2019 Annual Groundwater Monitoring and Corrective Action Report (August – December 2019) LOS Ponds 2 and 3 Multi-unit

Leland Olds Station
Stanton, North Dakota

Basin Electric Power Cooperative

January 31, 2019
Project #60558359

Basin Electric Power Cooperative
Bismarck, North Dakota

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	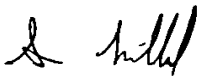		
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Revision History

Revision	Revision date	Details	Authorized	Name	Position

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List of Acronyms

AECOM	AECOM Technical Services, Inc.
ASD	Alternative Source Demonstration
Basin	Basin Electric Power Cooperative
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
cm/sec	centimeters per second
EPA	United States Environmental Protection Agency
FGD	Flue Gas Desulfurization
ft, amsl	feet above mean sea level
ft, bgs	feet below ground surface
ft/day	feet per day
GWPS	groundwater protection standard
LOS	Leland Olds Station
LPL	lower prediction limit
NDPDES	North Dakota Pollution Discharge and Elimination System
RCRA	Resource Conservation and Recovery Act
SSIs	statistically significant increases
SSLs	statistically significant levels
SU	standard units
TDS	total dissolved solids
UPLs	upper prediction limits

1. Introduction

On behalf of Basin Electric Power Cooperative, (Basin), AECOM Technical Services, Inc. (AECOM) has prepared the 2019 annual report documenting groundwater monitoring and corrective action for the Coal Combustion Residuals (CCR) Ponds 2 and 3 Multi-unit at Basin's Leland Olds Station (LOS).

Chapter 1 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 summarizes CCR groundwater monitoring activities conducted prior to August 2019. Chapter 3 summarizes the groundwater monitoring and corrective action activities completed between August and December 2019, and references attachments to this report that contain detailed documentation of those activities. Chapter 4 provides an evaluation of the condition of the groundwater monitoring system. Chapter 5 summarizes the groundwater sampling and analysis conducted during the reporting period. Chapter 6 reviews the methods and results of statistical analysis of the groundwater monitoring data. Chapter 7 presents a summary and conclusions from the CCR groundwater monitoring in August through December 2019 and statistical analysis of the results. Chapter 8 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 August 1, 2019 for inactive CCR Units including the Ponds 2 and 3 Multi-unit henceforth referred to as the Multi-unit. 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 second report, and includes activities performed between August and December 2019.

Facility Location and Operational History

LOS is a coal-based generating station located north of Stanton, North Dakota (**Figure 1**). The plant began operating in 1966 and consists of two power generating units with a total power output capacity of 669 megawatts.

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

CCR Unit Description

The Multi-unit is located on the east side of the LOS generating station (**Figure 2**). Pond 2 was primarily used for the settling of bottom ash with process water directed through Pond 3 for eventual discharge in accordance with North Dakota Pollution Discharge and Elimination System (NDPDES) Permit ND-0025232. These inactive impoundments represent the last configuration of a larger impoundment complex **(Figure 1)**.

Physical Setting

LOS and the Multi-unit are is situated in the valley of the Missouri River. The valley floor is relatively flat, with ground surface elevations ranging from 1,670 feet above mean sea level (ft. amsl) on the current floodplain adjacent to the river, up two relatively poorly defined terraces to 1,715 ft. amsl near the southern property boundary. Seven of the CCR monitoring wells are located on the floodplain or the lower (first) terrace level, while one well is located on the upper (second) terrace **(Figure 2)**.

The geology underlying the Multi-unit is generally comprised of a minimum of 50 feet of alluvial silt, silty sand, and gravel deposits. The upper terrace level appears to be underlain by at least 25 more feet of alluvial deposits than is found adjacent to the Multi-unit. The alluvial deposits are underlain by the Sentinel Butte Formation, which is described

as 1,000 feet or more of continental deposits consisting of dense clay, weakly cemented sandstone, and mudstone interlaced with occasional lignite beds that typically range from 5 to 10 feet in thickness.

Aquifer testing completed at monitoring wells MW-2017-3, MW-2017-4, MW-2017-5 and MW-2017-6 indicates hydraulic conductivity values within the monitored aquifer ranging from 1.28×10^{-2} to 6.94×10^{-4} centimeters per second (cm/sec) with a geometric mean of 2.0×10^{-3} cm/sec (5.67 feet per day [ft/day]). Groundwater at the lower terrace locations is found within alluvial deposits comprised primarily of silty, fine to medium-grained sand at depths ranging roughly from 17 to 35 feet below ground surface (ft, bgs). The resulting potentiometric surface on the lower terrace area is typically encountered at approximately 1,664 ft. amsl and, although the direction of groundwater flow is highly influenced by changes in the elevation of the Missouri River, the net flow direction is expected to be eastward in the general direction of river flow with some flow northward into the river. Groundwater on the upper terrace is perched considerably higher above groundwater the lower terrace water levels but is expected to act as a limited background/upgradient influence on the uppermost aquifer at the Multi-unit.

2. CCR Groundwater Monitoring Activities Prior to August 2019

The regulatory process for CCR groundwater monitoring and corrective action is established by 40 Code of Federal Regulations (CFR) Section 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 assessment of corrective measures followed by selection of remedy and remedy implementation.

The following paragraphs provide a brief summary of CCR groundwater monitoring activities performed prior to August 2019. CCR groundwater monitoring activities performed between August and December 2019 are discussed in Chapter 3.

Groundwater monitoring at LOS 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 the unit (**Figure 2**). The hydrostratigraphic positions of the CCR monitoring wells selected for sampling background and downgradient groundwater quality for the LOS CCR unit is summarized below:

CCR unit	Background wells	Downgradient wells
Ponds 2 and 3 Multi-unit	MW-2017-1 and MW-2017-8	MW-2017-2, MW-2017-3, MW-2017-4, MW-2017-5, MW-2017-6, and MW-2017-7

Baseline Monitoring was initiated in September 2017, which involved sampling groundwater for 40 CFR Part 257 Appendix III and IV constituents over eight monitoring events.

Baseline Monitoring events were performed in general accordance with procedures established in the site-specific Sampling and Analysis Plan (AECOM 2019a), which is included in the facility's 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. The results of Baseline Monitoring at LOS were presented and discussed in the First Annual Groundwater Monitoring and Corrective Action Report, Fall 2017-Spring 2019 (AECOM 2019b) issued on July 31, 2019.

3. CCR Groundwater Monitoring and Corrective Action Activities (August-December 2019)

This chapter summarizes the activities conducted at LOS in August – December 2019 to comply with the groundwater requirements of the CCR rule:

- Groundwater Detection Monitoring activities
  - monitoring system evaluation
  - groundwater sampling
  - laboratory analysis
- Statistical analysis of the monitoring results

Further details concerning each of these activities, including a brief discussion of work completed in early January 2020, are provided below.

Detection Monitoring Activities

Monitoring System Evaluation

As described in the CCR Groundwater Monitoring System Report (AECOM 2019c), monitoring wells were installed around the CCR Multi-unit with appropriate total depth and placement of the well screen to: (1) facilitate collection of representative groundwater samples from the uppermost aquifer, and (2) accurately measure water table elevations to support evaluation of groundwater gradient and flow direction. All monitoring wells comprising the Multi-unit monitoring system were found to be in good condition during the Detection Monitoring events conducted in November 2019.

Analysis of potentiometric surface maps constructed using the depth-to-groundwater measurements obtained during groundwater Detection Monitoring indicates the direction of groundwater flow was generally to the south-southwest, away from the Missouri River at the time of sampling. Baseline Detection Monitoring between fall of 2017 and spring of 2019 indicated the most common flow condition is generally toward the Missouri River; however, reverse flow conditions, as observed during the November 2019 Detection Monitoring event, are not uncommon (AECOM 2019b). The general groundwater flow direction determined during the Baseline Monitoring and 2019 Detection Monitoring periods support the designation of the wells noted in Section 2 above to represent background groundwater quality and the quality of groundwater downgradient of the Multi-unit.

Groundwater Sampling and Analysis

The initial Detection Monitoring event for the Multi-unit was conducted in November 2019, and included analysis of collected groundwater samples for the constituents listed in Part 257 Appendix III.

Detection Monitoring sampling and analysis was performed in general accordance with procedures established in the Sampling and Analysis Plan (AECOM 2018a). The tabulated laboratory analytical results are presented in **Attachment A** along with potentiometric surface maps for the uppermost aquifer, inferred groundwater flow direction and estimated velocities, and a tabulated summary of field measurements.

Statistical Procedures and Analysis

Statistical analysis of the results of Detection Monitoring in 2019 using both MW-2017-1 and MW-2017-8 as background wells identified pH as an unverified SSI for Monitoring Well MW-2017-6.

The Appendix III groundwater quality data were evaluated using an interwell approach that statistically compares constituent concentrations at downgradient monitoring wells to those present at background monitoring wells. For the

LOS Multi-unit, monitoring wells MW-2017-1 and MW-2017-8 are designated as background wells because they are consistently located in background positions whereas monitoring wells MW-2017-2, MW-2017-3, MW-2017-4, MW-2017-5, MW-2017-6 and MW-2017-7 are often located downgradient of the Multi-unit but may individually be upgradient or side-gradient during some events depending on the river influence on groundwater flow direction.

Prediction limits (i.e., parametric or nonparametric) 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. Analytical data from the background monitoring wells collected between September 2017 and November 2019 were used to develop upper prediction limits (UPLs) for the Appendix III constituents at 95 percent confidence. A lower prediction limit (LPL) was also developed for pH which is a two-sided parameter. ProUCL Version 5.1 was used to store the data and run the statistical analyses to calculate the UPLs.

Data from the downgradient monitoring wells for the same time period were compared to the UPL or LPL to identify statistically significant increases (SSIs) over background. Mann-Kendall trend analysis was used to identify statistically significant increasing trends for constituents with a verified SSI. The statistical analysis results indicate that calcium, chloride, fluoride, sulfate and total dissolved solids (TDS) do not currently exhibit SSIs over background. pH also does not exhibit a SSI below background. However, pH exhibits an unverified SSI above the background UPL at monitoring wells MW-2017-2 and MW-2017-3 and a verified SSI above the background UPL at monitoring well MW-2017-6. The results of the analyses, including the UPLs and LPL for pH, are summarized in **Table 1**. A summary of the SSIs above background is provided in **Table 2**.

January 2020 – Redevelopment of MW-2017-6

Redevelopment of MW-2017-6 was conducted on January 9, 2020 to preemptively support a potential Alternative Source Demonstration (ASD) for the elevated pH values observed at this location. The redevelopment was conducted by using the dedicated bladder pump to purge approximately 110 liters of groundwater for 2 hours at rates up to 600 milliliters per minute. The pH of the groundwater was measured using a calibrated YSI 556 water quality meter with a flow-through-cell at 5- to 10-minute intervals. At the start of the event the pH was reported at 8.64 SU, which rose to a maximum of 8.98 standard units (SU) at 5 minutes and 4 liters into the event. Thereafter, the pH value was observed drop consistently with every measurement reaching 7.83 SU and still trending lower when the redevelopment was concluded owing to time constraints. The lowering pH values after a relatively modest volume withdrawn indicates the elevated pH observed in this well is likely sourced back to the cement-bentonite grout used during well construction. This hypothesis, and the potential need for an ASD, will be further evaluated when MW-2017-6 is sampled during the next Detection Monitoring event in spring of 2020.

4. General Information

The following subsections summarize any problems encountered in the LOS Multi-unit CCR program through 2019, any resolutions to those problems, if needed and upcoming actions planned for 2020.

Program Transitions 2019

In August 2019, the LOS Multi-unit monitoring system transitioned from Baseline Detection to Detection Monitoring.

Problems Encountered

No problems were encountered during the August – December 2019 monitoring period.

Actions Planned for 2020

Basin may initiate a Detection-mode ASD for the elevated pH reported at MW-2017-6 with primary focus on likely grout contamination, depending on the results of pH testing during the next monitoring event.

Basin plans on continuing the Detection Monitoring program for the Multi-unit in 2020. The Detection Monitoring program will include semi-annual groundwater sampling events and the required statistical evaluations.

5. Summary and Conclusions

AECOM, on behalf of Basin, conducted one round of CCR groundwater Detection Monitoring at the LOS Pond 2 and Pond 3 Multi-unit between August and December 2019 The results were used to establish background groundwater quality for Appendix III constituents in the uppermost aquifer, identify appropriate UPLs, and determine whether any UPLs were exceeded at statistically significant levels (SSLs) downgradient of the Multi-unit.

The statistical analysis results indicate that, with the exception of pH in MW-2017-6, none of the Appendix III constituents had SSIs over background or statistically significant increasing trends in constituent concentrations. A Detection-mode ASD focused on the pH in MW-2017-6 will be initiated in the spring of 2020. Based on these results, Assessment Monitoring is not required at the LOS Pond 2 and Pond 3 Multi-unit. Detection monitoring will continue at the site in 2020.

6. References

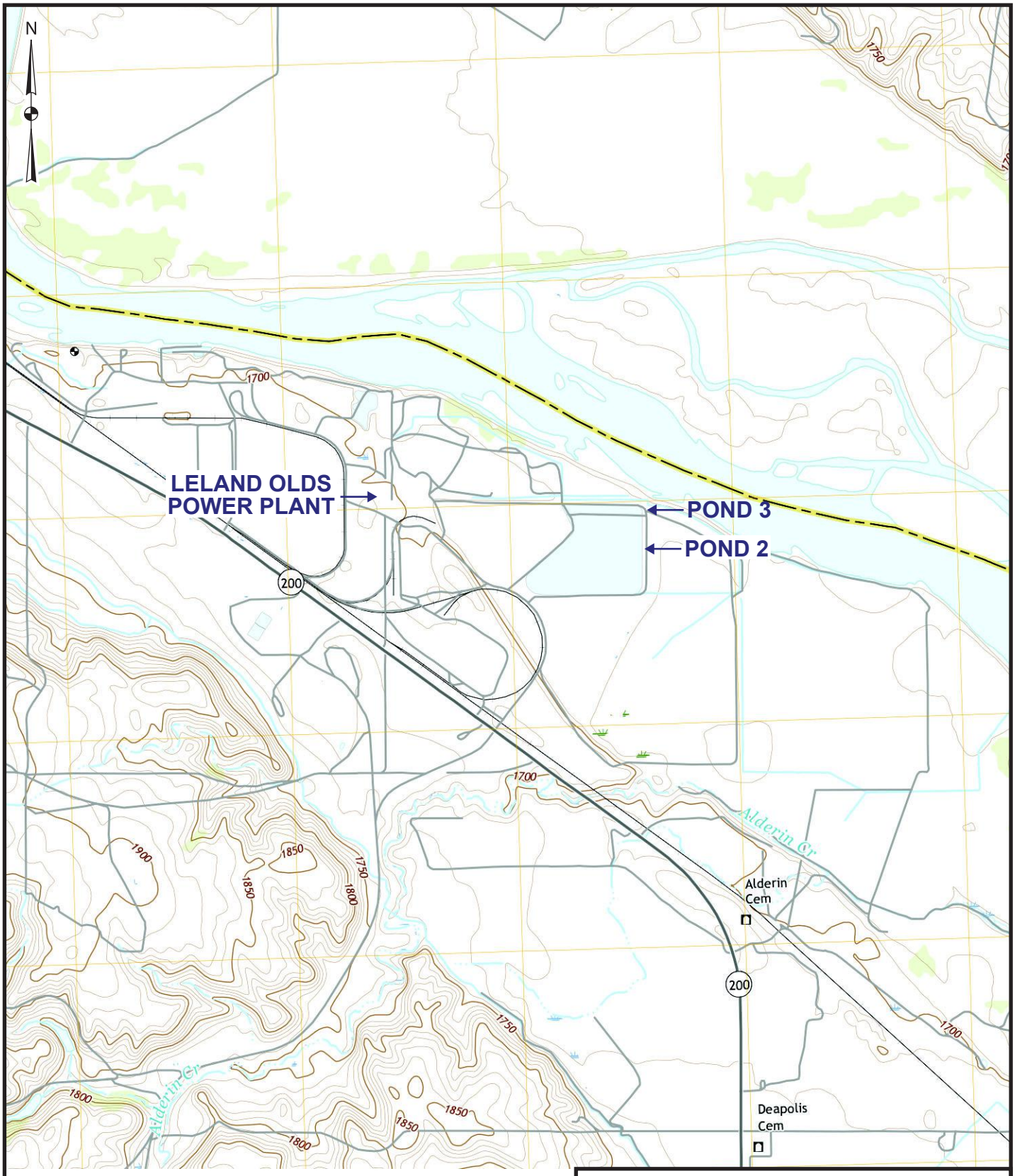
AECOM. 2019a. Pond 2 and Pond 3 Multi-unit Sampling and Analysis Plan, CCR Monitoring Program, Leland Olds Station, Stanton, North Dakota. Basin Electric Power Cooperative. April 2019.

AECOM. 2019b. First Annual Groundwater Monitoring and Corrective Action Report, Fall 2017- Spring 2019, Pond 2 and Pond 3 Multi-unit, Leland Olds Station, Stanton, North Dakota. Basin Electric Power Cooperative. July 31, 2019.

AECOM. 2019c. Pond 2 and Pond 3 Multi-unit CCR Groundwater Monitoring System Report, Leland Olds Station, Stanton, North Dakota. Basin Electric Power Cooperative. October 2017.

U.S. Environmental Protection Agency. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities. Unified Guidance. EPA 530-R-09-007. March 2009. 884 pp.

Figures



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0 2,000 4,000

APPROXIMATE SCALE IN FEET

ND

Quadrangle Location

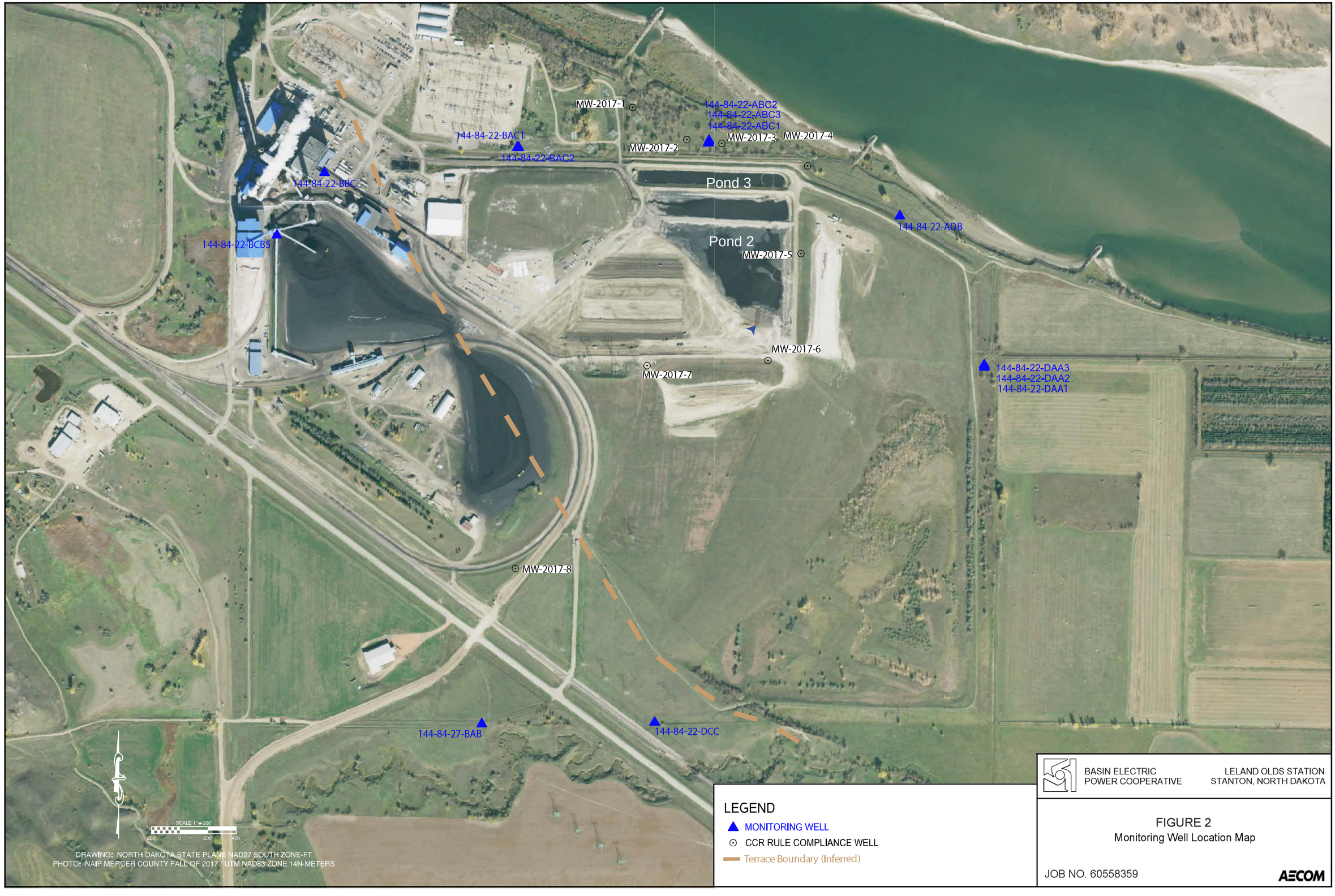
BASE MAP SOURCE: USGS 7½ minute topographic quadrangle mapStanton SE, North Dakota 2018.

BASIN ELECTRIC POWER COOPERATIVE

FIGURE 1
SITE VICINITY MAP
LOS POND 2 AND POND 3 MULTIUNIT

JOB NO. 60558359

AECOM


MW-2017-1
144-84-22-ABC2
144-84-22-ABC3
144-84-22-ABC1
MW-2017-3
MW-2017-4
144-84-22-BAC1
144-84-22-BAC2
MW-2017-2
144-84-22-BBC
Pond 3
144-84-22-ADB
144-84-22-BCB5
Pond 2
MW-2017-5
MW-2017-6
MW-2017-7
144-84-22-DAA3
144-84-22-DAA2
144-84-22-DAA1
MW-2017-8
144-84-27-BAB
144-84-22-DCC
SCALE 1" = 200'
200' 0 200' 400'
DRAWING: NORTH DAKOTA STATE PLANE NAD27 SOUTH ZONE-FT
PHOTO: NAIP MERCER COUNTY FALL OF 2017 / UTM NAD83 ZONE 14N-METERS
LEGEND
MONITORING WELL
CCR RULE COMPLIANCE WELL
Terrace Boundary (Inferred)
BASIN ELECTRIC POWER COOPERATIVE
LELAND OLDS STATION
STANTON, NORTH DAKOTA
FIGURE 2
Monitoring Well Location Map
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Tables

TABLE 1

Statistical Analysis Methods and Background Upper/Lower Prediction Limits
LOS Pond 2 and Pond 3 (Multi-Unit) CCR Monitoring Well Network

Parameter (Units)	Number of Samples	Percent Nondetects	Normal or Lognormal Distribution?	Statistical Method	Background Limit
Boron (mg/L)	14	0	No/No	Nonparametric 95% UPL	2.37
Calcium (mg/L)	14	0	Yes/Yes	Parametric 95% UPL	161
Chloride (mg/L)	14	0	No/No	Nonparametric 95% UPL	25
Fluoride (mg/L)	14	0	No/No	Nonparametric 95% UPL	1
pH (std units)	14	0	Yes/Yes	Parametric 95% LPL/UPL	6.68/7.65
Sulfate (mg/L)	14	0	No/No	Nonparametric 95% UPL	2,100
TDS (mg/L)	14	0	No/No	Nonparametric 95% UPL	4,000

TABLE 2

STATISTICAL METHOD ANALYSIS AND RESULTS

LOS POND 2 AND POND 3 (MULTIUNIT) CCR MONITORING WELL NETWORK

LELAND OLDS STATION - STANTON, NORTH DAKOTA

Well	Location	B	Ca	Cl	F	pH LPL/UPL)		SO4	TDS
MW-2017-2	Downgradient								
MW-2017-3	Downgradient								
MW-2017-4	Downgradient								
MW-2017-5	Downgradient								
MW-2017-6	Downgradient								
MW-2017-7	Downgradient								

Notes:

SSIs determined using interwell upper prediction limits (UPLs) at background monitoring well MW-2017-1

Less than or equal to background upper prediction limit (UPL) or greater than lower prediction limit (LPL) for pH

Unverified statistically significant increase (SSI) over background UPL or below background LPL for pH

Verified SSI over background UPL or below background LPL for pH

Attachment A
Sampling and Analysis Report, 2019

2019 Sampling and Analysis Report, Pond 2 and LOS Pond 3 Multi-unit CCR Monitoring Program

Leland Olds Station
Stanton, North Dakota

Basin Electric Power Cooperative

January 31, 2020

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List of Acronyms

AECOM	AECOM Technical Services, Inc.
Basin	Basin Electric Power Cooperative
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPA	United States Environmental Protection Agency
LOS	Leland Olds 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 Pond 2 and Pond 3 Multiunit at Basin's Leland Olds Station (LOS). The objective of the report is to provide a description of the field and office activities performed between August and December of 2019.

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), Section 257.90 to 257.98). Specifically, the report presents the data collected for the groundwater Detection Monitoring event conducted in November 2019.

2. Groundwater Flow

As required by 40 CFR Section 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 a potentiometric surface map for the uppermost aquifer for the detection monitoring event. The resulting potentiometric surface map was used to evaluate the direction of groundwater flow and hydraulic gradient for the subject CCR unit. **Figure 1** represents the potentiometric surface map constructed using measurements taken on November 11, 2019. This potentiometric map illustrates a pattern of groundwater flow generally to the south-southwest away from the Missouri River and then swinging broadly down-valley to the east-southeast. This flow direction is generally consistent with three of the eight baseline monitoring events for the site between the fall of 2017 and spring of 2019. The remaining five events exhibited groundwater flow directions generally north-northeast toward the Missouri River. Groundwater flow velocities were calculated and are summarized in **Table 2**.

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

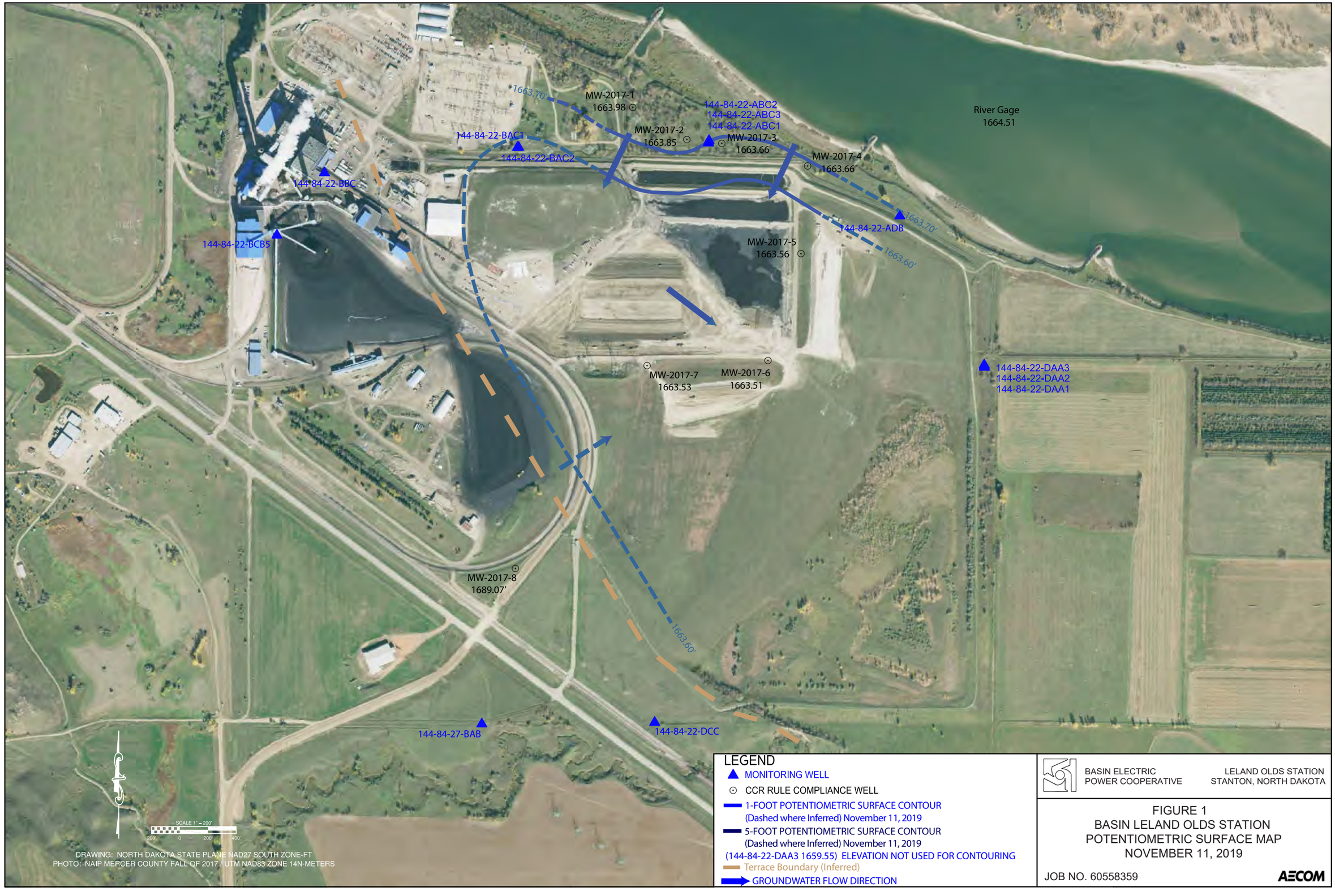
CCR unit	Background wells	Downgradient wells
Pond 2 and Pond 3 Multiunit	MW-2017-1 and MW-2017-8	MW-2017-2, MW-2017-3, MW-2017-4, MW-2017-5, MW-2017-6, and MW-2017-7

Monitoring well MW-2017-8 is being included from the groundwater monitoring network as a background well due to its upgradient location relative to the Multi-unit. Additional evaluation of MW-2017-8 is anticipated to occur in 2020 including gauging, sampling, and installation of a deeper well to evaluate the underlying stratigraphy.

3. Groundwater Quality

The analytical testing laboratory provided a report presenting the results of laboratory analysis for the November 2019 monitoring event. The laboratory report is included in the operating record and was reviewed for completeness against the project-required methods and the chain-of-custody forms. The laboratory report was also reviewed for holding times, and to check that the data was appropriately flagged based on the quality assurance/quality control (QA/QC) data provided. A data validation report was prepared for the monitoring event and is included in the operating record. The validated results were compiled into summary form as presented in **Table 3**.

Figure


1663.70'
MW-2017-1
1663.98
144-84-22-ABC2
144-84-22-ABC3
144-84-22-ABC1
MW-2017-2
1663.85
MW-2017-3
1663.66
River Gage
1664.51
144-84-22-BAC1
144-84-22-BAC2
MW-2017-4
1663.66
144-84-22-BBC
1663.70'
144-84-22-ADB
144-84-22-BCB5
MW-2017-5
1663.56
1663.60'
MW-2017-7
1663.53
MW-2017-6
1663.51
144-84-22-DAA3
144-84-22-DAA2
144-84-22-DAA1
MW-2017-8
1689.07'
1663.60'
144-84-27-BAB
144-84-22-DCC
SCALE 1" = 200'
200' 0 200' 400'
DRAWING: NORTH DAKOTA STATE PLANE NAD27 SOUTH ZONE-FT
PHOTO: NAIP MERCER COUNTY FALL OF 2017 / UTM NAD83 ZONE 14N-METERS
LEGEND
MONITORING WELL
CCR RULE COMPLIANCE WELL
1-FOOT POTENTIOMETRIC SURFACE CONTOUR
(Dashed where Inferred) November 11, 2019
5-FOOT POTENTIOMETRIC SURFACE CONTOUR
(Dashed where Inferred) November 11, 2019
(144-84-22-DAA3 1659.55) ELEVATION NOT USED FOR CONTOURING
Terrace Boundary (Inferred)
GROUNDWATER FLOW DIRECTION
BASIN ELECTRIC POWER COOPERATIVE
LELAND OLDS STATION
STANTON, NORTH DAKOTA
FIGURE 1
BASIN LELAND OLDS STATION
POTENTIOMETRIC SURFACE MAP
NOVEMBER 11, 2019
JOB NO. 60558359
AECOM

Tables

TABLE 1

DETECTION GROUNDWATER MONITORING WATER LEVELS AND ELEVATIONS
LOS POND 2 AND POND 3 (MULTIUNIT) CCR MONITORING WELL NETWORK
LELAND OLDS STATION - STANTON, NORTH DAKOTA

Well ID	Measurement Date	Reference Elevation Top of Inner Casing (feet, NAVD 88)	Depth to Water Feet Below Top of Inner Casing	Groundwater Elevation (feet, NAVD 88)
MW-2017-1	**11/12/2019**	1,683.86	19.88	1,663.98
MW-2017-2	**11/12/2019**	1,681.03	17.18	1,663.85
MW-2017-3	**11/11/2019**	1,682.36	18.70	1,663.66
MW-2017-4	**11/11/2019**	1,684.13	20.47	1,663.66
MW-2017-5	**11/11/2019**	1,691.72	28.16	1,663.56
MW-2017-6	**11/11/2019**	1,693.44	29.91	1,663.53
MW-2017-7	**11/11/2019**	1,698.25	34.74	1,663.51
MW-2017-8	**11/12/2019**	1,717.23	28.16	1,689.07
Missouri River	**11/11/2019**	1,650.00	14.51	1,664.51

NM = Measurement not available
Missouri River elevation as reported by USGS Gauge 06340700, Stanton, ND at 1200 on November 11, 2019

TABLE 2

POND 2 and POND 3 MULTIUNIT GROUNDWATER GRADIENT AND SEEPAGE VELOCITY

Date of event	d_l (ft)	d_h (ft)	i (ft/ft)	n_e	K (ft/day)	v_s (ft/day)
3/12/2018	Insufficient Data: Limited site access due to high water					
4/17/2018	307	0.25	0.00081	0.33	1.16E+01	2.86E-02
6/14/2018*	493	0.25	0.00051	0.33	1.16E+01	1.78E-02
7/23/2018*	397	0.5	0.00126	0.33	1.16E+01	4.43E-02
9/27/2018*	480	0.25	0.00052	0.33	1.16E+01	1.83E-02
3/12/2019	337	0.5	0.00148	0.33	1.16E+01	5.22E-02
3/27/2019	300	0.5	0.00167	0.33	1.16E+01	5.86E-02
4/9/2019	303	0.75	0.00248	0.33	1.16E+01	8.70E-02
11/11/2019*	300	0.1	0.00033	0.33	1.16E+01	1.17E-02

d_l = Horizontal separation between upgradient and downgradient locations perpendicular to potentiometric contours

d_h = Change in hydraulic head between upgradient and downgradient locations

i = Hydraulic gradient (change in elevation over distance)

n_e = Site average porosity of 33%

K = Site average hydraulic conductivity of 11.6 ft/day from slug tests at site

v_s = Seepage Velocity (ft/day)

Hydraulic Gradient Governing Equation[1] – $i = -dh/dl$

Seepage Velocity Governing Equation[2] – $v_s = -K * i/n_e$

Table 3

Analytical Results Summary
LOS Pond 2 and Pond 3 (Multiunit) CCR Monitoring Well Network
Leland Olds Station - Stanton, North Dakota

			Appendix III Constituents						
	Event	Date	Boron mg/L	Calcium mg/L	Chloride mg/L	Fluoride mg/L	pH SU	Sulfate mg/L	Total mg/L
MW-2017-1	Event 01	3/12/18	2.0 F1	100	8.8	< 0.50 U	6.95	210	710
MW-2017-1	Event 02	4/17/18	2.1 F1	96	9.4	< 0.50 U	6.86	200	680
MW-2017-1	Event 03	6/14/18	2.2	89	8.2	< 0.50 U	7.06	220	690 H
MW-2017-1	Event 04	7/25/18	2.36 F1	91.1	8.73	< 0.500 U	7.21	218	710
MW-2017-1	Event 05	8/27/18	2.37	89.6	8.65	< 0.500 U	7.38	219	707
MW-2017-1	Event 06	3/12/19	2.15	103	8.50 H	< 0.500 UH	7.19	217 H	735
MW-2017-1	Event 07	3/27/19	2.02	98.3	8.53 HF1	< 0.500 UH	7.26	212 H	718
MW-2017-1	Event 08	4/9/19	2.02	107	8.91	< 0.500 U	7.23	221	761 H
MW-2017-1	Event 09	11/12/19	1.11	130	9.00	0.426	7.73	233	740
MW-2017-1 Dup	Event 01	3/12/18	2.1	110	8.8	< 0.50 U	6.95	210	710 H
MW-2017-1 Dup	Event 02	4/17/18	2.1	97	8.7	< 0.50 U	6.86	190	720
MW-2017-1 Dup	Event 03	6/14/18	2.3	92	8.2	< 0.50 U		220	720
MW-2017-1 Dup	Event 04	7/25/18	2.34	90.3	8.74	< 0.500 U		215	710
MW-2017-1 Dup	Event 05	8/27/18	2.42	91.1	8.73	< 0.500 U		220	717
MW-2017-1 Dup	Event 06	3/12/19	2.18	106	9.23 H	< 0.500 UH		219 H	742
MW-2017-1 Dup	Event 07	3/27/19	2.25	106	8.46 H	< 0.500 UH		211 H	740
MW-2017-1 Dup	Event 08	4/9/19	2.02	109	9.00	< 0.500 U		218	773 H
MW-2017-2	Event 01	3/12/18	1.6	120	12	< 0.50 U	6.88	320	920
MW-2017-2	Event 02	4/17/18	1.4	130	12	< 0.50 U	7.37	330	930
MW-2017-2	Event 03	6/14/18	1.3	130	10	< 0.50 U	7.04	320	890 H
MW-2017-2	Event 04	7/23/18	1.60	73.7	10.6	0.608	7.19	262	690
MW-2017-2	Event 05	8/27/18	1.61	74.1	10.5	0.537	7.49	261	< 10.0 U
MW-2017-2	Event 06	3/12/19	1.18	120	11.8 H	< 0.500 UH	7.19	323 H	910
MW-2017-2	Event 07	3/27/19	1.13	122	11.2 H	< 0.500 UH	7.12	336 H	948
MW-2017-2	Event 08	4/9/19	1.22	121	11.3	< 0.500 U	7.25	308	853 H
MW-2017-2	Event 09	11/12/19	0.820	75.3	10.7	0.524	7.94	231	676
MW-2017-3	Event 01	3/12/18	1.6	84	11	0.50	6.71	190	760
MW-2017-3	Event 02	4/17/18	1.6	87	11	< 0.50 U	7.04	190	750
MW-2017-3	Event 03	6/14/18	1.6	84	9.4	< 0.50 U	7.1	200	750 H
MW-2017-3	Event 04	7/23/18	1.57	87.2	10.6	< 0.500 U	7.09	184	770
MW-2017-3	Event 05	8/27/18	1.61	81.4	10.5	< 0.500 U	7.35	187	765
MW-2017-3	Event 06	3/12/19	1.63	81.1	10.7 H	< 0.500 UH	7.25	190 H	765
MW-2017-3	Event 07	3/27/19	1.75 F1	80.3	10.6 H	0.516 H	7.15	182 H	756
MW-2017-3	Event 08	4/9/19	1.71	84.7	10.9	0.523	7.3	190	739 H
MW-2017-3	Event 09	11/11/19	1.45	72.4	10.6	0.498	7.86	184	710
MW-2017-3 Dup	Event 09	11/11/19	1.97	105	10.6	0.498	7.86	186	714
MW-2017-4	Event 01	3/12/18	1.4	140	9.8	0.75	6.82	300	830
MW-2017-4	Event 02	4/17/18	1.2	140	10	0.77	6.64	310	860
MW-2017-4	Event 03	6/14/18	1.2	140	9.3	0.59	7.02	300	870 H
MW-2017-4	Event 04	7/25/18	1.13	128	10.4	0.791	7.06	252	800
MW-2017-4	Event 05	8/28/18	1.15	127	10.3	0.790	7.31	292	818
MW-2017-4	Event 06	3/12/19	1.35	139	10.1 H	0.716 H	7.1	307 H	788
MW-2017-4	Event 07	3/27/19	1.47	133	9.55 H	0.725 H	7.06	294 H	850
MW-2017-4	Event 08	4/9/19	1.60	154	9.75	0.747	7.07	294	854 H
MW-2017-4	Event 09	11/11/19	1.74	78.5	10.4	0.768	7.78	289	832
MW-2017-5	Event 02	4/18/18	0.64	82	11	< 0.50 U	7.17	300	660
MW-2017-5	Event 03	6/14/18	0.74	82	9.5	< 0.50 U	6.98	290	650 H
MW-2017-5	Event 04	7/25/18	0.753	82.2	10.5	< 0.500 U	7.04	361	670
MW-2017-5	Event 05	8/28/18	0.870	84.1	10.4	0.514	7.34	304	676
MW-2017-5	Event 06	3/12/19	0.890	86.8	10.7 H	0.711 H	7.7	315 H	685
MW-2017-5	Event 07	3/27/19	0.897	79.7	11.1 H	0.778 H	7.49	314 H	659
MW-2017-5	Event 08	4/9/19	0.963	87.6	11.3	0.784	7.4	310	668 H
MW-2017-5	Event 09	11/11/19	1.78	82.3	11.0	0.812	7.42	293	628
MW-2017-5	Event Supp	11/1/18	0.930	85.4	10.8	0.640	7.22	321	1130

Table 3

Analytical Results Summary
LOS Pond 2 and Pond 3 (Multiunit) CCR Monitoring Well Network
Leland Olds Station - Stanton, North Dakota

			Appendix III Constituents						
	Event	Date	Boron mg/L	Calcium mg/L	Chloride mg/L	Fluoride mg/L	pH SU	Sulfate mg/L	Total mg/L
MW-2017-6	Event 02	4/18/18	2.6	87	8.3	< 0.50 U	11.79	220	630
MW-2017-6	Event 03	6/14/18	1.2	63	10	< 0.50 U	11.66	220	430 H
MW-2017-6	Event 04	7/25/18	1.06	65.8	11.0	0.503	10.08	212	470
MW-2017-6	Event 05	8/28/18	1.05	56.4	11.1	0.540	10.05	197	490
MW-2017-6	Event 06	3/12/19	1.26	55.5	11.1 H	0.545 H	9.52	205 H	534
MW-2017-6	Event 07	3/27/19	11.4	60.6	5.03 H	0.634 H	11.52	502 H	619
MW-2017-6	Event 08	4/9/19	5.06	46.5	9.17	< 0.500 U	11.81	270	618 H
MW-2017-6	Event 09	11/11/19	1.77	39.4	10.4	0.513	9.57	218	552
MW-2017-6	Event Supp	11/1/18	1.10	53.9	11.7	< 0.500 U	10.02	221	435
MW-2017-7	Event 01	3/14/18	1.9	65	11	1.0	6.58	310	690
MW-2017-7	Event 02	4/17/18	2.0	70	11	1.0	7.35	320	690
MW-2017-7	Event 03	6/15/18	1.9	66	< 30 U	< 5.0 U	7.54	280	720 H
MW-2017-7	Event 04	7/25/18	2.00	67.5	< 15.0 U	< 2.50 U	7.48	291	750
MW-2017-7	Event 05	8/28/18	2.07	65.2	< 30.0 U	< 5.00 U	7.78	300	696
MW-2017-7	Event 06	3/12/19	2.05	67.8	11.1 H	1.26 H	7.34	315 H	722
MW-2017-7	Event 07	3/27/19	1.96	63.1	11.1 H	1.39 H	7.96	302 H	701
MW-2017-7	Event 08	4/9/19	2.04	67.2	< 300 U	< 50.0 U	7.37	1030	896 H
MW-2017-7	Event 09	11/11/19	2.16	59.4	10.6	1.37	7.49	309	686
MW-2017-8	Event 01	3/14/18	0.48	150	25	< 1.0 U	7.03	2000	3800
MW-2017-8	Event 02	4/18/18	0.46	150	25	< 1.0 U	7.38	2100	4000
MW-2017-8	Event 03	6/15/18	0.46	140	22	< 1.0 U	7.19	2100	4000 H
MW-2017-8	Event 04	7/25/18	0.465	145	24.3	< 1.00 U	7.23	2010	3900
MW-2017-8	Event 05	8/28/18	0.468	140	24.0	< 1.00 U	7.52	2020	3880 H

TDS = Total Dissolved Solids
mg/L = milligrams per liter
S.U. = Standard units
pCi/L = picoCurie/liter
U = Analyte analyzed for but not detected
F1 = MS and/or MSD Recovery is outside acceptance limits
H = Sample was prepped or analyzed beyond the specified holdilng time