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CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI SIOUX ENERGY CENTER
ST CHARLES COUNTY, MISSOURI

by
Haley & Aldrich, Inc.
Cleveland, Ohio

for
Ameren Missouri
St. Louis, Missouri

May 2019

Overview

This Corrective Measures Assessment (CMA) was prepared by Haley & Aldrich, Inc. (Haley & Aldrich) for Union Electric Company d/b/a Ameren Missouri (Ameren) for the Coal Combustion Residual (CCR) surface impoundment (SCPA) located at the Sioux Energy Center (SEC). The SEC is a coal-fired power plant located between the Mississippi and Missouri Rivers in St. Charles County, Missouri. The CMA was completed in accordance with requirements stated in the U.S. Environmental Protection Agency's (USEPA) rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities*. 80 Fed. Reg. 21302 (Apr. 17, 2015) (promulgating 40 CFR §257.61); 83 Fed. Reg. 36435 (July 30, 2018) (amending 40 CFR §257.61) (CCR Rule).

Ameren implemented groundwater monitoring under the CCR Rule through a phased approach to allow for a graduated response and evaluation of steps to address groundwater quality. Assessment monitoring completed in 2018 evaluated the presence and concentration of constituents in groundwater specified in the CCR Rule (i.e. Appendix IV). Of the 23 CCR parameters evaluated, only one constituent of concern (COC), molybdenum, exceeds to a very limited extent, the Groundwater Protection Standards (GWPS) established for the SCPA. In fact, as described in **Section 3.3.1**, 96% of Appendix IV parameters tested complied with CCR Rule requirements.

Ameren completed a detailed environmental evaluation of the SCPA and surrounding area, including voluntary, supplemental surface water sampling. In 2018, a risk evaluation was undertaken to identify whether current groundwater conditions pose an unacceptable risk to human health and the environment, and whether corrective measures mitigate such an unacceptable risk, if present. The risk evaluation concluded that there are **no adverse effects on human health or the environment currently or under reasonably anticipated future uses** from either surface water or groundwater due to CCR management practices at SCPA.

In performing this CMA, Haley & Aldrich considered the following: presence and distribution of molybdenum, SCPA configuration, hydrogeologic setting, and the results of the detailed risk evaluation. Within the SCPA, CCR is managed in an impoundment that extends to a depth of approximately 75 feet (ft) below ground surface (bgs). The alluvial aquifer beneath the SCPA is approximately 100 ft in thickness. Although flow within the alluvial aquifer is directly controlled by the river stages of the Mississippi and Missouri Rivers and will generally flow from the higher of the two rivers toward the lower elevation river.

To provide a comprehensive CMA, this effort included surface impoundment closures and groundwater remediation alternatives, including:

- Alternative 1: Closure in place (CIP) with low permeability capping and monitored natural attenuation (MNA);
- Alternative 2: CIP with in-situ stabilization (ISS), low permeability capping and MNA;
- Alternative 3: CIP with low permeability capping and in-situ groundwater treatment;
- Alternative 4: CIP with low permeability capping, hydraulic containment (HC) of groundwater, and ex-situ groundwater treatment; and
- Alternative 5: Closure by removal (CBR) with MNA.

These five alternatives were evaluated based on the threshold criteria provided in the CCR rule and then compared to three of the four balancing criteria stated in the CCR Rule. The four balancing criteria consider:

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;
2. The effectiveness of the remedy in controlling the source to reduce further releases;
3. The ease or difficulty of implementing a potential remedy; and
4. The degree to which community concerns are addressed by a potential remedy.

Balancing criteria four, which considers community concerns, will be evaluated following a public information session scheduled for May 2019.

The following observations are made regarding closure scenarios and groundwater remedial alternatives for the SCPA and are described more fully in this report:

- **Cap Integrity and Hydrogeologic Conditions:** For all CIP alternatives, Ameren intends to install a geomembrane cap and cover system that exceeds by two orders-of-magnitude the performance criteria set forth in the CCR Rule and is referred to in this CMA as a "low permeability cap." Vertical infiltration via precipitation is virtually eliminated following installation of the geomembrane cover system. Modelling predicts that post-closure, 95% of groundwater will travel horizontally via a preferential pathway around the unit due to permeability differentials in the surrounding soils. In addition, groundwater flow in this area moves very slowly, approximately 11 feet per year, less than the length of a midsized vehicle.

- **No Risk:** Risk assessment evaluations confirm that the SCPA, even prior to closure, presents no **unacceptable risk** to human health or the environment. In fact, concentration levels of molybdenum would need to be **more than 1,000 times higher** than currently measured levels before an adverse impact in the Mississippi River could occur. Therefore, since no adverse risk currently exists, implementation of any of the remedies considered will not result in a meaningful reduction in risk.

- **Groundwater Compliance:** Ameren has retained XDD Environmental (XDD) to evaluate targeted in-situ treatment methods to address elevated levels of molybdenum. Bench-scale testing indicates that certain pH adjustments can reduce concentration levels and that in-situ treatment evaluations, including bio-augmentation, are ongoing at all facilities and will be completed this summer.

- **Excavation Timeframe:** As described in an Extraction & Transportation Study prepared by the Lochmueller Group, removal of large volumes of CCR stored at the SEC creates extensive logistical challenges – including excavation, transportation, and disposal, and could take decades to complete during which time the impoundment would remain open and would be subject to ongoing infiltration from precipitation.

In accordance with §257.98, Ameren will implement a groundwater monitoring program to document the effectiveness of the selected remedial alternative. Corrective measures are considered complete when monitoring reflects groundwater downgradient of the SCPA does not exceed Appendix IV GWPS for three consecutive years. USEPA is in the process of modifying certain CCR Rule requirements and, depending upon the nature of such changes, assessments made herein could be modified or supplemented to reflect such future regulatory revisions. See *Federal Register (March 15, 2018; 83 FR 11584*).

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List of Acronyms and Abbreviations

Ameren	Ameren Missouri
AMSL	Above Mean Sea Level
bgs	Below Ground Surface
CBR	Closure by Removal
CCR	Coal Combustion Residuals
CIP	Closure In-Place
CMA	Corrective Measures Assessment
cm/sec	Centimeters per Second
COC	Constituents of Concern
CSM	Conceptual Site Model
DSI	Detailed Site Investigation
ft	Feet
Golder	Golder Associates Inc.
GMP	Groundwater Monitoring Plan
GWPS	Groundwater Protection Standards
Haley & Aldrich	Haley & Aldrich, Inc.
HC	Hydraulic Containment
ISS	In-Situ Stabilization
MM	Million
MM CY	Million Cubic Yards
mg/kg	Milligrams per kilogram
mg/l	Milligrams per liter
MNA	Monitored Natural Attenuation
N&E	Nature and Extent
NAS	U.S. National Academy of Sciences
O&M	Operations and Maintenance
ORP	Oxidation Reduction Potential
ppm	Parts per Million
PRB	Permeable Reactive Barrier
RDA	Recommended Daily Allowance
RO	Reverse Osmosis
SCL4A	Dry CCR Disposal Area
SCPA	Bottom Ash Surface Impoundment
SCPB	Fly Ash Surface Impoundment
SCPC	Gypsum Disposal Area
SEC	Sioux Energy Center
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
ug/L	Micrograms per liter
UL	Tolerable Upper Limit
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
XDD	XDD Environmental

1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) has prepared this Corrective Measures Assessment (CMA) for the Coal Combustion Residual (CCR) surface impoundment (SCPA) located at the Ameren Missouri (Ameren) Sioux Energy Center (SEC). Ameren has conducted detailed geologic and hydrogeologic investigations under Missouri's utility and solid waste landfill requirements as well as the USEPA rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities*. 80 Fed. Reg. 21302 (Apr. 17, 2015) (promulgating 40 CFR §257.61); 83 Fed. Reg. 36435 (July 30, 2018) (amending 40 CFR §257.61) (CCR Rule). These investigations were, in part, related to determination of requirements related to the potential for both SCPA closure and groundwater corrective action.

This CMA includes a summary of the results of groundwater and site investigations at the SEC. Groundwater impacted by the SCPA exceeds the statistically-derived GWPS for molybdenum at only four monitoring well locations. This report evaluates potential corrective measures to address these limited exceedance of the GWPS.

1.1 FACILITY DESCRIPTION/BACKGROUND

The SEC is located near the confluence of the Missouri and Mississippi Rivers in rural St. Charles County. Historically, the SEC managed CCR in an unlined bottom ash pond (SCPA), and a lined fly ash (SCPB) pond. The SCPA is approximately 47 acres in size and is the focus of this CMA (**Figure 1-1**). The Mississippi River, Poeling Lake, and the Missouri River are located to the north, southwest and south of the facility, respectively. The facility is surrounded by agricultural fields and in 2008, Ameren constructed a utility waste landfill (UWL) to manage CCR and gypsum waste from the SEC's scrubber system. Site features are illustrated on **Figure 1-2**

Sioux Energy Center

Ameren is constructing wastewater treatment facilities and will terminate usage of the impoundment system in 2020 and commence closure of both the bottom and fly ash ponds in 2021.

1.2 SITE CHARACTERIZATION WORK SUMMARY

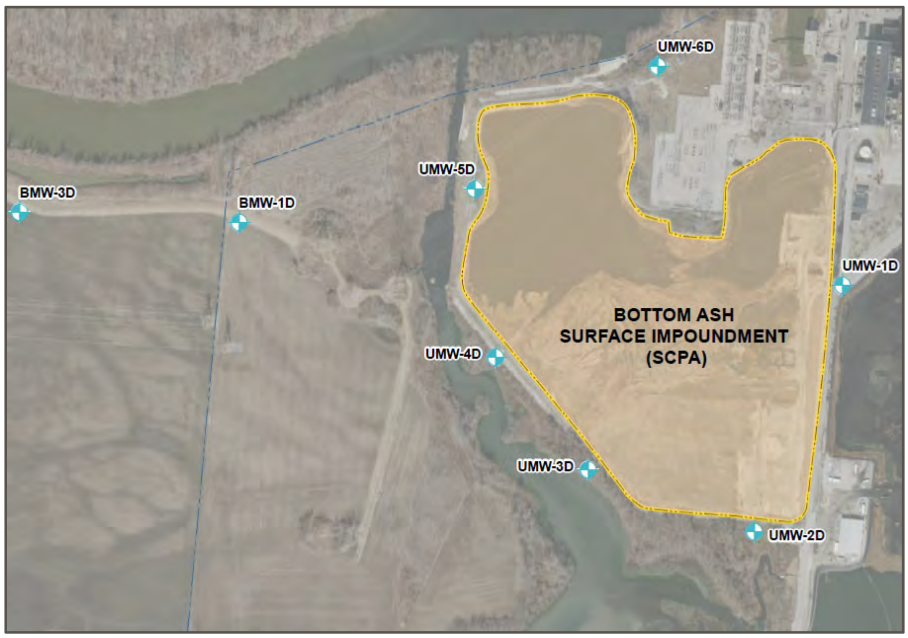
Extensive subsurface investigations have occurred pursuant Missouri's utility and solid waste landfill requirements as well as the CCR Rule. In August 2006, a Detailed Site Investigation (DSI) Report prepared by Gredell Engineering Resourcing, Inc. characterized the geology and hydrogeology of the UWL to support the development of a hydrogeologic Conceptual Site Model (CSM). The DSI investigation at the SEC included:

- Soil borings and sampling;
- Geotechnical testing;
- Rock coring;
- Well and piezometer installation;
- Slug testing; and
- Groundwater sampling.

The CSM has been further enhanced with ongoing CCR groundwater monitoring and supplemental subsurface investigation activities performed by Golder Associates, Inc. (Golder). Findings from these extensive and updated series of geologic, geotechnical, and hydrogeologic investigations, including voluntary surface water sampling conducted, have produced a robust CSM that supports the CMA activities discussed in this report.

1.3 GROUNDWATER MONITORING

Groundwater monitoring under the CCR Rule occurs through a phased approach to allow for a graduated response (i.e., baseline, detection, and assessment monitoring as applicable) and evaluation of steps to address groundwater quality. Golder prepared a Groundwater Monitoring Plan (GMP) as required by the CCR Rule. The GMP presents the design of the groundwater monitoring system, groundwater sampling and analysis procedures, and groundwater statistical analysis methods.



Groundwater Monitoring Well Locations

Monitoring wells were installed in November and December 2015 and includes two background wells (BMW-1D and BMW-3D) and six downgradient monitoring wells (UMW-1 through UMW-6) located around the perimeter of the SCPA. In general, the monitoring wells are screened in the alluvial aquifer zone near the base elevation of the SCPA.

Detection monitoring sampling events occurred in 2017 and 2018. The results of the sampling events were then compared to background, or natural groundwater values, using statistical methods to determine if Appendix III constituents at the base of the ash basin are present at concentrations above background, called statistically significant increases (SSI). Detection of Appendix III analytes triggered a verification sampling event in January 2018 and verified SSIs. The results of this analysis indicated SSIs necessitating the establishment of an Assessment Monitoring Program and respective notification of the same.

CCR Rule Monitoring Constituents			
Appendix III	Boron	Appendix IV	Antimony
	Calcium		Arsenic
	Chloride		Barium
	Fluoride		Beryllium
	Sulfate		Cadmium
	pH		Chromium
	Tot. Dissolved Solids		Cobalt
			Fluoride
			Lead
			Lithium
			Mercury
			Molybdenum
			Selenium
			Thallium
			Radium 226 & 228

During the Assessment Monitoring phase, CCR groundwater monitoring well samples were collected during April, May and November 2018 and subsequently analyzed for Appendix IV constituents. Appendix IV analytical results for the baseline and Assessment Monitoring events are summarized in **Table I**.

1.4 CORRECTIVE MEASURES ASSESSMENT PROCESS

The CMA process involves development of groundwater remediation technologies that will result in the following threshold criteria: protection of human health and the environment, attainment of GWPS, source control, COC removal and compliance with standards for waste management. Once these technologies are demonstrated to meet these criteria, they are then compared to one another with respect to long- and short-term effectiveness, source control, and implementability. Input from the community on such proposed measures will occur as part of a public meeting scheduled for May 2019.

1.5 RISK REDUCTION AND REMEDY

The CCR Rule at §257.97 (Selection of Remedy) at (b)(1) requires that remedies must be protective of human health and the environment. Further, at (c) the CCR Rule requires that in selecting a remedy, the owner or operator of the CCR unit shall consider specific evaluation factors, including the risk reduction achieved by each of the proposed corrective measures. Each of the evaluation factors listed here and discussed in **Section 4** are those that consider risk to human health or the environment.

> (1)(i) Magnitude of reduction of existing risks;
>
> (1)(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;
>
> (1)(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;

(1)(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;

(4) Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy[1];

(5)(i) Current and future uses of the aquifer;

(5)(ii) Proximity and withdrawal rate of users; and

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

[1] Factors 4 and 5 are not part of the CMA evaluation process as described in §257.97(d)(4), §257.97(d)(5)(i)(ii)(iv); rather they are factors the owner or operator must consider as part of the schedule for remedy implementation.

2. Groundwater Conceptual Site Model

To evaluate the magnitude of risk reduction, the degree of existing risk must first be identified. Prior risk evaluations and data collected are summarized below.

2.1 SITE SETTING

The SEC Site is in St. Charles County, Missouri and located between the Mississippi and Missouri Rivers. The Site is bounded to the north by wooded areas associated with the Mississippi River, to the south by a railroad, and to the east and west is a largely agricultural area that is served by municipal water.

The SCPA is constructed with perimeter berms at an elevation of approximately 446 ft above mean sea level (AMSL). Immediately adjacent to the SEC is a channelized area of the Mississippi River that is referred to as the Mississippi River Chute. Both fly ash and bottom ash have historically been managed and stored in the SCPA surface impoundment. Borings completed in the SCPA indicate a CCR thickness of up to approximately 75 ft bgs around 373 ft AMSL in the center of the unit and thinning out towards the edges.

2.2 GEOLOGY AND HYDROGEOLOGY

The SEC is located in the extreme southeastern corner of the Central Lowland Physiographic Province and the Dissected Till Plains. However, because the SEC lies between two major river systems in an area that has been mostly deposited by flow and deposition of river deposits, the regional physiographic setting is not representative of local Site geology.

Alluvial deposits associated with the Missouri and Mississippi Rivers overlie older sedimentary bedrock. These alluvial deposits comprise the surficial alluvial aquifer, which lies unconformably on top of bedrock and is typically 100 to 120 ft thick with base elevations of approximately 300 to 330 ft AMSL [2]. Overall, this aquifer is described as a fining upwards sequence of stratified sands and gravels with varying amounts of silts and clays. The alluvial deposits are comprised of various sub-units, including flood basin deposits, floodplain deposits, natural levee deposits, and channel deposits along with volumetrically less important loess deposits. Grain sizes of the alluvial deposits are highly variable.

The alluvial deposits are underlain by bedrock that includes Mississippian-aged rocks of the Meramecian Series. Formations include primarily limestone, dolomite, and shale and are comprised of the Salem Formation, Warsaw Formation, and the Osagean aged Burlington-Keokuk Formation. The depth to bedrock typically increases towards the Mississippi River. Based on regional well logs the upper-most

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[2] 40 CFR Part 257, Groundwater Monitoring Plan SCPA, Sioux Energy Center, St. Charles County, Missouri (Golder 2017)

Generalized Geologic Cross Section

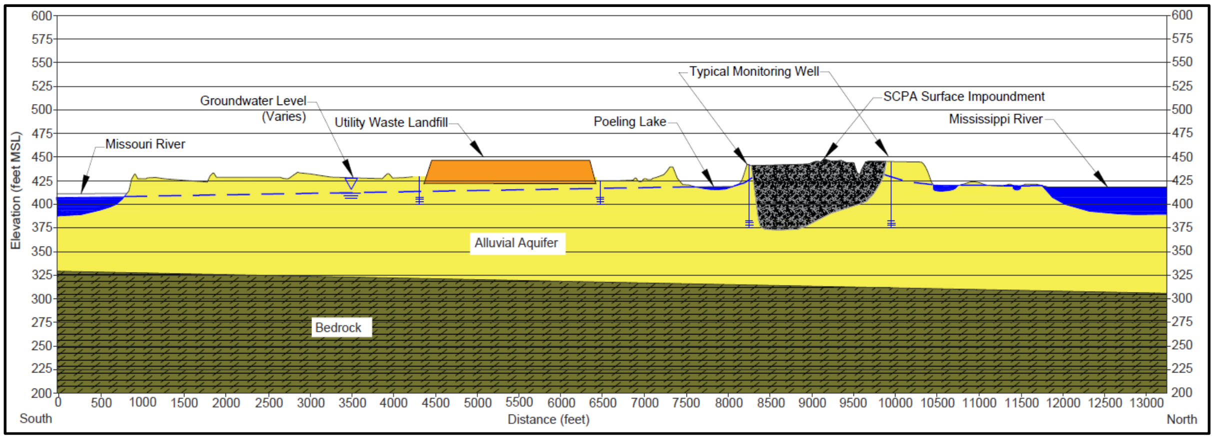


Image from Figure 3, Groundwater Monitoring Plan, SCPA SEC (Golder 2017)

bedrock unit beneath the SEC is the Salem formation. Proceeding northward from St. Louis County, the thickness of this unit thins to about 40 to 60 ft and is describes as a buff limestone with dolomitic limestone, dolomite and shale.

The alluvial aquifer is the uppermost aquifer across the Site and consist primarily of alluvial sands with some silt, clay, and gravel associated with the Missouri and Mississippi River Valley alluvium. Groundwater flow within the alluvial aquifer is directly controlled by the river stages of the Mississippi and Missouri Rivers, since the alluvial aquifer is hydraulically connected to these water bodies. Groundwater will generally flow from the higher of the two rivers toward the lower elevation river. The SCPA and Poeling Lake also locally affect water levels and flow directions. Horizontal groundwater hydraulic gradients in the alluvial aquifer are typically low and flat.

Groundwater Flow Map-November 12, 2018
Image from Figure C3, 2018 Annual Groundwater Monitoring and Corrective Action Report (Golder 2019)

Groundwater flow direction and gradient were estimated for the downgradient SCPA monitoring wells using the USEPA's On-line Tool for Site Assessment Calculation for Hydraulic Gradient (Magnitude and Direction) (USEPA, 2016). Results from this assessment indicate that while groundwater flow direction is variable and gradients are relatively flat, the overall net groundwater flow at the SCPA was slightly toward the north or toward the Mississippi River. Horizontal gradients calculated by the program range from 0.0002 to 0.0011 ft/ft with an estimated net annual groundwater velocity of approximately 11 ft per year[3].

[3] 2018 Annual Groundwater Monitoring and Corrective Action Report, SCPA Surface Impoundment, SEC, St. Charles County, Missouri (Golder 2019)

Vertical hydraulic gradients adjacent to the SCPA demonstrate low downward gradients, with the difference in groundwater elevations between the shallow and intermediate/deep groundwater monitoring zones typically less than 0.01 ft. Vertical gradients within the SCPA and the underlying alluvial groundwater zone changes seasonally based on river levels and fluctuating alluvial aquifer groundwater levels.

Groundwater flow modeling completed by Golder evaluated the flux of groundwater passing through the CCR, following closure and dewatering of the SCPA. As shown in the figure below, post-closure 95% of groundwater moving laterally through the alluvial aquifer preferentially flows under (and around) the SCPA, due to the notably lower horizontal hydraulic conductivity of the CCR.

Groundwater Preferentially Flows Under/Around the SCPA

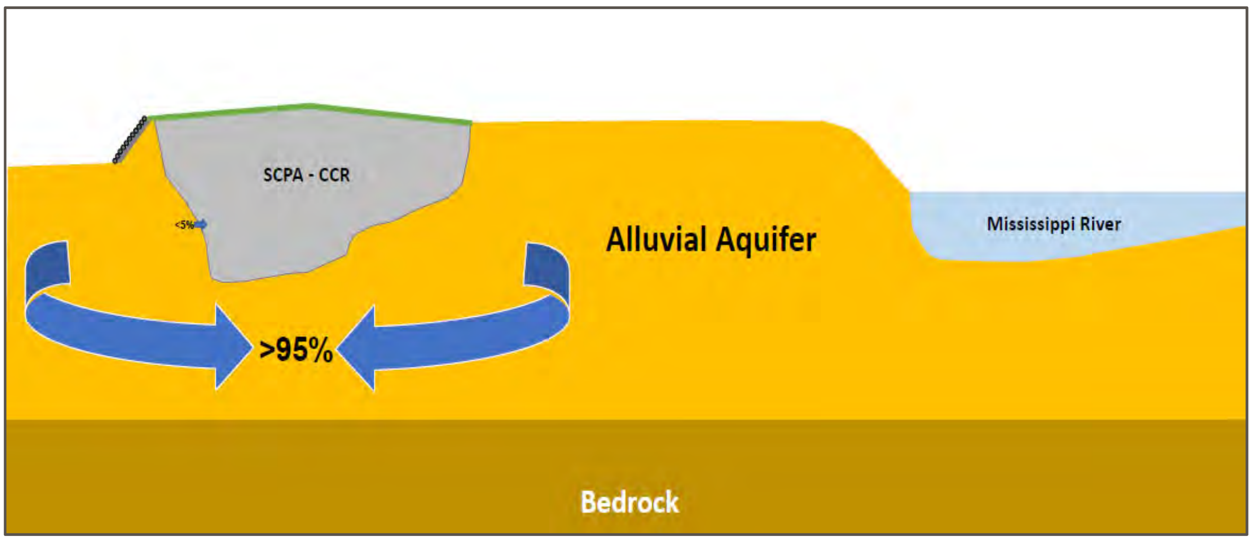


Image provided by Golder 2019

2.3 GROUNDWATER PROTECTION STANDARDS

Golder completed a statistical evaluation of groundwater samples using the methods and procedures outlined in the Groundwater Monitoring Plan's *Statistical Analysis Plan* (Golder 2017) to develop site-specific GWPS for each Appendix IV constituent.

Groundwater results were compared to the site-specific GWPS. Statistically significant levels (SSLs) above the GWPS are limited to four monitoring wells (UMW-2D, UMW-3D, UMW-4D and UMW-5D) and only for one parameter (molybdenum).

Parameter	Site GWPS	Units
Antimony	6	µg/L
Arsenic	10	µg/L
Barium	2000	µg/L
Beryllium	4	µg/L
Cadmium	5	µg/L
Chromium	100	µg/L
Cobalt	6	µg/L
Fluoride	4	mg/l
Lead	15	µg/L
Lithium	40	µg/L
Mercury	2	µg/L
Molybdenum	100	µg/L
Radium 226+228	5	pCi/L
Selenium	50	µg/L
Thallium	2	µg/L

Groundwater Protection Standards
ug/L – micrograms per liter
mg/l – milligrams per liter
pCi/L – picoCuries per liter

2.4 NATURE AND EXTENT OF GROUNDWATER IMPACTS

Ameren initiated a nature and extent (N&E) investigation as required by the CCR Rule in 2018 by installing 26 monitoring wells and piezometers (N&E wells). The N&E wells are screened in three different, generalized zones of the alluvial aquifer: shallow zone, middle/intermediate zone, and deep zone. Well screen lengths range from 5 to 10 ft long and total depths range from approximately 21 to 99 ft bgs.

Analytical results from the N&E wells indicate that molybdenum concentrations are limited in their extent. In the shallow alluvial aquifer zone, the results from monitoring wells at the property boundary are below the GWPS in all directions. In the intermediate and deep alluvial aquifer zone, molybdenum concentrations are below the GWPS in all N&E nested monitoring wells to the south, east, and west of the SCPA. One sample at AM-1D to the northwest of the SCPA has a molybdenum concentration above the GWPS. Concentrations of molybdenum are highest in the intermediate zone of the aquifer to the southwest of the SCPA. Results from the N&E wells were used to develop corrective measures alternatives. Monitoring Well locations are show on **Figure 2-1**.

2.5 SURFACE WATER SAMPLING

Elevated levels of molybdenum have not impacted surface waters. Prior to the CCR Rule, Ameren voluntarily collected samples of surface water from the Mississippi River, Missouri River and Mississippi River Chute to evaluate whether ash management operations at the SEC have impacted these surface water bodies. Surface water sampling locations are shown on **Figure 2-2.**

Surface water samples were collected by Golder from 12 locations in the Mississippi River in September 2017 and May 2018. At each sample location, samples were collected near the surface of the river. Where the depth of water was greater than four feet, a second sample was collected mid-depth in the river. A total of 40 samples were collected from the Mississippi River. Surface water samples were also collected by Golder from 12 locations (total of 20 samples) in the Missouri River and from 12 locations (total of 20 samples) in the Mississippi River Chute in September 2017.

Samples were analyzed for the same Appendix III and Appendix IV constituents listed in **Section 1.3**. There are no analytical results for the Mississippi River or the Missouri River above drinking water screening levels or human health recreational levels, with two exceptions not caused by the SEC[4]. All surface water results are below ecological screening levels.

The results of this investigation demonstrate that the Mississippi River, Missouri River and Mississippi River Chute sampling do not show evidence of impact of constituents derived from the SCPA.

[4] Even though the lithium results for the Missouri River are slightly above the drinking water screening level and arsenic concentrations in the Mississippi and Missouri Rivers are slightly above the human health recreational screening levels, the concentrations are statistically no different in upstream and downstream samples for both arsenic and lithium indicating **that the facility is not the source** of the arsenic and lithium detected in the rivers. With respect to groundwater, arsenic and lithium concentrations comply with GWPS established under the CCR Rule.

3. Risk Assessment and Exposure Evaluation

As described in this report, Ameren has conducted detailed environmental evaluations of the SEC and its environs. These investigations have been detailed in a risk evaluation report available to the public on the Ameren website:

- February 2018: Human Health and Ecological Assessment of the Sioux Energy Center. Available at: https://www.ameren.com/-/media/corporate-site/files/environment/ccr-rule/2017/groundwater-monitoring/sioux-haley-aldrich-report.ashx?la=en&hash=3DE8D6FAA7414CF6D875C5CCC99D1785C720185B

The purpose of the risk evaluations is to identify whether current groundwater conditions pose a risk to human health and the environment and, if so, whether the corrective measures identified in this report mitigate such risk.

3.1 APPROACH

The risk evaluation provided in the 2018 risk assessment report evaluated the environmental setting of the SEC, which has been in operation for over 50 years, including its location and ash management operations at the facility. Golder provided information on groundwater location and direction, the rate(s) of groundwater flow, and where waterbodies may intercept groundwater flow.

A conceptual model was then developed based on this physical setting information and used to identify whether human populations could contact groundwater and/or surface water in the area of the facility. This information was also used to identify locations where ecological populations could come into contact with surface water. Based on this conceptual model approach, Ameren's environmental consultants and risk assessors identified surface water sampling locations to evaluate potential impact to the environment. Sampling results were then evaluated, as appropriate, on both a human health and 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 (USEPA, 1989): (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 protective of specific human exposures. These screening levels are referred to as "Regional Screening Levels" and are published by USEPA and updated twice yearly (USEPA, 2018). 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 sources. The screening levels are used to determine if the concentration levels of constituents could pose an unacceptable 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.

3.2 CONCEPTUAL SITE MODEL

There are no on-site users of alluvial groundwater adjacent to SEC. As documented in the 2018 risk assessment report, there are two private wells recorded within a one-mile radius of the facility. One is located at the facility and is not in service, the second private well is screened in bedrock, located near the Missouri River and south of both the plant and nature and extent wells that are unimpacted by CCR. Impacts are not expected in a well that is further from the plant and screened in the less conductive bedrock aquifer.

Based on this CSM and the facility setting shown in **Figure 1-2**, samples have been collected from each of these environmental media – groundwater, Mississippi River surface water, and Missouri River surface water. The samples have been analyzed for constituents that are commonly associated with coal ash.

3.3 RESULTS

3.3.1 Alluvial Aquifer

Figure 1-2 shows the location of the CCR monitoring wells at the SCPA. A summary of the screening results is presented in the table below.

Table: Assessment Monitoring Reflects High Percentage Compliance

	Sioux Energy Center SCPA – Shallow Alluvial Aquifer
Percent of Assessment Monitoring Parameter Compliance	96%
Percent of Assessment Monitoring Parameter Results Requiring Corrective Action (Constituents)	4% Molybdenum

This is striking, given that the wells are located directly adjacent to and at the base of the ash management area, and the facility has been in operation for over 50 years. Over 96% of the groundwater results for the CCR Rule monitoring wells located at the edges of SCPA (UMW-1D, UMW-2D, UMW-3D, UMW-4D, UMW-5D, UMW-6D), are below the GWPS.

3.3.2 Surface Water

The Mississippi River and Missouri River sampling results do not show evidence of impact of constituents derived from the SCPA. There are also no analytical results for the Mississippi River that are above drinking water screening levels. While arsenic concentrations in the Mississippi and Missouri Rivers are slightly above the human health recreational screening levels and lithium concentrations are above the drinking water screening levels in the Missouri River, the concentrations are statistically no different in upstream and downstream samples for both arsenic and lithium indicating that **the facility is not the source** of either the arsenic or lithium detected in the rivers. Furthermore, groundwater samples reflect that arsenic and lithium concentrations attain the CCR Rule's GWPS for the SEC.

3.3.3 National Pollutant Discharge Elimination System Outfall

The outfall for the SCPA is identified as 002 and is shown on **Figure 2-2**. This is a permitted outfall under the National Pollutant Discharge Elimination System program. The outfall effluent water is tested for toxicity on a periodic basis as required by the permit. The biological toxicity testing results for Outfall 002 at the SCPA shows no evidence of aquatic toxicity in the outfall effluent.

3.4 CONCLUSION

The sampling results for the Mississippi River and Missouri River are important. Although groundwater at the edge of the SCPA shows that one constituent is present in some wells above the GWPS, less than 4% of the results are above a GWPS, and the adjacent surface water bodies do not show evidence of impact of constituents derived from the SCPA. This is important because the absence of concentrations above risk-based screening levels means that there is not a significant pathway of exposure.

Impacts to groundwater do 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. Groundwater and surface waters flow at very different rates and volumes. The Mississippi River is the largest river system in North America and as groundwater at the facility flows into the river, it is diluted by more than 90,000 times.

This conservative estimate of dilution is used to further understand how high a molybdenum groundwater concentration would have to be to potentially have an adverse impact on the Mississippi River. The following table shows how this factor is applied to the most conservative of the human health and ecological risk-based screening levels for surface water.

CALCULATING RISK-BASED SCREENING LEVELS FOR SCPA GROUNDWATER BASED ON THE MISSISSIPPI RIVER

	Estimated Dilution Factor for the Mississippi River	90,000			
Constituents	**Lowest of the Human Health and Ecological Screening Levels (mg/L)**	**Groundwater Risk-Based Screening Level* (mg/L)**	**Maximum SCPA Groundwater Concentration (mg/L)**		**Ratio Between Groundwater Risk-Based Screening Level and the Maximum SEC Groundwater Concentration**
Molybdenum	0.1	9000	8.3	S-UMW-4D	>1000

*Where the Groundwater Risk-Based Screening Level = Screening Level x Dilution Factor.

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 part per one million parts.

The table identifies the maximum groundwater concentration of molybdenum detected in the SCPA 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 molybdenum would need to be **more than 1,000 times higher** than currently measured levels before an adverse impact in the Mississippi River could occur.

The comprehensive evaluation summarized here 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 SCPA.

3.4.1 Trace Elements in Coal Ash

All of the inorganic minerals and elements that are present in coal ash are also present naturally in our environment. Molybdenum is referred to as a trace element, so called because it is present in soils (and in coal ash) at such low concentrations (in the milligrams per kilogram (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

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. 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 molybdenum. Thus, we are exposed to these trace elements in our natural environment every day, and in many ways.

3.4.2 Molybdenum

Haley & Aldrich has prepared a Fact Sheet (**Appendix B**) that provides information on molybdenum so that the groundwater data can be considered in context. There is no public exposure to groundwater at the SEC and concentration levels of molybdenum in adjacent surface waters are all well below health-based regulatory standards.

As discussed in more detail in **Appendix B**, molybdenum is an essential nutrient for humans, and the Institute of Medicine of the U.S. National Academy of Sciences (NAS) has provided recommended daily allowances (RDA) and tolerable upper limits (UL) to be used as guidelines for vitamins and supplements and other exposures (NAS, 2001).

The RDA for a nutrient is "the average daily dietary nutrient intake level sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) health individuals" (NAS, 2001). The RDA for molybdenum for adults set by the NAS in 2001 is 0.045 mg/day and is based on the amount of molybdenum needed to achieve a steady healthy balance in the body for the majority of the population.

The UL for molybdenum set by the NAS is 2 mg/day. This level is based on an evaluation of the potential toxicity of molybdenum at high levels of intake. Based on the UL, a safe drinking water level for molybdenum is 0.6 mg/L or 600 ug/L, or six-fold higher than the level set by USEPA of 0.1 mg/L or 100 ug/L in the CCR Rule. This difference serves to underscore the conservatism of the USEPA value when evaluating groundwater under the CCR Rule. As reflected in the chart below, over 90% of the GW results across all four energy centers, including 80% of Sioux samples, are below the standard the National Academy of Science developed for vitamins and supplements.

	Labadie	**Meramec**	**Rush Island**	**Sioux**
Groundwater				
Number of Samples	208	88	77	244
Molybdenum greater than CCR GWPS of 0.1 mg/L (a)	81	35	38	77
Molybdenum greater than NAS standard of 0.6 mg/L (b)	3	1	11	49
Surface Water				
Number of Samples	67	74	50	80
Molybdenum greater than 0.1 mg/L (a)	0	0	0	0

Notes:
mg/L - milligrams per liter.
(a) - Drinking water-based groundwater protection standard specified in the Coal Combustion Residuals Rule.
(b) - Alternative health-protective drinking water screening level based on the National Academy of Sciences review of molybdenum.

3.5 EVALUATION OF RISK IN THE CORRECTIVE MEASURES ASSESSMENT

In summary, there are no adverse impacts resulting from coal ash management practices at the SEC on human health or the environment from either surface water or groundwater uses. There are no users of groundwater near SCPA. In fact, as described above, concentrations of molybdenum detected in groundwater would need to be more than **1,000 times higher** before such an unacceptable risk could exist in the Mississippi River under current and reasonable anticipated future uses.

Although the purpose of this CMA is to evaluate remedies to address assumed risks from the SSLs, the current conditions at the SCPA, even prior to closure, do not pose an unacceptable risk to human health or the environment. Therefore, the risk-based evaluation provides additional support for the selection of a remedy moving forward.

4. Corrective Measures Alternatives

4.1 CORRECTIVE MEASURES ASSESSMENT GOALS

The overall goal of this CMA is to identify and evaluate the appropriateness of potential corrective measures to prevent further releases of Appendix IV constituents above their GWPS, to remediate releases of Appendix IV constituents detected during groundwater monitoring above their GWPS that have already occurred, and to restore groundwater in the affected area to conditions that do not exceed the GWPS for these Appendix IV constituents. The corrective measures evaluation that is discussed below and subsequent sections provides an analysis of the effectiveness of five potential corrective measures in meeting the requirements and objectives of remedies as described under §257.97 (also shown graphically on **Figure 4-1**). This assessment also meets the requirements promulgated in §257.96 which require the assessment to evaluate:

- The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to residual contamination;
- The time required to complete the remedy; and
- The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy.

The criteria listed above are included in the balancing criteria considered during the corrective measures evaluation, described in **Section 5**.

4.2 GROUNDWATER MODELING

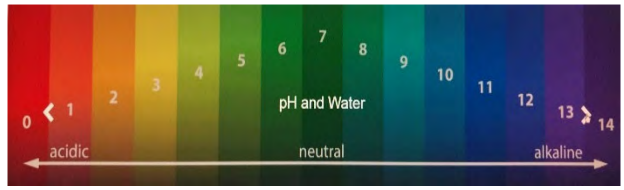
Modeling is an analytical tool used to create estimates based on computer-simulated conditions. Groundwater flow and geochemical modeling[5] performed by Golder evaluated the hydrogeologic and geochemical conditions at the SCPA. Golder used the numerical computer code MODFLOW to simulate groundwater flow and the software package MT3DMS to simulate groundwater transport of dissolved phase constituents. Golder used the geochemical modeling software PHREEQC to evaluate groundwater quality and determine the potential for attenuation of molybdenum.

4.3 GROUNDWATER TREATMENT EVALUATION

In-situ treatment to reduce the concentrations of dissolved metals in groundwater can occur via stabilization of metals through precipitation of a metal compound, co-precipitation of the target metal within the structure of another compound, and/or sorption of the target metal onto other compounds in the subsurface. In simple terms, groundwater amendments are injected into the aquifer to create a chemical reaction that attenuates metals through precipitation or sorption.

[5] Groundwater flow modeling was performed using MODFLOW 2000 supported by Groundwater Vistas as the graphical user interface.

Chemical precipitation is an available and demonstrated groundwater treatment technology recognized by USEPA[6]. Groundwater geochemistry (including oxidation reduction potential (ORP)) can greatly impact metals mobility at a site, where some metal compounds may be more soluble under highly oxidative (positive ORP) conditions while others are more soluble under reduced conditions (negative ORP). Also, the solubilities of many metal compounds are highly dependent on pH.



pH and Water (USGS - Water Science School publication).

Ameren has retained XDD Environmental (XDD) to research and develop appropriate treatment options for molybdenum and is performing bench-scale treatability studies to demonstrate the effectiveness of treatment options on site-specific basis. Evaluations of the Rush Island and Meramec Energy Centers commenced earlier this year and XDD has collected soil and groundwater samples from the SCPA impoundment area and, based on laboratory results from Rush Island, is developing bench scale studies targeted specific to the SEC. Bench-scale treatment results are expected to be completed in the Summer of 2019.

4.4 CORRECTIVE MEASURES ALTERNATIVES

Corrective measures can terminate when groundwater impacted by the SCPA does not exceed the Appendix IV GWPS for three consecutive years of groundwater monitoring. In accordance with §257.97, the groundwater corrective measures to be considered must meet, at a minimum, the following threshold criteria:

1. Be protective of human health and the environment;
2. Attain the GWPS;
3. Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of COCs to the environment;
4. Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, considering factors such as avoiding inappropriate disturbance of sensitive ecosystems; and
5. Comply with standards (regulations) for waste management.

Each of the remedial alternatives assembled as part of this CMA meet the requirements of the threshold criteria listed above.

The remedial alternatives presented below contemplate both CIP (Alternatives 1 through 4) and CBR (Alternative 5) of the SCPA. Both closure methods are expressly authorized under the CCR Rule. Ameren has prepared closure design documents, completed necessary closure notifications, engaged a qualified contractor and is currently in the process of closing the SCPA in place.

4.4.1 Alternative 1 – Closure in Place with Capping and Monitored Natural Attenuation

The SCPA would be closed in place with a geomembrane and soil protective cap system to reduce infiltration of surface water to groundwater thereby isolating source material. This cap selection

[6]EPA, "Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category: EPA's Response to Public Comments; Part 7 of 10", SE05958A6, p. 7-20

exceeds regulatory requirements by more than two orders of magnitude (<1 x 10^{-7} centimeters per second (cm/sec) planned versus 1 x 10-5 cm/sec required by the CCR Rule). Over time, depletion of COCs in CCR would allow the concentration of COCs in downgradient groundwater to decline and overall groundwater concentrations of COCs to attenuate. Geochemical modeling results indicate that post-closure 95% of groundwater will flow around and not through the SCPA, thereby isolating the source. The dissolved phase plume of molybdenum remaining above the GWPS post-closure eventually attenuates, albeit very slowly.

CIP can be completed safely, in compliance with applicable federal and state regulations, and be protective of public health and the environment. In general, CIP consists of installing a cap/cover designed to significantly reduce infiltration from surface water or rainwater, resist erosion, contain CCR materials, and prevent exposures to CCR. For this alternative, Ameren would install a geomembrane with a permeability that is 100 times lower than what the CCR Rule requires thus further reducing infiltration. At the SEC, CIP construction activities will take approximately 18-24 months and are expected to be completed in 2021.

MNA is a viable remedial technology recognized by both state and federal regulators that is applicable to inorganic compounds in groundwater. The USEPA defines MNA as "the reliance on natural attenuation processes to achieve site-specific remediation objectives within a time frame that is reasonable compared to that offered by other more active methods". The 'natural attenuation processes' that are at work in such a remediation approach include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These in-situ processes include biodegradation; dispersion; dilution; sorption; volatilization; radioactive decay; and chemical or biological stabilization, transformation, or destruction of contaminants (USEPA, 2015). When combined with a low-permeability cap to address the source by limiting the infiltration of precipitation into and through the CCR, MNA can reduce concentrations of molybdenum in groundwater at the SCPA boundary, although the time required to achieve the GWPS would be lengthy due to the low groundwater flux.

Following the installation of the cap system, Ameren would implement post-closure care activities. Post-closure care includes long-term groundwater monitoring until such time that groundwater conditions return to regulatory levels and cap system maintenance. Future development of the capped surface could be used for solar photovoltaic arrays or other site staging/ancillary operational needs.

4.4.2 Alternative 2 – CIP with In-Situ Stabilization, Capping and Monitored Natural Attenuation

In-situ stabilization is a technique that uses mixing of the CCR with amendments to solidify the material in place. Amendments typically include Portland Cement and the solidification is completed in-situ using large diameter augers. CCR located beneath the water table would be isolated by ISS, followed by capping of the surface impoundment. Groundwater impacts would be addressed through the processes of natural attenuation. This alternative would isolate the source (through solidification and installation of a low-permeability cap) and over time, allow the concentrations of COCs in downgradient groundwater to decline and overall groundwater concentrations of COCs to attenuate.

In-situ stabilization of the SCPA is predicted to take a number of years to complete, depending on the availability of specialized contractors and equipment. Additionally, implementation of ISS will require a detailed design effort with bench scale testing to determine the appropriate amendment mix. Pilot testing will also be needed to verify the ability of equipment to solidify material at depth. ISS has not been commonly used to stabilize entire ash units as part of a closure strategy. Changes to groundwater chemistry relative to the mobility of Appendix IV constituents following completion of ISS, where large volumes of amendments (typically Portland cement) are added to the subsurface, are unknown and would require pilot testing.

Following the ISS completion and low-permeability final cover system (<1 x 10^{-7} cm/sec) installation, Ameren would implement post-closure care activities that includes long-term groundwater monitoring and cover system maintenance; future development of the capped surface could be used for solar photovoltaic arrays or other site staging/ancillary operational needs.

4.4.3 Alternative 3 – CIP with Capping and In-Situ Groundwater Treatment

Similar to Alternative 1, the SCPA would be CIP with a low-permeability (<1 x 10^{-7} cm/sec) cap to reduce infiltration of surface water to groundwater and to isolate source material. Molybdenum would be addressed through in-situ injection of groundwater amendments downgradient of the SCPA with the objective of accelerating the time required to achieve the GWPS within the treatment zone.

Following the installation of the low-permeability cover and in-situ treatment system, Ameren would implement post-closure care activities that include periodic amendment injections or periodic replenishment of the treatment reagents within a permeable reactive barrier (PRB), long-term groundwater sampling to monitor treatment system performance, and cover system maintenance.

Future development of the capped surface could be used for solar photovoltaic arrays or other site staging/ancillary operational needs.

4.4.4 Alternative 4 – CIP with Capping and Hydraulic Containment Through Groundwater Pumping and Ex-situ Treatment

The SCPA would be closed in place with a low-permeability (<1 x 10^{-7} cm/sec) cap to reduce infiltration and isolate source material. Pumping wells would be used to hydraulically control the downgradient migration of molybdenum. However, pumping wells would generate large volumes of effluent that would require ex-situ treatment, likely with an ion exchange or a reverse osmosis (RO) treatment system. Both treatment systems are complex with ongoing operation and maintenance and would generate a secondary waste stream – including regeneration/replacement of the ion exchange media or concentration reject water from the RO system. Approvals and permitting would be required for the construction and installation of the treatment systems and discharge of the treated groundwater.

Implementation of a large-scale hydraulic containment (HC) system will require a detailed design effort with bench scale testing to verify groundwater treatment. Pilot testing, such as pumping tests and additional groundwater modeling, will be needed to verify the hydraulic capture zone. While HC is a widely used remediation technology, it has not been commonly used as part of a large-scale CCR unit closure strategy.

Following the installation of the low-permeability cover, groundwater pumping well network, and ex-situ treatment system, Ameren would implement post-closure care activities that includes operation and maintenance of the HC system, long-term groundwater sampling to monitor HC system performance, and cover system maintenance. Future development of the capped surface could be used for solar photovoltaic arrays or other site staging/ancillary operational needs.

4.4.5 Alternative 5 – Closure by Removal with Monitored Natural Attenuation

This alternative evaluates the removal of CCR from all impoundments at the SEC followed by natural attenuation of molybdenum in groundwater. While this alternative would eliminate (through removal) the source, it takes decades to implement during which time the impounded ash would remain open and subject to ongoing infiltration for the duration of the removal activities. As with Alternative 1, 2, and 3, concentrations of molybdenum in downgradient groundwater would decline via natural attenuation processes.

Lochmueller Group prepared an Extraction and Transportation Study (Lochmueller Study) to evaluate closure by removal excavation and disposal scenarios. On-site and off-site disposal options were considered. The SEC presents unique challenges that can impact cost estimates and closure times. It is important to note that the existing on-site utility waste landfill was designed and permitted to manage ongoing production through the retirement date of the SEC. Accordingly, excavated material would need to be transported off-site to a commercial landfill **or** Ameren would need to permit and construct a new on-site landfill. The regulatory process for construction of an on-site landfill could require multiple levels of approval including environmental permits, conditional use local authorization and, if necessary, certificate issuance from the Missouri Public Service Commission. Opposition to such projects and regulatory approval would take years to resolve *before* construction could commence.

There are also several potential community impacts, safety concerns and project duration challenges associated with the CBR alternative for the off-site disposal option. Given the magnitude of the total estimated haul volume (6.1 MM CY) along with the travel distance required to transport the CCR to one or more landfills, injuries and fatalities would be likely. The Lochmueller Study (**Appendix C)** estimated that the time period needed to transport off-site to a commercial landfill could be 15 plus years. The Lochmueller study bases its time estimate on assumed productivity rates that are subject to significant variability and potential disruptions (e.g., weather conditions, available landfill capacity, travel route traffic congestion, etc.) that could impact the overall CBR timeframe. As the report makes clear, there is simply a limit on how much excavation, and roundtrip truck hauls can occur on a given eight-hour workday.

Excavated CCR materials would not be suitable for beneficial use applications, due to chemical reactions that occurred during the placement of class C fly ash via wet sluicing. Traditional beneficial use applications for class C fly ash, such as replacement for cement in the production of ready-mix concrete and concrete related products require the materials to be capable of reacting chemically to produce cementitious bonds. The capability to produce these chemical reactions have been expended with the wet-sluicing process. In contrast, the chemistry of class F fly ash, produced at other utility sites, does not react with sluice water to create cementitious bonds, and thus may be suitable for recovery and processing for use in ready mix concrete and concrete related products[7].

In addition to the logistical challenges of designing and construction an on-site landfill, technical and logistical challenges of implementing a large-scale ash removal project also need to be considered (removal of CCR over 75-ft deep). Removal activities will be difficult and require full-time dewatering, implementation of CCR stabilization methods and temporary staging/stockpiling of material for drying

[7] Information provided by Ameren technical staff, May 2019.

prior to transportation; these considerations will affect productivity and increase removal duration. Excavation and construction safety during the removal duration is another major concern due to heavy equipment (bulldozers, excavators, front end loaders, off-road trucks) and dump truck operation within the active SEC site. Additional community impacts associated with the use of heavy equipment and truck traffic are also a consideration for this alternative. Lastly, further review of local restrictions and approvals would be required to verify that any selected landfill could receive the ash for disposal.

5. Comparison of Corrective Measures Alternatives

The purpose of this section is to evaluate, compare, and rank the five corrective measures alternatives using the balancing criteria described in §257.97.

5.1 EVALUATION CRITERIA

In accordance with §257.97, remedial alternatives that satisfy the threshold criteria are then compared to four balancing (evaluation) criteria. The balancing criteria allow a comparative analysis for each corrective measure, thereby providing the basis for final corrective measure selection. The four balancing criteria include the following:

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;
2. The effectiveness of the remedy in controlling the source to reduce further releases;
3. The ease or difficulty of implementing a potential remedy; and
4. The degree to which community concerns are addressed by a potential remedy.

Public input and feedback will be considered following a public information session to be held in May 2019.

5.2 COMPARISON OF ALTERNATIVES

This section compares the alternatives to each other based on evaluation of the balancing criteria listed above. The goal of this analysis is to identify the alternative that is technologically feasible, relevant and readily implementable, provides adequate protection to human health and the environment, and minimizes impacts to the community.

A graphic is provided within each subsection below to provide a visual snapshot of the favorability of each alternative, where green represents favorable, yellow represents less favorable, and red represents unfavorable.

5.2.1 The Long- and Short-Term Effectiveness and Protectiveness of the Potential Remedy, along with the Degree of Certainty that the Remedy Will Prove Successful

This balancing criterion takes into consideration the following sub criteria relative to the long-term and short-term effectiveness of the remedy, along with the anticipated success of the remedy.

5.2.1.1 Magnitude of reduction of existing risks

As summarized in **Section 3**, no unacceptable risk to human health and the environment exists with respect to the SCPA. Therefore, none of the remedial alternatives are necessary to reduce an assumed risk posed by Appendix IV constituents in groundwater because no such adverse risk currently exists. However, other types of impacts can be posed by the various remedial alternatives considered here. The remedial alternatives that pose the lowest risk to human health and the environment is Alternative 1 (CIP with MNA) and 3 (CIP with in-situ treatment) because they are implemented on-site and involve the least amount of construction, operations and maintenance activities and associated impacts.

Alternative 5 (CBR with MNA) has the highest potential impact due to the prolonged truck traffic, which increases the likelihood of roadway accidents during the estimated 15 years needed to complete off-site removal. Construction and material transportation will also be required for Alternative 2 (CIP with ISS) during the process of solidifying the CCR. Construction of the treatment system and cap will be required for Alternative 3 (CIP with in-situ treatment) and 4 (CIP with HC) and a waste stream will be generated for Alternative 4 (CIP with HC) posing additional risk. However, these alternatives, like Alternatives 1 (CIP with MNA) and 2 (CIP with ISS), pose a lesser risk than Alternative 5 (CBR with MNA).

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 1 - Subcriteria i) Magnitude of reduction of risks					

5.2.1.2 *Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy*

Alternative 5 (CBR with MNA) has the lowest long-term residual risk in that removal of the source material reduces the likelihood of future releases to groundwater. However, implementation of this alternative will take approximately 15 to 20 years (whether by off-site removal or a new on-site landfill) during which time the CCR material will remain open to the environment, thereby increasing the likelihood of releases during the implementation period. For Alternatives 1 through 4, the SCPA would be CIP with the installation of a low permeability (<1 x 10^{-7} cm/s) cap that would significantly reduce the infiltration of precipitation into the SCPA. The source is isolated under Alternatives 1 through 4, and dissolved phase molybdenum in groundwater is addressed through MNA. Molybdenum concentration in groundwater is not significant because it does not threaten human health or the environment even under current conditions. Alternatives 3 (CIP with in-situ treatment) and 4 (CIP with HC) also provide additional mitigation measures. A low risk for further releases exists with Alternative 2 (CIP with ISS) when completed, however implementation will require several years to complete with the potential for ongoing impacts during construction. The likelihood of a further release during the ISS construction period is high, relative to the other CIP alternatives but Alternative 4 (CIP with HC) will result in an additional waste stream.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 1 - Subcriteria ii) Magnitude of residual risk in terms of likelihood of further release					

5.2.1.3 *The type and degree of long-term management required, including monitoring, operation, and maintenance*

Alternative 1 (CIP with MNA) is the most favorable alternative with respect to this criterion because it requires the least amount of long-term management and involves no mechanical systems as part of the remedy. Alternative 5 (CBR with MNA) is least favorable because off-site removal and a new on-site landfill are estimated to take 15 to 20 years to complete and are both logistically complex as previously noted. The remaining alternatives fall between Alternatives 1 and 5 because they involve more intensive systems to implement and/or maintain throughout their remediation life cycle.

	Alternative 1 CIP with Cap & MNA	Alternative 2 CIP with Cap, ISS, & MNA	Alternative 3 CIP with Cap & In-Situ GW Treatment	Alternative 4 CIP with Cap & Hydraulic Containment	Alternative 5 CBR with MNA
Category 1 - Subcriteria iii) Type and degree of long-term management required					

5.2.1.4 *Short-term risks that might be posed to the community or the environment during implementation of such a remedy*

The highest short-term impact posed to the community or environment would be during implementation of Alternative 5 (CBR with MNA), followed by Alternative 2 (CIP with ISS), making these alternatives least favorable. Potential environmental impacts include noise and emissions from heavy equipment, the potential for a release during excavation and dewatering, and fugitive dust emissions. Community impacts include general impacts to the community due to increased truck traffic on public roads during the entire project duration, including construction of the on-site landfill (if off-site disposal is not selected), along with an increased potential for traffic accidents and fatalities, noise, and truck emissions. As noted, Alternative 5 (whether off-site disposal or a new onsite landfill) will require a substantial period of time when the CCR material will be open to the environment posing risk during implementation of this remedy.

For Alternatives 1 (CIP with MNA), 3 (CIP with in-situ treatment), and 4 (CIP with HC), risk to the community during implementation is considered the same and would be minimal compared to the other alternatives. Long-term sampling of the monitoring well network to verify treatment system effectiveness will pose no risk to the community.

	Alternative 1 CIP with Cap & MNA	Alternative 2 CIP with Cap, ISS, & MNA	Alternative 3 CIP with Cap & In-Situ GW Treatment	Alternative 4 CIP with Cap & Hydraulic Containment	Alternative 5 CBR with MNA
Category 1 - Subcriteria iv) Short term risk to community or environment during implementation					

5.2.1.5 *Time until full protection is achieved*

There is currently no unacceptable risk to human health and the environment associated with groundwater at the SCPA; therefore, protection is already achieved. Alternatives 1 (CIP with MNA), 3 (CIP with in-situ treatment), and 4 (CIP with HC) are anticipated to take a similar period of time until source depletion and natural attenuation reduces COCs to GWPS concentrations, but a waste stream is produced by implementation of Alternative 4. Although the Alternative 4 (CIP with HC) time duration may be slightly shorter due to the increase in groundwater flux through pumping, these three alternatives are considered equivalent due to the similar timeframe.

Alternative 5, (CBR with MNA), could take approximately 15 years or greater for construction with off-site disposal. This timeframe increases to 20 years or greater for on-site landfill disposal due to design, permitting, construction and disposal. Removal construction would be followed by a period of groundwater monitoring to verify natural attenuation of the groundwater plume, which makes this alternative not only unfavorable but will not achieve compliance with the CCR Rule closure time mandates. The period for construction is limited mainly by the construction of an on-site landfill, the amount of material that can be handled in one day (for both on site or off-site disposal), disposal facility capacity (if off-site disposal is selected), and the volume of ash to be handled.

Pending equipment availability, Alternative 2 (CIP with ISS) could take the least amount of time (if multiple mixing machines are available for ISS) at approximately 5 years to complete and a period of groundwater monitoring to verify natural attenuation of the groundwater plume. Implementation of Alternative 2 would require extensive engineering analysis and field testing. Assuming such studies confirm the viability of ISS technology at the SCPA and equipment availability, field implementation could take a significant amount of time to implement.

Due to the extended time frame that will be required to achieve the GWPS for each Alternative, each Alternative was given the same ranking for this balancing sub-criterion.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 1 - Subcriteria v) Time until full protection is achieved					

5.2.1.6 *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*

Alternatives 1 (CIP with MNA), 3 (CIP with in-situ treatment), and 4 (CIP with HC) all have similar, minimal potential for exposure to humans and environmental receptors during regrading and cap construction; monitoring well system installation; and installation of the in-situ treatment system or HC system. Alternative 1 (CIP with MNA) is the most favorable alternative since, aside from capping, no additional contact with CCR or impacted groundwater would be needed. Alternative 3 (CIP with in-situ treatment) is also favorable because treatment occurs below ground and no waste stream is generated. A waste stream would be generated under Alternative 4 (CIP with HC) and need to be managed either onsite or offsite, which creates a potential for exposure.

Alternatives 2 (CIP with ISS) and 5 (CBR with MNA) have moderate and high potential for exposure, respectively, which makes them the least favorable remedy for this criterion. A high potential for exposure exists during the excavation and transport (both off-site and on-site) of the CCR if Alternative 5 is implemented. A moderate potential to exposure exists during ISS construction (Alternative 2) if some CCR needs to be disposed off-site as part of the preliminary removal effort prior to ISS implementation.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 1 - Subcriteria vi) Potential for exposure of humans and environmental receptors to remaining wastes					

5.2.1.7 *Long-term reliability of the engineering and institutional controls*

Alternatives 1 (CIP with MNA), 3 (CIP with in-situ treatment), and 4 (CIP with HC) are all expected to have high long-term reliability, as capping and long-term monitoring are common methods for long-term waste management. HC and ex-situ treatment (Alternative 4) are considered proven technologies and would have high long-term reliability but create a significant, large-volume waste stream and require bench scale and pilot testing. Alternative 3 will require bench scale (in progress) and pilot scale testing to confirm treatability of molybdenum. Of the CIP alternatives, Alternative 1 (CIP with MNA) is considered the most favorable because no additional ongoing operations and maintenance (O&M)

would be needed, other than periodic groundwater sampling and verification of decreasing concentrations.

For Alternatives 1 through 4, which include CIP, institutional controls, such as recording of an environmental covenant restricting the use of groundwater can easily be implemented because the SCPA is located on property owned by Ameren.

Alternative 5 (CBR with MNA) engineering and institutional controls would have high long-term reliability because the CCR will have been removed from the SCPA and placed in a new on-site or existing off-site permitted landfill. With the CCR no longer in place, no additional engineering and institutional controls are anticipated. Alternative 2 (CIP with ISS) is also expected to have a high long-term reliability because the CCR would be isolated within the ISS monolith.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 1 - Subcriteria vii) Long-term reliability of engineering and institutional controls					

5.2.1.8 *Potential need for replacement of the remedy*

Closure in place of the SCPA with ISS and closure by removal are both considered permanent and can be effective in appropriate circumstances. Detailed engineering assessments would need to be completed before the viability of such approaches could be considered at a site such as the SCPA given its depth. Field pilot testing would be needed for ISS to confirm the ability of equipment to reach the bottom of CCR. From the perspective of needing to replace the remedy, source removal (Alternative 5) is permanent but takes decades to implement.

Alternatives 1 (CIP with MNA), 3 (CIP with in-situ treatment), and 4 (CIP with HC) are expected to have permanent closures with capping in place. Should monitoring results indicate that the selected remedial alternative is not effective at reducing the concentration of COCs over time, alternate and/or additional active remedial methods for groundwater may be considered in the future.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 1 - Subcriteria viii) Potential need for replacement of the remedy					

5.2.1.9 *Long- and short-term effectiveness and protectiveness criterion summary*

The following graphic provides a summary of the long- and short-term effectiveness and protectiveness of the potential remedy, along with the degree of certainty that the remedy will prove successful. Alternatives 1 (CIP with MNA) is the most favorable, while Alternative 5 (CBR with MNA) is the least favorable. Alternative 1 does not include additional treatment technology aside from MNA, and therefore long-term management requirements are minimal. Alternative 1 does not rely on mechanical systems aside from low-permeability capping. Alternatives 3 (CIP with in-situ treatment) and 4 (CIP with HC) provide groundwater treatment at the waste boundary but require additional long-term operation maintenance. Alternative 5 (CBR with MNA) includes large-scale construction, and a lengthy permitting and approval period if an on-site landfill is constructed, which adds the potential for exposure to humans and the environment during the construction period. Alternative 2 (CIP with ISS) also includes potential exposure to humans and environment during construction, although the construction duration is expected to be shorter than Alternative 5. Further, to implement Alternative 5, the CCR material will be open to the environment for decades during the lengthy removal process.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
CATEGORY 1 Long- and Short Term Effectiveness, Protectiveness, and Certainty of Success					

5.2.2 The Effectiveness of the Remedy in Controlling the Source to Reduce Further Releases

This balancing criterion takes into consideration the ability of the remedy to control a future release, and the extensiveness of treatment technologies that will be required.

5.2.2.1 The extent to which containment practices will reduce further releases

For remedial Alternatives 1 (CIP with MNA), 3 (CIP with in-situ treatment), and 4 (CIP with HC), installation of the low permeability cap will reduce the infiltration of surface water into the SCPA and decrease the flux of molybdenum to groundwater over time. Groundwater mounding, and associated outward hydraulic gradient, present at the SCPA during operation is expected to dissipate after closure. Alternatives 3 and 4 are considered the most favorable because active treatment technologies (in-situ treatment and HC with ex-situ treatment, respectively) will be implemented to limit further down-gradient migration of molybdenum in groundwater.

Under Alternatives 2 (CIP with ISS) and 5 (CBR with MNA), no further releases are anticipated following removal or stabilization of the CCR material. However, the implementation of each alternative is anticipated to require multiple years or decades to complete with MNA monitoring following completion of construction. During the period of design, permitting, and construction for Alternatives 2 and 5, there would be no source control of the Appendix IV constituents.

For Alternatives 3 (CIP with in-situ treatment) and 4 (CIP with HC), additional containment or treatment practices (in-situ treatment and HC with ex-situ treatment) will address COCs in groundwater migrating downgradient from the SCPA, achieving the performance criteria at the waste boundary. Alternative 4, however, will create additional waste streams requiring management on and off site. Alternative 1 will not have an additional containment technology beyond natural attenuation.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 2 - Subcriteria i) Extent to which containment practices will reduce further releases					

5.2.2.2 The extent to which treatment technologies may be used

No groundwater treatment technologies, other than natural attenuation, will be used for Alternatives 1 (CIP with MNA) and 5 (CBR with MNA). There would be no ongoing operation and maintenance of a treatment technology, other than periodic groundwater monitoring. Alternative 1 relies only on low-permeability capping with long-term groundwater monitoring, and therefore is the most favorable.

Alternative 2 (CIP with ISS) uses solidification of the CCR below the water table to address COCs in groundwater.

Alternative 3 will use one additional technology, in-situ treatment, while Alternative 4 will use two additional technologies, HC and ex-situ treatment. The operation of an ex-situ treatment system will create a secondary waste stream, such as concentrated reject water (RO) requiring off-site disposal, or depleted resin (ion exchange) requiring regeneration or off-site disposal.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 2 - Subcriteria ii) Extent to which treatment technologies may be used					

5.2.2.3 Effectiveness of the remedy in controlling the source to reduce further releases summary

The graphic below provides a summary of the effectiveness of the remedial alternatives to control the source to reduce further releases. Alternatives 3 (CIP with in-situ treatment) is the most favorable, while Alternatives 1 (CIP with MNA), 2 (CIP with ISS), 4 (CIP with HC) and 5 (CBR with MNA) are less favorable. The construction period for Alternative 3 (CIP with in-situ treatment) is expected to be brief and will begin treating groundwater at the unit boundary immediately. Further releases under Alternative 2 (CIP with ISS) and Alternative 5 (CBR with MNA) will not be addressed until construction is complete.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
CATEGORY 2 Effectiveness in controlling the source to reduce further releases					

5.2.3 The Ease or Difficulty of Implementing a Potential Remedy

This balancing criterion takes into consideration technical and logistical challenges required to implement a remedy, including practical considerations such as equipment availability and disposal facility capacity.

5.2.3.1 Degree of difficulty associated with constructing the technology

CIP with a low permeability cap will be straightforward and can be implemented with common construction methods for Alternatives 1 (CIP with MNA), 3 (CIP with in-situ treatment), and 4 (CIP with HC). No construction difficulties are anticipated if Alternatives 1, 3, and 4 are implemented. Specialty equipment or contractors are not required. For Alternative 1, no additional treatment technology is needed other than monitoring wells for groundwater monitoring. Installation of an in-situ treatment system (Alternative 3) or groundwater pumping wells with an ex-situ treatment system (Alternative 4) is expected to be straightforward, although with Alternative 4, an additional waste stream will require handling.

Alternatives 2 (CIP with ISS) and 5 (CBR with MNA) will be difficult to implement due to technical and logistical challenges. Alternative 5 will include a deep excavation below the water table, ongoing excavation, dewatering, CCR stabilization, seasonal impacts to construction due to wet weather and winter weather, and transportation. If the CCR is disposed on-site in a new landfill for Alternative 5, additional effort will be required for the design, permitting, approval, and construction. Under Alternative 2, the successful completion of ISS to target depths will be technically challenging and will require field pilot testing to confirm equipment reach. Alternatives 2 and 5 will both include large-scale construction, extensive permitting, specialty equipment and contractors, long project durations, and significant technical challenges.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 3 - Subcriteria i) Degree of difficulty associated with constructing the technology					

5.2.3.2 *Expected operational reliability of the technologies*

Alternative 1, (CIP with MNA) is considered the most favorable from an operational perspective because capping with MNA has a proven track record and requires limited O&M. While alternative 2 (CIP with ISS) is a proven technology and isolates the ponded material, pilot testing would be required to ensure ISS will be able to solidify CCR at depth. The potential for geochemical impact on the groundwater aquifer from the solidification amendments would need to be evaluated. Alternatives 3 (CIP with in-situ treatment) and 4 (CIP with HC) are expected to be reliable but will utilize additional groundwater treatment technologies. Alternative 5, CBR with MNA is considered a reliable alternative as all CCR material would be removed, although implementation would be challenging.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 3 - Subcriteria ii) Expected operational reliability of the technologies					

5.2.3.3 *Need to coordinate with and obtain necessary approvals and permits from other agencies*

Alternative 1, (CIP with MNA), is the most favorable since the implementation of the remedy is straightforward and only includes capping and MNA. Alternatives 2 (CIP with ISS) and 5 (CBR with MNA) will require extensive permitting for large-scale construction whereas the permitting is expected to be straightforward for CIP Alternatives 1, 3, and 4. Alternative 5 in particular, has the potential to present the greatest need for coordination of and obtaining numerous permits and approvals if on-site landfilling is selected. Additional approval and permitting may be required for Alternative 3 (CIP with in-situ treatment) because this alternative may include subsurface treatment via groundwater amendment and permitting will be required for Alternative 4 for the construction and installation of treatment systems and discharge of treated groundwater.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 3 - Subcriteria iii) Need to coordinate with and obtain necessary approvals and permits from other agencies					

5.2.3.4 *Availability of necessary equipment and specialists*

Alternative 1, (CIP with MNA), is the most favorable since specialty equipment and specialists will not be required to implement the MNA remedy. For Alternative 3, specialists have already been retained by Ameren. Alternative 4 will require equipment for pumping and treatment and is less favorable than Alternatives 1 and 3 but equipment required should not present great challenge.

Alternatives 2 (CIP with ISS) and 5 (CBR with MNA) are the least favorable since both will require specialty remediation contractors to implement full removal or ISS, respectively, which will include large-scale construction dewatering and effluent management and treatment, deep excavations below the water table, transportation of material for disposal, and implementation of ISS at depth (for Alternative 2 only). Alternative 4 does require the availability of necessary equipment so this Alternative is less favorable than Alternative 1. The specialists for Alternative 3 have already been retained so Alternative 3 is favorable as well.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 3 - Subcriteria iv) Availability of necessary equipment and specialists					

5.2.3.5 *Available capacity and location of needed treatment, storage, and disposal services*

The Lochmueller Study assists in the consideration of the CBR alternative (Alternative 5) by evaluating available capacity at landfills reasonably proximate to the SEC that could potentially receive CCR for disposal if off-site disposal is selected. However, Ameren intends to close ash impoundments at **all** of its energy centers over the next four years and it is uncertain whether nearby landfills have sufficient available capacity to accommodate such massive excavation projects in addition to their general municipal solid waste customers. Additionally, local restrictions will need to be reviewed to determine whether the ash material generated outstate can be accepted at such facilities. If on-site disposal is selected for Alternative 5, a new on-site landfill would need to be designed, permitted, and approved since the existing on-site landfills were designed and permitted to manage production needs of the SEC through the facility's planned retirement date. Due to the disposal requirements, Alternative 5 (CBR with MNA) is the least favorable alternative.

Alternative 2, (CIP with ISS), includes ISS of CCR below the water table. Amendments such as Portland Cement will be imported to the SEC to solidify the material in-situ.

Because the SCPA will be CIP for Alternatives 1, 2, 3, and 4, storage and disposal services for CCR material will not be needed. Temporary stockpiling of CCR during SCPA regrading and capping can be completed within the current boundaries of the ash unit. Alternative 1 is the most favorable alternative since no active treatment is needed. Both Alternatives 2 and 3 include treatment. For Alternative 4, the ex-situ treatment system may also generate a concentrated waste stream which would require onsite treatment or off-site transportation and disposal that the other alternatives would not require. For Alternative 1, the existing on-site UWL was designed and permitted to manage ongoing production through the retirement date of the SEC and not ponded CCR material. As such there is no available on-site capacity. Excavated material would need to be transported off-site to a commercial landfill **or** Ameren Missouri would need to permit and construct a new on-site landfill.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 3 - Subcriteria v) Available capacity and location of needed treatment, storage, and disposal services					

5.2.3.6 Ease or difficulty of implementation summary

The color ribbon below provides a summary of the ease or difficulty that will be needed to implement each alternative. Alternatives 1 (CIP with MNA) is the most favorable, while Alternatives 2 (CIP with ISS) and 5 (CBR with MNA) are the least favorable.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
CATEGORY 3 Ease of implementation					

6. Summary

This Corrective Measures Assessment has evaluated the following alternatives:

- Alternative 1 – Closure in Place (CIP) with Capping and Monitored Natural Attenuation
- Alternative 2 – CIP with In-Situ Stabilization, Capping and MNA
- Alternative 3 – CIP with Capping and In-Situ Groundwater Treatment
- Alternative 4 – CIP with Capping and Hydraulic Containment Through Groundwater Pumping and Ex-situ Treatment
- Alternative 5 – Closure by Removal with Monitored Natural Attenuation

In accordance with §257.97, each of these alternatives has been evaluated in the context of the following threshold criteria:

- Be protective of human health and the environment;
- Attain the GWPS;
- Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of COCs to the environment;
- Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, considering factors such as avoiding inappropriate disturbance of sensitive ecosystems; and
- Comply with standards (regulations) for waste management.

In addition, in accordance with §257.96, each of the alternatives has been evaluated in the context of the following balancing criteria:

- The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to residual contamination;
- The time required to complete the remedy; and
- The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy.

This Corrective Measures Assessment, and the input received during the public comment period, will be used to identify a final corrective measure for implementation at the SEC.

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TABLES

TABLE I
GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

		Constituents													
Monitoring Well ID	Date Sampled	Antimony, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Fluoride Total	Lead, Total	Lithium, Total	Mercury, Total	Molybdenum, Total	Selenium, Total	Thallium, Total
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	Site GWPS	6	10	2000	4	5	100	6	4	15	40	2	100	50	2
S-BMW-1D	3/16/2016	1 U	0.20 J	334	1 U	0.5 U	1 U	0.73 J	0.3	5 U	14.2	0.2 U	1.3 J	1 U	1 U
	5/9/2016	1 U	1 U	314	1 U	0.5 U	0.58 J	5 U	0.35	3.7 J	16.8	0.2 U	0.53 J	1 U	1 U
	7/5/2016	1 U	0.17 J	261	1 U	0.5 U	0.35 J	5 U	0.26	5 U	12.8	0.2 U	20 U	1 U	1 U
	9/14/2016	1 U	1 U	309	1 U	0.5 U	0.41 J	5 U		5 U	12.9	0.2 U	20 U	1 U	1 U
	10/20/2016								0.32						
	11/7/2016	1 U	0.15 J	308	1 U	0.5 U	0.35 J	5 U	0.29	5 U	14.8	0.2 U	20 U	1 U	1 U
	1/3/2017	1 U	1 U	334	1 U	0.5 U	0.42 J	5 U	0.27	5 U	15.1	0.2 U	0.75 J	1 U	1 U
	3/8/2017	1 U	1 U	376	1 U	0.5 U	1 U	5 U	0.25	5 U	13.7	0.2 U	20 U	1 U	1 U
	6/6/2017	1 U	0.16 J	332	1 U	0.5 U	0.16 J	5 U	0.24	5 U	10 U	0.1 U	20 U	1 U	1 U
	11/13/2017								0.28						
	4/5/2018	1 U	0.16 J	370	1 U	0.5 U	1 U	5 U	0.078 J	10 U	10.7	0.2 U	20 U	1 U	1 U
	5/14/2018		0.85 J	335					0.3		13.4		1.3 J		
	11/12/2018	1 U	0.20 J	297	1 U	0.5 U	1 U	5 U	0.29	10 U	16.2		20 U	1 U	1 U
S-BMW-3D	11/17/2016	1 U	0.24 J	612	1 U	0.5 U	0.46 J	5 U	0.28	5 U	14.2	0.2 U	20 U	1 U	1 U
	12/8/2016	0.076 J	1 U	667	1 U	0.5 U	0.99 J	5 U	0.34	5 U	20.6	0.2 U	1.8 J	1 U	1 U
	1/3/2017	1 U	1.5	183	1 U	0.5 U	0.59 J	2.8 J	0.34	5 U	7.9 J	0.2 U	6.2 J	1 U	1 U
	2/2/2017	1 U	1 U	650	1 U	0.5 U	0.61 J	5 U	0.34	5 U	20	0.2 U	20 U	1 U	0.082 J
	3/8/2017	1 U	0.086 J	699	1 U	0.5 U	0.70 J	5 U	0.26	5 U	21.5	0.2 U	20 U	1 U	1 U
	4/5/2017	0.041 J	1 U	684	1 U	0.5 U	1 U	5 U	0.31	5 U	23.6	0.2 U	20 U	0.10 J	1 U
	6/5/2017	1 U	1 U	665	1 U	0.5 U	0.17 J	5 U	0.27	5 U	10 U	0.1 U	20 U	1 U	1 U
	6/26/2017	1 U	1 U	668	1 U	0.5 U	1 U	5 U	0.29	5 U	25.3	0.2 U	20 U	1 U	1 U
	11/13/2017								0.29						
	4/5/2018	1 U	1 U	652	1 U	0.5 U	1 U	5 U	0.13 J	10 U	19.5	0.2 U	20 U	1 U	1 U
	5/14/2018		0.63 J	685					0.32		21.6		20 U		
	11/12/2018	1 U	1 U	645	1 U	0.5 U	1 U	5 U	0.3	10 U	25.4		20 U	1 U	1 U
S-UMW-1D	3/17/2016	0.13 J	0.90 J	161	1 U	0.5 U	1 U	5 U	0.34	5 U	13.1	0.2 U	31.7	1 U	1 U
	5/10/2016	0.11 J	0.90 J	120	1 U	0.5 U	0.62 J	5 U	0.31	3.0 J	14.6	0.2 U	38.3	1 U	1 U
	7/5/2016	0.078 J	1.1	138	1 U	0.5 U	1 U	5 U	0.22	5 U	13.7	0.2 U	40.3	1 U	1 U
	9/15/2016	0.066 J	0.98 J	195	1 U	0.5 U	0.36 J	5 U	0.19 J	5 U	14.2	0.2 U	27.9	1 U	1 U
	11/8/2016	1 U	1	184	1 U	0.5 U	1 U	5 U	0.25	5 U	15.5	0.2 U	27.9	1 U	1 U
	1/5/2017	1 U	0.98 J	146	1 U	0.5 U	0.71 J	5 U	0.27	5 U	13.5	0.2 U	40.9	1 U	1 U
	3/9/2017	0.041 J	1.1	123	1 U	0.5 U	1.5	5 U	0.34	5 U	10.1	0.2 U	35.7	1 U	0.17 J
	6/7/2017	1 U	0.98 J	109	1 U	0.5 U	0.22 J	5 U	0.34	5 U	10.7 J	0.1 U	36.4	1 U	1 U
	11/14/2017								0.41						
	1/8/2018								0.42						
	4/5/2018	0.037 J	1.2	130	1 U	0.38 J	0.062 J	5 U	0.15 J	10 U	14.3	0.2 U	31.4	1 U	1 U
	5/16/2018		1.5	133					0.33		11.6		25.7		
	11/14/2018	1 U	1.4	134	1 U	0.5 U	1 U	5 U	0.19 J	10 U	15.7		24	1 U	1 U
S-UMW-2D	3/16/2016	0.067 J	0.87 J	122	1 U	0.5 U	0.35 J	5 U	1.1	3.9 J	24.6	0.2 U	**1,310**	1 U	1 U
	5/10/2016	0.077 J	1.1	121	1 U	0.5 U	0.66 J	5 U	1.3	5 U	29.7	0.2 U	**1,440**	1 U	1 U
	7/6/2016	1 U	1.4	119	1 U	0.5 U	1 U	5 U	1.1	5 U	28.7	0.2 U	**1,360**	1 U	1 U
	9/14/2016	1 U	1.3	105	1 U	0.5 U	1 U	5 U	1	5 U	28	0.2 U	**1,270**	1 U	1 U
	11/7/2016	1 U	1.5	85.8	1 U	0.5 U	0.55 J	5 U	1	5 U	31.1	0.2 U	**989**	1 U	1 U
	1/5/2017	1 U	1.4	92.8	1 U	0.23 J	1 U	5 U	1.1	5 U	29.7	0.2 U	**1,310**	1 U	1 U
	3/9/2017	0.048 J	2.1	131	1 U	0.5 U	1.7 J	5 U	0.72	5 U	30.2	0.2 U	**1,880**	0.12 J	0.25 J
	6/7/2017	0.044 J	1.9	96.8	1 U	0.24 J	0.12 J	5 U	0.78	3.0 J	18.6	0.1 U	**2,170**	1 U	0.10 J
	11/13/2017								0.7						
	1/8/2018								0.58						
	4/6/2018	0.068 J	2.1	57.4	1 U	0.15 J	0.066 J	5 U	0.35	10 U	19.1	0.2 U	**1,590**	0.094 J	1 U
	5/14/2018		2.4	54.3					0.63		12.5		**1,530**		
	11/13/2018	1 U	2.8	65.7	1 U	0.29 J	1 U	5 U	0.46	10 U	23.4		**1,540**	0.11 J	1 U
S-UMW-3D	3/16/2016	0.083 J	0.82 J	88	1 U	1 U	0.56 J	5 U	0.81	4.2 J	14.7	0.2 U	**4,800**	1 U	1 U
	5/10/2016	0.21 J	0.85 J	75.6	1 U	0.5 U	0.62 J	5 U	1.1	5 U	27.2	0.2 U	**4,250**	0.23 J	1 U
	7/6/2016	1 U	0.44 J	70.1	1 U	0.5 U	1 U	5 U	1	2.7 J	26	0.2 U	**3,770**	0.30 J	1 U
	9/14/2016	1 U	0.29 J	71.8	1 U	0.25 J	1 U	5 U	1	3.1 J	18.4	0.2 U	**4,280**	0.30 J	1 U
	11/7/2016	1 U	0.41 J	70.9	1 U	0.12 J	1 U	5 U	0.95	3.5 J	16.2 J	0.2 U	**4,230**	0.27 J	1 U
	1/5/2017	1 U	0.14 J	76.1	1 U	0.79	0.35 J	5 U	1	5 U	18.4	0.2 U	**3,430**	0.21 J	1 U
	3/9/2017	1 U	1 U	79.8	1 U	0.5 U	1 U	5 U	0.99	2.8 J	14.9	0.2 U	**4,120**	0.12 J	0.084 J
	6/7/2017	0.030 J	0.23 J	70.5	1 U	0.53	0.67 J	5 U	0.94	5 U	16.7	0.1 U	**3,920**	0.17 J	0.052 J
	11/13/2017								1						
	1/8/2018								1.1						
	4/6/2018	1 U	0.58 J	90	0.40 J	0.37 J	0.083 J	5 U	0.9	10 U	25.9 J	0.2 U	**4,600**	0.22 J	1 U
	5/14/2018		1.8 J	92.4					0.98		14.8		**4,560**		
	11/13/2018	1 U	0.82 J	75	1 U	1	1 U	5 U	0.96	10 U	11.7		**4,000**	0.20 J	1 U

TABLE I
GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

		Constituents													
Monitoring Well ID	Date Sampled	Antimony, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Fluoride Total	Lead, Total	Lithium, Total	Mercury, Total	Molybdenum, Total	Selenium, Total	Thallium, Total
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	Site GWPS	6	10	2000	4	5	100	6	4	15	40	2	100	50	2
	3/16/2016	1 U	0.70 J	95.9	1 U	1.5 U	0.40 J	5 U	0.75	3.6 J	37.9	0.2 U	**8,300**	1 U	1 U
	5/10/2016	1 U	0.60 J	78.4	1 U	0.5 U	0.48 J	5 U	0.89	5 U	39.6	0.2 U	**7,220**	0.21 J	1 U
	7/6/2016	1 U	0.27 J	83.4	1 U	1 U	1 U	5 U	0.86	5 U	37.9	0.2 U	**7,550**	1 U	1 U
	9/14/2016	1 U	0.20 J	81.2	1 U	0.45 J	1 U	5 U	0.84	6.3	38	0.2 U	**7,200**	0.27 J	1 U
	11/7/2016	1 U	0.18 J	72	1 U	0.13 J	0.34 J	5 U	0.78	5.6	**41.3**	0.2 U	**7,190**	0.22 J	1 U
	1/5/2017	1 U	1 U	90.4	1 U	1.9	1 U	5 U	0.86	4.7 J	**44.2**	0.2 U	**7,830**	0.24 J	1 U
S-UMW-4D	3/9/2017	1 U	1 U	71.2	1 U	0.5 U	1 U	5 U	0.63	5 U	34.4	0.2 U	**6,480**	0.20 J	0.046 J
	6/7/2017	0.043 J	1 U	67.5	1 U	0.91	0.13 J	5 U	0.7	3.4 J	31.9	0.1 U	**6,120**	0.12 J	0.083 J
	11/13/2017								0.8						
	1/8/2018								0.82						
	4/6/2018	1 U	0.22 J	59.2	1 U	0.063 J	1 U	5 U	0.42	10 U	34	0.2 U	**4,380**	0.14 J	1 U
	5/14/2018		1.1	71.6					0.76		37.3		**5,870**		
	11/13/2018	1 U	0.29 J	56.9	1 U	0.94	1 U	5 U	0.49	10 U	38.3		**3,900**	0.12 J	1 U
	3/16/2016	1 U	0.80 J	369	1 U	0.5 U	0.42 J	5 U	0.58	4.8 J	31.4	0.2 U	**264**	0.20 J	1 U
	5/10/2016	1 U	0.88 J	333	1 U	0.5 U	0.56 J	5 U	0.65	2.5 J	32.5	0.2 U	**271**	1 U	1 U
	7/7/2016	1 U	0.65 J	312	1 U	0.5 U	0.46 J	5 U	0.66	3.0 J	29.8	0.2 U	**280**	0.22 J	1 U
	9/16/2016	1 U	0.51 J	300	1 U	0.5 U	0.64 J	5 U	0.63	5 U	31	0.2 U	**259**	0.20 J	1 U
	11/7/2016	1 U	0.62 J	296	1 U	0.5 U	0.44 J	5 U	0.7	5 U	32.5	0.2 U	**253**	0.29 J	1 U
	1/5/2017	1 U	0.26 J	281	1 U	0.041 J	1 U	5 U	0.56	5 U	28.4	0.2 U	**254**	1 U	1 U
S-UMW-5D	3/8/2017	1 U	1 U	248	1 U	0.5 U	1 U	5 U	0.47	5 U	21.5	0.2 U	**242**	0.091 J	1 U
	6/7/2017	1 U	0.41 J	284	1 U	0.028 J	1 U	5 U	0.53	5 U	24.7	0.2 U	**270**	0.11 J	0.038 J
	11/13/2017								0.55						
	1/8/2018								0.6						
	4/6/2018	1 U	0.32 J	249	1 U	0.5 U	1 U	5 U	0.4	10 U	19.6	0.2 U	**179**	0.094 J	1 U
	5/15/2018		0.64 J	265					0.62		18.9		**177**		
	11/13/2018	1 U	0.40 J	265	1 U	0.054 J	1 U	5 U	0.49	10 U	22.9		**181**	0.12 J	1 U
	3/17/2016	1 U	0.31 J	133	1 U	0.5 U	0.37 J	5 U	0.29	5 U	12.6	0.2 U	95.9	1 U	1 U
	5/10/2016	1 U	0.20 J	129	1 U	0.5 U	1 U	5 U	0.37	2.9 J	14.4	0.2 U	**106**	1 U	1 U
	7/7/2016	1 U	0.32 J	118	1 U	0.5 U	0.67 J	5 U	0.34	5 U	12.1	0.2 U	**109**	1 U	1 U
	9/16/2016	1 U	0.34 J	117	1 U	0.5 U	1 U	5 U	0.44	5 U	12	0.2 U	**112**	1 U	1 U
	11/8/2016	1 U	0.38 J	116	1 U	0.5 U	0.37 J	5 U	0.4	5 U	13.6	0.2 U	**114**	1 U	1 U
	1/5/2017	1 U	0.20 J	119	1 U	0.031 J	0.70 J	5 U	0.38	5 U	12.2	0.2 U	**110**	1 U	1 U
S-UMW-6D	3/8/2017	1 U	1 U	115	1 U	0.5 U	1 U	5 U	0.36	5 U	11.8	0.2 U	**108**	1 U	1 U
	6/6/2017	1 U	0.14 J	112	1 U	0.030 J	0.10 J	5 U	0.37	5 U	13.2	0.2 U	**115**	1 U	1 U
	11/13/2017								0.43						
	1/8/2018								0.47						
	4/6/2018	1 U	0.26 J	126	1 U	0.5 U	1 U	5 U	0.21	10 U	12.5	0.2 U	95.4	1 U	1 U
	5/14/2018		0.72 J	152					0.41		13.6		67.8		
	11/14/2018	1 U	0.29 J	182	1 U	0.5 U	1 U	5 U	0.33	10 U	20.3 J		52.8	1 U	1 U
S-AM-1D	11/13/2018	1 U	0.29 J	244	1 U	0.12 J	1 U	5 U	0.45	10 U	32.6	0.2 U	**446**	0.12 J	1 U
S-AM-1S	11/13/2018	1 U	1.3	112	1 U	0.055 J	1 U	1.5 J	0.6	10 U	19.3	0.2 U	58	1 U	1 U
S-TP-1D	11/16/2018	1 U	0.16 J	98	1 U	0.5 U	0.11 J	5 U	0.38	10 U	16.4	0.2 U	3.5 J	1 U	1 U
S-TP-1M	11/16/2018	1 U	0.12 J	212	1 U	0.5 U	0.19 J	5 U	0.35	10 U	17.5	0.2 U	1.8 J	1 U	1 U
S-TP-1S	11/16/2018	1 U	**25.3**	369	1 U	0.5 U	0.24 J	2.7 J	0.36	10 U	6.5 J	0.2 U	5.8 J	0.16 J	1 U
S-TP-2D	11/12/2018	1 U	0.12 J	87.2	1 U	0.5 U	1 U	5 U	0.2 U	10 U	**47.1**	0.2 U	20 U	0.095 J	1 U
S-TP-2M	11/12/2018	1 U	0.19 J	178	1 U	0.5 U	1 U	5 U	0.2 U	3.5 J	26.7	0.2 U	20 U	1 U	1 U
S-TP-2S	11/12/2018	1 U	**13.9**	283	1 U	0.5 U	1 U	2.9 J	0.2 U	3.3 J	13.2	0.2 U	11.8 J	0.15 J	1 U
S-TP-3D	11/14/2018	1 U	0.17 J	574	1 U	0.5 U	0.16 J	5 U	0.23	10 U	32.1	0.2 U	20 U	1 U	1 U
S-TP-3M	11/14/2018	1 U	0.26 J	434	1 U	0.5 U	0.22 J	5 U	0.29	10 U	21	0.2 U	1.2 J	1 U	1 U
S-TP-3S	11/14/2018	0.18 J	4.2	222	1 U	0.033 J	0.18 J	1.1 J	0.42	10 U	11.9	0.2 U	30.8	0.18 J	1 U
S-TP-4D	11/16/2018	1 U	0.95 J	557	1 U	0.5 U	0.16 J	5 U	0.31	10 U	29.6	0.2 U	20 U	1 U	1 U
S-TP-4M	11/16/2018	1 U	0.33 J	408	0.26 J	0.5 U	0.21 J	5 U	0.37	10 U	24.9	0.2 U	1.8 J	1 U	1 U
S-TP-4S	11/16/2018	1 U	5.8	192	1 U	0.5 U	1 U	1.4 J	0.35	10 U	14.8	0.2 U	33.1	0.21 J	1 U
S-TP-5D	11/13/2018	1 U	0.30 J	183	1 U	0.056 J	1 U	5 U	0.34	10 U	33.0 J	0.2 U	**175**	0.12 J	1 U
S-TP-5M	11/13/2018	1 U	3.5	252	1 U	0.5 U	1 U	5 U	0.3	10 U	31.0 J	0.2 U	12.8 J	1 U	1 U
S-TP-5S	11/13/2018	0.18 J	3.7	440	0.43 J	0.040 J	1 U	0.95 J	0.28 J	10 U	10 U	0.2 U	31.7	0.19 J	1 U
S-TP-6D	11/13/2018	1 U	0.17 J	391	0.33 J	0.5 U	1 U	5 U	0.2 U	10 U	28.0 J	0.2 U	2.0 J	1 U	1 U
S-TP-6M	11/13/2018	1 U	0.52 J	454	1 U	0.034 J	1 U	5 U	0.26	10 U	22.8 J	0.2 U	2.9 J	1 U	1 U
S-TP-6S	11/13/2018	1 U	2	224	1 U	0.5 U	1 U	1.2 J	0.27	10 U	33.7 J	0.2 U	4.3 J	1 U	1 U

TABLE I
GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

Monitoring Well ID	Date Sampled	Antimony, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Fluoride Total	Lead, Total	Lithium, Total	Mercury, Total	Molybdenum, Total	Selenium, Total	Thallium, Total
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	Site GWPS	**6**	**10**	**2000**	**4**	**5**	**100**	**6**	**4**	**15**	**40**	**2**	**100**	**50**	**2**
S-TP-7D	11/14/2018	0.11 J	0.23 J	410	1 U	0.5 U	0.22 J	5 U	0.26	10 U	**43.8**	0.2 U	20 U	1 U	1 U
S-TP-7M	11/14/2018	1 U	0.67 J	382	1 U	0.5 U	0.84 J	5 U	0.33	10 U	**40.2**	0.2 U	2.4 J	1 U	1 U
S-TP-7S	11/14/2018	1 U	8.4	443	1 U	0.5 U	0.083 J	1.0 J	0.38	10 U	25.4	0.2 U	59.2	0.17 J	1 U
S-TP-8D	11/14/2018	1 U	0.88 J	363	1 U	0.5 U	0.36 J	5 U	0.26	10 U	33.1	0.2 U	1.5 J	1 U	1 U
S-TP-8M	11/14/2018	1 U	0.91 J	248	1 U	0.041 J	0.15 J	5 U	0.29	10 U	27.6	0.2 U	1.0 J	1 U	1 U
S-TP-8S	11/14/2018	0.32 J	0.43 J	167	1 U	0.085 J	0.079 J	5 U	0.25	10 U	18.3	0.2 U	16.6 J	3.9	1 U

Notes:
40.2 Bold denotes concentration exceeding the GWPS
Blank cells - Constituent not included in this analysis.
mg/L - milligrams per liter.
ug/L - micrograms per liter.

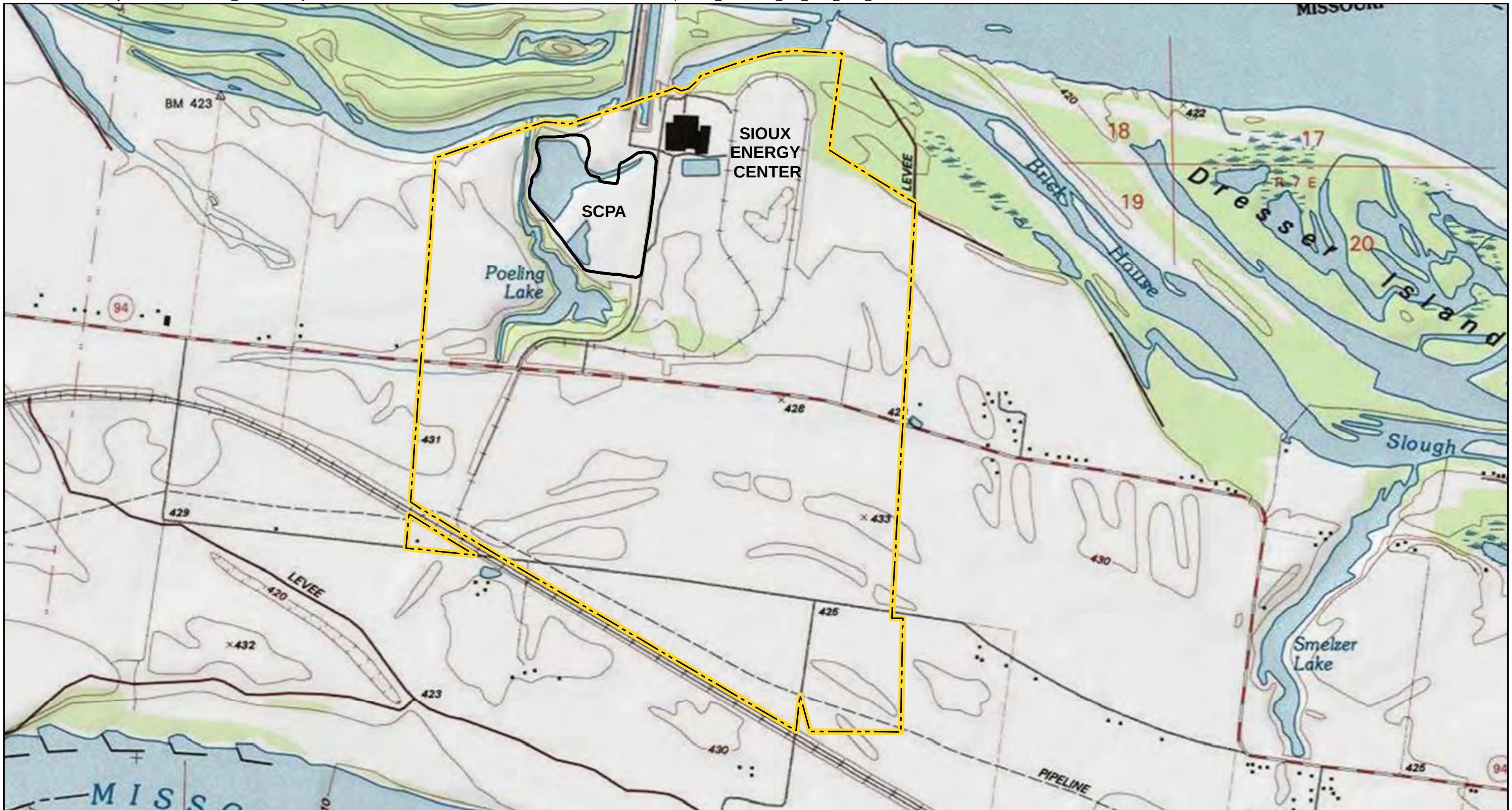
GWPS - Groundwater Protection Standard.
MCL - Maximum Contaminant Level.
RSL - Regional Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

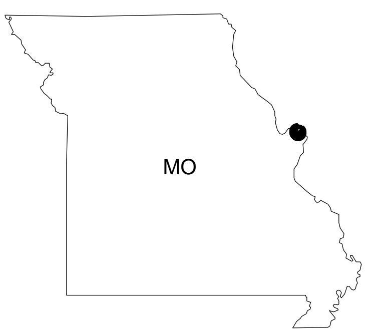
Qualifiers:
J - Value is estimated.
U - Constituent was not detected, value is the reporting limit.

Site GWPS is either the MCL/Health Based GWPS or based on background levels (calculated as described in the Statistical Analysis Plan for Assessment Monitoring), whichever is higher.
GWPS and background values calculated using baseline sampling results from monitoring wells BMW-1D and BMW-3D.

FIGURES

GIS FILE PATH: \\haleyaldrich.com\share\cle_common\Projects\132002 - Ameren Ash Pond Closure Assessment\005-Sioux\GIS\Maps\2019_04\132002_005_0001_SITE_LOCUS2.mxd — USER: hwachholz — LAST SAVED: 5/1/2019 3:36:26 PM





LEGEND

BOTTOM ASH SURFACE IMPOUNDMENT (SCPA)

SIOUX ENERGY CENTER PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.

2. IMAGERY SOURCE: ESRI

0 1,000 2,000

SCALE IN FEET

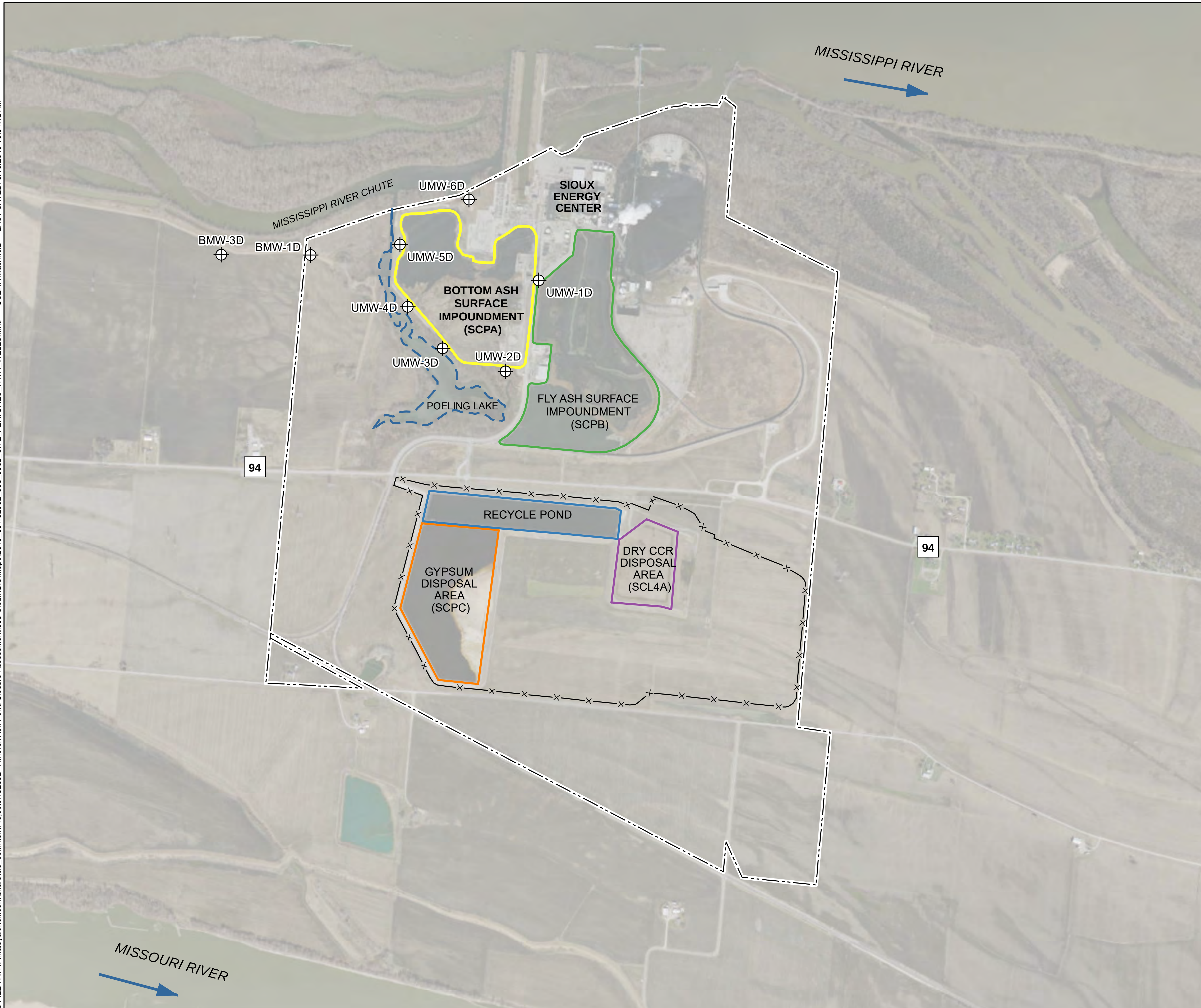
HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

SITE LOCATION MAP

MAY 2019

FIGURE 1-1



LEGEND

- SCPA BOTTOM ASH SURFACE IMPOUNDMENT MONITORING WELL LOCATION
- SIOUX ENERGY CENTER PROPERTY BOUNDARY
- UTILITY WASTE LANDFILL PERIMETER FENCE

NOTES

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI

N

0 1,200 2,400

SCALE IN FEET

HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

SITE FEATURES

MAY 2019

FIGURE 1-2

GIS FILE PATH: \\haleyaldrich.com\share\cle_common\Projects\132002 - Ameren Ash Pond Closure Assessment\005-Sioux\GIS\Maps\2019_05\132002_005_0002_SITE_FEATURES_WITH_WELLS.mxd — USER: hwachholz — LAST SAVED: 5/16/2019 10:31:12 AM

LEGEND

- NATURE AND EXTENT MONITORING WELL
- SCPA BOTTOM ASH SURFACE IMPOUNDMENT MONITORING WELL LOCATION
- SIOUX ENERGY CENTER PROPERTY BOUNDARY
- BOTTOM ASH SURFACE IMPOUNDMENT (SCPA)
- UTILITY WASTE LANDFILL PERIMETER FENCE

MOLYBDENUM CONCENTRATIONS - 2018 DATA

- NO MOLYBDENUM DETECTED
- MOLYBDENUM CONCENTRATION BELOW GWPS (<100 µg/L)
- MOLYBDENUM CONCENTRATION ABOVE GWPS (101-1000 µg/L)
- MOLYBDENUM CONCENTRATION ABOVE GWPS (>1000 µg/L)

NOTES

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI
3. MOLYBDENUM CONCENTRATIONS SHOWN BASED ON 2018 GROUNDWATER ANALYTICAL RESULTS.

0 1,000 2,000
SCALE IN FEET

HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

MONITORING WELL LOCATIONS

MAY 2019

FIGURE 2-1

GIS FILE PATH: \\haleyaldrich.com\share\cle_common\Projects\132002 - Ameren Ash Pond Closure Assessment\005-Sioux\GIS\Maps\2019_05\132002_005_0002_1_SITE_FEATURES.mxd — USER: hwachholz — LAST SAVED: 5/10/2019 3:59:51 PM

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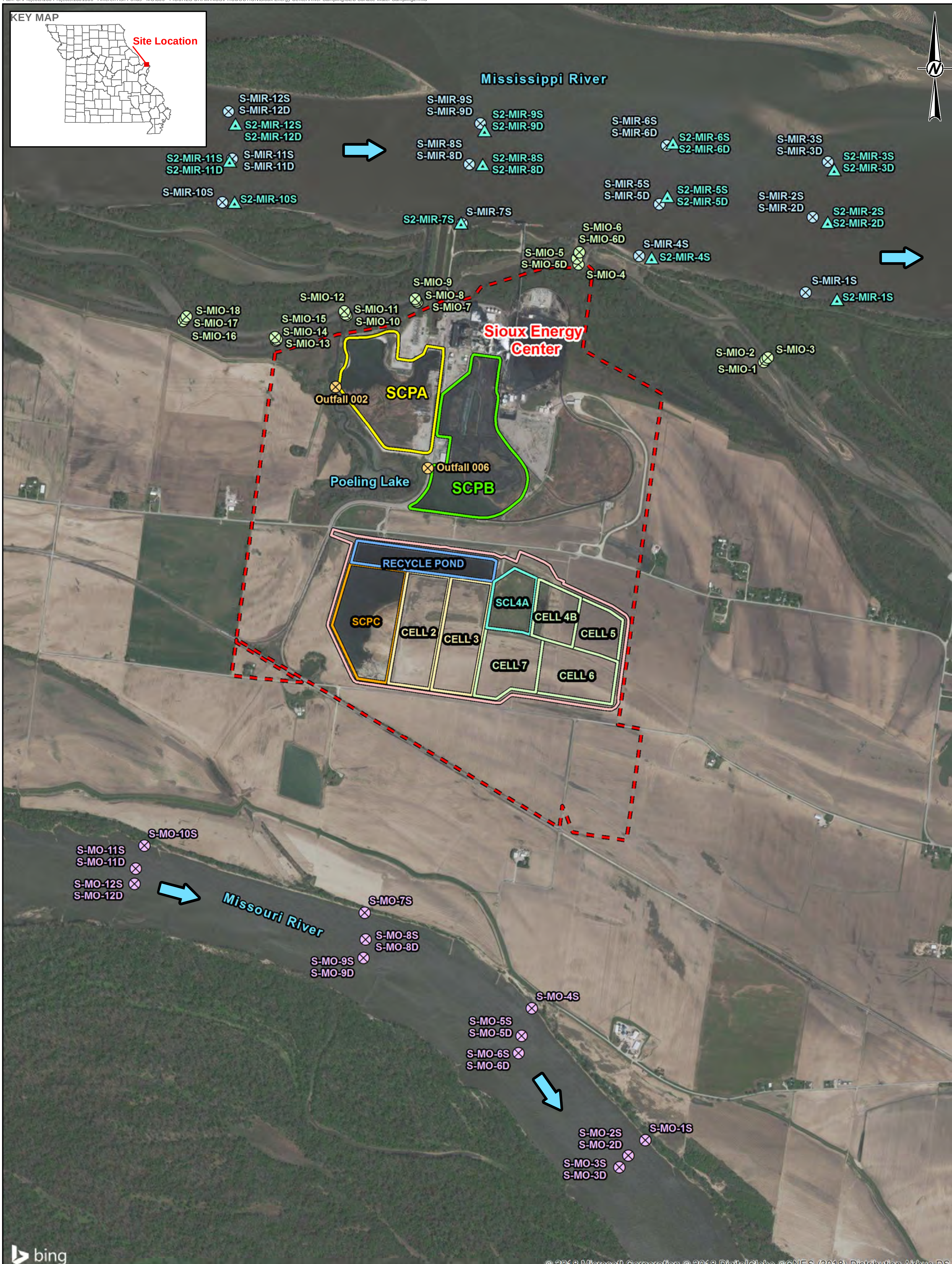

LEGEND

- Sioux Energy Center Property Boundary
- NPDES Outfalls

Surface Impoundments

- SCPB - Fly Ash Surface Impoundment
- SCPA - Bottom Ash Surface Impoundment

Utility Waste Landfill (UWL)

- Active Dry CCR Disposal Area
- Active WFGD Disposal
- Active Water Recycle Pond
- Surface Water Flow Direction
- Proposed Dry CCR Disposal Area
- Proposed WFGD Disposal Area
- UWL Perimeter Fence

Surface Water Sampling Locations

- September 2017 Missouri River Sample
- September 2017 Mississippi River Sample
- September 2017 Mississippi River chute Sample
- May 2018 Mississippi River Sample

NOTES

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2. NPDES - NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM.
3. SAMPLE LOCATIONS BASED ON HANDHELD TRIMBLE GPS MEASUREMENTS. SAMPLE LOCATION REPRESENTS CENTERPOINT BETWEEN SAMPLE STARTING AND ENDING LOCATION.
4. PREFIX S- USED FOR SAMPLES COLLECTED IN SEPTEMBER 2017 AND S2- USED FOR SAMPLES COLLECTED IN MAY 2018.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.

0 500 1,000 2,000 3,000 4,000
Feet

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
AMEREN HYDROGEOLOGICAL CONSULTING

TITLE
SURFACE WATER SAMPLING LOCATIONS
SIOUX ENERGY CENTER

CONSULTANT
GOLDER

YYYY-MM-DD	2018-05-25
PREPARED	JS
DESIGN	JSI
REVIEW	JSI
APPROVED	MNH

PROJECT No. 130-1560
PHASE 0006

Figure 2-2

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

FIGURE 4-1
REMEDIAL ALTERNATIVE ROADMAP
CORRECTIVE MEASURES ASSESSMENT
BOTTOM ASH SURFACE IMPOUNDMENT (SCPA)
SIOUX ENERGY CENTER - ST. CHARLES COUNTY, MISSOURI

Alternative Number	Remedial Alternative Description	SCPA Closure Description	Groundwater Remedy Components		
			A. Groundwater Remedy Approach	B. Groundwater Treatment Method	C. Post-Closure Actions
1	**Closure In Place (CIP) with Capping and Monitored Natural Attenuation (MNA)**	**CIP with Geomembrane and Soil Cap**	**Natural Attenuation with Monitoring** Mitigate off-site migration of groundwater with CCR constituents above GWPS through process of natural attenuation	**No Active Treatment** No active treatment technologies for groundwater to address CCR constituents	**MNA** Long-term groundwater monitoring to confirm reduction of CCR constituents
2	**CIP with In-Situ Stabilization (ISS), Capping and MNA**	**CIP with ISS, Geomembrane and Soil Cap**			
3	**CIP with Capping and In-Situ Groundwater Treatment**	**CIP with Geomembrane and Soil Cap**	**Subsurface Treatment System** Mitigate off-site migration of groundwater with CCR constituents above GWPS using in-situ amendments	**In-Situ Treatment** Subsurface treatment to reduce Appendix IV constituent concentrations in groundwater	**In-Situ Treatment Long-Term** Continue periodic in-situ treatment of groundwater long-term to maintain reduction of CCR constituents in groundwater
4	**CIP with Capping and Hydraulic Containment through Groundwater Pumping and Ex-Situ Treatment**	**CIP with Geomembrane and Soil Cap**	**Hydraulic Containment** Mitigate off-site migration of groundwater with CCR constituents above GWPS using extraction wells	**Ex-Situ Treatment** Treatment system (ion exchange or reverse osmosis) to remove CCR constituents from groundwater	**Pump & Treat Long-Term** Operate groundwater treatment system long-term to maintain reduction of CCR constituents in groundwater.
5	**Closure by Removal (CBR) with MNA**	**CBR**	**Natural Attenuation with Monitoring** Mitigate off-site migration of groundwater with CCR constituents above GWPS through process of natural attenuation	**No Active Treatment** No active treatment technologies for groundwater to address CCR constituents	**MNA** Long-term groundwater monitoring to confirm reduction of CCR constituents

APPENDIX A

Surface Water Screening Tables

Appendix A
Sioux Energy Center Surface Water Screening Tables – TOC

TABLES

HALEY ALDRICH

TABLE 1
HUMAN HEALTH SCREENING LEVELS
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

		Drinking Water Screening Levels (mg/L)				Surface Water Screening Levels (mg/L)	
Constituent	**CASRN**	**MCLs (b)**	**SMCLs (b)**	**November 2018 USEPA Tapwater RSLs (c)**	**Site-Specific Groundwater Protection Standards (d)**	**Drinking Water (e)**	**Recreational Use (a) (f)**
Antimony	7440-36-0	0.006	NA	0.0078 (m)	0.006	0.006	0.64
Arsenic	7440-38-2	0.01	NA	0.000052	0.03	0.01	0.00014 (i)
Barium	7440-39-3	2	NA	3.8	2	2	NA
Beryllium	7440-41-7	0.004	NA	0.025	0.004	0.004	NA
Boron	7440-42-8	NA	NA	4	NA	4	NA
Cadmium	7440-43-9	0.005	NA	0.0092	0.005	0.005	NA
Calcium	7440-70-2	NA	NA	NA	NA	NA	NA
Chloride	7647-14-5	NA	250	NA	NA	250	NA
Chromium	16065-83-1 (g)	0.1 (j)	NA	22 (n)	0.1	0.1	NA
Cobalt	7440-48-4	NA	NA	0.006	0.006	0.006	NA
Fluoride	16984-48-8	4	2	0.8	4	4	NA
Lead	7439-92-1	0.015 (k)	NA	0.015	0.015	0.015	NA
Lithium	7439-93-2	NA	NA	0.04	0.0647	0.04	NA
Mercury	7487-94-7 (h)	0.002 (l)	NA	0.0057 (o)	0.002	0.002	NA
Molybdenum	7439-98-7	NA	NA	0.1	0.1	0.1	NA
Radium 226/228 (pCi/L)	RADIUM226228	5	NA	NA	5	5	NA
Selenium	7782-49-2	0.05	NA	0.1	0.05	0.05	4.2
Sulfate	7757-82-6	NA	250	NA	NA	250	NA
Thallium	7440-28-0	0.002	NA	0.0002 (p)	0.002	0.002	0.00047
Total Dissolved Solids	TDS	NA	500	NA	NA	500	NA
pH (std)	PHFLD	NA	6.5 - 8.5	NA	NA	6.5 - 8.5	NA

Notes:
AWQC - Ambient Water Quality Criteria.
CASRN - Chemical Abstracts Service Re
GWPS - Groundwater Protection Standar
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) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology.
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.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - The site GWPS is either the MCL/Health Based GWPS or based on background levels, whichever is higher. GWPS and background values calculated using baseline sampling results from monitoring wells MW-B1 and MW-B2. See text for additional information.
(e) - Selected Drinking Water Screening Level uses the following hierarchy:
Federal USEPA MCL for Drinking Water.
Federal USEPA SMCL for Drinking Water.
Federal November 2018 USEPA Tapwater RSL.
(f) - The selected Human Health Recreational Use Screening Level is the Federal USEPA AWQC for Human Health Consumption of Organism Only.
(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.

TABLE 2
ECOLOGICAL SCREENING LEVELS - MISSISSIPPI RIVER
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

Constituent	CASRN	Federal Water Quality Criteria (mg/L)							
		Site-Specific USEPA Aquatic Life AWQC - 2018 Hardness Data Freshwater Acute (a)		Site-Specific USEPA Aquatic Life AWQC - 2018 Hardness Data Freshwater Chronic (a)		Site-Specific USEPA Aquatic Life AWQC - 2017 Hardness Data Freshwater Acute (b)		Site-Specific USEPA Aquatic Life AWQC - 2017 Hardness Data Freshwater Chronic (b)	
		Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Antimony	7440-36-0	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	0.34	0.34	0.15	0.15	0.34	0.34	0.15	0.15
Barium	7440-39-3	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	7440-41-7	NA	NA	NA	NA	NA	NA	NA	NA
Boron	7440-42-8	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	7440-43-9	0.0043 (c)	0.0039 (d)	0.0015 (c)	0.0013 (d)	0.0046 (f)	0.004 (g)	0.0016 (f)	0.0014 (g)
Calcium	7440-70-2	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	16887-00-6	860	NA	230	NA	860	NA	230	NA
Chromium	7440-47-3	3.6 (e,c)	1.1 (e,d)	0.17 (e,c)	0.15 (e,d)	3.8 (e,f)	1.2 (e,g)	0.18 (e,f)	0.16 (e,g)
Cobalt	7440-48-4	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride	16984-48-8	NA	NA	NA	NA	NA	NA	NA	NA
Lead	7439-92-1	0.23 (c)	0.16 (d)	0.009 (c)	0.0061 (d)	0.26 (f)	0.17 (g)	0.0101 (f)	0.0066 (g)
Lithium	7439-93-2	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	7439-97-6	0.0016	0.0014	0.001	0.00077	0.0016	0.001	0.00091	0.00077
Molybdenum	7439-98-7	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	7782-49-2	NA	NA	3.1	NA	NA	NA	3.1	NA
Sulfate	14808-79-8	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	7440-28-0	NA	NA	NA	NA	NA	NA	NA	NA
Total Dissolved Solids	TDS	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.

(a) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness using hardness data collected in May 2018 - see note (c).
USEPA provides AWQC for both total and dissolved results.
(a) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness using hardness data collected in April 2014 - see note (f).
USEPA provides AWQC for both total and dissolved results.
(c) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value for the Mississippi River of 229 mg/L as $CaCO_3$ used.
(d) - Hardness dependent value for total metals adjusted for dissolved fraction. Site-specific total recoverable mean hardness value for the Mississippi River of 229 mg/L as $CaCO_3$ used.
(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 247 mg/L as $CaCO_3$ used.
(g) - Hardness dependent value for total metals adjusted for dissolved fraction. Site-specific total recoverable mean hardness value for the Mississippi River of 247 mg/L as $CaCO_3$ used.

TABLE 3
SUMMARY OF SCREENING RESULTS
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

	Mississippi River - Human Health Drinking Water						Mississippi River - Human Health Recreational					
	Dissolved			Total			Dissolved			Total		
Constituent	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream
Antimony												
Arsenic							10 : 10 100%	20 : 20 100%	10 : 10 100%	10 : 10 100%	20 : 20 100%	10 : 10 100%
Barium												
Beryllium												
Boron												
Cadmium												
Calcium												
Chloride												
Chromium												
Cobalt												
Fluoride												
Lead												
Lithium												
Mercury												
Molybdenum												
pH												
Selenium												
Sulfate												
Thallium												
TDS												
Radium 226/228												

Notes:
Blank cells - no results above screening levels for the specified constituent / media.
Number of exceedences : total number of samples.

TABLE 3
SUMMARY OF SCREENING RESULTS
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

	Mississippi River - Ecological						Mississippi River Chute - Human Health Drinking Water					
	Dissolved			Total			Dissolved			Total		
Constituent	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream
Antimony												
Arsenic												
Barium												
Beryllium												
Boron												
Cadmium												
Calcium												
Chloride												
Chromium												
Cobalt												
Fluoride												
Lead												
Lithium												
Mercury												
Molybdenum												
pH												
Selenium												
Sulfate												
Thallium												
TDS												
Radium 226/228												

Notes:
Blank cells - no results above screening levels for the specified constituent / media.
Number of exceedences : total number of samples.

TABLE 3
SUMMARY OF SCREENING RESULTS
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

	Mississippi River Chute - Human Health Recreational						Mississippi River Chute - Ecological					
	Dissolved			Total			Dissolved			Total		
Constituent	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream
Antimony												
Arsenic	3 : 3 100%	14 : 14 100%	3 : 3 100%	3 : 3 100%	14 : 14 100%	3 : 3 100%						
Barium												
Beryllium												
Boron												
Cadmium												
Calcium												
Chloride												
Chromium												
Cobalt												
Fluoride												
Lead												
Lithium												
Mercury												
Molybdenum												
pH												
Selenium												
Sulfate												
Thallium												
TDS												
Radium 226/228												

Notes:
Blank cells - no results above screening levels for the specified constituent / media.
Number of exceedences : total number of samples.

TABLE 3
SUMMARY OF SCREENING RESULTS
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

	Missouri River - Human Health Drinking Water						Missouri River - Human Health Recreational					
	Dissolved			Total			Dissolved			Total		
Constituent	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream
Antimony												
Arsenic							5 : 5 100%	10 : 10 100%	5 : 5 100%	5 : 5 100%	10 : 10 100%	5 : 5 100%
Barium												
Beryllium												
Boron												
Cadmium												
Calcium												
Chloride												
Chromium												
Cobalt												
Fluoride												
Lead												
Lithium	5 : 5 100%	9 : 10 90%	5 : 5 100%	5 : 5 100%	10 : 10 100%	5 : 5 100%						
Mercury												
Molybdenum												
pH												
Selenium												
Sulfate												
Thallium												
TDS												
Radium 226/228												

Notes:
Blank cells - no results above screening levels for the specified constituent / media.
Number of exceedences : total number of samples.

TABLE 3
SUMMARY OF SCREENING RESULTS
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

	Missouri River - Ecological					
	Dissolved			Total		
Constituent	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream
Antimony						
Arsenic						
Barium						
Beryllium						
Boron						
Cadmium						
Calcium						
Chloride						
Chromium						
Cobalt						
Fluoride						
Lead						
Lithium						
Mercury						
Molybdenum						
pH						
Selenium						
Sulfate						
Thallium						
TDS						
Radium 226/228						

Notes:
Blank cells - no results above screening levels for the specified constituent / media.
Number of exceedences : total number of samples.

TABLE 4a
COMPARISON OF MAY 2018 MISSISSIPPI RIVER SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River Upstream					Mississippi River Adjacent										Mississippi River Downstream				
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		S2-MIR-10S	S2-MIR-11M	S2-MIR-11S	S2-MIR-12M	S2-MIR-12S	S2-MIR-4S	S2-MIR-5M	S2-MIR-5S	S2-MIR-6M	S2-MIR-6S	S2-MIR-7S	S2-MIR-8M	S2-MIR-8S	S2-MIR-9M	S2-MIR-9S	S2-MIR-1S	S2-MIR-2M	S2-MIR-2S	S2-MIR-3M	S2-MIR-3S
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006																				
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0017	0.0015	0.0016	0.0022	0.0021	0.0016	0.0016	0.0016	0.0017	0.0015	0.0015	0.0016	0.0015	0.0017	0.0015	0.0018	0.0016	0.0015	0.0015	0.0016
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.0969	0.0937	0.0991	0.0966	0.0952	0.0901	0.0969	0.0932	0.0919	0.0767	0.0909	0.092	0.0904	0.0905	0.0908	0.108	0.0968	0.0861	0.0883	0.0868
Beryllium	7440-41-7	mg/L	0.004	NA	0.025	0.004																	0.00035 J			
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0296 J	0.0276 J	0.0301 J	0.0285 J	0.0309 J	0.0313 J	0.0303 J	0.0289 J	0.0461 J	0.0437 J	0.0312 J	0.0286 J	0.0285 J	0.0366 J	0.0367 J	0.0338 J	0.0337 J	0.0273 J	0.0465 J	0.047 J
Cadmium	7440-43-9	mg/L	0.005	NA	0.0092	0.005											0.00058 J				0.00046 J					
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	56	53.3	56	53.1	54.6	55	54.6	53.5	56.5	54.2	55.8	53	53.4	55.6	55.9	56.6	54.9	52.5	58.5	58
Chloride	16887-00-6	mg/L	NA	250	NA	250	22.7	22.2	22.4	25.2	24.5	22.5	23	22.6	40.7	38.4	22.6	24.1	23.1	32.8	32	23	23.2	22.6	41	40.9
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1	0.0023 J	0.0026 J	0.0029 J	0.003 J	0.0023 J		0.0029 J	0.0023 J	0.0032 J	0.0013 J	0.0016 J	0.0014 J	0.0019 J	0.0021 J	0.0017 J	0.003 J	0.0019 J	0.0021 J	0.0012 J	0.0016 J
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006	0.0013 J	0.0016 J	0.0016 J	0.002 J	0.0018 J	0.0012 J	0.0023 J	0.0017 J	0.0018 J		0.0014 J	0.0016 J	0.0014 J	0.0014 J	0.0019 J	0.002 J	0.0021 J	0.0015 J	0.0013 J	0.0012 J
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.22	0.22	0.23	0.22	0.21	0.23	0.22	0.22	0.23	0.21 J	0.23	0.21	0.21	0.21	0.21	0.23	0.24	0.23	0.22	0.23
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015	0.0047 J	0.0048 J	0.0055 J	0.0046 J	0.0034 J		0.005 J	0.0052 J	0.005 J	0.0034 J	0.0033 J	0.0045 J	0.0034 J	0.0046 J		0.0049 J	0.0038 J			0.004 J
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.009 J	0.0089 J	0.0089 J	0.0088 J	0.0091 J	0.009 J	0.0091 J	0.0104	0.0089 J	0.0059 J	0.0092 J	0.0086 J	0.0104	0.0075 J	0.0085 J	0.0099 J	0.0089 J	0.0084 J	0.0074 J	0.0093 J
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1	0.001 J		0.00098 J	0.0011 J	0.0011 J	0.0011 J	0.0012 J	0.0011 J	0.0014 J	0.0018 J	0.0012 J		0.0013 J	0.0012 J	0.0012 J	0.0012 J	0.0015 J	0.001 J	0.0018 J	0.0018 J
Selenium*	7782-49-2	mg/L	0.05	NA	0.1	0.05																				
Sulfate	14808-79-8	mg/L	NA	250	NA	250	33.6	33	32.8	33.8	33.7	33.9	33.4	33.2	40.1	39.1	34	33.4	33.1	37.3	36.6	34.5	34	33.4	40.3	40.5
Thallium*	7440-28-0	mg/L	0.002	NA	0.0002	0.002																				
Total Hardness as CaCO3	471-34-1	mg/L	NA	NA	NA	NA	229	219	228	219	228	224	224	220	243	234	227	219	220	234	234	229	224	215	250	250
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	302	268	250	282	258	218	224	250	232 J	324	282	344	280	280	342	290	244	280	321	272

Notes:

Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level.
USEPA - United States Environmental Protection Agency.

Detected Concentration > Selected Drinking Water Screening Level.

(a) - Surface water samples collected in May 2018.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
Federal USEPA MCL for Drinking Water.
Federal USEPA SMCL for Drinking Water.
Federal November 2018 USEPA Tapwater RSL.

TABLE 4b
COMPARISON OF MAY 2018 MISSISSIPPI RIVER SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River Upstream					Mississippi River Adjacent										Mississippi River Downstream				
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		S2-MIR-10S	S2-MIR-11M	S2-MIR-11S	S2-MIR-12M	S2-MIR-12S	S2-MIR-4S	S2-MIR-5M	S2-MIR-5S	S2-MIR-6M	S2-MIR-6S	S2-MIR-7S	S2-MIR-8M	S2-MIR-8S	S2-MIR-9M	S2-MIR-9S	S2-MIR-1S	S2-MIR-2M	S2-MIR-2S	S2-MIR-3M	S2-MIR-3S
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006																				
Arsenic	7440-38-2	mg/L	0.01	NA	5.2E-05	0.01	0.0011	0.001	0.00096 J	0.0013	0.0014	0.0012	0.0011	0.0011	0.0011	0.0011 J	0.0011	0.0011	0.0011	0.0011	0.0011	0.0013	0.0012	0.0011	0.0012	0.0012
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.0698	0.0659	0.0645	0.0619	0.0614	0.0727	0.0666	0.067	0.0614	0.0604	0.0719	0.0629	0.0654	0.0632	0.0614	0.0757	0.0657	0.0679	0.0629	0.0652
Beryllium	7440-41-7	mg/L	0.004	NA	0.025	0.004																				
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0275 J	0.0278 J	0.0272 J	0.03 J	0.027 J	0.0323 J	0.0274 J	0.0299 J	0.0441 J	0.0427 J	0.0294 J	0.0271 J	0.0289 J	0.037 J	0.035 J	0.0315 J	0.0304 J	0.0305 J	0.0469 J	0.048 J
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	52.8	50.4	49.8	48.5	48.3	55.6	52.5	52.1	53.3	52.6	52.3	49.3	50.7	52.3	50.3	54.7	52	52.8	55.1	56.6
Chromium*	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1																				
Cobalt*	7440-48-4	mg/L	NA	NA	0.006	0.006																				
Lead*	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015							0.0035 J													
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0075 J	0.009 J	0.0083 J	0.0071 J	0.007 J	0.008 J	0.0085 J	0.0077 J	0.0074 J	0.0065 J	0.0083 J	0.0069 J	0.0067 J	0.0072 J	0.0067 J	0.0088 J	0.0088 J	0.0081 J	0.0074 J	0.0057 J
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1	0.0012 J			0.001 J		0.0013 J	0.001 J	0.0011 J	0.0016 J	0.0014 J	0.0015 J	0.00098 J		0.0014 J	0.0015 J	0.0018 J	0.0017 J	0.0014 J	0.0016 J	0.0018 J
Selenium*	7782-49-2	mg/L	0.05	NA	0.1	0.05																				
Thallium*	7440-28-0	mg/L	0.002	NA	0.0002	0.002																				

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level.
USEPA - United States Environmental Protection Agency.

Detected Concentration > Selected Drinking Water Screening Level.

(a) - Surface water samples collected in May 2018.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
Federal USEPA MCL for Drinking Water.
Federal USEPA SMCL for Drinking Water.
Federal November 2018 USEPA Tapwater RSL.

TABLE 4c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River Chute River Upstream			Mississippi River Chute River Adjacent																Mississippi River Chute River Downstream		
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		S-MIO-16	S-MIO-17	S-MIO-18	S-MIO-4	S-MIO-5	S-MIO-5D	S-MIO-6	S-MIO-6D	S-MIO-7	S-MIO-8	S-MIO-9	S-MIO-10	S-MIO-11	S-MIO-12	S-MIO-13	S-MIO-14	S-MIO-15	S-MIO-1	S-MIO-2	S-MIO-3
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006													0.0037 J							
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0064	0.0062	0.0066	0.0025	0.002	0.002	0.002	0.0021	0.0072	0.0069	0.0062	0.0077	0.0078	0.0077	0.0066	0.006	0.0067	0.0024	0.0024	0.0023
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.204	0.2	0.199	0.0746	0.0695	0.0669	0.0705	0.0668	0.263	0.256	0.235	0.288	0.278	0.285	0.212	0.193	0.232	0.0677	0.065	0.065
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004									0.00023 J	0.00035 J		0.0004 J								
Boron	7440-42-8	mg/L	NA	NA	4	4	0.75	0.746	0.718	0.0402 J	0.0461 J	0.0379 J	0.041 J	0.034 J	0.805	0.782	0.705	0.859	0.839	0.838	0.651	0.654	0.715	0.0361 J	0.0351 J	0.0358 J
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	80.8	84.8	82	44.6	45	45.2	45.3	44.6	82.5	81.8	78	84.3	83.2	84	76.2	74.4	77.5	44.3	44.4	44
Chloride	16887-00-6	mg/L	NA	250	NA	250	24.7	24.9	25	23	22.9	23.2	22.9	23.4	23.3	23.5	23.5	23.4	23.4	23.3	24	24	24	23.2	23.1	23.2
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1	0.0011 J		0.0013 J	0.0017 J	0.0011 J	0.00079 J		0.0015 J	0.002 J	0.0021 J	0.0018 J	0.0021 J	0.0027 J	0.0028 J	0.0024 J	0.0014 J	0.0024 J	0.00086 J	0.0012 J	0.0013 J
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006	0.0011 J			0.0012 J	0.0017 J		0.0014 J		0.0011 J	0.001 J		0.0012 J	0.0015 J	0.0011 J	0.0015 J	0.0011 J	0.0016 J	0.0012 J	0.0012 J	0.0013 J
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.56	0.58	0.57	0.17 J	0.17 J	0.17 J	0.17 J	0.17 J	0.59	0.58	0.54	0.63	0.6	0.61	0.51	0.51	0.55	0.17 J	0.16 J	0.16 J
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015		0.0044 J	0.0053			0.0032 J			0.0026 J			0.0036 J	0.0033 J				0.0025 J			
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0186	0.0172	0.018	0.0068 J	0.007 J	0.0046 J	0.006 J	0.0049 J	0.0222	0.0214	0.0211	0.024	0.0214	0.0241	0.0174	0.0178	0.0206	0.0058 J	0.0067 J	0.0067 J
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1	0.0527	0.0516	0.0499	0.0018 J	0.0032 J	0.0017 J	0.0018 J	0.0017 J	0.0633	0.0635	0.0553	0.0683	0.0667	0.0656	0.0481	0.0501	0.0546	0.0015 J	0.0015 J	0.0014 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05									0.0093 J	0.0054 J	0.0055 J	0.0077 J	0.0069 J	0.0067 J	0.0039 J	0.0045 J	0.0047 J			
Sulfate	14808-79-8	mg/L	NA	250	NA	250	143	144	144	31.3	32	32.3	31.7	31.5	162	157	143	177	173	169	135	133	146	30.2	30.2	30
Thallium*	7440-28-0	mg/L	0.002	NA	0.0002	0.002	0.000071 J	0.000044 J	0.000058 J						0.0001 J	0.00015 J	0.0001 J	0.00015 J	0.00012 J	0.0002 J	0.000085 J	0.000046 J	0.000083 J			
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	NA	NA	312	319	308	204	206	205	208	203	312	311	300	318	313	316	298	292	299	204	204	203
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	467	451	444	254	262	242	256	250	472	460	444	480	496	483	418	419	445	259	256	253

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level.
USEPA - United States Environmental Protection Agency.

Detected Concentration > Selected Drinking Water Screening Level

(a) - Surface water samples collected in September 2017.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
Federal USEPA MCL for Drinking Water.
Federal USEPA SMCL for Drinking Water.
Federal November 2018 USEPA Tapwater RSL.

TABLE 4c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			Federal Water Quality Screening Levels			Selected	Mississippi River River Upstream					Mississippi River River Adjacent										Mississippi River River Downstream				
Constituent	CAS	Units	USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)	Drinking Water Screening Level (h)	S-MIR-10S	S-MIR-11D	S-MIR-11S	S-MIR-12D	S-MIR-12S	S-MIR-4S	S-MIR-5D	S-MIR-5S	S-MIR-6D	S-MIR-6S	S-MIR-7S	S-MIR-8D	S-MIR-8S	S-MIR-9D	S-MIR-9S	S-MIR-1S	S-MIR-2D	S-MIR-2S	S-MIR-3D	S-MIR-3S
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006																				
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0019	0.0018	0.0016	0.0019	0.0019	0.0021	0.0018	0.0017	0.0021	0.002	0.0019	0.0019	0.0017	0.002	0.0019	0.002	0.0019	0.0018	0.0022	0.0022
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.0599	0.0628	0.0566	0.064	0.0582	0.066	0.0607	0.0548	0.0642	0.0609	0.0596	0.0614	0.0557	0.0687	0.0584	0.0681	0.0646	0.0582	0.07	0.0668
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004							0.00023 J			0.00022 J					0.00024 J				0.00027 J	
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0271 J	0.033 J	0.0274 J	0.0404 J	0.0412 J	0.0391 J	0.0362 J	0.0328 J	0.0492 J	0.0513 J	0.0279 J	0.0348 J	0.0303 J	0.0404 J	0.0369 J	0.0404 J	0.0385 J	0.0387 J	0.0534 J	0.0599 J
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	44.5	44	45	44.4	47	44.6	44.4	42.5	46.7	46	44.8	44.4	45.2	46	47.2	44.7	46.1	44.3	48.9	48.5
Chloride	16887-00-6	mg/L	NA	250	NA	250	23.9	23.2	24.9	26.5	31.6	23.7	22.8	24	31.1	34.1	24.1	23.5	26.2	26.2	28.4	23.9	23.5	23.7	31.6	36
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1		0.00081 J		0.00088 J		0.0013 J	0.00088 J		0.0011 J	0.0011 J		0.00081 J		0.00093 J		0.0018 J	0.0013 J	0.0013 J	0.0015 J	0.0015 J
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006		0.00095 J				0.0016 J	0.0018 J	0.001 J	0.0012 J	0.00077 J		0.00088 J		0.00091 J		0.0013 J	0.0013 J		0.0011 J	0.0014 J
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.17 J	0.16 J	0.17 J	0.17 J	0.18 J	0.17 J	0.16 J	0.16 J	0.17 J	0.18 J	0.17 J	0.16 J	0.17 J	0.18 J	0.17 J	0.17 J	0.16 J	0.17 J	0.18 J	0.19 J
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015	0.0033 J		0.0024 J		0.0026 J				0.003 J						0.0025 J	0.0025 J				
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0031 J	0.005 J		0.006 J	0.0033 J	0.0063 J	0.0055 J	0.0053 J	0.0056 J	0.0047 J		0.0056 J	0.003 J	0.0047 J		0.0048 J	0.0079 J	0.0053 J	0.0049 J	0.0063 J
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1		0.0018 J			0.0017 J	0.0019 J	0.0023 J	0.002 J	0.0021 J	0.0021 J	0.0013 J			0.0014 J	0.0018 J	0.002 J	0.0021 J	0.0022 J	0.0023 J	0.0021 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05									0.0037 J											
Sulfate	14808-79-8	mg/L	NA	250	NA	250	31.3	30.4	31.9	32.4	36.3	31.6	29.9	31.4	35.1	37.7	31.7	30.5	33.1	32.3	34.3	31.8	30.5	32.1	35.5	39.6
Thallium*	7440-28-0	mg/L	0.002	NA	0.0002	0.002											0.000069 J			0.000037 J	0.000058 J		0.000065 J		0.000078 J	
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	NA	NA	203	204	206	206	214	209	205	200	214	214	204	205	206	212	215	207	211	206	223	225
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	248	247	256	265	266	249	251	252	279	280	256	256	258	251	271	244	248	253	288	297

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level.
USEPA - United States Environmental Protection Agency.

Detected Concentration > Selected Drinking Water Screening Level

(a) - Surface water samples collected in September 2017.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
Federal USEPA MCL for Drinking Water.
Federal USEPA SMCL for Drinking Water.
Federal November 2018 USEPA Tapwater RSL.

TABLE 4c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			Federal Water Quality Screening Levels			Selected	Missouri River River Upstream					Missouri River River Adjacent										Missouri River River Downstream				
Constituent	CAS	Units	USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)	Drinking Water Screening Level (h)	S-MO-10S	S-MO-11D	S-MO-11S	S-MO-12D	S-MO-12S	S-MO-4S	S-MO-5D	S-MO-5S	S-MO-6D	S-MO-6S	S-MO-7S	S-MO-8D	S-MO-8S	S-MO-9D	S-MO-9S	S-MO-1S	S-MO-2D	S-MO-2S	S-MO-3D	S-MO-3S
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006																				
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0036	0.0035	0.0035	0.0036	0.0035	0.0036	0.0036	0.0035	0.0035	0.0036	0.0034	0.0035	0.0036	0.0036	0.0035	0.0034	0.0036	0.0034	0.0035	0.0036
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.117	0.117	0.113	0.118	0.114	0.118	0.118	0.115	0.115	0.118	0.114	0.116	0.116	0.116	0.117	0.113	0.115	0.114	0.116	0.116
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004																				
Boron	7440-42-8	mg/L	NA	NA	4	4	0.113	0.111	0.111	0.111	0.112	0.115	0.117	0.112	0.111	0.112	0.11	0.113	0.113	0.111	0.112	0.11	0.113	0.114	0.111	0.114
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	65.1	64.4	63.4	64.9	64.2	64.8	65.4	63.2	63.8	65.4	63.4	65	65.3	64.3	65	63	64.8	63.4	64.2	64.7
Chloride	16887-00-6	mg/L	NA	250	NA	250	23.5	23.4	23.6	23.6	23.7	23.3	23.4	23.9	23.3	23.3	23.9	23.5	23.4	23.4	23.6	23.3	23.3	23.4	23.4	23.3
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1		0.0012 J	0.00076 J	0.00099 J	0.00075 J	0.0011 J	0.0012 J	0.0013 J	0.00097 J	0.0011 J		0.00095 J	0.00098 J	0.00073 J	0.00074 J	0.0013 J				0.00075 J
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006				0.00083 J				0.00086 J	0.00074 J		0.00087 J	0.00085 J								0.00087 J
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.45	0.44	0.44	0.44	0.44	0.45	0.43	0.45	0.44	0.44	0.45	0.44	0.45	0.43	0.45	0.45	0.44	0.45	0.43	0.46
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015									0.0026 J				0.003 J						0.0028 J	
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0435	0.044	0.0429	0.0441	0.0436	0.0442	0.0444	0.0422	0.0427	0.0431	0.042	0.0428	0.0449	0.042	0.0423	0.042	0.0431	0.0427	0.0434	0.0435
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1	0.0031 J	0.0026 J	0.0028 J	0.0026 J	0.0027 J	0.003 J	0.0036 J	0.0026 J	0.003 J	0.0028 J	0.0031 J	0.003 J	0.0028 J	0.0028 J	0.003 J	0.0035 J	0.0029 J	0.0036 J	0.0028 J	0.0031 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05	0.0042 J																			
Sulfate	14808-79-8	mg/L	NA	250	NA	250	195	192	194	191	191	192	192	193	193	188	192	196	192	193	190	193	194	189	192	190
Thallium*	7440-28-0	mg/L	0.002	NA	0.0002	0.002			0.000064 J			0.000047 J	0.000063 J		0.000037 J			0.000045 J				0.000055 J				0.000064 J
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	NA	NA	266	263	259	265	262	266	267	259	260	267	259	265	267	263	265	258	265	259	262	264
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	475	496	492	497	490	493	490	491	491	488	478	496	482	476	473	487	496	485	484	465

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level.
USEPA - United States Environmental Protection Agency.

Detected Concentration > Selected Drinking Water Screening Level

(a) - Surface water samples collected in September 2017.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
Federal USEPA MCL for Drinking Water.
Federal USEPA SMCL for Drinking Water.
Federal November 2018 USEPA Tapwater RSL.

TABLE 4d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River Chute River Upstream			Mississippi River Chute River Adjacent														Mississippi River Chute River Downstream		
			USEPA MCLs (c)	USEPA SMCLs (c)	USEPA Tapwater RSLs (d)		S-MIO-16	S-MIO-17	S-MIO-18	S-MIO-4	S-MIO-5	S-MIO-5D	S-MIO-6	S-MIO-6D	S-MIO-7	S-MIO-8	S-MIO-9	S-MIO-10	S-MIO-11	S-MIO-12	S-MIO-13	S-MIO-14	S-MIO-15	S-MIO-1	S-MIO-2	S-MIO-3
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006		0.0037 J																		
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0055	0.0053	0.0053	0.0021	0.0017	0.0016	0.0017	0.0017	0.0064	0.0061	0.0056	0.0072	0.0071	0.0065	0.0052	0.0053	0.0057	0.0021	0.002	0.0021
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.185	0.192	0.191	0.0592	0.0558	0.0553	0.0564	0.0544	0.25	0.246	0.219	0.267	0.266	0.252	0.182	0.182	0.209	0.0599	0.0595	0.0583
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004												0.00019 J	0.0002 J							0.00026 J
Boron	7440-42-8	mg/L	NA	NA	4	4	0.755	0.769	0.769	0.039 J	0.0421 J	0.0431 J	0.0395 J	0.0406 J	0.805	0.796	0.715	0.853	0.849	0.812	0.652	0.657	0.734	0.0338 J	0.0351 J	0.0357 J
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium (f)	7440-70-2	mg/L	NA	NA	NA	NA	79.8	81.4	82.1	44.8	44.5	44.1	45.2	43.8	83	82.1	77.2	82.9	83.2	81	73.9	74.2	76.8	45.1	44.7	44
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (h)	0.1									0.00087 J			0.00095 J	0.0016 J	0.0008 J			0.00075 J			
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006	0.00089 J	0.0012 J	0.0013 J		0.00078 J				0.001 J	0.0013 J	0.00074 J	0.00088 J		0.00098 J	0.0013 J					
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015		0.0031 J																		
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0161	0.018	0.0197	0.0055 J	0.0056 J	0.0044 J	0.0059 J	0.0051 J	0.0218	0.0209	0.0189	0.0213	0.023	0.0229	0.0166	0.0166	0.0201	0.0054 J	0.0058 J	0.0067 J
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1	0.0524	0.0576	0.0561	0.0018 J	0.0026 J	0.0019 J	0.0022 J	0.002 J	0.064	0.0633	0.057	0.068	0.0685	0.0638	0.0478	0.0489	0.055	0.0019 J	0.0019 J	0.0023 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05		0.0061 J							0.0048 J	0.0046 J	0.0049 J	0.0052 J	0.0091 J	0.0062 J						
Silver*	7440-22-4	mg/L	NA	0.1	0.094	0.1																				
Thallium	7440-28-0	mg/L	0.002	NA	0.0002	0.002	0.000037 J						0.000039 J		0.000092 J	0.00014 J	0.000096 J	0.00011 J	0.00011 J	0.000096 J			0.0001 J	0.000055 J		

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level.
USEPA - United States Environmental Protection Agency.

Detected Concentration > Selected Drinking Water Screening Level

(a) - Surface water samples collected in September 2017.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
Federal USEPA MCL for Drinking Water.
Federal USEPA SMCL for Drinking Water.
Federal November 2018 USEPA Tapwater RSL.

TABLE 4d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River River Upstream					Mississippi River River Adjacent										Mississippi River River Downstream				
			USEPA MCLs (c)	USEPA SMCLs (c)	USEPA Tapwater RSLs (d)		S-MIR-10S	S-MIR-11D	S-MIR-11S	S-MIR-12D	S-MIR-12S	S-MIR-4S	S-MIR-5D	S-MIR-5S	S-MIR-6D	S-MIR-6S	S-MIR-7S	S-MIR-8D	S-MIR-8S	S-MIR-9D	S-MIR-9S	S-MIR-1S	S-MIR-2D	S-MIR-2S	S-MIR-3D	S-MIR-3S
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006																				
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0016	0.0016	0.0015	0.0017	0.0016	0.0017	0.0015	0.0015	0.0018	0.0018	0.0016	0.0014	0.0016	0.0016	0.0016	0.0017	0.0016	0.0016	0.0018	0.0018
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.0504	0.0417	0.0439	0.0447	0.0467	0.0525	0.042	0.0421	0.0453	0.0464	0.0508	0.0422	0.0429	0.0438	0.0457	0.0534	0.043	0.0475	0.047	0.049
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004									0.00025 J		0.00018 J			0.00029 J	0.00032 J		0.00025 J			
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0332 J	0.0333 J	0.0372 J	0.0392 J	0.0476 J	0.0368 J	0.0329 J	0.0338 J	0.0489 J	0.0522 J	0.0374 J	0.0354 J	0.0398 J	0.0396 J	0.0409 J	0.0395 J	0.0391 J	0.0398 J	0.0559 J	0.0603 J
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium (f)	7440-70-2	mg/L	NA	NA	NA	NA	44.8	44.4	44.9	45.7	45.9	45	43.4	44.4	45.8	46.2	43.8	43.9	43.6	45.4	44.8	44.4	45	44.3	47.4	48
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (h)	0.1													0.00097 J							
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006		0.0009 J		0.00091 J		0.0013 J	0.0013 J	0.00075 J		0.0012 J	0.00082 J		0.00078 J	0.0013 J	0.00091 J				0.00094 J	
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015																				
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0058 J	0.0063 J	0.0054 J	0.005 J	0.0068 J	0.0041 J	0.0043 J	0.0051 J	0.0033 J	0.0037 J	0.004 J	0.0041 J	0.0041 J	0.0043 J	0.0048 J	0.0059 J	0.0052 J	0.0033 J	0.0043 J	0.0078 J
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1	0.0015 J	0.0016 J	0.0019 J	0.002 J	0.0014 J	0.0022 J	0.0019 J	0.0014 J	0.002 J	0.0018 J	0.0027 J	0.0021 J	0.0026 J	0.0018 J	0.0023 J	0.002 J	0.0019 J	0.0016 J	0.0031 J	0.0022 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05																	0.0036 J			
Silver*	7440-22-4	mg/L	NA	0.1	0.094	0.1																				
Thallium	7440-28-0	mg/L	0.002	NA	0.0002	0.002	0.000059 J																0.00004 J			0.000047 J

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level.
USEPA - United States Environmental Protection Agency.

Detected Concentration > Selected Drinking Water Screening Level

(a) - Surface water samples collected in September 2017.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
- Federal USEPA MCL for Drinking Water.
- Federal USEPA SMCL for Drinking Water.
- Federal November 2018 USEPA Tapwater RSL.

TABLE 4d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI

			Federal Water Quality Screening Levels			Selected	Missouri River River Upstream					Missouri River River Adjacent										Missouri River River Downstream				
Constituent	CAS	Units	USEPA MCLs (c)	USEPA SMCLs (c)	USEPA Tapwater RSLs (d)	Drinking Water Screening Level (h)	S-MO-10S	S-MO-11D	S-MO-11S	S-MO-12D	S-MO-12S	S-MO-4S	S-MO-5D	S-MO-5S	S-MO-6D	S-MO-6S	S-MO-7S	S-MO-8D	S-MO-8S	S-MO-9D	S-MO-9S	S-MO-1S	S-MO-2D	S-MO-2S	S-MO-3D	S-MO-3S
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006																				
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0034	0.0034	0.0032	0.0033	0.0033	0.0033	0.0034	0.0033	0.0032	0.0033	0.0032	0.0033	0.0033	0.0034	0.0032	0.0033	0.0034	0.0033	0.0032	0.0033
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.108	0.11	0.108	0.109	0.109	0.11	0.11	0.107	0.106	0.109	0.109	0.109	0.107	0.108	0.108	0.112	0.107	0.111	0.107	0.109
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004																				
Boron	7440-42-8	mg/L	NA	NA	4	4	0.115	0.12	0.116	0.118	0.118	0.119	0.12	0.114	0.115	0.116	0.117	0.118	0.117	0.118	0.116	0.12	0.115	0.122	0.115	0.119
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium (f)	7440-70-2	mg/L	NA	NA	NA	NA	59.5	60.9	59.9	60.6	60.3	60.3	61.1	59.2	59.1	60	60.8	60.7	59.8	60	59.9	61.6	59.7	60.6	59.7	59.4
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (h)	0.1																				0.00074 J
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006																				
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015																				
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0422	0.0423	0.0435	0.0423	0.0417	0.0422	0.0422	0.0428	0.0412	0.0421	0.0432	0.0424	0.044	0.042	0.04	0.0441	0.0421	0.0446	0.0405	0.0437
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1	0.0039 J	0.004 J	0.0044 J	0.0036 J	0.0038 J	0.0037 J	0.0049 J	0.0037 J	0.004 J	0.0046 J	0.0038 J	0.0038 J	0.0036 J	0.0035 J	0.0038 J	0.0046 J	0.0038 J	0.0047 J	0.0032 J	0.0037 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05																				
Silver*	7440-22-4	mg/L	NA	0.1	0.094	0.1																				
Thallium	7440-28-0	mg/L	0.002	NA	0.0002	0.002			0.000063 J				0.000072 J		0.000037 J							0.000048 J				0.000075 J

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level.
USEPA - United States Environmental Protection Agency.

[green shading] Detected Concentration > Selected Drinking Water Screening Level

(a) - Surface water samples collected in September 2017.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
Federal USEPA MCL for Drinking Water.
Federal USEPA SMCL for Drinking Water.
Federal November 2018 USEPA Tapwater RSL.

TABLE 5a
COMPARISON OF MAY 2018 MISSISSIPPI RIVER SURFACE WATER RESULTS
TO HUMAN HEALTH AWQC SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

Constituent	CAS	Units	USEPA AWQC (b)	Mississippi River Upstream					Mississippi River Adjacent										Mississippi River Downstream				
				S2-MIR-10S	S2-MIR-11M	S2-MIR-11S	S2-MIR-12M	S2-MIR-12S	S2-MIR-4S	S2-MIR-5M	S2-MIR-5S	S2-MIR-6M	S2-MIR-6S	S2-MIR-7S	S2-MIR-8M	S2-MIR-8S	S2-MIR-9M	S2-MIR-9S	S2-MIR-1S	S2-MIR-2M	S2-MIR-2S	S2-MIR-3M	S2-MIR-3S
Antimony*	7440-36-0	mg/L	0.64																				
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0017	0.0015	0.0016	0.0022	0.0021	0.0016	0.0016	0.0016	0.0017	0.0015	0.0015	0.0016	0.0015	0.0017	0.0015	0.0018	0.0016	0.0015	0.0015	0.0016
Barium	7440-39-3	mg/L	NA	0.0969	0.0937	0.0991	0.0966	0.0952	0.0901	0.0969	0.0932	0.0919	0.0767	0.0909	0.092	0.0904	0.0905	0.0908	0.108	0.0968	0.0861	0.0883	0.0868
Beryllium*	7440-41-7	mg/L	NA																	0.00035 J			
Boron	7440-42-8	mg/L	NA	0.0296 J	0.0276 J	0.0301 J	0.0285 J	0.0309 J	0.0313 J	0.0303 J	0.0289 J	0.0461 J	0.0437 J	0.0312 J	0.0286 J	0.0285 J	0.0366 J	0.0367 J	0.0338 J	0.0337 J	0.0273 J	0.0465 J	0.047 J
Cadmium	7440-43-9	mg/L	NA											0.00058 J				0.00046 J					
Calcium	7440-70-2	mg/L	NA	56	53.3	56	53.1	54.6	55	54.6	53.5	56.5	54.2	55.8	53	53.4	55.6	55.9	56.6	54.9	52.5	58.5	58
Chloride	16887-00-6	mg/L	NA	22.7	22.2	22.4	25.2	24.5	22.5	23	22.6	40.7	38.4	22.6	24.1	23.1	32.8	32	23	23.2	22.6	41	40.9
Chromium	7440-47-3	mg/L	NA	0.0023 J	0.0026 J	0.0029 J	0.003 J	0.0023 J		0.0029 J	0.0023 J	0.0032 J	0.0013 J	0.0016 J	0.0014 J	0.0019 J	0.0021 J	0.0017 J	0.003 J	0.0019 J	0.0021 J	0.0012 J	0.0016 J
Cobalt	7440-48-4	mg/L	NA	0.0013 J	0.0016 J	0.0016 J	0.002 J	0.0018 J	0.0012 J	0.0023 J	0.0017 J	0.0018 J		0.0014 J	0.0016 J	0.0014 J	0.0014 J	0.0019 J	0.002 J	0.0021 J	0.0015 J	0.0013 J	0.0012 J
Fluoride	16984-48-8	mg/L	NA	0.22	0.22	0.23	0.22	0.21	0.23	0.22	0.22	0.23	0.21 J	0.23	0.21	0.21	0.21	0.21	0.23	0.24	0.23	0.22	0.23
Lead	7439-92-1	mg/L	NA	0.0047 J	0.0048 J	0.0055 J	0.0046 J	0.0034 J		0.005 J	0.0052 J	0.005 J	0.0034 J	0.0033 J	0.0045 J	0.0034 J	0.0046 J		0.0049 J	0.0038 J			0.004 J
Lithium	7439-93-2	mg/L	NA	0.009 J	0.0089 J	0.0089 J	0.0088 J	0.0091 J	0.009 J	0.0091 J	0.0104	0.0089 J	0.0059 J	0.0092 J	0.0086 J	0.0104	0.0075 J	0.0085 J	0.0099 J	0.0089 J	0.0084 J	0.0074 J	0.0093 J
Mercury*	7439-97-6	mg/L	NA																				
Molybdenum	7439-98-7	mg/L	NA	0.001 J		0.00098 J	0.0011 J	0.0011 J	0.0011 J	0.0012 J	0.0011 J	0.0014 J	0.0018 J	0.0012 J		0.0013 J	0.0012 J	0.0012 J	0.0012 J	0.0015 J	0.001 J	0.0018 J	0.0018 J
Selenium*	7782-49-2	mg/L	4.2																				
Sulfate	14808-79-8	mg/L	NA	33.6	33	32.8	33.8	33.7	33.9	33.4	33.2	40.1	39.1	34	33.4	33.1	37.3	36.6	34.5	34	33.4	40.3	40.5
Thallium*	7440-28-0	mg/L	0.00047																				
Total Hardness as CaCO3	471-34-1	mg/L	NA	229	219	228	219	228	224	224	220	243	234	227	219	220	234	234	229	224	215	250	250
Total Dissolved Solids	TDS	mg/L	NA	302	268	250	282	258	218	224	250	232 J	324	282	344	280	280	342	290	244	280	321	272

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency.

(green shading) Detected Concentration > AWQC.

(a) - Surface water samples collected in May 2018.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only
apply to total concentrations.
(c) - Value applies to inorganic form of arsenic only.

TABLE 5b
COMPARISON OF MAY 2018 MISSISSIPPI RIVER SURFACE WATER RESULTS
TO HUMAN HEALTH AWQC SCREENING LEVELS -
DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

Constituent	CAS	Units	USEPA AWQC (b)	Mississippi River Upstream					Mississippi River Adjacent					Mississippi River Adjacent					Mississippi River Downstream				
				S2-MIR-10S	S2-MIR-11M	S2-MIR-11S	S2-MIR-12M	S2-MIR-12S	S2-MIR-4S	S2-MIR-5M	S2-MIR-5S	S2-MIR-6M	S2-MIR-6S	S2-MIR-7S	S2-MIR-8M	S2-MIR-8S	S2-MIR-9M	S2-MIR-9S	S2-MIR-1S	S2-MIR-2M	S2-MIR-2S	S2-MIR-3M	S2-MIR-3S
Antimony*	7440-36-0	mg/L	0.64																				
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0011	0.001	0.00096 J	0.0013	0.0014	0.0012	0.0011	0.0011	0.0011	0.0011 J	0.0011	0.0011	0.0011	0.0011	0.0011	0.0013	0.0012	0.0011	0.0012	0.0012
Barium	7440-39-3	mg/L	NA	0.0698	0.0659	0.0645	0.0619	0.0614	0.0727	0.0666	0.067	0.0614	0.0604	0.0719	0.0629	0.0654	0.0632	0.0614	0.0757	0.0657	0.0679	0.0629	0.0652
Beryllium	7440-41-7	mg/L	NA																				
Boron	7440-42-8	mg/L	NA	0.0275 J	0.0278 J	0.0272 J	0.03 J	0.027 J	0.0323 J	0.0274 J	0.0299 J	0.0441 J	0.0427 J	0.0294 J	0.0271 J	0.0289 J	0.037 J	0.035 J	0.0315 J	0.0304 J	0.0305 J	0.0469 J	0.048 J
Cadmium*	7440-43-9	mg/L	NA																				
Calcium	7440-70-2	mg/L	NA	52.8	50.4	49.8	48.5	48.3	55.6	52.5	52.1	53.3	52.6	52.3	49.3	50.7	52.3	50.3	54.7	52	52.8	55.1	56.6
Chromium*	7440-47-3	mg/L	NA																				
Cobalt*	7440-48-4	mg/L	NA																				
Lead*	7439-92-1	mg/L	NA							0.0035 J													
Lithium	7439-93-2	mg/L	NA	0.0075 J	0.009 J	0.0083 J	0.0071 J	0.007 J	0.008 J	0.0085 J	0.0077 J	0.0074 J	0.0065 J	0.0083 J	0.0069 J	0.0067 J	0.0072 J	0.0067 J	0.0088 J	0.0088 J	0.0081 J	0.0074 J	0.0057 J
Mercury*	7439-97-6	mg/L	NA																				
Molybdenum	7439-98-7	mg/L	NA	0.0012 J			0.001 J		0.0013 J	0.001 J	0.0011 J	0.0016 J	0.0014 J	0.0015 J	0.00098 J		0.0014 J	0.0015 J	0.0018 J	0.0017 J	0.0014 J	0.0016 J	0.0018 J
Selenium*	7782-49-2	mg/L	4.2																				
Thallium*	7440-28-0	mg/L	0.00047																				

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency.

Detected Concentration > AWQC.

(a) - Surface water samples collected in May 2018.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only
apply to total concentrations.
(c) - Value applies to inorganic form of arsenic only.

TABLE 5c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO HUMAN HEALTH AWQC SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			USEPA	Mississippi River Chute River Upstream			Mississippi River Chute River Adjacent														Mississippi River Chute River Downstream		
Constituent	**CAS**	**Units**	**AWQC (b)**	**S-MIO-16**	**S-MIO-17**	**S-MIO-18**	**S-MIO-4**	**S-MIO-5**	**S-MIO-5D**	**S-MIO-6**	**S-MIO-6D**	**S-MIO-7**	**S-MIO-8**	**S-MIO-9**	**S-MIO-10**	**S-MIO-11**	**S-MIO-12**	**S-MIO-13**	**S-MIO-14**	**S-MIO-15**	**S-MIO-1**	**S-MIO-2**	**S-MIO-3**
Antimony*	7440-36-0	mg/L	0.64													0.0037 J							
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0064	0.0062	0.0066	0.0025	0.002	0.002	0.002	0.0021	0.0072	0.0069	0.0062	0.0077	0.0078	0.0077	0.0066	0.006	0.0067	0.0024	0.0024	0.0023
Barium	7440-39-3	mg/L	NA	0.204	0.2	0.199	0.0746	0.0695	0.0669	0.0705	0.0668	0.263	0.256	0.235	0.288	0.278	0.285	0.212	0.193	0.232	0.0677	0.065	0.065
Beryllium*	7440-41-7	mg/L	NA									0.00023 J	0.00035 J		0.0004 J								
Boron	7440-42-8	mg/L	NA	0.75	0.746	0.718	0.0402 J	0.0461 J	0.0379 J	0.041 J	0.034 J	0.805	0.782	0.705	0.859	0.839	0.838	0.651	0.654	0.715	0.0361 J	0.0351 J	0.0358 J
Cadmium*	7440-43-9	mg/L	NA																				
Calcium	7440-70-2	mg/L	NA	80.8	84.8	82	44.6	45	45.2	45.3	44.6	82.5	81.8	78	84.3	83.2	84	76.2	74.4	77.5	44.3	44.4	44
Chloride	16887-00-6	mg/L	NA	24.7	24.9	25	23	22.9	23.2	22.9	23.4	23.3	23.5	23.5	23.4	23.4	23.3	24	24	24	23.2	23.1	23.2
Chromium	7440-47-3	mg/L	NA	0.0011 J		0.0013 J	0.0017 J	0.0011 J	0.00079 J		0.0015 J	0.002 J	0.0021 J	0.0018 J	0.0021 J	0.0027 J	0.0028 J	0.0024 J	0.0014 J	0.0024 J	0.00086 J	0.0012 J	0.0013 J
Cobalt	7440-48-4	mg/L	NA	0.0011 J			0.0012 J	0.0017 J		0.0014 J		0.0011 J	0.001 J		0.0012 J	0.0015 J	0.0011 J	0.0015 J	0.0011 J	0.0016 J	0.0012 J	0.0012 J	0.0013 J
Fluoride	16984-48-8	mg/L	NA	0.56	0.58	0.57	0.17 J	0.17 J	0.17 J	0.17 J	0.17 J	0.59	0.58	0.54	0.63	0.6	0.61	0.51	0.51	0.55	0.17 J	0.16 J	0.16 J
Lead	7439-92-1	mg/L	NA		0.0044 J	0.0053			0.0032 J			0.0026 J			0.0036 J	0.0033 J				0.0025 J			
Lithium	7439-93-2	mg/L	NA	0.0186	0.0172	0.018	0.0068 J	0.007 J	0.0046 J	0.006 J	0.0049 J	0.0222	0.0214	0.0211	0.024	0.0214	0.0241	0.0174	0.0178	0.0206	0.0058 J	0.0067 J	0.0067 J
Mercury*	7439-97-6	mg/L	NA																				
Molybdenum	7439-98-7	mg/L	NA	0.0527	0.0516	0.0499	0.0018 J	0.0032 J	0.0017 J	0.0018 J	0.0017 J	0.0633	0.0635	0.0553	0.0683	0.0667	0.0656	0.0481	0.0501	0.0546	0.0015 J	0.0015 J	0.0014 J
Selenium	7782-49-2	mg/L	4.2									0.0093 J	0.0054 J	0.0055 J	0.0077 J	0.0069 J	0.0067 J	0.0039 J	0.0045 J	0.0047 J			
Sulfate	14808-79-8	mg/L	NA	143	144	144	31.3	32	32.3	31.7	31.5	162	157	143	177	173	169	135	133	146	30.2	30.2	30
Thallium*	7440-28-0	mg/L	0.00047	0.000071 J	0.000044 J	0.000058 J						0.0001 J	0.00015 J	0.0001 J	0.00015 J	0.00012 J	0.0002 J	0.000085 J	0.000046 J	0.000083 J			
Total Hardness as CaCO3	HARDNESS	mg/L	NA	312	319	308	204	206	205	208	203	312	311	300	318	313	316	298	292	299	204	204	203
Total Dissolved Solids	TDS	mg/L	NA	467	451	444	254	262	242	256	250	472	460	444	480	496	483	418	419	445	259	256	253

Notes:

* Constituent was not detected in any samples.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
mg/L - milligrams per liter.
NA - Not Analyzed/Not Available.
USEPA - United States Environmental Protection Agency.

[green shading] Detected Concentration > AWQC.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed November 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.
(c) - Value applies to inorganic form of arsenic only.

TABLE 5c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO HUMAN HEALTH AWQC SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

Constituent	CAS	Units	USEPA AWQC (b)	Mississippi River River Upstream					Mississippi River River Adjacent										Mississippi River River Downstream				
				S-MIR-10S	S-MIR-11D	S-MIR-11S	S-MIR-12D	S-MIR-12S	S-MIR-4S	S-MIR-5D	S-MIR-5S	S-MIR-6D	S-MIR-6S	S-MIR-7S	S-MIR-8D	S-MIR-8S	S-MIR-9D	S-MIR-9S	S-MIR-1S	S-MIR-2D	S-MIR-2S	S-MIR-3D	S-MIR-3S
Antimony*	7440-36-0	mg/L	0.64																				
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0019	0.0018	0.0016	0.0019	0.0019	0.0021	0.0018	0.0017	0.0021	0.002	0.0019	0.0019	0.0017	0.002	0.0019	0.002	0.0019	0.0018	0.0022	0.0022
Barium	7440-39-3	mg/L	NA	0.0599	0.0628	0.0566	0.064	0.0582	0.066	0.0607	0.0548	0.0642	0.0609	0.0596	0.0614	0.0557	0.0687	0.0584	0.0681	0.0646	0.0582	0.07	0.0668
Beryllium*	7440-41-7	mg/L	NA							0.00023 J			0.00022 J					0.00024 J				0.00027 J	
Boron	7440-42-8	mg/L	NA	0.0271 J	0.033 J	0.0274 J	0.0404 J	0.0412 J	0.0391 J	0.0362 J	0.0328 J	0.0492 J	0.0513 J	0.0279 J	0.0348 J	0.0303 J	0.0404 J	0.0369 J	0.0404 J	0.0385 J	0.0387 J	0.0534 J	0.0599 J
Cadmium*	7440-43-9	mg/L	NA																				
Calcium	7440-70-2	mg/L	NA	44.5	44	45	44.4	47	44.6	44.4	42.5	46.7	46	44.8	44.4	45.2	46	47.2	44.7	46.1	44.3	48.9	48.5
Chloride	16887-00-6	mg/L	NA	23.9	23.2	24.9	26.5	31.6	23.7	22.8	24	31.1	34.1	24.1	23.5	26.2	26.2	28.4	23.9	23.5	23.7	31.6	36
Chromium	7440-47-3	mg/L	NA		0.00081 J		0.00088 J		0.0013 J	0.00088 J		0.0011 J	0.0011 J		0.00081 J		0.00093 J		0.0018 J	0.0013 J	0.0013 J	0.0015 J	0.0015 J
Cobalt	7440-48-4	mg/L	NA		0.00095 J				0.0016 J	0.0018 J	0.001 J	0.0012 J	0.00077 J		0.00088 J		0.00091 J		0.0013 J	0.0013 J		0.0011 J	0.0014 J
Fluoride	16984-48-8	mg/L	NA	0.17 J	0.16 J	0.17 J	0.17 J	0.18 J	0.17 J	0.16 J	0.16 J	0.17 J	0.18 J	0.17 J	0.16 J	0.17 J	0.18 J	0.17 J	0.17 J	0.16 J	0.17 J	0.18 J	0.19 J
Lead	7439-92-1	mg/L	NA	0.0033 J		0.0024 J		0.0026 J				0.003 J						0.0025 J	0.0025 J				
Lithium	7439-93-2	mg/L	NA	0.0031 J	0.005 J		0.006 J	0.0033 J	0.0063 J	0.0055 J	0.0053 J	0.0056 J	0.0047 J		0.0056 J	0.003 J	0.0047 J		0.0048 J	0.0079 J	0.0053 J	0.0049 J	0.0063 J
Mercury*	7439-97-6	mg/L	NA																				
Molybdenum	7439-98-7	mg/L	NA		0.0018 J			0.0017 J	0.0019 J	0.0023 J	0.002 J	0.0021 J	0.0021 J	0.0013 J			0.0014 J	0.0018 J	0.002 J	0.0021 J	0.0022 J	0.0023 J	0.0021 J
Selenium	7782-49-2	mg/L	4.2									0.0037 J											
Sulfate	14808-79-8	mg/L	NA	31.3	30.4	31.9	32.4	36.3	31.6	29.9	31.4	35.1	37.7	31.7	30.5	33.1	32.3	34.3	31.8	30.5	32.1	35.5	39.6
Thallium*	7440-28-0	mg/L	0.00047											0.000069 J			0.000037 J	0.000058 J		0.000065 J		0.000078 J	
Total Hardness as CaCO3	HARDNESS	mg/L	NA	203	204	206	206	214	209	205	200	214	214	204	205	206	212	215	207	211	206	223	225
Total Dissolved Solids	TDS	mg/L	NA	248	247	256	265	266	249	251	252	279	280	256	256	258	251	271	244	248	253	288	297

Notes:
* Constituent was not detected in any samples.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
mg/L - milligrams per liter.
NA - Not Analyzed/Not Available.
USEPA - United States Environmental Protection Agency.

(green shading) Detected Concentration > AWQC.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed November 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.
(c) - Value applies to inorganic form of arsenic only.

TABLE 5c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO HUMAN HEALTH AWQC SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			USEPA	Missouri River					Missouri River								Missouri River				
				River Upstream					River Adjacent								River Downstream				
Constituent	CAS	Units	AWQC (b)	S-MO-10S	S-MO-11D	S-MO-11S	S-MO-12D	S-MO-12S	S-MO-4S	S-MO-5D	S-MO-5S	S-MO-6D	S-MO-6S	S-MO-8S	S-MO-9D	S-MO-9S	S-MO-1S	S-MO-2D	S-MO-2S	S-MO-3D	S-MO-3S
Antimony*	7440-36-0	mg/L	0.64																		
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0036	0.0035	0.0035	0.0036	0.0035	0.0036	0.0036	0.0035	0.0035	0.0036	0.0036	0.0036	0.0035	0.0034	0.0036	0.0034	0.0035	0.0036
Barium	7440-39-3	mg/L	NA	0.117	0.117	0.113	0.118	0.114	0.118	0.118	0.115	0.115	0.118	0.116	0.116	0.117	0.113	0.115	0.114	0.116	0.116
Beryllium*	7440-41-7	mg/L	NA																		
Boron	7440-42-8	mg/L	NA	0.113	0.111	0.111	0.111	0.112	0.115	0.117	0.112	0.111	0.112	0.113	0.111	0.112	0.11	0.113	0.114	0.111	0.114
Cadmium*	7440-43-9	mg/L	NA																		
Calcium	7440-70-2	mg/L	NA	65.1	64.4	63.4	64.9	64.2	64.8	65.4	63.2	63.8	65.4	65.3	64.3	65	63	64.8	63.4	64.2	64.7
Chloride	16887-00-6	mg/L	NA	23.5	23.4	23.6	23.6	23.7	23.3	23.4	23.9	23.3	23.3	23.4	23.4	23.6	23.3	23.3	23.4	23.4	23.3
Chromium	7440-47-3	mg/L	NA		0.0012 J	0.00076 J	0.00099 J	0.00075 J	0.0011 J	0.0012 J	0.0013 J	0.00097 J	0.0011 J	0.00098 J	0.00073 J	0.00074 J	0.0013 J				0.00075 J
Cobalt	7440-48-4	mg/L	NA				0.00083 J				0.00086 J	0.00074 J									0.00087 J
Fluoride	16984-48-8	mg/L	NA	0.45	0.44	0.44	0.44	0.44	0.45	0.43	0.45	0.44	0.44	0.45	0.43	0.45	0.45	0.44	0.45	0.43	0.46
Lead	7439-92-1	mg/L	NA									0.0026 J		0.003 J						0.0028 J	
Lithium	7439-93-2	mg/L	NA	0.0435	0.044	0.0429	0.0441	0.0436	0.0442	0.0444	0.0422	0.0427	0.0431	0.0449	0.042	0.0423	0.042	0.0431	0.0427	0.0434	0.0435
Mercury*	7439-97-6	mg/L	NA																		
Molybdenum	7439-98-7	mg/L	NA	0.0031 J	0.0026 J	0.0028 J	0.0026 J	0.0027 J	0.003 J	0.0036 J	0.0026 J	0.003 J	0.0028 J	0.0028 J	0.0028 J	0.003 J	0.0035 J	0.0029 J	0.0036 J	0.0028 J	0.0031 J
Selenium	7782-49-2	mg/L	4.2	0.0042 J																	
Sulfate	14808-79-8	mg/L	NA	195	192	194	191	191	192	192	193	193	188	192	193	190	193	194	189	192	190
Thallium*	7440-28-0	mg/L	0.00047			0.000064 J			0.000047 J	0.000063 J		0.000037 J					0.000055 J				0.000064 J
Total Hardness as CaCO3	HARDNESS	mg/L	NA	266	263	259	265	262	266	267	259	260	267	267	263	265	258	265	259	262	264
Total Dissolved Solids	TDS	mg/L	NA	475	496	492	497	490	493	490	491	491	488	482	476	473	487	496	485	484	465

Notes:
* Constituent was not detected in any samples.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
mg/L - milligrams per liter.
NA - Not Analyzed/Not Available.
USEPA - United States Environmental Protection Agency.

Detected Concentration > AWQC.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed November 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.
(c) - Value applies to inorganic form of arsenic only.

TABLE 5d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO HUMAN HEALTH AWQC SCREENING LEVELS -
DISSOLVED (FILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

Constituent	CAS	Units	USEPA AWQC (b)	Mississippi River Chute River Upstream			Mississippi River Chute River Adjacent														Mississippi River Chute River Downstream		
				S-MIO-16	S-MIO-17	S-MIO-18	S-MIO-4	S-MIO-5	S-MIO-5D	S-MIO-6	S-MIO-6D	S-MIO-7	S-MIO-8	S-MIO-9	S-MIO-10	S-MIO-11	S-MIO-12	S-MIO-13	S-MIO-14	S-MIO-15	S-MIO-1	S-MIO-2	S-MIO-3
Antimony*	7440-36-0	mg/L	0.64		0.0037 J																		
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0055	0.0053	0.0053	0.0021	0.0017	0.0016	0.0017	0.0017	0.0064	0.0061	0.0056	0.0072	0.0071	0.0065	0.0052	0.0053	0.0057	0.0021	0.002	0.0021
Barium	7440-39-3	mg/L	NA	0.185	0.192	0.191	0.0592	0.0558	0.0553	0.0564	0.0544	0.25	0.246	0.219	0.267	0.266	0.252	0.182	0.182	0.209	0.0599	0.0595	0.0583
Beryllium*	7440-41-7	mg/L	NA												0.00019 J	0.0002 J							0.00026 J
Boron	7440-42-8	mg/L	NA	0.755	0.769	0.769	0.039 J	0.0421 J	0.0431 J	0.0395 J	0.0406 J	0.805	0.796	0.715	0.853	0.849	0.812	0.652	0.657	0.734	0.0338 J	0.0351 J	0.0357 J
Cadmium*	7440-43-9	mg/L	NA																				
Calcium	7440-70-2	mg/L	NA	79.8	81.4	82.1	44.8	44.5	44.1	45.2	43.8	83	82.1	77.2	82.9	83.2	81	73.9	74.2	76.8	45.1	44.7	44
Chromium	7440-47-3	mg/L	NA									0.00087 J			0.00095 J	0.0016 J	0.0008 J			0.00075 J			
Cobalt	7440-48-4	mg/L	NA	0.00089 J	0.0012 J	0.0013 J		0.00078 J				0.001 J	0.0013 J	0.00074 J	0.00088 J		0.00098 J	0.0013 J					
Lead	7439-92-1	mg/L	NA		0.0031 J																		
Lithium	7439-93-2	mg/L	NA	0.0161	0.018	0.0197	0.0055 J	0.0056 J	0.0044 J	0.0059 J	0.0051 J	0.0218	0.0209	0.0189	0.0213	0.023	0.0229	0.0166	0.0166	0.0201	0.0054 J	0.0058 J	0.0067 J
Mercury*	7439-97-6	mg/L	NA																				
Molybdenum	7439-98-7	mg/L	NA	0.0524	0.0576	0.0561	0.0018 J	0.0026 J	0.0019 J	0.0022 J	0.002 J	0.064	0.0633	0.057	0.068	0.0685	0.0638	0.0478	0.0489	0.055	0.0019 J	0.0019 J	0.0023 J
Selenium	7782-49-2	mg/L	4.2		0.0061 J							0.0048 J	0.0046 J	0.0049 J	0.0052 J	0.0091 J	0.0062 J						
Silver*	7440-22-4	mg/L	NA																				
Thallium*	7440-28-0	mg/L	0.00047	0.000037 J						0.000039 J		0.000092 J	0.00014 J	0.000096 J	0.00011 J	0.00011 J	0.000096 J			0.0001 J	0.000055 J		

Notes:

* Constituent was not detected in any samples.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
mg/L - milligrams per liter.
NA - Not Analyzed/Not Available.
USEPA - United States Environmental Protection Agency.

Detected Concentration > AWQC.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed November 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.
(c) - Value applies to inorganic form of arsenic only.

TABLE 5d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO HUMAN HEALTH AWQC SCREENING LEVELS -
DISSOLVED (FILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

Constituent	CAS	Units	USEPA	Mississippi River					Mississippi River										Mississippi River				
				River Upstream					River Adjacent										River Downstream				
			AWQC (b)	S-MIR-10S	S-MIR-11D	S-MIR-11S	S-MIR-12D	S-MIR-12S	S-MIR-4S	S-MIR-5D	S-MIR-5S	S-MIR-6D	S-MIR-6S	S-MIR-7S	S-MIR-8D	S-MIR-8S	S-MIR-9D	S-MIR-9S	S-MIR-1S	S-MIR-2D	S-MIR-2S	S-MIR-3D	S-MIR-3S
Antimony*	7440-36-0	mg/L	0.64																				
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0016	0.0016	0.0015	0.0017	0.0016	0.0017	0.0015	0.0015	0.0018	0.0018	0.0016	0.0014	0.0016	0.0016	0.0016	0.0017	0.0016	0.0016	0.0018	0.0018
Barium	7440-39-3	mg/L	NA	0.0504	0.0417	0.0439	0.0447	0.0467	0.0525	0.042	0.0421	0.0453	0.0464	0.0508	0.0422	0.0429	0.0438	0.0457	0.0534	0.043	0.0475	0.047	0.049
Beryllium*	7440-41-7	mg/L	NA									0.00025 J		0.00018 J			0.00029 J	0.00032 J		0.00025 J			
Boron	7440-42-8	mg/L	NA	0.0332 J	0.0333 J	0.0372 J	0.0392 J	0.0476 J	0.0368 J	0.0329 J	0.0338 J	0.0489 J	0.0522 J	0.0374 J	0.0354 J	0.0398 J	0.0396 J	0.0409 J	0.0395 J	0.0391 J	0.0398 J	0.0559 J	0.0603 J
Cadmium*	7440-43-9	mg/L	NA																				
Calcium	7440-70-2	mg/L	NA	44.8	44.4	44.9	45.7	45.9	45	43.4	44.4	45.8	46.2	43.8	43.9	43.6	45.4	44.8	44.4	45	44.3	47.4	48
Chromium	7440-47-3	mg/L	NA													0.00097 J							
Cobalt	7440-48-4	mg/L	NA		0.0009 J		0.00091 J		0.0013 J	0.0013 J	0.00075 J		0.0012 J	0.00082 J		0.00078 J	0.0013 J	0.00091 J				0.00094 J	
Lead	7439-92-1	mg/L	NA																				
Lithium	7439-93-2	mg/L	NA	0.0058 J	0.0063 J	0.0054 J	0.005 J	0.0068 J	0.0041 J	0.0043 J	0.0051 J	0.0033 J	0.0037 J	0.004 J	0.0041 J	0.0041 J	0.0043 J	0.0048 J	0.0059 J	0.0052 J	0.0033 J	0.0043 J	0.0078 J
Mercury*	7439-97-6	mg/L	NA																				
Molybdenum	7439-98-7	mg/L	NA	0.0015 J	0.0016 J	0.0019 J	0.002 J	0.0014 J	0.0022 J	0.0019 J	0.0014 J	0.002 J	0.0018 J	0.0027 J	0.0021 J	0.0026 J	0.0018 J	0.0023 J	0.002 J	0.0019 J	0.0016 J	0.0031 J	0.0022 J
Selenium	7782-49-2	mg/L	4.2																	0.0036 J			
Silver*	7440-22-4	mg/L	NA																				
Thallium*	7440-28-0	mg/L	0.00047	0.000059 J																0.00004 J			0.000047 J

Notes:

* Constituent was not detected in any samples.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.

mg/L - milligrams per liter.
NA - Not Analyzed/Not Available.
USEPA - United States Environmental Protection Agency.

(green shading) Detected Concentration > AWQC.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed November 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.
(c) - Value applies to inorganic form of arsenic only.

TABLE 5d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO HUMAN HEALTH AWQC SCREENING LEVELS -
DISSOLVED (FILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			USEPA	Missouri River River Upstream					Missouri River River Adjacent								Missouri River River Downstream				
Constituent	CAS	Units	AWQC (b)	S-MO-10S	S-MO-11D	S-MO-11S	S-MO-12D	S-MO-12S	S-MO-4S	S-MO-5D	S-MO-5S	S-MO-6D	S-MO-6S	S-MO-8S	S-MO-9D	S-MO-9S	S-MO-1S	S-MO-2D	S-MO-2S	S-MO-3D	S-MO-3S
Antimony*	7440-36-0	mg/L	0.64																		
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0034	0.0034	0.0032	0.0033	0.0033	0.0033	0.0034	0.0033	0.0032	0.0033	0.0033	0.0034	0.0032	0.0033	0.0034	0.0033	0.0032	0.0033
Barium	7440-39-3	mg/L	NA	0.108	0.11	0.108	0.109	0.109	0.11	0.11	0.107	0.106	0.109	0.107	0.108	0.108	0.112	0.107	0.111	0.107	0.109
Beryllium*	7440-41-7	mg/L	NA																		
Boron	7440-42-8	mg/L	NA	0.115	0.12	0.116	0.118	0.118	0.119	0.12	0.114	0.115	0.116	0.117	0.118	0.116	0.12	0.115	0.122	0.115	0.119
Cadmium*	7440-43-9	mg/L	NA																		
Calcium	7440-70-2	mg/L	NA	59.5	60.9	59.9	60.6	60.3	60.3	61.1	59.2	59.1	60	59.8	60	59.9	61.6	59.7	60.6	59.7	59.4
Chromium	7440-47-3	mg/L	NA																		0.00074 J
Cobalt	7440-48-4	mg/L	NA																		
Lead	7439-92-1	mg/L	NA																		
Lithium	7439-93-2	mg/L	NA	0.0422	0.0423	0.0435	0.0423	0.0417	0.0422	0.0422	0.0428	0.0412	0.0421	0.044	0.042	0.04	0.0441	0.0421	0.0446	0.0405	0.0437
Mercury*	7439-97-6	mg/L	NA																		
Molybdenum	7439-98-7	mg/L	NA	0.0039 J	0.004 J	0.0044 J	0.0036 J	0.0038 J	0.0037 J	0.0049 J	0.0037 J	0.004 J	0.0046 J	0.0036 J	0.0035 J	0.0038 J	0.0046 J	0.0038 J	0.0047 J	0.0032 J	0.0037 J
Selenium	7782-49-2	mg/L	4.2																		
Silver*	7440-22-4	mg/L	NA																		
Thallium*	7440-28-0	mg/L	0.00047			0.000063 J				0.000072 J		0.000037 J					0.000048 J				0.000075 J

Notes:
* Constituent was not detected in any samples.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
mg/L - milligrams per liter.
NA - Not Analyzed/Not Available.
USEPA - United States Environmental Protection Agency.

(green shading) Detected Concentration > AWQC.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed November 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.
(c) - Value applies to inorganic form of arsenic only.

TABLE 6a
COMPARISON OF MAY 2018 MISSISSIPPI RIVER SURFACE WATER RESULTS
TO ECOLOGICAL SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

			Federal Water Quality Criteria		Mississippi River Upstream					Mississippi River Adjacent										Mississippi River Downstream				
Constituent	CAS	Units	USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	S2-MIR-10S	S2-MIR-11M	S2-MIR-11S	S2-MIR-12M	S2-MIR-12S	S2-MIR-4S	S2-MIR-5M	S2-MIR-5S	S2-MIR-6M	S2-MIR-6S	S2-MIR-7S	S2-MIR-8M	S2-MIR-8S	S2-MIR-9M	S2-MIR-9S	S2-MIR-1S	S2-MIR-2M	S2-MIR-2S	S2-MIR-3M	S2-MIR-3S
Antimony*	7440-36-0	mg/L	NA	NA																				
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0017	0.0015	0.0016	0.0022	0.0021	0.0016	0.0016	0.0016	0.0017	0.0015	0.0015	0.0016	0.0015	0.0017	0.0015	0.0018	0.0016	0.0015	0.0015	0.0016
Barium	7440-39-3	mg/L	NA	NA	0.0969	0.0937	0.0991	0.0966	0.0952	0.0901	0.0969	0.0932	0.0919	0.0767	0.0909	0.092	0.0904	0.0905	0.0908	0.108	0.0968	0.0861	0.0883	0.0868
Beryllium*	7440-41-7	mg/L	NA	NA																	0.00035 J			
Boron	7440-42-8	mg/L	NA	NA	0.0296 J	0.0276 J	0.0301 J	0.0285 J	0.0309 J	0.0313 J	0.0303 J	0.0289 J	0.0461 J	0.0437 J	0.0312 J	0.0286 J	0.0285 J	0.0366 J	0.0367 J	0.0338 J	0.0337 J	0.0273 J	0.0465 J	0.047 J
Cadmium	7440-43-9	mg/L	0.0043 (d)	0.0015 (d)											0.00058 J				0.00046 J					
Calcium	7440-70-2	mg/L	NA	NA	56	53.3	56	53.1	54.6	55	54.6	53.5	56.5	54.2	55.8	53	53.4	55.6	55.9	56.6	54.9	52.5	58.5	58
Chloride	16887-00-6	mg/L	860	230	22.7	22.2	22.4	25.2	24.5	22.5	23	22.6	40.7	38.4	22.6	24.1	23.1	32.8	32	23	23.2	22.6	41	40.9
Chromium	7440-47-3	mg/L	3.55 (c,d)	0.170 (c,d)	0.0023 J	0.0026 J	0.0029 J	0.003 J	0.0023 J		0.0029 J	0.0023 J	0.0032 J	0.0013 J	0.0016 J	0.0014 J	0.0019 J	0.0021 J	0.0017 J	0.003 J	0.0019 J	0.0021 J	0.0012 J	0.0016 J
Cobalt	7440-48-4	mg/L	NA	NA	0.0013 J	0.0016 J	0.0016 J	0.002 J	0.0018 J	0.0012 J	0.0023 J	0.0017 J	0.0018 J		0.0014 J	0.0016 J	0.0014 J	0.0014 J	0.0019 J	0.002 J	0.0021 J	0.0015 J	0.0013 J	0.0012 J
Fluoride	16984-48-8	mg/L	NA	NA	0.22	0.22	0.23	0.22	0.21	0.23	0.22	0.22	0.23	0.21 J	0.23	0.21	0.21	0.21	0.21	0.23	0.24	0.23	0.22	0.23
Lead	7439-92-1	mg/L	0.23 (d)	0.009 (d)	0.0047 J	0.0048 J	0.0055 J	0.0046 J	0.0034 J		0.005 J	0.0052 J	0.005 J	0.0034 J	0.0033 J	0.0045 J	0.0034 J	0.0046 J		0.0049 J	0.0038 J			0.004 J
Lithium	7439-93-2	mg/L	NA	NA	0.009 J	0.0089 J	0.0089 J	0.0088 J	0.0091 J	0.009 J	0.0091 J	0.0104	0.0089 J	0.0059 J	0.0092 J	0.0086 J	0.0104	0.0075 J	0.0085 J	0.0099 J	0.0089 J	0.0084 J	0.0074 J	0.0093 J
Mercury*	7439-97-6	mg/L	0.0016	0.001																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.001 J		0.00098 J	0.0011 J	0.0011 J	0.0011 J	0.0012 J	0.0011 J	0.0014 J	0.0018 J	0.0012 J		0.0013 J	0.0012 J	0.0012 J	0.0012 J	0.0015 J	0.001 J	0.0018 J	0.0018 J
Selenium*	7782-49-2	mg/L	NA	3.1																				
Sulfate	14808-79-8	mg/L	NA	NA	33.6	33	32.8	33.8	33.7	33.9	33.4	33.2	40.1	39.1	34	33.4	33.1	37.3	36.6	34.5	34	33.4	40.3	40.5
Thallium*	7440-28-0	mg/L	NA	NA																				
Total Hardness as CaCO3	471-34-1	mg/L	NA	NA	229	219	228	219	228	224	224	220	243	234	227	219	220	234	234	229	224	215	250	250
Total Dissolved Solids	TDS	mg/L	NA	NA	302	268	250	282	258	218	224	250	232 J	324	282	344	280	280	342	290	244	280	321	272

Notes:

Blank cells - Non-detect value.
J - Estimated value.
* Constituent was not detected in any samples.
mg/L - milligrams per liter.
AWQC - USEPA Ambient Water Quality Criteria.
NA - Not Available.
CAS - Chemical Abstracts Service.
USEPA - United States Environmental Protection Agency.

Detected Concentration> USEPA Aquatic Life AWQC Chronic.
Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in May 2018.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value for the Mississippi River of 229 mg/L as CaCO3 used.

TABLE 6b
COMPARISON OF MAY 2018 MISSISSIPPI RIVER SURFACE WATER RESULTS
TO ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

			Federal Water Quality Criteria		Mississippi River Upstream					Mississippi River Adjacent										Mississippi River Downstream				
Constituent	**CAS**	**Units**	**USEPA Aquatic Life AWQC Freshwater Acute (b)**	**USEPA Aquatic Life AWQC Freshwater Chronic (b)**	**S2-MIR-10S**	**S2-MIR-11M**	**S2-MIR-11S**	**S2-MIR-12M**	**S2-MIR-12S**	**S2-MIR-4S**	**S2-MIR-5M**	**S2-MIR-5S**	**S2-MIR-6M**	**S2-MIR-6S**	**S2-MIR-7S**	**S2-MIR-8M**	**S2-MIR-8S**	**S2-MIR-9M**	**S2-MIR-9S**	**S2-MIR-1S**	**S2-MIR-2M**	**S2-MIR-2S**	**S2-MIR-3M**	**S2-MIR-3S**
Antimony*	7440-36-0	mg/L	NA	NA																				
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0011	0.001	0.00096 J	0.0013	0.0014	0.0012	0.0011	0.0011	0.0011	0.0011 J	0.0011	0.0011	0.0011	0.0011	0.0011	0.0013	0.0012	0.0011	0.0012	0.0012
Barium	7440-39-3	mg/L	NA	NA	0.0698	0.0659	0.0645	0.0619	0.0614	0.0727	0.0666	0.067	0.0614	0.0604	0.0719	0.0629	0.0654	0.0632	0.0614	0.0757	0.0657	0.0679	0.0629	0.0652
Beryllium	7440-41-7	mg/L	NA	NA																				
Boron	7440-42-8	mg/L	NA	NA	0.0275 J	0.0278 J	0.0272 J	0.03 J	0.027 J	0.0323 J	0.0274 J	0.0299 J	0.0441 J	0.0427 J	0.0294 J	0.0271 J	0.0289 J	0.037 J	0.035 J	0.0315 J	0.0304 J	0.0305 J	0.0469 J	0.048 J
Cadmium*	7440-43-9	mg/L	0.0039 (d)	0.0013 (d)																				
Calcium	7440-70-2	mg/L	NA	NA	52.8	50.4	49.8	48.5	48.3	55.6	52.5	52.1	53.3	52.6	52.3	49.3	50.7	52.3	50.3	54.7	52	52.8	55.1	56.6
Chromium*	7440-47-3	mg/L	1.12 (c,d)	0.15 (c,d)																				
Cobalt*	7440-48-4	mg/L	NA	NA																				
Lead*	7439-92-1	mg/L	0.157 (d)	0.0061 (d)							0.0035 J													
Lithium	7439-93-2	mg/L	NA	NA	0.0075 J	0.009 J	0.0083 J	0.0071 J	0.007 J	0.008 J	0.0085 J	0.0077 J	0.0074 J	0.0065 J	0.0083 J	0.0069 J	0.0067 J	0.0072 J	0.0067 J	0.0088 J	0.0088 J	0.0081 J	0.0074 J	0.0057 J
Mercury*	7439-97-6	mg/L	0.0014	0.00077																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.0012 J			0.001 J		0.0013 J	0.001 J	0.0011 J	0.0016 J	0.0014 J	0.0015 J	0.00098 J		0.0014 J	0.0015 J	0.0018 J	0.0017 J	0.0014 J	0.0016 J	0.0018 J
Selenium*	7782-49-2	mg/L	NA	NA																				
Thallium*	7440-28-0	mg/L	NA	NA																				

Notes:

Blank cells - Non-detect value.
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency.

Detected Concentration> USEPA Aquatic Life AWQC Chronic.
Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in May 2018.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value for the Mississippi River of 229 mg/L as CaCO3 used.

TABLE 6c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO ECOLOGICAL SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			Federal Water Quality Criteria		Mississippi River Chute			Mississippi River Chute														Mississippi River Chute		
					River Upstream			River Adjacent														River Downstream		
Constituent	CAS	Units	USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	S-MIO-16	S-MIO-17	S-MIO-18	S-MIO-4	S-MIO-5	S-MIO-5D	S-MIO-6	S-MIO-6D	S-MIO-7	S-MIO-8	S-MIO-9	S-MIO-10	S-MIO-11	S-MIO-12	S-MIO-13	S-MIO-14	S-MIO-15	S-MIO-1	S-MIO-2	S-MIO-3
Antimony	7440-36-0	mg/L	NA	NA													0.0037 J							
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0064	0.0062	0.0066	0.0025	0.002	0.002	0.002	0.0021	0.0072	0.0069	0.0062	0.0077	0.0078	0.0077	0.0066	0.006	0.0067	0.0024	0.0024	0.0023
Barium	7440-39-3	mg/L	NA	NA	0.204	0.2	0.199	0.0746	0.0695	0.0669	0.0705	0.0668	0.263	0.256	0.235	0.288	0.278	0.285	0.212	0.193	0.232	0.0677	0.065	0.065
Beryllium*	7440-41-7	mg/L	NA	NA									0.00023 J	0.00035 J		0.0004 J								
Boron	7440-42-8	mg/L	NA	NA	0.75	0.746	0.718	0.0402 J	0.0461 J	0.0379 J	0.041 J	0.034 J	0.805	0.782	0.705	0.859	0.839	0.838	0.651	0.654	0.715	0.0361 J	0.0351 J	0.0358 J
Cadmium*	7440-43-9	mg/L	0.0046 (d)	0.00163 (d)																				
Calcium	7440-70-2	mg/L	NA	NA	80.8	84.8	82	44.6	45	45.2	45.3	44.6	82.5	81.8	78	84.3	83.2	84	76.2	74.4	77.5	44.3	44.4	44
Chloride	16887-00-6	mg/L	860	230	24.7	24.9	25	23	22.9	23.2	22.9	23.4	23.3	23.5	23.5	23.4	23.4	23.3	24	24	24	23.2	23.1	23.2
Chromium	7440-47-3	mg/L	3.8 (c,d)	0.181 (c,d)	0.0011 J		0.0013 J	0.0017 J	0.0011 J	0.00079 J		0.0015 J	0.002 J	0.0021 J	0.0018 J	0.0021 J	0.0027 J	0.0028 J	0.0024 J	0.0014 J	0.0024 J	0.00086 J	0.0012 J	0.0013 J
Cobalt	7440-48-4	mg/L	NA	NA	0.0011 J			0.0012 J	0.0017 J		0.0014 J		0.0011 J	0.001 J		0.0012 J	0.0015 J	0.0011 J	0.0015 J	0.0011 J	0.0016 J	0.0012 J	0.0012 J	0.0013 J
Fluoride	16984-48-8	mg/L	NA	NA	0.56	0.58	0.57	0.17 J	0.17 J	0.17 J	0.17 J	0.17 J	0.59	0.58	0.54	0.63	0.6	0.61	0.51	0.51	0.55	0.17 J	0.16 J	0.16 J
Lead	7439-92-1	mg/L	0.258 (d)	0.0101 (d)		0.0044 J	0.0053			0.0032 J			0.0026 J			0.0036 J	0.0033 J				0.0025 J			
Lithium	7439-93-2	mg/L	NA	NA	0.0186	0.0172	0.018	0.0068 J	0.007 J	0.0046 J	0.006 J	0.0049 J	0.0222	0.0214	0.0211	0.024	0.0214	0.0241	0.0174	0.0178	0.0206	0.0058 J	0.0067 J	0.0067 J
Mercury*	7439-97-6	mg/L	0.0016	0.001																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.0527	0.0516	0.0499	0.0018 J	0.0032 J	0.0017 J	0.0018 J	0.0017 J	0.0633	0.0635	0.0553	0.0683	0.0667	0.0656	0.0481	0.0501	0.0546	0.0015 J	0.0015 J	0.0014 J
Selenium	7782-49-2	mg/L	NA	3.1									0.0093 J	0.0054 J	0.0055 J	0.0077 J	0.0069 J	0.0067 J	0.0039 J	0.0045 J	0.0047 J			
Sulfate	14808-79-8	mg/L	NA	NA	143	144	144	31.3	32	32.3	31.7	31.5	162	157	143	177	173	169	135	133	146	30.2	30.2	30
Thallium	7440-28-0	mg/L	NA	NA	0.000071 J	0.000044 J	0.000058 J						0.0001 J	0.00015 J	0.0001 J	0.00015 J	0.00012 J	0.0002 J	0.000085 J	0.000046 J	0.000083 J			
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	312	319	308	204	206	205	208	203	312	311	300	318	313	316	298	292	299	204	204	203
Total Dissolved Solids	TDS	mg/L	NA	NA	467	451	444	254	262	242	256	250	472	460	444	480	496	483	418	419	445	259	256	253

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency.

Detected Concentration> USEPA Aquatic Life AWQC Chronic.
Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value
for Mississippi and Missouri River of 247 mg/L as CaCO3 used.

TABLE 6c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO ECOLOGICAL SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			Federal Water Quality Criteria		Mississippi River					Mississippi River										Mississippi River				
					River Upstream					River Adjacent										River Downstream				
Constituent	CAS	Units	USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	S-MIR-10S	S-MIR-11D	S-MIR-11S	S-MIR-12D	S-MIR-12S	S-MIR-4S	S-MIR-5D	S-MIR-5S	S-MIR-6D	S-MIR-6S	S-MIR-7S	S-MIR-8D	S-MIR-8S	S-MIR-9D	S-MIR-9S	S-MIR-1S	S-MIR-2D	S-MIR-2S	S-MIR-3D	S-MIR-3S
Antimony	7440-36-0	mg/L	NA	NA																				
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0019	0.0018	0.0016	0.0019	0.0019	0.0021	0.0018	0.0017	0.0021	0.002	0.0019	0.0019	0.0017	0.002	0.0019	0.002	0.0019	0.0018	0.0022	0.0022
Barium	7440-39-3	mg/L	NA	NA	0.0599	0.0628	0.0566	0.064	0.0582	0.066	0.0607	0.0548	0.0642	0.0609	0.0596	0.0614	0.0557	0.0687	0.0584	0.0681	0.0646	0.0582	0.07	0.0668
Beryllium*	7440-41-7	mg/L	NA	NA							0.00023 J			0.00022 J					0.00024 J				0.00027 J	
Boron	7440-42-8	mg/L	NA	NA	0.0271 J	0.033 J	0.0274 J	0.0404 J	0.0412 J	0.0391 J	0.0362 J	0.0328 J	0.0492 J	0.0513 J	0.0279 J	0.0348 J	0.0303 J	0.0404 J	0.0369 J	0.0404 J	0.0385 J	0.0387 J	0.0534 J	0.0599 J
Cadmium*	7440-43-9	mg/L	0.0046 (d)	0.00163 (d)																				
Calcium	7440-70-2	mg/L	NA	NA	44.5	44	45	44.4	47	44.6	44.4	42.5	46.7	46	44.8	44.4	45.2	46	47.2	44.7	46.1	44.3	48.9	48.5
Chloride	16887-00-6	mg/L	860	230	23.9	23.2	24.9	26.5	31.6	23.7	22.8	24	31.1	34.1	24.1	23.5	26.2	26.2	28.4	23.9	23.5	23.7	31.6	36
Chromium	7440-47-3	mg/L	3.8 (c,d)	0.181 (c,d)		0.00081 J		0.00088 J		0.0013 J	0.00088 J		0.0011 J	0.0011 J		0.00081 J		0.00093 J		0.0018 J	0.0013 J	0.0013 J	0.0015 J	0.0015 J
Cobalt	7440-48-4	mg/L	NA	NA		0.00095 J				0.0016 J	0.0018 J	0.001 J	0.0012 J	0.00077 J		0.00088 J		0.00091 J		0.0013 J	0.0013 J		0.0011 J	0.0014 J
Fluoride	16984-48-8	mg/L	NA	NA	0.17 J	0.16 J	0.17 J	0.17 J	0.18 J	0.17 J	0.16 J	0.16 J	0.17 J	0.18 J	0.17 J	0.16 J	0.17 J	0.18 J	0.17 J	0.17 J	0.16 J	0.17 J	0.18 J	0.19 J
Lead	7439-92-1	mg/L	0.258 (d)	0.0101 (d)	0.0033 J		0.0024 J		0.0026 J				0.003 J						0.0025 J	0.0025 J				
Lithium	7439-93-2	mg/L	NA	NA	0.0031 J	0.005 J		0.006 J	0.0033 J	0.0063 J	0.0055 J	0.0053 J	0.0056 J	0.0047 J		0.0056 J	0.003 J	0.0047 J		0.0048 J	0.0079 J	0.0053 J	0.0049 J	0.0063 J
Mercury*	7439-97-6	mg/L	0.0016	0.001																				
Molybdenum	7439-98-7	mg/L	NA	NA		0.0018 J			0.0017 J	0.0019 J	0.0023 J	0.002 J	0.0021 J	0.0021 J	0.0013 J			0.0014 J	0.0018 J	0.002 J	0.0021 J	0.0022 J	0.0023 J	0.0021 J
Selenium	7782-49-2	mg/L	NA	3.1									0.0037 J											
Sulfate	14808-79-8	mg/L	NA	NA	31.3	30.4	31.9	32.4	36.3	31.6	29.9	31.4	35.1	37.7	31.7	30.5	33.1	32.3	34.3	31.8	30.5	32.1	35.5	39.6
Thallium	7440-28-0	mg/L	NA	NA											0.000069 J			0.000037 J	0.000058 J		0.000065 J		0.000078 J	
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	203	204	206	206	214	209	205	200	214	214	204	205	206	212	215	207	211	206	223	225
Total Dissolved Solids	TDS	mg/L	NA	NA	248	247	256	265	266	249	251	252	279	280	256	256	258	251	271	244	248	253	288	297

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency.

Detected Concentration> USEPA Aquatic Life AWQC Chronic.
Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value
for Mississippi and Missouri River of 247 mg/L as CaCO3 used.

TABLE 6c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO ECOLOGICAL SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria		Missouri River					Missouri River									Missouri River				
					River Upstream					River Adjacent									River Downstream				
			USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	S-MO-10S	S-MO-11D	S-MO-11S	S-MO-12D	S-MO-12S	S-MO-4S	S-MO-6D	S-MO-6S	S-MO-7S	S-MO-8D	S-MO-8S	S-MO-9D	S-MO-9S	S-MO-1S	S-MO-2D	S-MO-2S	S-MO-3D	S-MO-3S
Antimony	7440-36-0	mg/L	NA	NA																		
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0036	0.0035	0.0035	0.0036	0.0035	0.0036	0.0035	0.0036	0.0034	0.0035	0.0036	0.0036	0.0035	0.0034	0.0036	0.0034	0.0035	0.0036
Barium	7440-39-3	mg/L	NA	NA	0.117	0.117	0.113	0.118	0.114	0.118	0.115	0.118	0.114	0.116	0.116	0.116	0.117	0.113	0.115	0.114	0.116	0.116
Beryllium*	7440-41-7	mg/L	NA	NA																		
Boron	7440-42-8	mg/L	NA	NA	0.113	0.111	0.111	0.111	0.112	0.115	0.111	0.112	0.11	0.113	0.113	0.111	0.112	0.11	0.113	0.114	0.111	0.114
Cadmium*	7440-43-9	mg/L	0.0046 (d)	0.00163 (d)																		
Calcium	7440-70-2	mg/L	NA	NA	65.1	64.4	63.4	64.9	64.2	64.8	63.8	65.4	63.4	65	65.3	64.3	65	63	64.8	63.4	64.2	64.7
Chloride	16887-00-6	mg/L	860	230	23.5	23.4	23.6	23.6	23.7	23.3	23.3	23.3	23.9	23.5	23.4	23.4	23.6	23.3	23.3	23.4	23.4	23.3
Chromium	7440-47-3	mg/L	3.8 (c,d)	0.181 (c,d)		0.0012 J	0.00076 J	0.00099 J	0.00075 J	0.0011 J	0.00097 J	0.0011 J		0.00095 J	0.00098 J	0.00073 J	0.00074 J	0.0013 J				0.00075 J
Cobalt	7440-48-4	mg/L	NA	NA				0.00083 J			0.00074 J		0.00087 J	0.00085 J								0.00087 J
Fluoride	16984-48-8	mg/L	NA	NA	0.45	0.44	0.44	0.44	0.44	0.45	0.44	0.44	0.45	0.44	0.45	0.43	0.45	0.45	0.44	0.45	0.43	0.46
Lead	7439-92-1	mg/L	0.258 (d)	0.0101 (d)							0.0026 J				0.003 J						0.0028 J	
Lithium	7439-93-2	mg/L	NA	NA	0.0435	0.044	0.0429	0.0441	0.0436	0.0442	0.0427	0.0431	0.042	0.0428	0.0449	0.042	0.0423	0.042	0.0431	0.0427	0.0434	0.0435
Mercury*	7439-97-6	mg/L	0.0016	0.001																		
Molybdenum	7439-98-7	mg/L	NA	NA	0.0031 J	0.0026 J	0.0028 J	0.0026 J	0.0027 J	0.003 J	0.003 J	0.0028 J	0.0031 J	0.003 J	0.0028 J	0.0028 J	0.003 J	0.0035 J	0.0029 J	0.0036 J	0.0028 J	0.0031 J
Selenium	7782-49-2	mg/L	NA	3.1	0.0042 J																	
Sulfate	14808-79-8	mg/L	NA	NA	195	192	194	191	191	192	193	188	192	196	192	193	190	193	194	189	192	190
Thallium	7440-28-0	mg/L	NA	NA			0.000064 J			0.000047 J	0.000037 J			0.000045 J				0.000055 J				0.000064 J
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	266	263	259	265	262	266	260	267	259	265	267	263	265	258	265	259	262	264
Total Dissolved Solids	TDS	mg/L	NA	NA	475	496	492	497	490	493	491	488	478	496	482	476	473	487	496	485	484	465

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency.

Detected Concentration> USEPA Aquatic Life AWQC Chronic.
Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value for Mississippi and Missouri River of 247 mg/L as CaCO3 used.

TABLE 6d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO
ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria		Mississippi River Chute			Mississippi River Chute															Mississippi River Chute		
					River Upstream			River Adjacent															River Downstream		
			USEPA Aquatic Life AWQC Freshwater Acute (c)	USEPA Aquatic Life AWQC Freshwater Chronic (c)	S-MIO-16	S-MIO-17	S-MIO-18	S-MIO-4	S-MIO-5	S-MIO-5D	S-MIO-6	S-MIO-6D	S-MIO-7	S-MIO-8	S-MIO-9	S-MIO-10	S-MIO-11	S-MIO-12	S-MIO-13	S-MIO-14	S-MIO-15	S-MIO-1	S-MIO-2	S-MIO-3
Antimony*	7440-36-0	mg/L	NA	NA		0.0037 J																		
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0055	0.0053	0.0053	0.0021	0.0017	0.0016	0.0017	0.0017	0.0064	0.0061	0.0056	0.0072	0.0071	0.0065	0.0052	0.0053	0.0057	0.0021	0.002	0.0021
Barium	7440-39-3	mg/L	NA	NA	0.185	0.192	0.191	0.0592	0.0558	0.0553	0.0564	0.0544	0.25	0.246	0.219	0.267	0.266	0.252	0.182	0.182	0.209	0.0599	0.0595	0.0583
Beryllium*	7440-41-7	mg/L	NA	NA												0.00019 J	0.0002 J							0.00026 J
Boron	7440-42-8	mg/L	NA	NA	0.755	0.769	0.769	0.039 J	0.0421 J	0.0431 J	0.0395 J	0.0406 J	0.805	0.796	0.715	0.853	0.849	0.812	0.652	0.657	0.734	0.0338 J	0.0351 J	0.0357 J
Cadmium*	7440-43-9	mg/L	0.0042 (b)	0.00142 (b)																				
Calcium	7440-70-2	mg/L	NA	NA	79.8	81.4	82.1	44.8	44.5	44.1	45.2	43.8	83	82.1	77.2	82.9	83.2	81	73.9	74.2	76.8	45.1	44.7	44
Chromium	7440-47-3	mg/L	1.19 (c,d)	0.155 (c,d)									0.00087 J			0.00095 J	0.0016 J	0.0008 J			0.00075 J			
Cobalt	7440-48-4	mg/L	NA	NA	0.00089 J	0.0012 J	0.0013 J		0.00078 J				0.001 J	0.0013 J	0.00074 J	0.00088 J		0.00098 J	0.0013 J					
Lead	7439-92-1	mg/L	0.170 (b)	0.0066 (b)		0.0031 J																		
Lithium	7439-93-2	mg/L	NA	NA	0.0161	0.018	0.0197	0.0055 J	0.0056 J	0.0044 J	0.0059 J	0.0051 J	0.0218	0.0209	0.0189	0.0213	0.023	0.0229	0.0166	0.0166	0.0201	0.0054 J	0.0058 J	0.0067 J
Mercury*	7439-97-6	mg/L	0.0014	0.00077																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.0524	0.0576	0.0561	0.0018 J	0.0026 J	0.0019 J	0.0022 J	0.002 J	0.064	0.0633	0.057	0.068	0.0685	0.0638	0.0478	0.0489	0.055	0.0019 J	0.0019 J	0.0023 J
Selenium	7782-49-2	mg/L	NA	NA		0.0061 J							0.0048 J	0.0046 J	0.0049 J	0.0052 J	0.0091 J	0.0062 J						
Thallium	7440-28-0	mg/L	NA	NA	0.000037 J						0.000039 J		0.000092 J	0.00014 J	0.000096 J	0.00011 J	0.00011 J	0.000096 J			0.0001 J	0.000055 J		

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
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Detected Concentration> USEPA Aquatic Life AWQC Chronic.
Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value
for Mississippi and Missouri River of 247 mg/L as CaCO3 used.

TABLE 6d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO
ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria		Mississippi River					Mississippi River										Mississippi River				
					River Upstream					River Adjacent										River Downstream				
			USEPA Aquatic Life AWQC Freshwater Acute (c)	USEPA Aquatic Life AWQC Freshwater Chronic (c)	S-MIR-10S	S-MIR-11D	S-MIR-11S	S-MIR-12D	S-MIR-12S	S-MIR-4S	S-MIR-5D	S-MIR-5S	S-MIR-6D	S-MIR-6S	S-MIR-7S	S-MIR-8D	S-MIR-8S	S-MIR-9D	S-MIR-9S	S-MIR-1S	S-MIR-2D	S-MIR-2S	S-MIR-3D	S-MIR-3S
Antimony*	7440-36-0	mg/L	NA	NA																				
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0016	0.0016	0.0015	0.0017	0.0016	0.0017	0.0015	0.0015	0.0018	0.0018	0.0016	0.0014	0.0016	0.0016	0.0016	0.0017	0.0016	0.0016	0.0018	0.0018
Barium	7440-39-3	mg/L	NA	NA	0.0504	0.0417	0.0439	0.0447	0.0467	0.0525	0.042	0.0421	0.0453	0.0464	0.0508	0.0422	0.0429	0.0438	0.0457	0.0534	0.043	0.0475	0.047	0.049
Beryllium*	7440-41-7	mg/L	NA	NA									0.00025 J		0.00018 J			0.00029 J	0.00032 J		0.00025 J			
Boron	7440-42-8	mg/L	NA	NA	0.0332 J	0.0333 J	0.0372 J	0.0392 J	0.0476 J	0.0368 J	0.0329 J	0.0338 J	0.0489 J	0.0522 J	0.0374 J	0.0354 J	0.0398 J	0.0396 J	0.0409 J	0.0395 J	0.0391 J	0.0398 J	0.0559 J	0.0603 J
Cadmium*	7440-43-9	mg/L	0.0042 (b)	0.00142 (b)																				
Calcium	7440-70-2	mg/L	NA	NA	44.8	44.4	44.9	45.7	45.9	45	43.4	44.4	45.8	46.2	43.8	43.9	43.6	45.4	44.8	44.4	45	44.3	47.4	48
Chromium	7440-47-3	mg/L	1.19 (c,d)	0.155 (c,d)													0.00097 J							
Cobalt	7440-48-4	mg/L	NA	NA		0.0009 J		0.00091 J		0.0013 J	0.0013 J	0.00075 J		0.0012 J	0.00082 J		0.00078 J	0.0013 J	0.00091 J				0.00094 J	
Lead	7439-92-1	mg/L	0.170 (b)	0.0066 (b)																				
Lithium	7439-93-2	mg/L	NA	NA	0.0058 J	0.0063 J	0.0054 J	0.005 J	0.0068 J	0.0041 J	0.0043 J	0.0051 J	0.0033 J	0.0037 J	0.004 J	0.0041 J	0.0041 J	0.0043 J	0.0048 J	0.0059 J	0.0052 J	0.0033 J	0.0043 J	0.0078 J
Mercury*	7439-97-6	mg/L	0.0014	0.00077																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.0015 J	0.0016 J	0.0019 J	0.002 J	0.0014 J	0.0022 J	0.0019 J	0.0014 J	0.002 J	0.0018 J	0.0027 J	0.0021 J	0.0026 J	0.0018 J	0.0023 J	0.002 J	0.0019 J	0.0016 J	0.0031 J	0.0022 J
Selenium	7782-49-2	mg/L	NA	NA																	0.0036 J			
Thallium	7440-28-0	mg/L	NA	NA	0.000059 J																0.00004 J			0.000047 J

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency.

Detected Concentration> USEPA Aquatic Life AWQC Chronic.
Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value
for Mississippi and Missouri River of 247 mg/L as CaCO3 used.

TABLE 6d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO
ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			Federal Water Quality Criteria		Missouri River					Missouri River										Missouri River				
					River Upstream					River Adjacent										River Downstream				
Constituent	CAS	Units	USEPA Aquatic Life AWQC Freshwater Acute (c)	USEPA Aquatic Life AWQC Freshwater Chronic (c)	S-MO-10S	S-MO-11D	S-MO-11S	S-MO-12D	S-MO-12S	S-MO-4S	S-MO-5D	S-MO-5S	S-MO-6D	S-MO-6S	S-MO-7S	S-MO-8D	S-MO-8S	S-MO-9D	S-MO-9S	S-MO-1S	S-MO-2D	S-MO-2S	S-MO-3D	S-MO-3S
Antimony*	7440-36-0	mg/L	NA	NA																				
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0034	0.0034	0.0032	0.0033	0.0033	0.0033	0.0034	0.0033	0.0032	0.0033	0.0032	0.0033	0.0033	0.0034	0.0032	0.0033	0.0034	0.0033	0.0032	0.0033
Barium	7440-39-3	mg/L	NA	NA	0.108	0.11	0.108	0.109	0.109	0.11	0.11	0.107	0.106	0.109	0.109	0.109	0.107	0.108	0.108	0.112	0.107	0.111	0.107	0.109
Beryllium*	7440-41-7	mg/L	NA	NA																				
Boron	7440-42-8	mg/L	NA	NA	0.115	0.12	0.116	0.118	0.118	0.119	0.12	0.114	0.115	0.116	0.117	0.118	0.117	0.118	0.116	0.12	0.115	0.122	0.115	0.119
Cadmium*	7440-43-9	mg/L	0.0042 (b)	0.00142 (b)																				
Calcium	7440-70-2	mg/L	NA	NA	59.5	60.9	59.9	60.6	60.3	60.3	61.1	59.2	59.1	60	60.8	60.7	59.8	60	59.9	61.6	59.7	60.6	59.7	59.4
Chromium	7440-47-3	mg/L	1.19 (c,d)	0.155 (c,d)																				0.00074 J
Cobalt	7440-48-4	mg/L	NA	NA																				
Lead	7439-92-1	mg/L	0.170 (b)	0.0066 (b)																				
Lithium	7439-93-2	mg/L	NA	NA	0.0422	0.0423	0.0435	0.0423	0.0417	0.0422	0.0422	0.0428	0.0412	0.0421	0.0432	0.0424	0.044	0.042	0.04	0.0441	0.0421	0.0446	0.0405	0.0437
Mercury*	7439-97-6	mg/L	0.0014	0.00077																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.0039 J	0.004 J	0.0044 J	0.0036 J	0.0038 J	0.0037 J	0.0049 J	0.0037 J	0.004 J	0.0046 J	0.0038 J	0.0038 J	0.0036 J	0.0035 J	0.0038 J	0.0046 J	0.0038 J	0.0047 J	0.0032 J	0.0037 J
Selenium	7782-49-2	mg/L	NA	NA																				
Thallium	7440-28-0	mg/L	NA	NA			0.000063 J				0.000072 J		0.000037 J							0.000048 J				0.000075 J

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency.

Detected Concentration> USEPA Aquatic Life AWQC Chronic.
Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value
for Mississippi and Missouri River of 247 mg/L as CaCO3 used.

APPENDIX B

What You Need to Know About Molybdenum

WHAT YOU NEED TO KNOW ABOUT MOLYBDENUM

Molybdenum is the one constituent that is present in at least one groundwater sample at each of the four Ameren energy centers in Missouri above the screening level used by the U.S. Environmental Protection Agency (USEPA) under the Coal Combustion Residuals (CCR) Rule. The purpose of this fact sheet is to provide information on molybdenum so that data can be considered in context. There is no public exposure to groundwater at the Ameren energy centers and concentration levels of molybdenum in adjacent surface waters are all well below health-based regulatory standards.

SOURCES OF INFORMATION ON MOLYBDENUM

Molybdenum had been evaluated by regulatory and health agencies in the U.S. As discussed below, molybdenum is an essential nutrient for humans, and the Institute of Medicine of the U.S. National Academy of Sciences (NAS) has provided recommended daily allowances and tolerable upper limits to be used as guidelines for vitamins and supplements and other exposures (NAS, 2001).

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency within the U.S. Department of Health and Human Services. The ATSDR Toxicological Profile for Molybdenum (ATSDR, 2017) provides a comprehensive summary and interpretation of available toxicological and epidemiological information on molybdenum and provides information on the naturally occurring levels in our environment and in our diet.

The U.S. Environmental Protection Agency (USEPA) published an oral toxicity value for molybdenum in 1992 (USEPA, 1992); this value serves as the basis for the tapwater screening level for molybdenum of 0.1 milligrams per liter (mg/L) or 100 micrograms per liter (ug/L) that was included in the Phase 1 Part update to the CCR Rule (USEPA, 2018a).

MOLYBDENUM IS NATURALLY OCCURRING AND AN ESSENTIAL NUTRIENT FOR PLANTS AND HUMANS

Molybdenum is a naturally occurring trace element that can be found extensively in nature. Biologically, molybdenum plays an important role as a micronutrient in plants and animals, including humans.

Molybdenum in Our Natural Environment

Molybdenum naturally accumulates in poorly drained soils and soils with high organic content (for example, peat bogs and wetlands). It is also present at high concentrations in "black shales," which are shale deposits with high organic content. The U.S. Geological Survey (USGS, 2013) reports that the average concentration in U.S. soils is approximately 1 milligram per kilogram of soil (mg/kg). USGS (2011) estimates the median concentration of molybdenum in groundwater is 0.001 milligrams per liter (mg/L), with most concentrations below 0.008 mg/L.

Molybdenum in Our Diet

Molybdenum is considered an essential nutrient or trace element for living beings. It is required in several mammalian enzyme systems and is present in most adult multi-vitamins. A deficiency syndrome has only been seen in people with a genetic defect that prevents the synthesis of a specific enzyme for which molybdenum is a cofactor. The deficiency leads to severe neurological damage and early death.

Because it is present in soils, it is also present in our diet. Food derived from above ground plants, such as legumes, leafy vegetables, and cauliflower generally has a relatively higher concentration of molybdenum in comparison to food from tubers or animals. Beans, cereal grains, leafy vegetables, legumes, liver, and milk are reported as the richest sources of molybdenum in the average diet (ATSDR, 2017). The amount of molybdenum in plants varies according to the amount in the soil. The National Academy of Sciences (NAS) has estimated that the average dietary intakes of molybdenum by adult men and women are 0.109 and 0.076 milligrams per day (mg/day), respectively. A study of the dietary intake of adult residents in Denver, Colorado reported a mean molybdenum ingestion rate of 180 µg/day (range 120–240 µg/day) (ATSDR, 2017).

Molybdenum for Health

How Much Do You Need - Daily Allowance:

The Institute of Medicine of the NAS sets dietary intake values for essential nutrients. The recommended dietary allowance (RDA) for a nutrient is “the average daily dietary nutrient intake level sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) health individuals” (NAS, 2001). The RDA for molybdenum for adults set by the NAS in 2001 is 0.045 milligram per day (mg/day) and is based on the amount of molybdenum needed to achieve a steady healthy balance in the body for the majority of the population.

How Much is Too Much - Upper Limits:

In addition to the RDA, the NAS also defines a Tolerable Upper Intake Level (UL) for essential nutrients. The UL is “the highest average daily nutrient intake level that is likely to pose no risk of adverse health effects to almost all individuals in the general population.” Thus, the RDA is a level that is considered to be sufficient for the health of the general population, while intake can be as high as the UL and pose no adverse health effects.

The UL for molybdenum set by the NAS is 2 mg/day. This level is based on an evaluation of the potential toxicity of molybdenum at high levels of intake. The most sensitive effect in the literature is associated with reproductive outcomes in rats, and the study was used to develop an oral toxicity value for humans of 0.03 milligrams of molybdenum ingested per day per kilogram of body weight (mg/kg-day). This value is used with an average adult body weight of 68-70 kg (154 lbs) to set the UL[1].

[1] The oral toxicity value identifies a level of intake in terms of milligrams of constituent per kilogram of body weight per day (mg/kg-day) that is considered to be safe for daily exposure for a lifetime. The oral toxicity value is used to calculate a safe drinking water level as follows: if the oral toxicity value is 0.03 mg/kg-day, and a 70 kg adult that consumes 2 liters of water per day, then the safe drinking water level = (0.03 mg/kg-day) x (70 kg) ÷ (2 liters water/day) = 1.05 milligrams per liter (mg/L).

USEPA'S ORAL TOXICITY VALUE FOR MOLYBDENUM

USEPA developed a lower oral toxicity value for molybdenum of 0.005 mg/kg-day (USEPA, 1992) based on a 1962 study of a small population (52 exposure subjects) in Armenia that had a high level of molybdenum in their diet. This population had high levels of uric acid and experienced gout. The findings from the Armenian study have not been replicated, and other regulatory bodies such as the NAS and ATSDR have rejected the study due to its many deficiencies. [It is likely that the observance of gout in the Armenian population had some other cause.]

The NAS concluded that there were "serious methodological difficulties with the [Armenian] study" and noted that no other studies in humans or animals have replicated this effect. The NAS toxicity value is 0.03 mg/kg-day, six-fold higher than the USEPA value. Based on the NAS toxicity value and USEPA assumptions (for body weight and drinking water intake) results in a calculated safe drinking water level of 0.6 mg/L or 600 ug/L.

ATSDR noted the study of the Armenian population was not considered suitable for derivation of a chronic-duration oral toxicity value for molybdenum due to deficiencies in the control group size and composition, and a lack of controlling for confounders, such as diet and alcohol, that could affect the results. ATSDR developed an oral toxicity value of 0.008 mg/kg-day, using the same study reproductive outcomes in rats as the NAS, but applying different assumptions, most notably a 3-fold higher uncertainty factor. Based on the ATSDR toxicity value and USEPA assumptions (for body weight and drinking water intake) results in a calculated safe drinking water level of 0.16 mg/L or 160 ug/L.

MOLYBDENUM UNDER THE CCR RULE

When the CCR Rule was published in 2015, groundwater standards were provided only for those Appendix IV constituents that have primary drinking water standards published by the USEPA under the Safe Drinking Water Act – values known as MCLs or maximum contaminant levels. Molybdenum does not have an MCL[2]. In a subsequent 2018 CCR rule-making, USEPA designated a health-based groundwater protection standard for molybdenum of 0.1 mg/L or 100 ug/L. That is the value used to evaluate groundwater at the Ameren facilities. This level is very conservative and could be much higher and still protective of human health, as described above. [Note that in its March 3, 2019 report the Environmental Integrity Project used a screening level for molybdenum of 0.04 mg/L (or 40 ug/L), which is <u>not</u> the level USEPA has required in the CCR Rule.]

However, based on the USEPA toxicity value, the drinking water levels USEPA has developed for molybdenum are:

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[2] USEPA is in the process of gathering information on the occurrence of molybdenum in public drinking water systems. The decision to develop an MCL (which is a multi-year process) is based on occurrence in public drinking water systems, the severity of adverse health effects, whether the constituent is present in public drinking water systems at levels of public health concern, and whether regulation would provide a meaningful opportunity for health risk reduction. No decision has yet been made as to whether molybdenum will be a candidate for the development of a drinking standard. Note that when USEPA included molybdenum for public water supply testing, it cited USEPA 1992, ATSDR 2017, and NAS 2001 as toxicity references. No mention was made of the differences in toxicity studies used or the values developed.

- 0.1 mg/L – The USEPA tapwater value in its Regional Screening Level (RSL) table and the value identified by USEPA for the CCR Rule (USEPA, 2018b). This is the value USEPA uses in the CCR Rule (USEPA, 2018a).
- 0.2 mg/L – The USEPA Office of Water value for the Drinking Water Equivalent Level (DWEL), which is a *lifetime exposure* concentration protective of adverse, non-cancer health effects, that assumes all of the exposure to a constituent is from drinking water (USEPA, 2018c).
- 0.04 mg/L – The USEPA Office of Water value for the Health Advisory Level (HA), which is based on the DWEL, but using a default assumption that only 20% of intake can come from water (USEPA, 2018c).

Therefore, drinking water concentrations of molybdenum up to 0.2 mg/L to are expected to be **without** adverse health effects. Based on the NAS review, daily exposure to drinking water concentrations of molybdenum up to 0.6 mg/L would be **without** adverse health effects.

WHAT THIS MEANS FOR THE AMEREN ENERGY CENTERS

This information from the NAS has been used to evaluate the levels of molybdenum in groundwater at the Ameren Energy Centers and in nearby surface waters. A total of 930 groundwater and surface water samples were collected from the four energy centers. The concentration levels in approximately 866 samples were below the screening level based on the National Academy of Science Tolerable Upper Intake Level (UL), while 241 are above the GWPS established by USEPA in the CCR Rule.

	Labadie	Meramec	Rush Island	Sioux
Groundwater				
Number of Samples	208	88	77	244
Molybdenum greater than CCR GWPS of 0.1 mg/L (a)	81	35	38	77
Molybdenum greater than NAS standard of 0.6 mg/L (b)	3	1	11	49
Surface Water				
Number of Samples	67	74	50	80
Molybdenum greater than 0.1 mg/L (a)	0	0	0	0

Notes:
mg/L - milligrams per liter.
(a) - Drinking water-based groundwater protection standard specified in the Coal Combustion Residuals Rule.
(b) - Alternative health-protective drinking water screening level based on the National Academy of Sciences review of molybdenum.

The groundwater results were collected from monitoring wells placed as close as practical to the ash basins' boundaries and provide near-source groundwater monitoring results. The groundwater downgradient of each of the Ameren ash basins is not used as a source of drinking water. Deep bedrock groundwater used as drinking water in the vicinity of Labadie and in the vicinity of Rush Island was sampled and demonstrated no impacts from CCR.

Surface water adjacent to each of the energy centers was sampled and all results for molybdenum in surface water are well below the USEPA drinking water screening level of 0.1 mg/L.

Thus, although there are some results for molybdenum in groundwater that are above the USEPA drinking water screening level, the groundwater at these facilities is not used as a source of drinking water, and molybdenum is not present in any of the adjacent water bodies above the drinking water screening level. These results confirm that molybdenum does not pose a risk to human health or the environment at any of the Ameren facilities.

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APPENDIX C

Extraction & Transportation Study

ADDENDUM

Meramec, Labadie and Sioux Ash Pond Closure: Extraction and Transportation Assessment

Lochmueller Group applied the methodology from the Extraction and Transportation Study for the Rush Island Energy Center to develop high-level estimates of the costs and timeframes associated with hypothetical CCR excavation processes at the Labadie, Sioux and Meramec Energy Centers. Specifically, the formula used to estimate daily productivity (i.e. number of trucks hauling excavated material offsite) was adapted for use at Labadie, Sioux and Meramec along with site-specific considerations.

Estimates from the Rush Island Study assumed a maximum of 192 truck loads per day over an 8-hour work day (24 per hour), with 155 to 193 days of annual operation. Once loaded, trucks would make multiple roundtrips to the closest available commercial landfill. Such estimates assume that the excavation, staging, and loading process is capable of accommodating a steady stream of trucks loading **every 2.5 minutes** and that such material can be quickly unloaded at the receiving commercial landfill without significant delay. While such productivity rates are undoubtedly optimistic, the resulting estimates nevertheless are useful in capturing the enormity of such projects and are sufficient at a planning-level.

It is important to note that the existing onsite utility waste landfills (UWLs) at Labadie and Sioux were designed and permitted to manage production needs of the energy centers through each facility's retirement date. To facilitate permanent storage, excavated CCR material would need to be transported offsite to a commercial landfill **or** Ameren Missouri would need to permit and construct new onsite landfills. Given the absence of an existing utility waste landfill at Meramec, onsite disposal options were considered for the Labadie and Sioux locations only.

Each facility presents unique challenges that are likely to impact cost estimates and closure times beyond the scope of this assessment. For example, the regulatory process for construction of an onsite landfill would require multiple levels of approval, including environmental permits, zoning or land use authorization, and potentially a certificate of issuance from the Missouri Public Service Commission. Opposition to such projects may further delay the regulatory approval process such that it would be years *before* construction could commence.[1]

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[1] Efforts to permit and construct the Labadie UWL commenced in 2008 with the completion of Preliminary Site Investigation (PSI). The landfill was placed in service in 2016 after years of opposition from environmental groups and litigation. See *Petition for Writ of Certiorari [to invalidate county landfill ordinance] Franklin County Circ. Ct., 11/23/11, Case # 11AB-C286; Appeal to Franklin County Board of Adjustment, #14-00002, Filed 1/8/14 (of Land Use Administrator 10/10/13 and 12/10/13 Decisions), Denied by BZA 6/24/14; Appealed to Circ. Ct. by Writ of Certiorari, Cause # 14AB-CC00155, 7/24/14; Intervention and Motion to Dismiss in PSC Case EA 2012-0281, Ameren Application to PSC for CCN to operate landfill (PSC overruled Motion to Dismiss on 4/17/13); Administrative Hearing Commission Petition for Review [of MDNR Solid Waste Disposal Construction Permit], Filed 1-30-15, #15-0136, dismissed by AHC 3/5/15.* See also *Campbell v. County Commission of Franklin County, 453 S.W.3d 762 (Mo. banc 2015).*

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Based on experience, it would be virtually impossible to sustain productivity at the planning level rate over extended, multi-year timeframe due to a variety of unpredictable factors. Excavation activities could be limited or precluded for several days following weather events. Other potential disruptions could include:

- loading equipment failure
- site restrictions that limit the number of excavation equipment
- traffic congestion on travel route
- truck breakdown
- staffing
- weather conditions
- commercial landfill available capacity in Illinois and Missouri
- landfill unloading equipment failure

In addition, site specific conditions can impact productivity. For example, an elementary school is located along Fine Road between the Meramec Energy Center and Telegraph Road. To accommodate local safety concerns, the hauling company would likely limit trips during the beginning and end of the school day, thereby limiting effective hauling hours to 5-6 per day during the school year.

Route 94 east of the Sioux Energy Center travels beneath multiple narrow, low-clearance railroad overpasses in the West Alton area. An entirely new roadway by-passing West Alton would avoid the railroad entirely, but would require regulatory approvals, land acquisition, and potentially eminent domain. Assumptions were adjusted to account for these impacts, but it is not possible to foresee every challenge and quantify every impact likely to surface.

Scenarios:

The following summarizes the assessment of five scenarios for CCR removal for the Meramec, Labadie and the Sioux Energy Centers. The assessment utilized the same methodology, assumptions, and unit costing information as for Rush Island. The volume of ash, hauling distances, and the anticipated infrastructure upgrades were adjusted for each site.

For each scenario, the total volume of excavated ash, total cost of removal, and closure duration are summarized. The reported volume of ash incorporates a swell factor. The closure duration is measured from the time the decision is made to close the ponds (i.e. removal from service) until such time that the CCR material is fully removed. It was assumed that 5 years of preparation time would be needed in advance of starting an offsite removal operation, whereas an onsite removal operation would require 10 years of preparation time to account for the regulatory process to secure approvals for construction of new onsite landfills.

The five scenarios are as follows:

1. Labadie Bottom Ash and Fly Ash Pond CCR Removal to an Offsite Landfill
2. Labadie Bottom Ash and Fly Ash Pond CCR Removal to an Onsite Landfill

3. Sioux Bottom Ash and Fly Ash Pond CCR Removal to an Offsite Landfill
4. Sioux Bottom Ash and Fly Ash Pond CCR Removal to an Onsite Landfill
5. Meramec Bottom Ash and Fly Ash Pond CCR Removal to an Offsite Landfill

Scenario 1: Offsite CCR Removal for Labadie

This scenario assumes offsite removal for the Labadie ash pond sites and includes the following:

- Pre-CCR removal preparation (5 years, included on a prorated basis in the Closure Duration for each pond);
- Stabilization, loading, and pond restoration;
- Seasonal impacts from wet and winter weather conditions impeding productivity;
- Hauling to an offsite landfill in Missouri;
- Landfill placement; and
- Loading and transportation infrastructure.

Labadie Energy Center	Estimated Ash Volume (CY) [2]	Estimated Total Removal Cost	Closure Duration (Years)
	17,325,126	$2,440 M – $2,930 M	35 plus years

Scenario 2: Onsite CCR Removal for Labadie

This scenario assumes onsite disposal the Labadie ash pond sites and includes the following:

- Pre-CCR removal preparation (10 years, included on a prorated basis in the Closure Duration for each pond);
- Stabilization, loading, and pond restoration;
- Hauling to an onsite landfill located near the existing ponds;
- Seasonal impacts from wet and winter weather conditions impeding productivity;
- Landfill placement; and
- Loading infrastructure.

Labadie Energy Center	Estimated Ash Volume (CY)	Estimated Total Removal Cost	Closure Duration (Years)
	17,325,126	$1,270 M - $1,520 M	40 plus years

[2]Estimated volumes do not include any dry amendment materials.

Scenario 3: Offsite CCR Removal for Sioux

This scenario assumes offsite removal for the Sioux ash pond sites and includes the following:

- Pre-CCR removal preparation (5 years, included on a prorated basis in the Closure Duration for each pond);
- Stabilization, loading, and pond restoration;
- Hauling to an offsite landfill in Illinois[3];
- Seasonal impacts from wet and winter weather conditions impeding productivity;
- Landfill placement; and
- Loading and transportation infrastructure.

Sioux Energy Center	Estimated Ash Volume (CY)	Estimated Total Removal Cost	Closure Duration (Years)
	6,079,808	$890 M - $1,060 M	15 plus years

Scenario 4: Onsite CCR Removal for Sioux

This scenario assumes onsite disposal the Sioux ash pond sites and includes the following:

- Pre-CCR removal preparation (10 years, included on a prorated basis in the Closure Duration for each pond);
- Stabilization, loading, and pond restoration;
- Hauling to an onsite landfill located near the existing ponds;
- Seasonal impacts from wet and winter weather conditions impeding productivity;
- Landfill placement; and
- Loading infrastructure.

Sioux Energy Center	Estimated Ash Volume (CY)	Estimated Total Removal Cost	Closure Duration (Years)
	6,079,808	$470 M - $570 M	20 plus years

Scenario 5: Onsite CCR Removal for Meramec

This scenario assumes offsite removal for the Meramec ash pond sites and includes the following:

- Pre-CCR removal preparation (5 years, included on a prorated basis in the Closure Duration for each pond);

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[3] Lochmueller did not review local siting requirements but many Illinois counties contain such restrictions.

- Stabilization, loading, and pond restoration;
- Hauling to an offsite landfill in Illinois;
- Seasonal impacts from wet and winter weather conditions impeding productivity;
- Site specific constraints with transportation access and associated limitations;
- Landfill placement; and
- Loading and transportation infrastructure.

Meramec Energy Center	**Estimated Ash Volume (CY)**	**Estimated Total Removal Cost**	**Closure Duration (Years)**
	5,194,923	**$740 M - $890 M**	**20 plus years**

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EXTRACTION & TRANSPORTATION STUDY: Rush Island Ash Pond Closure Assessment

Rush Island Site

Jefferson County, Missouri

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Introduction

Lochmueller Group completed the following planning-level assessment of the costs and logistics associated with extracting, stabilizing, and transporting coal combustion residuals (CCR) from the existing ash pond system at the Rush Island Power Generation Center to existing offsite, commercially available landfill facilities. The Rush Island site is located along the Mississippi River in Jefferson County, Missouri approximately nine (9) miles southeast of Festus, Missouri. The purpose of this assessment is to describe the methods, determine the impacts, and quantify the order-of-magnitude costs associated with removing and transporting all CCR from its current disposal location at the Rush Island site to a private landfill for permanent storage.

Extraction & Stabilization

Description of Method

Extraction and stabilization of the CCR material from the CCR unit at Rush Island Energy Center is complicated due to its depth and location. In addition, the CCR unit contains both Class C and F fly ash that complicates excavation methods. CCR material from the unit would need to be excavated at depths of up to 100 feet, dewatered, dried and conditioned, before being and loaded into trucks and transported offsite.

Removal of the CCR material would require multiple phases including dry extraction, partially wet extraction and fully submerged extraction. The various phases are described below:

Dry Extraction:

This phase includes the handling and removal of the existing CCR material from the current surface elevation down to the groundwater elevation (approximately 18' below the ground surface (BGS) elevation) (Geotechnical Investigation and Report, prepared by CEC and dated December 20, 2011). Generally, it is assumed that this material can be direct loaded and transported without additional drying or conditioning procedures (moisture content between approximately 25% and 35%). The work associated with this phase includes the extraction, on-site transportation to Staging/Loading Areas, storage, and loading onto transportation for off-site removal. Standard earth-moving equipment and procedures would be utilized including dozers, loaders, and excavators. In general, dozers would be used to excavate and move the CCR material into piles and loaders would be used to load the CCR material into the waiting trucks for transport off-site. Excavators would be used in a support role to dig in areas where dozers are not efficient. Sub-areas of the pond area would need to be established to facilitate extraction operations. The general size of these sub-areas, laterally and vertically, will be determined based on on-site conditions as the operation progresses and the CCR material is removed.

Partially Wet Extraction:

This phase includes the handling and removal of the existing CCR material from the groundwater elevation to a point in which hydraulic excavation is feasible (18' below ground surface to 28' below ground surface). This material is assumed to be in acceptable condition for loading and transportation with no additional drying and conditioning after the dewatering procedure described below is completed.

Dewatering of this material would involve excavation of channels to promote material drying prior to excavation and transportation. Water would be diverted from excavated depressions utilizing pumps and piping systems to transport the water away from the material excavation area. After sufficient dewatering and drying time, the CCR materials would be removed using the same means as described for dry excavation.

Fully Submerged Extraction:

CCR materials located further down in the pond (28' below ground surface to 100' below ground surface) may be saturated and would require drying and conditioning prior to off-site transport. Such materials would need to be extracted via hydraulic dredging methods. The complexities and potential costs associated with such dredging efforts are significantly higher per unit volume than the "Dry Extraction" and "Partially Wet Extraction" phases. In fact, successful pond closures at the depths required for the Rush Island site could were not discovered. Removal operations for CCR ponds with depths up to 50 feet were found.

This method employs equipment that removes the CCR material directly from the bottom of the CCR unit and pumps the “slurry” through a piping system to “geotubes” located in nearby drying areas. Geotubes are a geotextile filtration “bag” manufactured by sewing together multiple sheets of geotextiles using polyester or polypropylene. As the dredged water enters the geotubes, the geotextile captures the CCR materials as the water drains. Chemical addition during the pumping and piping operation using coagulants and flocculants will be necessary to aid in the dewatering process. The specific makeup of CCR materials are site specific. Therefore, selection of the most effective and efficient coagulants and flocculants will require bench testing. Maintenance of the dredging equipment, piping system, drying areas, settling ponds, and temporary roads will be necessary to facilitate the operation.

Significantly large drying areas will be required to accommodate the multi-week week drying procedure. After dewatering is complete, the geotubes are opened and the CCR material is loaded onto transportation for off-site removal. The transportation of material for off-site removal was the assumed limiting factor for the overall CCR disposal process flow based on the analysis performed in this study. However, extended, unforeseen weather conditions can contribute to additional lost working time due to icy conditions, mechanical system freeze-ups, or flooding.

Site Restoration:

This phase includes the final restoration of the site. This would include removal of all temporary access roads and residual ash in project area. Backfilling would likely need to occur for at least some volume of the remaining pond in conjunction with excavation activities to minimize infiltration from the Mississippi River. The closest source of backfill material would be sand dredged from the Mississippi River. Stabilization of the site with vegetative practices would be required for erosion control. The river banks and the remaining embankment along the river would require additional analysis and appropriate stabilization, but may include a combination of vegetation, large rocks or manufactured concrete products.

Extraction and Stabilization Impacts

Safety

Accidents

Workforce safety during the operation is a significant risk factor. With several unit processes operating with heavy machinery, proper safety planning is important. Accidents can be minimized during operations, but the planning and implementation of a safety plan will have significant costs associated with the effort.

Exposure

There is not only immediate physical injury risks, but there is also exposure risk to the people working on the site. Proper safety equipment will be necessary to limit exposure to potentially harmful substances in the CCR material removal process such as flocculants and coagulant used for the dewatering process.

Environment

Floodplain

The project area is currently shown within the 100 year floodplain for both the current and pending FIRM maps. The potential for the area to experience flooding during excavation activities creates additional risk to the extraction and stabilization operations.

River Embankment

The existing ash ponds are adjacent to the Mississippi River. There is a strip of land that separates these surface water bodies and serves and an embankment that separates the pond from the river. Proper excavation techniques and monitoring will need to be employed to ensure the land between the two surface water bodies remains stable during excavation and dredging activities. After dredging activities are complete, the embankment will require analysis to confirm stability. Removal of the embankment and/or significant re-stabilization may be necessary for the restoration of the site.

Emissions

The heavy equipment used during the extraction and stabilization phase of the project includes dozers, loaders, excavators, hydraulic dredges, and onsite hauling trucks. These types of equipment typically utilize diesel fuel and would generate emissions during operations. These emissions are in addition to the emissions discussed in the transportation impacts section of this assessment.

Fugitive Ash Particulate

As the CCR material is being extracted and stabilized, fugitive ash particulate will be created and would need to be managed through an ash management plan.

Capital Projects

Onsite Access Roads

The onsite access road utilized for the offsite hauling trucks is discussed in the transportation section of this assessment. The construction of temporary on-site hauling roads will be required throughout the extraction and stabilization process. These haul roads will need to be modified frequently in order to provide efficient transportation of the CCR to the stabilization and loading areas and to maintain dust control.

Geotube Staging Areas

Geotube staging areas will need to be constructed within the project area that are relatively flat to allow for proper dewatering of the CCR. These staging areas will be temporary and will need to be moved throughout the closure process as CCR is removed during different phases of the operation. Filtrate from the geotubes would be directed back to the settling ponds for treatment.

Water Treatment Facilities

The existing ponds could be utilized throughout the CCR removal process for settling any remaining solids from the filtrate from the drying process. There may be a need for the construction of new settling ponds toward the end of the process to fully remove CCR from the existing ponds. The filtrate will likely contain suspended solids and some form of treatment or settling may need to be evaluated depending on the final characteristics of the filtrate.

Loading Areas

Once the CCR is stabilized, the material may require some additional layout and loading area to ensure the material is dry enough for offsite hauling and ultimate placement in a landfill. The loading areas will need to be constructed as appropriate for the CCR removal areas that are active. The loading areas will require the construction of scales for measuring the weight of trucks and truck washing facilities to wash down tires of residual ash material.

Restoration of Former Ash Ponds

The post-CCR-removal condition of the ponds will be dependent on the final planned use of the area. Some options may include backfilling, removing embankment, creating or restoring habitat, etc. Achieving the desired future use may include utilizing the soil material that would remain between the pond and the river to backfill some of the remaining pond area. Sand backfill material could also be dredged from the Mississippi river for additional backfill material. Overall stabilization of the site would be required and would include vegetative, natural rock, and manufactured products to meet regulatory requirements.

Transportation & Disposal

This section addresses the transportation of CCR material from the site and its permanent disposal at a private landfill.

Modal Options (Truck, Rail, Barge)

The Rush Island site is located along the Mississippi River. Additionally, a BNSF rail line runs adjacent to the site. Therefore, the ability to haul CCR by barge and rail from Rush Island may be possible. However, significant infrastructure improvements would be required at the Rush Island site to provide ash loading capabilities for these modes.

The preferred landfill locations are all located within 80 miles of Rush Island. None of the sites have direct water access. Therefore, any CCR transported by barge from Rush Island would need to be transferred from barge to truck to reach the landfill destinations. The inefficiency of this transfer would render barge transportation considerably more costly than truck hauling. Moreover, most of the landfill sites are located further inland (east or west) from Rush Island such that north-south travel along the Mississippi River would not be beneficial.

With regards to rail, none of the preferred landfill sites have direct rail access. Several sites are located adjacent to rail corridors but spurs would need to be constructed to facilitate direct landfill access and allow for the temporary storage and unloading of rail cars. Additionally, three of the four preferred landfill sites are located in Illinois, which would require trains to travel through the congested St. Louis rail network to cross the Mississippi River. Rail is most efficient when transporting bulk materials over long distances. Given the relatively short travel distance to each landfill site, rail would not be cost-competitive with truck hauling.

This assessment assumed truck hauling to be the most cost-effective and feasible mode of transport. All subsequent analyses reflect truck hauling.

Truck Hauling

To determine a timeframe for extraction and removal of all CCR from its current, impounded location, the following was assumed:

- Truck hauling via 40-foot end load dump trucks loaded via conventional equipment – each trailer has a payload capacity of 25 tons based on a typical 80,000 lb. gross loaded maximum;
- 8-hour daily operation and a range of 155 to 193 days of annual operation (accounting for weekends, holidays, and time lost due to weather and imperfect execution);
- Loading operations on the Rush Island site occur adjacent to the impoundment and on the south portion of the site; and
- A maximum daily haul rate of 5,000 tons.

The resulting transportation haul assumptions are summarized in **Table 1**.

Table 1: Transportation Haul Summary

Total Tons of CCR Removed	Annual Tons of CCR Removed	Closure Duration*
21.6 million	742,772 to 928,465	28-34 Years

*Measured from the decision to begin extraction until fully removed

To accommodate the volume of truck traffic identified in **Table 1**, roadways internal to the Rush Island site would need to be improved. Specifically, a heavy-duty concrete roadway would need to be constructed along the western perimeter of the site extending from Big Hollow Road south to the ash pond area. Multiple at-grade railroad crossings with the site's rail spur would be required.

In the vicinity of the pond area, staging would need to be provided to accommodate several trucks in queue for multiple loading stations. Hence, a large loading station would need to be constructed. Once loaded, trucks would need to proceed to a washout area and scaled to verify the truck is loaded properly. A quick route back to the loading pad from the scale area would be needed for any overweight trucks.

Landfill Options

Four preferred landfills were identified as potential destinations for the CCR removed from the Rush Island site as shown in **Table 2**. Landfill disposal costs supplied by Ameren are similar across the four locations. With costs paid to the landfill being essentially equal, transportation costs would drive the landfill location decision. Assumed haul rates per ton to each landfill location were also supplied by Ameren. The lowest cost haul rate would be to the Progressive Waste site in Richwoods, which is also significantly closer to Rush Island than the other sites. Therefore, this assessment prioritized CCR disposal at the Progressive Waste landfill.

Table 2: Preferred Landfill Locations

Landfill Site	Address	Distance to Site (mi)	Travel Time to Site (min)
Progressive Waste	12581 State Hwy H, Richwoods, MO	34.7	44
Republic Services	4601 Cahokia Road, Roxana, IL	67.3	67
Waste Management	10400 Hillstown Road, Marissa, IL	73.4	82
Perry Ridge	6305 Sacred Heart Road, DuQuoin, IL	79.8	97

Capacity calculations were performed to determine the total space available for CCR disposal in aggregate. The annual disposal amount currently received by the landfill was assumed to remain constant over time and the incremental annual disposal amount due to the Rush Island CCR was added. Based on the capacity of the Progressive Waste site, at the combined disposal volume, it was estimated that the Progressive Waste landfill would become full upon receiving approximately 80 percent of the total CCR from Rush Island.

It was also assumed that the Progressive Waste site could feasibly accept the maximum daily load of trucks (192) and that Progressive Waste would be willing to receive the maximum amount of CCR possible and dedicate the necessary space on site for monofill construction to isolate the CCR material from other waste on site.

Given these assumptions, the calculations indicate that a second landfill site with available capacity would need to receive the final 20 percent of Rush Island CCR material once Progressive Waste reaches capacity. However, for purposes of the subsequent routing and transportation evaluations, it was assumed that the entire Rush Island CCR volume would be disposed at Progressive Waste.

Transportation Route

Many factors were considered when establishing a preferred route suitable for the removal of the CCR from the Rush Island site to the Progressive Waste landfill, including roadway functional classification and the available connectivity between the two sites using the existing roadway network. The selected route is approximately 36.5 miles long and utilizes the following roadways:

- Begin at the Rush Island site on Big Hollow Road
- Johnson Road west
- Danby Road west
- Highway 61 south
- Highway TT west
- Interstate 55 north
- Highway 67 south
- MO-110 west
- MO-21 south
- Highway H west
- End off Highway H at Progressive Waste

This route prioritizes roadways with the highest functional classifications along a reasonably direct line of travel. While a shorter route may be possible, it would rely upon roadways less suitable for truck traffic and therefore was not considered. The selected route emphasizes major numbered state routes, with the exception of leaving the Rush Island site (via Big Hollow Road, Johnson Road, and Danby Road) and accessing Progressive Waste (via Highway H).

The egress route from the Rush Island site utilizes Johnson Road and Danby Road instead of remaining on Big Hollow Road to Drury Road. Johnson Road/Danby Road is the designated route for truck traffic in and out of the Rush Island site. This route also promotes use of the half diamond interchange on Interstate 55 at Route TT, which was constructed approximately 10 years ago for purposes of serving truck traffic to/from the nearby Holcim Cement Plant.

Transportation Impacts

The following transportation impacts would be anticipated as a result of the hauling operation.

Traffic Flow

The selected route between Rush Island and Progressive Waste was evaluated in terms of its ability to accommodate the additional truck traffic, including both loaded and unloaded trucks. Overall, the truck volume distributed over the course of the day would not be expected to generate significant traffic flow impacts. The route emphasizes major roadways, which would be capable of handling the additional traffic. In fact, no improvements were assumed for Interstate 55 or Highway 67.

That said, the following transportation improvements would be recommended to mitigate anticipated impacts of the additional truck traffic at select locations:

- Big Hollow Road, Johnson Road, and Danby Road, which connect the Rush Island site with Highway 61, are not suitable for the volume of truck traffic anticipated. These roadways typically have 11-foot lanes and no shoulders. The horizontal and vertical geometry is substandard in places. The existing asphalt pavement would not likely withstand the effects of heavy truck traffic. It is recommended that this corridor be upgraded to provide an appropriate truck route between Rush Island and Highway 61. The assumed improvements consist of heavy-duty concrete pavement and alignment corrections along the existing roadway.

- The intersection of Danby Road with Highway 61 should be improved to include a dedicated northbound right-turn lane on Highway 61 and enlarged right-turn radius. This turn lane would serve trucks en route to Rush Island from Interstate 55. This intersection would be expected to remain unsignalized.

- The intersection of Route TT with Highway 61 should be improved to include a dedicated southbound right-turn lane on Highway 61 and enlarged right-turn radius. This turn lane would serve trucks en route to Progressive Waste. This intersection would be expected to remain unsignalized.

- The intersection of Highway 21 and Highway 110 was recently realigned and upgraded to current standards, so it should be well-equipped to serve truck turning maneuvers. However, the intersection remains unsignalized. Installation of a signal would be recommended in order to safely and efficiently serve trucks turning from westbound Highway 110 to southbound Highway 21 en route to Progressive Waste.

- The intersection of Highway 21 with Route H is signalized and currently includes a dedicated southbound right-turn lane and dedicated eastbound left-turn lane to serve truck turning movements along the selected route. It is recommended that the eastbound left-turn lane be extended to provide additional storage capacity. The existing turn lane is approximately 75 feet in length, which would accommodate only a single truck and possibly one additional vehicle.

- Route H is a low-volume and narrow two-lane highway with lane widths of approximately 10 feet, low shoulders, and substandard alignment in select areas. While upgrades to this corridor would be beneficial, given the length of the route, significant upgrades for purposes of the hauling operation would likely be deemed cost prohibitive.

Safety & Environment

The safety implications of the truck hauling operation were evaluated using information provided in the Highway Safety Manual (HSM), published by the American Association of State Highway and Transportation Officials (AASHTO). The HSM relates traffic volumes and roadway character to crash expectancy. Changes in volumes would then cause an increase or decrease in the crash expectancy. It is anticipated that the additional truck traffic would result in an increase of 6 crashes total on an annual basis along the entirety of the haul route, as follows:

- Net increase of 2 Severe (Fatal or Injury) Crashes per year
- Net increase of 4 PDO (Property Damage Only) Cashes per year

Additional environmental costs would also be incurred as a result of the hauling operation.[1] In total, transportation safety and environmental costs are estimated to be approximately $490 million to $611 million over the duration of the hauling operation. These costs would not be borne directly by Ameren but instead would be incurred by the general population.

Pavement

The additional truck volume would depreciate the pavement design life and accelerate pavement deterioration along the selected route. To compensate for the increased wear, pavement mill and overlay were assumed at 5-year increments along all segments of the route, with the exception of Interstate 55 (which as an interstate should be build to withstand truck traffic) and the upgraded access route to the Rush Island site (which would be reconstructed with heavy duty concrete).

[1] According to the Environmental Protection Agency’s (EPA) publication on National Average In-Use Emissions from Heavy-Duty Trucks, semi-tractor trailer rigs are responsible for emitting 12.5 grams of pollutants per mile into the air. The economic cost attributable to truck emissions using EPA's methodology was estimated to be $434M. This accounts for increased healthcare costs, lost productivity, welfare costs, environmental remediation, etc.

Conclusion

Lochmueller Group completed the preceding planning-level assessment of the methods and impacts associated with extracting, stabilizing, and transporting CCR from the existing Rush Island Power Generation Center. The purpose of this assessment was to determine the impacts and quantify the order-of-magnitude costs associate with completely removing all CCR from the Rush Island site and transporting it to a private landfill for permanent storage. The information contained herein is provided at a planning-level.

This study assumed that 12,725,000 cubic yards of coal combustion residuals would ultimately need to be removed from the Rush Island site. This would equate to approximately 21,650,000 tons of material to transport. This transport weight was calculated by multiplying the in place cubic yards by a swell factor to account for the uncompacted volume after excavation. The weight of the uncompacted unit volume was established from geotechnical testing data that provided the pounds per cubic foot and the percent moisture content. Based on a range of operating days per calendar year, it would take from 28 to 34 years to extract all material from the site.

Restoration of the site would include backfilling and stabilization with vegetative and structural practices. Restoration costs could be significant in that the resulting 70 – 100 foot depression may need to be backfilled via a dredging operation within the Mississippi River.

The total cost to extract, stabilize, transport, and dispose of the CCR material is summarized below in 2019 dollars. The total cost to Ameren could range from $1.9 to $2.1 Billion, depending upon the total period of removal operations. This includes transportation infrastructure upgrades both internal and external to the Rush Island site as discussed.

Extraction of CCR and Transport to Offsite Landfill	
Ameren Project Costs	
Extraction, Stabilization, Loading, and Restoration	$773-891 Million
Hauling	$372-375 Million
Landfill Placement Costs	$691-757 Million
Transportation Infrastructure (on and off-site)	$66-77 Million
Project Cost Total	**$1.9-$2.1 Billion**

Costs in 2019 Dollars