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REPORT ON

HUMAN HEALTH AND ECOLOGICAL ASSESSMENT OF THE LABADIE ENERGY CENTER

AMEREN MISSOURI
LABADIE, MISSOURI

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1. Introduction

The Ameren Missouri Labadie Energy Center (LEC) is a 2,407 MW coal-fueled steam electrical power generating facility located along the southern side of the Missouri River below the Missouri River bluffs, near the Town of Labadie in Franklin County, Missouri. The facility has been in operation since 1970. Coal ash is produced by the use of coal in the facility, and since 2010, approximately 50% of fly ash and bottom ash produced at the facility has been put into various beneficial uses.

Coal ash is presently stored on-site in two ponds and a Utility Waste Landfill (LC1) that are operated in accordance with permits issued by the State of Missouri. Figure 1 shows the location of the facility, and the location of the ash management areas LCPA, LCPB, and LCL1. LCPB contains fly ash and is lined with high density polyethylene (HDPE); LCPA currently receives bottom ash and is unlined. These ponds have been in operation for over 40 years. Labadie is in the process of converting to a dry ash management system. Following dry ash conversion, the ash ponds will be removed from service and closed. Thereafter, LCL1, which began operation in December 2016, will be used to manage coal ash not used for beneficial purposes.

The U.S. Environmental Protection Agency (USEPA) issued a final rule for "Disposal of Coal Combustion Residuals from Electric Utilities" in 2015 (the CCR Rule). One of the requirements in the CCR Rule is that utilities monitor groundwater at coal ash management facilities, and that the data be reported publicly. Ameren Missouri is complying with the CCR Rule, and has posted the required information on their publicly-available website: *https://www.ameren.com/Environment/ccr-rule-compliance*.

This Haley & Aldrich report is a companion document to the recently published 2017 Annual Groundwater Monitoring Report prepared by Golder & Associates ("Golder") to provide interested reviewers with the information needed to interpret and meaningfully understand the groundwater monitoring data. Beyond the specific monitoring requirements of the CCR Rule, Ameren Missouri has also voluntarily taken the additional steps to determine if there has been any off-site impact to surface water from the operation of the LEC ash management areas. The Labadie Energy Center has been a focus of interest of environmental groups. On multiple occasions, Ameren Missouri has retained outside experts (Golder, AECOM, Kleinfelder, Haley & Aldrich) to evaluate whether either the construction of a dry ash landfill at Labadie or historical ash pond operations pose a risk to the public. Those reports[1] are posted on Ameren's publicly available website: *https://www.ameren.com/Environment/managing-ccrs/ash-pond-closure*. In this report, Haley & Aldrich expands upon those earlier efforts and examines both surface and groundwater data reported under the CCR Rule, and the results of previous surface water investigations of the Missouri River and Labadie Creek, which border the Labadie Energy Center.

Ameren Missouri's comprehensive evaluation demonstrates that there are no adverse impacts resulting from coal ash management practices at the Labadie Energy Center on human health or the environment

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[1] The Kleinfelder report documents the following: groundwater sampling around perimeter and outside Ameren property; sampling of Labadie Creek and Missouri River; location of private wells; groundwater flow rate; groundwater modeling, and hydraulic gradients in alluvial and bedrock aquifers. To address whether groundwater from the Labadie Bottoms area could ever pose a risk to drinking water supplies, modelling was conducted to confirm that groundwater from the shallow aquifer within the Labadie Bottoms would not "reverse flow" into the bluffs area and impact private wells. It cannot. (The modelling evaluation assumed an extreme river condition (i.e., the 1993 flood lasting 55 straight days).

from either surface water or groundwater uses. In fact, as described in Sections 6 and 7, concentration levels of constituents detected in the groundwater would need to be multiple orders of magnitude higher before such a risk could exist. Details about the evaluation are provided below.

2. Approach

The analysis presented in this report was conducted by evaluating the environmental setting of the Labadie Energy Center, including its location and where ash management has occurred at the facility. Information on where groundwater is located at the facility, the rate(s) of groundwater flow, the direction(s) of groundwater flow, and where waterbodies may intercept groundwater flow was prepared by Golder, and is reviewed and summarized here.

A conceptual model was developed based on this physical setting information, and the model was used to identify what human populations could contact groundwater and/or surface water in the area of the facility. This conceptual model approach also identified where ecological populations could come into contact with surface water. This information was used to identify where to collect surface water samples to allow evaluation of potential impact to the environment. Groundwater and surface water data are evaluated on a human health risk basis and an ecological risk basis.

Human health risk assessment is a process used to estimate the chance that contact with constituents in the environment may result in harm to people. Generally, there are four components to the process: (1) Hazard Identification, (2) Toxicity Assessment, (3) Exposure Assessment, and (4) Risk Characterization.

The USEPA develops "screening levels" of constituent concentrations in groundwater (and other media) that are considered to be protective of specific human exposures. These screening levels are referred to as "Risk-Based Screening Levels" or RSLs, and are published by USEPA and updated twice yearly[2]. In developing the screening levels, USEPA uses a specific target risk level (component 4) combined with an assumed exposure scenario (component 3) and toxicity information from USEPA (component 2) to derive an estimate of a concentration of a constituent in an environmental medium, for example groundwater, (component 1) that is protective of a person in that exposure scenario (for example, drinking water). Similarly, ecological screening levels for surface water are developed by Federal and State agencies to be protective of the wide range of potential aquatic ecological resources, or receptors.

Risk-based screening levels are designed to provide a conservative estimate of the concentration to which a receptor (human or ecological) can be exposed without experiencing adverse health effects. Due to the conservative methods used to derive risk-based screening levels, it can be assumed with reasonable certainty that concentrations below screening levels will not result in adverse health effects, and that no further evaluation is necessary. Concentrations above conservative risk-based screening levels do not necessarily indicate that a potential risk exists, but indicate that further evaluation may be warranted.

The surface water and groundwater data were then evaluated using human health risk-based and ecological risk-based screening levels drawn from Federal and State sources. The evaluation looks first at whether constituents are present in groundwater and surface water that could be present due to the ash management operations. Then, if present, screening levels are used to determine if the concentration level of such constituent could pose a risk to human health or the environment.

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[2] USEPA Risk-Based Screening Levels (November 2017). http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Conceptual Site Model

A conceptual site model is used to evaluate the potential for human or ecological exposure to constituents that may have been released to the environment. Some of the questions posed during the CSM evaluation include:

> What is the source? How can constituents be released from the source? What environmental media may be affected by constituent release? How and where do constituents travel within a medium? Is there a point where a receptor (human or ecological) could contact the constituents in the medium? Are the constituent concentrations high enough to potentially exert a toxic effect?

For the evaluation of the ash management operations at the Labadie Energy Center, the coal ash stored in the LCPA, LCPB, and LCL1 is the potential source. Constituents present in the coal ash can be dissolved into infiltrating water (either from precipitation or from groundwater intrusion) and those constituents may then be present in shallow groundwater, also referred to as the alluvial aquifer. Constituents could move with groundwater as it flows in a downgradient/downhill direction. These constituents derived from the coal ash could then be introduced to adjacent surface water bodies; here, that could be the Missouri River and/or Labadie Creek. Figure 1 shows the facility location and layout, and identifies direction of groundwater flow and the adjacent surface water bodies. Thus, the environmental media of interest for this evaluation are:

- Groundwater on the facility;
- Missouri River surface water; and
- Labadie Creek surface water.

The direction of groundwater flow has been cataloged for many years at the Labadie Energy Center. The direction and rate of flow can vary with Missouri River stage but as Figure 1 shows, the direction of groundwater flow is mainly from the bluffs on the southern side of the facility towards the Missouri River.

There are no users of shallow groundwater in the vicinity of the ash management areas. While there are approximately 76 private wells recorded within a one-mile radius of the facility, all are located in the bluff area south and upgradient of the facility (see Figure 2; a detailed discussion of the wells in Figure 2 is presented in the AECOM 2014 report). Thus, there are no users of groundwater that may contain constituents derived from coal ash in the vicinity of the Labadie Energy Center ash management areas.

The Missouri River is a source of drinking water for the City of St. Louis, Missouri. The drinking water intake is located approximately 19.5 miles downstream from the facility at Howard Bend. Labadie Creek does not serve as a source of drinking water.

The Missouri River can be used for human recreation – wading, swimming, boating, fishing. Labadie Creek can also be used recreationally, though its small size would limit it mostly to wading.

Both the creek and the river serve as habitat for aquatic species – fish, amphibians, etc.

A depiction of the conceptual site model is shown in Figure 3.

Based on this conceptual site model, samples have been collected from each of these environmental media – groundwater, Missouri River and Labadie Creek. The samples have been analyzed for constituents that are commonly associated with coal ash, as discussed below. However, it is recognized by the USEPA that all of these constituents can also be naturally occurring and can be found in rocks, soils, water and sediments; thus the challenge is to understand what the naturally occurring background levels are for these constituents. [See Attachment A for a more detailed discussion of the constituents present in coal ash and in our natural environment.] The CCR Rule requires sampling and analysis of upgradient and/or background groundwater just for this reason. The same reasoning applies to the surface water, thus, when sampling surface water for this evaluation, samples were collected upstream to assess background conditions, and downstream to assess whether the facility may be having an impact on surface water quality. The sampling is detailed in the next section.

To answer the question, "Are the constituent concentrations high enough to potentially exert a toxic effect?" health risk-based screening levels from Federal and State sources are used for comparison to the data. To be conservative, all data are compared to risk-based drinking water screening level levels, even though the closest downgradient drinking water intake is 19.5 miles downstream in the Missouri River. All of the surface water data is compared to risk-based human recreational screening levels, and to ecological screening levels. The 2014 AECOM report demonstrated that the drinking water wells in the bluffs above the facility are screened in the bedrock aquifer and are not impacted by any release from the coal ash management areas.

Thus, this conceptual site model has guided the sample collection, sample analysis, and the risk-based sample results evaluation that are provided in the following sections.

3. Sample Collection

Alluvial Aquifer Groundwater

Groundwater samples were collected from monitoring wells placed around each ash management area consistent with the CCR Rule. In addition, four (4) background groundwater monitoring were installed at locations selected intentionally so as to avoid potential CCR impacts. The presence of constituents in a background well is indicative of naturally occurring conditions.

Eleven (11) groundwater monitoring wells were installed to evaluate deep alluvial groundwater at the LCPA under the CCR Rule, as shown on Figure 1. Nine (9) monitoring wells were installed around the perimeter of the LCPA to assess groundwater conditions at the ash management area (UMW-1D through UMW-9D), and two (2) monitoring wells were installed west of the facility to assess background groundwater conditions (BMW-1D and BMW-2D). LCPA has a deep alluvial aquifer monitoring system due to the depth of the ash in this unlined impoundment.

Ten (10) groundwater monitoring wells were installed to evaluate shallow alluvial groundwater at the LCPB under the CCR Rule, as shown on Figure 1. Eight (8) monitoring wells were installed around the perimeter of the LCPB to assess groundwater conditions at the ash management area (LMW-1S through LMW-8S), and the two (2) monitoring wells installed west of the facility are used to assess background groundwater conditions at the LCPB (BMW-1S and BMW-2S). LCPB has a shallow alluvial aquifer monitoring system due to the shallow depth of the lined impoundment.

Six (6) groundwater monitoring wells were installed to evaluate shallow alluvial groundwater at the LCL1 under the CCR Rule, as shown on Figure 1. Four (4) monitoring wells were installed around the perimeter of the LCL1 to assess groundwater conditions at the ash management area (MW-26, TMW-1, TMW-2, and TMW-3), and the two (2) shallow monitoring wells installed west of the facility are used to assess background groundwater conditions at the LCL1 also (BMW-1S and BMW-2S).

Each groundwater monitoring well was sampled nine (9) times[3] in 2016 and 2017.

Missouri River

Surface water samples were collected from 12 locations in the Missouri River in October 2013 and November 2014. These locations are shown on Figure 4. At each sample location, shallow samples were collected near the surface of the river. Where the depth of water was greater than four (4) feet, a second sample was collected mid-depth in the river.

Three (3) locations are approximately 0.25 miles upstream of the Facility (LBD-R-4 through -6) to assess water conditions unaffected by facility operations. Samples were collected in October 2013 and November 2014 to represent the following environments:

- Nearshore on the side closest to the Labadie Energy Center (LBD-R-4S and LBD-R-4AS), shallow depth;
- Midstream (LBD-R-6S/M and LBD-R-6AS/M), shallow depth, and mid-depth; and
- Near midstream (LBD-R-5S/M and LBD-R-5AS/M), shallow depth, and mid-depth.

Thus, a total of ten (10) upstream samples were collected.

Three (3) locations are approximately 0.25 miles downstream of the facility (LBD-R-1 through -3). The data from these locations are used to assess whether there is potential impact by the facility to river water quality. Similar to the upstream location, samples were collected in October 2013 and November 2014 to represent the following environments:

- Nearshore on the side closest to the Labadie Energy Center (LBD-R-1S and LBD-R-1AS), shallow depth;
- Midstream (LBD-R-3S/M and LBD-R-3AS/M), shallow depth, and mid-depth; and
- Near midstream (LBD-R-2S/M and LBD-R-2AS/M), shallow depth, and mid-depth.

Thus, a total of ten (10) downstream samples were collected.

In addition, an extra water sample was collected randomly from one of the locations, in this case an extra shallow sample was collected from the midstream downstream location.

Because of the variability in the groundwater flow directions over time, in November 2014, two additional downstream areas were sampled.

Three (3) locations are approximately 0.50 miles further downstream of the facility (LBD-R-10 through -12). The data from these locations are used to assess whether there is potential impact by the facility to river water quality. Similar to the upstream location, samples were collected in November 2014 to represent the following environments:

- Nearshore on the side closest to the Labadie Energy Center (LBD-R-10S), shallow depth;
- Midstream (LBD-R-12S/M), shallow depth, and mid-depth; and
- Near midstream (LBD-R-11S/M), shallow depth, and mid-depth.

[3] The CCR Rule requires eight (8) rounds of sampling events to establish baseline conditions in each well. Under the CCR Rule, the ninth sampling round is defined as the "Detection" sampling round.

Thus, a total of five (5) further downstream samples were collected.

In addition, an extra water sample was collected randomly from one of the locations, in this case an extra shallow sample was collected from the nearshore further downstream location.

Three (3) locations are approximately 0.75 miles furthest downstream of the facility (LBD-R-7 through -9). The data from these locations are used to assess whether there is potential impact by the facility to river water quality. Similar to the upstream location, samples were collected in November 2014 to represent the following environments:

- Nearshore on the side closest to the Labadie Energy Center (LBD-R-7S), shallow depth;
- Midstream (LBD-R-9S/M), shallow depth, and mid-depth; and
- Near midstream (LBD-R-8S/M), shallow depth, and mid-depth.

Thus, a total of five (5) furthest downstream samples were collected.

In addition, an extra water sample was collected randomly from one of the locations, in this case an extra shallow sample was collected from the nearshore furthest downstream location.

Thus, a total of 30 samples and three duplicates were collected from the 12 locations in the Missouri River.

Labadie Creek

The western border of the Labadie Energy Center is adjacent to Labadie Creek. Shallow surface water samples were collected from six (6) locations in the creek in October 2013. These locations are shown on Figure 4. Three locations are upstream of the facility, three locations are near the confluence of the creek with the Missouri River. Samples were collected:

- Upstream (LBD-C-4 through LBD-C-6); and
- Downstream (LBD-C-1 through LBD-C-3).

Thus, a total of six (6) surface water samples were collected. In addition, an extra water sample was collected randomly from one of the locations, in this case an extra shallow sample was collected from a downstream location.

4. Sample Analysis

The CCR Rule identifies the constituents that are included for groundwater testing; these are:

Boron	Antimony	Lead
Calcium	Arsenic	Lithium
Chloride	Barium	Mercury
pH	Beryllium	Molybdenum
Sulfate	Cadmium	Selenium
TDS	Chromium	Thallium
Fluoride	Cobalt	Radium 226/228

The CCR Rule requires eight (8) rounds of groundwater sampling and analysis. However, nine (9) rounds of groundwater samples collected through June 2017 were analyzed for all constituents. Detection monitoring samples from an additional tenth round from November 2017 were analyzed for the constituents listed in the first column above (these are the Appendix III constituents under the CCR Rule – the remaining are referred to as Appendix IV constituents). The CCR Rule requires statistical methods be used to determine whether a statistically significant increase (SSI) above background exists for the first column constituents. If so, additional assessment monitoring could be required.

So as to create an appropriate dataset for comparison, these same parameters were used for the surface water sample analysis except for chloride, TDS (TDS was included in the November 2014 sampling), lithium, and radium 226/228[4]. Two sets of analyses were conducted on the surface water samples. The samples were analyzed for the list above (referred to as the "total (unfiltered)" results), and then an aliquot of each sample was filtered to remove sediments/particulates and then analyzed (referred to as the "dissolved (filtered)" results). This is an important step for the analysis of surface water samples for two reasons:

- Surface water, especially in large rivers, can carry a large sediment load – the total (unfiltered results) include constituent concentrations that are associated with the sediment and not the water; and
- Some of the ecological screening levels used to evaluate the results apply only to dissolved (filtered) data.

The surface water samples were also analyzed for hardness, as some of the ecological screening levels are calculated based on site-specific hardness levels.

5. Risk-Based Screening Levels

A comprehensive set of risk-based screening levels have been compiled for this evaluation for the three types of potential exposures identified in the conceptual site model discussion above:

- Human health drinking water consumption;
- Human health recreational use of surface water; and
- Aquatic ecological receptors for surface water.

Table 1 provides the human health drinking water and recreational screening levels available from the State of Missouri sources and from Federal sources. Table 2 provides the ecological screening levels.

Drinking Water Screening Levels

The Missouri State drinking water supply levels are essentially the same as the Federal primary drinking water standards, also known as Maximum Contaminant Levels or MCLs. The Missouri State groundwater screening levels provide some additional screening levels not included on their list of drinking water screening levels.

[4] The analyte list was selected to be the same as the NPDES permit application analyte list, as the list is comprehensive and approved by the State. Because the radiological parameters included on the NPDES list were not above the screening levels during outfall monitoring, these parameters were not included in the surface water sampling program. As discussed in Section 6, chloride was not detected at concentrations above risk-based screening levels in the CCR Rule monitoring wells.

In addition to the MCLs that are enforceable for municipal drinking water supplies, there are Federal secondary MCLs, or SMCLs, that are generally based on aesthetics (taste, color) and are not risk-based. The USEPA also provides risk-based screening levels (RSLs) for tapwater (drinking water).

The selected screening levels used to evaluate potential drinking water exposures are shown on Table 1. Missouri drinking water supply screening levels were used and supplemented with Federal MCLs, then the USEPA risk-based levels for tapwater (RSLs), and finally the Federal SMCLs.

It is important to note that the CCR Rule limits the evaluation of groundwater monitoring data of ash management areas to Federal MCLs or to a comparison with site-specific background. That comparison and evaluation is provided in the CCR Rule Groundwater Monitoring Report prepared by Golder, which this report supplements. The use of a more comprehensive set of screening levels in this evaluation provides a broader risk-based evaluation of the groundwater data than would be provided by the CCR Rule requirements.

Recreational Screening Levels

Table 1 provides the State of Missouri human health recreational screening levels, based on fish consumption. The Federal Ambient Water Quality Criteria (AWQC) for consumption of organisms are also provided. Both sources were used to identify the screening levels used in this analysis, as listed on Table 1. The drinking water screening levels used to evaluate surface water are protective for other recreational uses of the river such as swimming, wading, and boating. Note that this evaluation of other uses of surface water are above and beyond the requirements of the CCR Rule.

Ecological Screening Levels

The ecological risk-based screening levels for surface water are provided in Table 2. As noted above, some of the screening levels are based on the hardness of the water. Therefore, Table 2 provides the screening levels for the Missouri River based on its hardness data. Note that this ecological evaluation of surface water is above and beyond the requirements of the CCR Rule.

6. Results

The level of analysis and comparison to risk-based screening levels presented below is above and beyond the requirements of the CCR Rule. The analysis of the groundwater results required by the CCR Rule is presented in the 2017 Groundwater Monitoring Annual Report: *https://www.ameren.com/Environment/managing-ccrs/ash-pond-closure*. This report serves to supplement that report by providing the risk-based analysis of groundwater and surface water, so that the groundwater results can be understood in their broader environmental context.

Groundwater – CCR Rule Evaluation

Ameren Missouri has filed on its website reports and notification required by the federal CCR Rule, as noted above, and additional reports will be prepared and posted on Ameren's website per the CCR Rule. The statistical analysis of the data has indicated an SSI for samples from the LCPA and the LCPB; there were no SSIs identified for the LCL1.

The statistical analysis of the LCPA data has indicated an SSI for samples collected from monitoring wells UMW-1 through UMW-9 (see Figure 1) that monitor the deeper alluvial aquifer. Analytes exhibiting an SSI are pH, boron, calcium, chloride, fluoride, sulfate, and TDS.

The statistical analysis of the LCPB data has indicated an SSI for samples collected from monitoring wells LMW-1S, LMW-2S, LMW-3S, LMW-4S, LMW-6S, LMW-7S, and LMW-8S. Analytes exhibiting an SSI are pH, boron, chloride, fluoride, and sulfate.

There were no SSIs identified for the LCL1.

The SSI values reflect a statistical evaluation that compares mathematically the results of the various rounds of samples to background water quality as required under the CCR rule. However, such values without further evaluation do not establish that there is an actual adverse impact to human health or the environment. The CSM process and screening analysis described in this report provides the relevant context for such groundwater monitoring results and whether the LCPA, LCPB, and LCL1 pose a true risk to human health and the environment. As explained in the remaining sections of this report, based upon surface water sampling data and the application of risk assessment principles uniformly adopted by USEPA and state environmental regulators including the Missouri Department of Natural Resources (MDNR), no such risk exists.

Groundwater – Risk-Based Evaluation

Groundwater data from all nine rounds of groundwater monitoring were compared to the human health risk-based drinking water screening levels. Figure 1 shows that the monitoring wells are all located at the edges of the LCPA, LCBP, and LCL1 and should, therefore, provide worst-case groundwater results.

Tables 3 through 5 provide a summary of the results. Analytical results greater than the screening level are provided; analytical results below the risk-based drinking water screening levels are indicated by "<". Note also that the first two wells listed in each table are the two background wells. The vast majority of the results are below the human health risk-based drinking water screening levels.

There are four (4) background wells. L-BMW-1D and L-BMW-2D serve as the background wells in the deeper alluvial aquifer for the LCPA. Both wells exhibit TDS concentrations above the human health drinking water screening level. L-BMW-2D also exhibits sulfate and lithium concentrations above the human health drinking water screening levels. L-BMW-1S and L-BMW-2S serve as the shallow alluvial aquifer background wells for the LCPB and LCL1. L-BMW-1S exhibits TDS concentrations above the human health drinking water screening level. Thus, these results represent naturally occurring conditions in the alluvial aquifer.

L-UMW-5D and L-UMW-7D, along the perimeter of the LCPA, have the most results above the screening levels: these are for boron, pH, sulfate, TDS, and molybdenum. As noted earlier, the alluvial aquifer in the vicinity of the LEC ash management areas is not used as a source of drinking water.

L-LMW-2S and L-LMW-4S, along the perimeter of the LCPB, have the most results above the screening levels: these are for boron, pH, sulfate, TDS, and molybdenum; and, boron, sulfate, TDS, lithium, and molybdenum, respectively. As noted earlier, the alluvial aquifer in the vicinity of the LEC ash management areas is not used as a source of drinking water.

L-TMW-3, associated with the LCL1, has the most results above the screening levels: these are for pH, TDS, and lithium. As noted earlier, the alluvial aquifer in the vicinity of the LEC ash management areas is not used as a source of drinking water.

The striking aspect of the analysis shown in Tables 3 through 5 is how few results are above a conservative risk-based drinking water screening level for human health, given that the wells are located at the base of the ash management area, and the facility has been in operation for 48 years[5]. Even for the very few results that may be above screening values for some of the sampling events, including the SSI results identified under the CCR Rule, there is no complete drinking water exposure pathway to groundwater. Where there is no exposure, there is no risk.

Missouri River

The comparison to risk-based screening levels of the analytical results for the Missouri River are presented in Tables 6 through 8.

- Table 6 – Comparison to drinking water screening levels – All results are below risk-based screening levels for drinking water with the exception of TDS; the TDS results upstream and downstream are similar, thus, indicative of normal river conditions.
- Table 7 – Comparison to human health recreational screening levels – Only total and dissolved concentrations of arsenic are above their screening levels. The arsenic results upstream and downstream are similar, thus, indicative of normal river conditions.
- Table 8 – Comparison to ecological screening levels – No results are above risk-based screening levels.

All analytical results for the Missouri River are below the ecological screening levels. All analytical results for the Missouri River are below drinking water screening levels with the exception of TDS, and the concentrations are similar upstream and downstream. While arsenic concentrations in the river are slightly above the human health recreational screening levels, the concentrations are similar upstream and downstream.

While arsenic concentrations in the river are slightly above the human health recreational screening levels, the concentrations are similar upstream and downstream indicating that the facility is not the source of the arsenic detected in the river. In fact, the concentrations of arsenic in all of the rivers sampled by Ameren for this evaluation (the Mississippi at Sioux, Meramec, and Rush Island; the Missouri River at Labadie and Sioux; and the Meramec River at Meramec) are all very similar with total results ranging from 0.0012 to 0.005 mg/L. This underscores the fact that arsenic is naturally occurring in our environment, as discussed in more detail in Attachment A.

Thus, the Missouri River sampling results do not show evidence of impact of constituents derived from LEC's ash management areas. This is important in that the absence of concentrations above risk-based screening levels means that there is not a significant pathway of exposure.

Labadie Creek

The comparison to risk-based screening levels of the analytical results for Labadie Creek are presented in:

- Table 9 – Comparison to drinking water screening levels – All results are below risk-based screening levels.

[5] Out of the 4386 groundwater analyses conducted at all three ash management areas, only 404 results are above a drinking water screening level (see Table 4). Put another way, approximately 90% of the groundwater results for the CCR Rule monitoring wells located at the edge of the LEC ash management areas are below drinking water screening levels.

- Table 10 – Comparison to human health recreational screening levels – only total concentrations of arsenic are above the screening level. The total arsenic results upstream and downstream are similar, thus indicative of normal creek conditions.
- Table 11 – Comparison to ecological screening levels – All results are below risk-based screening levels.

There are no analytical results for Labadie Creek that above drinking water or ecological screening levels. While arsenic concentrations in the creek are slightly above the human health recreational screening levels, the concentrations are similar upstream and downstream. As noted above, this is a common occurrence in surface water in Missouri.

Thus, even this small water body immediately adjacent to the Labadie Energy Center does not show evidence of risk to human health or the environment from ash management operations.

NPDES Outfall WET Testing Results

The outfall for the Labadie Energy Center is Outfall 002 and shown on Figure 4. This is a permitted outfall under the National Pollutant Discharge Elimination System (NPDES) program and discharges into a channel that runs parallel to Labadie Creek before reaching the Missouri River. The outfall effluent water is tested for toxicity on a periodic basis as required by the permit.

WET testing involves mixing the effluent water from Outfall 002 with synthetic laboratory water at various dilutions. If the effluent treatment results are not statistically different from the control results, then the effluent is considered to have passed the WET test.

Table 12 shows the results of the direct aquatic organism toxicity testing that was conducted using the outfall effluent. The results indicate no evidence of aquatic toxicity of the outfall effluent, even at a 100% effluent exposure concentration. This is a direct biological measure demonstrating the lack of toxicity of the Outfall 002 effluent.

7. Derivation of Risk-Based Screening Levels for Groundwater

The results presented here demonstrate that the 48-year history of ash management activities at the LEC have not had an adverse effect on human health or the environment. These results confirm that while some of the concentrations in the monitoring wells at the ash management areas are above the screening levels, and may be above the levels used to evaluate data under the CCR Rule, there is no pathway of exposure to the on-site groundwater. Where there is no exposure, there is no risk.

Ameren's facilities are located on major river systems with a massive and rapid river flow. In this section, we have attempted to illustrate how the groundwater – which is a fraction of the volume and flow rate of the river – may interact with a surface body under an assumed set of criteria and conditions (see Attachment B). Such an exercise in assumptions can help put in context whether a theoretical risk to public water supplies exists, particularly where, as here, actual surface water samples have been collected and evaluated.

However, impacts to groundwater does not mean that surface waters are impaired. The degree of interface between groundwater and surface waters is variable and complex and dependent upon a variety of factors including gradient and flow rate. It is possible, however, to determine the maximum concentration level that would need to be present on-site in groundwater and still be protective of the surface water environment, assuming gradient and flow rates are such that groundwater flows into the surface water. Groundwater and surface waters flow at very different rates and volumes. The Missouri River is the longest river in North America and as depicted on Table 13 and Attachment B, when compared to groundwater, its dilution factor is greater than 100,000.

It is possible to calculate a protective screening level for groundwater based upon the amount of dilution that occurs under the above assumption. This calculated risk-based screening level for groundwater can be used to determine whether an on-site groundwater concentration level is protective of the river. Stated differently, at what concentration level does groundwater entering the river system pose a human health or ecological risk?

Table 13 is summarized below and shows the application of the dilution factor to calculate alternative risk-based screening levels for the following parameters: boron, sulfate, cobalt, lithium, molybdenum, and TDS. These Tables 3-5 constituents have one or more monitoring well concentrations above the drinking water screening levels. For each constituent, the human health drinking water and recreational screening levels are presented as well as the ecological screening level. The lowest of the three screening levels is then identified for surface water. The dilution factor is then applied to this lowest screening level for surface water to result in the groundwater alternative risk-based screening level, which is what is shown in the table below.

This evaluation is not limited to only those constituents for which SSIs have been identified. The constituents listed here are those for which there is one or more groundwater result above a risk-based screening level[6].

CALCULATING RISK-BASED SCREENING LEVELS FOR GROUNDWATER BASED ON THE MISSOURI RIVER (see Table 13)

	Estimated Dilution Factor for Missouri River (d) =	100,000			
Constituents*	**Lowest of the Human Health and Eco Screening Levels (mg/L)**	**Groundwater Target Level** (mg/L)**	**Maximum LEC Groundwater Concentration (mg/L)**		**Ratio Between Groundwater Target Level and the Maximum LEC Groundwater Concentration**
Boron***	2	200000	18.2	L-UMW-6D	>10,000
Sulfate***	250	25000000	774	L-UMW-3D	>32,000
Cobalt	0.006	600	0.0095	L-LMW-6S	>63,000
Lithium	0.04	4000	0.0575	L-TMW-2	>69,000
Molybdenum	0.1	10000	0.674	L-UMW-6D	>14,000
TDS***	500	50000000	1240	L-UMW-3D	>40,000

*** A dilution factor is not directly applicable to pH, thus it is not included in this analysis.**
**** Where the Groundwater Target Level = Screening Level x Dilution Factor.**
***** Constituents for which an SSI has been identified. Note that although an SSI was identified for boron and sulfate, these constituents are not present in surface water at concentrations above the risk-based screening levels. Note that although an SSI was identified for chloride and fluoride for LCPA and LCPB, none of the groundwater results are above risk-based drinking water screening levels for these constituents.**

[6] Note that under the CCR Rule, statistically significant levels of Appendix IV constituents are determined after Assessment Monitoring has been conducted.

The groundwater target levels are calculated in units of milligrams of constituent per liter of water (mg/L). One mg/L is equivalent to one million parts per million[7,8].

The table identifies the maximum groundwater concentration of each constituent detected in the monitoring wells for the ash management areas. The comparison between the target levels and the maximum concentrations indicates that there is a wide margin of safety between the two values. This margin is shown in the last column of the table. To illustrate, concentration levels of boron and lithium would need to be more than 10,000 and 69,000 times higher, respectively, than currently measured levels before an adverse impact in the river could occur.

This means that not only do the present concentrations of constituents in groundwater at the LEC not pose a risk to human health or the environment, but even much higher concentrations would not be harmful.

8. Closure of the LCPA and LCPB

Current plans for the facility are to close the surface impoundments[9]. Closure of the surface impoundments is expected to be completed in 2020. Closure is estimated to reduce the movement of CCR constituents from the surface impoundments discharge (or flux) of water into the alluvial aquifer to groundwater by 90% or more. This reduction is the result of several factors: closure will cease the flow of water and ash to the surface impoundments, a cap will be installed that will limit infiltration of precipitation, and the closure plan includes stormwater run-on and run-off controls to route stormwater off of the capped area and away from the surface impoundments. It is likely that concentrations of constituents in groundwater at the in this area will decrease post-closure.

9. Summary

This comprehensive evaluation demonstrates that there are no adverse impacts on human health from either surface water or groundwater uses resulting from coal ash management practices at the Labadie Energy Center.

10. Attachments

<u>TABLES</u>

1 HUMAN HEALTH SCREENING LEVELS

2 ECOLOGICAL SCREENING LEVELS

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[7] Note that because the target level calculation is a mathematical exercise, certain results may not be applicable in the real world. For example, the result for sulfate is 25 million parts per million, which is not physically possible. However, what this means is that there is no level of sulfate that could be present in the groundwater at the LEC that could result in a risk of harm to human health or the environment.

[8] A million parts per million is equivalent to 1 penny in $10,000 worth of pennies, 1 second in 11.5 days, or 1 inch in 15.8 miles.

[9] Importantly, the CCR Rule promulgated by USEPA in 2015 is both under appeal [Utility Solid Waste Activities, et al v. EPA, Docket No. 15-01219, DC Circuit Court of Appeals Sept 13, 2017, Letter from Pruitt to reconsider.] and is being reconsidered by the current Administration. Notwithstanding any proposed changes to the federal CCR Rule, Ameren Missouri intends to implement its closure plan and schedule.

FIGURES

ATTACHMENTS

TABLES

TABLE 1
HUMAN HEALTH SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

			Missouri State Water Quality Screening Levels (mg/L)			Federal Water Quality Screening Levels (mg/L)				Selected Screening Level (mg/L)	
Constituent	**Abbreviation**	**CASRN**	**Human Health Fish Consumption (a)**	**Drinking Water Supply (a)**	**Groundwater (a)**	**USEPA AWQC Human Health Consumption of Organism Only (b)**	**MCLs (c)**	**SMCLs (c)**	**November 2017 USEPA Tapwater RSLs (d)**	**Drinking Water (e)**	**Recreational Use (f)**
Antimony	Sb	7440-36-0	4.3	0.006	0.006	0.64	0.006	NA	0.0078 (m)	0.006	4.3
Arsenic	As	7440-38-2	NA	0.05	0.05	0.00014 (i)	0.01	NA	0.000052	0.05	0.00014
Barium	Ba	7440-39-3	NA	2	2	NA	2	NA	3.8	2	NA
Beryllium	Be	7440-41-7	NA	0.004	0.004	NA	0.004	NA	0.025	0.004	NA
Boron	B	7440-42-8	NA	NA	2	NA	NA	NA	4	4 (q)	NA
Cadmium	Cd	7440-43-9	NA	0.005	0.005	NA	0.005	NA	0.0092	0.005	NA
Calcium	Ca	7440-70-2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	Cl	7647-14-5	NA	250	NA	NA	NA	250	NA	250	NA
Chromium	Cr	16065-83-1 (g)	NA	0.1	0.1	NA	0.1 (j)	NA	22 (n)	0.1	NA
Cobalt	Co	7440-48-4	NA	NA	1	NA	NA	NA	0.006	0.006	NA
Fluoride	Fl	16984-48-8	NA	4	4	NA	4	2	0.8	4	NA
Lead	Pb	7439-92-1	NA	0.015	0.015	NA	0.015 (k)	NA	0.015	0.015	NA
Lithium	Li	7439-93-2	NA	NA	NA	NA	NA	NA	0.04	0.04	NA
Mercury	Hg	7487-94-7 (h)	NA	0.002	0.002	NA	0.002 (l)	NA	0.0057 (o)	0.002	NA
Molybdenum	Mo	7439-98-7	NA	NA	NA	NA	NA	NA	0.1	0.1	NA
Radium 226/228 (pCi/L)	Ra 226/228	RADIUM226228	NA	NA	NA	NA	5	NA	NA	5	NA
Selenium	Se	7782-49-2	NA	0.05	0.05	4.2	0.05	NA	0.1	0.05	4.2
Sulfate	SO4	7757-82-6	NA	250	NA	NA	NA	250	NA	250	NA
Thallium	Tl	7440-28-0	0.0063	0.002	0.002	0.00047	0.002	NA	0.0002 (p)	0.002	0.0063
Total Dissolved Solids	TDS	TDS	NA	NA	NA	NA	NA	500	NA	500	NA
pH (std)	--	PHFLD	NA	NA	NA	NA	NA	6.5 - 8.5	NA	6.5 - 8.5	NA

Notes:

AWQC - Ambient Water Quality Criteria.
CASRN - Chemical Abstracts Service Registry Number.
HI - Hazard Index (noncancer child).
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - not available.
pCi/L - picoCurie per liter.
RSL - Risk-based Screening Levels (USEPA).
TR - Target Risk (carcinogenic).
USEPA - United States Environmental Protection Agency.

(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. Updated January 29, 2014. Per 10 CSR 20-7.031(4)(B)(2), the criteria for Human Protection Fish Consumption apply to dissolved metals data. All other criteria apply to total concentrations.
http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed November 2014.
https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.
(c) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012.
http://water.epa.gov/drink/contaminants/index.cfm
(d) - USEPA Risk-Based Screening Levels (November 2017). Values for tapwater. HI = 1.0, TR = 1E-06.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(e) - The hierachy for selecting the Human Health Screening Level for Drinking Water is: Missouri State Water Quality Criteria for Drinking Water Supply (a); Federal USEPA MCL for Drinking Water (c); Federal June 2017 USEPA Tapwater RSL (d); Federal USEPA SMCL for Drinking Water (c).
(f) - The hierachy for selecting the Human Health Screening Level for Recreational Use is: Missouri State Water Quality Criteria for Human Health Fish Consumption (a); Federal USEPA AWQC for Human Health Consumption of Organism Only (b).
(g) - CAS number for Trivalent Chromium.
(h) - CAS number for Mercuric Chloride.
(i) - Value applies to inorganic form of arsenic only.
(j) - Value for Total Chromium.
(k) - Lead Treatment Technology Action Level is 0.015 mg/L.
(l) - Value for Inorganic Mercury.
(m) - RSL for Antimony (metallic) used for Antimony.
(n) - RSL for Chromium (III), Insoluble Salts used for Chromium.
(o) - RSL for Mercuric Chloride used for Mercury.
(p) - RSL for Thallium (Soluble Salts) used for Thallium.
(q) - RSL selected for Boron as the Missouri State Water Quality Groundwater screening level is based on irrigation.

TABLE 2
ECOLOGICAL SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MISSOURI
AMEREN MISSOURI

		Missouri State Water Quality Criteria (mg/L)						Federal Water Quality Criteria (mg/L)			
		Site-Specific Protection of Aquatic Life Acute (a)		Site-Specific Protection of Aquatic Life Chronic (a)		Irrigation (a)	Livestock Wildlife Watering (a)	Site-Specific USEPA Aquatic Life AWQC Freshwater Acute (b)		Site-Specific USEPA Aquatic Life AWQC Freshwater Chronic (b)	
Constituent	**CASRN**	**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Total**	**Total**	**Dissolved**	**Total**	**Dissolved**
Antimony (c)	7440-36-0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	NA	NA	NA	0.02	0.1	NA	0.34	0.34	0.15	0.15
Barium (c)	7440-39-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	7440-41-7	NA	NA	NA	0.005	0.1	NA	NA	NA	NA	NA
Boron	7440-42-8	NA	NA	NA	NA	2	NA	NA	NA	NA	NA
Cadmium	7440-43-9	0.015	0.013	0.00059	0.0005	NA	NA	0.0053 (f)	0.0048 (g)	0.0018 (f)	0.0016 (g)
Calcium (c)	7440-70-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	16887-00-6	NA	NA	NA	NA	NA	NA	860	NA	230	NA
Chromium	7440-47-3	4.2	1.3	0.20	0.17	0.1 (e)	NA	4.2 (e,f)	1.3 (e,g)	0.20 (e,f)	0.17 (e,g)
Cobalt	7440-48-4	NA	NA	NA	NA	NA	1	NA	NA	NA	NA
Fluoride	16984-48-8	NA	NA	NA	NA	NA	4	NA	NA	NA	NA
Lead	7439-92-1	0.31	0.20	0.0120	0.0077	NA	NA	0.31 (f)	0.20 (g)	0.0120 (f)	0.0077 (g)
Lithium (c)	7439-93-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	7439-97-6	0.0024	0.0024	0.0005	0.0005	NA	NA	0.0016	0.0014	0.00091	0.00077
Molybdenum (c)	7439-98-7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	7782-49-2	NA	NA	NA	0.005	NA	NA	0.013 (d)	0.013 (d)	0.005 (d)	0.005 (d)
Sulfate	14808-79-8	NA	NA	1830 (g,h)	NA	NA	NA	NA	NA	NA	NA
Thallium (c)	7440-28-0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Dissolved Solids (c)	TDS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
AWQC - USEPA Ambient Water Quality Criteria.
CASRN - Chemical Abstracts Service Registry Number.
CMC - Criterion Maximum Concentration
mg/L - milligram per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency

(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. January 29, 2014.
http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf. Total values provided.
Missouri State Protection of Aquatic Life Acute and Chronic values apply only to dissolved results (except mercury).
irrigation, livestock/wildlife watering, and mercury Aquatic Life Acute and Chronic values apply only to totals results.
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed December 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (f).
USEPA provides AWQC for both total and dissolved results.
(c) - Water quality criteria from the presented sources are not available for this constituent
(d) - Acute AWQC is equal to 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate respectively, and CMC1 and CMC2 are 185.9 ug/L and 12.82 ug/L, respectively. Calculated assuming that all selenium is present as selenate a likely overly conservative assumption.
(e) - Value for trivalent chromium used.
(f) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value for the Missouri River of 284.5 mg/L as CaCO3 used
(g) - Hardness dependent value for total metals adjusted for dissolved fraction. Site-specific total recoverable mean hardness value for the Missouri River of 284.5 mg/L as CaCO3 used
(h) - Chloride dependent value (Site-specific mean chloride value of 19.5 mg/L is assumed) for the Missouri River
When chloride is greater than or equal to 25 and less than or equal to 500 mg/L and hardness is between 100 and 500 mg/L
sulfate limit in mg/L = [1276.7 + 5.508 (hardness) − 1.457 (chloride)] * 0.65.

TABLE 3
SUMMARY OF LCPA SURFACE IMPOUNDMENT GROUNDWATER MONITORING RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)																			
	Constituent	Boron	Calcium	Chloride	pH	Sulfate	TDS	Fluoride	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
	HH DW SL	4	NA	250	6.5-8.5	250	500	4	0.006	0.05	2	0.004	0.005	0.1	0.006	0.015	0.04	0.002	0.1	0.05	0.002
Monitoring Well ID	**Sampling Event Date**	mg/L	mg/L	mg/L	S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
L-BMW-1D (b)	Mar-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	<	<	570	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	504	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	514	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	521	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	505	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	518	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-17	<	<	<	NA	<	<	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
L-BMW-2D (b)	Mar-16	<	<	<	<	<	555	<	<	<	<	<	<	<	<	<	0.0474	<	<	<	<
	May-16	<	<	<	<	272	613	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	538	<	<	<	<	<	<	<	<	<	0.0441	<	<	<	<
	Sep-16	<	<	<	<	<	524	<	<	<	<	<	<	<	<	<	0.0432	<	<	<	<
	Nov-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	0.0461	<	<	<	<
	Jan-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	0.0415	<	<	<	<
	Jun-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-17	<	<	<	NA	<	<	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
L-UMW-1D	Mar-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	512	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	531	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	517	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	568	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-17	<	<	<	NA	<	<	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
L-UMW-2D	Mar-16	<	<	<	<	270	669	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	<	<	535	<	<	<	<	<	<	<	<	<	0.0451	<	<	<	<
	Jul-16	<	<	<	<	<	659	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	625	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	669	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	547	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	540	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	543	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-17	<	<	<	NA	<	583	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
L-UMW-3D	Mar-16	8.98	<	<	<	364	601	<	<	<	<	<	<	<	<	<	<	<	0.195	<	<
	May-16	9.43	<	<	<	473	735	<	<	<	<	<	<	<	<	<	<	<	0.171	<	<
	Jul-16	9.8	<	<	<	382	670	<	<	<	<	<	<	<	<	<	<	<	0.192	<	<
	Sep-16	9.23	<	<	<	454	781	<	<	<	<	<	<	<	<	<	<	<	0.175	<	<
	Nov-16	8.55	<	<	<	774	1240	<	<	<	<	<	<	<	<	<	<	<	0.113	<	<
	Jan-17	7.85	<	<	<	597	1030	<	<	<	<	<	<	<	<	<	<	<	0.127	<	<
	Mar-17	7.87	<	<	<	634	1150	<	<	<	<	<	<	<	<	<	<	<	0.116	<	<
	Jun-17	12.4	<	<	<	386	777	<	<	<	<	<	<	<	<	<	<	<	0.171	<	<
	Nov-17	9.85	<	<	NA	422	596	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
L-UMW-4D	Mar-16	4.01	<	<	<	343	590	<	<	<	<	<	<	<	<	<	<	<	0.148	<	<
	May-16	<	<	<	<	330	550	<	<	<	<	<	<	<	<	<	<	<	0.145	<	<
	Jul-16	4.34	<	<	<	372	629	<	<	<	<	<	<	<	<	<	<	<	0.192	<	<
	Sep-16	<	<	<	<	360	618	<	<	<	<	<	<	<	<	<	<	<	0.156	<	<
	Nov-16	<	<	<	<	274	<	<	<	<	<	<	<	<	<	<	<	<	0.122	<	<
	Jan-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	0.116	<	<
	Jun-17	5.24	<	<	<	342	610	<	<	<	<	<	<	<	<	<	<	<	0.192	<	<
	Nov-17	4.02	<	<	NA	312	536	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
L-UMW-5D	Mar-16	5.15	<	<	<	261	<	<	<	<	<	<	<	<	<	<	<	<	0.109	<	<
	May-16	5.22	<	<	9.3	312	548	<	<	<	<	<	<	<	<	<	<	<	0.13	<	<
	Jul-16	5.3	<	<	<	267	515	<	<	<	<	<	<	<	<	<	<	<	0.117	<	<
	Sep-16	5.08	<	<	9.2	275	513	<	<	<	<	<	<	<	<	<	<	<	0.12	<	<
	Nov-16	5.4	<	<	9.2	263	<	<	<	<	<	<	<	<	<	<	<	<	0.122	<	<
	Jan-17	5.48	<	<	9.1	<	<	<	<	<	<	<	<	<	<	<	<	<	0.106	<	<
	Mar-17	6.15	<	<	9.1	252	<	<	<	<	<	<	<	<	<	<	<	<	0.111	<	<
	Jun-17	5.69	<	<	9.3	<	<	<	<	<	<	<	<	<	<	<	<	<	0.136	<	<
	Nov-17	5.92	<	<	NA	<	<	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
L-UMW-6D	Mar-16	18.2	<	<	<	278	547	<	<	<	<	<	<	<	<	<	<	<	0.668	<	<
	May-16	16.7	<	<	<	400	571	<	<	<	<	<	<	<	<	<	<	<	0.634	<	<
	Jul-16	17.7	<	<	<	350	548	<	<	<	<	<	<	<	<	<	<	<	0.674	<	<
	Sep-16	16.8	<	<	<	316	589	<	<	<	<	<	<	<	<	<	<	<	0.596	<	<
	Nov-16	15.9	<	<	<	384	630	<	<	<	<	<	<	<	<	<	<	<	0.554	<	<
	Jan-17	14	<	<	<	504	680	<	<	<	<	<	<	<	<	<	<	<	0.504	<	<
	Mar-17	14.2	<	<	<	446	749	<	<	<	<	<	<	<	<	<	<	<	0.496	<	<
	Jun-17	17.4	<	<	<	366	672	<	<	<	<	<	<	<	<	<	<	<	0.548	<	<
	Nov-17	15.7	<	<	NA	467	645	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 3
SUMMARY OF LCPA SURFACE IMPOUNDMENT GROUNDWATER MONITORING RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)																			
	Constituent	Boron	Calcium	Chloride	pH	Sulfate	TDS	Fluoride	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
	HH DW SL	4	NA	250	6.5-8.5	250	500	4	0.006	0.05	2	0.004	0.005	0.1	0.006	0.015	0.04	0.002	0.1	0.05	0.002
Monitoring Well ID	**Sampling Event Date**	mg/L	mg/L	mg/L	S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
L-UMW-7D	Mar-16	5.81	<	<	<	<	725	<	<	<	<	<	<	<	<	<	<	<	0.201	<	<
	May-16	5.74	<	<	<	<	726	<	<	<	<	<	<	<	<	<	<	<	0.182	<	<
	Jul-16	5.82	<	<	<	<	760	<	<	<	<	<	<	<	<	<	<	<	0.198	<	<
	Sep-16	4.82	<	<	6	<	766	<	<	<	<	<	<	<	<	<	<	<	0.205	<	<
	Nov-16	5.26	<	<	<	252	740	<	<	<	<	<	<	<	<	<	<	<	0.191	<	<
	Jan-17	5.57	<	<	<	318	800	<	<	<	<	<	<	<	<	<	<	<	0.205	<	<
	Mar-17	5.84	<	<	<	295	801	<	<	<	<	<	<	<	<	<	<	<	0.191	<	<
	Jun-17	5.98	<	<	<	305	809	<	<	<	<	<	<	<	<	<	<	<	0.188	<	<
	Nov-17	6.36	<	<	NA	313	825	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
L-UMW-8D	Mar-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	507	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	521	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	511	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	536	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-17	<	<	<	NA	<	<	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
L-UMW-9D	Mar-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-17	<	<	<	NA	<	<	<	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Summary Ratio of # Results above the SL : Total # Results		40:99	0:99	0:99	7:88	38:99	63:99	0:99	0:88	0:88	0:88	0:88	0:88	0:88	0:88	0:88	6:88	0:88	39:88	0:88	0:88

Notes:
< - Less than the Human Health Drinking Water Screening Level.
DW - Drinking Water.
HH - Human Health.
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
RSL - Risk-Based Screening Level.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Drinking Water Supply.
Federal USEPA MCL for Drinking Water.
Federal November 2017 USEPA Tapwater RSL.
Federal USEPA SMCL for Drinking Water.
(b) - Background monitoring wells.

TABLE 4
SUMMARY OF LCPB SURFACE IMPOUNDMENT GROUNDWATER MONITORING RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)																			
	Constituent	Boron	Calcium	Chloride	pH	Sulfate	TDS	Fluoride	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
	HH DW SL	4	NA	250	6.5-8.5	250	500	4	0.006	0.05	2	0.004	0.005	0.1	0.006	0.015	0.04	0.002	0.1	0.05	0.002
Monitoring Well ID	**Sampling Event Date**	mg/L	mg/L	mg/L	S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
L-BMW-1S (b)	Mar-16	<	<	<	<	<	712	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	<	<	772	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	780	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	752	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	692	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	704	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	748	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	749	<	<	<	<	<	<	<	<	<	<	<	<	<	<
L-BMW-2S (b)	Mar-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
L-LMW-1S	Mar-16	<	<	<	<	<	529	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	<	<	525	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	552	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	4.34	<	<	<	<	615	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	6.23	<	<	<	<	688	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	519	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	521	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	685	<	<	<	<	<	<	<	<	<	<	<	<	<	<
L-LMW-2S	Mar-16	6.97	<	<	<	295	<	<	<	<	<	<	<	<	<	<	<	<	0.141	<	<
	May-16	6.92	<	<	9.3	312	505	<	<	<	<	<	<	<	<	<	<	<	0.137	<	<
	Jul-16	6.72	<	<	9.3	365	519	<	<	<	<	<	<	<	<	<	<	<	0.123	<	<
	Sep-16	6.9	<	<	9.4	311	526	<	<	<	<	<	<	<	<	<	<	<	0.119	<	<
	Nov-16	7.19	<	<	9.3	275	<	<	<	<	<	<	<	<	<	<	<	<	0.111	<	<
	Jan-17	6.86	<	<	9.2	285	<	<	<	<	<	<	<	<	<	<	<	<	0.115	<	<
	Mar-17	6.68	<	<	9	293	519	<	<	<	<	<	<	<	<	<	<	<	0.151	<	<
	Jun-17	7.3	<	<	9.3	317	523	<	<	<	<	<	<	<	<	<	<	<	0.148	<	<
L-LMW-3S	Mar-16	4.76	<	<	<	254	595	<	<	<	<	<	<	<	<	<	<	<	0.202	<	<
	May-16	4.04	<	<	<	286	508	<	<	<	<	<	<	<	<	<	<	<	0.172	<	<
	Jul-16	4.3	<	<	<	256	576	<	<	<	<	<	<	<	<	<	<	<	0.173	<	<
	Sep-16	<	<	<	<	256	501	<	<	<	<	<	<	<	<	<	<	<	0.171	<	<
	Nov-16	5.31	<	<	<	260	641	<	<	<	<	<	<	<	<	<	<	<	0.207	<	<
	Jan-17	5.55	<	<	<	257	666	<	<	<	<	<	<	<	<	<	<	<	0.197	<	<
	Mar-17	4.53	<	<	<	<	516	<	<	<	<	<	<	<	<	<	<	<	0.172	<	<
	Jun-17	5.39	<	<	<	271	627	<	<	<	<	<	<	<	<	<	<	<	0.187	<	<
L-LMW-4S	Mar-16	7.32	<	<	<	<	793	<	<	<	<	<	<	<	<	<	0.042	<	<	<	<
	May-16	9.46	<	<	<	266	648	<	<	<	<	<	<	<	<	<	<	<	0.218	<	<
	Jul-16	9.48	<	<	<	<	712	<	<	<	<	<	<	<	<	<	<	<	0.142	<	<
	Sep-16	9.56	<	<	<	<	677	<	<	<	<	<	<	<	<	<	<	<	0.214	<	<
	Nov-16	7.6	<	<	<	<	748	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	8.12	<	<	<	<	724	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	9.5	<	<	<	<	740	<	<	<	<	<	<	<	<	<	0.0446	<	<	<	<
	Jun-17	10.6	<	<	<	264	695	<	<	<	<	<	<	<	<	<	<	<	0.13	<	<
L-LMW-5S	Mar-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
L-LMW-6S	Mar-16	<	<	<	<	<	642	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	4.78	<	<	<	<	633	<	<	<	<	<	<	<	<	<	0.0444	<	<	<	<
	Jul-16	5.15	<	<	<	<	656	<	<	<	<	<	<	<	0.0095	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	659	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	608	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	602	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	599	<	<	<	<	<	<	<	<	<	0.0413	<	<	<	<
	Jun-17	5.77	<	<	<	<	627	<	<	<	<	<	<	<	0.0061	<	0.0408	<	<	<	<
L-LMW-7S	Mar-16	4.06	<	<	<	<	551	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	4.15	<	<	<	<	732	<	<	<	<	<	<	<	<	<	0.0486	<	<	<	<
	Jul-16	6.4	<	<	<	<	687	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	4.28	<	<	<	<	722	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	578	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	607	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	636	<	<	<	<	<	<	<	<	<	0.0402	<	<	<	<
	Jun-17	5.66	<	<	<	<	752	<	<	<	<	<	<	<	<	<	0.0442	<	<	<	<

TABLE 4
SUMMARY OF LCPB SURFACE IMPOUNDMENT GROUNDWATER MONITORING RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)																			
	Constituent	Boron	Calcium	Chloride	pH	Sulfate	TDS	Fluoride	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
	HH DW SL	4	NA	250	6.5-8.5	250	500	4	0.006	0.05	2	0.004	0.005	0.1	0.006	0.015	0.04	0.002	0.1	0.05	0.002
Monitoring Well ID	**Sampling Event Date**	mg/L	mg/L	mg/L	S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
L-LMW-8S	Mar-16	5.53	<	<	<	287	791	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	7.16	<	<	<	522	899	<	<	<	<	<	<	<	<	<	<	<	0.206	<	<
	Jul-16	6.22	<	<	<	338	865	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	5.22	<	<	<	309	845	<	<	<	<	<	<	<	<	<	<	<	0.11	<	<
	Nov-16	<	<	<	<	<	649	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	596	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	585	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	8.73	<	<	<	448	913	<	<	<	<	<	<	<	<	<	<	<	0.258	<	<
Summary Ratio of # Results above the SL : Total # Results		38:80	0:80	0:80	7:80	22:80	61:80	0:80	0:80	0:80	0:80	0:80	0:80	0:80	2:80	0:80	8:80	0:80	23:80	0:80	0:80

Notes:
< - Less than the Human Health Drinking Water Screening Level.
DW - Drinking Water.
HH - Human Health.
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
RSL - Risk-Based Screening Level.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Drinking Water Supply.
Federal USEPA MCL for Drinking Water.
Federal November 2017 USEPA Tapwater RSL.
Federal USEPA SMCL for Drinking Water.
(b) - Background monitoring well also associated with LCL1.

TABLE 5
SUMMARY OF LCL1 UTILITY WASTE LANDFILL CELL 1 GROUNDWATER MONITORING RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)																			
	Constituent	Boron	Calcium	Chloride	pH	Sulfate	TDS	Fluoride	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
	HH DW SL	4	NA	250	6.5-8.5	250	500	4	0.006	0.05	2	0.004	0.005	0.1	0.006	0.015	0.04	0.002	0.1	0.05	0.002
Monitoring Well ID	**Sampling Event Date**	mg/L	mg/L	mg/L	S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
L-BMW-1S (b)	Mar-16	<	<	<	<	<	712	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	<	<	772	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	780	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	752	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	692	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	704	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	748	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	749	<	<	<	<	<	<	<	<	<	<	<	<	<	<
L-BMW-2S (b)	Mar-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	May-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
L-MW-26	May-16	<	<	<	<	<	510	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-16	<	<	<	<	<	506	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	611	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	505	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
L-TMW-1	May-16	<	<	<	<	<	559	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jun-16	<	<	<	<	<	622	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jul-16	<	<	<	<	<	668	<	<	<	<	<	<	<	<	<	0.043	<	<	<	<
	Sep-16	<	<	<	<	<	647	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	578	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Jan-17	<	<	<	<	<	576	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Mar-17	<	<	<	<	<	642	<	<	<	<	<	<	<	<	<	0.0401	<	<	<	<
	Jun-17	<	<	<	<	<	628	<	<	<	<	<	<	<	<	<	<	<	<	<	<
L-TMW-2	May-16	<	<	<	<	<	664	<	<	<	<	<	<	<	<	<	0.049	<	<	<	<
	Jun-16	<	<	<	<	<	681	<	<	<	<	<	<	<	<	<	0.0401	<	<	<	<
	Jul-16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Sep-16	<	<	<	<	<	743	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	698	<	<	<	<	<	<	<	<	<	0.0526	<	<	<	<
	Jan-17	<	<	<	<	<	683	<	<	<	<	<	<	<	<	<	0.0506	<	<	<	<
	Mar-17	<	<	<	<	<	737	<	<	<	<	<	<	<	<	<	0.0575	<	<	<	<
	Jun-17	<	<	<	<	<	684	<	<	<	<	<	<	<	<	<	<	<	<	<	<
L-TMW-3	May-16	<	<	<	9.6	<	718	<	<	<	<	<	<	<	<	<	0.0546	<	<	<	<
	Jun-16	<	<	<	<	<	683	<	<	<	<	<	<	<	<	<	0.0419	<	<	<	<
	Jul-16	<	<	<	<	<	695	<	<	<	<	<	<	<	<	<	0.0463	<	<	<	<
	Sep-16	<	<	<	<	<	604	<	<	<	<	<	<	<	<	<	<	<	<	<	<
	Nov-16	<	<	<	<	<	717	<	<	<	<	<	<	<	<	<	0.0552	<	<	<	<
	Jan-17	<	<	<	<	<	668	<	<	<	<	<	<	<	<	<	0.045	<	<	<	<
	Mar-17	<	<	<	<	<	684	<	<	<	<	<	<	<	<	<	0.0543	<	<	<	<
	Jun-17	<	<	<	<	<	711	<	<	<	<	<	<	<	<	<	0.0475	<	<	<	<
Summary Ratio of # Results above the SL : Total # Results		0:48	0:48	0:48	1:48	0:48	35:48	0:48	0:48	0:48	0:48	0:48	0:48	0:48	0:48	0:48	14:48	0:48	0:48	0:48	0:48

Notes:
< - Less than the Human Health Drinking Water Screening Level.
DW - Drinking Water.
HH - Human Health.
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
RSL - Risk-Based Screening Level.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Drinking Water Supply.
Federal USEPA MCL for Drinking Water.
Federal November 2017 USEPA Tapwater RSL.
Federal USEPA SMCL for Drinking Water.
(b) - Background monitoring well also associated with LCPB.

TABLE 6
SUMMARY OF MISSOURI RIVER SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)																		
	Constituent	Boron		Calcium		Chloride	pH	Sulfate	TDS	Fluoride	Antimony		Arsenic		Barium		Beryllium		Cadmium	
	Fraction	Total	Dissolved	Total	Dissolved	Total	Total	Total	Total	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample	**HH DW SL**	4	4	NA	NA	250	6.5-8.5	250	500	4	0.006	0.006	0.05	0.05	2	2	0.004	0.004	0.005	0.005
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
UPSTREAM																				
LBD-R-4S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-4AS	Nov-14	<	<	<	<	NA	NA	<	539	<	<	<	<	<	<	<	<	<	<	<
LBD-R-5S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-5AS	Nov-14	<	<	<	<	NA	NA	<	548	<	<	<	<	<	<	<	<	<	<	<
LBD-R-5M	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-5AM	Nov-14	<	<	<	<	NA	NA	<	553	<	<	<	<	<	<	<	<	<	<	<
LBD-R-6S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-6AS	Nov-14	<	<	<	<	NA	NA	<	550	<	<	<	<	<	<	<	<	<	<	<
LBD-R-6M	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-6AM	Nov-14	<	<	<	<	NA	NA	<	544	<	<	<	<	<	<	<	<	<	<	<
DOWNSTREAM																				
LBD-R-1S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-1AS	Nov-14	<	<	<	<	NA	NA	<	532	<	<	<	<	<	<	<	<	<	<	<
LBD-R-2S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-2AS	Nov-14	<	<	<	<	NA	NA	<	541	<	<	<	<	<	<	<	<	<	<	<
LBD-R-2M	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-2M-DUP	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-2AM	Nov-14	<	<	<	<	NA	NA	<	531	<	<	<	<	<	<	<	<	<	<	<
LBD-R-3S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-3AS	Nov-14	<	<	<	<	NA	NA	<	540	<	<	<	<	<	<	<	<	<	<	<
LBD-R-3M	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-3AM	Nov-14	<	<	<	<	NA	NA	<	541	<	<	<	<	<	<	<	<	<	<	<
FURTHER DOWNSTREAM																				
LBD-R-10S	Nov-14	<	<	<	<	NA	NA	<	550	<	<	<	<	<	<	<	<	<	<	<
LBD-R-10S-DUP	Nov-14	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-11S	Nov-14	<	<	<	<	NA	NA	<	543	<	<	<	<	<	<	<	<	<	<	<
LBD-R-11M	Nov-14	<	<	<	<	NA	NA	<	546	<	<	<	<	<	<	<	<	<	<	<
LBD-R-12S	Nov-14	<	<	<	<	NA	NA	<	516	<	<	<	<	<	<	<	<	<	<	<
LBD-R-12M	Nov-14	<	<	<	<	NA	NA	<	555	<	<	<	<	<	<	<	<	<	<	<
FURTHEST DOWNSTREAM																				
LBD-R-7S	Nov-14	<	<	<	<	NA	NA	<	524	<	<	<	<	<	<	<	<	<	<	<
LBD-R-7S-DUP	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-8S	Nov-14	<	<	<	<	NA	NA	<	538	<	<	<	<	<	<	<	<	<	<	<
LBD-R-8M	Nov-14	<	<	<	<	NA	NA	<	551	<	<	<	<	<	<	<	<	<	<	<
LBD-R-9S	Nov-14	<	<	<	<	NA	NA	<	547	<	<	<	<	<	<	<	<	<	<	<
LBD-R-9M	Nov-14	<	<	<	<	NA	NA	<	551	<	<	<	<	<	<	<	<	<	<	<

Notes:
< - Less than the Human Health Drinking Water Screening Level.
DUP - Duplicate sample.
DW - Drinking Water.
HH - Human Health.
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
RSL - Risk-Based Screening Level.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Drinking Water Supply.
Federal USEPA MCL for Drinking Water.
Federal November 2017 USEPA Tapwater RSL.
Federal USEPA SMCL for Drinking Water.

TABLE 6
SUMMARY OF MISSOURI RIVER SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)																	
	Constituent	Chromium		Cobalt		Lead		Lithium		Mercury		Molybdenum		Selenium		Thallium		Radium-226/228	Hardness
	Fraction	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total
Sample	**HH DW SL**	0.1	0.1	0.006	0.006	0.015	0.015	0.04	0.04	0.002	0.002	0.1	0.1	0.05	0.05	0.002	0.002	5	NA
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	mg/L
UPSTREAM																			
LBD-R-4S	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-4AS	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-5S	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-5AS	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-5M	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-5AM	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-6S	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-6AS	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-6M	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-6AM	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
DOWNSTREAM																			
LBD-R-1S	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-1AS	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-2S	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-2AS	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-2M	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-2M	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-2AM	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-3S	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-3AS	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-3M	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-3AM	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
FURTHER DOWNSTREAM																			
LBD-R-10S	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-10S-DUP	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-11S	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-11M	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-12S	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-12M	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
FURTHEST DOWNSTREAM																			
LBD-R-7S	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-7S-DUP	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-8S	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-8M	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-9S	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-9M	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<

Notes:
< - Less than the Human Health Drinking Water Screening Level.
DUP - Duplicate sample.
DW - Drinking Water.
HH - Human Health.
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
RSL - Risk-Based Screening Level.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Drinking Water Supply.
Federal USEPA MCL for Drinking Water.
Federal November 2017 USEPA Tapwater RSL.
Federal USEPA SMCL for Drinking Water.

TABLE 7
SUMMARY OF MISSOURI RIVER SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH RECREATIONAL USE SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Human Health Recreational Use Screening (a)																		
	Constituent	Boron		Calcium		Chloride	pH	Sulfate	TDS	Fluoride	Antimony		Arsenic		Barium		Beryllium		Cadmium	
	Fraction	Total	Dissolved	Total	Dissolved	Total	Total	Total	Total	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample	**HH REC SL**	NA	NA	NA	NA	NA	6.5-8.5	NA	NA	NA	4.3	4.3	0.00014	0.00014	NA	NA	NA	NA	NA	NA
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
UPSTREAM																				
LBD-R-4S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0050	0.0035	<	<	<	<	<	<
LBD-R-4AS	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0033	0.0024	<	<	<	<	<	<
LBD-R-5S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0050	0.0035	<	<	<	<	<	<
LBD-R-5AS	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0035	0.0023	<	<	<	<	<	<
LBD-R-5M	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0048	0.0038	<	<	<	<	<	<
LBD-R-5AM	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0032	0.0027	<	<	<	<	<	<
LBD-R-6S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0047	0.0037	<	<	<	<	<	<
LBD-R-6AS	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0030	0.0026	<	<	<	<	<	<
LBD-R-6M	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0047	0.0034	<	<	<	<	<	<
LBD-R-6AM	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0031	0.0026	<	<	<	<	<	<
DOWNSTREAM																				
LBD-R-1S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0044	0.0040	<	<	<	<	<	<
LBD-R-1AS	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0038	0.0028	<	<	<	<	<	<
LBD-R-2S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0045	0.0037	<	<	<	<	<	<
LBD-R-2AS	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0032	0.0024	<	<	<	<	<	<
LBD-R-2M	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0047	0.0036	<	<	<	<	<	<
LBD-R-2M-DUP	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0047	0.0041	<	<	<	<	<	<
LBD-R-2AM	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0034	0.0022	<	<	<	<	<	<
LBD-R-3S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0048	0.0033	<	<	<	<	<	<
LBD-R-3AS	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0034	0.0026	<	<	<	<	<	<
LBD-R-3M	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0049	0.0035	<	<	<	<	<	<
LBD-R-3AM	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0028	0.0026	<	<	<	<	<	<
FURTHER DOWNSTREAM																				
LBD-R-10S	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0037	0.0026	<	<	<	<	<	<
LBD-R-10S-DUP	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0033	0.0027	<	<	<	<	<	<
LBD-R-11S	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0033	0.0027	<	<	<	<	<	<
LBD-R-11M	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0032	0.0025	<	<	<	<	<	<
LBD-R-12S	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0035	0.0026	<	<	<	<	<	<
LBD-R-12M	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0035	0.0023	<	<	<	<	<	<
FURTHEST DOWNSTREAM																				
LBD-R-7S	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0046	0.0027	<	<	<	<	<	<
LBD-R-7S-DUP	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0049	0.0027	<	<	<	<	<	<
LBD-R-8S	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0034	0.0028	<	<	<	<	<	<
LBD-R-8M	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0034	0.0026	<	<	<	<	<	<
LBD-R-9S	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0035	0.0025	<	<	<	<	<	<
LBD-R-9M	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	0.0037	0.0027	<	<	<	<	<	<

Notes:
< - Less than the Human Health Recreational Use Screening Level.
DUP - Duplicate sample.
HH - Human Health.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
REC - Recreational Use.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Recreational Use Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Human Health Fish Consumption.
USEPA Ambient Water Quality Criteria for Human Health Consumption of Organism Only.

TABLE 7
SUMMARY OF MISSOURI RIVER SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH RECREATIONAL USE SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Human Health Recreational Use Screening (a)															
	Constituent	Chromium		Cobalt		Lead		Mercury		Molybdenum		Selenium		Thallium		Radium-226/228	Hardness
	Fraction	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total
Sample	**HH REC SL**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.2	4.2	0.0063	0.0063	NA	NA
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	mg/L
UPSTREAM																	
LBD-R-4S	Oct-13	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-4AS	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-5S	Oct-13	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-5AS	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-5M	Oct-13	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-5AM	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-6S	Oct-13	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-6AS	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-6M	Oct-13	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-6AM	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
DOWNSTREAM																	
LBD-R-1S	Oct-13	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-1AS	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-2S	Oct-13	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-2AS	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-2M	Oct-13	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-2M	Oct-13	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-2AM	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-3S	Oct-13	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-3AS	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-3M	Oct-13	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-3AM	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
FURTHER DOWNSTREAM																	
LBD-R-10S	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-10S	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-11S	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-11M	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-12S	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-12M	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
FURTHEST DOWNSTREAM																	
LBD-R-7S	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-7S	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-8S	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-8M	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-9S	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<
LBD-R-9M	Nov-14	<	<	<	<	<	<	<	<	<	<	<	<	<	<	NA	<

Notes:
< - Less than the Human Health Recreational Use Screening Level.
DUP - Duplicate sample.
HH - Human Health.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
REC - Recreational Use.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Recreational Use Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Human Health Fish Consumption.
USEPA Ambient Water Quality Criteria for Human Health Consumption of Organism Only.

TABLE 8
SUMMARY OF MISSOURI RIVER SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO ECOLOGICAL SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Ecological Screening (a)																		
	Constituent	Boron		Calcium		Chloride	pH	Sulfate	TDS	Fluoride	Antimony		Arsenic		Barium		Beryllium		Cadmium	
	Fraction	Total	Dissolved	Total	Dissolved	Total	Total	Total	Total	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample	**ECO SL**	2	2	NA	NA	230	6.5-8.5	1825	NA	4	NA	NA	0.15	0.15	NA	NA	0.1	0.1	0.00059	0.00059
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	S.U	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
UPSTREAM																				
LBD-R-4S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-4AS	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-5S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-5AS	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-5M	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-5AM	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-6S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-6AS	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-6M	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-6AM	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
DOWNSTREAM																				
LBD-R-1S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-1AS	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-2S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-2AS	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-2M	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-2M-DUP	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-2AM	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-3S	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-3AS	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-3M	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-R-3AM	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
FURTHER DOWNSTREAM																				
LBD-R-10S	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-10S-DUP	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-11S	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-11M	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-12S	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-12M	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
FURTHEST DOWNSTREAM																				
LBD-R-7S	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-7S-DUP	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-8S	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-8M	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-9S	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<
LBD-R-9M	Nov-14	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	<	<	<	<	<

Notes:
< - Less than the Ecological Screening Level.
DUP - Duplicate sample.
ECO - Ecological.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Ecological Screening Levels selected in Table 2 following the following hierarchy:
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Chronic).
USEPA Aquatic Life Ambient Water Quality Criteria (Chronic).
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Acute).
USEPA Aquatic Life Ambient Water Quality Criteria (Acute).
Missouri State Water Quality Criteria for Irrigation.
Missouri State Water Quality Criteria for Livestock Wildlife Watering.

TABLE 8
SUMMARY OF MISSOURI RIVER SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO ECOLOGICAL SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Ecological Screening (a)																	
	Constituent	Chromium		Cobalt		Lead		Lithium		Mercury		Molybdenum		Selenium		Thallium		Radium-226/228	Hardness
	Fraction	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total
Sample	**ECO SL**	0.203	0.203	1	1	0.012	0.012	NA	NA	0.0005	0.0005	NA	NA	0.005	0.005	NA	NA	NA	NA
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	mg/L
UPSTREAM																			
LBD-R-4S	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-4AS	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-5S	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-5AS	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-5M	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-5AM	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-6S	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-6AS	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-6M	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-6AM	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
DOWNSTREAM																			
LBD-R-1S	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-1AS	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-2S	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-2AS	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-2M	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-2M-DUP	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-2AM	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-3S	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-3AS	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-3M	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-3AM	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
FURTHER DOWNSTREAM																			
LBD-R-10S	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-10S-DUP	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-11S	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-11M	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-12S	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-12M	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
FURTHEST DOWNSTREAM																			
LBD-R-7S	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-7S-DUP	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-8S	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-8M	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-9S	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-R-9M	Nov-14	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<

Notes:
< - Less than the Ecological Screening Level.
DUP - Duplicate sample.
ECO - Ecological.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Ecological Screening Levels selected in Table 2 following the following hierarchy:
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Chronic).
USEPA Aquatic Life Ambient Water Quality Criteria (Chronic).
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Acute).
USEPA Aquatic Life Ambient Water Quality Criteria (Acute).
Missouri State Water Quality Criteria for Irrigation.
Missouri State Water Quality Criteria for Livestock Wildlife Watering.

TABLE 9
SUMMARY OF LABADIE CREEK SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)																		
	Constituent	Boron		Calcium		Chloride	pH	Sulfate	TDS	Fluoride	Antimony		Arsenic		Barium		Beryllium		Cadmium	
	Fraction	Total	Dissolved	Total	Dissolved	Total	Total	Total	Total	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample	**HH DW SL**	4	4	NA	NA	250	6.5-8.5	250	500	4	0.006	0.006	0.05	0.05	2	2	0.004	0.004	0.005	0.005
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	S.U	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
UPSTREAM																				
LBD-C-4	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-C-5	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-C-6	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
DOWNSTREAM																				
LBD-C-1	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-C-1-DUP	Oct-13	<	NA	<	NA	NA	NA	<	NA	<	<	NA	<	NA	<	NA	<	NA	<	NA
LBD-C-2	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-C-3	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<

Notes:
< - Less than the Human Health Drinking Water Screening Level.
DUP - Duplicate sample.
DW - Drinking Water.
HH - Human Health.
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
RSL - Risk-Based Screening Level.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Drinking Water Supply.
Federal USEPA MCL for Drinking Water.
Federal November 2017 USEPA Tapwater RSL.
Federal USEPA SMCL for Drinking Water.

TABLE 9
SUMMARY OF LABADIE CREEK SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Human Health Drinking Water Screening (a)																	
	Constituent	Chromium		Cobalt		Lead		Lithium		Mercury		Molybdenum		Selenium		Thallium		Radium-226/228	Hardness
	Fraction	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total
Sample	**HH DW SL**	0.1	0.1	0.006	0.006	0.015	0.015	0.04	0.04	0.002	0.002	0.1	0.1	0.05	0.05	0.002	0.002	5	NA
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	mg/L
UPSTREAM																			
LBD-C-4	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-C-5	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-C-6	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
DOWNSTREAM																			
LBD-C-1	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-C-1-DUP	Oct-13	<	NA	<	NA	<	NA	NA	NA	<	NA	<	NA	<	NA	<	NA	NA	<
LBD-C-2	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-C-3	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<

Notes:
< - Less than the Human Health Drinking Water Screening Level.
DUP - Duplicate sample.
DW - Drinking Water.
HH - Human Health.
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
RSL - Risk-Based Screening Level.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Drinking Water Supply.
Federal USEPA MCL for Drinking Water.
Federal November 2017 USEPA Tapwater RSL.
Federal USEPA SMCL for Drinking Water.

TABLE 10
SUMMARY OF LABADIE CREEK SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH RECREATIONAL USE SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Human Health Recreational Use Screening (a)																		
	Constituent	Boron		Calcium		Chloride	pH	Sulfate	TDS	Fluoride	Antimony		Arsenic		Barium		Beryllium		Cadmium	
	Fraction	Total	Dissolved	Total	Dissolved	Total	Total	Total	Total	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample	**HH REC SL**	NA	NA	NA	NA	NA	6.5-8.5	NA	NA	NA	4.3	4.3	0.00014	0.00014	NA	NA	NA	NA	NA	NA
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
UPSTREAM																				
LBD-C-4	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0056	0.0056	<	<	<	<	<	<
LBD-C-5	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0055	0.0051	<	<	<	<	<	<
LBD-C-6	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0061	0.0051	<	<	<	<	<	<
DOWNSTREAM																				
LBD-C-1	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0065	0.0039	<	<	<	<	<	<
LBD-C-1-DUP	Oct-13	<	NA	<	NA	NA	NA	<	NA	<	<	NA	0.0067	NA	<	NA	<	NA	<	NA
LBD-C-2	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0061	0.0039	<	<	<	<	<	<
LBD-C-3	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	0.0066	0.0043	<	<	<	<	<	<

Notes:
< - Less than the Human Health Recreational Use Screening Level.
DUP - Duplicate sample.
HH - Human Health.
mg/L - milligram per liter.
pCi/L - picoCurie per liter.
NA - Not Applicable/Not Analyzed.
REC - Recreational Use.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Recreational Use Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Human Health Fish Consumption.
USEPA Ambient Water Quality Criteria for Human Health Consumption of Organism Only.

TABLE 10
SUMMARY OF LABADIE CREEK SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO HUMAN HEALTH RECREATIONAL USE SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Human Health Recreational Use Screening (a)																	
	Constituent	Chromium		Cobalt		Lead		Lithium		Mercury		Molybdenum		Selenium		Thallium		Radium-226+228	Hardness
	Fraction	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total
Sample	**HH REC SL**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.2	4.2	0.0063	0.0063	NA	NA
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	mg/L
UPSTREAM																			
LBD-C-4	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-C-5	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-C-6	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
DOWNSTREAM																			
LBD-C-1	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-C-1-DUP	Oct-13	<	NA	<	NA	<	NA	NA	NA	<	NA	<	NA	<	NA	<	NA	NA	<
LBD-C-2	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-C-3	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<

Notes:
< - Less than the Human Health Recreational Use Screening Level.
DUP - Duplicate sample.
HH - Human Health.
mg/L - milligram per liter.
pCi/L - picoCurie per liter.
NA - Not Applicable/Not Analyzed.
REC - Recreational Use.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Recreational Use Screening Levels selected in Table 1 following the following hierarchy:
Missouri State Water Quality Criteria for Human Health Fish Consumption.
USEPA Ambient Water Quality Criteria for Human Health Consumption of Organism Only.

TABLE 11
SUMMARY OF LABADIE CREEK SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO ECOLOGICAL SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Ecological Screening (a)																		
	Constituent	Boron		Calcium		Chloride	pH	Sulfate	TDS	Fluoride	Antimony		Arsenic		Barium		Beryllium		Cadmium	
	Fraction	Total	Dissolved	Total	Dissolved	Total	Total	Total	Total	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample	**ECO SL**	2	2	NA	NA	230	6.5-8.5	1825	NA	4	NA	NA	0.15	0.15	NA	NA	0.1	0.1	0.00059	0.00059
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	S.U	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
UPSTREAM																				
LBD-C-4	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-C-5	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-C-6	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
DOWNSTREAM																				
LBD-C-1	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-C-1-DUP	Oct-13	<	NA	<	NA	NA	NA	<	NA	<	<	NA	<	NA	<	NA	<	NA	<	NA
LBD-C-2	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<
LBD-C-3	Oct-13	<	<	<	<	NA	NA	<	NA	<	<	<	<	<	<	<	<	<	<	<

Notes:
< - Less than the Ecological Screening Level.
DUP - Duplicate sample.
ECO - Ecological.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Ecological Screening Levels selected in Table 2 following the following hierarchy:
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Chronic).
USEPA Aquatic Life Ambient Water Quality Criteria (Chronic).
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Acute).
USEPA Aquatic Life Ambient Water Quality Criteria (Acute).
Missouri State Water Quality Criteria for Irrigation.
Missouri State Water Quality Criteria for Livestock Wildlife Watering.

TABLE 11
SUMMARY OF LABADIE CREEK SURFACE WATER TOTAL (UNFILTERED) AND DISSOLVED (FILTERED) RESULTS COMPARISON TO ECOLOGICAL SCREENING LEVELS
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

		Ecological Screening (a)																	
	Constituent	Chromium		Cobalt		Lead		Lithium		Mercury		Molybdenum		Selenium		Thallium		Radium-226/228	Hardness
	Fraction	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total
Sample	**ECO SL**	0.203	0.203	1	1	0.012	0.012	NA	NA	0.0005	0.0005	NA	NA	0.005	0.005	NA	NA	NA	NA
Location ID	**Sampling Event Date**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	mg/L
UPSTREAM																			
LBD-C-4	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-C-5	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-C-6	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
DOWNSTREAM																			
LBD-C-1	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-C-1-DUP	Oct-13	<	NA	<	NA	<	NA	NA	NA	<	NA	<	NA	<	NA	<	NA	NA	<
LBD-C-2	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<
LBD-C-3	Oct-13	<	<	<	<	<	<	NA	NA	<	<	<	<	<	<	<	<	NA	<

Notes:
< - Less than the Ecological Screening Level.
DUP - Duplicate sample.
ECO - Ecological.
mg/L - milligram per liter.
NA - Not Applicable/Not Analyzed.
pCi/L - picoCurie per liter.
SL - Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

(a) - Ecological Screening Levels selected in Table 2 following the following hierarchy:
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Chronic).
USEPA Aquatic Life Ambient Water Quality Criteria (Chronic).
Missouri State Water Quality Criteria for the Protection of Aquatic Life (Acute).
USEPA Aquatic Life Ambient Water Quality Criteria (Acute).
Missouri State Water Quality Criteria for Irrigation.
Missouri State Water Quality Criteria for Livestock Wildlife Watering.

TABLE 12
SUMMARY OF WHOLE EFFLUENT TOXICITY TESTING RESULTS FOR NPDES OUTFALL 002
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

Sampling Event	Treatment	Percent Survival at 48 hours	
		Pimephales promelas	***Ceriodaphnia dubia***
Outfall 002 (Ash Pond)			
August 2015	100% Effluent	100%	100%
	50% Effluent	100%	100%
	100% Laboratory Control Water	100%	100%
August 2016	100% Effluent	100%	100%
	50% Effluent	100%	100%
	100% Laboratory Control Water	100%	100%
August 2017	100% Effluent	100%	100%
	50% Effluent	100%	100%
	100% Laboratory Control Water	100%	100%

Notes:
NPDES - Natural Pollutant Discharge Elimination System.

Effluent passes in all tests conducted from 2015 through 2017.
50% Effluent - Outfall 002 effluent mixed with laboratory control water.
Effluent dilutions were analzyed at 0%, 3.5%, 7%, 25%, 50%, and 100%. Only 50% and 100% are presented in the above table

TABLE 13
DERIVATION OF RISK-BASED SCREENING LEVELS FOR GROUNDWATER BASED ON MISSOURI RIVER
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI

Constituents	HH DW SL (a) (mg/L)	HH REC SL (b) (mg/L)	ECO SL (c) (mg/L)	Lowest of the Human Health and Ecological Screening Levels (mg/L)	Groundwater Risk-Based Screening Level* (mg/L)	Maximum LEC Groundwater Concentration (mg/L)		Ratio Between Groundwater Risk-Based Screening Level and the Maximum LEC Groundwater Concentration
				Estimated Dilution Factor (d) =	100,000			
Boron	4	NA	2	2	200000	18.2	L-UMW-6D	>10,000
Sulfate	250	NA	1773	250	25000000	774	L-UMW-3D	>32,000
Cobalt	0.006	NA	1	0.006	600	0.0095	L-LMW-6S	>63,000
Lithium	0.04	NA	NA	0.04	4000	0.0575	L-TMW-2	>69,000
Molybdenum	0.1	NA	NA	0.1	10000	0.674	L-UMW-6D	>14,000
TDS	500	NA	NA	500	50000000	1240	L-UMW-3D	>40,000

Notes:
* Where the Groundwater Risk-Based Screening Level = Screening Level x Dilution Factor.
ECO SL - Ecological Screening Level.
HH DW SL - Human Health Drinking Water Screening Level.
HH REC SL - Human Health Recreational Use Screening Level.
mg/L - milligram per liter.
NA - Not Available.

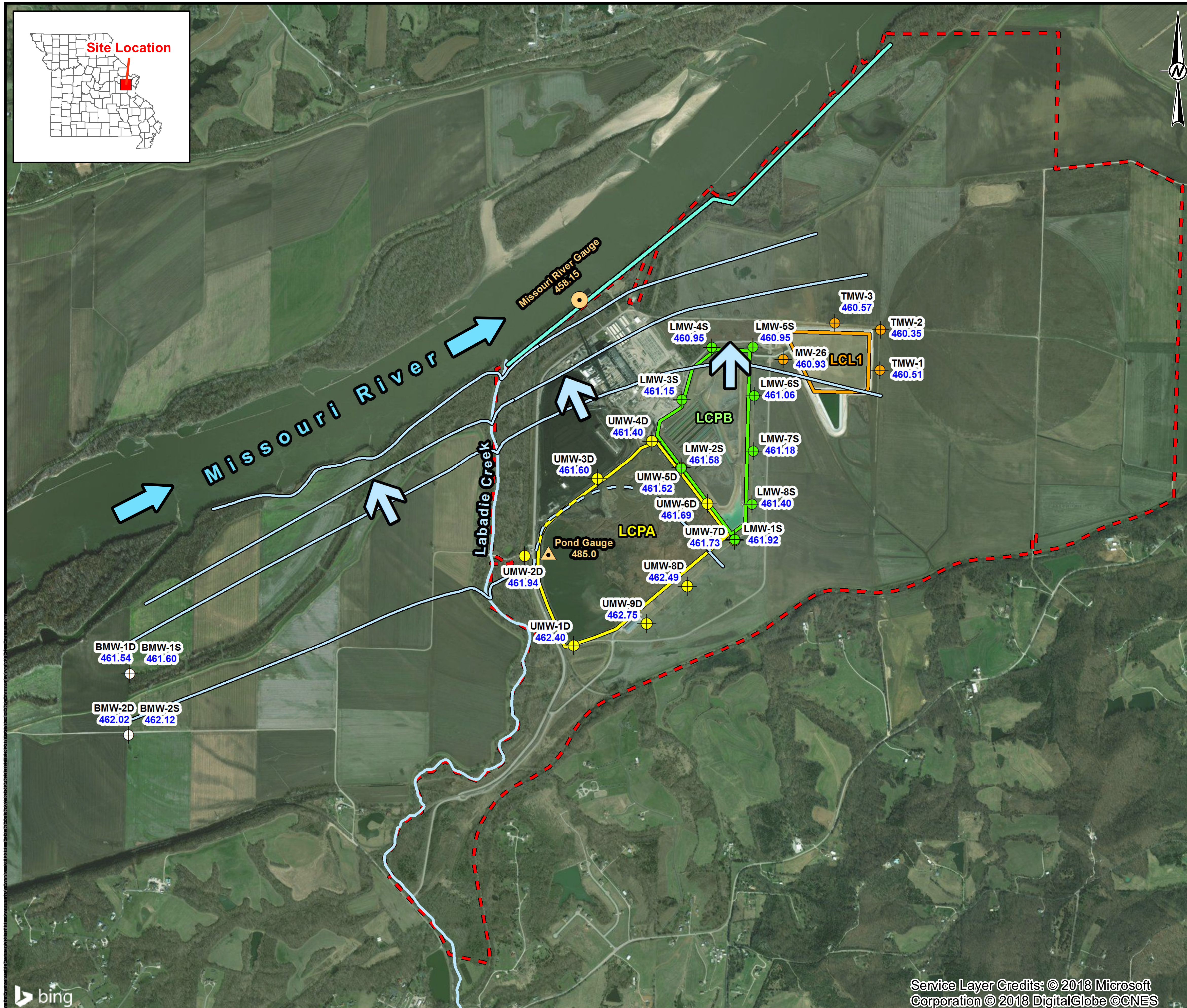
(a) - Drinking Water Screening Levels selected in Table 1 following the following hierarchy:
- Missouri State Water Quality Criteria for Drinking Water Supply.
- Federal USEPA MCL for Drinking Water.
- Federal November 2017 USEPA Tapwater RSL.
- Federal USEPA SMCL for Drinking Water.

(b) - Recreational Use Screening Levels selected in Table 1 following the following hierarchy:
- Missouri State Water Quality Criteria for Human Health Fish Consumption.
- USEPA Ambient Water Quality Criteria for Human Health Consumption of Organism Only.

(c) - Ecological Screening Levels selected in Table 2 following the following hierarchy:
- Missouri State Water Quality Criteria for the Protection of Aquatic Life (Chronic).
- USEPA Aquatic Life Ambient Water Quality Criteria (Chronic).
- Missouri State Water Quality Criteria for the Protection of Aquatic Life (Acute).
- USEPA Aquatic Life Ambient Water Quality Criteria (Acute).
- Missouri State Water Quality Criteria for Irrigation.
- Missouri State Water Quality Criteria for Livestock Wildlife Watering.

(d) - Estimated value, see text and Attachment B for derivation.

FIGURES



LEGEND

- Length of Groundwater Discharge Used in the Dilution Factor Calculations
- Labadie Energy Center Property Boundary
- LCPA - Bottom Ash Surface
- LCPB - Fly Ash Surface
- LCL1 - Utility Waste Landfill Cell 1

Groundwater Elevation Contours

- Groundwater Elevation Contour (FT MSL)
- Inferred Groundwater Elevation Contour (FT MSL)

Ground/Surface Water Measurement Locations

- LCPA Monitoring Well
- Missouri River Gauge
- LCPA - Bottom Ash Surface Impoundment
- LCPB Monitoring Well
- Background Monitoring Well
- UWL Monitoring Well
- Groundwater Flow Direction
- Surface Water Flow Direction

NOTES

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2. GROUNDWATER ELEVATION MEASUREMENTS OBTAINED ONSITE BY GOLDER ON JULY 11, 2016.
3. GROUNDWATER MONITORING WELLS (EXCEPT TMW-1 AND MW-26) SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON JANUARY 13 AND FEBRUARY 11, 2016.
4. GROUNDWATER MONITORING WELLS TMW-1 AND MW-26 INSTALLED BY RIETZ AND JENS, INC. AND SURVEYED BY KDG INC.
5. GROUNDWATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
6. MISSOURI RIVER LEVEL OBTAINED FROM USGS LABADIE GAUGE 06935550.
7. POND GAUGE LEVEL OBTAINED ONSITE BY GOLDER.
8. THE UWL BOUNDARIES AND DESIGNATIONS ARE BASED ON AMEREN LABADIE CONSTRUCTION PERMIT APPLICATION DRAWINGS.

REFERENCES

1. ZAHNER AND ASSOCIATES, INC. 2016. LOT CONSOLIDATION PLAT OF "LABADIE ENERGY CENTER" - PREPARED FOR AMEREN MISSOURI. REVISED JUNE 15, 2016.
2. COORDINATE SYSTEM: NAD 1983 STATEPLANE MISSOURI EAST FIPS 2,401 FEET.
3. USGS (UNITED STATES GEOLOGICAL SURVEY), NATIONAL WATER INFORMATION SYSTEM, USGS GAUGE 06935550 MISSOURI RIVER NEAR LABADIE, MO.

0 1,000 2,000 3,000 4,000 5,000
Feet

CLIENT
AMEREN MISSOURI
LABADIE ENERGY CENTER

Ameren

PROJECT
AMEREN HYDROGEOLOGICAL CONSULTING

TITLE
ESTIMATED LENGTH OF DISCHARGE AND EXAMPLE GROUNDWATER FLOW MAP

CONSULTANT

Golder Associates

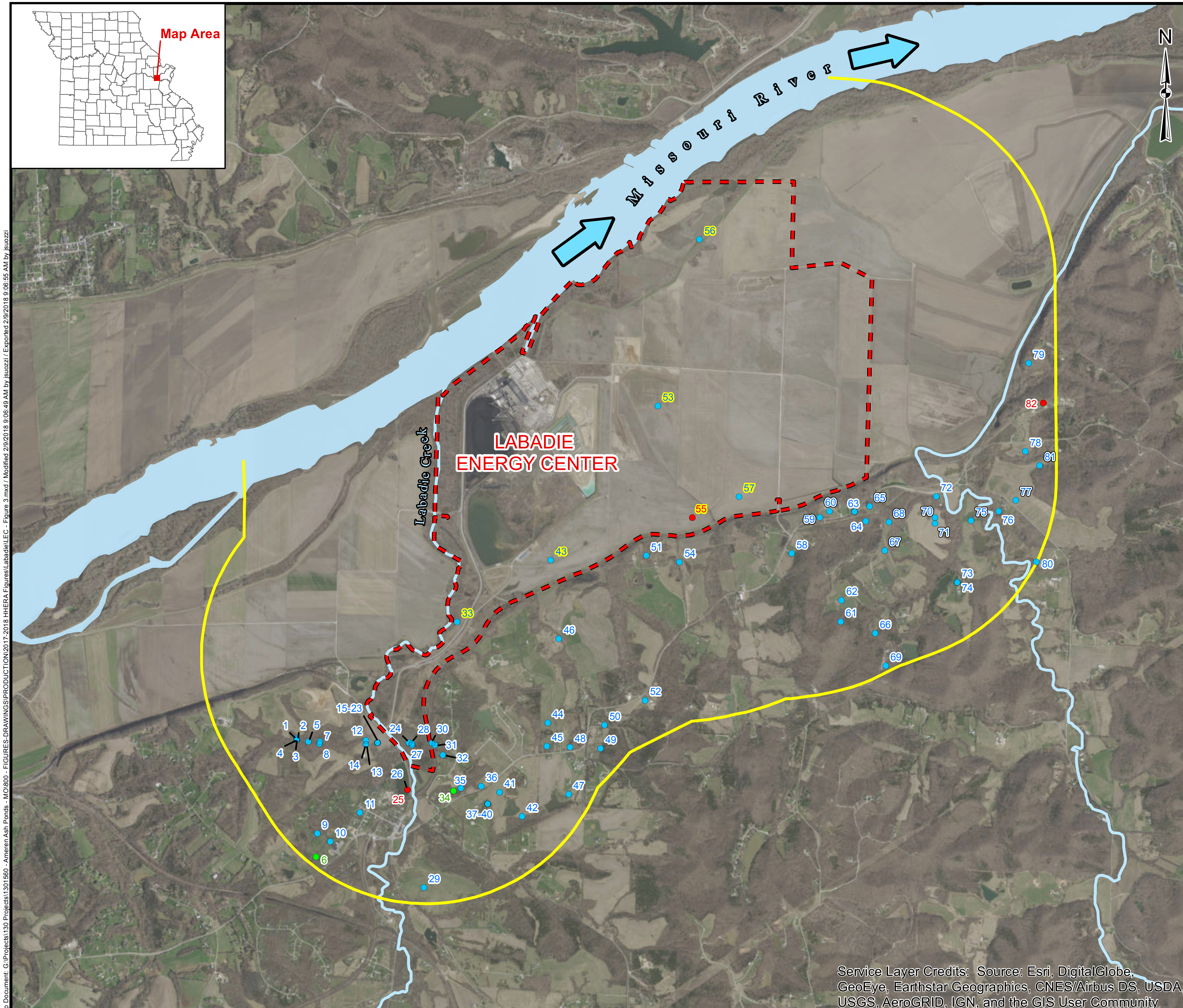
YYYY-MM-DD	2017-12-17
PREPARED	JSI
DESIGN	JSI
REVIEW	RJF
APPROVED	MNH

PROJECT No.
130-1560

FIGURE
1

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

Map Document: G:\Projects\130 Projects\1301560 - Ameren Ash Ponds - MO\800 - FIGURES-DRAWINGS\PRODUCTION\2017-2018 HHERA Figures\Labadie\LEC - Figure 3.mxd / Modified 2/9/2018 9:06:49 AM by jsuozzi / Exported 2/9/2018 9:06:55 AM by jsuozzi



TITLE

PRIVATE WELL LOCATIONS WITHIN 1-MILE RADIUS OF FACILITY BOUNDARY

LEGEND

- Labadie Energy Center Property Boundary
- Approximate 1-Mile Radius
- Private Well
- Industrial Well
- Non-Community Public Well

*Yellow highlighted wells appear to be located incorrectly in the MDNR Wellhead Protection Database.

- Surface Water Flow Direction

NOTES

1.) Search radius is approximately 1-mile beyond the Ameren Missouri Labadie Energy Center property boundary within Franklin County, Missouri.
2.) See Table 2 for details on wells within the 1-mile radius.
3.) Wells outside of the approximate 1-mile radius and those outside of Franklin County, Missouri are not shown.
4.) Yellow highlighted wells (33, 43, 53, 55, 56, 57) appear to be located incorrectly in MDNR Wellhead Protection Database. Further information for these wells is provided in Appendix B.
5.) This figure displays non-community public, private and industrial wells within approximately one mile of the Ameren Missouri Labadie Energy Center property boundary in Franklin County, Missouri; monitoring wells, soil borings, heat pump borings, stratigraphic test holes and abandonments are not displayed on this figure.
6.) All boundaries and locations are approximate. Wells are plotted according to database coordinates.
7.) MDNR - Missouri Department of Natural Resources.
8.) MSDIS - Missouri Spatial Data Information Service.

REFERENCES

1.) University of Missouri - Columbia - Department of Geography - MSDIS Database (MSDIS, 2013).
2.) Missouri Department of Natural Resources - Water Resources Center - Geologic Well Logs (MDNR, 2013c).
3.) Missouri Environmental Geology Atlas 2007 (MEGA) (MDNR, 2007).
4.) MDNR Wellhead Protection Program (MDNR, 2013b).
5.) Ameren Missouri Labadie Energy Center, Labadie Property. Control Map, November 2011.
6.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

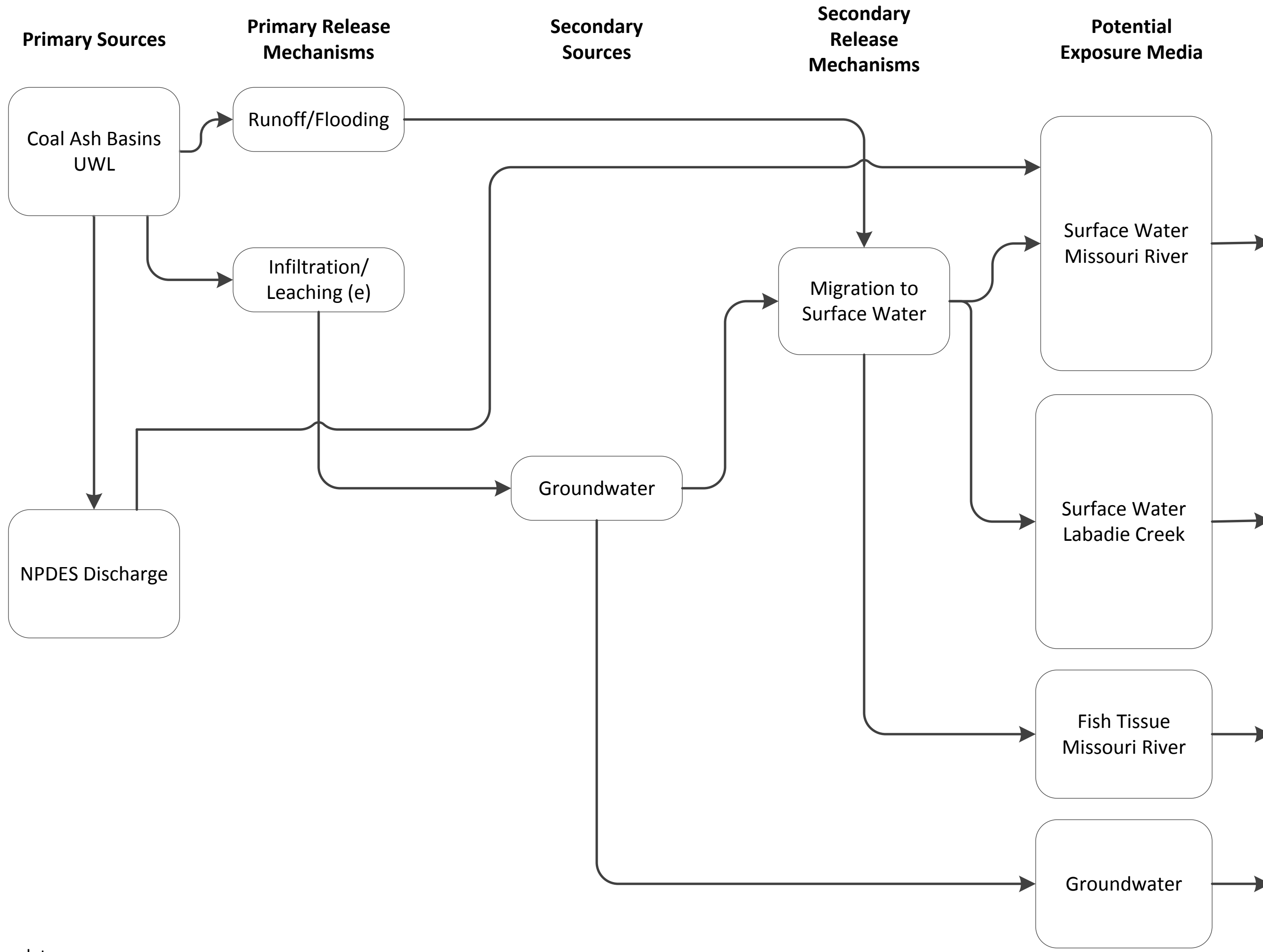
0 3,000 6,000 Feet

PROJECT

AMEREN MISSOURI LABADIE ENERGY CENTER
FRANKLIN COUNTY, MISSOURI

PROJECT No. 130-1560			FILE No. LEC - Figure 3.mxd	
DESIGN	-	-	SCALE: AS SHOWN	REV. 0
GIS	JSI	2/9/2018	FIGURE 2	
CHECK	MWD	2/9/2018		
REVIEW	MNH	2/9/2018		

FIGURE 3
CONCEPTUAL SITE MODEL
LABADIE ENERGY CENTER, FRANKLIN COUNTY, MO
AMEREN MISSOURI



Potential Human Health Receptors						Potential Ecological Receptors
Potential Exposure Route	Current/Future Off-Site Resident Adult/Child	Current/Future Off-Site Recreational Swimmer	Current/Future Off-Site Recreational Wader	Current/Future Off-Site Recreational Boater	Current/Future Off-Site Recreational Fisher	Aquatic Receptors
Drinking Water Use	⊙ (a)	O	O	O	O	NA
Incidental Ingestion	O	⊙	⊙	⊙	⊙	NA
Dermal Contact	O	⊙	⊙	⊙	⊙	NA
Aquatic Exposure	NA	NA	NA	NA	NA	⊙
Drinking Water Use	O (b)	O	O	O	O	NA
Incidental Ingestion	O	O (c)	⊙	O (c)	O (c)	NA
Dermal Contact	O	O (c)	⊙	O (c)	O (c)	NA
Aquatic Exposure	NA	NA	NA	NA	NA	⊙
Ingestion	O	O	O	O	●	NA
Aquatic Exposure	NA	NA	NA	NA	NA	⊙
Drinking Water Use	O (d)	O	O	O	O	NA
Aquatic Exposure	NA	NA	NA	NA	NA	O

Notes:

- ● Pathway potentially complete
- ⊙ Pathway potentially complete, but insignificant.
- O Pathway evaluated and found incomplete.

(a) The Missouri River is used as a source of drinking water; the nearest downstream drinking water intake is 19.5 miles downstream at Howard Bend in Missouri. All detected constituent concentrations are below drinking water screening levels.

(b) Labadie Creek is not used as a source of drinking water.

(c) The size of Labadie Creek precludes swimming, fishing and boating activities.

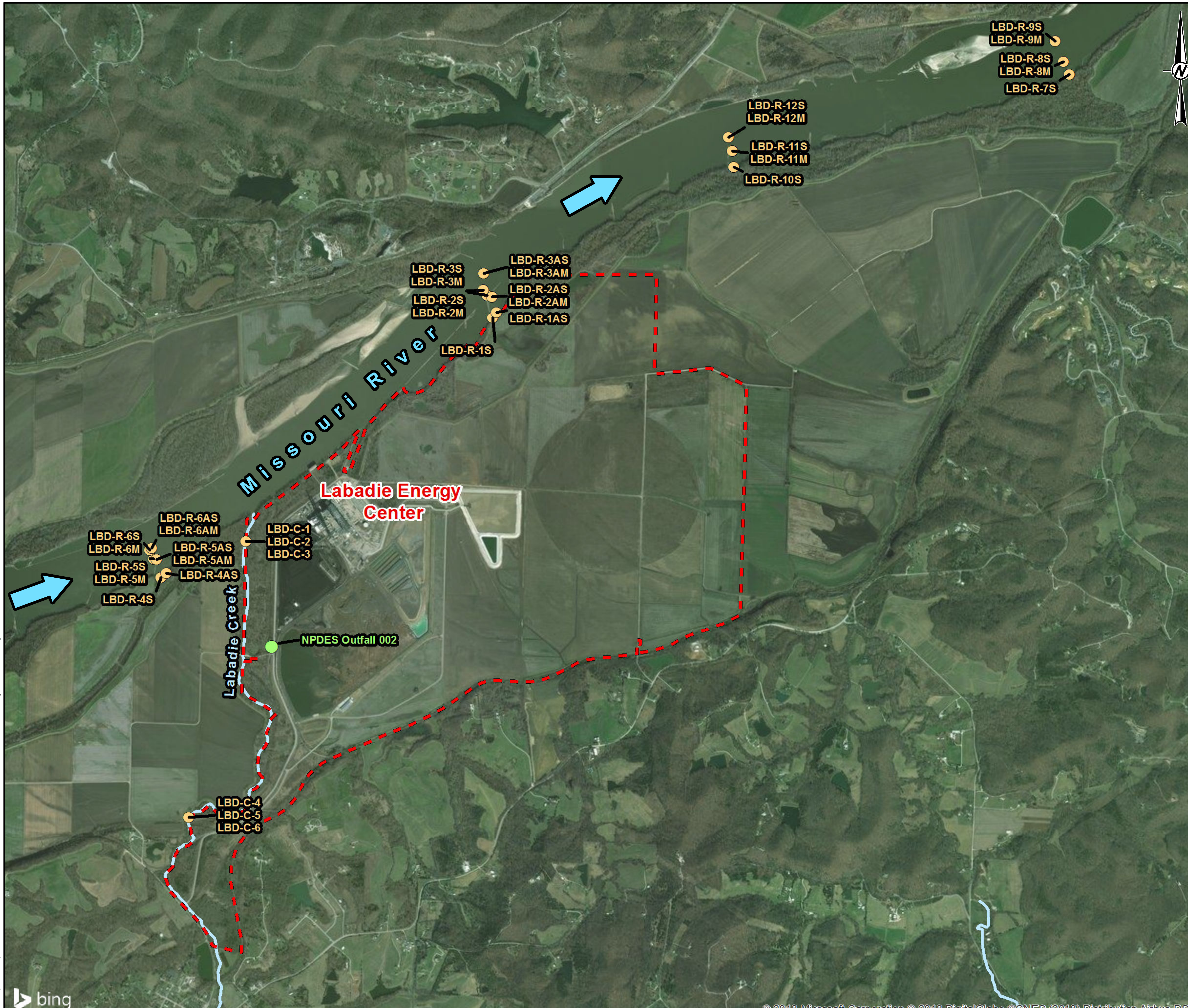
(d) The shallow alluvial aquifer in the vicinity of the coal ash management areas is not used for drinking water purposes.

(e) LCPB and LCL1 are lined, thus, infiltration/leaching to groundwater are incomplete pathways.

NA – Not Applicable.

NPDES - National Pollutant Discharge Elimination System.

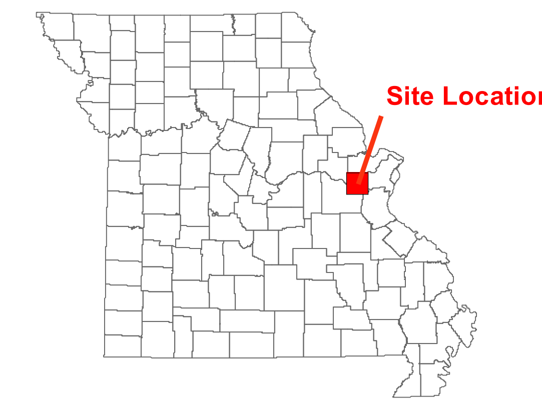
UWL – Utility Whole Landfill.



LEGEND

- NPDES Sample Location
- Surface Water Sample Location
- Approximate Property Boundary
- Surface Water Flow Direction

KEY MAP



NOTES

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2. SAMPLE LOCATIONS FOR SURFACE WATER SAMPLES WERE OBTAINED DURING SAMPLING USING A TRIMBLE GEOXH GPS UNIT.
3. NPDES - NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM.

REFERENCES

1. ZAHNER AND ASSOCIATES, INC. 2016. LOT CONSOLIDATION PLAT OF "LABADIE ENERGY CENTER" - PREPARED FOR AMEREN MISSOURI. REVISED JUNE 15, 2016.
2.) COORDINATE SYSTEM: NAD 1983 STATEPLANE MISSOURI EAST FIPS 2,401 FEET.

0 1,000 2,000 3,000 4,000 5,000 6,000 Feet

CLIENT
AMEREN MISSOURI
LABADIE ENERGY CENTER

Ameren

PROJECT
AMEREN HYDROGEOLOGICAL CONSULTING

TITLE
NPDES OUTFALL AND SURFACE WATER SAMPLE LOCATIONS

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-01-29
PREPARED	JSI
DESIGN	JSI
REVIEW	JS
APPROVED	MNH

PROJECT No. 130-1560 Rev. 0 FIGURE 4

ATTACHMENT A

Dilution Factor Calculation

Attachment A

Constituents Present in Coal Ash and in Our Natural Environment

It is important to understand what constituents are present in coal ash, which can be released to the environment, and to understand the natural occurrence of these constituents in our environment.

Coal is a type of sedimentary rock that is a natural component of the earth's crust and the inorganic minerals and elements it contains are also naturally occurring. It is the organic component of coal that burns and produces energy, and it is the inorganic minerals and elements that remain after combustion the make up the coal ash, or coal combustion products (CCPs).

A.1 Major, Minor and Trace Constituents in Coal Ash

All of the inorganic minerals and elements that are present in coal ash are also present in our natural environment. This is one fact that that the public seems either not to understand or will not acknowledge. **Figure A-1** shows the major and minor components of fly ash, bottom ash, volcanic ash, and shale. It is important to understand that the constituents that are the focus of many of the concerns expressed by the public about the toxicity of coal ash (e.g., lead, arsenic, mercury, cadmium, selenium, etc.) are trace elements, so called because they are present in such low concentrations (in the mg/kg or part per million (ppm) range). Together, the trace elements generally make up less than 1 percent of the total mass of these materials. To put these concentrations into context, a mg/kg or ppm is equivalent to:

- 1 penny in a large container holding $10,000 worth of pennies, or
- 1 second in 11.5 days, or
- 1 inch in 15.8 miles

These trace elements have been referred to by the public and even in the popular press as "toxic"—without any context provided for what this means. Moreover, claims have been made that there is no safe level of exposure to any of these elements.

This is simply not true, and there are two important facts that must be understood to put this in context. The first relates to background levels of constituents in our environment and the second relates to toxicity.

A.2 Background Levels in Soils

The first fact that must be understood is that all of the constituents present in coal ash occur naturally in our environment. U.S. Geological Survey (USGS) data demonstrate the presence of these constituents in the soils across the U.S. Prime examples include arsenic, lead, mercury and selenium. With respect to arsenic, **Figure A-2** shows the range of background levels of arsenic in soils across the U.S., as published by the USGS. The USGS is conducting a "national geochemical survey" to identify background levels of elements in soils in the U.S. (USGS, 2013). **Figures A-3 – A-6** provide maps prepared by the USGS demonstrating the naturally-occurring presence of other trace elements in soils in the U.S., including aluminum and copper (**Figure A-3**), iron and lead (**Figure A-4**), manganese and mercury (**Figure A-5**), and selenium and zinc (**Figure A-6**).

These soils are found in our backyards, schools, parks, etc., and because of their presence in soil, these constituents are also present in the foods we eat. Some of these constituents are present in our vitamins, such as manganese and selenium. Thus, we are exposed to these trace elements in our natural environment every day, and in many ways.

A.3 Toxicity and Risk

The second fact is that all constituents and materials that we encounter in our natural environment can be toxic, but what determines whether a toxic effect actually occurs is how one is exposed to the constituent, the amount of material to which one may be exposed, and the timing and duration of that exposure. Without sufficient exposure the science tells us that there are no toxic effects. Put another way, when a toxic effect is demonstrated by a particular constituent, it is generally caused by high levels of exposure over a long-term duration. The fundamental principles here are:

- All constituents can exert toxic effects (from aspirin[1] to table salt to water to minerals).
- For such toxic effects to occur, exposure must occur at a sufficiently high level for a sufficiently long period of time.
- If there is no exposure, there is no risk.

A.4 Risk-Based Screening Levels

The U.S. Environmental Protection Agency (USEPA) uses information on the potential toxicity of constituents to identify concentrations of trace elements in soil in a residential setting that are considered by USEPA to be protective for humans (including sensitive groups) over a lifetime (USEPA, 2014c). Specifically, residential soil screening levels are levels that are protective of a child and adult's daily exposure to constituents present in soil or a solid matrix over a residential lifetime. In the context of regulatory decision making, at sites where constituent concentrations fall below these screening levels, no further action or study is warranted under the federal Superfund program. Missouri Department of Natural Resources also applies this concept to the development of screening levels in its Risk-Based Corrective Action program (MDNR, 2006).

Figure A-7 shows USEPA's residential soil screening levels for a variety of trace elements that are present in coal ash. USEPA considers it to be safe for children to be exposed to these concentrations of each of these trace elements in soils on a daily basis, throughout their lifetime. What this tells us is that by developing these residential soil screening levels, USEPA considers the presence of these levels of these constituents in soils to be safe for humans, even for exposure on a daily basis. It is, therefore, simply not true that there are no safe levels of exposure to these constituents.

A.5 Comparison of Coal Ash Constituent Concentrations to Risk-Based Screening Levels and Background

A comparison of constituent concentrations in coal ash, as reported by the USGS (USGS, 2011a) to USEPA's risk-based screening levels for residential soil indicates that with only a few exceptions, constituent concentrations in coal ash are below screening levels developed by the USEPA for residential soils, and are similar in concentration to background U.S. soils. Details of this evaluation are provided in the report titled "Coal Ash Material Safety: A Health Risk-Based Evaluation of USGS

[1] For example, if one takes two aspirin every four hours as directed, aspirin is not toxic. If one takes the entire bottle at once, the aspirin is very toxic.

Coal Ash Data from Five US Power Plants" (AECOM, 2012). The study is available at: http://www.acaa-usa.org/associations/8003/files/ACAA_CoalAshMaterialSafety_June2012.pdf.

Figure A-8 is an updated chart from this study comparing ranges of trace element concentrations in fly ash produced from coal from the Powder River Basin in Wyoming (the same type of coal used at Rush Island Energy Center) to USEPA screening levels, and to background levels in soils in the U.S. The USEPA screening levels for residential soils (USEPA, 2014c) are shown as the green vertical bars, the ranges for the Wyoming coal fly ash are shown in purple on top of the green vertical bars, and the ranges of background levels in U.S. soils are shown in the grey bars. What this figure shows is that all but one of the constituents are present in the Wyoming fly ash at concentrations that are below the USEPA residential soil screening levels; and for cobalt, the concentration range is only marginally above the screening level. As noted in detail in the report itself, the toxicity value upon which the USEPA soil screening level for cobalt is based is two levels of magnitude lower than what has been derived by other regulatory agencies; thus a much higher health protective soil screening level for cobalt exists. What the data also show is that constituent concentrations in coal ash are not that different from concentrations in soils in the U.S.

The results are similar for all of the coal ashes evaluated in the report (AECOM, 2012). The evaluation in the report included not only the simple comparison of constituent concentrations in coal ash to USEPA screening levels, but also provided a detailed cumulative risk screen for each coal ash data set to account for potential additive effects of combined exposures to the trace elements in coal ash. The results confirm the simple screening results, which indicate that no significant risk would be posed by direct exposure to coal ash in a residential setting.

Thus, by considering the levels of trace elements in coal ash in comparison to the background levels in soils in the U.S., and in comparison to the USEPA screening levels for these constituents in residential soil, screening levels that are protective of daily exposure to soils by children and adults, including sensitive subgroups, it is concluded that even daily direct contact to trace elements in coal ash would not pose a significant risk to human health.

A.6 Background Levels in Groundwater

Because these constituents are naturally present in soils and rocks, they are also naturally present in our groundwaters and surface waters. The USGS has published a report titled "Trace Elements and Radon in Groundwater Across the United States" (USGS, 2011b). Just as for soil, it is important to understand that there are background levels of constituents in groundwater. Constituent concentrations in groundwater that is upgradient of a source represent background conditions. To demonstrate a release to groundwater by a source, concentrations downgradient of the source must be greater than the background/upgradient concentrations at a statistically significant level for a consistent period of time.

The same concept applies to surface water. These same constituents are naturally present in surface water due to discharge of groundwater to surface water and the effect of erosion of soil into our surface waters. To demonstrate an effect of a source on surface water, the concentrations downgradient/downstream of the source must be greater than the background/upstream concentrations at a statistically significant level for a consistent period of time.

Constituents in groundwater and surface water can be in a dissolved form, or they can be adhered to or part of a soil or sediment particle. Movement of these particles in groundwater is generally more difficult because of the presence of the soil and rock that the groundwater must move through. Surface water is constantly impacted by erosion of soils, thus in surface water, it is much more common for constituents to be bound to particles rather than dissolved in the water. For this reason, it is important to evaluate both total concentrations of constituents in water (which represents constituents dissolved in the water and as part of a soil or sediment particle) and the dissolved component (by filtering out the soil/sediment particles).

A.7 Toxicity Evaluation for Cobalt and Chromium

A.7.1 Cobalt

Cobalt is the only constituent in the Powder River Basin coal ash (the coal that is used at the Rush Island Energy Center) with concentrations above the USEPA screening level for residential soils. There is much uncertainty associated with the USEPA dose-response value for cobalt, and with the resulting screening level for residential soil. The World Health Organization (WHO) indicates that "there are no suitable data with which to derive a tolerable intake for chronic ingestion of cobalt" (WHO, 2006). Agency for Toxic Substances and Disease Registry (ATSDR, 2004) states that "adequate chronic studies of the oral toxicity of cobalt or cobalt compounds in humans and animals are not presently available." However, using a short-term study in six human volunteers, ATSDR (2004) derived an intermediate-term (15–364 days) minimal risk level (MRL) of 0.05 mg/kg-day. The "adverse" effect was identified as increased red blood cell count, although it is also noted that cobalt is used as a treatment for anemia (low red blood cell count). ATSDR also notes that "Since cobalt is naturally found in the environment, people cannot avoid being exposed to it. However, the relatively low concentrations present do not warrant any immediate steps to reduce exposure." WHO notes that the largest source of exposure to cobalt for the general population is the food supply; the estimated intake from food is 5–40 ug/day, most of which is inorganic cobalt (WHO, 2006). Expressed on a mg/kg-day basis, this is 0.00007–0.0005 mg/kg-day from the diet.

USEPA however has derived a Provisional Peer-Reviewed Toxicity Value (PPRTV) for cobalt of 0.0003 mg/kg-day, this is two orders of magnitude lower than the ATSDR intermediate term MRL, and is higher that most dietary intake estimates. Thus the RSL for cobalt for residential soil is much lower than values derived by other regulatory bodies.

A.7.2 Hexavalent Chromium

The data provided by USGS (2011a) for chromium is for total chromium in the samples; the Ameren data for groundwater and surface water are also based on analysis of total chromium. Many metals can exist in different oxidation states; for some metals, the oxidation state can have different toxicities. This is the case for chromium. Chromium exists in two common oxidation states: trivalent chromium (chromium-3, Cr(III) or Cr+3), and hexavalent chromium (chromium-6, Cr(VI) or Cr+6). Trivalent chromium is essentially nontoxic, as evidenced by its RSL of 120,000 mg/kg. It can be bought over-the-counter as a supplement, and is included in most vitamins. Hexavalent chromium has been concluded to be a human carcinogen by the inhalation route of exposure (USEPA, 2014a).

Currently on USEPA's toxicity database, the Integrated Risk Information System (IRIS) (USEPA, 2014a), the primary source of dose-response information for risk assessment and for the RSL tables, an oral reference dose is available for trivalent chromium, and IRIS provides an inhalation IUR for potential inhalation carcinogenic effects and an oral reference dose and inhalation reference concentration for hexavalent chromium. The oral noncancer dose-response value for hexavalent chromium is based on a study where no adverse effects were reported; thus the target endpoint is identified as "none reported."

Recent studies by the National Toxicology Program (NTP) have shown that when present in high concentrations in drinking water, hexavalent chromium can cause gastrointestinal tract tumors in mice (NTP, 2008). IRIS does not present an oral CSF for hexavalent chromium; a value developed by the New Jersey Department of Environmental Protection (NJDEP, 2009) was used in the development of the RSLs. USEPA developed a draft oral cancer dose-response value for hexavalent chromium, based on the same study and was the same as the NJDEP value. However, it should be noted that USEPA's Science Advisory Board (SAB) provided comments in July 2011 on the draft USEPA derivation of the oral CSF for hexavalent chromium and indicated many reservations with the assumptions of mode of action, and in the derivation itself. The SAB review can be accessed at http://cfpub.epa.gov/ncea/iris_drafts/recordisplay.cfm?deid=221433. Thus, the value used to develop the RSLs for hexavalent chromium has been called into question by USEPA's peer review panel. Currently there is much scientific debate about whether the mode of action of hexavalent chromium in very high concentrations in drinking water is relevant to the low concentrations most likely to be encountered in environmental situations (Proctor, et al., 2012).

Therefore, for this evaluation of chromium in the Powder River Basin coal ash, total chromium is evaluated assuming the total concentration is hexavalent chromium and using RSLs calculated using USEPA's on-line RSL calculator (USEPA, 2014b), based on the primary dose-response values provided in the IRIS database (USEPA, 2014a) for both potential carcinogenic and noncarcinogenic endpoints.

The assumption that all chromium in CCPs is in the hexavalent form is very conservative, and in fact unrealistic. Data for the Alaska Power Plant indicate that hexavalent chromium comprises 0.25% of the total chromium concentration in the combined fly ash/bottom ash material from that facility. Literature data for analyses of CCPs from US coals (total CCPs) indicate that hexavalent chromium can comprise up to 5% of the total chromium (Huggins, et al., 1999); thus over 95% of the total chromium is present in the nontoxic trivalent form. This is consistent with data from USEPA, though there are some single higher results (USEPA, 2009).

A.8 Summary

Constituents present in coal ash are also present in our natural environment, and we are exposed to them every day, in the soils that we contact and the food that we eat. All of these constituents have USEPA-derived risk-based screening levels for residential soils. The constituent concentrations in coal ash from the Powder River Basin, the source of the coal used at the Rush Island Energy Center, are below risk-based screening levels for residential soils (with one exception) and the concentrations are similar to background levels in U.S. soils.

A.9 References

AECOM. 2012. Coal Ash Material Safety: A Health Risk-Based Evaluation of USGS Coal Ash Data from Five US Power Plants. Prepared for the American Coal Ash Association. Available at: http://www.acaa-usa.org/associations/8003/files/ACAA_CoalAshMaterialSafety_June2012.pdf

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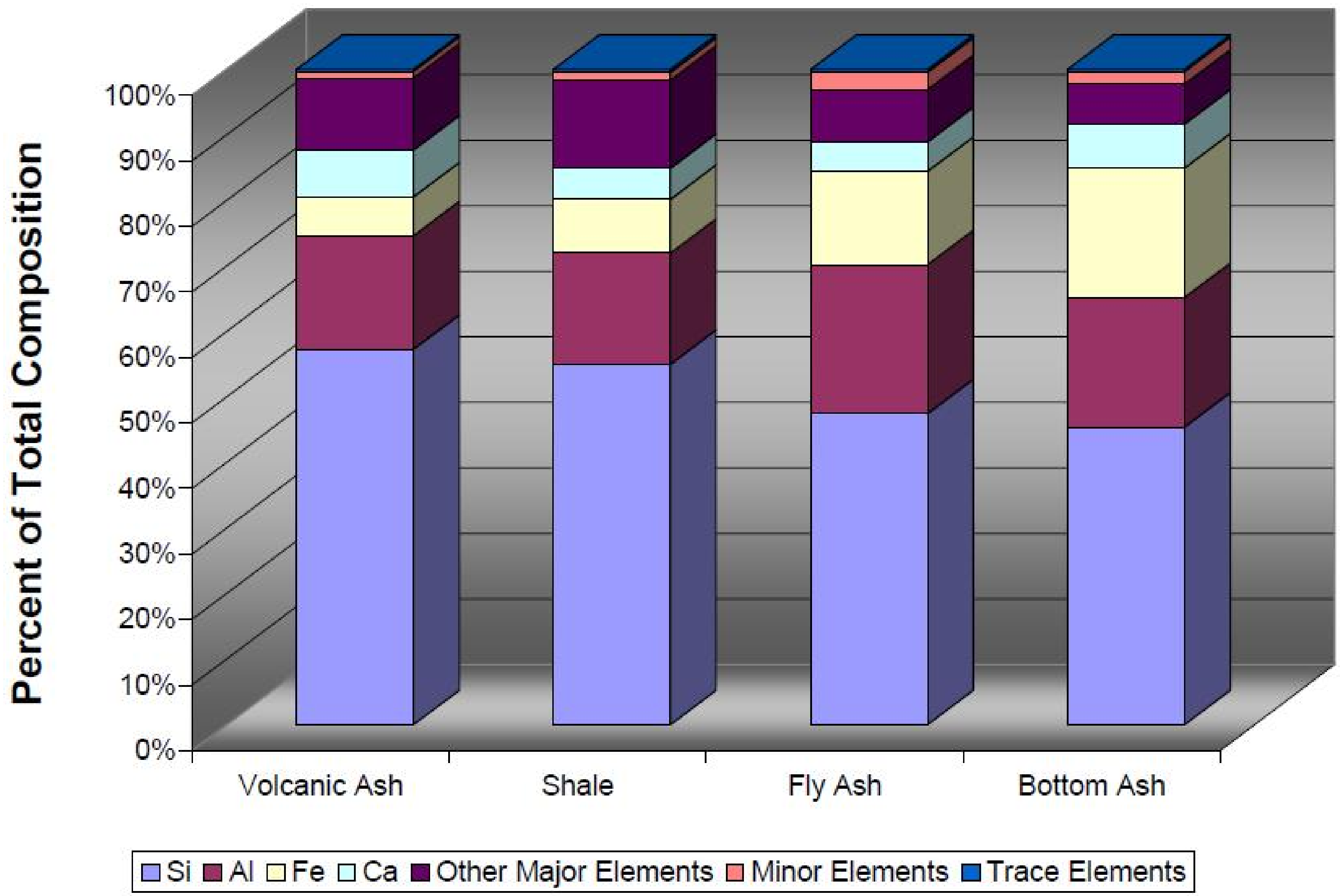
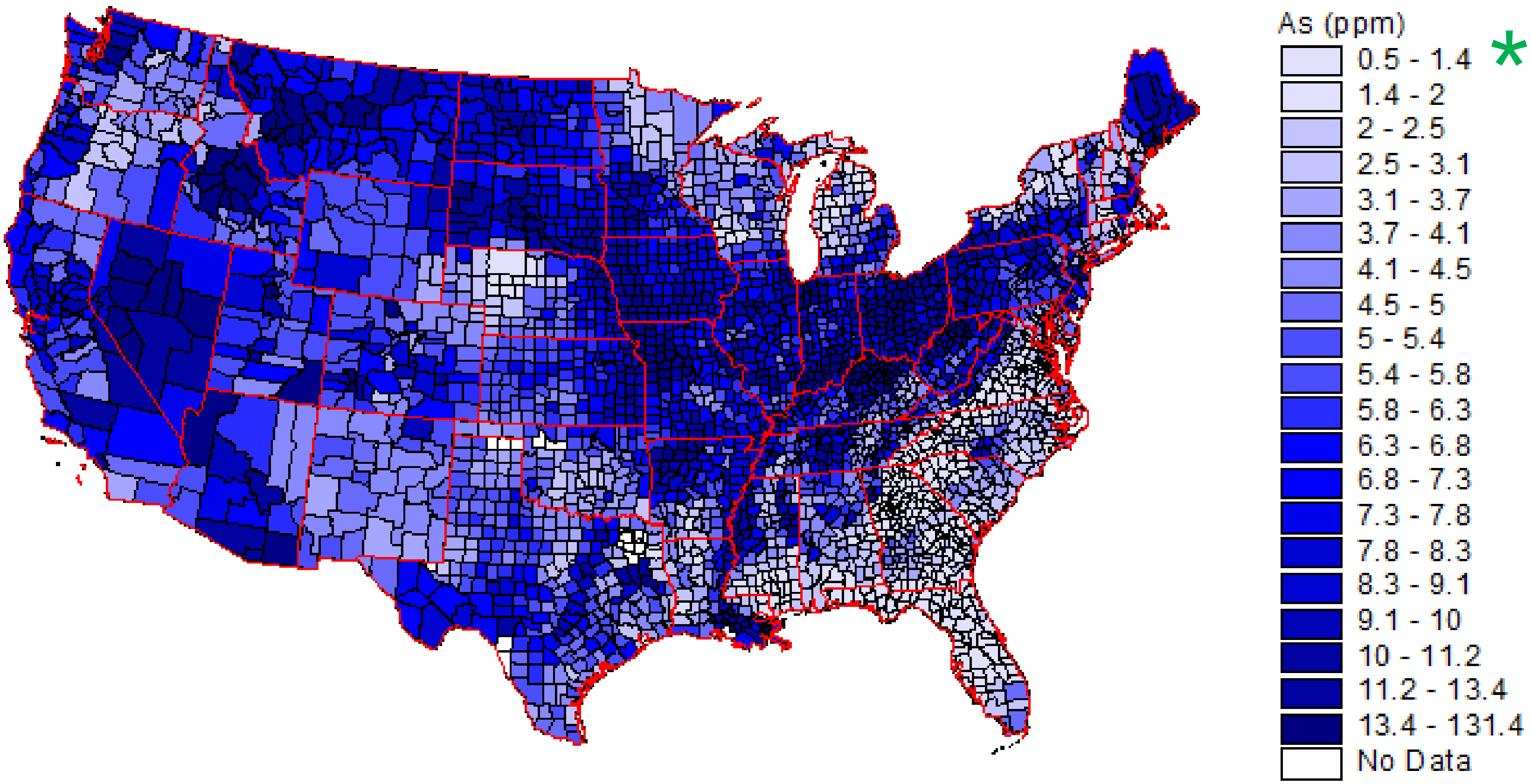
Attachment A – Figures

Figure A-1
Composition of Coal Ash and Other Natural Materials



Source: EPRI. 2010. Comparison of Coal Combustion Products to Other Common Materials – Chemical Characteristics. Report No. 1020556. Available for download at www.epri.com.

Figure A-2
Arsenic is Present in our Natural Environment –
Background Levels in Soils in the U.S.

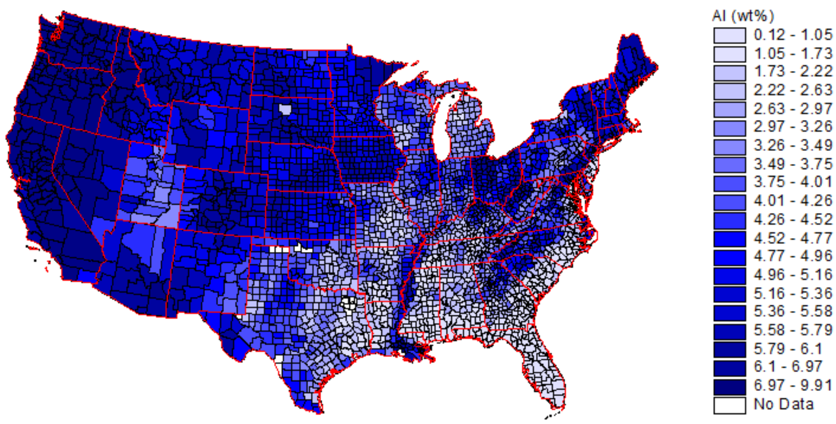


***The USEPA regional screening level for arsenic in residential soil at a one in one million risk level is 0.67 mg/kg. USEPA. 2014c.**
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
Thus the arsenic concentration in the majority of the soils in the U.S. are above the one in one million risk level.

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

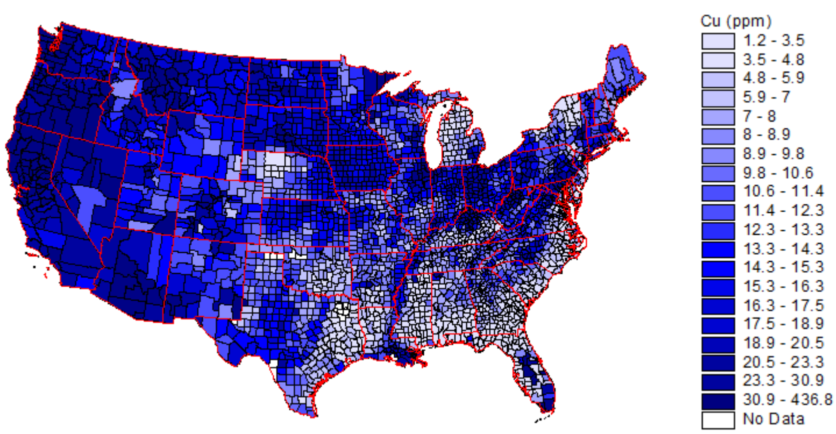
Figure A-3

Aluminum is Present in our Natural Environment –
Background Levels in Soils in the U.S.



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

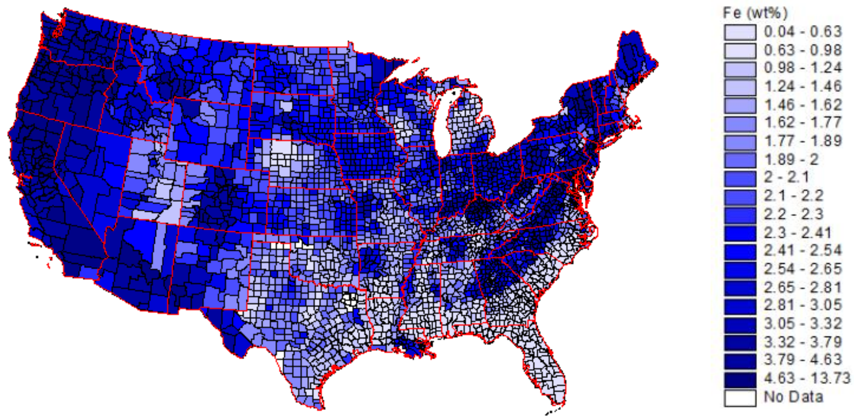
Copper is Present in our Natural Environment –
Background Levels in Soils in the U.S.



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

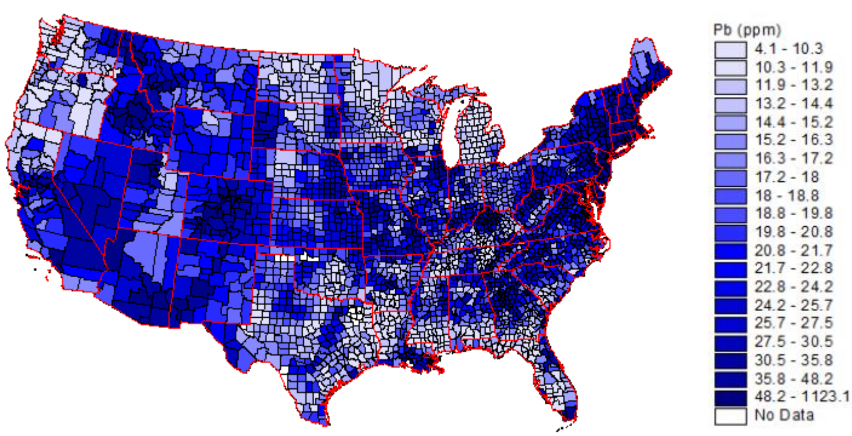
Figure A-4

Iron is present in our natural environment –
Background levels in soils in the U.S.



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

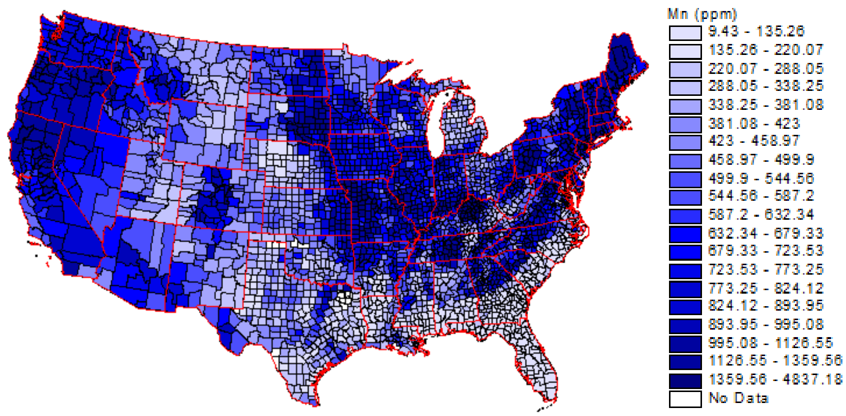
Lead is present in our natural environment –
Background levels in soils in the U.S.



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

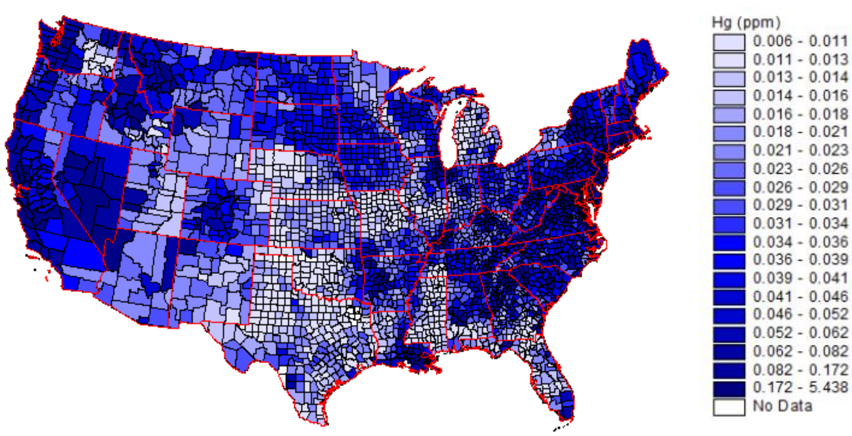
Figure A-5

Manganese is present in our natural environment –
Background levels in soils in the U.S.



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

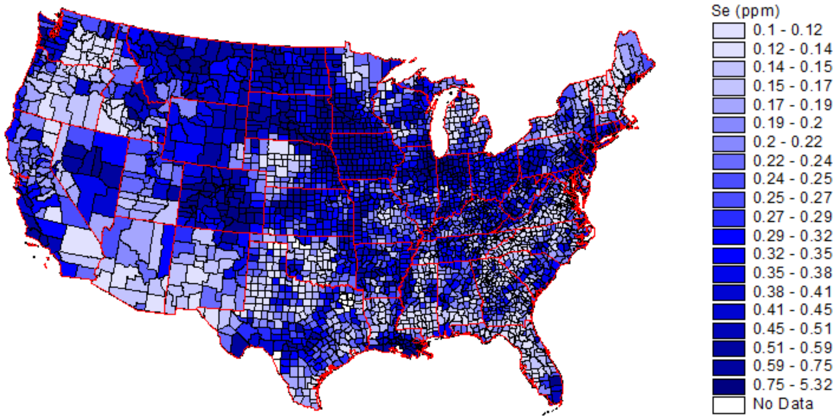
Mercury is present in our natural environment –
Background levels in soils in the U.S.



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

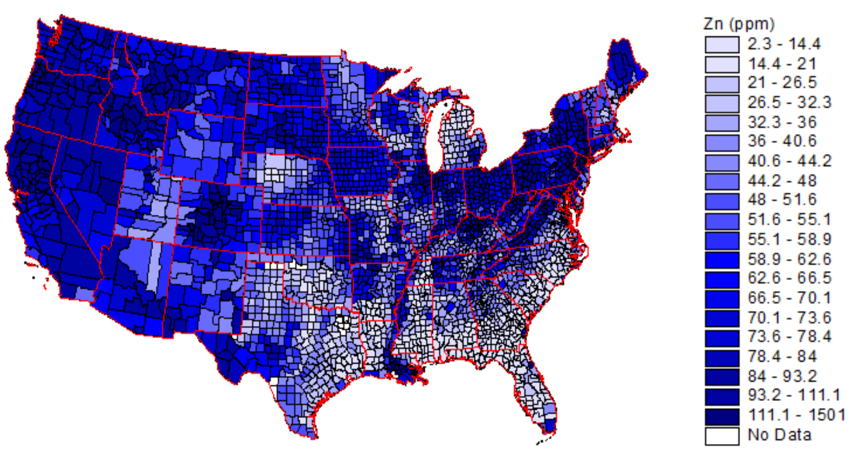
Figure A-6

Selenium is present in our natural environment –
Background levels in soils in the U.S.



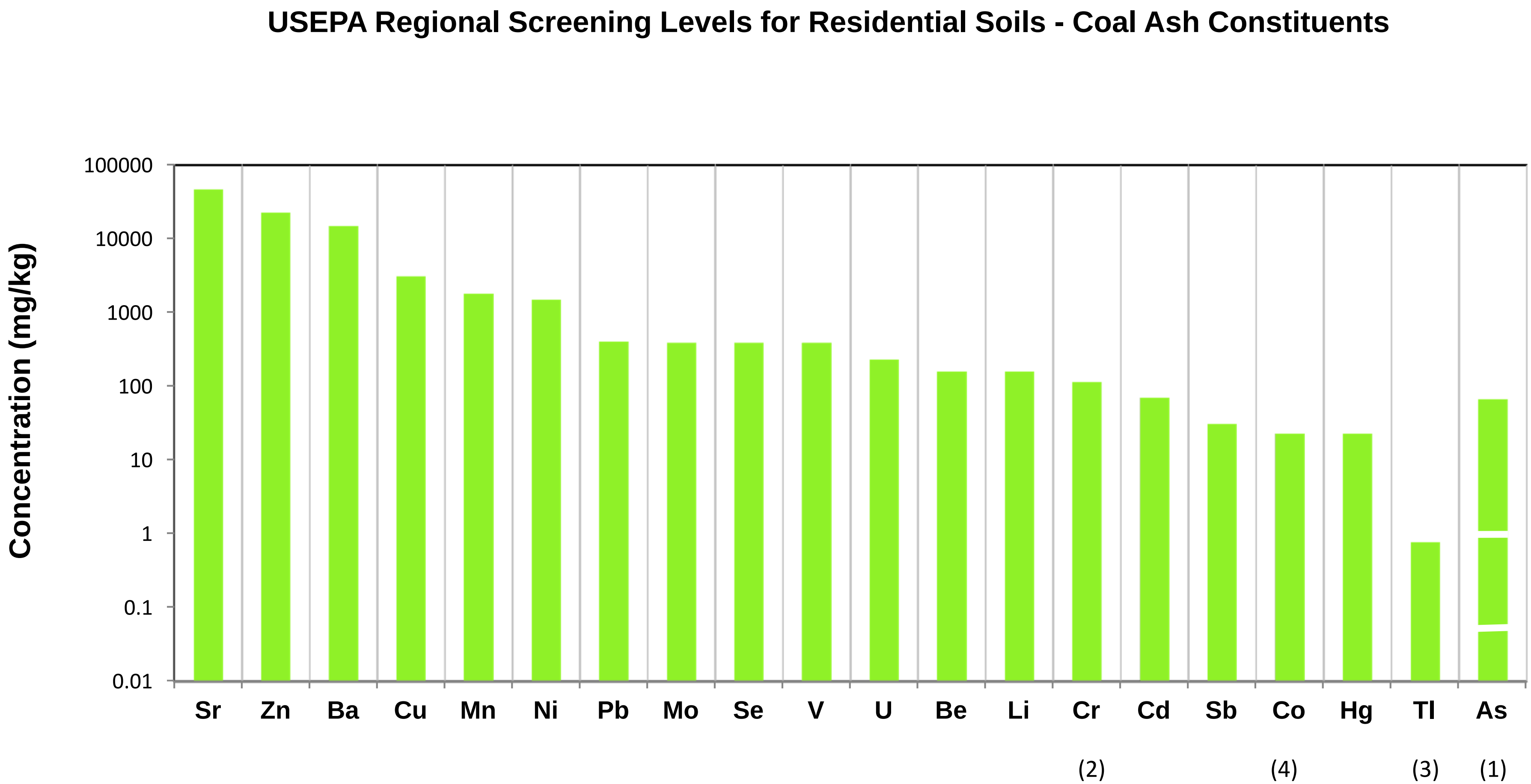
Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

Zinc is present in our natural environment –
Background levels in soils in the U.S.



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

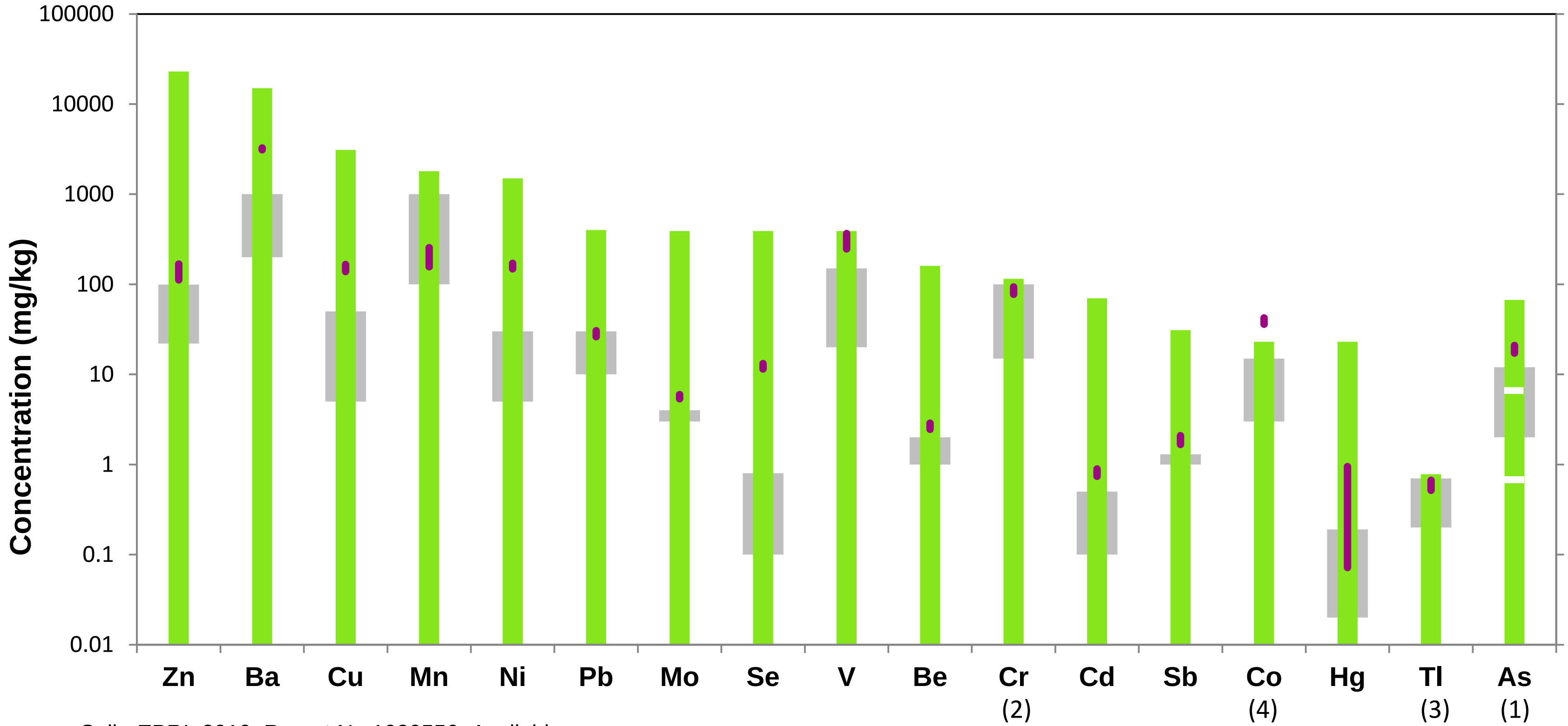
Figure A-7



■ Top of bar corresponds to the USEPA Regional Screening Level (RSL) - Residential Soil (May 2014)
http://www.epa.gov/region9/superfund//prg/index.html

Notes:
(1) Arsenic RSLs for target risk level of 10^{-4} (top of green bar), 10^{-5} (middle white bar), 10^{-6} (lower white bar.
(2) The screening level shown for chromium is the value calculated using toxicity information for hexavalent chromium currently available on USEPA's IRIS database [http://www.epa.gov/iris/subst/0144.htm]. The screening level for trivalent chromium is 120,000 mg/kg.
(3) The RSL for thallium is identified by USEPA as a "provisional value" of "limited usefulness" that was developed for information purposes although USEPA states "it is inappropriate to derive a provisional subchronic or chronic [toxicity value] for thallium" [http://hhpprtv.ornl.gov/issue_papers/ThalliumandCompounds.pdf]
(4) The RSL for cobalt is based on a provisional dose-response value that is two orders of magnitude lower than values from other regulatory sources, and higher than most dietary intake estimates. Thus, a more realistic RSL could be more than an order of magnitude higher than the value shown here.

Figure A-8 Comparison of 10th and 90th percentile USGS Database Constituent Concentrations in Fly Ash from the Wyoming Coal Power Plant and Background Levels in US Soils to the USEPA Regional Screening Levels for Residential Soils



Soil - EPRI, 2010. Report No.1020556. Available for download at www.epri.com.

USEPA Regional Screening Level (RSL) - Residential Soil (May 2014)

http://www.epa.gov/region9/superfund//prg/index.html

Concentration Range (10th - 90th Percentile) in Wyoming Fly Ash; USGS, 2011.

http://pubs.usgs.gov/ds/635/

Notes:

(1) Arsenic RSLs for target risk level of 10^{-4} (top of green bar), 10^{-5} (middle white bar), 10^{-6} (lower white bar).

(2) The screening level shown for chromium is the value calculated using toxicity information for hexavalent chromium currently available on USEPA's IRIS database [http://www.epa.gov/iris/subst/0144.htm]. The screening level for trivalent chromium is 120,000 mg/kg.

(3) The RSL for thallium is identified by USEPA as a "provisional value" of "limited usefulness" that was developed for information purposes although USEPA states "it is inappropriate to derive a provisional subchronic or chronic [toxicity value] for thallium" [http://hhpprtv.ornl.gov/issue_papers/ThalliumandCompounds.pdf]

(4) The RSL for cobalt is based on a provisional dose-response value that is two orders of magnitude lower than values from other regulatory sources, and higher than most dietary intake estimates. Thus, a more realistic RSL could be more than an order of magnitude higher than the value shown here.

ATTACHMENT B

Labadie Energy Center Dilution Factor Calculations

Golder Associates

CALCULATIONS

Date: February 8, 2018		**Made by:**	J. Ingram
Project No.: 130-1560		**Checked by:**	E. Kinder
Subject: Labadie Energy Center Dilution Factor Calculations		**Reviewed by:**	M.Haddock

1.0 Introduction

The Missouri River is a large, flowing water body and daily flow at the Labadie Energy Center (LEC) is estimated to range between 25 and 332 billion gallons per day, depending upon the river stage. In contrast, during low river flow conditions, average daily groundwater flow into the river is a fraction (estimated to be 163,000 gallons or 0.0006%) of the receiving water body. This ratio of flow is referred to as a "dilution factor" and is useful when assessing the relationship between smaller and larger water bodies. Set forth below is a calculation of a dilution factor based on specific criteria and assumptions delineated in Section 1.6.

1.1 Low River Conditions

Date	Washington Gauge Height (Feet Above Gauge)	Washington Gauge Elevation (Feet Above Mean Sea Level)	Missouri River Elevation at the Washington Gauge (feet MSL)	St. Charles Gauge Height (Feet Above Gauge)	St. Charles Gauge Elevation (Feet Above Mean Sea Level)	Missouri River Elevation at the St. Charles Gauge (feet MSL)
1/13/2015 17:00	1.21	457.27	458.48	7.92	413.47	421.39

Notes:
1) feet MSL - feet above mean sea level.
2) Information on the Washington Gauge available at https://waterdata.usgs.gov/usa/nwis/uv?06935450.
3) Information on the St. Charles Gauge available at https://waterdata.usgs.gov/mo/nwis/uv?site_no=06935965.
4) 1.21 is the lowest gauge height for the Missouri River since October, 2014. This date is used because prior to this date no publicly available flow data was collected at the Washington Gauge.

Missouri River Elevation at the Washington Gauge (feet MSL)	St. Charles Gauge Elevation (Feet Above Mean Sea Level)	Distance Between Washington and St. Charles Gauges (River Miles)	Missouri River Gradient (feet/feet)	Distance from Washington Gauge to LEC (River Miles)	Estimated Missouri River Elevation at LEC (feet MSL)
458.48	421.39	39.1	0.00018	10.0	449

Notes
1) Estimated Missouri River level calculated by subtracting the gradient of the Missouri River multiplied by the distance from the Washington Gauge (in river feet) from the Washington Gauge elevation.

1.2 Aquifer Discharge Length and Area

Description	Value	Units
Estimated length of discharge zone	9,200	feet
Estimated top of discharge zone (low river level)	449	feet above mean sea level
Estimated bottom of discharge zone (Bedrock)	365	feet above mean sea level
Estimated thickness of discharge zone (Top - Bottom)	84	feet
Estimated area of discharge zone (length x thickness)	772,800	$feet^2$

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CALCULATIONS

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1.3 Groundwater Properties

Description	Symbol	Value	Units
Average Hydraulic Conductivity (CCR Rule Monitoring Wells)	K	63	feet/day
Average Groundwater Gradient (from GMP)	I	0.0004	feet/feet
Effective Porosity (from GMP)	n	35	%
Average linear groundwater velocity (V=KI/n)	*V*	0.08	feet/day

1.4 Groundwater Discharge

Description	*Symbol*	Value	Units
Average linear groundwater velocity	*V*	0.08	feet/day
Estimated Discharge zone area	*A*	772,800	$feet^2$
Effective Porosity (from GMP)	*n*	35	%
Estimated total GW Discharge (Q=V*A*n)	*Q*	21,851	$feet^3$/day

1.5 Missouri River Flow

Description	*Value*	Units
Estimated low Missouri River Conditions (1/13/2015)	449	feet above mean sea level
Corresponding Discharge from Washington Gauge (1/13/2015)	39,700	$feet^3$/sec
Seconds per Day	86,400	seconds/day
Estimated low Flow Daily Discharge (Average Discharge * seconds per day)	3,430,080,000	$feet^3$/day

Washington Discharge data from https://waterdata.usgs.gov/usa/nwis/uv?06935450.

1.5 Dilution Factor

Description	Values	Units
Estimated Total Daily Groundwater Discha	21,851	$feet^3$/day
Estimated Daily Groundwater Discharge	163,457	gallons/day
Estimated Daily River Flow	3,430,080,000	$feet^3$/day
Estimated Daily River Flow	25,658,782,042	gallons/day
Estimated Dilution Factor (River / GW)	**156,975 or >100,000**	Unitless

1.6 List of Conservative Assumptions Used

1) Calculations are based on estimated flow rates under low flow river conditions. As an example, low flow values used for Labadie Energy Center are from January 13, 2015 which is the lowest value since October 2014. Using river flow averages would greatly increase the dilution by an order of magnitude. Missouri River data is available at https://waterdata.usgs.gov/nwis/uv?site_no=06935450.
2) To simplify the calculations, the alluvial aquifer was assumed to consist of higher permeability sands, resulting in conservative (higher) estimates of groundwater discharge.
3) The calculations do not take into account any dilution from the alluvial aquifer itself. The river locally recharges the aquifer at varying rates depending on river stage. In addition, on a near continuous basis, groundwater flows from the bedrock aquifer into the shallow alluvial aquifer. All of these sources increase dilution within the alluvial aquifer.

Although these calculations use conservative assumptions which would serve to increase the dilution factor ratio, the calculated value for the dilution factor has been rounded down. This dilution factor ratio represents a worst case scenario and actual dilution factors are likely greater.