First Annual Groundwater Monitoring and Corrective Action Report, 2016-2017

Laramie River Station
Wheatland, Wyoming

Basin Electric Power Cooperative

Project number: 60506860

January 31, 2018

Basin Electric Power Cooperative
Bismarck, North Dakota

Quality information

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Revision History

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List of Acronyms

bgs	below ground surface
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPA	United States Environmental Protection Agency
FGD	Flue Gas Desulfurization
ft	feet
ft/d	feet per day
GWMS	groundwater monitoring system
GWPS	groundwater protection standards
LRS	Laramie River Station
MCL	maximum contaminant level
MW	megawatt
RCRA	Resource Conservation and Recovery Act
SSI	statistically significant increase
SSL	statistically significant level
TDS	total dissolved solids
UPL	upper prediction limit
USGS	U.S. Geological Survey

1. Introduction

On behalf of Basin Electric Power Cooperative, (Basin), AECOM prepared this first annual report documenting groundwater monitoring and corrective action for the Coal Combustion Residuals (CCR) units at Basin's Laramie River Station.

Chapter 1.0 provides background information on the power generating facility, the CCR unit(s) present at the facility, and the physical setting of the CCR unit(s), specifically with regard to groundwater conditions. Chapter 2.0 presents an overview of the groundwater monitoring and corrective action process and requirements of Chapter 40 of the Code of Federal Regulations (CFR) Part 257 Subpart D, known as the CCR rule. Chapter 3.0 summarizes the groundwater monitoring and corrective action activities completed in 2016 and 2017, and references attachments to this report that contain detailed documentation of those activities. Chapter 4.0 provides an evaluation of the condition of the groundwater monitoring system. Chapter 5.0 summarizes the groundwater sampling and analysis conducted during the reporting period. Chapter 6.0 reviews the methods and results of statistical analysis of the groundwater monitoring data. Chapter 7.0 presents a summary and conclusions from the CCR groundwater monitoring in 2016-2017 and statistical analysis of the results. Chapter 8.0 lists references cited in this report.

Regulatory Background

The CCR rule became effective on October 19, 2015 and established standards for the disposal of CCR in landfills and surface impoundments (CCR units). In particular, the rule set forth groundwater monitoring and corrective action requirements for CCR units. The rule includes the requirement for an "annual groundwater monitoring and corrective action report" (annual report), with the first annual report due by January 31, 2018. The annual report is intended to document the status of the groundwater monitoring and corrective action program for each CCR unit, summarize key actions completed in the previous year, and project key activities for the upcoming year. This report is the first annual report, and includes activities performed in calendar years 2016 and 2017.

Facility Location and Operational History

Laramie River Station (LRS) is located east of Wheatland, Wyoming (**Figure 1-1**). The LRS is one of the largest consumer-operated, regional, joint power supply ventures in the United States. LRS is a coal-based generating station located in Platte County east of Wheatland, Wyoming. The plant consists of three power generating units with a total power output capacity of 1,710 megawatts (MW):

- Unit 1, with a rating of 570 MW, which began operating in 1980;
- Unit 2, with a rating of 570 net MW, which began operating in 1981; and
- Unit 3, with a rating of 570 net MW, which began operating in 1982.

CCR produced at LRS includes fly ash, bottom ash, and flue gas desulfurization (FGD) waste.

CCR Unit Description

Coal ash is disposed at LRS in the following CCR units/multi-units:

- Ash Pond 1
- Ash Pond 2, Ash Pond 3, Ash Landfill (multi-unit)
- Emergency Storage Ponds (multi-unit)

The ash landfill and three ash ponds are located west of the generating units and office complex, near the western edge of the site (**Figure 1-1**). The two emergency holding ponds are located north of the generating units in the northeastern part of the site. The landfill and ash ponds were permitted in 1978 and began receiving coal ash in 1980. The emergency holding ponds were subsequently incorporated due to disposal of FGD materials. Basin reported that in 2014 the landfill received 284,119 tons of solid waste, including fly ash, FGD waste, and a minor contribution of solid debris. The landfill is currently accessed via a haul road running generally east to west along the south side of the landfill.

Physical Setting

The geological and hydrogeological setting is important to understanding the groundwater environment in the vicinity of the LRS. The geologic history of Platte County is similar to most areas within the Front Range of the Rocky Mountains. Platte County is underlain by marine and continental deposits of limestone, conglomerate, sandstone, siltstone, shale, and unconsolidated sediments. Deposits range in thickness over the Laramie Range, Hartville uplift, and related features up to 10,000 feet in the east central and southeastern parts of the county. Precambrian rocks generally make up the mountainous (structurally complex) areas, Paleozoic and Mesozoic rocks adjoin the older formations, and Tertiary and Quaternary rocks underlie most of the county east of the Laramie Range (U.S. Geological Survey [USGS] 1960). The Laramide Orogeny was active in the county approximately 70 million years ago marking the beginning the Hartville uplift and Laramie Range. In the Cenozoic, streams eroded the eastern side of the range depositing silts, sands, and gravels of the Brule and Arikaree Formations that underlie the Wheatland area and subsequently Basin Electric LRS.

Precipitation landing on the eastern flank of the Laramie Range supplies surface water to perennial and ephemeral streams that flow east towards the basin. Most surface water west of Wheatland eventually joins with the Laramie River continuing east before discharging into the Platte River near Fort Laramie. Groundwater near Wheatland is recharged primarily through infiltration on the eastern flank of the Laramie Range, and through re-infiltration of irrigation water during the spring, summer, and fall months. Some groundwater in the saturated zones eventually returns to the land surface through seeps and springs, or is discharged by wells and evapotranspiration; however, the majority flows into surface streams. Alluvial drainages bounding the eastern (Wheatland Creek) and western portions (Chugwater Creek) of the facility transport surface water generally northward, discharging to the Laramie River (USGS 1960). Some groundwater within these regions percolates into the Arikaree Formation which holds the uppermost aquifer beneath the facility.

The LRS facility is underlain by a 5- to 30-feet (ft) thick section of Quaternary sediments that overlies the Arikaree Formation. The Arikaree Formation is comprised primarily of loosely to moderately cemented very fine to fine grained sandstone containing interbeds of silts and clays. A lower unit consists of lenses of loosely to well-cemented red to gray coarse sandstone interbedded with lenses of well-cemented conglomerate. A basal conglomerate lies unconformably upon the underlying Brule Formation in many places throughout Platte County (USGS 1960). A review of the geologic logs generated during the drilling of the onsite water supply well (Forell-Baumgardner No. 2) suggests the Brule Formation is approximately 820 ft below ground surface (bgs) in the western portions of the site. Based on this information, the local thickness of the Arikaree Formation onsite is approximately 790 ft thick.

The lithologic characteristics of the Arikaree Formation beneath the LRS are generally consistent, although there are slight differences in the degree of cementation and induration, and minor variations in grain size. Few fractures were noted in borehole soil cores obtained during monitoring well network installation. Interbeds with higher silt and clay content, coupled with greater cementation generate thin discontinuous perched groundwater horizons that are interpreted to hold only seasonal groundwater. The perched groundwater would tend to percolate downward to what is interpreted as the uppermost aquifer based on data obtained during monitoring well installation and aquifer testing. The uppermost aquifer is present at a depth of approximately 95 ft bgs in the southeastern portion of the LRS facility, and slopes generally north towards the Laramie River. The hydraulic gradient for the uppermost aquifer beneath the site appears to be controlled dominantly through topographic features and enhanced infiltration zones in permeable shallow alluvium. A representative potentiometric surface map from one of the baseline monitoring events conducted in 2016-2017 is presented in **Figure 1-2**. Aquifer pump testing was completed at eight groundwater monitoring wells. The resulting data were used to estimate hydraulic conductivities ranging from 0.65 feet per day (ft/d) to 3.12 ft/d, with an average of 1.40 ft/d. Aquifer slug tests were performed on eight other wells, with resulting estimated hydraulic conductivities ranging from 0.45 ft/d to 6.28 ft/d, with an average of 2.16 ft/d.

2. Groundwater Monitoring and Corrective Action Process Overview

The regulatory process for CCR groundwater monitoring and corrective action is established by 40 CFR Parts 257.90 through 257.98. The process includes a phased approach to groundwater monitoring, leading (if applicable) to the establishment of groundwater protection standards (GWPSs) for each CCR unit. Exceedances of the GWPSs that are determined to be statistically significant can trigger requirements for additional groundwater characterization and corrective action assessment followed by corrective action implementation. The following paragraphs provide additional detail, and distinguish between the activities performed to-date and activities planned for future years.

Groundwater monitoring is performed using a network of monitoring wells that includes both wells to monitor background water quality that is not potentially influenced by the presence of the CCR unit, and wells placed at the downgradient boundary of waste disposal. The first phase of groundwater monitoring is the detection monitoring phase. This phase evaluates the groundwater quality based on the constituents listed in Appendix III of the CCR rule that are the more mobile potential components of CCR and therefore represent indicators of possible impacts from the CCR unit to groundwater. Appendix III constituents include:

- pH, Total Dissolved Solids (TDS), Boron, Calcium, Chloride, Fluoride, and Sulfate.

If SSIs of any of the Appendix III constituents relative to background conditions are detected in the downgradient waste boundary wells, and cannot be demonstrated to be associated with a source other than the CCR unit, then groundwater monitoring moves into the second phase, assessment monitoring.

The second phase of groundwater monitoring focuses on the constituents listed in Appendix IV of the CCR rule. The Appendix IV constituents generally are less mobile and occur at lower concentrations in groundwater than the Appendix III constituents. Appendix IV constituents include:

- Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Fluoride, Lead, Lithium, Mercury, Molybdenum, Selenium, Thallium, and Radium 226 and 228 (combined).

Concentrations of Appendix IV constituents in downgradient wells are compared to GWPSs. The GWPSs, established for Appendix IV constituents, are the higher of either the federal Safe Drinking Water Act maximum contaminant level (MCL) or the background concentration for each constituent.

If exceedance of a GWPS is identified in one or more downgradient boundary wells at statistically significant levels (SSLs), and no alternative sources for the exceedances can be demonstrated, then both additional groundwater characterization and assessment of corrective measures will be initiated. Following assessment of corrective measures, a remedy (or set of remedies) will be selected for the groundwater corrective action program for the CCR unit. According to the CCR rule, groundwater corrective action will continue until compliance with the GWPS has been attained in all impacted wells, and sustained for a period of three consecutive years.

The process described above relies on appropriate sampling locations (monitoring wells), baseline data, and statistical methods to establish local background concentrations of the constituents in both Appendices III and IV, and to compare the concentrations in downgradient wells to background and/or MCLs. For each existing CCR unit that continued to receive CCR after October 2015, the rule requires that the following be performed prior to October 17, 2017, in order to support the process:

- Install and certify a groundwater monitoring system (GWMS) that is compliant with the rule, in the uppermost aquifer (and lower aquifers that are hydraulically interconnected to the uppermost aquifer) that underlies the unit;
- Develop a groundwater sampling and analysis program, including selection of statistical procedures;
- Collect and analyze a minimum of eight rounds of independent samples from the background and downgradient wells in the monitoring system; and
- Begin evaluating the data to support detection monitoring for the Appendix III constituents.

The activities listed above were completed in calendar year 2017 as described in this annual report. The following activities will be performed in calendar year 2018:

- Semi-annual monitoring of groundwater for Appendix III constituents, for detection monitoring purposes;
- Statistical evaluation to determine if SSIs of the Appendix III constituents are detected in downgradient wells; and
- Potentially conduct an Alternative Source Demonstration to evaluate whether the SSI constituent(s) can be attributed to a source other than the CCR unit.

An assessment monitoring program will be established in the event that SSIs of any Appendix III constituent are identified and are not demonstrated to be from a source other than the CCR unit being monitored. The assessment monitoring program, if triggered, will include:

- Sampling of all wells in the monitoring system for Appendix IV constituents and establish GWPSs in accordance with Part 257.95 (h) of the CCR rule;
- Continued sampling of the wells on a semi-annual basis (at a minimum) for the Appendix III constituents and all Appendix IV constituents detected in the previous round; and
- Determination if SSLs of any GWPSs have occurred.

If an SSL has occurred, the owner or operator shall determine whether the SSL can be attributed to a source other than the CCR unit or resulted from error in sampling, statistical evaluation or natural variation in groundwater quality. An assessment of corrective measures will be initiated if the SSL cannot be attributed to another source, error, or natural variation. The assessment of corrective measures will include:

- Additional groundwater characterization, if needed, to support assessment of corrective measures; and
- Evaluation of potentially applicable corrective measures to support selection of the remedial action, or set of actions to halt or reduce the potential for further introduction of the constituent(s) of concern to uppermost groundwater.

It is anticipated that implementation of a corrective action program, if required, would occur after calendar year 2018.

3. Groundwater Activities in 2016-2017

This chapter summarizes the following activities that were completed in support of the CCR rule beginning in the spring of 2016 and continuing through the summer of 2017:

- Monitoring Well Installation, Development and Testing
  - Site review and planning
  - Project safety and utility locates
  - Well drilling and construction
  - Surveying
  - Well development
  - Aquifer testing
- Monitoring Activities
  - Groundwater sampling
  - Laboratory analysis.

Further details concerning these groundwater monitoring activities are summarized below.

Monitoring Well Installation

A monitoring well system was established at LRS that utilizes several existing monitoring wells that predate the CCR rule, as well as additional monitoring wells that were installed to complete the system and comply with requirements of the Rule. Sixteen monitoring wells were installed at LRS during the summer of 2016 to target the uppermost aquifer in the vicinity of the LRS CCR units, including nine monitoring wells (MW-32B through MW-40B) around the landfill and ash ponds west of the main plant area, and seven monitoring wells (MW-41B through MW-47B) surrounding the emergency holding ponds generally north of the main plant area (**Figure 3-1**). The monitoring well locations were selected to evaluate the direction of groundwater flow as well as groundwater quality in the vicinity of the LRS CCR units. Monitoring well installation involved drilling, well construction, development, and aquifer testing, as described below.

Drilling and Well Construction in 2016

Sixteen new monitoring wells were installed at LRS targeting the uppermost aquifer within the investigation areas. Nine new monitoring wells (MW-32B through MW-40B) were installed around the ash ponds and landfill west of the main plant area, and seven new monitoring wells (MW-41B through MW-47B) were installed surrounding the emergency holding ponds generally north of the main plant area (**Figure 3-1**). The monitoring well locations were selected to evaluate the direction of groundwater flow in the vicinity of the LRS CCR units.

Monitoring well drilling and construction occurred between July 13 and August 12, 2016. The monitoring wells were installed by Major Drilling using sonic drilling methods. A combination of aquifer pumping and slug tests were performed on the 16 new monitoring wells around the emergency ponds and ash ponds to evaluate the hydraulic conductivity of the geologic formation at each well location. The aquifer tests were performed between August 19, 2016 and August 23, 2016. The estimated hydraulic conductivities measured by the pumping tests ranged from a minimum of 0.65 ft/d to a maximum of 3.12 ft/d, with an average of 1.40 ft/d.

A complete report documenting the construction, development and testing of the monitoring wells installed in 2016 is presented in the CCR Groundwater Monitoring System Report, Laramie River Station, Wheatland, Wyoming (AECOM 2017).

Addition of Existing Monitoring Wells in November 2016

The first CCR baseline groundwater monitoring event at LRS was conducted in September 2016. A review of the resulting data concluded that the assessment of baseline groundwater conditions associated with the ash impoundments and landfill could be improved by modifying the list of monitoring wells included in the CCR monitoring system. Therefore, the monitoring system was modified in November 2016 as described below for subsequent baseline monitoring events:

- Existing monitoring wells MW-14BR, MW-20B, and MW-21B were added to the groundwater monitoring program (**Figure 3-1**). These wells are located downgradient of the ash impoundments and eastern portion of the ash landfill, and supplement the downgradient data provided by MW-36B, MW-37B, MW-38B, and MW-48B.
- Monitoring wells MW-33B, MW-34B, and MW-35B were removed from the groundwater sampling program because they were found to be cross-gradient from the ash impoundments and landfill, although groundwater elevations continued to be measured in these wells to support interpretation of site-wide groundwater flow.

Addition of New and Existing Monitoring Wells in 2017

The LRS CCR groundwater monitoring network was modified in July 2017 based on an evaluation of interim baseline data acquired in 2016 through the spring of 2017. The rationale for expanding the network was to provide greater resolution of baseline groundwater quality and flow in the vicinity of the three ash ponds, and support an evaluation of upgradient and downgradient conditions for Ash Pond 1 and a multi-unit consisting of Ash Pond 2, Ash Pond 3, and the Ash Landfill. The monitoring wells added to the network in July 2017 included two existing wells along the northern edge of the ash ponds: MW-22B and MW-23B. In addition to these wells, six new monitoring wells were installed along the northern edge of the ash ponds and between the ash ponds: MW-48B, MW-49B, MW-50B, MW-51B, MW-52B and MW-53B (**Figure 3-1**).

The six new monitoring wells were installed using sonic drilling methods consistent with the methods for installing the monitoring wells in 2016. Drilling and well construction was performed by O'Keefe Drilling of Butte, Montana. Aquifer testing was not performed on the six new monitoring wells because sufficient data was obtained during testing of the sixteen wells installed in 2016 to adequately characterize the hydrogeological characteristics of the uppermost aquifer in the vicinity of the LRS CCR units. The CCR Groundwater Monitoring System Report (AECOM 2017) documents the construction, development and testing of the monitoring wells installed at LRS in 2017.

Monitoring Activities

Groundwater monitoring events for the reporting period include eight baseline events beginning in September 2016 and concluding in October 2017.

The hydrostratigraphic positions of the CCR monitoring wells selected for sampling background and downgradient groundwater quality for each LRS CCR unit or multi-unit is summarized below:

CCR unit/multi-unit	Background wells	Downgradient wells
Ash Pond 1	MW-52B, MW-53B	MW-49B, MW-21B, MW-38B
Ash Pond 2, Ash Pond 3, Ash Landfill	MW-39B, MW-32B	MW-36B, MW-37B, MW-20B, MW-14BR, MW-40B, MW-52B, MW-53B
Emergency Holding Ponds	MW-41B, MW-42B, MW-43B	MW-44B, MW-45B, MW-46B, MW-47B

The following eight monitoring wells are also included in the CCR monitoring system for the purpose of measuring groundwater elevations and evaluating groundwater flow direction and velocity in the vicinity of the ash ponds and landfill:

- MW-22B, MW-23B, MW-33B, MW-34B, MW-35B, MW-48B, MW-50B, MW-51B.

Baseline detection monitoring events performed in 2016 and 2017 were conducted in general accordance with procedures established in the Sampling and Analysis Plan (AECOM 2018), which is included in the operating record. The Sampling and Analysis Plan describes the procedures for equipment calibration, monitoring well water level measurement, monitoring well purging and sampling, sample custody, sample shipping, laboratory analysis and documentation requirements for each groundwater sample submitted.

4. Monitoring System Evaluation

As described in the CCR Groundwater Monitoring System Report (AECOM 2017), drilling equipment and procedures were employed to identify the uppermost aquifer and ensure each new monitoring well was installed with appropriate total depth and placement of the well screen to: (1) facilitate collection of representative samples of the uppermost aquifer, and (2) accurately measure water table elevations to support evaluation of groundwater gradient and flow direction. All monitoring wells comprising the LRS CCR monitoring system were found to be in good condition during each monitoring event in 2016 and 2017.

Analysis of potentiometric surface maps constructed using the depth to groundwater measurements obtained during baseline groundwater monitoring indicates the direction of groundwater flow is generally to the northeast, and supports the wells selected to represent background groundwater quality and the quality of groundwater downgradient of the CCR units.

5. Monitoring Results

The data obtained from the baseline monitoring events are provided in the Sampling and Analysis Report, 2016-2017 (**Attachment A**), which presents a representative potentiometric surface map for the uppermost aquifer, inferred groundwater flow direction and estimated velocities, and tabulated summary of field measurements and laboratory analytical data for parameters listed in Appendix III and Appendix IV of the CCR rule.

6. Statistical Procedures and Analysis

Ash Pond 1

The Appendix III groundwater quality data for the Ash Pond 1 unit were evaluated using an interwell approach that statistically compares constituent concentrations at downgradient monitoring wells to those present at background monitoring wells. For Ash Pond 1, monitoring wells MW-52B and MW-53B are designated as the background wells because they are located upgradient of Ash Pond 1, and monitoring wells MW-21B, MW-38B, and MW-49B are located downgradient of Ash Pond 1.

The statistical analyses were performed in accordance with the Statistical Method Certification and Statistical Methodology presented in the CCR Groundwater Monitoring System Report (AECOM 2017). Prediction limits (i.e., parametric or nonparametric) with 1 of 2 retesting were developed for each constituent based on the frequency of non-detect values and whether the background data for that constituent exhibited a normal, lognormal, or nonparametric distribution. For the statistical analysis, non-detect values were represented as one-half the detection limit. No outliers were identified in the background data. Analytical data from the background monitoring wells collected between August 2016 and October 2017 were used to develop an upper prediction limit (UPL) for the Appendix III background data at 95 percent confidence or better. Data from the downgradient monitoring wells for the seventh and eighth detection sampling events for each well were compared to the UPL to identify SSIs over background. The results from the eighth sampling event were used to verify the results of the seventh sampling event if an SSI was identified. Mann-Kendall trend analysis was used to identify statistically significant increasing trends for constituents with SSIs. ProUCL Version 5.1 was used to store the data and run the statistical analyses. The results of the analyses, including the UPLs, are provided in **Table 6-1**.

The statistical analysis results indicate that Appendix III constituents boron at monitoring well MW-38B and calcium, chloride, sulfate, and TDS at monitoring wells MW-21B and MW-38B have SSIs over background. No Appendix III SSIs were found at monitoring well MW-49B. Based on these results, assessment monitoring is required at Ash Pond 1 within 90 days of this determination.

Ash Pond 2, Ash Pond 3, Ash Landfill

The Appendix III groundwater quality data were evaluated for the Ash Pond 2, Ash Pond 3, Ash Landfill multi-unit using an interwell approach that statistically compares constituent concentrations at downgradient monitoring wells to those present at background monitoring wells. For the multi-unit (Ash Ponds 2 and 3 and the Ash Landfill), monitoring wells MW-32B and MW-39B are designated as the background wells because they are located upgradient of the multiunit, and monitoring wells MW-14BR, MW-20B, MW-36B, MW-37B, MW-40B, MW-52B, and MW-53B are located downgradient of the facility.

The statistical analyses were performed in accordance with the Statistical Method Certification and Statistical Methodology presented in the CCR Groundwater Monitoring System Report (AECOM 2017). Prediction limits (i.e., parametric or nonparametric) with 1 of 2 retesting were developed for each constituent based on the frequency of non-detect values and whether the background data for that constituent exhibited a normal, lognormal, or nonparametric distribution. For the statistical analysis, non-detect values were represented as one-half the detection limit. No outliers were identified in the background data. Analytical data from the background monitoring wells collected between August 2016 and October 2017 were used to develop a UPL for the Appendix III background data at 95 percent confidence or better. Data from the downgradient monitoring wells for the seventh and eighth detection sampling events for each well were compared to the UPL to identify SSIs over background. The results from the eighth sampling event were used to verify the results of the seventh sampling event if an SSI was identified. Mann-Kendall trend analysis was used to identify statistically significant increasing trends for constituents with SSIs. ProUCL Version 5.1 was used to store the data and run the statistical analyses. The results of the analyses, including the UPLs, are provided in **Table 6-2**.

The statistical analysis results indicate that fluoride at monitoring wells MW-20B, MW-40B and MW-53B and chloride at monitoring well MW-37B are the only Appendix III constituents that have SSIs over background. Monitoring wells MW-36B and MW-53B also had elevated chloride and pH levels, respectively, during the first four sampling events, but no SSI based on the results of the last sampling event for each well. No Appendix III SSIs were found at monitoring wells MW-14BR and MW-52B. Based on these results, assessment monitoring is required at the Multiunit within 90 days of this determination.

Emergency Holding Ponds

The Appendix III groundwater quality data were evaluated for the Emergency Holding Ponds multi-unit using an interwell approach that statistically compares constituent concentrations at downgradient monitoring wells to those present at background monitoring wells. For the Emergency Holding Ponds, monitoring wells MW-41B, MW-42B, and MW-43B are designated as the background wells because they are located upgradient of the holding ponds, and monitoring wells MW-44BB, MW-45B, MW-46B, and MW-47B are located downgradient of the ponds.

The statistical analyses were performed in accordance with the Statistical Method Certification and Statistical Methodology presented in the CCR Groundwater Monitoring System Report (AECOM 2017). Prediction limits (i.e., parametric or nonparametric) with 1 of 2 retesting were developed for each constituent based on the frequency of non-detect values and whether the background data for that constituent exhibited a normal, lognormal, or nonparametric distribution. For the statistical analysis, non-detect values were represented as one-half the detection limit. No outliers were identified in the background data. Analytical data from the background monitoring wells collected between August 2016 and October 2017 were used to develop a UPL for the Appendix III background data at 95 percent confidence or better. Data from the downgradient monitoring wells for the seventh and eighth detection sampling events for each well were compared to the UPL to identify SSIs over background. The results from the eighth sampling event were used to verify the results of the seventh sampling event if an SSI was identified. Mann-Kendall trend analysis was used to identify statistically significant increasing trends for constituents with SSIs. ProUCL Version 5.1 was used to store the data and run the statistical analyses. The results of the analyses, including the UPLs, are provided in **Table 6-3**.

The statistical analysis results indicate that fluoride at monitoring wells MW-44B and MW-45B is the only Appendix III constituent that has an SSI over background. However, the background fluoride data only has three detected values which is not sufficient to compute meaningful statistics, thus the fluoride SSIs at monitoring wells MW-44B and MW-45B cannot be reliably confirmed. Monitoring well MW-46B also had fluoride detections during the first four sampling events, but no SSI during the last sampling event. No Appendix III SSIs were found at monitoring well MW-47B. Based on these results, assessment monitoring is required at the Emergency Holding Ponds within 90 days of this determination.

7. Summary and Conclusions

AECOM, on behalf of Basin, oversaw the installation, testing and sampling of a CCR groundwater monitoring system at LRS. Eight rounds of baseline detection monitoring were performed for each monitoring well in the system prior to October 17, 2017. The results established baseline groundwater quality for CCR rule Appendix III and Appendix IV constituents in the uppermost aquifer upgradient and downgradient of the three LRS CCR unit/multi-units:

1. Ash Pond 1
2. Ash Pond 2, Ash Pond 3, Ash Landfill
3. Emergency Holding Ponds.

Statistical analysis of the baseline detection monitoring results identified an SSI for at least one Appendix III constituent for each LRS CCR unit/multi-units. Based on these results, assessment monitoring is required for all three CCR unit/multi-units within 90 days of this determination.

8. References

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Figures

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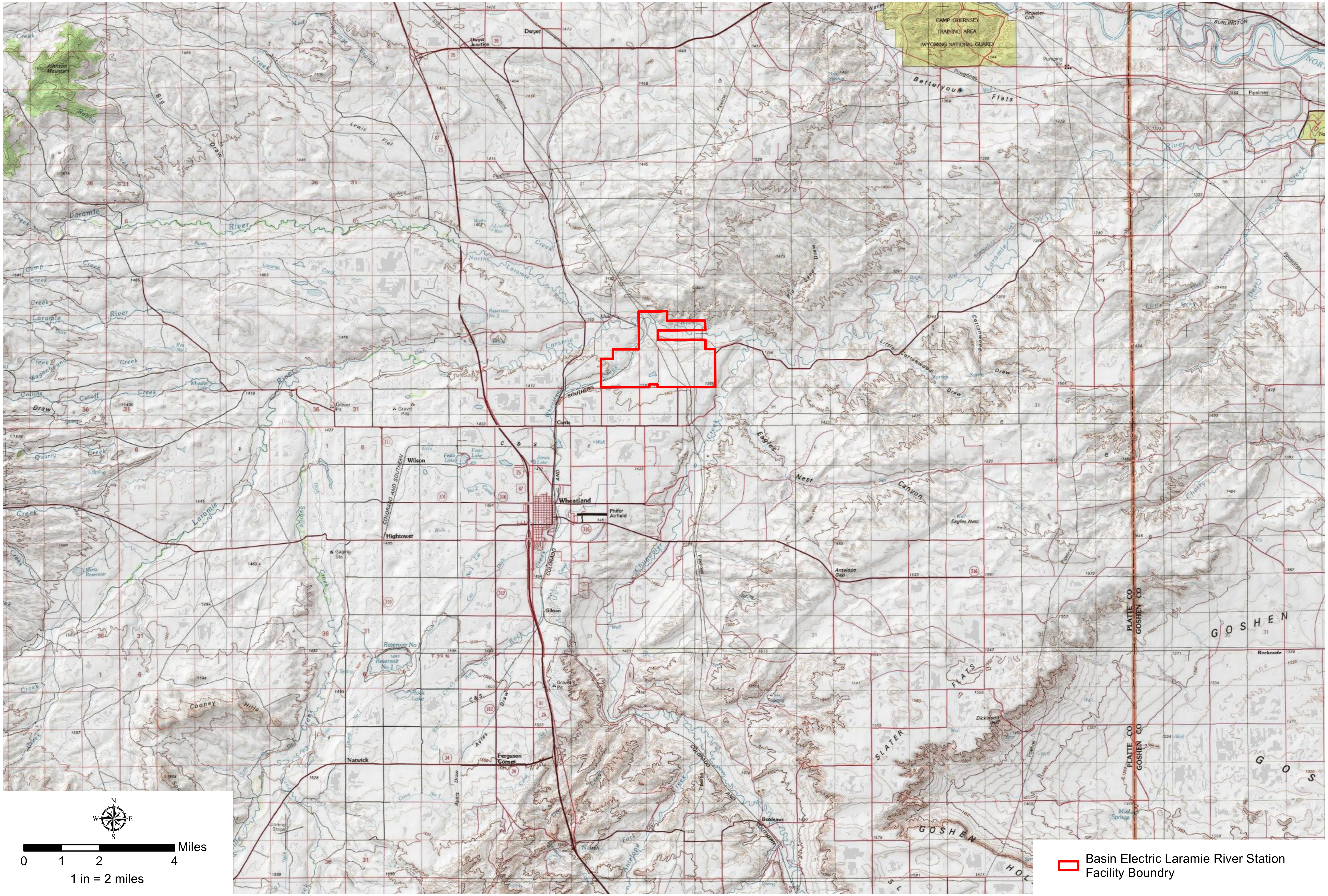
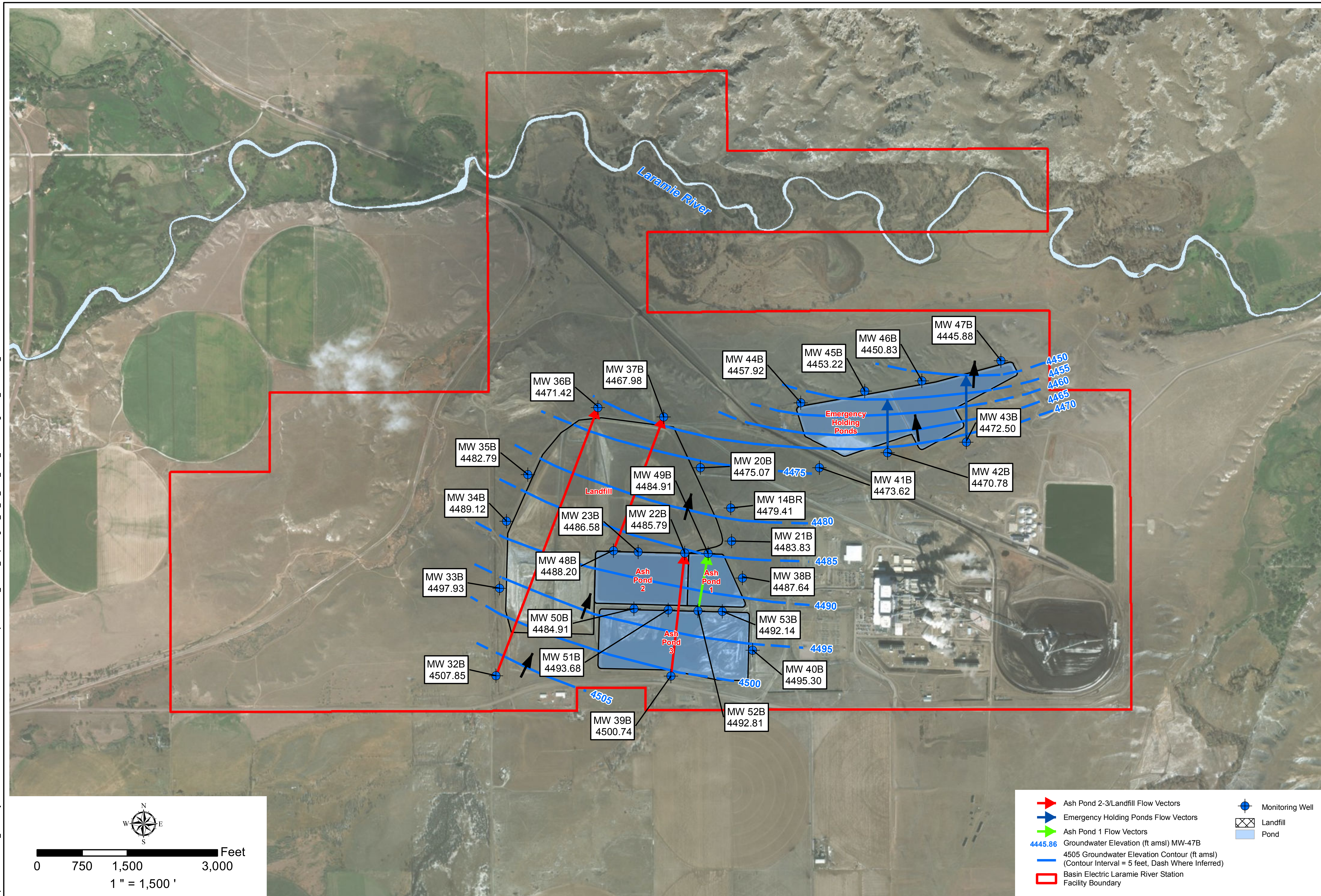


Figure: 1-1

Site Location Map

Basin Electric
Laramie River Station
Platte County, Wyoming
Project No.: 60506860 Date: 09/28/2016



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Potentiometric Surface Map
October 3, 2017

Basin Electric
Laramie River Station
Platte County, Wyoming
Project No.: 60506860 Date: 1/08/2018

Figure: 1-2

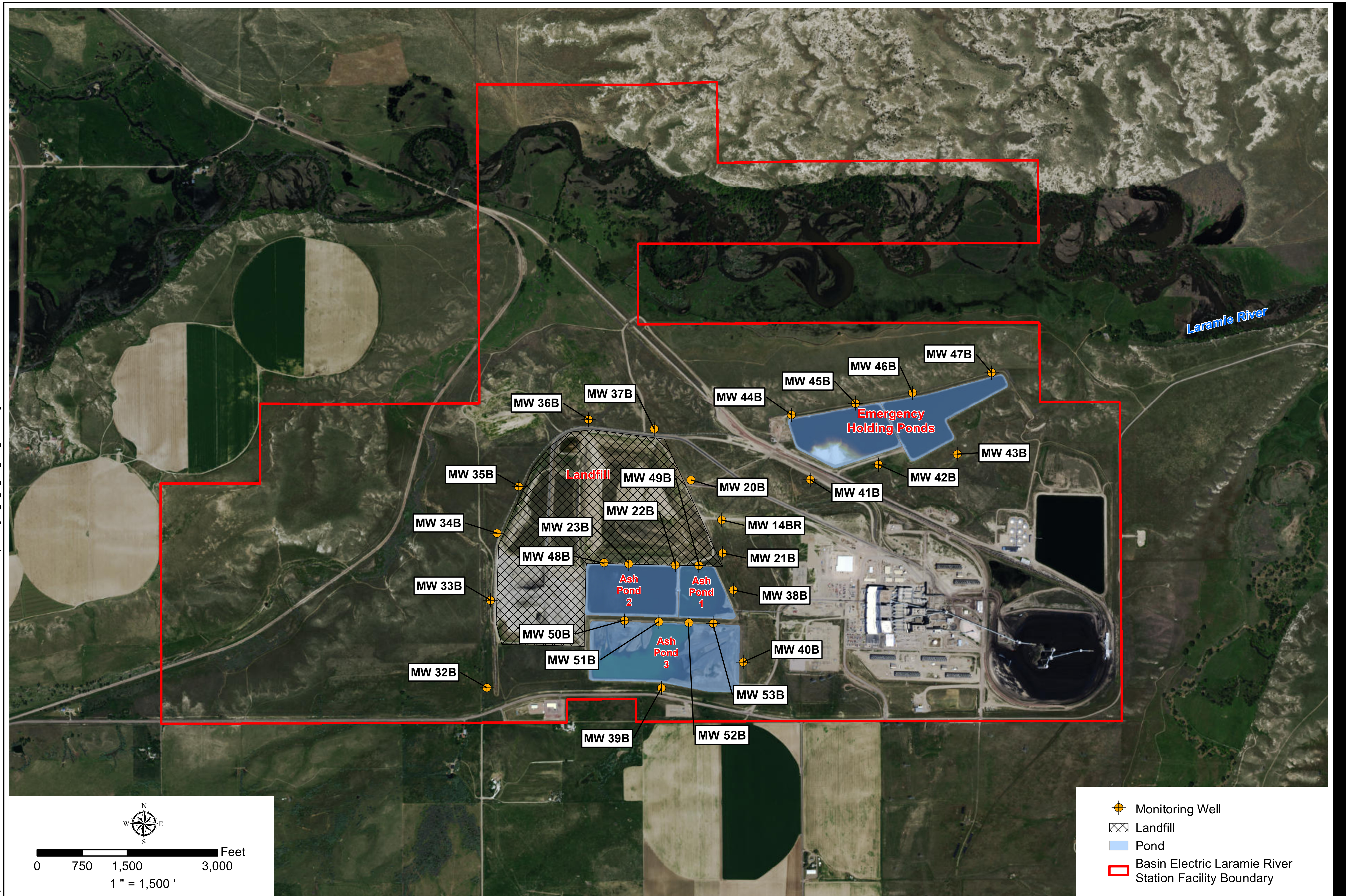

Figure: 3-1

AECOM

LRS CCR Monitoring Well Network

Basin Electric
Laramie River Station
Platte County, Wyoming
Project No.: 60506860 Date: 9/13/2017

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Tables

Table 6-1 Statistical Analysis Methods and Background Upper Prediction Limits - Ash Pond 1

Parameter (units)	Number of Samples	Percent Nondetects	Normal or Lognormal Distribution?	Statistical Test	Background Limit Value
Boron (mg/L)	16	50	No/No	Nonparametric	0.17
Calcium (mg/L)	16	0	No/No	Nonparametric	160
Chloride (mg/L)	16	0	No/No	Nonparametric	43
Fluoride (mg/L)	16	44	No/No	Nonparametric	1.1
pH (std units)	16	0	No/No	Nonparametric	8.98
Sulfate (mg/L)	16	0	No/No	Nonparametric	430
TDS (mg/L)	16	0	No/No	Nonparametric	1,000

Table 6-2 Statistical Analysis Methods and Background Upper Prediction Limits - Ash Pond 2, Ash Pond 3, Ash Landfill

Parameter (units)	Number of Samples	Percent Nondetects	Normal or Lognormal Distribution?	Statistical Test	Background Limit Value
Boron (mg/L)	16	0	Yes/No	Parametric	0.32
Calcium (mg/L)	16	0	Yes/Yes	Parametric	209
Chloride (mg/L)	16	0	No/No	Nonparametric	86
Fluoride (mg/L)	16	0	Yes/Yes	Parametric	0.73
pH (std units)	16	0	No/No	Nonparametric	7.78
Sulfate (mg/L)	16	0	No/No	Nonparametric	840
TDS (mg/L)	16	0	No/No	Nonparametric	1,800

Table 6-3 Statistical Analysis Methods and Background Upper Prediction Limits - Emergency Holding Ponds

Parameter (units)	Number of Samples	Percent Nondetects	Normal or Lognormal Distribution?	Statistical Test	Background Limit Value
Boron (mg/L)	24	0	No/No	Nonparametric	1
Calcium (mg/L)	24	0	Yes/No	Parametric	487
Chloride (mg/L)	24	0	Yes/No	Parametric	346
Fluoride (mg/L)	24	88	Yes/No	Parametric	0.69
pH (std units)	23	0	No/No	Nonparametric	7.81
Sulfate (mg/L)	24	8	No/No	Nonparametric	2,200
TDS (mg/L)	24	0	No/No	Nonparametric	4,000

Attachment A

Sampling and Analysis Report, 2016-2017

AECOM Imagine it. Delivered.

Sampling and Analysis Report, 2016-2017 CCR Monitoring Program

Laramie River Station
Wheatland, Wyoming

Basin Electric Power Cooperative

January 31, 2018

Prepared for:

Basin Electric Power Cooperative
Bismarck, North Dakota

Prepared by:

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Project number: 60506860

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List of Acronyms

CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPA	United States Environmental Protection Agency
LRS	Laramie River Station
QA/QC	quality assurance/quality control

1. Introduction

On behalf of Basin Electric Power Cooperative (Basin), AECOM Technical Services, Inc. (AECOM) prepared this Coal Combustion Residuals (CCR) Groundwater Sampling and Analysis Report for the Basin Laramie River Station (LRS). The objective of the report is to provide a description of the field and office activities performed in 2016 and 2017 in support of the LRS CCR groundwater monitoring program.

This Sampling and Analysis Report was prepared to present the results of sampling and analysis of groundwater conducted for the monitoring requirements of the United States Environmental Protection Agency (EPA) CCR rule (Chapter 40 of the Code of Federal Regulations (CFR), Parts 257.90 to 257.98). Specifically, the data collected for the baseline monitoring events conducted prior to October 17, 2017.

2. Groundwater Flow

As required by 40 CFR 257.93(c), groundwater elevations were measured in each well prior to purging each time groundwater was sampled. The measurements, presented in **Table 1**, were used to create potentiometric surface maps for the uppermost aquifer for the baseline monitoring events. The resulting potentiometric surface maps (contained in the operating record) were used to evaluate the direction of groundwater flow and hydraulic gradient for each subject CCR unit/multi-unit. **Appendix I** contains a potentiometric surface map constructed using measurements taken on October 3, 2017, and shows inferred groundwater flow directions for each CCR unit/multi-unit. This potentiometric map is generally consistent with the groundwater flow patterns observed during the other CCR monitoring events performed at LRS in 2016-2017. Groundwater flow velocities were calculated for each unit/multi-unit, as presented in **Appendix II** and summarized in **Table 2**.

Based on the groundwater flow conditions documented in this chapter, the relative function of the monitoring wells employed in the LRS CCR groundwater monitoring system is as follows:

CCR unit/multi-unit	Background wells	Downgradient wells
Ash Pond 1	MW-52B, MW-53B	MW-49B, MW-21B, MW-38B
Ash Pond 2, Ash Pond 3, Ash Landfill	MW-39B, MW-32B	MW-36B, MW-37B, MW-20B, MW-14BR, MW-40B, MW-52B, MW-53B
Emergency Holding Ponds	MW-41B, MW-42B, MW-43B	MW-44B, MW-45B, MW-46B, MW-47B

The following eight monitoring wells are also included in the LRS CCR monitoring system for the purpose of measuring groundwater elevations and evaluating groundwater flow direction and velocity in the vicinity of the ash ponds and landfill: MW-22B, MW-23B, MW-33B, MW-34B, MW-35B, MW-48B, MW-50B, and MW-51B.

3. Groundwater Quality

The analytical testing laboratory provided reports presenting the results of laboratory analysis for each monitoring event. These laboratory reports are included in the operating record, and were reviewed for completeness against the project-required methods and the chain-of-custody forms. Laboratory reports were also reviewed for holding times, and that the data was appropriately flagged based on the quality assurance/quality control (QA/QC) data provided. Data validation reports were prepared for each monitoring event and are included in the operating record. The validated results were compiled into summary form for each CCR unit/multi-unit as presented in **Tables 3, 4** and **5**. **Table 6** contains the results of QA/QC field blank samples collected during the monitoring events.

Tables

Table 1 Groundwater Level Measurements and Elevations

Location ID	Water Level Elevation (feet amsl)	Date	Depth To Water (feet)	Water Level Elevation (feet amsl)	Date	Depth To Water (feet)	Water Level Elevation (feet amsl)
MW-14BR	4537.90		NM	NM	11/10/2016	58.86	4479.04
MW-20B	4535.47		NM	NM	11/10/2016	60.58	4474.89
MW-21B	4539.58		NM	NM	11/10/2016	56.18	4483.40
MW-22B	4569.21		NM	NM		NM	NM
MW-23B	4569.48		NM	NM		NM	NM
MW-32B	4567.11	8/31/2016	60.57	4506.54	11/10/2016	60.26	4506.85
MW-33B	4566.61	8/31/2016	70.17	4496.44	11/10/2016	70.05	4496.56
MW-34B	4554.72	8/31/2016	66.60	4488.12	11/10/2016	66.89	4487.83
MW-35B	4548.67	8/31/2016	66.48	4482.19	11/10/2016	66.76	4481.91
MW-36B	4532.44	8/31/2016	61.22	4471.22	11/10/2016	61.28	4471.16
MW-37B	4530.37	8/31/2016	62.35	4468.02	11/10/2016	62.54	4467.83
MW-38B	4547.48	8/31/2016	60.23	4487.25	11/10/2016	60.35	4487.13
MW-39B	4581.45	8/31/2016	81.86	4499.59	11/10/2016	81.77	4499.68
MW-40B	4589.59	8/31/2016	95.06	4494.53	11/10/2016	95.06	4494.53
MW-41B	4529.64	8/31/2016	56.79	4472.85	11/10/2016	56.95	4472.69
MW-42B	4515.83	8/31/2016	46.18	4469.65	11/10/2016	46.78	4469.05
MW-43B	4501.44	8/31/2016	26.23	4475.21	11/10/2016	32.31	4469.13
MW-44B	4529.39	8/31/2016	70.76	4458.63	11/10/2016	71.28	4458.11
MW-45B	4530.92	8/31/2016	76.82	4454.10	11/10/2016	77.54	4453.38
MW-46B	4527.72	8/31/2016	76.11	4451.61	11/10/2016	76.79	4450.93
MW-47B	4522.60	8/31/2016	75.94	4446.66	11/10/2016	76.58	4446.02
MW-48B	4568.66		NM	NM		NM	NM
MW-49B	4564.36		NM	NM		NM	NM
MW-50B	4588.34		NM	NM		NM	NM
MW-51B	4588.90		NM	NM		NM	NM
MW-52B	4589.60		NM	NM		NM	NM
MW-53B	4589.23		NM	NM		NM	NM

Notes:
TOC = top of casing
amsl = above mean sea level
NM = Not Measured; MW-40B lock was jammed at the time of gauging

Table 1 Groundwater Level

Location ID	Water Level Elevation (feet amsl)	Date	Depth To Water (feet)	Water Level Elevation (feet amsl)	Date	Depth To Water (feet)	Water Level Elevation (feet amsl)
MW-14BR	4537.90	12/14/2016	58.74	4479.16	2/13/2017	58.82	4479.08
MW-20B	4535.47	12/14/2016	60.50	4474.97	2/13/2017	60.54	4474.93
MW-21B	4539.58	12/14/2016	56.09	4483.49	2/13/2017	56.15	4483.43
MW-22B	4569.21		NM	NM		NM	NM
MW-23B	4569.48		NM	NM		NM	NM
MW-32B	4567.11	12/14/2016	59.82	4507.29	2/13/2017	59.73	4507.38
MW-33B	4566.61	12/14/2016	69.54	4497.07	2/13/2017	69.77	4496.84
MW-34B	4554.72	12/14/2016	66.52	4488.20	2/13/2017	66.68	4488.04
MW-35B	4548.67	12/14/2016	66.42	4482.25	2/13/2017	66.57	4482.10
MW-36B	4532.44	12/14/2016	61.01	4471.43	2/13/2017	61.08	4471.36
MW-37B	4530.37	12/14/2016	62.35	4468.02	2/13/2017	62.42	4467.95
MW-38B	4547.48	12/14/2016	59.97	4487.51	2/13/2017	60.23	4487.25
MW-39B	4581.45	12/14/2016	81.60	4499.85	2/13/2017	81.40	4500.05
MW-40B	4589.59	12/14/2016	94.96	4494.63	2/13/2017	94.95	4494.64
MW-41B	4529.64	12/14/2016	56.87	4472.77	2/13/2017	57.18	4472.46
MW-42B	4515.83	12/14/2016	47.18	4468.65	2/13/2017	47.05	4468.78
MW-43B	4501.44	12/14/2016	32.90	4468.54	2/13/2017	33.75	4467.69
MW-44B	4529.39	12/14/2016	71.28	4458.11	2/13/2017	71.25	4458.14
MW-45B	4530.92	12/14/2016	77.70	4453.22	2/13/2017	77.77	4453.15
MW-46B	4527.72	12/14/2016	77.07	4450.65	2/13/2017	77.23	4450.49
MW-47B	4522.60	12/14/2016	76.81	4445.79	2/13/2017	76.90	4445.70
MW-48B	4568.66		NM	NM		NM	NM
MW-49B	4564.36		NM	NM		NM	NM
MW-50B	4588.34		NM	NM		NM	NM
MW-51B	4588.90		NM	NM		NM	NM
MW-52B	4589.60		NM	NM		NM	NM
MW-53B	4589.23		NM	NM		NM	NM

Notes:
TOC = top of casing
amsl = above mean sea level
NM = Not Measured; MW-40B lock was jam

Table 1 Groundwater Level

Location ID	Water Level Elevation (feet amsl)	Date	Depth To Water (feet)	Water Level Elevation (feet amsl)	Date	Depth To Water (feet)	Water Level Elevation (feet amsl)
MW-14BR	4537.90	4/3/2017	58.75	4479.15	5/16/2017	58.50	4479.40
MW-20B	4535.47	4/3/2017	60.39	4475.08	5/16/2017	60.25	4475.22
MW-21B	4539.58	4/3/2017	56.07	4483.51	5/16/2017	55.79	4483.79
MW-22B	4569.21		NM	NM		NM	NM
MW-23B	4569.48		NM	NM		NM	NM
MW-32B	4567.11	4/3/2017	59.41	4507.70	5/16/2017	59.96	4507.15
MW-33B	4566.61	4/3/2017	69.47	4497.14	5/16/2017	68.79	4497.82
MW-34B	4554.72	4/3/2017	66.69	4488.03	5/16/2017	66.05	4488.67
MW-35B	4548.67	4/3/2017	66.58	4482.09	5/16/2017	65.91	4482.76
MW-36B	4532.44	4/3/2017	61.08	4471.36	5/16/2017	60.81	4471.63
MW-37B	4530.37	4/3/2017	62.39	4467.98	5/16/2017	62.17	4468.20
MW-38B	4547.48	4/3/2017	60.07	4487.41	5/16/2017	59.86	4487.62
MW-39B	4581.45	4/3/2017	81.10	4500.35	5/16/2017	80.62	4500.83
MW-40B	4589.59	4/3/2017	94.62	4494.97	5/16/2017	94.24	4495.35
MW-41B	4529.64	4/3/2017	57.18	4472.46	5/16/2017	56.69	4472.95
MW-42B	4515.83	4/3/2017	46.51	4469.32	5/17/2017	45.65	4470.18
MW-43B	4501.44	4/3/2017	24.28	4477.16	5/17/2017	27.86	4473.58
MW-44B	4529.39	4/3/2017	71.16	4458.23	5/17/2017	70.78	4458.61
MW-45B	4530.92	4/3/2017	77.40	4453.52	5/17/2017	76.85	4454.07
MW-46B	4527.72	4/3/2017	77.08	4450.64	5/17/2017	76.45	4451.27
MW-47B	4522.60	4/3/2017	76.74	4445.86	5/17/2017	76.2	4446.40
MW-48B	4568.66		NM	NM		NM	NM
MW-49B	4564.36		NM	NM		NM	NM
MW-50B	4588.34		NM	NM		NM	NM
MW-51B	4588.90		NM	NM		NM	NM
MW-52B	4589.60		NM	NM		NM	NM
MW-53B	4589.23		NM	NM		NM	NM

Notes:
TOC = top of casing
amsl = above mean sea level
NM = Not Measured; MW-40B lock was jar

Table 1 Groundwater Level

Location ID	Water Level Elevation (feet amsl)	Date	Depth To Water (feet)	Water Level Elevation (feet amsl)	Date	Depth To Water (feet)	Water Level Elevation (feet amsl)
MW-14BR	4537.90	6/14/2017	58.46	4479.44	7/26/2017	58.61	4479.29
MW-20B	4535.47	6/14/2017	60.27	4475.20	7/26/2017	60.40	4475.07
MW-21B	4539.58	6/14/2017	55.75	4483.83	7/26/2017	55.93	4483.65
MW-22B	4569.21		NM	NM	7/20/2017	83.27	4485.94
MW-23B	4569.48		NM	NM	7/20/2017	82.36	4486.75
MW-32B	4567.11	6/13/2017	58.77	4508.34	7/26/2017	59.31	4507.80
MW-33B	4566.61	6/13/2017	68.66	4497.95	7/26/2017	68.87	4497.74
MW-34B	4554.72	6/13/2017	65.77	4488.95	7/26/2017	65.61	4489.11
MW-35B	4548.67	6/13/2017	65.62	4483.05	7/26/2017	65.67	4483.00
MW-36B	4532.44	6/14/2017	60.68	4471.76	7/26/2017	60.79	4471.65
MW-37B	4530.37	6/14/2017	62.02	4468.35	7/26/2017	62.11	4468.26
MW-38B	4547.48	6/14/2017	59.90	4487.58	7/26/2017	60.03	4487.45
MW-39B	4581.45	6/13/2017	80.52	4500.93	7/26/2017	80.83	4500.62
MW-40B	4589.59	6/14/2017	94.26	4495.33	7/26/2017	94.41	4495.18
MW-41B	4529.64	6/13/2017	56.40	4473.24	7/26/2017	56.35	4473.29
MW-42B	4515.83	6/13/2017	45.27	4470.56	7/27/2017	45.25	4470.58
MW-43B	4501.44	6/13/2017	29.00	4472.44	7/26/2017	25.73	4475.71
MW-44B	4529.39	6/13/2017	70.67	4458.72	7/27/2017	71.00	4458.39
MW-45B	4530.92	6/13/2017	76.72	4454.20	7/27/2017	77.15	4453.77
MW-46B	4527.72	6/13/2017	76.36	4451.36	7/27/2017	76.41	4451.31
MW-47B	4522.60	6/12/2017	75.96	4446.64	7/27/2017	76.38	4446.22
MW-48B	4568.66		NM	NM	7/20/2017	80.28	4488.38
MW-49B	4564.36		NM	NM	7/20/2017	79.12	4485.24
MW-50B	4588.34		NM	NM	7/19/2017	93.34	4495.00
MW-51B	4588.90		NM	NM	7/19/2017	94.90	4494.00
MW-52B	4589.60		NM	NM	7/19/2017	96.53	4493.07
MW-53B	4589.23		NM	NM	7/19/2017	96.77	4492.46

Notes:
TOC = top of casing
amsl = above mean sea level
NM = Not Measured; MW-40B lock was jam

Table 1 Groundwater Level

Location ID	Water Level Elevation (feet amsl)	Date	Depth To Water (feet)	Water Level Elevation (feet amsl)
MW-14BR	4537.90	9/19/2017	58.43	4479.47
MW-20B	4535.47	9/19/2017	60.33	4475.14
MW-21B	4539.58	9/19/2017	55.65	4483.93
MW-22B	4569.21	9/19/2017	83.17	4486.04
MW-23B	4569.48	9/19/2017	82.20	4487.28
MW-32B	4567.11	9/19/2017	59.09	4508.02
MW-33B	4566.61	9/19/2017	68.39	4498.22
MW-34B	4554.72	9/19/2017	65.56	4489.16
MW-35B	4548.67	9/19/2017	65.83	4482.84
MW-36B	4532.44	9/19/2017	60.98	4471.46
MW-37B	4530.37	9/19/2017	62.42	4467.95
MW-38B	4547.48	9/19/2017	59.62	4487.86
MW-39B	4581.45	9/19/2017	80.31	4501.14
MW-40B	4589.59		NM	NM
MW-41B	4529.64	9/19/2017	56.10	4473.54
MW-42B	4515.83	9/19/2017	44.89	4470.94
MW-43B	4501.44	9/19/2017	27.36	4474.08
MW-44B	4529.39	9/19/2017	71.48	4457.91
MW-45B	4530.92	9/19/2017	77.50	4453.42
MW-46B	4527.72	9/19/2017	76.72	4451.00
MW-47B	4522.60	9/19/2017	76.59	4446.01
MW-48B	4568.66	9/19/2017	80.04	4488.62
MW-49B	4564.36	9/19/2017	79.29	4485.07
MW-50B	4588.34	9/19/2017	93.13	4495.21
MW-51B	4588.90	9/18/2017	94.87	4494.03
MW-52B	4589.60	9/18/2017	96.46	4493.14
MW-53B	4589.23	9/18/2017	96.82	4492.41

Notes:
TOC = top of casing
amsl = above mean sea level
NM = Not Measured; MW-40B lock was jam

Table 2 Groundwater Velocities

CCR Unit/Multi-Unit	Calculated Seepage Velocities (ft/day)		
	Minimum	Maximum	Average
Ash Pond 1	0.022	0.433	0.227
Ash Pond 2, Ash Pond 3, Ash Landfill	0.011	2.678	1.344
Emergency Holding Ponds	0.031	3.672	1.851

Table 3 2016-2017 Groundwater Analytical Data - Ash Pond 1

				Appendix III Constituents							Appendix IV Constituents														
		Analyte Name		Boron	Calcium	Chloride	Fluoride	pH	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Fluoride	Lead	Lithium	Mercury	Molybdenum	Radium 226/228	Selenium	Thallium
		Unit		mg/L	mg/L	mg/L	mg/L	SU	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	mg/L
		Upper Limit		0.17	160	43	1.1	8.98	430	1000															
Relative Location	MW ID	Date	Type																						
Background	MW-32B	9/1/2016	N	0.27	200	83	0.54	7.21	820	1700	0.0020 U	0.0050 U	0.077	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.54	0.0010 U	0.074	0.00020 U	0.018	1.20	0.0050 U	0.0010 U
		11/11/2016	N	0.28	210	83	0.60	6.37	820	1700	0.0020 U	0.0050 U	0.057	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.60	0.0010 U	0.080	0.00020 U	0.0076	0.716	0.0050 U	0.0010 U
		12/15/2016	N	0.27	190	84	0.59	6.67	830	1700	0.0020 U	0.0050 U	0.053	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.59	0.0010 U	0.073	0.00020 U	0.0064	0.471	0.0050 U	0.0010 U
		2/13/2017	N	0.28	200	84	0.63	7.19	830	1700	0.0020 U	0.0050 U	0.047	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.63	0.0010 U	0.075	0.00020 U	0.0061	0.713	0.0050 U	0.0010 U
		4/4/2017	N	0.31	190	83	0.59	7.23	830	1700	0.020 U	0.050 U	0.038	0.010 U	0.010 U	0.020 U	0.010 U	0.59	0.0100 U	0.081	0.00020 U	0.020 U	0.375	0.050 U	0.010 U
		5/16/2017	N	0.29	180	84	0.60	7.29	830	1700	0.0020 U	0.0050 U	0.040 J	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.60	0.0010 U	0.069	0.00020 U	0.0085	0.752	0.0050 U	0.0010 U
		6/13/2017	N	0.28	190	84	0.64	7.28	840	1800	0.0020 U	0.0050 U	0.041	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.64	0.0010 U	0.081	0.00020 U	0.0079	0.793	0.0050 U	0.0010 U
		7/26/2017	N	0.26	190	86	0.53	7.37	790	1700	0.0020 U	0.0050 U	0.044	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.53	0.0010 U	0.072	0.00020 U	0.0095	0.915 U	0.0050 U	0.0010 U
	MW-39B	9/2/2016	N	0.17	170	43	0.79	7.31	450	400 J	0.0020 U	0.0057	0.11	0.0010 U	0.0010 U	0.0020 U	0.0028	0.79	0.0010 U	0.073	0.00020 U	0.069	0.823	0.0050 U	0.0010 U
		11/10/2016	N	0.19	190	45	0.65	7.11	530	970	0.0020 U	0.0050 U	0.073	0.0010 U	0.0010 U	0.0020 U	0.0015	0.65	0.0010 U	0.069	0.00020 U	0.039	0.926	0.0050 U	0.0010 U
		12/14/2016	N	0.18	180	46	0.63	7.78	540	1300	0.0020 U	0.0050 U	0.064	0.0010 U	0.0010 U	0.0020 U	0.0012	0.63	0.0010 U	0.066	0.00020 U	0.028	0.797	0.0050 U	0.0010 U
		2/13/2017	N	0.19	200	46	0.66	7.02	540	1200	0.0020 U	0.0050 U	0.069	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.66	0.0010 U	0.068	0.00020 U	0.020	0.609	0.0050 U	0.0010 U
		4/4/2017	N	0.20	180	46	0.61	7.13	550	1300	0.020 U	0.050 U	0.048	0.010 U	0.010 U	0.020 U	0.010 U	0.61	0.0100 U	0.069	0.00020 U	0.020 U	0.556	0.050 U	0.010 U
		5/16/2017	N	0.21	170	46	0.66	7.17	540	1300	0.0020 U	0.0050 U	0.051 J	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.66	0.0010 U	0.062	0.00020 U	0.017	0.373 U	0.0050 U	0.0010 U
		6/13/2017	N	0.18	170	46	0.66	7.18	550	1300	0.0020 U	0.0050 U	0.046	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.66	0.0010 U	0.064	0.00020 U	0.016	0.671	0.0050 U	0.0010 U
		7/26/2017	N	0.18	180	47	0.64	7.33	540	1300	0.0020 U	0.0050 U	0.050	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.64	0.0010 U	0.063	0.00020 U	0.017	0.426 U	0.0050 U	0.0010 U
	MW-52B	7/19/2017	N	0.15	120	33	0.50	7.91	370	820	0.0020 U	0.0050 U	0.13	0.0010 U	0.0010 U	0.0058	0.0014	0.50	0.0010 U	0.048	0.00020 U	0.013	0.347 U	0.0050 U	0.0010 U
		8/25/2017	N	0.16	120	41	0.50 U	7.54	410	920	0.0020 U	0.0050 U	0.12	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.0010 U	0.039	0.00020 U	0.0094	0.903	0.0050 U	0.0010 U
		8/31/2017	N	0.16	160	41	0.50 U	7.61	420	930	0.0020 U	0.0050 U	0.24	0.0010 U	0.0010 U	0.0110	0.0040	0.50 U	0.0041	0.063	0.00020 U	0.0088	1.25 U	0.0050 U	0.0010 U
		9/6/2017	N	0.17	140	41 J	0.50 U	7.61	430	980	0.0020 U	0.0050 U	0.11	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.0010 U	0.045	0.00020 U	0.0083	1.2 U	0.0050 U	0.0010 U
		9/14/2017	N	0.16	130	43	0.50 U	7.46	430	940	0.0020 U	0.0050 U	0.12	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.0010 U	0.049	0.00020 U	0.0071	0.482	0.0050 U	0.0010 U
		9/18/2017	N	0.15	130	41	0.50 U	7.45	420	1000	0.0020 U	0.0050 U	0.11	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.0010 U	0.049	0.00020 U	0.0066	0.566	0.0050 U	0.0010 U
		9/27/2017	N	0.15	140	40	0.50 U	7.55	430	960	0.0020 U	0.0050 U	0.11	0.0010 U	0.0010 U	0.0020 U	0.0010	0.50 U	0.0010 U	0.050	0.00020 U	0.0063	0.37 U	0.0050 U	0.0010 U
		10/3/2017	N	0.15	130	42	0.50 U	7.74	430	1000	0.0020 U	0.0050 UJ	0.10	0.0010 U	0.0010 U	0.0020 U	0.0010 UJ	0.50 U	0.0010 U	0.048	0.00020 U	0.0056	0.576 UJ	0.0050 U	0.0010 U
	MW-53B	7/19/2017	N	0.10 U	95	32	0.96	8.63	220	570	0.0020 U	0.0050 U	0.10	0.0010 U	0.0010 U	0.0045	0.0010 U	0.96	0.0010 U	0.042	0.00020 U	0.014	0.682 U	0.0060	0.0010 U
		8/25/2017	N	0.10 U	81	34	0.91	8.48	210	560	0.0020 U	0.0050 U	0.12	0.0010 U	0.0010 U	0.0038	0.0010 U	0.91	0.0010 U	0.033	0.00020 U	0.014	1.09	0.0050 U	0.0010 U
		8/31/2017	N	0.10 U	82	33	0.88	8.72	220	540	0.0020 U	0.0050 U	0.13	0.0010 U	0.0010 U	0.0045	0.0010 U	0.88	0.0010 U	0.042	0.00020 U	0.015	0.426 U	0.0050 U	0.0010 U
		9/6/2017	N	0.10 U	79	33 J	1.0	8.98	210	560	0.0020 U	0.0050 U	0.13	0.0010 U	0.0010 U	0.0052	0.0010 U	1.00	0.0010 U	0.035	0.00020 U	0.015	0.407 U	0.0050 U	0.0010 U
		9/14/2017	N	0.10 U	77	33	0.93	7.79	220	590	0.0020 U	0.0050 U	0.094	0.0010 U	0.0010 U	0.0028	0.0010 U	0.93	0.0010 U	0.038	0.00020 U	0.012	0.424 U	0.0050 U	0.0010 U
		9/18/2017	N	0.10 U	76	33	1.00	7.52	210	580	0.0020 U	0.0050 U	0.094	0.0010 U	0.0010 U	0.0033	0.0010 U	1.00	0.0010 U	0.041	0.00020 U	0.012	0.432 U	0.0050 U	0.0010 U
		9/27/2017	N	0.10 U	78	32	1.10	7.96	220	620	0.0020 U	0.0050 U	0.070	0.0010 U	0.0010 U	0.0020 U	0.0010 U	1.10	0.0010 U	0.042	0.00020 U	0.010	0.375 U	0.0050 U	0.0010 U
		10/3/2017	N	0.10 U	78	33	1.1	7.79	220	610	0.0020 U	0.0050 UJ	0.081	0.0010 U	0.0010 U	0.0022	0.0010 UJ	1.10	0.0010 U	0.040	0.00020 U	0.011	1.88 UJ	0.0050 U	0.0010 U
Downgradient	MW-21B	11/11/2016	N	0.16	290	250	0.76	6.63	680	1600 J	0.0020 U	0.0050 U	0.061	0.0010 U	0.0010 U	0.021	0.0010 U	0.76	0.0021	0.046	0.00020 U	0.016	0.513	0.035	0.0010 U
		12/15/2016	N	0.16	270	250	0.75	7.65	680	1600	0.0020 U	0.0050 U	0.068	0.0010 U	0.0010 U	0.021	0.0010 U	0.75	0.0015	0.044	0.00020 U	0.015	0.694	0.034	0.0010 U
		2/14/2017	N	0.16	290	250	0.77	7.66	660	1500	0.0020 U	0.0050 U	0.059	0.0010 U	0.0010 U	0.023	0.0010 U	0.77	0.0010 U	0.046	0.00020 U	0.016	0.385 U	0.036	0.0010 U
		4/4/2017	N	0.16	280	280	0.71	7.49	740	1700 J	0.020 U	0.050 U	0.053	0.010 U	0.010 U	0.031	0.010 U	0.71	0.0100 U	0.049	0.00020 U	0.020 U	0.310 U	0.050 U	0.010 U
		4/25/2017	N	0.16	290	290	0.73	7.53	770	1800	0.0020	0.0050	0.049	0.0050	0.0010	0.037	0.0010	0.73	0.0010	0.041	0.00020	0.017	0.328	0.049	0.0010
		5/16/2017	N	0.18	280	290	0.72	7.53	760	1800	0.0020 U	0.0050 U	0.049 J	0.0010 U	0.0010 U	0.041	0.0010 U	0.72	0.0010 U	0.043	0.00020 U	0.016	0.384 U	0.052	0.0010 U
		6/14/2017	N	0.16	290	300	0.73	7.46	760	1900	0.0020 U	0.0050 U	0.045	0.0010 U	0.0010 U	0.039	0.0010 U	0.73	0.0010 U	0.050	0.00020 U	0.016	0.606	0.047	0.0010 U
		7/26/2017	N	0.15	260	270	0.70	7.74	670	1600	0.0020 U	0.0050 U	0.057	0.0010 U	0.0010 U	0.038	0.0010 U	0.70	0.0010 U	0.040	0.00020 U	0.012	0.394 U	0.044	0.0010 U
	MW-38B	9/1/2016	N	3.0	510	400	1.0 U	7.30	4600	7800	0.0020 U	0.0050 U	0.050	0.0010 U	0.0010 U	0.0042	0.0029	1.00 U	0.0010 U	0.130	0.00020 U	0.21	0.604	0.012	0.0010 U
		11/10/2016	N	3.0	500	500	1.0 U	7.11	4800	4800	0.010 U	0.0050 U	0.038	0.0050 U	0.0050 U	0.0087	0.0014	1.00 U	0.0010 U	0.130	0.00020 U	0.18	0.412 U	0.025 U	0.0010 U
		12/15/2016	N	3.0	470	490	1.0 U	7.35	5000	7800	0.0020 U	0.0050 U	0.034	0.0010 U	0.0010 U	0.0100	0.0014	1.00 U	0.0010 U	0.130	0.00020 U	0.19	0.514	0.012	0.0010 U
		2/14/2017	N	2.8	460	470	1.0 U	7.38	4800	7700	0.0020 U	0.0050 U	0.060	0.0010 U	0.0010 U	0.013	0.0015	1.00 U	0.0010 U	0.130	0.00020 U	0.19	0.308 U	0.012	0.0010 U
		4/4/2017	N	2.9	440	420	1.0 U	7.28	4700	7800	0.020 U	0.050 U	0.026	0.010 U	0.010 U	0.020 U	0.010 U	1.00 U	0.0100 U	0.150	0.00020 U	0.17	0.317 U	0.050 U	0.010 U
		5/16/2017	FD	3.0	460	410	0.50 U	7.31	4800	7700	0.0020 U	0.0050 U	0.023 J	0.0010 U	0.0010 U	0.0091	0.0010 U	0.50 U	0.0010 U	0.140	0.00020 U	0.20	0.400 U	0.013	0.0010 U
		5/16/2017	N	2.8	420	410	0.60	7.31	4700	8000	0.0020 U	0.0050 U	0.025 J	0.0010 U	0.0010 U	0.0100	0.0010 U	0.60	0.0010 U	0.130	0.00020 U	0.21	0.357 U	0.013	0.0010 U
		6/14/2017	N	2.8	480	400	1.0 U	7.23	5000	8000	0.0020 U	0.0050 U	0.023	0.0010 U	0.0010 U	0.0088	0.0010 U	1.00 U	0.0010 U	0.140	0.00020 U	0.20	0.534	0.012	0.0010 U
		7/26/2017	FD	3.0	470	390	0.50 U	7.47	4600	7800	0.0020 U	0.0050 U	0.031	0.0010 U	0.0010 U	0.0099	0.0010	0.50 U	0.0010 U	0.140	0.00020 U	0.19	0.336 U	0.012	0.0010 U
		7/26/2017	N	3.0	470	390	0.50 U	7.47	4900	8000	0.0020 U	0.0050 U	0.034	0.0013	0.0011	0.0110	0.0021	0.50 U	0.0018	0.130	0.00020 U	0.19	0.671 U	0.013	0.0010
	MW-49B	7/27/2017	N	0.10 U	94	19	0.50 U	11.40	180	490	0.0020 U	0.0050 U	0.092	0.0010 U	0.0010 U	0.023	0.0010 U	0.50 U	0.0010 U	0.029	0.00020 U	0.0093	0.487 U	0.0050 U	0.0010 U
		8/25/2017	N	0.10 U	110	32	0.50 U	10.14	380	620	0.0020 U	0.0050 U	0.14	0.0010 U	0.0010 U	0.012	0.0010 U	0.50 U	0.0010 U	0.031	0.00020 U	0.0053	1.07	0.0050 U	0.0010 U
		8/31/2017	N	0.10 U	98	33	0.50 U	9.57	390	650	0.0020 U	0.0050 U	0.12	0.0010 U	0.0010 U	0.0087	0.0010 U	0.50 U	0.0010 U	0.038	0.00020 U	0.0055	0.616 U	0.0050 U	0.0010 U
		9/6/2017	N	0.11	100	32 J	0.53	9.70	390	730	0.0020 U	0.0050 U	0.12	0.0010 U	0.0010 U	0.0057	0.0010 U	0.53	0.0010 U	0.034	0.00020 U	0.0057	0.509 U	0.0050 U	0.0010 U
		9/14/2017	N	0.12	95	34	0.59	8.80	400	750	0.0020 U	0.0050 U	0.13	0.0010 U	0.0010 U	0.0031	0.0010 U	0.59	0.0010 U	0.043	0.00020 U	0.0051	0.432 U	0.0050 U	0.0010 U
		9/19/2017	N	0.12	94	34	0.50 U	8.49	400	820	0.0020 U	0.0050 U	0.14	0.0010 U	0.0010 U	0.0028	0.0010 U	0.50 U	0.0010 U	0.043	0.00020 U	0.0050	0.481 U	0.0050 U	0.0010 U
		9/27/2017	N	0.12	100	33	0.84 U	8.93	400	820	0.0020 U	0.0050 U	0.14	0.0010 U	0.0010 U	0.0028	0.0010 U	0.50 U	0.0010 U	0.043	0.00020 U	0.0050	0.548 U	0.0050 U	0.0010 U
		10/3/2017	FD	0.12	110	32	0.69	8.76	390	830	0.0020 U	0.0050 UJ	0.12	0.0010 U	0.0010 U	0.0020 U	0.0010 UJ	0.69	0.0010 U	0.042	0.00020 U	0.0049	1.97 UJ	0.0050 U	0.0010 U
		10/3/2017	N	0.12	100	32	0.69	8.76	390	830	0.0020 U	0.0050 UJ	0.12	0.0010 U	0.0010 U	0.0020 U	0.0010 UJ	0.69	0.0010 U	0.039	0.00020 U	0.0043	0.573 UJ	0.0050 U	0.0010 U

Notes:
U - undetected at the reporting limit/concentration
J - estimated concentration
FB - field blank
FD - field duplicate
N - primary sample

Table 4 2016-2017 Groundwater Analytical Data - Ash Pond 2, Ash Pond 3, Ash Landfill

				Appendix III Constituents							Appendix IV Constituents														
		Analyte Name		Boron	Calcium	Chloride	Fluoride	pH	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Fluoride	Lead	Lithium	Mercury	Molybdenum	Radium 226/228	Selenium	Thallium
		Unit		mg/L	mg/L	mg/L	mg/L	SU	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	mg/L
		Upper Limit		0.32	209	86	0.73	7.78	840	1800															
Relative Location	MW ID	Date	Type																						
Background	MW-32B	9/1/2016	N	0.27	200	83	0.54	7.21	820	1700	0.0020 U	0.0050 U	0.077	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.54	0.0010 U	0.074	0.00020 U	0.018	1.20	0.0050 U	0.0010 U
		11/11/2016	N	0.28	210	83	0.60	6.37	820	1700	0.0020 U	0.0050 U	0.057	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.60	0.0010 U	0.080	0.00020 U	0.0076	0.716	0.0050 U	0.0010 U
		12/15/2016	N	0.27	190	84	0.59	6.67	830	1700	0.0020 U	0.0050 U	0.053	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.59	0.0010 U	0.073	0.00020 U	0.0064	0.471	0.0050 U	0.0010 U
		2/13/2017	N	0.28	200	84	0.63	7.19	830	1700	0.0020 U	0.0050 U	0.047	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.63	0.0010 U	0.075	0.00020 U	0.0061	0.713	0.0050 U	0.0010 U
		4/4/2017	N	0.31	190	83	0.59	7.23	830	1700	0.020 U	0.050 U	0.038	0.010 U	0.010 U	0.02 U	0.010 U	0.59	0.0100 U	0.081	0.00020 U	0.020 U	0.375	0.050 U	0.010 U
		5/16/2017	N	0.29	180	84	0.60	7.29	830	1700	0.0020 U	0.0050 U	0.040 J	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.60	0.0010 U	0.069	0.00020 U	0.0085	0.752	0.0050 U	0.0010 U
		6/13/2017	N	0.28	190	84	0.64	7.28	840	1800	0.0020 U	0.0050 U	0.041	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.64	0.0010 U	0.081	0.00020 U	0.0079	0.793	0.0050 U	0.0010 U
		7/26/2017	N	0.26	190	86	0.53	7.37	790	1700	0.0020 U	0.0050 U	0.044	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.53	0.0010 U	0.072	0.00020 U	0.0095	0.915 U	0.0050 U	0.0010 U
	MW-39B	9/2/2016	N	0.17	170	43	0.79	7.31	450	400 J	0.0020 U	0.0057	0.11	0.0010 U	0.0010 U	0.002 U	0.0028	0.79	0.0010 U	0.073	0.00020 U	0.069	0.823	0.0050 U	0.0010 U
		11/10/2016	N	0.19	190	45	0.65	7.11	530	970	0.0020 U	0.0050 U	0.073	0.0010 U	0.0010 U	0.002 U	0.0015	0.65	0.0010 U	0.069	0.00020 U	0.039	0.926	0.0050 U	0.0010 U
		12/14/2016	N	0.18	180	46	0.63	7.78	540	1300	0.0020 U	0.0050 U	0.064	0.0010 U	0.0010 U	0.002 U	0.0012	0.63	0.0010 U	0.066	0.00020 U	0.028	0.797	0.0050 U	0.0010 U
		2/13/2017	N	0.19	200	46	0.66	7.02	540	1200	0.0020 U	0.0050 U	0.069	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.66	0.0010 U	0.068	0.00020 U	0.020	0.609	0.0050 U	0.0010 U
		4/4/2017	N	0.20	180	46	0.61	7.13	550	1300	0.020 U	0.050 U	0.048	0.010 U	0.010 U	0.02 U	0.010 U	0.61	0.0100 U	0.069	0.00020 U	0.020 U	0.556	0.050 U	0.010 U
		5/16/2017	N	0.21	170	46	0.66	7.17	540	1300	0.0020 U	0.0050 U	0.051 J	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.66	0.0010 U	0.062	0.00020 U	0.017	0.373 U	0.0050 U	0.0010 U
		6/13/2017	N	0.18	170	46	0.66	7.18	550	1300	0.0020 U	0.0050 U	0.046	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.66	0.0010 U	0.064	0.00020 U	0.016	0.671	0.0050 U	0.0010 U
		7/26/2017	N	0.18	180	47	0.64	7.33	540	1300	0.0020 U	0.0050 U	0.050	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.64	0.0010 U	0.063	0.00020 U	0.017	0.426 U	0.0050 U	0.0010 U
Downgradient	MW-14BR	11/10/2016	N	0.16	150	61	0.51	7.27	290	770	0.0020 U	0.0050 U	0.047	0.0010 U	0.0010 U	0.011	0.0010 U	0.51	0.0028	0.032	0.00020 U	0.0063	0.550 U	0.0063	0.0010 U
		12/15/2016	N	0.16	150	65	0.50 U	7.81	310	790	0.0020 U	0.0050 U	0.045	0.0010 U	0.0010 U	0.012	0.0010 U	0.50 U	0.0010 U	0.030	0.00020 U	0.0066	0.403 U	0.0068	0.0010 U
		2/14/2017	FD	0.16	150	62	0.54	7.77	310	800	0.0020 U	0.0050 U	0.049	0.0010 U	0.0010 U	0.0096	0.0010 U	0.54	0.0010 U	0.031	0.00020 U	0.0062	0.349 U	0.0062	0.0010 U
		2/14/2017	N	0.16	150	65	0.52	7.77	310	810	0.0020 U	0.0050 U	0.049	0.0010 U	0.0010 U	0.011	0.0010 U	0.52	0.0010 U	0.033	0.00020 U	0.0062	0.318 U	0.0066	0.0010 U
		4/4/2017	N	0.16	140	63	0.50 U	7.62	310	770	0.0200 U	0.0500 U	0.037	0.0100 U	0.0100 U	0.0200 U	0.0100 U	0.50 U	0.0100 U	0.032	0.00020 U	0.0200 U	0.294 U	0.0500 U	0.0100 U
		4/25/2017	N	0.16	140	64	0.50	7.74	310	800	0.0020	0.0050	0.038	0.0050	0.0010	0.011	0.0010	0.50	0.0010	0.030	0.00020	0.0066	0.36	0.0066	0.0010
		5/16/2017	N	0.17	140	66	0.50 U	7.71	310	810	0.0020 U	0.0050 U	0.054 J	0.0010 U	0.0010 U	0.014	0.0010 U	0.50 U	0.0015	0.032	0.00020 U	0.0071	0.638 U	0.0076	0.0010 U
		6/14/2017	N	0.15	150	69	0.50 U	7.65	310	820	0.0020 U	0.0050 U	0.038	0.0010 U	0.0010 U	0.013	0.0010 U	0.50 U	0.0010 U	0.033	0.00020 U	0.0067	0.339 U	0.0066	0.0010 U
		7/26/2017	N	0.15	150	64	0.50 U	7.75	310	800	0.0020 U	0.0050 U	0.047	0.0010 U	0.0010 U	0.011	0.0010 U	0.50 U	0.0010 U	0.027	0.00020 U	0.0064	0.319 U	0.0063	0.0010 U
	MW-20B	11/11/2016	N	0.22	150	46	0.79	6.49	410	930	0.0020 U	0.0050 U	0.060	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.79	0.0010 U	0.039	0.00020 U	0.0074	0.818	0.0050 U	0.0010 U
		12/15/2016	N	0.22	140	46	0.75	7.94	410	960	0.0020 U	0.0050 U	0.063	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.75	0.0010 U	0.039	0.00020 U	0.0078	0.517 U	0.0050 U	0.0010 U
		2/14/2017	N	0.24	150	47	0.80	7.84	410	950	0.0020 U	0.0050 U	0.061	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.8	0.0010 U	0.035	0.00020 U	0.0081	0.401 U	0.0050 U	0.0010 U
		4/3/2017	N	0.24	140	47	0.79	7.70	420	960	0.0200 U	0.0500 U	0.054	0.0100 U	0.0100 U	0.02 U	0.0100 U	0.79	0.0100 U	0.038	0.00020 U	0.0200 U	0.395 U	0.0500 U	0.0100 U
		4/25/2017	FD	0.22	140	48	0.78	7.67	410	960	0.0020	0.0250	0.058	0.0050	0.0010	0.002	0.0010	0.78	0.0010	0.034	0.00020	0.0081	0.377	0.0250	0.0010
		4/25/2017	N	0.22	140	48	0.80	7.67	420	960	0.0020	0.0050	0.055	0.0050	0.0010	0.002	0.0010	0.8	0.0010	0.030	0.00020	0.0074	0.342	0.0050	0.0010
		5/16/2017	N	0.22	130	46	0.76	7.70	400	950	0.0020 U	0.0050 U	0.063 J	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.76	0.0010 U	0.031	0.00020 U	0.0079	0.387 U	0.0050 U	0.0010 U
		6/14/2017	N	0.22	140	47	0.78	7.61	420	980	0.0020 U	0.0050 U	0.056	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.78	0.0010 U	0.041	0.00020 U	0.0082	0.308 U	0.0050 U	0.0010 U
		7/26/2017	N	0.22	140	48	0.73	7.77	410	960	0.0020 U	0.0050 U	0.061	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.73	0.0010 U	0.035	0.00020 U	0.0075	0.358 U	0.0050 U	0.0010 U
	MW-36B	9/1/2016	N	0.10 U	150	44	0.65	7.50	380	870	0.0020 U	0.0050 U	0.078	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.65	0.0010 U	0.034	0.00020 U	0.0460	1.340	0.0050 U	0.0010 U
		11/11/2016	N	0.10 U	150	45	0.69	6.67	370	900	0.0020 U	0.0050 U	0.068	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.69	0.0010 U	0.034	0.00020 U	0.0290	0.743	0.0050	0.0010 U
		12/15/2016	FD	0.10 U	140	45	0.67	7.50	390	900	0.0020 U	0.0050 U	0.067	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.67	0.0010 U	0.029	0.00020 U	0.0230	0.713	0.0053	0.0010 U
		12/15/2016	N	0.10 U	140	45	0.66	7.50	390	910	0.0020 U	0.0050 U	0.068	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.66	0.0010 U	0.033	0.00020 U	0.0230	0.798	0.0050 U	0.0010 U
		2/13/2017	N	0.10 U	140	45	0.70	7.48	390	860	0.0020 U	0.0050 U	0.068	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.70	0.0010 U	0.035	0.00020 U	0.0170	0.562	0.0050 U	0.0010 U
		4/4/2017	N	0.10 U	130	45	0.66	7.45	390	890	0.0200 U	0.0500 U	0.065	0.0100 U	0.0100 U	0.02 U	0.0100 U	0.66	0.0100 U	0.035	0.00020 U	0.0200 U	0.540	0.0500 U	0.0100 U
		5/16/2017	N	0.11	130	44	0.67	7.60	390	930	0.0020 U	0.0050 U	0.066 J	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.67	0.0010 U	0.029	0.00020 U	0.0100	0.716	0.0050 U	0.0010 U
		6/13/2017	N	0.10 U	130	45	0.69	7.52	390	920	0.0020 U	0.0050 U	0.059	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.69	0.0010 U	0.034	0.00020 U	0.0092	0.375 U	0.0050 U	0.0010 U
		7/26/2017	N	0.10 U	130	46	0.63	7.70	380	890	0.0020 U	0.0050 U	0.067	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.63	0.0010 U	0.029	0.00020 U	0.0095	0.682 U	0.0053	0.0010 U
	MW-37B	9/1/2016	FD	0.13	230	190	0.55	7.42	480	1200 J	0.0020 U	0.0050 U	0.12	0.0010 U	0.0010 U	0.002 U	0.0013	0.55	0.0010 U	0.046	0.00020 U	0.0720	0.578	0.017	0.0010 U
		9/1/2016	N	0.13	220	190	0.56	7.42	480	1200 J	0.0020 U	0.0050 U	0.11	0.0010 U	0.0010 U	0.002 U	0.0014	0.56	0.0010 U	0.046	0.00020 U	0.0720	0.664	0.017	0.0010 U
		11/11/2016	FD	0.14	230	190	0.55	6.63	490	1200 J	0.0020 U	0.0050 U	0.11	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.55	0.0010 U	0.046	0.00020 U	0.0470	0.432	0.017	0.0010 U
		11/11/2016	N	0.14	230	190	0.55	6.63	490	1200 J	0.0020 U	0.0050 U	0.100	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.55	0.0010 U	0.046	0.00020 U	0.0470	0.582	0.016	0.0010 U
		12/15/2016	N	0.14	230	190	0.55	7.49	510	1300	0.0020 U	0.0050 U	0.100	0.0010 U	0.0010 U	0.004	0.0010 U	0.55	0.0010 U	0.044	0.00020 U	0.0460	0.377 U	0.018	0.0010 U
		2/13/2017	N	0.14	240	190	0.57	7.38	510	1300	0.0020 U	0.0050 U	0.095	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.57	0.0010 U	0.042	0.00020 U	0.0450	0.342 U	0.017	0.0010 U
		4/4/2017	FD	0.15	210	190	0.53	7.40	510	1300 J	0.0200 U	0.0500 U	0.090	0.0100 U	0.0100 U	0.02 U	0.0100 U	0.53	0.0100 U	0.043	0.00020 U	0.0480	0.390	0.0500 U	0.0100 U
		4/4/2017	N	0.16	230	190	0.52	7.40	520	1300 J	0.0200 U	0.0500 U	0.093	0.0100 U	0.0100 U	0.02 U	0.0100 U	0.52	0.0100 U	0.047	0.00020 U	0.0480	0.322 U	0.0500 U	0.0100 U
		5/16/2017	N	0.16	210	190	0.56	7.50	520	1400	0.0020 U	0.0050 U	0.094 J	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.56	0.0010 U	0.038	0.00020 U	0.0540	0.352 U	0.017	0.0010 U
		6/13/2017	FD	0.14	220	180	0.52	7.47	520	1400	0.0020 U	0.0050 U	0.088	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.52	0.0010 U	0.045	0.00020 U	0.0510	0.44	0.016	0.0010 U
		6/13/2017	N	0.14	210	180	0.57	7.47	530	1400	0.0020 U	0.0050 U	0.087	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.57	0.0010 U	0.046	0.00020 U	0.0520	0.327 U	0.016	0.0010 U
		7/26/2017	N	0.14	230	180	0.52	7.57	520	1400	0.0020 U	0.0050 U	0.092	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.52	0.0010 U	0.040	0.00020 U	0.0530	0.36 U	0.015	0.0010 U
	MW-40B	9/2/2016	N	0.15	130	32	0.78	7.32	310	840	0.0020 U	0.0050 U	0.054	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.78	0.0010 U	0.047	0.00020 U	0.0260	0.733	0.0077	0.0010 U
		11/10/2016	N	0.16	150	34	0.84	7.19	340	920	0.0020 U	0.0050 U	0.046	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.84	0.0010 U	0.053	0.00020 U	0.0120	0.651	0.0065	0.0010 U
		12/14/2016	N	0.16	140	35	0.83	7.99	350	910	0.0020 U	0.0050 U	0.047	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.83	0.0010 U	0.049	0.00020 U	0.0140	0.988	0.0076	0.0010 U
		2/14/2017	N	0.16	150	36	0.87	7.49	350	900	0.0020 U	0.0050 U	0.041	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.87	0.0010 U	0.049	0.00020 U	0.0110	0.423	0.01	0.0010 U
		4/4/2017	N	0.17	130	36	0.83	7.61	350	900	0.020 U	0.050 U	0.039	0.010 U	0.010 U	0.020 U	0.010 U	0.83	0.010 U	0.052	0.00020 U	0.020 U	0.410	0.05 U	0.010 U
		5/16/2017	N	0.18	130	36	0.87	7.51	350	960	0.0020 U	0.0050 0	0.001 0	0.0010 0	0.0010 U	0.002 U	0.0010 U	0.87	0.0010 U	0.046	0.00020 U	0.0140	0.745	0.0092	0.0010 U
		6/14/2017	N	0.15	130	36	0.88	7.45	360	940	0.0020 U	0.0050 0	0.001 0	0.0010 0	0.0010 U	0.002 U	0.0010 U	0.88	0.0010 U	0.053	0.00020 U	0.0130	0.938	0.01	0.0010 U
		7/26/2017	N	0.16	150	37	0.83	7.61	350	900	0.0020 U	0.0050 0	0.001 0	0.0010 0	0.0010 U	0.002 U	0.0010 U	0.83	0.0010 U	0.050	0.00020 U	0.0140	0.862 U	0.01	0.0010 U
	MW-52B	7/19/2017	N	0.15	120	33	0.50	7.91	370	820	0.0020 U	0.0050 U	0.13	0.0010 U	0.0010 U	0.0058	0.0014	0.50	0.0010 U	0.048	0.00020 U	0.013	0.347 U	0.0050 U	0.0010 U
		8/25/2017	N	0.16	120	41	0.50 U	7.54	410	920	0.0020 U	0.0050 U	0.12	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.0010 U	0.039	0.00020 U	0.0094	0.903	0.0050 U	0.0010 U
		8/31/2017	N	0.16	160	41	0.50 U	7.61	420	930	0.0020 U	0.0050 U	0.24	0.0010 U	0.0010 U	0.0110	0.004	0.50 U	0.0041	0.063	0.00020 U	0.0088	1.25	0.0050 U	0.0010 U
		9/6/2017	N	0.17	140	41 J	0.50 U	7.61	430	980	0.0020 U	0.0050 U	0.11	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.0010 U	0.045	0.00020 U	0.0083	1.20 U	0.0050 U	0.0010 U
		9/14/2017	N	0.16	130	43	0.50 U	7.46	430	940	0.0020 U	0.0050 U	0.12	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.0010 U	0.049	0.00020 U	0.0071	0.482	0.0050 U	0.0010 U
		9/18/2017	N	0.15	130	41	0.50 U	7.45	420	1000	0.0020 U	0.0050 U	0.11	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.0010 U	0.049	0.00020 U	0.0066	0.566	0.0050 U	0.0010 U
		9/27/2017	N	0.15	140	40	0.50 U	7.55	430	960	0.0020 U	0.0050 U	0.11	0.0010 U	0.0010 U	0.0020 U	0.0010	0.50 U	0.0010 U	0.050	0.00020 U	0.0063	0.37 U	0.0050 U	0.0010 U
		10/3/2017	N	0.15	130	42	0.50 U	7.74	430	1000	0.0020 U	0.0050 UJ	0.096	0.0010 U	0.0010 U	0.0020 U	0.0010 UJ	0.50 U	0.0010 U	0.048	0.00020 U	0.0056	0.576 UJ	0.0050 U	0.0010 U
	MW-53B	7/19/2017	N	0.10 U	95	32	0.96	8.63	220	570	0.0020 U	0.0050 U	0.10	0.0010 U	0.0010 U	0.0045	0.0010 U	0.96	0.0010 U	0.042	0.00020 U	0.014	0.682 U	0.006	0.0010 U
		8/25/2017	N	0.10 U	81	34	0.91	8.48	210	560	0.0020 U	0.0050 U	0.12	0.0010 U	0.0010 U	0.0038	0.0010 U	0.91	0.0010 U	0.033	0.00020 U	0.014	1.09	0.0050 U	0.0010 U
		8/31/2017	N	0.10 U	82	33	0.88	8.72	220	540	0.0020 U	0.0050 U	0.13	0.0010 U	0.0010 U	0.0045	0.0010 U	0.88	0.0010 U	0.042	0.00020 U	0.015	0.426	0.0050 U	0.0010 U
		9/6/2017	N	0.10 U	79	33 J	1.00	8.98	210	560	0.0020 U	0.0050 U	0.13	0.0010 U	0.0010 U	0.0052	0.0010 U	1.0	0.0010 U	0.035	0.00020 U	0.015	0.407 U	0.0050 U	0.0010 U
		9/14/2017	N	0.10 U	77	33	0.93	7.79	220	590	0.0020 U	0.0050 U	0.094	0.0010 U	0.0010 U	0.0028	0.0010 U	0.93	0.0010 U	0.038	0.00020 U	0.012	0.424 U	0.0050 U	0.0010 U
		9/18/2017	N	0.10 U	76	33	1.00	7.52	210	580	0.0020 U	0.0050 U	0.094	0.0010 U	0.0010 U	0.0033	0.0010 U	1.0	0.0010 U	0.041	0.00020 U	0.012	0.432 U	0.0050 U	0.0010 U
		9/27/2017	N	0.10 U	78	32	1.10	7.96	220	620	0.0020 U	0.0050 U	0.070	0.0010 U	0.0010 U	0.002 U	0.0010 U	1.1	0.0010 U	0.042	0.00020 U	0.010	0.375 U	0.0050 U	0.0010 U
		10/3/2017	N	0.10 U	78	33	1.10	7.79	220	610	0.0020 U	0.0050 UJ	0.081	0.0010 U	0.0010 U	0.0022	0.0010 UJ	1.1	0.0010 U	0.040	0.00020 U	0.011	1.88 UJ	0.0050 U	0.0010 U

Notes:
U - undetected at the reporting limit/concentration
J - estimated concentration
FB - field blank
FD - field duplicate
N - primary sample

Table 5 2016-2017 Groundwater Analytical Data - Emergency Holding Ponds

				Appendix III Constituents							Appendix IV Constituents														
		Analyte Name		Boron	Calcium	Chloride	Fluoride	pH	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Fluoride	Lead	Lithium	Mercury	Molybdenum	Radium 226/228	Selenium	Thallium
		Unit		mg/L	mg/L	mg/L	mg/L	SU	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	mg/L
		Upper Limit		1.00	487	346	0.69	7.81	2200	4000															
Relative Location	MW ID	Date	Type																						
Background	MW-41B	8/31/2016	N	0.61	240	160	0.50 U	7.41	1300	2300	0.0020 U	0.0050 U	0.069	0.0010 U	0.0010 U	0.002 U	0.0016	0.50 U	0.0010 U	0.050	0.00020 U	0.037	1.02	0.0097	0.0010 U
		11/11/2016	N	0.68	270	170	0.50 U	6.45	1800	2400	0.0020 U	0.0050 U	0.050	0.0010 U	0.0010 U	0.0039	0.0010 U	0.50 U	0.0010 U	0.057	0.00020 U	0.048	0.807	0.010	0.0010 U
		12/15/2016	N	0.66	260	180	0.50 U	7.70	1500	2500	0.0020 U	0.0050 U	0.045	0.0010 U	0.0010 U	0.0042	0.0010 U	0.50 U	0.0010 U	0.053	0.00020 U	0.045	0.938	0.011	0.0010 U
		2/14/2017	N	0.64	280	180	0.50 U	7.53	1500	2600	0.0020 U	0.0050 U	0.046	0.0010 U	0.0010 U	0.0051	0.0010 U	0.50 U	0.0010 U	0.055	0.00020 U	0.055	0.358 U	0.011	0.0010 U
		4/3/2017	N	0.70	270	180	0.50 U	7.43	5.0 U	2700	0.020 U	0.050 U	0.036	0.010 U	0.010 U	0.02 U	0.010 U	0.50 U	0.0100 U	0.062	0.00020 U	0.053	0.408	0.050 U	0.010 U
		5/16/2017	N	0.66	270	190	0.50 U	7.48	1600	2800	0.0020 U	0.0050 U	0.037 J	0.0010 U	0.0010 U	0.0048	0.0010 U	0.50 U	0.0010 U	0.054	0.00020 U	0.060	0.373	0.012	0.0010 U
		6/13/2017	N	0.60	270	190	0.50 U	7.47	1600	2800	0.0020 U	0.0050 U	0.032	0.0010 U	0.0010 U	0.0042	0.0010 U	0.50 U	0.0010 U	0.058	0.00020 U	0.056	0.538	0.011	0.0010 U
		7/26/2017	N	0.64	280	200	0.50 U	7.56	1500	2700	0.0020 U	0.0050 U	0.034	0.0010 U	0.0010 U	0.004	0.0010 U	0.50 U	0.0010 U	0.054	0.00020 U	0.054	0.609 U	0.011	0.0010 U
	MW-42B	8/31/2016	N	0.94	530	320	0.50 U	7.40	2200	3800	0.0020 U	0.0050 U	0.061	0.0010 U	0.0010 U	0.002 U	0.0012	0.50 U	0.0010 U	0.085	0.00020 U	0.18	0.535	0.0050 U	0.0010 U
		11/11/2016	N	0.92	330	230	0.68	6.52	1700	2800	0.0020 U	0.0050 U	0.047	0.0010 U	0.0010 U	0.0024	0.0010 U	0.68	0.0010 U	0.066	0.00020 U	0.15	0.488 U	0.0050 U	0.0010 U
		12/14/2016	N	0.89	320	210	0.69	7.85	1600	2700	0.0020 U	0.0050 U	0.046	0.0010 U	0.0010 U	0.0029	0.0010 U	0.69	0.0010 U	0.061	0.00020 U	0.13	0.590	0.0050 U	0.0010 U
		2/15/2017	N	0.91	340	220	0.70	7.47	1600	2900	0.0020 U	0.0050 U	0.046	0.0010 U	0.0010 U	0.0036	0.0010 U	0.70	0.0010 U	0.063	0.00020 U	0.15	0.509 U	0.0050 U	0.0010 U
		4/3/2017	N	0.94	450	320	0.50 U	7.47	5.0 U	3900	0.020 U	0.050 U	0.030	0.010 U	0.010 U	0.02 U	0.010 U	0.50 U	0.0100 U	0.083	0.00020 U	0.17	0.477	0.050 U	0.010 U
		5/17/2017	N	0.87	430	320	0.50 U	7.47	2200	3900	0.0020 U	0.0050 U	0.032 J	0.0010 U	0.0010 U	0.0027	0.0010 U	0.50 U	0.0010 U	0.075	0.00020 U	0.18	0.397	0.0065	0.0010 U
		6/13/2017	N	0.82	450	310	0.50 U	7.48	2200	4000	0.0020 U	0.0050 U	0.030	0.0010 U	0.0010 U	0.0024	0.0010 U	0.50 U	0.0010 U	0.081	0.00020 U	0.17	0.609	0.0050 U	0.0010 U
		7/27/2017	N	1.0	410	300	0.50 U	7.40	1900	3400	0.0020 U	0.0050 U	0.027	0.0010 U	0.0010 U	0.0025	0.0010 U	0.50 U	0.0010 U	0.071	0.00020 U	0.15	0.503 U	0.0055	0.0010 U
	MW-43B	9/1/2016	N	0.33	180	69	0.50 U	7.19	660	1300	0.0020 U	0.0050 U	0.056	0.0010 U	0.0010 U	0.003	0.0010 U	0.50 U	0.0010 U	0.041	0.00020 U	0.049	0.525	0.0050 U	0.0010 U
		11/11/2016	N	0.35	140	42	0.50 U	6.49	470	1000	0.0020 U	0.0050 U	0.038	0.0010 U	0.0010 U	0.008	0.0010 U	0.50 U	0.0010 U	0.040	0.00020 U	0.048	0.722	0.0050 U	0.0010 U
		12/14/2016	N	0.34	120	40	0.50 U	7.62	450	970	0.0020 U	0.0050 U	0.034	0.0010 U	0.0010 U	0.0089	0.0010 U	0.50 U	0.0010 U	0.038	0.00020 U	0.043	0.714 U	0.0050 U	0.0010 U
		2/15/2017	N	0.35	120	39	0.50 U	7.37	410	910	0.0020 U	0.0050 U	0.034	0.0010 U	0.0010 U	0.0076	0.0010	0.50 U	0.0010 U	0.035	0.00020 U	0.039	0.460 U	0.0050 U	0.0010 U
		4/4/2017	N	0.35	100	42	0.50 U	7.42	400	890	0.020 U	0.050 U	0.033	0.010 U	0.010 U	0.02 U	0.010 U	0.50 U	0.0100 U	0.035	0.00020 U	0.032	0.316 U	0.050 U	0.010 U
		5/17/2017	N	0.36	110	47	0.50 U	7.50	420	910	0.0020 U	0.0050 U	0.031 J	0.0010 U	0.0010 U	0.003	0.0010 U	0.50 U	0.0010 U	0.031	0.00020 U	0.034	0.315 U	0.0050 U	0.0010 U
		6/13/2017	N	0.32	100	48	0.50 U		420	930	0.0020 U	0.0050 U	0.029	0.0010 U	0.0010 U	0.0024	0.0010 U	0.50 U	0.0010 U	0.037	0.00020 U	0.031	0.640	0.0050 U	0.0010 U
		7/26/2017	N	0.34	110	50	0.50 U	7.56	430	930	0.0020 U	0.0050 U	0.030	0.0010 U	0.0010 U	0.004	0.0010 U	0.50 U	0.0010 U	0.033	0.00020 U	0.030	0.384 U	0.0050 U	0.0010 U
Downgradient	MW-44B	8/31/2016	N	0.11	150	53	0.82	7.61	340	870	0.0020 U	0.0050 U	0.069	0.0010 U	0.0010 U	0.002	0.0010 U	0.82	0.0010 U	0.042	0.00020 U	0.031	0.942	0.0050 U	0.0010 U
		11/12/2016	N	0.11	160	58	0.86	6.92	380	970	0.0020 U	0.0050 U	0.068	0.0050 U	0.0010 U	0.0079	0.0010 U	0.86	0.0010 U	0.035	0.00020 U	0.0067	0.783	0.0050 U	0.0010 U
		12/14/2016	N	0.11	160	58	0.85	8.11	390	980	0.0020 U	0.0050 U	0.071	0.0010 U	0.0010 U	0.0088	0.0010 U	0.85	0.0010 U	0.032	0.00020 U	0.0066	0.480 U	0.0055	0.0010 U
		2/15/2017	N	0.10	160	58	0.83	7.60	380	980	0.0020 U	0.0050 U	0.070	0.0010 U	0.0010 U	0.0087	0.0010 U	0.83	0.0010 U	0.032	0.00020 U	0.0065	0.444 U	0.0050	0.0010 U
		4/3/2017	N	0.11	150	59	0.79	7.60	390	980	0.020 U	0.050 U	0.065	0.010 U	0.010 U	0.02 U	0.010 U	0.79	0.0100 U	0.036	0.00020 U	0.020 U	0.484	0.050 U	0.010 U
		5/17/2017	N	0.11	150	60	0.78	7.62	400	990	0.0020 U	0.0050 U	0.062 J	0.0010 U	0.0010 U	0.0082	0.0010 U	0.78	0.0010 U	0.033	0.00020 U	0.0064	0.439	0.0058	0.0010 U
		6/13/2017	N	0.10 U	150	59	0.79	7.57	400	1000	0.0020 U	0.0050 U	0.059	0.0010 U	0.0010 U	0.0079	0.0010 U	0.79	0.0010 U	0.034	0.00020 U	0.0062	0.858	0.0050 U	0.0010 U
		7/27/2017	N	0.10	160	61	0.87	7.49	410	1000	0.0020 U	0.0050 U	0.067	0.0010 U	0.0010 U	0.0064	0.0010 U	0.87	0.0010 U	0.031	0.00020 U	0.0066	0.655 U	0.0084	0.0010 U
	MW-45B	8/31/2016	N	0.18	150	44	0.82	7.61	300	1000 J	0.0020 U	0.0050 U	0.063	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.82	0.0010 U	0.038	0.00020 U	0.026	0.635	0.0086	0.0010 U
		11/12/2016	N	0.18	150	45	0.9	6.59	320	830	0.0020 U	0.0050 U	0.061	0.0050 U	0.0010 U	0.002 U	0.0010 U	0.90	0.0010 U	0.035	0.00020 U	0.013	0.738	0.0074	0.0010 U
		12/14/2016	N	0.17	130	46	0.91	8.13	320	840	0.0020 U	0.0050 U	0.058	0.0010 U	0.0010 U	0.0026	0.0010 U	0.91	0.0010 U	0.029	0.00020 U	0.011	0.680	0.0091	0.0010 U
		2/14/2017	N	0.19	150	45	0.91	7.72	320	820	0.0020 U	0.0050 U	0.052	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.91	0.0010 U	0.034	0.00020 U	0.0088	0.465 U	0.0088	0.0010 U
		4/3/2017	N	0.19	130	46	0.87	7.75	320	850	0.020 U	0.050 U	0.048	0.010 U	0.010 U	0.02 U	0.010 U	0.87	0.0100 U	0.034	0.00020 U	0.020 U	0.488	0.050 U	0.010 U
		5/17/2017	N	0.18	130	47	0.9	7.74	330	840	0.0020 U	0.0050 U	0.056 J	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.90	0.0010 U	0.030	0.00020 U	0.0088	0.323 U	0.0099	0.0010 U
		6/13/2017	N	0.16	130	46	0.87	7.72	350	870	0.0020 U	0.0050 U	0.046	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.87	0.0010 U	0.036	0.00020 U	0.0081	0.587	0.0087	0.0010 U
		7/27/2017	N	0.17	140	47	0.94	7.57	330	870	0.0020 U	0.0050 U	0.051	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.94	0.0010 U	0.033	0.00020 U	0.0079	0.390 U	0.0090	0.0010 U
	MW-46B	8/31/2016	N	0.10 U	76	19	0.82	7.64	150	480	0.0020 U	0.0050 U	0.059	0.0010 U	0.0010 U	0.002	0.0010 U	0.82	0.0010 U	0.032	0.00020 U	0.014	0.761	0.0050 U	0.0010 U
		11/11/2016	N	0.11	78	19	0.95	6.48	160	500	0.0020 U	0.0050 U	0.049	0.0050 U	0.0010 U	0.002 U	0.0010 U	0.95	0.0010 U	0.026	0.00020 U	0.0059	1.020	0.0050 U	0.0010 U
		12/14/2016	N	0.12	74	19	0.94	8.12	160	510	0.0020 U	0.0050 U	0.049	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.94	0.0010 U	0.025	0.00020 U	0.0051	0.870	0.0050 U	0.0010 U
		2/14/2017	N	0.11	78	20	0.95	7.66	160	500	0.0020 U	0.0050 U	0.049	0.0010 U	0.0010 U	0.0025	0.0010 U	0.95	0.0010 U	0.025	0.00020 U	0.0041	0.577	0.0050 U	0.0010 U
		4/3/2017	N	0.10 U	78	24	0.69	7.61	170	530	0.020 U	0.050 U	0.053	0.010 U	0.010 U	0.02 U	0.010 U	0.69	0.0100 U	0.026	0.00020 U	0.020 U	0.510	0.050 U	0.010 U
		5/17/2017	N	0.10 U	71	25	0.68	7.58	170	540	0.0020 U	0.0050 U	0.060 J	0.0010 U	0.0010 U	0.0074	0.0010 U	0.68	0.0010 U	0.020	0.00020 U	0.0056	0.391	0.0050 U	0.0010 U
		6/13/2017	N	0.10 U	73	24	0.66	7.54	170	550	0.0020 U	0.0050 U	0.052	0.0010 U	0.0010 U	0.0071	0.0010 U	0.66	0.0010 U	0.028	0.00020 U	0.0054	0.530	0.0050 U	0.0010 U
		7/27/2017	N	0.10 U	73	23	0.84	7.44	170	540	0.0020 U	0.0050 U	0.052	0.0010 U	0.0010 U	0.0049	0.0010 U	0.84	0.0010 U	0.021	0.00020 U	0.0044	0.495 U	0.0050 U	0.0010 U
	MW-47B	8/31/2016	N	0.13	130	27	0.50 U	7.52	270	730	0.0020 U	0.0050 U	0.085	0.0010 U	0.0010 U	0.002 U	0.0010 U	0.50 U	0.0010 U	0.039	0.00020 U	0.025	0.672	0.0050 U	0.0010 U
		11/11/2016	N	0.13	130	30	0.50 U	6.46	300	710	0.0020 U	0.0050 U	0.097	0.0050 U	0.0010 U	0.0025	0.0010 U	0.50 U	0.0010 U	0.032	0.00020 U	0.013	1.400	0.0050 U	0.0010 U
		12/14/2016	N	0.13	120	30	0.50 U	7.95	310	740	0.0020 U	0.0050 U	0.085	0.0010 U	0.0010 U	0.0032	0.0010 U	0.50 U	0.0010 U	0.027	0.00020 U	0.013	1.640	0.0050 U	0.0010 U
		2/14/2017	N	0.13	130	31	0.50 U	7.51	310	750	0.0020 U	0.0050 U	0.086	0.0010 U	0.0010 U	0.0043	0.0010 U	0.50 U	0.0010 U	0.030	0.00020 U	0.0091	0.423 U	0.0050 U	0.0010 U
		4/3/2017	N	0.14	120	30	0.50 U	7.54	310	740	0.020 U	0.050 U	0.079	0.010 U	0.010 U	0.02 U	0.010 U	0.50 U	0.0100 U	0.029	0.00020 U	0.020 U	0.768	0.050 U	0.010 U
		5/17/2017	N	0.14	120	31	0.50 U	7.54	320	780	0.0020 U	0.0050 U	0.083 J	0.0010 U	0.0010 U	0.0039	0.0010 U	0.50 U	0.0010 U	0.025	0.00020 U	0.0071	0.587	0.0050 U	0.0010 U
		6/12/2017	N	0.12	110	30	0.50 U	7.57	320	790	0.0020 U	0.0050 U	0.074	0.0010 U	0.0010 U	0.0036	0.0010 U	0.50 U	0.0010 U	0.032	0.00020 U	0.0069	0.568	0.0050 U	0.0010 U
		7/27/2017	N	0.12	130	32	0.50 U	7.28	310	780	0.0020 U	0.0050 U	0.079	0.0010 U	0.0010 U	0.0038	0.0010 U	0.50 U	0.0010 U	0.024	0.00020 U	0.0076	0.413 U	0.0050 U	0.0010 U

Notes:
U - undetected at the reporting limit/concentration
J - estimated concentration
FB - field blank
FD - field duplicate
N - primary sample

Table 6 2016-2017 Groundwater Analytical Data - Field Blanks

			Appendix III Constituents						Appendix IV Constituents														
		Analyte Name Unit	Boron mg/L	Calcium mg/L	Chloride mg/L	Fluoride mg/L	Sulfate mg/L	TDS mg/L	Antimony mg/L	Arsenic mg/L	Barium mg/L	Beryllium mg/L	Cadmium mg/L	Chromium mg/L	Cobalt mg/L	Fluoride mg/L	Lead mg/L	Lithium mg/L	Mercury mg/L	Molybdenum mg/L	Radium 226/228 pCi/L	Selenium mg/L	Thallium mg/L
Sample ID	Date	Type																					
FB-01	9/14/2017	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.404 U	0.0050 U	0.0010 U
FB-01	9/18/2017	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.330 U	0.0050 U	0.0010 U
FB-01	9/27/2017	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.423	0.0050 U	0.0010 U
FB-01	10/3/2017	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.386	0.0050 U	0.0010 U
FB-01-042517	4/25/2017	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.025 U	0.0010 U	0.0050 U	0.0010 U	0.0020 U	0.0010 U	0.001 U	0.001 U	0.020 U	0.00200 U	0.00200 U	0.386 U	0.025 U	0.0010 U
FB-01-061417	6/14/2017	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.343 U	0.0050 U	0.0010 U
FB-01-071917	7/19/2017	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.122 U	0.0050 U	0.0010 U
FB-01-083117	8/31/2017	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.367	0.0050 U	0.0010 U
FB-01-090617	9/6/2017	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.386	0.0050 U	0.0010 U
FB-021417	2/14/2017	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.308 U	0.0050 U	0.0010 U
FB-1	9/1/2016	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.558 U	0.0050 U	0.0010 U
FB-1	5/17/2017	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	13	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.368	0.0050 U	0.0010 U
FB-1	7/26/2017	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.597	0.0050 U	0.0010 U
FB-1-082517	8/25/2017	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.424 U	0.0050 U	0.0010 U
FB-1-121516	12/15/2016	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.361 U	0.0050 U	0.0010 U
FIELD BLANK-1-040417	4/4/2017	FB	0.10 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0010 U	0.0010 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.346 U	0.0050 U	0.0010 U
FIELD BLANK-1-111116	11/11/2016	FB	0.1 U	1.0 U	3.0 U	0.50 U	5.0 U	10 U	0.0020 U	0.0050 U	0.0050 U	0.0050 U	0.0010 U	0.0020 U	0.0010 U	0.50 U	0.50 U	0.020 U	0.00020 U	0.00200 U	0.468 U	0.0050 U	0.0010 U

Notes:

U - undetected at the reporting limit/concentration

FB - field blank

Table 7 Statistical Analysis Methods and Background Upper Prediction Limits - Ash Pond 1

Parameter (units)	Number of Samples	Percent Nondetects	Normal or Lognormal Distribution?	Statistical Test	Background Limit Value
Boron (mg/L)	16	50	No/No	Nonparametric	0.17
Calcium (mg/L)	16	0	No/No	Nonparametric	160
Chloride (mg/L)	16	0	No/No	Nonparametric	43
Fluoride (mg/L)	16	44	No/No	Nonparametric	1.1
pH (std units)	16	0	No/No	Nonparametric	8.98
Sulfate (mg/L)	16	0	No/No	Nonparametric	430
TDS (mg/L)	16	0	No/No	Nonparametric	1,000

Table 8 Statistical Analysis Methods and Background Upper Prediction Limits - Ash Pond 2, Ash Pond 3, Ash Landfill

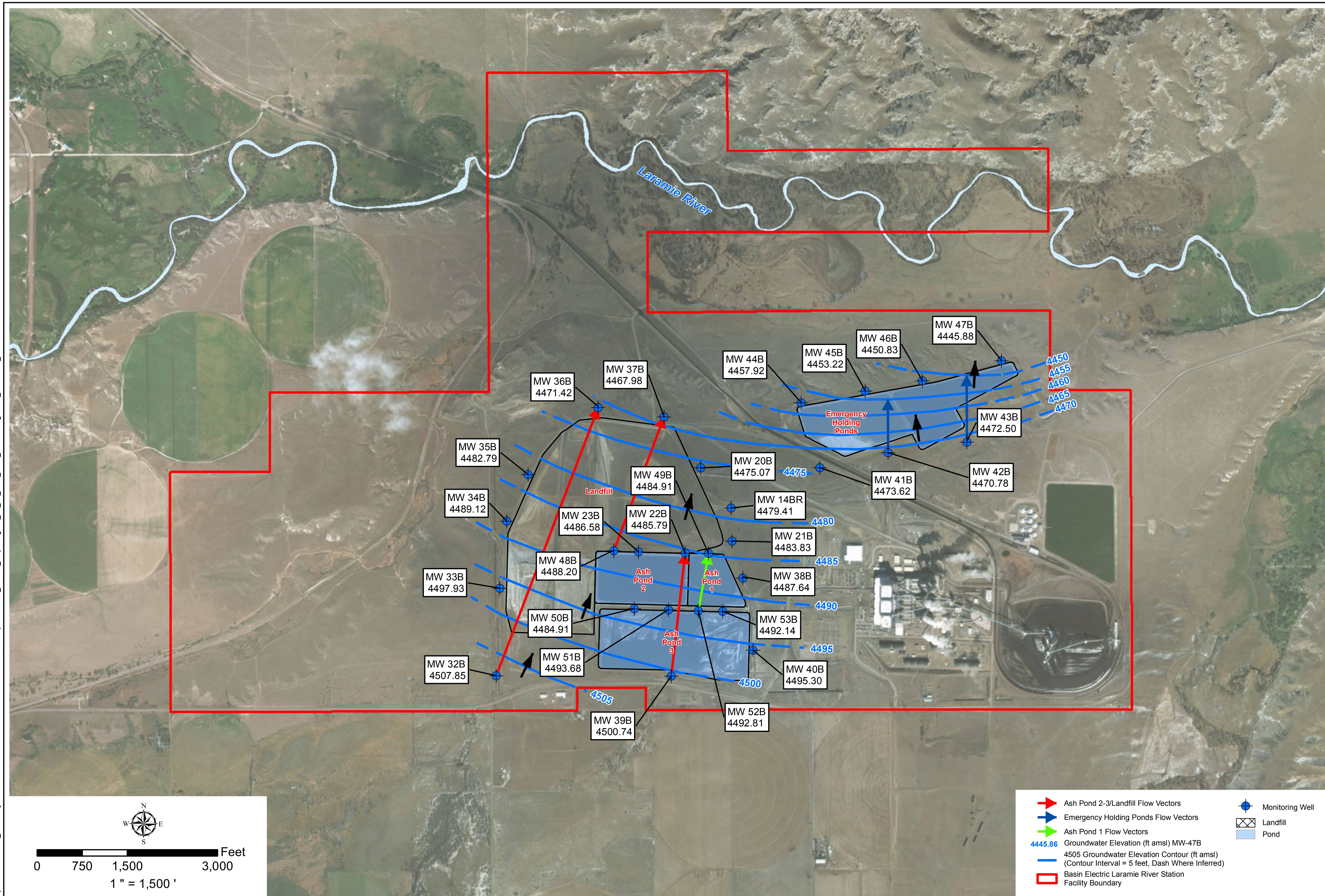
Parameter (units)	Number of Samples	Percent Nondetects	Normal or Lognormal Distribution?	Statistical Test	Background Limit Value
Boron (mg/L)	16	0	Yes/No	Parametric	0.32
Calcium (mg/L)	16	0	Yes/Yes	Parametric	209
Chloride (mg/L)	16	0	No/No	Nonparametric	86
Fluoride (mg/L)	16	0	Yes/Yes	Parametric	0.73
pH (std units)	16	0	No/No	Nonparametric	7.78
Sulfate (mg/L)	16	0	No/No	Nonparametric	840
TDS (mg/L)	16	0	No/No	Nonparametric	1,800

Table 9 Statistical Analysis Methods and Background Upper Prediction Limits - Emergency Holding Ponds

Parameter (units)	Number of Samples	Percent Nondetects	Normal or Lognormal Distribution?	Statistical Test	Background Limit Value
Boron (mg/L)	24	0	No/No	Nonparametric	1
Calcium (mg/L)	24	0	Yes/No	Parametric	487
Chloride (mg/L)	24	0	Yes/No	Parametric	346
Fluoride (mg/L)	24	88	Yes/No	Parametric	0.69
pH (std units)	23	0	No/No	Nonparametric	7.81
Sulfate (mg/L)	24	8	No/No	Nonparametric	2,200
TDS (mg/L)	24	0	No/No	Nonparametric	4,000

Appendix I

Potentiometric Surface Map



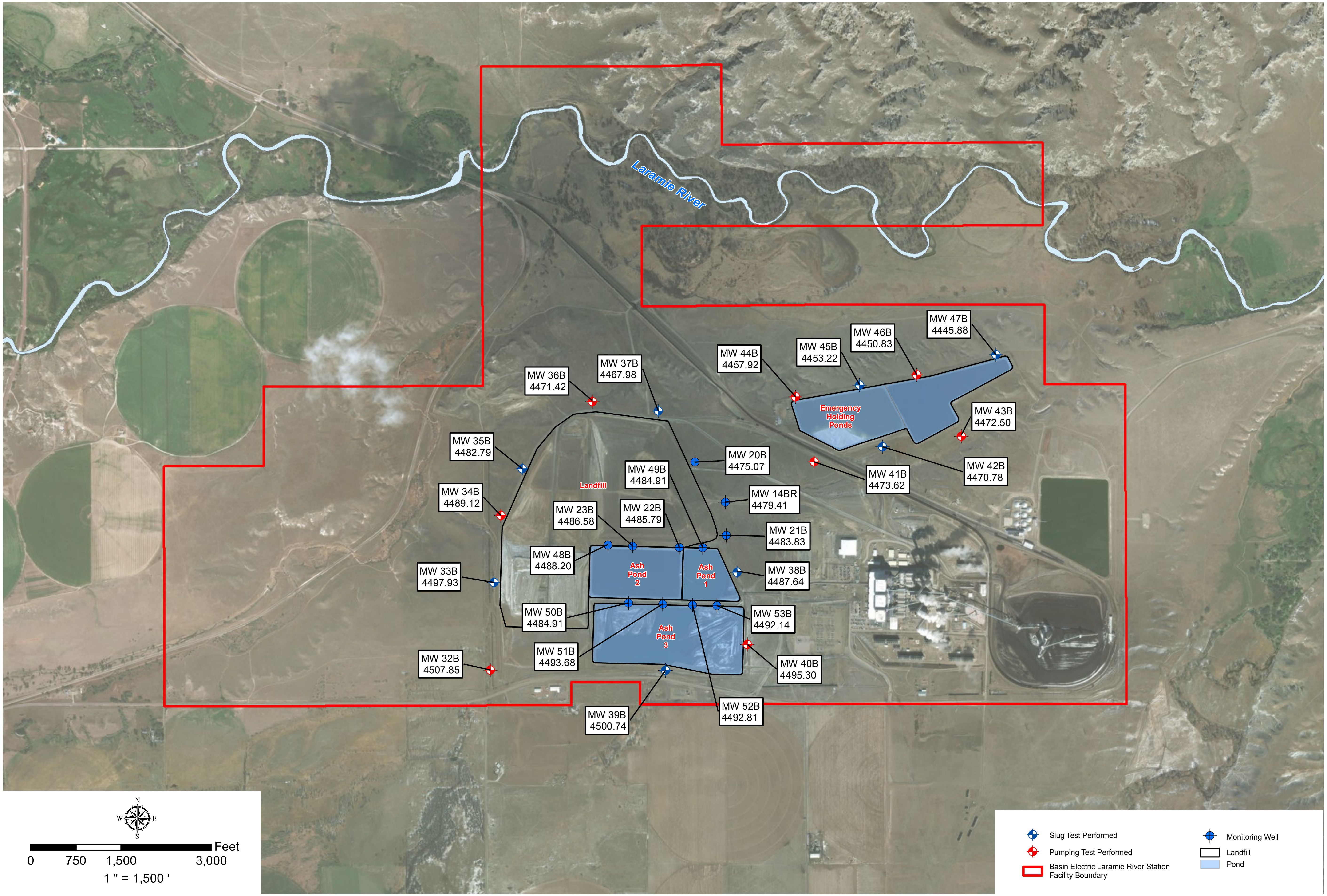
Potentiometric Surface Map
October 3, 2017

Basin Electric
Laramie River Station
Platte County, Wyoming
Project No.: 60506860 Date: 1/08/2018

Filepath: M:\Denver_GIS\Projects\60506860 Basin Electric LRS CCR\920-GIS-Graphics\Flow_Vector_Maps\Figure_05_03_LRS_CCR_MonitoringWells_Contours_October.mxd

Appendix II

Groundwater Flow Calculations



Slug Test vs. Pumping Test

Basin Electric
Laramie River Station
Platte County, Wyoming
Project No.: 60506860 Date: 1/08/2018

Filepath: M:\Denver_GIS\Projects\60506860 Basin Electric LRS CCR\920-GIS-Graphics\Flow_Vector_Maps\Figure_05_01_LRS_CCR_MonitoringWells_SlugTest_vs_PumpTest.mxd

Calculations
Laramie River Station
CCR Unit/Multi-Unit

Project:	Laramie River Station	CCR Unit:	Ash Pond 1
Calculations by:	Jeremy Hurshman/Chris Ahrendt	Checked by:	Gregg Somermeyer
Date:	1/10/2018	Date:	1/10/2018

Hydrualic Gradient (i, ft/ft) **(Specific to the Ash Pond 1 Unit)**

Governing Equation:
(Hydrualic Gradient)

$$i = -{}^{dh}/_{dl}$$

where,
i= hydraulic gradient (rise over run)
dh= change in hydraulic head between upgradient and do
dl= horizontal distance between upgradient and downgra
Note: in textbook form, dh is a negative number beca

Summary Table

Date	dh (ft)	dl (ft)	i (ft/ft)
August 31, 2016	5.00	729.39	0.0069
November 10, 2016	5.00	750.62	0.0067
December 14, 2016	5.00	750.62	0.0067
February 13, 2017	5.00	793.24	0.0063
April 3, 2017	5.00	782.36	0.0064
April 25, 2017	5.00	736.76	0.0068
May 16, 2017	5.00	716.48	0.0070
June 12-14, 2017	5.00	783.52	0.0064
July 19-27, 2017	7.83	970	0.0081
September 18-19, 2017	8.07	970	0.0083
October 3, 2017	7.90	970	0.0081
Minimum			**0.0063**
Maximum			**0.0083**
Average			**0.0071**

Hydraulic Conductivity (K, ft/d) **(Specific to the Ash Pond 1 Unit)**

K, from slug and pumping tests conducted at site		
Minimum	1.04	ft/day
Maximum	1.04	ft/day
Average (geomean)	1.04	ft/day

Specific Yield, Effective Porosity

Specific Yield, Effective Porosity		
Minimum	0.02	
Maximum	0.3	
Average	0.15	

Seepage Velocity (Flow Rate through pore throats) **(Specific to the Ash Pond 1 Unit)**

Governing Equation:
(Seepage Velocity)

$$v_s = {}^{-K * i}/_{n_e}$$

where,
v_s= seepage velocity, feet per day (ft/d)
K= hydraulic conductivity, feet per day (ft/d)
i= hydraulic gradient, feet per foot (ft/ft)
n_e= effective porosity/specific yield, unitless, porosity thr
Note: in textbook form, hydraulic gradient is negative

Summary Table - Groundwater Seepage Velocities, Ash Pond 1 Unit

Calculated Seepage Velocities (ft/day)				
	K (ft/day)	i (ft/ft)	n_e	v_s (ft/day)
Minimum	1.04	0.0063	0.30	**0.022**
Maximum	1.04	0.0083	0.02	**0.433**
Average	1.04	0.0071	0.15	**0.227**

Notes:
1. Hydraulic conductivities are site specific
2. Effective porosity/specific yield is based on literature values from Arikaree Formation literature and textbook values for sandstone

Calculations
Laramie River Station
CCR Unit/Multi-Unit

Project:	Laramie River Station	CCR Unit:	Ash Ponds 2-3 and Ash Landfill	Background Wells:	MW-39B, MW-32B
Calculations by:	Jeremy Hurshman/Chris Ahrendt	Checked by:	Gregg Somermeyer	Downgradient Wells:	MW-36B, MW-37B, MW-20B, MW-14BR, MW-40B, MW-52B, MW-53B
Date:	1/10/2018	Date:	1/10/2018		

Hydrualic Gradient (i, ft/ft) **(Specific to the Ash Ponds 2-3 and Ash Landfill Unit)**

Governing Equation:
(Hydrualic Gradient)

$$i = -{}^{dh}/_{dl}$$

where,
i= hydraulic gradient (rise over run)
dh= change in hydraulic head between upgradient and downgradient locations (rise)
dl= horizontal distance between upgradient and downgradient locations, parallel to flow (perpendicular to potentiometric contours) (run)
Note: in textbook form, dh is a negative number because they subtract the higher head value from the lower head value.

Summary Table - Hydraulic Gradient

Date	dh (ft)	dl (ft)	i (ft/ft)
August 31, 2016	35.25	4769.11	0.0074
November 10, 2016	35.69	4769.11	0.0075
December 14, 2016	35.86	4769.11	0.0075
February 13, 2017	36.02	4769.11	0.0076
April 3, 2017	36.34	4769.11	0.0076
April 25, 2017	36.73	4769.11	0.0077
May 16, 2017	35.52	4769.11	0.0074
June 12-14, 2017	36.58	4769.11	0.0077
July 19-27, 2017	36.15	4769.11	0.0076
September 18-19, 2017	36.56	4769.11	0.0077
October 3, 2017	36.43	4769.11	0.0076
August 31, 2016	15.00	2231.2	0.0067
November 10, 2016	15.00	2255.95	0.0066
December 14, 2016	15.00	2190.22	0.0068
February 13, 2017	15.00	2035.43	0.0074
April 3, 2017	15.00	2058.49	0.0073
April 25, 2017	15.00	2065.43	0.0073
May 16, 2017	15.00	2040.74	0.0074
June 12-14, 2017	15.00	1988.67	0.0075
July 19-27, 2017	14.68	2059.99	0.0071
September 18-19, 2017	15.10	2059.99	0.0073
October 3, 2017	14.95	2059.99	0.0073
August 31, 2016	21.92	2685.96	0.0082
November 10, 2016	22.17	2821.8	0.0079
December 14, 2016	21.98	2808.56	0.0078
February 13, 2017	22.05	2804.29	0.0079
April 3, 2017	22.02	2811.76	0.0078
April 25, 2017	21.98	2824.02	0.0078
May 16, 2017	21.80	2838.83	0.0077
June 12-14, 2017	21.65	2847.48	0.0076
July 19-27, 2017	20.54	2377.09	0.0086
September 18-19, 2017	20.67	2377.09	0.0087
October 3, 2017	20.22	2377.09	0.0085
Minimum			**0.0066**
Maximum			**0.0087**
Average			**0.0076**

Calculation Table

Vector	Date	Upgradient WL elevation (ft MSL)	Downgradient WL Elevation (ft MSL)	dh (ft)	dl (ft)
Vector 1 (32B)	August 31, 2016	4506.54	4471.29	35.25	4769.11
	November 10, 2016	4506.85	4471.16	35.69	4769.11
	December 14, 2016	4507.29	4471.43	35.86	4769.11
	February 13, 2017	4507.38	4471.36	36.02	4769.11
	April 3, 2017	4507.70	4471.36	36.34	4769.11
	April 25, 2017	4508.13	4471.40	36.73	4769.11
	May 16, 2017	4507.15	4471.63	35.52	4769.11
	June 12-14, 2017	4508.34	4471.76	36.58	4769.11
	July 19-27, 2017	4507.80	4471.65	36.15	4769.11
	September 18-19, 2017	4508.02	4471.46	36.56	4769.11
	October 3, 2017	4507.85	4471.42	36.43	4769.11
Vector 2 (39B)	August 31, 2016	4500.00	4485.00	15.00	2231.20
	November 10, 2016	4500.00	4485.00	15.00	2255.95
	December 14, 2016	4500.00	4485.00	15.00	2190.22
	February 13, 2017	4500.00	4485.00	15.00	2035.43
	April 3, 2017	4500.00	4485.00	15.00	2058.49
	April 25, 2017	4500.00	4485.00	15.00	2065.43
	May 16, 2017	4500.00	4485.00	15.00	2040.74
	June 12-14, 2017	4500.00	4485.00	15.00	1988.67
	July 19-27, 2017	4500.62	4485.94	14.68	2059.99
	September 18-19, 2017	4501.14	4486.04	15.10	2059.99
	October 3, 2017	4500.74	4485.79	14.95	2059.99
Vector 3 (48B)	August 31, 2016	4490.00	4468.08	21.92	2685.96
	November 10, 2016	4490.00	4467.83	22.17	2821.8
	December 14, 2016	4490.00	4468.02	21.98	2808.56
	February 13, 2017	4490.00	4467.95	22.05	2804.29
	April 3, 2017	4490.00	4467.98	22.02	2811.76
	April 25, 2017	4490.00	4468.02	21.98	2824.02
	May 16, 2017	4490.00	4468.20	21.80	2838.83
	June 12-14, 2017	4490.00	4468.35	21.65	2847.48
	July 19-27, 2017	4488.80	4468.26	20.54	2377.09
	September 18-19, 2017	4488.62	4467.95	20.67	2377.09
	October 3, 2017	4488.20	4467.98	20.22	2377.09

Hydraulic Conductivity (K, ft/d) **(Specific to the Ash Ponds 2-3 and Ash Landfill Unit)**

K from slug and pumping tests conducted at site		
Minimum	0.50	ft/day
Maximum	6.16	ft/day
Average (geomean)	1.54	ft/day

Specific Yield, Effective Porosity

Specific Yield, Effective Porosity		
Minimum	0.02	
Maximum	0.3	
Average	0.15	

Seepage Velocity (Flow Rate through pore throats) **(Specific to the Ash Ponds 2-3 and Ash Landfill Unit)**

Governing Equation:
(Seepage Velocity)

$$v_s = {}^{-K * i}/_{n_e}$$

where,
v_s= seepage velocity, feet per day (ft/d)
K= hydraulic conductivity, feet per day (ft/d)
i= hydraulic gradient, feet per foot (ft/ft)
n_e= effective porosity/specific yield, unitless, porosity through which flow can occur, similar to specific yield (Sy). Porosity=Volume voids/Total bulk volume of material
Note: in textbook form, hydraulic gradient is negative (-), so they take the negative value of K*I here to cancel out the negatives.

Summary Table - Groundwater Seepage Velocities, Ash Ponds 2-3 and Ash Landfill Unit

Calculated Seepage Velocities (ft/day)				
	K (ft/day)	**i** (ft/ft)	n_e	v_s (ft/day)
Minimum	0.50	0.0066	0.30	**0.011**
Maximum	6.16	0.0087	0.02	**2.678**
Average	1.54	0.0076	0.15	**1.344**

Notes:
1. Hydraulic conductivities are site specific
2. Effective porosity/specific yield is based on literature values from Arikaree Formation literature and textbook values for sandstone

Calculations
Laramie River Station
CCR Unit/Multi-Unit

Project:	Laramie River Station	CCR Unit:	Emergency Holding Ponds	Background Wells:	MW-41B, MW-42B, MW-43B
Calculations by:	Jeremy Hurshman/Chris Ahrendt	Checked by:	Gregg Somermeyer	Downgradient Wells:	MW-44B, MW-45B, MW-46B, MW-47B
Date:	1/10/2018	Date:	1/10/2018		

Hydraulic Gradient (i, ft/ft) **(Specific to the Emergency Holding Ponds Unit)**

Governing Equation:
(Hydraulic Gradient)

$$i = -{}^{dh}/_{dl}$$

where,
i= hydraulic gradient (rise over run)
dh= change in hydraulic head between upgradient and downgradient locations (rise)
dl= horizontal distance between upgradient and downgradient locations, parallel to flow (perpendicular to potentiometric contours) (run)
Note: in textbook form, dh is a negative number because they subtract the higher head value from the lower head value.

Summary Table

Date	dh (ft)	dl (ft)	i (ft/ft)
August 31, 2016	14.65	891.87	0.0164
November 10, 2016	14.05	907.31	0.0155
December 14, 2016	13.65	887.01	0.0154
February 13, 2017	13.78	891.64	0.0155
April 3, 2017	14.32	859.45	0.0167
April 25, 2017	14.85	1203.82	0.0123
May 16, 2017	15.18	879.83	0.0173
June 12-14, 2017	15.56	859.23	0.0181
July 19-27, 2017	15.58	866.59	0.0180
September 18-19, 2017	15.94	840.59	0.0190
October 3, 2017	15.78	873.01	0.0181
August 31, 2016	25.21	1127.23	0.0224
November 10, 2016	19.13	1099.86	0.0174
December 14, 2016	18.54	1057.12	0.0175
February 13, 2017	17.69	1119	0.0158
April 3, 2017	27.16	1203.82	0.0226
April 25, 2017	25.90	1100.33	0.0235
May 16, 2017	23.58	1098.04	0.0215
June 12-14, 2017	15.56	863.36	0.0180
July 19-27, 2017	25.71	1138.97	0.0226
September 18-19, 2017	24.08	1147.97	0.0210
October 3, 2017	22.50	1063.94	0.0211
Minimum			**0.0123**
Maximum			**0.0235**
Average			**0.0184**

Calculation Table

Vector	Date	Upgradient WL elevation (ft MSL)	Downgradient WL Elevation (ft MSL)	dh (ft)	dl (ft)
vector 1(42B)	August 31, 2016	4469.65	4455.00	14.65	891.87
	November 10, 2016	4469.05	4455.00	14.05	907.31
	December 14, 2016	4468.65	4455.00	13.65	887.01
	February 13, 2017	4468.78	4455.00	13.78	891.64
	April 3, 2017	4469.32	4455.00	14.32	859.45
	April 25, 2017	4469.85	4455.00	14.85	1203.82
	May 16, 2017	4470.18	4455.00	15.18	879.83
	June 12-14, 2017	4470.56	4455.00	15.56	859.23
	July 19-27, 2017	4470.58	4455.00	15.58	866.59
	September 18-19, 2017	4470.94	4455.00	15.94	840.59
	October 3, 2017	4470.78	4455.00	15.78	873.01
vector 2 (43B)	August 31, 2016	4475.21	4450.00	25.21	1127.23
	November 10, 2016	4469.13	4450.00	19.13	1099.86
	December 14, 2016	4468.54	4450.00	18.54	1057.12
	February 13, 2017	4467.69	4450.00	17.69	1119.00
	April 3, 2017	4477.16	4450.00	27.16	1203.82
	April 25, 2017	4475.90	4450.00	25.90	1100.33
	May 16, 2017	4473.58	4450.00	23.58	1098.04
	June 12-14, 2017	4470.56	4455.00	15.56	863.36
	July 19-27, 2017	4475.71	4450.00	25.71	1138.97
	September 18-19, 2017	4474.08	4450.00	24.08	1147.97
	October 3, 2017	4472.50	4450.00	22.50	1063.94

Hydraulic Conductivity (K, ft/d) **(Specific to the Emergency Holding Ponds Unit)**

K from slug and pumping tests conducted at site		
Minimum	0.75	ft/day
Maximum	3.12	ft/day
Average (geomean)	1.31	ft/day

Specific Yield, Effective Porosity

Specific Yield, Effective Porosity		
Minimum	0.02	
Maximum	0.3	
Average	0.15	

Seepage Velocity (Flow Rate through pore throats) **(Specific to the Emergency Holding Ponds Unit)**

Governing Equation:
(Seepage Velocity)

$$v_s = {}^{-K * i}/_{n_e}$$

where,
v_s= seepage velocity, feet per day (ft/d)
K= hydraulic conductivity, feet per day (ft/d)
i= hydraulic gradient, feet per foot (ft/ft)
n_e= effective porosity/specific yield, unitless, porosity through which flow can occur, similar to specific yield (Sy). Porosity=Volume voids/Total
Note: in textbook form, hydraulic gradient is negative (-), so they take the negative value of K*I here to cancel out the negatives.

Summary Table - Groundwater Seepage Velocities, Emergency Holding Ponds Unit

Calculated Seepage Velocities (ft/day)				
	K (ft/day)	**i (ft/ft)**	**n_e**	**v_s (ft/day)**
Minimum	0.75	0.0123	0.30	**0.031**
Maximum	3.12	0.0235	0.02	**3.672**
Average	1.31	0.0184	0.15	**1.851**

Notes:
1. Hydraulic conductivities are site specific
2. Effective porosity/specific yield is based on literature values from Arikaree Formation literature and textbook values for sandstone

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