

2020 Annual Groundwater Monitoring and Corrective Action Report

CCR Landfill

R.M. Heskett Station

Mandan, North Dakota

Prepared for
Montana-Dakota Utilities Co.

January 2021



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January 31, 2021

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Acronyms

Acronym	Description
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
MDU	Montana Dakota Utilities Co.
SSI	Statistically Significant Increase
TDS	Total dissolved solids

1.0 Introduction

Montana-Dakota Utilities Co. (MDU) owns and operates R.M. Heskett Station, a coal-fired generating station and a gas fired turbine located in Mandan, North Dakota (Figure 1). One CCR landfill, as defined by 40 CFR 257.53, is located on the property. Wastes contained in the CCR landfill primarily consist of coal combustion by-products, asbestos wastes generated from construction activity associated with MDU-owned facilities, and ash derived from the burning of tire-derived fuel at the facility.

This 2020 Annual Groundwater Monitoring and Corrective Action Report (Annual Report) describes the monitoring program and results for the CCR landfill at MDU's R.M. Heskett Station (Site).

1.1 Purpose

As stated in Section §257.90 (e), the Annual Report must:

- Document the status of groundwater monitoring and any corrective action programs for the CCR unit,
- Summarize key actions completed,
- Describe any problems encountered,
- Discuss actions to resolve the problems, and
- Project key activities for the upcoming year.

1.2 CCR Rule Requirements

Additional requirements for the Annual Report, as outlined in §257.90 (e) of the CCR Rule and this Site's compliance with the CCR Rule, are summarized in Table 1.

Table 1 CCR Rule Requirements and Compliance

CCR Rule Reference	Content Required in Report	Location
§257.90(e)(1)	Monitoring System Figure: A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit.	Section 2.2 Groundwater Monitoring System; see Figure 1.
§257.90(e)(2)	Monitoring System Adjustments: Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken.	Section 2.2 Groundwater Monitoring System
§257.90(e)(3)	Data and Collection Summary: In addition to all the monitoring data obtained under §257.90 through §257.98, a summary including the number of groundwater samples that were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs.	Section 2.4 Monitoring and Analytical Results
§257.90(e)(4)	Monitoring Program: A narrative discussion of any transition between monitoring programs (e.g. the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels).	Section 2.4 Monitoring and Analytical Results
§257.90(e)(5)	<p>Other Information: Other information required, if applicable, to be included in the annual report as specified in §257.90 through §257.98.</p> <ul style="list-style-type: none"> - Alternative Monitoring Frequency Demonstration (§257.94(d) and §257.95 (c)(3)) - Appendix III Alternative Source Demonstration Report (§257.94(e)(2)) - Assessment Monitoring Results and Discussion (§257.95(d)(3)) - Appendix IV Alternative Source Demonstration Report (§257.95(g)(3)(ii)) - Demonstration for Additional Time for Assessment or Corrective Measures (§257.96(a)) 	Section 2.4 Monitoring and Analytical Results

Table 2 CCR Rule Requirements and Compliance (con't)

CCR Rule Reference	Content Required in Report	Location
§257.90(e)(6)	<p>Executive Summary: A section at the beginning of the annual report that provides an overview of the current status of groundwater monitoring and corrective action programs for the CCR unit. At a minimum, the summary must specify all of the following (as outlined in §257.90(e)(6)(i) through §257.90(e)(6)(vi):</p> <ul style="list-style-type: none"> - If the CCR unit was operating under detection monitoring or assessment monitoring at the start and end of the current annual reporting period - If an SSI over background for one or more Appendix III constituents: <ul style="list-style-type: none"> o identify the constituents and monitoring wells associated with the increase; and o provide the date when the assessment monitoring program was initiated. - If an SSI over groundwater protection standard for one or more Appendix IV constituents: <ul style="list-style-type: none"> o Identify the constituents and monitoring wells associated with the increase, o Provide the date when the assessment of corrective measures was initiated; o Provide the date when the public meeting was held for the assessment of corrective measures; and o Provide the date when the assessment of corrective measures was completed. - If a remedy was selected pursuant to §257.97 during the current annual reporting period, and if so, the date of remedy selection; and - If remedial activities were initiated or on-going pursuant to §257.98 during the current annual reporting period. 	Section 2.1 Executive Summary

2.0 Groundwater Monitoring Program

This section documents the status of the groundwater monitoring and corrective action program for the CCR unit in 2020. The executive summary is in Section 2.1, followed by a description of the groundwater monitoring system is described in Section 2.2, key actions completed, and problems encountered are described in Section 2.3, the monitoring and analytical results are described in Section 2.4, and key activities planned for 2021 are described in Section 2.5.

2.1 Executive Summary

The CCR unit at the Site operated under detection monitoring throughout 2020. SSIs were identified in April 2020 for chloride at MW-105 and sulfate and TDS at MW-104 and in September 2020 for fluoride at MW2-90, chloride at MW-105, and sulfate and TDS at MW-104. Successful ASDs were conducted for the October 2019 and April 2020 SSIs, therefore allowing the Site to continue operating under detection monitoring; an ASD is forthcoming for the September 2020 event.

2.2 Groundwater Monitoring System

The groundwater monitoring system is consistent with the Groundwater Monitoring System Certification (Barr, 2017a), as seen in Figure 1; no adjustments or changes were made to the groundwater monitoring system in 2020.

2.3 Actions Completed/Problems Encountered

The following actions were completed in 2020:

- **Detection Monitoring Sampling:** Groundwater samples were collected from each well in the groundwater monitoring system on March 31-April 6, 2020 and September 14-15, 2020; samples were analyzed for Appendix III constituents, per the detection monitoring program of the CCR Rule (§257.94).
- **SSI Evaluation:** SSI evaluations were conducted in accordance with the Groundwater Statistical Method Selection Certification (Statistical Certification; Barr, 2017b) for the September 2019 and April 2020, detection monitoring events, both of which resulted in potential SSIs.
- **Verification Retesting:** No verification retesting was conducted in 2020.
- **Alternative Source Demonstration (ASD):** ASDs were conducted on the verified SSIs for the September 2019 and April 2020 detection monitoring events. Both ASDs were able to demonstrate an alternative source, as allowed by the CCR rule (§257.94(e)(2)). More details are provided in Section 2.4.

2.4 Data and Collection Summary

2.4.1 September 2019 Detection Monitoring Event

As mentioned in the 2019 Annual Report, an SSI evaluation was to be conducted on the results of the September 2019 detection monitoring event. Four potential SSIs (fluoride at MW2-90, chloride at MW-

105, and sulfate and TDS at MW-104) were identified. Field data sheets and analytical laboratory reports for detection monitoring sampling is included in Appendix A.

An Appendix III ASD was conducted on the verified SSIs and was able to successfully demonstrate that a natural variation in groundwater quality resulted in the SSIs, as allowed by §257.94(e)(4). The Alternative Source Demonstration: September 2019 Event Report is included in Appendix B.

2.4.2 April 2020 Detection Monitoring Event

Groundwater samples were collected from all 12 monitoring wells at the Site on March 30-April 6, 2020. Three potential SSIs (chloride at MW-105 and sulfate and TDS at MW-104) were identified. Field data sheets and analytical laboratory reports for detection monitoring sampling and verification resampling are included in Appendix A.

An Appendix III ASD was conducted on the verified SSIs and was able to successfully demonstrate that a natural variation in groundwater quality and/or "a source other than the CCR unit" resulted in the SSIs, as allowed by §257.94(e)(4). The Alternative Source Demonstration: April 2020 Event is included in Appendix B.

2.4.3 September 2020 Detection Monitoring Event

Groundwater samples were collected from all 12 monitoring wells at the Site on September 14-16, 2020. Four potential SSIs (fluoride at MW2-90, chloride at MW-105, and sulfate and TDS at MW-104) were identified. Field data sheets and analytical laboratory reports for detection monitoring sampling are included in Appendix A.

2.5 Activities for Upcoming Year

The following key activities for analytical results and statistical evaluations are planned for 2020:

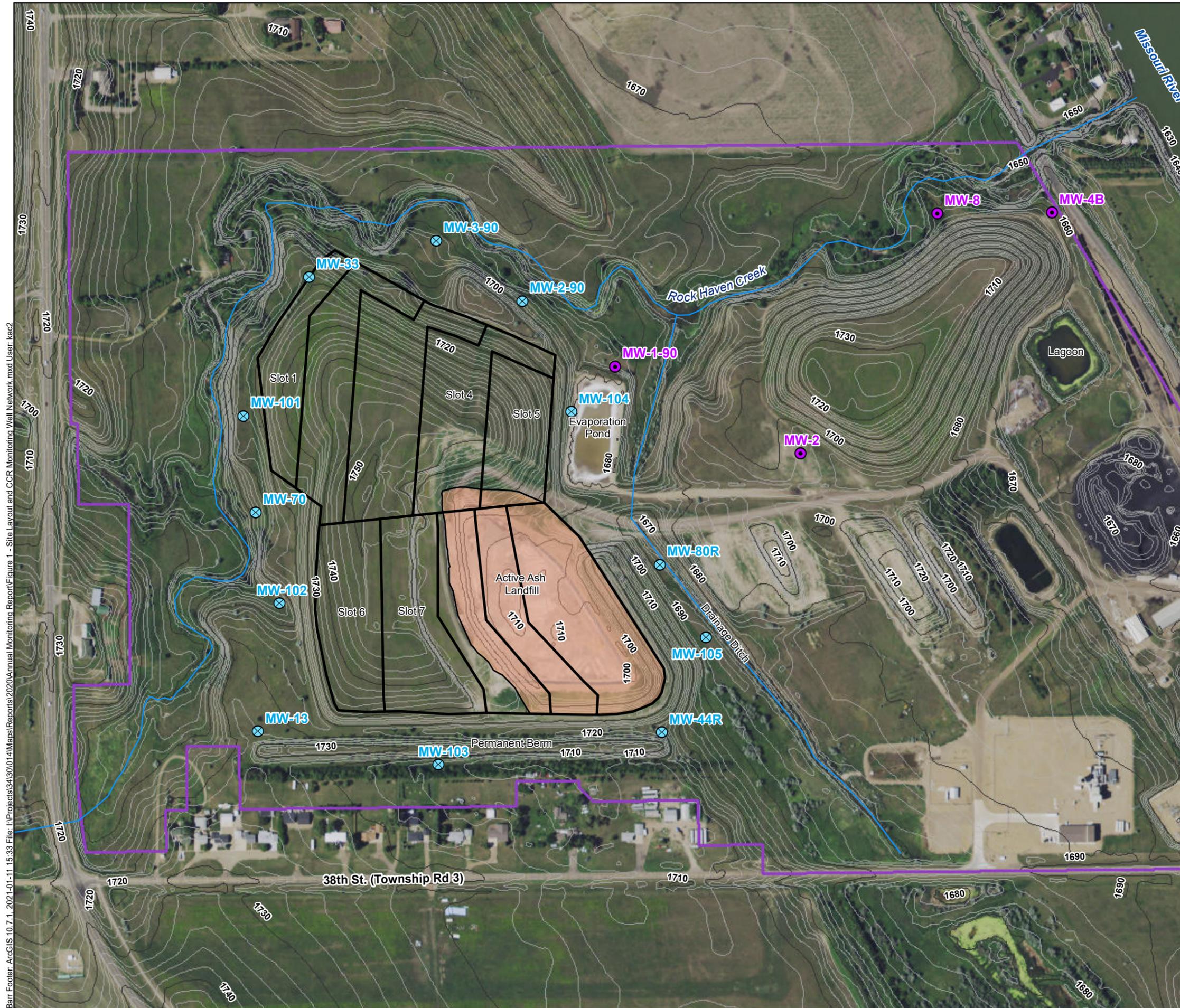
- Complete ASD evaluation for the September 2020 detection monitoring event in accordance with the Statistical Certification (Barr, 2017b).
- Evaluate analytical results from 2021 semi-annual detection monitoring events for SSIs according to the Statistical Certification (Barr, 2017b).

3.0 References

Barr Engineering Co. (Barr), 2017a, Groundwater Monitoring System Certification, October 2017.

Barr, 2017b, Statistical Method Selection Certification, October 2017.

Figure



- Monitoring Well Location
- Monitoring Well Location - Water Level Only
- Existing Slot Boundaries
- Streams
- Property Line
- 10ft Contours
- 2ft Contours
- Active Portion of Landfill

Image Source: 2020 Statewide Imagery (ND GIS Hub)

CAD Data Source: Slot Linework.dwg



Figure 1

**SITE LAYOUT AND CCR
MONITORING WELL NETWORK
R. M. Heskett Station
2020 Annual Groundwater Monitoring
and Corrective Action Report
Montana Dakota Utilities
Mandan, North Dakota**

Appendix A

Laboratory Reports and Field Sheets



MINNESOTA VALLEY TESTING LABORATORIES, INC.

1126 North Front St. ~ New Ulm, MN 56073 ~ 800-782-3557 ~ Fax 507-359-2890
2616 East Broadway Ave. ~ Bismarck, ND 58501 ~ 800-279-6885 ~ Fax 701-258-9724
1201 Lincoln Hwy. ~ Nevada, IA 50201 ~ 800-362-0855 ~ Fax 515-382-3885
www.mvttl.com



APP III

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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 23 Apr 20
Lab Number: 20-W540
Work Order #: 82-0721
Account #: 002800
Date Sampled: 30 Mar 20 9:51
Date Received: 31 Mar 20 14:40
Sampled By: MVTL Field Servies

Project Name: MDU Heskett Active Ash
Sample Description: 13

Temp at Receipt: 1.6C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	7.01	units	NA	SM 4500 H+ B	30 Mar 20 9:51	JSM
pH	* 7.2	units	0.1	SM4500 H+ B	31 Mar 20 17:00	HT
Temperature - Field	7.72	Degrees C	NA	SM 2550B	30 Mar 20 9:51	JSM
Conductivity - Field	10325	umhos/cm	1	EPA 120.1	30 Mar 20 9:51	JSM
Fluoride	0.94	mg/l	0.10	SM4500-F-C	31 Mar 20 17:00	HT
Sulfate	7280	mg/l	5.00	ASTM D516-11	1 Apr 20 9:47	EV
Chloride	77.5	mg/l	1.0	SM4500-Cl-E	1 Apr 20 12:09	EV
Total Dissolved Solids	10700	mg/l	10	I1750-85	2 Apr 20 13:45	HT
Calcium - Total	430	mg/l	1.0	6010D	22 Apr 20 9:12	MDE
Boron - Total	0.54	mg/l	0.10	6010D	8 Apr 20 10:21	SZ

* Holding time exceeded

Approved by:

Claudette K. Carroll

CC
29-Apr 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:

@ = Due to sample matrix
! = Due to sample quantity

= Due to concentration of other analytes
+ = Due to internal standard response

CERTIFICATION: ND # ND-00016



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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 23 Apr 20
Lab Number: 20-W541
Work Order #: 82-0721
Account #: 002800
Date Sampled: 30 Mar 20
Date Received: 31 Mar 20 14:40
Sampled By: MVTL Field Servies

Project Name: MDU Heskett Active Ash
Sample Description: Dup1

Temp at Receipt: 1.6C ROI

Event and Year: Spring 2020

	As Received Result	units	Method RL	Method Reference	Date Analyzed	Analyst
pH	* 7.2	units	0.1	SM4500 H+ B	31 Mar 20 17:00	HT
Fluoride	0.94	mg/l	0.10	SM4500-F-C	31 Mar 20 17:00	HT
Sulfate	7620	mg/l	5.00	ASTM D516-11	1 Apr 20 9:47	EV
Chloride	78.4	mg/l	1.0	SM4500-Cl-E	1 Apr 20 12:09	EV
Total Dissolved Solids	10700	mg/l	10	I1750-85	2 Apr 20 13:45	HT
Calcium - Total	414	mg/l	1.0	6010D	3 Apr 20 13:55	MDE
Boron - Total	0.55	mg/l	0.10	6010D	8 Apr 20 10:21	SZ

* Holding time exceeded

Approved by:

CC
Claudette K. Carroll 27 Apr 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 23 Apr 20
Lab Number: 20-W542
Work Order #: 82-0721
Account #: 002800
Date Sampled: 31 Mar 20 9:20
Date Received: 31 Mar 20 14:40
Sampled By: MVTL Field Servies

Project Name: MDU Heskett Active Ash
Sample Description: 102

Temp at Receipt: 1.6C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.88	units	NA	SM 4500 H+ B	31 Mar 20 9:20	JSM
pH	* 7.1	units	0.1	SM4500 H+ B	31 Mar 20 17:00	HT
Temperature - Field	7.35	Degrees C	NA	SM 2550B	31 Mar 20 9:20	JSM
Conductivity - Field	9149	umhos/cm	1	EPA 120.1	31 Mar 20 9:20	JSM
Fluoride	0.13	mg/l	0.10	SM4500-F-C	31 Mar 20 17:00	HT
Sulfate	6220	mg/l	5.00	ASTM D516-11	1 Apr 20 9:47	EV
Chloride	5.6	mg/l	1.0	SM4500-Cl-E	1 Apr 20 12:09	EV
Total Dissolved Solids	9110	mg/l	10	I1750-85	2 Apr 20 13:45	HT
Calcium - Total	446	mg/l	1.0	6010D	3 Apr 20 13:55	MDE
Boron - Total	1.42	mg/l	0.10	6010D	8 Apr 20 10:21	SZ

* Holding time exceeded

Approved by:

Claudette K. Carroll *29 Apr 2020*

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 23 Apr 20
Lab Number: 20-W543
Work Order #: 82-0721
Account #: 002800
Date Sampled: 31 Mar 20 10:55
Date Received: 31 Mar 20 14:40
Sampled By: MVTL Field Servies

Project Name: MDU Heskett Active Ash
Sample Description: 70

Temp at Receipt: 1.6C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	7.04	units	NA	SM 4500 H+ B	31 Mar 20 10:55	JSM
pH	* 7.3	units	0.1	SM4500 H+ B	31 Mar 20 17:00	HT
Temperature - Field	8.54	Degrees C	NA	SM 2550B	31 Mar 20 10:55	JSM
Conductivity - Field	4133	umhos/cm	1	EPA 120.1	31 Mar 20 10:55	JSM
Fluoride	0.35	mg/l	0.10	SM4500-F-C	31 Mar 20 17:00	HT
Sulfate	2460	mg/l	5.00	ASTM D516-11	1 Apr 20 9:47	EV
Chloride	48.4	mg/l	1.0	SM4500-Cl-E	1 Apr 20 12:09	EV
Total Dissolved Solids	3970	mg/l	10	I1750-85	2 Apr 20 13:45	HT
Calcium - Total	381	mg/l	1.0	6010D	3 Apr 20 13:55	MDE
Boron - Total	0.45	mg/l	0.10	6010D	8 Apr 20 10:21	SZ

* Holding time exceeded

Approved by:

Claudette K. Carroll ^{CC} *29 Apr 2020*

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 23 Apr 20
Lab Number: 20-W544
Work Order #: 82-0721
Account #: 002800
Date Sampled: 31 Mar 20 13:25
Date Received: 31 Mar 20 14:40
Sampled By: MVTL Field Servies

Project Name: MDU Heskett Active Ash
Sample Description: 101

Temp at Receipt: 1.6C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.75	units	NA	SM 4500 H+ B	31 Mar 20 13:25	JSM
pH	* 7.0	units	0.1	SM4500 H+ B	31 Mar 20 17:00	HT
Temperature - Field	10.8	Degrees C	NA	SM 2550B	31 Mar 20 13:25	JSM
Conductivity - Field	4574	umhos/cm	1	EPA 120.1	31 Mar 20 13:25	JSM
Fluoride	0.10	mg/l	0.10	SM4500-F-C	31 Mar 20 17:00	HT
Sulfate	2860	mg/l	5.00	ASTM D516-11	1 Apr 20 9:47	EV
Chloride	16.7	mg/l	1.0	SM4500-Cl-E	1 Apr 20 12:44	EV
Total Dissolved Solids	4640	mg/l	10	I1750-85	2 Apr 20 13:45	HT
Calcium - Total	386	mg/l	1.0	6010D	3 Apr 20 13:55	MDE
Boron - Total	1.01	mg/l	0.10	6010D	8 Apr 20 10:21	SZ

* Holding time exceeded

Approved by:

Claudette K. Carroll ^{CC} *21 Apr 2020*

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 23 Apr 20
Lab Number: 20-W545
Work Order #: 82-0721
Account #: 002800
Date Sampled: 30 Mar 20 11:36
Date Received: 31 Mar 20 14:40
Sampled By: MVTL Field Servies

Project Name: MDU Heskett Active Ash
Sample Description: 103

Temp at Receipt: 1.6C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.80	units	NA	SM 4500 H+ B	30 Mar 20 11:36	JSM
pH	* 7.0	units	0.1	SM4500 H+ B	31 Mar 20 17:00	HT
Temperature - Field	9.66	Degrees C	NA	SM 2550B	30 Mar 20 11:36	JSM
Conductivity - Field	4963	umhos/cm	1	EPA 120.1	30 Mar 20 11:36	JSM
Fluoride	0.13	mg/l	0.10	SM4500-F-C	31 Mar 20 17:00	HT
Sulfate	2790	mg/l	5.00	ASTM D516-11	1 Apr 20 9:47	EV
Chloride	138	mg/l	1.0	SM4500-Cl-E	1 Apr 20 12:44	EV
Total Dissolved Solids	4500	mg/l	10	I1750-85	2 Apr 20 13:45	HT
Calcium - Total	545	mg/l	1.0	6010D	3 Apr 20 13:55	MDE
Boron - Total	0.11	mg/l	0.10	6010D	8 Apr 20 10:21	SZ

* Holding time exceeded

Approved by:

Claudette K. Carroll

*1C
29 Apr 2020*

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 23 Apr 20
Lab Number: 20-W546
Work Order #: 82-0721
Account #: 002800
Date Sampled: 30 Mar 20 13:07
Date Received: 31 Mar 20 14:40
Sampled By: MVTL Field Servies

Project Name: MDU Heskett Active Ash
Sample Description: 44R

Temp at Receipt: 1.6C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.62	units	NA	SM 4500 H+ B	30 Mar 20 13:07	JSM
pH	* 6.9	units	0.1	SM4500 H+ B	31 Mar 20 17:00	HT
Temperature - Field	9.79	Degrees C	NA	SM 2550B	30 Mar 20 13:07	JSM
Conductivity - Field	9077	umhos/cm	1	EPA 120.1	30 Mar 20 13:07	JSM
Fluoride	0.71	mg/l	0.10	SM4500-F-C	31 Mar 20 17:00	HT
Sulfate	6870	mg/l	5.00	ASTM D516-11	15 Apr 20 8:40	EV
Chloride	227	mg/l	1.0	SM4500-Cl-E	1 Apr 20 12:44	EV
Total Dissolved Solids	10200	mg/l	10	I1750-85	2 Apr 20 13:45	HT
Calcium - Total	421	mg/l	1.0	6010D	3 Apr 20 13:55	MDE
Boron - Total	< 0.5 @	mg/l	0.10	6010D	8 Apr 20 10:21	SZ

* Holding time exceeded

CC

Approved by: Claudette K. Carroll 29 Apr 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 23 Apr 20
Lab Number: 20-W547
Work Order #: 82-0721
Account #: 002800
Date Sampled: 31 Mar 20
Date Received: 31 Mar 20 14:40
Sampled By: MVTL Field Servies

Project Name: MDU Heskett Active Ash
Sample Description: FB1

Temp at Receipt: 1.6C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH	* 6.4	units	0.1	SM4500 H+ B	31 Mar 20 17:00	HT
Fluoride	< 0.1	mg/l	0.10	SM4500-F-C	31 Mar 20 17:00	HT
Sulfate	< 5	mg/l	5.00	ASTM D516-11	1 Apr 20 9:47	EV
Chloride	< 1	mg/l	1.0	SM4500-Cl-E	1 Apr 20 12:44	EV
Total Dissolved Solids	< 10	mg/l	10	I1750-85	2 Apr 20 13:45	HT
Calcium - Total	< 1	mg/l	1.0	6010D	3 Apr 20 14:55	MDE
Boron - Total	< 0.1	mg/l	0.10	6010D	8 Apr 20 11:21	SZ

* Holding time exceeded

Approved by:

Claudette K. Carroll

CC
29 Apr 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:

@ = Due to sample matrix

= Due to concentration of other analytes

! = Due to sample quantity

+ = Due to internal standard response

CERTIFICATION: ND # ND-00016



2616 E. Broadway Ave
Bismarck, ND 58501
(701) 258-9720

Chain of Custody Record

Project Name: MDU Heskett	Event: Spring 2020	Work Order Number: 82-0721
Report To: Montana-Dakota Utilities Attn: Todd Peterson Address: 400 North 4th St. Bismarck, ND 58501 Phone: 701-425-2427 Email: todd.peterson@mdu.com	CC:	Collected By: <i>Jeremy Meyer</i>

Lab Number	Sample ID	Date	Time	Sample Type	Sample Type				Temp (°C)	Spec. Cond.	pH	Analysis Required
					1 Liter Raw	500 mL Nitric	500 mL Nitric (filtered)	1 Liter Nitric				
W540	13	30 Mar 2020	0951	GW	X	X	X	X	7.72	10325	7.01	MDU List AA & MDU List C
W541	Dup1	30 Mar 2020	NA	GW	X	X	X	X	NA	NA	NA	
W542	102	31 Mar 2020	0920	GW	X	X	X	X	7.35	9149	6.88	
W543	70	31 Mar 2020	1055	GW	X	X	X	X	8.54	4133	7.04	
W544	101	31 Mar 2020	1325	GW	X	X	X	X	10.78	4574	6.75	
W545	103	30 Mar 2020	1136	GW	X	X	X	X	9.66	4963	6.80	
W546	44R	30 Mar 2020	1367	GW	X	X	X	X	9.79	9077	6.62	
W547	FB1	31 Mar 2020	NA	GW	X	X	X	X	NA	NA	NA	

Comments:

Relinquished By		Sample Condition		Received By	
Name	Date/Time	Location	Temp (°C)	Name	Date/Time
<i>[Signature]</i>	31 Mar 2020 1440	Log In Walk In #2	201 L6 TM562/ TM805	<i>[Signature]</i>	31 Mar 2020 1440
1					
2					



Field Datasheet

Groundwater Assessment

2616 E. Broadway Ave, Bismarck, ND

Phone: (701) 258-9720

Company: MDU Heskett

Event: Spring 2020

Sample ID: MW 13

Sampling Personal: Jerry Heskett

Weather Conditions: Temp: 35 °F Wind: N @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Casing Strait?	YES	NO
Grout Seal Intact?	YES	NO
Repairs Necessary?	Not Visible	
Casing Diameter:	2"	
Water Level Before Purge:	29.31	ft
Total Depth of Well:	—	
Well Volume:	—	
Depth to Top of Pump:	—	
Water Level After Sample:	29.60	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

Purging Method:	Bladder	
Sampling Method:	Bladder	
Dedicated Equipment?	YES	NO

Control Settings:	
Purge:	3 Sec.
Recover:	27 Sec.
PSI:	20

Duplicate Sample?	YES	NO
Duplicate Sample ID:	Dup 1	

Bottle List:	
1 Liter Raw	
500mL Nitric	
500mL Nitric (filtered)	
250mL Sulfuric	

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	Liters Removed	Appearance or Comment Clarity, Color, Odor, Ect.
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10					clear, slightly turbid, turbid
30 Mar 2020											
	0826	Start of Well Purge									
	0831	5.68	10172	6.98	8.22	258.9	34.9	29.40	100.0	500.0	Clear
	0901	7.26	10288	7.02	8.60	247.8	7.66	29.59	100.0	3000.0	Clear
	0921	7.41	10292	7.03	8.09	250.8	8.72	29.65	100.0	2000.0	Clear
	0931	7.56	10303	7.01	7.80	256.0	5.83	29.69	100.0	1000.0	Clear
	0936	7.63	10315	7.02	7.86	257.5	5.36	29.72	100.0	500.0	Clear
	0941	7.67	10314	7.01	8.03	258.6	3.93	29.72	100.0	500.0	Clear
	0946	7.69	10330	7.01	7.92	256.2	4.11	29.71	100.0	500.0	Clear
	0951	7.72	10325	7.01	7.87	251.3	4.23	29.72	100.0	500.0	Clear

Well Stabilized? YES NO Total Volume Purged: 8500.0 Liters

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH		Turbidity (NTU)			Appearance or Comment Clarity, Color, Odor, Ect.
30 Mar 2020	0951	7.72	10325	7.01		4.23			Clear

Comments:



Field Datasheet

Groundwater Assessment

2616 E. Broadway Ave, Bismarck, ND

Phone: (701) 258-9720

Company: MDU Heskett

Event: Spring 2020

Sample ID: 102

Sampling Personal: Jerry May

Weather Conditions: Temp: 35 °F Wind: N @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Casing Strait?	YES	NO
Grout Seal Intact?	YES	NO
Repairs Necessary?		Not Visible
Casing Diameter:	2"	
Water Level Before Purge:	15.01	ft
Total Depth of Well:	—	ft
Well Volume:	—	liters
Depth to Top of Pump:	—	ft
Water Level After Sample:	16.48	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

Purging Method:	Bladder	
Sampling Method:	Bladder	
Dedicated Equipment?	YES	NO
Duplicate Sample?	YES	NO
Duplicate Sample ID:	—	
Bottle List:		
1 Liter Raw		
500mL Nitric		
500mL Nitric (filtered)		
250mL Sulfuric		
Control Settings:		
Purge:	3	Sec.
Recover:	27	Sec.
PSI:	20	

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	Liters Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10					Clarity, Color, Odor, Ect.
31 Mar 2020	0830	Start of Well Purge									
	0835	6.64	9392	6.90	5.46	44.9	9.73	15.97	100.0	500.0	Clear
	0905	6.94	9248	6.90	6.23	58.2	2.92	16.16	100.0	3000.0	Clear
	0910	7.07	9215	6.89	7.31	59.5	1.97	16.23	100.0	500.0	Clear
	0915	7.20	9173	6.87	7.29	61.4	2.08	16.25	100.0	500.0	Clear
	0920	7.35	9149	6.88	7.32	62.3	1.89	16.29	100.0	500.0	Clear

Well Stabilized? YES NO

Total Volume Purged: 5000.0 Liters mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH		Turbidity (NTU)			Appearance or Comment
Clarity, Color, Odor, Ect.									
31 Mar 2020	0920	7.35	9149	6.88		1.89			Clear

Comments:



Field Datasheet

Groundwater Assessment

2616 E. Broadway Ave, Bismarck, ND

Phone: (701) 258-9720

Company: MDU Heskett

Event: Spring 2020

Sample ID: 70

Sampling Personal: Jerry Hyslop

Weather Conditions: Temp: 40 °F Wind: N @ 10-15 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Casing Strait?	YES	NO
Grout Seal Intact?	YES	NO
Repairs Necessary?		Not Visible
Casing Diameter:	2"	
Water Level Before Purge:	19.43	ft
Total Depth of Well:	—	
Well Volume:	—	
Depth to Top of Pump:	—	
Water Level After Sample:	20.60	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

Purging Method:	Bladder	Control Settings:
Sampling Method:	Bladder	Purge: 3 Sec.
Dedicated Equipment?	YES	Recover: 27 Sec.
		PSI: 30
Duplicate Sample?	YES	
Duplicate Sample ID:	—	
Bottle List:		
1 Liter Raw		
500mL Nitric		
500mL Nitric (filtered)		
250mL Sulfuric		

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	Liters Removed	Appearance or Comment Clarity, Color, Odor, Ect.
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10					
31 Mar 2020	1005	Start of Well Purge									
	1010	7.79	4753	7.06	5.65	75.5	3.20	19.75	100.0	500.0	Clear
	1040	8.22	4135	7.07	3.93	149.5	3.84	20.50	100.0	3000.0	Clear
	1045	8.20	4125	7.02	3.63	153.3	1.86	20.53	100.0	500.0	Clear
	1050	8.44	4135	7.05	3.82	154.9	1.49	20.56	100.0	500.0	Clear
	1055	8.54	4133	7.04	3.84	155.0	1.16	20.60	100.0	500.0	Clear

Well Stabilized? YES NO

Total Volume Purged: 5000.0 Liters

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH		Turbidity (NTU)				Appearance or Comment Clarity, Color, Odor, Ect.
31 Mar 2020	1055	8.54	4133	7.04		1.16				Clear

Comments:



Field Datasheet

Groundwater Assessment

2616 E. Broadway Ave, Bismarck, ND

Phone: (701) 258-9720

Company: MDU Heskett

Event: Spring 2020

Sample ID: 101

Sampling Personal: Jerry & Amy

Weather Conditions: Temp: 45 °F Wind: N @ 10-15 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO	
Well Labeled?	YES	NO	
Casing Strait?	YES	NO	
Grout Seal Intact?	YES	NO	Not Visible
Repairs Necessary?			
Casing Diameter:	2"		
Water Level Before Purge:	35.26	ft	
Total Depth of Well:	—	ft	
Well Volume:	—	liters	
Depth to Top of Pump:	—	ft	
Water Level After Sample:	38.91	ft	
Measurement Method:	Electric Water Level Indicator		

SAMPLING INFORMATION

Purging Method:	Bladder
Sampling Method:	Bladder
Dedicated Equipment?	YES NO

Control Settings:	
Purge: 3	Sec.
Recover: 27	Sec.
PSI: 40	

Duplicate Sample?	YES NO
Duplicate Sample ID:	—

Bottle List:	
1 Liter Raw	
500mL Nitric	
500mL Nitric (filtered)	
250mL Sulfuric	

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	Liters- Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10					clear, slightly turbid, turbid
Start of Well Purge											
31 Mar 2020	1140										
	1145	9.36	4624	6.77	5.67	126.0	61.6	36.18	100.0	500.0	Clear
	1215	9.68	4595	6.73	3.34	110.4	18.4	38.12	100.0	3000.0	Clear
	1245	9.90	4577	6.73	4.53	119.1	7.11	38.82	100.0	3000.0	Clear
	1300	10.15	4563	6.75	4.30	104.0	5.82	38.86	100.0	1500.0	Clear
	1315	10.52	4570	6.76	4.16	96.9	4.25	38.90	100.0	1500.0	Clear
	1320	10.77	4569	6.75	4.23	95.6	4.37	38.89	100.0	500.0	Clear
	1325	10.78	4574	6.75	4.39	95.1	4.24	38.90	100.0	500.0	Clear

Well Stabilized? YES NO

Total Volume Purged: 10,500.0 Liters/mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	Liters- Removed	Appearance or Comment
											Clarity, Color, Odor, Ect.
31 Mar 2020	1325	10.78	4574	6.75			4.24				

Comments:



Field Datasheet

Groundwater Assessment

2616 E. Broadway Ave, Bismarck, ND

Phone: (701) 258-9720

Company: MDU Heskett

Event: Spring 2020

Sample ID: 103

Sampling Personal: Jeremy Meyer

Weather Conditions: Temp: 40 °F Wind: N @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Casing Strait?	YES	NO
Grout Seal Intact?	YES	NO
Repairs Necessary?	YES	NO
Casing Diameter:	2"	
Water Level Before Purge:	30.26	ft
Total Depth of Well:	—	ft
Well Volume:	—	liters
Depth to Top of Pump:	—	ft
Water Level After Sample:	31.46	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

Purging Method:	Bladder	
Sampling Method:	Bladder	
Dedicated Equipment?	YES	NO
Duplicate Sample?	YES	NO
Duplicate Sample ID:	—	
Control Settings:		
Purge:	3	Sec.
Recover:	27	Sec.
PSI:	30	
Bottle List:		
1 Liter Raw		
500mL Nitric		
500mL Nitric (filtered)		
250mL Sulfuric		

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	Liters Removed	Appearance or Comment Clarity, Color, Odor, Ect.
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10					clear, slightly turbid, turbid
30 Mar 2020	1046	Start of Well Purge									
	1051	7.63	5940	6.83	6.26	210.4	4.93	30.79	100.0	500.0	Clear
	1121	9.26	4988	6.79	6.34	227.6	1.79	31.25	100.0	3000.0	Clear
	1126	9.13	4996	6.79	5.68	230.8	1.94	31.32	100.0	500.0	Clear
	1131	9.40	4974	6.79	5.79	233.6	1.72	31.38	100.0	500.0	Clear
	1136	9.66	4963	6.80	5.54	234.9	1.50	31.38	100.0	500.0	Clear

Well Stabilized? YES NO Total Volume Purged: 5000.0 Liters

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	Liters Removed	Appearance or Comment Clarity, Color, Odor, Ect.
30 Mar 2020	1136	9.66	4963	6.80			1.50				Clear

Comments:



Field Datasheet

Groundwater Assessment

Company: MDU Heskett

Event: Spring 2020

Sample ID: 44R

Sampling Personal: Jerry Boyer

2616 E. Broadway Ave, Bismarck, ND

Phone: (701) 258-9720

Weather Conditions: Temp: 45 °F Wind: N @ 10-15 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO	
Well Labeled?	YES	NO	
Casing Strait?	YES	NO	
Grout Seal Intact?	YES	NO	Not Visible
Repairs Necessary?			
Casing Diameter:	2"		
Water Level Before Purge:	24.71		ft
Total Depth of Well:			ft
Well Volume:			liters
Depth to Top of Pump:			ft
Water Level After Sample:	24.94		ft
Measurement Method:	Electric Water Level Indicator		

SAMPLING INFORMATION

Purging Method:	Bladder		Control Settings:
Sampling Method:	Bladder		Purge: 3 Sec.
Dedicated Equipment?	YES	NO	Recover: 27 Sec.
			PSI: 30

Duplicate Sample?	YES	NO
Duplicate Sample ID:		

Bottle List:	
1 Liter Raw	
500mL Nitric	
500mL Nitric (filtered)	
250mL Sulfuric	

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	Liters Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10					clear, slightly turbid, turbid
30 Mar 2020	1222	Start of Well Purge									
	1227	10.16	9006	6.78	6.94	215.3	7.31	24.87	100.0	500.0	Clear
	1257	9.76	9049	6.64	5.03	228.4	2.83	24.86	100.0	3000.0	Clear
	1302	9.78	9059	6.63	5.25	233.4	2.91	24.85	100.0	500.0	Clear
	1307	9.79	9077	6.62	5.31	234.8	2.87	24.90	100.0	500.0	Clear

Well Stabilized? YES NO Total Volume Purged: 4500.0 Liters mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	Liters Removed	Appearance or Comment
30 Mar 2020	1307	9.78	9077	6.62			2.87				Clear

Comments:



MINNESOTA VALLEY TESTING LABORATORIES, INC.

1126 N. Front St. ~ New Ulm, MN 56073 ~ 800-782-3557 ~ Fax 507-359-2890
 2616 E. Broadway Ave. ~ Bismarck, ND 58502 ~ 800-279-6885 ~ Fax 701-258-9724
 1201 Lincoln Highway ~ Nevada, IA 50201 ~ 800-362-0855 ~ Fax 515-382-3885
 www.mvttl.com

MEMBER
ACIL

Page: 1 of 1

Quality Control Report

Lab IDs: 20-W540 to 20-W547

Project: MDU Heskett Active Ash

Work Order: 202082-0721

Analyte	LCS Spike Amt	LCS Rec %	LCS % Rec Limits	Matrix Spike Amt	Matrix Spike ID	Matrix Spike Orig Result	Matrix Spike Result	Matrix Spike Rec %	Matrix Spike % Rec Limits	MSD/Dup Orig Result	MSD/Dup Result	MSD Rec %	MSD/Dup RPD	MSD/Dup RPD Limit (<=)	Known Rec (%)	Known % Rec Limits	Method Blank
Boron - Total mg/l	0.40	100	80-120	0.400	20-D980	0.30	0.68	95	75-125	0.68	0.66	90	3.0	20	-	-	< 0.1
	0.40	102	80-120	4.00	20-M670	1.49	4.67	80	75-125	4.67	4.59	78	1.7	20	-	-	< 0.1
	0.40	100	80-120	0.400	20-W543	0.45	0.80	88	75-125	0.80	0.80	88	0.0	20	-	-	< 0.1
	0.40	98	80-120	0.400	20-W564	0.12	0.46	85	75-125	0.46	0.48	90	4.3	20	-	-	< 0.1
	0.40	100	80-120	0.400	20-W578	< 0.1	0.39	98	75-125	0.39	0.39	98	0.0	20	-	-	< 0.1
Calcium - Total mg/l	20.0	109	80-120	500	20W545q	545	980	87	75-125	980	990	89	1.0	20	-	-	< 1
	20.0	110	80-120	100	20W547q	< 1	104	104	75-125	104	104	104	0.0	20	-	-	< 1
	20.0	114	80-120	500	20W565q	362	910	110	75-125	910	865	101	5.1	20	-	-	< 1
	20.0	115	80-120	100	20D1209q	50.1	140	90	75-125	140	141	91	0.7	20	-	-	< 1
				100	20W724q	94.8	183	88	75-125	183	183	88	0.0	20	-	-	< 1
Chloride mg/l	30.0	92	80-120	30.0	20-W533	1.4	28.9	92	80-120	28.9	28.7	91	0.7	20	-	-	< 1
	30.0	92	80-120	30.0	20-W545	138	167	97	80-120	167	167	97	0.0	20	-	-	< 1
	30.0	91	80-120												-	-	< 1
Fluoride mg/l	0.50	106	90-110	0.500	20-D944	1.94	2.48	108	80-120	2.48	2.49	110	0.4	20	-	-	< 0.1
				0.500	20-W544	0.10	0.59	98	80-120	0.59	0.59	98	0.0	20	-	-	< 0.1
pH units	-	-	-	-	-	-	-	-	-	8.1	8.1	-	0.0	20	-	-	-
	-	-	-	-	-	-	-	-	-	7.2	7.3	-	1.4	20	-	-	-
Sulfate mg/l	100	102	80-120	100	20-W547	< 5	110	110	80-120	110	110	110	0.0	20	-	-	< 5
	100	106	80-120												-	-	
Total Dissolved Solids mg/l	-	-	-	-	-	-	-	-	-	1210	1210	-	0.0	20	-	-	< 10
	-	-	-	-	-	-	-	-	-	7700	9000	-	15.6	20	-	-	

Samples were received in good condition on 31 Mar 2020 at 1440.

Temperature upon receipt at the Bismarck laboratory was 1.6°C.

All samples were properly preserved unless noted here and/or flagged on the individual analytical laboratory report.

With the exception of pH, all holding times were met.

Approved methodology was followed for all sample analyses.

All acceptance criteria were met for calibration, method blanks, laboratory control samples, laboratory fortified matrix/duplicates unless noted here.

- For some analytes, the reported results were elevated due to additional dilutions required to minimize the effects of sample matrix.

Approved by: _____

C. Canfield

29 Apr 2020



MINNESOTA VALLEY TESTING LABORATORIES, INC.

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APP III

Page: 1 of 4

CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 15 Apr 20
Lab Number: 20-W563
Work Order #: 82-0754
Account #: 002800
Date Sampled: 1 Apr 20 10:17
Date Received: 2 Apr 20 10:20
Sampled By: MVTL Field Services

Project Name: MDU Heskett Active Ash
Sample Description: 33

Temp at Receipt: 5.3C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.61	units	NA	SM 4500 H+ B	1 Apr 20 10:17	JSM
pH	* 7.1	units	0.1	SM4500 H+ B	2 Apr 20 17:00	HT
Temperature - Field	6.65	Degrees C	NA	SM 2550B	1 Apr 20 10:17	JSM
Conductivity - Field	5180	umhos/cm	1	EPA 120.1	1 Apr 20 10:17	JSM
Fluoride	0.25	mg/l	0.10	SM4500-F-C	2 Apr 20 17:00	HT
Sulfate	3460	mg/l	5.00	ASTM D516-11	8 Apr 20 9:21	EV
Chloride	14.2	mg/l	1.0	SM4500-Cl-E	6 Apr 20 8:53	EV
Total Dissolved Solids	5430	mg/l	10	I1750-85	2 Apr 20 13:45	HT
Calcium - Total	510	mg/l	1.0	6010D	3 Apr 20 14:55	MDE
Boron - Total	0.30	mg/l	0.10	6010D	8 Apr 20 11:21	SZ

* Holding time exceeded

Approved by:

Claudette K. Carroll

*CC
29 Apr 2020*

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:

@ = Due to sample matrix
! = Due to sample quantity

= Due to concentration of other analytes
+ = Due to internal standard response

CERTIFICATION: ND # ND-00016



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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 15 Apr 20
Lab Number: 20-W564
Work Order #: 82-0754
Account #: 002800
Date Sampled: 1 Apr 20 11:21
Date Received: 2 Apr 20 10:20
Sampled By: MVTL Field Services

Project Name: MDU Heskett Active Ash
Sample Description: 3-90

Temp at Receipt: 5.3C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.94	units	NA	SM 4500 H+ B	1 Apr 20 11:21	JSM
pH	* 7.4	units	0.1	SM4500 H+ B	2 Apr 20 17:00	HT
Temperature - Field	6.50	Degrees C	NA	SM 2550B	1 Apr 20 11:21	JSM
Conductivity - Field	4365	umhos/cm	1	EPA 120.1	1 Apr 20 11:21	JSM
Fluoride	0.13	mg/l	0.10	SM4500-F-C	2 Apr 20 17:00	HT
Sulfate	2190	mg/l	5.00	ASTM D516-11	8 Apr 20 9:21	EV
Chloride	30.8	mg/l	1.0	SM4500-Cl-E	6 Apr 20 8:53	EV
Total Dissolved Solids	3900	mg/l	10	I1750-85	2 Apr 20 13:45	HT
Calcium - Total	386	mg/l	1.0	6010D	3 Apr 20 14:55	MDE
Boron - Total	0.12	mg/l	0.10	6010D	8 Apr 20 11:21	SZ

* Holding time exceeded

Approved by:

C
Claudette K. Carroll 29 Apr 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

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! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 15 Apr 20
Lab Number: 20-W565
Work Order #: 82-0754
Account #: 002800
Date Sampled: 1 Apr 20
Date Received: 2 Apr 20 10:20
Sampled By: MVTL Field Services

Project Name: MDU Heskett Active Ash
Sample Description: Dup2

Temp at Receipt: 5.3C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH	* 7.4	units	0.1	SM4500 H+ B	2 Apr 20 17:00	HT
Fluoride	0.13	mg/l	0.10	SM4500-F-C	2 Apr 20 17:00	HT
Sulfate	2160	mg/l	5.00	ASTM D516-11	8 Apr 20 9:21	EV
Chloride	30.8	mg/l	1.0	SM4500-Cl-E	6 Apr 20 8:53	EV
Total Dissolved Solids	3920	mg/l	10	I1750-85	2 Apr 20 13:45	HT
Calcium - Total	362	mg/l	1.0	6010D	3 Apr 20 14:55	MDE
Boron - Total	0.12	mg/l	0.10	6010D	8 Apr 20 11:21	SZ

* Holding time exceeded

Approved by:

Claudette K. Carroll

CC
29 Apr 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

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The reporting limit was elevated for any analyte requiring a dilution as coded below:

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= Due to concentration of other analytes

! = Due to sample quantity

+ = Due to internal standard response

CERTIFICATION: ND # ND-00016



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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 15 Apr 20
Lab Number: 20-W566
Work Order #: 82-0754
Account #: 002800
Date Sampled: 1 Apr 20 12:46
Date Received: 2 Apr 20 10:20
Sampled By: MVTL Field Services

Project Name: MDU Heskett Active Ash
Sample Description: 2-90

Temp at Receipt: 5.3C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.92	units	NA	SM 4500 H+ B	1 Apr 20 12:46	JSM
pH	* 7.4	units	0.1	SM4500 H+ B	2 Apr 20 17:00	HT
Temperature - Field	6.54	Degrees C	NA	SM 2550B	1 Apr 20 12:46	JSM
Conductivity - Field	7245	umhos/cm	1	EPA 120.1	1 Apr 20 12:46	JSM
Fluoride	0.98	mg/l	0.10	SM4500-F-C	2 Apr 20 17:00	HT
Sulfate	5150	mg/l	5.00	ASTM D516-11	8 Apr 20 9:21	EV
Chloride	64.2	mg/l	1.0	SM4500-Cl-E	6 Apr 20 8:53	EV
Total Dissolved Solids	7700	mg/l	10	I1750-85	2 Apr 20 13:45	HT
Calcium - Total	477	mg/l	1.0	6010D	3 Apr 20 15:55	MDE
Boron - Total	< 0.5 @	mg/l	0.10	6010D	8 Apr 20 11:21	SZ

* Holding time exceeded

Approved by:

CC
Claudette K. Carroll 21 Apr 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:

@ = Due to sample matrix

! = Due to sample quantity

= Due to concentration of other analytes

+ = Due to internal standard response

CERTIFICATION: ND # ND-00016



2616 E. Broadway Ave
Bismarck, ND 58501
(701) 258-9720

Chain of Custody Record

Project Name: MDU Heskett	Event: Spring 2020	Work Order Number: 82-0754
Report To: Montana-Dakota Utilities Attn: Todd Peterson Address: 400 North 4th St. Bismarck, ND 58501 Phone: 701-425-2427 Email: todd.peterson@mdu.com	CC:	Collected By:

Lab Number	Sample ID	Date	Time	Sample Type	1 Liter Raw	500 mL Nitric	500 mL Nitric (filtered)	250 mL Sulfuric	1 Liter Nitric	Temp (°C)	Spec. Cond.	PH	Analysis Required
W563	33	1 Apr 2020	1017	GW	X	X	X	X		6.65	5180	6.61	MDU List AA & MDU List C
W564	3-90	1 Apr 2020	1121	GW	X	X	X	X		6.50	4365	6.94	
W565	Dup2	1 Apr 2020	NA	GW	X	X	X	X		NA	NA	NA	
W566	2-90	1 Apr 2020	1246	GW	X	X	X	X		6.54	7245	6.92	

Comments:

Relinquished By		Sample Condition		Received By	
Name	Date/Time	Location	Temp (°C)	Name	Date/Time
	2 Apr 2020	Log In	20.5.3		2 Apr 2020
	1020	Walk In #2	TM562 / TM805		1120



Field Datasheet

Groundwater Assessment

2616 E. Broadway Ave, Bismarck, ND

Phone: (701) 258-9720

Company: MDU Heskett

Event: Spring 2020

Sample ID: 33

Sampling Personal: Jerry Hays

Weather Conditions: Temp: 35 °F Wind: N @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Casing Strait?	YES	NO
Grout Seal Intact?	YES	NO
Repairs Necessary?		Not Visible
Casing Diameter:	2"	
Water Level Before Purge:	39.05	ft
Total Depth of Well:	—	ft
Well Volume:	—	liters
Depth to Top of Pump:	—	ft
Water Level After Sample:	39.16	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

Purging Method:	Bladder
Sampling Method:	Bladder
Dedicated Equipment?	YES NO

Control Settings:	
Purge:	3 Sec.
Recover:	27 Sec.
PSI:	30

Duplicate Sample?	YES NO
Duplicate Sample ID:	—

Bottle List:	
1 Liter Raw	
500mL Nitric	
500mL Nitric (filtered)	
250mL Sulfuric	

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	Liters Removed	Appearance or Comment Clarity, Color, Odor, Ect.
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10					clear, slightly turbid, turbid
1 Apr 2020	0827	Start of Well Purge									
	0832	7.04	5195	6.60	8.03	103.4	42.4	39.16	100.0	500.0	clear
	0902	6.57	5182	6.62	7.81	107.1	24.6	39.13	100.0	3000.0	clear
	0932	6.78	5165	6.63	9.17	109.9	16.6	39.11	100.0	3000.0	clear
	1002	6.75	5180	6.62	8.27	117.3	11.9	39.16	100.0	3000.0	clear
	1007	6.59	5183	6.62	8.21	118.6	6.59	39.15	100.0	500.0	clear
	1012	6.63	5184	6.60	8.33	120.1	6.25	39.17	100.0	500.0	clear
	1017	6.65	5180	6.61	8.55	120.9	6.33	39.16	100.0	500.0	clear

Well Stabilized? YES NO

Total Volume Purged: 11,000.0 Liters

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH		Turbidity (NTU)			Appearance or Comment Clarity, Color, Odor, Ect.
1 Apr 2020	1017	6.65	5180	6.61		6.33			clear

Comments:

Quality Control Report

Lab IDs: 20-W563 to 20-W566

Project: MDU Heskett Active Ash

Work Order: 202082-0754

Analyte	LCS Spike Amt	LCS Rec %	LCS % Rec Limits	Matrix Spike Amt	Matrix Spike ID	Matrix Spike Orig Result	Matrix Spike Result	Matrix Spike Rec %	Matrix Spike % Rec Limits	MSD/ Dup Orig Result	MSD/ Dup Result	MSD Rec %	MSD/ Dup RPD	MSD/ Dup RPD Limit (<)	Known Rec (%)	Known % Rec Limits	Method Blank
Boron - Total mg/l	0.40	98	80-120	0.400	20-W564	0.12	0.46	85	75-125	0.46	0.48	90	4.3	20	-	-	< 0.1
	0.40	100	80-120	0.400	20-W578	< 0.1	0.39	98	75-125	0.39	0.39	98	0.0	20	-	-	< 0.1
Calcium - Total mg/l	20.0	115	80-120	100	20W547q	< 1	104	104	75-125	104	104	104	0.0	20	-	-	< 1
	20.0	117	80-120	500	20W565q	362	910	110	75-125	910	865	101	5.1	20	-	-	< 1
				500	20W566q	477	960	97	75-125	960	970	99	1.0	20	-	-	< 1
Chloride mg/l	30.0	91	80-120	30.0	20-W570	25.6	55.2	99	80-120	55.2	54.8	97	0.7	20	-	-	< 1
	30.0	91	80-120												-	-	< 1
Fluoride mg/l	0.50	106	90-110	0.500	20-W566	0.98	1.38	80	80-120	1.38	1.41	86	2.2	20	-	-	< 0.1
pH units	-	-	-	-	-	-	-	-	-	8.4	8.4	-	0.0	20	-	-	-
	-	-	-	-	-	-	-	-	-	7.1	7.2	-	1.4	20	-	-	-
Sulfate mg/l	100	104	80-120	100	20-W555	18.3	121	103	80-120	121	120	102	0.8	20	-	-	< 5
Total Dissolved Solids mg/l	-	-	-	-	-	-	-	-	-	1210	1210	-	0.0	20	-	-	< 10
	-	-	-	-	-	-	-	-	-	7700	9000	-	15.6	20	-	-	< 10

Samples were received in good condition on 2 Apr 2020 at 1020.

Temperature upon receipt at the Bismarck laboratory was 5.3°C.

All samples were properly preserved unless noted here and/or flagged on the individual analytical laboratory report.

With the exception of pH, all holding times were met.

Approved methodology was followed for all sample analyses.

All acceptance criteria were met for calibration, method blanks, laboratory control samples, laboratory fortified matrix/duplicates unless noted here.

- For some analytes, the reported results were elevated due to additional dilutions required to minimize the effects of sample matrix.

Approved by: _____

C. Cantor

29 Apr 2020



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APP III

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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 23 Apr 20
Lab Number: 20-W575
Work Order #: 82-0773
Account #: 002800
Date Sampled: 6 Apr 20 11:32
Date Received: 6 Apr 20 12:22
Sampled By: MVTL Field Services

Project Name: MDU Heskett
Sample Description: 104

Temp at Receipt: 6.7C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.96	units	NA	SM 4500 H+ B	6 Apr 20 11:32	JSM
pH	* 7.2	units	0.1	SM4500 H+ B	6 Apr 20 17:00	HT
Temperature - Field	8.32	Degrees C	NA	SM 2550B	6 Apr 20 11:32	JSM
Conductivity - Field	13655	umhos/cm	1	EPA 120.1	6 Apr 20 11:32	JSM
Fluoride	0.56	mg/l	0.10	SM4500-F-C	6 Apr 20 17:00	HT
Sulfate	10300	mg/l	5.00	ASTM D516-11	8 Apr 20 9:38	EV
Chloride	84.7	mg/l	1.0	SM4500-Cl-E	13 Apr 20 11:44	EV
Total Dissolved Solids	16500	mg/l	10	I1750-85	9 Apr 20 10:07	HT
Calcium - Total	460	mg/l	1.0	6010D	9 Apr 20 14:34	SZ
Boron - Total	0.82	mg/l	0.10	6010D	8 Apr 20 11:21	SZ

* Holding time exceeded

Approved by:

Claudette K. Carroll ^{CC} 29 Apr 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

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CERTIFICATION: ND # ND-00016



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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 23 Apr 20
Lab Number: 20-W576
Work Order #: 82-0773
Account #: 002800
Date Sampled: 6 Apr 20 10:30
Date Received: 6 Apr 20 12:22
Sampled By: MVTL Field Services

Project Name: MDU Heskett
Sample Description: 80R

Temp at Receipt: 6.7C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	7.10	units	NA	SM 4500 H+ B	6 Apr 20 10:30	JSM
pH	* 7.3	units	0.1	SM4500 H+ B	6 Apr 20 17:00	HT
Temperature - Field	6.39	Degrees C	NA	SM 2550B	6 Apr 20 10:30	JSM
Conductivity - Field	5365	umhos/cm	1	EPA 120.1	6 Apr 20 10:30	JSM
Fluoride	0.26	mg/l	0.10	SM4500-F-C	6 Apr 20 17:00	HT
Sulfate	2960	mg/l	5.00	ASTM D516-11	8 Apr 20 9:38	EV
Chloride	143	mg/l	1.0	SM4500-Cl-E	13 Apr 20 11:44	EV
Total Dissolved Solids	5460	mg/l	10	I1750-85	9 Apr 20 10:07	HT
Calcium - Total	320	mg/l	1.0	6010D	9 Apr 20 14:34	SZ
Boron - Total	< 0.5 @	mg/l	0.10	6010D	8 Apr 20 11:21	SZ

* Holding time exceeded

Approved by:

CC
Claudette K. Carroll 29 Apr 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

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CERTIFICATION: ND # ND-00016



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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 23 Apr 20
Lab Number: 20-W577
Work Order #: 82-0773
Account #: 002800
Date Sampled: 6 Apr 20 9:10
Date Received: 6 Apr 20 12:22
Sampled By: MVTL Field Services

Project Name: MDU Heskett
Sample Description: 105

Temp at Receipt: 6.7C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.82	units	NA	SM 4500 H+ B	6 Apr 20 9:10	JSM
pH	* 7.0	units	0.1	SM4500 H+ B	6 Apr 20 17:00	HT
Temperature - Field	5.49	Degrees C	NA	SM 2550B	6 Apr 20 9:10	JSM
Conductivity - Field	6201	umhos/cm	1	EPA 120.1	6 Apr 20 9:10	JSM
Fluoride	0.27	mg/l	0.10	SM4500-F-C	6 Apr 20 17:00	HT
Sulfate	4100	mg/l	5.00	ASTM D516-11	8 Apr 20 9:38	EV
Chloride	278	mg/l	1.0	SM4500-Cl-E	13 Apr 20 11:44	EV
Total Dissolved Solids	6400	mg/l	10	I1750-85	9 Apr 20 10:07	HT
Calcium - Total	361	mg/l	1.0	6010D	9 Apr 20 14:34	SZ
Boron - Total	< 0.5 @	mg/l	0.10	6010D	8 Apr 20 11:21	SZ

* Holding time exceeded

Approved by:

Claudette K. Carroll

CC
29 Apr 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

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! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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Page: 4 of 4

CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 23 Apr 20
Lab Number: 20-W578
Work Order #: 82-0773
Account #: 002800
Date Sampled: 6 Apr 20
Date Received: 6 Apr 20 12:22
Sampled By: MVTL Field Services

Project Name: MDU Heskett
Sample Description: FB2

Temp at Receipt: 6.7C ROI

Event and Year: Spring 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH	* 5.9	units	0.1	SM4500 H+ B	6 Apr 20 17:00	HT
Fluoride	< 0.1	mg/l	0.10	SM4500-F-C	6 Apr 20 17:00	HT
Sulfate	< 5	mg/l	5.00	ASTM D516-11	8 Apr 20 9:38	EV
Chloride	< 1	mg/l	1.0	SM4500-Cl-E	13 Apr 20 11:44	EV
Total Dissolved Solids	< 10	mg/l	10	I1750-85	9 Apr 20 10:07	HT
Calcium - Total	< 1	mg/l	1.0	6010D	9 Apr 20 14:34	SZ
Boron - Total	< 0.1	mg/l	0.10	6010D	8 Apr 20 11:21	SZ

* Holding time exceeded

Approved by:

Claudette K. Carroll *29 Apr 2020*

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:

@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



2616 E. Broadway Ave
 Bismarck, ND 58501
 (701) 258-9720

Chain of Custody Record

Project Name: MDU Heskett	Event: Spring 2020	Work Order Number: 82-0773
Report To: Montana-Dakota Utilities Attn: Todd Peterson Address: 400 North 4th St. Bismarck, ND 58501 Phone: 701-425-2427 Email: todd.peterson@mdu.com	CC:	Collected By: <i>[Signature]</i>

Lab Number	Sample ID	Date	Time	Sample Type	Sample Type				Temp (°C)	Spec. Cond.	pH	Analysis Required
					1 Liter Raw	500 mL Nitric	500 mL Nitric (filtered)	1 Liter Nitric				
W575	104	6 Apr 2020	1132	GW	X	X	X	X	8.32	13655	6.96	MDU List AA & MDU List C
W576	80R	6 Apr 2020	1030	GW	X	X	X	X	6.39	5365	7.10	
W577	105	6 Apr 2020	0910	GW	X	X	X	X	5.49	6201	6.82	
W578	FB2	6 Apr 2020	NA	GW	X	X	X	X	NA	NA	NA	

Comments:

Relinquished By		Sample Condition		Received By	
Name	Date/Time	Location	Temp (°C)	Name	Date/Time
<i>[Signature]</i>	6 Apr 2020 1222	Log In Walk In #2	20.6 + TM562 / TM805	<i>[Signature]</i>	6 Apr 2020 1222
1					
2					



Field Datasheet

Groundwater Assessment

2616 E. Broadway Ave, Bismarck, ND

Phone: (701) 258-9720

Company: MDU Heskett

Event: Spring 2020

Sample ID: 104

Sampling Personal: *Jay May*

Weather Conditions: Temp: 40°F Wind: E @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Casing Strait?	YES	NO
Grout Seal Intact?	YES	NO
Repairs Necessary?	YES	NO
Casing Diameter:	2"	
Water Level Before Purge:	12.90	ft
Total Depth of Well:	—	ft
Well Volume:	—	liters
Depth to Top of Pump:	—	ft
Water Level After Sample:	13.20	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

Purging Method:	Bladder	Control Settings:
Sampling Method:	Bladder	Purge: 3 Sec.
Dedicated Equipment?	YES NO	Recover: 27 Sec.
Duplicate Sample?	YES NO	PSI: 20
Duplicate Sample ID:	—	
Bottle List:		
1 Liter Raw		
500mL Nitric		
500mL Nitric (filtered)		
250mL Sulfuric		

FIELD READINGS

Stabilization Parameters (3 Consecutive)	Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	ml Liters Removed	Appearance or Comment Clarity, Color, Odor, Ect.	
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10	(ft)	mL/Min		clear, slightly turbid, turbid	
6 Apr 2020	1052	Start of Well Purge									
	1057	7.84	13739	7.01	5.07	203.9	2.54	13.13	100.0	500.0	Clear
	1117	7.99	13676	6.99	3.87	209.2	0.89	13.19	100.0	200.0	Clear
	1122	8.13	13659	6.97	3.26	214.8	1.13	13.18	100.0	500.0	Clear
	1127	8.33	13660	6.97	3.22	218.0	1.03	13.18	100.0	500.0	Clear
	1132	8.32	13655	6.96	3.30	219.8	1.02	13.19	100.0	500.0	Clear

Well Stabilized? ~~YES~~ NO

Total Volume Purged: 4000.0 Liters

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH	Turbidity (NTU)	Appearance or Comment Clarity, Color, Odor, Ect.
6 Apr 2020	1132	8.32	13655	6.96	1.02	Clear

Comments:



Field Datasheet

Groundwater Assessment

2616 E. Broadway Ave, Bismarck, ND

Phone: (701) 258-9720

Company: MDU Heskett

Event: Spring 2020

Sample ID: 105

Sampling Personal: *Jon Phy*

Weather Conditions: Temp: 35 °F Wind: E @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Casing Strait?	YES	NO
Grout Seal Intact?	YES	NO
Repairs Necessary?		Not Visible
Casing Diameter:	2"	
Water Level Before Purge:	12.08	ft
Total Depth of Well:	—	ft
Well Volume:	—	liters
Depth to Top of Pump:	—	ft
Water Level After Sample:	12.33	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

Purging Method:	Bladder	Control Settings:
Sampling Method:	Bladder	Purge: 3 Sec.
Dedicated Equipment?	YES NO	Recover: 27 Sec.
Duplicate Sample?	YES NO	PSI: 20
Duplicate Sample ID:	—	

Bottle List:	
1 Liter Raw	
500mL Nitric	
500mL Nitric (filtered)	
250mL Sulfuric	

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	Liters Removed	Appearance or Comment
Purge Date	Time	±0.5	±5%	±0.1	±10%	±10					Clarity, Color, Odor, Ect.
6 Apr 2020	0740	Start of Well Purge									
	0745	5.43	3858	6.90	6.41	255.3	6.62	12.46	100.0	500.0	Clear
	0755	4.95	3347	6.98	4.60	230.6	3.78	12.38	100.0	1000.0	Clear
	0800	4.94	3872	6.95	4.76	221.0	2.25	12.35	100.0	500.0	Clear
	0805	5.21	4482	6.92	5.15	213.7	2.29	12.34	100.0	500.0	Clear
	0810	5.16	4859	6.92	6.42	206.3	2.10	12.32	100.0	500.0	Clear
	0815	5.15	5075	6.90	6.08	203.3	2.21	12.35	100.0	500.0	Clear
	0830	5.09	5555	6.85	5.73	199.3	1.79	12.34	100.0	1500.0	Clear
	0900	5.19	6094	6.82	7.04	200.9	2.25	12.33	100.0	1500.0	Clear
	0905	5.31	6147	6.86	7.14	201.6	2.14	12.34	100.0	500.0	Clear
	0910	5.49	6201	6.82	7.19	203.5	1.99	12.35	100.0	500.0	Clear

Well Stabilized? YES NO Total Volume Purged: 7500.0 Liters mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH		Turbidity (NTU)			Appearance or Comment
Clarity, Color, Odor, Ect.									
6 Apr 2020	0910	5.49	6201	6.82		1.99			Clear

Comments:

Quality Control Report

Lab IDs: 20-W575 to 20-W578

Project: MDU Heskett

Work Order: 202082-0773

Analyte	LCS Spike Amt	LCS Rec %	LCS % Rec Limits	Matrix Spike Amt	Matrix Spike ID	Matrix Spike Orig Result	Matrix Spike Result	Matrix Spike Rec %	Matrix Spike % Rec Limits	MSD/ Dup Orig Result	MSD/ Dup Result	MSD Rec %	MSD/ Dup RPD	MSD/ Dup RPD Limit (<)	Known Rec (%)	Known % Rec Limits	Method Blank		
Boron - Total mg/l	0.40	98	80-120	0.400	20-W564	0.12	0.46	85	75-125	0.46	0.48	90	4.3	20	-	-	< 0.1		
	0.40	100	80-120	0.400	20-W578	< 0.1	0.39	98	75-125	0.39	0.39	98	0.0	20	-	-	< 0.1		
Calcium - Total mg/l	20.0	110	80-120	2000	20M705q	2140	4160	101	75-125	4160	4120	99	1.0	20	-	-	< 1		
				1000	20M707q	1220	2240	102	75-125										< 1
				500	20W576q	320	840	104	75-125	840	835	103	0.6	20	-	-			
Chloride mg/l	30.0	93	80-120	30.0	20-W598	< 1	27.4	91	80-120	27.4	27.6	92	0.7	20	-	-	< 1		
	30.0	93	80-120															< 1	
Fluoride mg/l	0.50	106	90-110	0.500	20-W576	0.26	0.73	94	80-120	0.73	0.73	94	0.0	20	-	-	< 0.1		
	0.50	106	90-110															< 0.1	
pH units	-	-	-	-	-	-	-	-	-	6.6	6.7	-	1.5	20	-	-	-		
Sulfate mg/l	100	97	80-120	100	20-W578	< 5	99.0	99	80-120	99.0	99.2	99	0.2	20	-	-	< 5		
Total Dissolved Solids mg/l	-	-	-	-	-	-	-	-	-	6400	6840	-	6.6	20	-	-	< 10		

Samples were received in good condition on 6 Apr 2020 at 1222.

Temperature upon receipt at the Bismarck laboratory was 6.7°C.

All samples were properly preserved unless noted here and/or flagged on the individual analytical laboratory report.

With the exception of pH, all holding times were met.

Approved methodology was followed for all sample analyses.

All acceptance criteria were met for calibration, method blanks, laboratory control samples, laboratory fortified matrix/duplicates unless noted here.

- For some analytes, the reported results were elevated due to additional dilutions required to minimize the effects of sample matrix.

Approved by: C. Gentry
 29 Apr 2020



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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 28 Sep 20
Lab Number: 20-W3472
Work Order #: 82-2544
Account #: 002800
Date Sampled: 14 Sep 20 9:22
Date Received: 14 Sep 20 15:35
Sampled By: MVTL Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: 33

Temp at Receipt: 5.8C ROI

Event and Year: Fall 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.53	units	NA	SM 4500 H+ B	14 Sep 20 9:22	DJN
pH	* 6.8	units	0.1	SM4500-H+-B-11	14 Sep 20 17:00	CC
Temperature - Field	9.70	Degrees C	NA	SM 2550B	14 Sep 20 9:22	DJN
Conductivity - Field	4544	umhos/cm	1	EPA 120.1	14 Sep 20 9:22	DJN
Fluoride	0.22	mg/l	0.10	SM4500-F-C	14 Sep 20 17:00	CC
Sulfate	3000	mg/l	5.00	ASTM D516-11	16 Sep 20 9:38	EV
Chloride	11.1	mg/l	1.0	SM4500-Cl-E-11	16 Sep 20 11:10	EV
Total Dissolved Solids	4650	mg/l	10	USGS I1750-85	15 Sep 20 9:55	CC
Calcium - Total	458	mg/l	1.0	6010D	18 Sep 20 10:17	MDE
Boron - Total	0.30	mg/l	0.10	6010D	17 Sep 20 9:54	MDE

* Holding time exceeded

Approved by:

Claudette K. Carroll

CC
15OCT2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:

@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 28 Sep 20
Lab Number: 20-W3473
Work Order #: 82-2544
Account #: 002800
Date Sampled: 14 Sep 20 10:33
Date Received: 14 Sep 20 15:35
Sampled By: MVTL Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: 3-90

Temp at Receipt: 5.8C ROI

Event and Year: Fall 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.88	units	NA	SM 4500 H+ B	14 Sep 20 10:33	DJN
pH	* 7.0	units	0.1	SM4500-H+-B-11	14 Sep 20 17:00	CC
Temperature - Field	8.75	Degrees C	NA	SM 2550B	14 Sep 20 10:33	DJN
Conductivity - Field	5144	umhos/cm	1	EPA 120.1	14 Sep 20 10:33	DJN
Fluoride	0.13	mg/l	0.10	SM4500-F-C	14 Sep 20 17:00	CC
Sulfate	3120	mg/l	5.00	ASTM D516-11	16 Sep 20 9:38	EV
Chloride	36.5	mg/l	1.0	SM4500-Cl-E-11	16 Sep 20 11:10	EV
Total Dissolved Solids	4990	mg/l	10	USGS I1750-85	15 Sep 20 9:55	CC
Calcium - Total	486	mg/l	1.0	6010D	18 Sep 20 10:17	MDE
Boron - Total	< 0.5 @	mg/l	0.10	6010D	17 Sep 20 9:54	MDE

* Holding time exceeded

Approved by:

Claudette K. Carroll ^{CC} 15 OCT 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:
@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 28 Sep 20
Lab Number: 20-W3474
Work Order #: 82-2544
Account #: 002800
Date Sampled: 14 Sep 20
Date Received: 14 Sep 20 15:35
Sampled By: MVTL Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: Dup2

Temp at Receipt: 5.8C ROI

Event and Year: Fall 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH	* 7.0	units	0.1	SM4500-H+-B-11	14 Sep 20 17:00	CC
Fluoride	0.13	mg/l	0.10	SM4500-F-C	14 Sep 20 17:00	CC
Sulfate	2970	mg/l	5.00	ASTM D516-11	16 Sep 20 10:03	EV
Chloride	36.7	mg/l	1.0	SM4500-Cl-E-11	16 Sep 20 11:10	EV
Total Dissolved Solids	5130	mg/l	10	USGS I1750-85	15 Sep 20 9:55	CC
Calcium - Total	486	mg/l	1.0	6010D	18 Sep 20 10:17	MDE
Boron - Total	< 0.5 @	mg/l	0.10	6010D	17 Sep 20 9:54	MDE

* Holding time exceeded

Approved by:

Claudette K. Carroll

*CC
150152020*

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:
@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 28 Sep 20
Lab Number: 20-W3475
Work Order #: 82-2544
Account #: 002800
Date Sampled: 14 Sep 20 11:57
Date Received: 14 Sep 20 15:35
Sampled By: MVTL Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: 2-90

Temp at Receipt: 5.8C ROI

Event and Year: Fall 2020

	As Received Result	units	Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.93	units	NA	SM 4500 H+ B	14 Sep 20 11:57	DJN
pH	* 7.1	units	0.1	SM4500-H+-B-11	14 Sep 20 17:00	CC
Temperature - Field	11.0	Degrees C	NA	SM 2550B	14 Sep 20 11:57	DJN
Conductivity - Field	8082	umhos/cm	1	EPA 120.1	14 Sep 20 11:57	DJN
Fluoride	1.01	mg/l	0.10	SM4500-F-C	14 Sep 20 17:00	CC
Sulfate	5980	mg/l	5.00	ASTM D516-11	16 Sep 20 10:03	EV
Chloride	76.8	mg/l	1.0	SM4500-Cl-E-11	16 Sep 20 11:10	EV
Total Dissolved Solids	9180	mg/l	10	USGS I1750-85	15 Sep 20 9:55	CC
Calcium - Total	510	mg/l	1.0	6010D	18 Sep 20 10:17	MDE
Boron - Total	< 0.5 @	mg/l	0.10	6010D	17 Sep 20 9:54	MDE

* Holding time exceeded

Approved by:

Claudette K. Carroll ^{CC} 15 OCT 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:

@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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Page: 5 of 5

CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 28 Sep 20
Lab Number: 20-W3476
Work Order #: 82-2544
Account #: 002800
Date Sampled: 14 Sep 20 14:31
Date Received: 14 Sep 20 15:35
Sampled By: MVTL Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: MW-104

Temp at Receipt: 5.8C ROI

Event and Year: Fall 2020

	As Received Result	units	Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.90	units	NA	SM 4500 H+ B	14 Sep 20 14:31	DJN
pH	* 7.0	units	0.1	SM4500-H+-B-11	14 Sep 20 17:00	CC
Temperature - Field	13.8	Degrees C	NA	SM 2550B	14 Sep 20 14:31	DJN
Conductivity - Field	13948	umhos/cm	1	EPA 120.1	14 Sep 20 14:31	DJN
Fluoride	0.55	mg/l	0.10	SM4500-F-C	14 Sep 20 17:00	CC
Sulfate	10700	mg/l	5.00	ASTM D516-11	16 Sep 20 10:03	EV
Chloride	93.9	mg/l	1.0	SM4500-Cl-E-11	16 Sep 20 11:10	EV
Total Dissolved Solids	17900	mg/l	10	USGS I1750-85	15 Sep 20 9:55	CC
Calcium - Total	444	mg/l	1.0	6010D	18 Sep 20 10:17	MDE
Boron - Total	0.84	mg/l	0.10	6010D	17 Sep 20 9:54	MDE

* Holding time exceeded

Approved by:

Claudette K. Carroll

CC
15 OCT 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:
@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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Page: 1 of 1

Quality Control Report – Appendix III

Lab IDs: 20-W3472 to 20-W3476

Project: MDU Heskett

Work Order: 202082-2544

Analyte	LCS Spike Amt	LCS Rec %	LCS % Rec Limits	Matrix Spike Amt	Matrix Spike ID	Matrix Spike Orig Result	Matrix Spike Result	Matrix Spike Rec %	Matrix Spike % Rec Limits	MSD/ Dup Orig Result	MSD/ Dup Result	MSD Rec %	MSD/ Dup RPD	MSD/ Dup RPD Limit (<)	Known Rec (%)	Known % Rec Limits	Method Blank
Boron - Total mg/l	0.40	98	80-120	0.400	20-D2967	0.28	0.64	90	75-125	0.64	0.63	88	1.6	20	-	-	< 0.1
	0.40	98	80-120	2.00	20-W3492	0.62	2.40	89	75-125	2.40	2.36	87	1.7	20	-	-	< 0.1
	0.40	98	80-120												-	-	
	0.40	98	80-120												-	-	
Calcium - Total mg/l	20.0	112	80-120	500	20M1686q	258	745	97	75-125	745	750	98	0.7	20	-	-	< 1
				500	20W3472q	458	985	105	75-125	985	985	105	0.0	20	-	-	< 1
Chloride mg/l	30.0	98	80-120	30.0	20-W3481	4.4	36.4	107	80-120	36.4	36.5	107	0.3	20	-	-	< 1
	30.0	101	80-120												-	-	< 1
Fluoride mg/l	0.50	102	90-110	0.500	20-W3474	0.13	0.61	96	80-120	0.61	0.62	98	1.6	20	-	-	< 0.1
	0.50	104	90-110												-	-	< 0.1
pH units	-	-	-	-	-	-	-	-	-	6.8	6.8	-	0.0	20	-	-	-
Sulfate mg/l	100	103	80-120	1000	20-W3445	1080	1850	77	80-120	1850	1850	77	0.0	20	-	-	< 5
Total Dissolved Solids mg/l	-	-	-	-	-	-	-	-	-	4650	4640	-	0.2	20	-	-	< 10

Samples were received in good condition on 14 Sep 2020 at 1535.

Temperature upon receipt at the Bismarck laboratory was 5.8°C. Samples were received on ice and evidence of cooling had begun.

All samples were properly preserved unless noted here and/or flagged on the individual analytical laboratory report.

With the exception of pH, all holding times were met.

Approved methodology was followed for all sample analyses.

All acceptance criteria were met for calibration, method blanks, laboratory control samples, laboratory fortified matrix/duplicates unless noted here.

- For some analytes, the reported results were elevated due to additional dilutions required to minimize the effects of sample matrix.
- The recoveries for one sulfate matrix spike/matrix spike duplicate were outside the acceptable limits. RPD for the recoveries was within limits. Poor recoveries were determined to be due to sample matrix. LCS was acceptable. No further action was taken.

Approved by: _____

C. Tawel

15 OCT 2020



2616 E. Broadway Ave
Bismarck, ND 58501
(701) 258-9720

Chain of Custody Record

Project Name: MDU Heskett	Event: Fall 2020	Work Order Number: <i>82-2544</i>
Report To: Montana-Dakota Utilities Attn: Todd Peterson Address: 400 North 4th St. Bismarck, ND 58501 Phone: 701-425-2427 Email: todd.peterson@mdu.com	CC:	Collected By: <i>Darren Niesmars</i>

Lab Number	Sample ID	Date	Time	Sample Type	1 Liter Raw	500 mL Nitric	500 mL Nitric (filtered)	1 Liter Sulfuric	1 Liter Nitric	Temp (°C)	Spec. Cond.	pH	Analysis Required
W3472	33	14 Sept 2020	0922	GW	X	X	X	X		9.70	4544	6.53	MDU List AA & MDU List C
W3473	3-90	14 Sept 2020	1033	GW	X	X	X	X		8.75	5144	6.88	
W3474	Dup2	14 Sept 2020	NA	GW	X	X	X	X		NA	NA	NA	
W3475	2-90	14 Sept 2020	1157	GW	X	X	X	X		10.97	8082	6.93	
W3476	MW-104	14 Sept 2020	1431	GW	X	X	X	X		13.77	13948	6.90	

Comments:

Relinquished By		Sample Condition		Received By	
Name	Date/Time	Location	Temp (°C)	Name	Date/Time
<i>[Signature]</i>	14 Sept 2020 1535	Log In Walk In #2	TM562 / TM805 ROD 5.8	<i>[Signature]</i>	14 Sept 2020 1535



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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 2 Oct 20
Lab Number: 20-W3489
Work Order #: 82-2559
Account #: 002800
Date Sampled: 15 Sep 20 13:05
Date Received: 15 Sep 20 13:50
Sampled By: MVTL Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: 80R

Temp at Receipt: 0.9C ROI

Event and Year: Fall 2020

Table with 6 columns: As Received Result, Method RL, Method Reference, Date Analyzed, Analyst. Rows include pH - Field, pH, Temperature - Field, Conductivity - Field, Fluoride, Sulfate, Chloride, Total Dissolved Solids, Calcium - Total, Boron - Total.

* Holding time exceeded

Approved by: Claudette K. Carroll 15 OCT 2020
Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:
@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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2616 East Broadway Ave. ~ Bismarck, ND 58501 ~ 800-279-6885 ~ Fax 701-258-9724
1201 Lincoln Hwy. ~ Nevada, IA 50201 ~ 800-362-0855 ~ Fax 515-382-3885
www.mvttl.com



CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 2 Oct 20
Lab Number: 20-W3490
Work Order #: 82-2559
Account #: 002800
Date Sampled: 15 Sep 20 12:10
Date Received: 15 Sep 20 13:50
Sampled By: MVTL Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: 105

Temp at Receipt: 0.9C ROI

Event and Year: Fall 2020

Table with 6 columns: Parameter, As Received Result, Units, Method RL, Method Reference, Date Analyzed, Analyst. Rows include pH - Field, pH, Temperature - Field, Conductivity - Field, Fluoride, Sulfate, Chloride, Total Dissolved Solids, Calcium - Total, Boron - Total.

* Holding time exceeded

Approved by:

Claudette K. Carroll 15 OCT 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:
@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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www.mvttl.com



CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 2 Oct 20
Lab Number: 20-W3491
Work Order #: 82-2559
Account #: 002800
Date Sampled: 15 Sep 20
Date Received: 15 Sep 20 13:50
Sampled By: MVTL Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: FB2

Temp at Receipt: 0.9C ROI

Event and Year: Fall 2020

Table with 6 columns: Analyte, As Received Result, Method RL, Method Reference, Date Analyzed, Analyst. Rows include pH, Fluoride, Sulfate, Chloride, Total Dissolved Solids, Calcium - Total, and Boron - Total.

* Holding time exceeded

Approved by:

Claudette K. Carroll 15 OCT 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:
@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016

Quality Control Report – Appendix III

Lab IDs: 20-W3489 to 20-W3491

Project: MDU Heskett

Work Order: 202082-2559

Analyte	LCS Spike Amt	LCS Rec %	LCS % Rec Limits	Matrix Spike Amt	Matrix Spike ID	Matrix Spike Orig Result	Matrix Spike Result	Matrix Spike Rec %	Matrix Spike % Rec Limits	MSD/ Dup Orig Result	MSD/ Dup Result	MSD Rec %	MSD/ Dup RPD	MSD/ Dup RPD Limit (<)	Known Rec (%)	Known % Rec Limits	Method Blank
Boron - Total mg/l	0.40	98	80-120	0.400	20-D2967	0.28	0.64	90	75-125	0.64	0.63	88	1.6	20	-	-	< 0.1
	0.40	98	80-120	2.00	20-W3492	0.62	2.40	89	75-125	2.40	2.36	87	1.7	20	-	-	< 0.1
	0.40	98	80-120												-	-	
	0.40	98	80-120												-	-	
Calcium - Total mg/l	20.0	112	80-120	500	20W3494q	478	960	96	75-125	960	960	96	0.0	20	-	-	< 1
	22.6	113	80-120												-	-	< 1
Chloride mg/l	30.0	98	80-120	30.0	20-W3481	4.4	36.4	107	80-120	36.4	36.5	107	0.3	20	-	-	< 1
	30.0	101	80-120												-	-	< 1
Fluoride mg/l	0.50	104	90-110	0.500	20-W3486	3.27	3.84	114	80-120	3.84	3.84	114	0.0	20	-	-	< 0.1
	0.50	104	90-110	0.500	20-W3494	0.19	0.67	96	80-120	0.67	0.67	96	0.0	20	-	-	< 0.1
	0.50	104	90-110												-	-	
	0.50	104	90-110												-	-	
pH units	-	-	-	-	-	-	-	-	-	7.2	7.3	-	1.4	20	-	-	-
	-	-	-	-	-	-	-	-	-	7.4	7.5	-	1.3	20	-	-	-
Sulfate mg/l	100	99	80-120	100	20-W3491	< 5	93.7	94	80-120	93.7	92.6	93	1.2	20	-	-	< 5
Total Dissolved Solids mg/l	-	-	-	-	-	-	-	-	-	10300	10400	-	1.0	20	-	-	< 10
	-	-	-	-	-	-	-	-	-	< 10	< 10	-	0.0	*	-	-	

* Data reported based on acceptance criteria of Absolute Difference of ± 3 mg/L.

Samples were received in good condition on 15 Sep 2020 at 1350.
 Temperature upon receipt at the Bismarck laboratory was 0.9°C. Samples were received on ice and evidence of cooling had begun.
 All samples were properly preserved unless noted here and/or flagged on the individual analytical laboratory report.
 With the exception of pH, all holding times were met.
 Approved methodology was followed for all sample analyses.
 All acceptance criteria were met for calibration, method blanks, laboratory control samples, laboratory fortified matrix/duplicates unless noted here.

- For some analytes, the reported results were elevated due to additional dilutions required to minimize the effects of sample matrix.

Approved by: C. Cantor
 Amended 10 Nov 2020



Field Datasheet

Groundwater Assessment

2616 E. Broadway Ave, Bismarck, ND

Phone: (701) 258-9720

Company: MDU Heskett
 Event: Fall 2020
 Sample ID: 80R
 Sampling Personal: J. J. [Signature]

Weather Conditions: Temp: 65°F Wind: S @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	<u>YES</u>	<u>NO</u>	
Well Labeled?	<u>YES</u>	<u>NO</u>	
Casing Strait?	<u>YES</u>	<u>NO</u>	
Grout Seal Intact?	<u>YES</u>	<u>NO</u>	Not Visible
Repairs Necessary?			
Casing Diameter:	<u>2"</u>		
Water Level Before Purge:	<u>14.28</u>	ft	
Total Depth of Well:	<u>—</u>	ft	
Well Volume:	<u>—</u>	liters	
Depth to Top of Pump:	<u>—</u>	ft	
Water Level After Sample:	<u>14.73</u>	ft	
Measurement Method:	<u>Electric Water Level Indicator</u>		

SAMPLING INFORMATION

Purging Method:	<u>Bladder</u>
Sampling Method:	<u>Bladder</u>
Dedicated Equipment?	<u>(YES)</u> NO
Duplicate Sample?	YES <u>(NO)</u>
Duplicate Sample ID:	<u>—</u>
Bottle List:	
1 Liter Raw	
500mL Nitric	
500mL Nitric (filtered)	
250mL Sulfuric	
Control Settings:	
Purge:	<u>3</u> Sec.
Recover:	<u>23</u> Sec.
PSI:	<u>20</u>

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	Liters Removed	Appearance or Comment Clarity, Color, Odor, Ect.
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10					clear, slightly turbid, turbid
<u>15 Sept 2020</u>	<u>1225</u>	<u>Start of Well Purge</u>									
	<u>1230</u>	<u>11.49</u>	<u>5567</u>	<u>7.10</u>	<u>1.91</u>	<u>240.0</u>	<u>0.42</u>	<u>14.50</u>	<u>1000</u>	<u>500.0</u>	<u>Clear</u>
	<u>1250</u>	<u>10.77</u>	<u>5633</u>	<u>7.09</u>	<u>1.18</u>	<u>221.9</u>	<u>0.49</u>	<u>14.63</u>	<u>1200</u>	<u>2000.0</u>	<u>Clear</u>
	<u>1255</u>	<u>10.96</u>	<u>5556</u>	<u>7.08</u>	<u>1.20</u>	<u>223.4</u>	<u>0.15</u>	<u>14.68</u>	<u>1000</u>	<u>500.0</u>	<u>Clear</u>
	<u>1300</u>	<u>10.77</u>	<u>5572</u>	<u>7.09</u>	<u>1.29</u>	<u>220.0</u>	<u>0.91</u>	<u>14.70</u>	<u>600.0</u>	<u>500.0</u>	<u>Clear</u>
	<u>1305</u>	<u>10.51</u>	<u>5562</u>	<u>7.09</u>	<u>1.32</u>	<u>220.9</u>	<u>0.16</u>	<u>14.71</u>	<u>600.0</u>	<u>500.0</u>	<u>Clear</u>

Well Stabilized? (YES) NO Total Volume Purged: 4000.0 Liters

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	Liters Removed	Appearance or Comment Clarity, Color, Odor, Ect.
<u>15 Sept 2020</u>	<u>1305</u>	<u>10.51</u>	<u>5562</u>	<u>7.09</u>			<u>0.16</u>				<u>Clear</u>

Comments:



Field Datasheet

Groundwater Assessment

2616 E. Broadway Ave, Bismarck, ND

Phone: (701) 258-9720

Company: MDU Heskett

Event: Fall 2020

Sample ID: 105

Sampling Personal: *Jay Eby*

Weather Conditions: Temp: 60°F Wind: S @ 5-10 Precip: Sunny / Partly Cloudy / ~~Cloudy~~

WELL INFORMATION

Well Locked?	YES	NO	
Well Labeled?	YES	NO	
Casing Strait?	YES	NO	
Grout Seal Intact?	YES	NO	Not Visible
Repairs Necessary?			
Casing Diameter:	2"		
Water Level Before Purge:	13.23	ft	
Total Depth of Well:	—	ft	
Well Volume:	—	liters	
Depth to Top of Pump:	—	ft	
Water Level After Sample:	13.63	ft	
Measurement Method:	Electric Water Level Indicator		

SAMPLING INFORMATION

Purging Method:	Bladder	Control Settings:
Sampling Method:	Bladder	Purge: 3 Sec.
Dedicated Equipment?	YES NO	Recover: 27 Sec.
Duplicate Sample?	YES NO	PSI: 20
Duplicate Sample ID:	—	
Bottle List:		
1 Liter Raw		
500mL Nitric		
500mL Nitric (filtered)		
250mL Sulfuric		

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level (ft)	Pumping Rate mL/Min	Liters Removed	Appearance or Comment Clarity, Color, Odor, Ect.
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10					clear, slightly turbid, turbid
15 Sept 2020	1115	Start of Well Purge									
	1120	10.06	3908	6.91	0.68	211.3	5.51	13.60	100.0	500.0	Clear
	1140	10.07	5758	6.83	0.67	208.2	1.52	13.53	100.0	2000.0	Clear
	1145	9.93	5945	6.82	0.64	204.8	1.60	13.62	100.0	500.0	Clear
	1150	9.74	6372	6.81	0.89	206.6	1.74	13.56	100.0	500.0	Clear
	1155	10.03	6543	6.80	1.07	211.9	0.91	13.56	100.0	500.0	Clear
	1200	9.91	6874	6.80	1.34	212.3	0.94	13.57	100.0	500.0	Clear
	1205	10.06	6961	6.79	1.10	216.3	0.97	13.56	100.0	500.0	Clear
	1210	10.01	6966	6.78	1.05	216.2	0.61	13.61	100.0	500.0	Clear

Well Stabilized? YES NO

Total Volume Purged: 5500.0 Liters

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment Clarity, Color, Odor, Ect.
15 Sept 2020	1210	10.01	6966	6.78			0.61				Clear

Comments:



2616 E. Broadway Ave
Bismarck, ND 58501
(701) 258-9720

Chain of Custody Record

Project Name: MDU Heskett	Event: Fall 2020	Work Order Number: 82-2559
Report To: Montana-Dakota Utilities Attn: Todd Peterson Address: 400 North 4th St. Bismarck, ND 58501 Phone: 701-425-2427 Email: todd.peterson@mdu.com	CC:	Collected By: <i>Jeremy Meyer</i>

Lab Number	Sample ID	Date	Time	Sample Type	Sample Type				Temp (°C)	Spec. Cond.	pH	Analysis Required
					1 Liter Raw	500 mL Nitric	500 mL Nitric (filtered)	1 Liter Nitric				
*	104			GW	X	X	X	X				MDU List AA & MDU List C
W3489	80R	15 Sept 2020	1305	GW	X	X	X	X	10.51	5562	7.09	
W3490	105	15 Sept 2020	1210	GW	X	X	X	X	10.01	6966	6.78	
W3491	FB2	15 Sept 2020	NA	GW	X	X	X	X	NA	NA	NA	

Comments: * 15 Sept 2020 2

Relinquished By		Sample Condition			Received By	
Name	Date/Time	Location	Temp (°C)	Name	Date/Time	
<i>Todd Peterson</i>	15 Sept 2020	LOG In Walk In #2	Real 0.9 TM562 / TM805	<i>Eily Johnson</i>	15 Sept 2020 1350	
2						



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www.mvttl.com



CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 2 Oct 20
Lab Number: 20-W3492
Work Order #: 82-2560
Account #: 002800
Date Sampled: 14 Sep 20 9:39
Date Received: 15 Sep 20 13:50
Sampled By: MVTL Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: 13

Temp at Receipt: 0.9C ROI

Event and Year: Fall 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	7.08	units	NA	SM 4500 H+ B	14 Sep 20 9:39	JSM
pH	* 7.4	units	0.1	SM4500-H+-B-11	15 Sep 20 16:30	CC
Temperature - Field	9.34	Degrees C	NA	SM 2550B	14 Sep 20 9:39	JSM
Conductivity - Field	9792	umhos/cm	1	EPA 120.1	14 Sep 20 9:39	JSM
Fluoride	0.98	mg/l	0.10	SM4500-F-C	15 Sep 20 16:30	CC
Sulfate	6570	mg/l	5.00	ASTM D516-11	16 Sep 20 10:23	EV
Chloride	77.8	mg/l	1.0	SM4500-Cl-E-11	16 Sep 20 11:10	EV
Total Dissolved Solids	10500	mg/l	10	USGS I1750-85	16 Sep 20 14:05	CC
Calcium - Total	402	mg/l	1.0	6010D	18 Sep 20 11:17	MDE
Boron - Total	0.62	mg/l	0.10	6010D	17 Sep 20 9:54	MDE

* Holding time exceeded

Approved by:

Claudette K. Carroll

*CC
15 OCT 2020*

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:

@ = Due to sample matrix
! = Due to sample quantity

= Due to concentration of other analytes
+ = Due to internal standard response

CERTIFICATION: ND # ND-00016



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Page: 2 of 8

CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 2 Oct 20
Lab Number: 20-W3493
Work Order #: 82-2560
Account #: 002800
Date Sampled: 14 Sep 20
Date Received: 15 Sep 20 13:50
Sampled By: MVTL Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: Dup1

Temp at Receipt: 0.9C ROI

Event and Year: Fall 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH	* 7.2	units	0.1	SM4500-H+-B-11	15 Sep 20 16:30	CC
Fluoride	1.00	mg/l	0.10	SM4500-F-C	15 Sep 20 16:30	CC
Sulfate	6730	mg/l	5.00	ASTM D516-11	16 Sep 20 10:23	EV
Chloride	77.5	mg/l	1.0	SM4500-Cl-E-11	16 Sep 20 11:10	EV
Total Dissolved Solids	10400	mg/l	10	USGS I1750-85	16 Sep 20 14:05	CC
Calcium - Total	418	mg/l	1.0	6010D	18 Sep 20 11:17	MDE
Boron - Total	0.62	mg/l	0.10	6010D	17 Sep 20 10:54	MDE

* Holding time exceeded

Approved by:

Claudette K. Carroll

CC
15 OCT 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

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@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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Page: 3 of 8

CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 2 Oct 20
Lab Number: 20-W3494
Work Order #: 82-2560
Account #: 002800
Date Sampled: 15 Sep 20 8:40
Date Received: 15 Sep 20 13:50
Sampled By: MVTL Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: 102

Temp at Receipt: 0.9C ROI

Event and Year: Fall 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.88	units	NA	SM 4500 H+ B	15 Sep 20 8:40	JSM
pH	* 7.1	units	0.1	SM4500-H+-B-11	15 Sep 20 16:30	CC
Temperature - Field	8.95	Degrees C	NA	SM 2550B	15 Sep 20 8:40	JSM
Conductivity - Field	8165	umhos/cm	1	EPA 120.1	15 Sep 20 8:40	JSM
Fluoride	0.19	mg/l	0.10	SM4500-F-C	15 Sep 20 16:30	CC
Sulfate	5340	mg/l	5.00	ASTM D516-11	16 Sep 20 10:23	EV
Chloride	5.6	mg/l	1.0	SM4500-Cl-E-11	16 Sep 20 11:10	EV
Total Dissolved Solids	8130	mg/l	10	USGS I1750-85	16 Sep 20 14:05	CC
Calcium - Total	478	mg/l	1.0	6010D	18 Sep 20 11:17	MDE
Boron - Total	1.28	mg/l	0.10	6010D	17 Sep 20 10:54	MDE

* Holding time exceeded

Approved by:

Claudette K. Carroll

CC
15 OCT 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:
@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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Page: 4 of 8

CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 2 Oct 20
Lab Number: 20-W3495
Work Order #: 82-2560
Account #: 002800
Date Sampled: 15 Sep 20 9:40
Date Received: 15 Sep 20 13:50
Sampled By: MVTL Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: 70

Temp at Receipt: 0.9C ROI

Event and Year: Fall 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	7.08	units	NA	SM 4500 H+ B	15 Sep 20 9:40	JSM
pH	* 7.3	units	0.1	SM4500-H+-B-11	15 Sep 20 16:30	CC
Temperature - Field	9.41	Degrees C	NA	SM 2550B	15 Sep 20 9:40	JSM
Conductivity - Field	4643	umhos/cm	1	EPA 120.1	15 Sep 20 9:40	JSM
Fluoride	0.34	mg/l	0.10	SM4500-F-C	15 Sep 20 16:30	CC
Sulfate	2500	mg/l	5.00	ASTM D516-11	16 Sep 20 10:23	EV
Chloride	52.0	mg/l	1.0	SM4500-Cl-E-11	16 Sep 20 11:47	EV
Total Dissolved Solids	4350	mg/l	10	USGS I1750-85	16 Sep 20 14:05	CC
Calcium - Total	416	mg/l	1.0	6010D	18 Sep 20 12:17	MDE
Boron - Total	0.50	mg/l	0.10	6010D	17 Sep 20 10:54	MDE

* Holding time exceeded

Approved by:

Claudette K. Carroll ^{CC} 15 OCT 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:
@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 2 Oct 20
Lab Number: 20-W3496
Work Order #: 82-2560
Account #: 002800
Date Sampled: 15 Sep 20 10:40
Date Received: 15 Sep 20 13:50
Sampled By: MVTl Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: 101

Temp at Receipt: 0.9C ROI

Event and Year: Fall 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.74	units	NA	SM 4500 H+ B	15 Sep 20 10:40	JSM
pH	* 7.0	units	0.1	SM4500-H+-B-11	15 Sep 20 16:30	CC
Temperature - Field	11.2	Degrees C	NA	SM 2550B	15 Sep 20 10:40	JSM
Conductivity - Field	5217	umhos/cm	1	EPA 120.1	15 Sep 20 10:40	JSM
Fluoride	0.21	mg/l	0.10	SM4500-F-C	15 Sep 20 16:30	CC
Sulfate	3160	mg/l	5.00	ASTM D516-11	16 Sep 20 10:23	EV
Chloride	21.7	mg/l	1.0	SM4500-Cl-E-11	16 Sep 20 11:47	EV
Total Dissolved Solids	5530	mg/l	10	USGS I1750-85	16 Sep 20 14:05	CC
Calcium - Total	429	mg/l	1.0	6010D	18 Sep 20 12:17	MDE
Boron - Total	0.68	mg/l	0.10	6010D	17 Sep 20 10:54	MDE

* Holding time exceeded

Approved by:

Claudette K. Carroll

CC
15 OCT 20 20

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:

@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 2 Oct 20
Lab Number: 20-W3497
Work Order #: 82-2560
Account #: 002800
Date Sampled: 14 Sep 20 11:30
Date Received: 15 Sep 20 13:50
Sampled By: MVTL Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: 103

Temp at Receipt: 0.9C ROI

Event and Year: Fall 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.80	units	NA	SM 4500 H+ B	14 Sep 20 11:30	JSM
pH	* 7.0	units	0.1	SM4500-H+-B-11	15 Sep 20 16:30	CC
Temperature - Field	9.81	Degrees C	NA	SM 2550B	14 Sep 20 11:30	JSM
Conductivity - Field	4977	umhos/cm	1	EPA 120.1	14 Sep 20 11:30	JSM
Fluoride	0.14	mg/l	0.10	SM4500-F-C	15 Sep 20 16:30	CC
Sulfate	2740	mg/l	5.00	ASTM D516-11	16 Sep 20 10:23	EV
Chloride	139	mg/l	1.0	SM4500-Cl-E-11	16 Sep 20 11:47	EV
Total Dissolved Solids	4930	mg/l	10	USGS I1750-85	16 Sep 20 14:05	CC
Calcium - Total	580	mg/l	1.0	6010D	18 Sep 20 12:17	MDE
Boron - Total	0.12	mg/l	0.10	6010D	17 Sep 20 10:54	MDE

* Holding time exceeded

Approved by:

Claudette K. Carroll

CC
15 OCT 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 2 Oct 20
Lab Number: 20-W3498
Work Order #: 82-2560
Account #: 002800
Date Sampled: 14 Sep 20 10:30
Date Received: 15 Sep 20 13:50
Sampled By: MVTL Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: 44R

Temp at Receipt: 0.9C ROI

Event and Year: Fall 2020

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
pH - Field	6.66	units	NA	SM 4500 H+ B	14 Sep 20 10:30	JSM
pH	* 6.9	units	0.1	SM4500-H+-B-11	15 Sep 20 16:30	CC
Temperature - Field	9.63	Degrees C	NA	SM 2550B	14 Sep 20 10:30	JSM
Conductivity - Field	9115	umhos/cm	1	EPA 120.1	14 Sep 20 10:30	JSM
Fluoride	0.67	mg/l	0.10	SM4500-F-C	15 Sep 20 16:30	CC
Sulfate	6660	mg/l	5.00	ASTM D516-11	16 Sep 20 10:42	EV
Chloride	223	mg/l	1.0	SM4500-Cl-E-11	16 Sep 20 11:47	EV
Total Dissolved Solids	10300	mg/l	10	USGS I1750-85	16 Sep 20 14:05	CC
Calcium - Total	444	mg/l	1.0	6010D	18 Sep 20 12:17	MDE
Boron - Total	< 0.5 @	mg/l	0.10	6010D	17 Sep 20 10:54	MDE

* Holding time exceeded

Approved by:

Claudette K. Carroll

CC
15 OCT 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

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@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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CERTIFICATE of ANALYSIS - CCR

Todd Peterson
Montana-Dakota Utilities Co.
400 N 4th St
Bismarck ND 58501

Report Date: 2 Oct 20
Lab Number: 20-W3499
Work Order #: 82-2560
Account #: 002800
Date Sampled: 14 Sep 20
Date Received: 15 Sep 20 13:50
Sampled By: MVTl Field Services

Project Name: MDU Heskett

PO #: 180609 OP

Sample Description: FB1

Temp at Receipt: 0.9C ROI

Event and Year: Fall 2020

	As Received Result	units	Method RL	Method Reference	Date Analyzed	Analyst
pH	* 5.7	units	0.1	SM4500-H+-B-11	15 Sep 20 16:30	CC
Fluoride	< 0.1	mg/l	0.10	SM4500-F-C	15 Sep 20 16:30	CC
Sulfate	< 5	mg/l	5.00	ASTM D516-11	16 Sep 20 10:42	EV
Chloride	< 1	mg/l	1.0	SM4500-Cl-E-11	16 Sep 20 11:47	EV
Total Dissolved Solids	< 10	mg/l	10	USGS I1750-85	16 Sep 20 14:05	CC
Calcium - Total	< 1	mg/l	1.0	6010D	18 Sep 20 12:17	MDE
Boron - Total	< 0.1	mg/l	0.10	6010D	17 Sep 20 10:54	MDE

* Holding time exceeded

Approved by:

Claudette K. Carroll

CC
15 OCT 2020

Claudette K. Carroll, Laboratory Manager, Bismarck, ND

RL = Method Reporting Limit

The reporting limit was elevated for any analyte requiring a dilution as coded below:

@ = Due to sample matrix # = Due to concentration of other analytes
! = Due to sample quantity + = Due to internal standard response

CERTIFICATION: ND # ND-00016



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MEMBER
 ACIL

Quality Control Report – Appendix III

Lab IDs: 20-W3492 to 20-W3499

Project: MDU Heskett

Work Order: 202082-2560

Analyte	LCS Spike Amt	LCS Rec %	LCS % Rec Limits	Matrix Spike Amt	Matrix Spike ID	Matrix Spike Orig Result	Matrix Spike Result	Matrix Spike Rec %	Matrix Spike % Rec Limits	MSD/ Dup Orig Result	MSD/ Dup Result	MSD Rec %	MSD/ Dup RPD	MSD/ Dup RPD Limit (<)	Known Rec (%)	Known % Rec Limits	Method Blank
Boron - Total mg/l	0.40	98	80-120	0.400	20-D2967	0.28	0.64	90	75-125	0.64	0.63	88	1.6	20	-	-	< 0.1
	0.40	98	80-120	2.00	20-W3492	0.62	2.40	89	75-125	2.40	2.36	87	1.7	20	-	-	< 0.1
	0.40	98	80-120	2.00	20-W3499	< 0.1	1.96	98	75-125	1.96	1.92	96	2.1	20	-	-	< 0.1
	0.40	98	80-120												-	-	< 0.1
	0.50	80	80-120												-	-	< 0.1
Calcium - Total mg/l	20.0	112	80-120	500	20W3494q	478	960	96	75-125	960	960	96	0.0	20	-	-	< 1
	20.0	109	80-120	500	20W3508q	174	690	103	75-125	690	680	101	1.5	20	-	-	< 1
	20.0	109	80-120	500	20W3537q	318	805	97	75-125	805	815	99	1.2	20	-	-	< 1
	20.0	113	80-120												-	-	< 1
Chloride mg/l	30.0	98	80-120	30.0	20-W3481	4.4	36.4	107	80-120	36.4	36.5	107	0.3	20	-	-	< 1
	30.0	101	80-120	30.0	20-W3509	5.5	38.7	111	80-120	38.7	38.9	111	0.5	20	-	-	< 1
	30.0	101	80-120												-	-	< 1
	30.0	102	80-120												-	-	< 1
Fluoride mg/l	0.50	104	90-110	0.500	20-W3486	3.27	3.84	114	80-120	3.84	3.84	114	0.0	20	-	-	< 0.1
	0.50	104	90-110	0.500	20-W3494	0.19	0.67	96	80-120	0.67	0.67	96	0.0	20	-	-	< 0.1
	0.50	104	90-110												-	-	< 0.1
	0.50	104	90-110												-	-	< 0.1
pH units	-	-	-	-	-	-	-	-	-	7.2	7.3	-	1.4	20	-	-	-
	-	-	-	-	-	-	-	-	-	7.4	7.5	-	1.3	20	-	-	-
Sulfate mg/l	100	99	80-120	100	20-W3491	< 5	93.7	94	80-120	93.7	92.6	93	1.2	20	-	-	< 5
	100	98	80-120	100	20-W3499	< 5	96.6	97	80-120	96.6	97.8	98	1.2	20	-	-	< 5
Total Dissolved Solids mg/l	-	-	-	-	-	-	-	-	-	10300	10400	-	1.0	20	-	-	< 10
	-	-	-	-	-	-	-	-	-	< 10	< 10	-	0.0	*	-	-	< 10

Page: 2 of 2

Quality Control Report – Appendix III

Lab IDs: 20-W3492 to 20-W3499

Project: MDU Heskett

Work Order: 202082-2560

* Data reported based on acceptance criteria of Absolute Difference of ± 3 mg/L.

Samples were received in good condition on 15 Sep 2020 at 1350.

Temperature upon receipt at the Bismarck laboratory was 0.9°C. Samples were received on ice and evidence of cooling had begun.

All samples were properly preserved unless noted here and/or flagged on the individual analytical laboratory report.

With the exception of pH, all holding times were met.

Approved methodology was followed for all sample analyses.

All acceptance criteria were met for calibration, method blanks, laboratory control samples, laboratory fortified matrix/duplicates unless noted here.

- For some analytes, the reported results were elevated due to additional dilutions required to minimize the effects of sample matrix.
- For some analytes, the reported results were elevated due to matrix effect on the response of the internal standard.

Approved by: _____



15 OCT 2020



2616 E. Broadway Ave
Bismarck, ND 58501
(701) 258-9720

Chain of Custody Record

Project Name: MDU Heskett		Event: Fall 2020	Work Order Number: <i>82-2560</i>
Report To: Montana-Dakota Utilities Attn: Todd Peterson Address: 400 North 4th St. Bismarck, ND 58501 Phone: 701-425-2427 Email: todd.peterson@mdu.com		CC:	Collected By: <i>Jeremy Meyer</i>

Lab Number	Sample ID	Date	Time	Sample Type	Sample Type				Temp (°C)	Spec. Cond.	pH	Analysis Required
					1 Liter Raw	500 mL Nitric	500 mL Nitric (filtered)	1 Liter Sulfuric				
W3492	13	14 Sept 2020	0939	GW	X	X	X	X	9.34	9792	7.08	MDU List AA & MDU List C
W3493	Dup1	14 Sept 2020	NA	GW	X	X	X	X	NA	NA	NA	
W3494	102	15 Sept 2020	0840	GW	X	X	X	X	8.95	8165	6.88	
W3495	70	15 Sept 2020	0940	GW	X	X	X	X	9.41	4643	7.08	
W3496	101	15 Sept 2020	1040	GW	X	X	X	X	11.23	5217	6.74	
W3497	103	14 Sept 2020	1130	GW	X	X	X	X	9.81	4977	6.80	
W3498	44R	14 Sept 2020	1030	GW	X	X	X	X	9.63	9115	6.66	
W3499	FB1	14 Sept 2020	NA	GW	X	X	X	X	NA	NA	NA	

Comments:

Relinquished By		Sample Condition		Received By	
Name	Date/Time	Location	Temp (°C)	Name	Date/Time
<i>[Signature]</i>	15 Sept 2020	Log ID Walk In #2	*E 0.9 TM562 / TM805	<i>[Signature]</i>	15 Sept 2020 1350
2					

*4/2 15 Sept 2020

Appendix B

Alternative Source Demonstration Reports

Alternative Source Demonstration: September 2019 Event

R.M. Heskett Station

Prepared for
Montana-Dakota Utilities Co.

May 2020



Alternative Source Demonstration: September 2019 Event

R.M. Heskett Station

Prepared for
Montana-Dakota Utilities Co.

May 2020

Alternative Source Demonstration
September 2019 Event

May 2020

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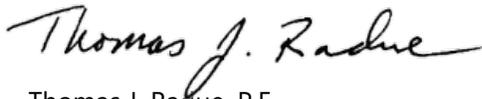
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Appendix A	Ash SPLP Laboratory Report (2011)
Appendix B	Aerial Photo (March 30, 1988)
Appendix C	Boring Logs
Appendix D	MW1-90 Time Series Plots
Appendix E	Geochemist's Workbench Results

Certifications

I hereby certify that I, or my agent, have examined this written demonstration and attest that this Coal Combustion Residuals Facility Alternative Source Demonstration (ASD) is accurate and has been prepared in accordance with good engineering practice, including consideration of applicable industry standards and the requirements of 40 CFR §257.94. I further certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of North Dakota.

Revision	Date	Summary of Revisions
0	5/7/2020	Initial Alternative Source Demonstration



Thomas J. Radue, P.E.

Barr Engineering Co.

ND Registration Number PE – 3632

1.0 Introduction

Montana-Dakota Utilities Co. (MDU) owns and operates R.M. Heskett Station (Site), a coal-fired generating station and a gas-fired turbine located in Mandan, Morton County, North Dakota (Figure 1). One CCR (coal combustion residual) unit, as defined by 40 CFR 257.53, is located on the property. The CCR unit contains coal combustion by-products, asbestos wastes generated from construction activity associated with MDU-owned facilities, and ash derived from burning tire-derived fuel (TDF) at the facility.

The CCR Rule (US EPA, 2015) §257.94(e)(2) allows for an alternative source demonstration (ASD) in the event of an identified statistically significant increase (SSI) in a water quality parameter in a downgradient monitoring well over background levels:

The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report.

The purpose of this work is to evaluate the data collected as part of the September 2019 monitoring event, along with historical data, to demonstrate if the potential SSIs are the results of a “source other than the CCR unit” or due to natural variation in groundwater quality, an error in sampling, analysis, or statistical evaluation.

2.0 September 2019 SSIs

Sampling for the second detection monitoring event in 2019 was conducted on September 16-18. Four potential SSIs over background were identified: chloride at MW-105, sulfate and total dissolved solids (TDS) at MW-104, and fluoride at MW-2-90.

Evaluations were undertaken to review potential alternative sources for the SSIs. These evaluations included comparing the following:

- Leaching tests of on-site CCR materials;
- Leachate collected in the Evaporation Pond (non-CCR unit);
- Regional (background) groundwater quality data; and
- Groundwater quality collected at the site prior to construction of the CCR unit.

Several characteristics of the CCR unit site geology, groundwater monitoring well locations, and historic groundwater quality data prompted consideration of potential alternative sources for the potential SSIs, including:

- Elevated water quality parameters in pre-landfill groundwater monitoring data;
- Site-specific geologic conditions; and
- Leakage from the Evaporation Pond (non-CCR unit).

A successful alternative source demonstration for the potential SSIs is discussed in Section 3.0.

2.1 September Sampling Event

Methods used to evaluate potential alternative sources as the basis for water quality parameter concentrations over background from the September 2019 detection monitoring event are discussed below. Concentrations for potential SSIs observed in September 2019 are similar to those observed during prior detection monitoring events (Table 1).

Table 1. Detection Monitoring Results for Potential SSI Well-Parameter Pairs

Well	Parameter	Interwell Prediction Limit (mg/L)	Detection Monitoring Results			
			April 2018 (mg/L)	October 2018 (mg/L)	April 2019 (mg/L)	September 2019 (mg/L)
MW-105	Chloride	271	333	384	282	290
MW-104	Sulfate	7,300	10,700	11,000	11,100	11,300
MW-104	TDS	10,400	17,400	18,000	17,700	17,200
MW-2-90	Fluoride	0.98	1.03	1.00	1.02	1.03

Bolded values indicate concentrations exceed the associated interwell prediction limits.

2.2 Verification Sampling

No verification sampling was conducted on the potential SSIs.

3.0 Alternative Source Demonstration

Successful demonstrations of alternative sources have previously been documented for the four potential SSIs. The associated ASD Reports (Barr, 2018a; Barr, 2018b; Barr, 2019a; Barr, 2019b) documented that each of the SSIs could be explained by natural groundwater quality variability based on concentrations that were either present at the Site before the landfill was constructed, consistent with regional groundwater quality data, and/or associated with a release from the Evaporation Pond (non-CCR unit).

The purpose of this ASD Report is to validate the results of prior findings with the September 2019 data. For each potential SSI, three hypotheses regarding the potential source of the SSI are assessed: 1) a release of leachate from the CCR unit is the source of one or more of the potential SSIs; 2) natural variations of pre-landfill or regional groundwater quality is the source of one or more of the potential SSIs; or 3) a release of leachate from the Evaporation Pond (non-CCR unit) is the source of one or more of the potential SSIs.

3.1 Source Hypothesis #1: CCR Unit Release

To accept the hypothesis that a release of leachate from the CCR unit is the source of one or more of the potential SSIs, it would be assumed that groundwater chemistry at one or more of the potentially impacted wells (MW-2-90, MW-104, and MW-105) would be geochemically similar to impacted water from the CCR unit represented by leach tests results. However, if they are geochemically dissimilar, this indicates that a source "other than the CCR unit" may be responsible for the potential SSI. Therefore, major ion chemistry from the CCR monitoring locations (upgradient and downgradient) was compared to CCR Synthetic Precipitation Leaching Procedure (SPLP; EPA Method 1312) data collected July 2011 (Appendix A).

In order to test this hypothesis, Piper diagrams were used to visually compare the CCR SPLP results (Appendix A) and the measured groundwater quality at the Site (Figure 2). Piper diagrams are plots of major ion chemistry of water samples (calcium, magnesium, potassium, sodium, chloride, sulfate, and alkalinity) that are used to differentiate between water types and to identify potential mixing of water types. This method is a means to identify or "fingerprint" water samples by their common characteristics (major ions) to assess which types of water are similar or dissimilar to potential source water types (Helsel and Hirsch, 2002). On the Piper diagram depicted in Figure 2, downgradient well compositions are shown as circular points, CCR SPLP compositions as red triangles, and the range of upgradient compositions as a blue polygon.

Downgradient water quality (including the potential SSI parameter-well pairs) is characterized as a Mg-SO₄ type water, whereas the ash SPLP results are Na-SO₄ type water. The major difference observed between the downgradient water quality and the SPLP results is the dominant cation concentration (magnesium vs. sodium). Because water quality data from SSI well-parameter pairs are clustered with data from that of the upgradient wells, which are Na-Mg-SO₄ to Mg-SO₄ type water, rather than near the SPLP results, it indicates that the water chemistry at those locations are more like upgradient groundwater than a potential release from the CCR unit. **Therefore, we reject the hypothesis that the CCR unit is the**

source of the fluoride observed at MW-2-90, sulfate and TDS observed at MW-104, and chloride at MW-105.

3.2 Source Hypothesis #2: Natural Variations of Pre-Landfill or Regional Groundwater Quality

As Source Hypothesis #1 (CCR Unit Release) was rejected as a potential source of the SSIs, natural variations of pre-landfill conditions and/or regional groundwater quality were evaluated for each of the potential SSIs. The second hypothesis evaluated is that concentrations of fluoride at MW-2-90, sulfate and TDS at MW-104, and chloride at MW-105 are consistent with historical (pre-landfill) or regional (background) groundwater data. To test this hypothesis, results of September 2019 Detection Monitoring were compared to pre-landfill data and/or regional groundwater quality data from the Cannonball Formation and associated units to determine if natural variation is a potential alternative source for the SSIs.

3.2.1 Chloride at MW-105

Results from groundwater samples collected in 1986 were included in the 1989 Special Use Disposal Site Permit Application (Permit Application; MDU, 1989). The 1986 samples were collected prior to construction of the CCR unit; an aerial photograph from March 30, 1988 shows the area of the CCR unit, which appears undisturbed (Appendix B).

Pre-landfill chloride concentrations collected from groundwater at the Site were measured as high as 558 mg/L (Well 44, 1986), indicating that high chloride concentrations pre-date construction of the CCR unit. Additionally, the North Dakota State Water Commission conducted a groundwater study in Morton County (Ackerman, 1980); 45 wells screened in the Cannonball and Ludlow Formations were sampled for various parameters including chloride. Chloride concentrations ranged from 0 to 500 mg/L (37% of which had concentrations greater than 250 mg/L).

Historic data shows that concentrations of chloride in groundwater at the Site measured prior to the construction of the CCR unit (558 mg/L) as well as regional groundwater quality data (0 to 500 mg/L) are consistent with and/or higher than chloride measured at MW-105 in September 2019 (290 mg/L). This supports the hypothesis that the SSI for chloride at MW-105 is due to a “source other than the CCR unit.”

Therefore, we accept the hypothesis that chloride concentrations observed at MW-105 are consistent with regional (background) groundwater data.

3.2.2 Fluoride at MW2-90

Source Hypothesis #2 was tested by comparing fluoride concentrations collected as part of several regional groundwater quality studies on the Cannonball Formation and associated units. A summary of the range of fluoride concentrations in the Cannonball Formation and associated units are included in the table below.

Table 3. Fluoride Concentrations in Morton County, North Dakota

Reference	Fluoride Conc. Range	Formation/Units	Data Source Location
Ackerman, D.J., 1980. Ground-Water Resources of Morton County, North Dakota. North Dakota Geological Survey Bulletin 72, Part III. 51 p.	0.0 to 4.0 mg/L	Cannonball and Ludlow formations, undifferentiated	Morton County
Crosby, O.A. and Klausung, R.L., 1984. Hydrology of Area 47, Northern Great Plains and Rocky Mountain Coal Provinces, North Dakota, South Dakota, and Montana. USGS Water-Resources Investigations Open-File Report 83-221, 93 p.	0.1 to 6.3 mg/L	Entire Fort Union Formation (includes Cannonball Formation)	Morton County

The Ackerman study provides summary statistics for the fluoride concentrations observed in Morton County. Forty-six samples were analyzed for fluoride; of those, 20 (or 43%) had concentrations greater than 1.3 mg/L (Ackerman, 1980). The fluoride concentration observed at MW-2-90 in September 2019 (1.03 mg/L) is within the range of values consistent with naturally-occurring concentrations of fluoride associated with the Cannonball Formation in Morton County. **Therefore, we accept the hypothesis that fluoride concentrations observed at MW-2-90 are consistent with regional (background) groundwater data.**

3.2.3 Sulfate and TDS at MW-104

Analyses of groundwater samples collected prior to construction of the CCR unit included in the Permit Application notes that high sulfate and TDS was observed at the Site. Maximum sulfate and TDS concentrations reported in 1986 were 11,632 mg/L and 14,917 mg/L, respectively, in Well 60 (approximately 700 feet southwest of MW-104), with similar concentrations observed two years later. Sulfate concentrations reported in September 2019 (11,300 mg/L) at MW-104 are within range of historically observed concentrations, but TDS concentrations are somewhat higher than historically observed (17,200 mg/L). Figures 3 and 4 show the range of sulfate and TDS concentrations, respectively, across the Site, including recent and historical monitoring well data.

The mineralogy of the underlying Fort Union Formation may yield an explanation for the elevated sulfate concentrations (which leads to elevated TDS concentrations). The dominant lithology observed at the Site is unconsolidated silt in a clay matrix with interspersed fine to medium-grained sand (10% to 30%). Small gypsum crystals are documented discontinuously throughout the upper 30 feet of the surface materials, which have been presumed to be the result of diagenetic processes which occur above the water table during alternating wetting and drying cycles (Groenewold et al., 1983). Gypsum is a hydrated calcium sulfate mineral that can be a source of high sulfate concentrations in groundwater.

The boring log for MW-104 (Appendix C) notes gypsum present throughout the upper layer of the screened interval. Boring logs for other CCR wells and pre-landfill wells note gypsum occurrences across the Site (Appendix C). The water level and screened interval in MW-104 are within the gypsum-bearing unit. In other wells with lower sulfate and TDS concentrations, the water levels and/or screened units are

below the documented gypsum occurrences. As groundwater fluctuates and surface water infiltration occurs, periodic dissolution of gypsum into the water column may occur, resulting in elevated sulfate concentrations (and therefore elevated TDS, too).

Based on presence of gypsum in native subsurface deposits and documentation of elevated sulfate and TDS in pre-landfill groundwater, the hypothesis that the SSI for sulfate and TDS at MW-104 may be due to natural conditions (a "source other than the CCR unit.") is possible. However, a statistically significant increasing trend for TDS at MW-104 was observed. Although natural/background groundwater can be affected by seasonality and/or site-wide aquifer changes, resulting in trending data, no other monitoring wells at the Site has observed trends for TDS (or sulfate). Additionally, seasonality was not detected in TDS or sulfate at MW-104. **Sulfate and TDS concentrations at MW-104 may be due to natural conditions, however additional source considerations were evaluated.**

3.3 Source Hypothesis #3: Evaporation Pond Release

Two conditions are necessary in order to accept the hypothesis that a release of Evaporation Pond water is the source of one or more of the potential SSIs:

- Mechanism of release (such as an issue with Evaporation Pond liner integrity) and
- Geochemically similar groundwater chemistry at one or more of the potentially impacted wells with water from the Evaporation Pond.

Based on proximity, only the SSIs observed at MW-104 (TDS and sulfate) are being evaluated for this potential source.

3.3.1 TDS and Sulfate at MW-104

A statistically significant increasing trend in TDS was observed at MW-104 following the September 2019 detection monitoring event. No other statistically significant trends were observed for other Appendix III parameters at this location. Past ASD Reports (Barr, 2019b) attributed elevated sulfate and TDS concentrations at MW-104 to either natural conditions or a release from the Evaporation Pond. MW-104 is located between the CCR unit and the Evaporation Pond (a non-CCR unit). The Evaporation Pond was constructed to collect surface water run-off from the Site as well as leachate from the CCR Unit. Due to the relative proximity of MW-104 to the Evaporation Pond, an evaluation was conducted to assess the Evaporation Pond liner integrity, potential impacts to downgradient wells, and determine the geochemical feasibility of Evaporation Pond water contributing to the conditions observed at MW-104.

Liner Integrity Evaluation

In the 2010 Annual Report for the Special Waste Disposal Permit (SP-087), it was noted that erosion was encountered at the Evaporation Pond. More specifically, "cuts in the banks of the pond ranged from 8 to 24-inches. Erosion was caused from storm water running into the evaporation pond from closed Slots and the haul road" (MDU, 2011). No repairs were made at that time due to standing water in the pond. Similar erosional features were noted in the 2011 and 2012 Annual Reports, citing erosion cuts of 8 to 48-inches (MDU, 2012 and MDU, 2013). These erosion cuts were repaired in 2013 during the construction of Slot 10. Additionally, the 2013 Annual Report stated that "the west wall of the evaporation pond was raised and

graded to reroute storm water that accumulates outside of the ash disposal area from the cover of Phase I ash disposal site away from the pond during rain events” (MDU, 2014).

These reports did not specify if the erosional cuts were 8 to 48-inches wide or 8 to 48-inches deep. Based on the Phase I Development “as-constructed” Plan Sheets (January and November 1990), the Evaporation Pond was built with a 3-foot-thick compacted clay liner (MDU, 1989 Exhibit 6-B). If the erosional cuts were up to 48-inches deep, then the cuts would extend through the entirety of the liner thickness, creating a conduit for Evaporation Pond water to enter the groundwater. Additionally, no details were provided on the materials used for repairing the Evaporation Pond (i.e. if the liner was impacted, were the erosion cuts filled in with a comparable clay liner material).

Additionally, the integrity of the Evaporation Pond liner may have been compromised due to cation exchange. Time series plots of groundwater quality at nearby well MW1-90 (Appendix D) show an increase in sodium; this increase is most apparent at MW1-90 between 2012 and 2019. The Evaporation Pond liner may be composed of a clay with sodium as its main interlayer cation (e.g., sodium-montmorillonite and/or sodium-bentonite, which are common in the area (Groenewold et al., 1983)), and cation exchange processes can occur between the sodium in the clay and positively charged cations concentrated in the evaporation pond water (calcium, magnesium, potassium, and aluminum), increasing the concentration of dissolved sodium as it is released from the clay structure. Over time this exchange may decrease swelling potential and increase hydraulic conductivity of the clay constituting the pond liner, resulting in increased leakage of Evaporation Pond water.

Downgradient Impacts

The base of the Evaporation Pond sits at approximately 1675 feet above MSL whereas the most recent groundwater elevations in MW-104 and MW1-90 were measured at roughly 1670 feet above MSL and 1665 feet above MSL, respectively. Therefore, any water leaking from the Evaporation Pond would report radially downward into the groundwater, toward both MW-104 and MW1-90, making both wells downgradient of the Pond.

As MW-104 was installed on August 20, 2015, it is not possible to determine if the erosional cuts observed in the early 2010s impacted the water quality at this location. However, data has consistently been collected from nearby well MW1-90, also downgradient of the Evaporation Pond. As seen in the time series plots (Appendix D; 1990-2019), in approximately 2010 concentrations of chloride, sulfate, TDS, magnesium, sodium, and specific conductance at MW1-90 began increasing more rapidly. To a lesser extent, changes in concentrations were observed around this same time for potassium, nitrogen, and total alkalinity. This timing corresponds to when the erosional cuts at the Evaporation Pond were first observed in the Annual Monitoring Reports. The increasing trends have since continued, despite reports of the erosional cuts being repaired in 2013, except for chloride, which has since leveled off and is now decreasing.

Geochemical Feasibility

A simple mixing model was developed in April, 2019 (Barr, 2019b) to determine the potential of producing a similar water quality observed at MW-104 (and MW1-90, as a historical analogue) when mixing Evaporation Pond water with unimpacted upgradient water. This mixing model was conducted in Geochemist's Workbench® v.12.0, using a water sample collected from the Evaporation Pond in September 2014 and a water sample from upgradient monitoring wells MW-13 and MW-103 in September 2014 and April 2019, respectively. Both wells are hydraulically upgradient of MW-104, which has consistently exhibited Mg-SO₄ type groundwater. The mixing model assumes a starting concentration equal to the upgradient groundwater concentrations and then iteratively mixes it with incremental amounts of Evaporation Pond water.

It should be noted that this is not a perfect model, as the groundwater quality in the upgradient monitoring wells has slightly different major ion chemistry than downgradient wells, due to heterogeneity of the geology at the Site. Due to the lack of historical (pre-landfill) data at MW-104, it was decided to use upgradient (non-impacted) water. Therefore, the ultimate purpose of this model was to evaluate the potential to produce a similar water sample to what has been observed at MW-104, not an identical match.

The results of the April 2019 model, using Stiff and Piper plots, are provided in Appendix E. Figures E.1 and E.3 show the results of the mixing model on a stiff diagram for MW-13 and MW-103, respectively. Downgradient wells MW-104 and MW1-90 are shown as gray and green diamonds, respectively, in each figure. The blue line in each figure represents the various possible outcomes when mixing the upgradient water quality with the Evaporation Pond. The purple squares (E.1) or black circles (E.3) represent specific proportions (1-part upgradient water to 0.01-, 0.05-, 0.1-, 0.5-, and 1-part Evaporation Pond water). Figures E.2 and E.4 show the results as Stiff plots. Table E.1 provides the numerical inputs and results of the various mixing proportions.

As shown on Figure E.3, the downgradient well compositions are similar to the chemistry anticipated if the Evaporation Pond is mixing with upgradient groundwater emanating from the proximity of monitoring well MW-103. However, mixing of the upgradient monitoring well MW-13 with the Evaporation Pond water did not result in a composition that appears chemically similar to MW-104, as the path of the mixing reaction does not intersect the location of the MW-104 sample. However, the difference in composition is almost entirely due to the difference in Na:Mg ratio, which can be affected by additional processes such as those described in previous sections. The geometry of the Stiff plots in Figures E.2 and E.4 shows the similarity in anionic concentrations and calcium in the mixing models. As seen in Figure E.3, the path of the mixing reaction from MW-103 to the Evaporation Pond transects MW-104 when 1-part upgradient (MW-103) water is mixed with as little as 0.05-part Evaporation Pond water. Therefore, it appears plausible that a relatively small portion of Evaporation Pond water would be needed to "impact" upgradient groundwater to get a similar chemistry as observed in MW-104.

Based on the description of erosional features extending upwards of 48 inches in the liner of the Evaporation Pond in 2010-2013 corresponding with the increased concentrations of several parameters observed in downgradient monitoring well MW1-90, it is possible that a release from the Evaporation

Pond occurred starting in approximately 2011. Furthermore, the results of the geochemical model along with the general proximity and hydraulic position of MW-104 relative to the Evaporation Pond supports the hypothesis that the SSI for TDS and sulfate at MW-104 is due to a "source other than the CCR unit." **Therefore, we accept the hypothesis that TDS and sulfate concentrations observed at MW-104 are consistent with a potential release from the Evaporation Pond, a non CCR unit.**

4.0 Conclusions

Four SSIs were identified from the September 2019 detection monitoring event. This report demonstrates that a “source other than the CCR unit” caused the potential SSIs (natural variation in regional and/or pre-landfill groundwater quality and the Evaporation Pond), as allowed by §257.94(e)(2). The results of this alternative source demonstration are summarized in the table below.

Table 4. Summary of SSIs and Alternative Sources

Well	Parameter	Report Section	Evidence for Alternative Source
MW-105	Chloride	3.2.1	Natural variability (pre-landfill values and geologic background)
MW-104	Sulfate	3.3.1	Natural variability and/or Other (Evaporation Pond, a non CCR unit)
MW-104	Total Dissolved Solids	3.3.1	Natural Variability or Other (Evaporation Pond, a non CCR unit)
MW-2-90	Fluoride	3.2.2	Natural variability (pre-landfill values and geologic background)

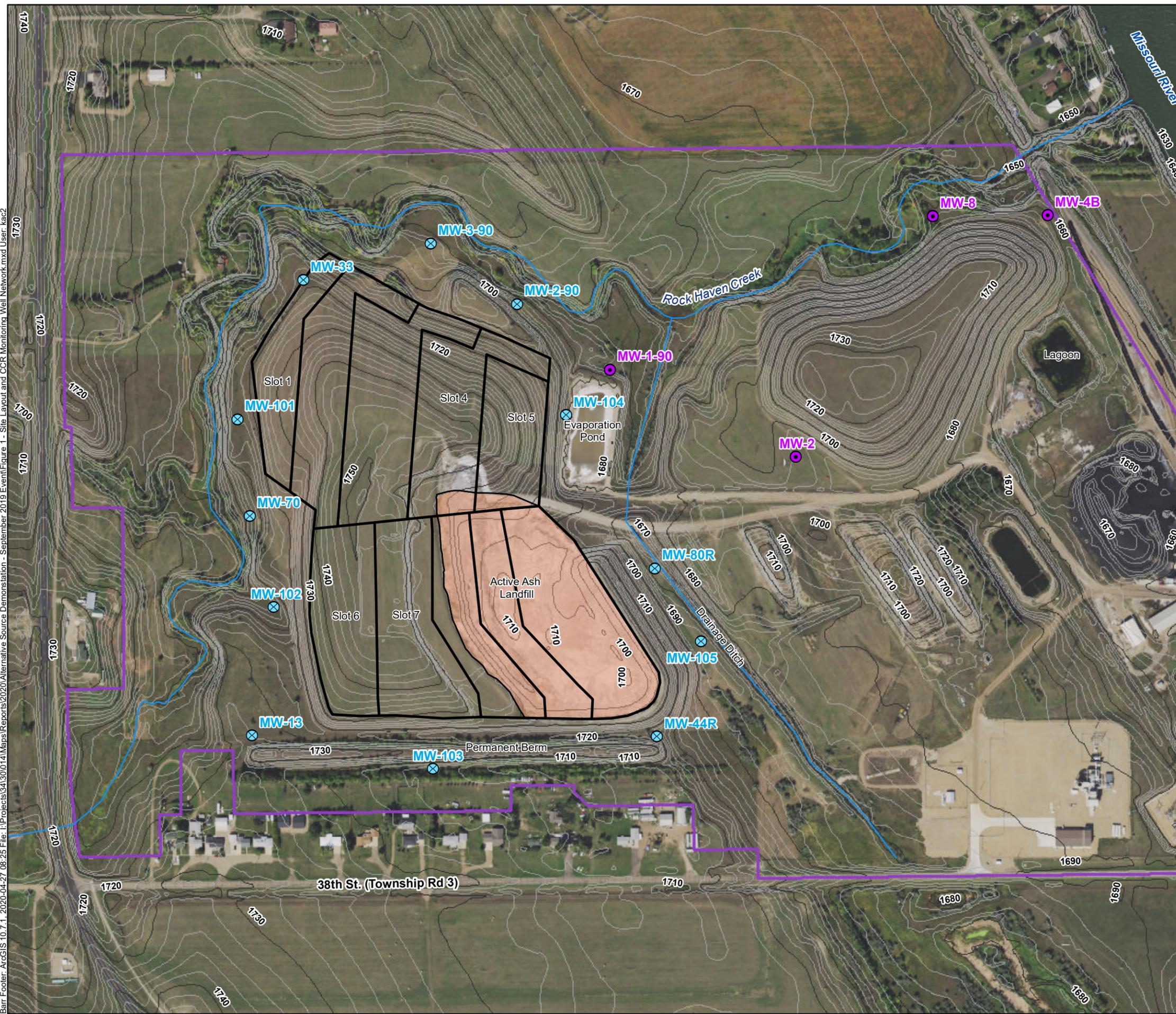
Based on the foregoing, the alternative source demonstration presented herein meets the requirements of CCR Rule §257.94(e)(2). As coal unit operations will cease around March 2022, MDU will work with the North Dakota Department of Environmental Quality (NDDEQ) on closure options for the Evaporation Pond as it is regulated under a permit through the NDDEQ.

5.0 References

- Ackerman, D.J., 1980. Ground-Water Resources of Morton County, North Dakota. North Dakota Geological Survey Bulletin 72, Part III. 51 p.
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- Barr Engineering Co., 2019b. Alternative Source Demonstration: April 2019 Event. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. November 2019.
- Crosby, O.A. and Klausning, R.L., 1984. Hydrology of Area 47, Northern Great Plains and Rocky Mountain Coal Provinces, North Dakota, South Dakota, and Montana. USGS Water-Resources Investigations Open-File Report 83-221, 93 p.
- Groenewold, G.H., Koob, G.J., McCarthy, B.W., and Peterson, W.M., 1983, Geologic and Geochemical Controls on the Chemical Evolution of Subsurface Water in Undisturbed and Surface-Mined Landscapes on Western North Dakota, North Dakota Geological Survey Report of Investigation 79, 151 p.
- Helsel, D.R. and R. M. Hirsch, 2002. Statistical Methods in Water Resources Techniques of Water Resources Investigations, Book 4, chapter A3. U.S. Geological Survey. 522 pages.
- Montana-Dakota Utilities Co. (MDU), 1989, R.M. Heskett Station Special Use Disposal Site Permit Application. Submitted to North Dakota State Department of Health, March 1, 1989.
- MDU, 2011, R.M. Heskett Station Special Waste Disposal Permit SP-087 2010 Annual Report. February 2011.
- MDU, 2012, R.M. Heskett Station Special Waste Disposal Permit SP-087 2011 Annual Report. February 2012.
- MDU, 2013, R.M. Heskett Station Special Waste Disposal Permit SP-087 2012 Annual Report. February 2013.
- MDU, 2014, R.M. Heskett Station Special Waste Disposal Permit SP-087 2013 Annual Report. February 2014.
- US EPA, 2015, Hazardous and Solid Waste Management Systems; Management of Coal Combustion Residuals from Electric Utility, CFR Parts 257 and 261, Federal Register, Vol. 80, No. 74, April 17, 2015

Figures

Barr Footer: ArcGIS 10.7.1, 2020-04-27 08:25 File: I:\Projects\341301014\Maps\Reports\2020\Alternative Source Demonstration - September 2019 Event\Figure 1 - Site Layout and CCR Monitoring Well Network.mxd User: kac2



- Monitoring Well Location
- Monitoring Well Location - Water Level Only
- Existing Slot Boundaries
- Streams
- Property Line
- 10ft Contours
- 2ft Contours
- Active Portion of Landfill

Image Source: 2019 Statewide Imagery (ND GIS Hub)

CAD Data Source: Slot Linework.dwg



Figure 1

**SITE LAYOUT AND CCR
MONITORING WELL NETWORK**
R. M. Heskett Station
Alternative Source Demonstration:
September 2019 Event
Montana Dakota Utilities
Mandan, North Dakota

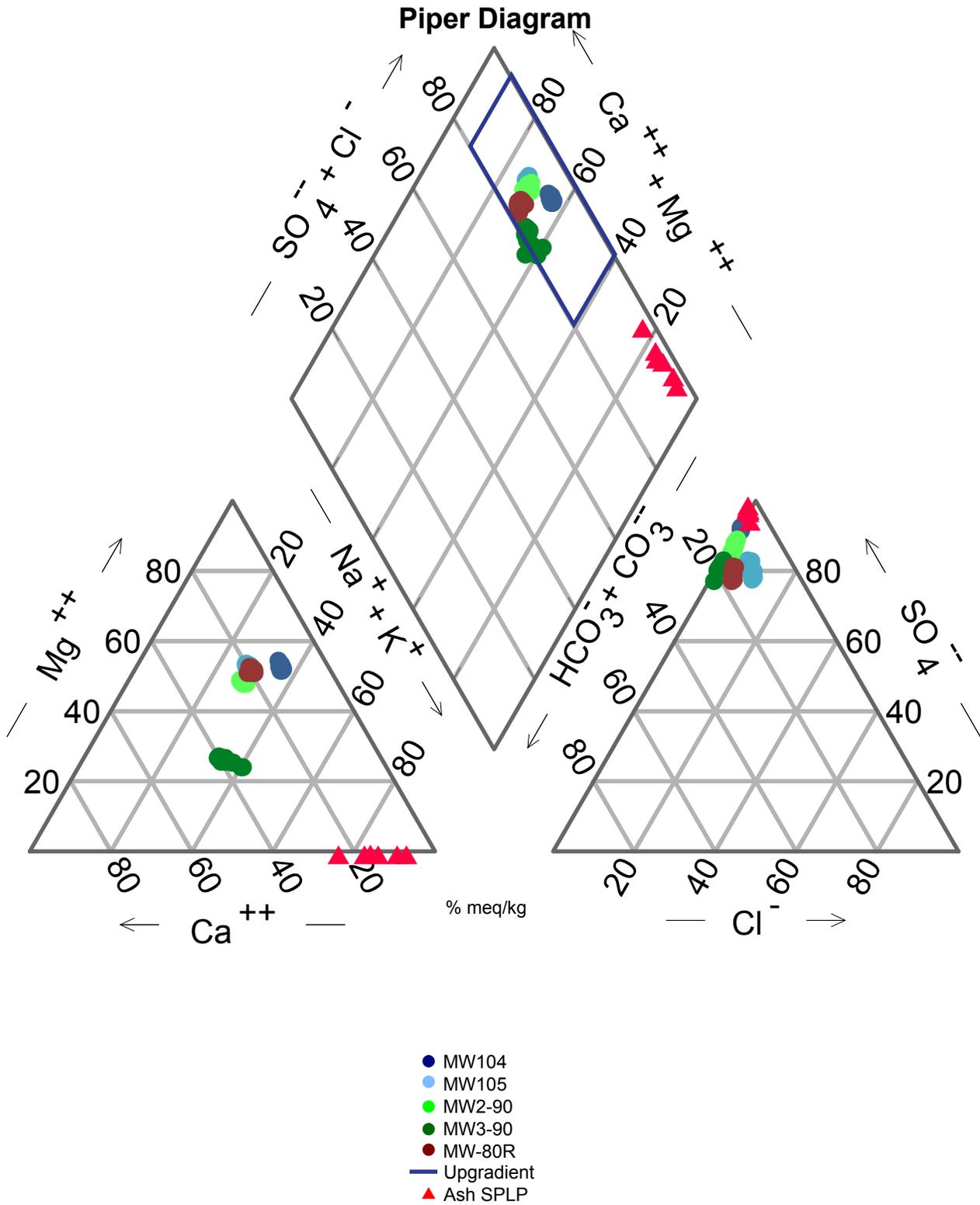
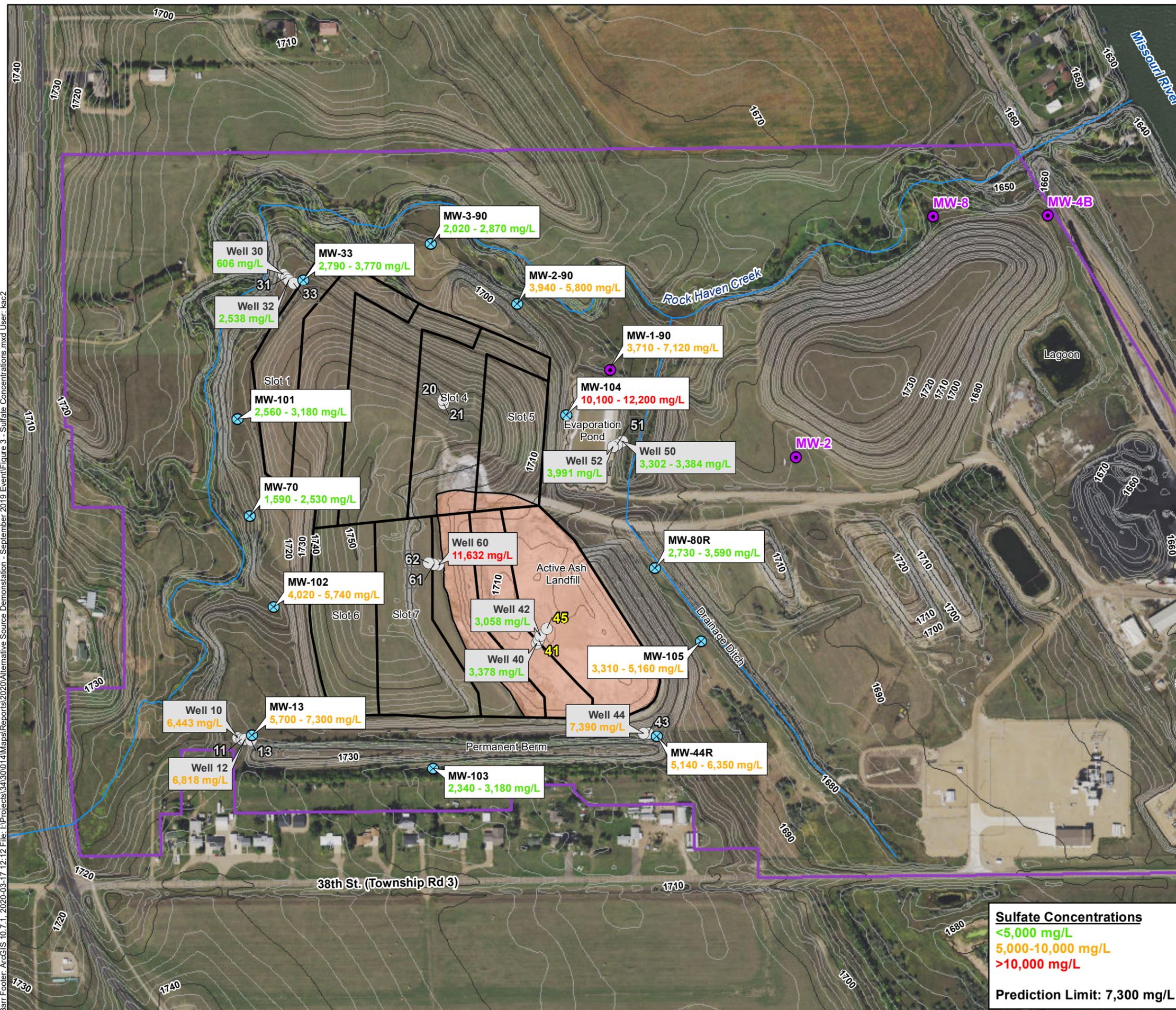


Figure 2
PIPER PLOT
R.M. Heskett Station
Alternative Source Demonstration
September 2019 Event
Montana Dakota Utilities
Mandan, North Dakota

Barr Footer: ArcGIS 10.7.1, 2020-03-17 12:12 File: I:\Projects\3430014\Map\Reports\2020\Alternative Source Demonstration - September 2019 Event\Figure 3 - Sulfate Concentrations.mxd User: kac2



- Monitoring Well Location
- Monitoring Well Location - Water Level Only
- Pre-Landfill Wells (Approximate)
- Existing Slot Boundaries
- Streams
- Property Line
- 10ft Contours
- 2ft Contours
- Active Portion of Landfill

Image Source: 2018 Statewide Imagery (ND GIS Hub)
 CAD Data Source: Slot Linework.dwg
 Pre-Landfill well concentrations are from 9/11/1986, 11/21/1986 (MDU, 1989), and CCR Rule monitoring well concentrations are from 2016-2019.

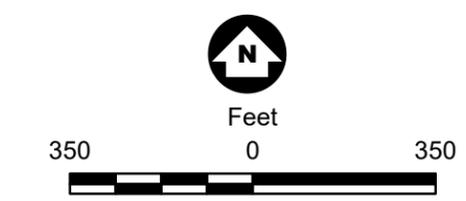
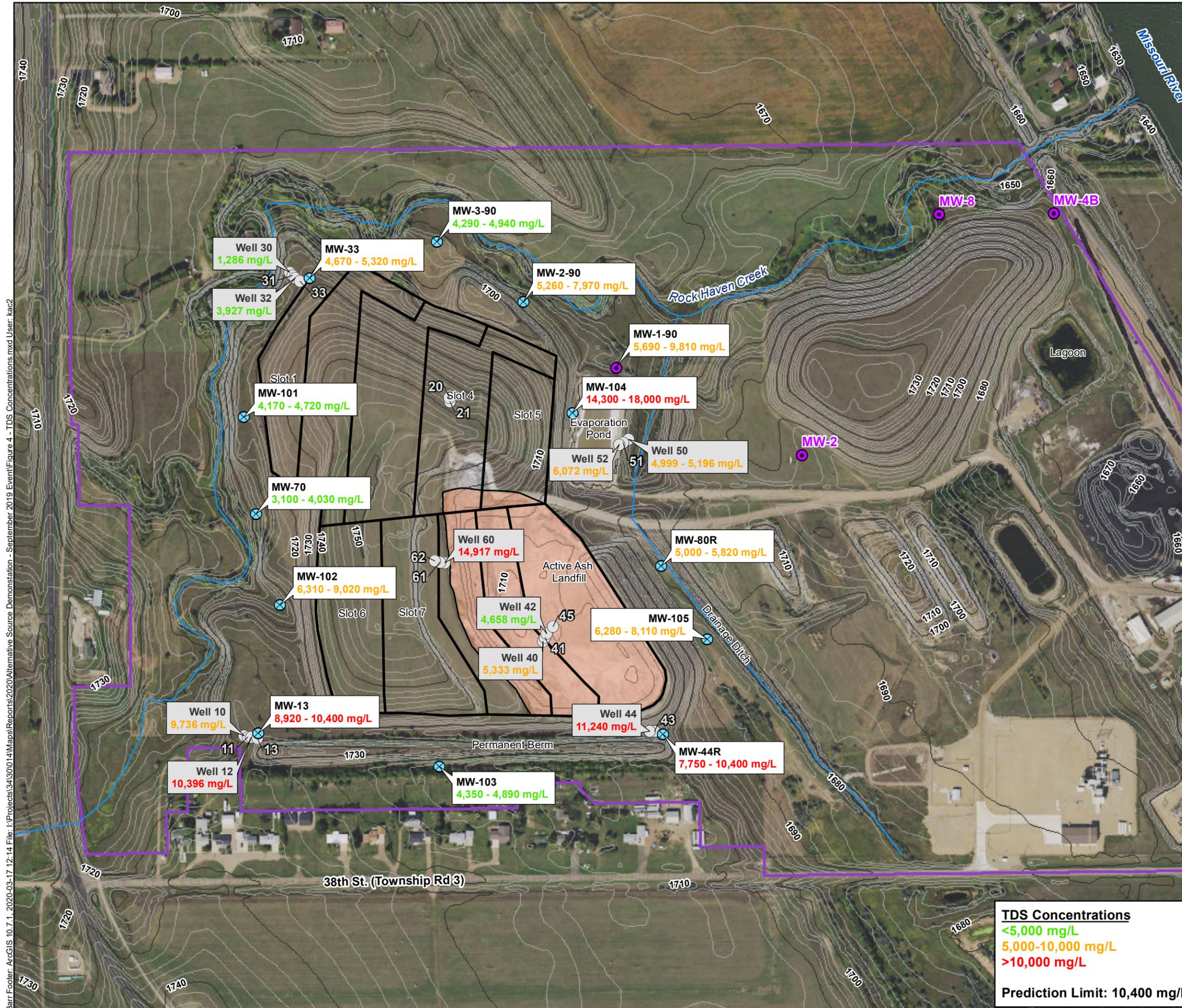


Figure 3

SULFATE CONCENTRATIONS
 R. M. Heskett Station
 Alternative Source Demonstration:
 September 2019 Event
 Montana Dakota Utilities
 Mandan, North Dakota

Sulfate Concentrations
 <5,000 mg/L
 5,000-10,000 mg/L
 >10,000 mg/L
 Prediction Limit: 7,300 mg/L



- Monitoring Well Location
- Monitoring Well Location - Water Level Only
- Pre-Landfill Wells (Approximate)
- Existing Slot Boundaries
- Streams
- Property Line
- 10ft Contours
- 2ft Contours
- Active Portion of Landfill

Image Source: 2018 Statewide Imagery (ND GIS Hub)
 CAD Data Source: Slot Linework.dwg
 Pre-Landfill well concentrations are from 9/11/1986, 11/21/1986 (MDU, 1989), and CCR Rule monitoring well concentrations are from 2016-2019.

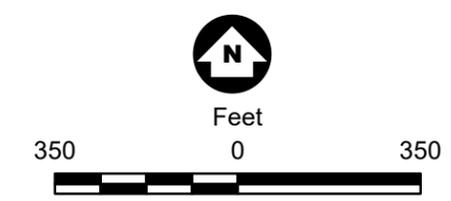


Figure 4

TDS CONCENTRATIONS
 R. M. Heskett Station
 Alternative Source Demonstration:
 September 2019 Event
 Montana Dakota Utilities
 Mandan, North Dakota

Barr Footer: ArcGIS 10.7.1, 2020-03-17 12:14 File: I:\Projects\3430014\Map\Reports\2020\Alternative Source Demonstration - September 2019 Event\Figure 4 - TDS Concentrations.mxd User: kac2

Appendix A

Ash SPLP Laboratory Report (2011)



MINNESOTA VALLEY TESTING LABORATORIES, INC.

1126 North Front St. ~ New Ulm, MN 56073 ~ 800-782-3557 ~ Fax 507-359-2890
 2616 East Broadway Ave. ~ Bismarck, ND 58501 ~ 800-279-6885 ~ Fax 701-258-9724
 51 West Lincoln Way ~ Nevada, IA 50201 ~ 800-362-0855 ~ Fax 515-382-3885
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Page: 1 of 2

Duane Leingang
 Montana Dakota Utilities
 PO Box 40
 Mandan ND 58554

Report Date: 8 Sep 11
 Lab Number: 11-M2450
 Work Order #: 81-818
 Account #: 013479
 Date Sampled:
 Date Received: 28 Jun 11 9:00
 PO #: 131460 OP

Sample Description: Unit I Bottom Ash
 Sample Site: MDU Heskett

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
SPLP Extraction				1312	22 Jul 11	SS
pH	12.2	units	N/A	SM4500 H+ B	22 Jul 11 17:00	Claudette
Specific Conductance	8778	umhos/cm	N/A	SM2510-B	22 Jul 11 17:00	Claudette
Total Suspended Solids	3	mg/l	1	SM2540-D	22 Jul 11 14:00	CLB
Total Alkalinity	1120	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Phenolphthalein Alk	1090	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Bicarbonate	< 4	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Carbonate	60	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Hydroxide	1060	mg/l CaCO3	0	SM2320-B	22 Jul 11 17:00	Claudette
Tot Dis Solids (Summation)	4860	mg/l	NA	SM1030-F	3 Aug 11 8:40	Calculated
Total Hardness as CaCO3	524	mg/l	NA	SM2340-B	3 Aug 11 8:40	Calculated
Hardness in grains/gallon	30.7	gr/gal	NA	SM2340-B	3 Aug 11 8:40	Calculated
Cation Summation	74.3	meq/L	NA	SM1030-F	3 Aug 11 8:40	Calculated
Anion Summation	74.6	meq/L	NA	SM1030-F	28 Jul 11 14:30	Calculated
Percent Error	-0.24	%	NA	SM1030-F	3 Aug 11 8:40	Calculated
Sodium Adsorption Ratio	27.1		NA	USDA 20b	3 Aug 11 8:40	Calculated
Gross Alpha Radiation	Attached	pCi/l			22 Aug 11 2:03	
Radon 222	Attached				28 Jul 11 4:37	
Radium 226	Attached	pCi/l			22 Aug 11 22:20	
Radium 228	Attached	pCi/l			16 Aug 11 16:50	
Total Organic Carbon	0.7	mg/l	0.5	SM5310-C	1 Aug 11 8:00	Eric
Fluoride	< 0.1	mg/l	0.10	SM4500-F-C	4 Aug 11 17:00	CLB
Sulfate	2440	mg/l	5.00	ASTM D516-02	27 Jul 11 9:00	KMP
Chloride	50.5	mg/l	1.0	SM4500-Cl-E	27 Jul 11 14:00	KMP
Nitrate-Nitrite as N	0.21	mg/l	0.10	EPA 353.2	28 Jul 11 14:30	KMP
Ammonia-Nitrogen as N	0.32	mg/l	0.10	EPA 350.1	28 Jul 11 10:45	KMP
Phosphorus as P - Total	< 0.1	mg/l	0.10	EPA 365.1	28 Jul 11 13:00	KMP
Mercury - Total	< 0.0002	mg/l	0.0002	EPA 245.1	28 Jul 11 8:00	Eric
Chemical Oxygen Demand	< 5	mg/l	5.0	HACH 8000	1 Aug 11 8:30	Wayne
Calcium - Total	210	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Magnesium - Total	< 2.5	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Sodium - Total	1440	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Potassium - Total	44.8	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Aluminum - Total	< 0.5	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Iron - Total	< 0.5	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Strontium - Total	28.2	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Titanium - Total	< 0.5	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Boron - Total	< 0.5	mg/l	0.10	6010	11 Aug 11 8:40	Stacy

RL = Method Reporting Limit

Elevated "Less Than Result" (<): @ = Due to sample matrix
 ! = Due to sample quantity

= Due to sample concentration
 + = Due to extract volume

CERTIFICATION: MN LAB # 038-999-267 ND # ND-00016



MINNESOTA VALLEY TESTING LABORATORIES, INC.

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Page: 2 of 2

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

Report Date: 8 Sep 11
Lab Number: 11-M2450
Work Order #: 81-818
Account #: 013479
Date Sampled:
Date Received: 28 Jun 11 9:00
PO #: 131460 OP

Sample Description: Unit I Bottom Ash
Sample Site: MDU Heskett

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
Antimony - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Arsenic - Total	0.0044	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Barium - Total	0.1135	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Beryllium - Total	< 0.001	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Cadmium - Total	0.00164	mg/l	0.00100	6020	25 Jul 11 16:18	Claudette
Chromium - Total	0.0065	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Cobalt - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Copper - Total	0.0213	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Lead - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Manganese - Total	0.0027	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Molybdenum - Total	0.6860	mg/l	0.0020	6020	26 Jul 11 12:46	Claudette
Nickel - Total	0.0074	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Selenium - Total	0.0133	mg/l	0.0020	6020	26 Jul 11 9:46	Claudette
Silver - Total	< 0.001	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Thallium - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Tin - Total	< 0.05	mg/l	0.0500	6020	25 Jul 11 16:18	Claudette
Vanadium - Total	0.0189	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Zinc - Total	0.0151	mg/l	0.0100	6020	25 Jul 11 16:18	Claudette
Uranium	< 0.002	mg/l	0.002	6020	25 Jul 11 16:18	Claudette

All analyses were performed on the extract from Method 1312 (SPLP) with a modified solution to solids ratio of 4:1.

Approved by:

RL = Method Reporting Limit

Elevated "Less Than Result" (<): @ = Due to sample matrix
! = Due to sample quantity

= Due to sample concentration
+ = Due to extract volume

CERTIFICATION: MN LAB # 038-999-267 ND # ND-00016



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 www.mvttl.com



Page: 1 of 2

Duane Leingang
 Montana Dakota Utilities
 PO Box 40
 Mandan ND 58554

Report Date: 8 Sep 11
 Lab Number: 11-M2451
 Work Order #: 81-818
 Account #: 013479
 Date Sampled:
 Date Received: 28 Jun 11 9:00
 PO #: 131460 OP

Sample Description: Unit II Sand Ash
 Sample Site: MDU Heskett

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
SPLP Extraction				1312	22 Jul 11	SS
pH	11.1	units	N/A	SM4500 H+ B	22 Jul 11 17:00	Claudette
Specific Conductance	20110	umhos/cm	N/A	SM2510-B	22 Jul 11 17:00	Claudette
Total Suspended Solids	21	mg/l	1	SM2540-D	22 Jul 11 14:00	CLB
Total Alkalinity	203	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Phenolphthalein Alk	171	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Bicarbonate	< 4	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Carbonate	64	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Hydroxide	139	mg/l CaCO3	0	SM2320-B	22 Jul 11 17:00	Claudette
Tot Dis Solids(Summation)	22500	mg/l	NA	SM1030-F	3 Aug 11 8:40	Calculated
Total Hardness as CaCO3	1200	mg/l	NA	SM2340-B	3 Aug 11 8:40	Calculated
Hardness in grains/gallon	70.2	gr/gal	NA	SM2340-B	3 Aug 11 8:40	Calculated
Cation Summation	318	meq/L	NA	SM1030-F	3 Aug 11 8:40	Calculated
Anion Summation	314	meq/L	NA	SM1030-F	28 Jul 11 14:30	Calculated
Percent Error	0.65	%	NA	SM1030-F	3 Aug 11 8:40	Calculated
Sodium Adsorption Ratio	80.9		NA	USDA 20b	3 Aug 11 8:40	Calculated
Gross Alpha Radiation	Attached	pCi/l			22 Aug 11 2:03	
Radon 222	See Attached				28 Jul 11 4:37	
Radium 226	Attached	pCi/l			22 Aug 11 22:20	
Radium 228	Attached	pCi/l			16 Aug 11 16:50	
Total Organic Carbon	< 0.5	mg/l	0.5	SM5310-C	1 Aug 11 8:00	Eric
Fluoride	< 0.1	mg/l	0.10	SM4500-F-C	4 Aug 11 17:00	CLB
Sulfate	14900	mg/l	5.00	ASTM D516-02	27 Jul 11 9:00	KMP
Chloride	2.0	mg/l	1.0	SM4500-Cl-E	27 Jul 11 14:00	KMP
Nitrate-Nitrite as N	< 0.1	mg/l	0.10	EPA 353.2	28 Jul 11 14:30	KMP
Ammonia-Nitrogen as N	0.10	mg/l	0.10	EPA 350.1	28 Jul 11 10:45	KMP
Phosphorus as P - Total	< 0.1	mg/l	0.10	EPA 365.1	28 Jul 11 13:00	KMP
Mercury - Total	< 0.0002	mg/l	0.0002	EPA 245.1	28 Jul 11 8:00	Eric
Chemical Oxygen Demand	< 5	mg/l	5.0	HACH 8000	1 Aug 11 8:30	Wayne
Calcium - Total	481	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Magnesium - Total	< 5	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Sodium - Total	6500	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Potassium - Total	459	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Aluminum - Total	1.09	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Iron - Total	< 1	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Strontium - Total	66.0	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Titanium - Total	< 1	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Boron - Total	5.96	mg/l	0.10	6010	11 Aug 11 8:40	Stacy

RL = Method Reporting Limit

Elevated "Less Than Result" (<): @ = Due to sample matrix
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= Due to sample concentration
 + = Due to extract volume

CERTIFICATION: MN LAB # 038-999-267 ND # ND-00016



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Page: 2 of 2

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

Report Date: 8 Sep 11
Lab Number: 11-M2451
Work Order #: 81-818
Account #: 013479
Date Sampled:
Date Received: 28 Jun 11 9:00
PO #: 131460 OP

Sample Description: Unit II Sand Ash
Sample Site: MDU Heskett

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
Antimony - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Arsenic - Total	0.0822	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Barium - Total	0.0930	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Beryllium - Total	< 0.001	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Cadmium - Total	0.00182	mg/l	0.00100	6020	25 Jul 11 16:18	Claudette
Chromium - Total	0.0244	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Cobalt - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Copper - Total	0.1108	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Lead - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Manganese - Total	0.0052	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Molybdenum - Total	0.1000	mg/l	0.0020	6020	26 Jul 11 12:46	Claudette
Nickel - Total	0.0136	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Selenium - Total	0.0937	mg/l	0.0020	6020	26 Jul 11 9:46	Claudette
Silver - Total	< 0.001	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Thallium - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Tin - Total	< 0.05	mg/l	0.0500	6020	25 Jul 11 16:18	Claudette
Vanadium - Total	0.3026	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Zinc - Total	0.0327	mg/l	0.0100	6020	25 Jul 11 16:18	Claudette
Uranium	< 0.002	mg/l	0.002	6020	25 Jul 11 16:18	Claudette

All analyses were performed on the extract from Method 1312 (SPLP) with a modified solution to solids ratio of 4:1.

Approved by: 

RL = Method Reporting Limit

Elevated "Less Than Result" (<): @ = Due to sample matrix
! = Due to sample quantity

= Due to sample concentration
+ = Due to extract volume

CERTIFICATION: MN LAB # 038-999-267 ND # ND-00016



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Page: 1 of 2

Duane Leingang
 Montana Dakota Utilities
 PO Box 40
 Mandan ND 58554

Report Date: 8 Sep 11
 Lab Number: 11-M2452
 Work Order #: 81-818
 Account #: 013479
 Date Sampled:
 Date Received: 28 Jun 11 9:00
 PO #: 131460 OP

Sample Description: Unit I Fly Ash
 Sample Site: MDU Heskett

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
SPLP Extraction				1312	22 Jul 11	SS
pH	12.9	units	N/A	SM4500 H+ B	22 Jul 11 17:00	Claudette
Specific Conductance	50660	umhos/cm	N/A	SM2510-B	22 Jul 11 17:00	Claudette
Total Suspended Solids	30	mg/l	1	SM2540-D	22 Jul 11 14:00	CLB
Total Alkalinity	7020	mg/l CaCO3	4	SM2320-B	25 Jul 11 17:00	Claudette
Phenolphthalein Alk	6900	mg/l CaCO3	4	SM2320-B	25 Jul 11 17:00	Claudette
Bicarbonate	< 4	mg/l CaCO3	4	SM2320-B	25 Jul 11 17:00	Claudette
Carbonate	240	mg/l CaCO3	4	SM2320-B	25 Jul 11 17:00	Claudette
Hydroxide	6780	mg/l CaCO3	0	SM2320-B	25 Jul 11 17:00	Claudette
Tot Dis Solids(Summation)	42200	mg/l	NA	SM1030-F	3 Aug 11 8:40	Calculated
Total Hardness as CaCO3	1750	mg/l	NA	SM2340-B	3 Aug 11 8:40	Calculated
Hardness in grains/gallon	102	gr/gal	NA	SM2340-B	3 Aug 11 8:40	Calculated
Cation Summation	663	meq/L	NA	SM1030-F	3 Aug 11 8:40	Calculated
Anion Summation	613	meq/L	NA	SM1030-F	28 Jul 11 14:30	Calculated
Percent Error	3.99	%	NA	SM1030-F	3 Aug 11 8:40	Calculated
Sodium Adsorption Ratio	143		NA	USDA 20b	3 Aug 11 8:40	Calculated
Gross Alpha Radiation	Attached	pCi/l			22 Aug 11 2:03	
Radon 222	Attached				28 Jul 11 4:37	
Radium 226	Attached	pCi/l			22 Aug 11 22:20	
Radium 228	Attached	pCi/l			16 Aug 11 16:50	
Total Organic Carbon	1.5	mg/l	0.5	SM5310-C	1 Aug 11 8:00	Eric
Fluoride	5.60	mg/l	0.10	SM4500-F-C	10 Aug 11 17:00	CLB
Sulfate	22600	mg/l	5.00	ASTM D516-02	27 Jul 11 9:00	KMP
Chloride	53.8	mg/l	1.0	SM4500-Cl-E	27 Jul 11 14:00	KMP
Nitrate-Nitrite as N	0.68	mg/l	0.10	EPA 353.2	28 Jul 11 14:30	KMP
Ammonia-Nitrogen as N	7.22	mg/l	0.10	EPA 350.1	28 Jul 11 10:45	KMP
Phosphorus as P - Total	< 0.1	mg/l	0.10	EPA 365.1	28 Jul 11 13:00	KMP
Mercury - Total	< 0.0002	mg/l	0.0002	EPA 245.1	28 Jul 11 8:00	Eric
Chemical Oxygen Demand	22.4	mg/l	5.0	HACH 8000	1 Aug 11 8:30	Wayne
Calcium - Total	700	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Magnesium - Total	< 25	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Sodium - Total	14100	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Potassium - Total	580	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Aluminum - Total	< 5	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Iron - Total	< 5	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Strontium - Total	59.5	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Titanium - Total	< 5	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Boron - Total	1.89	mg/l	0.10	6010	11 Aug 11 8:40	Stacy

RL = Method Reporting Limit

Elevated "Less Than Result" (<): @ = Due to sample matrix
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= Due to sample concentration
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CERTIFICATION: MN LAB # 038-999-267

ND # ND-00016



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Page: 2 of 2

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

Report Date: 8 Sep 11
Lab Number: 11-M2452
Work Order #: 81-818
Account #: 013479
Date Sampled:
Date Received: 28 Jun 11 9:00
PO #: 131460 OP

Sample Description: Unit I Fly Ash
Sample Site: MDU Heskett

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
Antimony - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Arsenic - Total	0.1128	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Barium - Total	0.0906	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Beryllium - Total	< 0.001	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Cadmium - Total	0.00244	mg/l	0.00100	6020	25 Jul 11 16:18	Claudette
Chromium - Total	0.0270	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Cobalt - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Copper - Total	0.2934	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Lead - Total	0.0161	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Manganese - Total	0.0102	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Molybdenum - Total	0.9246	mg/l	0.0020	6020	26 Jul 11 12:46	Claudette
Nickel - Total	0.0175	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Selenium - Total	0.1959	mg/l	0.0020	6020	26 Jul 11 9:46	Claudette
Silver - Total	< 0.001	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Thallium - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Tin - Total	< 0.05	mg/l	0.0500	6020	25 Jul 11 16:18	Claudette
Vanadium - Total	0.0158	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Zinc - Total	0.3984	mg/l	0.0100	6020	25 Jul 11 16:18	Claudette
Uranium	< 0.002	mg/l	0.002	6020	25 Jul 11 16:18	Claudette

All analyses were performed on the extract from Method 1312 (SPLP) with a modified solution to solids ratio of 4:1.

Approved by: _____

RL = Method Reporting Limit

Elevated "Less Than Result" (<): @ = Due to sample matrix
! = Due to sample quantity

= Due to sample concentration
+ = Due to extract volume

CERTIFICATION: MN LAB # 038-999-267 ND # ND-00016



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Page: 1 of 2

Duane Leingang
 Montana Dakota Utilities
 PO Box 40
 Mandan ND 58554

Report Date: 8 Sep 11
 Lab Number: 11-M2453
 Work Order #: 81-818
 Account #: 013479
 Date Sampled:
 Date Received: 28 Jun 11 9:00
 PO #: 131460 OP

Sample Description: Unit II Fly Ash
 Sample Site: MDU Heskett

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
SPLP Extraction				1312	22 Jul 11	SS
pH	12.8	units	N/A	SM4500 H+ B	22 Jul 11 17:00	Claudette
Specific Conductance	27240	umhos/cm	N/A	SM2510-B	22 Jul 11 17:00	Claudette
Total Suspended Solids	13	mg/l	1	SM2540-D	22 Jul 11 14:00	CLB
Total Alkalinity	4570	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Phenolphthalein Alk	4520	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Bicarbonate	< 4	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Carbonate	100	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Hydroxide	4470	mg/l CaCO3	0	SM2320-B	22 Jul 11 17:00	Claudette
Tot Dis Solids(Summation)	16000	mg/l	NA	SM1030-F	3 Aug 11 8:40	Calculated
Total Hardness as CaCO3	1960	mg/l	NA	SM2340-B	3 Aug 11 8:40	Calculated
Hardness in grains/gallon	115	gr/gal	NA	SM2340-B	3 Aug 11 8:40	Calculated
Cation Summation	252	meq/L	NA	SM1030-F	9 Aug 11 9:09	Calculated
Anion Summation	247	meq/L	NA	SM1030-F	28 Jul 11 14:30	Calculated
Percent Error	1.00	%	NA	SM1030-F	9 Aug 11 9:09	Calculated
Sodium Adsorption Ratio	46.1		NA	USDA 20b	3 Aug 11 8:40	Calculated
Gross Alpha Radiation	Attached	pCi/l			22 Aug 11 2:03	
Radon 222	Attached				28 Jul 11 4:37	
Radium 226	Attached	pCi/l			22 Aug 11 22:20	
Radium 228	Attached	pCi/l			16 Aug 11 16:50	
Total Organic Carbon	1.6	mg/l	0.5	SM5310-C	1 Aug 11 8:00	Eric
Fluoride	3.60	mg/l	0.10	SM4500-F-C	4 Aug 11 17:00	CLB
Sulfate	7400	mg/l	5.00	ASTM D516-02	27 Jul 11 9:00	KMP
Chloride	66.0	mg/l	1.0	SM4500-Cl-E	27 Jul 11 14:00	KMP
Nitrate-Nitrite as N	0.38	mg/l	0.10	EPA 353.2	28 Jul 11 14:30	KMP
Ammonia-Nitrogen as N	15.0	mg/l	0.10	EPA 350.1	28 Jul 11 10:45	KMP
Phosphorus as P - Total	< 0.1	mg/l	0.10	EPA 365.1	28 Jul 11 13:00	KMP
Mercury - Total	< 0.0002	mg/l	0.0002	EPA 245.1	28 Jul 11 8:00	Eric
Chemical Oxygen Demand	9.4	mg/l	5.0	HACH 8000	1 Aug 11 8:30	Wayne
Calcium - Total	785	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Magnesium - Total	< 5	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Sodium - Total	4720	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Potassium - Total	275	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Aluminum - Total	< 1	mg/l	0.10	6010	9 Aug 11 9:09	Stacy
Iron - Total	< 1	mg/l	0.10	6010	9 Aug 11 9:09	Stacy
Strontium - Total	85.0	mg/l	0.10	6010	9 Aug 11 9:09	Stacy
Titanium - Total	< 1	mg/l	0.10	6010	9 Aug 11 9:09	Stacy
Boron - Total	< 1	mg/l	0.10	6010	11 Aug 11 8:40	Stacy

RL = Method Reporting Limit

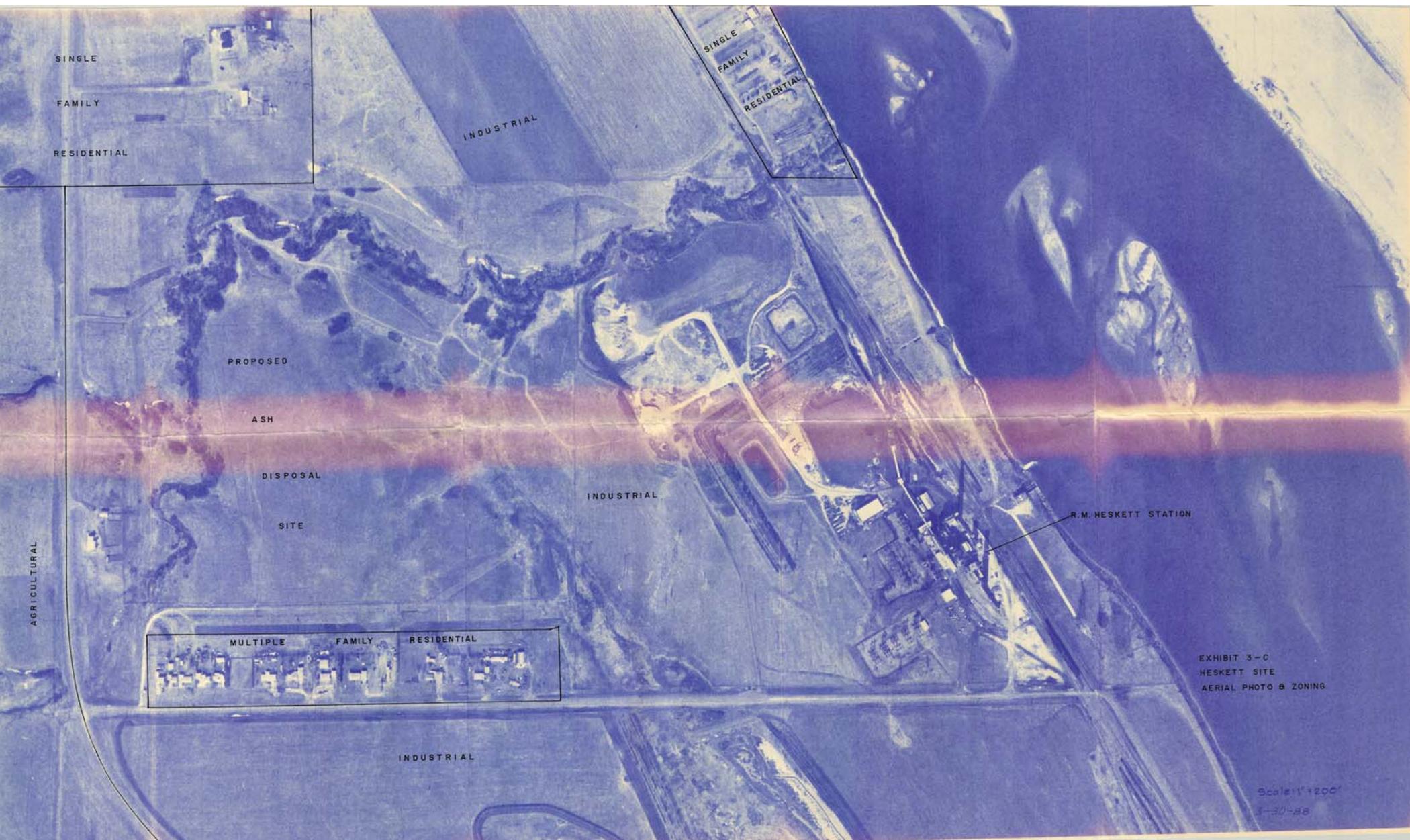
Elevated "Less Than Result" (<): @ = Due to sample matrix
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CERTIFICATION: MN LAB # 038-999-267 ND # ND-00016

Appendix B

Aerial Photo (March 30, 1988)



SINGLE
FAMILY
RESIDENTIAL

SINGLE
FAMILY
RESIDENTIAL

INDUSTRIAL

PROPOSED

ASH

DISPOSAL

SITE

INDUSTRIAL

AGRICULTURAL

MULTIPLE FAMILY RESIDENTIAL

R.M. HESKETT STATION

INDUSTRIAL

EXHIBIT 3-C
HESKETT SITE
AERIAL PHOTO & ZONING

Scale: 1" = 200'
3-30-88

Appendix C

Boring Logs

EXHIBIT 5-E

LITHOLOGIC LOGS

Wells 10, 11, 12 and 13

- 0-1 Top soil, silty, clayey, sandy, brown, calcareous; with some limestone pebbles.
- 1-11 Silt, clayey, brownish-tan, slightly indurated, very dry, calcareous; with thin coarse-grained, clean silt lenses and a few small (less than .5 in.) iron oxide concretions. Abundant small gypsum crystals (less than .13 in. long). Some small, black flakes of organic plant material. Cannonball-Ludlow Formations.
- 11-14 Silt, as above, with some (less than 20%) very fine- to fine-grained sand interspersed.
- 14-30 Silt, as above, clayey, less sand than above interval, oxidized; with very fine-grained silty sand lenses and very few gypsum crystals.
- 30-41 Silt, very clayey, with some (less than 20%) very fine-grained sand interspersed, steel-gray (color change), moderately indurated; with fewer small gypsum crystals than above intervals.
- 41-59 Silt, as above, very clayey, with some (less than 20%) fine- to medium-grained sand interspersed in a silt and clay matrix.
- 59-65 Silt, as above, with abundant (more than 20%) fine- to medium-grained sand interspersed.
- 65-81 Silt, clayey, steel-gray to bluish, moderately indurated; with thin coarse-grained silt to very fine-grained sand lenses in an otherwise fine silt to clay matrix.
- 81-84 Clay, silty, steel-gray to bluish, moderately indurated, dense.
- 84-91 Siltstone, sandy, clayey, steel-gray to bluish, slightly indurated; with small fine-grained sand lenses and abundant (more than 20%) sand interspersed in the matrix.
- 91-110 Silt, clayey, bluish-gray, moderately indurated; with thin (less than 1 foot) mudstone lenses.
- 110-120 Silt, very clayey, steel-gray to bluish, moderately indurated, very dense. Cannonball-Ludlow Formations.

Wells 20 and 21

- 0-1 Top soil, silty, sandy, clayey, dark-brown, calcareous; with some limestone and granite pebbles.
- 1-21 Silt, clayey, with minor amounts (less than 10%) of very fine-grained sand interspersed, brownish-tan, slightly indurated, calcareous, oxidized; with small iron oxide concretions and abundant small gypsum crystals.
Cannonball-Ludlow Formations.
- 21-26 Silt, as above, steel-gray (color change).
- 26-49 Silt, clayey, with some (less than 20%) very fine- to medium-grained sand interspersed, steel-gray to bluish, slightly indurated; with very few small gypsum crystals and some thin (less than 1 foot) siltstone lenses.
- 49-53 Silt, as above, with abundant (more than 20%) fine- to medium-grained sand interspersed.
- 53-63 Silt, as above, clayey, less sand, with thin (less than 1 foot) siltstone to mudstone lenses.
- 63-80 Silt, very clayey, steel-gray to bluish, moderately indurated, very dense.
Cannonball-Ludlow Formations.

Wells 30, 31, 32 and 33

- 0-1 Top soil, silty, sandy, brownish, calcareous; with some granite and limestone pebbles.
- 1-2 Pebble-loam (glacial till), silty, sandy, clayey, yellowish-brown, dry, calcareous.
- 2-31 Silt, clayey, with minor amounts (less than 10%) of very fine-grained sand interspersed, brownish-tan, slightly indurated, calcareous, oxidized; with small iron oxide concretions. Some small, black flakes organic plant material.
Cannonball-Ludlow Formations.
- 31-44 Silt, clayey, steel-gray (color change), slightly indurated, calcareous; with small iron oxide concretions, thin coarse silt lenses, small gypsum crystals and gray to reddish-brown mottling.

- 44-61 Silt, as above, with some (less than 20%) fine- to medium-grained sand interspersed.
- 61-65 Silt, as above, with abundant (more than 20%) fine- to medium-grained sand interspersed, dense.
- 65-76 Silt, as above, clayey, less sand, some thin (less than 1 foot) lenses of siltstone to mudstone.
- 76-80 Siltstone, sandy, clayey, steel-gray to bluish, slightly indurated; with small fine-grained sand lenses and abundant (more than 20%) fine-grained sand interspersed in the matrix.
- 80-92 Silt, clayey, steel-gray to bluish, moderately indurated, with some (less than 20%) very fine- to fine grained sand interspersed.
- 92-120 Silt, very clayey, steel-gray to bluish, moderately indurated, very dense. Cannonball-Ludlow Formations.
- Well 40
- 0-1 Top soil, sandy, silty, brownish-tan, calcareous; with some granite and limestone pebbles.
- 1-5 Pebble-loam (glacial till), sandy, silty, with detrital lignite and organic matter, yellowish-brown, very dry, calcareous.
- 5-22 Sand, very fine- to medium-grained, unconsolidated, with thin lenses of clay and detrital lignite, brownish-yellow, calcareous.
- 22-40 Silt, clayey, with minor amounts (less than 10%) very fine-grained sand interspersed, brownish-tan, slightly indurated, calcareous, oxidized; with small iron oxide concretions and small gypsum crystals; Cannonball-Ludlow Formations.
- 40-51 Silt, clayey, with minor amounts (less than 10%) of very fine-grained sand interspersed, steel-gray (color change), moderately indurated; with some reddish-brown mottling and some very thin (less than 6 inches) mudstone lenses.
- 51-58 Silt, as above, with abundant (more than 20%) fine-grained sand and thin silty-clay lenses.

- 58-62 Siltstone, sandy, clayey, steel-gray to bluish, moderately indurated; with small fine-grained sand lenses and abundant (more than 20%) sand interspersed in the matrix.
- 62-70 Silt, clayey, with some (less than 20%) fine- to medium-grained sand interspersed, steel-gray to bluish, moderately indurated; with thin (less than 2 feet) sandy lenses.
- 70-80 Silt, as above, very clayey, some (less than 10%) fine-grained sand interspersed; less sand than above interval.
- 80-120 Silt, as above, dark-steel-gray.
Cannonball-Ludlow Formations.

Wells 41, 42 and 43

- 0-1 Top soil, sandy, silty, dark-brown, calcareous; with some granite and limestone pebbles.
- 1-4 Pebble-loam (glacial till), sandy, silty, clayey, yellowish-brown, very dry, calcareous.
- 4-40 Silt, clayey, with some (less than 20%) very fine-grained sand interspersed, brownish-tan, unconsolidated, noncompacted, calcareous to 25 feet, oxidized; with small iron oxide concretions and abundant small gypsum crystals.
Cannonball-Ludlow Formations.
- 40-51 Silt, clayey, with minor amounts (less than 10%) of very fine-grained sand interspersed, steel-gray (color change), moderately indurated; with some reddish-brown mottling and some very thin (less than 6 inches) mudstone lenses.
- 51-58 Silt, as above, with abundant (more than 20%) fine-grained sand and thin silty-clay lenses.
- 58-62 Siltstone, sandy, clayey, steel-gray to bluish, moderately indurated; with small fine-grained sand lenses and abundant (more than 20%) sand interspersed in the matrix.
- 62-70 Silt, clayey, with some (less than 20%) fine- to medium-grained sand interspersed, steel-gray to bluish, moderately indurated; with thin (less than 2 feet) sandy lenses.

70-80 Silt, as above, very clayey, some (less than 10%) fine-grained sand interspersed; less sand than above interval.

Wells 43 and 44

- 0-2 Top soil, clayey, silty, some sand, brownish-tan to light-gray, calcareous.
- 2-20 Silt, clayey, with some (less than 20%) fine-grained sand interspersed, brownish-tan, slightly indurated, very dry, calcareous; with small iron oxide concretions, abundant small gypsum crystals and occasional thin silt lenses. Cannonball-Ludlow Formations.
- 20-25 Silt, as above, very clayey, oxidized, with minor amounts (less than 10%) of fine-grained sand.
- 25-35 Silt, as above, dark-brownish-tan to bluish-gray (color change), with thin very fine-grained sand lenses.
- 35-60 Silt, clayey, with some (less than 20%) fine- to medium-grained sand interspersed, steel-gray to bluish, moderately indurated; with some indurated silty sand lenses. Cannonball-Ludlow Formations.

Wells 50, 51 and 52

- 0-4 Top soil, clayey, silty, very dark-brown.
- 4-10 Clay, silty, with some (less than 20%) fine-grained sand, dark-brownish-tan, soft, cohesive, wet, sticky; with some pebbles.
- 10-22 Silt, very clayey, with some (less than 20%) very fine-grained sand interspersed, brownish-tan, slightly indurated, calcareous, dense; with abundant small gypsum crystals and very thin silt and sand lenses; Cannonball-Ludlow Formations.
- 22-23 Sandstone, fine-grained, silty, indurated, oxidized, dark-brown.
- 23-30 Silt, very clayey, with some (less than 20%) very fine-grained sand interspersed, steel-gray (color change), moderately indurated; with thin medium grained sand lenses.

30-40 Silt, as above, very clayey, less sand than above interval, dark-steel-gray.
Cannonball-Ludlow Formations.

Wells 53 and 54

- 0-4 Top soil, clayey, silty, very dark-brown, wet, sticky.
- 4-15 Clay, silty, with some (less than 20%) fine- to medium-grained sand interspersed, brownish-tan, slightly indurated, dry, calcareous; with small iron oxide concretions, small gypsum crystals and occasional reddish-brown mottling;
Cannonball-Ludlow Formations.
- 15-20 Sand, very fine-grained to medium-grained, silty, clayey, unconsolidated, yellowish-brown, oxidized.
- 20-30 Silt, clayey, with some (less than 20%) fine-grained sand interspersed, steel-gray (color change), slightly indurated; with clay and sand lenses, some small concretions and some small gypsum crystals.
- 30-45 Silt, as above, very clayey.
- 45-60 Silt, as above, clayey, brownish-gray, moderately indurated, some reddish-brown mottling.
Cannonball-Ludlow Formations.

Wells 55 and 56

- 0-5 Sandy-loam (glacial), with fine- to medium-grained sand, silty, calcareous; with small granite and limestone pebbles.
- 5-26 Clay, silty, with minor amounts (less than 10%) of very fine-grained sand, dark-brownish-tan, moderately indurated, brittle, very dry, calcareous; with small iron oxide concretions, small gypsum crystals and occasional thin sandstone laminae. Some small, black flakes of organic plant material.
Cannonball-Ludlow Formations.
- 26-35 Clay, as above, very silty, sandy, brownish-tan, oxidized.

- 35-40 Silt, clayey, with some (less than 20%) very fine- to fine-grained sand interspersed, steel-gray (color change) moderately indurated; with small gypsum crystals and occasional clay lenses.
- 40-60 Silt, as above, with minor amounts (less than 10%) of fine-grained sand interspersed.
- 60-85 Silt, as above, clayey, less sand than above interval.
- 85-100 Silt, as above, very clayey, with minor amounts (less than 10%) of sand interspersed, light-gray. Cannonball-Ludlow Formations.

Wells 60, 61 and 62

- 0-2 Top soil, silty, clayey, dark-brown to tanish-brown, calcareous.
- 2-25 Silt, very clayey, with some minor amounts (less than 10%) of very fine- to fine-grained sand interspersed, brownish-tan, slightly indurated, dry, calcareous; with abundant small gypsum crystals and thin silt and sand lenses; Cannonball-Ludlow Formations.
- 25-29 Silt, as above, with abundant (more than 20%) fine- to medium-grained sand interspersed.
- 29-36 Silt, as above, clayey, less sand than above interval, dark-brownish-tan, oxidized.
- 36-60 Silt, very clayey, with some (less than 20%) very fine-grained sand interspersed, steel-gray (color change), moderately indurated; with thin (less than 1 foot) sandy-silt lenses. Cannonball-Ludlow Formations.

Well 70 0-2 Pebble-loam (glacial till), clayey, sandy, yellowish-brown, unconsolidated, damp, calcareous.

- 2-21 Silty, clayey, with some (less than 20%) fine-grained sand interspersed, brownish-tan, moderately indurated, very dry, calcareous, oxidized; with small iron oxide concretions and abundant small gypsum crystals. Cannonball-Ludlow Formations.

- 21-24 Shale, silty, steel- to dark-gray (color change), indurated, fissile, very dry; with occasional thin silt and sand lenses.
- 24-31 Silt, clayey, with abundant (more than 30%) sand, steel-gray, moderately indurated.
- 31-62 Silt, clayey, with some (less than 20%) very fine- to fine- grained sand interspersed, steel-gray, moderately indurated; with some small gypsum crystals and small iron oxide concretions.
- 62-76 Silt, as above, with some (less than 20%) fine-grained sand interspersed.
- 76-82 Silt, as above, with abundant (more than 20%) fine- to medium-grained sand.
- 82-100 Silt, as above, clayey, with some (less than 20%) fine-grained sand interspersed, dark-gray.
Cannonball-Ludlow Formations.
-

The lithologic logs for wells 1-4 were described by personal from Water Supply Incorporated (WS), Bismarck, North Dakota. The wells were installed during a previous ground water investigation at Heskett Station.

Well WS 2

0-1 Top soil, silty, black.
1-4 Pebble-loam (glacial till), silty, clayey, some cobbles, yellowish-brown.
4-7 Gravel, sand and rocks.
7-21 Sand, fine- to coarse-grained, some pebbles.
21-39 Clay, silty, sandy, yellowish-brown to gray.
39-52 Clay, silty, sandy, gray.
52-67 Sand, fine-grained, bluish, with some clay layers.
67-89 Clay, silty, sandy, brown to gray.

Wells WS 1, 1A and 1B

0-1 Top soil, silty, black
1-4 Clay, (glacial), silty, with pebbles, yellowish-brown.
4-21 Sand, fine- to medium-grained, yellowish-brown; with clay and silt lenses.
21-25 Clay, silty, yellowish-brown.
25-30 Sand, fine-grained, yellowish-brown, some indurated layers.
30-35 Clay, silty, yellowish-brown.
35-45 Sand, fine-grained, yellowish-brown.
45-50 Clay, silty, sandy, gray, about 50 percent shale.
50-56 Sand, fine-grained, with clay layers.
56-73 Clay, silty, sandy, gray.

Wells WS 4, 4A and 4B

0-13 Pebble-loam (glacial till), silty, sandy, with some cobbles, yellowish-brown.
13-23 Sand, fine- to medium-grained, yellowish-brown.
23-25 Slay, silty, sandy, yellowish-brown.
25-27 Sandstone, indurated.
27-30 Clay, sandy, silty, gray.
30-36 Sand, fine-grained, gray.
36-52 Clay, silty, sandy, gray; with some sand layers.

Wells WS 3 and 3A

0-1 Top soil, silty, black.
1-12 Pebble-loam, clayey, silty, with some cobbles, yellowish-brown.
12-16 Clay, silty, gray; with some shale layers.
16-18 Limestone, indurated.
18-23 Clay, silty, yellowish-brown; with some sand layers.
23-44 Sand, fine- to medium-grained, gray; with some clay layers.
44-50 Clay, silty, medium-gray.

Project: Heskett Station
 Project No.: 34301012
 Location: Mandan, ND
 Coordinates: Lat: 46.86620° Long: -100.89313°
 Datum:

Surface Elevation:
 Drilling Method: HSA
 Sampling Method: Split Spoon
 Completion Depth: 46.0 ft

Unique Well No.: MW-44 R

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	OL/OH	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						0-1': TOPSOIL (OL/OH); Very Dark Brown (2.5/2 7.5YR); low to medium plasticity; roots, fine to medium grained sand.		
1		1	3-3-5-8.	OL/OH		1-46': SANDY CLAY (CL): Brown (5/4 7.5YR) to Dark Gray (4/1 7.5YR); medium to high plasticity; massive; fine to medium grained sand. Moist; 20% gravel, 30% sand, 50% fines. At 1-5': Gravel sized inclusions. Moist; 10% gravel, 20% sand, 70% fines.	<p>PRO. CASING Diameter: 4" by 4" Type: Steel Interval: 3' up & 3' down</p> <p>RISER CASING Diameter: 2" Type: Schd 40 PVC Interval: Stick up to screen (23')</p> <p>GROUT Type: Cement Interval: 0-0.5' BGS</p> <p>SEAL Type: Bentonite Interval: Chips 0.5-21' BGS</p> <p>SANDPACK Type: Granusil Interval: 21-46' BGS</p> <p>SCREEN Diameter: 2" Type: No. 10 Slot Interval: 23-43' BGS</p>	
2		2	9-9-7-7.			Moist; 10% gravel, 20% sand, 70% fines.		
5		3	7-5-5-7.			Moist; 0% gravel, 30% sand, 70% fines.		
		4	7-9-11-13.			Moist; 0% gravel, 20% sand, 80% fines.		
		5	7-9-12-13.			At 8': Oxidized staining.		
10		6	6-7-11-13.					
		7	7-10-12-14.	CL				
15		8	6-10-14-14.					
		9	10-10-13-16.			At 20': Interbedded layer of sand.		
20		10	10-10-12-16.	CL		(CL): At 24': Color change to dark brown (3/3 7.5YR). Moist; 0% gravel, 20% sand, 80% fines. At 25': Sand lens.		

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Date Boring Started: 10/20/14
 Date Boring Completed: 10/20/14
 Logged By: JEG3
 Drilling Contractor: Midwest Testing (Terracon)
 Drill Rig:

Remarks: Water encountered at 28.7' BGS in MW-44R while drilling on 10/2014

Additional data may have been collected in the field which is not included on this log.
 Weather:



Barr Engineering Company
 234 West Century Avenue
 Bismarck, ND 58503
 Telephone: 701-255-5460

LOG OF BORING MW-44 R

SHEET 2 OF 2

Project: Heskett Station
 Project No.: 34301012
 Location: Mandan, ND
 Coordinates: Lat: 46.86620° Long: -100.89313°
 Datum:

Surface Elevation:
 Drilling Method: HSA
 Sampling Method: Split Spoon
 Completion Depth: 46.0 ft
 Unique Well No.: MW-44 R

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	SOUC	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet	
30		11	8-12-14-18	CL		(CL): At 24': Color change to dark brown (3/3 7.5YR). (continued) Wet; 0% gravel, 20% sand, 80% fines. At 30.5': Sand lens. (CL): At 32': Color change to dark gray (4/1 7.5YR).	<p>PRO. CASING Diameter: 4" by 4" Type: Steel Interval: 3' up & 3' down</p> <p>RISER CASING Diameter: 2" Type: Schd 40 PVC Interval: Stick up to screen (23')</p> <p>GROUT Type: Cement Interval: 0-0.5' BGS</p> <p>SEAL Type: Bentonite Interval: Chips 0.5-21' BGS</p> <p>SANDPACK Type: Granusil Interval: 21-46' BGS</p> <p>SCREEN Diameter: 2" Type: No. 10 Slot Interval: 23-43' BGS</p>		
35		12	8-13-16-27	CL					
40		13	11-19-25-27	CL					
45		14	14-18-27-34	SC		(SC): At 45.8': Clayey Sand (SC), fine to medium grained, low to medium plasticity, dark greenish gray (4/10G Gley 2).			

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Date Boring Started: 10/20/14
 Date Boring Completed: 10/20/14
 Logged By: JEG3
 Drilling Contractor: Midwest Testing (Terracon)
 Drill Rig:

Remarks: Water encountered at 28.7' BGS in MW-44R while drilling on 10/2014

Additional data may have been collected in the field which is not included on this log.
 Weather:



Barr Engineering Company
 234 West Century Avenue
 Bismarck, ND 58503
 Telephone: 701-255-5460

LOG OF BORING MW-80 R

SHEET 1 OF 1

Project: Heskett Station

Project No.: 34301012

Location: Mandan, ND

Coordinates: Lat: 46.86789° Long: -100.89320°

Datum:

Surface Elevation:

Drilling Method: HSA

Sampling Method: Split Spoon

Completion Depth: 27.0 ft

Unique Well No.: MW-80 R

Depth, feet	Sample Type & Recovery	Sample No.	Blows/fin.	SOOC	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet	
0						0-0.5': TOPSOIL (OL/OH): Black; organic roots.			
		1	4-4-4-5			0.5-27': SANDY CLAY (CL): Brown (4/4 7.5 YR) to Black (2.5/1 7.5YR); medium to high plasticity; fine to medium grained sand. Moist: 0% gravel, 30% sand, 70% fines. At 2': Gravel inclusions.	<p>PRO. CASING Diameter: 4" by 4" Type: Steel Interval: 3' up & 3' down</p> <p>RISER CASING Diameter: 2" Type: Schd 40 PVC Interval: Stick up to screen (7')</p> <p>GROUT Type: Cement Interval: 0-0.5' BGS</p> <p>SEAL Type: Bentonite Interval: Chips 0.5-5' BGS</p> <p>SANDPACK Type: Granusil Interval: 5-27' BGS</p> <p>SCREEN Diameter: 2" Type: No 10 Slot Interval: 7-27' BGS</p>		
		2	4-5-7-9			Moist: 10% gravel, 30% sand, 60% fines.			
5		3	4-4-5-8	CL		Moist: 0% gravel, 20% sand, 80% fines.			
		4	4-4-6-6			(CL): At 8': Color change to 2.5/1 7.5YR black, no odor.			
		5	3-4-5-6	CL		(CL): At 9': Color change to 2.5/2 7.5YR very dark brown. Moist: 0% gravel, 20% sand, 80% fines.			
10		6	1-3-3-4	CL		(CL): At 11': Color change to 3/3 7.5YR dark brown, Moist: 0% gravel, 20% sand, 80% fines.			
		7	1-1-2-1			(CL): At 13': Color change to 4/4 7.5YR brown. Wet: 0% gravel, 20% sand, 80% fines.			
15		8	1-2-2-1						
20		9	7-11-12-17	CL		At 21': Thin sand lens less than 0.1" thick. Wet: 0% gravel, 20% sand, 80% fines. At 21.5': Thin sand lens less than 0.1" thick.			
25		10	7-11-17-17			Wet: 0% gravel, 20% sand, 80% fines. At 26.5': Thin sand lens less than 0.1" thick.			

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Date Boring Started: 10/20/14
 Date Boring Completed: 10/20/14
 Logged By: JEG3
 Drilling Contractor: Midwest Testing (Terracon)
 Drill Rig:

Remarks: Water encountered at 11.8' BGS in MW-80R while drilling on 10/20/14

Additional data may have been collected in the field which is not included on this log.
 Weather:



Barr Engineering Company
 4300 MarketPointe Drive Suite 200
 Minneapolis, MN 55435
 Telephone: 952-832-2600

LOG OF BORING MW-101
DRAFT

SHEET 1 OF 3

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438844.919° Long: 1868647.777°
 Datum: NAD 83

Surface Elevation: 1716.6 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 58.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S C	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL: Brown (5/4 7.5YR).		
1		1	4-4-4-6.			SANDY LEAN CLAY WITH GRAVEL (CL): fine to medium grained; Brown (5/3 7.5YR); moist; thinly laminated; some mottling; low plasticity; [Cannonball Formation]. At 2': Start to see gravel inclusions.	PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 2.98' ags - 34' bgs GROUT Type: Neat cement Interval: 0 - 29' bgs SEAL Type: Bentonite chips Interval: 29 - 32' bgs SANDPACK Type: Silica 40-70 Interval: 32 - 56' bgs SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 34 - 54' bgs	1715
2		2	4-6-6-7.			At 4': Oxidized staining. At 5': Oxidized staining.		
3		3	7-9-14-16.			At 7': Oxidized staining and white staining.		1710
4		4	8-9-12-15.					
5		5	10-15-21-26.					
6		6	7-18-24-27.	CL		At 11': Oxidized staining.		1705
7		7	8-12-19-23.					
8		8	8-14-18-23.			At 15': Gypsum. 16-20': No recovery.		1700
9		9	7-10-13-15.			At 20.5': Gypsum.		
10		10	7-9-13-15.	CL		LEAN CLAY (CL): Dark Brown (3/2 7.5YR); oxidized staining, some mottling; medium to high plasticity; [Cannonball Formation]. At 22': Color change to Brown (4/2 7.5YR). At 24': Interbedded sand, fine grained.		1695

25
 Date Boring Started: 8/18/15
 Date Boring Completed: 8/19/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: Hole caved in from 56 - 58' bgs.
 DTW = 36.66' TOR on 9/23/2015 (elev. 1682.87)

 Additional data may have been collected in the field which is not included on this log.
 Weather:

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 4300 MarketPointe Drive Suite 200
 Minneapolis, MN 55435
 Telephone: 952-832-2600

LOG OF BORING MW-101 DRAFT

SHEET 2 OF 3

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438844.919° Long: 1868647.777°
 Datum: NAD 83

Surface Elevation: 1716.6 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 58.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S C	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet		
25		11	7-11-13-15.			LEAN CLAY (CL): Dark Brown (3/2 7.5YR); oxidized staining, some mottling; medium to high plasticity; [Cannonball Formation]. <i>(continued)</i> At 25' and 25.5': Gypsum.	<p>PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs</p> <p>RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 2.98' ags - 34' bgs</p> <p>GROUT Type: Neat cement Interval: 0 - 29' bgs</p> <p>SEAL Type: Bentonite chips Interval: 29 - 32' bgs</p> <p>SANDPACK Type: Silica 40-70 Interval: 32 - 56' bgs</p> <p>SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 34 - 54' bgs</p>	1690		
		12	8-11-15-19.			At 26.5': Gypsum.				
		13	8-11-13-15.			At 29.5': Gypsum.				
30		14	6-11-14-17.	CL						1685
		15	8-13-17-22.			At 33': Gypsum.				
		16	8-14-19-21.			At 34.5': Gypsum.				
35		17	11-16-20-27.			At 35.5-36': Color change to Black (2.5/1 7.5YR), turns back to brown.				1680
		18	9-13-20-25.			FAT CLAY (CH): Black (2.5/1 7.5YR); very stiff; high plasticity; wet at 43'; [Cannonball Formation].				
		19	7-14-23-26.			At 38': Oxidized staining.				
40		20	9-16-23-26.	CH						1675
						At 41': Oxidized staining.				
45										1670
50										

Date Boring Started: 8/18/15
 Date Boring Completed: 8/19/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: Hole caved in from 56 - 58' bgs.
 DTW = 36.66' TOR on 9/23/2015 (elev. 1682.87)

Additional data may have been collected in the field which is not included on this log.
 Weather:

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Barr Engineering Company
 4300 MarketPointe Drive Suite 200
 Minneapolis, MN 55435
 Telephone: 952-832-2600

LOG OF BORING MW-101
DRAFT

SHEET 3 OF 3

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438844.919° Long: 1868647.777°
 Datum: NAD 83

Surface Elevation: 1716.6 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 58.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S C	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
50						FAT CLAY (CH): Black (2.5/1 7.5YR); very stiff; high plasticity; wet at 43'; [Cannonball Formation]. (continued)	<p>PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs</p> <p>RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 2.98' ags - 34' bgs</p> <p>GROUT Type: Neat cement Interval: 0 - 29' bgs</p> <p>SEAL Type: Bentonite chips Interval: 29 - 32' bgs</p> <p>SANDPACK Type: Silica 40-70 Interval: 32 - 56' bgs</p> <p>SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 34 - 54' bgs</p>	1665
55					CH			1660
60						End of boring 58.0 feet		
65								
70								
75								

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Date Boring Started: 8/18/15
 Date Boring Completed: 8/19/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: Hole caved in from 56 - 58' bgs.
 DTW = 36.66' TOR on 9/23/2015 (elev. 1682.87)

Additional data may have been collected in the field which is not included on this log.
 Weather:



Barr Engineering Company
 4300 MarketPointe Drive Suite 200
 Minneapolis, MN 55435
 Telephone: 952-832-2600

LOG OF BORING MW-102 DRAFT

SHEET 1 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438161.145° Long: 1868782.871°
 Datum: NAD 83

Surface Elevation: 1703.8 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 46.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	SCUC	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL: Brown (5/4 7.5YR).		
1		1	3-3-3-2.			LEAN CLAY (CL): medium grained; Brown (4/3 7.5YR); moist; low to medium plasticity; with gravel to 4"; [Cannonball Formation].	PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs	1700
2		2	3-2-2-3.					
3		3	3-3-4-5.	CL		LEAN CLAY (CL): Dark Brown (3/2 7.5YR); medium to high plasticity; [Cannonball Formation].	RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 2.85' ags - 10' bgs	1695
4		4	3-4-5-7.					
5		5	4-8-7-4.	ML	SANDY SILT WITH GRAVEL (ML): Strong Brown (5/6 7.5YR); fine to coarse sand, fine to medium gravel, unconsolidated; [Cannonball Formation].			
6		6	4-3-5-9.	CL		LEAN CLAY WITH GRAVEL (CL): fine to medium grained; Brown (5/3 7.5YR); some mottling; medium plasticity; [Cannonball Formation].	GROUT Type: None Interval: None	1690
7		7	3-5-7-9.					
8		8	6-8-12-14.			LEAN CLAY (CL): Dark Brown (3/2 7.5YR); medium to high plasticity; [Cannonball Formation].	SEAL Type: Bentonite chips Interval: 0 - 8' bgs	1685
9		9	6-10-12-16.	CL				
10		10	5-9-14-16.					
11		11	5-12-15-18.					
12		12	9-15-18-22.			At 21': Color changes to Black (2.5/1).	SANDPACK Type: Silica 40-70 Interval: 8 - 31' bgs	1680
13								
14							SCREEN Diameter: 2"; No. 6 slot Type: PVC SCH 80 Interval: 20 - 30' bgs	1680
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

Date Boring Started: 8/18/15
 Date Boring Completed: 8/18/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: Lithological descriptions for a hole that was abandoned. Monitoring well blind drilled and installed next to abandoned hole.
 DTW = 17.09' TOR on 8/21/2015 (elev. 1689.51)

Additional data may have been collected in the field which is not included on this log.
 Weather:

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LOG OF BORING MW-102
DRAFT

SHEET 2 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438161.145° Long: 1868782.871°
 Datum: NAD 83

Surface Elevation: 1703.8 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 46.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	SPT	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
25		13	9-14-19-22.			LEAN CLAY (CL): Dark Brown (3/2 7.5YR); medium to high plasticity; [Cannonball Formation]. (continued)	 PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 2.85' ags - 10' bgs GROUT Type: None Interval: None SEAL Type: Bentonite chips Interval: 0 - 8' bgs SANDPACK Type: Silica 40-70 Interval: 8 - 31' bgs SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 20 - 30' bgs	1675
		14	10-17-18-24.			At 29': Gypsum.		
		15	6-15-18-26.			At 33.5' and 34': Gypsum.		
30		16	7-14-18-22.					
		17	11-16-20-27.					
		18	10-14-15-24.					
35		19	13-19-25-35.					
		20	8-17-26-31.					
		21	10-20-27-38.					
		22	13-20-27-37.					
45		23	15-27-27-32.			SILTY SAND (SM): fine to medium grained; Dark Gray (4/1 7.5YR); wet; [Cannonball Formation].	1660	
						End of boring 46.0 feet		

Date Boring Started: 8/18/15
 Date Boring Completed: 8/18/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: Lithological descriptions for a hole that was abandoned. Monitoring well blind drilled and installed next to abandoned hole.
 DTW = 17.09' TOR on 8/21/2015 (elev. 1689.51)

Additional data may have been collected in the field which is not included on this log.
 Weather:

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LOG OF BORING MW-103 DRAFT

SHEET 1 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 437578.205° Long: 1869355.992°
 Datum: NAD 83

Surface Elevation: 1714.7 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 44.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S U	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL (OL/OH): Brown (5/4 7.5YR).		
1		1	3-4-5-5.		OL/OH	LEAN CLAY (CL): Very Dark Gray (3/1 7.5YR); moist; stiff; medium to high plasticity; [Cannonball Formation].	PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs	1710
2		2	5-5-8-8.		CL			
3		3	5-8-10-11.		CL	POORLY GRADED SAND WITH GRAVEL (SP): fine to coarse grained; Brown (5/4 7.5YR); some oxidized staining, some mottling; [Cannonball Formation].	RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 2.79' ags - 24' bgs	1705
4		4	6-9-15-15.		SP			
5		5	5-6-5-4.		SP	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; Brown (5/4 7.5YR); [Cannonball Formation].	GROUT Type: Neat cement Interval: 0 - 19' bgs	1700
6		6	4-5-5-7.		SP-SM			
7		7	2-2-2-3.		SP-SM	NO RECOVERY (16 - 20').	SEAL Type: Bentonite chips Interval: 19 - 22' bgs	1695
8		8	3-3-3-3.		SP-SM			
9		9	3-3-5-5.		CL	SANDY LEAN CLAY (CL): fine to medium grained; Light Brown (6/4 7.5YR); wet; some mottling and oxidized staining, cohesive; low to medium plasticity; [Cannonball Formation].	SANDPACK Type: Silica 40-70 Interval: 22 - 44' bgs	1690
10								
15								
20								
25								

Date Boring Started: 8/19/15
 Date Boring Completed: 8/20/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: DTW = 33.24' TOR on 8/20/2015 (elev. 1684.29)
 Additional data may have been collected in the field which is not included on this log.
 Weather:

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LOG OF BORING MW-103 DRAFT

SHEET 2 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 437578.205° Long: 1869355.992°
 Datum: NAD 83

Surface Elevation: 1714.7 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 44.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S C	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
25		10	2-2-4-4.	CL		SANDY LEAN CLAY (CL): fine to medium grained; Light Brown (6/4 7.5YR); wet; some mottling and oxidized staining, cohesive; low to medium plasticity; [Cannonball Formation]. <i>(continued)</i>	PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 2.79' ags - 24' bgs GROUT Type: Neat cement Interval: 0 - 19' bgs SEAL Type: Bentonite chips Interval: 19 - 22' bgs SANDPACK Type: Silica 40-70 Interval: 22 - 44' bgs SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 24 - 44' bgs	1685
30		11	10-10-7-9.	SM		SILTY SAND WITH GRAVEL (SM): wet; [Cannonball Formation].		
		12	8-15-17-22.			LEAN CLAY (CL): Brown (4/4 7.5YR); moist; oxidized staining; medium to high plasticity; [Cannonball Formation]. At 32.5': Sand lens, color changes to Black (2.5/1 7.5YR). At 33.5': Sand lens. At 34': Interbedded sand with oxidized staining.		
35		13	7-19-15-25.					1680
		14	11-16-21-50 for 5".	CL		At 36.5': Sand lens. At 37': Sand lens. At 37.5': Color change to Gray (5/1 7.5YR). At 38-38.5': 6" thick layer of hard material.		
40		15	50 for 2"-.					1675
		16	12-17-22-30.					
		17	9-18-24-50.			At 42-42.5': Silt layer. At 43.5-44': Silt layer.		
45						End of boring 44.0 feet		

Date Boring Started: 8/19/15
 Date Boring Completed: 8/20/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: DTW = 33.24' TOR on 8/20/2015 (elev. 1684.29)

 Additional data may have been collected in the field which is not included on this log.
 Weather:

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LOG OF BORING MW-104 DRAFT

SHEET 1 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438853.542° Long: 1869832.72°
 Datum: NAD 83

Surface Elevation: 1681.5 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 32.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S C	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL: Brown (5/4 7.5YR).		
1		1	4-5-5-5.			LEAN CLAY WITH SAND (CL): fine to medium grained; Brown (5/4 7.5YR); moist; gravel; medium plasticity; [Cannonball Formation].	PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs	1680
2		2	3-5-6-8.	CL				
3		3	3-7-9-10.			LEAN CLAY (CL): Brown (4/4 7.5YR); oxidized staining and mottling; medium to high plasticity; with gypsum throughout; [Cannonball Formation].	RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 3.06' ags - 9' bgs	1675
4		4	5-7-9-10.					
5		5	5-9-9-10.					
6		6	5-7-9-10.	CL			GROUT Type: None Interval: None	
7		7	5-8-8-12.			At 12': Heavily oxidized.		
8		8	5-9-11-15.			At 15': Start seeing black staining.	SEAL Type: Bentonite chips Interval: 0 - 7' bgs	1670
9		9	6-9-11-13.			At 17': Heavily oxidized.		
10		10	4-7-16-19.			SILTY SAND (SM): Strong Brown (5/6 7.5YR); wet; [Cannonball Formation].	SANDPACK Type: Silica 40-70 Interval: 7 - 32' bgs	
11		11	5-16-22-26.	SM		At 19.5': Color change to Brown (5/4 7.5YR). At 21': Oxidized layer.		
12		12	7-11-14-16.	CH		FAT CLAY (CH): Dark Gray (4/1 7.5YR); moist; stiff; high plasticity; with interbedded sand layers below 27'; [Cannonball Formation].		
13							SCREEN Diameter: 2"; No. 6 slot Type: PVC SCH 80 Interval: 9 - 29' bgs	1665
14								
15								1660
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

Date Boring Started: 8/20/15
 Date Boring Completed: 8/20/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: DTW = 13.25' TOR on 8/21/2015 (elev. 1671.26)

Additional data may have been collected in the field which is not included on this log.
 Weather:

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LOG OF BORING MW-104
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SHEET 2 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438853.542° Long: 1869832.72°
 Datum: NAD 83

Surface Elevation: 1681.5 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 32.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S C	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet	
25		13	6-12-16-17.			FAT CLAY (CH): Dark Gray (4/1 7.5YR); moist; stiff; high plasticity; with interbedded sand layers below 27'; [Cannonball Formation]. (continued)	 PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 3.06' ags - 9' bgs GROUT Type: None Interval: None SEAL Type: Bentonite chips Interval: 0 - 7' bgs SANDPACK Type: Silica 40-70 Interval: 7 - 32' bgs SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 9 - 29' bgs	1655	
		14	8-12-16-21.	CH					
		15	8-12-16-20.						
30		16				Driller notes: sluff.		1650	
						End of boring 32.0 feet			

Date Boring Started: 8/20/15
 Date Boring Completed: 8/20/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: DTW = 13.25' TOR on 8/21/2015 (elev. 1671.26)

 Additional data may have been collected in the field which is not included on this log.
 Weather:

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LOG OF BORING MW-105 DRAFT

SHEET 1 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438042.079° Long: 1870325.657°
 Datum: NAD 83

Surface Elevation: 1686.0 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 30.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S C U	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL: Brown (5/4 7.5YR).		1686
1		1	6-7-6-5.			SANDY LEAN CLAY (CL): fine to medium grained; Brown (4/2 7.5YR); moist; gravel; medium plasticity; [Cannonball Formation].	PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 3.16' ags - 10' bgs GROUT Type: None Interval: None SEAL Type: Bentonite chips Interval: 0 - 7' bgs SANDPACK Type: Silica 40-70 Interval: 7 - 30' bgs SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 10 - 30' bgs	1685
2		2	5-5-5-6.					1680
3		3	3-2-4-5.	CL				1675
4		4	2-2-2-3.					1670
5		5	2-1-2-2.			LEAN CLAY (CL): Brown (4/2 7.5YR); soft; high plasticity; wet at 16"; [Cannonball Formation].		
6		6	2-1-2-1.			At 10.5': Color change to Reddish-Yellow (6/6 7.5YR).		
7		7	2-1-1-3.					
8		8	4-3-5-5.	CL		At 14.5-15.5': Gravel inclusions. At 15.5': Color change to Brown (4/3 7.5YR).		
9		9	7-9-11-13.					
10		10	7-9-11-13.			At 18': Color change to Brown (5/3 7.5YR).		
11		11	7-9-13-15.					
12		12	19-26-28-30.	SP-SM		POORLY GRADED SAND WITH SILT (SP-SM): medium to coarse grained; Brown (5/4 7.5YR); [Cannonball Formation].		

25
 Date Boring Started: 8/17/15
 Date Boring Completed: 8/17/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: DTW = 13.22' TOR on 8/21/2015 (elev. 1675.92)

Additional data may have been collected in the field which is not included on this log.
 Weather:

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LOG OF BORING MW-105
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SHEET 2 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438042.079° Long: 1870325.657°
 Datum: NAD 83

Surface Elevation: 1686.0 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 30.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S C	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
25		13	15-25-31-40.			FAT CLAY (CL): Dark Brown (3/4 7.5YR); high plasticity; sand lens at 26.5'; [Cannonball Formation]. At 26': Color change to Gray (5/1 7.5YR).		1660
		14	10-15-18-30.	CL				
		15	11-16-22-32.					
30						End of boring 30.0 feet	RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 3.16' ags - 10' bgs GROUT Type: None Interval: None SEAL Type: Bentonite chips Interval: 0 - 7' bgs SANDPACK Type: Silica 40-70 Interval: 7 - 30' bgs SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 10 - 30' bgs	

Date Boring Started: 8/17/15
 Date Boring Completed: 8/17/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: DTW = 13.22' TOR on 8/21/2015 (elev. 1675.92)

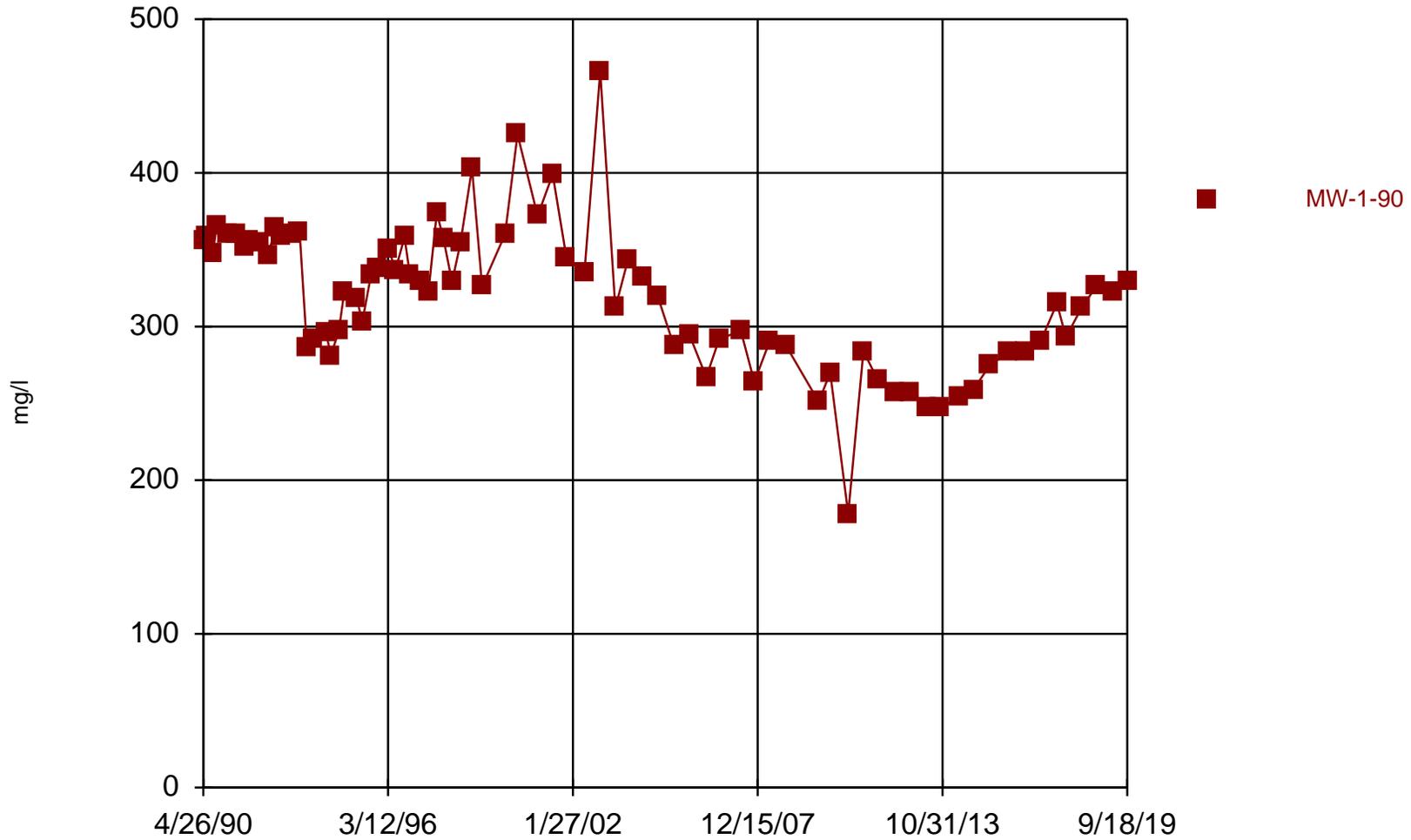
 Additional data may have been collected in the field which is not included on this log.
 Weather:

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Appendix D

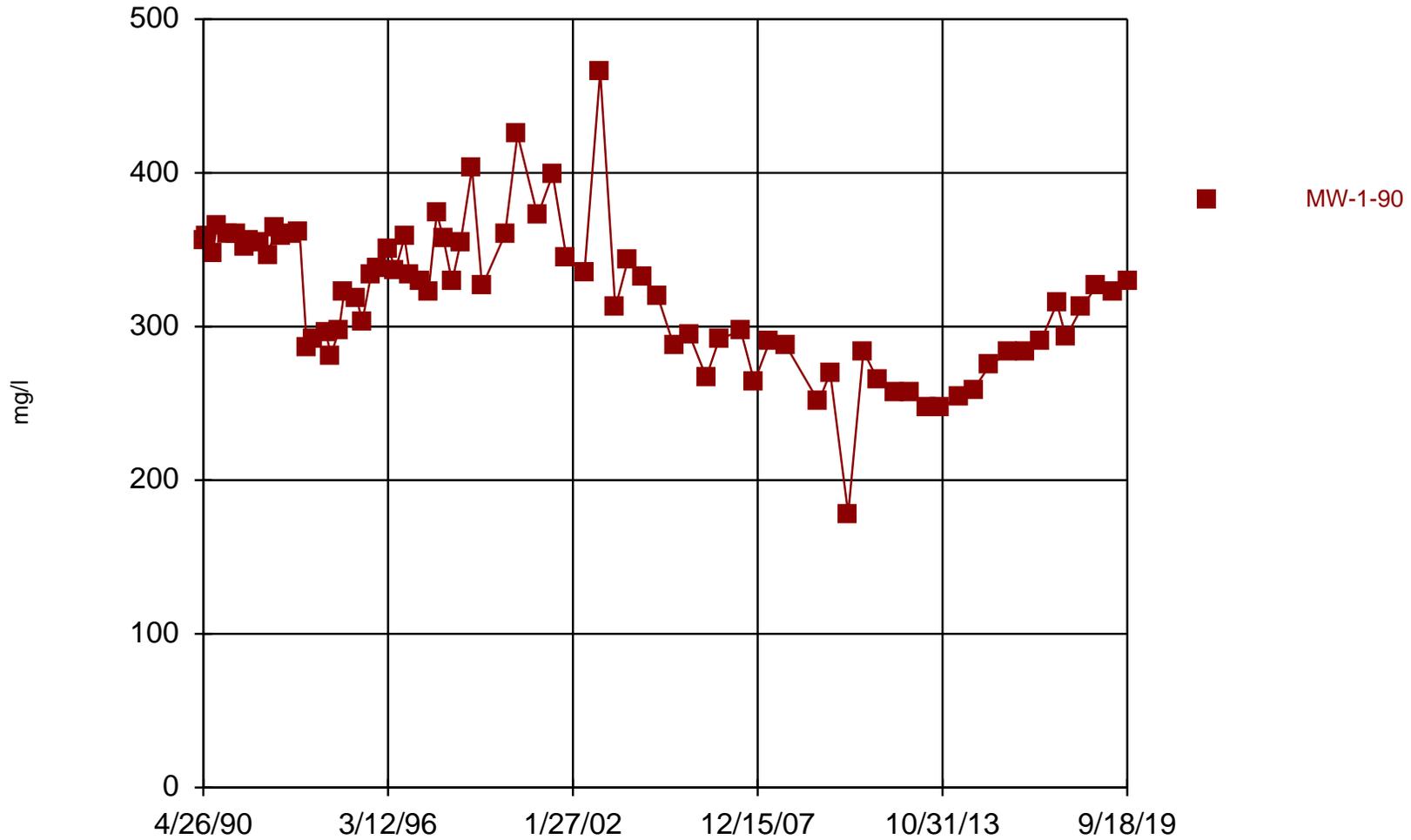
MW1-90 Time Series Plots

Time Series



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Heskett Station Client: Barr Engineering Company Data: MDUHeskett_AMR_HistoricalALL

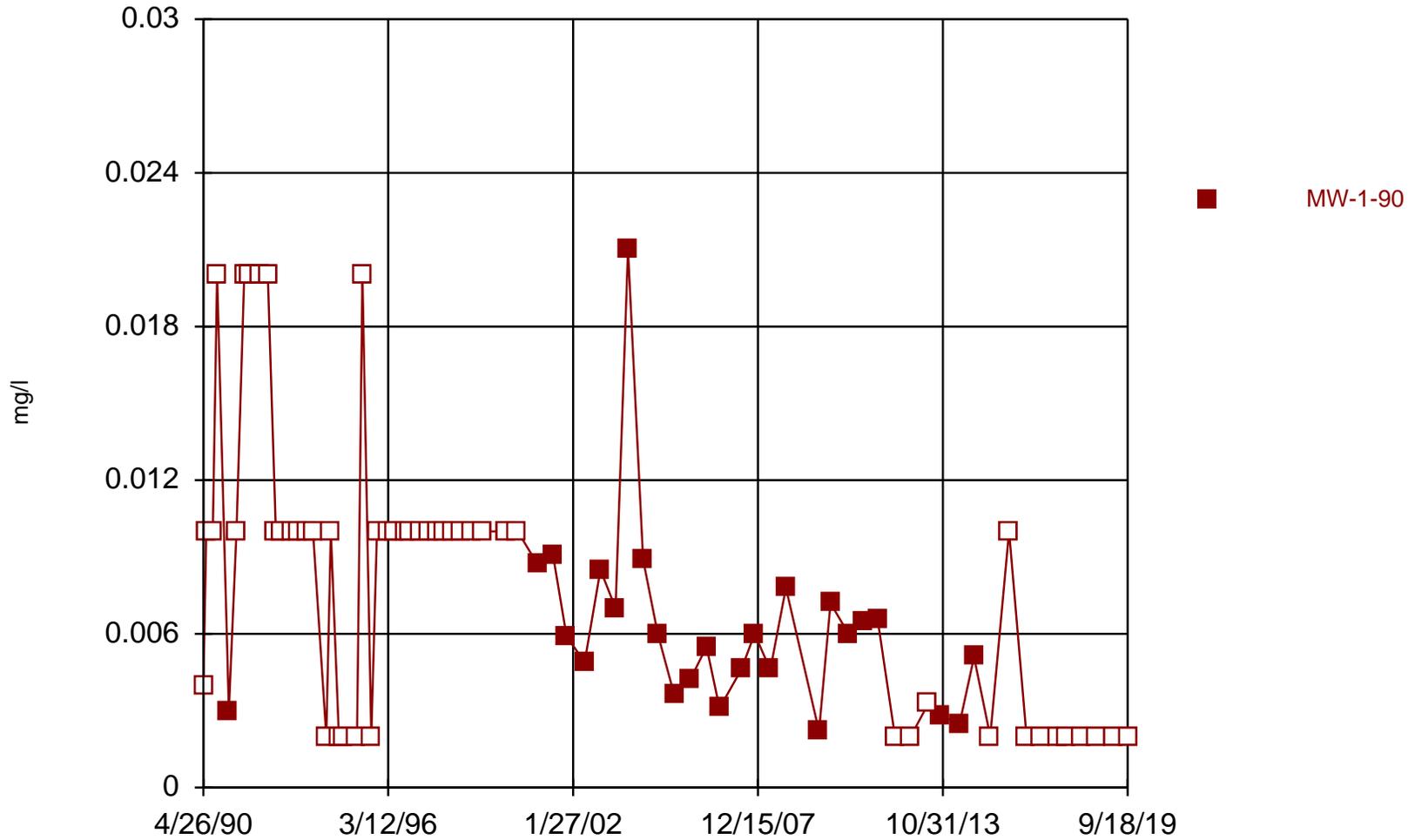
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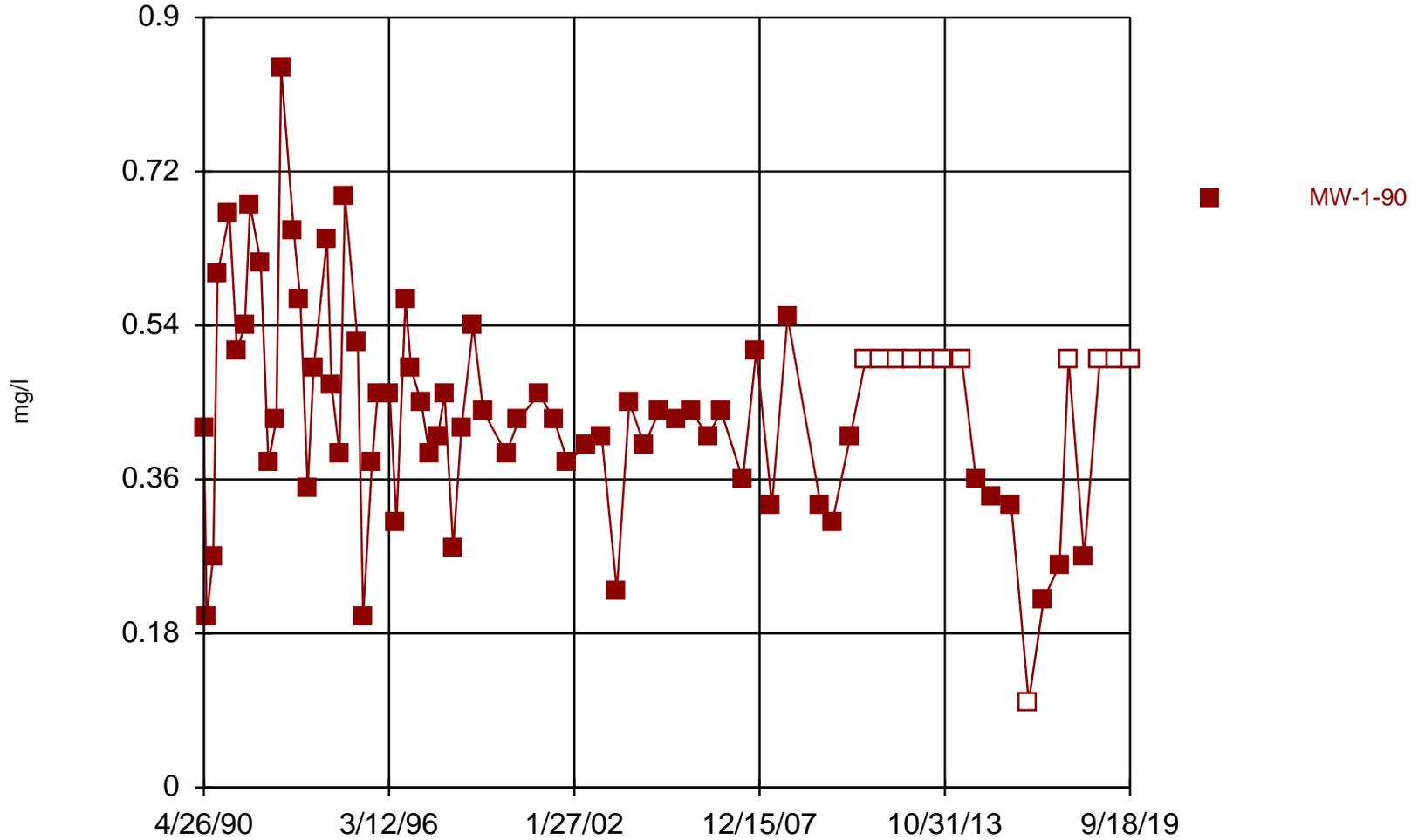
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Heskett Station Client: Barr Engineering Company Data: MDUHeskett_AMR_HistoricalALL

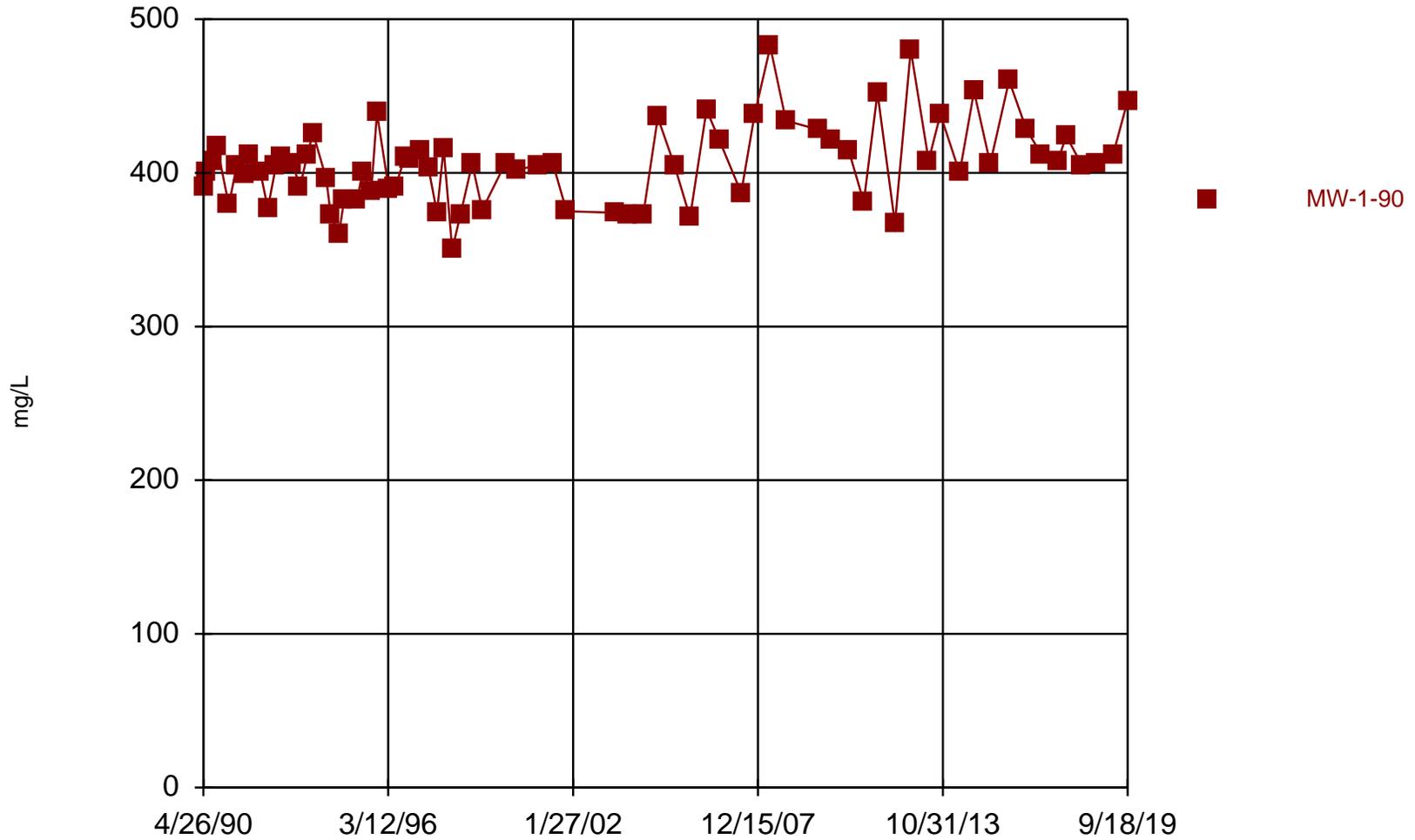
Time Series



Time Series



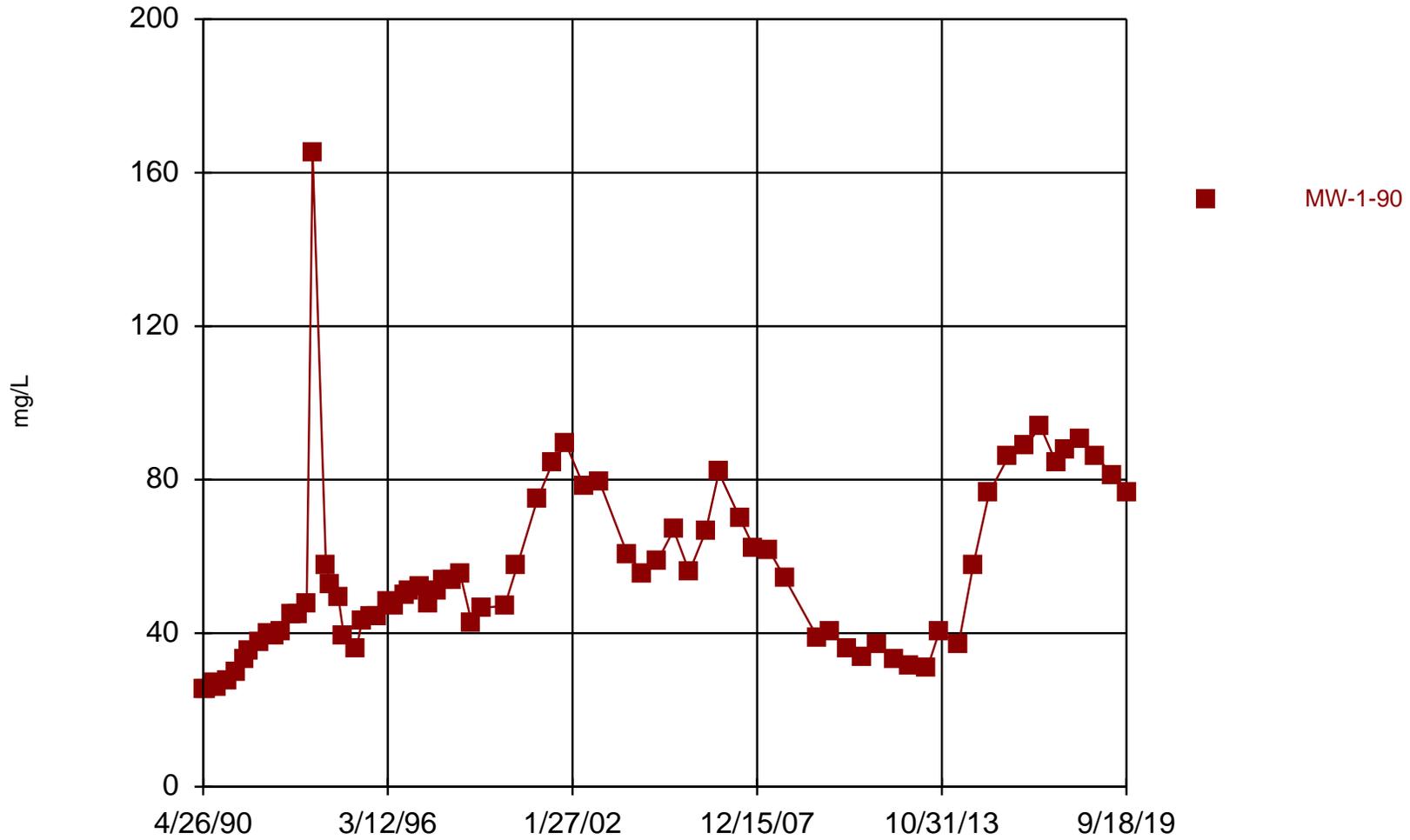
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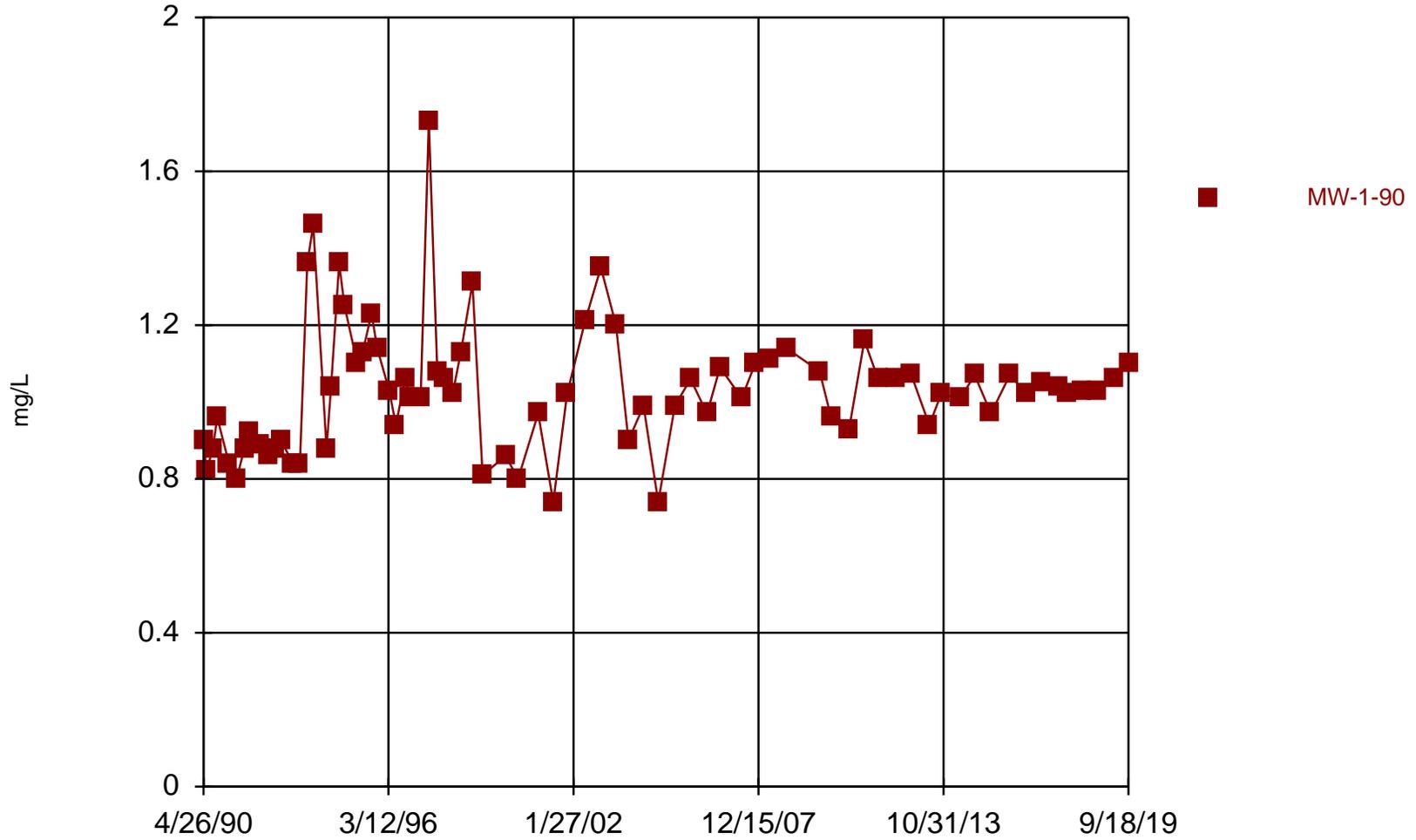
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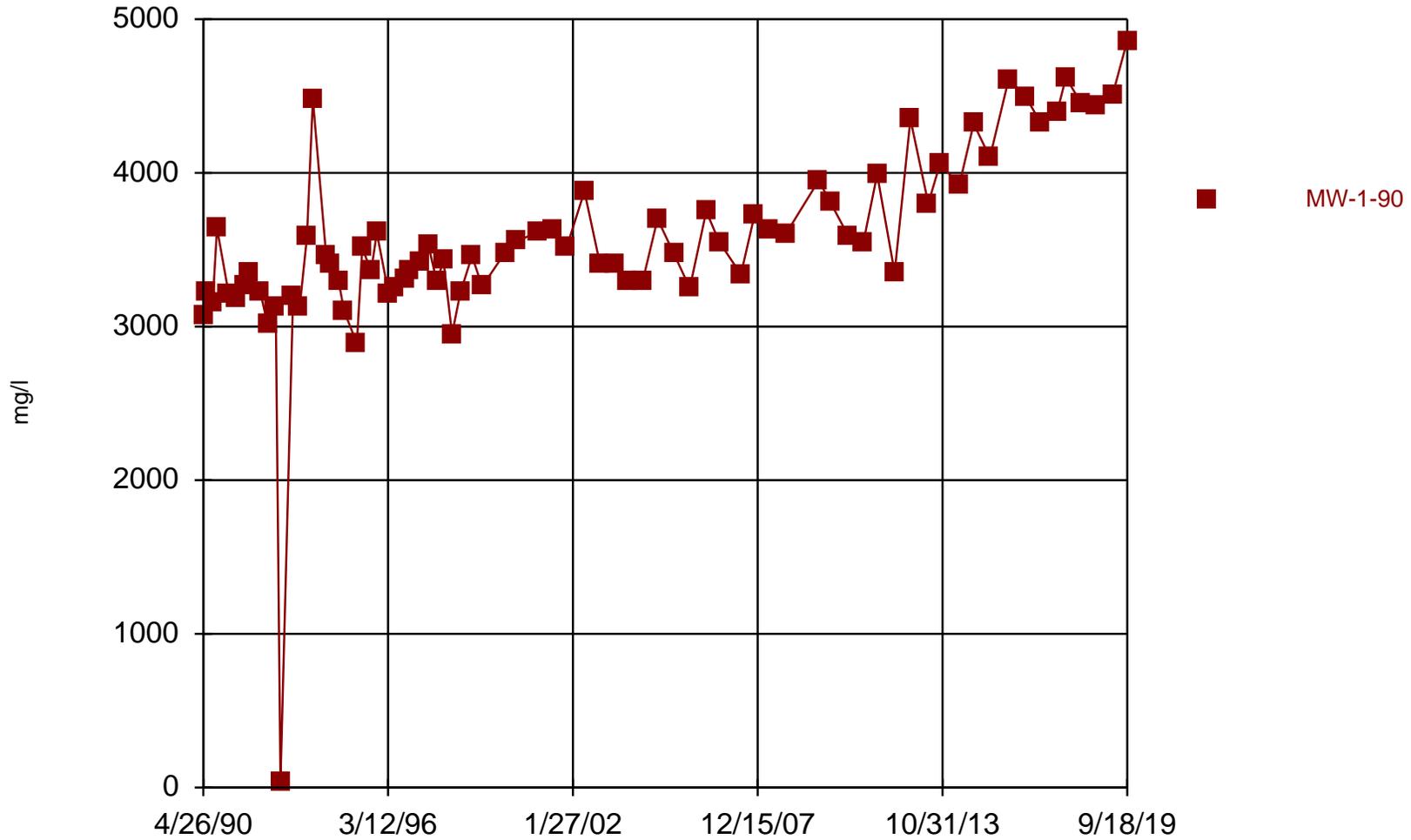
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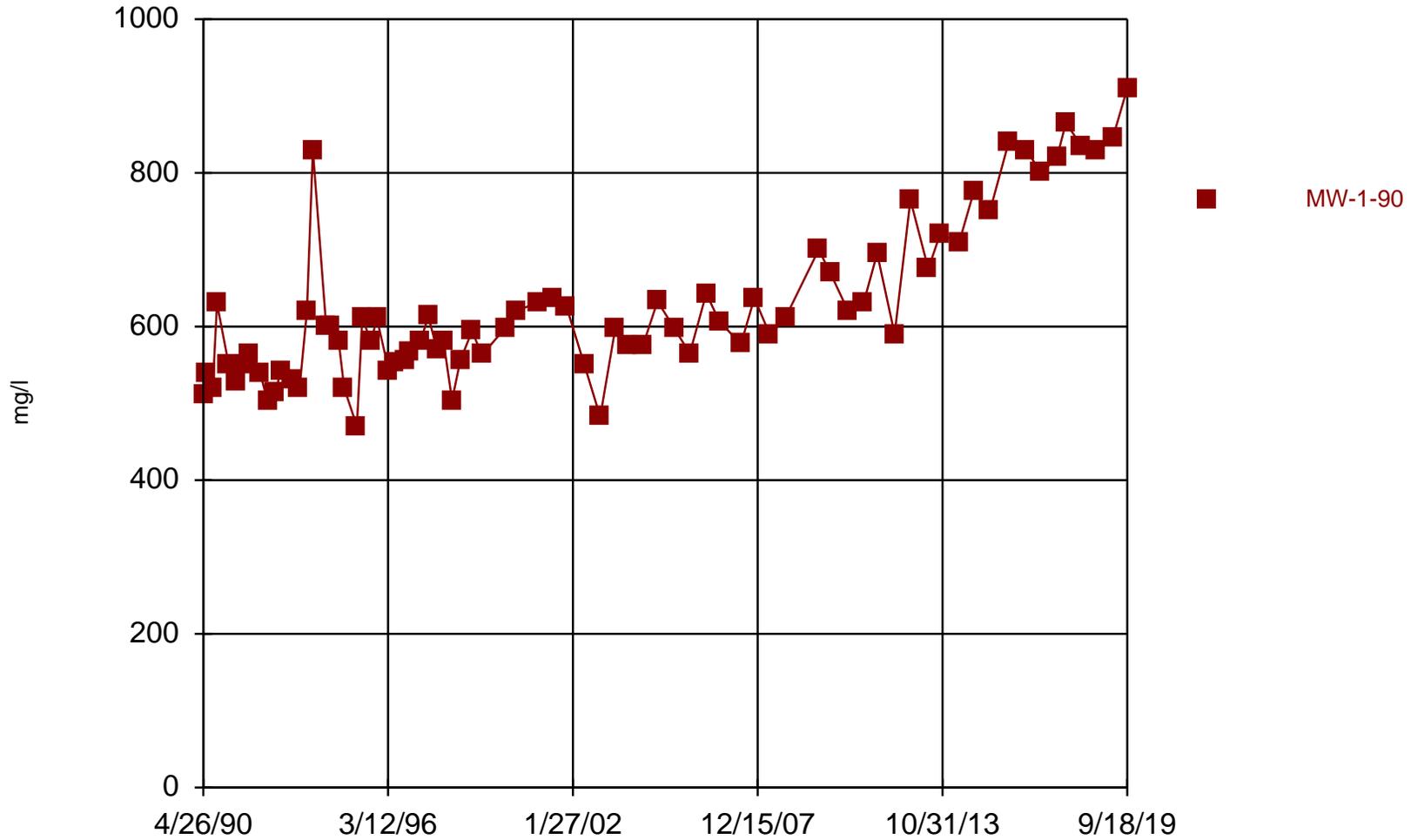
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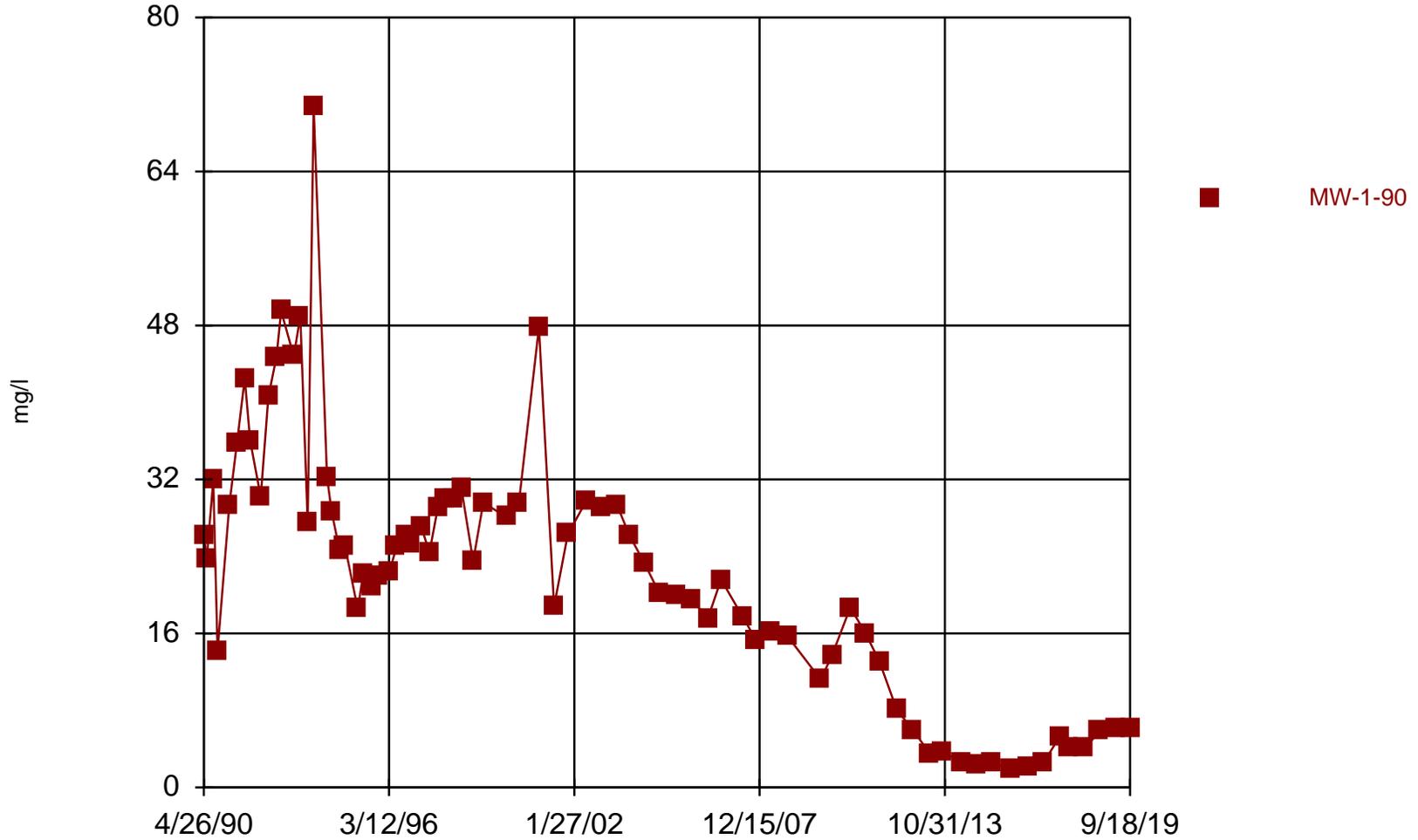
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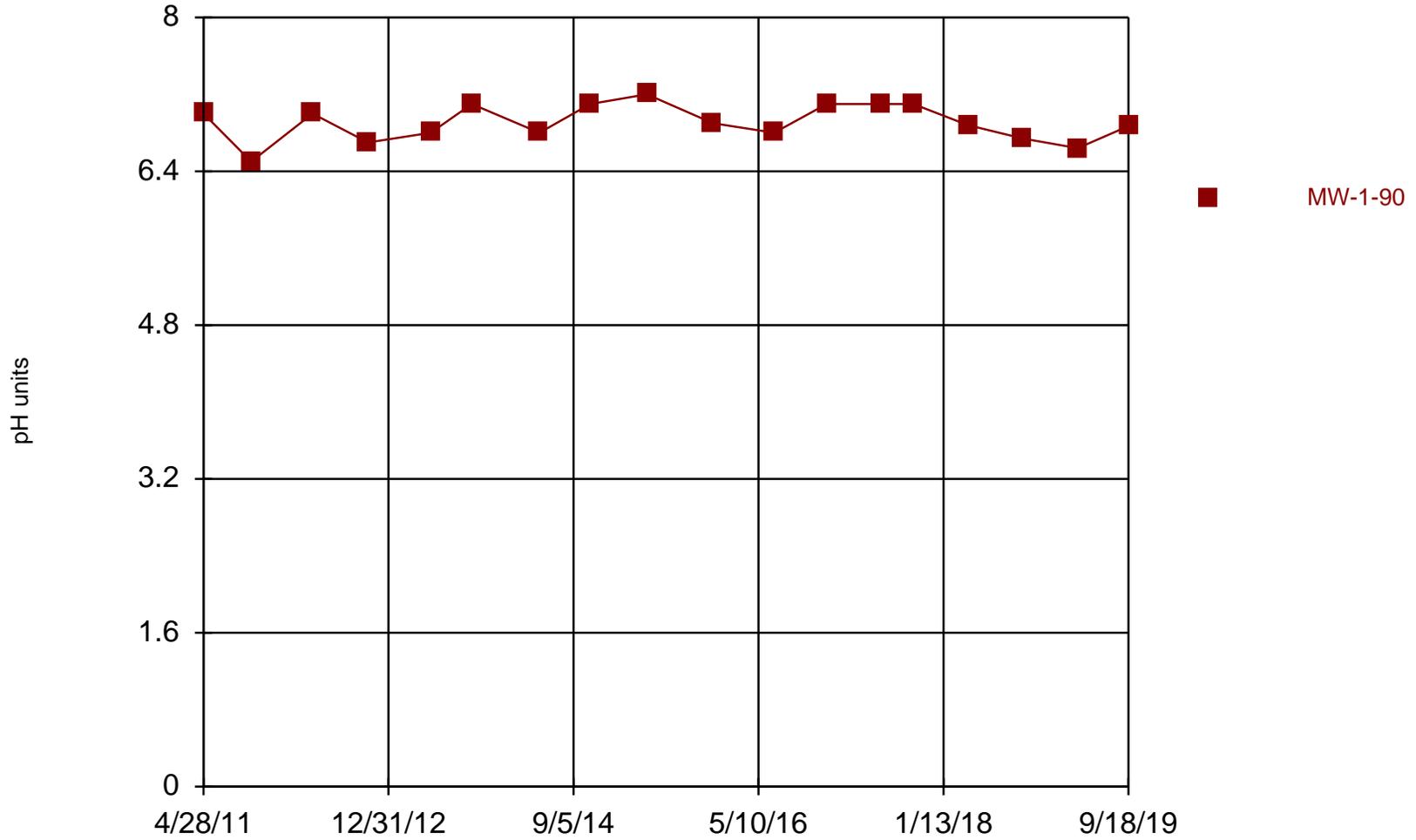
Time Series



Time Series



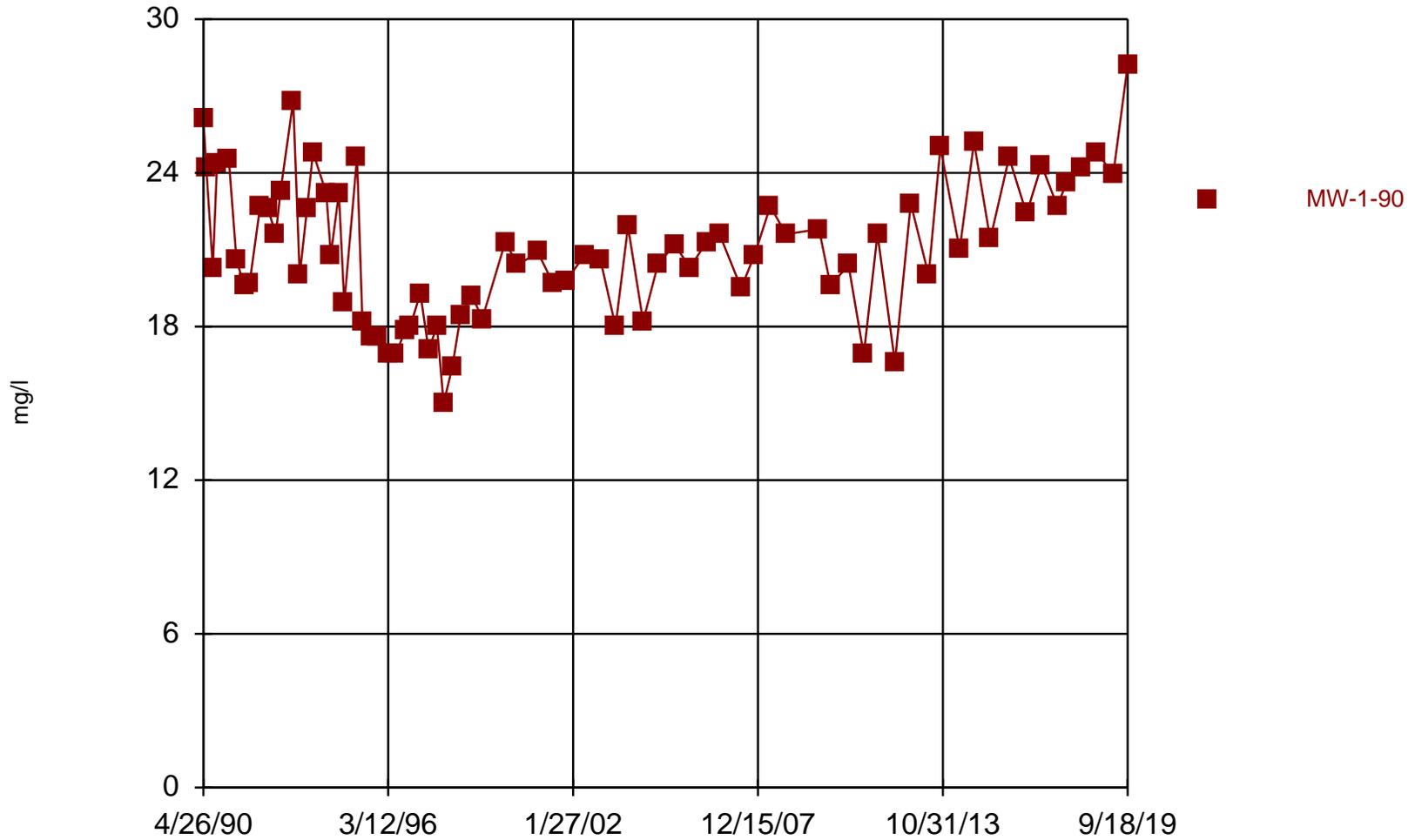
Time Series



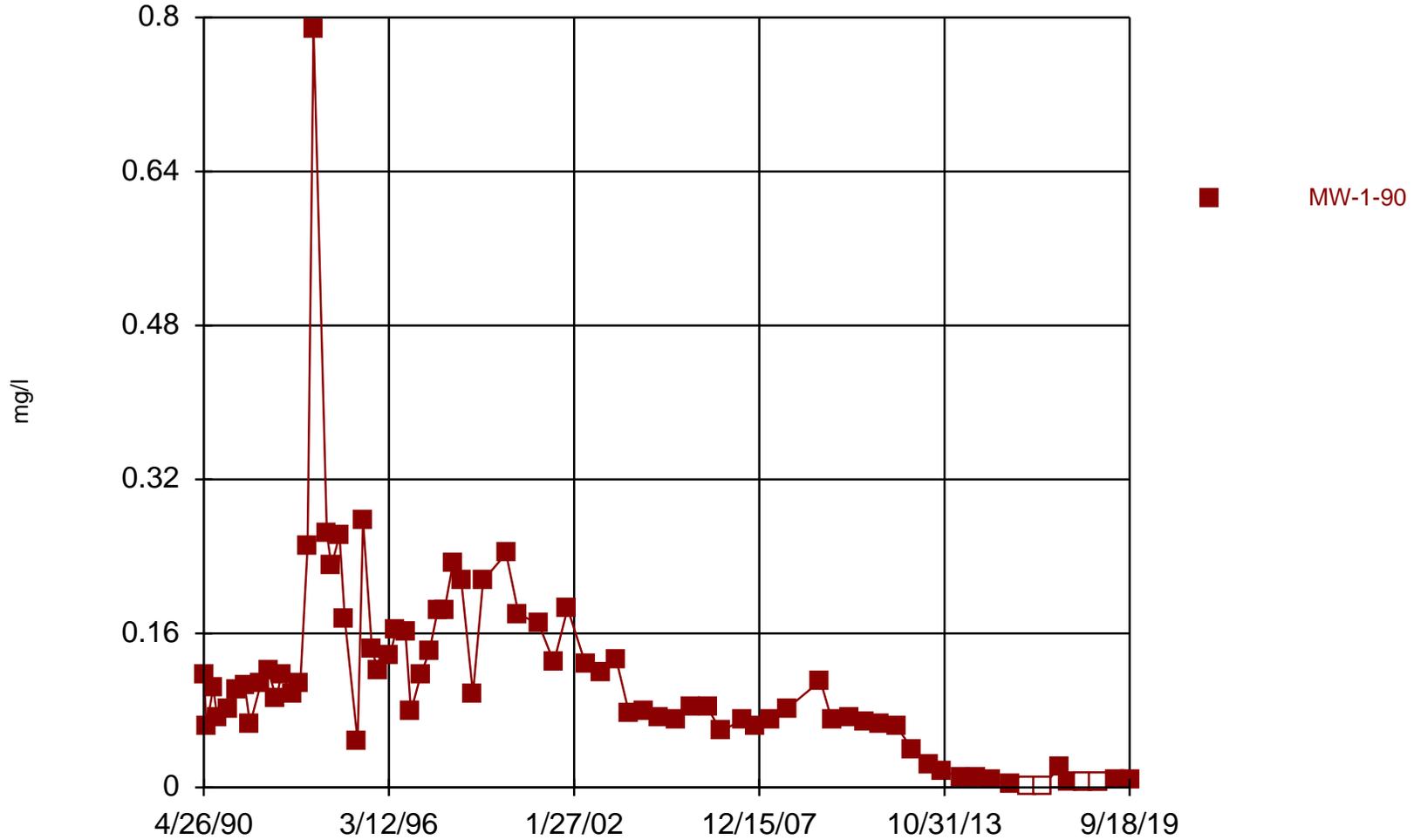
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Heskett Station Client: Barr Engineering Company Data: MDUHeskett_AMR_HistoricalALL

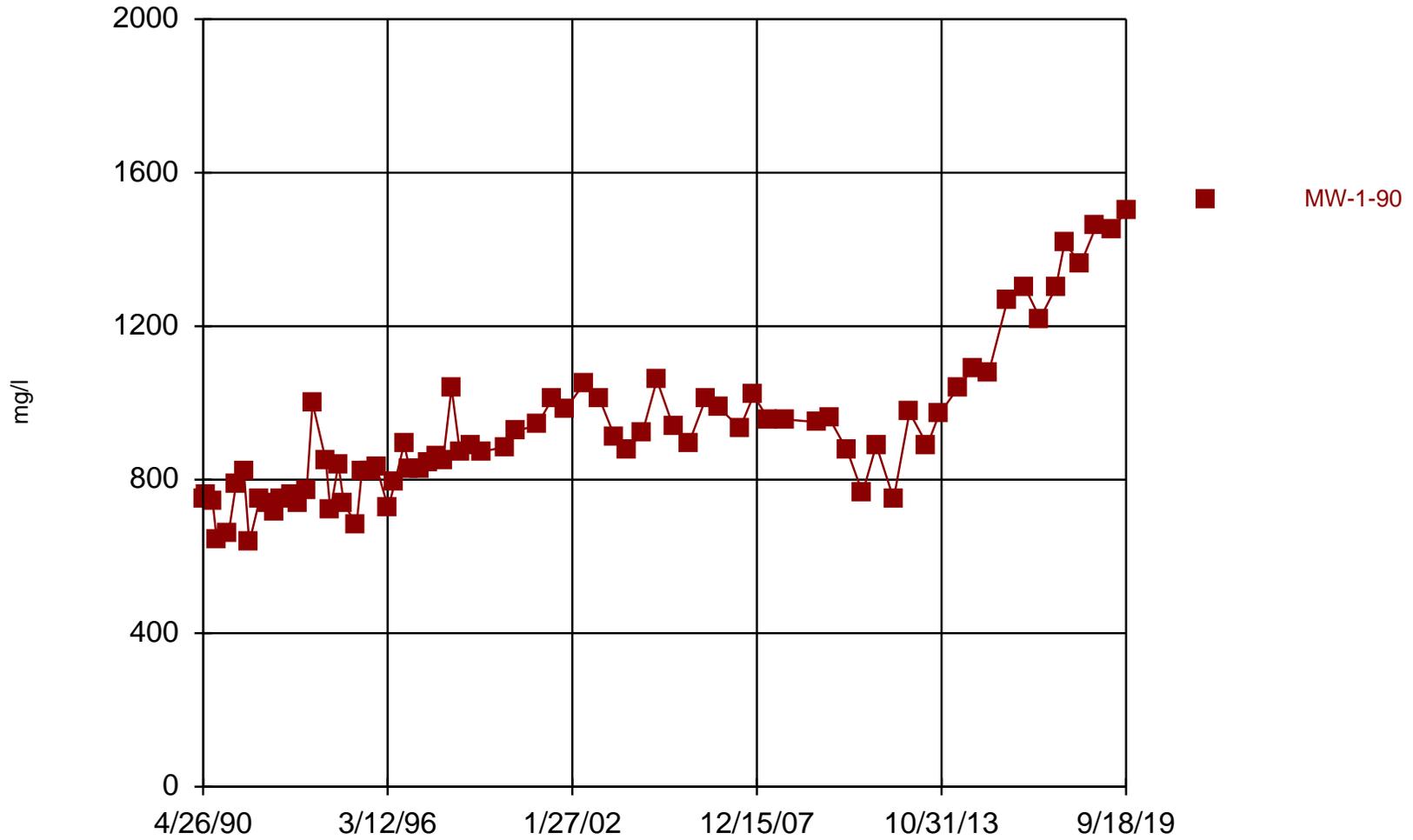
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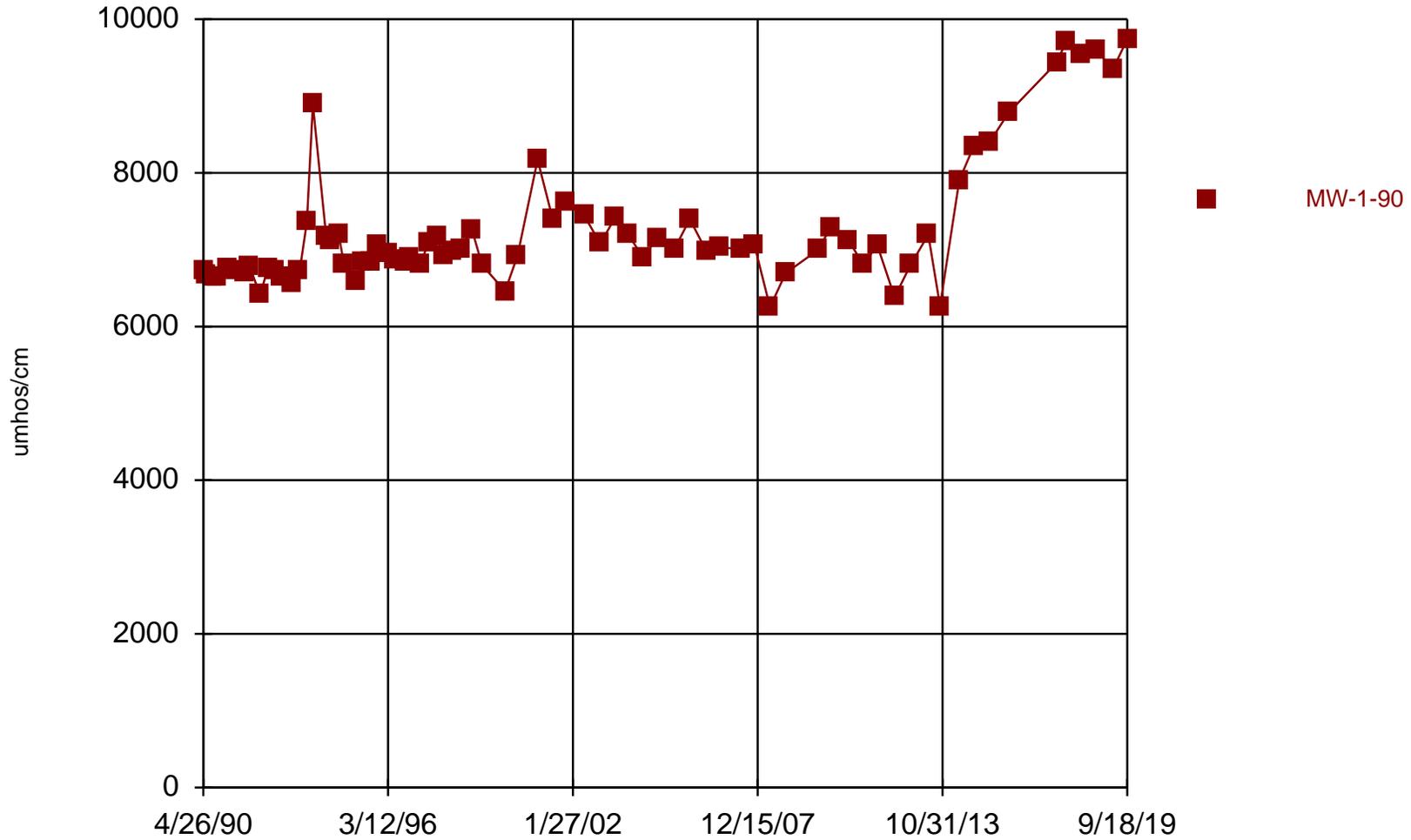
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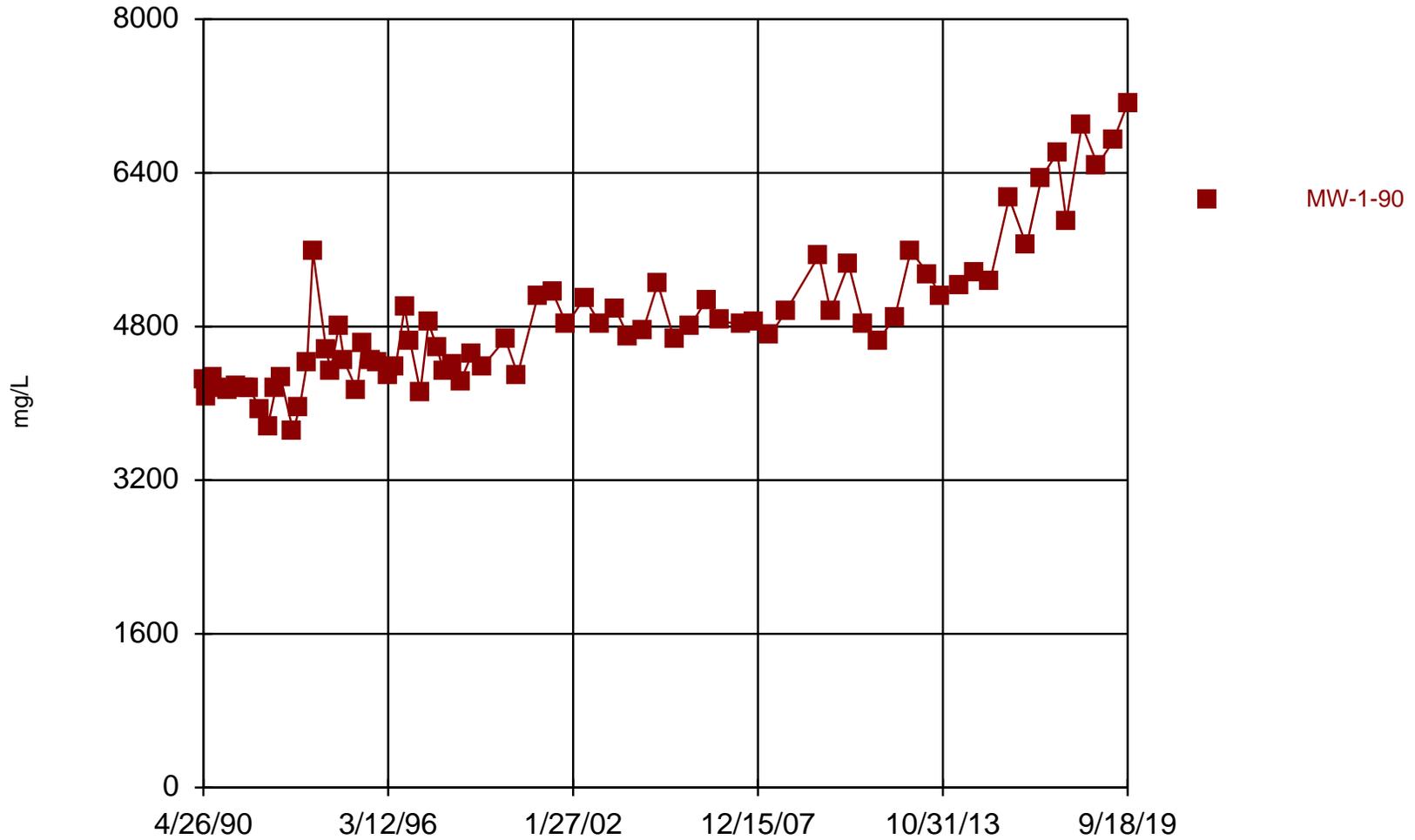
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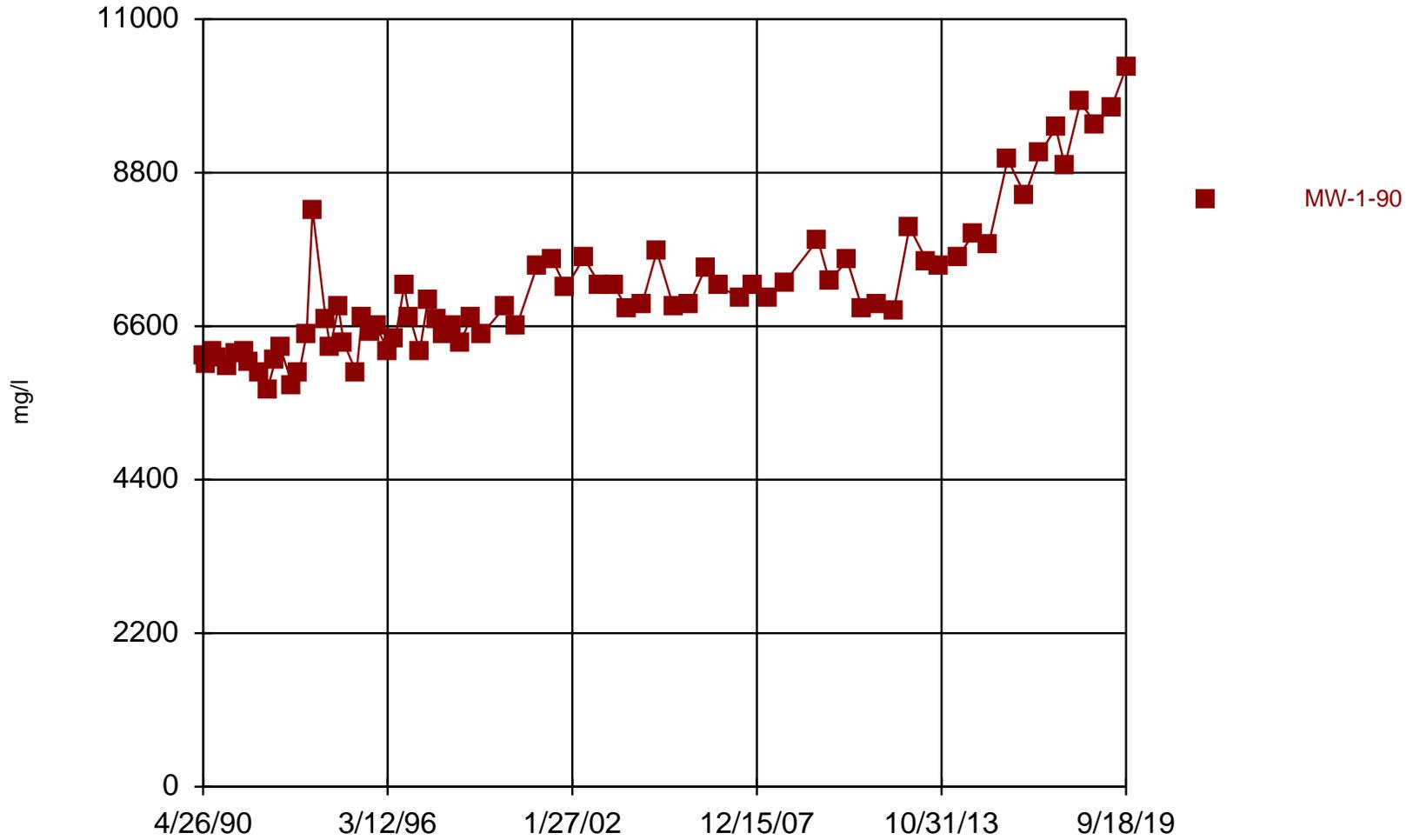
Time Series



Time Series



Time Series



Appendix E

Geochemist's Workbench Results

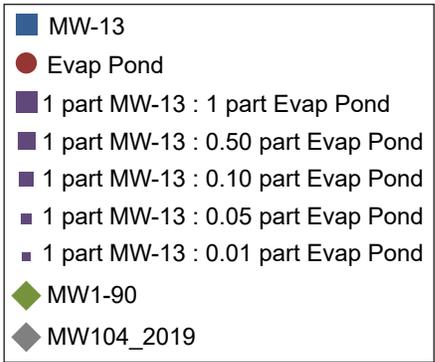
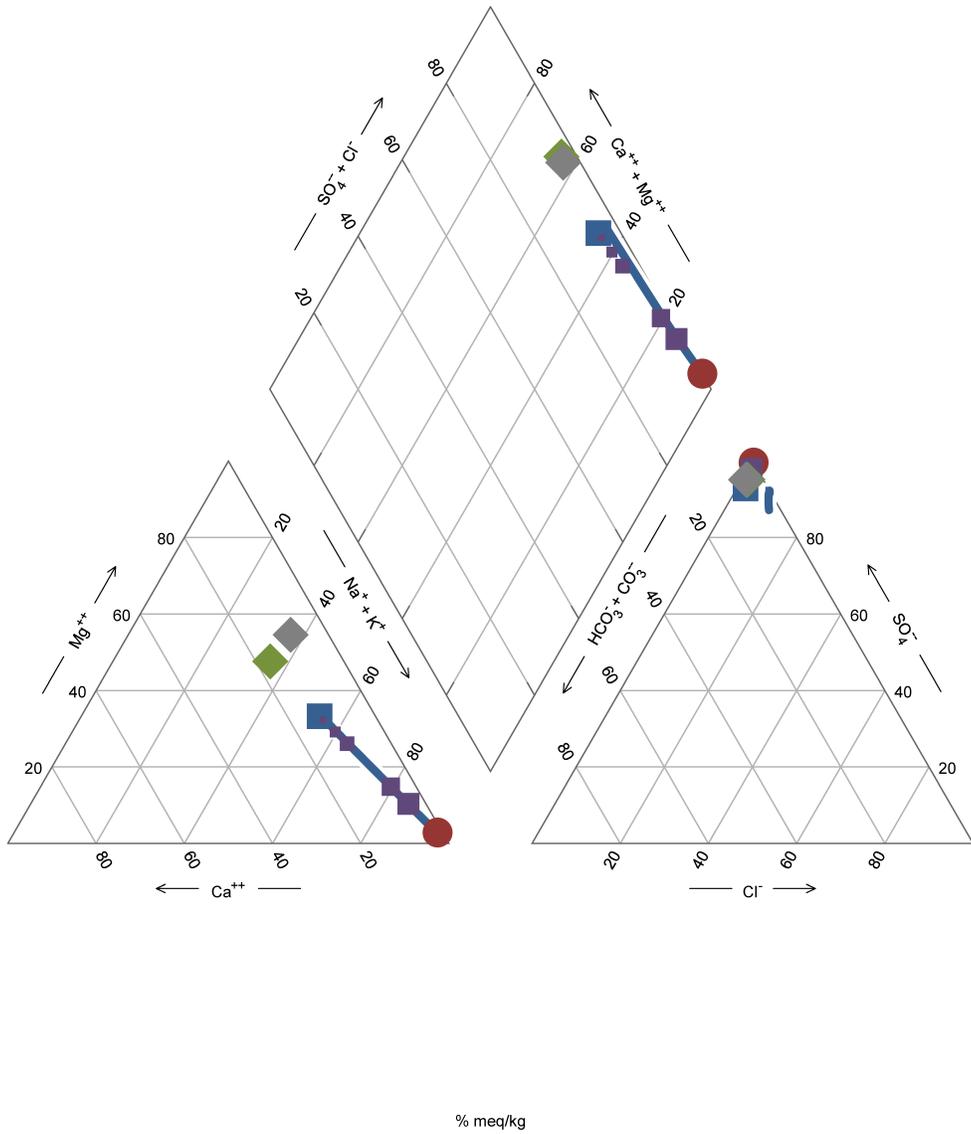
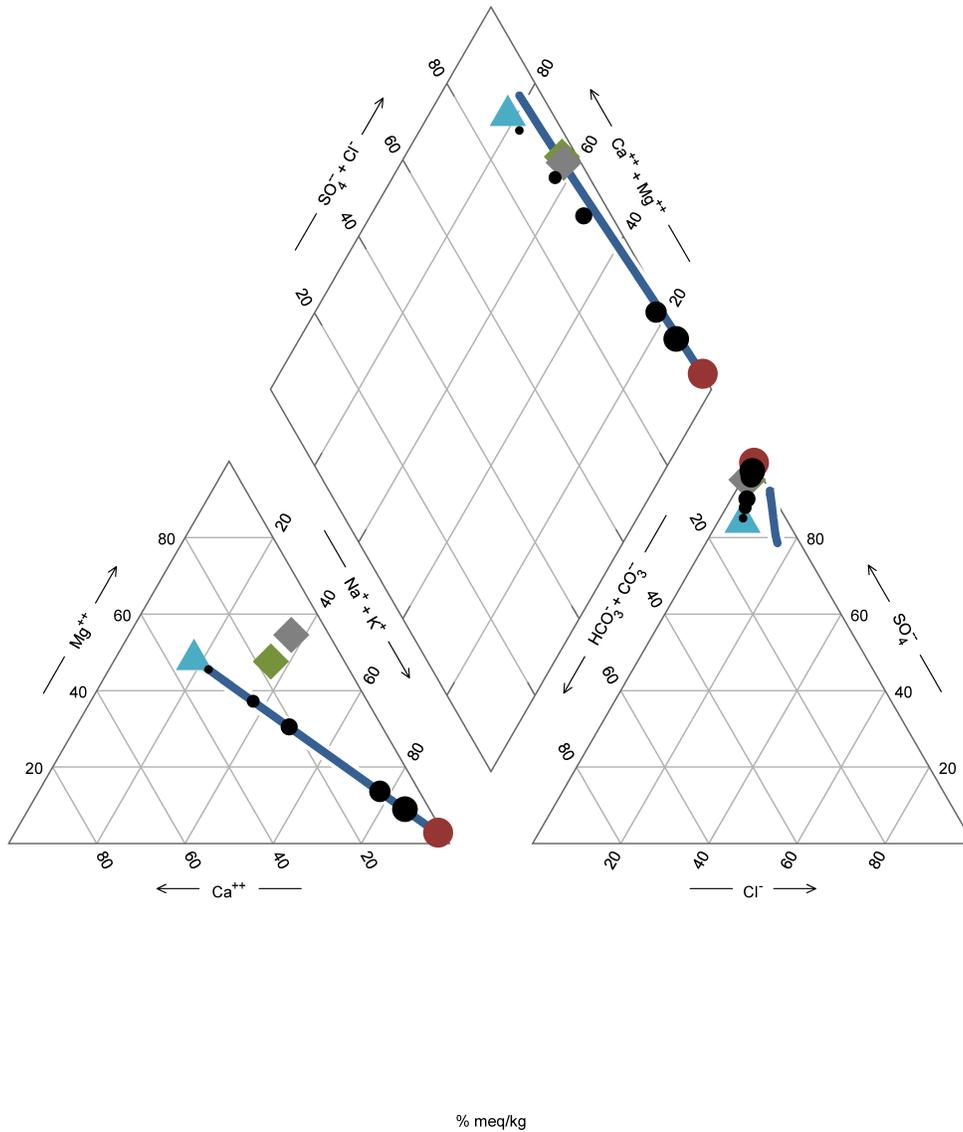


Figure E.1
 Piper Plot for Mixing
 Evaporation Pond into MW-13
 R.M. Heskett Station
 Alternative Source Demonstration
 April 2019 Event
 Montana Dakota Utilities
 Mandan, North Dakota



- ▲ MW103_2019
- Evap Pond
- 1 part MW-103 : 1 part Evap Pond
- 1 part MW-103 : 0.50 part Evap Pond
- 1 part MW-103 : 0.10 part Evap Pond
- 1 part MW-103 : 0.05 part Evap Pond
- 1 part MW-103 : 0.01 part Evap Pond
- ◆ MW1-90
- ◆ MW104_2019

Figure E.3
Piper Plot for Mixing
Evaporation Pond into MW-103
R.M. Heskett Station
Alternative Source Demonstration
April 2019 Event
Montana Dakota Utilities
Mandan, North Dakota

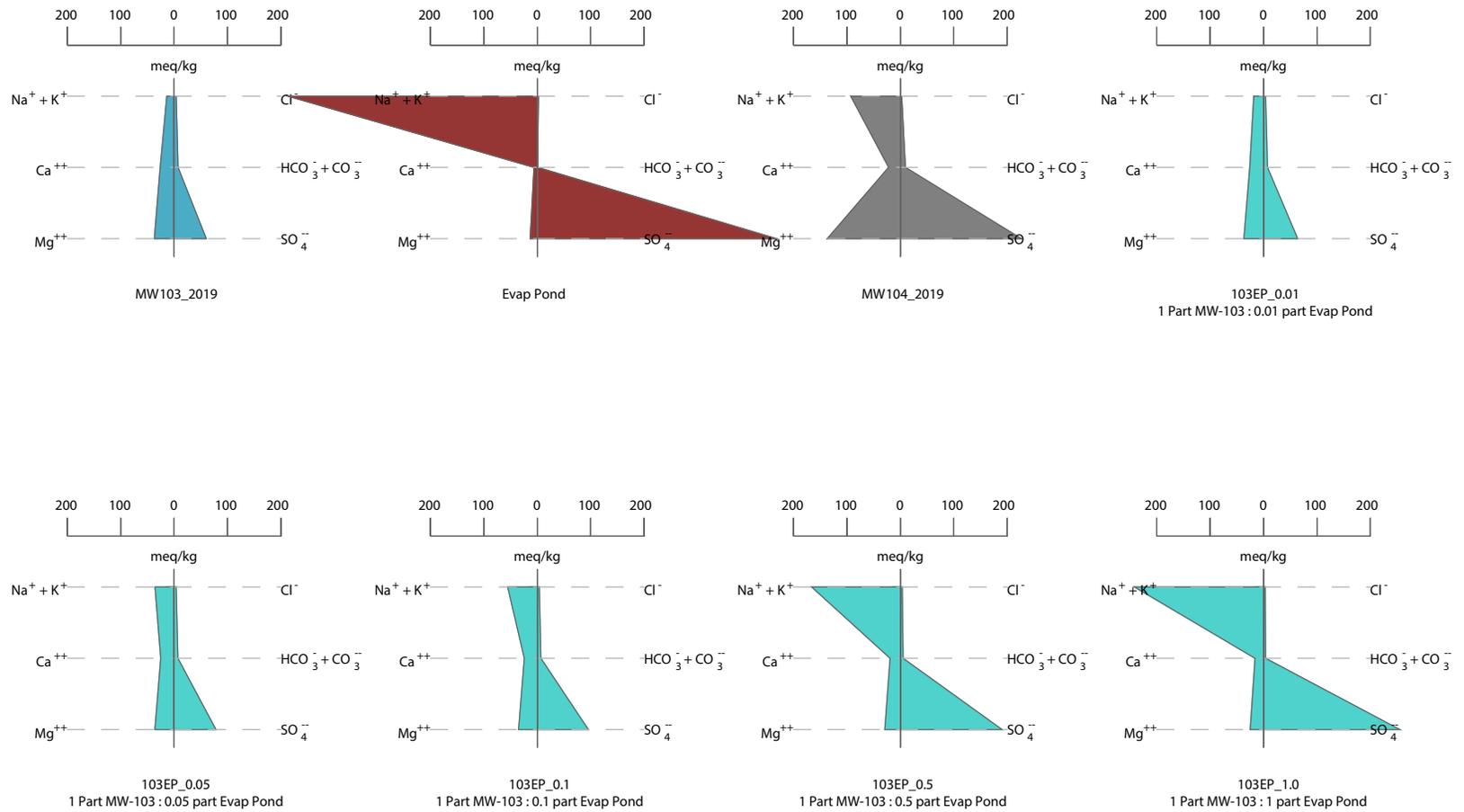


Figure E.4
Stiff Plot for Mixing
Evaporation Pond into MW-103
R.M. Heskett Station
Alternative Source Demonstration
April 2019 Event
Montana Dakota Utilities
Mandan, North Dakota

Table E.1
 Geochemist's Workbench Mixing Model Results

Description	Upgradient Wells		Evap Pond	Mixing Ratio MW-13 : Evaporation Pond					Mixing Ratio MW-103 : Evaporation Pond					Downgradient Wells	
	Sample ID	MW-13	MW103	Evap Pond	1 : 0.01	1 : 0.05	1 : 0.1	1 : 0.5	1 : 1	1 : 0.01	1 : 0.05	1 : 0.1	1 : 0.5	1 : 1	MW1-90
HCO3- mg/l	482	457	20	477.4	460	440	328	251	452.7	436.2	417.3	311.3	238.5	259	591
Ca++ mg/l	418	530	125	415.1	404	391.4	320.3	271.5	526	510.7	493.2	395	327.5	453	448
Cl- mg/l	109	142	79.8	108.7	107.6	106.3	99.28	94.42	141.4	139	136.3	121.3	110.9	57.4	87.6
F- mg/l	0.73	0.15	0.1	0.7237	0.7	0.6727	0.52	0.415	0.1495	0.1476	0.1455	0.1334	0.125	1.07	0.55
Mg++ mg/l	660	458	165	655.1	636.4	615	495	412.5	455.1	444.1	431.4	360.4	311.5	775	1700
pH SU	7.1	6.5	10.7	7.106	7.133	7.17	7.62	8.435	6.502	6.511	6.523	6.643	6.854	7.1	6.8
K+ mg/l	29.4	18.8	734	36.38	62.97	93.48	264.4	381.9	25.88	52.87	83.85	257.3	376.6	25.2	37
Na+ mg/l	2020	311	10600	2105	2429	2800	4882	6312	412.9	801.2	1247	3742	5458	1090	2160
SO4-- mg/l	6750	2930	22100	6902	7481	8146	11869.8	14429.8	3120	3843	4674	9323	12520	5350	11100
TDS mg/kg	10300	4860	34000	10537.2	11440.3	12476	18257.4	22214.5	5152	6265	7541	14660.2	19527.5	7910	17700

**Alternative Source Demonstration:
April 2020 Event**

R.M. Heskett Station

Prepared for
Montana-Dakota Utilities Co.

October 2020



Alternative Source Demonstration: April 2020 Event

R.M. Heskett Station

Prepared for
Montana-Dakota Utilities Co.

October 2020

Alternative Source Demonstration
April 2020 Event

October 2020

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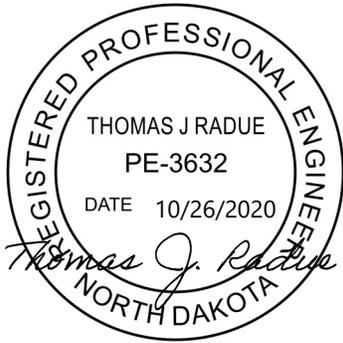
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Certifications

I hereby certify that I, or my agent, have examined this written demonstration and attest that this Coal Combustion Residuals Facility Alternative Source Demonstration (ASD) is accurate and has been prepared in accordance with good engineering practice, including consideration of applicable industry standards and the requirements of 40 CFR §257.94. I further certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of North Dakota.

Revision	Date	Summary of Revisions
0		Initial Alternative Source Demonstration



1.0 Introduction

Montana-Dakota Utilities Co. (MDU) owns and operates R.M. Heskett Station (Site), a coal-fired generating station and a gas-fired turbine located in Mandan, Morton County, North Dakota (Figure 1). One CCR (coal combustion residual) unit, as defined by 40 CFR 257.53, is located on the property. The CCR unit contains coal combustion by-products, asbestos wastes generated from construction activity associated with MDU-owned facilities, and ash derived from burning tire-derived fuel (TDF) at the facility.

The CCR Rule (US EPA, 2015) §257.94(e)(2) allows for an alternative source demonstration (ASD) in the event of an identified statistically significant increase (SSI) in a water quality parameter in a downgradient monitoring well over background levels:

The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report.

The purpose of this work is to evaluate the data collected as part of the April 2020 monitoring event, along with historical data, to demonstrate if the potential SSIs are the results of a “source other than the CCR unit” or due to natural variation in groundwater quality, an error in sampling, analysis, or statistical evaluation.

2.0 April 2020 SSIs

Sampling for the first detection monitoring event in 2020 was conducted March 30 through April 6. Three potential SSIs over background were identified: sulfate and total dissolved solids (TDS) at MW-104 and chloride at MW-105 (see time series plots in Appendix A and prediction limit plots in Appendix B).

Evaluations were undertaken to review potential alternative sources for the SSIs. These evaluations included comparing leaching tests of on-site CCR materials, leachate collected in the Evaporation Pond (non-CCR unit), regional (background) groundwater quality data, and groundwater quality collected at the site prior to construction of the CCR unit.

Several characteristics of the CCR unit site geology, groundwater monitoring well locations, and historic groundwater quality data prompted consideration of potential alternative sources for the potential SSIs, including elevated water quality parameters in pre-landfill groundwater monitoring data, site-specific geologic conditions, and/or leakage from the Evaporation Pond (non-CCR unit).

A successful demonstration of alternative source(s) for the potential SSIs are discussed in Section 3.0.

2.1 September Sampling Event

Methods used to evaluate potential alternative sources as the basis for water quality parameter concentrations over background from the April 2020 detection monitoring event are discussed below. Concentrations for potential SSIs observed in April 2020 are less than those observed during the prior four detection monitoring events (Table 1).

Table 1. Detection Monitoring Results for Potential SSI Well-Parameter Pairs

Well	Parameter	Interwell Prediction Limit (mg/L)	Detection Monitoring Results (mg/L)				
			April 2018	October 2018	April 2019	September 2019	April 2020
MW-105	Chloride	271	333	384	282	290	278
MW-104	Sulfate	7,300	10,700	11,000	11,100	11,300	10,300
MW-104	TDS	10,400	17,400	18,000	17,700	17,200	16,500

Bolded values indicate concentrations exceed the associated interwell prediction limits.

Trend analysis results indicate chloride at MW-105 has a statistically significant decreasing trend (95% confidence level) whereas TDS at MW-104 has a statistically significant increasing trend (95% confidence level).

2.2 Verification Sampling

No verification sampling was conducted on the potential SSIs.

3.0 Alternative Source Demonstration

Successful demonstrations of alternative sources have previously been documented for the three potential SSIs. The associated ASD Reports (Barr, 2018a; Barr, 2018b; Barr, 2019a; Barr, 2019b; Barr, 2020) documented that each of the SSIs could be explained by natural groundwater quality variability based on concentrations that were either present at the Site before the landfill was constructed, consistent with regional groundwater quality data, and/or associated with a release from the Evaporation Pond (non-CCR unit).

The purpose of this ASD Report is to validate the results of prior findings with the April 2020 data. For each potential SSI, three hypotheses regarding the potential source of the SSI are assessed: 1) a release of leachate from the CCR unit is the source of one or more of the potential SSIs; 2) natural variations of pre-landfill or regional groundwater quality is the source of one or more of the potential SSIs; or 3) a release of leachate from the Evaporation Pond (non-CCR unit) is the source of one or more of the potential SSIs.

3.1 Source Hypothesis #1: CCR Unit Release

To accept the hypothesis that a release of leachate from the CCR unit is the source of one or more of the potential SSIs, it would be assumed that groundwater chemistry at one or both of the potentially impacted wells (MW-104 and MW-105) would be geochemically similar to impacted water from the CCR unit represented by leach tests results. However, if they are geochemically dissimilar, this indicates that a source “other than the CCR unit” may be responsible for the potential SSI. Therefore, major ion chemistry from the CCR monitoring locations (upgradient and downgradient) was compared to CCR Synthetic Precipitation Leaching Procedure (SPLP; EPA Method 1312) data collected July 2011 (Appendix C).

In order to test this hypothesis, Piper diagrams were used to visually compare the CCR SPLP results (Appendix C) and the measured groundwater quality at the Site (Figure 2). Piper diagrams are plots of major ion chemistry of water samples (calcium, magnesium, potassium, sodium, chloride, sulfate, and alkalinity) that are used to differentiate between water types and to identify potential mixing of water types. This method is a means to identify or “fingerprint” water samples by their common characteristics (major ions) to assess which types of water are similar or dissimilar to potential source water types (Helsel and Hirsch, 2002). On the Piper diagram depicted in Figure 2, downgradient well compositions are shown as circular points, CCR SPLP compositions as red triangles, and the range of upgradient compositions as a blue polygon.

Downgradient water quality (including the potential SSI parameter-well pairs) is characterized as a Mg-SO₄ type water, whereas the ash SPLP results are Na-SO₄ type water. The major difference observed between the downgradient water quality and the SPLP results is the dominant cation concentration (magnesium vs. sodium). Because water quality data from SSI well-parameter pairs are clustered with data from that of the upgradient wells, which are Na-Mg-SO₄ to Mg-SO₄ type water, rather than near the SPLP results, it indicates that the water chemistry at those locations are more like upgradient groundwater than a potential release from the CCR unit. **Therefore, we reject the hypothesis that the CCR unit is the source of the sulfate and TDS observed at MW-104 and chloride at MW-105.**

3.2 Source Hypothesis #2: Natural Variations of Pre-Landfill or Regional Groundwater Quality

As Source Hypothesis #1 (CCR Unit Release) was rejected as a potential source of the SSIs, natural variations of pre-landfill conditions and/or regional groundwater quality were evaluated for each of the potential SSIs. The second hypothesis evaluated is that concentrations of sulfate and TDS at MW-104 and chloride at MW-105 are consistent with historical (pre-landfill) or regional (background) groundwater data. To test this hypothesis, results of April 2020 detection monitoring event were compared to pre-landfill data and/or regional groundwater quality data from the Cannonball Formation and associated units to determine if natural variation is a potential alternative source for the SSIs.

3.2.1 Chloride at MW-105

Results from groundwater samples collected in 1986 were included in the 1989 Special Use Disposal Site Permit Application (Permit Application; MDU, 1989). The 1986 samples were collected prior to construction of the CCR unit; an aerial photograph from March 30, 1988 shows the area of the CCR unit, which appears undisturbed (Appendix D).

Pre-landfill chloride concentrations collected from groundwater at the Site were measured as high as 558 mg/L (Well 44, 1986), indicating that high chloride concentrations pre-date construction of the CCR unit. Additionally, the North Dakota State Water Commission conducted a groundwater study in Morton County (Ackerman, 1980); 45 wells screened in the Cannonball and Ludlow Formations were sampled for various parameters including chloride. Chloride concentrations ranged from 0 to 500 mg/L (37% of which had concentrations greater than 250 mg/L).

Historic data shows that concentrations of chloride in groundwater at the Site measured prior to the construction of the CCR unit (558 mg/L) as well as regional groundwater quality data (0 to 500 mg/L) are consistent with and/or higher than chloride measured at MW-105 in April 2020 (278 mg/L). This supports the hypothesis that the SSI for chloride at MW-105 is due to a "source other than the CCR unit."

Therefore, we accept the hypothesis that chloride concentrations observed at MW-105 are consistent with regional (background) groundwater data.

3.2.2 Sulfate and TDS at MW-104

Analyses of groundwater samples collected prior to construction of the CCR unit included in the Permit Application notes that high sulfate and TDS was observed at the Site. Maximum sulfate and TDS concentrations reported in 1986 (pre-landfill) were 11,632 mg/L and 14,917 mg/L, respectively, in Well 60 (approximately 700 feet southwest of MW-104), with similar concentrations observed two years later. Sulfate concentrations reported in April 2020 at MW-104 (10,300 mg/L) are within range of historically observed concentrations (Figure 3), but TDS concentrations (16,500 mg/L) are somewhat higher than historically observed (Figure 4). Figures 3 and 4 show the range of sulfate and TDS concentrations, respectively, across the Site, including recent and historical monitoring well data.

The mineralogy of the underlying Fort Union Formation may yield an explanation for the elevated sulfate concentrations (which leads to elevated TDS concentrations). The dominant lithology observed at the Site

is unconsolidated silt in a clay matrix with interspersed fine to medium-grained sand (10% to 30%). Small gypsum crystals are documented discontinuously throughout the upper 30 feet of the surface materials, which have been presumed to be the result of diagenetic processes which occur above the water table during alternating wetting and drying cycles (Groenewold et al., 1983). Gypsum is a hydrated calcium sulfate mineral that can be a source of high sulfate concentrations in groundwater.

The boring log for MW-104 (Appendix E) notes gypsum present throughout the upper layer of the screened interval. Boring logs for other CCR wells and pre-landfill wells note gypsum occurrences across the Site (Appendix E). The water level and screened interval in MW-104 are within the gypsum-bearing unit. In other wells with lower sulfate and TDS concentrations, the water levels and/or screened units are below the documented gypsum occurrences. As groundwater fluctuates and surface water infiltration occurs, periodic dissolution of gypsum into the water column may occur, resulting in elevated sulfate concentrations (and therefore elevated TDS, too).

Based on presence of gypsum in native subsurface deposits and documentation of elevated sulfate and TDS in pre-landfill groundwater, the hypothesis that the SSI for sulfate and TDS at MW-104 may be due to natural conditions (a "source other than the CCR unit.") is possible. However, a statistically significant increasing trend for TDS at MW-104 was observed. Natural/background groundwater can be affected by seasonality and/or site-wide aquifer changes, resulting in trending data; two other monitoring wells at the site have statistically significant increasing trends at the site: upgradient well MW-13 and downgradient well MW2-90 (conversely, MW-13 has a long-term (late 1980s to present) statistically significant decreasing trend). Seasonality was not detected in TDS or sulfate at MW-104. **Sulfate and TDS concentrations at MW-104 may be due to natural conditions, however additional source considerations were evaluated.**

3.3 Source Hypothesis #3: Evaporation Pond Release

Two conditions are necessary in order to accept the hypothesis that a release of Evaporation Pond water is the source of one or more of the potential SSIs: (1) mechanism of release (such as an issue with Evaporation Pond liner integrity) and (2) geochemically similar groundwater chemistry at one or more of the potentially impacted wells with water from the Evaporation Pond. Based on proximity, only the SSIs observed at MW-104 (TDS and sulfate) are being evaluated for this potential source.

3.3.1 TDS and Sulfate at MW-104

A statistically significant increasing trend in TDS was observed at MW-104 following the April 2020 detection monitoring event. No other statistically significant trends were observed for other Appendix III parameters at this location. Past ASD Reports (Barr, 2019b and Barr, 2020) attributed elevated sulfate and TDS concentrations at MW-104 to either natural conditions or a release from the Evaporation Pond. MW-104 is located between the CCR unit and the Evaporation Pond (a non-CCR unit). The Evaporation Pond was constructed to collect surface water run-off from the Site as well as leachate from the CCR Unit. Due to the relative proximity of MW-104 to the Evaporation Pond, an evaluation was conducted to assess the Evaporation Pond liner integrity, potential impacts to downgradient wells, and determine the geochemical feasibility of Evaporation Pond water contributing to the conditions observed at MW-104.

Liner Integrity Evaluation

In the 2010 Annual Report for the Special Waste Disposal Permit (SP-087), it was noted that erosion was encountered at the Evaporation Pond. More specifically, “cuts in the banks of the pond ranged from 8 to 24-inches. Erosion was caused from storm water running into the evaporation pond from closed Slots and the haul road” (MDU, 2011). No repairs were made at that time due to standing water in the pond. Similar erosional features were noted in the 2011 and 2012 Annual Reports, citing erosion cuts of 8 to 48-inches (MDU, 2012 and MDU, 2013). These erosion cuts were repaired in 2013 during the construction of Slot 10. Additionally, the 2013 Annual Report stated that “the west wall of the evaporation pond was raised and graded to reroute storm water that accumulates outside of the ash disposal area from the cover of Phase I ash disposal site away from the pond during rain events” (MDU, 2014).

These reports did not specify if the erosional cuts were 8 to 48-inches wide or 8 to 48-inches deep. Based on the Phase I Development “as-constructed” Plan Sheets (January and November 1990), the Evaporation Pond was built with a 3-foot-thick compacted clay liner (MDU, 1989 Exhibit 6-B). If the erosional cuts were up to 48-inches deep, then the cuts would extend through the entirety of the liner thickness, creating a conduit for Evaporation Pond water to enter the groundwater. Additionally, no details were provided on the materials used for repairing the Evaporation Pond (i.e. if the liner was impacted, were the erosion cuts filled in with a comparable clay liner material).

Additionally, the integrity of the Evaporation Pond liner may have been compromised due to cation exchange. Time series plots of groundwater quality at nearby well MW1-90 (Appendix F) show an increase in sodium; this increase is most apparent at MW1-90 between 2012 and 2019. The Evaporation Pond liner may be composed of a clay with sodium as its main interlayer cation (e.g., sodium-montmorillonite and/or sodium-bentonite, which are common in the area (Groenewold et al., 1983)), and cation exchange processes can occur between the sodium in the clay and positively charged cations concentrated in the evaporation pond water (calcium, magnesium, potassium, and aluminum), increasing the concentration of dissolved sodium as it is released from the clay structure. Over time this exchange may decrease swelling potential and increase hydraulic conductivity of the clay constituting the pond liner, resulting in increased leakage of Evaporation Pond water.

Downgradient Impacts

The base of the Evaporation Pond sits at approximately 1675 feet above MSL whereas the most recent groundwater elevations in MW-104 and MW1-90 were measured at roughly 1672 feet above MSL and 1665 feet above MSL, respectively. Therefore, any water leaking from the Evaporation Pond would report radially downward into the groundwater, toward both MW-104 and MW1-90, reaching both wells downgradient of the Pond.

As MW-104 was installed on August 20, 2015, it is not possible to determine if the erosional cuts observed in the early 2010s impacted the water quality at this location. However, data has consistently been collected from nearby well MW1-90, also downgradient of the Evaporation Pond. As seen in the time series plots (Appendix F; 1990-2020), in approximately 2010 concentrations of chloride, sulfate, TDS, magnesium, sodium, and specific conductance at MW1-90 began increasing more rapidly. To a lesser

extent, changes in concentrations were observed around this same time for potassium, nitrogen, and total alkalinity. This timing corresponds to when the erosional cuts at the Evaporation Pond were first observed in the Annual Monitoring Reports. The increasing trends have since continued, despite reports of the erosional cuts being repaired in 2013, except for chloride, which has since leveled off and is now decreasing.

Geochemical Feasibility

A simple mixing model was developed in April 2019 (Barr, 2019b) to determine the potential of producing a similar water quality observed at MW-104 (and MW1-90, as a historical analogue) when mixing Evaporation Pond water with unimpacted upgradient water. This mixing model was conducted in Geochemist's Workbench® v.12.0, using a water sample collected from the Evaporation Pond in September 2014 and a water sample from upgradient monitoring well MW-103 in April 2019. The mixing model assumes a starting concentration equal to the upgradient groundwater concentrations and then iteratively mixes it with incremental amounts of Evaporation Pond water.

The results of the April 2019 model are provided in Appendix G. Figure G.1 shows the results of the mixing model on a stiff diagram for MW-103. Downgradient wells MW-104 and MW1-90 are shown as gray and green diamonds, respectively. The blue line represents the various possible outcomes when mixing the upgradient water quality with the Evaporation Pond. The black circles (G.3) represent specific proportions (1-part upgradient water to 0.01-, 0.05-, 0.1-, 0.5-, and 1-part Evaporation Pond water). Figure G.2 shows the results as Stiff plots. Table E.1 provides the numerical inputs and results of the various mixing proportions.

As shown on Figure G.1, the downgradient well compositions are similar to the chemistry anticipated if the Evaporation Pond is mixing with upgradient groundwater emanating from the proximity of monitoring well MW-103. The path of the mixing reaction from MW-103 to the Evaporation Pond transects MW-104 when 1-part upgradient (MW-103) water is mixed with as little as 0.05-part Evaporation Pond water. Therefore, it appears plausible that a relatively small portion of Evaporation Pond water would be needed to "impact" upgradient groundwater to get a similar chemistry as observed in MW-104. The geometry of the Stiff plots in Figure G.2 show the similarity in anionic concentrations and calcium in the mixing models.

Based on the description of erosional features extending upwards of 48 inches in the liner of the Evaporation Pond in 2010-2013 corresponding with the increased concentrations of several parameters observed in downgradient monitoring well MW1-90, it is possible that a release from the Evaporation Pond occurred starting in approximately 2011. Furthermore, the results of the geochemical model along with the general proximity and hydraulic position of MW-104 relative to the Evaporation Pond supports the hypothesis that the SSI for TDS and sulfate at MW-104 is due to a "source other than the CCR unit." **Therefore, we accept the hypothesis that TDS and sulfate concentrations observed at MW-104 are consistent with a potential release from the Evaporation Pond, a non CCR unit.**

4.0 Conclusions

Three SSIs were identified from the April 2020 detection monitoring event. This report demonstrates that a “source other than the CCR unit” caused the potential SSIs (natural variation in regional and/or pre-landfill groundwater quality and the Evaporation Pond), as allowed by §257.94(e)(2). The results of this alternative source demonstration are summarized in the table below.

Table 3. Summary of SSIs and Alternative Sources

Well	Parameter	Report Section	Evidence for Alternative Source
MW-105	Chloride	3.2.1	Natural variability (pre-landfill values and geologic background)
MW-104	Sulfate	3.2.2, 3.3.1	Natural variability and/or Other (Evaporation Pond, a non CCR unit)
MW-104	Total Dissolved Solids	3.2.2, 3.3.1	Natural Variability and/or Other (Evaporation Pond, a non CCR unit)

Based on the foregoing, the alternative source demonstration presented herein meets the requirements of CCR Rule §257.94(e)(2). As coal unit operations will cease around March 2022, MDU will work with the North Dakota Department of Environmental Quality (NDDEQ) on closure options for the Evaporation Pond as it is regulated under a permit through the NDDEQ.

5.0 References

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Figures



- Monitoring Well Location
- Monitoring Well Location - Water Level Only
- Existing Slot Boundaries
- Streams
- Property Line
- 10ft Contours
- 2ft Contours
- Active Portion of Landfill

Image Source: 2019 Statewide Imagery (ND GIS Hub)

CAD Data Source: Slot Linework.dwg



Figure 1

**SITE LAYOUT AND CCR
MONITORING WELL NETWORK**
R. M. Heskett Station
Alternative Source Demonstration:
April 2020 Event
Montana Dakota Utilities
Mandan, North Dakota

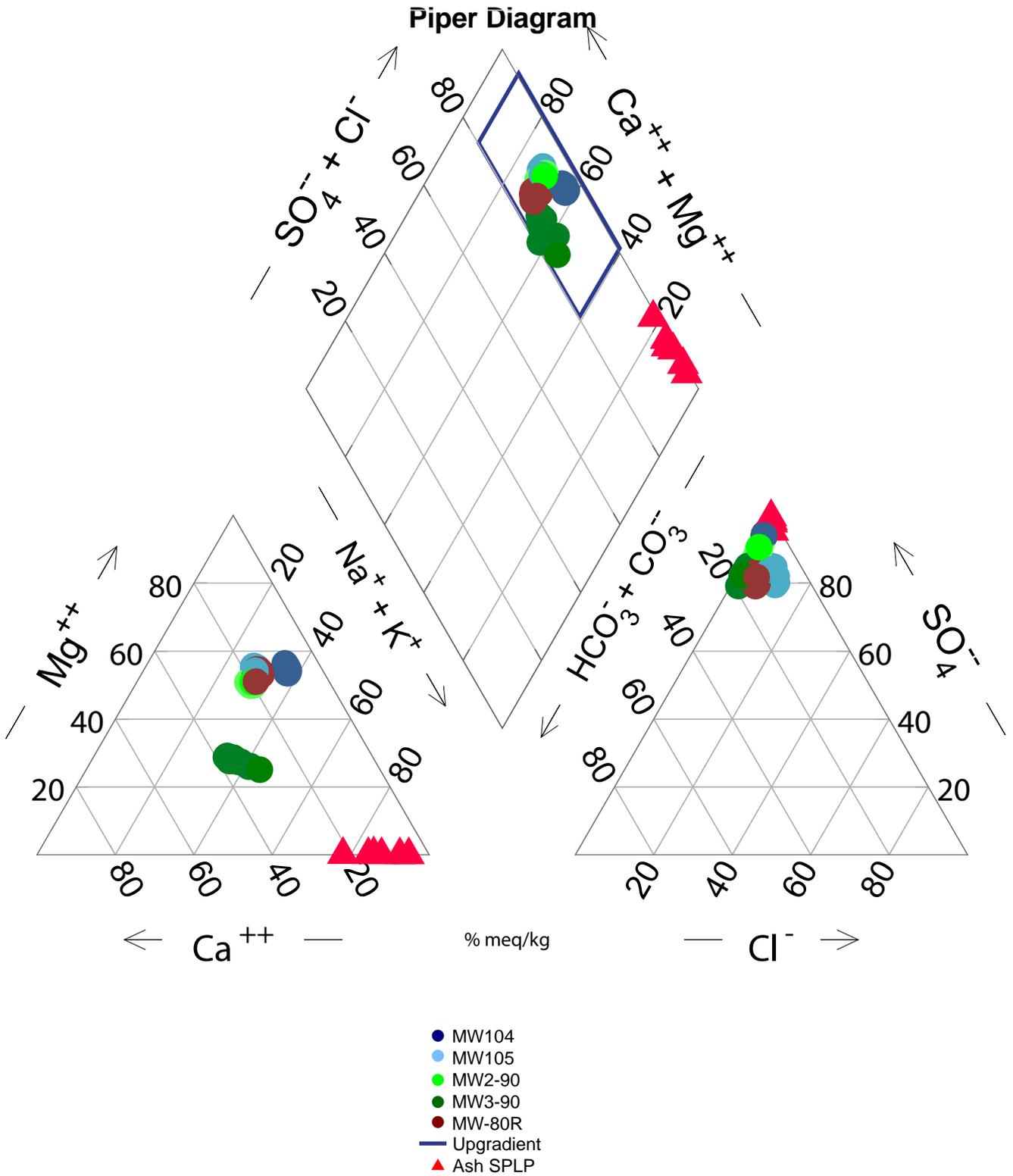
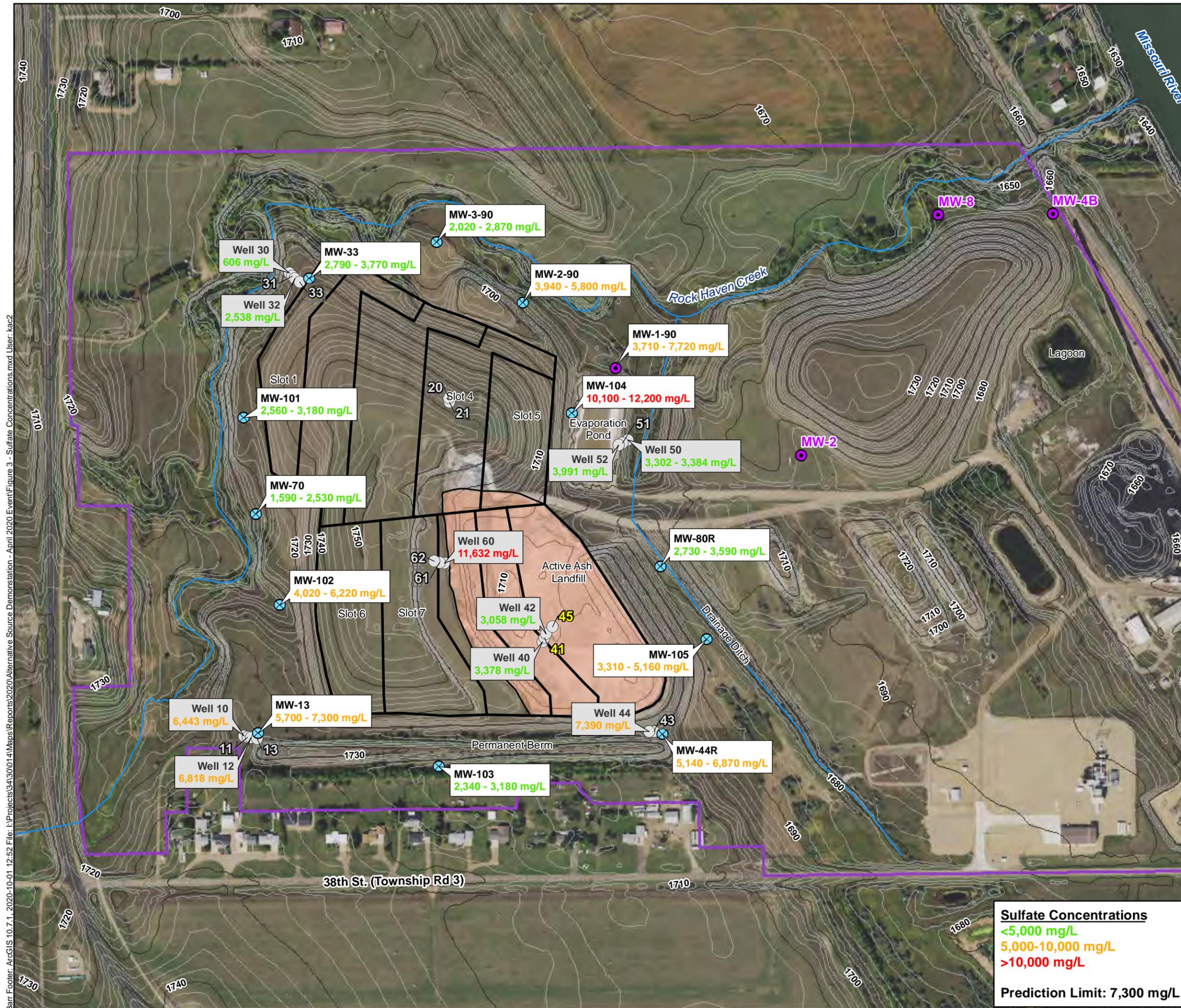


Figure 2
PIPER PLOT
R.M. Heskett Station
Alternative Source Demonstration
April 2020 Event
Montana Dakota Utilities
Mandan, North Dakota



Barr Footer: ArcGIS 10.7.1, 2020-10-01 12:52 File: I:\Projects\24\30014\Maps\Reports\2020\Alternative Source Demonstration - April 2020 Event\Figure 3 - Sulfate Concentrations.mxd User: kac2



- Monitoring Well Location
- Monitoring Well Location - Water Level Only
- Pre-Landfill Wells
- Existing Slot Boundaries
- Streams
- Property Line
- 10ft Contours
- 2ft Contours
- Active Portion of Landfill

Image Source: 2018 Statewide Imagery (ND GIS Hub)

CAD Data Source: Slot Linework.dwg
 Pre-Landfill well concentrations are from 9/11/1986, 11/21/1986 (MDU, 1989), and CCR Rule monitoring well concentrations are from 2016-2019.

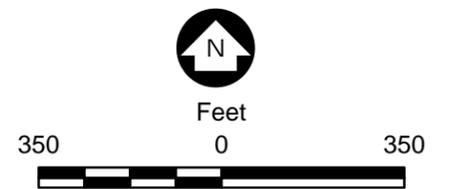
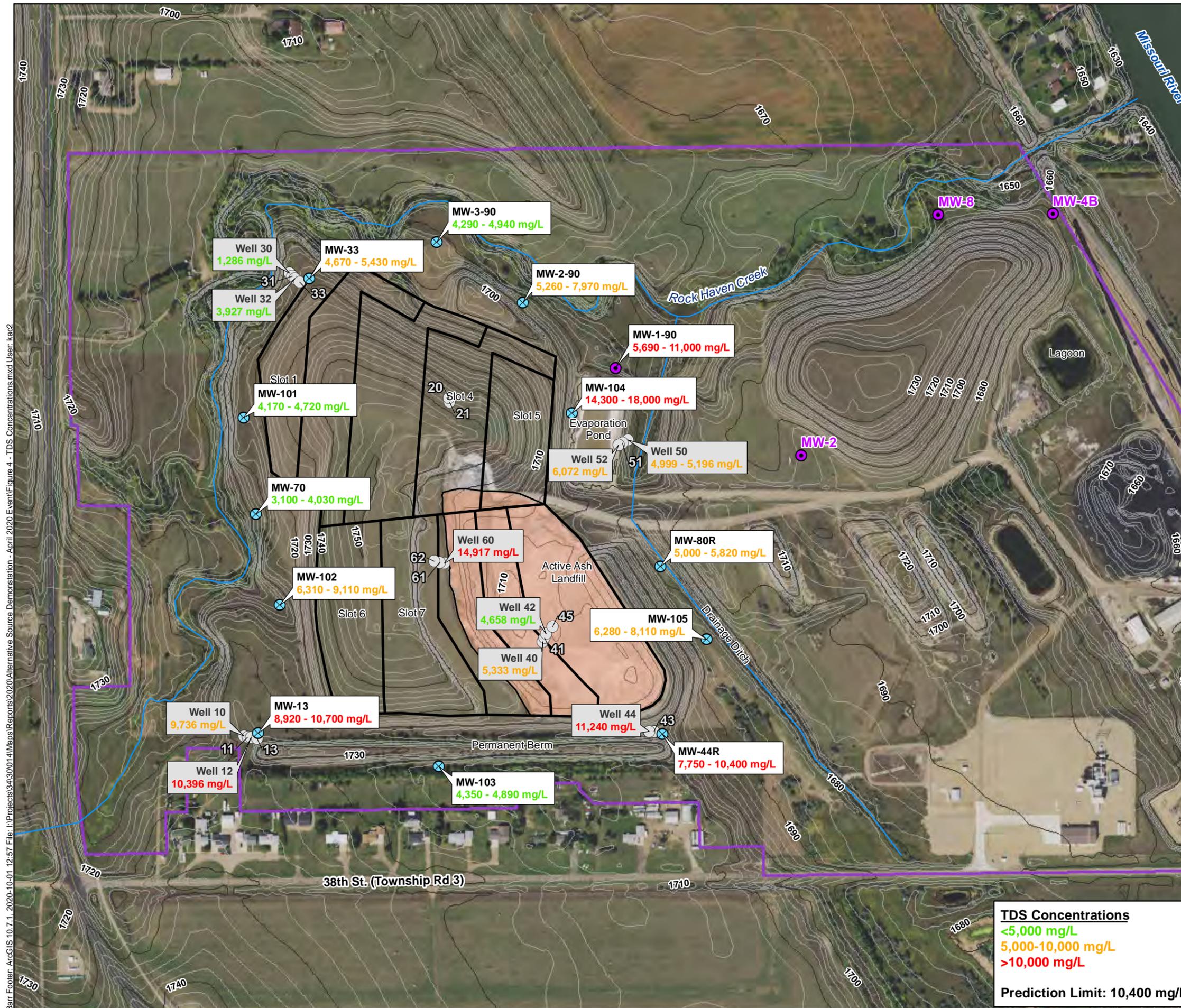


Figure 3

SULFATE CONCENTRATIONS
 R. M. Heskett Station
 Alternative Source Demonstration:
 April 2020 Event
 Montana Dakota Utilities
 Mandan, North Dakota



- Monitoring Well Location
- Monitoring Well Location - Water Level Only
- Pre-Landfill Wells (Approximate)
- Existing Slot Boundaries
- Streams
- Property Line
- 10ft Contours
- 2ft Contours
- Active Portion of Landfill

Image Source: 2018 Statewide Imagery (ND GIS Hub)

CAD Data Source: Slot Linework.dwg
 Pre-Landfill well concentrations are from 9/11/1986, 11/21/1986 (MDU, 1989), and CCR Rule monitoring well concentrations are from 2016-2019.

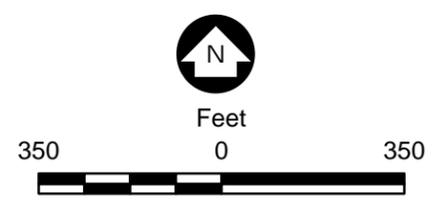


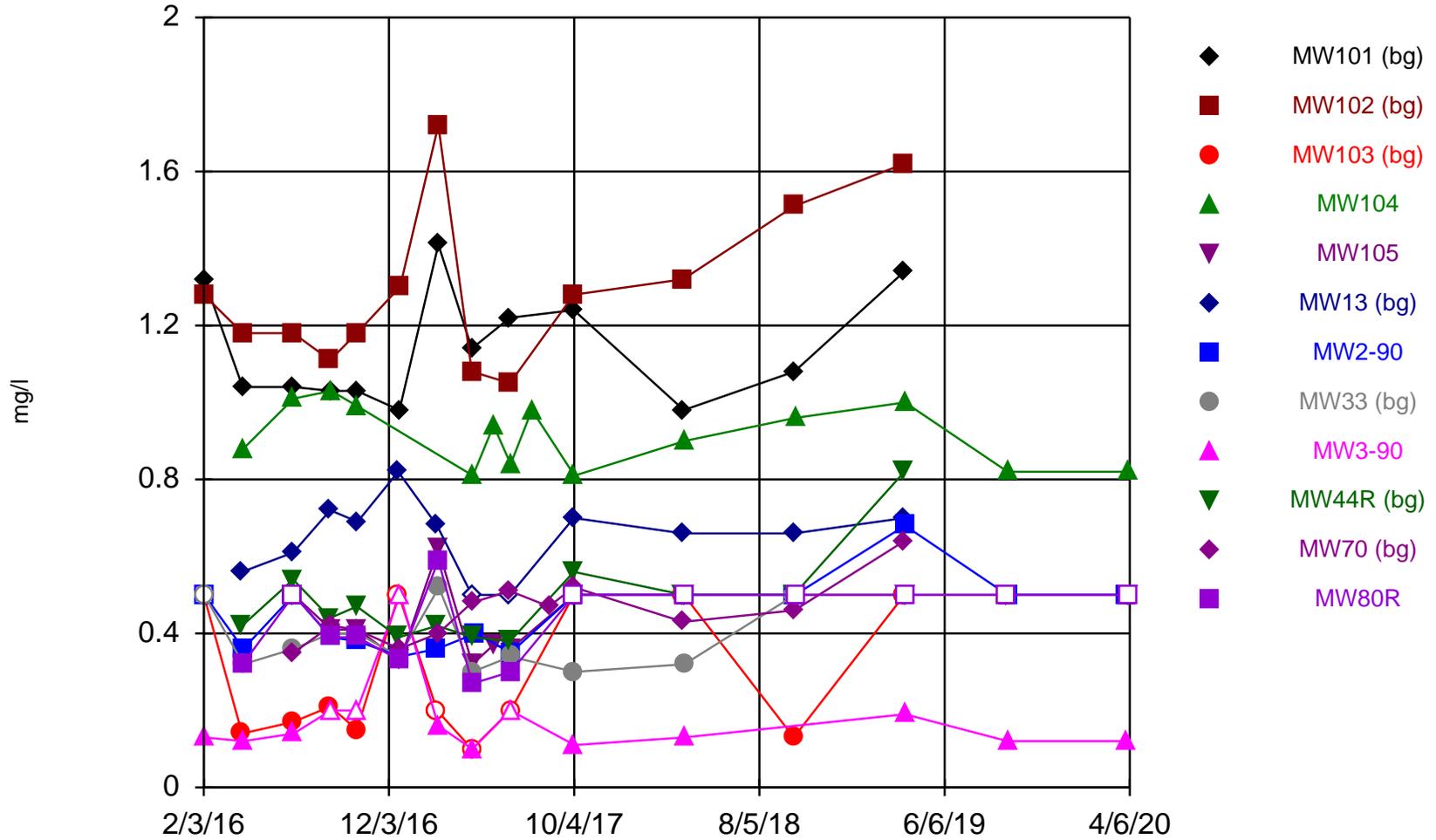
Figure 4

TDS CONCENTRATIONS
 R. M. Heskett Station
 Alternative Source Demonstration:
 April 2020 Event
 Montana Dakota Utilities
 Mandan, North Dakota

Appendix A

Appendix III Time Series Plots

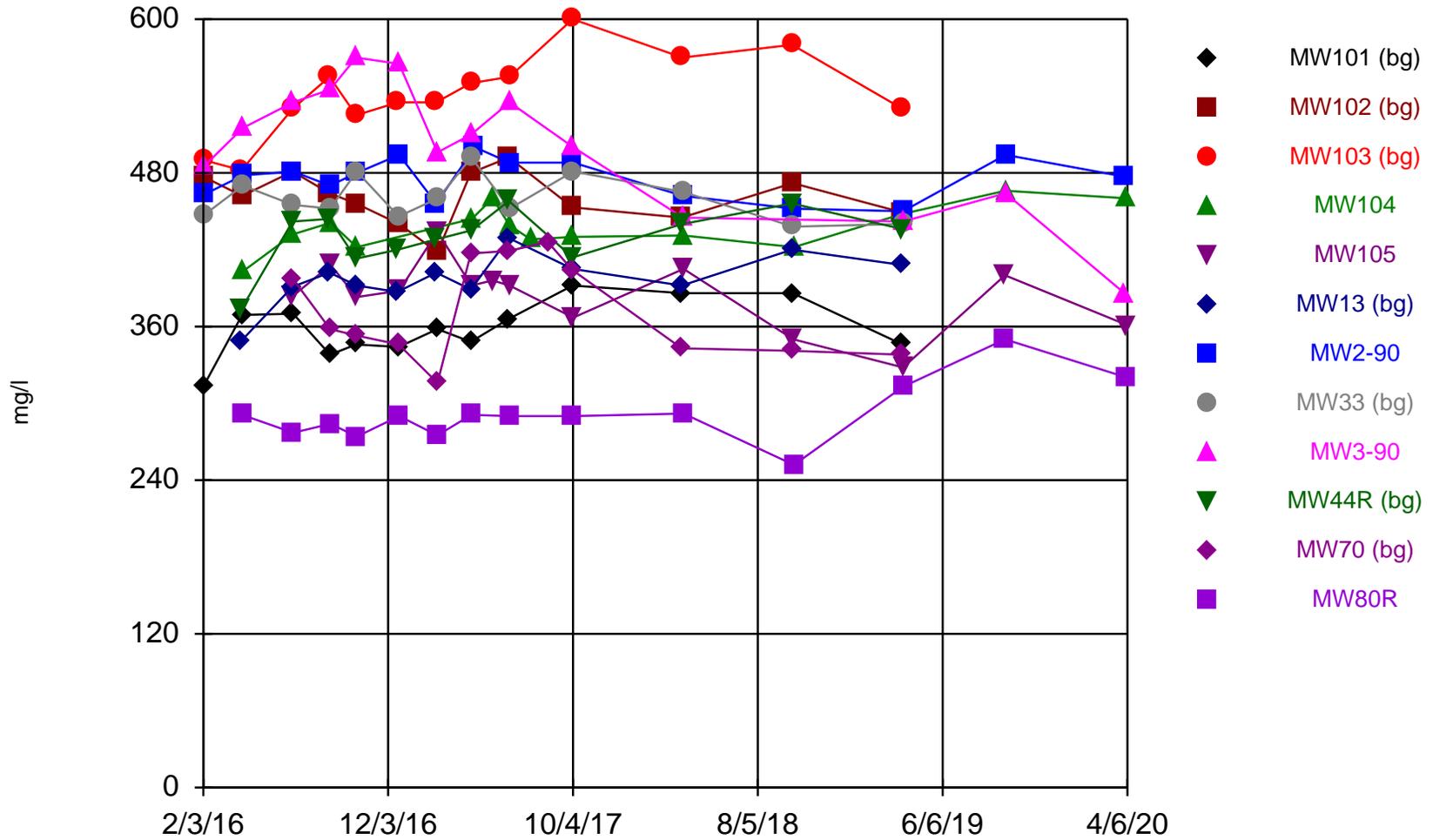
Time Series



Constituent: Boron, Total Analysis Run 10/8/2020 9:52 PM

R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII

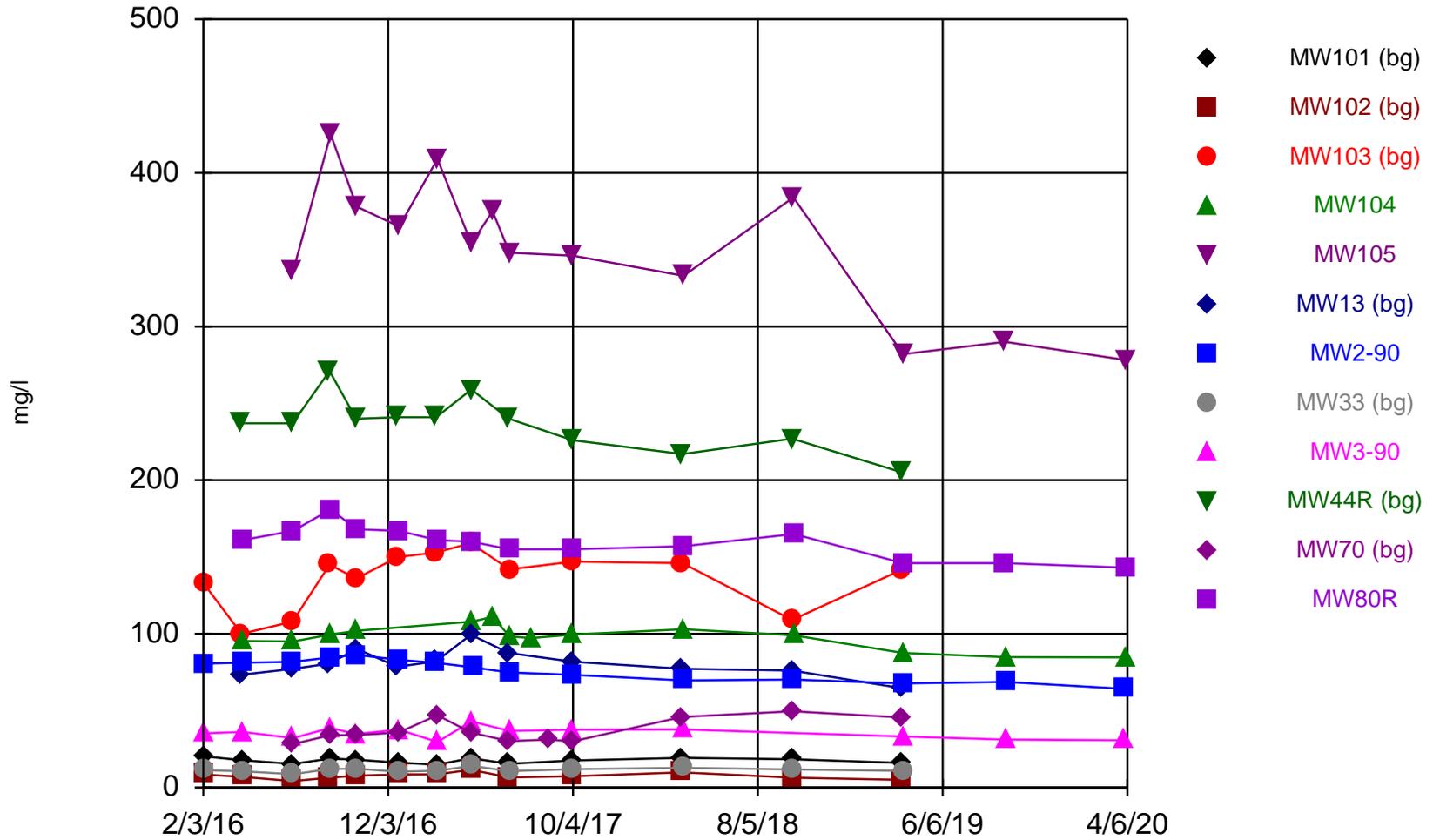
Time Series



Constituent: Calcium, Total Analysis Run 10/8/2020 9:52 PM

R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII

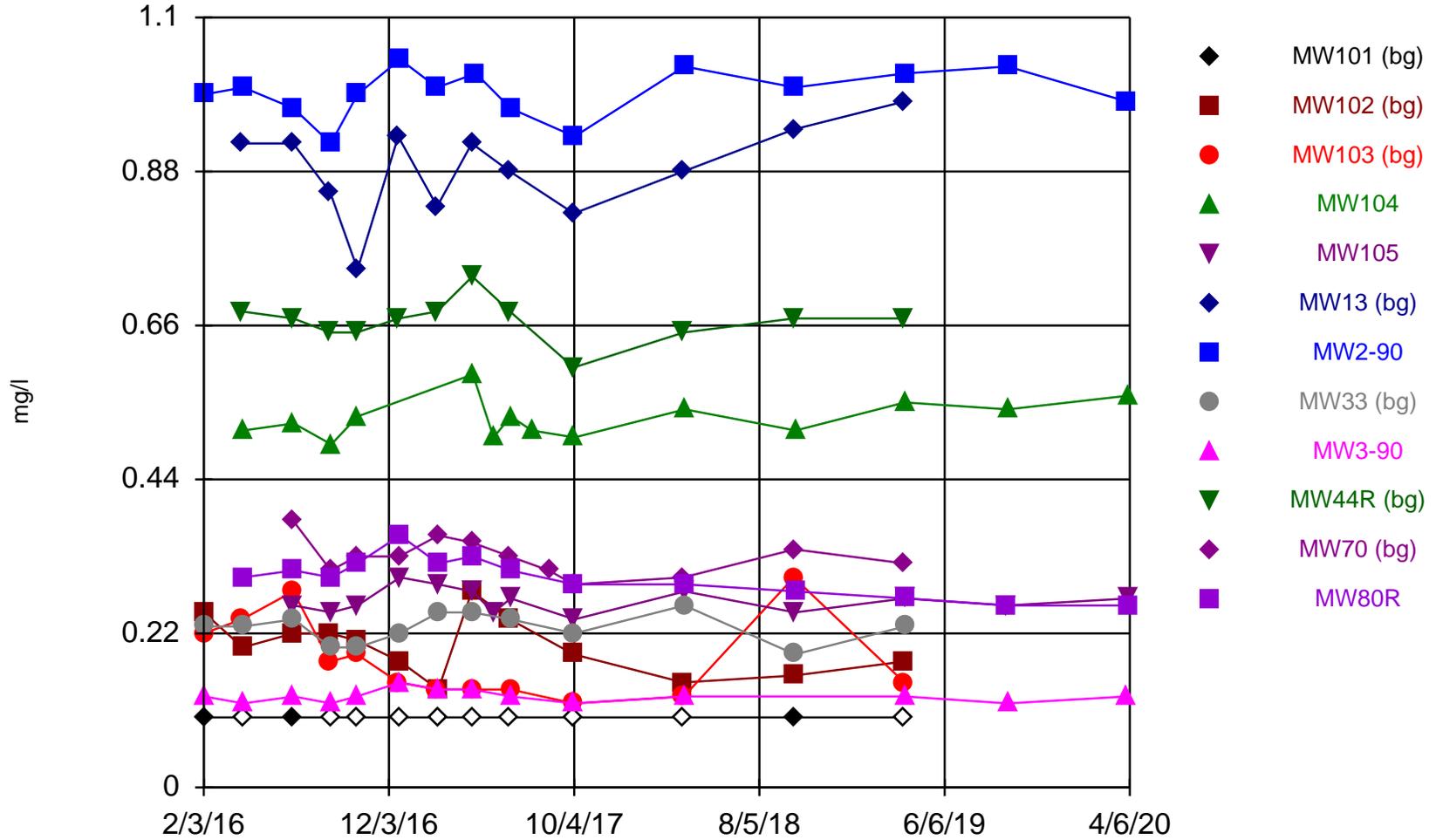
Time Series



Constituent: Chloride Analysis Run 10/8/2020 9:52 PM

R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII

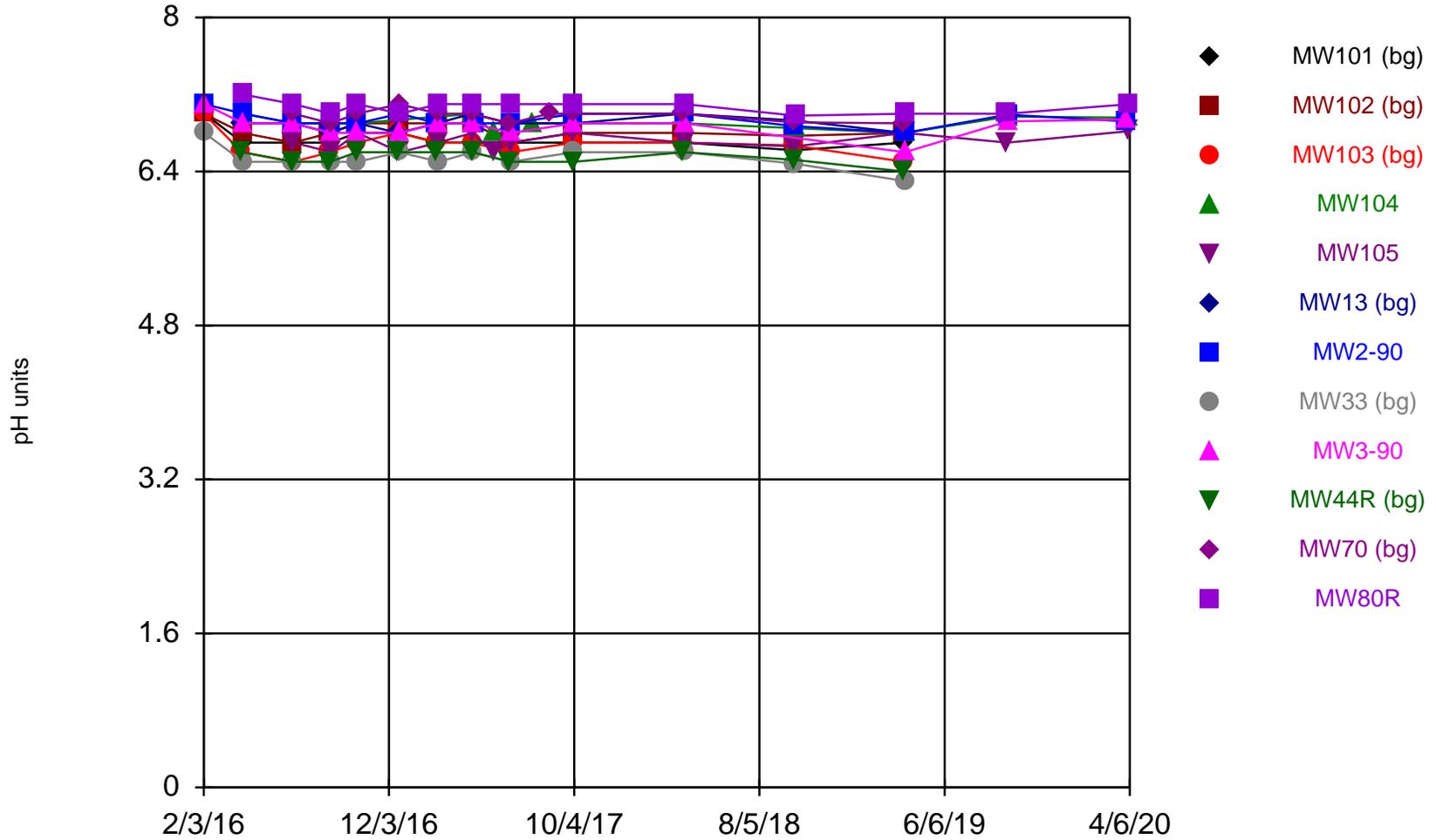
Time Series



Constituent: Fluoride Analysis Run 10/8/2020 9:52 PM

R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII

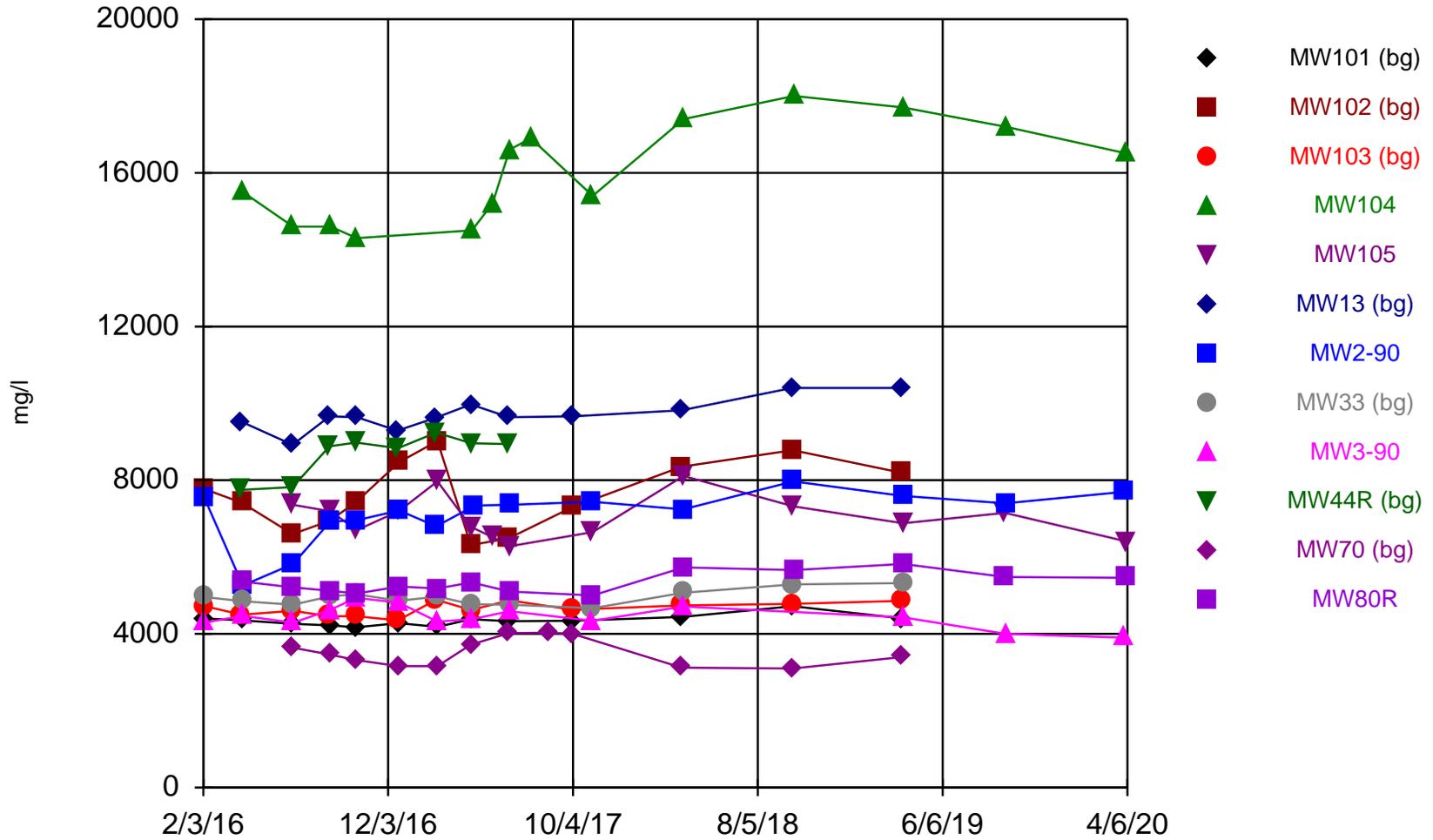
Time Series



Constituent: pH, Field Analysis Run 10/8/2020 9:52 PM

R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII

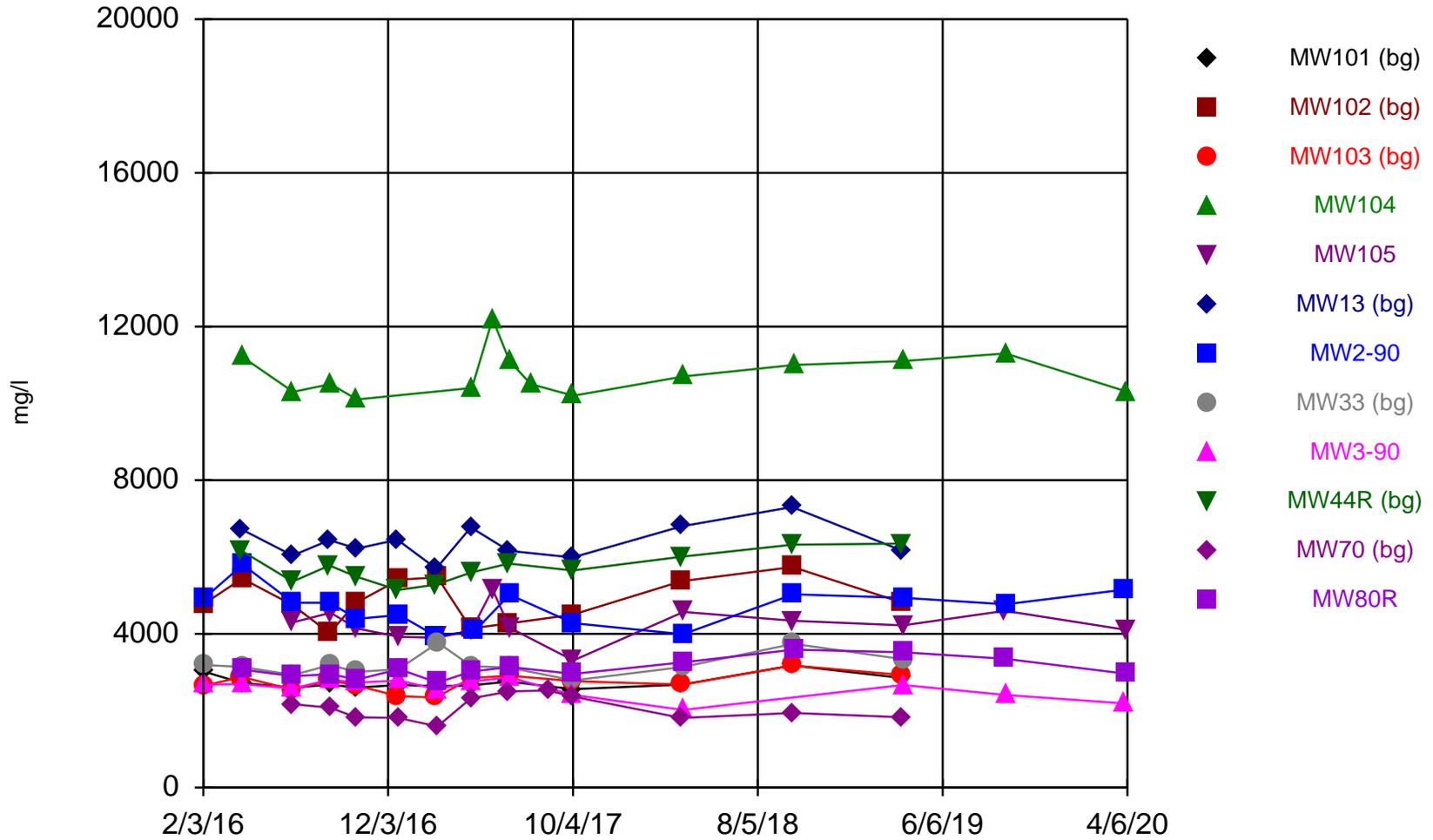
Time Series



Constituent: Solids, total dissolved Analysis Run 10/8/2020 9:52 PM

R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII

Time Series



Constituent: Sulfate, as SO4 Analysis Run 10/8/2020 9:52 PM

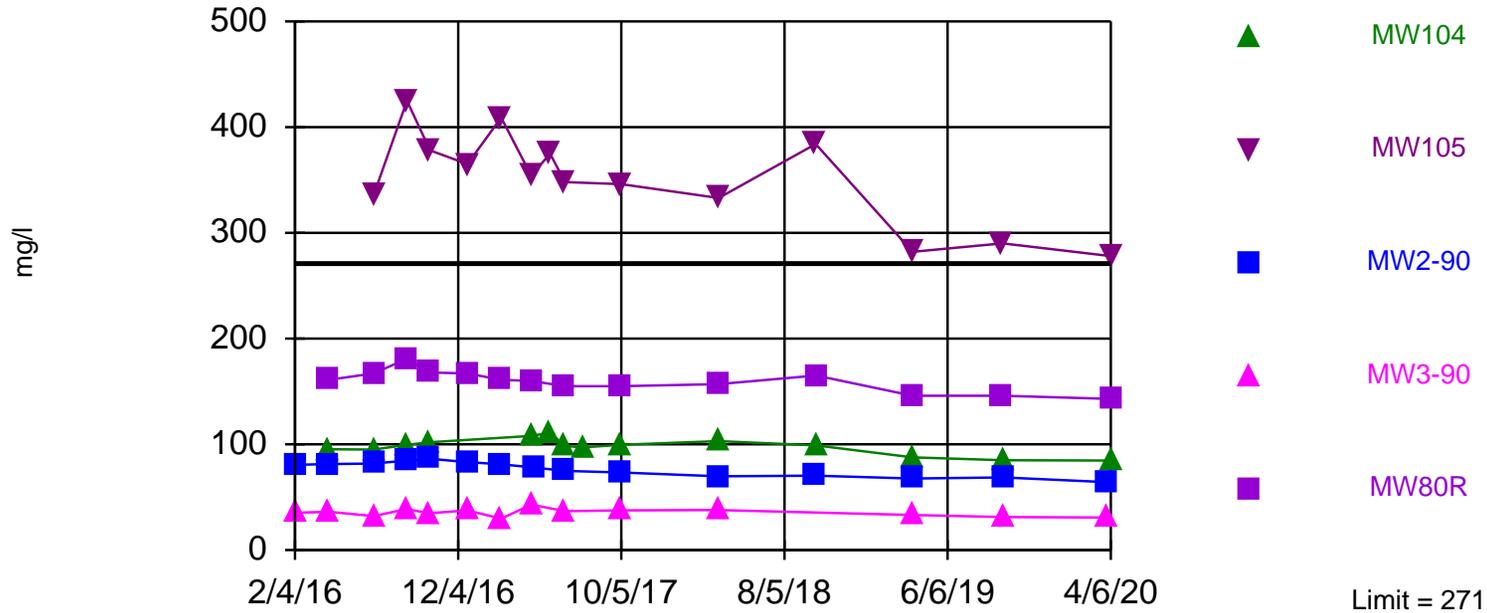
R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII

Appendix B

April 2020 Prediction Limit Plots

Exceeds Limit: MW105

Prediction Limit Interwell Non-parametric



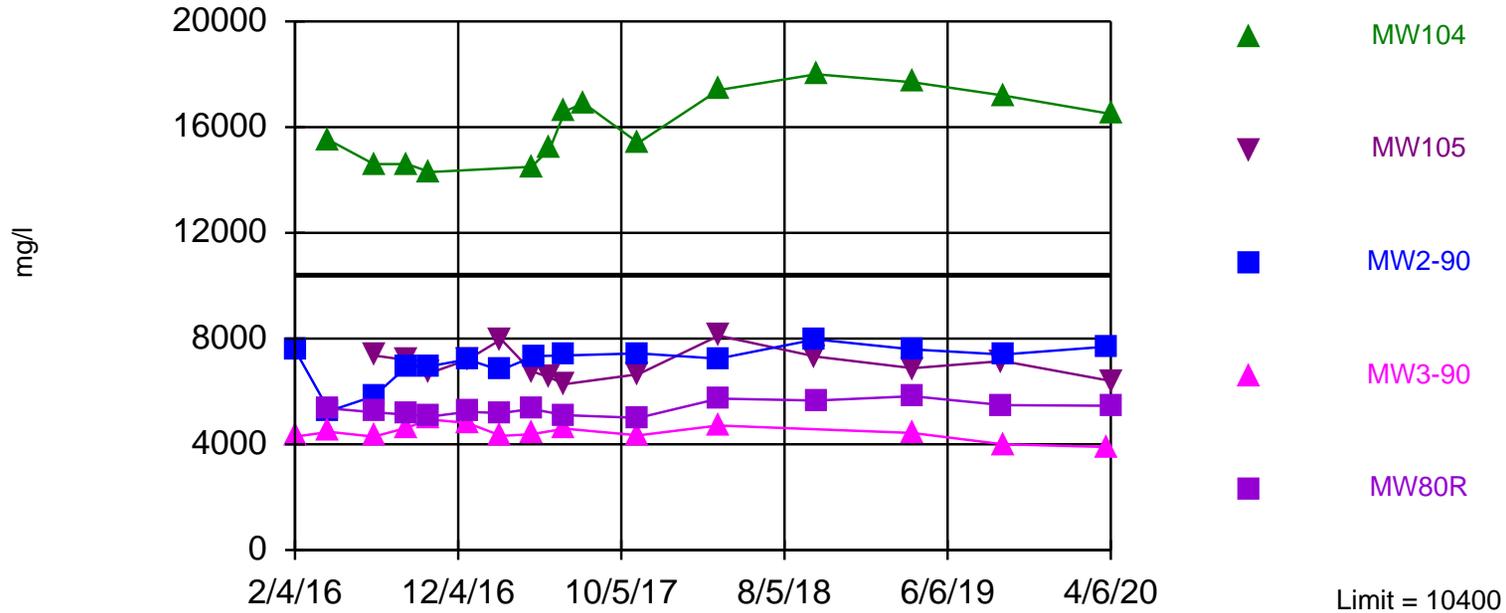
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Francia normality test showed the data to be non-normal at the 0.05 alpha level. Limit is highest of 88 background values. Annual per-constituent alpha = 0.002497. Individual comparison alpha = 0.00025 (1 of 2). Comparing 5 points to limit. Seasonality was not detected with 95% confidence.

Constituent: Chloride Analysis Run 10/8/2020 9:54 PM

R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII

Exceeds Limit: MW104

Prediction Limit Interwell Non-parametric



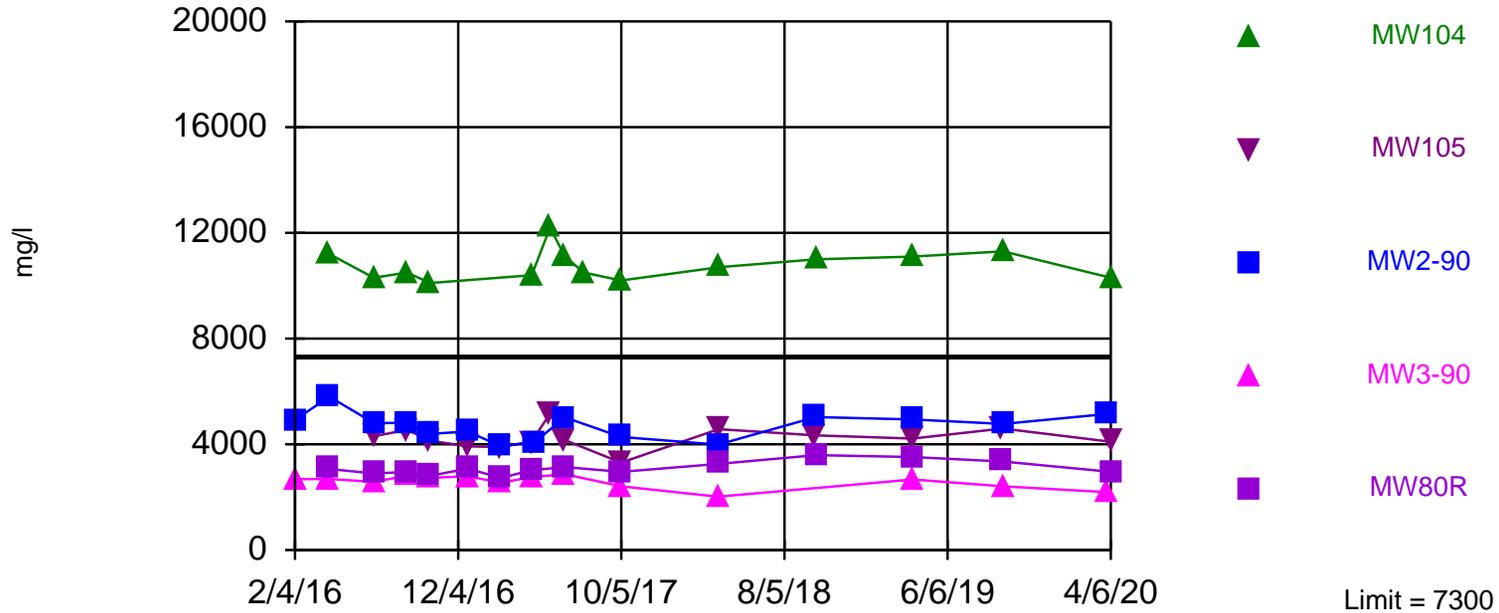
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Francia normality test showed the data to be non-normal at the 0.05 alpha level. Limit is highest of 84 background values. Annual per-constituent alpha = 0.002742. Individual comparison alpha = 0.0002746 (1 of 2). Comparing 5 points to limit. Seasonality was not detected with 95% confidence.

Constituent: Solids, total dissolved Analysis Run 10/8/2020 9:55 PM

R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII

Exceeds Limit: MW104

Prediction Limit Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Francia normality test showed the data to be non-normal at the 0.05 alpha level. Limit is highest of 88 background values. Annual per-constituent alpha = 0.002497. Individual comparison alpha = 0.00025 (1 of 2). Comparing 5 points to limit. Seasonality was not detected with 95% confidence.

Constituent: Sulfate, as SO4 Analysis Run 10/8/2020 9:55 PM

R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII

Appendix C

Ash SPLP Laboratory Report (2011)



MINNESOTA VALLEY TESTING LABORATORIES, INC.

1126 North Front St. ~ New Ulm, MN 56073 ~ 800-782-3557 ~ Fax 507-359-2890
 2616 East Broadway Ave. ~ Bismarck, ND 58501 ~ 800-279-6885 ~ Fax 701-258-9724
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 www.mvttl.com



Page: 1 of 2

Duane Leingang
 Montana Dakota Utilities
 PO Box 40
 Mandan ND 58554

Report Date: 8 Sep 11
 Lab Number: 11-M2450
 Work Order #: 81-818
 Account #: 013479
 Date Sampled:
 Date Received: 28 Jun 11 9:00
 PO #: 131460 OP

Sample Description: Unit I Bottom Ash
 Sample Site: MDU Heskett

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
SPLP Extraction				1312	22 Jul 11	SS
pH	12.2	units	N/A	SM4500 H+ B	22 Jul 11 17:00	Claudette
Specific Conductance	8778	umhos/cm	N/A	SM2510-B	22 Jul 11 17:00	Claudette
Total Suspended Solids	3	mg/l	1	SM2540-D	22 Jul 11 14:00	CLB
Total Alkalinity	1120	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Phenolphthalein Alk	1090	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Bicarbonate	< 4	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Carbonate	60	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Hydroxide	1060	mg/l CaCO3	0	SM2320-B	22 Jul 11 17:00	Claudette
Tot Dis Solids (Summation)	4860	mg/l	NA	SM1030-F	3 Aug 11 8:40	Calculated
Total Hardness as CaCO3	524	mg/l	NA	SM2340-B	3 Aug 11 8:40	Calculated
Hardness in grains/gallon	30.7	gr/gal	NA	SM2340-B	3 Aug 11 8:40	Calculated
Cation Summation	74.3	meq/L	NA	SM1030-F	3 Aug 11 8:40	Calculated
Anion Summation	74.6	meq/L	NA	SM1030-F	28 Jul 11 14:30	Calculated
Percent Error	-0.24	%	NA	SM1030-F	3 Aug 11 8:40	Calculated
Sodium Adsorption Ratio	27.1		NA	USDA 20b	3 Aug 11 8:40	Calculated
Gross Alpha Radiation	Attached	pCi/l			22 Aug 11 2:03	
Radon 222	Attached				28 Jul 11 4:37	
Radium 226	Attached	pCi/l			22 Aug 11 22:20	
Radium 228	Attached	pCi/l			16 Aug 11 16:50	
Total Organic Carbon	0.7	mg/l	0.5	SM5310-C	1 Aug 11 8:00	Eric
Fluoride	< 0.1	mg/l	0.10	SM4500-F-C	4 Aug 11 17:00	CLB
Sulfate	2440	mg/l	5.00	ASTM D516-02	27 Jul 11 9:00	KMP
Chloride	50.5	mg/l	1.0	SM4500-Cl-E	27 Jul 11 14:00	KMP
Nitrate-Nitrite as N	0.21	mg/l	0.10	EPA 353.2	28 Jul 11 14:30	KMP
Ammonia-Nitrogen as N	0.32	mg/l	0.10	EPA 350.1	28 Jul 11 10:45	KMP
Phosphorus as P - Total	< 0.1	mg/l	0.10	EPA 365.1	28 Jul 11 13:00	KMP
Mercury - Total	< 0.0002	mg/l	0.0002	EPA 245.1	28 Jul 11 8:00	Eric
Chemical Oxygen Demand	< 5	mg/l	5.0	HACH 8000	1 Aug 11 8:30	Wayne
Calcium - Total	210	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Magnesium - Total	< 2.5	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Sodium - Total	1440	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Potassium - Total	44.8	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Aluminum - Total	< 0.5	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Iron - Total	< 0.5	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Strontium - Total	28.2	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Titanium - Total	< 0.5	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Boron - Total	< 0.5	mg/l	0.10	6010	11 Aug 11 8:40	Stacy

RL = Method Reporting Limit

Elevated "Less Than Result" (<): @ = Due to sample matrix
 ! = Due to sample quantity

= Due to sample concentration
 + = Due to extract volume

CERTIFICATION: MN LAB # 038-999-267 ND # ND-00016



MINNESOTA VALLEY TESTING LABORATORIES, INC.

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Page: 2 of 2

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

Report Date: 8 Sep 11
Lab Number: 11-M2450
Work Order #: 81-818
Account #: 013479
Date Sampled:
Date Received: 28 Jun 11 9:00
PO #: 131460 OP

Sample Description: Unit I Bottom Ash
Sample Site: MDU Heskett

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
Antimony - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Arsenic - Total	0.0044	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Barium - Total	0.1135	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Beryllium - Total	< 0.001	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Cadmium - Total	0.00164	mg/l	0.00100	6020	25 Jul 11 16:18	Claudette
Chromium - Total	0.0065	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Cobalt - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Copper - Total	0.0213	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Lead - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Manganese - Total	0.0027	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Molybdenum - Total	0.6860	mg/l	0.0020	6020	26 Jul 11 12:46	Claudette
Nickel - Total	0.0074	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Selenium - Total	0.0133	mg/l	0.0020	6020	26 Jul 11 9:46	Claudette
Silver - Total	< 0.001	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Thallium - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Tin - Total	< 0.05	mg/l	0.0500	6020	25 Jul 11 16:18	Claudette
Vanadium - Total	0.0189	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Zinc - Total	0.0151	mg/l	0.0100	6020	25 Jul 11 16:18	Claudette
Uranium	< 0.002	mg/l	0.002	6020	25 Jul 11 16:18	Claudette

All analyses were performed on the extract from Method 1312 (SPLP) with a modified solution to solids ratio of 4:1.

Approved by: *D. Zarda*

RL = Method Reporting Limit

Elevated "Less Than Result" (<): @ = Due to sample matrix
! = Due to sample quantity

= Due to sample concentration
+ = Due to extract volume

CERTIFICATION: MN LAB # 038-999-267 ND # ND-00016



MINNESOTA VALLEY TESTING LABORATORIES, INC.

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 51 West Lincoln Way ~ Nevada, IA 50201 ~ 800-362-0855 ~ Fax 515-382-3885
 www.mvttl.com



Page: 1 of 2

Duane Leingang
 Montana Dakota Utilities
 PO Box 40
 Mandan ND 58554

Report Date: 8 Sep 11
 Lab Number: 11-M2451
 Work Order #: 81-818
 Account #: 013479
 Date Sampled:
 Date Received: 28 Jun 11 9:00
 PO #: 131460 OP

Sample Description: Unit II Sand Ash
 Sample Site: MDU Heskett

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
SPLP Extraction				1312	22 Jul 11	SS
pH	11.1	units	N/A	SM4500 H+ B	22 Jul 11 17:00	Claudette
Specific Conductance	20110	umhos/cm	N/A	SM2510-B	22 Jul 11 17:00	Claudette
Total Suspended Solids	21	mg/l	1	SM2540-D	22 Jul 11 14:00	CLB
Total Alkalinity	203	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Phenolphthalein Alk	171	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Bicarbonate	< 4	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Carbonate	64	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Hydroxide	139	mg/l CaCO3	0	SM2320-B	22 Jul 11 17:00	Claudette
Tot Dis Solids(Summation)	22500	mg/l	NA	SM1030-F	3 Aug 11 8:40	Calculated
Total Hardness as CaCO3	1200	mg/l	NA	SM2340-B	3 Aug 11 8:40	Calculated
Hardness in grains/gallon	70.2	gr/gal	NA	SM2340-B	3 Aug 11 8:40	Calculated
Cation Summation	318	meq/L	NA	SM1030-F	3 Aug 11 8:40	Calculated
Anion Summation	314	meq/L	NA	SM1030-F	28 Jul 11 14:30	Calculated
Percent Error	0.65	%	NA	SM1030-F	3 Aug 11 8:40	Calculated
Sodium Adsorption Ratio	80.9		NA	USDA 20b	3 Aug 11 8:40	Calculated
Gross Alpha Radiation	Attached	pCi/l			22 Aug 11 2:03	
Radon 222	See Attached				28 Jul 11 4:37	
Radium 226	Attached	pCi/l			22 Aug 11 22:20	
Radium 228	Attached	pCi/l			16 Aug 11 16:50	
Total Organic Carbon	< 0.5	mg/l	0.5	SM5310-C	1 Aug 11 8:00	Eric
Fluoride	< 0.1	mg/l	0.10	SM4500-F-C	4 Aug 11 17:00	CLB
Sulfate	14900	mg/l	5.00	ASTM D516-02	27 Jul 11 9:00	KMP
Chloride	2.0	mg/l	1.0	SM4500-Cl-E	27 Jul 11 14:00	KMP
Nitrate-Nitrite as N	< 0.1	mg/l	0.10	EPA 353.2	28 Jul 11 14:30	KMP
Ammonia-Nitrogen as N	0.10	mg/l	0.10	EPA 350.1	28 Jul 11 10:45	KMP
Phosphorus as P - Total	< 0.1	mg/l	0.10	EPA 365.1	28 Jul 11 13:00	KMP
Mercury - Total	< 0.0002	mg/l	0.0002	EPA 245.1	28 Jul 11 8:00	Eric
Chemical Oxygen Demand	< 5	mg/l	5.0	HACH 8000	1 Aug 11 8:30	Wayne
Calcium - Total	481	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Magnesium - Total	< 5	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Sodium - Total	6500	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Potassium - Total	459	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Aluminum - Total	1.09	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Iron - Total	< 1	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Strontium - Total	66.0	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Titanium - Total	< 1	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Boron - Total	5.96	mg/l	0.10	6010	11 Aug 11 8:40	Stacy

RL = Method Reporting Limit

Elevated "Less Than Result" (<): @ = Due to sample matrix
 ! = Due to sample quantity

= Due to sample concentration
 + = Due to extract volume

CERTIFICATION: MN LAB # 038-999-267 ND # ND-00016



MINNESOTA VALLEY TESTING LABORATORIES, INC.

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Page: 2 of 2

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

Report Date: 8 Sep 11
Lab Number: 11-M2451
Work Order #: 81-818
Account #: 013479
Date Sampled:
Date Received: 28 Jun 11 9:00
PO #: 131460 OP

Sample Description: Unit II Sand Ash
Sample Site: MDU Heskett

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
Antimony - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Arsenic - Total	0.0822	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Barium - Total	0.0930	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Beryllium - Total	< 0.001	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Cadmium - Total	0.00182	mg/l	0.00100	6020	25 Jul 11 16:18	Claudette
Chromium - Total	0.0244	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Cobalt - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Copper - Total	0.1108	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Lead - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Manganese - Total	0.0052	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Molybdenum - Total	0.1000	mg/l	0.0020	6020	26 Jul 11 12:46	Claudette
Nickel - Total	0.0136	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Selenium - Total	0.0937	mg/l	0.0020	6020	26 Jul 11 9:46	Claudette
Silver - Total	< 0.001	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Thallium - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Tin - Total	< 0.05	mg/l	0.0500	6020	25 Jul 11 16:18	Claudette
Vanadium - Total	0.3026	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Zinc - Total	0.0327	mg/l	0.0100	6020	25 Jul 11 16:18	Claudette
Uranium	< 0.002	mg/l	0.002	6020	25 Jul 11 16:18	Claudette

All analyses were performed on the extract from Method 1312 (SPLP) with a modified solution to solids ratio of 4:1.

Approved by:

RL = Method Reporting Limit

Elevated "Less Than Result" (<): @ = Due to sample matrix
! = Due to sample quantity

= Due to sample concentration
+ = Due to extract volume

CERTIFICATION: MN LAB # 038-999-267 ND # ND-00016



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Page: 1 of 2

Duane Leingang
 Montana Dakota Utilities
 PO Box 40
 Mandan ND 58554

Report Date: 8 Sep 11
 Lab Number: 11-M2452
 Work Order #: 81-818
 Account #: 013479
 Date Sampled:
 Date Received: 28 Jun 11 9:00
 PO #: 131460 OP

Sample Description: Unit I Fly Ash
 Sample Site: MDU Heskett

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
SPLP Extraction				1312	22 Jul 11	SS
pH	12.9	units	N/A	SM4500 H+ B	22 Jul 11 17:00	Claudette
Specific Conductance	50660	umhos/cm	N/A	SM2510-B	22 Jul 11 17:00	Claudette
Total Suspended Solids	30	mg/l	1	SM2540-D	22 Jul 11 14:00	CLB
Total Alkalinity	7020	mg/l CaCO3	4	SM2320-B	25 Jul 11 17:00	Claudette
Phenolphthalein Alk	6900	mg/l CaCO3	4	SM2320-B	25 Jul 11 17:00	Claudette
Bicarbonate	< 4	mg/l CaCO3	4	SM2320-B	25 Jul 11 17:00	Claudette
Carbonate	240	mg/l CaCO3	4	SM2320-B	25 Jul 11 17:00	Claudette
Hydroxide	6780	mg/l CaCO3	0	SM2320-B	25 Jul 11 17:00	Claudette
Tot Dis Solids (Summation)	42200	mg/l	NA	SM1030-F	3 Aug 11 8:40	Calculated
Total Hardness as CaCO3	1750	mg/l	NA	SM2340-B	3 Aug 11 8:40	Calculated
Hardness in grains/gallon	102	gr/gal	NA	SM2340-B	3 Aug 11 8:40	Calculated
Cation Summation	663	meq/L	NA	SM1030-F	3 Aug 11 8:40	Calculated
Anion Summation	613	meq/L	NA	SM1030-F	28 Jul 11 14:30	Calculated
Percent Error	3.99	%	NA	SM1030-F	3 Aug 11 8:40	Calculated
Sodium Adsorption Ratio	143		NA	USDA 20b	3 Aug 11 8:40	Calculated
Gross Alpha Radiation	Attached	pCi/l			22 Aug 11 2:03	
Radon 222	Attached				28 Jul 11 4:37	
Radium 226	Attached	pCi/l			22 Aug 11 22:20	
Radium 228	Attached	pCi/l			16 Aug 11 16:50	
Total Organic Carbon	1.5	mg/l	0.5	SM5310-C	1 Aug 11 8:00	Eric
Fluoride	5.60	mg/l	0.10	SM4500-F-C	10 Aug 11 17:00	CLB
Sulfate	22600	mg/l	5.00	ASTM D516-02	27 Jul 11 9:00	KMP
Chloride	53.8	mg/l	1.0	SM4500-Cl-E	27 Jul 11 14:00	KMP
Nitrate-Nitrite as N	0.68	mg/l	0.10	EPA 353.2	28 Jul 11 14:30	KMP
Ammonia-Nitrogen as N	7.22	mg/l	0.10	EPA 350.1	28 Jul 11 10:45	KMP
Phosphorus as P - Total	< 0.1	mg/l	0.10	EPA 365.1	28 Jul 11 13:00	KMP
Mercury - Total	< 0.0002	mg/l	0.0002	EPA 245.1	28 Jul 11 8:00	Eric
Chemical Oxygen Demand	22.4	mg/l	5.0	HACH 8000	1 Aug 11 8:30	Wayne
Calcium - Total	700	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Magnesium - Total	< 25	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Sodium - Total	14100	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Potassium - Total	580	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Aluminum - Total	< 5	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Iron - Total	< 5	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Strontium - Total	59.5	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Titanium - Total	< 5	mg/l	0.10	6010	2 Aug 11 9:30	Stacy
Boron - Total	1.89	mg/l	0.10	6010	11 Aug 11 8:40	Stacy

RL = Method Reporting Limit

Elevated "Less Than Result" (<): @ = Due to sample matrix
 ! = Due to sample quantity

= Due to sample concentration
 + = Due to extract volume

CERTIFICATION: MN LAB # 038-999-267

ND # ND-00016



MINNESOTA VALLEY TESTING LABORATORIES, INC.

1126 North Front St. ~ New Ulm, MN 56073 ~ 800-782-3557 ~ Fax 507-359-2890
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51 West Lincoln Way ~ Nevada, IA 50201 ~ 800-362-0855 ~ Fax 515-382-3885
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Page: 2 of 2

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

Report Date: 8 Sep 11
Lab Number: 11-M2452
Work Order #: 81-818
Account #: 013479
Date Sampled:
Date Received: 28 Jun 11 9:00
PO #: 131460 OP

Sample Description: Unit I Fly Ash
Sample Site: MDU Heskett

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
Antimony - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Arsenic - Total	0.1128	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Barium - Total	0.0906	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Beryllium - Total	< 0.001	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Cadmium - Total	0.00244	mg/l	0.00100	6020	25 Jul 11 16:18	Claudette
Chromium - Total	0.0270	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Cobalt - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Copper - Total	0.2934	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Lead - Total	0.0161	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Manganese - Total	0.0102	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Molybdenum - Total	0.9246	mg/l	0.0020	6020	26 Jul 11 12:46	Claudette
Nickel - Total	0.0175	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Selenium - Total	0.1959	mg/l	0.0020	6020	26 Jul 11 9:46	Claudette
Silver - Total	< 0.001	mg/l	0.0010	6020	25 Jul 11 16:18	Claudette
Thallium - Total	< 0.002	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Tin - Total	< 0.05	mg/l	0.0500	6020	25 Jul 11 16:18	Claudette
Vanadium - Total	0.0158	mg/l	0.0020	6020	25 Jul 11 16:18	Claudette
Zinc - Total	0.3984	mg/l	0.0100	6020	25 Jul 11 16:18	Claudette
Uranium	< 0.002	mg/l	0.002	6020	25 Jul 11 16:18	Claudette

All analyses were performed on the extract from Method 1312 (SPLP) with a modified solution to solids ratio of 4:1.

Approved by: 

RL = Method Reporting Limit

Elevated "Less Than Result" (<): @ = Due to sample matrix
! = Due to sample quantity

= Due to sample concentration
+ = Due to extract volume

CERTIFICATION: MN LAB # 038-999-267 ND # ND-00016



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Page: 1 of 2

Duane Leingang
 Montana Dakota Utilities
 PO Box 40
 Mandan ND 58554

Report Date: 8 Sep 11
 Lab Number: 11-M2453
 Work Order #: 81-818
 Account #: 013479
 Date Sampled:
 Date Received: 28 Jun 11 9:00
 PO #: 131460 OP

Sample Description: Unit II Fly Ash
 Sample Site: MDU Heskett

	As Received Result		Method RL	Method Reference	Date Analyzed	Analyst
SPLP Extraction				1312	22 Jul 11	SS
pH	12.8	units	N/A	SM4500 H+ B	22 Jul 11 17:00	Claudette
Specific Conductance	27240	umhos/cm	N/A	SM2510-B	22 Jul 11 17:00	Claudette
Total Suspended Solids	13	mg/l	1	SM2540-D	22 Jul 11 14:00	CLB
Total Alkalinity	4570	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Phenolphthalein Alk	4520	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Bicarbonate	< 4	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Carbonate	100	mg/l CaCO3	4	SM2320-B	22 Jul 11 17:00	Claudette
Hydroxide	4470	mg/l CaCO3	0	SM2320-B	22 Jul 11 17:00	Claudette
Tot Dis Solids(Summation)	16000	mg/l	NA	SM1030-F	3 Aug 11 8:40	Calculated
Total Hardness as CaCO3	1960	mg/l	NA	SM2340-B	3 Aug 11 8:40	Calculated
Hardness in grains/gallon	115	gr/gal	NA	SM2340-B	3 Aug 11 8:40	Calculated
Cation Summation	252	meq/L	NA	SM1030-F	9 Aug 11 9:09	Calculated
Anion Summation	247	meq/L	NA	SM1030-F	28 Jul 11 14:30	Calculated
Percent Error	1.00	%	NA	SM1030-F	9 Aug 11 9:09	Calculated
Sodium Adsorption Ratio	46.1		NA	USDA 20b	3 Aug 11 8:40	Calculated
Gross Alpha Radiation	Attached	pCi/l			22 Aug 11 2:03	
Radon 222	Attached				28 Jul 11 4:37	
Radium 226	Attached	pCi/l			22 Aug 11 22:20	
Radium 228	Attached	pCi/l			16 Aug 11 16:50	
Total Organic Carbon	1.6	mg/l	0.5	SM5310-C	1 Aug 11 8:00	Eric
Fluoride	3.60	mg/l	0.10	SM4500-F-C	4 Aug 11 17:00	CLB
Sulfate	7400	mg/l	5.00	ASTM D516-02	27 Jul 11 9:00	KMP
Chloride	66.0	mg/l	1.0	SM4500-Cl-E	27 Jul 11 14:00	KMP
Nitrate-Nitrite as N	0.38	mg/l	0.10	EPA 353.2	28 Jul 11 14:30	KMP
Ammonia-Nitrogen as N	15.0	mg/l	0.10	EPA 350.1	28 Jul 11 10:45	KMP
Phosphorus as P - Total	< 0.1	mg/l	0.10	EPA 365.1	28 Jul 11 13:00	KMP
Mercury - Total	< 0.0002	mg/l	0.0002	EPA 245.1	28 Jul 11 8:00	Eric
Chemical Oxygen Demand	9.4	mg/l	5.0	HACH 8000	1 Aug 11 8:30	Wayne
Calcium - Total	785	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Magnesium - Total	< 5	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Sodium - Total	4720	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Potassium - Total	275	mg/l	1.0	6010	3 Aug 11 8:40	Stacy
Aluminum - Total	< 1	mg/l	0.10	6010	9 Aug 11 9:09	Stacy
Iron - Total	< 1	mg/l	0.10	6010	9 Aug 11 9:09	Stacy
Strontium - Total	85.0	mg/l	0.10	6010	9 Aug 11 9:09	Stacy
Titanium - Total	< 1	mg/l	0.10	6010	9 Aug 11 9:09	Stacy
Boron - Total	< 1	mg/l	0.10	6010	11 Aug 11 8:40	Stacy

RL = Method Reporting Limit

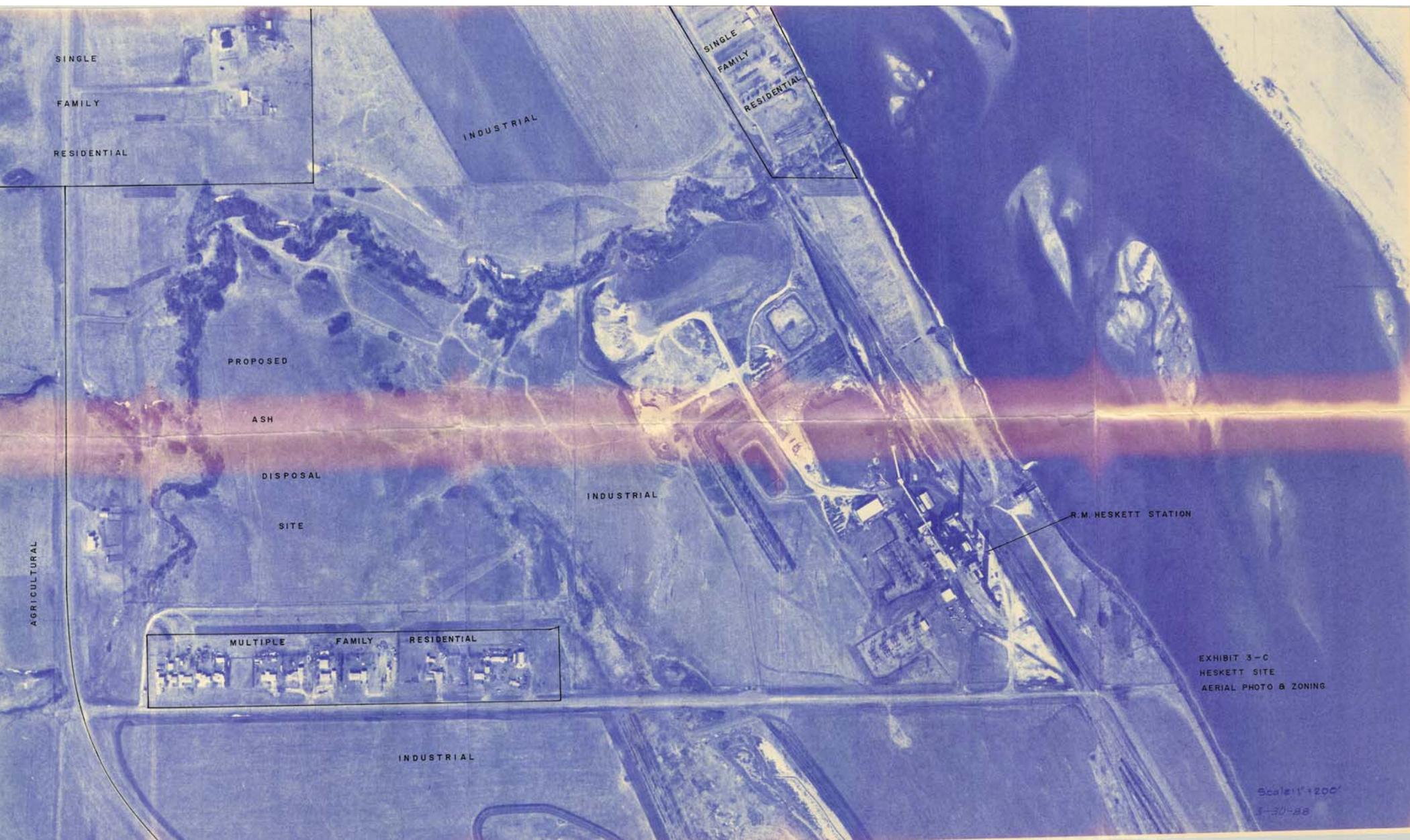
Elevated "Less Than Result" (<): @ = Due to sample matrix
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= Due to sample concentration
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CERTIFICATION: MN LAB # 038-999-267 ND # ND-00016

Appendix D

Aerial Photo (March 30, 1988)



SINGLE
FAMILY
RESIDENTIAL

SINGLE
FAMILY
RESIDENTIAL

INDUSTRIAL

PROPOSED

ASH

DISPOSAL

SITE

INDUSTRIAL

AGRICULTURAL

MULTIPLE FAMILY RESIDENTIAL

R.M. HESKETT STATION

INDUSTRIAL

EXHIBIT 3-C
HESKETT SITE
AERIAL PHOTO & ZONING

Scale: 1" = 200'
3-30-88

Appendix E

Boring Logs

EXHIBIT 5-E

LITHOLOGIC LOGS

Wells 10, 11, 12 and 13

- 0-1 Top soil, silty, clayey, sandy, brown, calcareous; with some limestone pebbles.
- 1-11 Silt, clayey, brownish-tan, slightly indurated, very dry, calcareous; with thin coarse-grained, clean silt lenses and a few small (less than .5 in.) iron oxide concretions. Abundant small gypsum crystals (less than .13 in. long). Some small, black flakes of organic plant material. Cannonball-Ludlow Formations.
- 11-14 Silt, as above, with some (less than 20%) very fine- to fine-grained sand interspersed.
- 14-30 Silt, as above, clayey, less sand than above interval, oxidized; with very fine-grained silty sand lenses and very few gypsum crystals.
- 30-41 Silt, very clayey, with some (less than 20%) very fine-grained sand interspersed, steel-gray (color change), moderately indurated; with fewer small gypsum crystals than above intervals.
- 41-59 Silt, as above, very clayey, with some (less than 20%) fine- to medium-grained sand interspersed in a silt and clay matrix.
- 59-65 Silt, as above, with abundant (more than 20%) fine- to medium-grained sand interspersed.
- 65-81 Silt, clayey, steel-gray to bluish, moderately indurated; with thin coarse-grained silt to very fine-grained sand lenses in an otherwise fine silt to clay matrix.
- 81-84 Clay, silty, steel-gray to bluish, moderately indurated, dense.
- 84-91 Siltstone, sandy, clayey, steel-gray to bluish, slightly indurated; with small fine-grained sand lenses and abundant (more than 20%) sand interspersed in the matrix.
- 91-110 Silt, clayey, bluish-gray, moderately indurated; with thin (less than 1 foot) mudstone lenses.
- 110-120 Silt, very clayey, steel-gray to bluish, moderately indurated, very dense. Cannonball-Ludlow Formations.

Wells 20 and 21

- 0-1 Top soil, silty, sandy, clayey, dark-brown, calcareous; with some limestone and granite pebbles.
- 1-21 Silt, clayey, with minor amounts (less than 10%) of very fine-grained sand interspersed, brownish-tan, slightly indurated, calcareous, oxidized; with small iron oxide concretions and abundant small gypsum crystals.
Cannonball-Ludlow Formations.
- 21-26 Silt, as above, steel-gray (color change).
- 26-49 Silt, clayey, with some (less than 20%) very fine- to medium-grained sand interspersed, steel-gray to bluish, slightly indurated; with very few small gypsum crystals and some thin (less than 1 foot) siltstone lenses.
- 49-53 Silt, as above, with abundant (more than 20%) fine- to medium-grained sand interspersed.
- 53-63 Silt, as above, clayey, less sand, with thin (less than 1 foot) siltstone to mudstone lenses.
- 63-80 Silt, very clayey, steel-gray to bluish, moderately indurated, very dense.
Cannonball-Ludlow Formations.

Wells 30, 31, 32 and 33

- 0-1 Top soil, silty, sandy, brownish, calcareous; with some granite and limestone pebbles.
- 1-2 Pebble-loam (glacial till), silty, sandy, clayey, yellowish-brown, dry, calcareous.
- 2-31 Silt, clayey, with minor amounts (less than 10%) of very fine-grained sand interspersed, brownish-tan, slightly indurated, calcareous, oxidized; with small iron oxide concretions. Some small, black flakes organic plant material.
Cannonball-Ludlow Formations.
- 31-44 Silt, clayey, steel-gray (color change), slightly indurated, calcareous; with small iron oxide concretions, thin coarse silt lenses, small gypsum crystals and gray to reddish-brown mottling.

- 44-61 Silt, as above, with some (less than 20%) fine- to medium-grained sand interspersed.
- 61-65 Silt, as above, with abundant (more than 20%) fine- to medium-grained sand interspersed, dense.
- 65-76 Silt, as above, clayey, less sand, some thin (less than 1 foot) lenses of siltstone to mudstone.
- 76-80 Siltstone, sandy, clayey, steel-gray to bluish, slightly indurated; with small fine-grained sand lenses and abundant (more than 20%) fine-grained sand interspersed in the matrix.
- 80-92 Silt, clayey, steel-gray to bluish, moderately indurated, with some (less than 20%) very fine- to fine grained sand interspersed.
- 92-120 Silt, very clayey, steel-gray to bluish, moderately indurated, very dense. Cannonball-Ludlow Formations.
- Well 40
- 0-1 Top soil, sandy, silty, brownish-tan, calcareous; with some granite and limestone pebbles.
- 1-5 Pebble-loam (glacial till), sandy, silty, with detrital lignite and organic matter, yellowish-brown, very dry, calcareous.
- 5-22 Sand, very fine- to medium-grained, unconsolidated, with thin lenses of clay and detrital lignite, brownish-yellow, calcareous.
- 22-40 Silt, clayey, with minor amounts (less than 10%) very fine-grained sand interspersed, brownish-tan, slightly indurated, calcareous, oxidized; with small iron oxide concretions and small gypsum crystals; Cannonball-Ludlow Formations.
- 40-51 Silt, clayey, with minor amounts (less than 10%) of very fine-grained sand interspersed, steel-gray (color change), moderately indurated; with some reddish-brown mottling and some very thin (less than 6 inches) mudstone lenses.
- 51-58 Silt, as above, with abundant (more than 20%) fine-grained sand and thin silty-clay lenses.

- 58-62 Siltstone, sandy, clayey, steel-gray to bluish, moderately indurated; with small fine-grained sand lenses and abundant (more than 20%) sand interspersed in the matrix.
- 62-70 Silt, clayey, with some (less than 20%) fine- to medium-grained sand interspersed, steel-gray to bluish, moderately indurated; with thin (less than 2 feet) sandy lenses.
- 70-80 Silt, as above, very clayey, some (less than 10%) fine-grained sand interspersed; less sand than above interval.
- 80-120 Silt, as above, dark-steel-gray.
Cannonball-Ludlow Formations.

Wells 41, 42 and 43

- 0-1 Top soil, sandy, silty, dark-brown, calcareous; with some granite and limestone pebbles.
- 1-4 Pebble-loam (glacial till), sandy, silty, clayey, yellowish-brown, very dry, calcareous.
- 4-40 Silt, clayey, with some (less than 20%) very fine-grained sand interspersed, brownish-tan, unconsolidated, noncompacted, calcareous to 25 feet, oxidized; with small iron oxide concretions and abundant small gypsum crystals.
Cannonball-Ludlow Formations.
- 40-51 Silt, clayey, with minor amounts (less than 10%) of very fine-grained sand interspersed, steel-gray (color change), moderately indurated; with some reddish-brown mottling and some very thin (less than 6 inches) mudstone lenses.
- 51-58 Silt, as above, with abundant (more than 20%) fine-grained sand and thin silty-clay lenses.
- 58-62 Siltstone, sandy, clayey, steel-gray to bluish, moderately indurated; with small fine-grained sand lenses and abundant (more than 20%) sand interspersed in the matrix.
- 62-70 Silt, clayey, with some (less than 20%) fine- to medium-grained sand interspersed, steel-gray to bluish, moderately indurated; with thin (less than 2 feet) sandy lenses.

70-80 Silt, as above, very clayey, some (less than 10%) fine-grained sand interspersed; less sand than above interval.

Wells 43 and 44

- 0-2 Top soil, clayey, silty, some sand, brownish-tan to light-gray, calcareous.
- 2-20 Silt, clayey, with some (less than 20%) fine-grained sand interspersed, brownish-tan, slightly indurated, very dry, calcareous; with small iron oxide concretions, abundant small gypsum crystals and occasional thin silt lenses. Cannonball-Ludlow Formations.
- 20-25 Silt, as above, very clayey, oxidized, with minor amounts (less than 10%) of fine-grained sand.
- 25-35 Silt, as above, dark-brownish-tan to bluish-gray (color change), with thin very fine-grained sand lenses.
- 35-60 Silt, clayey, with some (less than 20%) fine- to medium-grained sand interspersed, steel-gray to bluish, moderately indurated; with some indurated silty sand lenses. Cannonball-Ludlow Formations.

Wells 50, 51 and 52

- 0-4 Top soil, clayey, silty, very dark-brown.
- 4-10 Clay, silty, with some (less than 20%) fine-grained sand, dark-brownish-tan, soft, cohesive, wet, sticky; with some pebbles.
- 10-22 Silt, very clayey, with some (less than 20%) very fine-grained sand interspersed, brownish-tan, slightly indurated, calcareous, dense; with abundant small gypsum crystals and very thin silt and sand lenses; Cannonball-Ludlow Formations.
- 22-23 Sandstone, fine-grained, silty, indurated, oxidized, dark-brown.
- 23-30 Silt, very clayey, with some (less than 20%) very fine-grained sand interspersed, steel-gray (color change), moderately indurated; with thin medium grained sand lenses.

30-40 Silt, as above, very clayey, less sand than above interval, dark-steel-gray.
Cannonball-Ludlow Formations.

Wells 53 and 54

- 0-4 Top soil, clayey, silty, very dark-brown, wet, sticky.
- 4-15 Clay, silty, with some (less than 20%) fine- to medium-grained sand interspersed, brownish-tan, slightly indurated, dry, calcareous; with small iron oxide concretions, small gypsum crystals and occasional reddish-brown mottling;
Cannonball-Ludlow Formations.
- 15-20 Sand, very fine-grained to medium-grained, silty, clayey, unconsolidated, yellowish-brown, oxidized.
- 20-30 Silt, clayey, with some (less than 20%) fine-grained sand interspersed, steel-gray (color change), slightly indurated; with clay and sand lenses, some small concretions and some small gypsum crystals.
- 30-45 Silt, as above, very clayey.
- 45-60 Silt, as above, clayey, brownish-gray, moderately indurated, some reddish-brown mottling.
Cannonball-Ludlow Formations.

Wells 55 and 56

- 0-5 Sandy-loam (glacial), with fine- to medium-grained sand, silty, calcareous; with small granite and limestone pebbles.
- 5-26 Clay, silty, with minor amounts (less than 10%) of very fine-grained sand, dark-brownish-tan, moderately indurated, brittle, very dry, calcareous; with small iron oxide concretions, small gypsum crystals and occasional thin sandstone laminae. Some small, black flakes of organic plant material.
Cannonball-Ludlow Formations.
- 26-35 Clay, as above, very silty, sandy, brownish-tan, oxidized.

- 35-40 Silt, clayey, with some (less than 20%) very fine- to fine-grained sand interspersed, steel-gray (color change) moderately indurated; with small gypsum crystals and occasional clay lenses.
- 40-60 Silt, as above, with minor amounts (less than 10%) of fine-grained sand interspersed.
- 60-85 Silt, as above, clayey, less sand than above interval.
- 85-100 Silt, as above, very clayey, with minor amounts (less than 10%) of sand interspersed, light-gray. Cannonball-Ludlow Formations.

Wells 60, 61 and 62

- 0-2 Top soil, silty, clayey, dark-brown to tanish-brown, calcareous.
- 2-25 Silt, very clayey, with some minor amounts (less than 10%) of very fine- to fine-grained sand interspersed, brownish-tan, slightly indurated, dry, calcareous; with abundant small gypsum crystals and thin silt and sand lenses; Cannonball-Ludlow Formations.
- 25-29 Silt, as above, with abundant (more than 20%) fine- to medium-grained sand interspersed.
- 29-36 Silt, as above, clayey, less sand than above interval, dark-brownish-tan, oxidized.
- 36-60 Silt, very clayey, with some (less than 20%) very fine-grained sand interspersed, steel-gray (color change), moderately indurated; with thin (less than 1 foot) sandy-silt lenses. Cannonball-Ludlow Formations.

Well 70 0-2 Pebble-loam (glacial till), clayey, sandy, yellowish-brown, unconsolidated, damp, calcareous.

- 2-21 Silty, clayey, with some (less than 20%) fine-grained sand interspersed, brownish-tan, moderately indurated, very dry, calcareous, oxidized; with small iron oxide concretions and abundant small gypsum crystals. Cannonball-Ludlow Formations.

- 21-24 Shale, silty, steel- to dark-gray (color change), indurated, fissile, very dry; with occasional thin silt and sand lenses.
- 24-31 Silt, clayey, with abundant (more than 30%) sand, steel-gray, moderately indurated.
- 31-62 Silt, clayey, with some (less than 20%) very fine- to fine- grained sand interspersed, steel-gray, moderately indurated; with some small gypsum crystals and small iron oxide concretions.
- 62-76 Silt, as above, with some (less than 20%) fine-grained sand interspersed.
- 76-82 Silt, as above, with abundant (more than 20%) fine- to medium-grained sand.
- 82-100 Silt, as above, clayey, with some (less than 20%) fine-grained sand interspersed, dark-gray.
Cannonball-Ludlow Formations.
-

The lithologic logs for wells 1-4 were described by personal from Water Supply Incorporated (WS), Bismarck, North Dakota. The wells were installed during a previous ground water investigation at Heskett Station.

Well WS 2

0-1 Top soil, silty, black.
1-4 Pebble-loam (glacial till), silty, clayey, some cobbles, yellowish-brown.
4-7 Gravel, sand and rocks.
7-21 Sand, fine- to coarse-grained, some pebbles.
21-39 Clay, silty, sandy, yellowish-brown to gray.
39-52 Clay, silty, sandy, gray.
52-67 Sand, fine-grained, bluish, with some clay layers.
67-89 Clay, silty, sandy, brown to gray.

Wells WS 1, 1A and 1B

0-1 Top soil, silty, black
1-4 Clay, (glacial), silty, with pebbles, yellowish-brown.
4-21 Sand, fine- to medium-grained, yellowish-brown; with clay and silt lenses.
21-25 Clay, silty, yellowish-brown.
25-30 Sand, fine-grained, yellowish-brown, some indurated layers.
30-35 Clay, silty, yellowish-brown.
35-45 Sand, fine-grained, yellowish-brown.
45-50 Clay, silty, sandy, gray, about 50 percent shale.
50-56 Sand, fine-grained, with clay layers.
56-73 Clay, silty, sandy, gray.

Wells WS 4, 4A and 4B

0-13 Pebble-loam (glacial till), silty, sandy, with some cobbles, yellowish-brown.
13-23 Sand, fine- to medium-grained, yellowish-brown.
23-25 Clay, silty, sandy, yellowish-brown.
25-27 Sandstone, indurated.
27-30 Clay, sandy, silty, gray.
30-36 Sand, fine-grained, gray.
36-52 Clay, silty, sandy, gray; with some sand layers.

Wells WS 3 and 3A

0-1 Top soil, silty, black.
1-12 Pebble-loam, clayey, silty, with some cobbles, yellowish-brown.
12-16 Clay, silty, gray; with some shale layers.
16-18 Limestone, indurated.
18-23 Clay, silty, yellowish-brown; with some sand layers.
23-44 Sand, fine- to medium-grained, gray; with some clay layers.
44-50 Clay, silty, medium-gray.

Project: Heskett Station
 Project No.: 34301012
 Location: Mandan, ND
 Coordinates: Lat: 46.86620° Long: -100.89313°
 Datum:
 Surface Elevation:
 Drilling Method: HSA
 Sampling Method: Split Spoon
 Unique Well No.: MW-44 R
 Completion Depth: 46.0 ft

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	OL/OH	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						0-1': TOPSOIL (OL/OH); Very Dark Brown (2.5/2 7.5YR); low to medium plasticity; roots, fine to medium grained sand.		
1		1	3-3-5-8.	OL/OH		1-46': SANDY CLAY (CL): Brown (5/4 7.5YR) to Dark Gray (4/1 7.5YR); medium to high plasticity; massive; fine to medium grained sand. Moist; 20% gravel, 30% sand, 50% fines. At 1-5': Gravel sized inclusions. Moist; 10% gravel, 20% sand, 70% fines.	PRO. CASING Diameter: 4" by 4" Type: Steel Interval: 3' up & 3' down	
2		2	9-9-7-7.				RISER CASING Diameter: 2" Type: Schd 40 PVC Interval: Stick up to screen (23')	
3		3	7-5-5-7.			Moist; 0% gravel, 30% sand, 70% fines.	GROUT Type: Cement Interval: 0-0.5' BGS	
4		4	7-9-11-13.			Moist; 0% gravel, 20% sand, 80% fines.	SEAL Type: Bentonite Interval: Chips 0.5-21' BGS	
5		5	7-9-12-13.			At 8': Oxidized staining.	SANDPACK Type: Granusil Interval: 21-46' BGS	
6		6	6-7-11-13.				SCREEN Diameter: 2" Type: No. 10 Slot Interval: 23-43' BGS	
7		7	7-10-12-14.	CL				
8		8	6-10-14-14.					
9		9	10-10-13-16.			At 20': Interbedded layer of sand.		
10		10	10-10-12-16.	CL		(CL): At 24': Color change to dark brown (3/3 7.5YR). Moist; 0% gravel, 20% sand, 80% fines. At 25': Sand lens.		

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Date Boring Started: 10/20/14
 Date Boring Completed: 10/20/14
 Logged By: JEG3
 Drilling Contractor: Midwest Testing (Terracon)
 Drill Rig:

Remarks: Water encountered at 28.7' BGS in MW-44R while drilling on 10/2014

Additional data may have been collected in the field which is not included on this log.
 Weather:



Barr Engineering Company
 234 West Century Avenue
 Bismarck, ND 58503
 Telephone: 701-255-5460

LOG OF BORING MW-44 R

SHEET 2 OF 2

Project: Heskett Station
 Project No.: 34301012
 Location: Mandan, ND
 Coordinates: Lat: 46.86620° Long: -100.89313°
 Datum:

Surface Elevation:
 Drilling Method: HSA
 Sampling Method: Split Spoon
 Completion Depth: 46.0 ft
 Unique Well No.: MW-44 R

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	SOUC	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet	
30		11	8-12-14-18	CL		(CL): At 24': Color change to dark brown (3/3 7.5YR). (continued) Wet; 0% gravel, 20% sand, 80% fines. At 30.5': Sand lens. (CL): At 32': Color change to dark gray (4/1 7.5YR).	<p>PRO. CASING Diameter: 4" by 4" Type: Steel Interval: 3' up & 3' down</p> <p>RISER CASING Diameter: 2" Type: Schd 40 PVC Interval: Stick up to screen (23')</p> <p>GROUT Type: Cement Interval: 0-0.5' BGS</p> <p>SEAL Type: Bentonite Interval: Chips 0.5-21' BGS</p> <p>SANDPACK Type: Granusil Interval: 21-46' BGS</p> <p>SCREEN Diameter: 2" Type: No. 10 Slot Interval: 23-43' BGS</p>		
35		12	8-13-16-27						
40		13	11-19-25-27	CL					
45		14	14-18-27-34	SC		(SC): At 45.8': Clayey Sand (SC), fine to medium grained, low to medium plasticity, dark greenish gray (4/10G Gley 2).			

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Date Boring Started: 10/20/14
 Date Boring Completed: 10/20/14
 Logged By: JEG3
 Drilling Contractor: Midwest Testing (Terracon)
 Drill Rig:

Remarks: Water encountered at 28.7' BGS in MW-44R while drilling on 10/2014

Additional data may have been collected in the field which is not included on this log.
 Weather:



Barr Engineering Company
 234 West Century Avenue
 Bismarck, ND 58503
 Telephone: 701-255-5460

LOG OF BORING MW-80 R

SHEET 1 OF 1

Project: Heskett Station

Project No.: 34301012

Location: Mandan, ND

Coordinates: Lat: 46.86789° Long: -100.89320°

Datum:

Surface Elevation:

Drilling Method: HSA

Sampling Method: Split Spoon

Completion Depth: 27.0 ft

Unique Well No.: MW-80 R

Depth, feet	Sample Type & Recovery	Sample No.	Blows/fin.	SOFC	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet	
0						0-0.5': TOPSOIL (OL/OH): Black; organic roots.			
1		1	4-4-4-5			0.5-27': SANDY CLAY (CL): Brown (4/4 7.5 YR) to Black (2.5/1 7.5YR); medium to high plasticity; fine to medium grained sand. Moist: 0% gravel, 30% sand, 70% fines. At 2': Gravel inclusions.	<p>PRO. CASING Diameter: 4" by 4" Type: Steel Interval: 3' up & 3' down</p> <p>RISER CASING Diameter: 2" Type: Schd 40 PVC Interval: Stick up to screen (7')</p> <p>GROUT Type: Cement Interval: 0-0.5' BGS</p> <p>SEAL Type: Bentonite Interval: Chips 0.5-5' BGS</p> <p>SANDPACK Type: Granusil Interval: 5-27' BGS</p> <p>SCREEN Diameter: 2" Type: No 10 Slot Interval: 7-27' BGS</p>		
2		2	4-5-7-9			Moist: 10% gravel, 30% sand, 60% fines.			
5		3	4-4-5-8	CL		Moist: 0% gravel, 20% sand, 80% fines.			
		4	4-4-6-6			(CL): At 8': Color change to 2.5/1 7.5YR black, no odor.			
		5	3-4-5-6	CL		(CL): At 9': Color change to 2.5/2 7.5YR very dark brown. Moist: 0% gravel, 20% sand, 80% fines.			
10		6	1-3-3-4	CL		(CL): At 11': Color change to 3/3 7.5YR dark brown, Moist: 0% gravel, 20% sand, 80% fines.			
		7	1-1-2-1			(CL): At 13': Color change to 4/4 7.5YR brown. Wet: 0% gravel, 20% sand, 80% fines.			
15		8	1-2-2-1						
20		9	7-11-12-17	CL		At 21': Thin sand lens less than 0.1" thick. Wet: 0% gravel, 20% sand, 80% fines. At 21.5': Thin sand lens less than 0.1" thick.			
25		10	7-11-17-17			Wet: 0% gravel, 20% sand, 80% fines. At 26.5': Thin sand lens less than 0.1" thick.			

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Date Boring Started: 10/20/14
 Date Boring Completed: 10/20/14
 Logged By: JEG3
 Drilling Contractor: Midwest Testing (Terracon)
 Drill Rig:

Remarks: Water encountered at 11.8' BGS in MW-80R while drilling on 10/20/14

Additional data may have been collected in the field which is not included on this log.
 Weather:



Barr Engineering Company
 4300 MarketPointe Drive Suite 200
 Minneapolis, MN 55435
 Telephone: 952-832-2600

LOG OF BORING MW-101 DRAFT

SHEET 1 OF 3

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438844.919° Long: 1868647.777°
 Datum: NAD 83

Surface Elevation: 1716.6 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 58.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	SCUC	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL: Brown (5/4 7.5YR).		
1		1	4-4-4-6.			SANDY LEAN CLAY WITH GRAVEL (CL): fine to medium grained; Brown (5/3 7.5YR); moist; thinly laminated; some mottling; low plasticity; [Cannonball Formation]. At 2': Start to see gravel inclusions.	PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs	1715
2		2	4-6-6-7.			At 4': Oxidized staining.	RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 2.98' ags - 34' bgs	1710
3		3	7-9-14-16.			At 5': Oxidized staining.		
4		4	8-9-12-15.			At 7': Oxidized staining and white staining.	GROUT Type: Neat cement Interval: 0 - 29' bgs	
5		5	10-15-21-26.				SEAL Type: Bentonite chips Interval: 29 - 32' bgs	
6		6	7-18-24-27.	CL		At 11': Oxidized staining.	SANDPACK Type: Silica 40-70 Interval: 32 - 56' bgs	1705
7		7	8-12-19-23.				SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 34 - 54' bgs	1700
8		8	8-14-18-23.			At 15': Gypsum. 16-20': No recovery.		
9		9	7-10-13-15.			At 20.5': Gypsum.		
10		10	7-9-13-15.	CL		LEAN CLAY (CL): Dark Brown (3/2 7.5YR); oxidized staining, some mottling; medium to high plasticity; [Cannonball Formation]. At 22': Color change to Brown (4/2 7.5YR).		1695
11						At 24': Interbedded sand, fine grained.		

Date Boring Started: 8/18/15
 Date Boring Completed: 8/19/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: Hole caved in from 56 - 58' bgs.
 DTW = 36.66' TOR on 9/23/2015 (elev. 1682.87)

Additional data may have been collected in the field which is not included on this log.
 Weather:

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 Minneapolis, MN 55435
 Telephone: 952-832-2600

LOG OF BORING MW-101
DRAFT

SHEET 2 OF 3

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438844.919° Long: 1868647.777°
 Datum: NAD 83

Surface Elevation: 1716.6 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 58.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S C	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
25		11	7-11-13-15.			LEAN CLAY (CL): Dark Brown (3/2 7.5YR); oxidized staining, some mottling; medium to high plasticity; [Cannonball Formation]. (continued) At 25' and 25.5': Gypsum.	PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs	1690
		12	8-11-15-19.			At 26.5': Gypsum.		RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 2.98' ags - 34' bgs
30		13	8-11-13-15.			At 29.5': Gypsum.	GROUT Type: Neat cement Interval: 0 - 29' bgs	
		14	6-11-14-17.	CL				SEAL Type: Bentonite chips Interval: 29 - 32' bgs
35		15	8-13-17-22.			At 33': Gypsum.	SANDPACK Type: Silica 40-70 Interval: 32 - 56' bgs	
		16	8-14-19-21.			At 34.5': Gypsum.		SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 34 - 54' bgs
		17	11-16-20-27.			At 35.5-36': Color change to Black (2.5/1 7.5YR), turns back to brown.		
		18	9-13-20-25.			FAT CLAY (CH): Black (2.5/1 7.5YR); very stiff; high plasticity; wet at 43'; [Cannonball Formation].		
40		19	7-14-23-26.			At 38': Oxidized staining.		
		20	9-16-23-26.	CH			At 41': Oxidized staining.	

Date Boring Started: 8/18/15
 Date Boring Completed: 8/19/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: Hole caved in from 56 - 58' bgs.
 DTW = 36.66' TOR on 9/23/2015 (elev. 1682.87)

Additional data may have been collected in the field which is not included on this log.
 Weather:

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LOG OF BORING MW-101
DRAFT

SHEET 3 OF 3

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438844.919° Long: 1868647.777°
 Datum: NAD 83

Surface Elevation: 1716.6 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 58.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S C	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
50						FAT CLAY (CH): Black (2.5/1 7.5YR); very stiff; high plasticity; wet at 43'; [Cannonball Formation]. (continued)	 <p>PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs</p> <p>RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 2.98' ags - 34' bgs</p> <p>GROUT Type: Neat cement Interval: 0 - 29' bgs</p> <p>SEAL Type: Bentonite chips Interval: 29 - 32' bgs</p> <p>SANDPACK Type: Silica 40-70 Interval: 32 - 56' bgs</p> <p>SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 34 - 54' bgs</p>	1665
55								1660
60						End of boring 58.0 feet		
65								
70								
75								

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Date Boring Started: 8/18/15
 Date Boring Completed: 8/19/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: Hole caved in from 56 - 58' bgs.
 DTW = 36.66' TOR on 9/23/2015 (elev. 1682.87)

Additional data may have been collected in the field which is not included on this log.
 Weather:



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 4300 MarketPointe Drive Suite 200
 Minneapolis, MN 55435
 Telephone: 952-832-2600

LOG OF BORING MW-102 DRAFT

SHEET 1 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438161.145° Long: 1868782.871°
 Datum: NAD 83

Surface Elevation: 1703.8 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 46.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	SCUC	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL: Brown (5/4 7.5YR).		
1		1	3-3-3-2.			LEAN CLAY (CL): medium grained; Brown (4/3 7.5YR); moist; low to medium plasticity; with gravel to 4"; [Cannonball Formation].	PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 2.85' ags - 10' bgs GROUT Type: None Interval: None SEAL Type: Bentonite chips Interval: 0 - 8' bgs SANDPACK Type: Silica 40-70 Interval: 8 - 31' bgs SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 20 - 30' bgs	1700
2		2	3-2-2-3.					
3		3	3-3-4-5.	CL				
4		4	3-4-5-7.					
5		5	4-8-7-4.	ML		SANDY SILT WITH GRAVEL (ML): Strong Brown (5/6 7.5YR); fine to coarse sand, fine to medium gravel, unconsolidated; [Cannonball Formation].	1695	
6		6	4-3-5-9.	CL		LEAN CLAY WITH GRAVEL (CL): fine to medium grained; Brown (5/3 7.5YR); some mottling; medium plasticity; [Cannonball Formation].		
7		7	3-5-7-9.			LEAN CLAY (CL): Dark Brown (3/2 7.5YR); medium to high plasticity; [Cannonball Formation].		
8		8	6-8-12-14.				1690	
9		9	6-10-12-16.					
10		10	5-9-14-16.	CL			1685	
11		11	5-12-15-18.					
12		12	9-15-18-22.			At 21': Color changes to Black (2.5/1).		

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Date Boring Started: 8/18/15
 Date Boring Completed: 8/18/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: Lithological descriptions for a hole that was abandoned. Monitoring well blind drilled and installed next to abandoned hole.
 DTW = 17.09' TOR on 8/21/2015 (elev. 1689.51)

Additional data may have been collected in the field which is not included on this log.
 Weather:



Barr Engineering Company
 4300 MarketPointe Drive Suite 200
 Minneapolis, MN 55435
 Telephone: 952-832-2600

LOG OF BORING MW-102
DRAFT

SHEET 2 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438161.145° Long: 1868782.871°
 Datum: NAD 83

Surface Elevation: 1703.8 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 46.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	SPT	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet	
25		13	9-14-19-22.			LEAN CLAY (CL): Dark Brown (3/2 7.5YR); medium to high plasticity; [Cannonball Formation]. (continued)	<p>PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs</p> <p>RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 2.85' ags - 10' bgs</p> <p>GROUT Type: None Interval: None</p> <p>SEAL Type: Bentonite chips Interval: 0 - 8' bgs</p> <p>SANDPACK Type: Silica 40-70 Interval: 8 - 31' bgs</p> <p>SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 20 - 30' bgs</p>	1675	
		14	10-17-18-24.			At 29': Gypsum.			
		15	6-15-18-26.			At 29': Gypsum.			
30		16	7-14-18-22.			At 33.5' and 34': Gypsum.			
		17	11-16-20-27.			At 33.5' and 34': Gypsum.			
		18	10-14-15-24.			At 33.5' and 34': Gypsum.			
35		19	13-19-25-35.			At 33.5' and 34': Gypsum.			
		20	8-17-26-31.			At 33.5' and 34': Gypsum.			
		21	10-20-27-38.			At 33.5' and 34': Gypsum.			
		22	13-20-27-37.			At 33.5' and 34': Gypsum.			
		23	15-27-27-32.			SILTY SAND (SM): fine to medium grained; Dark Gray (4/1 7.5YR); wet; [Cannonball Formation].			
45						End of boring 46.0 feet			

Date Boring Started: 8/18/15
 Date Boring Completed: 8/18/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: Lithological descriptions for a hole that was abandoned. Monitoring well blind drilled and installed next to abandoned hole.
 DTW = 17.09' TOR on 8/21/2015 (elev. 1689.51)

Additional data may have been collected in the field which is not included on this log.
 Weather:

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Barr Engineering Company
 4300 MarketPointe Drive Suite 200
 Minneapolis, MN 55435
 Telephone: 952-832-2600

LOG OF BORING MW-103 DRAFT

SHEET 1 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 437578.205° Long: 1869355.992°
 Datum: NAD 83

Surface Elevation: 1714.7 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 44.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S U	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL (OL/OH): Brown (5/4 7.5YR).		
1		1	3-4-5-5.		OL/OH	LEAN CLAY (CL): Very Dark Gray (3/1 7.5YR); moist; stiff; medium to high plasticity; [Cannonball Formation].	PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs	1710
2		2	5-5-8-8.		CL			
3		3	5-8-10-11.		CL	POORLY GRADED SAND WITH GRAVEL (SP): fine to coarse grained; Brown (5/4 7.5YR); some oxidized staining, some mottling; [Cannonball Formation].	RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 2.79' ags - 24' bgs	1705
4		4	6-9-15-15.		SP			
5		5	5-6-5-4.		SP	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; Brown (5/4 7.5YR); [Cannonball Formation].	GROUT Type: Neat cement Interval: 0 - 19' bgs	1700
6		6	4-5-5-7.		SP-SM			
7		7	2-2-2-3.		SP-SM	NO RECOVERY (16 - 20').	SEAL Type: Bentonite chips Interval: 19 - 22' bgs	1695
8		8	3-3-3-3.		SP-SM			
9		9	3-3-5-5.		CL	SANDY LEAN CLAY (CL): fine to medium grained; Light Brown (6/4 7.5YR); wet; some mottling and oxidized staining, cohesive; low to medium plasticity; [Cannonball Formation].	SANDPACK Type: Silica 40-70 Interval: 22 - 44' bgs	1690
10								
15								
20								
25								

Date Boring Started: 8/19/15
 Date Boring Completed: 8/20/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: DTW = 33.24' TOR on 8/20/2015 (elev. 1684.29)
 Additional data may have been collected in the field which is not included on this log.
 Weather:

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 Telephone: 952-832-2600

LOG OF BORING MW-103 DRAFT

SHEET 2 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 437578.205° Long: 1869355.992°
 Datum: NAD 83

Surface Elevation: 1714.7 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 44.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S C	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
25		10	2-2-4-4.	CL		SANDY LEAN CLAY (CL): fine to medium grained; Light Brown (6/4 7.5YR); wet; some mottling and oxidized staining, cohesive; low to medium plasticity; [Cannonball Formation]. <i>(continued)</i>	PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 2.79' ags - 24' bgs GROUT Type: Neat cement Interval: 0 - 19' bgs SEAL Type: Bentonite chips Interval: 19 - 22' bgs SANDPACK Type: Silica 40-70 Interval: 22 - 44' bgs SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 24 - 44' bgs	1685
30		11	10-10-7-9.	SM		SILTY SAND WITH GRAVEL (SM): wet; [Cannonball Formation].		
		12	8-15-17-22.			LEAN CLAY (CL): Brown (4/4 7.5YR); moist; oxidized staining; medium to high plasticity; [Cannonball Formation]. At 32.5': Sand lens, color changes to Black (2.5/1 7.5YR). At 33.5': Sand lens. At 34': Interbedded sand with oxidized staining.		
35		13	7-19-15-25.					1680
		14	11-16-21-50 for 5".	CL		At 36.5': Sand lens. At 37': Sand lens. At 37.5': Color change to Gray (5/1 7.5YR). At 38-38.5': 6" thick layer of hard material.		
40		15	50 for 2"-.					
		16	12-17-22-30.					
		17	9-18-24-50.			At 42-42.5': Silt layer. At 43.5-44': Silt layer.		1675
45						End of boring 44.0 feet		

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Date Boring Started: 8/19/15
 Date Boring Completed: 8/20/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: DTW = 33.24' TOR on 8/20/2015 (elev. 1684.29)

Additional data may have been collected in the field which is not included on this log.
 Weather:



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LOG OF BORING MW-104 DRAFT

SHEET 1 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438853.542° Long: 1869832.72°
 Datum: NAD 83

Surface Elevation: 1681.5 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 32.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	SCUC	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL: Brown (5/4 7.5YR).		
1		1	4-5-5-5.			LEAN CLAY WITH SAND (CL): fine to medium grained; Brown (5/4 7.5YR); moist; gravel; medium plasticity; [Cannonball Formation].	PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs	1680
2		2	3-5-6-8.	CL				
3		3	3-7-9-10.			LEAN CLAY (CL): Brown (4/4 7.5YR); oxidized staining and mottling; medium to high plasticity; with gypsum throughout; [Cannonball Formation].	RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 3.06' ags - 9' bgs	1675
4		4	5-7-9-10.					
5		5	5-9-9-10.					
6		6	5-7-9-10.	CL			GROUT Type: None Interval: None	
7		7	5-8-8-12.			At 12': Heavily oxidized.		
8		8	5-9-11-15.			At 15': Start seeing black staining.	SEAL Type: Bentonite chips Interval: 0 - 7' bgs	1670
9		9	6-9-11-13.			At 17': Heavily oxidized.		
10		10	4-7-16-19.			SILTY SAND (SM): Strong Brown (5/6 7.5YR); wet; [Cannonball Formation].	SANDPACK Type: Silica 40-70 Interval: 7 - 32' bgs	
11		11	5-16-22-26.	SM		At 19.5': Color change to Brown (5/4 7.5YR). At 21': Oxidized layer.		
12		12	7-11-14-16.	CH		FAT CLAY (CH): Dark Gray (4/1 7.5YR); moist; stiff; high plasticity; with interbedded sand layers below 27'; [Cannonball Formation].		
13							SCREEN Diameter: 2"; No. 6 slot Type: PVC SCH 80 Interval: 9 - 29' bgs	1665
14								
15								1660
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

Date Boring Started: 8/20/15
 Date Boring Completed: 8/20/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: DTW = 13.25' TOR on 8/21/2015 (elev. 1671.26)

Additional data may have been collected in the field which is not included on this log.
 Weather:

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LOG OF BORING MW-104
DRAFT

SHEET 2 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438853.542° Long: 1869832.72°
 Datum: NAD 83

Surface Elevation: 1681.5 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 32.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S C	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet	
25		13	6-12-16-17.			FAT CLAY (CH): Dark Gray (4/1 7.5YR); moist; stiff; high plasticity; with interbedded sand layers below 27'; [Cannonball Formation]. (continued)	 PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 3.06' ags - 9' bgs GROUT Type: None Interval: None SEAL Type: Bentonite chips Interval: 0 - 7' bgs SANDPACK Type: Silica 40-70 Interval: 7 - 32' bgs SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 9 - 29' bgs	1655	
		14	8-12-16-21.	CH					
		15	8-12-16-20.						
30		16				Driller notes: sluff.		1650	
						End of boring 32.0 feet			

Date Boring Started: 8/20/15
 Date Boring Completed: 8/20/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: DTW = 13.25' TOR on 8/21/2015 (elev. 1671.26)

 Additional data may have been collected in the field which is not included on this log.
 Weather:

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LOG OF BORING MW-105 DRAFT

SHEET 1 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438042.079° Long: 1870325.657°
 Datum: NAD 83

Surface Elevation: 1686.0 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 30.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S C	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet	
0						TOPSOIL: Brown (5/4 7.5YR).		1685	
1		1	6-7-6-5.	CL		SANDY LEAN CLAY (CL): fine to medium grained; Brown (4/2 7.5YR); moist; gravel; medium plasticity; [Cannonball Formation].	PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 3.16' ags - 10' bgs GROUT Type: None Interval: None SEAL Type: Bentonite chips Interval: 0 - 7' bgs SANDPACK Type: Silica 40-70 Interval: 7 - 30' bgs SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 10 - 30' bgs	1685	
2		2	5-5-5-6.						
3		3	3-2-4-5.						
4		4	2-2-2-3.						
5				CL		LEAN CLAY (CL): Brown (4/2 7.5YR); soft; high plasticity; wet at 16"; [Cannonball Formation].		1680	
6		5	2-1-2-2.						
7		6	2-1-2-1.					At 10.5': Color change to Reddish-Yellow (6/6 7.5YR).	1675
8		7	2-1-1-3.						
9		8	4-3-5-5.					At 14.5-15.5': Gravel inclusions. At 15.5': Color change to Brown (4/3 7.5YR).	1670
10		9	7-9-11-13.						
11		10	7-9-11-13.	At 18': Color change to Brown (5/3 7.5YR).					
12		11	7-9-13-15.	SP-SM		POORLY GRADED SAND WITH SILT (SP-SM): medium to coarse grained; Brown (5/4 7.5YR); [Cannonball Formation].		1665	
13		12	19-26-28-30.						

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25
 Date Boring Started: 8/17/15
 Date Boring Completed: 8/17/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

Remarks: DTW = 13.22' TOR on 8/21/2015 (elev. 1675.92)

 Additional data may have been collected in the field which is not included on this log.
 Weather:



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 Telephone: 952-832-2600

LOG OF BORING MW-105
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SHEET 2 OF 2

Project: R.M. Haskett Station CCR Monitoring Network
 Project No.: 34300014.12
 Location: Mandan, ND
 Coordinates: Lat: 438042.079° Long: 1870325.657°
 Datum: NAD 83

Surface Elevation: 1686.0 ft
 Drilling Method: HSA
 Sampling Method: SPT
 Completion Depth: 30.0 ft

Unique Well No.:

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	S C S C	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
25		13	15-25-31-40.			FAT CLAY (CL): Dark Brown (3/4 7.5YR); high plasticity; sand lens at 26.5'; [Cannonball Formation]. At 26': Color change to Gray (5/1 7.5YR).	<p>PRO. CASING Diameter: 4" Type: Steel pipe Interval: 3.5' ags - 1.5' bgs</p> <p>RISER CASING Diameter: 2" Type: PVC SCH 80 Interval: 3.16' ags - 10' bgs</p> <p>GROUT Type: None Interval: None</p> <p>SEAL Type: Bentonite chips Interval: 0 - 7' bgs</p> <p>SANDPACK Type: Silica 40-70 Interval: 7 - 30' bgs</p> <p>SCREEN Diameter: 2"; No.6 slot Type: PVC SCH 80 Interval: 10 - 30' bgs</p>	1660
		14	10-15-18-30.	CL				
		15	11-16-22-32.					
30						End of boring 30.0 feet		
35								
40								
45								
50								

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Date Boring Started: 8/17/15
 Date Boring Completed: 8/17/15
 Logged By: JEG3
 Drilling Contractor: Terracon
 Drill Rig: Rig mounted HSA

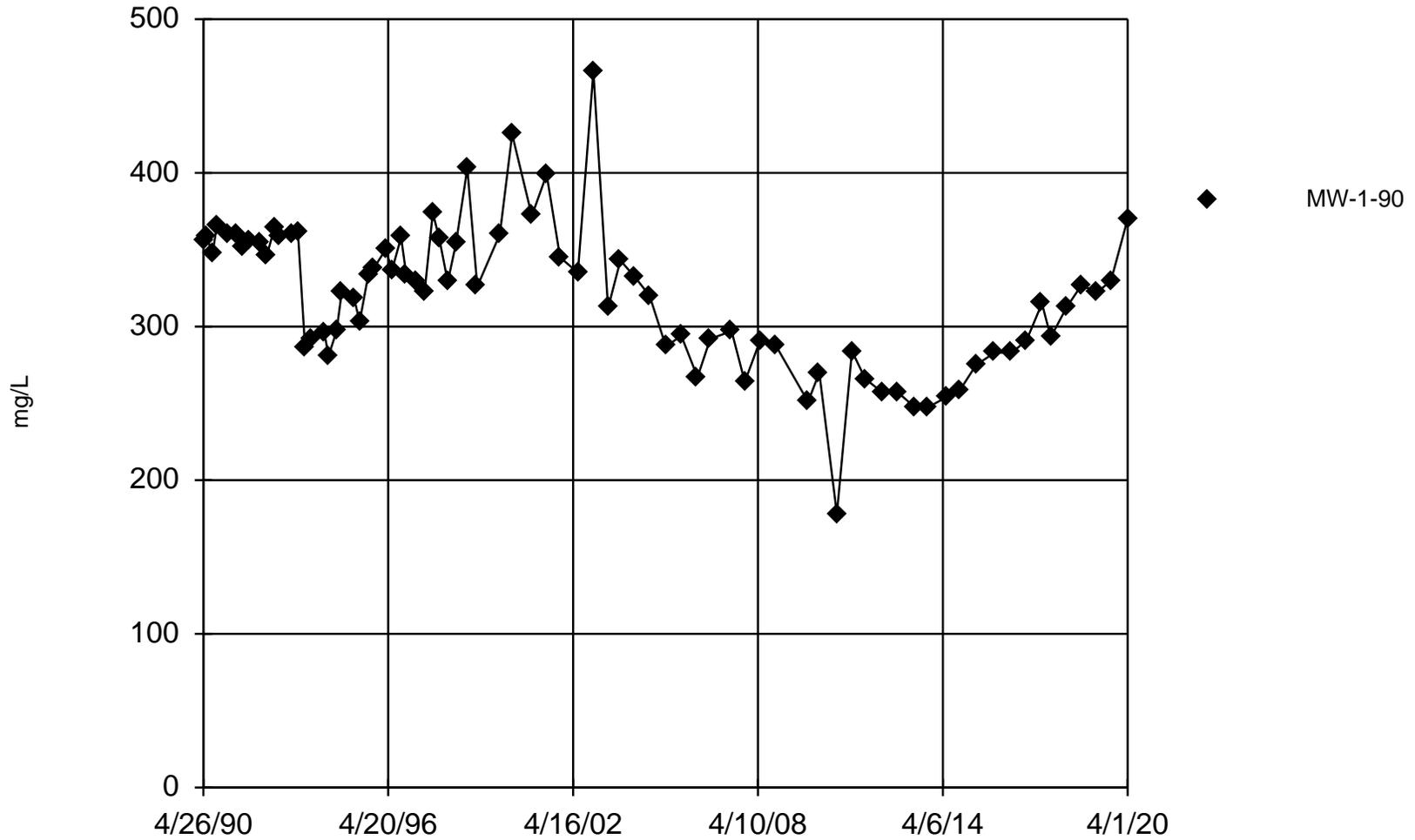
Remarks: DTW = 13.22' TOR on 8/21/2015 (elev. 1675.92)

Additional data may have been collected in the field which is not included on this log.
 Weather:

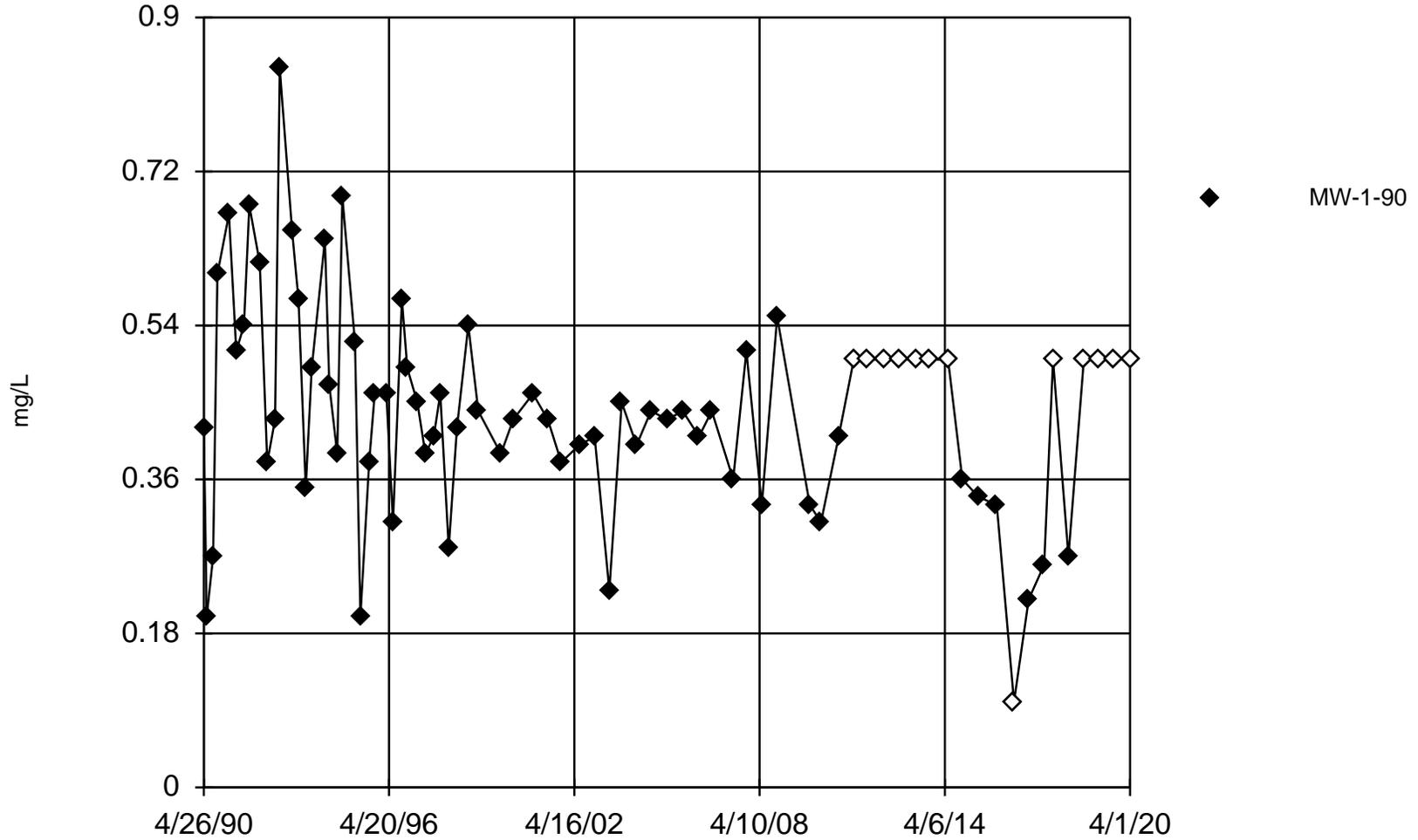
Appendix F

MW1-90 Time Series Plots

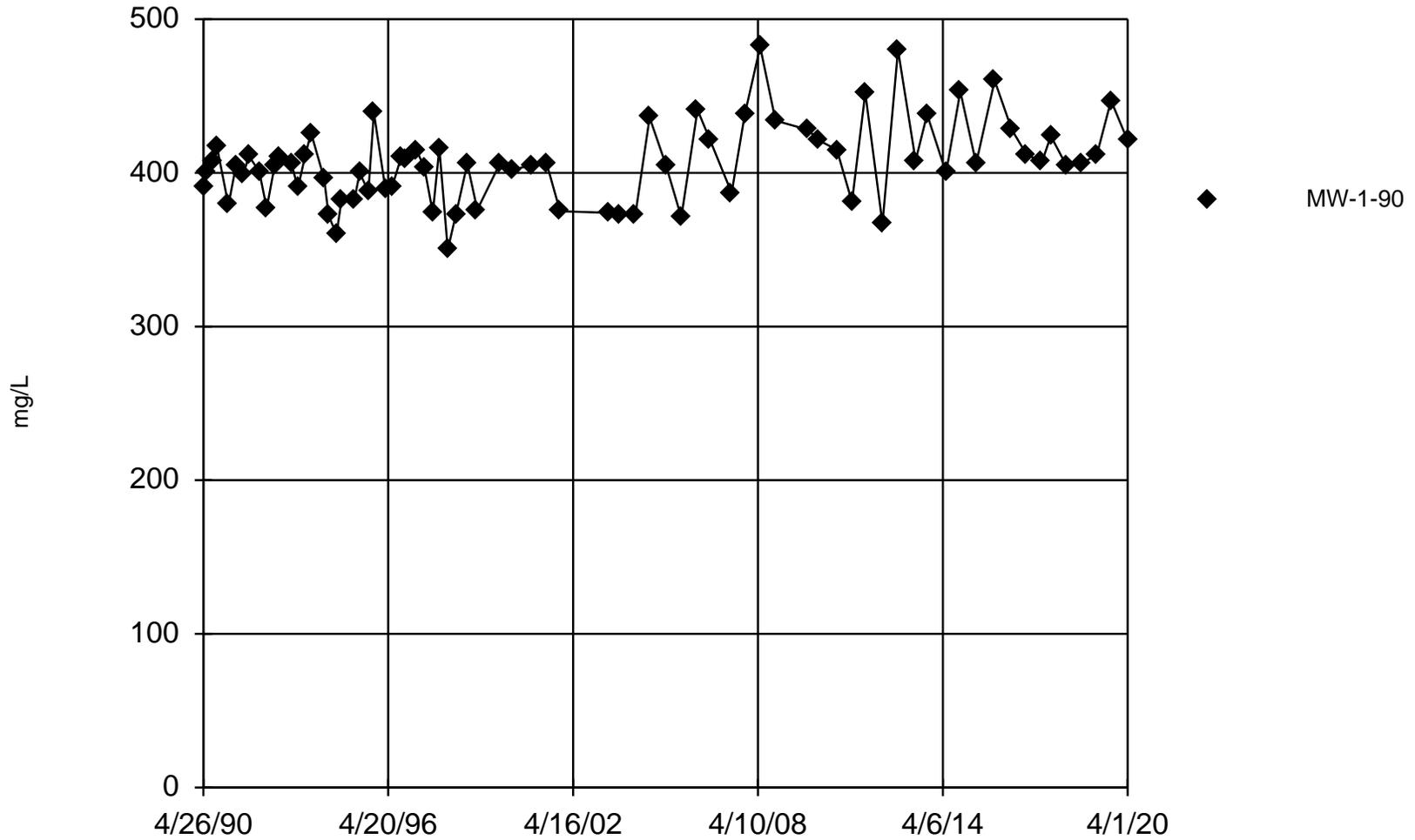
Time Series



Time Series



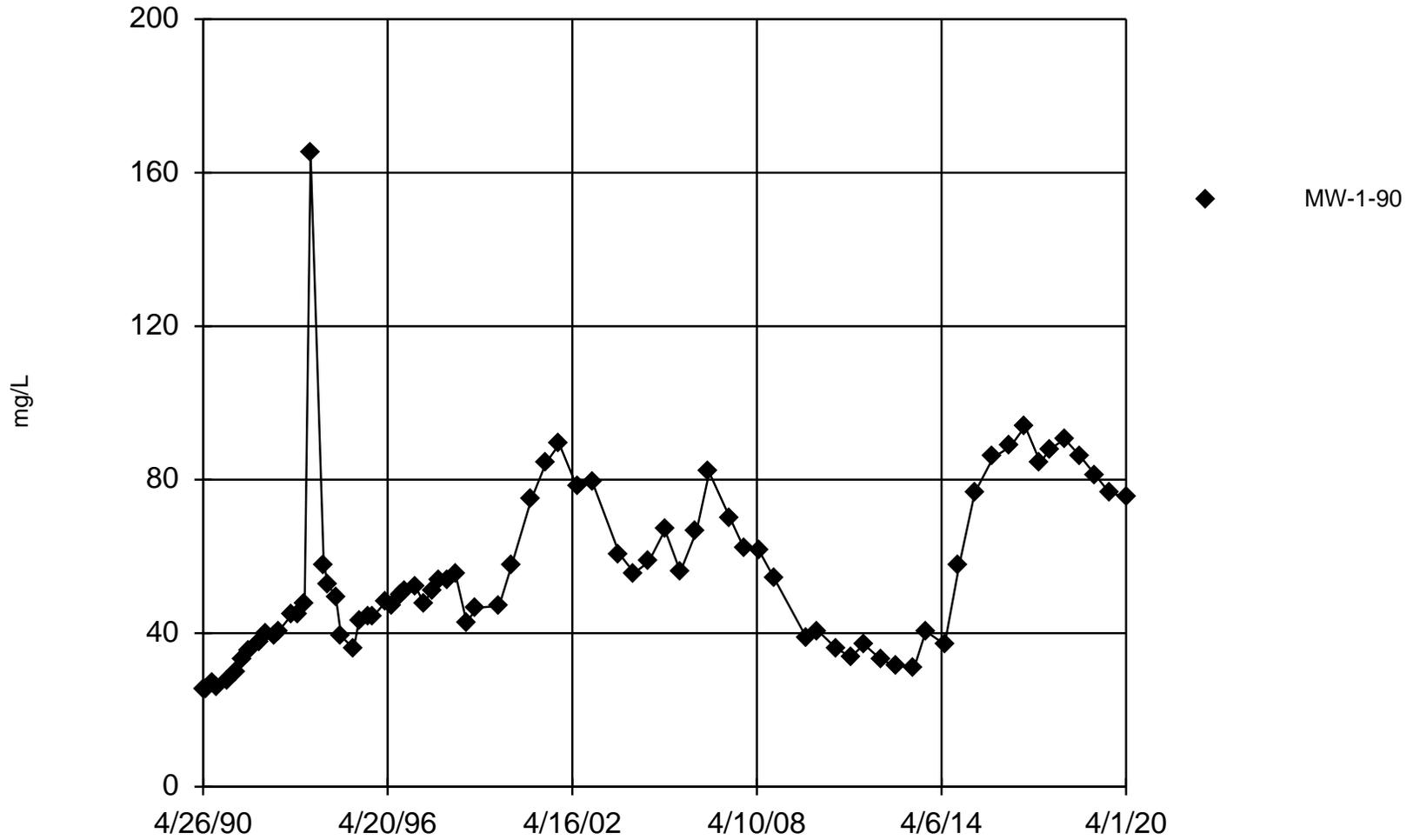
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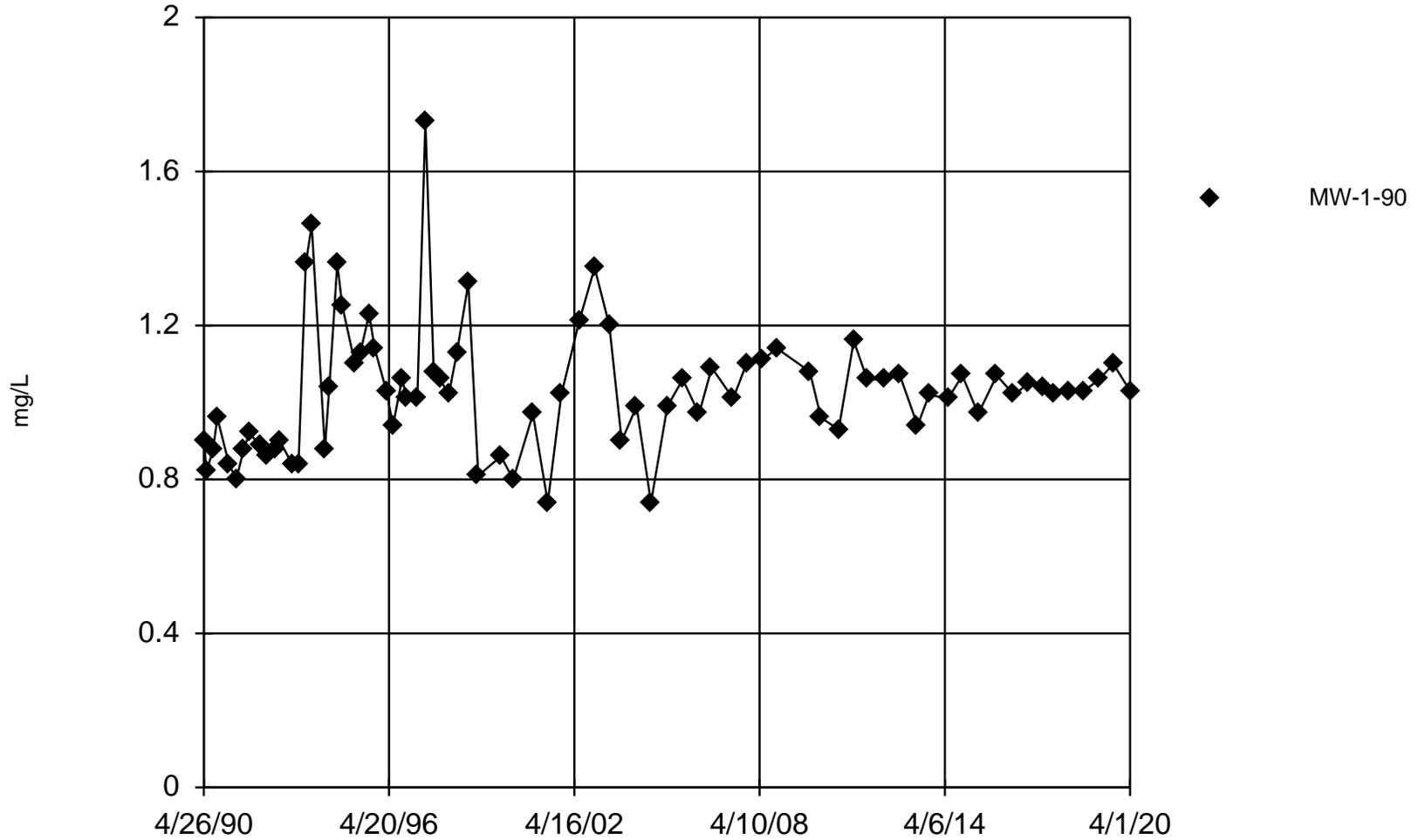
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R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: MDUHeskett_AMR_MW190

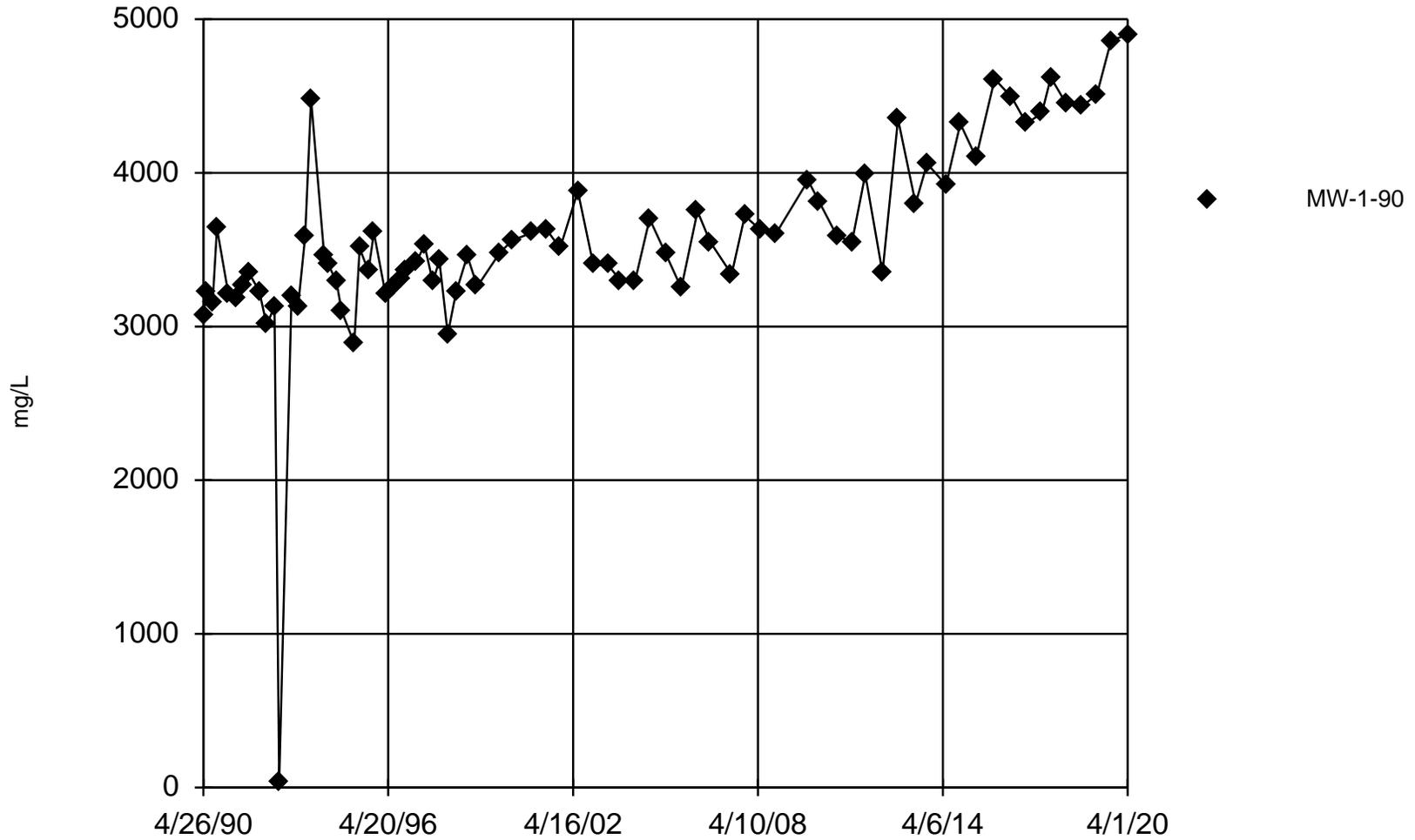
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Time Series



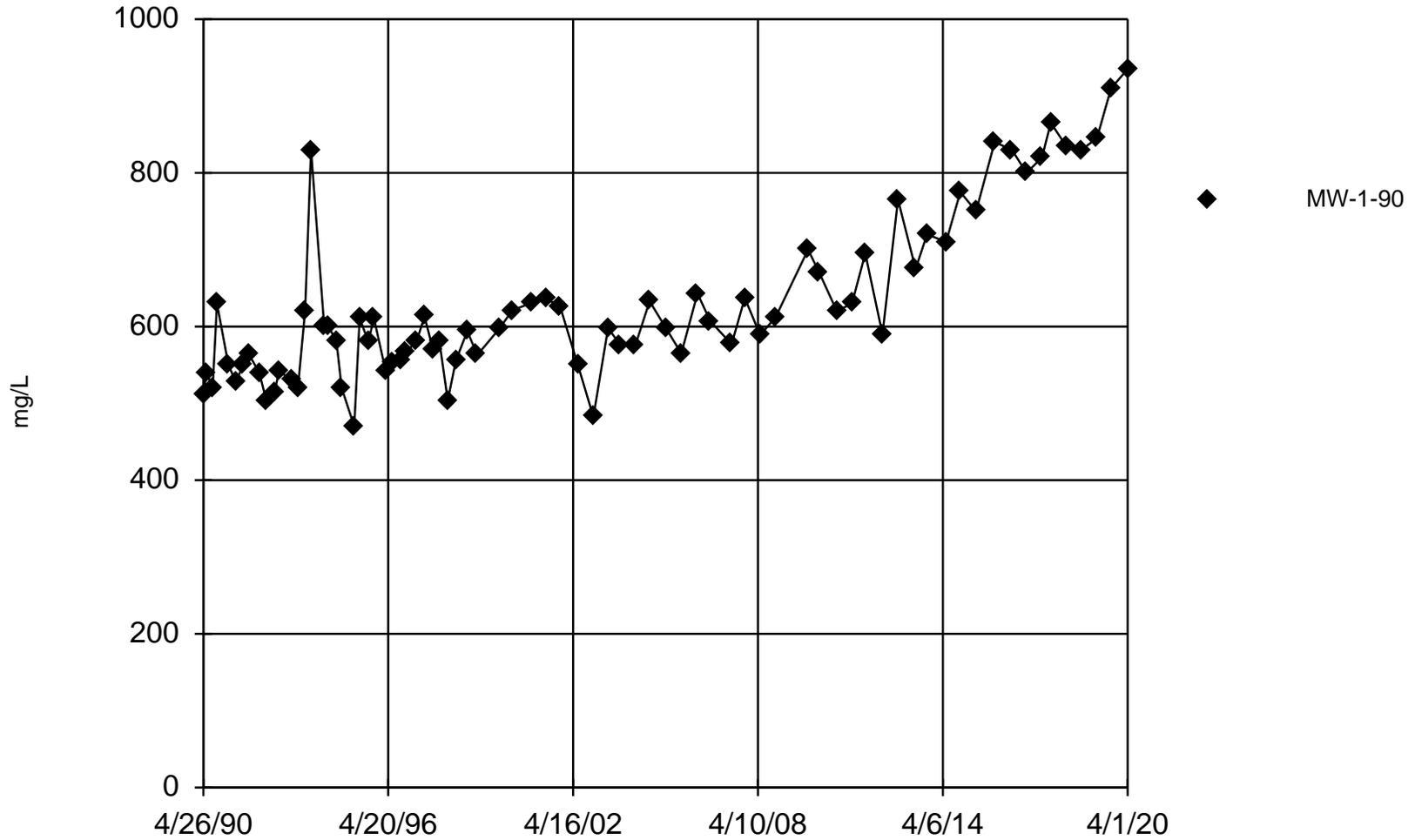
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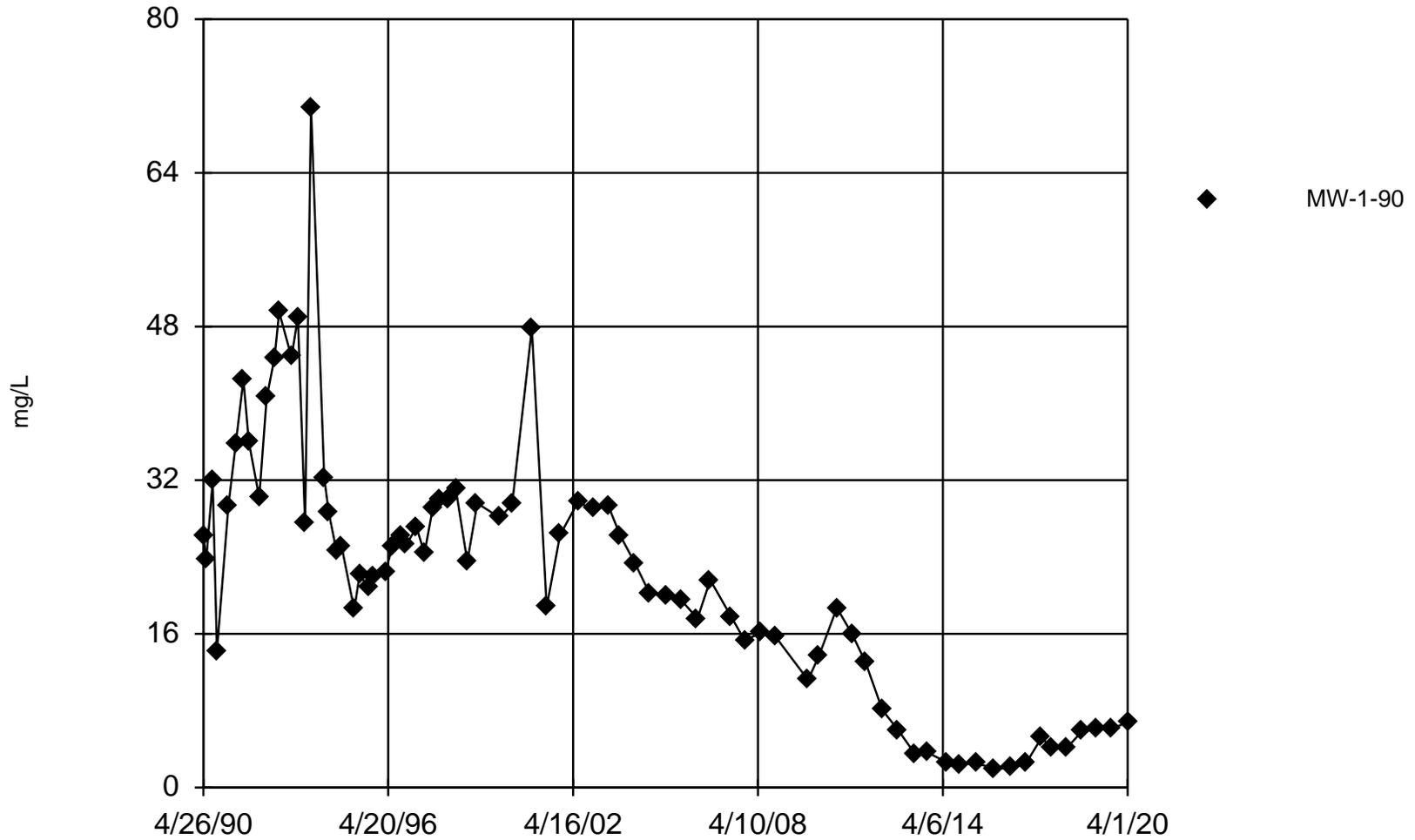
Constituent: Hardness Analysis Run 9/30/2020 11:14 PM

R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: MDUHeskett_AMR_MW190

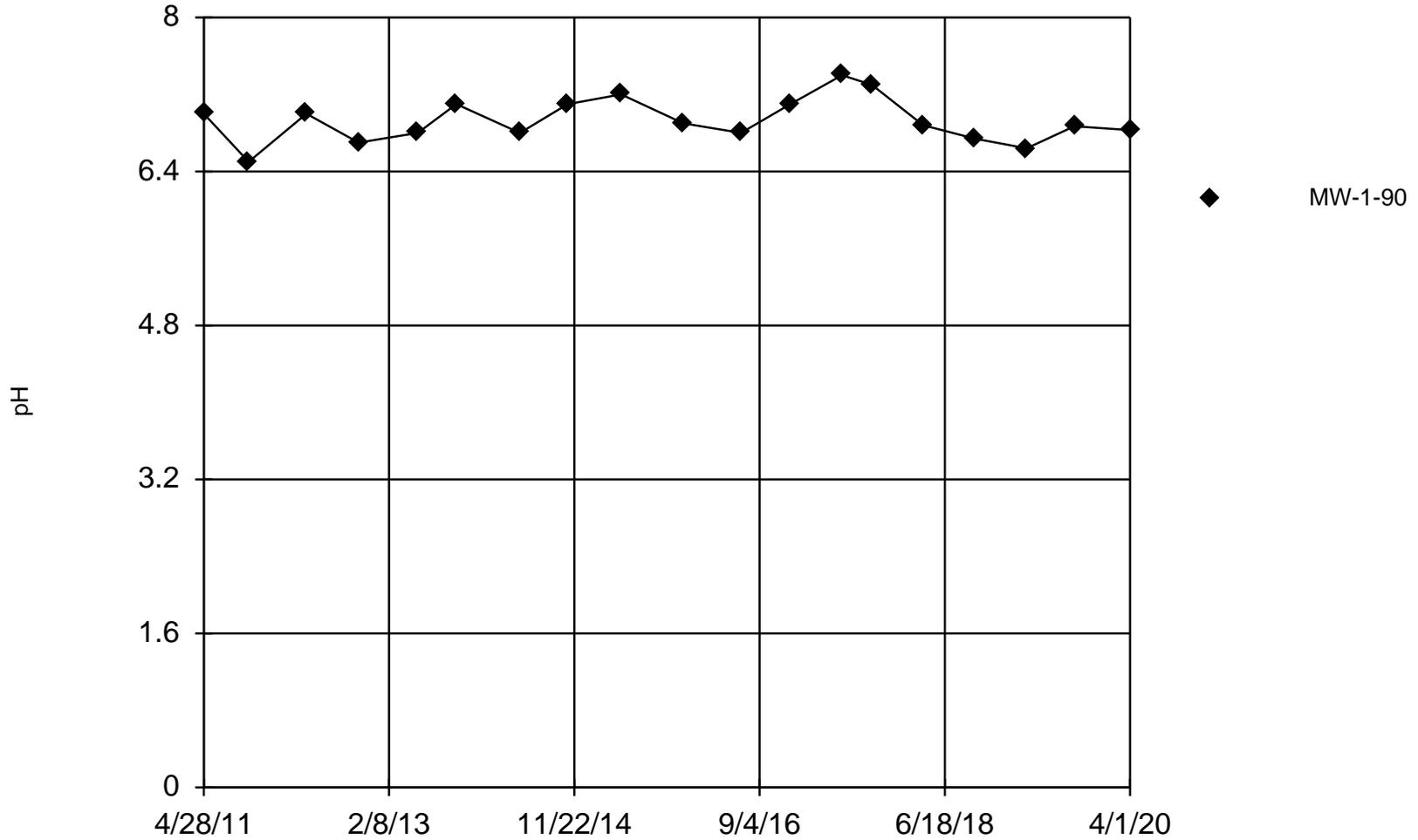
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Time Series



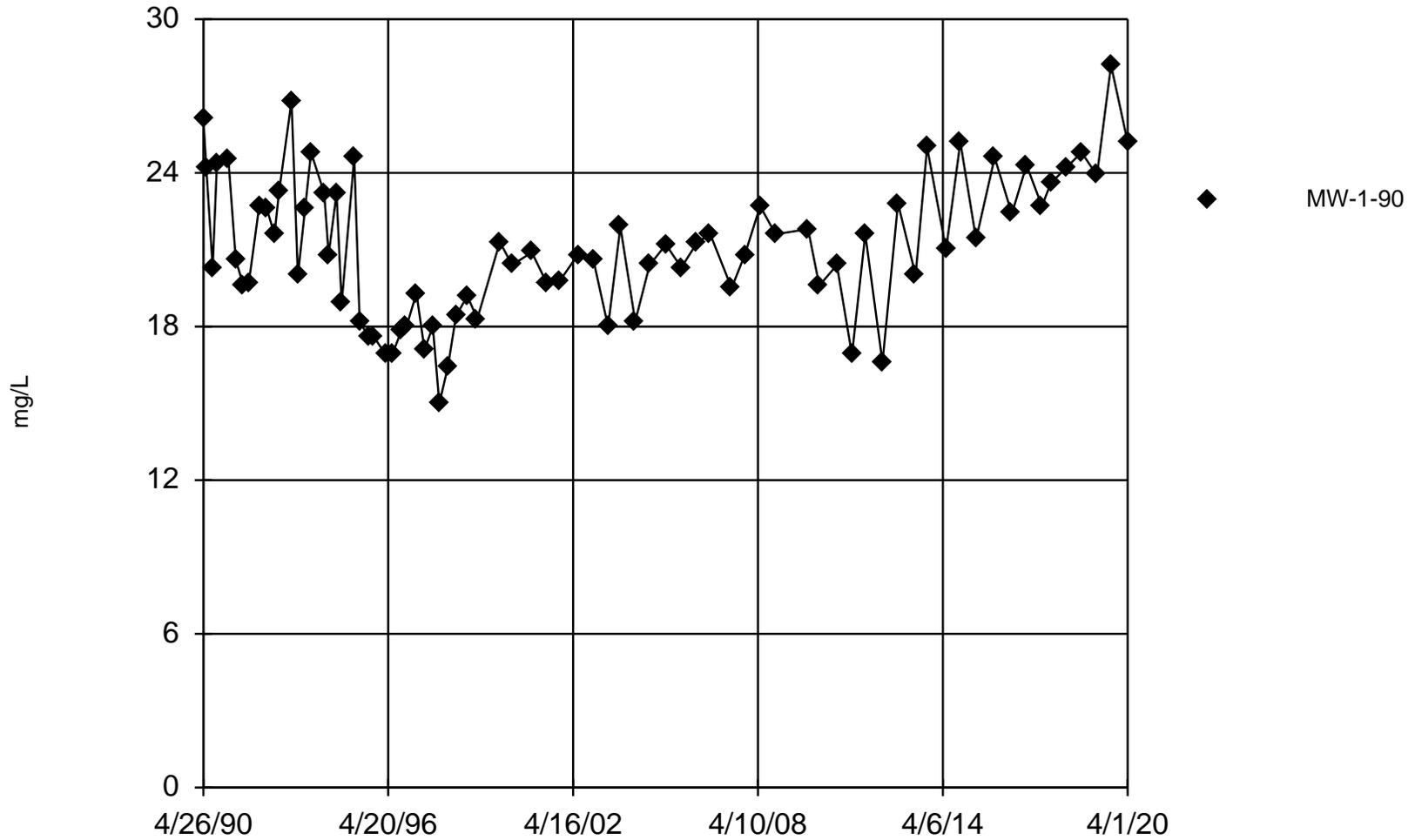
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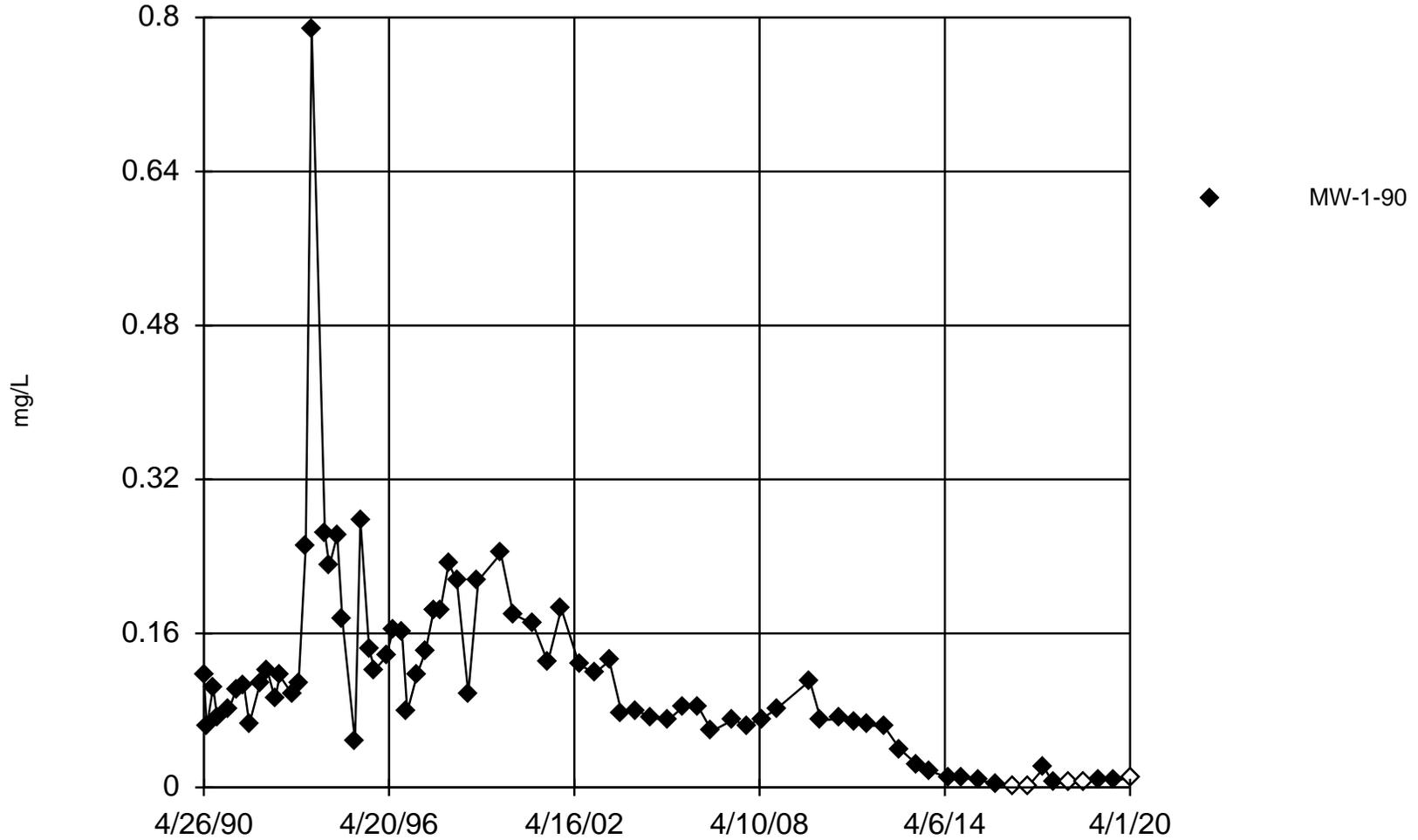
Constituent: pH Analysis Run 9/30/2020 11:15 PM

R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: MDUHeskett_AMR_MW190

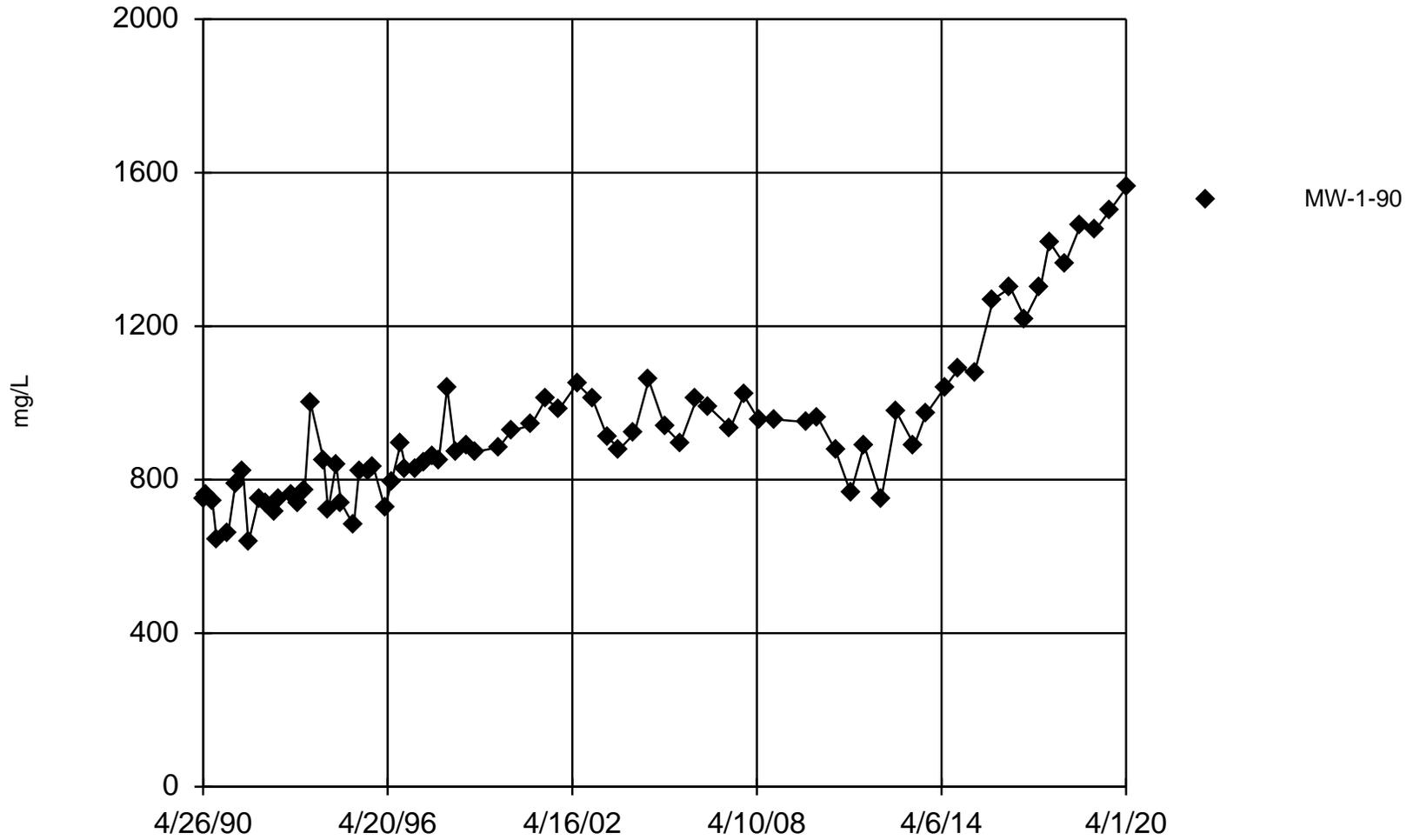
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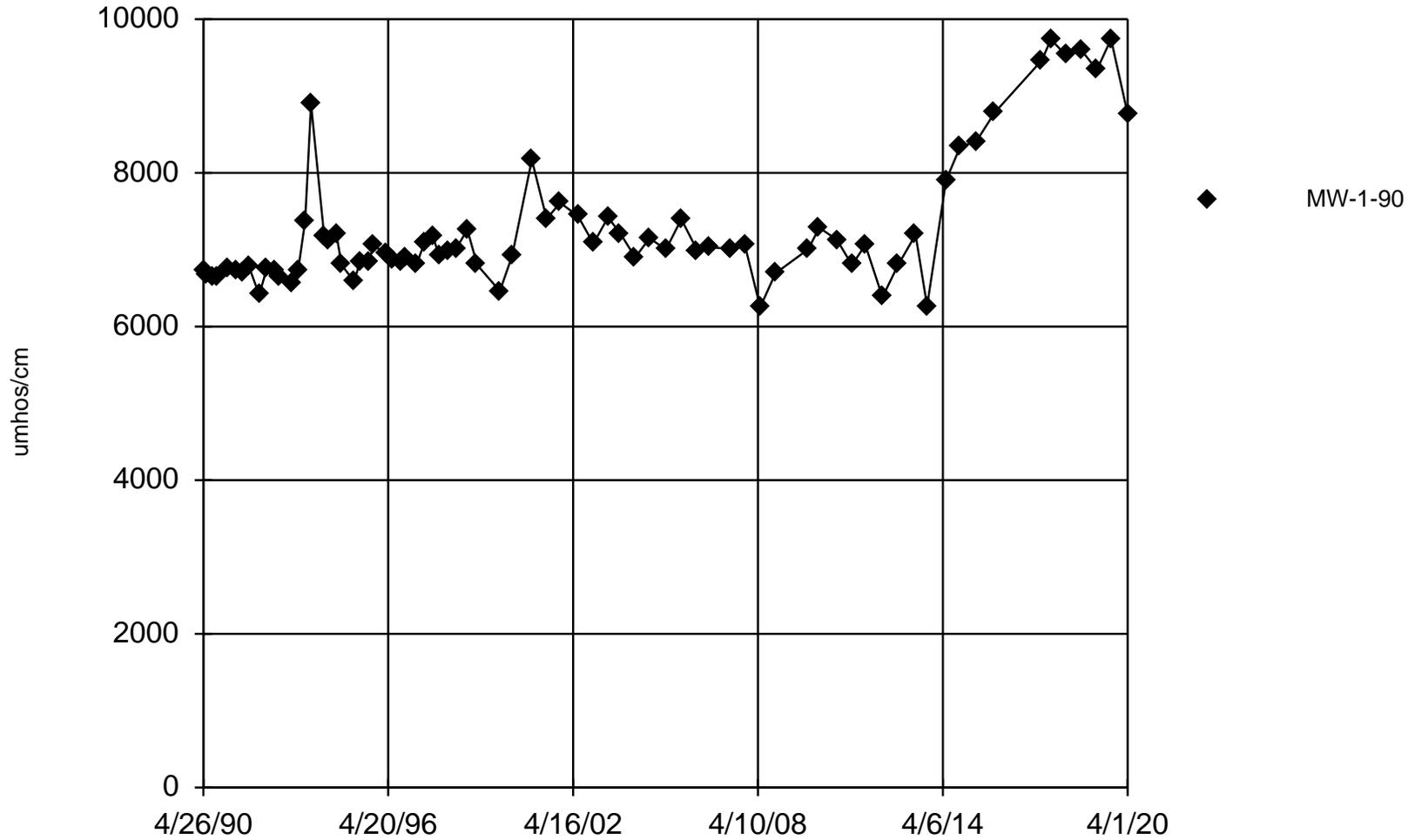
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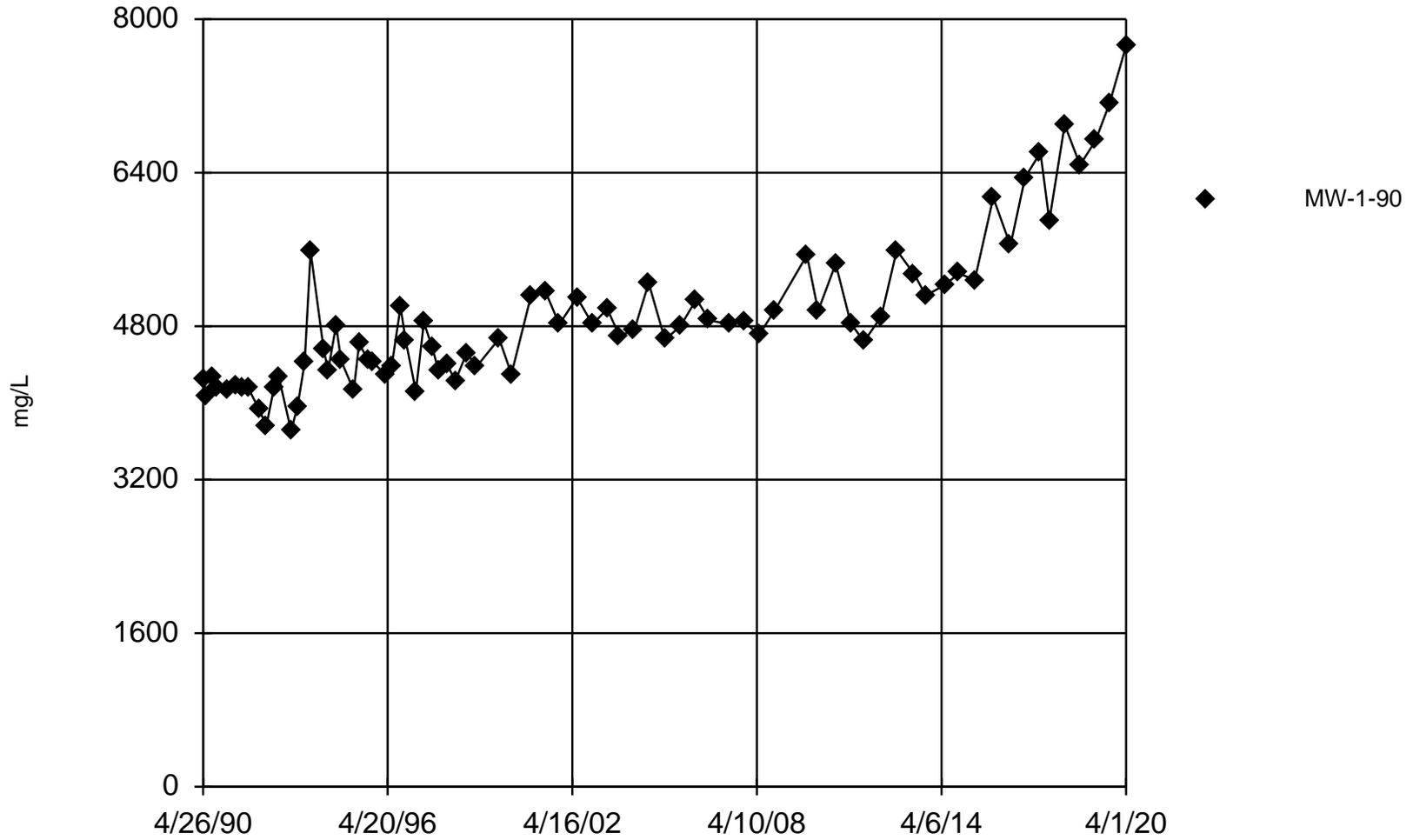
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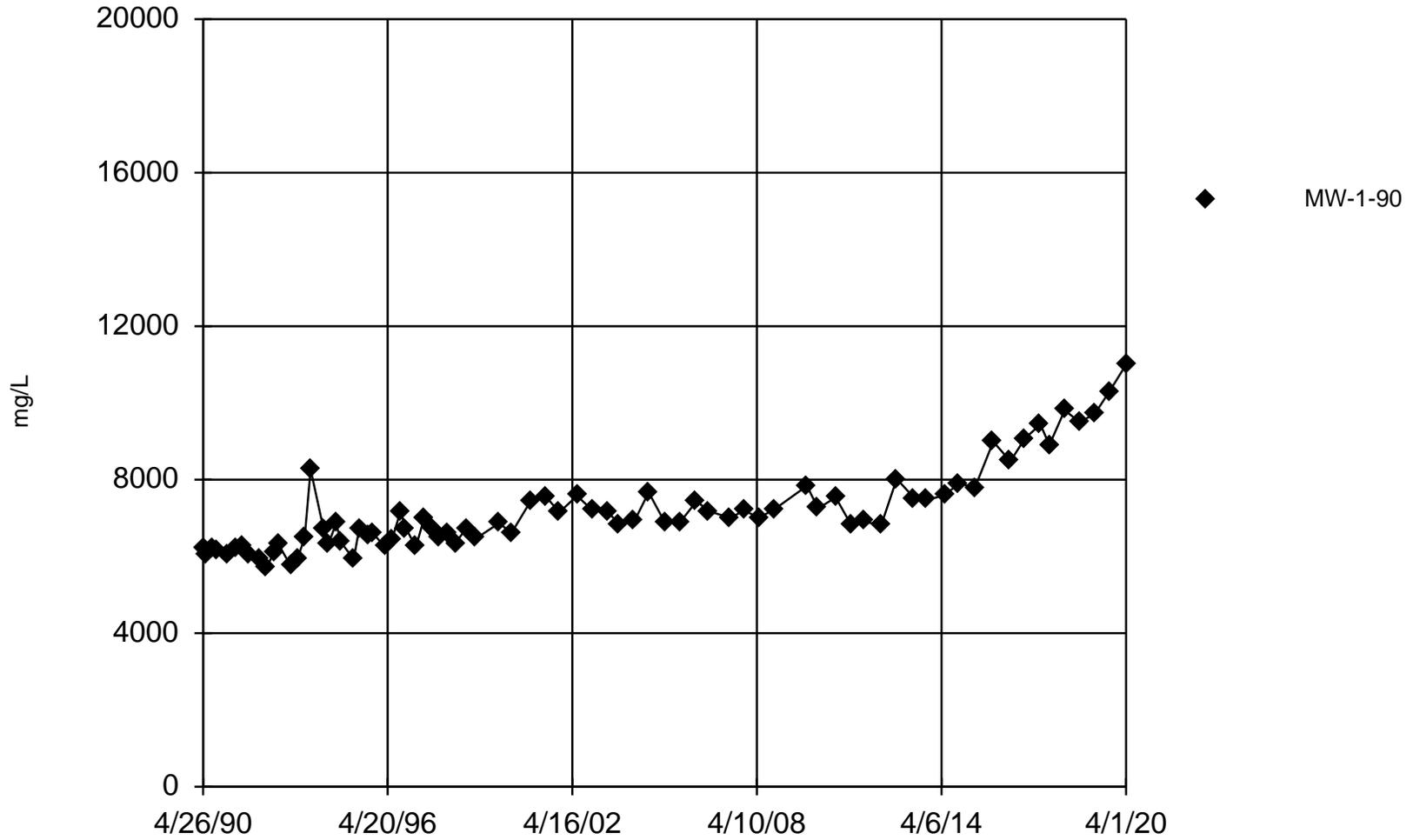
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Time Series

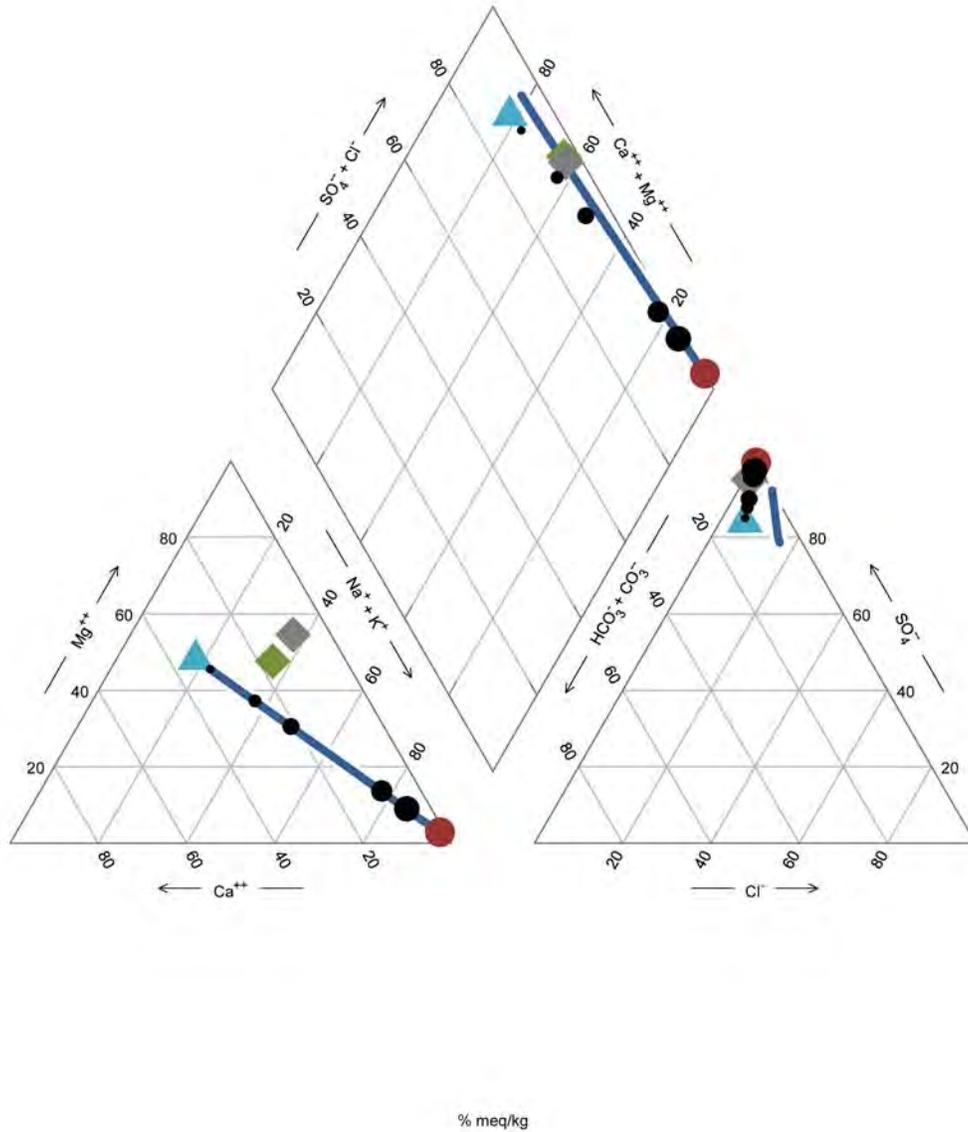


Time Series



Appendix G

Geochemist's Workbench Results



- ▲ MW103_2019
- Evap Pond
- 1 part MW-103 : 1 part Evap Pond
- 1 part MW-103 : 0.50 part Evap Pond
- 1 part MW-103 : 0.10 part Evap Pond
- 1 part MW-103 : 0.05 part Evap Pond
- 1 part MW-103 : 0.01 part Evap Pond
- ◆ MW1-90
- ◆ MW104_2019

Figure G.1
 Piper Plot for Mixing
 Evaporation Pond into MW-103
 R.M. Heskett Station
 Alternative Source Demonstration
 April 2020 Event
 Montana Dakota Utilities
 Mandan, North Dakota

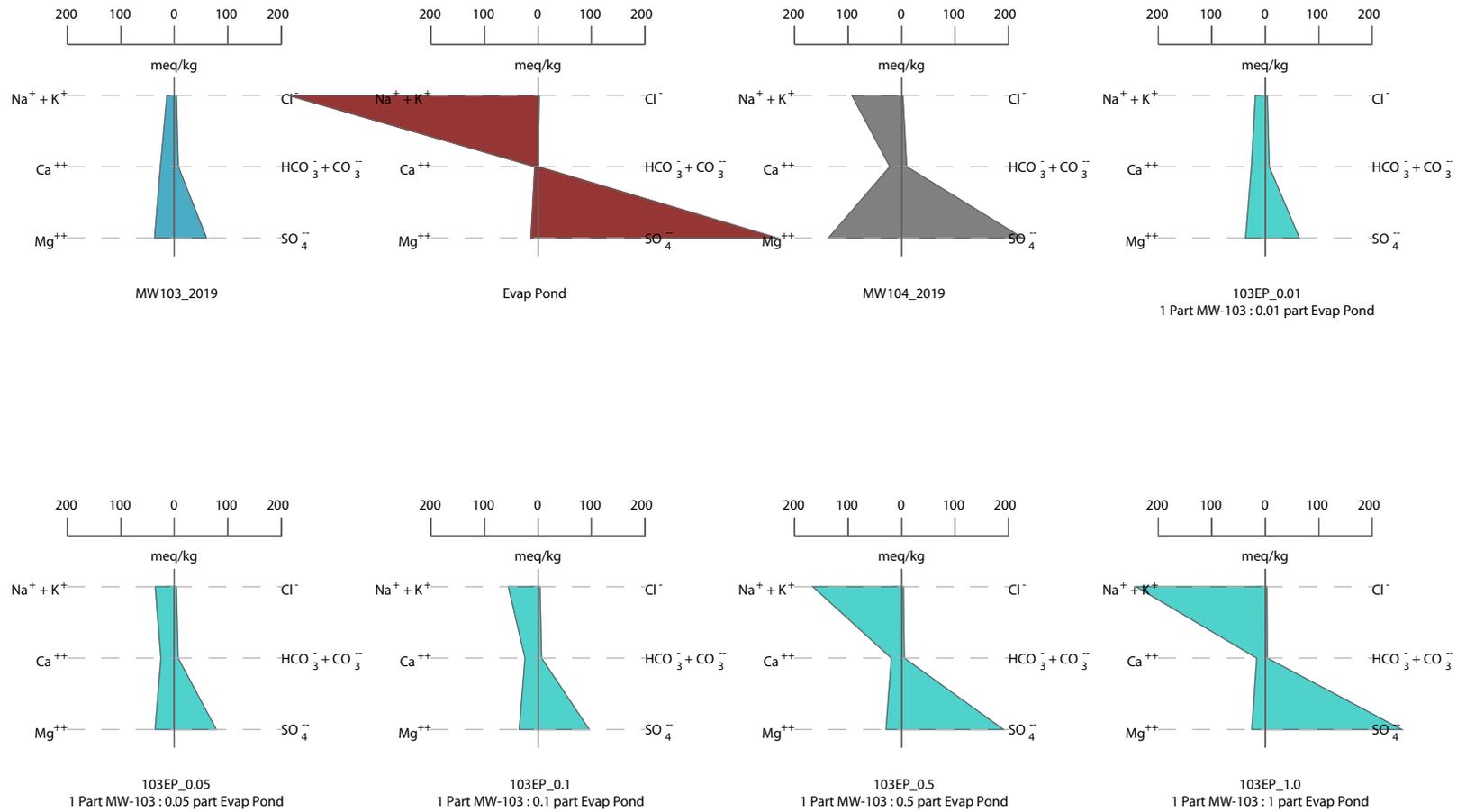


Figure G.2
 Stiff Plot for Mixing
 Evaporation Pond into MW-103
 R.M. Heskett Station
 Alternative Source Demonstration
 April 2020 Event
 Montana Dakota Utilities
 Mandan, North Dakota

Table G.1
Geochemist's Workbench Mixing Model Results

Description		Upgradient	Evap Pond	Mixing Evap Pond into MW-103					Downgradient	
Sample ID		MW103	Evap Pond	1 : 0.01	1 : 0.05	1 : 0.1	1 : 0.5	1 : 1	MW1-90	MW-104
HCO3-	mg/l	457	20	452.7	436.2	417.3	311.3	238.5	259	591
Ca++	mg/l	530	125	526	510.7	493.2	395	327.5	453	448
Cl-	mg/l	142	79.8	141.4	139	136.3	121.3	110.9	57.4	87.6
F-	mg/l	0.15	0.1	0.1495	0.1476	0.1455	0.1334	0.125	1.07	0.55
Mg++	mg/l	458	165	455.1	444.1	431.4	360.4	311.5	775	1700
pH	SU	6.5	10.7	6.502	6.511	6.523	6.643	6.854	7.1	6.8
K+	mg/l	18.8	734	25.88	52.87	83.85	257.3	376.6	25.2	37
Na+	mg/l	311	10600	412.9	801.2	1247	3742	5458	1090	2160
SO4--	mg/l	2930	22100	3120	3843	4674	9323	12520	5350	11100
TDS	mg/kg	4860	34000	5152	6265	7541	14660.2	19527.5	7910	17700