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CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS 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) to evaluate five regulated Coal Combustion Residual (CCR) surface impoundments (CCR Units) located at the Ameren Meramec Energy Center (MEC) located in St. Louis 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 associated with the CCR Units. 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 CCR 23 parameters evaluated, only three constituents of concern (COC), arsenic, lithium and molybdenum, exceeded the Groundwater Protection Standards (GWPS) established for the MEC in a very limited number of wells and to a limited extent. More specifically, arsenic excursions occur in only two wells; lithium in only one well and molybdenum in only three wells. As described in **Section 3.3.1**, 95% of Appendix IV parameters tested complied with CCR Rule requirements.

Ameren completed a detailed environmental evaluation of the regulated surface impoundments and surrounding area, including voluntary, supplemental surface water sampling. In 2018, risk evaluations were 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 evaluations 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 MEC.

In performing this CMA, Haley & Aldrich considered the following: presence and distribution of arsenic, lithium and molybdenum, site configuration, hydrogeologic setting, and the results of the detailed risk evaluation. CCR is managed in impoundments that extend to a depth of approximately 30 feet (ft) below ground surface (bgs). Groundwater within the Meramec and Mississippi River valley alluvium ranges in thickness from not present (zero thickness) at the aquifer pinch-out along the bedrock bluff to the northeast of the MEC, up to greater than 95 ft thick where the bedrock surface has been eroded by the Meramec and Mississippi Rivers. Although groundwater flow direction is influenced by elevation changes of surface water in the Mississippi and Meramec Rivers, groundwater generally/predominantly flows to the southwest, flowing from the bluffs toward the rivers.

To provide a comprehensive CMA, this effort included four CCR Unit closure and groundwater remediation alternatives, including:

- Alternative 1: Closure in place (CIP) with low permeability capping and monitored natural attenuation (MNA);
- Alternative 2: CIP with low permeability capping and in-situ groundwater treatment;
- Alternative 3: CIP with low permeability capping, hydraulic containment (HC) of groundwater, and ex-situ groundwater treatment; and

- Alternative 4: Closure by removal (CBR) with MNA.

These four 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 CCR Units 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. The CCR Units are situated **above** the groundwater table during normal river conditions which could account for such limited groundwater impacts notwithstanding the MEC's 65 years of operation.

- **No Risk:** Risk assessment evaluations confirm that the CCR Units, even prior to closure, present **no unacceptable risk** to human health or the environment. In fact, concentration levels of arsenic, lithium and molybdenum would need to be **more than 600, more than 24,000 and more than 13,000 times higher**, respectively, 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:** Post-closure, and based on the outcome of geochemical attenuation modeling, concentration levels for lithium and molybdenum are predicted to reduce below GWPS within five years following in situ treatment (See **Figures 4-2, 4-3 and 4-4),** with arsenic reduction modeled to occur in 11 years. Ameren has retained XDD Environmental (XDD) to evaluate and develop in-situ groundwater treatment methods to address arsenic, lithium and molybdenum.

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

- **Groundwater Treatment:** Laboratory testing performed by XDD indicates that through modifications to groundwater pH, arsenic concentrations can decrease to below action levels earlier than the modeled estimates. Bench-scale testing and in-situ treatment evaluations are ongoing and will be completed this summer.

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 CCR Units does not exceed the 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
Burns & McDonnell	Burns & McDonnell Engineering Company, Inc.
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
ft	Feet
Golder	Golder Associates Inc.
GMP	Groundwater Monitoring Plan
GWPS	Groundwater Protection Standards
Haley & Aldrich	Haley & Aldrich, Inc.
HC	Hydraulic Containment
Lochmueller	Lochmueller Group
MM CY	Million Cubic Yards
MEC	Meramec Energy Center
MSD	Metropolitan Sewer District
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
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 impoundments (CCR Units) located at the Ameren Missouri (Ameren) Meramec Energy Center (MEC) located in St. Louis County, Missouri. Ameren has conducted detailed geologic and hydrogeologic investigations under 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 closure and groundwater corrective action.

This CMA includes a summary of the results of groundwater and site investigations at the MEC. Groundwater impacted by the surface impoundments exceeds statistically-derived GWPS for only three constituents: arsenic, lithium and molybdenum at only five monitoring locations. Of these parameters, USEPA has developed drinking water standards only for arsenic. This report evaluates potential corrective measures to address these limited exceedances of the GWPS.

1.1 FACILITY DESCRIPTION/BACKGROUND

The MEC was constructed in the 1950's in a then- rural area of St Louis County on approximately 480-acres (**Figure 1-1)**. A Metropolitan Sewer District (MSD) treatment plant is located to the immediate north of the facility and residential homes are located in the bluffs area above the MEC. Multiple impoundments are located on the property. In 2018, Ameren proactively closed 36 acres located adjacent to the Meramec River[1] with additional closures scheduled for 2021 and in 2023 following retirement of the facility. Site features are shown on **Figure 1-2**.

Meramec Energy Center

Over the past 17 years, Ameren has been able to beneficially use approximately 79% of the fly ash and 26% of the bottom ash produced by the MEC with the remaining CCR managed in the active on-site surface impoundments. The estimated volume of CCR within the CCR Units and exempt units is estimated at approximately 5.2 million cubic yards (MM CY).

1.2 SITE CHARACTERIZATION WORK SUMMARY

Hydrogeologic Assessments were completed in 1988 by Woodward-Clyde Consultants and CH2MHill in 1997. Golder Associates Inc. (Golder) completed subsurface investigations pursuant to the CCR Rule.

[1] The cover system installed by Ameren complied with the performance requirements set forth in 40 CFR part §257.102(3)

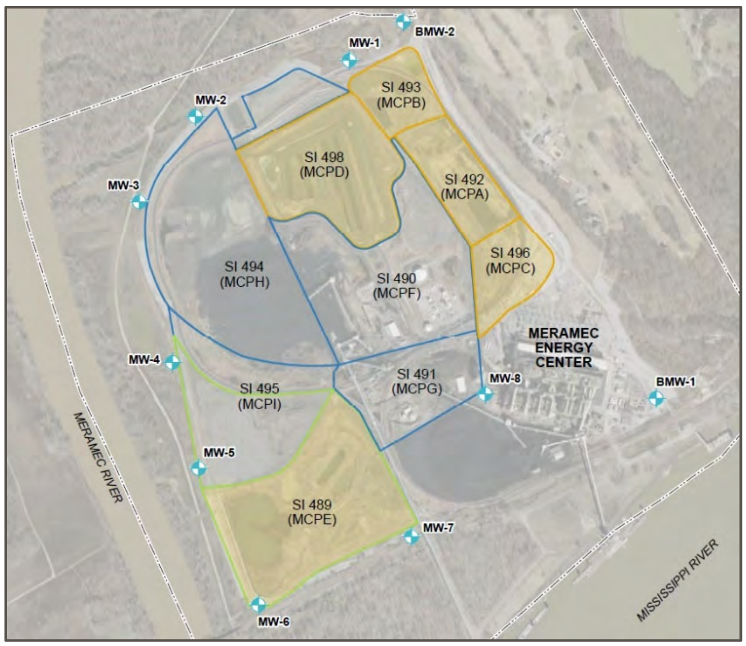
Ameren also voluntarily conducted surface water sampling. All these activities delineated the site-specific geology and hydrogeology to support the development of a hydrogeologic Conceptual Site Model (CSM). The investigation activities at the MEC included:

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

Findings from these extensive and updated series of geologic, hydrogeologic and surface water investigations have produced a robust CSM that supports the CMA activities discussed in this report.

1.3 GROUNDWATER MONITORING

One groundwater monitoring system encompasses all MEC impoundments and is used to monitor facility groundwater. 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 associated with a CCR unit. 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 January and April 2016 and includes two background wells (BMW-1 and BMW-2) and eight downgradient monitoring wells (MW-1 through MW-8) located around the perimeter of the various impoundments. The monitoring wells are screened in the alluvial aquifer below the base elevation of the CCR Units.

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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 CCR Units were 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	**Appendix IV**
Boron	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 OF 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[2];

(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.

[2] 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

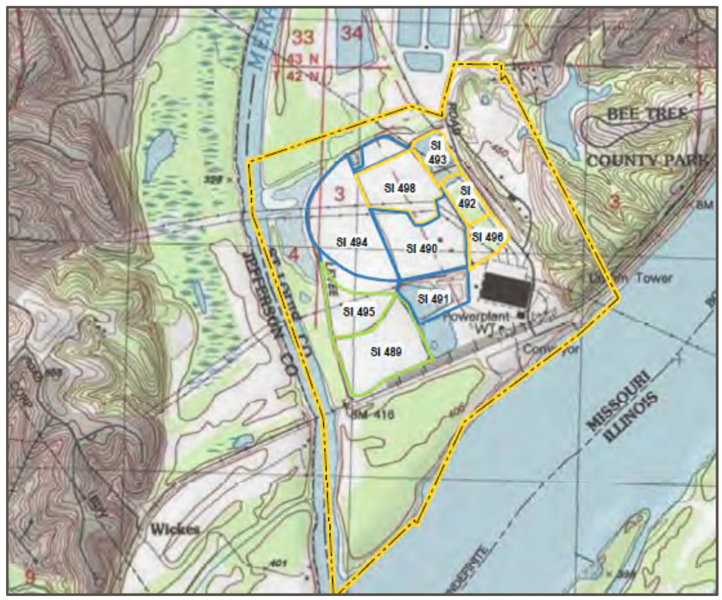
To evaluate the magnitude of risk reduction, the degree of existing risk must first be identified. Prior risk evaluations and data collected are summarized below.

2.1 SITE SETTING

The MEC Site is at the southernmost point in St. Louis County, Missouri approximately 18 miles southwest of downtown St. Louis. The area around the facility is fully developed and public drinking water is provided by American Water of Missouri. There are no users of groundwater at or near the MEC site.

2.2 SITE TOPOGRAPHY

The MEC is in a topographically low area in a valley at the confluence of the Meramec and Mississippi Rivers. Ground surface elevation around the surface impoundments ranges between 395 ft to 421 ft above mean sea level (AMSL). The existing Site grade is as much as 20 ft above the original ground surface. Topographically higher terrain is located west of the Meramec River Valley. The terrain to the east of the Site consists of topographically higher terrain, at elevations generally ranging from 450 AMSL ft to as high as 550 ft AMSL.



Topographic Map

2.3 GEOLOGY AND HYDROGEOLOGY

The geology immediately surrounding the MEC is composed of two distinctly different geological terrains; (1) floodplain deposits of the Mississippi and Meramec River Valleys and (2) older sedimentary bedrock formations. Most of the MEC, including all the plant infrastructure and the CCR Units lie within these floodplain deposits. The river valley area is comprised of floodplain and alluvial deposits that are the result of the water flow and deposition of the Mississippi and Meramec River[3].

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[3] 40 CFR Part 257, Groundwater Monitoring Plan Meramec Energy Center, St. Louis County, Missouri (Golder 2017)

Geologic Cross Section (West to East)

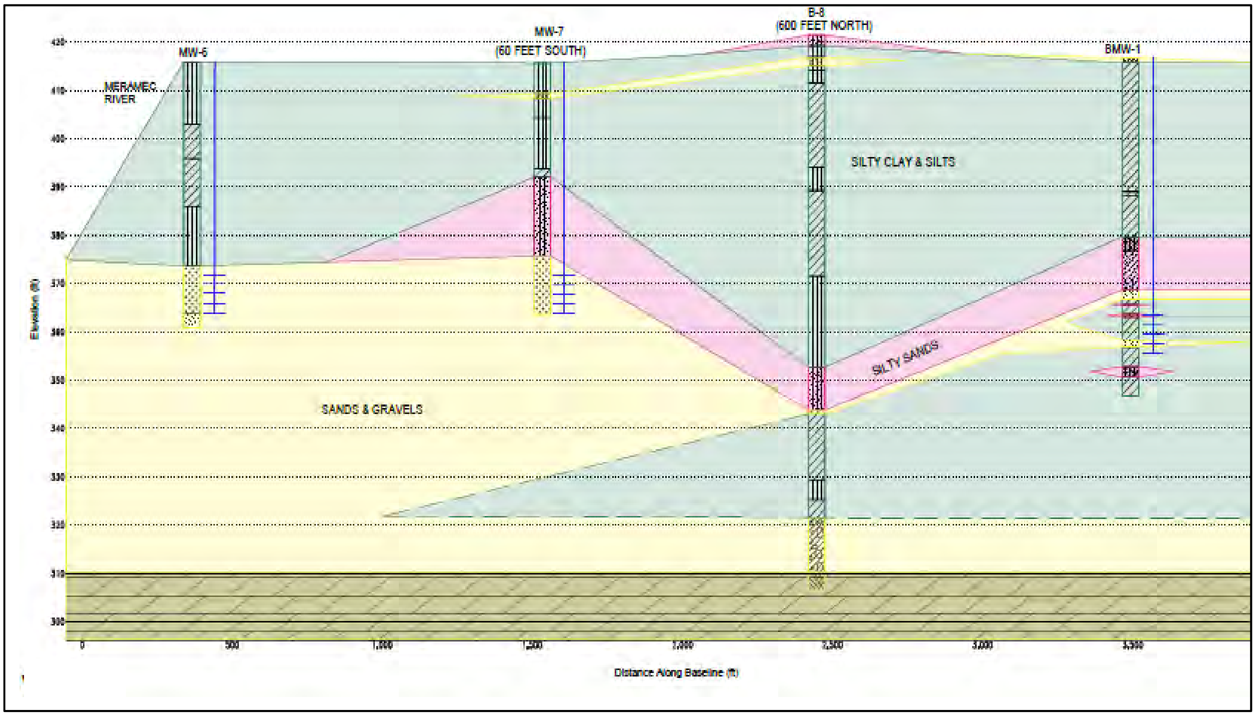

Image from Figure A-3, 2017 Groundwater Monitoring Plan (Golder 2017)

As shown in the geologic cross-section the alluvial materials on the east side of the MEC tend to have more silty clays and fine sands. Alluvial materials to the west, closer to the Meramec River, include coarser materials, including fine-to medium-grained sand with clay, silt, and some gravels[4].

The uppermost aquifer is the alluvial silt, sand and gravel deposits associated with the Meramec and Mississippi River Valley alluvium. These channel deposits are intermixed with a wide variety of clay/silty clay floodplain deposits and, therefore, can appear at varying depths. However, sandy/gravelly units were encountered at many locations at approximately 360-370 ft AMSL, likely deposited from a historic meander of the Meramec River. These alluvial deposits overlie Mississippian-age limestone and shale of the Meramecian Series. The alluvial aquifer varies in thickness from 0 ft thick at the aquifer pinch-out along the bedrock bluff to the northeast of the MEC, up to greater than 95 ft thick where the bedrock surface has been eroded by the Meramec and Mississippi Rivers.

Groundwater flow direction and levels within the alluvial aquifer is dynamic and influenced by seasonal changes in water levels of the adjacent rivers. Under normal conditions, groundwater flows from the bluffs toward the rivers and generally towards the southwest. However, during periods of high river levels, groundwater flow can temporarily reverse in localized areas and decrease in horizontal gradient with little net movement of groundwater occurs[5].

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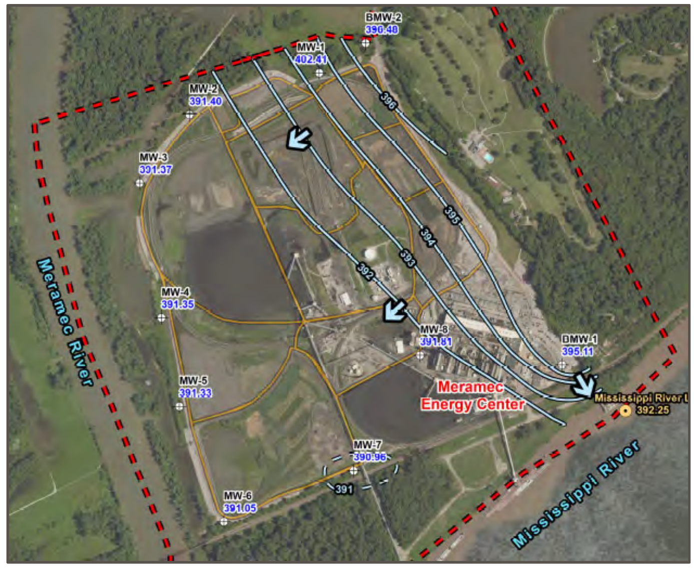
[4] Hydrogeologic Assessment (CH2MHILL, 1997).
[5] 2018 Annual Groundwater Monitoring and Corrective Action Report (Golder 2019).

Groundwater flow direction and gradient were estimated for the downgradient CCR Units 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, the overall net groundwater flow is from the bluffs toward the rivers. There are no users of groundwater of the alluvial aquifer at MEC. All private and public wells recorded within a one-mile radius of the facility are upgradient of the facility or located on the opposite side of the Meramec River and are therefore isolated from the MEC. Horizontal gradients determined by CCR Rule compliance wells (not including background or MW-1) range from 0.0002 to 0.0005 ft/ft with an estimated net annual groundwater velocity of approximately 16 ft per year.



Groundwater Flow Map-May 17, 2018
Image from Figure C2, 2018 Annual Groundwater Monitoring and Corrective Action Report (Golder 2019)

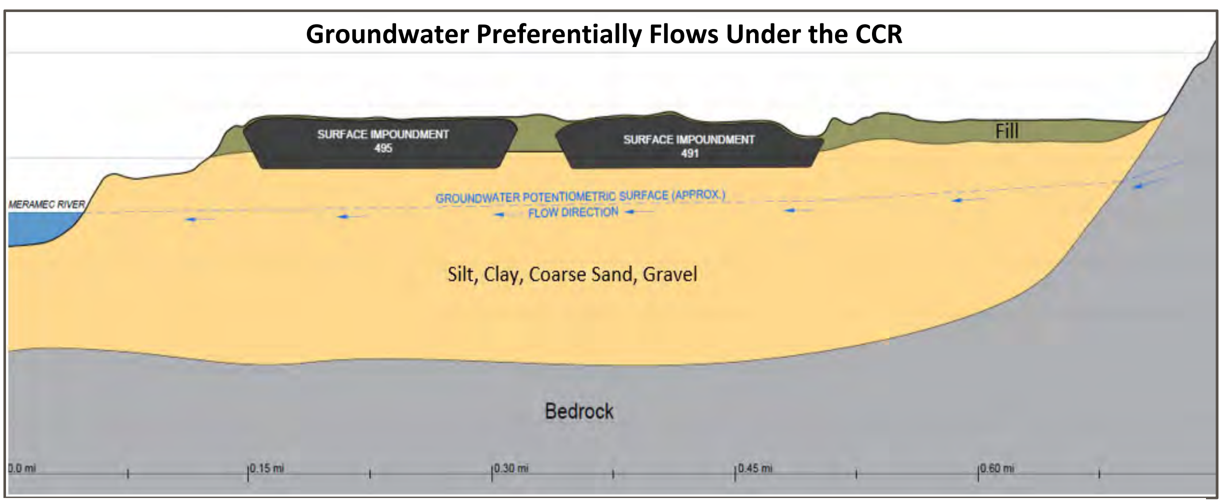


Image from Figure 2-2, MEC Groundwater Model Report (Burns & McDonnell 2019)

The existing Site grade is as much as 20 ft above the original ground surface the original grade of the plant was increased during construction by using fill material. The surface impoundments were made by excavating silts and clays and using the materials as fill beneath the plant as well as for surface impoundment berms (CH2MHILL, 1997). The surface impoundments were excavated approximately 10-20 ft below the original grade. Therefore, present day CCR thickness is estimated to be typically 20 to 30 ft below the present Site grade. As reflected above, the bottom elevations of the CCR is **higher** than the normal groundwater table. As such, groundwater flows under the surface impoundments.

Vertical hydraulic gradients are based on comparing the groundwater elevations in the monitoring wells to the water levels in the active surface impoundments. On average, the groundwater elevation of the impoundments is approximately 9 to 30 ft higher than the alluvial groundwater zone but can change seasonally based on river levels. During high river level conditions, the difference in groundwater elevation between the surface impoundments and the alluvial groundwater zone is the smallest.

2.4 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 constituents.

Groundwater results were compared to the site-specific GWPS. As shown on **Figure 2-1,** statistically significant levels (SSL) above the GWPS are limited to five monitoring wells: arsenic at MW-4, MW-5; lithium at MW-6; molybdenum at MW-6, MW-7 and MW-8.

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

2.5 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 two monitoring wells and two temporary piezometers (N&E wells). The N&E wells are screened in two different, depth zones of the alluvial aquifer: shallow zone and deep zone. Well screen lengths range from 5 to 10 ft long and total depths range from approximately 31 to 91 ft bgs.

Analytical results from the N&E wells indicate arsenic concentrations are limited in their extent to the shallow zone of the alluvial aquifer to the west of the CCR Units. Arsenic concentrations to the west of the CCR Units are similar to the Assessment Monitoring results, but decrease to less than the GWPS, 10 micrograms per liter (ug/L) in the deep alluvial zone. Monitoring wells to the south near the Mississippi River are similar to those near the CCR Units to the north, with concentrations below the GWPS for arsenic.

Based on the analytical results from the N&E wells molybdenum concentrations are limited in extent in the alluvial aquifer towards both the Meramec River to the west and toward the Mississippi River to the south. Results from the N&E wells are below the GWPS (100 ug/L) in both the shallow and deep alluvial aquifer samples.

Analytical results from the N&E wells also indicate that lithium concentrations west of the CCR Units are below the GWPS. Results to the south of the CCR Units nearer to the Mississippi River are consistent with the Assessment Monitoring wells to the south of the CCR Units with results that are very close in range (36 to 42.7 ug/L) to the GWPS of Lithium (40 ug/L).

The extent of contamination is limited to the alluvial aquifer and the results from the N&E wells were used to develop corrective measures alternatives.

2.6 SURFACE WATER SAMPLING

Ash management operations at the MEC have not impacted adjacent surface water bodies. Ameren voluntarily collected samples of surface water from the Mississippi River, Meramec River and Creek/Drainage surface water along the northern boundary of the facility. Golder collected surface water samples from 12 locations in the Mississippi River and 9 locations in the Meramec River. At each sample location, shallow 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 (referred to here as a deep sample). A total of 40 samples were collected from the Mississippi River and a total of 26 samples were collected in the Meramec River. In addition, shallow surface water samples were collected from three locations in the creek / drainage bed that runs along the northwestern boundary of the MEC. A total of six samples were collected in the creek. Surface water sampling locations are shown on **Figure 2-2.**

Samples were analyzed for the same Appendix III and Appendix IV CCR constituents listed in **Section 1.3**, with the exception of radium (all CCR monitoring well data are below the GWPS for radium). Sample results were also compared to human health and ecological risk-based screening levels. The screening levels and comparison of the surface water results to the screening levels are provided in **Appendix A.**

In summary, the results of this investigation demonstrate that the Mississippi River and Meramec River sampling **do not** show evidence of impact of CCR constituents derived from the surface impoundments[6].

[6] In some samples, the concentrations of arsenic, lead, or thallium are above risk-based screening levels, however, the results are statistically **no different** in upstream and downstream samples indicating that the CCR Units are not the source of the constituents detected in the rivers.

3. Risk Assessment and Exposure Evaluation

As described in this report, Ameren has conducted detailed environmental evaluations of the MEC 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 Meramec Energy Center. Available at: https://www.ameren.com/-/media/corporate-site/files/environment/ccr-rule/2017/groundwater-monitoring/Meramec-haley-aldrich-report.ashx?la=en&hash=76A0B8C34676EA9D3A7C8F61284917F50E02ED46

The purpose of this risk evaluation was 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 MEC, which has been in operation for 65 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 what 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 allow evaluation of 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 considered 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, 2018a). 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 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 the MEC. As documented in the 2018 risk assessment report, all private and public wells recorded within a one-mile radius of the facility are upgradient of the facility or located on the opposite side of the Meramec River and, therefore, such groundwater is isolated from the facility (see the February 2018 report for more details).

3.3 RESULTS

3.3.1 Alluvial Aquifer

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

Table: Assessment Monitoring Reflects High Percentage Compliance

	Meramec Energy Center – Shallow Alluvial Aquifer
Percent of Assessment Monitoring Parameter Compliance	95%
Percent of Assessment Monitoring Parameter Results Requiring Corrective Action (Constituents)	5% Arsenic, Lithium, Molybdenum

The striking aspect of the analysis is how few results are above conservative GWPS applicable to the Site, given that the wells are located directly adjacent to and at the base of the surface impoundments, and the facility has been in operation for 65 years. Note that out of the 1,818 groundwater analyses conducted, only 76 results are above the GWPS. Put another way, over 95% of the groundwater results for the CCR Rule monitoring wells located at the edges of the MEC surface impoundments (MW-1 through MW-8) are below the GWPS.

3.3.2 Surface Water

The Mississippi River and the Meramec River sampling results do not show evidence of impact of constituents derived from MEC[7].

There are no analytical results for the Mississippi River that are above drinking water screening levels with the exception of arsenic and thallium in one sampling location and the MEC is not the source[8].

3.3.3 National Pollutant Discharge Elimination System Outfall

The outfalls for the MEC are identified as 003 and 009 and are shown on **Figure 2-2**. These are permitted outfalls 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 Outfalls 003 and 009 at the MEC shows no evidence of aquatic toxicity in the outfall effluent.

3.4 CONCLUSION

The sampling results for the Mississippi River, the Meramec River, and the adjacent creek-drainage area are important. Although groundwater at the edge of the impoundment(s) shows that three constituents are present in some wells to a very limited extent above the GWPS, less than 5% of the results are above a GWPS, and the adjacent surface water bodies do not show evidence of impact of constituents derived from the surface impoundments at MEC. 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 and ultimately all such waters near the MEC flow towards the Mississippi River. The Mississippi is the largest river system in North America and as groundwater at the facility flows into the river, it is diluted by more than 100,000 times.

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

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[7] There are no analytical results for the Meramec River that are above drinking water screening levels, with the exception of lead. The total lead results upstream and downstream are similar and, thus, indicative of normal river conditions. Furthermore, all dissolved concentrations of lead are below the screening level, indicating that lead is associated with particulate in the river. In addition, groundwater samples on-site indicate that lead is either below screening levels or non-detected, thus, indicating that lead in the river is not attributable to the surface impoundments. Lead is not a COC at the MEC under the CCR Rule.

[8] The arsenic concentrations in the Mississippi River, Meramec River, and the creek/drainage along the northern portion of the facility are slightly above the human health recreational screening levels, however, the concentrations are statistically no different in upstream and downstream samples for both arsenic and thallium indicating that the facility is not the source of the arsenic and thallium detected in the rivers.

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

	Estimated Dilution Factor for the Mississippi River	100,000			
Constituents	**Lowest of the Human Health and Ecological Screening Levels (mg/L)**	**Groundwater Risk-Based Screening Level* (mg/L)**	**Maximum MEC Groundwater Concentration (mg/L)**		**Ratio Between Groundwater Risk-Based Screening Level and the Maximum MEC Groundwater Concentration**
Arsenic	0.00014	14	0.0221	M-MW-5	>600
Lithium	0.04	4000	0.164	M-MW-6	>24,000
Molybdenum	0.1	10000	0.717	M-MW-7	>13,000

CALCULATING RISK-BASED SCREENING LEVELS FOR MEC GROUNDWATER BASED ON THE MERAMEC RIVER

	Estimated Dilution Factor for the Meramec River	700			
Constituents	**Lowest of the Human Health and Ecological Screening Levels (mg/L)**	**Groundwater Risk-Based Screening Level* (mg/L)**	**Maximum MEC Groundwater Concentration (mg/L)**		**Ratio Between Groundwater Target Level and the Maximum MEC Groundwater Concentration**
Arsenic	0.00014	0.098	0.0221	M-MW-5	>4
Lithium	0.04	28	0.164	M-MW-6	>100
Molybdenum	0.1	70	0.717	M-MW-7	>90

***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 tables identify the maximum groundwater concentrations of arsenic, lithium, and molybdenum detected in the MEC 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 each table. To illustrate, concentration levels of arsenic, lithium, and molybdenum would need to be **more than 600, 24,000, and 13,000 times higher,** respectively, 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 MEC.

3.4.1 Trace Elements in Coal Ash

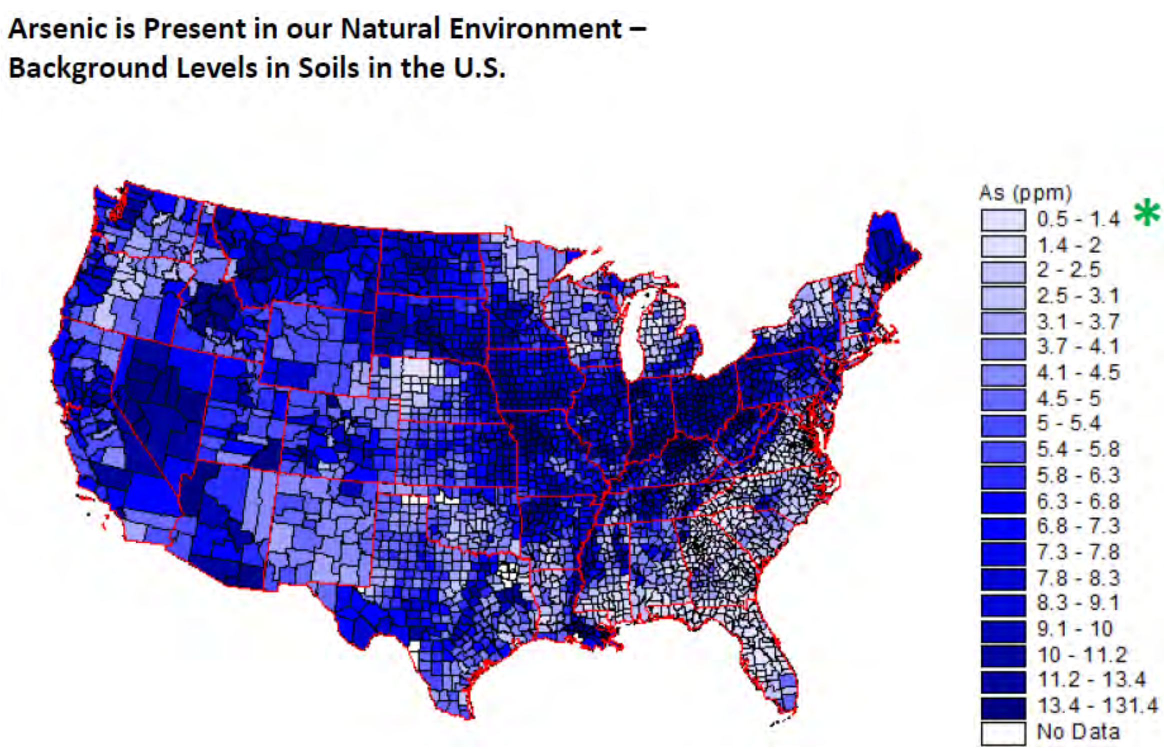
All of the inorganic minerals and elements that are present in coal ash are also present naturally in our environment. Arsenic, lithium, and molybdenum are referred to as trace elements, so called because they are present in soils (and in coal ash) at such low concentrations (in the milligrams per kilogram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

Arsenic is present in soils across the U.S. The USGS map of arsenic in surface soils in the U.S. is shown below.



Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

*The USEPA regional screening level for arsenic in residential soil at a one in one million risk level is 0.61 mg/kg (USEPA, 2018a). Thus, the arsenic concentration in the majority of the soils in the U.S. are above the one in one million risk level.

Because arsenic is naturally present in soils and rocks, it is also naturally present in our groundwaters and surface waters. Just as for soil, there are background levels of constituents in groundwater. Constituent concentrations in groundwater that is upgradient of a source represent background conditions. To demonstrate a release to groundwater by a source, concentrations downgradient of the source must be greater than the background/upgradient concentrations at a statistically significant level for a consistent period of time. Thus, it is not surprising that arsenic is present in both of the CCR background wells for the MEC.

3.4.3 Lithium

Lithium is present in groundwater at the MEC at levels above the GWPS in one well location. The fact sheet in **Appendix B** provides information on lithium so that the groundwater data can be considered in context. There is no public exposure to groundwater at the MEC and concentration levels of lithium in adjacent surface waters are all well below health-based regulatory standards.

Lithium is naturally occurring in soils and water. Primary dietary sources of lithium are grains and vegetables, dairy products and meat. Estimates for daily dietary intake of lithium have been reported from different sources and varies amongst different countries. Ranges have included 0.0168 – 0.105 mg Li/day to 2.310 – 5.600 mg Li/day from food and water.

Lithium is used medicinally in the U.S. and globally as the leading treatment for bipolar disease. Adult daily dosages are approximately 900 mg/day or higher, and recommended doses for children are approximately 600 mg/day.

However, there are limited studies on lithium of the type upon which to base a toxicity value to use in human health risk assessment. USEPA has derived a provisional toxicity value (i.e., the value does not have the normal level of review or confidence compared to final toxicity values published by USEPA) that equates to a drinking water screening level of 0.04 mg/L, and a general intake of 0.14 mg/day for an adult. Note that this level is below many estimates of daily intake in humans presented above, and well below the typical therapeutic doses presented above.

3.4.4 Molybdenum

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

As discussed in more detail in **Appendix C**, 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. Below is a chart that depicts groundwater and surface

water samples collected from Ameren's four energy centers and compares concentration levels based on both the NAS tolerable upper limit and the GWPS established by the USEPA in the CCR Rule. As reflected in the chart, over 90% of the groundwater results across all four energy centers and all but **one sample** at Meramec 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 CCR 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 MEC on human health or the environment from either surface water or groundwater uses. There are no users of groundwater near the MEC or its CCR units. In fact, as described above, concentrations of arsenic, lithium, and molybdenum detected in groundwater would need to be **more than 600, 24,000, and 13,000 times higher**, respectively**,** before such an unacceptable risk could exist 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 MEC, 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 four 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[9] performed by Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) evaluated the hydrogeologic and geochemical conditions at the CCR Unit. Burns & McDonnell used the numerical computer code MODFLOW to simulate groundwater flow and the software package MT3DMS to simulate groundwater transport of dissolved phase constituents.

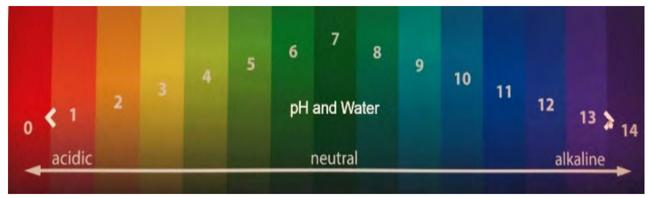
4.3 GROUNDWATER TREATMENT EVALUATION

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.

[9] 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 [10]. 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.

Ameren has retained XDD Environmental to research and develop appropriate treatment options for arsenic, lithium, and molybdenum and is performing bench-scale treatability studies to demonstrate the effectiveness of treatment options on a site-specific basis. Laboratory results indicate that through pH adjustments arsenic concentrations at the MEC will fall to below action levels. Appropriate treatment trains for molybdenum and lithium at the MEC are under evaluation and bench-scale treatment results for all four of Ameren's energy centers are expected to be completed in the Summer of 2019.



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

4.4 CORRECTIVE MEASURES ALTERNATIVES

Corrective measures can terminate when groundwater impacted by the CCR Units 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.

The remedial alternatives presented below contemplate both CIP (Alternative 1 through 3) and CBR (Alternative 4) of the unit. Both closure methods are expressly authorized under the CCR Rule.

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

The regulated surface impoundments would be closed in place with a low-permeability geomembrane and soil protective layer to reduce infiltration of surface water to groundwater thereby isolating source material. This cap selection exceeds regulatory requirements by more than two orders of magnitude ($<1x10^{-7}$ centimeters per second (cm/sec) planned versus $1x10^{-5}$ cm/sec required by the CCR Rule). Over time, decreased surface water infiltration and porewater flux through the CCR would allow the concentration of COCs in downgradient groundwater to decline and overall groundwater concentrations

[10] 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

of COCs to attenuate. Geochemical modeling results indicate that the dissolved phase plume of arsenic, lithium, and molybdenum remaining above the GWPS post-closure would remain stable and within the MEC property boundary long-term as such levels attenuate. The timelines for MNA duration for arsenic, lithium, and molybdenum are shown on **Figures 4-2, 4-3, and 4-4**, respectively.

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 cover layer with a permeability that is 100 times lower than what the CCR Rule requires thus further reducing infiltration. At the MEC, site preparation, construction and installation of cap and cover systems take approximately 12 to 18 months and additional closure activities are planned for 2021 with all remaining closures expected to be completed within four years.

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 over time reduce concentrations of arsenic, lithium, and molybdenum in groundwater at the waste boundary.

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 below 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 Capping and In-Situ Groundwater Treatment

Similar to Alternative 1, the regulated surface impoundments would be CIP with a low-permeability (<1 x 10^{-7} cm/sec) geomembrane to reduce infiltration of surface water to groundwater and to isolate source material. COCs would be addressed through in-situ injection of groundwater amendments downgradient of the regulated surface impoundments, or through the installation of a permeable reactive barrier (PRB). Over time, decreased surface water infiltration and porewater flux would allow the concentration of COCs to attenuate and active remediation (injections or PRB replenishment) could cease.

Following the installation of the low-permeability cover and in-situ treatment system (via a trench or injection wells), Ameren would implement post-closure care activities that include periodic amendment injections or periodic replenishment of the treatment reagents within the PRB, long-term groundwater sampling to monitor treatment system performance, and cover system maintenance. Based upon laboratory testing performed by XDD, the timeline for in-situ treatment is expected to be less than Alternative 1 as shown on **Figures 4-2, 4-3, and 4-4**.

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 Hydraulic Containment Through Groundwater Pumping and Ex-situ Treatment

The regulated surface impoundments would be closed in place with a low-permeability (<1 x 10^{-7} cm/sec) geomembrane to reduce infiltration of surface water to groundwater and isolate source material. Pumping wells would be used to hydraulically control the migration of constituents downgradient. 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.

The timeline for active treatment is expected to be comparable to Alternatives 1 and 2 because treatment would continue until source concentrations attenuate to levels less than the GWPS. With active groundwater pumping along the boundary of the impoundments, such process creates a waste stream that must be permitted and managed prior to discharge back into the Meramec River.

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 hydraulic containment (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.

4.4.4 Alternative 4 – Closure by Removal with Monitored Natural Attenuation

This alternative evaluates the removal of CCR from the impoundments at the Site. While this alternative would eliminate (through removal) the source, it takes over 20 years to implement during which time the impoundments would remain open and the ponded ash subject to ongoing infiltration for the duration of the removal activities. As with Alternatives 1 and 2, concentrations of COCs in downgradient groundwater would decline via natural attenuation processes.

The MEC is located in a heavily developed area of St. Louis County and, as a consequence, any large scale excavation operation would have several potential community impacts, safety concerns and challenges. Given the magnitude of the total estimated haul volume (5.2 MM CY) along with the travel distance to one or more off-site and potentially out of state landfills, injuries and fatalities would be likely. A study completed by the Lochmueller Group (Lochmueller) **(Appendix D)** estimated that the time period needed to transport material off-site to a commercial landfill could be 20 years or greater.

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. The Lochmueller study bases its time estimate on assumed productivity rates that are subject to potential disruptions (e.g., weather conditions, truck synchronizing, available landfill capacity, travel route traffic congestion, road enhancements, etc.) that could impact overall CBR timeframe. The study identified productivity targets for other Ameren facilities at approximately 200 truckloads a day (**one every 2.5 minutes**).

The presence of a nearby school just up the road from the MEC negatively impacts transportation to and from the site. It is likely that the frequency of hauling trips would need to be reduced during school days to accommodate community concerns. Haulers would need to avoid trips past the school during school arrival and departure times, thereby reducing the hauling workday from 8 hours to 5 ½ to 6 hours. Additionally, further review of local restrictions and approvals would be required to verify that any selected landfill, particularly if located in Illinois, could receive the ash for disposal.

Excavated materials from the MEC would not be suitable for beneficial use applications, due to the ash production quality and 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 of CCR into the surface impoundments. In addition, historical F ash materials at MEC site have already been recovered and utilized as part of the Taum Sauk reconstruction project. No recoverable F ash is available from the site[11].

Technical and logistical challenges of implementing a large-scale ash removal project also need to be considered (removal of CCR over 30-ft deep adjacent to the Meramec and Mississippi rivers). Removal activities will be difficult and require implementation of CCR stabilization methods and temporary staging/stockpiling of material for drying prior to transportation off-site; 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 MEC site. Additional community impacts associated with the use of heavy equipment and truck traffic are also a consideration for this alternative. During the long removal period (20-years or more), the ash in the non-closed impoundments remain exposed to infiltration via precipitation.

[11] Information provided by Ameren technical staff, May 10, 2019.

5. Comparison of Corrective Measures Alternatives

The purpose of this section is to evaluate, compare, and rank the six 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 the 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 surface impoundments. 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 least external impact are Alternative 1 (CIP with MNA) because it involves the least amount of construction and operations and maintenance activities and associated impacts, and Alternative 2 (CIP with in-situ treatment) since treatment will reduce concentrations of constituents in groundwater short-term without generating a secondary waste stream. Alternative 4 (CBR with MNA) has the highest risk to human health and the environment related to excessive and prolonged truck traffic, which increases the likelihood of roadway accidents during the period of time needed to complete the CBR project. Construction of the treatment system and the cap will be required for Alternative 3 (CIP with HC) and a waste stream including a high volume of effluent will be generated posing additional risk but this alternative, like Alternatives 1 and 2, pose a lesser risk than Alternative 4.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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 4 (CBR with MNA) has the lowest long-term residual risk in that the source material is removed. However, implementation of this alternative would take 20 years or greater to implement during which time the source material (ash) is subject to ongoing infiltration (because it remains open to the environment during removal), relative to the other alternatives. For Alternatives 1 through 3, the CCR would be CIP with the installation of a low permeability (<1 x 10^{-7} cm/s) geomembrane that virtually eliminates infiltration of precipitation and isolates the source material. Dissolved phase COCs to groundwater are addressed through MNA process. Alternatives 2 and 3 also provide additional measures to address potential groundwater impacts through in-situ treatment and hydraulic controls. but Alternative 3 will result in an additional waste stream.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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 4 (CBR with MNA) is least favorable because off-site removal is estimated to take 20 years or greater to complete and is logistically complex with transportation and coordination with off-site disposers (commercial landfills). The remaining alternatives fall between Alternatives 1 and 4 because they involve active remediation systems to implement and/or maintain throughout their remediation life cycle.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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 4 (CBR with MNA), making this alternative the 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, along with an increased potential for traffic accidents and fatalities, noise, and truck emissions.

For Alternatives 1 (CIP with MNA), 2 (CIP with in-situ treatment), and 3 (CIP with HC), risk to the community during implementation is considered the same and would be minimal compared to Alternative 4. Periodic 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 & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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 regulated surface impoundments; therefore, protection is already achieved. Based upon predictive modeling, Alternative 1 (CIP with MNA) arsenic concentrations will attain GWPS in approximately 27 years (see **Figures 4-2, 4-3, and 4-4**). Alternatives 2 (CIP with in-situ treatment) and 3 (CIP with HC) take the least amount of time for COC concentrations to attain the GWPS (see **Figures 4-2, 4-3, and 4-4**) but a waste stream is produced by implementation of Alternative 3. These two alternatives are favorable given the shorter timeframe to achieve concentrations less than the GWPS.

Alternative 4 (CBR with MNA) could take approximately 20 years or greater to fully implement followed by a period of groundwater monitoring to verify natural attenuation of the existing groundwater plume, which makes this alternative unfavorable. As detailed in the Lochmueller report, implementation is limited mainly by the amount of material that can be excavated and hauled during a workday, disposal facility capacity, and the volume of ash.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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), 2 (CIP with in-situ treatment), and 3 (CIP with HC) all have similar, minimal potential for exposure of 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 2 (CIP with in-situ treatment) is also favorable because treatment occurs below ground and no waste stream is generated. Alternative 3 (CIP with HC) is slightly less favorable since a secondary waste stream will be generated and will need to be managed either onsite or offsite, which creates a potential for exposure.

Alternative 4 (CBR with MNA) has high potential for exposure which makes this alternative the least favorable remedy for this criterion. A high potential for exposure exists during the excavation and transport of the CCR over local roadways, if Alternative 4 is implemented.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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), 2 (CIP with in-situ treatment), and 3 (CIP with HC) are 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 (Alternatives 3) are considered reliable, proven technologies and would have high long-term reliability, but rely require bench scale testing and rely on mechanical systems to operate. 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 3, which include CIP, institutional controls such as the recording of an environmental covenant restricting the use of groundwater can easily be implemented because the surface impoundments are located on property owned by Ameren.

Alternative 4 (CBR with MNA) engineering and institutional controls would have high long-term reliability because the CCR will have been removed from the surface impoundments. With the CCR no longer in place, no additional engineering and institutional controls are anticipated.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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 of the surface impoundments by CBR (Alternative 4) is considered permanent and can be effective in appropriate circumstances. From the perspective of needing to replace the remedy, source removal (Alternative 4) is permanent but takes decades to implement.

Alternatives 1 (CIP with MNA), 2 (CIP with in-situ treatment), and 3 (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 & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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 graphic below 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. Alternative 1 (CIP with MNA) is the most favorable, while Alternative 4 (CBR with MNA) is the least favorable. Alternative 1 is expected to be effective both short- and long-term and does not include additional treatment technology aside from MNA. Alternative 2 (CIP with in-situ treatment) is comparable to Alternative 1 because it has a shorter potential timeframe to meet the GWPS despite requiring treatment, but no secondary waste stream is generated. A secondary waste stream is generated under Alternative 3 (CIP with HC). Alternative 4 (CBR with MNA) will require a lengthy construction period, and therefore is not effective in the short-term, and creates short-term risk (for 20 plus years) to the community during construction. Further, to implement Alternative 4 (CBR and MNA) the CCR Units will be open to the environment during the 20 plus year removal process resulting in no source control for decades.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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), 2 (CIP with in-situ treatment), and 3 (CIP with HC) installation of the low permeability cap will reduce the infiltration of surface water into the surface impoundments and decrease the flux of COCs to groundwater over time. Groundwater mounding and an associated outward hydraulic gradient present during operation is expected to dissipate after closure. Alternatives 2 and 3 are considered the most favorable because treatment technologies will be implemented to further limit down-gradient migration of COCs in groundwater.

Under Alternative 4 (CBR with MNA), no further releases are anticipated following removal of the CCR material. However, the implementation of Alternative 4 is anticipated to require multiple decades to complete with MNA monitoring following completion of construction. During the period of construction, there would be no source control of the Appendix IV constituents because the CCR Units will be open to the environment.

For Alternatives 2 (CIP with in-situ treatment) and 3 (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 surface impoundments, achieving the performance criteria at the waste boundary. Alternative 3, however, will create additional waste streams requiring management on and off-site. Alternative 1 will not have an additional containment technology beyond natural attenuation but is expected to reduce the concentrations below the GWPS over time.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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 and 4. 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, and therefore is the most favorable.

Alternative 2 will use one additional technology, in-situ treatment, while Alternatives 3 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 & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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. Alternative 2 (CIP with in-situ treatment) is the most favorable, while Alternatives 1 (CIP with MNA), 3 (CIP with HC), and 4 (CBR with MNA) are the least favorable. The construction period for Alternative 2 (CIP with in-situ treatment) is expected to be brief and will begin treating groundwater at the unit boundary immediately. Further releases under Alternative 4 (CBR with MNA) will not be addressed until construction is complete.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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), 2 (CIP with in-situ treatment), and 3 (CIP with HC). No construction difficulties are anticipated if Alternatives 1, 2, and 3 are implemented. Specialty equipment or contractors are not required. Alternative 2 may be slightly more difficult to implement should a subsurface trench be required for a permeable barrier and Alternative 3 does require construction and installation of a treatment system. For Alternative 1, no additional treatment technology is needed other than monitoring wells for groundwater monitoring.

Alternative 4 (CBR with MNA) will be difficult to implement due to technical and logistical challenges. Alternative 4 will include large-scale excavation adjacent to the Meramec River and the transportation of 5.2 MM CY of CCR over local roadways. Alternative 4 will include large-scale construction, specialty equipment and contractors, long project durations, and significant technical challenges.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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. Alternatives 2 and 3 are expected to be reliable but will utilize additional groundwater treatment technologies. Alternative 4 (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 & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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. Alternative 4 (CBR with MNA) will require confirmation that off-site landfills are permitted to accept the ash and that there are no local siting restrictions that apply and permitting for large-scale construction will likely be required. Permitting is expected to be straightforward for CIP Alternatives 2 and 3. Additional approval and permitting may be required for Alternative 2 (CIP with in-situ treatment) because this alternative includes subsurface application of groundwater amendments and permitting would likely be required for Alternative 3 for treated groundwater discharge.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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. Equipment needed to implement Alternatives 2 and 3 are expected to be readily available.

Alternative 4 (CBR with MNA) is the least favorable since specialty remediation contractors will be needed to implement full removal, which will include large-scale construction and transportation of material to off-site disposal facilities.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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 evaluation of the CBR alternative (Alternative 4) by evaluating available capacity at an Illinois landfill reasonably proximate to the MEC that could potentially receive CCR for disposal. Three such landfills were identified in the main report text associated with material disposal from a separate Ameren site. However, further work would be required to confirm that the landfills identified are permitting to accept the ash for disposal and that there are no local siting restrictions preventing those landfills from accepting the ash material. Due to the disposal requirements, Alternative 4 (CBR with MNA) is the least favorable alternative.

Because the regulated surface impoundments will be CIP for Alternatives 1, 2, and 3, treatment, storage, and disposal services for CCR material will not be needed. Temporary stockpiling of CCR during 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 included. For Alternative 3, the ex-situ treatment system will generate a concentrated waste stream which will require off-site transportation and disposal that the other alternatives would not require.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap & In-Situ GW Treatment	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** 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 graphic below provides a summary of the ease or difficulty that will be needed to implement each alternative. Alternative 1 (CIP with MNA) is the most favorable, while Alternative 4 (CBR with MNA) is the least favorable.

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

6. Summary

This Corrective Measures Assessment has evaluated the following alternatives:

- Alternative 1 – Closure in Place with Capping and Monitored Natural Attenuation
- Alternative 2 – CIP with Capping and In-Situ Groundwater Treatment
- Alternative 3 – CIP with Capping and Hydraulic Containment Through Groundwater Pumping and Ex-situ Treatment
- Alternative 4 – 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 units 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 §257.97(c), each of the alternatives has been evaluated in the context of the following balancing criteria:

- The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful based on consideration of eight factors.
- The effectiveness of the remedy in controlling the source to reduce further releases based on consideration of the extent to which containment practices will reduce further releases and the extent to which treatment technologies may be used.
- The ease or difficulty of implementing a potential remedy(s) based on consideration of five types of factors

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 MEC.

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TABLES

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

Monitoring Well ID	Date Sampled	Antimony Total	Arsenic Total	Barium Total	Beryllium Total	Cadmium Total	Chromium Total	Fluoride Total	Cobalt 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	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	Site GWPS	6	10	2000	4	5	100	4	6	15	40	2	100	50	2
BMW-1	5/13/2016	0.71 J	1.2	254	1 U	0.5 U	1 U	0.42	5 U	5 U	16	0.2 U	5.6 J	0.39 J	1 U
	6/16/2016	1 U	1.3	239	1 U	0.5 U	0.50 J	0.42	5 U	5 U	12	0.2 U	6.6 J	0.32 J	1 U
	7/19/2016	0.081 J	5.5	232	1 U	0.5 U	0.47 J	0.37	5 U	5 U	15.2	0.2 U	6.8 J	1 U	1 U
	9/7/2016	0.62 J	0.99 J	237	1 U	0.5 U	1 U	0.38	5 U	5 U	13.4	0.2 U	7.2 J	0.36 J	1 U
	11/10/2016	0.64 J	1.1	230	1 U	0.5 U	0.46 J	0.44	5 U	5 U	14.2	0.2 U	20 U	0.29 J	1 U
	1/6/2017	1 U	0.89 J	241	1 U	0.5 U	1 U	0.44	5 U	5 U	14.6	0.2 U	5.4 J	0.19 J	1 U
	3/7/2017	0.60 J	2.1	221	1 U	0.5 U	1.8	0.39	5 U	5 U	14.9	0.2 U	6.7 J	0.18 J	1 U
	6/14/2017	0.60 J	1.7	224	1 U	0.5 U	1 U	0.38	5 U	5 U	12.8	0.2 U	6.4 J	0.11 J	1 U
	11/6/2017							0.48							
	4/4/2018	0.51 J	1.9	237	1 U	0.5 U	0.11 J	0.18 J	5 U	10 U	13.8	0.2 U	4.3 J	1 U	1 U
	5/17/2018		1.5	251			1 U	0.36			500 UO		5.1 J		
	11/19/2018		1.4	204			0.11 J	0.43			15		4.6 J		
BMW-2	3/29/2016	1 U	0.80 J	485	1 U	0.5 U	0.62 J	0.38	5 U	5 U	5.7 J	0.2 U	20 U	1 U	1 U
	5/13/2016	1 U	1.3	538	1 U	0.5 U	1 U	0.34	5 U	3.1 J	8.3 J	0.2 U	20 U	1 U	1 U
	7/19/2016	0.63 J	1.2	503	1 U	0.5 U	0.36 J	0.25	5 U	5 U	6.8 J	0.2 U	0.53 J	0.28 J	1 U
	9/7/2016	1 U	1.2	534	1 U	0.5 U	0.65 J	0.34	5 U	3.5 J	10 U	0.2 U	20 U	1 U	1 U
	11/10/2016	1 U	1.6	528	1 U	0.5 U	0.66 J	0.28	5 U	5 U	6.9 J	0.2 U	20 U	1 U	1 U
	1/6/2017	1 U	1.8	553	1 U	0.5 U	1 U	0.26	5 U	5 U	7.5 J	0.2 U	20 U	1 U	1 U
	3/7/2017	1 U	1.5	566	1 U	0.5 U	1.2	0.28	5 U	5 U	7.4 J	0.2 U	20 U	1 U	1 U
	6/14/2017	1 U	1.8	547	1 U	0.5 U	1 U	0.27	5 U	2.5 J	5.6 J	0.2 U	20 U	1 U	1 U
	11/6/2017							0.28							
	4/4/2018	1 U	1.1	537	1 U	0.31 J	0.45 J	0.10 J	5 U	10 U	9.3 J	0.2 U	20 U	1 U	1 U
	5/17/2018		1.7	566			1 U	0.31			500 UO		10 U		
	11/19/2018		1.1	524			0.45 J	0.35			6.5 J		20 U		
MW-1	3/29/2016	0.063 J	0.83 J	352	1 U	0.042 J	0.97 J	0.3	1.5 J	5 U	10 U	0.2 U	20 U	1 U	1 U
	5/17/2016	1 U	0.63 J	375	1 U	0.5 U	1 U	0.3	5 U	4.3 J	10 U	0.041 J	0.84 J	1 U	1 U
	7/18/2016	1 U	0.49 J	374	1 U	0.5 U	0.79 J	0.25	5 U	4.9 J	10 U	0.2 U	20 U	1 U	1 U
	9/8/2016	1 U	0.62 J	378	1 U	0.5 U	0.88 J	0.22	5 U	5 U	10 U	0.2 U	20 U	1 U	1 U
	11/10/2016	1 U	0.46 J	364	1 U	0.5 U	0.77 J	0.24	5 U	5 U	10 U	0.2 U	20 U	1 U	1 U
	1/6/2017	1 U	0.38 J	357	1 U	0.5 U	1 U	0.25	5 U	5 U	10 U	0.2 U	20 U	1 U	1 U
	3/7/2017	1 U	0.67 J	372	1 U	0.5 U	1 U	0.25	5 U	5 U	10 U	0.2 U	20 U	1 U	0.064 J
	6/14/2017	0.032 J	1 U	374	0.23 J	0.5 U	1.6	0.23	5 U	5 U	10 U	0.2 U	20 U	1 U	0.076 J
	11/6/2017							0.26							
	4/4/2018	0.028 J	0.71 J	359	0.17 J	0.22 J	0.74 J	0.069 J	5 U	10 U	7.1 J	0.2 U	20 U	0.10 J	1 U
	5/18/2018		1.2	358			0.52 J	0.28			500 UO		10 U		
	11/20/2018		0.68 J	370			0.36 J	0.3			5.3 J		20 U		
MW-2	3/29/2016	1 U	2	471	1 U	0.5 U	0.74 J	0.17 J	5 U	2.6 J	10 U	0.2 U	1.2 J	1 U	1 U
	5/16/2016	1 U	2.5	500	1 U	0.5 U	1 U	0.16 J	5 U	2.8 J	6.0 J	0.040 J	20 U	1 U	1 U
	7/18/2016	1 U	1.4	490	1 U	0.5 U	0.43 J	0.11 J	5 U	5 U	6.1 J	0.2 U	2.1 J	1 U	1 U
	9/8/2016	1 U	1.6	515	1 U	0.5 U	1.3	0.088 J	5 U	2.7 J	10 U	0.2 U	20 U	1 U	1 U
	11/10/2016	1 U	1.3	491	1 U	0.5 U	0.70 J	0.11 J	5 U	5 U	6.0 J	0.2 U	20 U	1 U	1 U
	1/6/2017	1 U	1.5	456	1 U	0.5 U	1 U	0.093 J	5 U	5 U	10 U	0.2 U	20 U	1 U	1 U
	3/7/2017	1 U	1.8	466	1 U	0.5 U	1.7	0.11 J	5 U	5 U	5.2 J	0.2 U	20 U	1 U	1 U
	6/14/2017	1 U	1.6	393	1 U	0.5 U	1 U	0.2 U	5 U	2.4 J	3.2 J	0.2 U	2.5 J	1 U	1 U
	11/6/2017							0.11 J							
	1/2/2018							0.15 J							
	4/4/2018	0.16 J	1.8	324	1 U	0.5 U	0.16 J	0.2 U	5 U	10 U	8.2 J	0.2 U	20 U	1 U	1 U
	5/17/2018		2.5	328			1 U	0.13 J			500 UO		10 U		
	11/19/2018		1.7	299			0.31 J	0.2 U			6.4 J		20 U		
MW-3	3/29/2016	1 U	4.6	238	1 U	0.5 U	0.93 J	0.14 J	1.0 J	5 U	10 U	0.2 U	2.5 J	1 U	1 U
	5/17/2016	1 U	6.1	255	1 U	0.5 U	1 U	0.14 J	5 U	5 U	8.0 J	0.041 J	1.9 J	1 U	1 U
	7/18/2016	1 U	1 UO	253	1 U	0.5 U	0.50 J	0.082 J	5 U	5 U	7.1 J	0.2 U	3.4 J	1 U	1 U
	9/8/2016	1 U	7.7	270	1 U	0.5 U	1 U	0.076 J	1.0 J	5 U	10 U	0.2 U	20 U	1 U	1 U
	11/10/2016	1 U	7.8	244	1 U	0.5 U	0.52 J	0.091 J	1.5 J	5 U	5.6 J	0.2 U	20 U	1 U	1 U
	1/6/2017	1 U	6.6	201	1 U	0.5 U	1 U	0.079 J	5 U	5 U	5.1 J	0.2 U	3.1 J	1 U	1 U
	3/7/2017	1 U	7.9	217	1 U	0.5 U	1 U	0.13 J	5 U	5 U	8.1 J	0.2 U	5.0 J	1 U	0.053 J
	6/14/2017	0.031 J	7.1	206	1 U	0.5 U	1 U	0.2 U	1.7 J	2.5 J	3.7 J	0.2 U	5.2 J	1 U	0.061 J
	11/6/2017							0.2 U							
	4/4/2018	1 U	8.1	253	1 U	0.11 J	0.34 J	0.2 U	5 U	10 U	9.0 J	0.2 U	2.6 J	1 U	1 U
	5/17/2018		8.3	264			0.64 J	0.12 J			500 UO		10 U		
	11/19/2018		7.8	232			1 U	0.2 U			10 U		3.6 J		

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

Monitoring Well ID	Date Sampled	Antimony Total	Arsenic Total	Barium Total	Beryllium Total	Cadmium Total	Chromium Total	Fluoride Total	Cobalt 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	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	Site GWPS	6	10	2000	4	5	100	4	6	15	40	2	100	50	2
MW-4	3/29/2016	1 U	**10.5**	222	1 U	0.5 U	0.68 J	0.21	5 U	5 U	22.4	0.2 U	51.7	1 U	1 U
	5/16/2016	1 U	**13**	222	0.47 J	0.5 U	1 U	0.21	5 U	3.6 J	22.7	0.2 U	49.7	1 U	1 U
	7/19/2016	1 U	**13.3 J**	216	1 U	0.5 U	1	0.15 J	5 U	5 U	23.2	0.2 U	54	1 U	1 U
	9/8/2016	1 U	**13.7**	229	1 U	0.5 U	0.61 J	0.13 J	5 U	5 U	20.3	0.2 U	52.5	1 U	1 U
	11/10/2016	1 U	**14.5**	213	1 U	0.5 U	0.56 J	0.16 J	5 U	5 U	26.3	0.2 U	54.4	1 U	1 U
	1/6/2017	1 U	**13.3**	214	1 U	0.5 U	1 U	0.12 J	5 U	2.7 J	22.4	0.2 U	50.4	1 U	1 U
	3/7/2017	1 U	**14.6**	228	1 U	0.5 U	1 U	0.18 J	5 U	5 U	23.5	0.2 U	53.8	1 U	1 U
	6/14/2017	1 U	**14.8**	219	0.23 J	0.5 U	1 U	0.12 J	5 U	5 U	20.9	0.2 U	56	1 U	1 U
	11/6/2017							0.14 J							
	4/4/2018	0.027 J	**14.4**	214	0.28 J	0.16 J	0.33 J	0.2 U	5 U	10 U	27	0.2 U	55	0.12 J	1 U
	5/17/2018		**15**	218			1 U	0.18 J			500 UO		55.6		
	11/19/2018		**14.8**	200			0.25 J	0.2 U			23.3		51.1		
MW-5	3/29/2016	1 U	8	289	1 U	0.5 U	0.42 J	0.25	5 U	5 U	19.6	0.2 U	82.2	1 U	1 U
	5/13/2016	1 U	**13.4**	292	1 U	0.5 U	1 U	0.25	5 U	4.2 J	21.2	0.2 U	74.4	1 U	1 U
	7/19/2016	1 U	**17.1**	293	1 U	0.5 U	1 U	0.21	5 U	3.3 J	20.9	0.2 U	84	1 U	1 U
	9/8/2016	1 U	**18.7**	301	1 U	0.5 U	0.42 J	0.16 J	5 U	3.2 J	18.3	0.2 U	83.8	1 U	1 U
	11/10/2016	1 U	**19.9**	305	1 U	0.5 U	0.37 J	0.25 J	5 U	5 U	25.3	0.2 U	90.4	1 U	1 U
	1/6/2017	1 U	**20.6**	304	1 U	0.052 J	1 U	0.17 J	5 U	5 U	22.9	0.2 U	96.5	1 U	1 U
	3/7/2017	1 U	**21.9**	312	1 U	0.5 U	1 U	0.21	5 U	5 U	23.1	0.2 U	93.7	1 U	1 U
	6/14/2017	1 U	**21**	308	1 U	0.5 U	1 U	0.16 J	5 U	5 U	20.2	0.2 U	97.3	1 U	1 U
	11/6/2017							0.18 J							
	4/5/2018	1 U	**22.1**	245	1 U	0.5 U	0.22 J	0.10 J	5 U	10 U	26.2	0.2 U	98.3	1 U	1 U
	5/18/2018		**22.1**	259			1 U	0.24			500 UO		**105**		
	11/19/2018		1.8	195			0.14 J	0.22			18.1		**101**		
	1/24/2019		**19.7**												
MW-6	3/30/2016	0.062 J	5	75.4	1 U	0.5 U	0.37 J	0.17 J	0.86 J	5 U	**129**	0.2 U	**137**	1 U	1 U
	5/13/2016	1 U	8.3	94.4	1 U	0.5 U	1 U	0.15 J	0.74 J	5 U	**164**	0.2 U	**124**	1 U	1 U
	7/19/2016	1 U	1 U	72.5	1 U	0.5 U	1 U	0.13 J	5.7	5 U	**130**	0.2 U	**129**	1 U	1 U
	9/8/2016	1 U	4.8	69.3	1 U	0.5 U	1 U	0.097 J	3.8 J	5 U	**123**	0.2 U	**120**	1 U	1 U
	11/10/2016	0.066 J	3	66.8	1 U	0.5 U	0.54 J	0.38	**6.1**	5 U	**130**	0.2 U	**135**	1 U	1 U
	1/6/2017	1 U	2.5	66.5	1 U	0.050 J	1 U	0.10 J	**6.5**	5 U	**138**	0.2 U	**163**	1 U	1 U
	3/7/2017	0.030 J	4	66.3	1 U	0.5 U	1 U	0.16 J	5.7	2.7 J	**140**	0.2 U	**157**	1 U	0.038 J
	6/15/2017	0.073 J	2.3	59.6	1 U	0.027 J	1 U	0.12 J	**7.8**	5 U	**129**	0.2 U	**147**	1 U	1 U
	11/6/2017							0.3							
	4/3/2018	0.043 J	4.9	53.8	0.36 J	0.069 J	2.4	0.13 J	4.1 J	10 U	**144**	0.2 U	**134**	1 U	1 U
	5/18/2018		5.5	55			0.71 J	0.15 J			**419 J**		**140**		
	11/19/2018		2.9	49.4			0.12 J	0.2 U			**131**		**135**		
MW-7	3/29/2016	0.41 J	2.6	57.4	1 U	0.081 J	0.91 J	0.31	5 U	5 U	37.8	0.2 U	**451**	1.5	1 U
	5/13/2016	0.37 J	3.8	59.6	1 U	0.11 J	1 U	0.36	1.2 J	5 U	**40.3**	0.2 U	**338**	0.55 J	1 U
	7/19/2016	0.065 J	3.7	49.1	1 U	0.5 U	0.74 J	0.25	5 U	5 U	**50.9**	0.2 U	**359**	1 U	1 U
	9/7/2016	0.40 J	2.4	44.8	1 U	0.5 U	1 U	0.52	5 U	5 U	**43.6**	0.2 U	**351**	10.3	1 U
	11/10/2016	0.39 J	2.4	43.3	1 U	0.22 J	0.57 J	0.6	5 U	5 U	**58.3**	0.2 U	**331**	12.9	1 U
	1/6/2017	1 U	2.4	51.5	1 U	0.33 J	1 U	0.64	5 U	2.7 J	**71.1**	0.2 U	**297**	16.6	1 U
	3/7/2017	0.44 J	2.5	56	1 U	0.20 J	1 U	0.3	5 U	2.8 J	**74.2**	0.2 U	**314**	7.7	0.11 J
	6/15/2017	0.39 J	2.1	36.3	1 U	0.14 J	1.5	0.46	5 U	5 U	38.1	0.2 U	**717**	0.61 J	0.13 J
	11/6/2017							0.61							
	1/3/2018							0.35							
	4/3/2018	0.42 J	3.2	41.8	0.35 J	0.22 J	1 U	0.31 J	5 U	10 U	**62**	0.2 U	**502**	0.45 J	0.12 J
	5/18/2018		4.8	40.2			1 U	0.4			**287 J**		**560**		
	11/19/2018		2.6	37.9			0.25 J	0.31 J			**48.6**		**461**		

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

Monitoring Well ID	Date Sampled	Antimony Total ug/L	Arsenic Total ug/L	Barium Total ug/L	Beryllium Total ug/L	Cadmium Total ug/L	Chromium Total ug/L	Fluoride Total mg/L	Cobalt Total ug/L	Lead Total ug/L	Lithium Total ug/L	Mercury Total ug/L	Molybdenum Total ug/L	Selenium Total ug/L	Thallium Total ug/L
	Site GWPS	**6**	**10**	**2000**	**4**	**5**	**100**	**4**	**6**	**15**	**40**	**2**	**100**	**50**	**2**
MW-8	3/30/2016	0.060 J	6.6	179	1 U	0.5 U	0.88 J	0.29	5 U	5 U	27.6	0.2 U	**229**	1 U	1 U
	5/16/2016	1 U	6.2	218	1 U	0.5 U	1 U	0.28	5 U	4.8 J	30.4	0.047 J	**204**	1 U	1 U
	7/19/2016	0.38 J	2.1	236	1 U	0.11 J	1 U	0.23	5 U	5 U	32	0.2 U	**215**	9	1 U
	9/8/2016	1 U	5.6	234	1 U	0.5 U	1 U	0.20 J	5 U	5 U	26.1	0.2 U	**211**	1 U	1 U
	11/10/2016	1 U	5.9	211	1 U	0.5 U	1 U	0.21	5 U	5 U	30.8	0.2 U	**212**	1 U	1 U
	1/6/2017	1 U	5.2	226	1 U	0.052 J	1 U	0.34	5 U	5 U	32.2	0.2 U	**207**	1 U	1 U
	3/7/2017	0.37 J	6.1	240	1 U	0.5 U	1.2	0.22	5 U	5.2	33	0.2 U	**213**	1 U	1 U
	6/14/2017	1 U	5.8	227	1 U	0.5 U	1 U	0.2	5 U	5 U	31.4	0.2 U	**190**	1 U	1 U
	11/6/2017							0.23							
	4/5/2018	1 U	6	199	1 U	0.035 J	0.20 J	0.2 UO	5 U	3.4 J	32.4	0.2 U	**192**	1 U	1 U
	5/17/2018		6.5	196			1 U	0.23			500 UO		**205**		
	11/19/2018		5.8	168			1 U	0.22			33.7		**183**		
AMW-1	11/20/2018	1 U	**18**	325	1 U	0.5 U	0.19 J	0.19 J	5 U	10 U	16.4	0.2 U	39.1	1 U	1 U
AMW-2	11/19/2018	1 U	**11.7**	147	1 U	0.5 U	0.23 J	0.3	5 U	10 U	36	0.2 U	4.3 J	1 U	1 U
TP-1	11/20/2018	1 U	1.9	386	1 U	0.039 J	0.17 J	0.3	5 U	4.1 J	17.2	0.2 U	3.1 J	1 U	1 U
TP-2	11/19/2018	1 U	3.8	58.8	1 U	0.5 U	1 U	0.36	5 U	10 U	**42.7**	0.2 U	6.2 J	1 U	1 U

Notes:
49 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.

Qualifiers:
J - Value is estimated.
U - Constituent was not detected, value is the reporting limit.
O - Value identified as an outlier.

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-1 and BMW-2.

FIGURES

GIS FILE PATH: \\haleyaldrich.com\share\cle_common\Projects\132002 - Ameren Ash Pond Closure Assessment\008-Meramec\GIS\Maps\2019_05\132002_008_0001_SITE_LOCUS.mxd — USER: hwachholz — LAST SAVED: 5/7/2019 10:43:41 AM

LEGEND

- MERMEC ENERGY CENTER PROPERTY BOUNDARY
- ACTIVE SURFACE IMPOUNDMENT
- EXEMPT SURFACE IMPOUNDMENT
- CAPPED AND CLOSED SURFACE IMPOUNDMENT

N

0 1,000 2,000
SCALE IN FEET

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

HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

SITE LOCATION MAP

MAY 2019

FIGURE 1-1

LEGEND

- CCR GROUNDWATER MONITORING WELL
- REGULATED SURFACE IMPOUNDMENT
- ACTIVE SURFACE IMPOUNDMENT
- CAPPED AND CLOSED SURFACE IMPOUNDMENT
- EXEMPT SURFACE IMPOUNDMENT
- MERAMEC ENERGY CENTER PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2. CCR - COAL COMBUSTION RESIDUALS.
3. AERIAL IMAGERY SOURCE: ESRI

N

0 800 1,600
SCALE IN FEET

HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
AMEREN MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

SITE FEATURES

MAY 2019

FIGURE 1-2

LEGEND

- CCR GROUNDWATER MONITORING WELL
- NATURE AND EXTENT MONITORING WELL
- NATURE AND EXTENT PIEZOMETER
- REGULATED SURFACE IMPOUNDMENT
- ACTIVE SURFACE IMPOUNDMENT
- CAPPED AND CLOSED SURFACE IMPOUNDMENT
- EXEMPT SURFACE IMPOUNDMENT
- MERAMEC ENERGY CENTER PROPERTY BOUNDARY
- MW-4 MW-5 As = ARSENIC CONCENTRATION ABOVE THE GWPS
- MW-6 Li = LITHIUM CONCENTRATION ABOVE THE GWPS
- MW-6 MW-7 MW-8 Mo = MOLYBDENUM CONCENTRATION ABOVE THE GWPS

NOTES

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2. CCR - COAL COMBUSTION RESIDUALS.
3. GWPS- GROUNDWATER PROTECTION STANDARD
4. AERIAL IMAGERY SOURCE: ESRI

N

0 800 1,600
SCALE IN FEET

HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
AMEREN MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

MONITORING WELL LOCATIONS WITH STATISTICALLY SIGNIFICANT LEVELS ABOVE THE GWPS

MAY 2019

FIGURE 2-1

GIS FILE PATH: \\haleyaldrich.com\share\cle_common\Projects\132002 - Ameren Ash Pond Closure Assessment\008-Meramec\GIS\Maps\2019_05\132002_008_0002_MW_ABOVE_GWPS.mxd — USER: hwachholz — LAST SAVED: 5/14/2019 9:27:28 AM

LEGEND

- Meramec Energy Center Property Boundary
- Unnamed Creek/Drainage
- NPDES Outfall Location
- All Surface Impoundments

May 2018 Surface Water Samples (M2)

- Small Creek/Drainage Sample
- Meramec River Sample
- Mississippi River Sample

September 2017 Surface Water Samples (M)

- Small Creek/Drainage Sample
- Meramec River Sample
- Mississippi River Sample
- Surface Water Flow Direction

KEY MAP

Site Location

NOTES
1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2. SAMPLE LOCATIONS BASED ON HANDHELD TRIMBLE GPS MEASUREMENTS. SAMPLE LOCATION REPRESENTS CENTERPOINT BETWEEN SAMPLE STARTING AND ENDING LOCATION.
3. PREFIX M- USED FOR SAMPLES COLLECTED IN SEPTEMBER 2017 AND M2- USED FOR SAMPLES COLLECTED IN MAY 2018.
4. NPDES - NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

REFERENCES
1.) AMEREN MISSOURI MERAMEC ENERGY CENTER, MERAMEC PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATEPLANE MISSOURI EAST FIPS 2401 FEET.

0 250 500 1,000 1,500 2,000 2,500 Feet

CLIENT
AMEREN MISSOURI
MERAMEC ENERGY CENTER

Ameren

PROJECT
AMEREN HYDROGEOLGICAL CONSULTING

TITLE
SURFACE WATER SAMPLING LOCATIONS
MERAMEC ENERGY CENTER

CONSULTANT

GOLDER

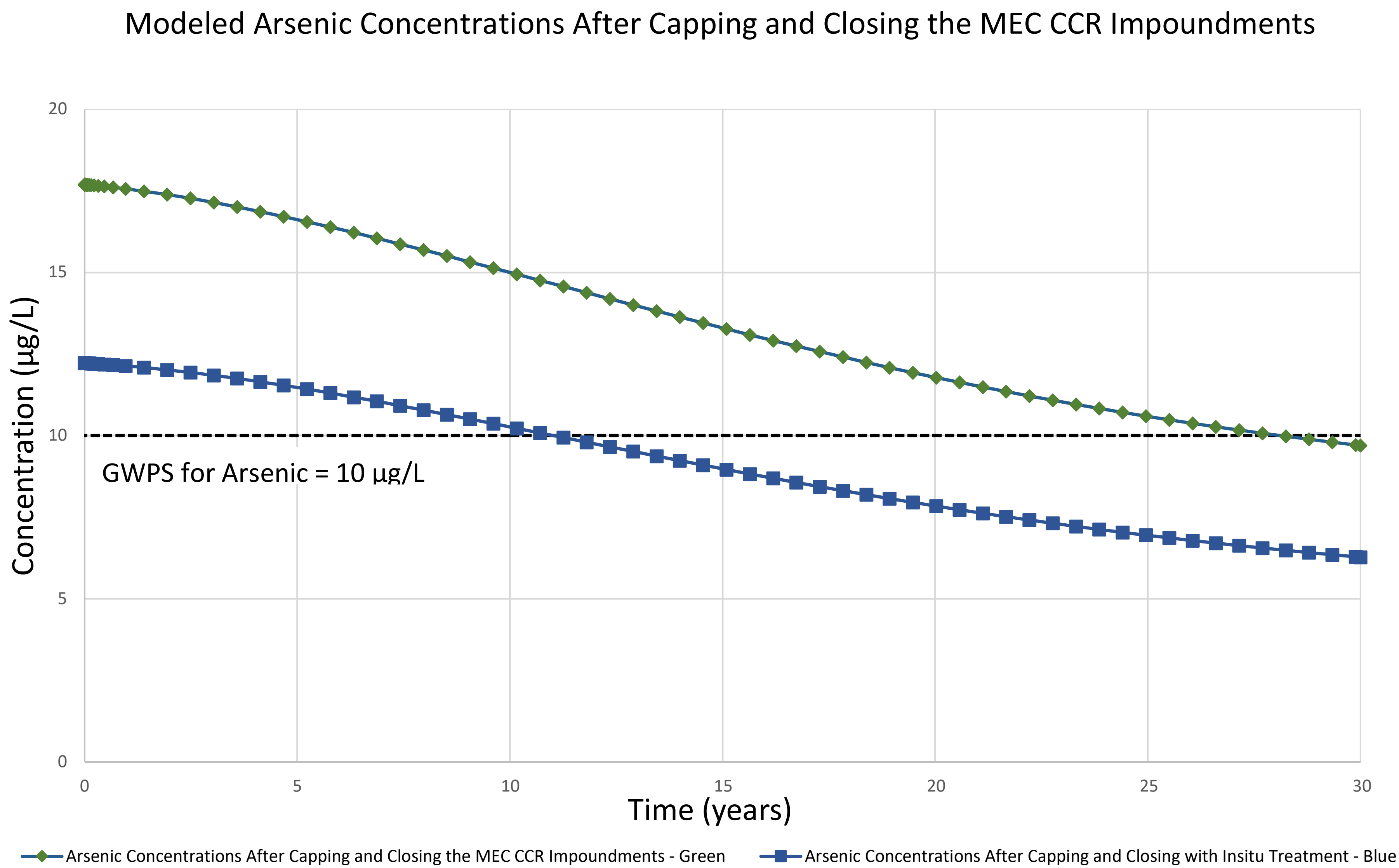
YYYY-MM-DD	2018-05-31
PREPARED	JS
DESIGN	JS
REVIEW	JSI
APPROVED	MNH

PROJECT No. 130-1560 PHASE 0006

Figure 2-2

FIGURE 4-1
REMEDIAL ALTERNATIVE ROADMAP
CORRECTIVE MEASURES ASSESSMENT
COAL COMBUSTION RESIDUAL (CCR) SURFACE IMPOUNDMENTS
MERAMEC ENERGY CENTER - ST. LOUIS COUNTY, MISSOURI

Alternative Number	Remedial Alternative Description	Surface Impoundments 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 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 treatment technology	**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 to maintain reduction of CCR constituents in groundwater
3	**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
4	**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



Notes:

µg/L = micrograms per Liter

CCR = Coal Combustion Residual

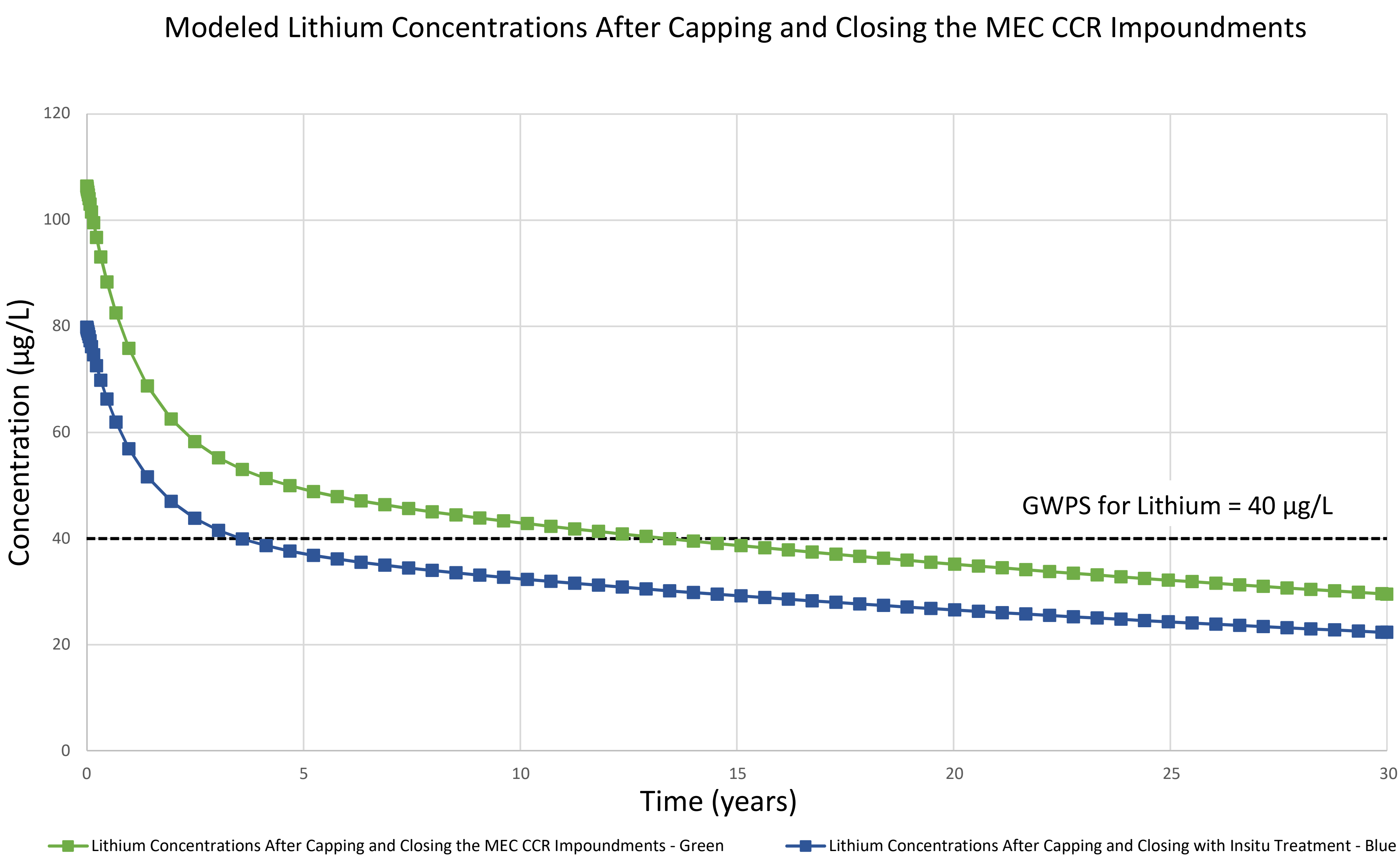
GWPS = Groundwater Protection Standard

MEC = Meramec Energy Center

BURNS McDONNELL

Figure 4-2

Modeled Arsenic Concentrations After Capping and Closing the CCR Units and Groundwater Remediation



Notes:

µg/L = micrograms per Liter

CCR = Coal Combustion Residuals

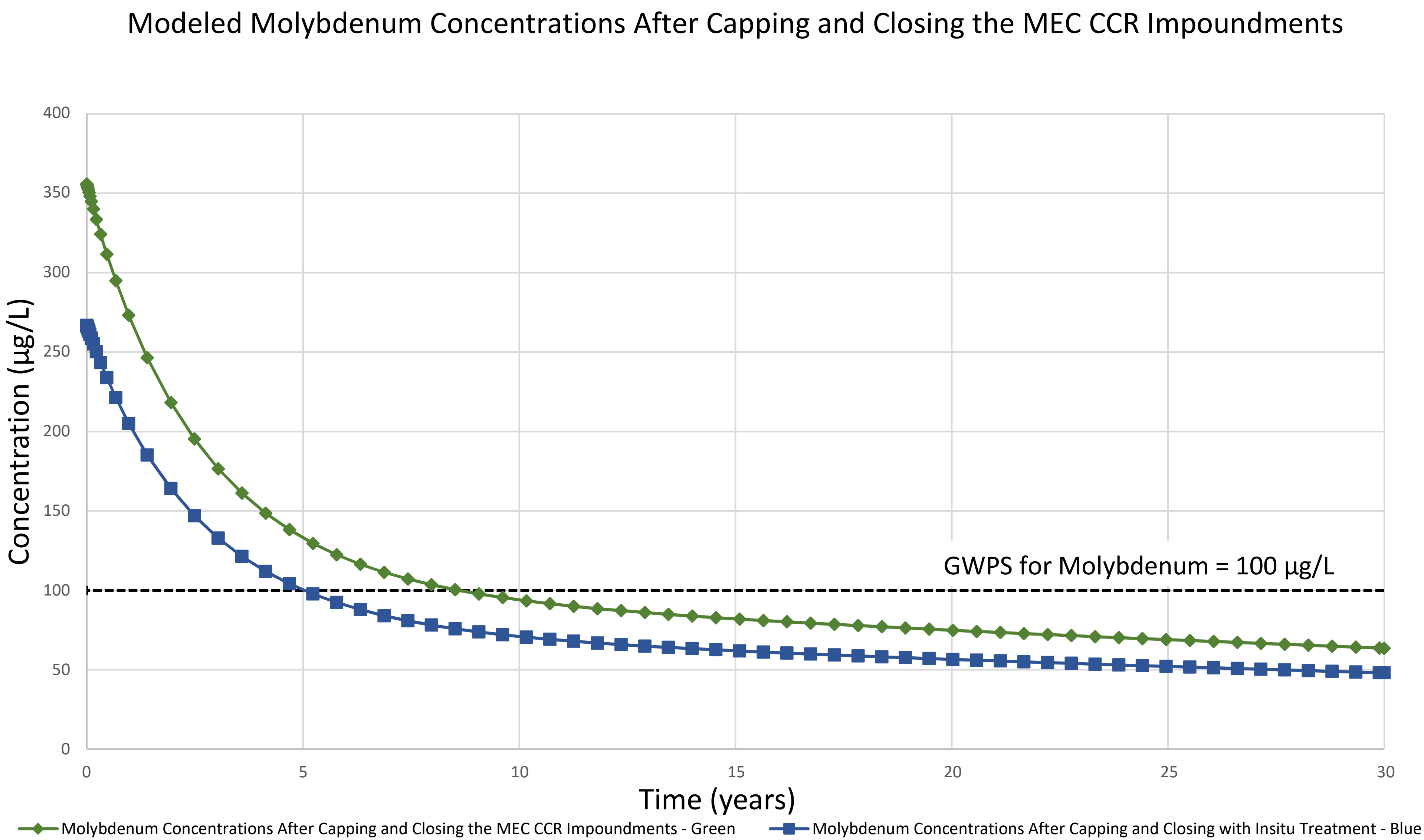
GWPS = Groundwater Protection Standard

MEC = Meramec Energy Center

BURNS McDONNELL

Figure 4-3

Modeled Lithium Concentrations After Capping and Closing the CCR Units and Groundwater Remediation



Notes:

µg/L = micrograms per Liter

CCR = Coal Combustion Residuals

GWPS = Groundwater Protection Standard

MEC = Meramec Energy Center

BURNS McDONNELL

Figure 4-4

Modeled Molybdenum Concentrations After Capping and Closing the CCR Units and Groundwater Remediation

APPENDIX A

Surface Water Screening Tables

Appendix A
Meramec Energy Center Surface Water Screening Tables – TOC

TABLES

TABLE 1
HUMAN HEALTH SCREENING LEVELS
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, 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)**	**Drinking Water (d)**	**Recreational Use (a) (e)**
Antimony	7440-36-0	0.006	NA	0.0078 (m)	0.006	0.64
Arsenic	7440-38-2	0.01	NA	0.000052	0.01	0.00014 (i)
Barium	7440-39-3	2	NA	3.8	2	NA
Beryllium	7440-41-7	0.004	NA	0.025	0.004	NA
Boron	7440-42-8	NA	NA	4	4	NA
Cadmium	7440-43-9	0.005	NA	0.0092	0.005	NA
Calcium	7440-70-2	NA	NA	NA	NA	NA
Chloride	7647-14-5	NA	250	NA	250	NA
Chromium	16065-83-1 (g)	0.1 (j)	NA	22 (n)	0.1	NA
Cobalt	7440-48-4	NA	NA	0.006	0.006	NA
Fluoride	16984-48-8	4	2	0.8	4	NA
Lead	7439-92-1	0.015 (k)	NA	0.015	0.015	NA
Lithium	7439-93-2	NA	NA	0.04	0.04	NA
Mercury	7487-94-7 (h)	0.002 (l)	NA	0.0057 (o)	0.002	NA
Molybdenum	7439-98-7	NA	NA	0.1	0.1	NA
Radium 226/228 (pCi/L)	RADIUM226228	5	NA	NA	5	NA
Selenium	7782-49-2	0.05	NA	0.1	0.05	4.2
Sulfate	7757-82-6	NA	250	NA	250	NA
Thallium	7440-28-0	0.002	NA	0.0002 (f)	0.002	0.00047
Total Dissolved Solids	TDS	NA	500	NA	500	NA
pH (std)	PHFLD	NA	6.5 - 8.5	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) - 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.
(e) - The selected Human Health Recreational Use Screening Level is the Federal USEPA AWQC for Human Health Consumption of Orga
(f) - RSL for Thallium (Soluble Salts) used for Thallium.
(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.

TABLE 2
ECOLOGICAL SCREENING LEVELS - MISSISSIPPI AND MERAMEC RIVERS
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

		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)			
Constituent	**CASRN**	**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	0.0036	(c)	0.0033	(d)	0.0013	(c)	0.0012	(d)	0.0042	(f)	0.0038	(g)	0.0015	(f)	0.0013	(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	3.1	(e,c)	0.97	(e,d)	0.15	(e,c)	0.13	(e,d)	3.5	(e,f)	1.1	(e,g)	0.17	(e,f)	0.14	(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	0.19	(c)	0.13	(d)	0.0073	(c)	0.0051	(d)	0.23	(f)	0.15	(g)	0.0089	(f)	0.0060	(g)
Lithium	7439-93-2	NA		NA		NA		NA		NA		NA		NA		NA	
Mercury	7439-97-6	0.0016		0.0014		0.00091		0.00077		0.0016		0.0014		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.
(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 using hardness data collected in September 2017 - 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 and Meramec Rivers of 192 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 and Meramec Rivers of 192 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 and Meramec Rivers of 224 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 and Meramec Rivers of 224 mg/L as $CaCO_3$ used.

TABLE 3
ECOLOGICAL SCREENING LEVELS - UNAMED CREEK/DRAINAGE
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, 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	0.0040	(c)	0.0037	(d)	0.0015	(c)	0.0013	(d)	0.0048	(f)	0.0043	(g)	0.0017	(f)	0.0015	(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	3.4	(e,c)	1.1	(e,d)	0.16	(e,c)	0.14	(e,d)	3.9	(e,f)	1.2	(e,g)	0.19	(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	0.22	(c)	0.15	(d)	0.0084	(c)	0.0057	(d)	0.27	(f)	0.18	(g)	0.011	(f)	0.0069	(g)
Lithium	7439-93-2	NA		NA		NA		NA		NA		NA		NA		NA	
Mercury	7439-97-6	0.0016		0.0014		0.00091		0.00077		0.0016		0.0014		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.
(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 using hardness data collected in September 2017 - 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 Unnamed Creek/Drainage of 215 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 Unnamed Creek/Drainage of 215 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 Unnamed Creek/Drainage of 256 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 Unnamed Creek/Drainage of 256 mg/L as $CaCO_3$ used.

TABLE 4
SUMMARY OF SCREENING RESULTS
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

	Meramec River - Human Health Drinking Water						Meramec River - Human Health Recreational					
	Dissolved			Total			Dissolved			Total		
Constituent	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream
Antimony												
Arsenic							9 : 9 100%	9 : 9 100%	10 : 10 100%	9 : 9 100%	9 : 9 100%	10 : 10 100%
Barium												
Beryllium												
Boron												
Cadmium												
Calcium												
Chloride												
Chromium												
Cobalt												
Fluoride												
Lead				3 : 9 33%	2 : 9 22%	1 : 10 10%						
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 4
SUMMARY OF SCREENING RESULTS
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

	Meramec River - Ecological						Mississippi River - Human Health Drinking Water					
	Dissolved			Total			Dissolved			Total		
Constituent	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream
Antimony												
Arsenic								2 : 20 10%				
Barium												
Beryllium												
Boron												
Cadmium												
Calcium												
Chloride												
Chromium												
Cobalt												
Fluoride												
Lead				8 : 9 89%	6 : 9 67%	7 : 10 70%						
Lithium												
Mercury												
Molybdenum												
pH												
Selenium												
Sulfate												
Thallium								2 : 20 10%				
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 4
SUMMARY OF SCREENING RESULTS
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

	Mississippi River - Human Health Recreational						Mississippi River - Ecological					
	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										1 : 10 10%		
Lithium												
Mercury												
Molybdenum												
pH												
Selenium												
Sulfate												
Thallium		2 : 20 10%										
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 4
SUMMARY OF SCREENING RESULTS
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	Unnamed Creek/Drainage - Human Health Drinking Water		Unnamed Creek/Drainage - Human Health Recreational		Unnamed Creek/Drainage - Ecological	
	Dissolved	Total	Dissolved	Total	Dissolved	Total
Antimony						
Arsenic			6 : 6 100%	6 : 6 100%		
Barium						
Beryllium						
Boron						
Cadmium						
Calcium						
Chloride						
Chromium						
Cobalt						
Fluoride						
Lead						
Lithium						
Mercury						
Molybdenum						
pH						
Selenium						
Sulfate						
Thallium						
TDS		1 : 6 17%				
Radium 226/228						

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

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

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Meramec River Upstream					Meramec River Adjacent					Meramec River Downstream				
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		M2-MEC-7S	M2-MEC-8D	M2-MEC-8S	M2-MEC-9D	M2-MEC-9S	M2-MEC-4S	M2-MEC-5D	M2-MEC-5S	M2-MEC-6D	M2-MEC-6S	M2-MEC-1S	M2-MEC-2D	M2-MEC-2S	M2-MEC-3D	M2-MEC-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	0.00061 J	0.00064 J	0.00061 J	0.00063 J	0.00064 J	0.00062 J	0.00061 J	0.00058 J	0.00064 J	0.00069 J	0.00069 J	0.00066 J	0.00061 J	0.00059 J	0.00069 J
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.134	0.139	0.133	0.14	0.133	0.135	0.14	0.135	0.139	0.136	0.135	0.141	0.137	0.137	0.135
Beryllium	7440-41-7	mg/L	0.004	NA	0.025	0.004	0.00017 J	0.00017 J													
Boron	7440-42-8	mg/L	NA	NA	4	4						0.0151 J					0.0142 J	0.0151 J	0.0143 J	0.0139 J	0.0139 J
Cadmium	7440-43-9	mg/L	0.005	NA	0.0092	0.005															
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	28.6	28.8	28.3	29.1	28.3	28.8	28.9	28.9	28.7	29	28.6	28.9	29.3	28.3	28.5
Chloride	16887-00-6	mg/L	NA	250	NA	250	6.4	6.5	6.5	6.5	6.5	6.4	6.4	6.5	6.5	6.4	6.5	6.4	6.7	6.4	6.3
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														0.00089 J	
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.074 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.11 J	0.11 J
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015	0.0081 J	0.0092 J	0.0077 J	0.0086 J	0.005 J	0.0071 J	0.0094 J	0.0057 J	0.0114	0.0054 J	0.0065 J	0.0097 J	0.0062 J	0.0096 J	0.0067 J
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04															
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															
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05															
Sulfate	14808-79-8	mg/L	NA	250	NA	250	12.2	13.3	13.1	15.4	13.1	13	12.9	12.9	13	12.8	13.2	12.9	13	12.9	12.9
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	135	135	133	137	133	135	136	136	135	136	136	137	138	134	135
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	163	165	166	160	134	162	163	169	163	179	260	177	172	177	173

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 5a
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

			Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River Upstream					Mississippi River Adjacent									
Constituent	**CAS**	**Units**	**USEPA MCLs (b)**	**USEPA SMCLs (b)**	**USEPA Tapwater RSLs (c)**		**M2-MIS-10S**	**M2-MIS-11D**	**M2-MIS-11S**	**M2-MIS-12D**	**M2-MIS-12S**	**M2-MIS-4S**	**M2-MIS-5D**	**M2-MIS-5S**	**M2-MIS-6D**	**M2-MIS-6S**	**M2-MIS-7S**	**M2-MIS-8D**	**M2-MIS-8S**	**M2-MIS-9D**	**M2-MIS-9S**
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	0.0031	0.0023	0.0024	0.0034	0.0029	0.003	0.0021	0.0022	0.0033	0.0031	0.0034	0.002	0.0021
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.139	0.146	0.136	0.106	0.118	0.136	0.122	0.131	0.105	0.0973	0.137	0.144	0.14	0.0934	0.1
Beryllium	7440-41-7	mg/L	0.004	NA	0.025	0.004	0.00017 J		0.0002 J								0.00018 J				
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0659 J	0.058 J	0.0522 J	0.0368 J	0.0408 J	0.0656 J	0.0503 J	0.0531 J	0.0341 J	0.0347 J	0.0651 J	0.0561 J	0.0576 J	0.0345 J	0.0338 J
Cadmium	7440-43-9	mg/L	0.005	NA	0.0092	0.005															
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	61.1	61.7	57.2	51.8	54	61	56.4	58.4	50.2	50.4	62.5	58.9	60.1	48.3	49.6
Chloride	16887-00-6	mg/L	NA	250	NA	250	24.5	24.6	24.6	28.4	28.3	23.2	24.1	24	28.8	29	23.2	23.6	23.6	30.4	29.6
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1	0.0044 J	0.0056	0.0047 J	0.0043 J	0.0045 J	0.0044 J	0.0029 J	0.0045 J	0.0043 J	0.003 J	0.0035 J	0.0053	0.0039 J	0.0028 J	0.004 J
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006	0.0018 J	0.0022 J	0.0019 J	0.0021 J	0.0022 J	0.002 J	0.0016 J	0.0019 J	0.0015 J	0.0015 J	0.0017 J	0.0025 J	0.002 J	0.0014 J	0.0015 J
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.35	0.32	0.32	0.25	0.26	0.29 J	0.24	0.25	0.19 J	0.18 J	0.3	0.27	0.27	0.18 J	0.17 J
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015	0.0063 J	0.0087 J	0.0067 J	0.0069 J	0.0068 J	0.0052 J	0.0048 J	0.0071 J	0.0071 J	0.0065 J	0.006 J	0.0061 J	0.005 J	0.004 J	0.0059 J
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.026	0.0232	0.0202	0.0095 J	0.012	0.0252	0.0176	0.0189	0.0092 J	0.0096 J	0.028	0.0229	0.0227	0.0068 J	0.0076 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	0.002 J	0.0023 J	0.0017 J	0.0012 J	0.0013 J	0.002 J	0.0014 J	0.0016 J	0.0013 J	0.00097 J	0.0023 J	0.0016 J	0.0018 J	0.0013 J	0.0012 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05				0.0068 J											
Sulfate	14808-79-8	mg/L	NA	250	NA	250	132	107	105	53.9	54.5	127	85.1	90.3	44.9	44.5	128	105	105	39.7	42.4
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	250	253	235	214	222	253	232	239	206	207	256	242	246	200	205
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	440	392	389	347	426	446	400	379	319	330	442	469	401	298	225

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 5a
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River Downstream				
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		M2-MIS-1S	M2-MIS-2D	M2-MIS-2S	M2-MIS-3D	M2-MIS-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	0.0022	0.0031	0.0032	0.0025	0.0026
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.142	0.139	0.138	0.111	0.11
Beryllium	7440-41-7	mg/L	0.004	NA	0.025	0.004		0.00029 J		0.00022 J	0.00018 J
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0413 J	0.0623 J	0.0642 J	0.0407 J	0.044 J
Cadmium	7440-43-9	mg/L	0.005	NA	0.0092	0.005	0.00065 J		0.00045 J		
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	50.7	61.9	62	53	53.4
Chloride	16887-00-6	mg/L	NA	250	NA	250	16.2	23.3	23.4	26	25.6
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1	0.0021 J	0.0041 J	0.005	0.0035 J	0.0036 J
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006	0.0011 J	0.0024 J	0.0021 J	0.002 J	0.0022 J
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.18 J	0.26	0.26	0.2	0.21
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015	0.0049 J	0.0059 J	0.006 J	0.0068 J	0.0062 J
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0155	0.022	0.0252	0.0119	0.0137
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	0.0021 J	0.0023 J	0.0015 J	0.0015 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05					
Sulfate	14808-79-8	mg/L	NA	250	NA	250	73.2	109	104	63.4	66.7
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	215	254	254	214	219
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	303	423	404	351	348

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 5b
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS -
DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Meramec River Upstream					Meramec River Adjacent					Meramec River Downstream				
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		M2-MEC-7S	M2-MEC-8D	M2-MEC-8S	M2-MEC-9D	M2-MEC-9S	M2-MEC-4S	M2-MEC-5D	M2-MEC-5S	M2-MEC-6D	M2-MEC-6S	M2-MEC-1S	M2-MEC-2D	M2-MEC-2S	M2-MEC-3D	M2-MEC-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	0.00058 J	0.00058 J	0.00065 J	0.00059 J	0.00059 J	0.00061 J	0.00056 J	0.00066 J	0.00056 J	0.00064 J	0.00063 J	0.00062 J	0.0006 J	0.00061 J	0.00059 J
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.13	0.127	0.128	0.127	0.128	0.127	0.128	0.13	0.129	0.128	0.127	0.127	0.128	0.129	0.13
Beryllium	7440-41-7	mg/L	0.004	NA	0.025	0.004						0.00018 J	0.00018 J	0.00019 J		0.00018 J	0.00018 J	0.00019 J	0.00024 J	0.00018 J	
Boron	7440-42-8	mg/L	NA	NA	4	4									0.0129 J		0.0129 J				
Cadmium	7440-43-9	mg/L	0.005	NA	0.0092	0.005															
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	28.4	28.4	28.2	28.2	28.5	28.3	28.3	28.7	28.6	28.4	28.1	28.2	28.4	28.5	28.8
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															
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04															
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															
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 5b
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS -
DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River Upstream					Mississippi River Adjacent									
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		M2-MIS-10S	M2-MIS-11D	M2-MIS-11S	M2-MIS-12D	M2-MIS-12S	M2-MIS-4S	M2-MIS-5D	M2-MIS-5S	M2-MIS-6D	M2-MIS-6S	M2-MIS-7S	M2-MIS-8D	M2-MIS-8S	M2-MIS-9D	M2-MIS-9S
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	0.0023	0.0021	0.0022	0.0015	0.0016	0.002 J	0.0521	0.052	0.0014	0.0015	0.0024	0.0023	0.0021	0.0014	0.0014
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.0969	0.0829	0.0856	0.066	0.0727	0.0981	0.0823	0.0848	0.0634	0.0698	0.096	0.0899	0.0906	0.065	0.0665
Beryllium	7440-41-7	mg/L	0.004	NA	0.025	0.004															
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0648 J	0.0502 J	0.0538 J	0.0343 J	0.0369 J	0.068 J	0.0501 J	0.0514 J	0.0328 J	0.0346 J	0.0675 J	0.0578 J	0.059 J	0.0336 J	0.0331 J
Cadmium	7440-43-9	mg/L	0.005	NA	0.0092	0.005													0.00046 J		
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	62.8	57.7	60.1	49.5	52.6	61.5	53.6	55	51.8	52.7	64.7	59.4	60.8	50.6	52.2
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		0.003 J				0.0042 J									
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0246	0.016	0.0172	0.0079 J	0.011	0.0269	0.0156	0.0192	0.0046 J	0.0074 J	0.0255	0.0213	0.0219	0.0054 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	0.002 J	0.0017 J	0.002 J	0.0014 J	0.0018 J	0.0022 J	0.0016 J	0.0019 J	0.0015 J	0.0014 J	0.0024 J	0.0017 J	0.0021 J	0.0012 J	0.0015 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							0.0506	0.0512							

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 5b
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS -
DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River Downstream				
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		M2-MIS-1S	M2-MIS-2D	M2-MIS-2S	M2-MIS-3D	M2-MIS-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	0.0018	0.0025	0.0023	0.0021	0.0019
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.109	0.0917	0.0941	0.0732	0.0798
Beryllium	7440-41-7	mg/L	0.004	NA	0.025	0.004	0.00018 J				
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0408 J	0.0666 J	0.0573 J	0.0435 J	0.0479 J
Cadmium	7440-43-9	mg/L	0.005	NA	0.0092	0.005					
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	48.5	58.5	61.8	50.8	54
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		0.0034 J		0.0035 J	0.004 J
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0136	0.0207	0.0231	0.0106	0.0131
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	0.0024 J	0.0017 J	0.0017 J	0.0021 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 5c
COMPARISON OF SEPTEMBER 2017 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Meramec River												
							River Upstream				River Adjacent				River Downstream				
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		M-MEC-7S	M-MEC-8S	M-MEC-9D	M-MEC-9S	M-MEC-4S	M-MEC-5S	M-MEC-6D	M-MEC-6S	M-MEC-1S	M-MEC-2D	M-MEC-2S	M-MEC-3D	M-MEC-3S
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006			0.0038										
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0018	0.0014	0.0013	0.0012	0.0018	0.0016	0.0014	0.0013	0.0016	0.0014	0.0015	0.0014	0.0015
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.186	0.18	0.193	0.186	0.193	0.19	0.194	0.18	0.19	0.195	0.191	0.188	0.19
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004													
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0305	0.0256	0.0248	0.0257	0.0749	0.0609	0.0289	0.0282	0.0364	0.0305	0.0312	0.0336	0.0306
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005													
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	44.1	43.1	43.9	42.9	44.4	44.6	44.1	42.9	44	44.9	44	43.1	43.7
Chloride	16887-00-6	mg/L	NA	250	NA	250	20.6	19.8	19.9	20	20.3	20.4	19.6	19.8	19.6	19.8	19.9	19.5	20
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1	0.0013		0.0018		0.0014	0.00092	0.0011	0.0012	0.0018	0.0015		0.0014	0.0009
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006			0.00073		0.00085								
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.18	0.17	0.17	0.17	0.18	0.18	0.18	0.18	0.17	0.18	0.18	0.18	0.18
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015	0.0172	0.0112	0.0205	0.0196	0.0175	0.0139	0.018	0.0121	0.014	0.0142	0.0146	0.0155	0.0143
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04				0.0042		0.0057			0.0035				0.0035
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						0.0016					0.0014		
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05													
Sulfate	14808-79-8	mg/L	NA	250	NA	250	24.3	23.4	23.1	23.1	26.7	26.6	23.2	23.2	24.5	23.1	23.9	23.3	23.3
Thallium*	7440-28-0	mg/L	0.002	NA	0.0002	0.002									0.000073		0.000075		
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	NA	NA	212	211	214	209	212	214	213	209	214	219	213	209	213
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	242	240	229	248	254	250	227	247	245	249	238	224	245

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 5c
COMPARISON OF SEPTEMBER 2017 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

			Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River																			
							River Upstream					River Adjacent										River Downstream				
Constituent	CAS	Units	USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		M-MIS-10S	M-MIS-11D	M-MIS-11S	M-MIS-12D	M-MIS-12S	M-MIS-4S	M-MIS-5D	M-MIS-5S	M-MIS-6D	M-MIS-6S	M-MIS-7S	M-MIS-8D	M-MIS-8S	M-MIS-9D	M-MIS-9S	M-MIS-1S	M-MIS-2D	M-MIS-2S	M-MIS-3D	M-MIS-3S
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006														0.0035			0.0057			
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.003	0.0028	0.003	0.0024	0.0022	0.0032	0.0028	0.0027	0.0024	0.0023	0.0035	0.0029	0.0027	0.0022	0.0022	0.0028	0.003	0.003	0.0024	0.0026
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.102	0.0987	0.103	0.081	0.0807	0.106	0.0976	0.0967	0.081	0.0825	0.124	0.0999	0.0978	0.0783	0.078	0.133	0.106	0.103	0.0859	0.11
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004																				
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0953	0.0822	0.0858	0.0547	0.0573	0.0943	0.0803	0.0755	0.0593	0.0587	0.0981	0.0842	0.0846	0.0548	0.0535	0.0801	0.0902	0.0888	0.0665	0.0674
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	57	56	56.8	52.6	52.4	57.9	55.8	52.4	51.5	52.1	59.5	56.6	55.1	50.7	51.1	59.4	57.1	57.5	52	52.9
Chloride	16887-00-6	mg/L	NA	250	NA	250	24.9	24.6	24.7	25.4	25.7	25	24.6	24.7	25.7	25.9	25.1	24.7	24.9	26	26	24	24.7	24.7	24.8	24.9
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1	0.00072	0.0018	0.0015	0.0013	0.0014	0.0013	0.0014	0.002	0.0013	0.0016	0.0018	0.0015	0.0012	0.0012	0.00093	0.0016		0.0016	0.0012	0.002
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006											0.0008									
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.37	0.35	0.35	0.27	0.28	0.37	0.32	0.33	0.27	0.27	0.37	0.34	0.34	0.26	0.26	0.32	0.35	0.34	0.3	0.31
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015	0.0028			0.0035	0.0026	0.0037	0.0035			0.0028	0.0043	0.0032	0.0034		0.0033	0.0056	0.0033	0.0027		0.0029
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0321	0.0288	0.0284	0.0169	0.012	0.032	0.0277	0.0215	0.0172	0.0158	0.0331	0.0255	0.0267	0.0123	0.0113	0.0266	0.0323	0.0302	0.0193	0.021
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	0.0029	0.0026	0.0025	0.002	0.002	0.0026	0.0024	0.0024	0.0026	0.0027	0.0032	0.0024	0.0023	0.0022	0.0021	0.0029	0.0027	0.0028	0.0024	0.0025
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05						0.005			0.004											
Sulfate	14808-79-8	mg/L	NA	250	NA	250	140	130	129	71	69.8	140	111	110	61.8	63.2	140	120	123	57.2	57.6	109	130	123	87.9	88.4
Thallium*	7440-28-0	mg/L	0.002	NA	0.0002	0.002											0.00016							0.000062		
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	NA	NA	236	233	235	230	230	238	234	221	226	227	245	237	229	223	224	243	235	240	224	226
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	398	391	384	300	309	393	374	357	290	303	408	389	373	288	277	355	393	390	332	328

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 5d
COMPARISON OF SEPTEMBER 2017 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS -
DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Meramec River												
							River Upstream				River Adjacent				River Downstream				
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		M-MEC-7S	M-MEC-8S	M-MEC-9D	M-MEC-9S	M-MEC-4S	M-MEC-5S	M-MEC-6D	M-MEC-6S	M-MEC-1S	M-MEC-2D	M-MEC-2S	M-MEC-3D	M-MEC-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	0.0013	0.0011	0.0011	0.0014	0.0013	0.0012	0.0011	0.0013	0.0012	0.0011	0.0011	0.0012
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.167	0.166	0.176	0.172	0.18	0.177	0.177	0.173	0.171	0.172	0.174	0.18	0.176
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004													
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0281	0.0266	0.0263	0.025	0.0625	0.0596	0.0282	0.027	0.0359	0.0285	0.0341	0.0314	0.0289
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005													
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	41.2	40.2	41.9	41.2	43.2	42.8	42.1	41.2	41.1	41	41.3	41.7	41.9
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									0.00073		0.00074		
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													
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						0.0013							
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									0.000057				0.00005

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
-- - Constituent not included in this analysis.
CAS - Chemical Abstracts Service.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Risk-Based 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 5d
COMPARISON OF SEPTEMBER 2017 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS -
DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

			Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River																			
							River Upstream					River Adjacent										River Downstream				
Constituent	CAS	Units	USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		M-MIS-10S	M-MIS-11D	M-MIS-11S	M-MIS-12D	M-MIS-12S	M-MIS-4S	M-MIS-5D	M-MIS-5S	M-MIS-6D	M-MIS-6S	M-MIS-7S	M-MIS-8D	M-MIS-8S	M-MIS-9D	M-MIS-9S	M-MIS-1S	M-MIS-2D	M-MIS-2S	M-MIS-3D	M-MIS-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	0.0028	0.0026	0.0025	0.0019	0.0019	0.0028	0.0024	0.0024	0.0019	0.002	0.0027	0.0024	0.0025	0.0018	0.0021	0.0024	0.0025	0.0024	0.0021	0.0021
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.0965	0.0887	0.0899	0.066	0.0656	0.0936	0.0826	0.0845	0.0687	0.0688	0.0949	0.0844	0.0861	0.0645	0.0674	0.112	0.0874	0.0872	0.073	0.0746
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004								0.0014												
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0979	0.0859	0.0862	0.0542	0.0566	0.0946	0.0771	0.0812	0.0593	0.057	0.0943	0.0806	0.0836	0.0515	0.0579	0.0804	0.0873	0.082	0.0627	0.0672
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	58.1	56	56	51	50.2	57.2	54.1	53.8	51.4	52.9	57.2	54.3	54.5	50.2	51.2	52	55.5	51	51.9	52.5
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1	0.00079	0.00074		0.00076		0.00093	0.00096				0.00075				0.0011					0.00099
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	0.0026	0.0027		0.0024			0.0027						0.0025						0.003	
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0306	0.0241	0.032	0.0132	0.0144	0.0289	0.023	0.0316	0.0176	0.0155	0.0335	0.0287	0.032	0.0135	0.0166	0.0264	0.0263	0.0278	0.019	0.0207
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	0.0032	0.0025	0.0027	0.0025	0.0018	0.0029	0.0025	0.0031	0.0026	0.0026	0.0028	0.0026	0.0027	0.0017	0.0022	0.0023	0.0034	0.0024	0.0027	0.0022
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05	0.0036									0.0051						0.0043		0.0039		
Thallium	7440-28-0	mg/L	0.002	NA	0.0002	0.002																		0.000053		

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
-- - Constituent not included in this analysis.
CAS - Chemical Abstracts Service.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Risk-Based 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 6a
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH AWQC SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

			USEPA	Meramec River Upstream					Meramec River Adjacent					Meramec River Downstream				
Constituent	**CAS**	**Units**	**AWQC (b)**	**M2-MEC-7S**	**M2-MEC-8D**	**M2-MEC-8S**	**M2-MEC-9D**	**M2-MEC-9S**	**M2-MEC-4S**	**M2-MEC-5D**	**M2-MEC-5S**	**M2-MEC-6D**	**M2-MEC-6S**	**M2-MEC-1S**	**M2-MEC-2D**	**M2-MEC-2S**	**M2-MEC-3D**	**M2-MEC-3S**
Antimony*	7440-36-0	mg/L	0.64															
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.00061 J	0.00064 J	0.00061 J	0.00063 J	0.00064 J	0.00062 J	0.00061 J	0.00058 J	0.00064 J	0.00069 J	0.00069 J	0.00066 J	0.00061 J	0.00059 J	0.00069 J
Barium	7440-39-3	mg/L	NA	0.134	0.139	0.133	0.14	0.133	0.135	0.14	0.135	0.139	0.136	0.135	0.141	0.137	0.137	0.135
Beryllium	7440-41-7	mg/L	NA	0.00017 J	0.00017 J													
Boron	7440-42-8	mg/L	NA						0.0151 J					0.0142 J	0.0151 J	0.0143 J	0.0139 J	0.0139 J
Cadmium	7440-43-9	mg/L	NA															
Calcium	7440-70-2	mg/L	NA	28.6	28.8	28.3	29.1	28.3	28.8	28.9	28.9	28.7	29	28.6	28.9	29.3	28.3	28.5
Chloride	16887-00-6	mg/L	NA	6.4	6.5	6.5	6.5	6.5	6.4	6.4	6.5	6.5	6.4	6.5	6.4	6.7	6.4	6.3
Chromium	7440-47-3	mg/L	NA															
Cobalt	7440-48-4	mg/L	NA														0.00089 J	
Fluoride	16984-48-8	mg/L	NA	0.074 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.11 J	0.11 J
Lead	7439-92-1	mg/L	NA	0.0081 J	0.0092 J	0.0077 J	0.0086 J	0.005 J	0.0071 J	0.0094 J	0.0057 J	0.0114	0.0054 J	0.0065 J	0.0097 J	0.0062 J	0.0096 J	0.0067 J
Lithium	7439-93-2	mg/L	NA															
Mercury*	7439-97-6	mg/L	NA															
Molybdenum	7439-98-7	mg/L	NA															
Selenium	7782-49-2	mg/L	4.2															
Sulfate	14808-79-8	mg/L	NA	12.2	13.3	13.1	15.4	13.1	13	12.9	12.9	13	12.8	13.2	12.9	13	12.9	12.9
Thallium*	7440-28-0	mg/L	0.00047															
Total Hardness as CaCO3	471-34-1	mg/L	NA	135	135	133	137	133	135	136	136	135	136	136	137	138	134	135
Total Dissolved Solids	TDS	mg/L	NA	163	165	166	160	134	162	163	169	163	179	260	177	172	177	173

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 6a
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH AWQC SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

			USEPA	Mississippi River Upstream					Mississippi River Adjacent									
Constituent	CAS	Units	AWQC (b)	M2-MIS-10S	M2-MIS-11D	M2-MIS-11S	M2-MIS-12D	M2-MIS-12S	M2-MIS-4S	M2-MIS-5D	M2-MIS-5S	M2-MIS-6D	M2-MIS-6S	M2-MIS-7S	M2-MIS-8D	M2-MIS-8S	M2-MIS-9D	M2-MIS-9S
Antimony*	7440-36-0	mg/L	0.64															
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0034	0.0034	0.0031	0.0023	0.0024	0.0034	0.0029	0.003	0.0021	0.0022	0.0033	0.0031	0.0034	0.002	0.0021
Barium	7440-39-3	mg/L	NA	0.139	0.146	0.136	0.106	0.118	0.136	0.122	0.131	0.105	0.0973	0.137	0.144	0.14	0.0934	0.1
Beryllium	7440-41-7	mg/L	NA	0.00017 J		0.0002 J								0.00018 J				
Boron	7440-42-8	mg/L	NA	0.0659 J	0.058 J	0.0522 J	0.0368 J	0.0408 J	0.0656 J	0.0503 J	0.0531 J	0.0341 J	0.0347 J	0.0651 J	0.0561 J	0.0576 J	0.0345 J	0.0338 J
Cadmium	7440-43-9	mg/L	NA															
Calcium	7440-70-2	mg/L	NA	61.1	61.7	57.2	51.8	54	61	56.4	58.4	50.2	50.4	62.5	58.9	60.1	48.3	49.6
Chloride	16887-00-6	mg/L	NA	24.5	24.6	24.6	28.4	28.3	23.2	24.1	24	28.8	29	23.2	23.6	23.6	30.4	29.6
Chromium	7440-47-3	mg/L	NA	0.0044 J	0.0056	0.0047 J	0.0043 J	0.0045 J	0.0044 J	0.0029 J	0.0045 J	0.0043 J	0.003 J	0.0035 J	0.0053	0.0039 J	0.0028 J	0.004 J
Cobalt	7440-48-4	mg/L	NA	0.0018 J	0.0022 J	0.0019 J	0.0021 J	0.0022 J	0.002 J	0.0016 J	0.0019 J	0.0015 J	0.0015 J	0.0017 J	0.0025 J	0.002 J	0.0014 J	0.0015 J
Fluoride	16984-48-8	mg/L	NA	0.35	0.32	0.32	0.25	0.26	0.29 J	0.24	0.25	0.19 J	0.18 J	0.3	0.27	0.27	0.18 J	0.17 J
Lead	7439-92-1	mg/L	NA	0.0063 J	0.0087 J	0.0067 J	0.0069 J	0.0068 J	0.0052 J	0.0048 J	0.0071 J	0.0071 J	0.0065 J	0.006 J	0.0061 J	0.005 J	0.004 J	0.0059 J
Lithium	7439-93-2	mg/L	NA	0.026	0.0232	0.0202	0.0095 J	0.012	0.0252	0.0176	0.0189	0.0092 J	0.0096 J	0.028	0.0229	0.0227	0.0068 J	0.0076 J
Mercury*	7439-97-6	mg/L	NA															
Molybdenum	7439-98-7	mg/L	NA	0.002 J	0.0023 J	0.0017 J	0.0012 J	0.0013 J	0.002 J	0.0014 J	0.0016 J	0.0013 J	0.00097 J	0.0023 J	0.0016 J	0.0018 J	0.0013 J	0.0012 J
Selenium	7782-49-2	mg/L	4.2				0.0068 J											
Sulfate	14808-79-8	mg/L	NA	132	107	105	53.9	54.5	127	85.1	90.3	44.9	44.5	128	105	105	39.7	42.4
Thallium*	7440-28-0	mg/L	0.00047															
Total Hardness as CaCO3	471-34-1	mg/L	NA	250	253	235	214	222	253	232	239	206	207	256	242	246	200	205
Total Dissolved Solids	TDS	mg/L	NA	440	392	389	347	426	446	400	379	319	330	442	469	401	298	225

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 6a
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH AWQC SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	USEPA AWQC (b)		Mississippi River Downstream M2-MIS-1S	M2-MIS-2D	M2-MIS-2S	M2-MIS-3D	M2-MIS-3S
Antimony*	7440-36-0	mg/L	0.64						
Arsenic	7440-38-2	mg/L	0.00014	(c)	0.0022	0.0031	0.0032	0.0025	0.0026
Barium	7440-39-3	mg/L	NA		0.142	0.139	0.138	0.111	0.11
Beryllium	7440-41-7	mg/L	NA			0.00029 J		0.00022 J	0.00018 J
Boron	7440-42-8	mg/L	NA		0.0413 J	0.0623 J	0.0642 J	0.0407 J	0.044 J
Cadmium	7440-43-9	mg/L	NA		0.00065 J		0.00045 J		
Calcium	7440-70-2	mg/L	NA		50.7	61.9	62	53	53.4
Chloride	16887-00-6	mg/L	NA		16.2	23.3	23.4	26	25.6
Chromium	7440-47-3	mg/L	NA		0.0021 J	0.0041 J	0.005	0.0035 J	0.0036 J
Cobalt	7440-48-4	mg/L	NA		0.0011 J	0.0024 J	0.0021 J	0.002 J	0.0022 J
Fluoride	16984-48-8	mg/L	NA		0.18 J	0.26	0.26	0.2	0.21
Lead	7439-92-1	mg/L	NA		0.0049 J	0.0059 J	0.006 J	0.0068 J	0.0062 J
Lithium	7439-93-2	mg/L	NA		0.0155	0.022	0.0252	0.0119	0.0137
Mercury*	7439-97-6	mg/L	NA						
Molybdenum	7439-98-7	mg/L	NA		0.0012 J	0.0021 J	0.0023 J	0.0015 J	0.0015 J
Selenium	7782-49-2	mg/L	4.2						
Sulfate	14808-79-8	mg/L	NA		73.2	109	104	63.4	66.7
Thallium*	7440-28-0	mg/L	0.00047						
Total Hardness as CaCO3	471-34-1	mg/L	NA		215	254	254	214	219
Total Dissolved Solids	TDS	mg/L	NA		303	423	404	351	348

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 6b
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH AWQC SCREENING LEVELS -
DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	USEPA AWQC (b)	Meramec River Upstream					Meramec River Adjacent					Meramec River Downstream				
				M2-MEC-7S	M2-MEC-8D	M2-MEC-8S	M2-MEC-9D	M2-MEC-9S	M2-MEC-4S	M2-MEC-5D	M2-MEC-5S	M2-MEC-6D	M2-MEC-6S	M2-MEC-1S	M2-MEC-2D	M2-MEC-2S	M2-MEC-3D	M2-MEC-3S
Antimony*	7440-36-0	mg/L	0.64															
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.00058 J	0.00058 J	0.00065 J	0.00059 J	0.00059 J	0.00061 J	0.00056 J	0.00066 J	0.00056 J	0.00064 J	0.00063 J	0.00062 J	0.0006 J	0.00061 J	0.00059 J
Barium	7440-39-3	mg/L	NA	0.13	0.127	0.128	0.127	0.128	0.127	0.128	0.13	0.129	0.128	0.127	0.127	0.128	0.129	0.13
Beryllium	7440-41-7	mg/L	NA						0.00018 J	0.00018 J	0.00019 J		0.00018 J	0.00018 J	0.00019 J	0.00024 J	0.00018 J	
Boron	7440-42-8	mg/L	NA									0.0129 J		0.0129 J				
Cadmium	7440-43-9	mg/L	NA															
Calcium	7440-70-2	mg/L	NA	28.4	28.4	28.2	28.2	28.5	28.3	28.3	28.7	28.6	28.4	28.1	28.2	28.4	28.5	28.8
Chromium*	7440-47-3	mg/L	NA															
Cobalt*	7440-48-4	mg/L	NA															
Lead	7439-92-1	mg/L	NA															
Lithium	7439-93-2	mg/L	NA															
Mercury*	7439-97-6	mg/L	NA															
Molybdenum	7439-98-7	mg/L	NA															
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.

(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 6b
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH AWQC SCREENING LEVELS -
DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	USEPA AWQC (b)	Mississippi River Upstream M2-MIS-10S	M2-MIS-11D	M2-MIS-11S	M2-MIS-12D	M2-MIS-12S	Mississippi River Adjacent M2-MIS-4S	M2-MIS-5D	M2-MIS-5S	M2-MIS-6D	M2-MIS-6S	M2-MIS-7S	M2-MIS-8D	M2-MIS-8S	M2-MIS-9D	M2-MIS-9S
Antimony*	7440-36-0	mg/L	0.64															
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0023	0.0021	0.0022	0.0015	0.0016	0.002 J	0.0521	0.052	0.0014	0.0015	0.0024	0.0023	0.0021	0.0014	0.0014
Barium	7440-39-3	mg/L	NA	0.0969	0.0829	0.0856	0.066	0.0727	0.0981	0.0823	0.0848	0.0634	0.0698	0.096	0.0899	0.0906	0.065	0.0665
Beryllium	7440-41-7	mg/L	NA															
Boron	7440-42-8	mg/L	NA	0.0648 J	0.0502 J	0.0538 J	0.0343 J	0.0369 J	0.068 J	0.0501 J	0.0514 J	0.0328 J	0.0346 J	0.0675 J	0.0578 J	0.059 J	0.0336 J	0.0331 J
Cadmium	7440-43-9	mg/L	NA													0.00046 J		
Calcium	7440-70-2	mg/L	NA	62.8	57.7	60.1	49.5	52.6	61.5	53.6	55	51.8	52.7	64.7	59.4	60.8	50.6	52.2
Chromium*	7440-47-3	mg/L	NA															
Cobalt*	7440-48-4	mg/L	NA															
Lead	7439-92-1	mg/L	NA		0.003 J				0.0042 J									
Lithium	7439-93-2	mg/L	NA	0.0246	0.016	0.0172	0.0079 J	0.011	0.0269	0.0156	0.0192	0.0046 J	0.0074 J	0.0255	0.0213	0.0219	0.0054 J	
Mercury*	7439-97-6	mg/L	NA															
Molybdenum	7439-98-7	mg/L	NA	0.002 J	0.0017 J	0.002 J	0.0014 J	0.0018 J	0.0022 J	0.0016 J	0.0019 J	0.0015 J	0.0014 J	0.0024 J	0.0017 J	0.0021 J	0.0012 J	0.0015 J
Selenium	7782-49-2	mg/L	4.2															
Thallium	7440-28-0	mg/L	0.00047							0.0506	0.0512							

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 6b
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH AWQC SCREENING LEVELS -
DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	USEPA AWQC (b)		Mississippi River Downstream M2-MIS-1S	M2-MIS-2D	M2-MIS-2S	M2-MIS-3D	M2-MIS-3S
Antimony*	7440-36-0	mg/L	0.64						
Arsenic	7440-38-2	mg/L	0.00014	(c)	0.0018	0.0025	0.0023	0.0021	0.0019
Barium	7440-39-3	mg/L	NA		0.109	0.0917	0.0941	0.0732	0.0798
Beryllium	7440-41-7	mg/L	NA		0.00018 J				
Boron	7440-42-8	mg/L	NA		0.0408 J	0.0666 J	0.0573 J	0.0435 J	0.0479 J
Cadmium	7440-43-9	mg/L	NA						
Calcium	7440-70-2	mg/L	NA		48.5	58.5	61.8	50.8	54
Chromium*	7440-47-3	mg/L	NA						
Cobalt*	7440-48-4	mg/L	NA						
Lead	7439-92-1	mg/L	NA			0.0034 J		0.0035 J	0.004 J
Lithium	7439-93-2	mg/L	NA		0.0136	0.0207	0.0231	0.0106	0.0131
Mercury*	7439-97-6	mg/L	NA						
Molybdenum	7439-98-7	mg/L	NA		0.0015 J	0.0024 J	0.0017 J	0.0017 J	0.0021 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.

[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 6c
COMPARISON OF SEPTEMBER 2017 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO HUMAN HEALTH AWQC SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

				Meramec River												
			USEPA	River Upstream				River Adjacent				River Downstream				
Constituent	CAS	Units	AWQC (b)	M-MEC-7S	M-MEC-8S	M-MEC-9D	M-MEC-9S	M-MEC-4S	M-MEC-5S	M-MEC-6D	M-MEC-6S	M-MEC-1S	M-MEC-2D	M-MEC-2S	M-MEC-3D	M-MEC-3S
Antimony*	7440-36-0	mg/L	0.64			0.0038										
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0018	0.0014	0.0013	0.0012	0.0018	0.0016	0.0014	0.0013	0.0016	0.0014	0.0015	0.0014	0.0015
Barium	7440-39-3	mg/L	NA	0.186	0.18	0.193	0.186	0.193	0.19	0.194	0.18	0.19	0.195	0.191	0.188	0.19
Beryllium*	7440-41-7	mg/L	NA													
Boron	7440-42-8	mg/L	NA	0.0305	0.0256	0.0248	0.0257	0.0749	0.0609	0.0289	0.0282	0.0364	0.0305	0.0312	0.0336	0.0306
Cadmium*	7440-43-9	mg/L	NA													
Calcium	7440-70-2	mg/L	NA	44.1	43.1	43.9	42.9	44.4	44.6	44.1	42.9	44	44.9	44	43.1	43.7
Chloride	16887-00-6	mg/L	NA	20.6	19.8	19.9	20	20.3	20.4	19.6	19.8	19.6	19.8	19.9	19.5	20
Chromium	7440-47-3	mg/L	NA	0.0013		0.0018		0.0014	0.00092	0.0011	0.0012	0.0018	0.0015		0.0014	0.0009
Cobalt	7440-48-4	mg/L	NA			0.00073		0.00085								
Fluoride	16984-48-8	mg/L	NA	0.18	0.17	0.17	0.17	0.18	0.18	0.18	0.18	0.17	0.18	0.18	0.18	0.18
Lead	7439-92-1	mg/L	NA	0.0172	0.0112	0.0205	0.0196	0.0175	0.0139	0.018	0.0121	0.014	0.0142	0.0146	0.0155	0.0143
Lithium	7439-93-2	mg/L	NA				0.0042		0.0057			0.0035				0.0035
Mercury*	7439-97-6	mg/L	NA													
Molybdenum	7439-98-7	mg/L	NA						0.0016					0.0014		
Selenium	7782-49-2	mg/L	4.2													
Sulfate	14808-79-8	mg/L	NA	24.3	23.4	23.1	23.1	26.7	26.6	23.2	23.2	24.5	23.1	23.9	23.3	23.3
Thallium*	7440-28-0	mg/L	0.00047									0.000073		0.000075		
Total Hardness as CaCO3	HARDNESS	mg/L	NA	212	211	214	209	212	214	213	209	214	219	213	209	213
Total Dissolved Solids	TDS	mg/L	NA	242	240	229	248	254	250	227	247	245	249	238	224	245

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
-- - Constituent not included in this analysis.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
mg/L - milligrams per liter.
NA - 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 6c
COMPARISON OF SEPTEMBER 2017 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS - TO HUMAN HEALTH AWQC SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

				Mississippi River																			
			USEPA	River Upstream					River Adjacent											River Downstream			
Constituent	CAS	Units	AWQC (b)	M-MIS-10S	M-MIS-11D	M-MIS-11S	M-MIS-12D	M-MIS-12S	M-MIS-4S	M-MIS-5D	M-MIS-5S	M-MIS-6D	M-MIS-6S	M-MIS-7S	M-MIS-8D	M-MIS-8S	M-MIS-9D	M-MIS-9S	M-MIS-1S	M-MIS-2D	M-MIS-2S	M-MIS-3D	M-MIS-3S
Antimony*	7440-36-0	mg/L	0.64														0.0035			0.0057			
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.003	0.0028	0.003	0.0024	0.0022	0.0032	0.0028	0.0027	0.0024	0.0023	0.0035	0.0029	0.0027	0.0022	0.0022	0.0028	0.003	0.003	0.0024	0.0026
Barium	7440-39-3	mg/L	NA	0.102	0.0987	0.103	0.081	0.0807	0.106	0.0976	0.0967	0.081	0.0825	0.124	0.0999	0.0978	0.0783	0.078	0.133	0.106	0.103	0.0859	0.11
Beryllium*	7440-41-7	mg/L	NA																				
Boron	7440-42-8	mg/L	NA	0.0953	0.0822	0.0858	0.0547	0.0573	0.0943	0.0803	0.0755	0.0593	0.0587	0.0981	0.0842	0.0846	0.0548	0.0535	0.0801	0.0902	0.0888	0.0665	0.0674
Cadmium*	7440-43-9	mg/L	NA																				
Calcium	7440-70-2	mg/L	NA	57	56	56.8	52.6	52.4	57.9	55.8	52.4	51.5	52.1	59.5	56.6	55.1	50.7	51.1	59.4	57.1	57.5	52	52.9
Chloride	16887-00-6	mg/L	NA	24.9	24.6	24.7	25.4	25.7	25	24.6	24.7	25.7	25.9	25.1	24.7	24.9	26	26	24	24.7	24.7	24.8	24.9
Chromium	7440-47-3	mg/L	NA	0.00072	0.0018	0.0015	0.0013	0.0014	0.0013	0.0014	0.002	0.0013	0.0016	0.0018	0.0015	0.0012	0.0012	0.00093	0.0016		0.0016	0.0012	0.002
Cobalt	7440-48-4	mg/L	NA											0.0008									
Fluoride	16984-48-8	mg/L	NA	0.37	0.35	0.35	0.27	0.28	0.37	0.32	0.33	0.27	0.27	0.37	0.34	0.34	0.26	0.26	0.32	0.35	0.34	0.3	0.31
Lead	7439-92-1	mg/L	NA	0.0028			0.0035	0.0026	0.0037	0.0035			0.0028	0.0043	0.0032	0.0034		0.0033	0.0056	0.0033	0.0027		0.0029
Lithium	7439-93-2	mg/L	NA	0.0321	0.0288	0.0284	0.0169	0.012	0.032	0.0277	0.0215	0.0172	0.0158	0.0331	0.0255	0.0267	0.0123	0.0113	0.0266	0.0323	0.0302	0.0193	0.021
Mercury*	7439-97-6	mg/L	NA																				
Molybdenum	7439-98-7	mg/L	NA	0.0029	0.0026	0.0025	0.002	0.002	0.0026	0.0024	0.0024	0.0026	0.0027	0.0032	0.0024	0.0023	0.0022	0.0021	0.0029	0.0027	0.0028	0.0024	0.0025
Selenium	7782-49-2	mg/L	4.2						0.005			0.004											
Sulfate	14808-79-8	mg/L	NA	140	130	129	71	69.8	140	111	110	61.8	63.2	140	120	123	57.2	57.6	109	130	123	87.9	88.4
Thallium*	7440-28-0	mg/L	0.00047											0.00016							0.000062		
Total Hardness as CaCO3	HARDNESS	mg/L	NA	236	233	235	230	230	238	234	221	226	227	245	237	229	223	224	243	235	240	224	226
Total Dissolved Solids	TDS	mg/L	NA	398	391	384	300	309	393	374	357	290	303	408	389	373	288	277	355	393	390	332	328

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
-- - Constituent not included in this analysis.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
mg/L - milligrams per liter.
NA - 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 6d
COMPARISON OF SEPTEMBER 2017 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS - TO HUMAN HEALTH AWQC SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	USEPA AWQC (b)	Meramec River: River Upstream M-MEC-7S	M-MEC-8S	M-MEC-9D	M-MEC-9S	Meramec River: River Adjacent M-MEC-4S	M-MEC-5S	M-MEC-6D	M-MEC-6S	Meramec River: River Downstream M-MEC-1S	M-MEC-2D	M-MEC-2S	M-MEC-3D	M-MEC-3S
Antimony*	7440-36-0	mg/L	0.64													
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0016	0.0013	0.0011	0.0011	0.0014	0.0013	0.0012	0.0011	0.0013	0.0012	0.0011	0.0011	0.0012
Barium	7440-39-3	mg/L	NA	0.167	0.166	0.176	0.172	0.18	0.177	0.177	0.173	0.171	0.172	0.174	0.18	0.176
Beryllium*	7440-41-7	mg/L	NA													
Boron	7440-42-8	mg/L	NA	0.0281	0.0266	0.0263	0.025	0.0625	0.0596	0.0282	0.027	0.0359	0.0285	0.0341	0.0314	0.0289
Cadmium*	7440-43-9	mg/L	NA													
Calcium	7440-70-2	mg/L	NA	41.2	40.2	41.9	41.2	43.2	42.8	42.1	41.2	41.1	41	41.3	41.7	41.9
Chromium	7440-47-3	mg/L	NA													
Cobalt	7440-48-4	mg/L	NA									0.00073		0.00074		
Lead	7439-92-1	mg/L	NA													
Lithium	7439-93-2	mg/L	NA													
Mercury*	7439-97-6	mg/L	NA													
Molybdenum	7439-98-7	mg/L	NA						0.0013							
Selenium	7782-49-2	mg/L	4.2													
Thallium*	7440-28-0	mg/L	0.00047									0.000057				0.00005

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
-- - Constituent not included in this analysis.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
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 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 6d
COMPARISON OF SEPTEMBER 2017 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS - TO HUMAN HEALTH AWQC SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

			USEPA	Mississippi River																			
				River Upstream					River Adjacent										River Downstream				
Constituent	CAS	Units	AWQC (b)	M-MIS-10S	M-MIS-11D	M-MIS-11S	M-MIS-12D	M-MIS-12S	M-MIS-4S	M-MIS-5D	M-MIS-5S	M-MIS-6D	M-MIS-6S	M-MIS-7S	M-MIS-8D	M-MIS-8S	M-MIS-9D	M-MIS-9S	M-MIS-1S	M-MIS-2D	M-MIS-2S	M-MIS-3D	M-MIS-3S
Antimony*	7440-36-0	mg/L	0.64																				
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0028	0.0026	0.0025	0.0019	0.0019	0.0028	0.0024	0.0024	0.0019	0.002	0.0027	0.0024	0.0025	0.0018	0.0021	0.0024	0.0025	0.0024	0.0021	0.0021
Barium	7440-39-3	mg/L	NA	0.0965	0.0887	0.0899	0.066	0.0656	0.0936	0.0826	0.0845	0.0687	0.0688	0.0949	0.0844	0.0861	0.0645	0.0674	0.112	0.0874	0.0872	0.073	0.0746
Beryllium*	7440-41-7	mg/L	NA								0.0014												
Boron	7440-42-8	mg/L	NA	0.0979	0.0859	0.0862	0.0542	0.0566	0.0946	0.0771	0.0812	0.0593	0.057	0.0943	0.0806	0.0836	0.0515	0.0579	0.0804	0.0873	0.082	0.0627	0.0672
Cadmium*	7440-43-9	mg/L	NA																				
Calcium	7440-70-2	mg/L	NA	58.1	56	56	51	50.2	57.2	54.1	53.8	51.4	52.9	57.2	54.3	54.5	50.2	51.2	52	55.5	51	51.9	52.5
Chromium	7440-47-3	mg/L	NA	0.00079	0.00074		0.00076		0.00093	0.00096				0.00075				0.0011					0.00099
Cobalt	7440-48-4	mg/L	NA																				
Lead	7439-92-1	mg/L	NA	0.0026	0.0027		0.0024			0.0027						0.0025						0.003	
Lithium	7439-93-2	mg/L	NA	0.0306	0.0241	0.032	0.0132	0.0144	0.0289	0.023	0.0316	0.0176	0.0155	0.0335	0.0287	0.032	0.0135	0.0166	0.0264	0.0263	0.0278	0.019	0.0207
Mercury*	7439-97-6	mg/L	NA																				
Molybdenum	7439-98-7	mg/L	NA	0.0032	0.0025	0.0027	0.0025	0.0018	0.0029	0.0025	0.0031	0.0026	0.0026	0.0028	0.0026	0.0027	0.0017	0.0022	0.0023	0.0034	0.0024	0.0027	0.0022
Selenium	7782-49-2	mg/L	4.2	0.0036									0.0051						0.0043		0.0039		
Thallium*	7440-28-0	mg/L	0.00047																		0.000053		

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
-- - Constituent not included in this analysis.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
mg/L - milligrams per liter.
NA - 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 7a
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS - TO ECOLOGICAL SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria		Meramec River Upstream					Meramec River Adjacent					Meramec River Downstream				
			USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	M2-MEC-7S	M2-MEC-8D	M2-MEC-8S	M2-MEC-9D	M2-MEC-9S	M2-MEC-4S	M2-MEC-5D	M2-MEC-5S	M2-MEC-6D	M2-MEC-6S	M2-MEC-1S	M2-MEC-2D	M2-MEC-2S	M2-MEC-3D	M2-MEC-3S
Antimony*	7440-36-0	mg/L	NA	NA															
Arsenic	7440-38-2	mg/L	0.34	0.15	0.00061 J	0.00064 J	0.00061 J	0.00063 J	0.00064 J	0.00062 J	0.00061 J	0.00058 J	0.00064 J	0.00069 J	0.00069 J	0.00066 J	0.00061 J	0.00059 J	0.00069 J
Barium	7440-39-3	mg/L	NA	NA	0.134	0.139	0.133	0.14	0.133	0.135	0.14	0.135	0.139	0.136	0.135	0.141	0.137	0.137	0.135
Beryllium	7440-41-7	mg/L	NA	NA	0.00017 J	0.00017 J													
Boron	7440-42-8	mg/L	NA	NA						0.0151 J					0.0142 J	0.0151 J	0.0143 J	0.0139 J	0.0139 J
Cadmium	7440-43-9	mg/L	0.0036 (d)	0.0013 (d)															
Calcium	7440-70-2	mg/L	NA	NA	28.6	28.8	28.3	29.1	28.3	28.8	28.9	28.9	28.7	29	28.6	28.9	29.3	28.3	28.5
Chloride	16887-00-6	mg/L	860	230	6.4	6.5	6.5	6.5	6.5	6.4	6.4	6.5	6.5	6.4	6.5	6.4	6.7	6.4	6.3
Chromium	7440-47-3	mg/L	3.1 (c,d)	0.15 (c,d)															
Cobalt	7440-48-4	mg/L	NA	NA														0.00089 J	
Fluoride	16984-48-8	mg/L	NA	NA	0.074 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.12 J	0.11 J	0.11 J
Lead	7439-92-1	mg/L	0.19 (d)	0.0073 (d)	0.0081 J	0.0092 J	0.0077 J	0.0086 J	0.005 J	0.0071 J	0.0094 J	0.0057 J	0.0114	0.0054 J	0.0065 J	0.0097 J	0.0062 J	0.0096 J	0.0067 J
Lithium	7439-93-2	mg/L	NA	NA															
Mercury*	7439-97-6	mg/L	0.0016	0.00091															
Molybdenum	7439-98-7	mg/L	NA	NA															
Selenium	7782-49-2	mg/L	NA	3.1															
Sulfate	14808-79-8	mg/L	NA	NA	12.2	13.3	13.1	15.4	13.1	13	12.9	12.9	13	12.8	13.2	12.9	13	12.9	12.9
Thallium*	7440-28-0	mg/L	NA	NA															
Total Hardness as CaCO3	471-34-1	mg/L	NA	NA	135	135	133	137	133	135	136	136	135	136	136	137	138	134	135
Total Dissolved Solids	TDS	mg/L	NA	NA	163	165	166	160	134	162	163	169	163	179	260	177	172	177	173

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 Meramec River and Mississippi River of 192 mg/L as CaCO3 used.

TABLE 7a
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO ECOLOGICAL SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria		Mississippi River Upstream					Mississippi River Adjacent									
			USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	M2-MIS-10S	M2-MIS-11D	M2-MIS-11S	M2-MIS-12D	M2-MIS-12S	M2-MIS-4S	M2-MIS-5D	M2-MIS-5S	M2-MIS-6D	M2-MIS-6S	M2-MIS-7S	M2-MIS-8D	M2-MIS-8S	M2-MIS-9D	M2-MIS-9S
Antimony*	7440-36-0	mg/L	NA	NA															
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0034	0.0034	0.0031	0.0023	0.0024	0.0034	0.0029	0.003	0.0021	0.0022	0.0033	0.0031	0.0034	0.002	0.0021
Barium	7440-39-3	mg/L	NA	NA	0.139	0.146	0.136	0.106	0.118	0.136	0.122	0.131	0.105	0.0973	0.137	0.144	0.14	0.0934	0.1
Beryllium	7440-41-7	mg/L	NA	NA	0.00017 J		0.0002 J								0.00018 J				
Boron	7440-42-8	mg/L	NA	NA	0.0659 J	0.058 J	0.0522 J	0.0368 J	0.0408 J	0.0656 J	0.0503 J	0.0531 J	0.0341 J	0.0347 J	0.0651 J	0.0561 J	0.0576 J	0.0345 J	0.0338 J
Cadmium	7440-43-9	mg/L	0.0036 (d)	0.0013 (d)															
Calcium	7440-70-2	mg/L	NA	NA	61.1	61.7	57.2	51.8	54	61	56.4	58.4	50.2	50.4	62.5	58.9	60.1	48.3	49.6
Chloride	16887-00-6	mg/L	860	230	24.5	24.6	24.6	28.4	28.3	23.2	24.1	24	28.8	29	23.2	23.6	23.6	30.4	29.6
Chromium	7440-47-3	mg/L	3.1 (c,d)	0.15 (c,d)	0.0044 J	0.0056	0.0047 J	0.0043 J	0.0045 J	0.0044 J	0.0029 J	0.0045 J	0.0043 J	0.003 J	0.0035 J	0.0053	0.0039 J	0.0028 J	0.004 J
Cobalt	7440-48-4	mg/L	NA	NA	0.0018 J	0.0022 J	0.0019 J	0.0021 J	0.0022 J	0.002 J	0.0016 J	0.0019 J	0.0015 J	0.0015 J	0.0017 J	0.0025 J	0.002 J	0.0014 J	0.0015 J
Fluoride	16984-48-8	mg/L	NA	NA	0.35	0.32	0.32	0.25	0.26	0.29 J	0.24	0.25	0.19 J	0.18 J	0.3	0.27	0.27	0.18 J	0.17 J
Lead	7439-92-1	mg/L	0.19 (d)	0.0073 (d)	0.0063 J	0.0087 J	0.0067 J	0.0069 J	0.0068 J	0.0052 J	0.0048 J	0.0071 J	0.0071 J	0.0065 J	0.006 J	0.0061 J	0.005 J	0.004 J	0.0059 J
Lithium	7439-93-2	mg/L	NA	NA	0.026	0.0232	0.0202	0.0095 J	0.012	0.0252	0.0176	0.0189	0.0092 J	0.0096 J	0.028	0.0229	0.0227	0.0068 J	0.0076 J
Mercury*	7439-97-6	mg/L	0.0016	0.00091															
Molybdenum	7439-98-7	mg/L	NA	NA	0.002 J	0.0023 J	0.0017 J	0.0012 J	0.0013 J	0.002 J	0.0014 J	0.0016 J	0.0013 J	0.00097 J	0.0023 J	0.0016 J	0.0018 J	0.0013 J	0.0012 J
Selenium	7782-49-2	mg/L	NA	3.1				0.0068 J											
Sulfate	14808-79-8	mg/L	NA	NA	132	107	105	53.9	54.5	127	85.1	90.3	44.9	44.5	128	105	105	39.7	42.4
Thallium*	7440-28-0	mg/L	NA	NA															
Total Hardness as CaCO3	471-34-1	mg/L	NA	NA	250	253	235	214	222	253	232	239	206	207	256	242	246	200	205
Total Dissolved Solids	TDS	mg/L	NA	NA	440	392	389	347	426	446	400	379	319	330	442	469	401	298	225

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.

[Orange shading] Detected Concentration> USEPA Aquatic Life AWQC Chronic.
[Yellow shading] 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 Meramec River and Mississippi River of 192 mg/L as CaCO3 used.

TABLE 7a
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS - TO ECOLOGICAL SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria				Mississippi River Downstream				
			USEPA Aquatic Life AWQC Freshwater Acute (b)		USEPA Aquatic Life AWQC Freshwater Chronic (b)		M2-MIS-1S	M2-MIS-2D	M2-MIS-2S	M2-MIS-3D	M2-MIS-3S
Antimony*	7440-36-0	mg/L	NA		NA						
Arsenic	7440-38-2	mg/L	0.34		0.15		0.0022	0.0031	0.0032	0.0025	0.0026
Barium	7440-39-3	mg/L	NA		NA		0.142	0.139	0.138	0.111	0.11
Beryllium	7440-41-7	mg/L	NA		NA			0.00029 J		0.00022 J	0.00018 J
Boron	7440-42-8	mg/L	NA		NA		0.0413 J	0.0623 J	0.0642 J	0.0407 J	0.044 J
Cadmium	7440-43-9	mg/L	0.0036	(d)	0.0013	(d)	0.00065 J		0.00045 J		
Calcium	7440-70-2	mg/L	NA		NA		50.7	61.9	62	53	53.4
Chloride	16887-00-6	mg/L	860		230		16.2	23.3	23.4	26	25.6
Chromium	7440-47-3	mg/L	3.1	(c,d)	0.15	(c,d)	0.0021 J	0.0041 J	0.005	0.0035 J	0.0036 J
Cobalt	7440-48-4	mg/L	NA		NA		0.0011 J	0.0024 J	0.0021 J	0.002 J	0.0022 J
Fluoride	16984-48-8	mg/L	NA		NA		0.18 J	0.26	0.26	0.2	0.21
Lead	7439-92-1	mg/L	0.19	(d)	0.0073	(d)	0.0049 J	0.0059 J	0.006 J	0.0068 J	0.0062 J
Lithium	7439-93-2	mg/L	NA		NA		0.0155	0.022	0.0252	0.0119	0.0137
Mercury*	7439-97-6	mg/L	0.0016		0.00091						
Molybdenum	7439-98-7	mg/L	NA		NA		0.0012 J	0.0021 J	0.0023 J	0.0015 J	0.0015 J
Selenium	7782-49-2	mg/L	NA		3.1						
Sulfate	14808-79-8	mg/L	NA		NA		73.2	109	104	63.4	66.7
Thallium*	7440-28-0	mg/L	NA		NA						
Total Hardness as CaCO3	471-34-1	mg/L	NA		NA		215	254	254	214	219
Total Dissolved Solids	TDS	mg/L	NA		NA		303	423	404	351	348

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.

(orange) Detected Concentration> USEPA Aquatic Life AWQC Chronic.
(yellow) 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 Meramec River and Mississippi River of 192 mg/L as CaCO3 used.

TABLE 7b
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria		Meramec River Upstream					Meramec River Adjacent					Meramec River Downstream				
			USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	M2-MEC-7S	M2-MEC-8D	M2-MEC-8S	M2-MEC-9D	M2-MEC-9S	M2-MEC-4S	M2-MEC-5D	M2-MEC-5S	M2-MEC-6D	M2-MEC-6S	M2-MEC-1S	M2-MEC-2D	M2-MEC-2S	M2-MEC-3D	M2-MEC-3S
Antimony*	7440-36-0	mg/L	NA	NA															
Arsenic	7440-38-2	mg/L	0.34	0.15	0.00058 J	0.00058 J	0.00065 J	0.00059 J	0.00059 J	0.00061 J	0.00056 J	0.00066 J	0.00056 J	0.00064 J	0.00063 J	0.00062 J	0.0006 J	0.00061 J	0.00059 J
Barium	7440-39-3	mg/L	NA	NA	0.13	0.127	0.128	0.127	0.128	0.127	0.128	0.13	0.129	0.128	0.127	0.127	0.128	0.129	0.13
Beryllium	7440-41-7	mg/L	NA	NA						0.00018 J	0.00018 J	0.00019 J		0.00018 J	0.00018 J	0.00019 J	0.00024 J	0.00018 J	
Boron	7440-42-8	mg/L	NA	NA									0.0129 J		0.0129 J				
Cadmium	7440-43-9	mg/L	0.0033 (d)	0.0012 (d)															
Calcium	7440-70-2	mg/L	NA	NA	28.4	28.4	28.2	28.2	28.5	28.3	28.3	28.7	28.6	28.4	28.1	28.2	28.4	28.5	28.8
Chromium*	7440-47-3	mg/L	0.97 (c,d)	0.13 (c,d)															
Cobalt*	7440-48-4	mg/L	NA	NA															
Lead	7439-92-1	mg/L	0.13 (d)	0.0051 (d)															
Lithium	7439-93-2	mg/L	NA	NA															
Mercury*	7439-97-6	mg/L	0.0014	0.00077															
Molybdenum	7439-98-7	mg/L	NA	NA															
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 Meramec River and Mississippi River of 192 mg/L as CaCO3 used.

TABLE 7b
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria		Mississippi River Upstream					Mississippi River Adjacent									
			USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	M2-MIS-10S	M2-MIS-11D	M2-MIS-11S	M2-MIS-12D	M2-MIS-12S	M2-MIS-4S	M2-MIS-5D	M2-MIS-5S	M2-MIS-6D	M2-MIS-6S	M2-MIS-7S	M2-MIS-8D	M2-MIS-8S	M2-MIS-9D	M2-MIS-9S
Antimony*	7440-36-0	mg/L	NA	NA															
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0023	0.0021	0.0022	0.0015	0.0016	0.002 J	0.0521	0.052	0.0014	0.0015	0.0024	0.0023	0.0021	0.0014	0.0014
Barium	7440-39-3	mg/L	NA	NA	0.0969	0.0829	0.0856	0.066	0.0727	0.0981	0.0823	0.0848	0.0634	0.0698	0.096	0.0899	0.0906	0.065	0.0665
Beryllium	7440-41-7	mg/L	NA	NA															
Boron	7440-42-8	mg/L	NA	NA	0.0648 J	0.0502 J	0.0538 J	0.0343 J	0.0369 J	0.068 J	0.0501 J	0.0514 J	0.0328 J	0.0346 J	0.0675 J	0.0578 J	0.059 J	0.0336 J	0.0331 J
Cadmium	7440-43-9	mg/L	0.0033 (d)	0.0012 (d)													0.00046 J		
Calcium	7440-70-2	mg/L	NA	NA	62.8	57.7	60.1	49.5	52.6	61.5	53.6	55	51.8	52.7	64.7	59.4	60.8	50.6	52.2
Chromium*	7440-47-3	mg/L	0.97 (c,d)	0.13 (c,d)															
Cobalt*	7440-48-4	mg/L	NA	NA															
Lead	7439-92-1	mg/L	0.13 (d)	0.0051 (d)		0.003 J				0.0042 J									
Lithium	7439-93-2	mg/L	NA	NA	0.0246	0.016	0.0172	0.0079 J	0.011	0.0269	0.0156	0.0192	0.0046 J	0.0074 J	0.0255	0.0213	0.0219	0.0054 J	
Mercury*	7439-97-6	mg/L	0.0014	0.00077															
Molybdenum	7439-98-7	mg/L	NA	NA	0.002 J	0.0017 J	0.002 J	0.0014 J	0.0018 J	0.0022 J	0.0016 J	0.0019 J	0.0015 J	0.0014 J	0.0024 J	0.0017 J	0.0021 J	0.0012 J	0.0015 J
Selenium	7782-49-2	mg/L	NA	NA															
Thallium	7440-28-0	mg/L	NA	NA							0.0506	0.0512							

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 Meramec River and Mississippi River of 192 mg/L as CaCO3 used.

TABLE 7b
COMPARISON OF MAY 2018 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS -
TO ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria		Mississippi River Downstream				
			USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	M2-MIS-1S	M2-MIS-2D	M2-MIS-2S	M2-MIS-3D	M2-MIS-3S
Antimony*	7440-36-0	mg/L	NA	NA					
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0018	0.0025	0.0023	0.0021	0.0019
Barium	7440-39-3	mg/L	NA	NA	0.109	0.0917	0.0941	0.0732	0.0798
Beryllium	7440-41-7	mg/L	NA	NA	0.00018 J				
Boron	7440-42-8	mg/L	NA	NA	0.0408 J	0.0666 J	0.0573 J	0.0435 J	0.0479 J
Cadmium	7440-43-9	mg/L	0.0033 (d)	0.0012 (d)					
Calcium	7440-70-2	mg/L	NA	NA	48.5	58.5	61.8	50.8	54
Chromium*	7440-47-3	mg/L	0.97 (c,d)	0.13 (c,d)					
Cobalt*	7440-48-4	mg/L	NA	NA					
Lead	7439-92-1	mg/L	0.13 (d)	0.0051 (d)		0.0034 J		0.0035 J	0.004 J
Lithium	7439-93-2	mg/L	NA	NA	0.0136	0.0207	0.0231	0.0106	0.0131
Mercury*	7439-97-6	mg/L	0.0014	0.00077					
Molybdenum	7439-98-7	mg/L	NA	NA	0.0015 J	0.0024 J	0.0017 J	0.0017 J	0.0021 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 Meramec River and Mississippi River of 192 mg/L as CaCO3 used.

TABLE 7c
COMPARISON OF SEPTEMBER 2017 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS TO ECOLOGICAL SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria		Meramec River												
					River Upstream				River Adjacent				River Downstream				
			USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	M-MEC-7S	M-MEC-8S	M-MEC-9D	M-MEC-9S	M-MEC-4S	M-MEC-5S	M-MEC-6D	M-MEC-6S	M-MEC-1S	M-MEC-2D	M-MEC-2S	M-MEC-3D	M-MEC-3S
Antimony	7440-36-0	mg/L	NA	NA			0.0038										
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0018	0.0014	0.0013	0.0012	0.0018	0.0016	0.0014	0.0013	0.0016	0.0014	0.0015	0.0014	0.0015
Barium	7440-39-3	mg/L	NA	NA	0.186	0.18	0.193	0.186	0.193	0.19	0.194	0.18	0.19	0.195	0.191	0.188	0.19
Beryllium*	7440-41-7	mg/L	NA	NA													
Boron	7440-42-8	mg/L	NA	NA	0.0305	0.0256	0.0248	0.0257	0.0749	0.0609	0.0289	0.0282	0.0364	0.0305	0.0312	0.0336	0.0306
Cadmium*	7440-43-9	mg/L	0.0042 (d)	0.0015 (d)													
Calcium	7440-70-2	mg/L	NA	NA	44.1	43.1	43.9	42.9	44.4	44.6	44.1	42.9	44	44.9	44	43.1	43.7
Chloride	16887-00-6	mg/L	860	230	20.6	19.8	19.9	20	20.3	20.4	19.6	19.8	19.6	19.8	19.9	19.5	20
Chromium	7440-47-3	mg/L	3.5 (c,d)	0.17 (c,d)	0.0013		0.0018		0.0014	0.00092	0.0011	0.0012	0.0018	0.0015		0.0014	0.0009
Cobalt	7440-48-4	mg/L	NA	NA			0.00073		0.00085								
Fluoride	16984-48-8	mg/L	NA	NA	0.18	0.17	0.17	0.17	0.18	0.18	0.18	0.18	0.17	0.18	0.18	0.18	0.18
Lead	7439-92-1	mg/L	0.23 (d)	0.0089 (d)	0.0172	0.0112	0.0205	0.0196	0.0175	0.0139	0.018	0.0121	0.014	0.0142	0.0146	0.0155	0.0143
Lithium	7439-93-2	mg/L	NA	NA				0.0042		0.0057			0.0035				0.0035
Mercury*	7439-97-6	mg/L	0.0016	0.0009													
Molybdenum	7439-98-7	mg/L	NA	NA						0.0016					0.0014		
Selenium	7782-49-2	mg/L	NA	3.1													
Sulfate	14808-79-8	mg/L	NA	NA	24.3	23.4	23.1	23.1	26.7	26.6	23.2	23.2	24.5	23.1	23.9	23.3	23.3
Thallium	7440-28-0	mg/L	NA	NA									0.000073		0.000075		
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	212	211	214	209	212	214	213	209	214	219	213	209	213
Total Dissolved Solids	TDS	mg/L	NA	NA	242	240	229	248	254	250	227	247	245	249	238	224	245

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

(orange) Detected Concentration> USEPA Aquatic Life AWQC Chronic.
(yellow) 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 Meramec River and Mississippi River of 224 mg/L as CaCO3 used.

TABLE 7c
COMPARISON OF SEPTEMBER 2017 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS
TO ECOLOGICAL SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

			Federal Water Quality Criteria				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)		M-MIS-10S	M-MIS-11D	M-MIS-11S	M-MIS-12D	M-MIS-12S	M-MIS-4S	M-MIS-5D	M-MIS-5S	M-MIS-6D	M-MIS-6S	M-MIS-7S	M-MIS-8D	M-MIS-8S	M-MIS-9D	M-MIS-9S	M-MIS-1S	M-MIS-2D	M-MIS-2S	M-MIS-3D	M-MIS-3S
Antimony	7440-36-0	mg/L	NA		NA															0.0035			0.0057			
Arsenic	7440-38-2	mg/L	0.34		0.15		0.003	0.0028	0.003	0.0024	0.0022	0.0032	0.0028	0.0027	0.0024	0.0023	0.0035	0.0029	0.0027	0.0022	0.0022	0.0028	0.003	0.003	0.0024	0.0026
Barium	7440-39-3	mg/L	NA		NA		0.102	0.0987	0.103	0.081	0.0807	0.106	0.0976	0.0967	0.081	0.0825	0.124	0.0999	0.0978	0.0783	0.078	0.133	0.106	0.103	0.0859	0.11
Beryllium*	7440-41-7	mg/L	NA		NA																					
Boron	7440-42-8	mg/L	NA		NA		0.0953	0.0822	0.0858	0.0547	0.0573	0.0943	0.0803	0.0755	0.0593	0.0587	0.0981	0.0842	0.0846	0.0548	0.0535	0.0801	0.0902	0.0888	0.0665	0.0674
Cadmium*	7440-43-9	mg/L	0.0042	(d)	0.0015	(d)																				
Calcium	7440-70-2	mg/L	NA		NA		57	56	56.8	52.6	52.4	57.9	55.8	52.4	51.5	52.1	59.5	56.6	55.1	50.7	51.1	59.4	57.1	57.5	52	52.9
Chloride	16887-00-6	mg/L	860		230		24.9	24.6	24.7	25.4	25.7	25	24.6	24.7	25.7	25.9	25.1	24.7	24.9	26	26	24	24.7	24.7	24.8	24.9
Chromium	7440-47-3	mg/L	3.5	(c,d)	0.17	(c,d)	0.00072	0.0018	0.0015	0.0013	0.0014	0.0013	0.0014	0.002	0.0013	0.0016	0.0018	0.0015	0.0012	0.0012	0.00093	0.0016		0.0016	0.0012	0.002
Cobalt	7440-48-4	mg/L	NA		NA												0.0008									
Fluoride	16984-48-8	mg/L	NA		NA		0.37	0.35	0.35	0.27	0.28	0.37	0.32	0.33	0.27	0.27	0.37	0.34	0.34	0.26	0.26	0.32	0.35	0.34	0.3	0.31
Lead	7439-92-1	mg/L	0.23	(d)	0.0089	(d)	0.0028			0.0035	0.0026	0.0037	0.0035			0.0028	0.0043	0.0032	0.0034		0.0033	0.0056	0.0033	0.0027		0.0029
Lithium	7439-93-2	mg/L	NA		NA		0.0321	0.0288	0.0284	0.0169	0.012	0.032	0.0277	0.0215	0.0172	0.0158	0.0331	0.0255	0.0267	0.0123	0.0113	0.0266	0.0323	0.0302	0.0193	0.021
Mercury*	7439-97-6	mg/L	0.0016		0.0009																					
Molybdenum	7439-98-7	mg/L	NA		NA		0.0029	0.0026	0.0025	0.002	0.002	0.0026	0.0024	0.0024	0.0026	0.0027	0.0032	0.0024	0.0023	0.0022	0.0021	0.0029	0.0027	0.0028	0.0024	0.0025
Selenium	7782-49-2	mg/L	NA		3.1							0.005			0.004											
Sulfate	14808-79-8	mg/L	NA		NA		140	130	129	71	69.8	140	111	110	61.8	63.2	140	120	123	57.2	57.6	109	130	123	87.9	88.4
Thallium	7440-28-0	mg/L	NA		NA												0.00016							0.000062		
Total Hardness as CaCO3	HARDNESS	mg/L	NA		NA		236	233	235	230	230	238	234	221	226	227	245	237	229	223	224	243	235	240	224	226
Total Dissolved Solids	TDS	mg/L	NA		NA		398	391	384	300	309	393	374	357	290	303	408	389	373	288	277	355	393	390	332	328

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
-- - Constituent not included in this analysis.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
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 Meramec River and Mississippi River of 224 mg/L as CaCO3 used.

TABLE 7d
COMPARISON OF SEPTEMBER 2017 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS TO ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria				Meramec River												
							River Upstream				River Adjacent				River Downstream				
			USEPA Aquatic Life AWQC Freshwater Acute (b)		USEPA Aquatic Life AWQC Freshwater Chronic (b)		M-MEC-7S	M-MEC-8S	M-MEC-9D	M-MEC-9S	M-MEC-4S	M-MEC-5S	M-MEC-6D	M-MEC-6S	M-MEC-1S	M-MEC-2D	M-MEC-2S	M-MEC-3D	M-MEC-3S
Antimony*	7440-36-0	mg/L	NA		NA														
Arsenic	7440-38-2	mg/L	0.34		0.15		0.0016	0.0013	0.0011	0.0011	0.0014	0.0013	0.0012	0.0011	0.0013	0.0012	0.0011	0.0011	0.0012
Barium	7440-39-3	mg/L	NA		NA		0.167	0.166	0.176	0.172	0.18	0.177	0.177	0.173	0.171	0.172	0.174	0.18	0.176
Beryllium*	7440-41-7	mg/L	NA		NA														
Boron	7440-42-8	mg/L	NA		NA		0.0281	0.0266	0.0263	0.025	0.0625	0.0596	0.0282	0.027	0.0359	0.0285	0.0341	0.0314	0.0289
Cadmium*	7440-43-9	mg/L	0.0038	(d)	0.0013	(d)													
Calcium	7440-70-2	mg/L	NA		NA		41.2	40.2	41.9	41.2	43.2	42.8	42.1	41.2	41.1	41	41.3	41.7	41.9
Chromium	7440-47-3	mg/L	1.1	(c,d)	0.14	(c,d)													
Cobalt	7440-48-4	mg/L	NA		NA										0.00073		0.00074		
Lead	7439-92-1	mg/L	0.15	(d)	0.0060	(d)													
Lithium	7439-93-2	mg/L	NA		NA														
Mercury*	7439-97-6	mg/L	0.0014		0.00077														
Molybdenum	7439-98-7	mg/L	NA		NA							0.0013							
Selenium	7782-49-2	mg/L	NA		NA														
Thallium	7440-28-0	mg/L	NA		NA										0.000057				0.00005

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

(orange) Detected Concentration> USEPA Aquatic Life AWQC Chronic.
(yellow) 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 Meramec River and Mississippi River of 224 mg/L as $CaCO_3$ used.

TABLE 7d
COMPARISON OF SEPTEMBER 2017 MERAMEC AND MISSISSIPPI RIVER SURFACE WATER RESULTS TO ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria				Mississippi River																			
							River Upstream					River Adjacent										River Downstream				
			USEPA Aquatic Life AWQC Freshwater Acute (b)		USEPA Aquatic Life AWQC Freshwater Chronic (b)		M-MIS-10S	M-MIS-11D	M-MIS-11S	M-MIS-12D	M-MIS-12S	M-MIS-4S	M-MIS-5D	M-MIS-5S	M-MIS-6D	M-MIS-6S	M-MIS-7S	M-MIS-8D	M-MIS-8S	M-MIS-9D	M-MIS-9S	M-MIS-1S	M-MIS-2D	M-MIS-2S	M-MIS-3D	M-MIS-3S
Antimony*	7440-36-0	mg/L	NA		NA																					
Arsenic	7440-38-2	mg/L	0.34		0.15		0.0028	0.0026	0.0025	0.0019	0.0019	0.0028	0.0024	0.0024	0.0019	0.002	0.0027	0.0024	0.0025	0.0018	0.0021	0.0024	0.0025	0.0024	0.0021	0.0021
Barium	7440-39-3	mg/L	NA		NA		0.0965	0.0887	0.0899	0.066	0.0656	0.0936	0.0826	0.0845	0.0687	0.0688	0.0949	0.0844	0.0861	0.0645	0.0674	0.112	0.0874	0.0872	0.073	0.0746
Beryllium*	7440-41-7	mg/L	NA		NA									0.0014												
Boron	7440-42-8	mg/L	NA		NA		0.0979	0.0859	0.0862	0.0542	0.0566	0.0946	0.0771	0.0812	0.0593	0.057	0.0943	0.0806	0.0836	0.0515	0.0579	0.0804	0.0873	0.082	0.0627	0.0672
Cadmium*	7440-43-9	mg/L	0.0038	(d)	0.0013	(d)																				
Calcium	7440-70-2	mg/L	NA		NA		58.1	56	56	51	50.2	57.2	54.1	53.8	51.4	52.9	57.2	54.3	54.5	50.2	51.2	52	55.5	51	51.9	52.5
Chromium	7440-47-3	mg/L	1.1	(c,d)	0.14	(c,d)	0.00079	0.00074		0.00076		0.00093	0.00096				0.00075				0.0011					0.00099
Cobalt	7440-48-4	mg/L	NA		NA																					
Lead	7439-92-1	mg/L	0.15	(d)	0.0060	(d)	0.0026	0.0027		0.0024			0.0027						0.0025						0.003	
Lithium	7439-93-2	mg/L	NA		NA		0.0306	0.0241	0.032	0.0132	0.0144	0.0289	0.023	0.0316	0.0176	0.0155	0.0335	0.0287	0.032	0.0135	0.0166	0.0264	0.0263	0.0278	0.019	0.0207
Mercury*	7439-97-6	mg/L	0.0014		0.00077																					
Molybdenum	7439-98-7	mg/L	NA		NA		0.0032	0.0025	0.0027	0.0025	0.0018	0.0029	0.0025	0.0031	0.0026	0.0026	0.0028	0.0026	0.0027	0.0017	0.0022	0.0023	0.0034	0.0024	0.0027	0.0022
Selenium	7782-49-2	mg/L	NA		NA		0.0036									0.0051						0.0043		0.0039		
Thallium	7440-28-0	mg/L	NA		NA																			0.000053		

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

(orange) Detected Concentration> USEPA Aquatic Life AWQC Chronic.
(yellow) 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 Meramec River and Mississippi River of 224 mg/L as $CaCO_3$ used.

TABLE 8a
COMPARISON OF MAY 2018 UNNAMED CREEK/DRAINAGE SURFACE WATER RESULTS -
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels: USEPA MCLs (b)	Federal Water Quality Screening Levels: USEPA SMCLs (b)	Federal Water Quality Screening Levels: USEPA Tapwater RSLs (c)	Selected Drinking Water Screening Level (h)	Unnamed Creek / Drainage: M2-C-1	Unnamed Creek / Drainage: M2-C-2	Unnamed Creek / Drainage: M2-C-3
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	0.0035	0.0019
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.0918	0.182	0.151
Beryllium	7440-41-7	mg/L	0.004	NA	0.025	0.004		0.00021 J	
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0246 J	0.789	0.257
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005			
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	78.8	48.5	38.5
Chloride	16887-00-6	mg/L	NA	250	NA	250	146	30.2	20.6
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1	0.0023 J	0.0064	
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006	0.0014 J		0.0012 J
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.56	0.71	0.33
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015		0.0037 J	
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04		0.0266	0.0095 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	0.0052 J	0.0249	0.0079 J
Selenium*	7782-49-2	mg/L	0.05	NA	0.1	0.05			
Sulfate	14808-79-8	mg/L	NA	250	NA	250	58.5	140	77.3
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	265	206	174
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	570	374	283

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 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 8b
COMPARISON OF MAY 2018 UNNAMED CREEK/DRAINAGE SURFACE WATER RESULTS -
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Unnamed Creek / Drainage		
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		M2-C-1	M2-C-2	M2-C-3
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	0.0013	0.0031	0.0016
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.0788	0.165	0.137
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004			
Boron	7440-42-8	mg/L	NA	NA	4	4		0.964	0.246
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005			
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	82.6	53.4	42.6
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1		0.0069	
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			
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	0.0052 J	0.0313	0.0077 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05		0.0124 J	
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.

[green shading] 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 8c
COMPARISON OF SEPTEMBER 2017 UNNAMED CREEK/DRAINAGE SURFACE WATER RESULTS -
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Creek / Drainage		
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		M-C-1	M-C-2	M-C-3
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	0.00077	0.0022	0.0025
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.0734	0.107	0.122
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004			
Boron	7440-42-8	mg/L	NA	NA	4	4	0.03	0.366	0.358
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005			
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	78.5	69.7	69.4
Chloride	16887-00-6	mg/L	NA	250	NA	250	54.8	44	44.1
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1	0.0011	0.0011	
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006			
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.63	0.56	0.56
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015		0.0035	
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0039	0.014	0.0132
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	0.0067	0.0119	0.0115
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05			
Sulfate	14808-79-8	mg/L	NA	250	NA	250	49.1	97.6	97.8
Thallium*	7440-28-0	mg/L	0.002	NA	0.0002	0.002		0.000042	0.000092
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	NA	NA	263	252	253
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	386	414	407

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 8d
COMPARISON OF SEPTEMBER 2017 UNNAMED CREEK/DRAINAGE SURFACE WATER RESULTS -
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels					Selected Drinking Water Screening Level (h)	Creek / Drainage		
			USEPA MCLs (b)		USEPA SMCLs (b)	USEPA Tapwater RSLs (c)			M-C-1	M-C-2	M-C-3
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	0.00084	0.0023	0.0024
Barium	7440-39-3	mg/L	2		NA	3.8		2	0.0712	0.105	0.123
Beryllium*	7440-41-7	mg/L	0.004		NA	0.025		0.004			
Boron	7440-42-8	mg/L	NA		NA	4		4	0.0308	0.389	0.392
Cadmium*	7440-43-9	mg/L	0.005		NA	0.0092		0.005			
Calcium	7440-70-2	mg/L	NA		NA	NA		NA	78.8	69.5	70.7
Chromium	7440-47-3	mg/L	0.1	(e)	NA	22	(f)	0.1		0.00095	0.00085
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	0.0047	0.0147	0.0152
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	0.0066	0.0132	0.0128
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	0.000053	0.000041	0.000085

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 9a
COMPARISON OF MAY 2018 UNNAMED CREEK/DRAINAGE SURFACE WATER RESULTS -
TO HUMAN HEALTH AWQC SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	USEPA AWQC (b)	Unnamed Creek / Drainage		
				M2-C-1	M2-C-2	M2-C-3
Antimony*	7440-36-0	mg/L	0.64			
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0016	0.0035	0.0019
Barium	7440-39-3	mg/L	NA	0.0918	0.182	0.151
Beryllium	7440-41-7	mg/L	NA		0.00021 J	
Boron	7440-42-8	mg/L	NA	0.0246 J	0.789	0.257
Cadmium*	7440-43-9	mg/L	NA			
Calcium	7440-70-2	mg/L	NA	78.8	48.5	38.5
Chloride	16887-00-6	mg/L	NA	146	30.2	20.6
Chromium	7440-47-3	mg/L	NA	0.0023 J	0.0064	
Cobalt	7440-48-4	mg/L	NA	0.0014 J		0.0012 J
Fluoride	16984-48-8	mg/L	NA	0.56	0.71	0.33
Lead	7439-92-1	mg/L	NA		0.0037 J	
Lithium	7439-93-2	mg/L	NA		0.0266	0.0095 J
Mercury*	7439-97-6	mg/L	NA			
Molybdenum	7439-98-7	mg/L	NA	0.0052 J	0.0249	0.0079 J
Selenium*	7782-49-2	mg/L	4.2			
Sulfate	14808-79-8	mg/L	NA	58.5	140	77.3
Thallium*	7440-28-0	mg/L	0.00047			
Total Hardness as CaCO3	471-34-1	mg/L	NA	265	206	174
Total Dissolved Solids	TDS	mg/L	NA	570	374	283

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 9b
COMPARISON OF MAY 2018 UNNAMED CREEK/DRAINAGE SURFACE WATER RESULTS -
TO HUMAN HEALTH AWQC SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	USEPA AWQC (b)	Unnamed Creek / Drainage M2-C-1	M2-C-2	M2-C-3
Antimony*	7440-36-0	mg/L	0.64			
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0013	0.0031	0.0016
Barium	7440-39-3	mg/L	NA	0.0788	0.165	0.137
Beryllium	7440-41-7	mg/L	NA			
Boron	7440-42-8	mg/L	NA		0.964	0.246
Cadmium	7440-43-9	mg/L	NA			
Calcium	7440-70-2	mg/L	NA	82.6	53.4	42.6
Chromium*	7440-47-3	mg/L	NA		0.0069	
Cobalt*	7440-48-4	mg/L	NA			
Lead	7439-92-1	mg/L	NA			
Lithium	7439-93-2	mg/L	NA			
Mercury*	7439-97-6	mg/L	NA			
Molybdenum	7439-98-7	mg/L	NA	0.0052 J	0.0313	0.0077 J
Selenium	7782-49-2	mg/L	4.2		0.0124 J	
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.

[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 9c
COMPARISON OF SEPTEMBER 2017 UNNAMED CREEK/DRAINAGE SURFACE WATER RESULTS -
TO HUMAN HEALTH AWQC SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	USEPA AWQC (b)	Creek / Drainage M-C-1	Creek / Drainage M-C-2	Creek / Drainage M-C-3
Antimony*	7440-36-0	mg/L	0.64			
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.00077	0.0022	0.0025
Barium	7440-39-3	mg/L	NA	0.0734	0.107	0.122
Beryllium*	7440-41-7	mg/L	NA			
Boron	7440-42-8	mg/L	NA	0.03	0.366	0.358
Cadmium*	7440-43-9	mg/L	NA			
Calcium	7440-70-2	mg/L	NA	78.5	69.7	69.4
Chloride	16887-00-6	mg/L	NA	54.8	44	44.1
Chromium	7440-47-3	mg/L	NA	0.0011	0.0011	
Cobalt	7440-48-4	mg/L	NA			
Fluoride	16984-48-8	mg/L	NA	0.63	0.56	0.56
Lead	7439-92-1	mg/L	NA		0.0035	
Lithium	7439-93-2	mg/L	NA	0.0039	0.014	0.0132
Mercury*	7439-97-6	mg/L	NA			
Molybdenum	7439-98-7	mg/L	NA	0.0067	0.0119	0.0115
Selenium	7782-49-2	mg/L	4.2			
Sulfate	14808-79-8	mg/L	NA	49.1	97.6	97.8
Thallium*	7440-28-0	mg/L	0.00047		0.000042	0.000092
Total Hardness as CaCO3	HARDNESS	mg/L	NA	263	252	253
Total Dissolved Solids	TDS	mg/L	NA	386	414	407

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
-- - Constituent not included in this analysis.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
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 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 9d
COMPARISON OF SEPTEMBER 2017 UNNAMED CREEK/DRAINAGE SURFACE WATER RESULTS - TO HUMAN HEALTH AWQC SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	USEPA AWQC (b)	Creek / Drainage M-C-1	Creek / Drainage M-C-2	Creek / Drainage M-C-3
Antimony*	7440-36-0	mg/L	0.64			
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.00084	0.0023	0.0024
Barium	7440-39-3	mg/L	NA	0.0712	0.105	0.123
Beryllium*	7440-41-7	mg/L	NA			
Boron	7440-42-8	mg/L	NA	0.0308	0.389	0.392
Cadmium*	7440-43-9	mg/L	NA			
Calcium	7440-70-2	mg/L	NA	78.8	69.5	70.7
Chromium	7440-47-3	mg/L	NA		0.00095	0.00085
Cobalt	7440-48-4	mg/L	NA			
Lead	7439-92-1	mg/L	NA			
Lithium	7439-93-2	mg/L	NA	0.0047	0.0147	0.0152
Mercury*	7439-97-6	mg/L	NA			
Molybdenum	7439-98-7	mg/L	NA	0.0066	0.0132	0.0128
Selenium	7782-49-2	mg/L	4.2			
Thallium*	7440-28-0	mg/L	0.00047	0.000053	0.000041	0.000085

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
-- - Constituent not included in this analysis.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
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 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 10a
COMPARISON OF MAY 2018 UNNAMED CREEK/DRAINAGE SURFACE WATER RESULTS -
TO ECOLOGICAL SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria: Aquatic Life AWQC Freshwater Acute (b)		Federal Water Quality Criteria: USEPA Aquatic Life AWQC Freshwater Chronic (b)		Unnamed Creek / Drainage: M2-C-1	Unnamed Creek / Drainage: M2-C-2	Unnamed Creek / Drainage: M2-C-3
Antimony*	7440-36-0	mg/L	NA		NA				
Arsenic	7440-38-2	mg/L	0.34		0.15		0.0016	0.0035	0.0019
Barium	7440-39-3	mg/L	NA		NA		0.0918	0.182	0.151
Beryllium	7440-41-7	mg/L	NA		NA			0.00021 J	
Boron	7440-42-8	mg/L	NA		NA		0.0246 J	0.789	0.257
Cadmium*	7440-43-9	mg/L	0.0040	(d)	0.0015	(d)			
Calcium	7440-70-2	mg/L	NA		NA		78.8	48.5	38.5
Chloride	16887-00-6	mg/L	860		230		146	30.2	20.6
Chromium	7440-47-3	mg/L	3.4	(c,d)	0.16	(c,d)	0.0023 J	0.0064	
Cobalt	7440-48-4	mg/L	NA		NA		0.0014 J		0.0012 J
Fluoride	16984-48-8	mg/L	NA		NA		0.56	0.71	0.33
Lead	7439-92-1	mg/L	0.22	(d)	0.0084	(d)		0.0037 J	
Lithium	7439-93-2	mg/L	NA		NA			0.0266	0.0095 J
Mercury*	7439-97-6	mg/L	0.0016		0.00091				
Molybdenum	7439-98-7	mg/L	NA		NA		0.0052 J	0.0249	0.0079 J
Selenium*	7782-49-2	mg/L	NA		3.1				
Sulfate	14808-79-8	mg/L	NA		NA		58.5	140	77.3
Thallium*	7440-28-0	mg/L	NA		NA				
Total Hardness as CaCO3	471-34-1	mg/L	NA		NA		265	206	174
Total Dissolved Solids	TDS	mg/L	NA		NA		570	374	283

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.

[orange] Detected Concentration> USEPA Aquatic Life AWQC Chronic.
[yellow] 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 Unnamed Creek/Drainage of 215 mg/L as CaCO3 used.

TABLE 10b
COMPARISON OF MAY 2018 UNNAMED CREEK/DRAINAGE SURFACE WATER RESULTS -
TO ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria		Unnamed Creek / Drainage		
			Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	M2-C-1	M2-C-2	M2-C-3
Antimony*	7440-36-0	mg/L	NA	NA			
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0013	0.0031	0.0016
Barium	7440-39-3	mg/L	NA	NA	0.0788	0.165	0.137
Beryllium	7440-41-7	mg/L	NA	NA			
Boron	7440-42-8	mg/L	NA	NA		0.964	0.246
Cadmium	7440-43-9	mg/L	0.0037 (d)	0.0013 (d)			
Calcium	7440-70-2	mg/L	NA	NA	82.6	53.4	42.6
Chromium*	7440-47-3	mg/L	1.1 (c,d)	0.14 (c,d)		0.0069	
Cobalt*	7440-48-4	mg/L	NA	NA			
Lead	7439-92-1	mg/L	0.15 (d)	0.0057 (d)			
Lithium	7439-93-2	mg/L	NA	NA			
Mercury*	7439-97-6	mg/L	0.0014	0.00077			
Molybdenum	7439-98-7	mg/L	NA	NA	0.0052 J	0.0313	0.0077 J
Selenium	7782-49-2	mg/L	NA	NA		0.0124 J	
Thallium	7440-28-0	mg/L	NA	NA			

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
-- - Constituent not included in this analysis.
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 adjusted for dissolved fraction. Site-specific total recoverable mean hardness value for Unnamed Creek/Drainage of 215 mg/L as CaCO3 used.

TABLE 10c
COMPARISON OF SEPTEMBER 2017 UNNAMED CREEK/DRAINAGE SURFACE WATER RESULTS - TO ECOLOGICAL SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a) AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria				Creek / Drainage		
			USEPA Aquatic Life AWQC Freshwater Acute (b)		USEPA Aquatic Life AWQC Freshwater Chronic (b)		M-C-1	M-C-2	M-C-3
Antimony	7440-36-0	mg/L	NA		NA				
Arsenic	7440-38-2	mg/L	0.34		0.15		0.00077	0.0022	0.0025
Barium	7440-39-3	mg/L	NA		NA		0.0734	0.107	0.122
Beryllium*	7440-41-7	mg/L	NA		NA				
Boron	7440-42-8	mg/L	NA		NA		0.03	0.366	0.358
Cadmium*	7440-43-9	mg/L	0.0048	(d)	0.0017	(d)			
Calcium	7440-70-2	mg/L	NA		NA		78.5	69.7	69.4
Chromium	7440-47-3	mg/L	3.9	(c,d)	0.19	(c,d)	0.0011	0.0011	
Cobalt	7440-48-4	mg/L	NA		NA				
Fluoride	16984-48-8	mg/L	NA		NA		0.63	0.56	0.56
Lead	7439-92-1	mg/L	0.27	(d)	0.011	(d)		0.0035	
Lithium	7439-93-2	mg/L	NA		NA		0.0039	0.014	0.0132
Mercury*	7439-97-6	mg/L	0.0016		0.00091				
Molybdenum	7439-98-7	mg/L	NA		NA		0.0067	0.0119	0.0115
Selenium	7782-49-2	mg/L	NA		3.1				
Sulfate	14808-79-8	mg/L	NA		NA		49.1	97.6	97.8
Thallium	7440-28-0	mg/L	NA		NA			0.000042	0.000092
Total Hardness as CaCO3	HARDNESS	mg/L	NA		NA		263	252	253
Total Dissolved Solids	TDS	mg/L	NA		NA		386	414	407

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
-- - Constituent not included in this analysis.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
mg/L - milligrams per liter.
NA - Not Available.
ND - Not Detected.
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 Unnamed Creek/Drainage of 256mg/L as CaCO3 used.

TABLE 10d
COMPARISON OF SEPTEMBER 2017 UNNAMED CREEK/DRAINAGE SURFACE WATER RESULTS -
TO ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI MERAMEC ENERGY CENTER
ST. LOUIS COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria				Creek / Drainage		
			USEPA Aquatic Life AWQC Freshwater Acute (b)		USEPA Aquatic Life AWQC Freshwater Chronic (b)		M-C-1	M-C-2	M-C-3
Antimony*	7440-36-0	mg/L	NA		NA				
Arsenic	7440-38-2	mg/L	0.34		0.15		0.00084	0.0023	0.0024
Barium	7440-39-3	mg/L	NA		NA		0.0712	0.105	0.123
Beryllium*	7440-41-7	mg/L	NA		NA				
Boron	7440-42-8	mg/L	NA		NA		0.0308	0.389	0.392
Cadmium*	7440-43-9	mg/L	0.0043	(d)	0.0015	(d)			
Calcium	7440-70-2	mg/L	NA		NA		78.8	69.5	70.7
Chromium	7440-47-3	mg/L	1.2	(c,d)	0.16	(c,d)		0.00095	0.00085
Cobalt	7440-48-4	mg/L	NA		NA				
Lead	7439-92-1	mg/L	0.18	(d)	0.0069	(d)			
Lithium	7439-93-2	mg/L	NA		NA		0.0047	0.0147	0.0152
Mercury*	7439-97-6	mg/L	0.0014		0.00077				
Molybdenum	7439-98-7	mg/L	NA		NA		0.0066	0.0132	0.0128
Selenium	7782-49-2	mg/L	NA		NA				
Thallium	7440-28-0	mg/L	NA		NA		0.000053	0.000041	0.000085

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
-- - Constituent not included in this analysis.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
U - Constituent was not detected.
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 adjusted for dissolved fraction. Site-specific total recoverable mean hardness value for Unnamed Creek/Drainage of 256 mg/L as CaCO3 used.

APPENDIX B

What You Need to Know About Lithium

WHAT YOU NEED TO KNOW ABOUT LITHIUM

Lithium is present in at least one groundwater sample from two monitoring wells at the Ameren Meramec Energy Center (MEC) 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 lithium so that data can be considered in context. There is no public exposure to groundwater at the Meramec Energy Center and concentration levels of litium in adjacent surface waters of the Mississippi River and the Missouri River are all well below health-based regulatory standards. In fact, for lithium to pose a risk to surface water, concentration levels would need to be more than **24,000 times higher** than the level observed at Meramec.

LITHIUM IS NATURALLY OCCURING

Lithium is naturally occurring in soils and water. Based on a literature review, Aral and Vecchio-Sadus (2008) reported that typical background lithium concentrations are between 0.001 and 0.01 mg/L (milligrams of lithium per liter of water) in surface waters, approximately 0.17 mg/L in seawater, and around 0.003 mg/L in rivers. Some natural mineral waters may contain up to 100 mg/L of lithium (Schrauzer, 2002). Lithium is also present in soil between 3 and 350 mg/kg (milligrams of lithium per kilogram of soil) and in the earth's crust between 20 and 60 mg/kg (Aral and Vecchio-Sadus, 2008). Lithium is typically found in sediment at concentrations of approximately 56 mg/kg. United States Geological Survey (USGS, 2013) estimates the average concentration of lithium in soil in the U.S. is 21 mg/kg.

Lithium is not routinely evaluated in groundwater samples as it is not a typical constituent of concern and the concentrations are often below instrument detection limits. The USGS conducted the first comprehensive analysis of trace-element concentrations in groundwater that were evaluated from samples collected between 1992 and 2003 from aquifers across the U.S. (USGS, 2011). Lithium was one of the trace elements evaluated in the study and samples from drinking-water wells in dry regions had greater concentrations than other areas. The study found that the maximum concentration of lithium in the analysis of 936 groundwater samples was 1.2 mg/L with a 90th percentile concentration of 0.054 mg/L and a median concentration of 0.006 mg/L (USGS, 2011).

Lithium is Present in Our Diet

Primary dietary sources of lithium are grains and vegetables, dairy products and meat. Estimates for daily dietary intake of lithium have been reported from different sources and varies amongst different countries. Ranges have included 0.0168 to 0.105 mg lithium/day with other authors estimating daily intake from food and tap water ranging from 2.31 to 5.6 mg lithium/day (USEPA, 2008). Schrauzer (2002) reports the daily estimate to be from 0.65 to 3.1 mg lithium/day for a 70 kg (154 lb) adult. The

U.S. Food and Drug Administration has not established a recommended daily value for lithium; however, a provisional recommended daily allowance (RDA) has been proposed to be 1 mg lithium/day for a 70 kg adult based on the lithium intake data in different countries (Schrauzer, 2002).

The USEPA provisional toxicity value (2008; see below) is roughly equivalent to an intake of 0.14 mg lithium/day for a 70 kg (154 lb) adult (i.e., USEPA would suggest that a safe intake of lithium is at or below this level). However, many of the estimated daily exposures and the recommended daily allowances for lithium from the diet and tapwater are above the USEPA level, and there have been no reported findings that these lithium exposures have resulted in any toxicological effects; this suggests that the current USEPA level overestimates potential risks associated with lithium exposures.

Lithium is Used Medicinally

Lithium is used medicinally in the U.S. and globally as the leading treatment for bipolar disease. Adult daily dosages are approximately 900 mg lithium/day or higher, and recommended doses for children are approximately 600 mg lithium/day. These intakes are much higher than the USEPA provisional level.

USEPA'S ORAL TOXICITY VALUE FOR LITHIUM

There are limited studies on lithium of the type upon which to base a toxicity value to use in human health risk assessment. USEPA has derived a provisional toxicity value (i.e., the value does not have the normal level of review or confidence compared to final toxicity values published by USEPA) that equates to a drinking water screening level of 0.04 mg/L, and a general intake of 0.14 mg/day for an adult. As noted above, this level is below many estimates of daily intake in humans presented above, and well below the typical therapeutic doses presented above.

DRINKING WATER SCREENING LEVELS FOR LITHIUM

Using this toxicity value, the USEPA regional screening level (RSL) for lithium for tapwater (drinking water) is 0.04 mg/L (USEPA, 2018b). This is also the screening level identified by USEPA for the CCR Rule (USEPA, 2018a). Surface water samples taken by Ameren of the Mississippi and Meramec Rivers near the MEC and evaluated for lithium were all below the drinking water screening level. Lithium was rarely detected in the Meramec River; lithium concentrations detected in the Mississippi River were similar upstream and downstream indicating that MEC is not the source of lithium in the Mississippi River.

OTHER LITHIUM TOXICITY EVALUATIONS

In 1990, Schauzer et al. published data for 27 Texas counties showing that incidence rates of suicide, homicide, and rape were significantly higher in counties whose drinking water contained little or no lithium compared to counties with water lithium levels ranging from 0.7 – 0.17 mg/L. The authors suggested that continuous exposure to low dose lithium may have a generally beneficial effect on human behavior. Since that publication, additional studies investigating the anti-suicidal effects of lithium as a trace element in drinking water have been conducted throughout the world.

A review of these studies published recently by Liaugaudaite (2016) found that 7 of the 9 studies reported an association between low levels of lithium and suicide rates suggesting that lithium levels in drinking water could reduce the suicide risk in the general population. The mean lithium levels in the drinking water from these 7 studies ranged from 0.0007 to 0.219 mg/L, which is around less than a thousandth of the minimum daily dose of lithium given for bipolar disorders and depression.

For example, Ohgami et al. (2009) examined lithium levels in tap water in 18 municipalities of Oita prefecture in Japan and found that the levels ranged from 0.0007 to 0.059 mg/L. The standardized mortality ratio of suicide across the municipalities was significantly and negatively associated with lithium levels in males as well as females (Ohgami et al, 2009).

Additional studies conducted in Japan, Austria, Texas, Greece, and Austria corroborate these results finding that higher lithium levels in the drinking water were associated with lower suicide rates. One negative study has been reported in England. However, the evidence that has been accumulating over the years, especially in the last 5-10 years, that small doses of lithium can have beneficial effects has even recently been the topic of an opinion editorial piece in the New York Times by a psychiatrist and faculty member at Weill Cornell Medical College who cites the different studies and questions why more research is not being conducted to evaluate this trend in the literature that shows lithium at low levels in drinking water could have an impact on suicide levels, violent acts and even dementia (Fels, 2014). She concludes that for the public health issue of suicide prevention alone, studies should be conducted with lithium to determine if it should be considered an essential trace element nutrient which would then allow its addition to vitamins, foods, etc. which could result in beneficial clinical, societal, and behavioral outcomes.

These data suggest that long term exposure to low levels of lithium in drinking water, which can range from 0.0007 to 0.219 mg/L may actually have beneficial effects in humans. The tap water screening level of 0.04 mg/L used by USEPA in the CCR Rule is well below the high end of this range. Therefore, lithium levels could be as high as 0.219 mg/L without adverse effect, well above the maximum concentration level observed at Meramec of 0.164 mg/L.

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APPENDIX C

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].

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[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 not 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 D

Extraction and Transportation Assessment

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);

[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**

APRIL 29, 2019

EXTRACTION & TRANSPORTATION STUDY: Rush Island Ash Pond Closure Assessment

Rush Island Site

Jefferson County, Missouri

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Table of Contents

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