate that no significant risk would be posed by direct exposure to coal ash in a residential setting.

Thus, by considering the levels of trace elements in coal ash in comparison to the background levels in soils in the U.S., and in comparison to the USEPA screening levels for these constituents in residential soil, screening levels that are protective of daily exposure to soils by children and adults, including sensitive subgroups, it is concluded that even daily direct contact to trace elements in coal ash would not pose a significant risk to human health.

A.6 Background Levels in Groundwater

Because these constituents are naturally present in soils and rocks, they are also naturally present in our groundwaters and surface waters. The USGS has published a report titled "Trace Elements and Radon in Groundwater Across the United States" (USGS, 2011b). Just as for soil, it is important to understand that there are background levels of constituents in groundwater. Constituent concentrations in groundwater that is upgradient of a source represent background conditions. To demonstrate a release to groundwater by a source, concentrations downgradient of the source must be greater than the background/upgradient concentrations at a statistically significant level for a consistent period of time.

The same concept applies to surface water. These same constituents are naturally present in surface water due to discharge of groundwater to surface water and the effect of erosion of soil into our surface waters. To demonstrate an effect of a source on surface water, the concentrations downgradient/downstream of the source must be greater than the background/upstream concentrations at a statistically significant level for a consistent period of time.

Constituents in groundwater and surface water can be in a dissolved form, or they can be adhered to or part of a soil or sediment particle. Movement of these particles in groundwater is generally more difficult because of the presence of the soil and rock that the groundwater must move through. Surface water is constantly impacted by erosion of soils, thus in surface water, it is much more

common for constituents to be bound to particles rather than dissolved in the water. For this reason, it is important to evaluate both total concentrations of constituents in water (which represents constituents dissolved in the water and as part of a soil or sediment particle) and the dissolved component (by filtering out the soil/sediment particles).

A.7 Toxicity Evaluation for Cobalt and Chromium

A.7.1 Cobalt

Cobalt is the only constituent in the Powder River Basin coal ash (the coal that is used at the Rush Island Energy Center) with concentrations above the USEPA screening level for residential soils. There is much uncertainty associated with the USEPA dose-response value for cobalt, and with the resulting screening level for residential soil. The World Health Organization (WHO) indicates that "there are no suitable data with which to derive a tolerable intake for chronic ingestion of cobalt" (WHO, 2006). Agency for Toxic Substances and Disease Registry (ATSDR, 2004) states that "adequate chronic studies of the oral toxicity of cobalt or cobalt compounds in humans and animals are not presently available." However, using a short-term study in six human volunteers, ATSDR (2004) derived an intermediate-term (15–364 days) minimal risk level (MRL) of 0.05 mg/kg-day. The "adverse" effect was identified as increased red blood cell count, although it is also noted that cobalt is used as a treatment for anemia (low red blood cell count). ATSDR also notes that "Since cobalt is naturally found in the environment, people cannot avoid being exposed to it. However, the relatively low concentrations present do not warrant any immediate steps to reduce exposure." WHO notes that the largest source of exposure to cobalt for the general population is the food supply; the estimated intake from food is 5–40 ug/day, most of which is inorganic cobalt (WHO, 2006). Expressed on a mg/kg-day basis, this is 0.00007–0.0005 mg/kg-day from the diet.

USEPA however has derived a Provisional Peer-Reviewed Toxicity Value (PPRTV) for cobalt of 0.0003 mg/kg-day, this is two orders of magnitude lower than the ATSDR intermediate term MRL, and is higher that most dietary intake estimates. Thus the RSL for cobalt for residential soil is much lower than values derived by other regulatory bodies.

A.7.2 Hexavalent Chromium

The data provided by USGS (2011a) for chromium is for total chromium in the samples; the Ameren data for groundwater and surface water are also based on analysis of total chromium. Many metals can exist in different oxidation states; for some metals, the oxidation state can have different toxicities. This is the case for chromium. Chromium exists in two common oxidation states: trivalent chromium (chromium-3, Cr(III) or Cr+3), and hexavalent chromium (chromium-6, Cr(VI) or Cr+6). Trivalent chromium is essentially nontoxic, as evidenced by its RSL of 120,000 mg/kg. It can be bought over-the-counter as a supplement, and is included in most vitamins. Hexavalent chromium has been concluded to be a human carcinogen by the inhalation route of exposure (USEPA, 2014a).

Currently on USEPA's toxicity database, the Integrated Risk Information System (IRIS) (USEPA, 2014a), the primary source of dose-response information for risk assessment and for the RSL tables, an oral reference dose is available for trivalent chromium, and IRIS provides an inhalation IUR for potential inhalation carcinogenic effects and an oral reference dose and inhalation reference concentration for hexavalent chromium. The oral noncancer dose-response value for hexavalent chromium is based on a study where no adverse effects were reported; thus the target endpoint is identified as "none reported."

Recent studies by the National Toxicology Program (NTP) have shown that when present in high concentrations in drinking water, hexavalent chromium can cause gastrointestinal tract tumors in mice (NTP, 2008). IRIS does not present an oral CSF for hexavalent chromium; a value developed by the New Jersey Department of Environmental Protection (NJDEP, 2009) was used in the development of the RSLs. USEPA developed a draft oral cancer dose-response value for hexavalent chromium, based on the same study and was the same as the NJDEP value. However, it should be noted that USEPA's Science Advisory Board (SAB) provided comments in July 2011 on the draft USEPA derivation of the oral CSF for hexavalent chromium and indicated many reservations with the assumptions of mode of action, and in the derivation itself. The SAB review can be accessed at http://cfpub.epa.gov/ncea/iris_drafts/recordisplay.cfm?deid=221433. Thus, the value used to develop the RSLs for hexavalent chromium has been called into question by USEPA's peer review panel. Currently there is much scientific debate about whether the mode of action of hexavalent chromium in very high concentrations in drinking water is relevant to the low concentrations most likely to be encountered in environmental situations (Proctor, et al., 2012).

Therefore, for this evaluation of chromium in the Powder River Basin coal ash, total chromium is evaluated assuming the total concentration is hexavalent chromium and using RSLs calculated using USEPA's on-line RSL calculator (USEPA, 2014b), based on the primary dose-response values provided in the IRIS database (USEPA, 2014a) for both potential carcinogenic and noncarcinogenic endpoints.

The assumption that all chromium in CCPs is in the hexavalent form is very conservative, and in fact unrealistic. Data for the Alaska Power Plant indicate that hexavalent chromium comprises 0.25% of the total chromium concentration in the combined fly ash/bottom ash material from that facility. Literature data for analyses of CCPs from US coals (total CCPs) indicate that hexavalent chromium can comprise up to 5% of the total chromium (Huggins, et al., 1999); thus over 95% of the total chromium is present in the nontoxic trivalent form. This is consistent with data from USEPA, though there are some single higher results (USEPA, 2009).

A.8 Summary

Constituents present in coal ash are also present in our natural environment, and we are exposed to them every day, in the soils that we contact and the food that we eat. All of these constituents have USEPA-derived risk-based screening levels for residential soils. The constituent concentrations in coal ash from the Powder River Basin, the source of the coal used at the Rush Island Energy Center, are below risk-based screening levels for residential soils (with one exception) and the concentrations are similar to background levels in U.S. soils.

A.9 References

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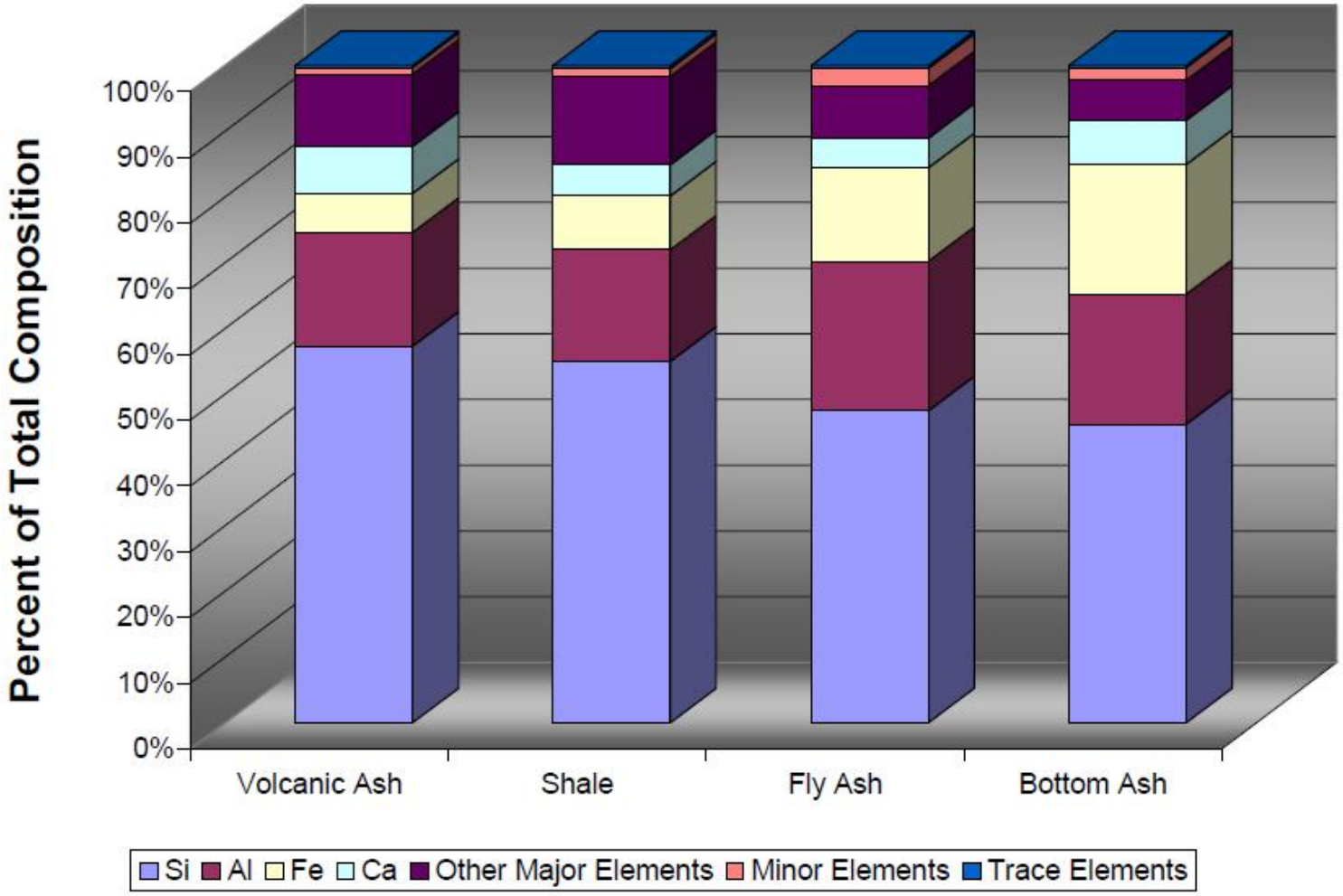
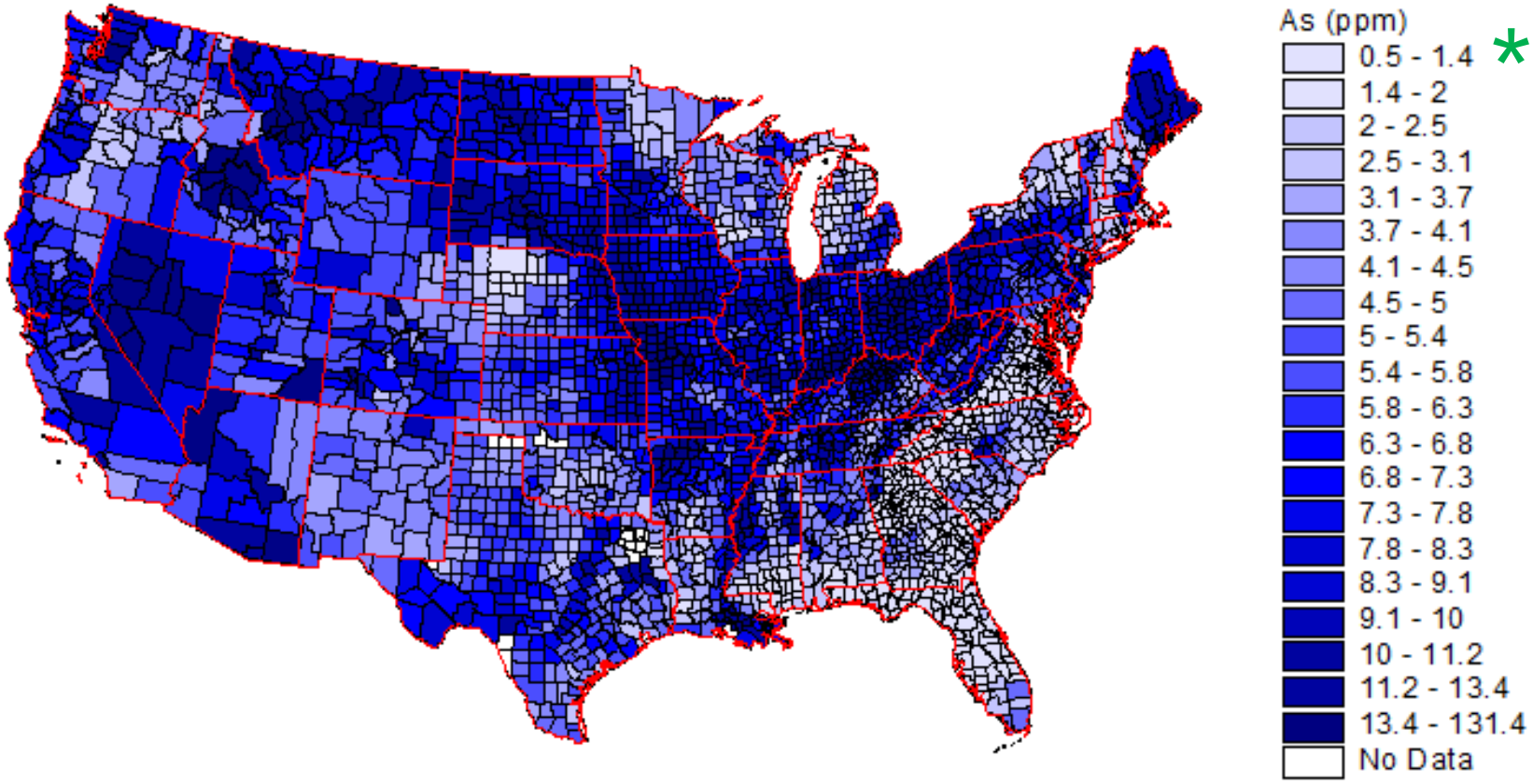
Attachment A – Figures

Figure A-1
Composition of Coal Ash and Other Natural Materials



Source: EPRI. 2010. Comparison of Coal Combustion Products to Other Common Materials – Chemical Characteristics. Report No. 1020556. Available for download at www.epri.com.

Figure A-2
Arsenic is Present in our Natural Environment –
Background Levels in Soils in the U.S.

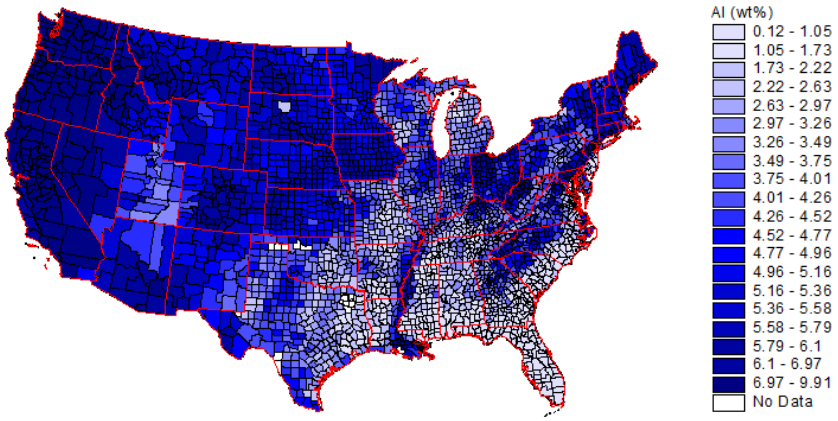


***The USEPA regional screening level for arsenic in residential soil at a one in one million risk level is 0.67 mg/kg. USEPA. 2014c.** http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
Thus the arsenic concentration in the majority of the soils in the U.S. are above the one in one million risk level.

Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

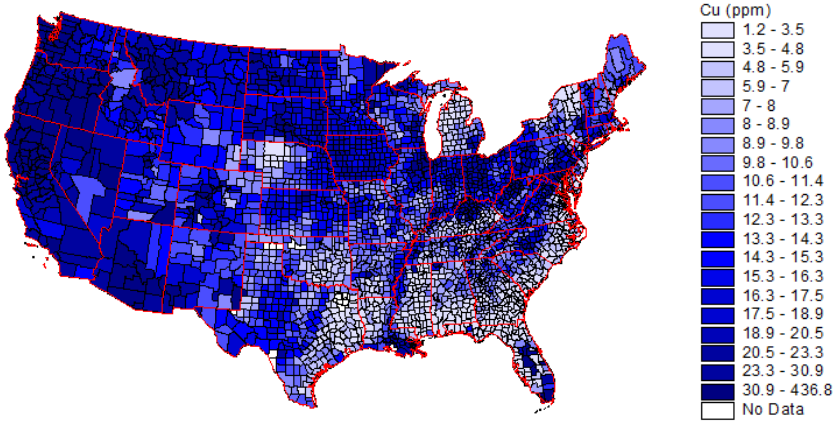
Figure A-3

Aluminum is Present in our Natural Environment –
Background Levels in Soils in the U.S.



Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

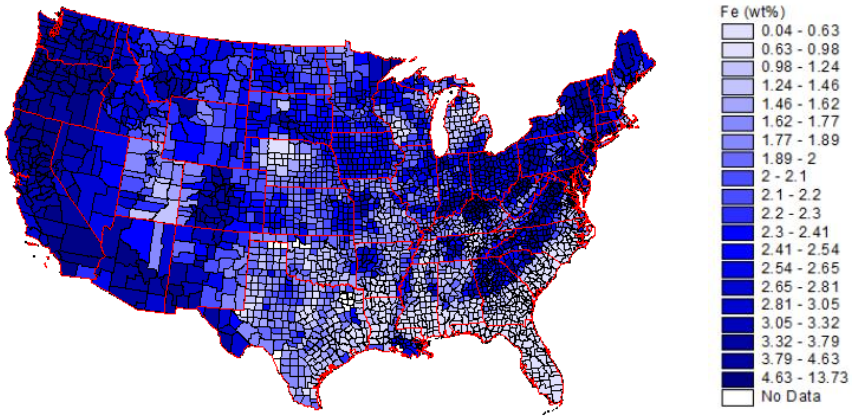
Copper is Present in our Natural Environment –
Background Levels in Soils in the U.S.



Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

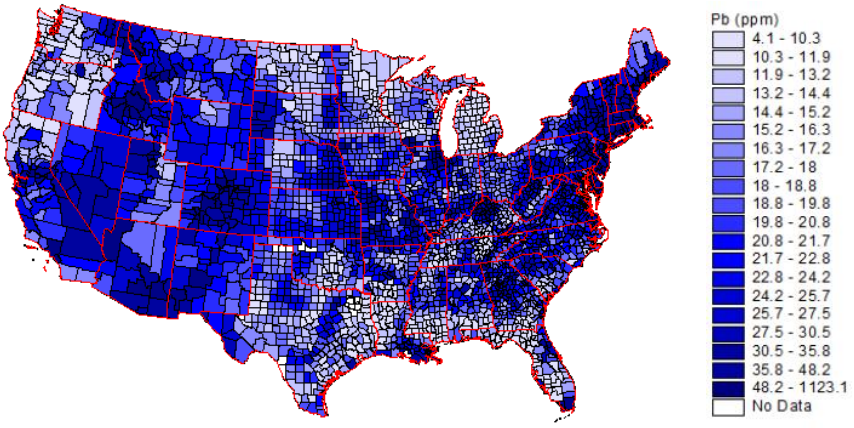
Figure A-4

Iron is present in our natural environment –
Background levels in soils in the U.S.



Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

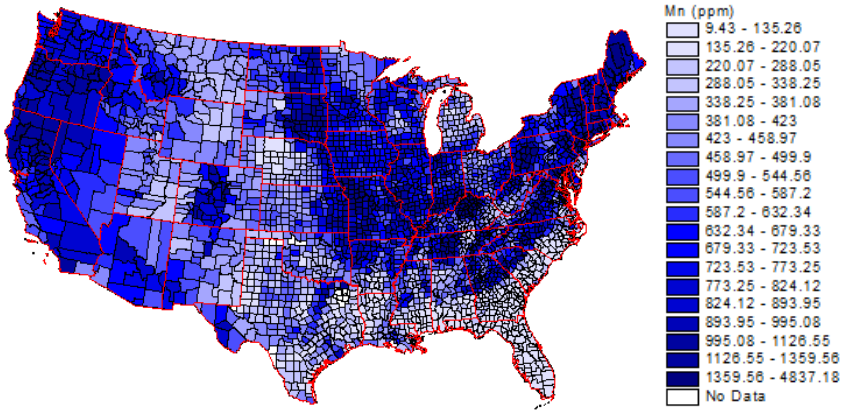
Lead is present in our natural environment –
Background levels in soils in the U.S.



Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

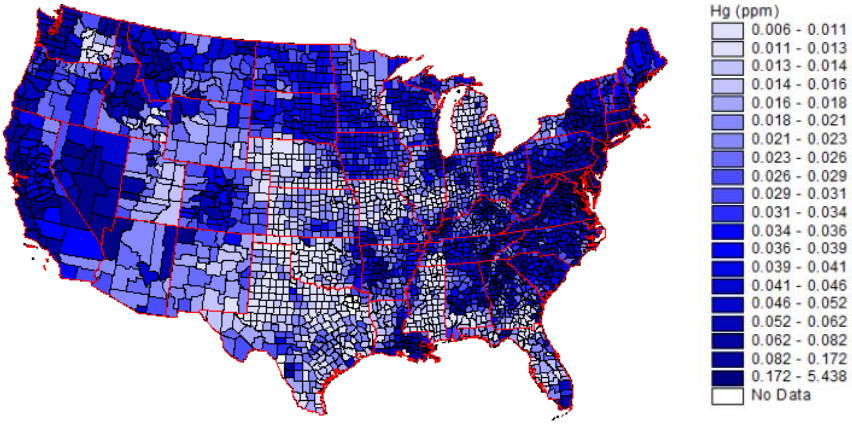
Figure A-5

Manganese is present in our natural environment –
Background levels in soils in the U.S.



Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

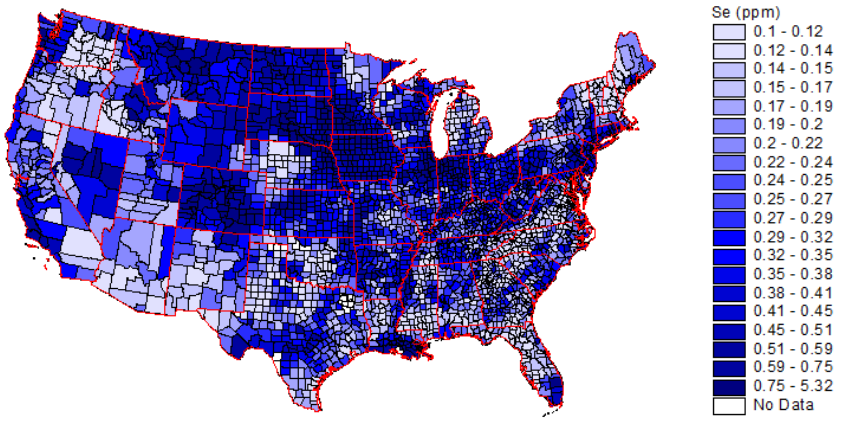
Mercury is present in our natural environment –
Background levels in soils in the U.S.



Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

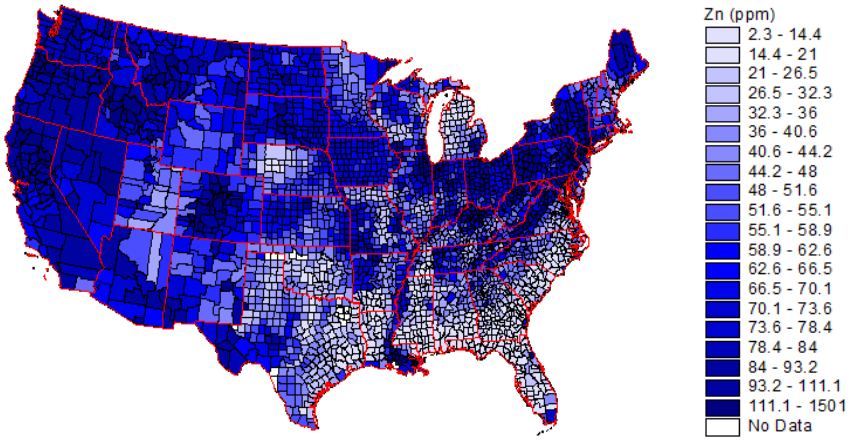
Figure A-6

Selenium is present in our natural environment –
Background levels in soils in the U.S.



Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

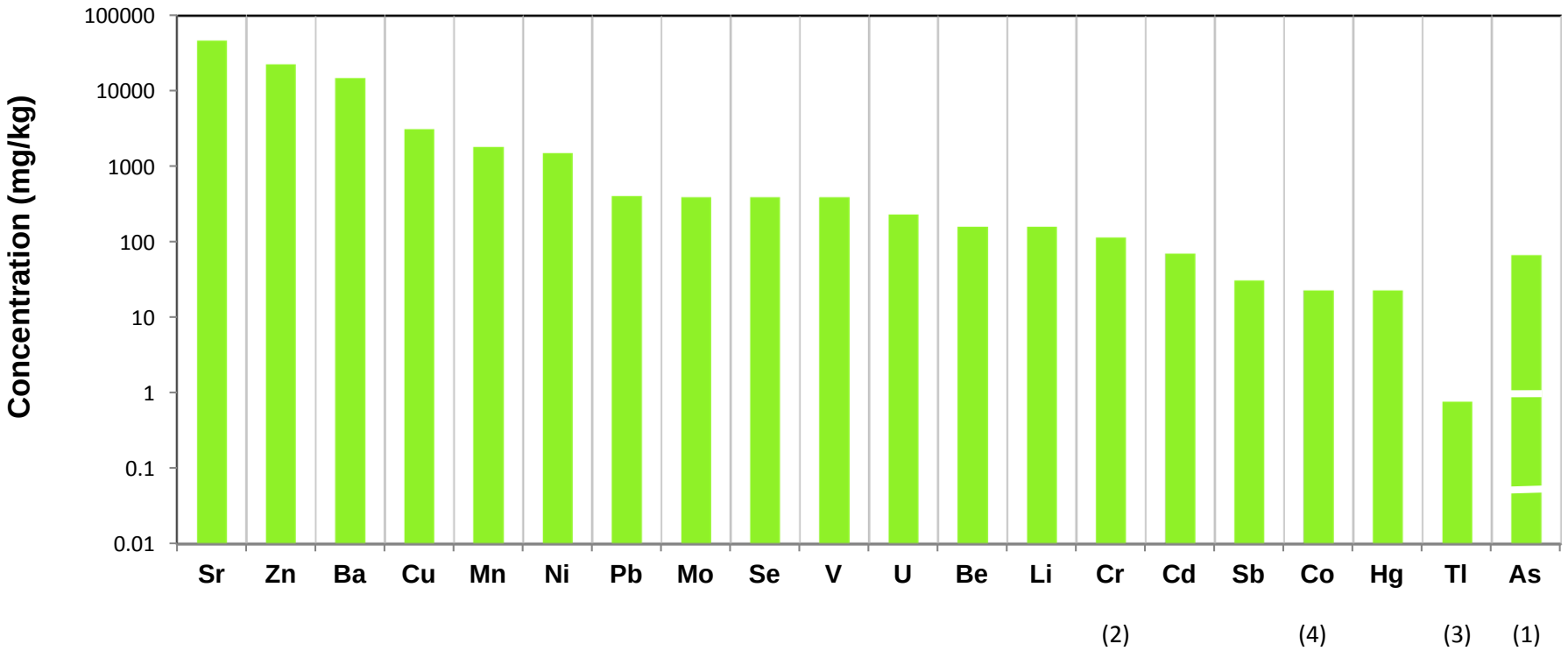
Zinc is present in our natural environment –
Background levels in soils in the U.S.



Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

Figure A-7

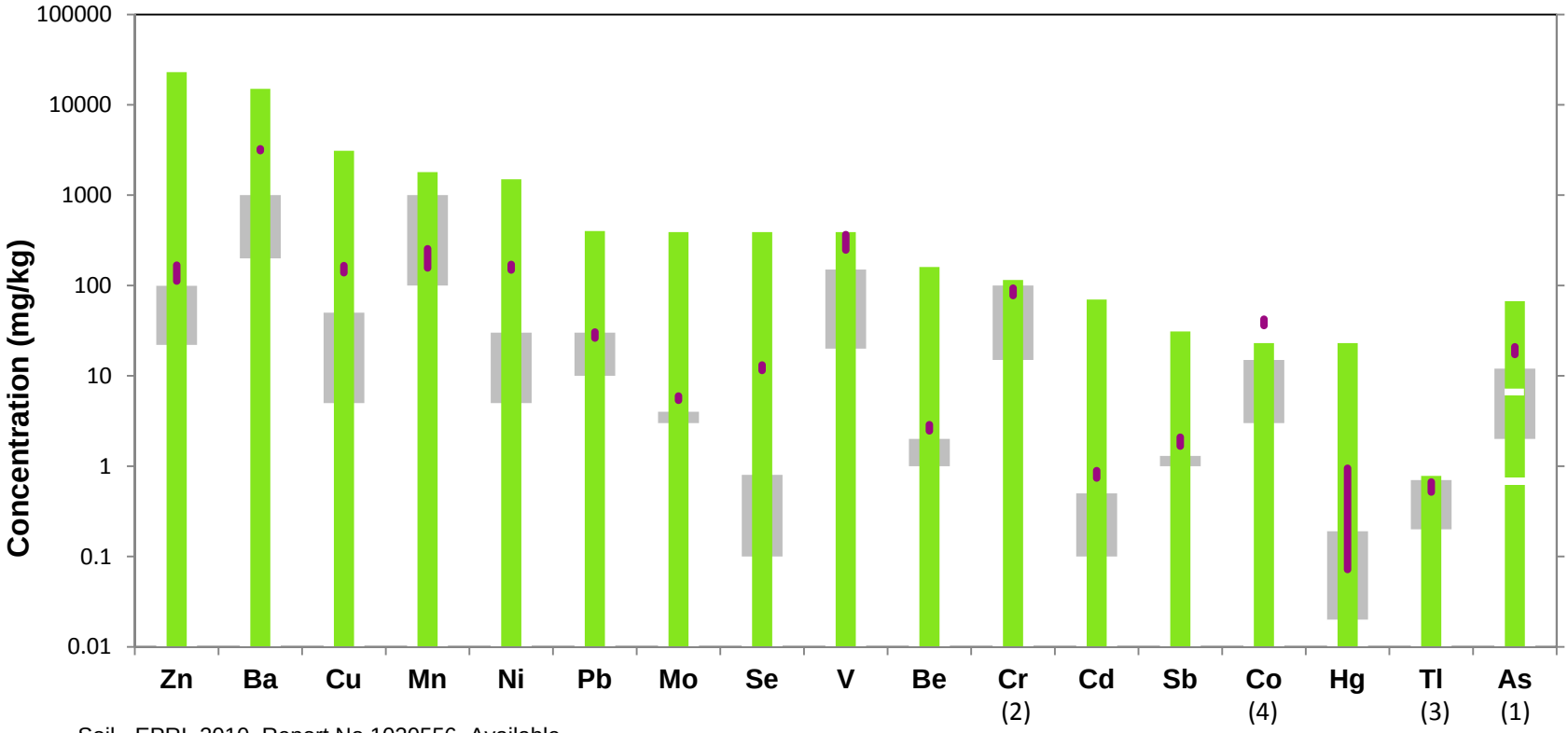
USEPA Regional Screening Levels for Residential Soils - Coal Ash Constituents



Top of bar corresponds to the USEPA Regional Screening Level (RSL) - Residential Soil (May 2014)
http://www.epa.gov/region9/superfund//prg/index.html

Notes:
(1) Arsenic RSLs for target risk level of 10^{-4} (top of green bar), 10^{-5} (middle white bar), 10^{-6} (lower white bar.
(2) The screening level shown for chromium is the value calculated using toxicity information for hexavalent chromium currently available on USEPA's IRIS database [http://www.epa.gov/iris/subst/0144.htm]. The screening level for trivalent chromium is 120,000 mg/kg.
(3) The RSL for thallium is identified by USEPA as a "provisional value" of "limited usefulness" that was developed for information purposes although USEPA states "it is inappropriate to derive a provisional subchronic or chronic [toxicity value] for thallium" [http://hhpprtv.ornl.gov/issue_papers/ThalliumandCompounds.pdf]
(4) The RSL for cobalt is based on a provisional dose-response value that is two orders of magnitude lower than values from other regulatory sources, and higher than most dietary intake estimates. Thus, a more realistic RSL could be more than an order of magnitude higher than the value shown here.

Figure A-8 **Comparison of 10th and 90th percentile USGS Database Constituent Concentrations in Fly Ash from the Wyoming Coal Power Plant and Background Levels in US Soils to the USEPA Regional Screening Levels for Residential Soils**



Soil - EPRI, 2010. Report No.1020556. Available for download at www.epri.com.

USEPA Regional Screening Level (RSL) - Residential Soil (May 2014)
http://www.epa.gov/region9/superfund//prg/index.html

Concentration Range (10th - 90th Percentile) in Wyoming Fly Ash; USGS, 2011.
http://pubs.usgs.gov/ds/635/

Notes:
(1) Arsenic RSLs for target risk level of 10^{-4} (top of green bar), 10^{-5} (middle white bar), 10^{-6} (lower white bar).
(2) The screening level shown for chromium is the value calculated using toxicity information for hexavalent chromium currently available on USEPA's IRIS database [http://www.epa.gov/iris/subst/0144.htm]. The screening level for trivalent chromium is 120,000 mg/kg.
(3) The RSL for thallium is identified by USEPA as a "provisional value" of "limited usefulness" that was developed for information purposes although USEPA states "it is inappropriate to derive a provisional subchronic or chronic [toxicity value] for thallium" [http://hhpprtv.ornl.gov/issue_papers/ThalliumandCompounds.pdf]
(4) The RSL for cobalt is based on a provisional dose-response value that is two orders of magnitude lower than values from other regulatory sources, and higher than most dietary intake estimates. Thus, a more realistic RSL could be more than an order of magnitude higher than the value shown here.

ATTACHMENT B

Rush Island Energy Center Dilution Factor Calculations

CALCULATIONS

Date: February 8, 2018 **Made by:** J. Ingram

Project No.: 130-1560 **Checked by:** J. White/ E. Kidner

Subject: Rush Island Energy Center Dilution Factor Calculations **Reviewed by:** M.Haddock

1.0 Introduction

Mississippi River is a large, flowing water body and daily flow at the Rush Island Energy Center (RIEC) is estimated to range between 36 and 538 billion gallons per day, depending upon the river stage. In contrast, during low river flow conditions, average daily groundwater flow into the river is a fraction (estimated to be 199,000 gallons or 0.0006%) of the receiving water body. This ratio of flow is referred to as a "dilution factor" and is useful when assessing the relationship between smaller and larger water bodies. Set forth below is a calculation of a dilution factor based on specific criteria and assumptions delineated in Section 1.6.

1.1 Low River Conditions

Date	St. Louis Gauge Height	St. Louis Gauge Elevation	Mississippi River Elevation at the St. Louis Gauge	Chester Gauge Height	Chester Gauge Elevation	Mississippi River Elevation at the Chester Gauge
Units	FT Above Gauge	FT MSL	FT MSL	FT Above Gauge	FT MSL	FT MSL
1/1/2013	-4.55	379.58	375.03	-1.12	340.72	339.6

Notes:
1) FT MSL - feet above mean sea level.
2) Information on the St. Louis Gauge available at https://waterdata.usgs.gov/usa/nwis/uv?07010000.
3) Information on the Chester Gauge available at https://waterdata.usgs.gov/il/nwis/uv?site_no=07020500.

Mississippi River Elevation at the St. Louis Gauge	Mississippi River Elevation at the Chester Gauge	Distance Between St. Louis and Chester Gauges	Estimated Mississippi River Gradient	Distance from St. Louis Gauge to RIEC	Estimated Mississippi River Elevation at RIEC
FT MSL	FT MSL	River Miles	feet/feet	River Miles	FT MSL
375.0	339.6	70.1	0.00010	40.0	355

1) Estimated Mississippi River level calculated by subtracting the gradient of the Mississippi River multiplied by the distance from the St. Louis Gauge (in river feet) from the St. Louis Gauge Mississippi River elevation.

1.2 Aquifer Discharge Length and Area

Description	Value	Units
Estimated length of discharge zone	5,100	feet
Estimated top of discharge zone (low river conditions)	355	feet above mean sea level
Estimated bottom of discharge zone (Bedrock)	265	feet above mean sea level
Estimated thickness of discharge zone (Top - Bottom)	90	feet
Estimated area of discharge zone (length x thickness)	459,000	$feet^2$

Golder Associates

CALCULATIONS

Date: 2-6-2018 **Made by:** J. Ingram

Project No.: 130-1560 **Checked by:** J. White/ E. Kidner

Subject: Rush Island Energy Center Dilution Factor Calculations **Reviewed by:** M.Haddock

1.3 Groundwater Properties

Description	Symbol	Value	Units
Average Hydraulic Conductivity (includes MW-1, MW-2, MW-3, P17I, P17D, P19I, P19D, P21I, and P21D)	K	83	feet/day
Average Groundwater Gradient (from GMP)	I	0.0007	feet/feet
Effective Porosity (from GMP)	n	35	%
Average linear groundwater velocity (V=KI/n)	*V*	0.17	feet/day

1.4 Groundwater Discharge

Description	*Symbol*	Value	Units
Average linear groundwater velocity	*V*	0.17	feet/day
Estimated Discharge zone area	*A*	459,000	$feet^2$
Effective Porosity (from GMP)	*n*	35	%
Estimated total GW Discharge (Q=V*A*n)	*Q*	26,668	$feet^3/day$

1.5 Mississippi River Flow

Description	*Value*	Units
Estimated low Mississippi River Conditions (1/1/2013)	355	feet above mean sea level
Corresponding STL Discharge (1/1/2013)	56,400	$feet^3/sec$
Seconds per Day	86,400	seconds/day
Estimated low Flow Daily Discharge (Discharge * seconds per day)	4,872,960,000	$feet^3/day$

1.5 Dilution Factor at Low River Flow

Description	Values	Units
Estimated Daily Groundwater Discharge	26,668	$feet^3/day$
Estimated Daily Groundwater Discharge	199,490	gallons/day
Estimated Daily River Flow	4,872,960,000	$feet^3/day$
Estimated Daily River Flow	36,452,274,739	gallons/day
Estimated Dilution Factor (River / GW)	**182,728 or >100,000**	Unitless

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1.6 List of Conservative Assumptions Used

1) Calculations are based on estimated flow rates under low flow river conditions. As an example, low flow values used for Rush Island are from January 1, 2013 which is the lowest value since 1989 and the 9th lowest in recorded history at the St. Louis Mississippi River gauge. Using river flow averages would greatly increase the dilution by an order of magnitude. Mississippi River data is available at http://water.weather.gov/ahps2/hydrograph.php?wfo=lsx&gage=EADM7.

2) To simplify the calculations, the alluvial aquifer was assumed to consist of higher permeability sands, resulting in conservative (higher) estimates of groundwater discharge.

3) The calculations do not take into account any dilution from the alluvial aquifer itself. The river locally recharges the aquifer at varying rates depending on river stage. In addition, on a near continuous basis, groundwater flows from the bedrock aquifer into the shallow alluvial aquifer. All of these sources increase dilution within the alluvial aquifer.

Although these calculations use conservative assumptions which would serve to increase the dilution factor ratio, the calculated value for the dilution factor has been rounded down. This dilution factor ratio represents a worst case scenario and actual dilution factors are likely greater.